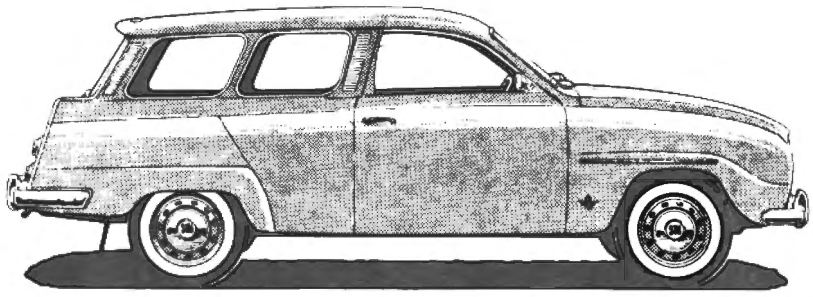
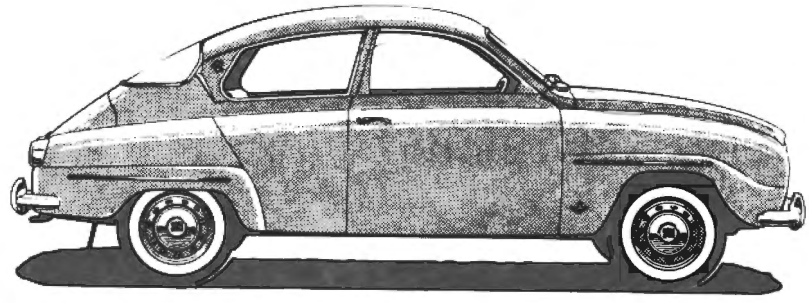
WORKSHOP MANUAL

for

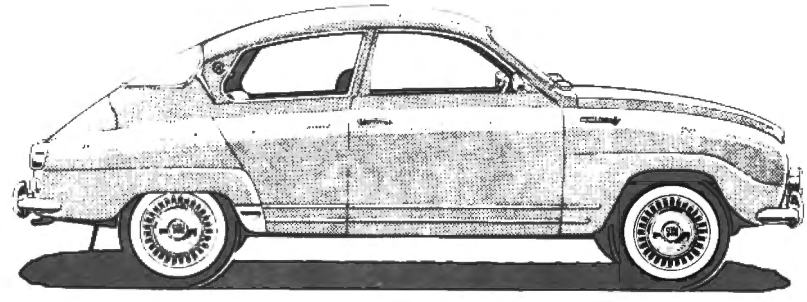
SAAB 95/96 V.4



Saab 95 (Estate)



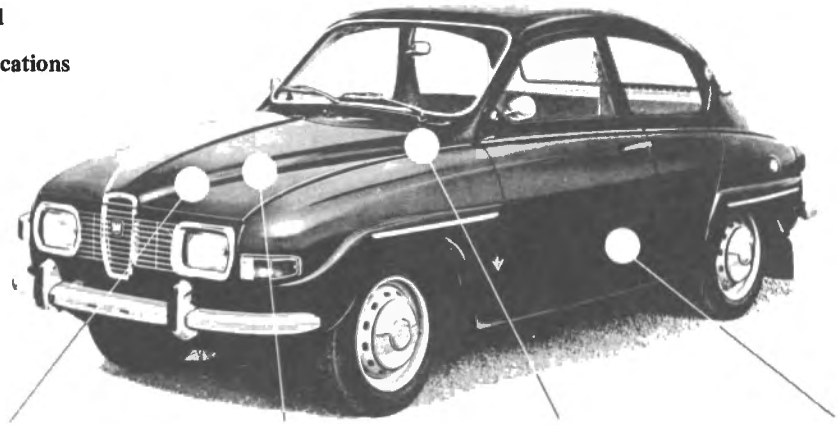
Saab 96 (Saloon)

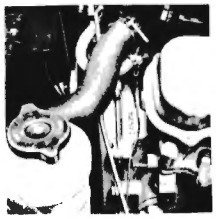


Saab Monte Carlo

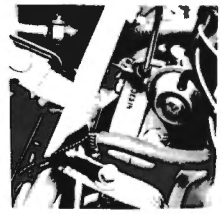
Engine, gearbox and

chassis number locations

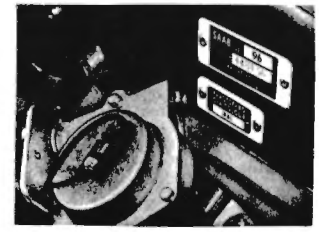




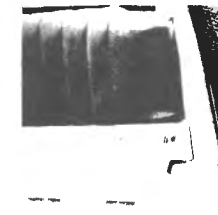
Engine number



Gearbox number



Chassis number and paint code plates



Chassis number imprinted on body

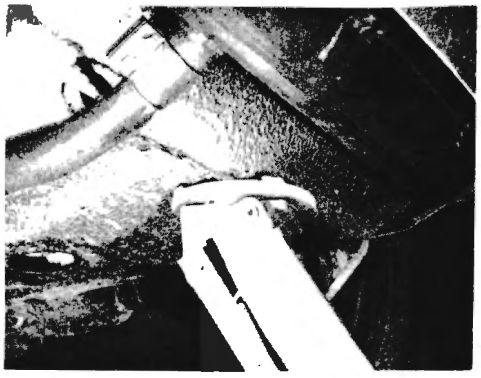
Chassis number plate

CHASSIS NUMBER LIMITS FOR YEAR MODELS.

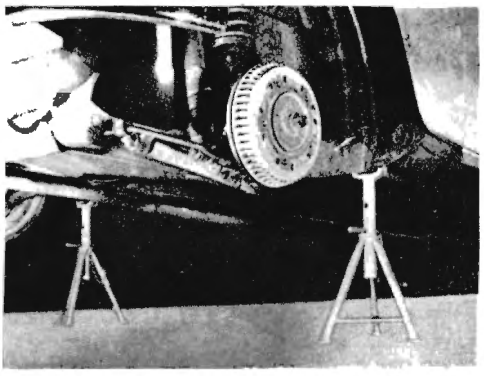
SAAB 95	1966	42.001 - 50.197
SAAB 95	1967	52.001 - 62.059
SAAB 95	1968	65.001 - 74.986
SAAB 95	1970	80.001 -
SAAB 96	1966	420.001 - 458.526
SAAB 96	1967	470.001 - 507.018
SAAB 96	1968	520.001 - 552.859
SAAB 96	1970	560.001 -
Monte Carlo	1966	420.001 - 458.526
Monte Carlo	1967	470.001 - 507.018

Colour code plate

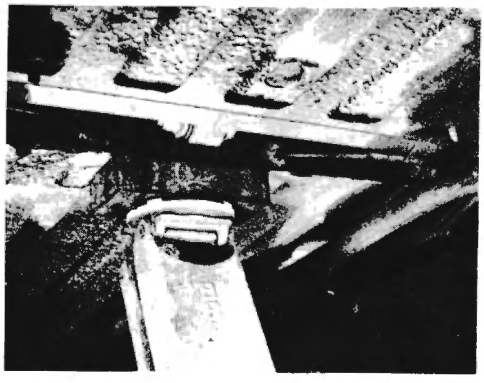
Chassis number and colour code plates, USA versions, models 1969 onwards.



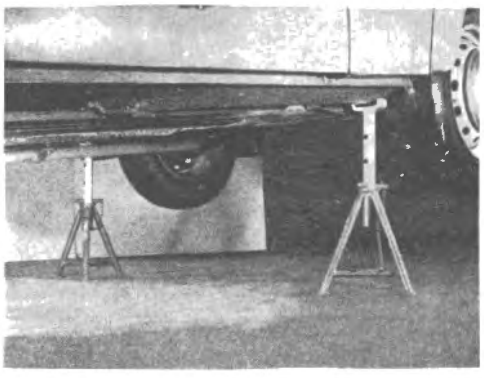
Front end jacking point



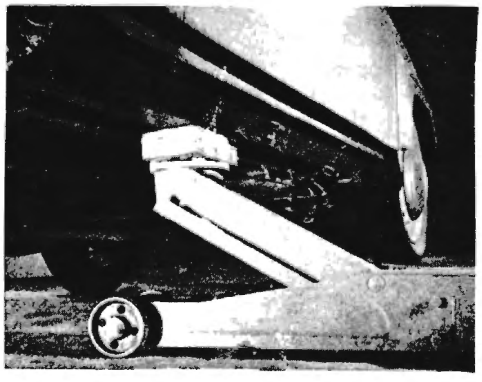
Front end support points



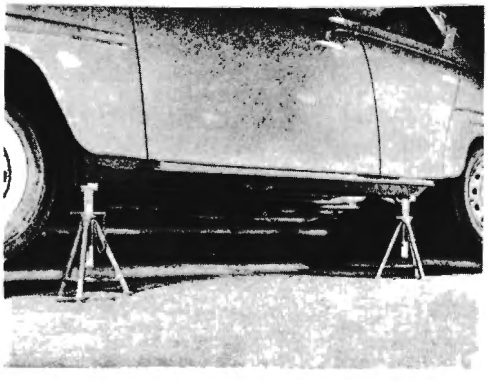
Rear end jacking point



Rear end support points



Side jacking point



Side support points

Index

Introduction

Our intention in writing this manual is to provide the reader with all the information necessary together with the data, so that repairs and maintenance can be undertaken as they become necessary. The information has been checked against that provided by the vehicle manufacturer, and any peculiarities are mentioned if they depart from normal workshop practice. Where special tools are required to enable a job to be undertaken, these have been described, together with their usage.

It will be observed that a fault finding and trouble shooting chart has been inserted at end of manual to enable a quick reference to be made, with consequent time saving. As it is impossible to include every malfunction in a book of this nature, only the more usual faults have been included.

A linear conversion table of millimetres to inches has been included but we would recommend that wherever possible the metric measurements are taken, for the sake of accuracy.

Brevity and simplicity have been the aim in compiling the manual, relying on the numerous illustrations and clear text to instruct and inform. At the request of the users of our manuals, the book has been slanted towards repair and overhaul rather than maintenance.

NO LIABILITY CAN BE ACCEPTED FOR ANY INACCURACIES OR OMISSIONS IN THIS MANUAL, although every possible care has been taken to make it as complete and accurate as possible.

GENERAL DIMENSIONS

Overall length (including bumpers) :			
96 & Monte Carlo models – 1967 - 68	13 ft 8 in	(4170 mm)	approx.
– From 1969	13 ft 9 in	(4200 mm)	approx.
95 (Estate) models – 1967 - 68	14 ft 0 in	(4270 mm)	approx.
– From 1969	14 ft 1 in	(4300 mm)	approx.
Overall width	5 ft 2 in	(1580 mm)	
Overall height (unladen)	4 ft 10 in	(1470 mm)	approx.
Ground clearance (with 2 people, front)	5.1 in	(130 mm)	approx.
Track – front & rear	4 ft 0 in	(1220 mm)	
Wheel-base	8 ft 2 in	(2498 mm)	
Turning circle :			
1967 - 68 models	34 ft 10 in	(10.6 m)	approx.
Models from 1969	35 ft 6 in	(10.8 m)	approx.
Kerb weight :			
96 models– 1967 - 68	1940 lb	(880 kg)	approx.
– From 1969	2000 lb	(910 kg)	approx.
95 (Estate) models – 1967 - 68	2080 lb	(945 kg)	approx.
– From 1969	2160 lb	(980 kg)	approx.
Monte Carlo models	2000 lb	(910 kg)	approx.
Number of seats :			
96 models	5		
95 (Estate) models	7		
Monte Carlo models	2 + 2		
Available load luggage space :			
96 & Monte Carlo models	13 cu.ft.	(0.37 cu.m)	
95 (Estate) models	39 cu.ft.	(1.1 cu.m)	
Max. roof load	200 lb	(100 kg)	
Max. trailer weight	2000 lb	(910 kg)	

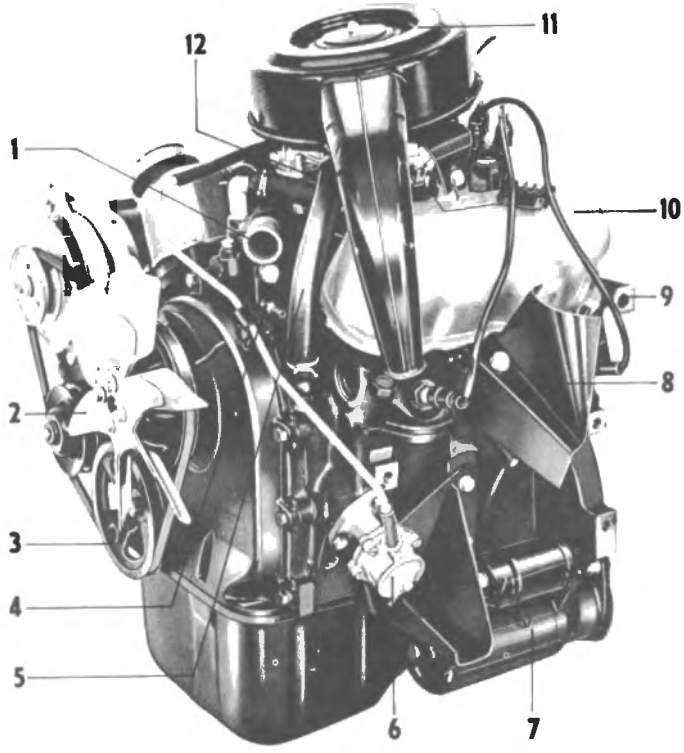


Fig. A:1
Left-hand view of the engine assembly.

1. *Radiator top hose connection.*
2. *Cooling fan.*
3. *Balance shaft pulley.*
4. *Temperature sender unit*
5. *Crankcase ventilation hose*
6. *Fuel pump.*
7. *Starter motor*
8. *Intake air pre-heater plate.*
9. *Engine side-stay bracket.*
10. *Rocker cover.*
11. *Air cleaner.*
12. *Carburettor.*

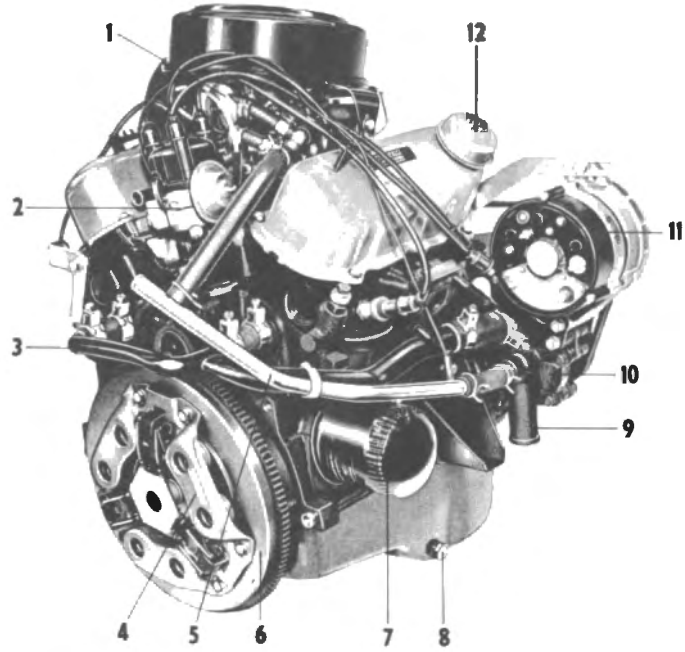


Fig. A:2
Right-hand view of the engine assembly.

1. *Carburettor automatic choke.*
2. *Ignition distributor.*
3. *Water distribution manifold.*
4. *Clutch.*
5. *Cooling system by-pass pipe.*
6. *Flywheel.*
7. *Oil filter.*
8. *Sump drain plug.*
9. *Radiator bottom hose connection.*
10. *Water pump.*
11. *Alternator.*
12. *Oil filler cap.*

Engine

GENERAL

The engine is a four-stroke, V4, water-cooled unit of the overhead-valve type. The cylinder bloc is a one-piece casting with the cylinder bores machined directly into .t. The cast-iron crankshaft runs in three main bearings, the middle one of which also serves as an axial guide bearing. The connecting rods are shrunk onto the piston pins and are thus not detachable from the pistons. The aluminium pistons are fitted with two compression and one oil control ring.

The three bearing camshaft is driven by the crankshaft via a gear wheel with a ratio of 2 : 1. To ensure quiet running, the camshaft gear wheel is made of fibre. A balance shaft, to provide proper engine balance, is located on the right hand side of the block and is also driven by the crankshaft. The balance shaft runs in two bearings and is driven at engine speed. The distributor and the fuel pump are driven by a camshaft skew gear and an eccentric, respectively.

The cylinder heads for both banks are identical. The heads have separate inlet ports and common exhaust ports for each bank of cylinders. The valves operate in guides machined directly in the cylinder head and there are thus no separate valve guides and valve seats. The valves are operated via rockers, push rods and tappets from the camshaft, the tappets being located in the cylinder block and actuated directly by the camshaft. The rocker covers are of pressed steel and the right hand one is fitted with an oil filler cap. The inlet manifold completely encloses the area between the two cylinder heads.

The oil pump is of the bi-rotor type. The pump is mounted in the sump on the lower face of the cylinder block and is driven by a shaft from the distributor. A full-flow oil filter of the disposable cannister type, is screwed directly onto the right hand side of the cylinder block. The filter incorporates an overflow valve to provide a safety factor in the event of the filter becoming inoperative due tu dirt or sludge accumulation.

Engines up to and including engine No. 16100 are equipped with a semi closed crankcase ventilation system. With this system air is admitted into the crankcase through the oil filler cap and then led via a hose into the carburettor intake at the air filter, by-passing the filter element. Late engines use a crankcase ventilation system of the totally enclosed type. In this case filtered air is drawn from the air filter via a flame trap and hose into the right hand rocker cover. The ventilation flow then passes through the crankcase and into the left hand rocker cover, where it is led via a hose to an intermediate flange beneath the carburettor. A regulating valve fitted at this point governs the flow of air through the system.

ROUTINE MAINTENANCE

Every 6.000 miles (10,000 km) the engine oil should be changed and the oil filter replaced. Refer to the TECHNICAL DATA at the end of this section for the list of recommended lubricants. The sump drain plug is situated on the right hand side of the oil pan (8, Fig. A:2). The filter is of the disposable cannister type and should be removed using Tool. No. GC 6883 or other suitable strap wrench (Fig. A:6). Apply a film of oil to the rubber gasket on the new cartridge. Screw in the cartridge until the gasket makes contact with the engine block and then further tighten half a turn. DO NOT overtighten the cartridge otherwise the rubber seal may tilt in its groove and leakage will result.

THE FOLLOWING OPERATIONS CAN BE PERFORMED WITH THE ENGINE IN THE CAR :-

- VALVE CLEARANCES – Measurement and Adjustment.
- CYLINDER HEAD – Removal and Installation.
- FRONT COVER – Removal and Installation.
- FAN BEARING – Replacement.
- CAMSHAFT – Removal and Installation.

VALVE CLEARANCES – Measurement and Adjustment :

To ensure quiet and smooth running of the engine, the valve clearance should be adjusted carefully and accurately with the engine warm.

With the engine at normal operating temperature, remove the air cleaner. Detach the spark plug leads from the rocker covers, unscrew the retaining bolts and lift off both the rocker covers. The cylinders are arranged with No. 1 and 2 in the right hand bank and Nos. 3 and 4 in the left hand bank, No. 1 cylinder being at the front of the car. Check the valve clearances by rotating the crankshaft until the rocker arms at one cylinder "rock" (ie.- one arm will be just starting to move whilst the other will be just reaching the returned position). Both the valves at the cylinder in the second column below can then be checked and, if necessary adjusted.

VALVES ROCKING (Cylinder No.)	VALVES TO ADJUST (Cylinder No.)
1	4
3	2
4	1
2	3

The correct valve clearances are 0.016 in. (0.40 mm) for both inlet and exhaust valves with the engine warm. To adjust the clearance, screw the adjusting screw clockwise to decrease the clearance and vice versa (Fig. A:7).

Refit the rocker covers and the air cleaner. The rocker cover with the oil filler cap must always be installed on the right hand side of the engine. If a rocker cover gasket is damaged, discard the old gasket, fit the new gasket in the rocker cover and press the gasket tabs into the locating slots in the cover (Fig. A:8).

CYLINDER HEAD – Removal and Installation :

Remove the air cleaner and inlet manifold as described in the FUEL SYSTEM section. Disconnect the alternator cables, noting their respective positions. Release the alternator adjusting and mounting bolts, remove the drive belt and detach the alternator and mounting bracket.

Disconnect the engine sire support from the bracket on the left hand side of the engine (9, Fig. A:1). Detach the pre-heater plate (8, Fig. A:1). Unscrew the flange nuts securing the exhaust pipes to the cylinder heads. Unbolt the exhaust pipe clamps at the engine mounting brackets and remove the spacers at the cylinder heads.

Release, evenly, the two bolts securing the rocker shaft pillars to the cylinder head, lift off the rocker assembly and remove the oil return plate (Fig. A:9). Lift out the push rods, keeping them in their correct order. This can be acheived by pushing the rods through a piece of card with "LEFT BANK - FRONT" or "RIGHT BANK - FRONT" marked at the appropriate end. Release the cylinder head bolts evenly, in the reverse order to that shown in Fig. A:11 and lift off the cylinder head assembly and gasket. Repeat for the other cylinder head. Note that the outer rear bolt on the right hand cylinder head also secures the engine earth cable.

Before installing the cylinder heads, ensure that the mating faces of the cylinder block and heads are clean and free from old gasket material. The cylinder head gaskets for the right hand and left hand banks are different and are not interchangeable (Fig. A:10). The gaskets are marked "FRONT" and "TOP". Place one of the cylinder head gaskets over the two locating dowels on its respective face of the cylinder block. Install the cylinder head on the locating sleeves. Repeat for the other cylinder head and gasket. Note that the outer rear bolt of the right hand cylinder head also secures the engine earth cable. Tighten the cylinder head bolts in three stages following the sequence shown in Fig. A:11.

STAGE 1 40 lbft. (5.5 kgm)
STAGE 2 50 lbft. (7.0 kgm)
STAGE 3 68 lbft. (9.5 kgm)

Dip the push rods ends in engine oil and install the push rods in their original bores. Fit the oil return plate and rocker shaft assembly to each cylinder head, locating the adjusting screw in the cupped end of the push rods. Secure each rocker shaft assembly with the two retaining bolts and tighten evenly. Adjust the valve clearances as described previously.

Install the inlet manifold, carburettor and air cleaner as detailed in the FUEL SYSTEM section under "INLET MANIFOLD - Removal and Installation".

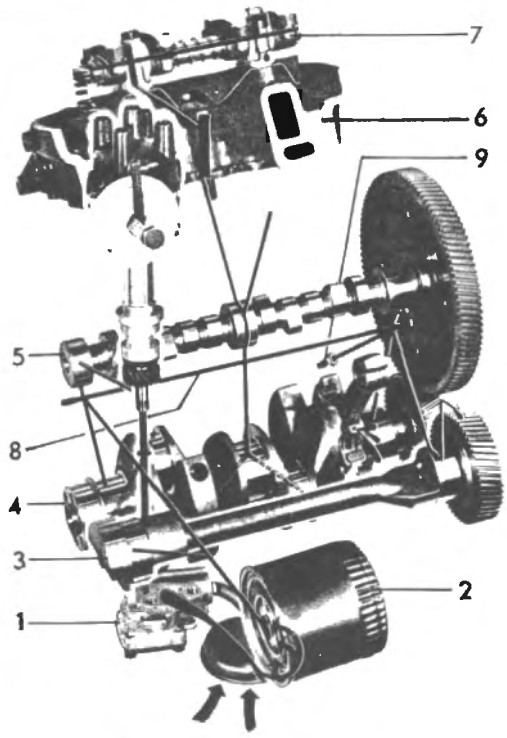


Fig. A:3
Engine lubrication system.

1. *Oil pump.*
2. *Oil filter.*
3. *Balance shaft.*
4. *Crankshaft.*
5. *Camshaft*
6. *Cylinder head.*
7. *Rocker assembly.*
8. *Main oil gallery.*
9. *Oil pressure switch.*

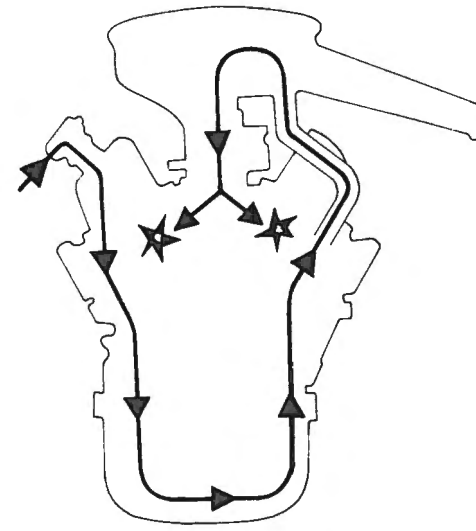


Fig. A:4 **Semi-closed crankcase ventilation system**

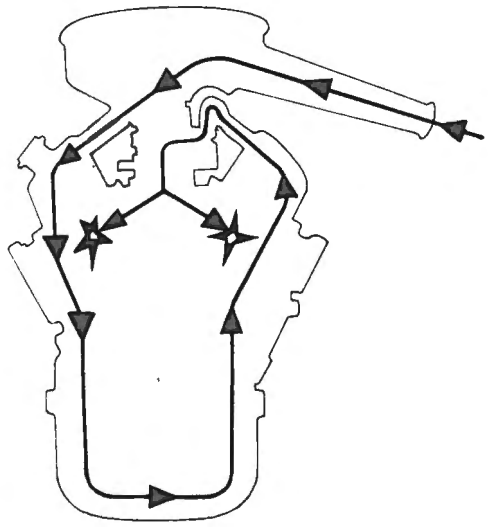


Fig. A:5 **Closed crankcase ventilation system**

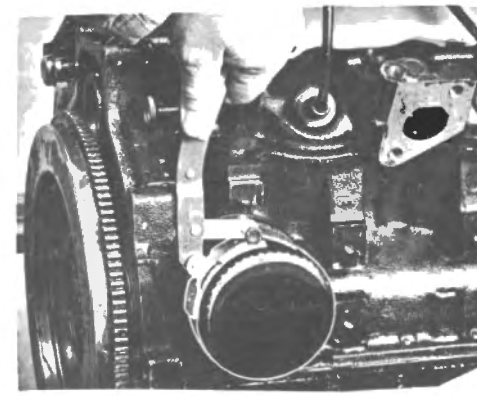


Fig. A:6 **Removing the oil filter**

CYLINDER HEAD – Decarbonising :

Plug all push rod cylinder head bolt and water-way apertures in the cylinder block and cylinder head faces. Using a suitable tool, scrape all carbon deposits from the cylinder head faces, combustion chambers, valve heads and piston crowns. Care should be taken to prevent damage to the metal faces and to prevent carbon particles from contaminating any parts of the engine. Clean all carbon particles from the cylinder head and cylinder block.

If it is required to grind the valves and valve seats, refer to "CYLINDER HEAD – Overhaul" in this section.

CYLINDER HEAD – Overhaul :

Remove the spark plugs. Compress one of the valve springs, using a suitable valve spring compressor (Fig. A:12). Extract the split tapered collets from around the valve stem. Release the compressor and remove the valve spring retainer and valve spring. Remove the rubber oil seal fitted to the valve stem and withdraw the valve (Fig. A:13). Repeat for the other valves.

Rocker shaft assembly :

Drive the roll pin out of one end of the rocker shaft, using a suitable drift, and detach the spring washer which bears against the end rocker arm. The rocker arms, rocker shaft pillars, spring and second spring washer can now be removed from the shaft (Fig. A:14).

Clean all parts thoroughly and inspect. Check that all oil passages are clear. Inspect the rocker shaft and rocker arm bore for nicks, scratches, scores, scuffs or excessive wear. Inspect the pad at the valve end of the rocker arm for any indication of scuffing or abnormal wear. If the pad is grooved, replace the rocker arm. DO NOT attempt to true this surface by grinding. Replace any damaged adjusting screws.

Assemble the rocker shaft in the reverse order of removal. The rocker shaft must be assembled with the grinding mark downwards (indicated by the arrow in Fig. A:14), so that the rocker arm lubrication holes will be correctly positioned. The rocker shaft pillar with the oil feed hole must be positioned at the rear on the right hand cylinder head and at the front on the left hand cylinder head.

Push rods :

Check the rods for straightness. DO NOT attempt to straighten push rods. Inspect the ends of the rods for nicks, grooves, roughness or excessive wear. Replace as necessary.

Cylinder head :

Check the cylinder head for cracks and inspect the machined face for burrs, scratches or nicks. Replace the head if it is cracked. Remove any burrs or scratches with an oil stone. Check the machined face for flatness, using a straight edge. Check the spark plug holes for stripped or damaged threads and rectify as necessary.

Valves :

Clean all carbon deposits from the valves and inspect the face and edges for pits, grooves, scores or other damage. Check the valve face run-out. If run-out is excessive, or if any other of the above faults are present, the valve can be corrected by refacing. Remove only sufficient metal to correct the fault. If the edge of the valve head is less than 1/32 in. (0.79 mm) thick after grinding, the valve should be replaced as it will run too hot in use.

Check the valve head for signs of burring, warpage, erosion or cracking. Minor pits, grooves, etc., may be removed. Inspect the end of the valve stem for grooves or scores. Minor damage may be rectified by grinding. Check that the valve stem is not bent. Discard valves that are severly damaged.

Valve guides :

Check the valve stem to valve guide clearance of each valve in its respective guide. Refer to the TECHNICAL DATA at the end of the section for the specified clearances. If the clearence is excessive or the guide bore is worn oval, the bore must be reamed to a suitable outsize (Fig. A:15). Reaming must be done in stages, starting with the smallest diameter and working up, to the largest diameter. Use paraffin (Kerosene) as cutting oil while reaming. After reaming the valve guide bore the valve seat must be recut to ensure that the seat is concentric with the valve guide.

Valve seats :

Inspect the valve seats for pitting or burning. Check the valve seat run-out, using an accurate gauge. If run-out is excessive, or if any other of the above faults are present, the valve seats must be recut. The valve seats should also be recut after reaming the valve guides and when fitting new valves. Refacing of the valve seat should be closely co-ordinated with the refacing of the valve face so that the finished seat and valve face will be concentric and the correct interference fit will be maintained.

Cut the valve seats to a true angle of 45° removing only sufficient metal to clean up pits and grooves, or to correct the valve seat run-out. If there is a hard carbon deposit on the seat, this may be removed with a flange breaker.

After refacing, the valve seat width will probably be excessive. Determine where the valve seat contacts the valve face by coating the seat with Prussian Blue and rotating the valve lightly in the seat. If the blue is transferred to the centre of the valve face, metal must be removed from both sides of the seat to narrow it. Blue on the top edge of the valve face indicates that the seat should be narrowed with a top-face cutter. Blue on the bottom edge indicates that metal should be removed from the port edge of the seat. Narrow the seat with the appropriate cutter. A 11° cutter should be used for the top face and a 75° cutter for the port (Fig. A:16).

The valves may be lapped in using fine grinding paste (Fig. A:17). When a uniform seating surface has been obtained, carefully clean all grinding paste off the seat and valve.

Valve springs :

Check the valve springs for squareness, using a steel rule and a flat surface. Revolve the spring slowly and observe the space between the top coil of the spring and the square. Check that the valve spring tension is within the prescribed specifications. Inspect the valve springs, valve spring retainers and valve retaining collets for wear or damage. Discard any visually damaged parts. When replacing valve springs it is recommended that they be replaced in sets.

To reassemble the cylinder head, install one of the valves in its respective port. Fit the rubber oil seal over the valve stem with the open end in the cylinder head and fit the valve spring and retainer over the valve stem. Compress the valve spring, locate the two split tapered collets in the groove in the valve stem and slowly release the spring compressor to engage the collets in the retainer taper. Repeat for the other valves. Fit the spark plugs.

FRONT COVER – Removal and Installation :

Disconnect the battery earth lead. Drain the cooling system. Release the alternator adjusting and mounting bolts. Unscrew the four retaining bolts and detach the cooling fan and drive pulley from the bearing flange. Disconnect the water hoses at the water pump. Unscrew the retaining bolts and withdraw the balance shaft pulley. Remove the front bolts securing the oil pan. Unscrew the 9 retaining bolts and separate the front cover from the cylinder block.

If the balance shaft oil seal is to be replaced, drive the old oil seal out of the front cover using Tool GC 6059 (Fig. A:18). Drive the new seal into place from the rear, using Tool GC 7600-B, until it bottoms (Fig. A:19).

Ensure that the mating faces of the front cover and cylinder block are clean and free from old gasket material. The portion of sump gasket beneath the front cover is inevitably damaged during the removal operation. The old sump gasket should be cut off, level with the cylinder block front face, using a sharp knife. Cut a corresponding portion of new sump gasket, coat it with suitable jointing compound at the ends and place carefully in position on the engine.

Apply a thin coating of sealing compound to the mating surfaces of the

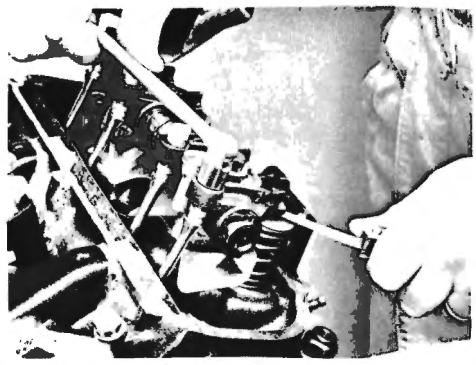


Fig. A:7 Adjusting the valve clearances

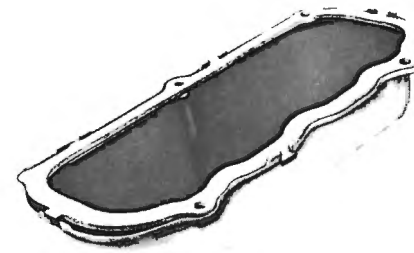


Fig A:8 Rocker cover gasket location

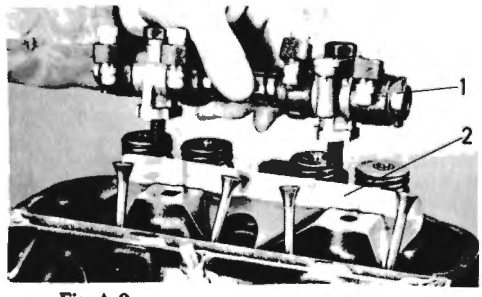


Fig. A:9
Removing/Installing the rocker assembly.

1. *Rocker shaft with rocker arms.*
2. *Oil return plate.*

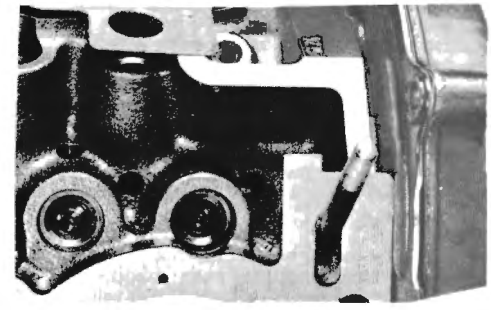


Fig. A:10 Installation of the cylinder head gaskets

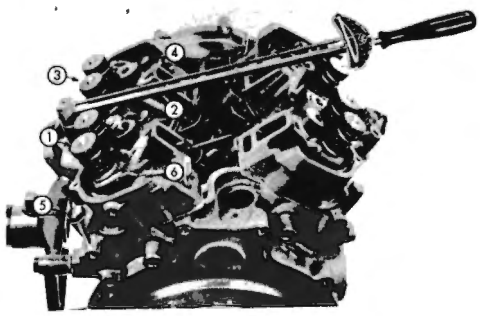


Fig. A:11 Cylinder head bolt tightening sequence

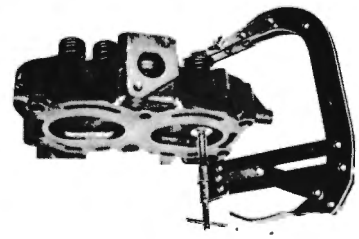


Fig. A:12 Removing the valves and valve springs

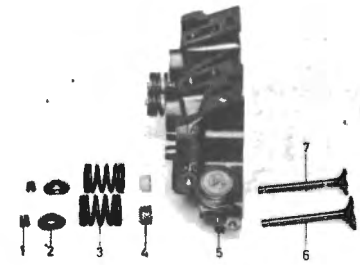


Fig. A:13
Cylinder head assembly

1. *Split tapered collets*
2. *Spring retainer*
3. *Valve spring.*
4. *Valve stem oil seal.*
5. *Cylinder head.*
6. *Inlet valve.*
7. *Exhaust valve.*

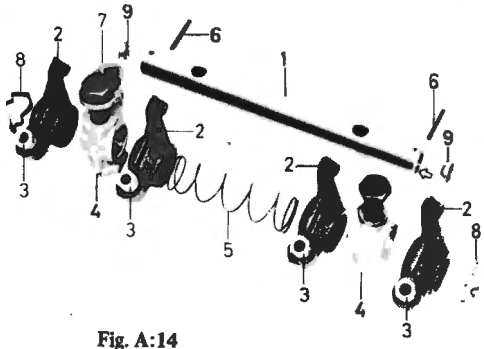


Fig. A:14
Rocker assembly.

1. *Rocker shaft.*
2. *Rocker arms.*
3. *Adjusting screws.*
4. *Rocker shaft pillars.*
5. *Spring.*
6. *Roll pins.*
7. *Cover plate.*
8. *Spring washers.*
9. *Plugs.*

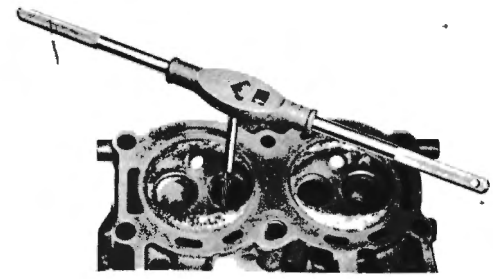


Fig. A:15 Reaming the valve guides

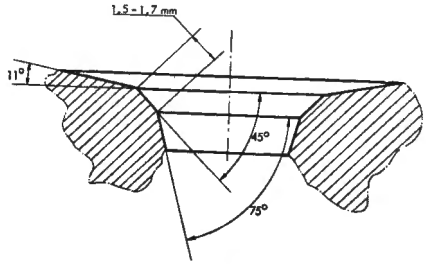


Fig. A:16 Valve seat angles

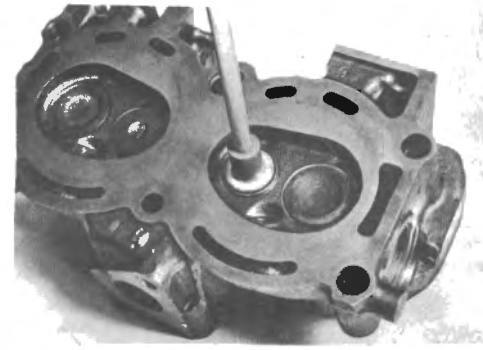


Fig. A:17 Grinding the valves

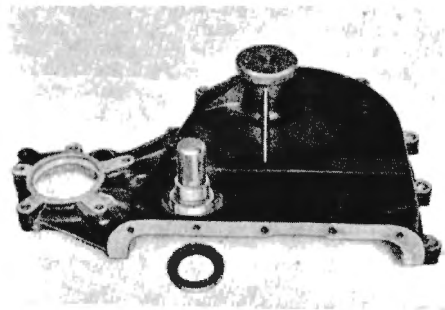


Fig. A:18 Removing the front cover oil seal

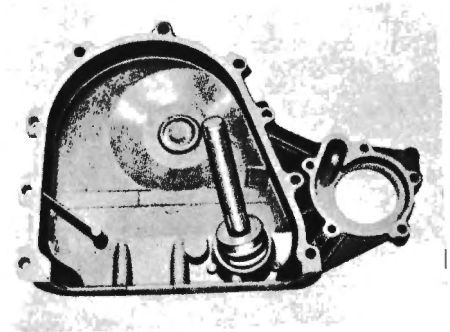


Fig. A:19 Installing the front cover oil seal

front cover. Position a new gasket on the front cover. Install the front cover, align it using Tool GC 6059 and tighten the retaining bolts. Secure the oil pan to the front cover with the 5 retaining bolts. Lightly oil the sealing surface of the balance shaft pulley, install the pulley and secure with the retaining bolt and washer.

Install the cooling fan and drive pulley. Reconnect the water hoses to the water pump. Install the alternator and drive belt and adjust the drive belt tension as described in the COOLING SYSTEM section. Refill the cooling system. Reconnect the battery earth lead. Start the engine and check for oil and water leaks.

FAN BEARING – Replacement :

Remove the front cover as described above. A piece of tubing with an inside diameter of 2 in. (50 mm) is required to support the front cover during the removal and installation operation. Support the front cover around the fan bearing with the piece of tube and press out the bearing and shaft assembly with an arbor (Fig. A:21). The bearing sealing washer will be displaced from the underside of the cover.

Remove the piece of tubing from under the cover and press the new shaft and bearing assembly into the cover. Place the cover on the tubing again and press in the new bearing, until it bottoms out, using Tool No. GC 8501-A (Fig. A:22). Suitably support the inner end of the fan shaft and press the flange onto the shaft until the flange top face is 3.75 in. (95.5 mm) from the front cover mating surface (Fig. A:23). Turn the cover over, hold in the hand and tap a new sealing washer into position (Fig. A:24). Install the front as described above.

CAMSHAFT – Removal and Installation :

Remove the cylinder heads as described previously. Remove the tappets from the cylinder block with the aid of a bar magnet or a piece of bent wire (Fig. A:25). Keep the tappets in their correct order. Unscrew the 2 retaining bolts and detach the fuel pump and gasket and push rod. Mark the end of the push rod that rests against the camshaft to ensure correct assembly. Remove the front cover as described previously. Unscrew the retaining bolt and withdraw the camshaft gear by hand. Unscrew the two retaining bolts and detach the camshaft thrust plate (Fig. A:27). Carefully withdraw the camshaft from the cylinder block. Extract the key from the shaft and remove the spacer.

Lubricate the camshaft bearings with engine oil and carefully pass the camshaft into the cylinderblock. Fit the spacer ring over the camshaft, countersunk inwards, and insert the key. Position the thrust plate on the front of the cylinder block so that it covers the main oil gallery hole and secure with the two retaining screws and spring washers (Fig. A:27). Check the camshaft end-float. If required, the spacer thickness can be adjusted to bring the end-float within specifications. The spacer is available in two different thicknesses. A red marking identifies the thinner spacer whilst the thicker one has a blue marking.

Turn the crankshaft until one of the marks on the crankshaft gear aligns with the mark on the balance shaft gear and the other faces the camshaft (Fig. A:28). Fit the gear wheel onto the camshaft so that the mark on the gear aligns with the mark on the crankshaft gear. Secure the camshaft gear with the retaining bolt and washer. Install the front cover as described under the appropriate heading. Install the fuel pump push rod with the same end against the cam as originally. Install the fuel pump and gasket and secure with the two retaining bolts. Install the cylinder heads as described previously in this section.

ENGINE – Removal and Installation :

The engine may be removed independently or as a unit with the transmission. In the latter case, refer to the TRANSMISSION section for the details of the additional operations required.

To remove the power unit only the associated components should be removed or disconnected in the follwing sequence :-

1. Disconnect battery earth lead.
2. Remove the retaining clips from bonnet pivot pins. Bend one of the stays inwards to release it from the pivot bracket and, with the aid of an assistant, lift off the bonnet, (Fig. A:29).
3. Drain the cooling system including the heater.
4. Disconnect wiring from headlights and side/indicator lights.
5. Disconnect cord from radiator blind, if fitted.
6. Disconnect the cable from bonnet lock mechanism.
7. Remove four retaining screws from front panel (Fig. A:30). Unbolt two support arms at wheel housings and two brackets at radiator and lift off front panel (Fig. A:31).
8. Disconnect top and bottom radiator hoses at engine. Unscrew two radiator lower rataining bolts and remove radiator. Remove expansion tank, if fitted.
9. Remove the air cleaner. It is recommended that a cover be placed over the carburettor intake to prevent entry of foreign matter,
10. Disconnect a) Alternator leads (NOTE positions)
    b) Distributor low tension lead
    c) Coil high tension lead
    d) Oil pressure switch lead
    e) Water temperature sender unit lead
    f) Starter motor leads.
11. Disconnect a) Heater hoses
    b) Fuel pipe at pump inlet
    c) Throttle linkage
    d) Engine side-stay at engine bracket
12. Remove pre-heater casing from left side of the engine (8, Fig. A:1).
13. Remove the nuts from exhaust pipe flange at cylinder head. Remove exhaust pipe clamps at engine mountings. Detach middle exhaust pipe mounting from underbody. Remove spacers at cylinder heads and lower silencer as far as possible.
14. Remove alternator and mounting bracket.
15. Remove water distribution manifold from rear of engine (Fig. A:33).
16. Attach suitable lifting tackle to engine (eg. Lifting Hook, Tool No. 766202) Remove both front engine mounting brackets and raise unit approx. 2 in. (50 mm) to clear sump (Fig. A:32).
17. Remove starter motor. Remove protective plate in front of the flywheel.
18. Suitably support gearbox and remove clutch housing to engine bolts.
19. Draw engine forward off clutch shaft splines and lift out.

Installation is the reverse of the removal procedure with special attention to the following points :-

a) When reassembling the exhaust pipes, tighten the flange nuts at the cylinder heads, the clamps at the engine mounting brackets and the middle exhaust pipe mounting in that order.

b) DO NOT confuse the alternator leads. If necessary refer to the ELECTRICAL EQUIPMENT section at the end of this manual for correct pointing of the leads.

c) If necessary, adjust the clutch pedal free play as described in the CLUTCH section.

d) Refill the cooling system and, if drained, the engine sump.

e) After installation is complete, road test the car.

ENGINE – Disassembly :

Drain the engine oil. If not already removed, detach the drive belt, alternator and mounting bracket. Remove the cooling fan. Remove the fuel pump, pump push rod and gasket from the left side of the cylinder block (see Fig. D:5). Unscrew the oil pressure switch located below the fuel pump (Fig. A:34). Remove the oil filter, using Tool No. GC 6883 or other suitable strap wrench (Fig. A:6).

Disconnect the spark plug leads, release the retaining clips and lift off the distributor cap. Disconnect the vacuum pipe, fuel pipe and choke water hoses at the carburettor, unscrew the two retaining nuts and lift off the carburettor and gasket. Release the clamping bolt and remove the distributor.

Unscrew the retaining bolts and lift off the rocker covers. Release, evenly, the bolts securing the rocker shaft pillars to the cylinder heads and lift the rocker assembly and oil return plate from each cylinder head (Fig. A:9). Remove the push rods, keeping them in their correct order. This can be done by pushing the rods through a piece of card with "LEFT BANK – FRONT" or "RIGHT BANK – FRONT" marked at the appropriate end.

Remove the water outlet housing from the inlet manifold and lift out the thermostat and gasket (see Fig. B:9). Unscrew the inlet manifold retaining bolts and nuts, separate the manifold from the gasket and lift off the

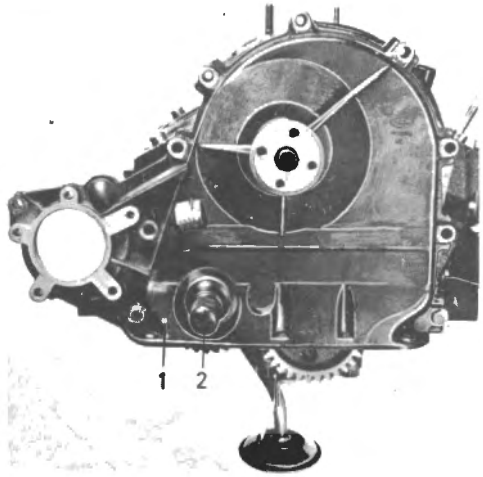


Fig. A:20
Installing the front cover.

1. *Front cover.*
2. *Aligning tool GC 6059*

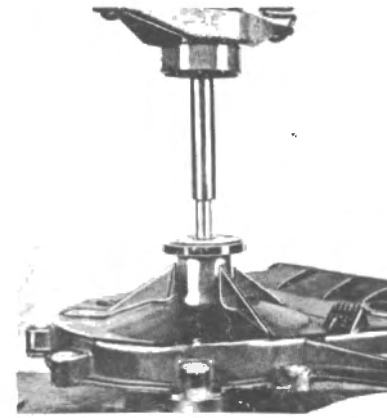


Fig. A:21 Pressing out the fan shaft and bearing

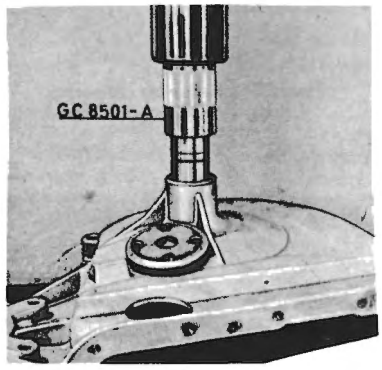


Fig. A:22 Installing the fan bearing

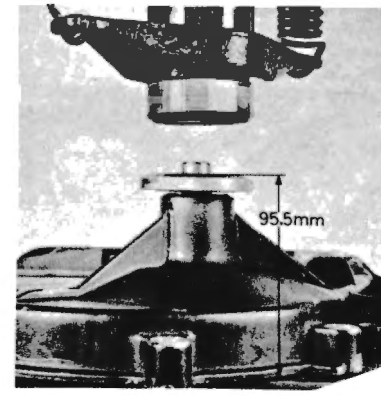


Fig. A:23 Installing the fan pulley flange

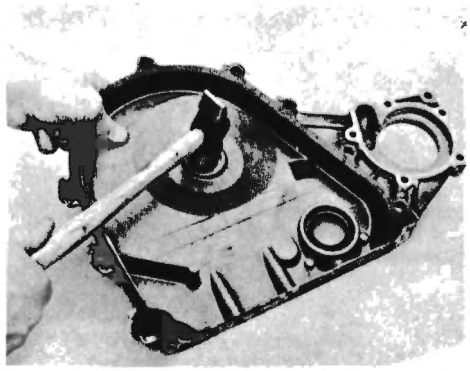


Fig. A:24 Installing the fan bearing cover plate

Fig. A:25 Removing the tappets

Fig. A:26 Measuring the camshaft thrust plate

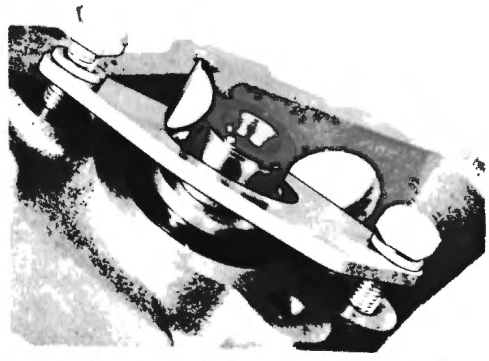


Fig. A:27 Camshaft thrust plate, spacer washer and woodruff key

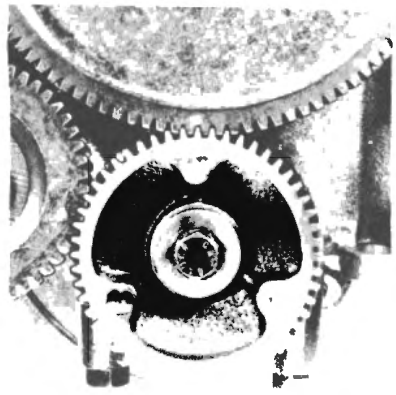


Fig. A:28 Timing gear alignment marks

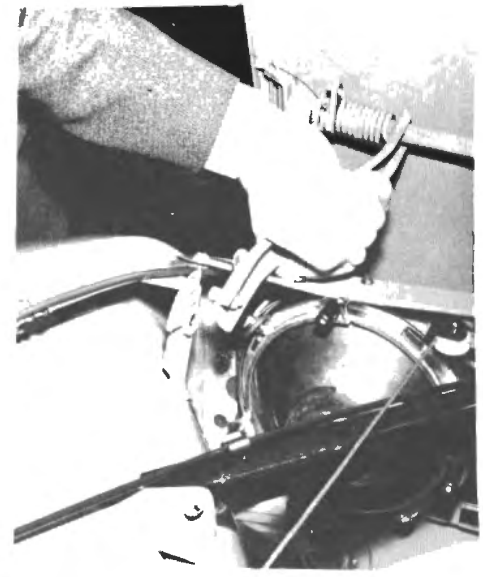


Fig. A:29 Removing the bonnet

Fig. A:30 Front panel retaining screws

manifold. Disconnect the engine side stay bracket from the left hand side of the engine (Fig. A : 1). Release the cylinder head bolts evenly, in the reverse order to that shown in Fig. A : 11 and lift off the cylinder head and gaskets. Repeat for the other cylinder head. Note that the outer rear bolt on the right hand cylinder head also secures the engine earth cable. Remove the tappets from their bores in the cylinder block with the aid of a magnet or a piece of bent wire (Fig. A : 25). Keep the tappets in their correct order.

Unscrew the sump retaining bolts and remove the sump and gaskets. Remove the oil pump and pump drive shaft (Fig. A:35).

Unscrew the retaining bolt and withdraw the pulley from the balance shaft. Remove the 9 bolts retaining the front cover to the cylinder block and tap the rear of the water pump with a plastic mallet or similar, to separate the cover from the intermediate plate. If required, the water pump can be unbolted from the front cover (see Fig. B:12).

Unscrew the retaining bolt and remove the camshaft fibre gear wheel by hand. Remove the retaining bolt and withdraw the balance shaft gear wheel. Unscrew the intermediate plate retaining bolts (2, Fig. A:36), and detach the plate. Remove the camshaft thrust plate, woodruff key and spacer (Fig. A:27), and carefully withdraw the camshaft.

Unscrew the big end bolts several turns on one of the connecting rods and tap them to release the cap. Completely remove the bolts and big end cap and push the piston and connecting rod assembly up out of the cylinder bore. Repeat for the other piston and connecting rod assemblies. Remove the crankshaft gear retaining bolt and withdraw the gear using a suitable puller (eg: Tool 786218). Mark the relative position of the flywheel and crankshaft flange and remove the flywheel.

Drive out the balance shaft sealing washer by tapping the balance shaft towards the rear using a plastic mallet or similar and then carefully withdraw the balance shaft from the rear (Fig. A:39). Release the main bearing cap bolts evenly and lift off each cap. Carefully lift out the crankshaft and slide the oil seal off the rear end of the shaft.

ENGINE – Inspection and Overhaul :

Cylinder Head Assembly :

The components of the cylinder head assemblies, including the push rods, have been dealt with previously under "CYLINDER HEAD – Inspection and Overhaul".

Cylinder Block :

Thoroughly clean the dismantled block. Remove the oil gasket material from the surfaces. Clean and blow out all passages, bolt holes etc. Ensure that the threads in the cylinder head bolt holes are clean.

Check all machined gasket surfaces for burrs, nicks, scratches and scores. Remove minor imperfections with an oil stone. Check the cylinder head gasket surfaces for flatness and if necessary, have the cylinder block face corrected by planing. Replace any core plugs which show signs of leakage.

Cylinder Bores :

Inspect the cylinder walls for scoring, roughness or other signs of wear. Check the cylinder bore for out-of-round and taper. Measure the bore with an accurate bore gauge, following the equipment manufacturers instructions. Measure the diameter of each cylinder bore at the top, middle and bottom with the gauge placed first at right angles (A) and then parallel (B) to the centre line of the engine. The difference between A and B will give the out-of-round, and the difference between A at the top of the bore and A at the bottom of the bore will give the taper. It may be possible to remove minor surface imperfection by honing, but cylinders which are deeply scored excessively worn, must be rebored to the next oversize.

Pistons and Connecting Rod Assemblies :

The piston, connecting rod and piston pin form an integral unit and are serviced as such. No attempt, therefore, should be made to separate them.

When removing the piston and connecting rod assemblies from the engine, check that the connecting rods and big-end caps have been numbered correctly (Fig. A:37). Where the rods and caps are unmarked they should be suitably stamped unless the assemblies are being scrapped.
Remove all deposits from the piston surfaces. Clean gum or varnish from the piston skirt and rings with solvent. DO NOT use a caustic cleaning solution or wire brush to clean the pistons. Clean the ring grooves and make sure that the oil ring slots are clean. Clean the connecting rods, caps and bearing shells with solvent and dry with compressed air.

Inspect the pistons for fractures at the ring lands, skirts and pin bosses, and for scuffed, rough or scored skirts. A shining surface on either pin-boss side of the piston usually indicates that the connecting rod is bent. If the lower portion of the ring groove has a high step, replace the piston. Spongy, eroded areas near the edge of the piston crown are usually caused by detonation or pre-ignition. Replace pistons that show signs of excessive wear, wavy ring lands or fractures, or damage from detonation or pre-ignition. Although, in production, pistons are graded to match the cylinder bore, pistons obtained as service replacements are not classified. The diameter of replacement pistons lies within the upper part of the tolerance range so that in most cases the cylinder bore requires to be honed in order to get the correct piston clearance with a new piston. If the clearance obtained is excessive, the cylinders must be rebored to the next oversize.

The piston clearance in the cylinder bore should be 0.0011 - 0.0024 in. (0.03 - 0.06 mm). If the clearance is excessive, the piston must be replaced with one of suitable diameter or the cylinder rebored to the next oversize.

The piston fit in the cylinder bore can be checked with a piston pull-scale, fitted with a feeler blade 1/2 in. (12.7 mm) wide and 0.0012 - 0.0020 in. (0.03 - 0.06 mm) thick. Place the feeler blade at one side of the cylinder bore and then slide the piston (without piston rings) crown first into the cylinder bore to trap the feeler blade between the piston and the cylinder wall. The piston should be inserted with its front marking pointing towards the front of the engine. Hold the piston in the bore without applying any side thrust and withdraw the feeler blade with a steady pull on the piston scale (Fig. A:46). If the clearance is correct, the pull required will be 2.2 lb (1 kg). Repeat the test at several different depth positions in the bore.

Inspect the connecting rods for signs of fracture and the big end bearing bores for out-of-round and taper. Abnormal big-end bearing wear can be caused by either a bent connecting rod, a worn or damaged crankpin, or a tapered big-end bearing bore. If any unsatisfactory condition is found, the connecting rod should be replaced. New connecting rod bolts should be used every time the bearing caps are removed.

Piston Rings :

Replace all piston rings which are broken, cracked, chipped, scored or worn. Rings should NOT be transferred from one piston to another regardless of mileage. Locate each piston ring in turn in its respective cylinder bore, using the inverted piston to position the ring squarely in the bore, and check the piston ring gap (Fig. A:47). With worn cylinder bores the ring should be located at the lower limit of travel of the piston as this portion of the bore will be least worn. If the piston ring gap is too small, the ends of the ring must be trimmed with a special file.

Check the clearance of each piston ring to its respective groove in the piston at several points by rolling the ring around the piston. Refer to TECHNICAL DATA at the end of this section for the specified clearances.

When assembling the piston rings to the pistons, position the gap in the oil control ring main segment at 180° to the mark on the piston crown and stagger the gaps in the ring rails 1 in. (25 mm) on either side of the gap. The compression ring gaps should be positioned 150° on either side of the oil control ring main segment gap.

Crankshaft :

Clean the crankshaft with solvent and blow out the oil passages with compressed air. Inspect the bearing journals for cracks, scratches, grooves or scores and the rear oil seal surface for nicks, sharp edges or burrs that might damage the oil seal or cause premature seal wear. Use emery cloth to remove the minor imperfections.

Measure the diameter of each journal in at least four places to determine out-of-round, taper and undersize. If the taper or out-of-round is excessive, or if any of the journal surfaces are severely marred, the crankshaft must be reground. If the journal will not clean up to the maximum undersize bearing available, replace the crankshaft.

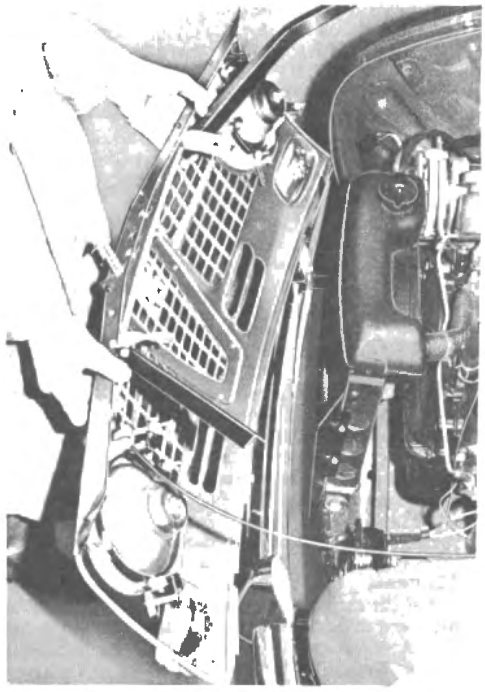


Fig. A:31 Removing the front panel

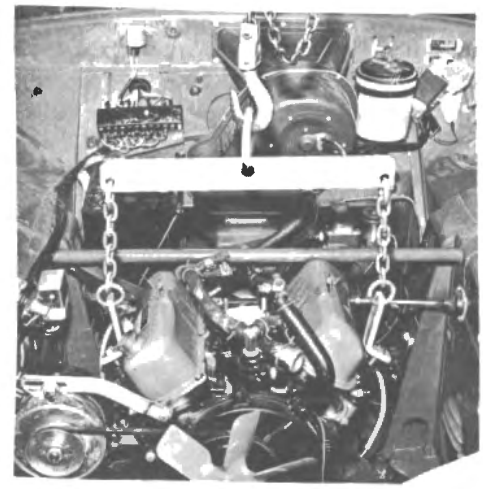


Fig. A:32 Removing/installing the engine

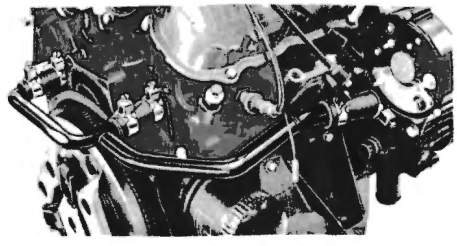


Fig. A:33 Water distribution pipe

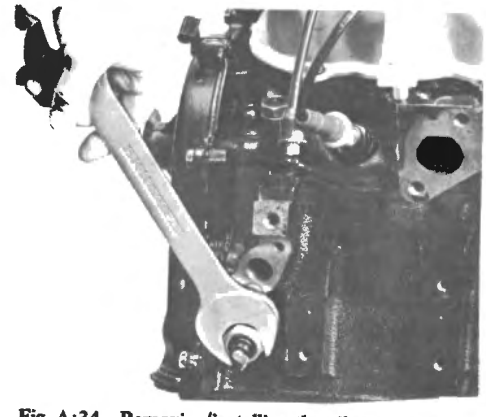


Fig. A:34 Removing/installing the oil pressure switch

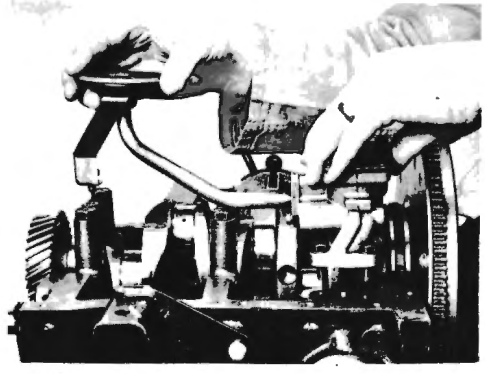


Fig. A:35 Removing/installing the oil pump

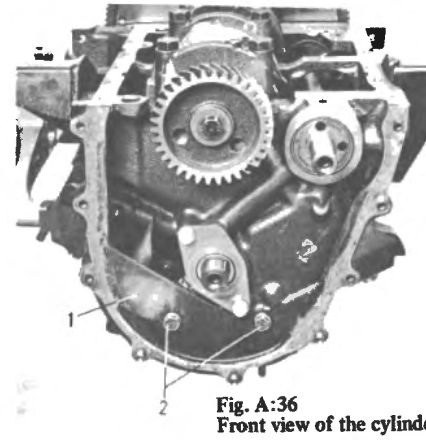


Fig. A:36
Front view of the cylinder block.

1. *Intermediate plate.*
2. *Plate retaining bolts.*

Fig. A:37 Connecting rod and cap numbering

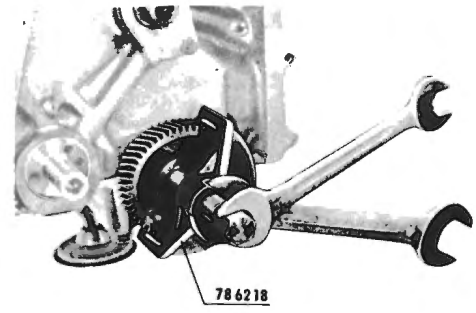


Fig. A:38 Removing the crankshaft sprocket

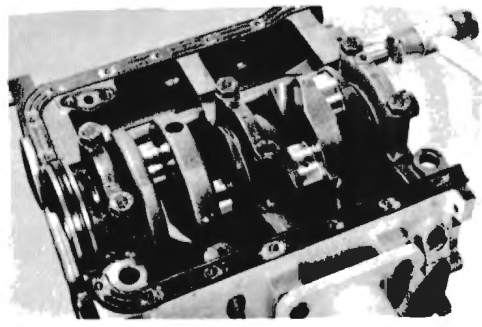


Fig. A:39 Removing the balance shaft

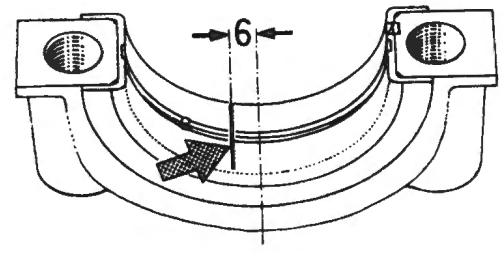


Fig. A:40 Placing plastigauge on the bearing cap

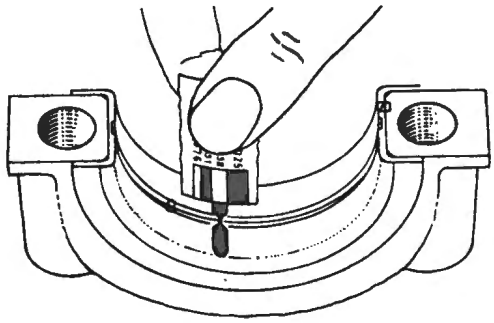


Fig. A:41 Measuring the plastigauge width

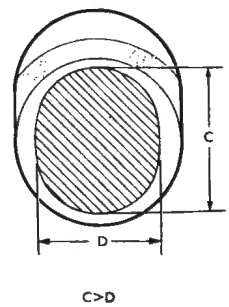


Fig. A:42 Crankshaft out-of-round

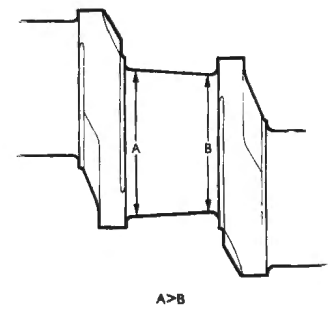


Fig. A:43 Crankshaft taper

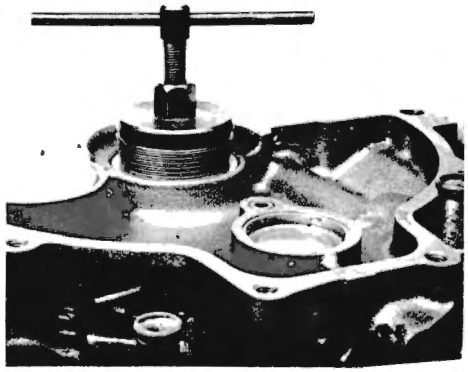


Fig. A:44 Removing the crankshaft rear oil seal

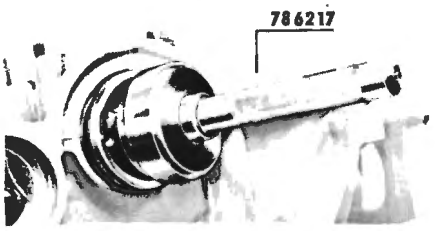


Fig. A:45 Installing the crankshaft rear oil seal

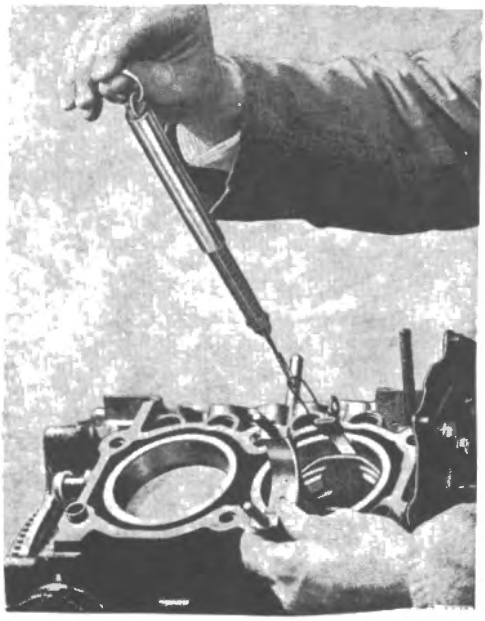


Fig. A:46 Checking the piston fit with a pull-scale

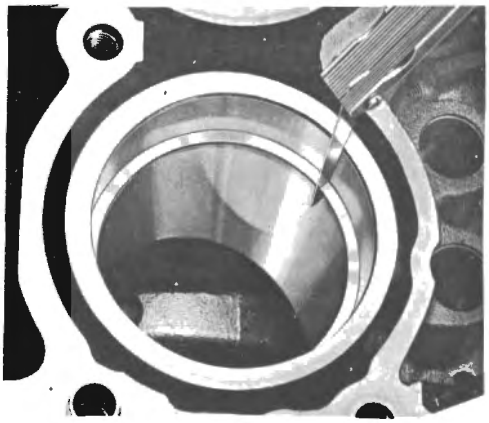


Fig. A:47 Checking the piston ring gap

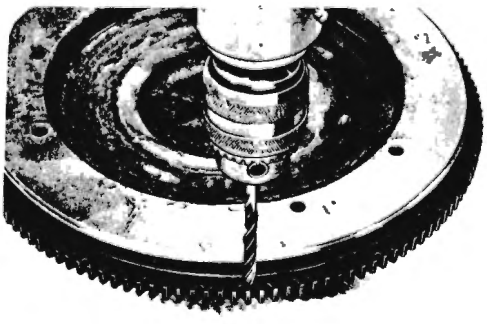


Fig. A:48 Removing the ring gear from the flywheel

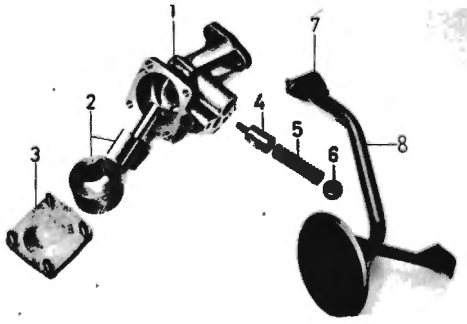


Fig. A:49
Oil pump, dismantled.

1. *Pump housing.*
2. *Inner and outer rotor.*
3. *Cover plate.*
4. *Relief valve.*
5. *Spring.*
6. *Valve cap.*
7. *Gasket.*
8. *Oil pick-up pipe.*

Crankshaft Rear Oil Seal :

The crankshaft rear oil seal can be replaced without major disassembly of the engine. With the engine removed from the car, unbolt the clutch and flywheel. Withdraw the old crankshaft seal using Tool No. 786216 by first retracting the tool spindle pressure, screwing it on with the conical threaded part in the seal and then advancing the pressure spindle to pull out the seal (Fig. A:44). Lubricate the inner diameter of the new seal with engine oil, push it onto Tool No. 786217 and drive it into the main bearing until it bottoms out (Fig. A:45).

Main Bearings :

Clean the bearing inserts and caps thoroughly in solvent and dry with compressed air. DO NOT scrape gum or varnish deposits from the bearing shells. Inspect each bearing carefully. Bearings that have a scored, chipped or worn surface should be exchanged. The bearing base may be visible through the bearing overlay but this does not mean that the bearing is worn. It is not necessary to replace the bearing if the clearance is within the recommended limits.

Check the clearance of bearings which appear to be satisfactory, using Plastigage. Plastigage is available under spare part No. 786050 and is supplied in three different thicknesses. Use type PG-1 (green) as this is suitable for clearance measurements, of 0.00098 - 0.00299 in. (0.025 - 0.076 mm).

Position the engine with the sump face upwards and install the crankshaft and main bearing inserts. Ensure that the parts to be measured are free from oil and dirt. Install a dry bearing insert in the main bearing cap and place a piece of plastigage across the full width of the insert about 1/4 in. (6 mm) off-centre (Fig. A:40). Position the crankshaft about 30° B.B.D.C. and install the bearing cap with insert and Plastigage. Tighten the bearing cap bolts to the normal specified torque.

NOTE :– DO NOT turn the crankshaft while the Plastigage is in place.

Remove the bearing cap and, using the Plastigage scale, check the width of the Plastigage strip (Fig. A:41). The widest point will give the minimum clearance and the narrowest point the maximum clearance. The difference between the readings gives the taper on the journal.

To check the crankshaft journals for out-of-round, rotate the crankshaft 90° and repeat the measuring procedure. The difference between the readings indicates the out-of-round of the journal.

NOTE :– All bearings and journals must be cleaned of Plastigage material.

The main bearing clearance should be 0.012 - 0.048 mm for standard journals and 0.014 - 0.058 mm for undersize journals.

Standard bearing inserts are supplied in two different thicknesses, the thicker of the two being identified by a blue dot and the other by a red dot. Red bearing inserts should be fitted for the initial measurement of the bearing clearances. If the clearance is excessive a blue and a red, or two blue inserts should be installed. If the clearance is still excessive, even with two blue inserts, the crankshaft must be reground to the next undersize and corresponding undersize inserts fitted.

NOTE :– If blue inserts are used on more than one journal, ensure that they are all installed on the cylinder block side of the bearing.

NOTE :– All main bearing inserts are interchangeable.

When refitting the main bearing caps, the arrows on the centre and front caps must point to the front. Care should be taken to avoid confusing the cylinder head bolts with those for the main bearing caps. Although the bolts have the same diameter, the main bearings cap bolts are approximately 0.4 in (10 mm) longer than those for the cylinder head. As from engine No. 74900 the cylinder head bolts have been lengthened to make them the same, thus eliminating possibility of confusion.

The centre main bearing also serves as an axial guide bearing for the crankshaft.

Big-End Bearings :

The big-end bearing inserts should be inspected and the bearing clearances checked in the same manner as already described for the main bearings. When measuring a bearing clearance with Plastigage, ensure that the connecting rod is not moved. The crankpin to bearing clearance should be 0.014 - 0.054 mm for standard journals and 0.014 - 0.064 mm for undersize journals. Similar remedial procedure should be carried out.

Camshaft :

Clean the camshaft in solvent and wipe dry. Inspect the cam lobes for scoring and signs of abnormal wear. Lobe wear characteristics may result in pitting in the general wear of the lobe toe but this is not detrimental to the operation of the camshaft. The camshaft should not, therefore, be replaced until the lobe lift loss has exceeded 0.005 in (0.127 mm).Check the distributor drive gear for broken or chipped teeth and, if this condition is present, the camshaft must be exchanged.

The camshaft end-float is controlled by a thrust plate and spacer ring, the spacer ring being slightly thicker than the thrust plate (Fig. A:27). The end-float corresponds to the difference in thickness between the spacer ring and thrust plate. This should be 0.025 - 0.076 mm. The spacer ring is available in different sizes, the size group being indicated by red or blue markings. A red spacer decreases the end-float while a blue one increases the end-float. When fitting new parts, select a spacer to give the specified end-float.

Camshaft Followers :

The cam followers can be withdrawn from the tip of the cylinder block after the cylinder heads have been removed (Fig. A:25). Thoroughly clean the followers in clean solvent and wipe them with a clean, lint-free cloth. Check them for wear or scoring. Replace followers which are scored, worn, or if the bottom is not smooth. It is recommended that only new cam followers be used when fitting a new camshaft.

Timing Gears :

To ensure quiet running, the camshaft gear wheel is made of fibre. Check all three gear wheels for cracks and worn or damaged teeth. If required, the gear wheels can be replaced separately.

The backlash for the timing gears should be as follows :-

	Camshaft Gear	Balance Shaft Gear
New gear wheels	0.0020 - 0.0079 in. (0.05 - 0.20 mm)	0.0020 - 0.0055 in. (0.05 - 0.14 mm)
Worn gear wheels (max.)	0.0157 in. (0.4 mm)	0.0157 in. (0.4 mm)

A backlash of 0.0157 in. (0.4 mm) at the balance shaft gear wheel is equivalent to 0.022 in. (0.56 mm) on the outside diameter of the balance shaft pulley.

Front Cover :

If the balance shaft oil seal is to be replaced, drive the old oil seal out of the front cover using Tool GC 6059 (Fig. A:18). Drive the new seal into place from the rear, using Tool No. GC 7600-B, until it bottoms (Fig. A:19).

Flywheel :

If required the flywheel ring gear can be replaced by drilling a hole, 0.28 - 0.32 in (7 - 8 mm) in diameter between two adjacent teeth of the ring at two diametrically opposite points (Fig. A:48). As a rule the ring gear splits off during drilling, but otherwise it can be split with the aid of a chisel. During the drilling operation, ensure that the drill passes through the ring gear only and not into the flywheel.

Heat the new gear evenly to a temperature of not in excess of 554°F (290°C). The ring gear is induction hardened and loses its hardness if heated above this temperature. Once expanded with the heat, fit the ring gear over the flywheel so that it drops down onto the flywheel lug. Allow the ring gear to cool naturally in air. DO NOT QUENCH.

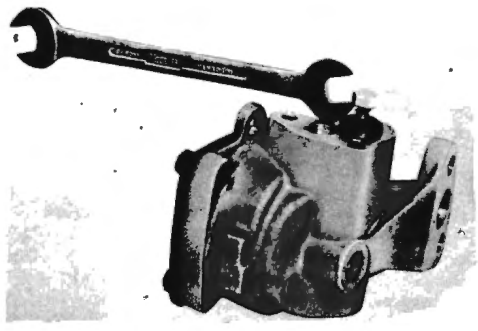


Fig. A:50 Removing the relief valve cap

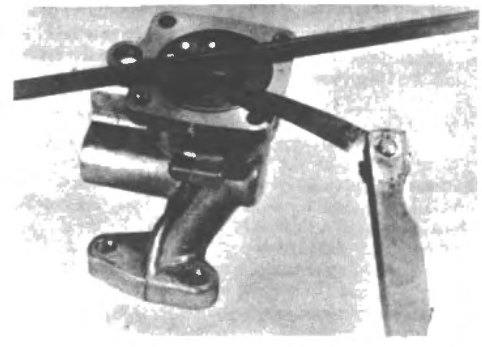


Fig. A:51 Checking the rotor end-float

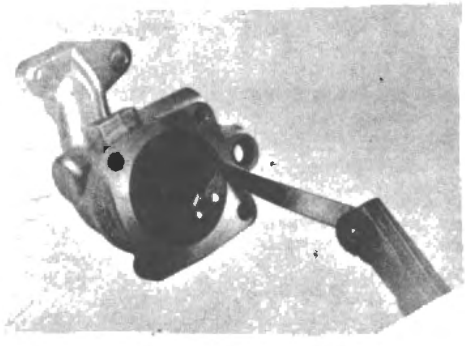


Fig. A:52 Checking the rotor radial clearance

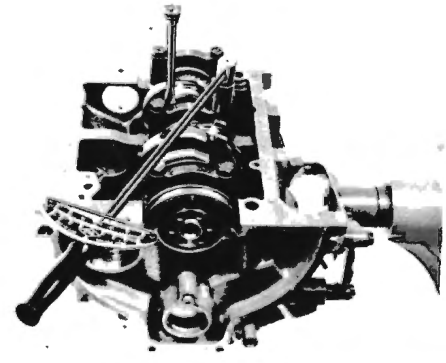


Fig. A:53 Tightening the centre main bearing cap

Fig. A:54 Installing the piston and connecting rod assemblies

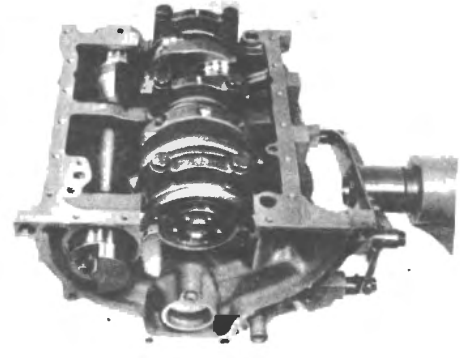


Fig. A:55 Installing the balance shaft

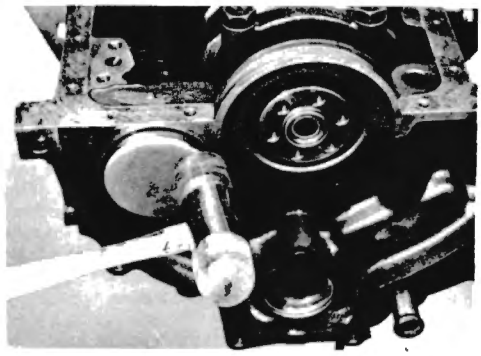


Fig. A:56 Installing the balance shaft cover plate

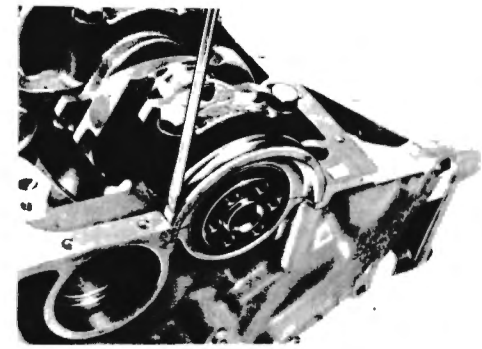


Fig. A:57 Installing the wedge-shaped seals in the rear main bearing cap.

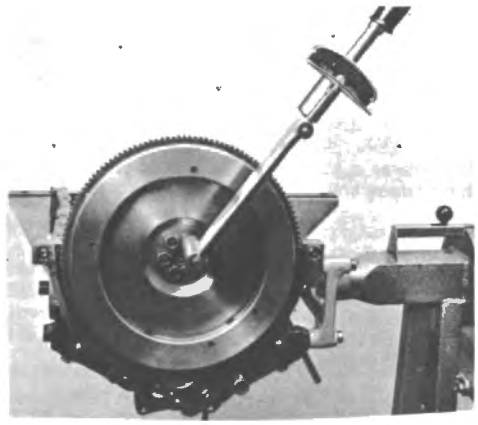


Fig. A:58 Installing the flywheel

Fig. A:59 Installing the intermediate plate

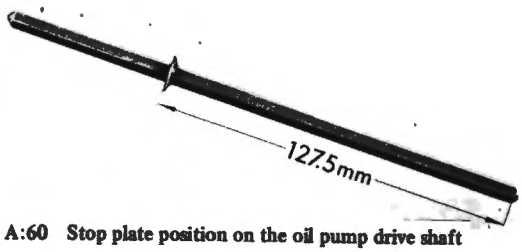


Fig. A:60 Stop plate position on the oil pump drive shaft

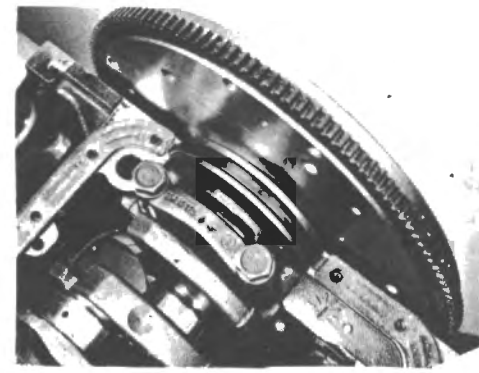


Fig. A:61 Sump gasket location

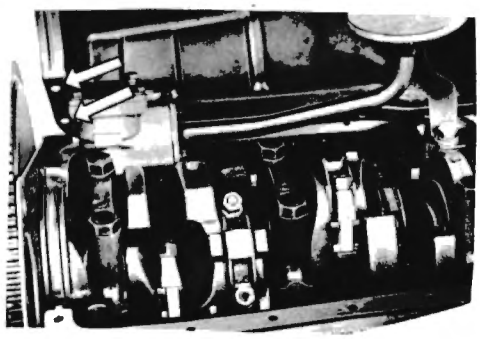


Fig. A:62 Installing the sump

Oil Pump :

Unscrew the oil pick-up pipe from the oil pump. Uncover the four retaining bolts and lift off the cover plate (Fig. A:49).

Check the clearance between the outer rotor and the pump housing with a feeler blade (Fig. A:52). If the clearance exceeds 0.012 in. (0.3 mm). the rotor assembly and/or the pump body must be replaced. Substitute a new rotor assembly and recheck the clearance to determine the worn component.

NOTE :– The inner rotor and drive shaft are an integral unit and are serviced as such.

Check the rotor end-float by placing a straight-edge across the face of the pump housing and measuring the clearance between the straight-edge and the inner and outer rotors (Fig. A:51). The clearance should be 0.004 in. (0.1 mm). If the end-float is outside specification, the face of the pump housing or the end faces of the rotors can be carefully lapped in on a surface plate until the correct clearance is obtained.

After lapping in, great care should be exercised to ensure that all traces of grinding dust are removed from the components before reassembly.

The relief valve can be dismantled, if required, by making a hole in the valve cap with a suitable drift and screwing in a suitable self-tapping screw with which to pull out the cap (Fig. A:50). The spring and the relief valve can then be removed.

Coat all components with engine oil before reassembly. Press the new relief valve cap home with the flat side facing outwards until it bottoms out and then tap the middle of the cap with a suitable round-tipped drift (approx. 0.48 in / 12 mm diameter) to fully secure it. Tighten the cover plate bolts to the specified torque setting and then check that the pump turns over easily without binding. Use a new gasket when assembling the oil pick-up pipe to the pump body.

ENGINE – Assembly :

With the cylinder block inverted, lightly coat the backs of the main bearings inserts with engine oil and install the inserts in the block and the bearing caps. Place the crankshaft carefully in the cylinder block and check the main bearing clearances as described above in "ENGINE – Inspection and Overhaul". Finally apply a thin coat of sealing compound to the rear part of the contact surface of the rear bearing cap, coat the bearing inserts with engine oil and install the three main bearing caps. Tighten the front and rear bearing caps to the specified torque. Screw up the bolts on the centre cap finger tight. Press the crankshaft forwards, at the same time pry the centre bearing cap to the rear. Tighten the centre bearing cap bolts to the specified torque while holding the crankshaft forwards (Fig. A:53).

Lubricate the inner diameter of the new crankshaft rear oil seal with engine oil, push it onto Tool No. 786217 and drive it onto the rear main bearing until it bottoms out (Fig. A:45). Coat the two wedge-shaped seals with sealing compound and press them into the rear main bearing cap with a suitable tool such as a blunt screwdriver (Fig. A:57). The dowel side of the seal must face the main bearing cap.

Lubricate the balance shaft journals and bearings with engine oil and install the balance shaft from the rear (Fig. A:55). Apply a thin coat of sealing compound to the new shaft cover plate and drive the plate, with the flat side out, into the rear end of the cylinder block until it bottoms out (Fig. A:56). Ensure that the mating faces are clean and using new retaining bolts, assemble the flywheel to the crankshaft flange. Tighten the bolts to the specified torque (Fig. A:58).

Lubricate the camshaft journals and bearings with engine oil and carefully pass the camshaft into the cylinder block. Fit the spacer ring over the camshaft with its countersunk side inwards and insert the woodruff key. Position the thrust plate on the front of the cylinder block so that it covers the main oil gallery hole and secure with the two retaining screws and spring washers (Fig. A:27). Check the camshaft end-float and, if necessary, adjust by fitting a spacer ring of a different thickness.

Apply a thin coating of sealing compound to the mating faces of the cylinder block and intermediate plate (Fig. A:59). Position the gasket on the block face and install the plate loosely with the two retaining bolts (Fig. A:36). Temporarily install two of the lower bolts as guide dowels and fully tighten the two retaining bolts. Check that the lower edge of the plate is level with the sump face of the block. Remove the two guide bolts.

Locate the woodruff key in the front end of the crankshaft, install the crankshaft gear wheel, retaining bolt and washer and tighten to the specified torque. Avoid tapping the gear as this may cause damage to the axial centre bearing of the crankshaft. Turn the crankshaft until one of the marks on the crankshaft gear wheel aligns with the mark on the balance shaft gear and the other faces the camshaft (Fig. A:28). Fit the gear wheel onto the camshaft so that the mark on the gear aligns with the mark on the crankshaft gear. Fit the gear wheel onto the balance shaft so that the mark on the gear aligns with the other mark on the crankshaft gear. Secure each gear with a retaining bolt and washer.

Install the water pump in the engine front cover plate and secure with the retaining bolts (see, Fig. B:12). Apply a thin coating of sealing compound to the mating faces of the intermediate plate and the front cover. Position the gasket on the intermediate plate. Install the front cover, align it using Tool No. GC 6059 and tighten the 9 retainging bolts (Fig. A:20). Lightly oil the sealing surface of the balance shaft pulley, install the pulley and secure with the retaining bolt and washer.

Fit new connecting rod bores in the connecting rods. Assemble the piston rings to the pistons as described in "ENGINE – Inspection and Overhaul". Compress the rings using a suitable piston ring compressor and push the piston into its cylinder bore with the mark on the crown towards the front of the engine (Fig. A:54). Install the bearing inserts dry in the connecting rod and cap. Turn the crankshaft as necessary to fit the crankrod to the crankpin. Check the bearing clearances as described in "ENGINE – Inspection and Overhaul". Finally coat the bearing inserts with engine oil, install the big-end bearing cap and tighten the nuts to the specified torque. Repeat the procedure for the other piston assemblies.

Check that the stop plate on the oil pump drive shaft is positioned 5.02 in (127.5 mm) from the blunt end (Fig. A:60). Insert the drive shaft into the block, pointed end first, and install the oil pump and gasket. Tighten the pump retaining bolts and then the oil pick-up pipe bolt.

Position the sump gasket on the cylinder block flange, using sealing compound at the two points where the front cover and intermediate plate meet. Ensure that the two tabs on the gasket are located in the recesses in the rear main bearing cap and then insert the rubber seal in the groove in the cap (Fig. A:61). Install the sump and tighten the retaining bolts. The two bolts with the rubber washers must be positioned at the rear balance shaft bearing (Fig. A:62).

Turn the engine upright, lubricate the tappet bores and install the tappets in their original locations. Install the cylinder heads as described previously under "CYLINDER HEAD – Removal and Installation". Fit the engine side stay bracket to the left hand cylinder head. Install the inlet manifold as described in the FUEL SYSTEM section. Install the thermostat in its bore in the inlet manifold with the thermostat holder at right angles to the axis of the engine (see, Fig. B:10). Install the water outlet housing and gasket over the thermostat and secure with the retaining bolts. Fit the carburettor and gasket to the inlet manifold.

Apply a film of oil to the rubber gasket on the oil filter cartridge. Screw the cartridge into the adaptor on the cylinder block until the gasket makes contact and then further tighten half a turn. DO NOT overtighten the cartridge. Apply sealing compound to the threads of the oil pressure switch and screw the switch into the cylinder block (Fig. A:34). Insert the fuel pump push rod into the cylinder block with the same end on the cam as originally and install the fuel pump and gasket. Reconnect the fuel line.

Install the distributor as described in the IGNITION SYSTEM section. Reconnect the distributor vacuum line, install the distributor cap and fit the H.T. leads to the spark plugs. Fit the cooling fan and drive pulley to the front cover. Install the alternator and mounting bracket, fit the drive belt and adjust the drive belt tension. Install the dipstick. Assemble the clutch to the flywheel.

Technical Data

ENGINE

Type	4 stroke, 4 cylinder in a 60°V
Bore	3,54 in (90 mm)
Stroke	2,32 in (58,86 mm)
Cubic capacity	91.4 cu.in (1498 cc)
Compression ratio	9.0 : 1
Brake horse power, DIN	65 at 4700 rev/min.
Torque (max.), DIN	85 lb.ft. (11.7 kgm) at 2500 rev/min.
Firing order	1 – 3 – 4 – 2
Placement of cylinder (from front of car)	
– Right hand bank	1 – 2
– Left hand bank	3 – 4

CYLINDER BLOCK

Cylinder bore diameter		
– Standard		90.030 – 90.040 mm
– 0.02 in (0.5 mm) oversize		90.530 – 90.540 mm
– 0.04 in (1,0 mm) oversize		91.030 – 91.040 mm
Main bearing parent bore in block	– red	60.62 – 60.63 mm
	– blue	60.63 – 60.64 mm
Camshaft parent bore in block	– front	44.65 – 44.68 mm
	– centre	44.27 – 44.30 mm
	– rear	43.89 – 43.92 mm
Balance shaft parent bore in block	– front	54.420 – 54.445 mm
	– rear	57.620 – 57.645 mm

PISTON & CONNECTING ROD ASSEMBLIES

NOTE :– The piston and connecting rod is serviced only as an assembly and no attempt should be made to separate them.

Piston diameter		
– Standard		89.978 – 90.002 mm
– 0.02 in (0.5 mm) oversize		90.478 – 90.502 mm
– 0.04 in (1.0 mm) oversize		90.978 – 91.002 mm
Piston to bore clearance		0.0011 – 0.0024 in (0.03 – 0.06 mm)
Number of piston rings on each piston		Two compression, one oil control
Piston ring grove width		
– Upper		2.030 – 2.055 mm
– Centre		3.030 – 3.056 mm
– Lower		5.017 – 5.042 mm
Maximum weight differential between piston & connecting assemblies		0.46 oz (13 g)
Inside diameter of big-end bearing inserts (fitted)		
– Standard	– blue	54.004 – 54.034 mm
	– red	54.014 – 54.044 mm
– 0.002 in (0.05 mm) undersize		53.943 – 53.983 mm
– 0.010 in (0.25 mm) undersize		53.760 – 53.800 mm
– 0.020 in (0.50 mm) undersize		53.506 – 53.546 mm
– 0.030 in (0.75 mm) undersize		53.252 – 53.292 mm
– 0.040 in (1.00 mm) undersize		52.998 – 53.038 mm
Big-end parent bore	– red	56.820 – 56.830 mm
	– blue	58.830 – 56.840 mm
Crankpin to bearing clearance		
	– Standard	0.014 – 0.054 mm
	– Undersize	0.014 – 0.064 mm

PISTON RINGS

Piston ring clearance in groove	
– Compression rings	0.040 – 0.078 mm
– Oil control ring	0.026 – 0.203 mm
Piston ring gap	
– Compression rings	0.250 – 0.500 mm
– Oil control ring segments	0.380 – 1.400 mm

CRANKSHAFT

Number of main bearings		3
Main bearing journal diameter		
– Standard	– red	57.000 – 56.990 mm
	– blue	56.990 – 56.980 mm
– 0.002 in (0.05 mm) undersize		56.929 – 56.919 mm
– 0.010 in (0.25 mm) undersize		56.746 – 56.737 mm
– 0.020 in (0.50 mm) undersize		56.492 – 56.482 mm
– 0.030 in (0.75 mm) undersize		56.238 – 56.228 mm
– 0.040 in (1,00 mm) undersize		55.984 – 55.974 mm
Inside diameter of main bearing inserts (fitted)		
– Standard	– blue	57.004 – 57.020 mm
	– red	57.014 – 57.030 mm
– 0.010 in (0.25 mm) undersize		56.760 – 56.776 mm
– 0.020 in (0.50 mm) undersize		56.506 – 56.522 mm
– 0.030 in (0.75 mm) undersize		56.252 – 56.268 mm
– 0.040 in (1.00 mm) undersize		55.998 – 56.014 mm
Main bearing clearance	– Standard	0.012 – 0.048 mm
	– Undersize	0.014 – 0.058 mm
Thrust journal length (centre main bearing)		26.44 – 26.39 mm
Crankshaft end float		0.102 – 0.203 mm
Thrust bearing insert width		26.29 – 26.24 mm
Crankpin diameter		
– Standard	– red	57.000 – 56.990 mm
	– blue	56.990 – 56.980 mm
– 0.002 in (0.05 mm) undersize		56.929 – 56.919 mm
– 0.010 in (0.25 mm) undersize		56.746 – 56.736 mm
– 0.020 in (0.50 mm) undersize		56.492 – 56.482 mm
– 0.030 in (0.75 mm) undersize		56.238 – 56.228 mm
– 0.040 in (1.00 mm) undersize		55.984 – 55.974 mm

CAMSHAFT

Number of bearings		3
Journal diameter	– front	41.516 – 41.542 mm
	– centre	41.135 – 41.161 mm
	– rear	40.754 – 40.780 mm
Inside diameter of bushings		
	– front	41.587 – 41.593 mm
	– centre	41.186 – 41.212 mm
	– rear	40.805 – 40.831 mm
Bearing clearance		0.025 – 0.077 mm
End float		0.025 – 0.076 mm
Spacer thickness	– red	4.064 – 4.089 mm
	– blue	4.089 – 4.114 mm
Cam lift		0.256 in (6.490 mm)
Cam heel to toe dimension		34.201 – 33.998 mm
Maximum gear wheel backlash		0.0157 in (0.4 mm)

VALVE MECHANISM

Valve head diameter		
– Inlet		1.46 in (37 mm)
– Exhaust		1.26 in (32 mm)
Valve stem diameter		
– Inlet	– Standard	8.043 – 8.025 mm
	– Oversize	8.243 – 8.225 mm
		8.443 – 8.425 mm
		8.643 – 8.625 mm
		8.843 – 8.825 mm
– Exhaust	– Standard	8.017 – 7.999 mm
	– Oversize	8.217 – 8.199 mm
		8.417 – 8.399 mm
		8.617 – 8.599 mm
		8.817 – 8.799 mm
Valve guide inside diameter		8.063 – 8.088 mm

Valve stem to guide clearance	
– Inlet	0.020 – 0.063 mm
– Exhaust	0.046 – 0.089 mm
Valve seat angle (cylinder head)	45°
Valve seat width	0.060 – 0.070 in (1.5 – 1.7 mm)
Valve lift	0.38 in (9.7 mm)
Valve clearance (hot)	
– Inlet & Exhaust	0.016 in (0.40 mm)
Valve spring free length	
– Except Monte Carlo	1.78 in (45.2 mm)
– Monte Carlo only	1.85 in (47.0 mm)
Valve spring length, fully compressed	
– Except Monte Carlo	1.13 in (28.6 mm)
– Monte Carlo only	1.06 in (27.0 mm)
Compression load to 1.59 in (40.26 mm)	
– Except Monte Carlo	39 – 47 lbs (17.8 – 21.5 kg)
– Monte Carlo only	59 – 66 lbs (27.0 – 30.0 kg)
Cam follower diameter	22.202 – 22.190 mm
Cam follower to bore clearance	0.023 – 0.060 mm
Valve timing (with a valve clearance of 0.425 mm)	
– Inlet opens	21°BTDC
– Inlet closes	82°ATDC
– Exhaust opens	63°BTDC
– Exhaust closes	40°ATDC

OIL PUMP

Rotor to housing clearance	0.012 in (0.3 mm)
Rotor end – front	0.004 in (0.1 mm)
Relief valve opening pressure	47 – 55.5 lb/sq.in (3.3 – 3.9 kg/cm^2)

LUBRICATION

Sump capacity (inc. oil filter)	5.8 imp. pts (3.3 US qts. 3.3 litres)
Filter capacity	0,53 imp. pts (0.3 US qts. 0.3 litres)
Grade of oil (Ford spec. ESE–M2C–101 B)	
Summer	SAE 20W/20, 10W/30, 10W/40
Winter (below 14°F/–10°C)	SAE 10W, 10W/30, 10W/40

BALANCE SHAFT

Number of bearings		2
Journal diameter	– front	50.83 – 50.80 mm
	– rear	54.00 – 53.98 mm
Inside diameter of bushings	– front	50.85 – 50.88 mm
	– rear	54.03 – 54.05 mm
Bearing clearance	– front	0.02 – 0.08 mm
	– rear.	0.03 – 0.07 mm
End float		0.05 – 0.15 mm
Maximum gear wheel backlash		0.40 mm

TORQUE TABLE

Balance shaft pulley bolt		36 lb.ft (5.0 kgm)
Big end nuts		25 lb.ft (3.5 kgm)
Cam shaft thrust plate bolts		15 lb.ft (2.0 kgm)
Camshaft gear wheel bolt		36 lb.ft (5.0 kgm)
Crankshaft gear wheel bolt		36 lb.ft (5.0 kgm)
Cylinder head bolts	– 1st stage	40 lb.ft (5.5 kgm)
	– 2nd stage	50 lb.ft (7.0 kgm)
	– 3rd stage	68 lb.ft (9.5 kgm)
Front cover bolts		15 lb.ft (2.0 kgm)
Flywheel bolts		50 lb.ft (7.0 kgm)
Inlet manifold bolts	– 1st stage	4 lb.ft (0.5 kgm)
	– 2nd stage	11 lb.ft (1.5 kgm)
	– 3rd stage	15 lb.ft (2.0 kgm)
	– 4th stage	18 lb.ft (2.5 kgm)
Intermediate plate bolts		15 lb.ft (2.0 kgm)
Main bearing car bolts		72 lb.ft (10 kgm)
Oil pump to block, bolts		11 lb.ft (1.5 kgm)
Rocker shaft pillar bolts		32 lb.ft (4.5 kgm)
Rocker cover bolts		4 lb.ft (0.5 kgm)
Sump bolts		4 lb.ft (0.5 kgm)
Thermostat housing bolts		15 lb.ft (2.0 kgm)
Water pump bolts.		7 lb.ft (1.0 kgm)

Cooling System

GENERAL

The cooling system is of the pressurised type and consists of a water jacket surrounding the cylinder bores in the cylinder block, a water pump, a thermostat and a front mounted radiator. The coolant is also used as a source of heat for the interior heater.

The water pump is mounted on the right hand side of the engine in a flange on the front cover. A manifold distributes the coolant from the water pump outlet to the rear of both cylinder banks. The cooling fan assembly is mounted independently in the front cover and is driven, together with the water pump from the balance shaft pulley. The thermostat is located in the water outlet housing on the inlet manifold. On 1969 and later models an expansion tank is incorporated in the cooling system. In this case a non-release cap is fitted to the radiator and the pressure cap is fitted to the expansion tank.

ROUTINE MAINTENANCE

Every 6.000 miles (10.000 km) the drive belt tension should be checked. At the same time check the level of coolant, the cooling system for leaks and the condition of the water hoses.

The complete system should be drained and refilled twice a year.

DRIVE BELT

It is important that the correct tension of the drive belt be maintained to ensure efficient operation of the cooling and electrical systems. Too much tension will place undue strain on the water pump, cooling fan and alternator bearings and cause excessive wear of the drive belt.

Check the tension of the drive belt on the longest span, midway between the two pulleys. Total free movement of 0.3 in (7 mm) should be present (Fig. B:6).

To adjust the belt tension, slacken the single adjustment bolt and the two mounting bolts at the alternator, move the alternator towards or away from the engine as necessary to obtain the correct belt tension, tighten the bolts.

Check the condition of the drive belt periodically and replace if excessively worn, nicked, cut or otherwise damaged. To replace the drive belt, proceed as for adjusting but press the alternator fully towards the engine and detach the belt from the pulleys. Fit the new belt, adjust to give the correct tension and tighten the alternator bolts.

ANTIFREEZE

Because of the properties of antifreeze in lowering the freezing point and raising the boiling point of the coolant, it is recommended that an all season antifreeze is used permanently in the cooling system to offer maximum protection against freezing and overheating. The presence of anti-corrosion inhibitor in most antifreezes will also prevent corrosion in the system. During the winter months, an antifreeze mixture MUST be used in the system to protect against frost damage. An inhibited Ethylene Glycol type antifreeze is recommended and should be diluted as shown in the table below.

SOLUTION STRENGTH %	FREEZING POINT	SPECIFIC GRAVITY
25	10°F (-12°C)	1.028
30	3°F (-16°C)	1.034
35	-4°F (-20°C)	1.038
40	-10°F (-23°C)	1.044
50	-32°F (-36°C)	1.055

Before putting antifreeze into the cooling system, ensure that the cylinder head nuts are tightened to the correct torque and inspect all hoses, hose connections and cooling system joints. Tighten or renew where necessary. Add the antifreeze solution already diluted to the correct strength. Run the engine until it is warm and check for leaks. Attach a label to the radiator to record the date of filling.

If it becomes necessary to top up the coolant, add the antifreeze solution already diluted to the correct strength.

Drain, flush and refill the system with new antifreeze solution every two years or as recommended by the antifreeze manufacturer.

COOLING SYSTEM – Draining and Refilling

NOTE :– Three drainpoints are provided, a tap at the bottom of the radiator and two hexagon plugs, one on either side of the cylinder block.

If the system contains an antifreeze solution and it is required for re-use, coolant should be drained into a clean container.

Set the heater control to maximum heat. Open the drain points and slowly remove the radiator filler cap. If the engine is hot, allow it to cool before removing the filler cap. When the coolant has fully drained, probe the drain point orifices to ensure that sediment, scale, etc., has not prevented the entire contents from draining away.

If the car is to be left standing with the cooling system drained, it is advisable to leave an indication to this effect.

To refill the system, check that the heater control is set to maximum heat, open the heater bleed valve and close the cooling system drain points. On late models where an expansion tank is fitted, fill the tank up to the maximum mark. Fill the system slowly to avoid air locks and run the engine until the coolant overflows from the bleed valve. Close the bleed valve, stop the engine and top up the coolant if required. Run the engine until warm and check for leaks. Recheck the coolant level and top up if necessary. Refit the radiator cap.

On late models, check the level in the expansion tank after a few days driving, as complete bleeding is achieved only when the system has been warmed up and cooled off a few times. Top up once the level is at the minimum mark again.

COOLING SYSTEM – Flushing

The use of a commercial solvent is recommended and in this case the solvent manufacturers instructions should be followed.

Drain the cooling system as described previously. Run clean water through the system until the water runs clear from the drain points. Close the drain taps and fill the system. Run the engine to circulate the water and switch off and allow to stand for a few minutes before draining. Drain and flush again with clean water. In extreme cases, flush the engine, radiator and heater separately and in the reverse direction to normal coolant flow, ie. cylinder head from the water outlet down, and the radiator from the bottom outlet pipe up. Reconnect any hoses which were removed and refill the system as described above.

COOLING SYSTEM – Testing

To test the complete cooling system for leaks, remove the pressure cap and fit a pressure tester in its place (Fig. B:7). Pump up the tester until a pressure of 14 psi. (1 kg/cm^2) is indicated on the gauge. If the pressure drops once the pumping is stopped, visually inspect all the parts for leaks. If no external leaks are apparent but the pressure continues to drop inspect the engine oil on the dip-stick to determine whether or not the coolant is leaking into the crankcase due to a cracked cylinder block or a leaking cylinder head gasket.

To check for compression or combustion leakage into the cooling system, run the engine until it reaches operating temperature. With the engine running and the tester installed, pump up the system again. The pressure must never be allowed to build up to more than 14 psi. (1 kg/cm^2). Any fluctuation of the tester dial needle indicates a compression or a combustion leak. To locate the leaking cylinder disconnect the spark plug leads one at a time, and observe the tester dial. When the plug lead is removed from the leaking cylinder, the indicator will stop fluctuating. If more than one

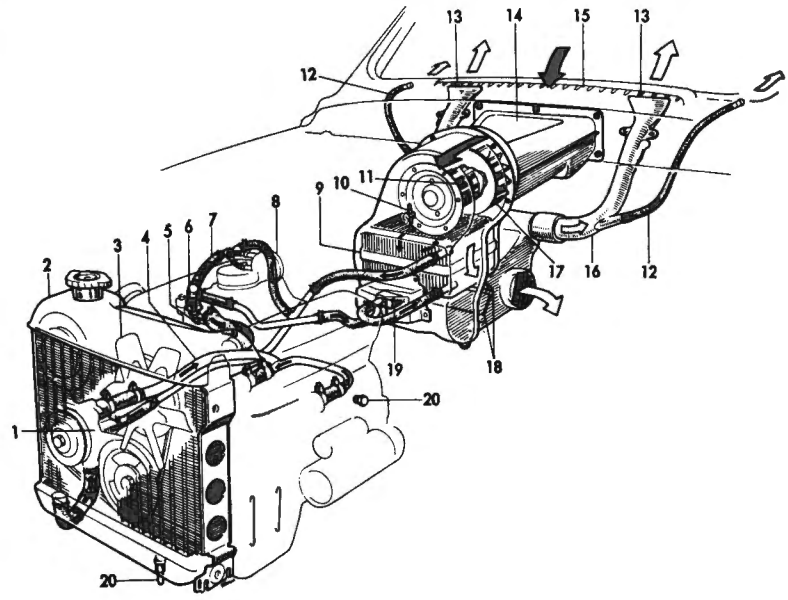


Fig. B:1
Cooling system - prior to 1969

1. *Water pump.*
2. *Radiator.*
3. *Cooling fan.*
4. *Water distribution tube.*
5. *Temperature sender unit.*
6. *Thermostat.*
7. *By-pass.*
8. *Water jacket, automatic choke carburettor.*
9. *Heater core.*
10. *Heater bleed valve.*
11. *Blower motor.*
12. *Side de-mist hose.*
13. *Main de-mister outlet.*
14. *Collector box.*
15. *Fresh air intake.*
16 *Demister pipe.*
17. *Blower fan.*
18. *Air flow control flap.*
19. *Heater temperature control valve.*
20. *Drain points (3).*

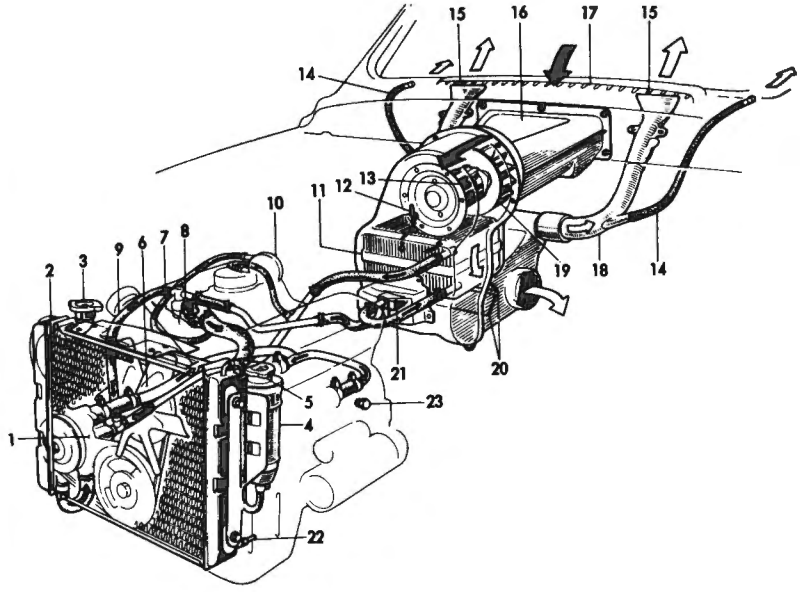


Fig. B:2
Cooling system - 1969

1. *Water pump.*
2. *Radiator.*
3. *Radiator cap (non-pressure-release type)*
4. *Expansion tank.*
5. *Pressure cap.*
6. *Cooling fan.*
7. *Temperature sender unit.*
8. *Thermostat,*
9. *By-pass.*
10. *Water jacket, automatic choke carburettor.*
11. *Heater core.*
12. *Heater bleed valve.*
13. *Blower motor.*
14. *Side de-mist hose.*
15. *Main de-mister outlet.*
16. *Collector box.*
17. *Fresh air intake.*
18. *De-mister pipe.*
19. *Blower fan.*
20. *Air flow control flap*
21. *Heater temperature control valve.*
22. *Drain point, radiator.*
23. *Drain points, cylinder block. (one either side).*

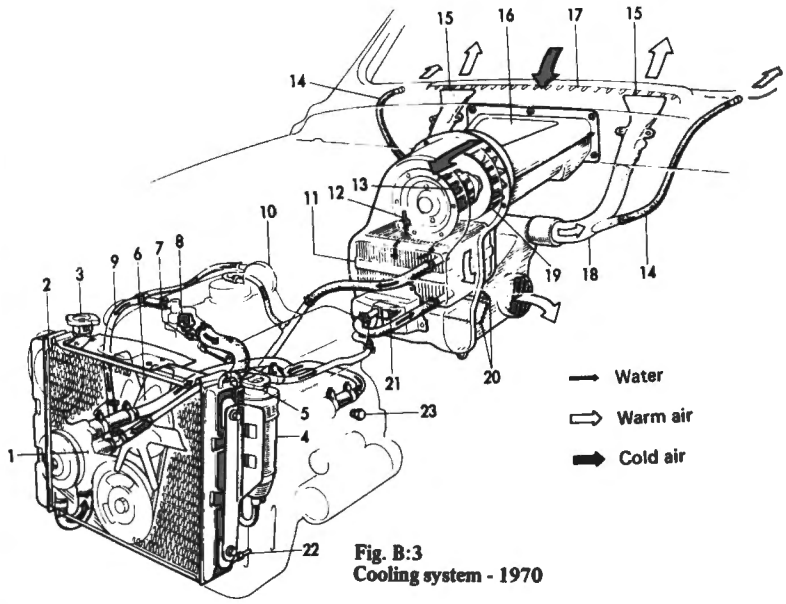


Fig. B:3
Cooling system - 1970

1. *Water pump.*
2. *Radiator.*
3. *Radiator cap (non-pressure release type).*
4. *Expansion tank.*
5. *Pressure cap.*
6. *Cooling fan.*
7. *Temperature sender unit.*
8. *Thermostat.*
9. *By-pass.*
10. *Water jacket, automatic choke carburettor.*
11. *Heater core.*
12. *Heater bleed valve.*
13. *Blower motor.*
14. *Side de-mist hose.*
15. *Main de-mister outlet.*
16. *Collector box.*
17. *Fresh air intake*
18. *De-mister pipe.*
19. *Blower fan.*
20. *Air flow control flap.*
21. *Drain point, radiator.*
22. *Drain points, cylinder block. (one either side).*

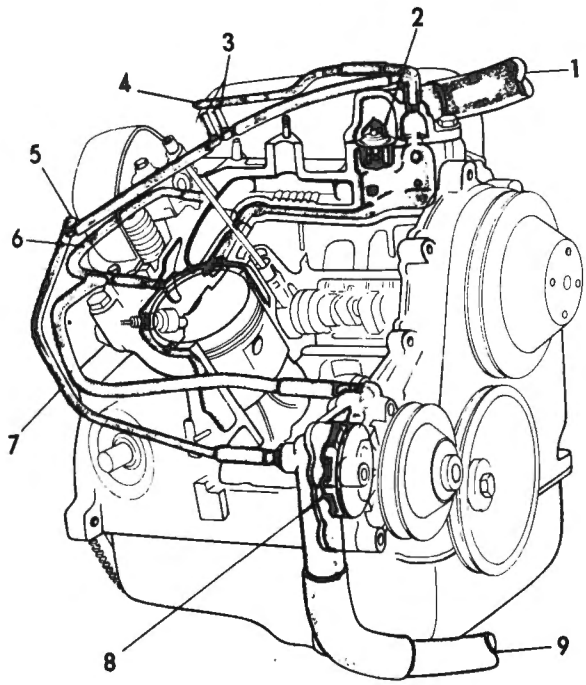


Fig. B:4
Coolant circulation.

1. *Radiator top hose connection.*
2. *Thermostat.*
3. *Automatic choke carburettor connections.*
4. *Inlet connection to interior heater.*
5. *Outlet connection from interior heater.*
6. *Water distribution manifold.*
77. *By-pass hose.*
8. *Water pump.*
9. *Radiator bottom hose connection.*

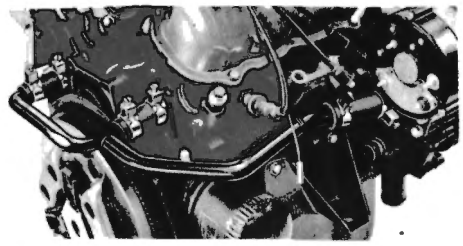


Fig. B:5 Water distribution manifold

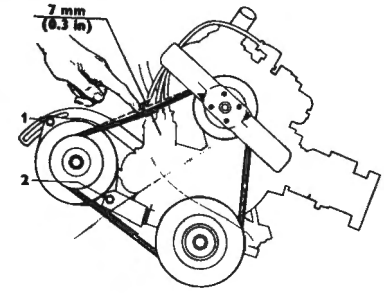


Fig. B:6
Adjusting the drive belt tension.

1. *Adjusting bolt.*
2. *Retaining bolts.*

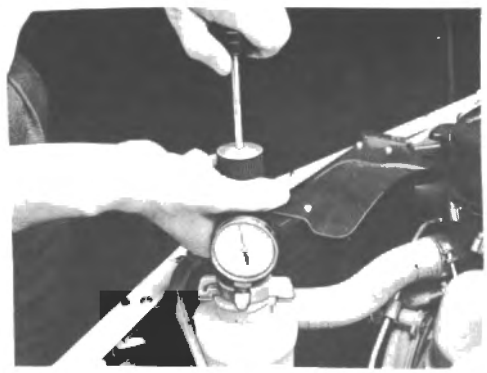


Fig. B:7 Testing the cooling system

Fig. B:8 Testing the pressure cap

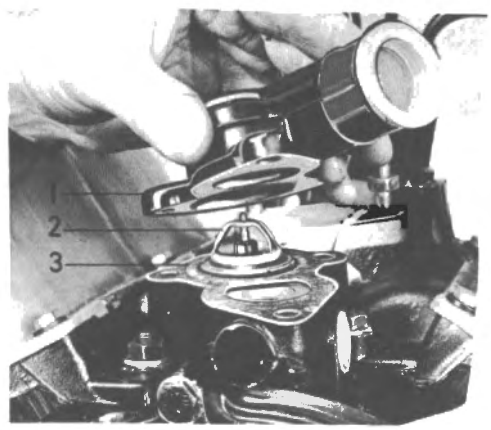


Fig. B:9
Removing the thermostat.

1. *Water outlet housing.*
2. *Thermostat.*
3. *Gasket.*

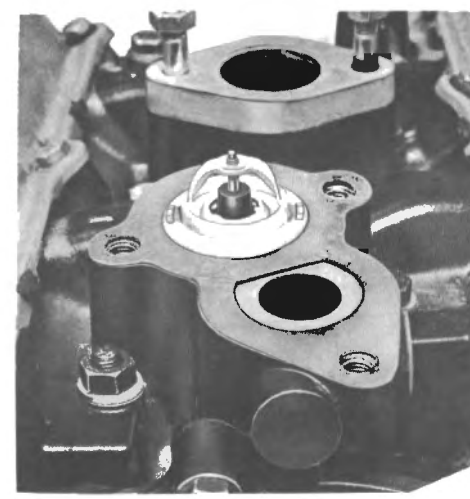


Fig. B:10 Thermostat installation position

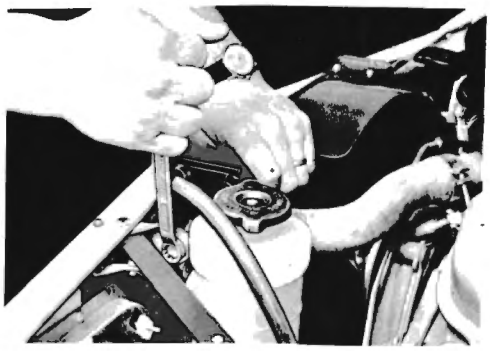


Fig. B:11 Removing the radiator

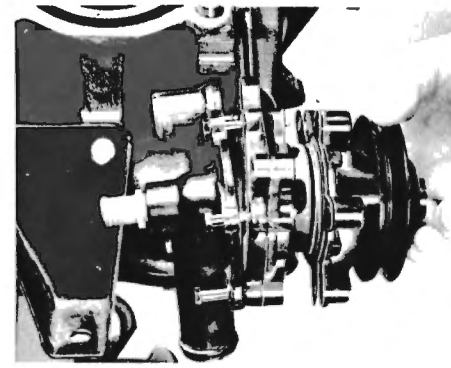


Fig. B:12 Removing the water pump

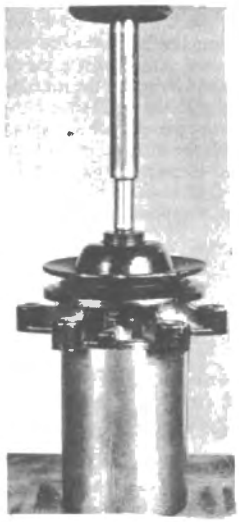


Fig. B:13 Removing the pump shaft and bearing

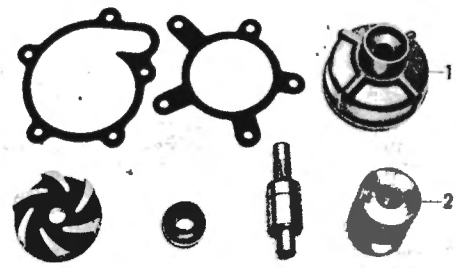


Fig. B:14 Water pump repair kit and assembly tools.
1. Tool No. GC 8501 - B
2. Tool No. GC 8501 - A

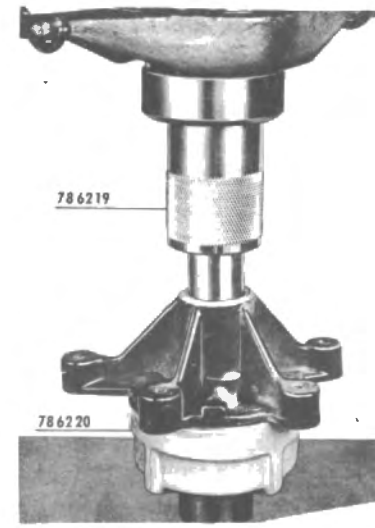


Fig. B:15 Installing the pump shaft and bearing

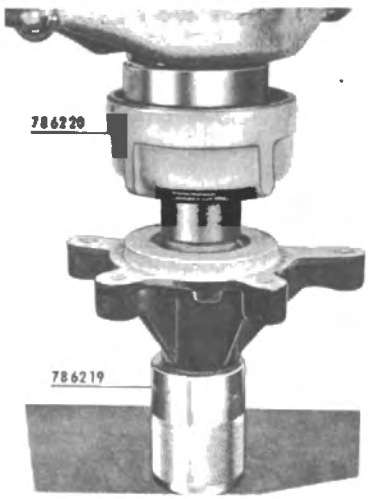


Fig. B:16 Installing the pump seal

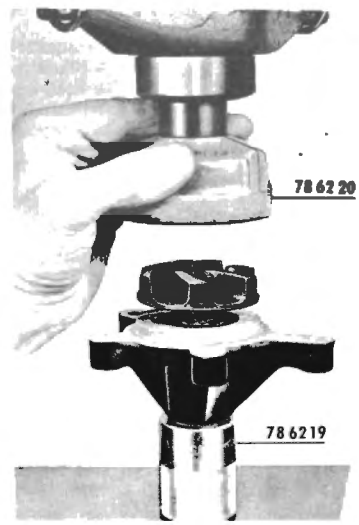


Fig. B:17 Installing the impeller on the pump shaft

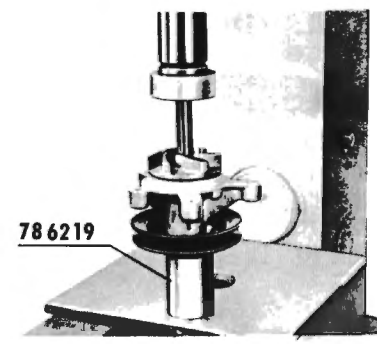


Fig. B:18 Installing the drive pulley

cylinder is leaking, removing the spark plug lead from an offending cylinder will cause the fluctuations to become less frequent. If the cylinder head gasket is leaking it must be replaced.

PRESSURE CAP – Testing

NOTE :– On early models the pressure cap is fitted to the radiator filler neck. On late models, where an expansion tank is incorporated, the radiator filler cap is of the non-pressure-release type. In this case the pressure cap is fitted to the expansion tank neck.

The pressure cap may be tested for proper operation using a pressure tester similar to that described for testing the cooling system. To test the pressure cap, remove the cap from the car, wet the cap rubber gasket to ensure an air-tight seal and attach the cap to the tester (Fig. B:8). Give the pump several violent strokes to seat the valve and continue pumping. The cap should be capable of retaining pressure within a range of 2.2 – 4.3 psi. (0.25 – 0.30 kg/cm^2). If otherwise it must be exchanged.

THERMOSTAT – Testing

The thermostat is located on the inlet manifold. To test the thermostat for proper operation, partially drain the cooling system, detach the water outlet housing and remove the thermostat from the engine (Fig. B:9). Tie a length of thread to the thermostat and suspend it, fully submerged in a container of antifreeze solution. Place a thermometer with a suitable temperature range also in the solution. Both the thermostat and the thermometer should be suspended in the solution in such a way that they do NOT rest on the bottom or contact the sides of the container. Heat the solution gradually and observe the temperature at which the thermostat begins to open. The thermostat rating is 180°F (81°C). The opening temperature must be within ± 5°F (2.8°C) of this figure. It must be fully open at 200°F (92°C). If the thermostat does not function properly it must be replaced.

Install the thermostat in the inlet manifold as shown in Fig. B:10. Refit the water outlet housing using a new gasket and tighten the retaining bolts. Check that the drain taps are fully closed, top-up the coolant and refit the radiator cap.

RADIATOR – Removal and Installation

Open the bonnet. Remove the locking springs from the bonnet hinges. Grip the hinge stay and bend it slightly inwards to release the pin on one side. With the aid of an assistant lift off the bonnet. Drain the cooling system as described previously. Disconnect the top and bottom hoses at the radiator and pull the flexible over-flow pipe from the tube at the radiator filler neck. Unscrew the four mounting bolts and lift out the radiator (Fig. B:11).

If the radiator is being exchanged, transfer the drain tap to the new radiator. Install the radiator and secure it in position with the four mounting bolts. Connect the top and bottom hoses and tighten the hose clips. Refit the over-flow pipe to the tube at the radiator filler neck. Check that the drain points are fully closed and refill the cooling system. Refit the radiator cap. Run the engine and check for leaks.

WATER PUMP – Removal and Installation

Drain the cooling system as described previously. Slacken the generator or alternator mounting and adjusting bolts and detach the drive belt from the pulleys. Completely remove the mounting and adjusting bolts and detach the generator or alternator from the engine. Unscrew the water pump retaining bolts but allow them to remain in the front cover flange. Remove the water pump (Fig. B:12).

Ensure that the mating surfaces of the pump and the front cover are clean and free from old gasket material. Use a new gasket when installing the pump. Installation is the reverse of the removal procedure. Adjust the drive belt tension as described previously.

WATER PUMP – Overhaul

Using a suitable drift, press the pump shaft, bearing and impeller simultaneously out of the pump housing (Fig. B:13). Discard all parts except the pulley and the pump housing.

All the necessary parts for overhauling the water pump are supplied in the water pump repair kit (Fig. B:14). Press the long end of the pump shaft into the upper pump housing face using the two tools supplied in the repair kit (Fig. B:15). To secure the new pump bearing in the old pump housing the outer bearing race should be coated with Loctite prior to installation. Invert the position of the tools and pump on the pressing table, position the seal and press it in firmly with the small edge of tool 786220 (Fig. B:16). Mount the impeller on the pump shaft and press it home until it bottoms out (Fig. B:17). Install the drive pulley in tool 786219 and, with the aid of a suitable mandrel, press the pump shaft onto the pulley so that it protrudes 0.03 – 0.08 in (0.8 – 2.0 mm). Care should be taken to ensure that pressure is applied against the pump shaft and not the impeller (Fig. B:18).

Technical Data

Cooling system capacity (inc. heater)	
1967 - 68 models	13.0 imp. pts (7.9 US qts, 7.5 litres)
1969 models	12.0 imp. pts (7.2 US qts, 6.8 litres)
1969 USA models	12.5 imp. pts (7.5 US qts, 7.1 litres)
Radiator cap release pressure	2.2 – 4.3 psi (0.25 – 0.30 kg/cm^2)
Thermostat :	
– Starts to open	180°F (81°C)
– Fully open	200°F (92°C)
Drive belt tension (total free movement)	0.3 in (7 mm)

Ignition System

GENERAL

The ignition system is made up of two circuits; a low tension or primary circuit, and a high tension circuit. The primary circuit supplies the battery feed through the ignition switch to the ignition coil and on to the distributor. The high tension circuit supplies the spark produced in the ignition coil to the distributor where it is distributed to the spark plugs.

The distributor is located at the rear of the engine between the cylinder banks and is driven from the camshaft via an angle drive. Advance is controlled by both a centrifugal and a vacuum governor. Various types of distributors are used and these can be individually identified by their respective designation numbers.

APPLICATION (CHASSIS NO.)	BOSCH DESIGNATION	REMARKS
Up to and inc. 95/46.137	JFUR 4/0 231 146 044	Semi-enclosed Crankcase ventilation
Up to and inc. 96/434.173	JFUR 4/0 231 146 024	
96/46.138 - 47.503 96/434.174 - 444.941	JFUR 4/0 231 145 033	Fully enclosed Crankcase vent.
95/47.504 - 49.092 96/444.942 - 453.129	JFUR 4/0 231 146 072	Fully enclosed Crankcase vent.
95/49.093 - 65.000 96/453.130 - 520.000	JFUR 4/0 231 146 073	Fully enclosed Crankcase vent.
95/65.001 onwards 96/520.001 onwards	JFUR 4/0 231 146 084	Fully enclosed Crankcase vent.

ROUTINE MAINTENANCE

The spark plugs should be examined and the electrode gap checked every 6.000 miles (10.000 km). The spark plugs should be replaced every 12.000 miles (20.000 km).

The distributor contact breaker points should be examined and adjusted every 6.000 miles (10.000 km). Lubricate the distributor cam and the felt pad inside the cam spindle. At the same time the distributor cap, high tension leads and the ignition coil should be wiped clean.

IGNITION TIMING – Checking and Adjusting

The firing order is 1 – 3 – 4 – 2, No. 1 cylinder being the front cylinder on the right hand bank. The ignition setting is always done on the No. 1 cylinder. Before checking the ignition timing, the contact breaker points gap should be checked and adjusted if necessary. Ensure that the distributor is correctly fitted to the engine as described in "DISTRIBUTOR – Removal and Installation".

Static (Basic Setting)

Align the mark on the crankshaft pulley with the 6° mark on the front cover (Fig. C:2). Slacken the distributor body clamp bolt. Connect a test lamp between the distributor low tension terminal and a good earthing point and switch on the ignition. Exert slight pressure anti clockwise on the rotor to eliminate any slackness in the mechanism. Turn the distributor body slightly to determine the position at which the test lamp illuminates. Re-tighten the clamp bolt.

Turn the crankshaft two turns clockwise and check that the test lamp lights when the mark on the crank shaft pulley aligns with the 6° mark on the cylinder block. At this point the marks on the distributor rotor and the distributor housing should also align. Switch off the ignition and remove the test lamp.

Dynamic (Stroboscope)

Disconnect the vacuum pipe at the distributor. Connect the stroboscope to the ignition cable of the No. 1 cylinder and start the engine. Check, and adjust if required, the ignition setting at starter r.p.m. or with the engine running at approximately 500 revs per minute. The mark on the crankshaft pulley should be adjacent to the 6° mark on the front cover.

If necessary, slacken the distributor body clamp bolt and turn the distributor body slightly until the correct setting is obtained. Re-tighten the clamp bolt. Turn off the engine, remove the stroboscope and reconnect the vacuum pipe. If necessary, adjust the engine idling speed as described in the FUEL SYSTEM section.

CONTACT BREAKER POINTS – Inspection

Examine the contact breaker points for wear, burning and excessive metal transfer. Metal transfer is considered excessive when it exceeds the recommended points gap. After considerable use the contact surfaces may show a greyish colour and slight signs of pitting but these need not be replaced as satisfactory service will be provided until most of the tungsten is worn off. Oxidized points may be caused by a high resistance or loose connections in the condenser circuit, oil contamination on the contact surfaces or, most commonly, high breaking current. Check for these conditions where burnt contacts are encountered. The resistance is considered high when the voltage drop across the points exceeds 0.25 volts.

If the contact points are to be retained they should be dressed with a clean, fine cut contact file. NEVER use emery cloth to clean contact points.

CONTACT BREAKER POINTS – Adjustment

The contact breaker points can be set either by measuring the gap with a feeler blade or by measuring the dwell angle with a dwell meter. Where possible the use of a dwell meter is recommended.

Contact Gap

Remove the distributor cap and rotor arm. Crank the engine until the breaker arm is resting on the highest point of the cam lobe and insert a 0.016 in (0.4 mm) thick feeler blade between the contact faces of the two points. The blade should be able to move freely between the points without showing any excess clearance.

If adjustment is necessary, release the lock screw and adjust the position of the fixed contact plate by applying a screwdriver between the two lugs on the mounting plate and the corresponding groove in the fixed contact plate.

When the correct gap is obtained, retighten the locking screw. Refit the rotor arm and the distributor cap. Check the ignition setting as described previously.

Dwell Angle :

Connect the dwell meter in accordance with the equipment manufacturer's instructions. Crank the engine at starter speed with the ignition turned on and check the dwell angle. The indicated reading should be 50 ± 2°.

If the dwell angle is outside specification, adjustment is carried out as described above for the Contact Gap.

CONTACT BREAKER POINTS – Replacement

NOTE :– On late distributors (types 003, 073 & 084) the contact breaker points are of the unit type and are therefore removed as an assembly.

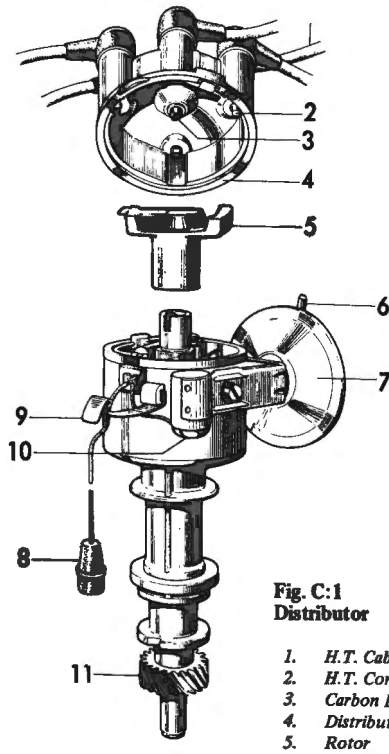


Fig. C:1
Distributor

1. *H.T. Cable*
2. *H.T. Contact*
3. *Carbon Brush*
4. *Distributor Cap*
5. *Rotor*
6. *Vacuum hose connection*
7. *Vacuum unit*
8. *Grease cup*
9. *Primary (L.T.) terminal*
10. *Distributor cap retaining clip*
11. *Capacitor*
12. *Skew gear.*

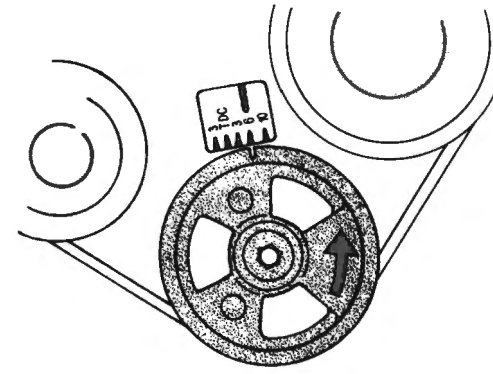


Fig. C:2 Basic ignition setting

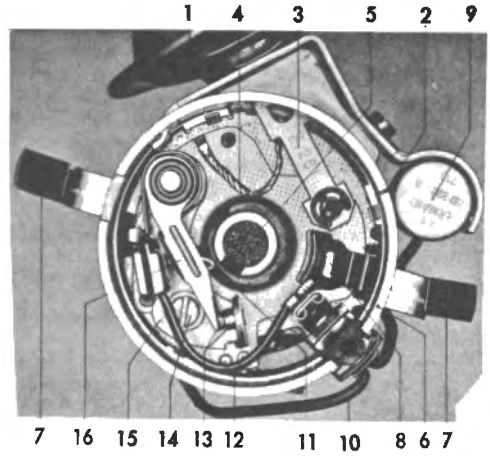


Fig. C:3
Contact breaker points

1. *Vacuum unit*
2. *Adjustment mark*
3. *Vacuum control arm*
4. *Earth lead*
5. *Felt lubricating pad*
6. *Assembly mark*
7. *Distributor cap retaining clip*
8. *Bearing*
9. *Capacitor*
10. *Primary (L.T.) terminal*
11. *Fibre lug*
12. *Adjustment lugs, fixed contact plate*
13. *Breaker points*
14. *Locking screw*
15. *Fixed contact plate*
16. *Breaker arm.*

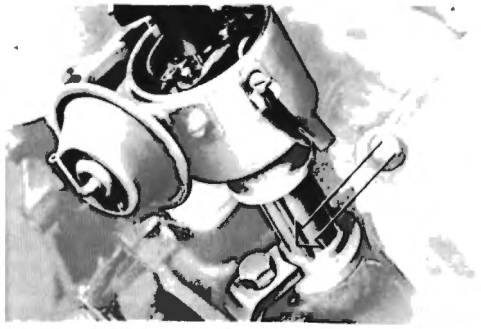


Fig. C:4 Distributor body clamping bolt

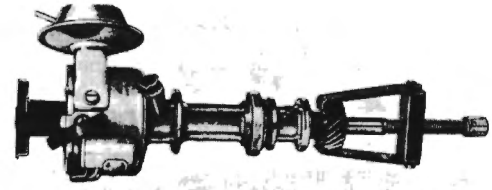


Fig. C:5 Removing the skew gear

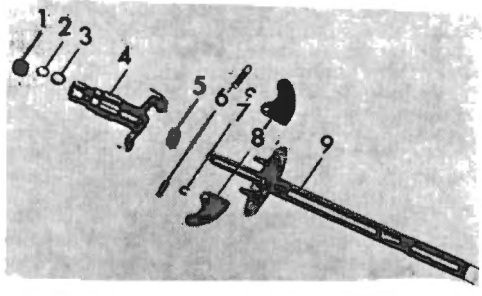


Fig. C:6
Distributor shaft & cam assembly

1. *Felt lubricating pad*
2. *Retaining ring, cam assembly*
3. *Bearing washer*
4. *Cam assembly*
5. *Spacing washer*
6. *Governor springs*
7. *Retaining clips, governor weights*
8. *Governor weights*
9. *Distributor shaft and action plate.*

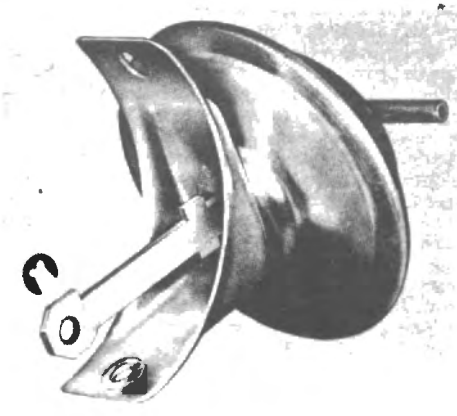


Fig. C:7 Vacuum unit

Remove the distributor cap and rotor arm. Detach the breaker arm lead from the insulator on the fixed contact plate. Remove the retaining clip from the pivot post, release the spring end from the insulator and lift the breaker arm and shims off the pivot post. Unscrew the locking screw and remove the fixed contact plate.

Fit the new contact plate and secure with the locking screw. Apply a smear of grease to the breaker arm pivot post and fit the new breaker arm. If necessary, adjust the height and axial play of the arm in relation to the fixed contact using shims. Engage the breaker arm spring end and then the low tension lead in the insulator on the fixed contact plate. Fit the retaining clip to the breaker arm pivot. Adjust the contact breaker points as described previously.

DISTRIBUTOR – Removal and Installation

Disconnect the battery earth lead and the distributor low tension lead. Remove the distributor cap and disconnect the vacuum hose from the vacuum unit. Release the clamping bolt (Fig. C:4) and withdraw the distributor from the engine.

To install the distributor, first remove the spark plug from the front cylinder on the right hand bank (No. 1 cylinder). With this cylinder on its compression stroke, align the mark on the crank shaft pulley with the six degree mark on the front cover. Align the mark on the rotor with the dot on the distributor housing (6, Fig. C:3) and fit the distributor to the engine. Ensure that the gears mesh properly and rock the engine back and forth until the distributor shaft engages the oil pump drive shaft properly.

Re-check that the mark on the crank shaft pulley aligns with the six degree mark on the front cover and turn the distributor body so that the mark on the rotor aligns with the adjustment line on the distributor housing (2, Fig. C:3). Refit the spark plug to No. 1 cylinder. Adjust the ignition timing as described previously. Tighten the distributor clamp bolt, re-fit the distributor cap and re-connect the vacuum pipe.

DISTRIBUTOR – Overhaul

Pull the rotor off the distributor shaft. Detach the breaker arm connection from the connector terminal. Unscrew the retaining screw and remove the capacitor together with connector block and primary lead. Remove the 'e' clip from the vacuum arm pivot on the breaker plate assembly. Unscrew the two retaining screws and remove the vacuum unit from the distributor (Fig. C:7).

On early models, remove the retaining clip and washers from the breaker arm pivot, press the breaker arm spring out of the insulated terminal and remove the breaker arm. Unscrew the retaining screw and remove the fixed breaker point. On late models, unscrew the retaining screw and lift off the contact breaker points assembly (Fig. C:3).

Unscrew the two screws securing the distributor cap retaining clips, detach the two clips and lift out the breaker plate assembly. Drive out the retaining pin securing the skew gear to the distributor shaft and, using a suitable puller, pull out the gear (Fig. C.5.).
Withdraw the complete shaft assembly from the distributor body.

Unhook the governor springs from the cam assembly. The cam assembly is held on the distributor shaft by a retaining ring. To release the ring, insert two screwdrivers, one at each side, between the cam assembly and the distributor shaft action plate and twist carefully. Lift off the cam assembly. Remove the felt lubricating pad, retaining ring and bearing washer from inside the cam spindle. Unhook the governor spings from the distributor shaft action plate. Remove the "e" clips from the governor weight pivot posts and lift off the weights (Fig. C:6).

If the bushing in the distributor body is worn and requires replacement turn the distributor body upside down and drive out the bushing by using a suitable mandrel.

Assembly is the reverse of the removal procedure. However, particular attention should be paid to the following points.

a) When assembling the cam to the distributor shaft, press the retaining ring into place on the spindle using a steel tube with an inside diameter 0.25 in (6 mm), an outside diameter 0.32 in (8 mm) and approximately 2 in (50 mm) long.

b) The distributor cap retaining clip bracket with the lug which locates the distributor cap should be fitted adjacent to the primary connector block.

c) Adjust the contact breaker points as described previously.

Technical Data

Ignition distributor

Identification (Bosch designation)	
– up to & inc. chassis No. 95/46.137	JFUR 4/0 231 146 044
– up to & inc. chassis No. 96/434.173	JFUR 4/0 231 146 024
– chassis Nos 95/46.138 to 47.503	JFUR 4/0 231 146 033
– chassis Nos 96/434.174 to 444.941	
– chassis Nos 95/47.504 to 49.092	JFUR 4/0 231 146 072
– chassis Nos 96/444.942 to 453.129	
– chassis Nos 95/49.093 - 65.000	JFUR 4/0 231 146 073
– chassis Nos 96/453.130 - 520.000	
– chassis Nos 95/65.001 onwards	JFUR 4/0 231 146 084
– chassis No 96/520.001 onwards	
Firing order	1 – 3 – 4 – 2
Position of No. 1 cylinder	Front cylinder on R.H. Bank
Direction of rotation	Clockwise
Contact breaker gap	0.016 in (0.4 mm)
Dwell angle	50 ± 2°
Breaker arm spring tension	14 - 19 oz (400 - 530 gr)
Capacitor type	1 237 330 091
Ignition setting	
– Basic	6° BTDC
– 500 rpm (starter cranking speed)	6° BTDC (vacuum disconnected)

Ignition coil

Make	Bosch
Type	K–12

Spark plugs

– Black or silver painted engine (up to chassis No. 95/55.766 and 96/487.638. For USA, up to chassis No. 95/54.854 and 96/482.197)	Autolite AE-22, Autolite AER-22, Bosch W225 T 35, Champion L 82Y or NGK B-7-H
– Blue painted engine (from chassis No. 95/55.767 and 96/487.639. For USA, from chassis No. 95/54.855 and 96/482.198.	Autolite AG-22, Bosch W200 T 30, Champion N-9Y or NGK BP 7E
Electrode gap	0.024 - 0.028 in (0.6 - 0.7 mm)
Tightening torque	22 - 29 lb.ft (3.0 - 4.0 kgm)

Fuel System

GENERAL

The fuel system consists basically of a fuel tank, a fuel pump and a carburettor. The fuel tank is located directly behind the rear axle. The fuel gauge sender unit is mounted in the top of the tank. The diaphragm type fuel pump is mounted on the left-hand side of the engine crankcase at the front and is actuated through a push rod from a special cam on the camshaft. The fuel pump incorporates a nylon filter.

Several types of carburettor are used, dependent on the year of manufacture and whether an exhaust emission control system is fitted to the engine. Up to and including engine No. 16.100 (chassis Nos. 96/434.173 & 95/46.137) a Solex 28-32 PDSIT-7 carburettor is fitted. As from engine No. 16.101 (chassis Nos. 96/434.174 & 95/46.138) a Solex 32 PDSIT-4 carburettor is used. Both Solex carburettors are similar, both being of the down-draught type and featuring an automatic choke device with rapid idling, an acceleration pump and a pressure controlled booster system known as an "econostat".

As from 1969, all models are fitted with a FoMoCo down-draught carburettor. An automatic choke device with fast idle and an acceleration pump is featured. The carburettor differs from the Solex carburettor previously used in that the fast idle device is situated on the outside of the carburettor and only the main jet is removeable. As from 1970, the carburettor fitted to North American models is slightly modified in accordance with Federal Emission Requirements. On these models, a deceleration valve and an air cleaner assembly incorporating a thermostatically controlled valve assembly are fitted in addition.

An air-cleaner with a replaceable paper element is mounted above the carburettor and serves both to clean the inducted air and as an induction silencer. A special pre-heater plate is provided at the exhaust manifold on the left-hand side of the engine and the air intake spout on the cleaner body can be moved to the pre-heating position as temperature conditions require.

ROUTINE MAINTENANCE

Every 6.000 miles (10.000 km) the air cleaner element should be cleaned. See "AIR CLEANER" below. At the same time, the throttle linkage should be lubricated with light oil and the carburettor idling adjustment checked as described under the appropriate carburettor heading.

Every 12.000 miles (20.000 km) renew the air cleaner element. Clean the fuel pump filter. Clean out the carburettor float chamber, blow out the jets and passages and reset the carburettor idling adjustment. Check the condition of the exhaust system.

AIR CLEANER

In order for the air cleaner to function properly it must be serviced at the specified intervals. A dirty element will restrict air flow to the carburettor and create an over-rich mixture condition. It will also cause excessive fuel consumption as well as becoming unable to filter dust and dirt and thereby causing abnormal wear of the working parts of the engine.

To service the air cleaner, unscrew the retaining bolt and remove the top cover (Fig. D.1). Lift out the air cleaner element. Wipe the inside of the housing and the cover clean, taking to prevent dirt and dust from falling down into the carburettor. The element should only be cleaned by tapping it to dislodge dirt and dust particles or by blowing it through with compressed air from the inside. The element is made from a special grade of paper which must NOT be washed or moistened. If the element is excessively dirty it should be renewed.

FUEL PUMP

Cleaning

Unscrew the centre-bolt and lift off the cover and gasket ring. Carefully remove the nylon filter screen and wash it in petrol. Inspect the filter screen and gasket for damage and renew if necessary. Install the filter screen. Install the filter screen. Install the gasket ring and cover and secure with the centre bolt, ensuring that the fibre washer is fitted under the bolt head. DO NOT over-tighten the centre-bolt otherwise the washer may be damaged or the cover distorted.

Testing

If the fuel pump is suspected of being defective, the following tests should be carried out :—

1. Check the fuel pump filter screen and sediment chamber to ensure that they are not clogged. Clean if necessary.

2. Disconnect the fuel line at the carburettor. When the engine is cranked by means of the starter motor, a well-defined spurt of fuel should be apparent for each revolution of the camshaft.

3. If fuel flow is present, connect a T-piece and manometer (fuel pressure tester) in the fuel pipe (Fig. D:4). The reading should be 3.4 - 4.3 psi (0.24 - 0.30 kp/cm^2) at 4.000 rev/min. When the engine is stopped, the pressure should not fall appreciably immediately and should then fall only slowly. A quick loss of pressure indicates a probable leak in the gaskets, valves or diaphragm.

Overhaul

Disconnect the fuel lines, unscrew the two retaining bolts and detach the fuel pump, gasket and push rod from the crankcase (Fig. D:5). Mark the end of the push rod which rests against the camshaft to ensure that it is positioned the correct way round on reassembly.

Unscrew the centre-bolt, lift off the top cover and gasket ring and remove the filter screen. Mark the two halves of the pump body to ensure correct alignment on reassembly. Release the flange screws and separate the two halves of the pump body, taking care to avoid damaging the diaphragm.

NOTE :— The upper part of the pump body with the inlet and outlet valves is an integral unit and NO attempt should be made to dismantle it.

A small seal is provided to afford a seal between the diaphragm rod and the lower part of the pump body. As the seal is NOT replaceable and the lips of the seal face the lock washer groove in the diaphragm rod, the rod MUST NOT be withdrawn up through the lower part of the pump lower body. If this does happen, the rod seal will be completely ruined and the lower part of the pump body must be replaced. To avoid damaging the seal proceed as follows :—

Place the lower part of the pump body with the diaphragm on a flat surface. Using a 10 mm spanner, press down the spring retainer and extract the lock washer from its groove in the diaphragm rod. Remove the spring retainer and spring from the rod and replace the lock ring in its groove. Lift the lower part of the pump body in the hand, press the diaphragm lightly inwards and remove the lock ring again. Release the diaphragm only far enough to allow the pins which hold the diaphragm to the rod to be pressed out. Withdraw the diaphragm rod out of the pump lower body FROM THE MOUNTING FACE SIDE. Remove the diaphragm and the compression spring.

A fuel pump repair kit containing all necessary replacement parts is available. The components contained in the kit are shown in Fig. D:6.

To reassemble the fuel pump, apply a little grease to the diaphragm rod and pass it into the pump lower body FROM THE MOUNTING FACE SIDE. Fit the compression spring over the rod and draw the rod through only sufficiently to allow the diaphragm to be connected to the rod with the retaining pin. Place the pump lower body with the diaphragm on a flat surface. Fit the return spring and spring retainer over the rod, press down the spring retainer with a 10 mm open-end spanner and fit the lock ring in the groove in the rod.

Align the marks on the upper and lower parts of the pump body. Press in the push rod so that the diaphragm is not under tension and secure the two halves of the pump body with the six retaining screws. Install the filter screen. Install the gasket ring and cover and secure with the centre-

Fig. D:1 Air cleaner

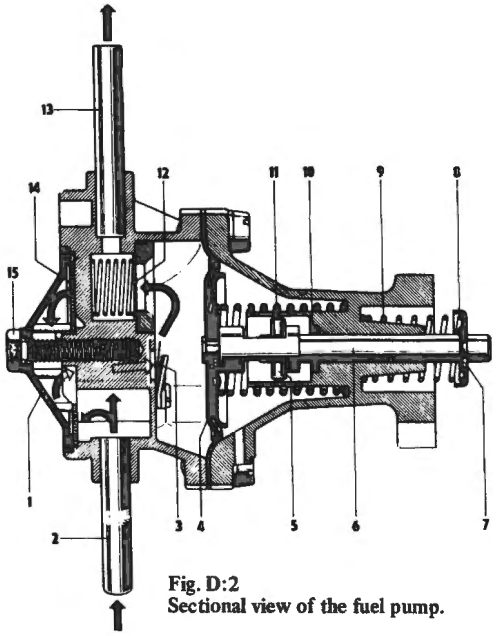


Fig. D:2
Sectional view of the fuel pump.

1. *Cover*
2. *Fuel inlet*
3. *Inlet valve*
4. *Diaphragm*
5. *Retaining pin*
6. *Diaphragm rod*
7. *Lock washer*
8. *Spring retainer*
9. *Return spring*
10. *Seal*
11. *Compression spring*
12. *Outlet valve*
13. *Fuel outlet*
14. *Filter*
15. *Cover centre-bolt.*

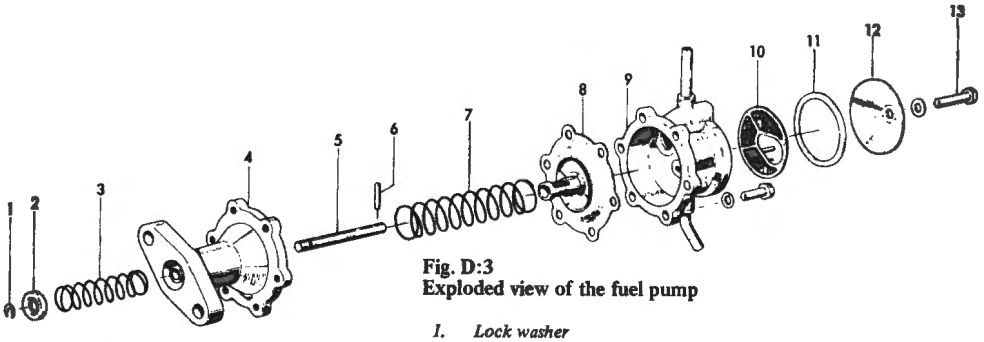


Fig. D:3
Exploded view of the fuel pump

1. *Lock washer*
2. *Spring retainer*
3. *Return spring*
4. *Pump body, lower part*
5. *Diaphragm rod*
6. *Retaining pin*
7. *Compression spring*
8. *Diaphragm*
9. *Pump body, upper part*
10. *Filter*
11. *Gasket*
12. *Cover*
13. *Cover centre-bolt.*

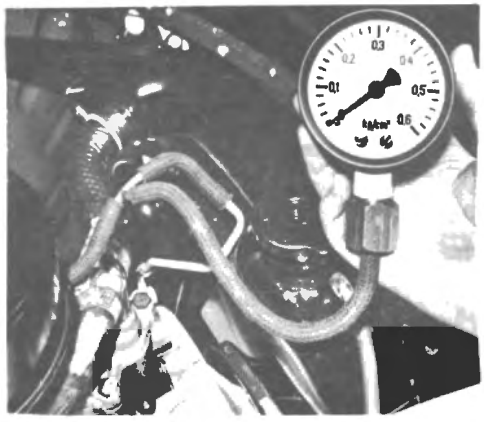


Fig. D:4 Testing the fuel pump output pressure

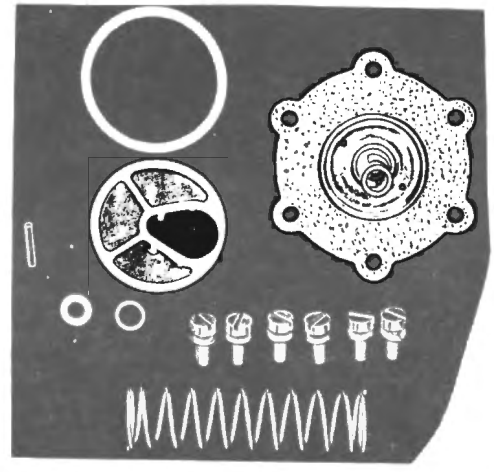


Fig. D:6 Fuel pump overhaul kit

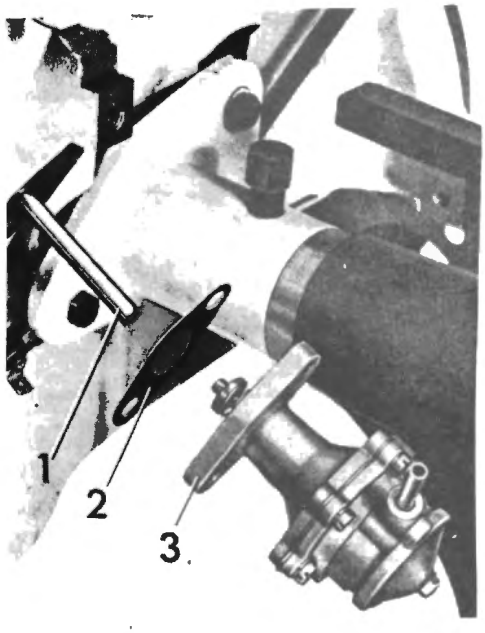


Fig. D:5
Removing the fuel pump

1. *Pump push rod*
2. *Gasket*
3. *Fuel pump.*

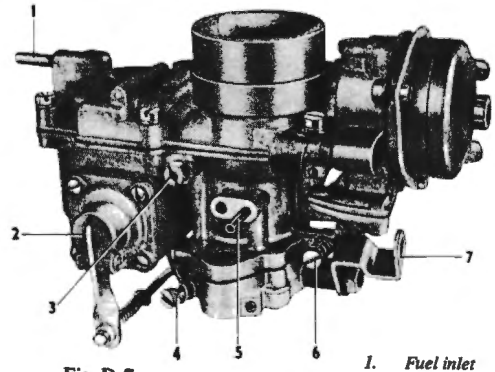


Fig. D:7
Left-hand view of the Solex 28-32 PDSIT-7 carburettor.

1. *Fuel inlet*
2. *Acceleration pump*
3. *Idling fuel jet*
4. *Idling mixture adjusting screw*
5. *Vacuum connection*
6. *Idling speed adjusting screw.*
7. *Throttle control lever.*

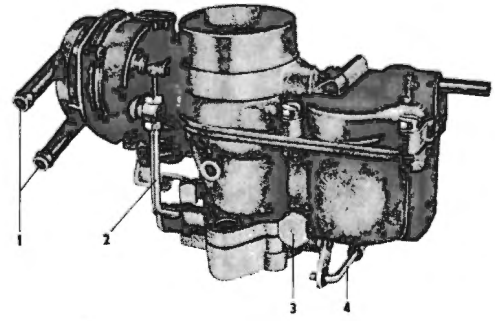
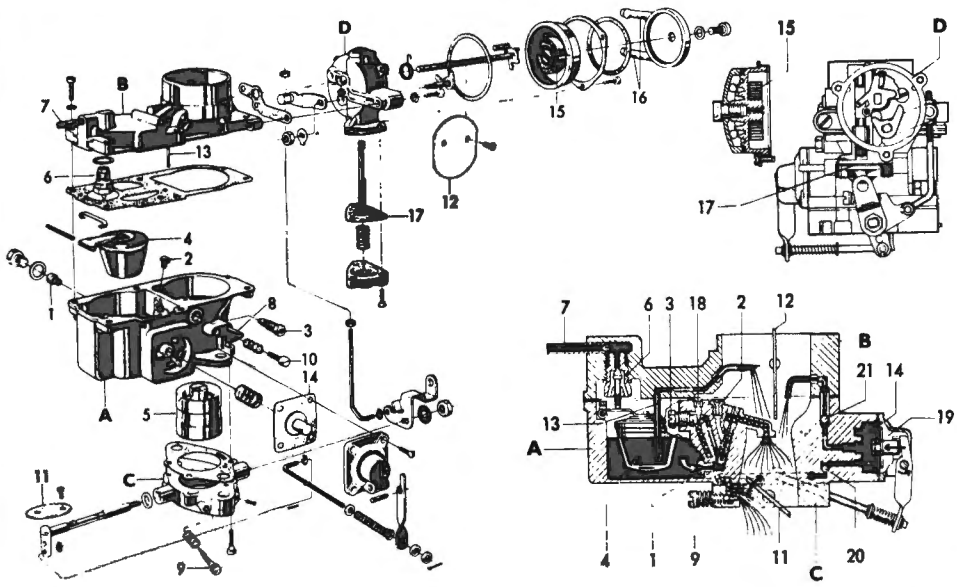


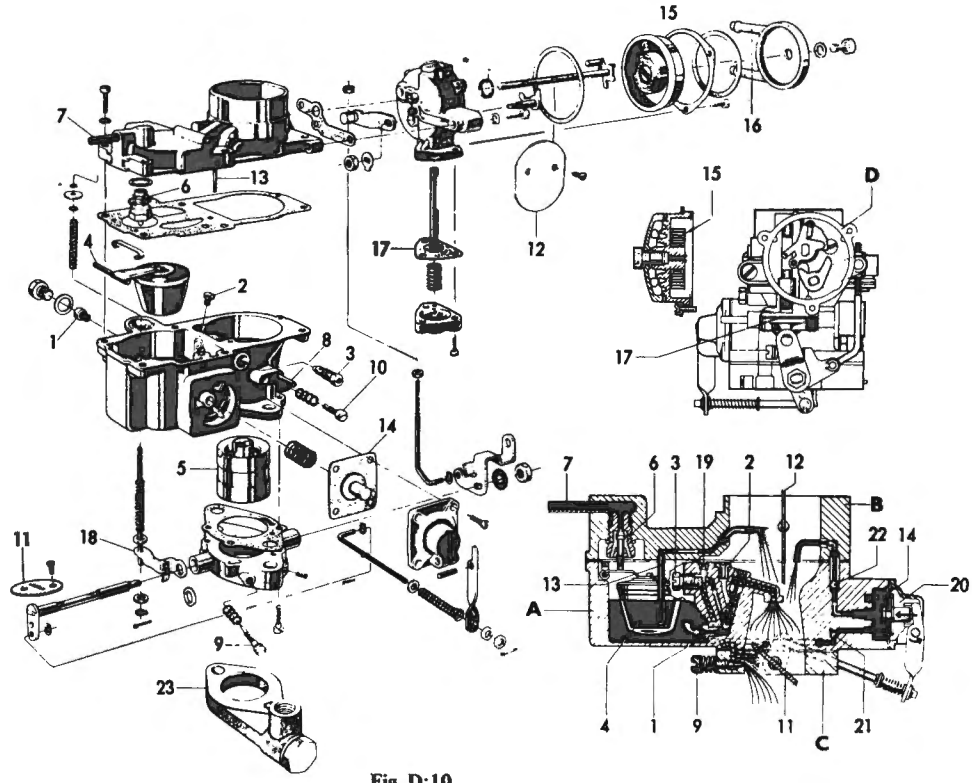
Fig. D:8
Right-hand view of the Solex 28-32 PDSIT-7 carburettor

1. *Choke water connections*
2. *Fast idling control link*
3. *Main jet access plug*
4. *Acceleration control link.*



1. *Main jet*
2. *Emulsion jet*
3. *Idling fuel jet*
4. *Float*
5. *Choke tube*
6. *Float valve*
7. *Fuel inlet connection*
8. *Vacuum connection*
9. *Idling mixture adjusting screw*
10. *Idling speed adjusting screw*
11. *Throttle plate*
12. *Choke plate*
13. *Econostat system ascending pipe*
14. *Acceleration pump diaphragm*
15. *Choke thermostatic spring*
16. *Choke water connections*
17. *Choke control diaphragm*
18. *Idling air jet (drilling)*
19. *Acceleration pump*
20. *Acceleration pump inlet valve*
21. *Acceleration pump outlet valve*
- *A. Float chamber*
- *B. Float chamber cover*
- *C. Carburettor main body*
- *D. Automatic choke housing.*

Fig. D:9
Exploded view of the Solex 28-32 PDSIT-7 carburettor.



1. *Main jet*
2. *Emulsion jet*
3. *Idling fuel jet*
4. *Float*
5. *Choke tube*
6. *Float valve*
7. *Fuel inlet connection*
8. *Vacuum connection*
9. *Idling mixture adjusting screw*
10. *Idling speed adjusting screw*
11. *Throttle plate*
12. *Choke plate*
13. *Econostat system ascending pipe*
14. *Acceleration pump diaphragm*
15. *Choke thermostatic spring.*
16. *Choke water connections*
17. *Choke control diaphragm*
18. *Regulating device, float chamber ventilation*
19. *Idling air jet (drilling)*
20. *Acceleration pump*
21. *Acceleration pump inlet valve*
22. *Acceleration pump outlet valve*
23. *Intermediate flange.*
- *A. Float chamber.*
- *B. Float chamber cover.*
- *C. Carburettor main body.*
- *D. Automatic choke housing.*

Fig. D:10
Exploded view of the Solex 32 PDSIT-4 carburettor

bolt, ensuring that the fibre washer is fitted under the bolt head. DO NOT over-tighten the centre-bolt otherwise the washer may be damaged or the cover distorted.

FUEL TANK

The fuel tank is located immediately behind the rear axle where it is secured by two straps. A drain plug, accessible from under the car, is provided to facilitate emptying the tank. Mounted in the top of the tank is the fuel gauge sender unit.

Removal:

Drain the fuel from the tank. Remove the rear seat squab and back rest. On saloon models, lift out the spare wheel and remove the front part of the luggage compartment floor. On estate models, unhook the two spiral fasteners and remove the sheathing over the fuel tank. Disconnect the tank earth lead at the body. Disconnect the lead at the fuel gauge sender unit. Disconnect the fuel line at the tank. Release the two tank retaining straps. On saloon models, the nuts for these straps are accessible through the holes in the rear sloping panel. Jack up the car. Release the hose clips and disconnect the vent and filler pipes at the tank. Raise the right-hand side of the tank and remove the tank in an upward and rearward direction. Collect the rubber seal in the wheel arch panel.

Installation :

Installation is the reverse of the removal procedure. Refitment of the rubber seal will be facilitated by the installation of a leather thong, or similar, in its groove before installation. Once the tank is in position the leather thong can be withdrawn, pulling the rubber seal into position in the wheel arch panel. To prevent dirt entering the tank during installation, cover the filler pipe aperture, etc., with masking tape.

SOLEX 28-32 PDSIT-7 & 32 PDSIT-4 CARBURETTORS

Refer to Figs. D:9 & D:10 for exploded views of the components referred to in this section.

Idle Adjustment :

Before commencing adjustment, check that all other direct influences on engine behaviour (eg. ignition system, valve clearance, etc.) are correct and in proper working order. Check the air cleaner to ensure that the element is clean, otherwise an incorrect setting will be obtained. Also check that the throttle operation is free and unrestricted.

With the engine at normal operating temperature, adjust the idle speed screw to give an idling speed a little faster than normal. Slowly screw in the idle mixture screw until the engine begins to run unevenly. DO NOT screw in the screw so hard that it bottoms out. Slowly back off the idle mixture screw until the best idle setting is obtained (approx. 1/4 turn). Readjust the idle speed screw to give an idling speed of 800 - 900 rev/min. A further re-adjustment of the idle mixture may then be required. These operations should be repeated until the running and idle speed is satisfactory.

Once the carburettor is correctly adjusted, it is recommended that the ignition setting be checked and if necessary adjusted.

Cleaning :

It is not necessary to remove the carburettor for cleaning. It is recommended that the fuel pump filter also be cleaned out at the same time as the carburettor.

Remove the air cleaner. Detach the retaining clip from the choke connecting link at the throttle control arm and disconnect the link end from the throttle control arm. Unscrew the five retaining screws and lift off the float chamber cover and gasket. Remove the retaining clip and lift out the float and pivot pin. Unscrew the main jet access plug from the outside of the float chamber and unscrew the main jet inside the float chamber using a suitably long screwdriver. Unscrew the idling fuel jet from the outside of the carburettor body and the emulsion jet from the carburettor body top face.

Blow out the float chamber, jets and passages with compressed air. A drill, wire or other sharp instrument must NEVER be used for cleaning jets or passages as this may cause damage and affect the carburettor calibration. Clean the needle valve in the float chamber cover. Inspect the cover gasket and renew if damaged in any way.

Reassembly of the carburettor is the reverse of the dismantling procedure. Set the idle adjustment as described above.

Float Level Adjustment :

The float level must be checked and adjusted whilst the carburettor is installed on the car.

Allow the engine to idle and then switch off the ignition without touching the accelerator. Remove the air cleaner. Detach the retaining clip from the choke connecting link at the throttle control arm and disconnect the link end from the throttle control arm. Unscrew the five retaining screws and lift off the float chamber cover and gasket. The petrol level should be 0.59 ± 0.04 in (15 ± 1 mm) from the top face of the float chamber. If necessary, the float level is adjusted by altering the thickness of fibre washer under the fuel needle valve. To raise the level, decrease the washer thickness and vice versa. Recheck the level after performing the adjustment.

Automatic Choke Housing Adjustment :

The automatic choke is set for the choke flap to be fully open at 60 - 65°C (140 - 149°F). The setting mark on the housing cover must align with the centre one of the five setting marks (Fig. D:11). Turning the cover clockwise makes the choke open later.

Fast Idle Adjustment :

A tachometer is required for this adjustment.

Remove the air cleaner and bring the engine to normal operating temperature. Connect the tachometer to the engine. Adjust the idle speed to 800 - 900 rev/min. Close the choke plate slightly to contact the ratchet in the automatic mechanism and hold the plate in this position, pressing it towards the ratchet. Carefully open the throttle plate sufficiently to allow the choke plate to move to the next position and then carefully release first the throttle plate and then the choke plate. The fast idle ratchet is now in the first step position. The throttle control must NOT be touched at this stage as this would cause the ratchet to revert to the neutral position. For safety's sake, the choke link should be pushed up hard with the fingers to eliminate this possibility.

At this point the engine speed should be 1200 - 1300 rev/min. If necessary the engine speed can be regulated by adjusting the length of the choke link. Lenghtening the link increases the speed and vice versa. Recheck the engine speed after performing the adjustment and check that the link does not jam in the throttle control lever due to twisting during the tightening of the two adjusting nuts.

Check the function of the fast idle at all stages. The engine speed should be:–

Stage 1.	1100 - 1300 rev/min.
Stage 2.	1700 - 1900 rev/min.
Stage 3.	2700 - 2900 rev/min.

Reset the idle speed to 800 - 900 rev/min if necessary. Disconnect the tachometer and refit the air cleaner.

Removal and Installation :

Remove the air cleaner. Disconnect the throttle linkage from the carburettor. Disconnect the fuel pipe at the carburettor. Partially drain the cooling system and disconnect both water hoses from the automatic choke housing. Disconnect the distributor vacuum hose at the carburettor. On 32 PDSIT - 4 carburettors, disconnect the hose from the valve cover. Remove the two nuts and spring washers securing the carburettor to the inlet manifold and lift off the carburettor and gasket. On 32 PDSIT - 4 carburettors, also lift off the intermediate flange and gasket.

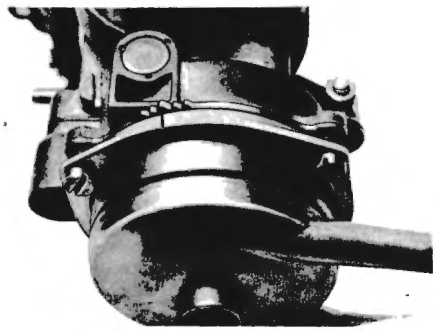


Fig. D:11 Choke thermostat housing adjustment - Solex

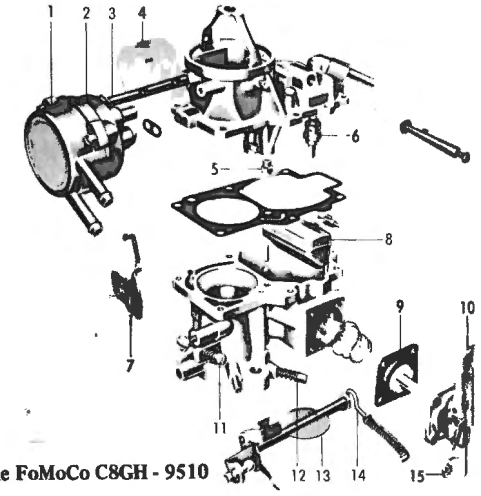


Fig. D:12
Exploded view of the FoMoCo C8GH - 9510 carburettor

1. *Thermostatic spring housing*
2. *Automatic choke housing*
3. *Choke plate shaft*
4. *Choke plate*
5. *Main jet*
6. *Float needle valve*
7. *Step cam*
8. *Float and pivot pin*
9. *Acceleration pump diaphragm*
10. *Vent actuating lever*
11. *Idling speed adjusting screw*
12. *Idling mixture adjusting screw*
13. *Throttle plate*
14. *Acceleration pump operating link*
15. *Acceleration pump operating lever.*

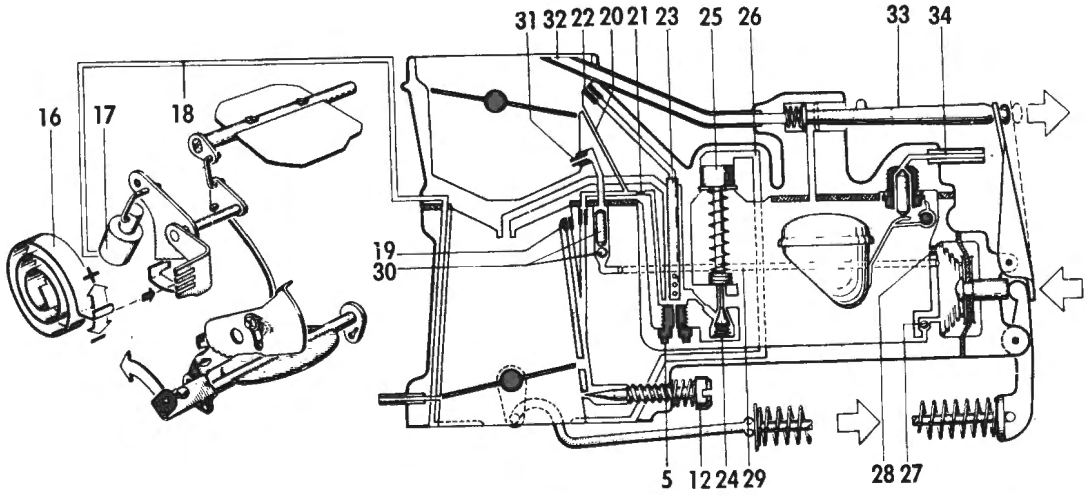


Fig. D:13
Sectional view of the FoMoCo C8GH - 9510 Carburettor.

16. *Thermostatic spring*
17. *Vacuum piston*
18. *Vacuum passage*
19. *Idling air jet*
20. *Idling air passage*
21. *Idling fuel passage*
22. *Air correction jet*
23. *Emulsion tube*
24. *Full-load enrichment*
25. *Control piston*
26. *Vacuum passage*
27. *Acceleration inlet valve*
28. *Pressure-equalising hole*
29. *Acceleration pump discharge passage.*
30. *Ball valve and weight (acceleration pump outlet valve.*
31. *Acceleration pump discharge nozzle*
32. *Float chamber vent tube*
33. *Vent push rod*
34. *Fuel inlet connection.*

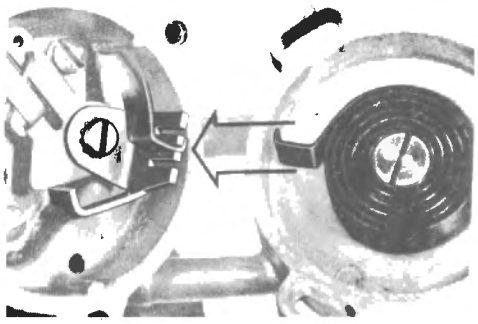


Fig. D:14 Choke thermostatic spring setting - FoMoCo

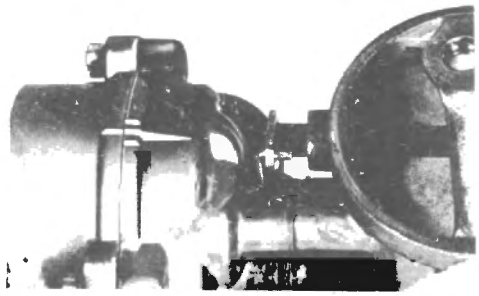


Fig. D:15 Choke thermostat housing adjustment - FoMoCo

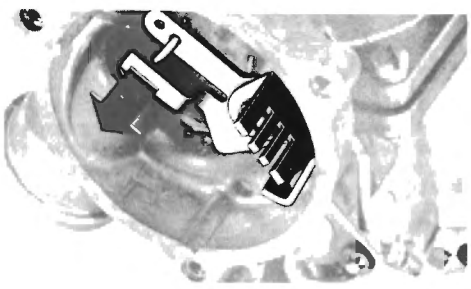


Fig. D:16 Vacuum piston position for choke plate pull-down setting -FoMoCo

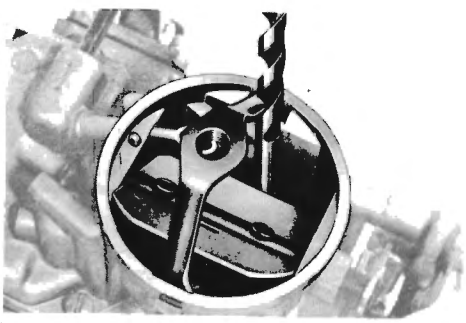


Fig. D:17 Checking the choke plate pull-down setting - FoMoCo

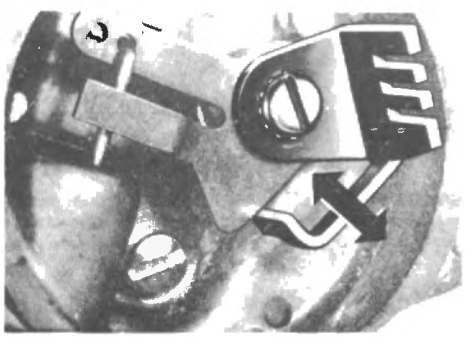


Fig. D:18 Choke plate pull-down adjustment - FoMoCo

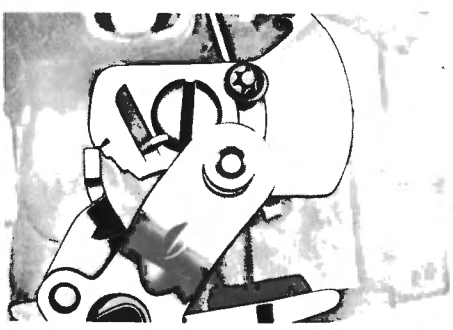


Fig. D:19 Correct stop-cam position during choke plate pull-down - FoMoCo

Fig. D:20 Step-cam adjustment - FoMoCo

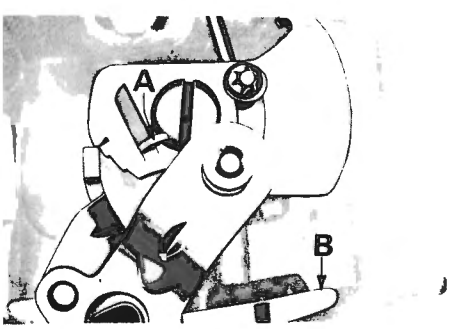


Fig. D:21 Step cam stop (A) and choke plate arm (B) - FoMoCo

Installation is reverse of the removal procedure. Use a new carburettor to manifold gasket. After installation is complete, check the idle adjustment as described above.

Disassembly :

Detach the retaining clip from the choke connecting link at the throttle control arm and disconnect the link end from the throttle control arm. Unscrew the five retaining screws and lift off the float chamber cover and gasket. Unscrew the needle valve from the float chamber cover and collect the fibre washer.

Remove the retaining clip and lift out the float and pivot pin. Unscrew the main jet access plug from the outside of the float chamber and unscrew the main jet inside the float chamber. Unscrew the idling fuel jet from the outside of the carburettor body and the emulsion jet from the carburettor body top face. Pull off the acceleration pump jet from over the acceleration pump. Release the four retaining screws and remove the accelerator pump cover, diaphragm and return spring. Disconnect the pump push rod and spring from the pump operating arm.

Unscrew the retaining nut on the throttle spindle and remove the throttle control lever. Release the two clamping screws on the throttle spindle and slide out the throttle plate. Remove any burrs around the screw holes and withdraw the spindle from the carburettor body. Unscrew the idling mixture screw and locking spring. If required, the throttle body assembly and gasket can be removed from the bottom of the carburettor body after releasing the two retaining screws. On 32 PDSIT - 4 carburettors, remove the intermediate flange valve.

If required, the choke mechanism can be dismantled as follows :– Remove the three retaining screws and lift off the choke water housing cover and thermostatic spring. Release the two clamping screws on the choke spindle and slide out the choke plate. Remove any burrs around the screw holes and withdraw the spindle from the float chamber cover. Remove the two retaining screws and detach the water housing from the float chamber cover. Collect the gasket. Unscrew the retaining nut, detach the fast idle control arm and withdraw the fast idle engagement lever and shaft assembly from the housing. Remove the three retaining screws and detach the vacuum control cover, return spring and diaphragm from the bottom of the housing.

Inspection :

Clean all the components of the carburettor, except the diaphragms, in an approved immersible type carburettor cleaning fluid. DO NOT use thinners or carbon tetrachloride for this purpose. Follow the particular solvent manufacturer's instructions.

Blow out the float chamber, jets and passages with compressed air. A drill, wire or other sharp instrument must NEVER be used for cleaning jets or passages as this may cause damage and affect the carburettor calibration.

Inspect the float, float arm and pivot pin for damage or wear. The throttle and choke plates must be discarded if the edges are nicked or otherwise damaged. Examine the throttle and choke spindles and their respective bores in the carburettor body for nicks, binding or wear. Inspect all linkages for bends or worn surfaces indicating interference with another part.

Discard any springs which are distorted, broken or corroded. Retaining screws which are stripped or damaged should be exchanged for new ones. Check the idling mixture screw for excessive wear, nicks or other damage, particularly at the needle point. Check the needle valve for wear or damage. Check the carburettor mounting and mating flanges for distortion. Inspect both diaphragms for ruptures or perishing.

Assembly :

The carburettor should be re-built in the reverse order to that described above for dismantling. However, special attention should be paid to the following points :–

1. It is recommended that new gaskets should be used throughout when reassembling.
2. When assembling the automatic choke mechanism, great care should be taken to ensure that the components are correctly located in the water housing.
3. Centralise the choke and throttle plates with the plate in the closed position before finally tightening the clamping screws. Lightly peen over the threaded ends to lock the screws in position.
4. When installing the idle mixture screw, turn in the screw carefully until it bottoms out and then back it off one full turn.
5. Set the fast idle setting initially by moving the fast idle arm to the semi-open position and at the same time fully closing the choke plate with the fingers. Hold the fast idle arm firmly and check that the throttle plate is slightly open. The clearance between the throttle plate and the throttle bore should be 0.032 in (0.8 mm). This can be checked using a drill of the required diameter. If adjustment is required slacken off the locknuts on the choke connecting link and adjust the rod to give the required clearance at the throttle plate. When adjustment is complete, re-tighten the lock nuts. Final adjustment should be performed once the carburettor in re-installed on the car as described above under "Fast Idle Adjustment".

FoMoCo CARBURETTORS (EXCEPT USA VERSIONS FROM 1970)

Refer to Fig. D:12 for an exploded view, and Fig. D:13 for a sectional view of the components referred to in this section.

Idle Adjustment :

Before commencing adjustment, check that all other direct influences on engine behaviour (e.g. ignition system, valve clearance, etc.) are correct and in proper working order. Check the air cleaner to ensure that the element is clean, otherwise an incorrect setting will be obtained. Also check that the throttle operation is free and unrestricted.

With the engine at normal operating temperature, reduce the idling speed until the engine runs as slowly as possible or at a maximum speed of 500 rev/min. Adjust the idle mixture screw to obtain the setting at which the engine runs most evenly. Switch on the headlights and adjust the idle speed screw to give the recommended engine idling speed.

Once the carburettor is correctly adjusted, it is recommended that the ignition setting be checked and if necessary adjusted.

Cleaning :

It is not necessary to remove the carburettor for cleaning. It is recommended that the fuel pump filter also be cleaned out at the same time as the carburettor.

Remove the air cleaner. Release the shoulder screw securing the step cam to the carburettor body. Release the retaining screws and lift off the float chamber cover and gasket. Unscrew the main jet from the float chamber cover.

NOTE :– Care should be exercised when operating the throttle linkage once the float chamber cover is removed, as the accelerator pump discharge valve (Fig. D:29) will be exposed in its bore and may be ejected causing serious damage if the valve should enter the engine.

Blow out the float chamber, jets and passages with compressed air. A drill, wire or other sharp instrument must NEVER be used for cleaning jets or passages as this may cause damage and affect the carburettor calibration. Clean the needle valve in the float chamber cover. Inspect the cover gasket and renew if damaged in any way.

Reassembly of the carburettor is the reverse of the dismantling procedure. Set the idle adjustment as described above. It may also be necessary to reset the step cam adjustment.

Float and Fuel Level Adjustment :

Remove the air cleaner. Disconnect the fuel pipe from the carburettor. If necessary, partially drain the engine cooling system and disconnect the water hoses from the automatic choke housing. Release the shoulder screw securing the step cam to the carburettor body. Release the retaining screws and lift off the float chamber cover, ensuring that the gasket comes away with it.

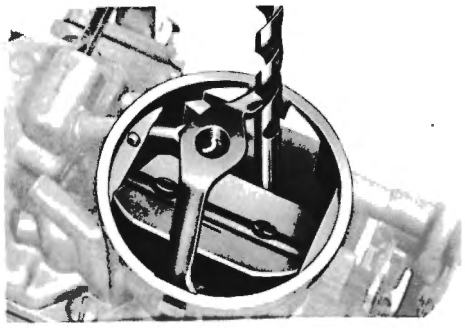


Fig. D:22 Checking the de-choke setting - FoMoCo

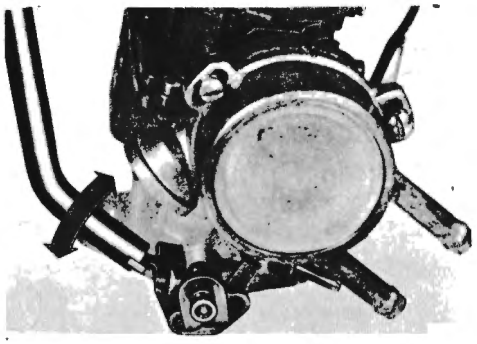


Fig. D:23 Adjusting the fast idle setting - FoMoCo

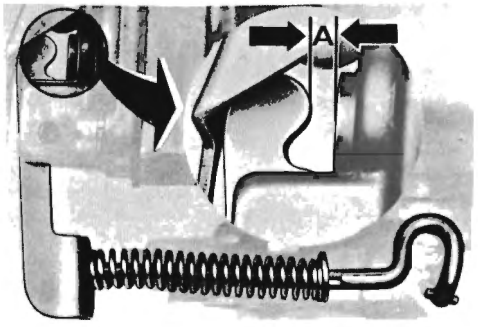


Fig. D:24 Accelerator pump setting - FoMoCo
A = 0.09 - 0.10 in (2.3 - 2.5 mm)

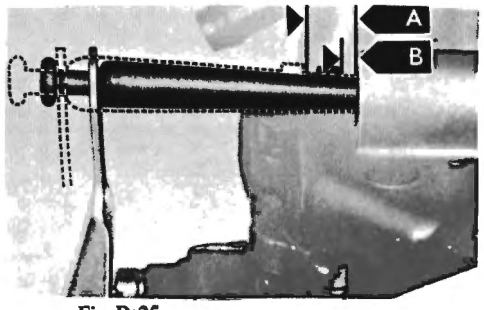


Fig. D:25
Float chamber valve settings.

A = 0.32 - 0.40 in (8 - 10 mm) with throttle wide open.
B = 0.008 - 0.012 in (0.2 - 0.3 mm) with throttle valve fully closed.

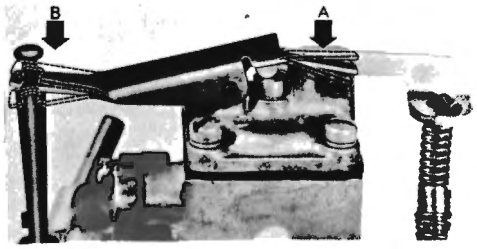


Fig. D:26 Float chamber valve adjustments - FoMoCo

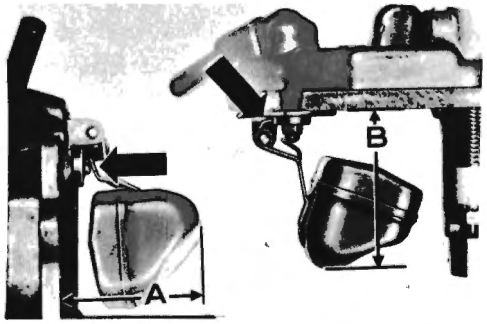


Fig. D:27 Float and fuel level settings - FoMoCo
A = 1.08 in (27.5 mm)
B = 1.34 in (34 mm)

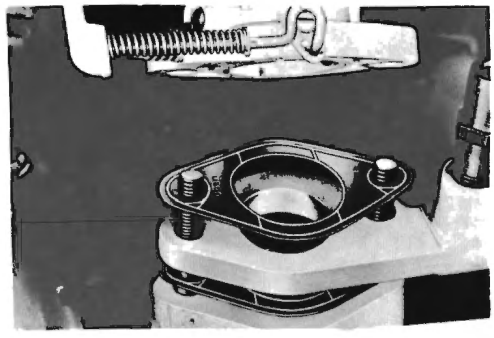


Fig. D:28 Gasket location - FoMoCo

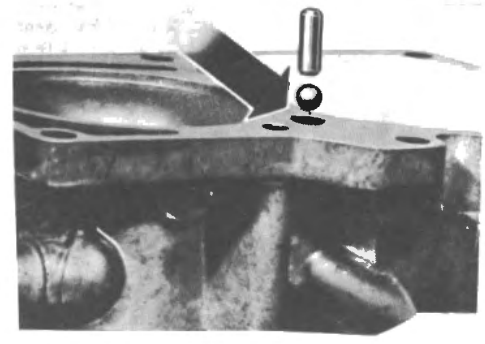


Fig. D:29 Accelerator pump ball valve and weights - FoMoCo

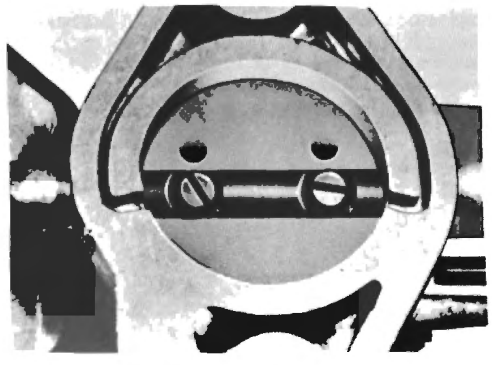


Fig. D:30 Throttle plate installation position - FoMoCo

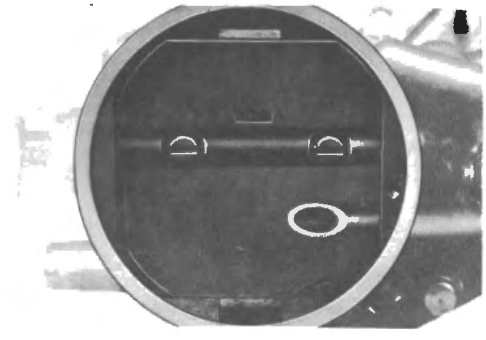


Fig. D:31 Choke plate installation position - FoMoCo

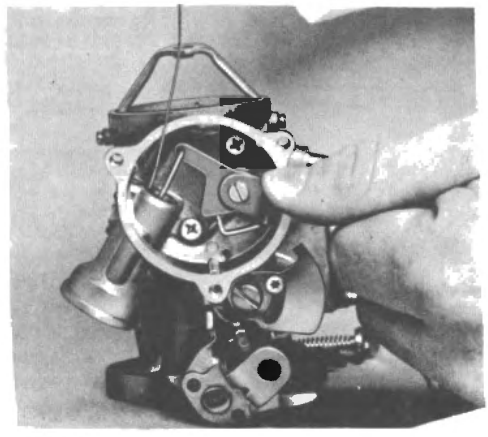


Fig. D:32 Vacuum piston position for choke plate pull-down setting - FoMoCo, USA version 1970 onwards

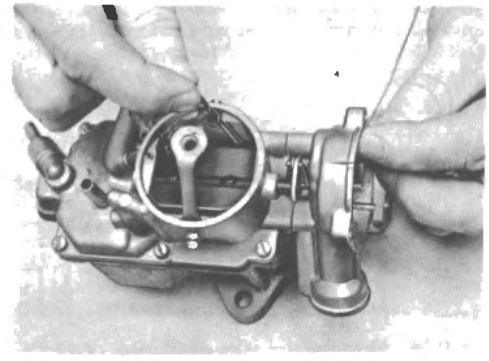


Fig. D:33 Checking the choke plate pull-down setting - FoMoCo, USA version 1970 onwards

NOTE :– Care should be taken when operating the throttle linkage once the float chamber cover is removed, as the acceleration pump discharge valve (Fig. D:29) will be exposed in its bore and may be ejected causing serious damage if the valve should enter the engine.

Hold the float chamber cover in a vertical position with the float hanging down and measure the distance from the upper body gasket to the bottom of the float (A, Fig. D:27). The distance should be 1.08 in (27.5 mm). If necessary, adjust by bending the tab resting against the needle valve housing (arrowed on illustration).

Hold the float chamber cover in a horizontal position with the float hanging down and again measure the distance from the upper body gasket to the bottom of the float (B, Fig. D:27). The distance should be 1.34 in (34 mm). If necessary, adjust by bending the stop contacting the float chamber cover (arrowed on illustration).

Fit the float chamber cover and tighten the retaining screws. Secure the step cam to the carburettor body with the shoulder screw. It may be necessary to reset the step cam adjustment. Refit the fuel pipe. Where required, refit the choke water hoses and top up the cooling system. Refit the air cleaner.

Acceleration Pump Stroke Adjustment :

Remove the air cleaner and unscrew the throttle stop screw until the throttle plate is fully closed. Depress the diaphragm plunger on the acceleration pump with a small screwdriver and, using a drill of suitable diameter, check the clearance between the operating lever and the plunger (A, Fig. D:24). The clearance should be 0.09 - 0.10 in (2.3 - 2.5 mm). If necessary, adjust by bending the goose-neck of the pump push rod. Close the goose-neck to lengthen the stroke and expand it to shorten the stroke. Reset the throttle stop screw to its original position. Refit the air cleaner.

Float Chamber Valve Setting :

With the throttle fully open, dimension A in Fig. D:25 should be 0.32 - 0.40 in (8 - 10 mm). With the throttle fully closed, dimension B should be 0.008 - 0.12 in (0.2 - 0.3 mm). Adjustment of A is effected by bending the lower part of the lever stop towards the tension pin, whilst that of B is effected by bending the lever at the push rod (Fig. D:26).

Automatic Choke Housing Setting :

The automatic choke is set for the choke flap to be fully open at 60 - 65°C (140 - 149°F). The setting mark on the housing cover must align with the centre mark on the housing (Fig. D:15). Turning the choke cover clockwise makes the choke open later.

Choke Plate Pull-Down Setting :

Remove the air cleaner. Remove the water housing cover and thermostatic spring. Hold the vacuum piston in its fully depressed position and manually close the choke plate until its movement is stopped by the tongue on the thermostatic spring lever contacting the vacuum piston lever (Fig. D:16). Using a drill of suitable diameter, check the clearance between the lower edge of the choke plate and the carburettor wall (Fig. D:17). The clearance should be 0.17 - 0.19 in (4.2 - 4.7 mm). If necessary, adjust by bending the extension on the choke thermostatic spring lever (Fig. D.18).

Refit the water housing cover, locating the thermostatic spring in the centre slot on the lever (Fig. D:14). Align the mark on the cover with the centre mark on the housing (Fig. D:15) and tighten the retaining screws.

Step Cam Setting :

Insert a drill of 0.17 - 0.19 in (4.2 - 4.7 mm) diameter between the lower edge of the choke plate and the carburettor wall (Fig. D:17). The mark on the third catch of the step cam should align exactly with the stop arm on the throttle control lever (Fig. D:19). If necessary, adjust by choke connecting link at its existing bend (Fig. D:20).

De-choke Setting :

Open the throttle fully so that the arm B on the throttle control lever contacts stop A on the step cam and forces the choke plate to open (Fig. D:21). Using a drill of suitable diameter, check the clearance between the lower edge of the choke plate and the carburettor wall (Fig. D:22). The clearance should be 0.19 - 0.23 in (4.8 - 5.8 mm). If necessary, adjust by bending the stop A on the step cam.

Fast Idle Adjustment :

A tachometer is required for this adjustment.

Bring the engine to normal operating temperature and remove the air cleaner. Connect the tachometer to the engine. Hold the throttle control lever and the step cam so that the stop arm on the lever aligns the mark at the third catch on the step cam (Fig. D:19). At this point the engine speed should be 1800 rev/min. If necessary, the engine speed can be regulated by bending the stop arm on the throttle control arm (Fig. D:23). Re-check the engine speed after adjustment. Refit the air cleaner.

Removal and Installation :

Remove the air cleaner. Disconnect the throttle linkage from the carburettor. Disconnect the fuel pipe at the carburettor. Partially drain the cooling system and disconnect both water hoses from the automatic choke housing. Disconnect the distributor vacuum hose at the carburettor. Remove the two nuts and spring washers securing the carburettor to the inlet manifold and lift off the carburettor and gasket.

Installation is the reverse of the removal procedure. Fit new gaskets beneath the carburettor and intermediate flange with the face marked "Oben" upwards (Fig. D:28). Note that a special gasket is required for the FoMoCo carburettor and must not be confused with the one for the Solex carburettor. After installation is complete, check the idle adjustment as described above.

Disassembly :

Release the shoulder screw securing the step cam to the carburettor. Release the retaining screws and lift off the float chamber cover and gasket. Withdraw the float arm pivot pin, remove the float and lift the gasket off the float chamber cover. Unscrew the main jet and fuel needle valve from the float chamber cover.

Remove the accelerator pump ball valve and weight (Fig. D:29) by inverting the carburettor body. Release the four retaining screws and remove the accelerator pump cover, diaphragm and return spring. Disconnect the pump push rod and spring from the pump operating arm.

To remove the throttle plate and spindle, release the two clamping screws on the throttle spindle and slide out the throttle plate. Remove any burrs around the screw holes and withdraw the spindle from the carburettor body. Unscrew the idling mixture screw and spring. Unscrew the idling speed screw and locking spring.

If the automatic choke mechanism is required to be dismantled, proceed as follows :–

Remove the three retaining screws and detach the water housing cover and thermostatic spring. Release the retaining screw and remove the thermostatic lever, the choke piston lever, the choke piston link and the piston from the choke housing. Release the two retaining screws and detach the choke housing and gasket from the float chamber cover. Withdraw the choke control lever and shaft assembly from the rear of the housing.

To remove the choke plate and spindle, the two pins securing the air cleaner mounting bracket must first be removed using side-cutters. Remove the mounting bracket, unscrew the two clampings screws from the choke spindle and slide out the choke plate. Remove any burrs around the screw holes and withdraw the spindle from the float chamber cover.

Inspection :

Refer to the inspection procedures described previously for the Solex carburettors.

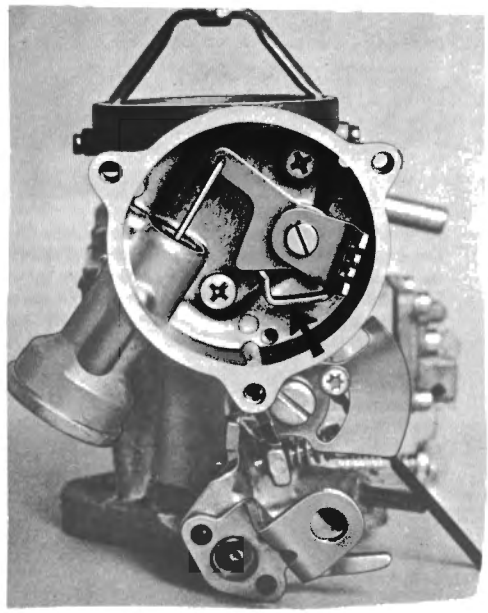


Fig. D:34 Choke plate pull-down adjustment - FoMoCo, USA version 1970 onwards

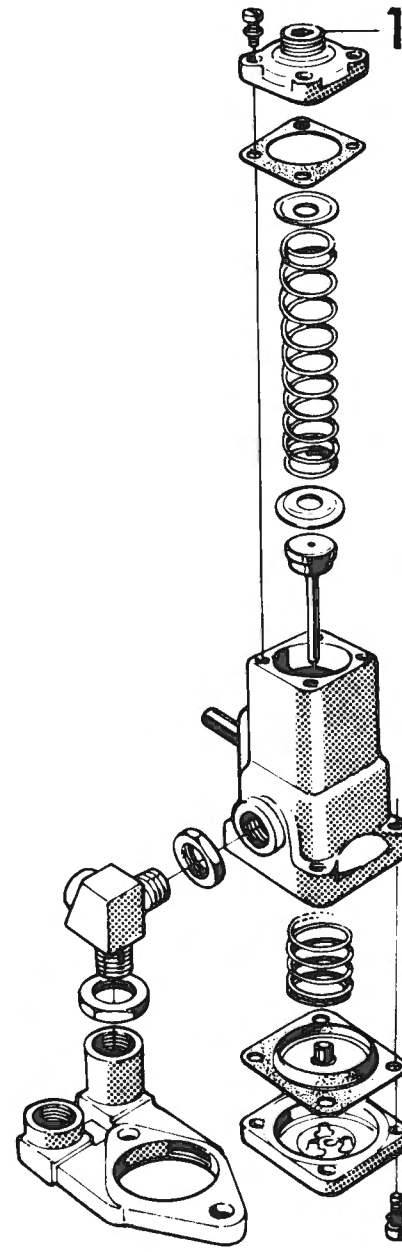


Fig. D:35 Explodes view of the decel. valve - FoMoCo, USA version 1970 onwards.
1. Adjusting screw

Assembly :

The carburettor should be re-built by reversing the dismantling procedure. Special attention should be paid to the following points :-

1. It is recommended that new gaskets should be used throughout when reassembling.

2. Centralise the choke plate with the plate in the closed position before finally tightening the clamping screws (Fig. D:31). Lightly peen over the threaded ends to lock the screws in position.

3. When reassembling the automatic choke mechanism, great care should be taken to ensure that the components are correctly installed in the choke housing. Refit the water housing cover, locating the thermostatic housing in the centre slot of the lever (Fig. D:14). Align the mark on the cover with the centre mark on the choke housing (Fig. D:15) and tighten the retaining screws.

4. After the throttle spindle has been inserted in the throttle body, fit the acceleration pump lever on the shaft and turn the side marked O upwards. Fit the throttle plate so that the face with the two punch marks faces downwards when the throttle is closed (Fig. D:30). Centralise the throttle plate with the plate in the closed position before finally tightening the clamping screws. Lightly peen over the threaded ends to lock the screws in position.

5. When assembling the acceleration pump, the small end of the return spring should face the diaphragm.

6. After assembling the fuel float to the float chamber cover, check the fuel and float level as described above.

7. When reassembly is complete, check and if necessary adjust the acceleration pump setting, the float chamber valve setting, the choke plate pull-down setting, the step cam setting and the de-choke setting as described above. Once installed on the car, the idle and fast idle settings can be adjusted.

FoMoCo CARBURETTORS (USA VERSIONS FROM 1970 ONLY)

A slightly modified choke mechanism is fitted to models as from 1970, and the procedure for setting the choke plate pull-down differs slightly from previous models. To meet Federal Emission Requirements, a deceleration valve is also fitted to these models.

Idle Adjustment :

Before commencing adjustment, check that all other direct influences on engine behaviour (e.g. ignition system, valve clearances, etc.) are correct and in proper working order. Check the air cleaner to ensure that the element is clean, otherwise an incorrect setting will be obtained. Also check that the throttle operation is free and unrestricted.

With the engine at normal operating temperature, connect a tachometer to the engine and adjust the idling speed screw to give an engine speed of 900 rev/min. Using an exhaust gas analyser, adjust the idling mixture screw until the content at the exhaust is 1.5 - 2 %.

NOTE :– The idling mixture screw has an internal restriction and can only be screwed out a certain distance. No attempt must be made to withdraw the screw further.

NOTE :– If satisfactory idling cannot be obtained, check the deceleration valve for correct function as described below.

Choke Plate Pull-Down Setting :

Remove the air cleaner. Remove the choke water housing cover and thermostatic spring. Depress the vacuum piston and insert a piece of wire 0.040 in (1.02 mm) thick into the innermost of the two slots in the piston bore, above the piston. Release the piston and hold the piston lever to keep both the piston and wire in position (Fig. D:32). Using a drill of a suitable diameter, check the clearance between the lower edge of the choke plate and the carburettor wall (Fig. D:33). The clearance should be 0.080 - 0.100 in (2.03 - 2.54 mm). If necessary, adjust by bending the extension of the choke thermostatic spring lever (Fig. D:34).

Deceleration Valve :

The deceleration valve should be checked and, if necessary, adjusted every 6.000 miles (10.000 km).

To check the function of the deceleration valve, with the air cleaner fitted, run the engine up to normal operating temperature. Check that the valve is working at idling speed by disconnecting one of the hoses between the valve and the carburettor and checking that no vacuum is passing the valve. If the valve is open and vacuum is passing the valve, screw in the adjusting screw on the top of the valve until the valve is closed. Reconnect the hose.

Connect a tachometer to the engine and adjust the engine speed to 850 R.P.M. Advance the engine speed to 3.000 R.P.M. with the throttle and then release the throttle quickly and measure the time required for the engine speed to reach idle again. The correct time interval is 7 - 8 seconds.

If the elapsed time is greater, the air cleaner should be removed and the adjusting screw screwed in further until the required setting is obtained. If the elapsed time is less, the screw should be backed off. Refit the air cleaner and recheck the time interval.

Persistant stalling and irregular running may be due to a weak mixture resulting from failure of the diaphragm. Check both the carburettor and ignition settings and, if the symptom persists, check the diaphragm by covering the bleed hole in the bottom cover. If correct idling is then restored, the deceleration valve should be dismantled and the diaphragm renewed.

NOTE :– The diaphragm is the only component of the deceleration valve available in service. If the valve itself is jammed or in any other way defective, the complete deceleration valve assembly must be replaced.

To replace the diaphragm, disconnect the inlet pipe to the deceleration valve. Remove the valve from the car. Release the four retaining screws and remove the bottom cover, diaphragm and spring. Install the spring and new diaphragm, locating the diaphragm on the end of the valve stem. Fit the cover and secure with the retaining screws. Fit the deceleration valve to the inlet manifold and reconnect the inlet pipe.

Air Cleaner Thermostatic Valve :

A thermostatic bulb and a spring-loaded flap valve is incorporated in the air cleaner assembly on these models so that the carburettor is provided with air at the correct temperature under normal operating conditions. As failure of the system to function correctly will affect the E.E.C. system and may result in failure of the vehicle to meet Federal regulations as well as affect the driveability, it is important that, if a defect is suspected, the system be tested as follows :–

Remove the front hose. With the engine cold and an ambient temperature in the engine compartment not exceeding 85°F (29°C) the flap valve should be in the "forward" position, shutting off the cold air intake.

Start the engine and run at fast idle for 2 - 6 minutes. If the ambient temperature is 50 - 70°F (10 - 21°C), the valve plate should now move towards the middle or back position.

If the flap valve does not function correctly, it should be removed and checked for wear or breakage of the valve or linkage.

The thermostatic bulb can be tested after removing the unit from the car. Place the bulb in water with a temperature of 82 - 85°F (28 - 30°C) and hold the flap at an angle of 15° to the bulb spindle. After a minute, the valve should remain in the same position when released. Raise the temperature of the water to 87 - 90°F (31 - 32°C) when the flap valve should move to the central position. At 95 - 105°F (35 - 40°C) the flap valve should move to its furthest position.

If these requirements are not met, the thermostatic unit should be replaced. After replacement, check the operation of the new unit.

INLET MANIFOLD – Removal and Installation :

Disconnect the battery earth lead. Drain the cooling system. Remove the air cleaner. Disconnect the water hoses at the inlet manifold and the carburettor automatic choke housing. Disconnect the temperature gauge sender unit lead.

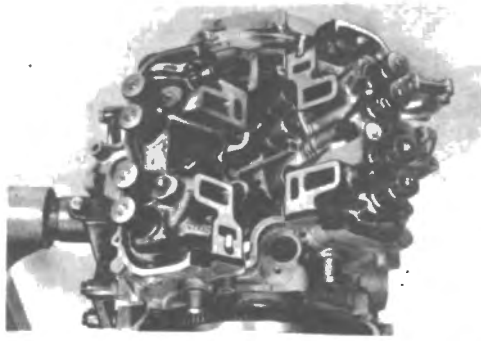


Fig. D:36 Apply sealing compound to the locations marked

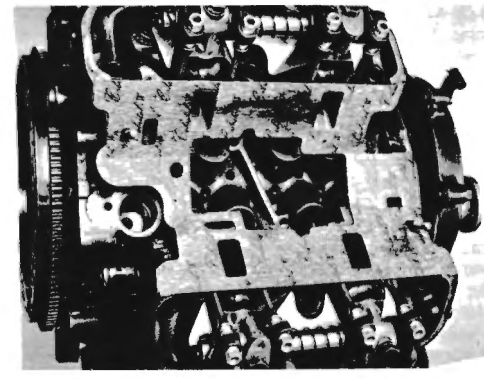


Fig. D:37 Installation of inlet manifold gasket

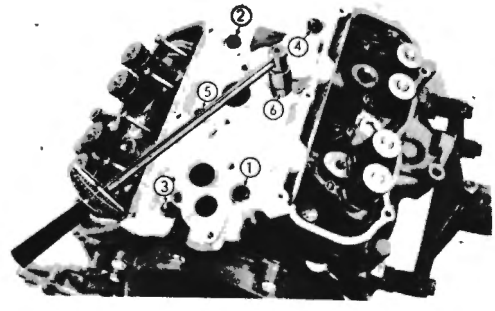


Fig. D:38 Tightening the inlet manifold bolts

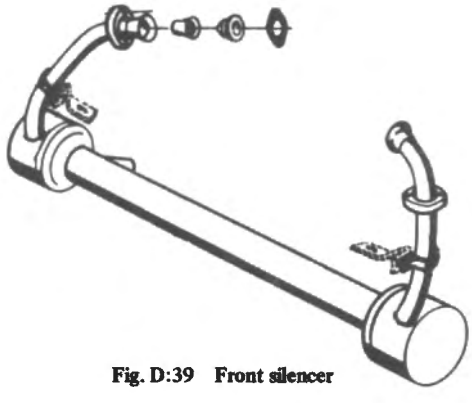


Fig. D:39 Front silencer

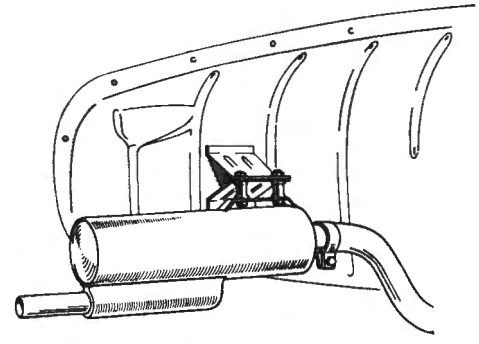


Fig. D:40 Rear silencer

Disconnect the spark plug H.T. leads, release the retaining clips and lift off the distributor cap. Disconnect the vacuum pipe and the L.T. lead, release the clamping bolt (see Fig. C:15) and withdraw the distributor. Disconnect the throttle control linkage, vacuum pipe and fuel pipe at the carburettor. Unscrew the two retaining nuts and lock washers and lift off the carburettor and gasket. Unscrew the retaining bolts and lift off both rocker covers. Unscrew the inlet manifold retaining nuts and bolts, separate the manifold from the gasket and lift off the manifold.

Before installing the inlet manifold, ensure that the mating faces of the cylinder heads and the manifold are clean and free from old gasket material. Apply sealing compound to the cylinder head faces as indicated in Fig. D:36. Install the manifold gasket and ensure that the tab on the right-hand cylinder head gasket is engaged in the slot at the front of the manifold gasket (Fig. D:37). Install the inlet manifold and tighten the bolts in four stages following the sequence shown in Fig. D:38.

Stage 1.	4 lb.ft (0.5 kgm)
Stage 2.	11 lb.ft (1.5 kgm)
Stage 3.	15 lb.ft (2.0 kgm)
Stage 4.	18 lb.ft (2.5 kgm)

Install the distributor as described in the IGNITION SYSTEM section. Reconnect the spark plug H.T. leads, ensuring that they are replaced in their correct order. Install the carburettor, using a new gasket, and reconnect the fuel pipe, vacuum pipe and throttle control linkage. Reconnect the water hoses to the inlet manifold and the choke housing. Connect the temperature gauge sender unit lead. Refit the rocker covers and the air cleaner. The rocker cover with the oil filler cap must always be installed on the right-hand side of the engine.

If the rocker cover gasket is damaged, discard the old gasket, fit the new gasket in the rocker cover and press the gasket into the locating slots in the cover (see Fig. A:8).

Refill the cooling system. Check the carburettor idling adjustment and the ignition timing and adjust if necessary.

EXHAUST SYSTEM

The exhaust system consists of the front silencer assembly, the rear silencer and the connecting pipe. The down-pipes for each bank of cylinders are in unit with the front silencer which is located under the front of the engine compartment, behind the front lower panel (Fig. D:39). The rear silencer is located behind the right rear wheel and is carried in rubber bushes on a bracket welded to the wall of the wheel arch (Fig. D:40).

When replacing all or part of the system, the silencer suspension bolts should be tightened first and then the exhaust pipe clamps, otherwise tension may be caused at the connections.

Technical Data

Fuel tank capacity :
95 . . . . . 9,5 imp.galls (11.5 US galls; 43 litres) approx.
96 & Monte Carlo . . 8.7 imp.galls (10.5 US galls; 40 litres) approx.
Fuel pump delivery pressure . . . . 3.4 - 4.3 psi (0.24 - 0.30 kg/cm^2) at 4,000 rev/min (crankshaft)

Carburettors
Solex 28 - 32 PDSIT - 7

Choke tube diameter	25.5 mm
Main jet	125
Emulsion jet	110
Idling petrol jet	50
Idling air jet (drilling)	1.5
Acceleration jet	50
Acceleration pump capacity	0.6 ± 0.12 cu.in (10 ± 2 cu.cm) per 10 strokes
Float needle valve	1.5
Float weight	7.3 gms
Float level when idling (nominal)	0.59 ± 0.04 in (15.0 ± 1.0 mm) from gasket
Idling speed	800 - 900 rev/min
Fast idling speed :	
Stage 1	1100 - 1300 rev/min
Stage 2	1700 - 1900 rev/min
Stage 3	2700 - 2900 rev/min

Solex 32 PDSIT - 4

	Standard engines	Engines with SaFree E.E.C.
Choke tube diameter	25.5 mm.	25.5 mm
Main jet	127.5	127.5
Emulsion jet	95	100
Idling petrol jet	50	42.5
Idling air jet (drilling)	1.5	1.5
Acceleration jet	50	50
Accelerator pump capacity	0.6 ± 0.12 cu.in (10 ± 2 cu.cm) per 10 strokes	
Float needle valve	1.5	1.5
Float weight	7.3 gms	7.3 gms
Float level when idling (nominal)	0.59 ± 0.04 in (15.0 ± 1.0 mm) from gasket	
Idling speed	800 - 900 rev/min	800 - 900 rev/min
Fast idling speed		
Stage 1	1100 - 1300 rev/min	1100 - 1300 rev/min
Stage 2	1700 - 1900 rev/min	1700 - 1900 rev/min
Stage 3	2700 - 2900 rev/min	2700 - 2900 rev/min

FoMoCo C8GH - 9510

Type	9510 - G.	9510 - H
Main jet	140	135
Acceleration pump capacity	0.27 - 0.4 cu.in (4.5 - 6.5 cu.cm) per 10 strokes	
Float needle valve	2.0	2.0
Float level, fully-closed float valve	1.08 in (27.5 mm)	1.08 ± 0.010 in (27.5 ± 0.25 mm)
Float level, fully-open float valve	1.34 in (34.0 mm)	1.420 ± 0.010 in (36 ±0.25 mm)
Idling speed	800 - 900 rev/min	900 rev/min
Fast idling speed (third step)	1.800 rev/min	1.900 - 2100 rev/min

FoMoCo 70 TW - 9510 - AA

Main jet	135
Float needle valve	2.0
Float level, fully-closed float valve	1.080 ± 0.010 in (27.5 ± 0.25 mm)
Float level, fully-open float valve.	1.420 ± 0.010 in (36.0 ± 0.25 mm)
Idling speed.	900 rev/min
Fast idling speed (third step, headlights on low beam)	1700 - 1900 rev/min

Clutch

GENERAL

The single dry plate clutch is of Fichtel and Sachs manufacture. A steel cover assembly, bolted to the flywheel, contains the clutch disc, pressure plate, release levers and coil type pressure springs. The release mechanism comprises a ball bearing in a housing which is secured to the clutch release fork by two spring clips. A graphite or Teflon coating is used on the pressure face of the ball bearing. The release mechanism is hydraulically actuated.

ROUTINE MAINTENANCE

Every 6.000 miles (10.000 km) check the fluid level in the clutch master cylinder and the adjustment of the free-play at the release arm.

CLUTCH ADJUSTMENT

The clearance between the clutch release bearing and the release plate can be regulated by an adjustment screw on the clutch housing, located on the opposite side in relation to the slave cylinder (Fig. E:3). The correct clearance is present when a free-play of 0.16 in (4 mm) is obtained at the end of the clutch release arm (Fig. E:4). If adjustment is necessary, release the lock nut and turn the screw clockwise to increase the free-play or vice versa. Retighten the lock nut once the correct adjustment has been obtained.

CLUTCH – Overhaul :

Remove the engine / gearbox unit from the car and separate as described in the GEARBOX section.

Clutch Pressure Plate Assembly and Clutch Disc :

Release the six retaining bolts evenly, working diagonally across the clutch, and remove the pressure plate assembly and clutch disc.

Check the pressure plate cover for cracks or any distortion caused by uneven slackening of the retaining bolts. Check the pressure plate friction face for cracks or scratches. Check the surface of the plate for distortion using a straight edge, placed diametrically across the face, and a feeler gauge. Check the plate at several points. Check the compression springs for any signs of overheating, craks, distortion or "tiredness".

If any of the components of the pressure plate assembly require replacement, mark all the parts before dismantling to ensure correct reassembly in the same relative positions. Incorrect reassembly will affect the clutch balance. Disengage the three retaining springs and lift the release plate off the release levers. Compress the pressure plate assembly in a press. Remove the release levers from the clutch cover. Slowly reduce the pressure on the assembly and then lift off the clutch cover and remove the pressure springs. Reassemble in the reverse order.

Check the friction face of the flywheel. Blueing or small cracks are of no particular importance, but if there are any deep scratches the flywheel should be machined or exchanged.

Check the clutch disc friction linings for wear, burning, contamination or looseness. Check the hub splines for wear. The clutch disc should slide freely on the gearbox clutch shaft splines without excessive side-play. Replace the clutch disc if the linings are worn down near the rivet heads or if any of the above conditions are apparent.

Place the clutch disc in position on the flywheel and refit the pressure plate assembly. If paint balancing marks are present on the pressure plate assembly or flywheel, these should be placed at 180° to each other. Centre the clutch disc using alignment arbor, Tool No. 784064, and tighten the pressure plate retaining bolts evenly, working diagonally. Remove the alignment tool.

Release Bearing :

Pull the release lever forward, remove the two spring clips retaining the release bearing to the release fork and remove the release bearing (Fig. E:8).

If the bearing is of the graphite ring type and the ring is worn level with its retainer, it must be replaced. When fitting a new release bearing, check whether the bearing has a graphite ring or Teflon coating on its pressure face. If the bearing has a Teflon coating, the pressure face of the release plate must be surface ground and NOT Teflon coated. When installing the bearing, ensure that the spring clips are correctly engaged.

Install the gearbox as described in the GEARBOX section.

SLAVE CYLINDER – Removal and Installation :

Disconnect the hydraulic hose at the slave cylinder and fit a blanking plug in the hose. Unscrew the retaining bolt, separate the slave cylinder from the push rod and detach the cylinder from the clutch housing. Collect any shims fitted between the slave cylinder and the clutch housing.

To install the slave cylinder, locate the cylinder with any removed shims on the clutch housing, pass the push rod through the hole in the rubber dust cover and secure with the retaining bolt. Reconnect the hydraulic hose and bleed the system as described later in this section.

SLAVE CYLINDER – Overhaul :

Refer to Fig. E:14 for an exploded view of the components referred to in this section.

Remove the rubber dust cover from the end of the cylinder and extract the circlip from inside the cylinder bore. The piston, complete with seal, can now be withdrawn, followed by the spring.

Wash the components in methylated spirit, commercial alcohol or approved hydraulic fluid. Examine the cylinder and piston bore for signs of scores, wear or corrosion pits. If any imperfection, no matter how slight, is present, a new cylinder should be fitted. A new piston seal should be fitted as a matter of course when reassembling. If the rubber dust cover shows signs of deterioration, wear or damage, it should be replaced.

Fit the piston seal on the spigot at the front end of the piston, with the sealing lip away from the body of the piston. Dip the piston assembly in clean hydraulic fluid. Fit the small diameter of the spring over the piston spigot and carefully insert the assembly, spring first, into the cylinder. Retain with the circlip. Pack the dust cover with rubber grease and refit over the end of the cylinder.

MASTER CYLINDER – General :

As from 1969 a new type of master cylinder is fitted, being of the vertical type instead of the horizontal type used previously. Because of the difference in design of the two types, a different overhaul procedure is required.

MASTER CYLINDER (BOTH TYPES) – Removal and Installation :

Disconnect the hydraulic hose at the master cylinder and fit the blanking plugs in the hose and master cylinder orifices to prevent the ingress of dirt. Extract the split pin and withdraw the cotter pin securing the master cylinder push rod to the clutch pedal. Release the retaining bolts and detach the master cylinder from the bulkead. Empty the contents of the fluid reservoir into a container.

Installation is the reverse of the removal procedure. Bleed the system as described later in this section.

MASTER CYLINDER (EARLY TYPE) – Overhaul :

Refer to Fig. E:10 for an exploded view of the components referred to in this section.

Remove the rubber dust cover, extract the circlip and withdraw the push rod and retaining washer. Pull the piston and valve assembly from the cylinder. Carefully lift the tab on the spring retainer which engages under

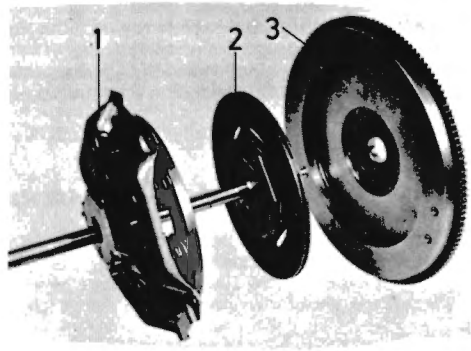


Fig. E:1
Clutch and flywheel assembly

1. *Pressure plate assembly*
2. *Clutch disc*
3. *Flywheel.*

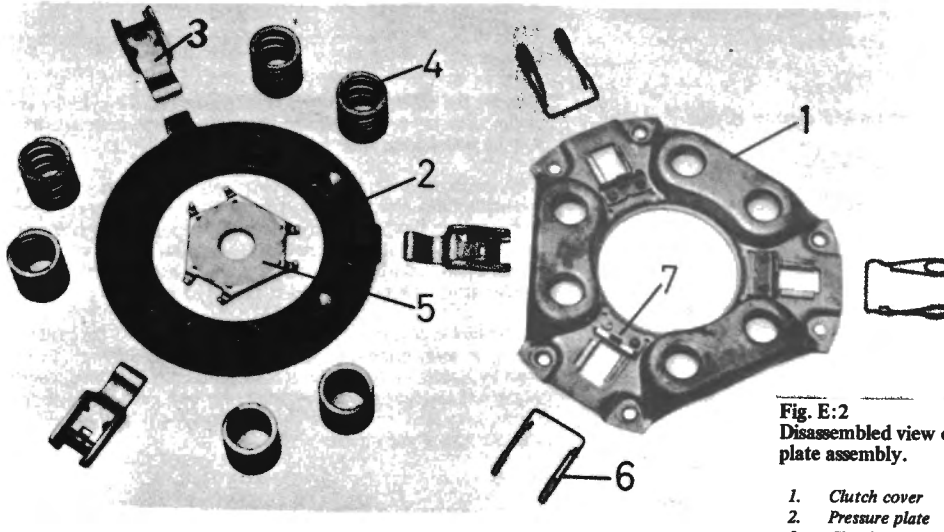


Fig. E:2
Disassembled view of the clutch pressure plate assembly.

1. *Clutch cover*
2. *Pressure plate*
3. *Clutch release levers*
4. *Pressure springs.*
5. *Release plate.*
6. *Retaining spring.*
7. *Release lever pivots.*

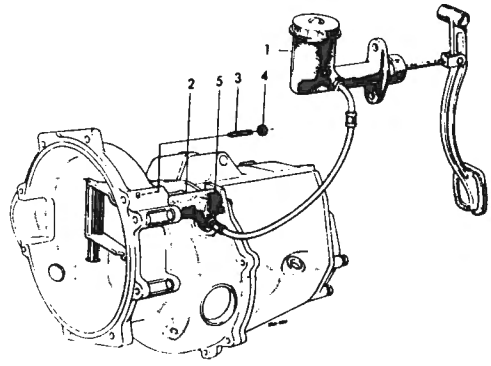


Fig. E:3
Clutch release mechanism

1. *Master cylinder*
2. *Slave cylinder*
3. *Adjustment screw*
4. *Lock nut*
5. *Bleed valve*

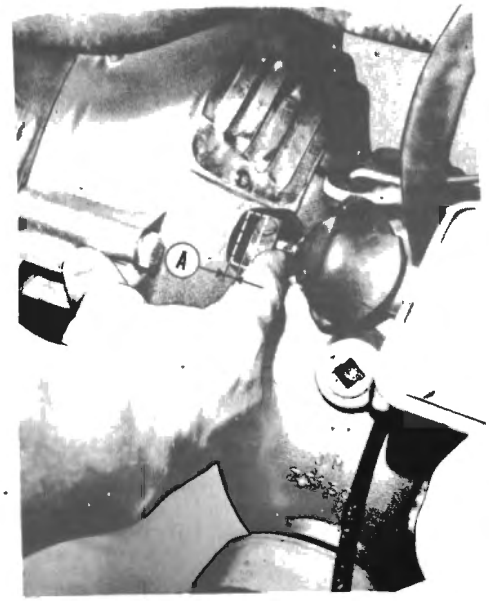


Fig. E:4 Checking the release arm free-play
A = 5/32 in (4 mm)

Fig. E:5 Sectional view of the clutch disc

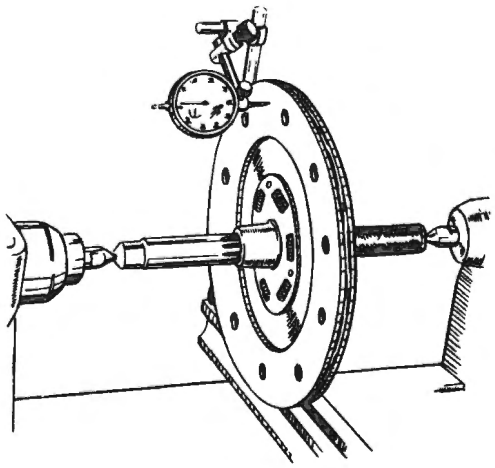


Fig. E:6 Checking the clutch disc throw-out

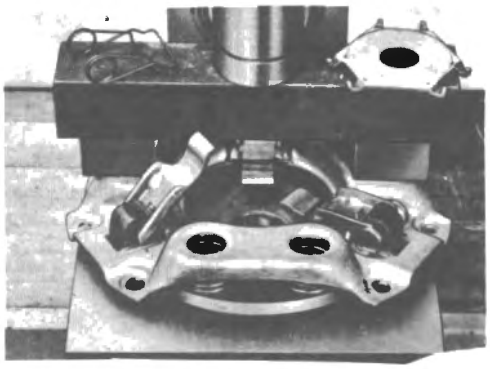


Fig. E:7 Dismantling the pressure plate assembly

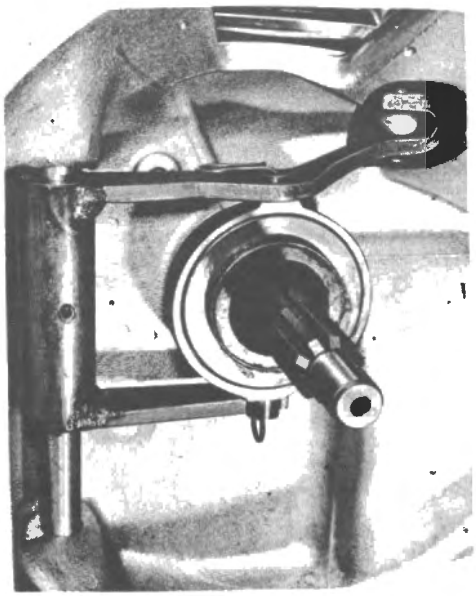


Fig. E:8 Clutch release arm and bearing

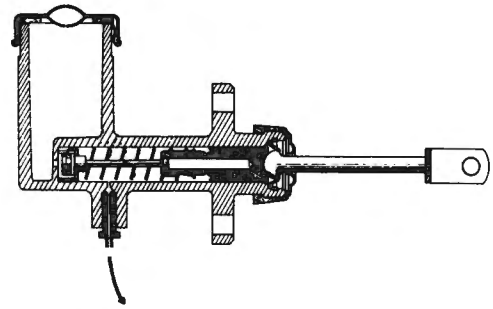


Fig. E:9 Sectional view of the master cylinder - Models prior to 1969

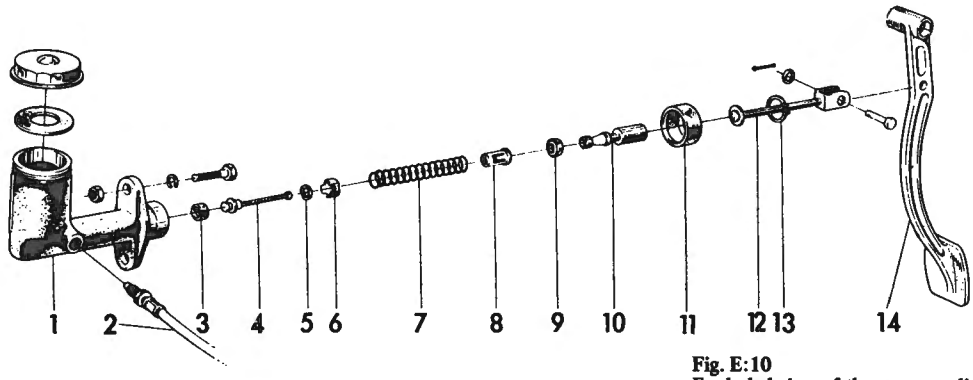


Fig. E:10
Exploded view of the master cylinder - Models prior to 1969.

1. *Cylinder body and reservoir*
2. *Hydraulic hose*
3. *Valve seal*
4. *Valve stem*
5. *Spring washer*
6. *Valve spacer*
7. *Spring*
8. *Spring retainer*
9. *Piston seal*
10. *Piston*
11. *Rubber dust cover*
12. *Push rod and retaining washer*
13. *Retaining circlip*
14. *Clutch pedal.*

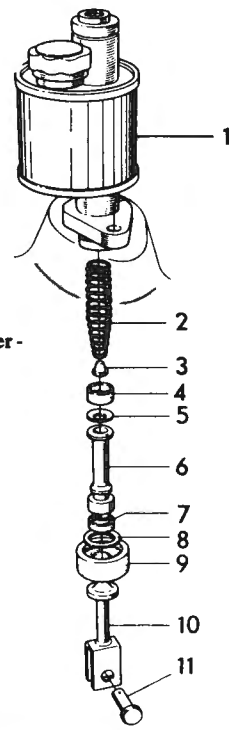


Fig. E:11
Exploded view of the master cylinder - Models 1969 onwards.

1. *Cylinder body and reservoir*
2. *Piston return spring*
3. *Spring seat*
4. *Piston primary cup*
5. *Dished washer*
6. *Piston*
7. *Piston secondary cup*
8. *Stop washer*
9. *Rubber dust cover*
10. *Push rod*
11. *Clevis pin (to pedal).*

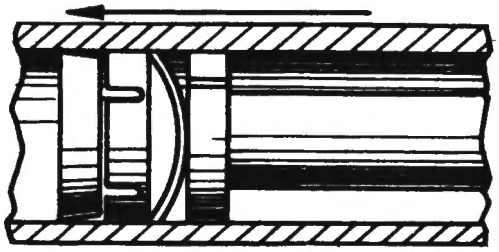


Fig. E:12 Correct positioning of the dished washer

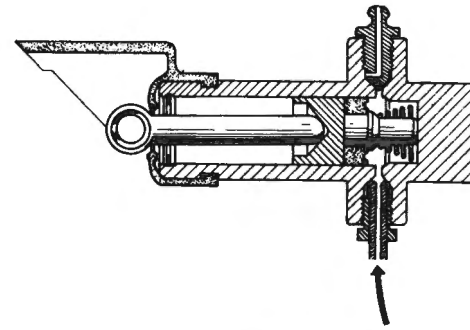


Fig. E:13 Sectional view of the slave cylinder

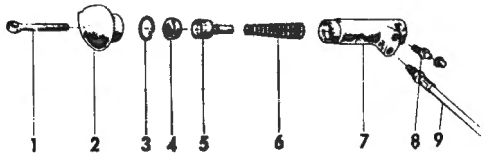


Fig. E:14
Exploded view of the slave cylinder

1. *Push rod*
2. *Rubber dust cover*
3. *Retaining circlip*
4. *Piston seal*
5. *Piston*
6. *Piston return spring*
7. *Cylinder body*
8. *Bleed valve*
9. *Hydraulic hose.*

Fig. E:15 Bleeding the hydraulic system

a shoulder on the spigot of the piston and separate the piston from the valve assembly. Compress the spring on the valve assembly and slide the valve stem to one side so that the stem is released from the "keyhole" in the spring retainer. Remove the spring retainer, valve spacer and spring washer from the valve stem. Remove the rubber seals from the valve and piston.

Wash the components in methylated spirit, commercial alcohol or clean approved hydraulic fluid. Mineral based oils such as petrol, paraffin, etc. must NOT be used. Examine the piston and bores for scores, ridges, corrosion pits or other damage. If any imperfection, no matter how slight, is present, a new cylinder should be fitted. New seals should be fitted as a matter of course when reassembling. The seals should be inspected carefully before fitting, even if they have hust been drawn from stock. Check that the sealing lips are perfectly formed, concentric with the bore of the seal, and free from "knife-edges", surface blemishes or other marks. Any seal which does not appear to be perfect, no matter how minute the blemish might appear to be, should be replaced. If the rubber dust cover shows signs of deterioration, wear or damage, it should be replaced.

To reassemble, fit the valve seal with the flat side against the valve head. Slide the spring washer onto the valve stem with the domed side towards the head of the valve. Locate the valve spacer against the spring washer with the legs towards the valve seal. Fit the return spring over the valve stem and insert the spring retainer into the end of the return spring. Compress the spring and engage the end of the valve stem in the "keyhole" in the spring retainer. Fit the piston seal to the piston, flat side against the piston, and insert the piston into the spring retainer until the shoulder engages the tab. Press the tab down to secure the piston. Dip the assembly in clean hydraulic fluid and carefully insert it into the cylinder, valve first. Install the push rod and the retaining washer and retain with the circlip. Pack the dust cover with rubber grease and refit over the end of the cylinder.

MASTER CYLINDER (LATE TYPE) – Overhaul :

Refer to Fig. E:11 for an exploded view of the components referred to in this section.

Remove the rubber dust cover, extract the circlip and withdraw the push rod and retaining washer. The piston, dished washer, piston primary cup, spring seat and spring can now be removed from the cylinder. Remove the rubber secondary cup from the piston.

Clean and inspect the components as described above for the early type master cylinder.

Lubricate the bore of the cylinder with clean hydraulic fluid and insert the return spring, largest coils first, and the spring seat. Fit the secondary cup to the piston, flat side towards the nearest end of the piston. Dip the piston in hydraulic fluid. Insert the primary cup, lip first, into the cylinder. Next, install the dished washer with the convex side towards the piston (Fig. E:12). Fit the piston into the bore with the long spigot first, taking care to avoid damaging the lip of the seal. Install the push rod and retaining washer and retain with the circlip. Pack the dust cover with rubber grease and refit over the end of the cylinder.

BLEEDING THE HYDRAULIC SYSTEM

Top up the master cylinder reservoir with approved hydraulic fluid. Clean the area around the bleed valve on the slave cylinder and remove the rubber dust cap from the valve. Fit one end of a bleeder tube to the bleed valve and immerse the other end in a small quantity of hydraulic fluid in a clean jar. Open the bleed valve half a turn and depress the clutch pedal. Close the bleed valve just before the bottom position and release the pedal. Repeat this procedure until the fluid emerging from the bleed tube is completely free from air bubbles. Remove the bleed tube from the bleed valve and refit the rubber dust cover cap. Top up the master cylinder reservoir to the correct level and refit the reservoir cap.

NOTE :– The hydraulic system can also be bled using a cooling system tester (Fig. E:15). This eliminates the need for pumping the clutch pedal. Place the tester over the fluid reservoir filler hole and pump the handle several times until all air has left the system.

Technical Data

Make	Fichtel & Sachs
Type	Single dry plate
Actuation	Hydraulic
Hydraulic fluid	To specification SAE 70 R 3
Clutch free play (measured) at outer end of release arm	0.16 in (4 mm)
Clutch disc	
Inside diameter of friction facing	5 in (127 mm)
Outside diameter of friction facing	6.5 in (190.5 mm)
Max. permissible run-out at facing	0.024 in (0.6 mm)
Disc thickness (new, unloaded)	0.33 ± 0.04 in (8.4 ± 0.1 mm)
Disc thickness (new, loaded)	0.024 in @ 825 lbs (0.6 mm @ 375 kg)
Engagement pressure	750 - 935 lbs (340 - 425 kg)
Pressure plate assembly	
Pressure spring compressed length	0.96 in (24.5 mm)
Tension when compressed	134 - 147 lb (61 - 67 kg)
Clearance between release plate and flywheel	1.0 in (26 mm) approx.

	Prior to 1969	From 1969
Master cylinder		
Make	Girling	Lockheed
Cylinder bore diameter	5/8 in	5/8 in
Max. permissible stroke	1.38 in (35 mm)	1.22 in (31 mm)
Hose connection	3/8 in UNF - 24	7/16 in 20 UNF - 2B
Hose length between master and slave cylinder	14.0 in (355.6 mm)	15.3 in (388.6 mm)
Slave cylinder		
Make	Girling	Girling
Cylinder bore diameter	3/4 in	3/4 in
Hose connection	3/8 in UNF - 24	7/16 in 20 UNF - 2B

Transmission

GENERAL

The gearbox, free-wheel, differential, inner drive shafts and inner universal joints form an integral unit, located immediately behind the engine.

All models are equipped with a 4-speed transmission with synchromesh on all forward gears. The gear ratios are the same for all models.

A free-wheel device is incorporated in the transmission between the clutch shaft and the transmission primary shaft. When the road speed of the car exceeds the engine speed, as may occur when running downhill with the engine idling, for example, the free-wheel disengages the transmission from the engine. If desired, the free wheel can be locked in the engaged position, by means of a control, from the driving seat.

As from transmission No. F 118.182, drain plugs of a different type are used and are not interchangeable with the former ones. Special tool No. 839153 is necessary for the removal of the new plugs.

The inner drive shafts are splined to the differential side gears and are retained by a spring lock ring at the inner end of the drive shaft which engages a groove in the side gear (5, Fig. F:14). As from transmission No. F 68929 a new differential casing, differential side gears, spring lock rings and inner drive shafts have been introduced. The new drive shafts are of increased diameter and have a greater number of lands on the splines. All components mentioned previously have been modified accordingly and are thus not inter-changeable with former parts.

The outer universal joint is incorporated in the outer drive shaft (Fig. F:20).

ROUTINE MAINTENANCE

Every 6.000 miles (10.000 km) or at least twice a year, the transmission oil level should be checked. If the level is more than 0.2 in (5 mm) below the level plug opening, add SAE 80 EP gear oil until it flows out through the plug opening. The rubber belows on the drive shafts should be inspected for damage and leakage at the same time.

Every 12.000 miles (20.000 km) or at least once a year, change the transmission oil. The oil should be drained when warm. Clean the magnetic drain plug before refitting. Refill with SAE 80 EP gear oil.

NOTE :– As from transmission No. F 118.182, drain plugs of a different type are used and are not interchangeable with the former ones. Special Tool No. 839153 is necessary for the removal of the new type plug.

GEAR CHANGE ADJUSTMENT

If adjustment or overhaul of the column change mechanism or linkage is necessary refer to the appropriate heading in the STEERING section.

TRANSMISSION UNIT – Removal and Installation :

If the transmission is to be removed from the car, the engine and the transmission must be removed as a single unit and then separated. Follow items 1 - 13 described previously for the engine removal, then proceed as follows :–

14. Disconnect free-wheel control and speedometer cable from transmission.

15. Unbolt clutch slave cylinder from clutch housing and suspend cylinder in suitable position. Collect any shims fitted between cylinder and clutch housing.

16. Unscrew nut at lower universal joint on gear shift shaft and drive out tapered pin, using Tool No. 784083. If pin is threaded at both ends, remove nut and transfer to other end of pin. Tighten nut to loosen pin.

17. From inside car, turn back floor mat and remove rubber plugs to provide access to engine rear mounting centre bolt (Fig. F:27). If mounting is jammed, free by tapping with an arbor inserted through upper hole (Fig. F:28).

18. Raise car on stands placed at front edges of sills so that front wheels are clear of ground.

19. Remove larger of two clamps around rubber boots at inner universal joints.

20. Attach suitable lifting tackle to engine (e.g. Lifting Tool No. 786202). Remove both front engine mounting brackets and raise unit approx. 2 in (50 mm) to clear sump. Pull gearbox stub out of engine rear mounting bracket.

21. Open up inner universal joints, first on right side and then on left. Do this with T-shaped pieces of drive shafts located vertically and with power unit pushed as far as possible in opposite direction. Fit protective cover, Tool No. 731762, in each of rubber boots to stop needle bearings falling out and to prevent ingress of dirt. Fit covers, Tool No. 783846, on inner drive shafts.

22. Lift unit from car, ensuring that distributor vacuum unit is not damaged against engine compartment cross-stay.

Clean the power unit. Remove the bolts securing the transmission case to the engine and separate the units.

To install the transmission, assemble the transmission unit to the engine and lift the complete unit into the car.

With the T-shaped pieces of the drive shafts located vertically, insert first one drive shaft and then the other into its respective joints. Great care should be exercised to, prevent the ingress of dirt during this operation. Check that the joints are full of grease and refit the rubber boots and retaining clamps.

The remainder of the installation procedure is the reverse of that described for removal. Check the clutch adjustment as described in the CLUTCH section and check that the transmission functions correctly. If drained, refill the gearbox with SAE 80 EP gear oil until it flows out through the filler plug opening.

TRANSMISSION UNIT – Overhaul :

Specialised knowledge and equipment are required to dismantle, check and reassemble the transmission unit. It is therefore recommended that any overhaul procedure be entrusted to an authorised dealer or transmission specialist.

If required, a visual inspection can be afforded by the removal of the top cover from the transmission case (Fig. F:8). The mating surfaces of the cover and case must be clean and free from old sealing compound before reassembly. Check that the gearbox is in neutral and that the shifter and lock levers in the cover are in the neutral position. Coat the top cover mating surface with suitable sealing compound such as Permatex No. 3 and fit the cover to the car. Tighten the retaining bolts and check the function of the gear shift mechanism.

CLUTCH SHAFT SEAL – Replacement :

If the clutch shaft seal has become worn or damaged it can be replaced after the engine has been removed from the car. Detach the clutch release bearing from the release fork. Remove the old seal using Tool No. 784220 (Fig. F:11).

The seal ring may be one of two types. If the seal has double sealing lips, the space between the lips must be filled with chassis grease before installation (Fig. F:11). Install the seal using Tool No. 784220 (Fig. 13).

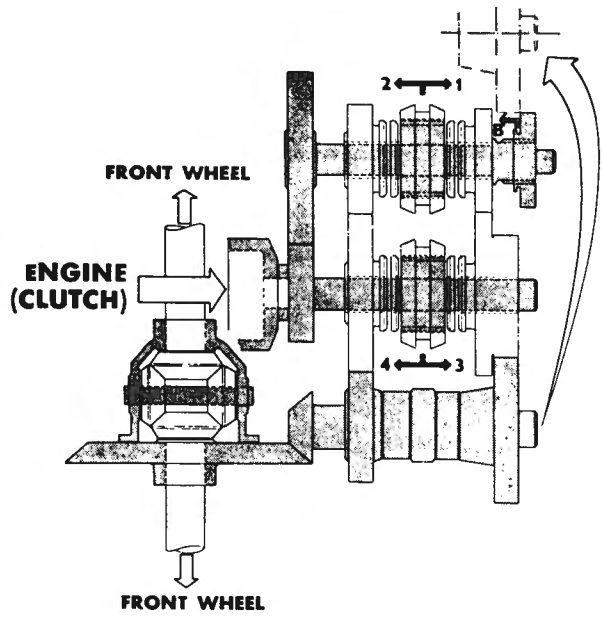


Fig. F:1 Diagrammatic arrangement of the transmission

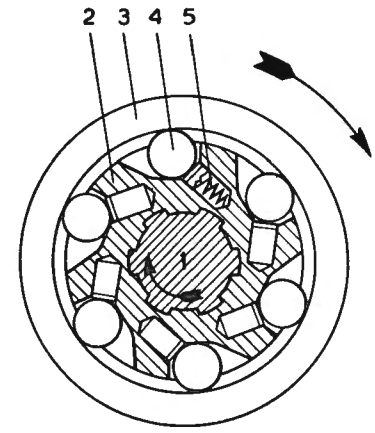


Fig. F:2
Diagrammatic arrangement of the free-wheel.

1. *Clutch shaft*
2. *Free-wheel hub*
3. *Free-wheel sleeve*
4. *Rollers*
5. *Coil springs*

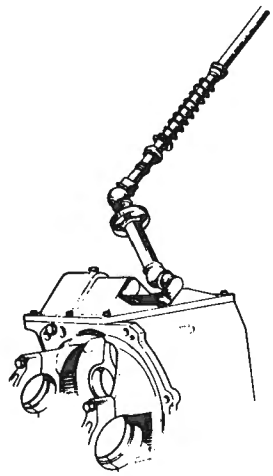


Fig. F:4 Gear-shift shaft universal joint - RHD models

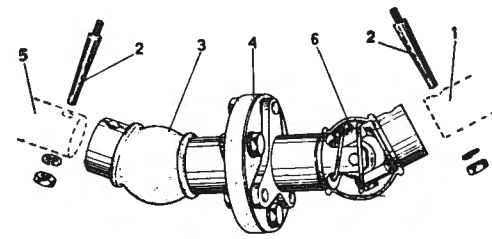


Fig. F:5
Gear-shift shaft universal joint, LHD models.

1. *Gear-shift rod*
2. *Conical pin with lock nut*
3. *Rubber boot*
4. *Rubber disc*
5. *Operating shaft, gearbox*
6. *Spring.*

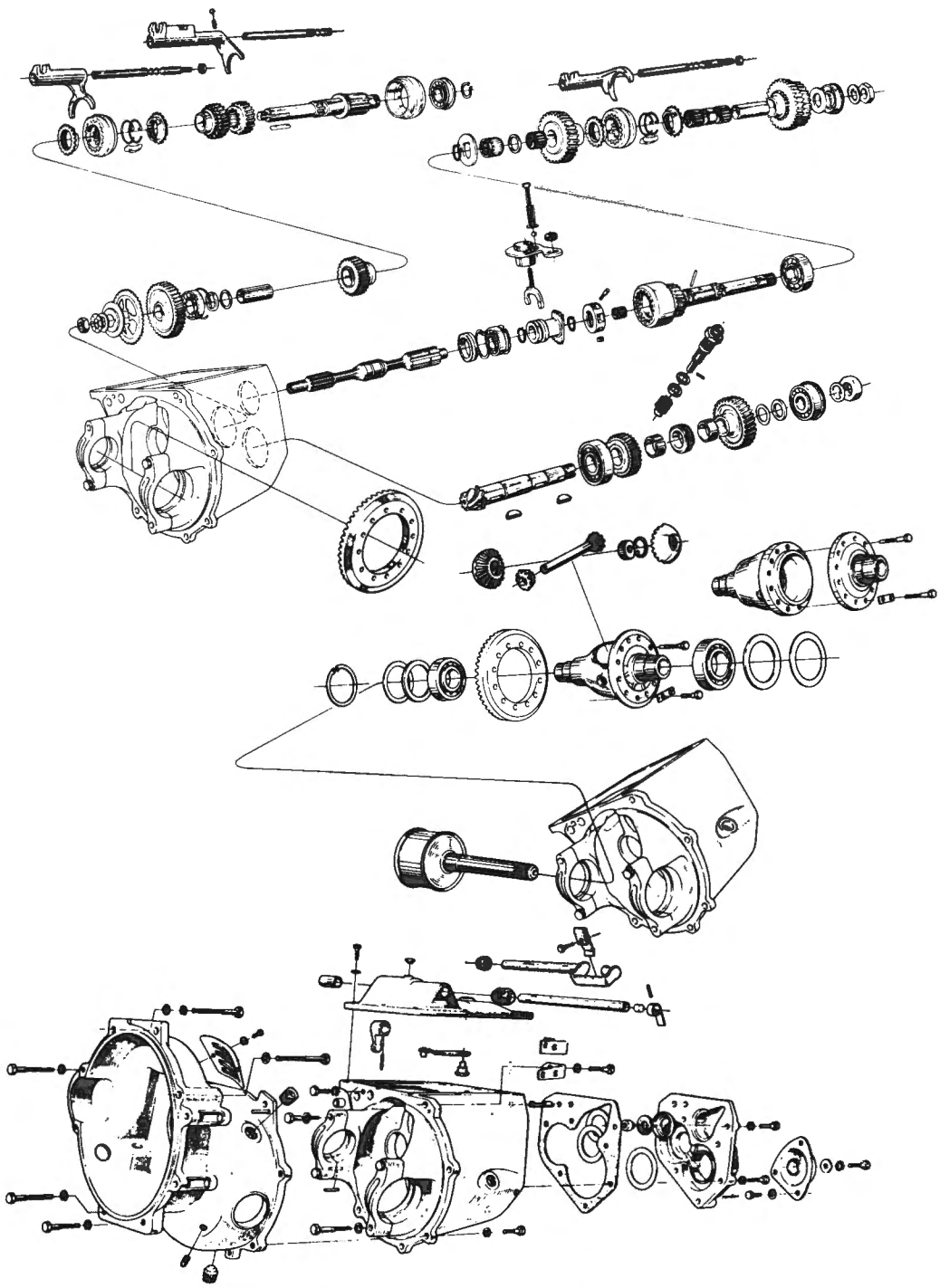


Fig. F:3 Exploded view of the transmission

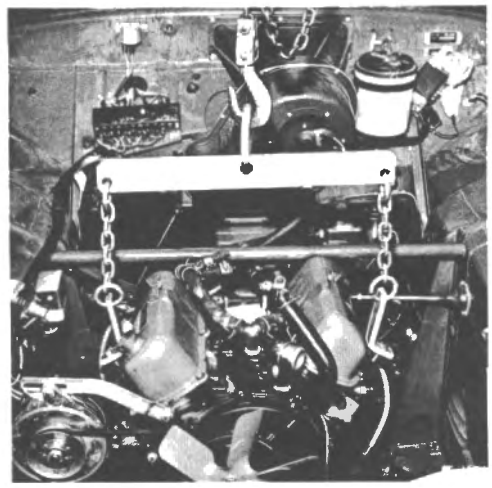


Fig. F:6 Removing/installing the engine-transmission unit

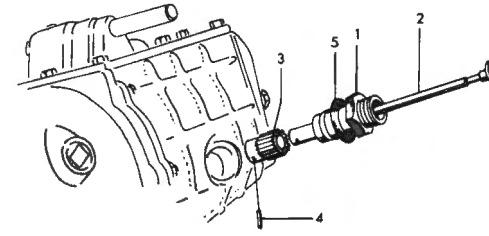


Fig. F:7
Speedometer drive gear.

1. *Bearing sleeve*
2. *Spindle*
3. *Driven gear*
4. *Retaining pin*
5. *Gasket.*

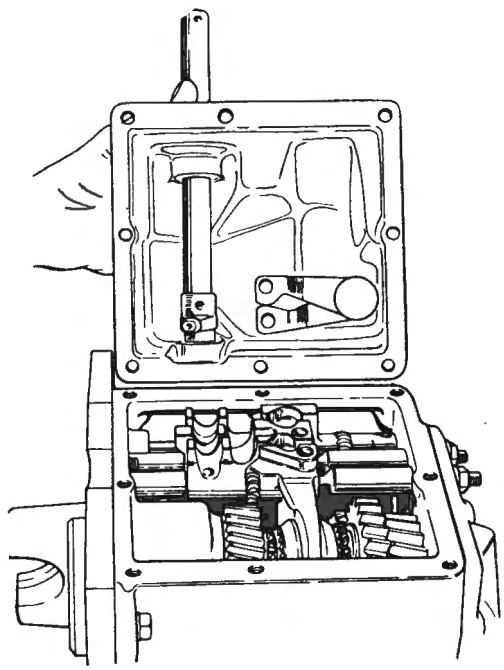


Fig. F:8 Transmission case cover removed.

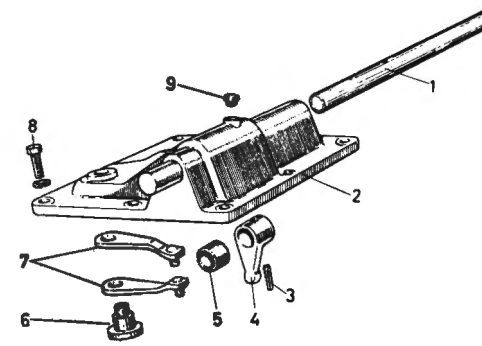


Fig. F:9
Transmission case cover and shifter mechanism.

1. *Operating shaft*
2. *Transmission case cover*
3. *Retaining pins*
4. *Shifter levers*
5. *Lock lever shaft*
6. *Lock lever*
7. *Screw, cover to case*
8. *Plug.*

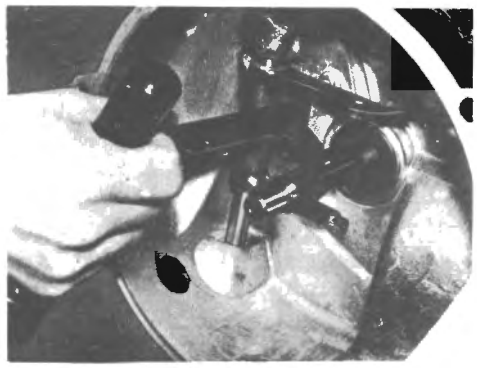


Fig. F:10 Removing the clutch shaft seal.

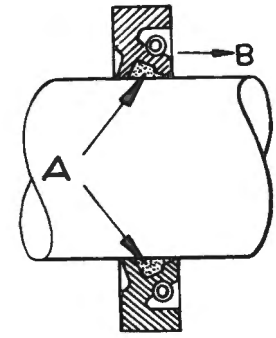


Fig. F:11 Clutch shaft seal with double sealing lips.
A. The space between the lips to be filled with chassis grease.
B. This side to face inwards towards the transmission case.

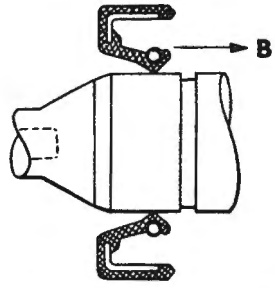


Fig. F:12 Clutch shaft seal with single sealing lip
B. This side to face inwards towards the transmission case

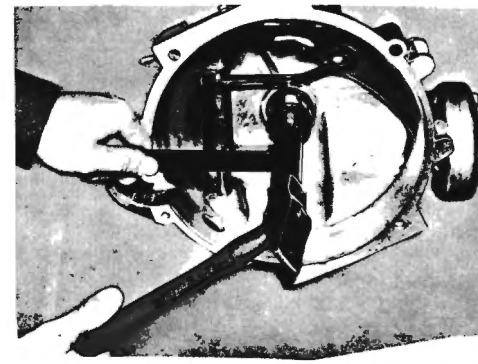


Fig. F:13 Installing the clutch shaft seal

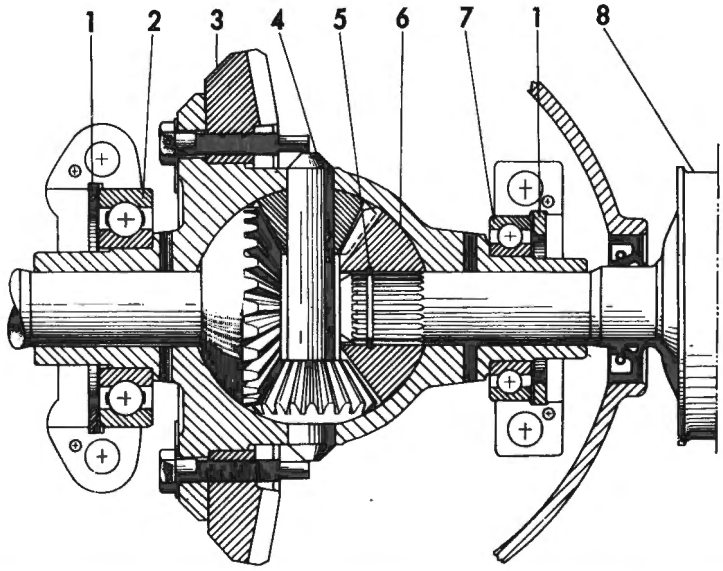


Fig. F:14
Differential unit and inner drive shaft

1. *Spacer*
2. *Ball bearing*
3. *Crown wheel*
4. *Differential shaft*
5. *Lock ring*
6. *Differential side gear*
7. *Ball bearing*
8. *Inner drive shaft.*

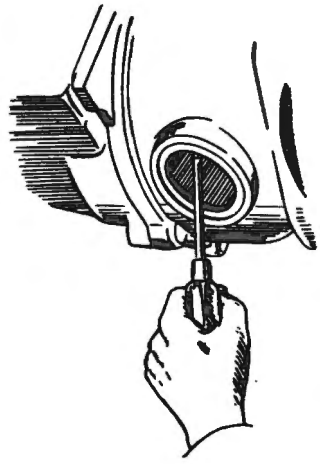


Fig. F:15 Removing the inner drive shaft oil seal.

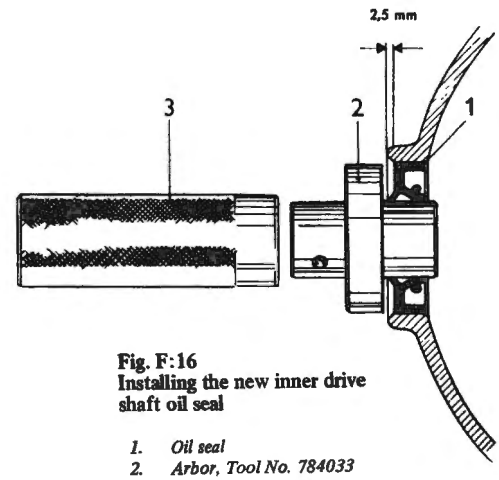


Fig. F:16
Installing the new inner drive shaft oil seal

1. *Oil seal*
2. *Arbor, Tool No. 784033*
3. *Handle, Tool No. 784030.*

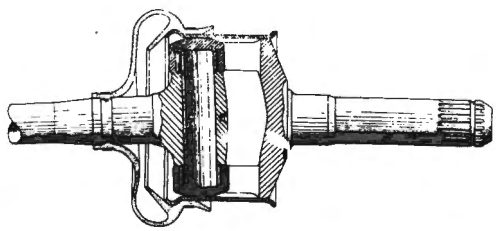


Fig. F:17 Inner universal joint

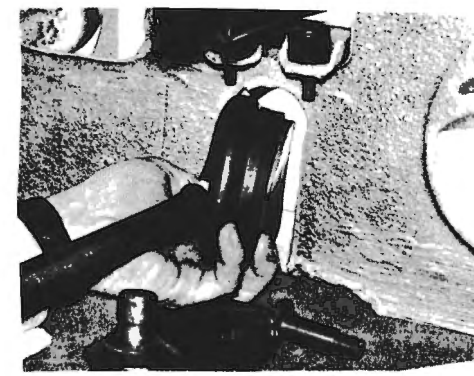


Fig. F:18 Removing/installing the drive shaft

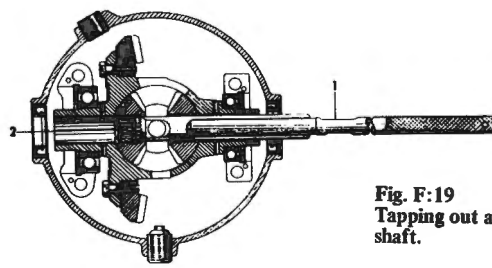


Fig. F:19
Tapping out a broken inner drive shaft.

1. *Arbor, Tool No. 784142.*
2. *Inner drive shaft.*

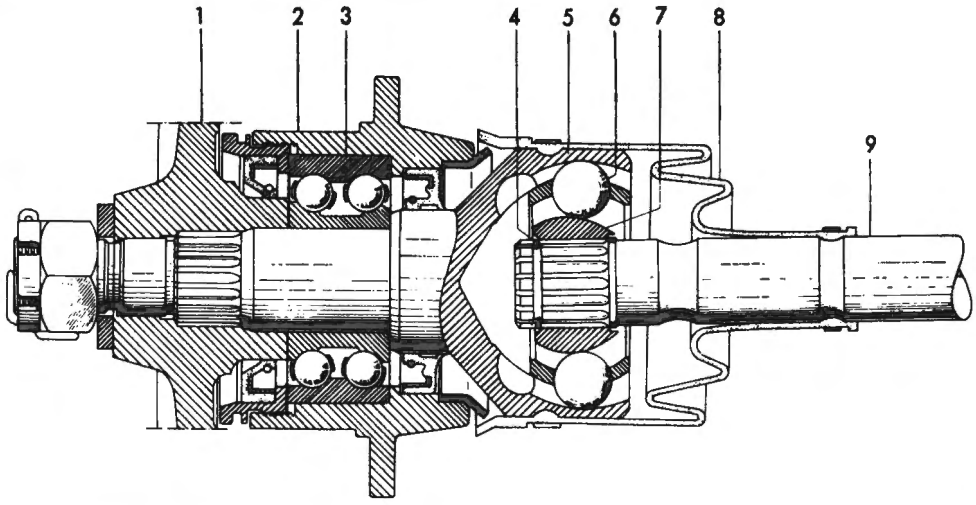


Fig. F:20.
Outer universal joint.

1. *Wheel hub*
2. *Steering knuckle housing*
3. *Ball bearing*
4. *Lock ring*
5. *Outer drive shaft*
6. *Joint balls*
7. *Hub.*
8. *Rubber bellows.*
9. *Connecting drive shaft.*

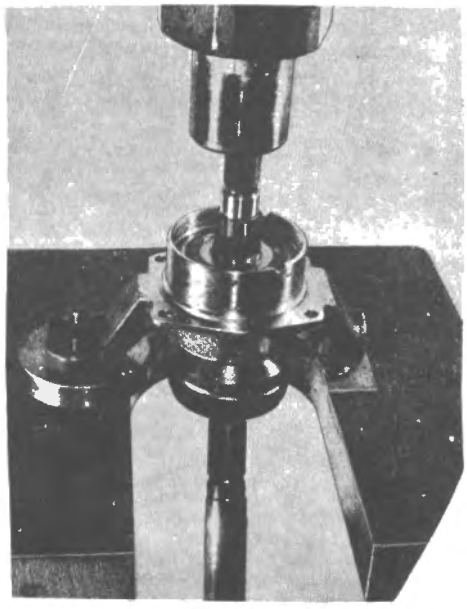


Fig. F:21 Pressing out the outer drive shaft

Fig. F:23 Installing the ball bearing in the steering knuckle

Fig. F:22 Removing the outer universal joint from the drive shaft

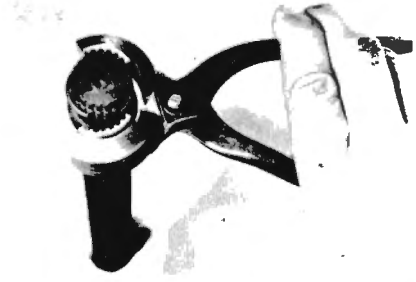


Fig. F:24 Installing the lock ring using tool No. 784161

Fig.F:25 Installing the connecting drive shaft in the outer universal joint.

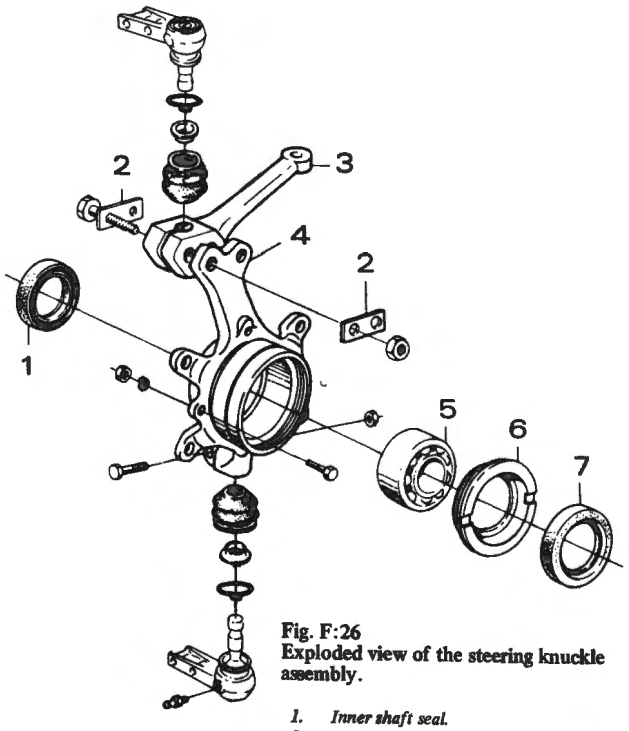


Fig. F:26
Exploded view of the steering knuckle assembly.

1. *Inner shaft seal.*
2. *Lock plates.*
3. *Steering arm.*
4. *Steering knuckle housing.*
5. *Ball bearing.*
6. *Nut.*
7. *Outer shaft seal.*

Fig. F:27 Releasing the rear engine mounting centre bolt.

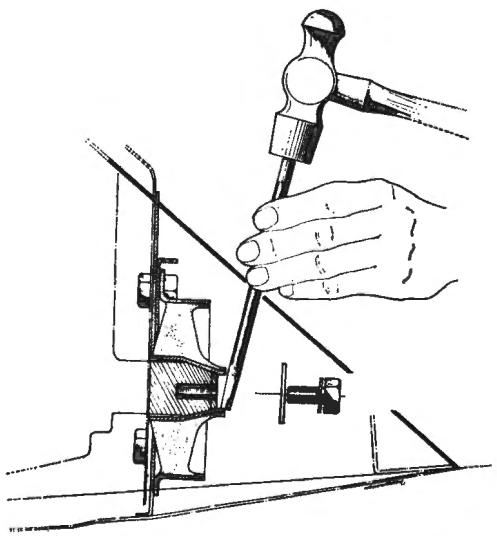


Fig. F:28 Tapping loose the rear engine mounting.

Ensure that the seal is fitted the correct way round. Refit the clutch release bearing and install the engine in the car.

INNER UNIVERSAL JOINTS – Disassembly and Assembly :

The connecting drive shaft forms part of the inner universal joint, the end of the shaft being T-shaped, and is carried in the joint housing in needle bearings (Fig. F:17). The inner drive shaft is retained by a spring lock ring at its inner end which engages a groove in the differential side gear (Fig. F:14).

NOTE :– As from transmission No. F 68929 a new differential casing, differential side gears, spring lock rings and inner drive shafts have been introduced. The new drive shafts are of increased diameter and have a greater number of lands on the splines. All the components mentioned previously have been modified accordingly and are thus not interchangeable with former parts.

Jack up the front of the car, fit safety stands and remove the relevant road wheel. Remove the larger of the two clamps from around the rubber boot at the inner universal joint. Unscrew the two retaining bolts and detach the steering arm and upper control arm ball joint from the steering knuckle. Open up the inner universal joint and fit protective cover, Tool No. 731762, in the rubber boot to stop the needle bearings falling out and the ingress of dirt. Fit cover, Tool No. 783846, on the inner drive shaft. Remove the inner drive shaft by tapping it out of the transmission case using a suitable arbor positioned behind the joint flange.

NOTE :– If the rubber boots at either the inner or outer universal joint needs replacing the middle and outer drive shafts must be removed and the middle shaft separated from the outer universal joint as described later in this section. The rubber boots can then be removed from the shaft.

The drive shaft oil seal can be easily replaced at this time if required. Prise the sealing ring out of the transmission case using a screwdriver or similar tool (Fig. F:15). Ensure that the seal is fitted the correct way round, with the spring to the inside of the transmission casing. Install the seal with the aid of arbors, Tools Nos. 784033 & 784030. When installed, the seal should be 0.1 in (2.5 mm) inside the casing bore to ensure sufficient clearance (Fig. F:16).

Ensure that the joint housing is clean, and then fill the needle bearing grooves with 3.5 oz. (100 gr) of SAAB special grease. The quantity will be correct if the grooves are filled first, then roughly as much again is inserted in the bottom of the housing. Fill the space between the lips of the oil seal with chassis grease and install the inner drive shaft into the transmission, taking care to avoid damaging the seal with the shaft splines. Check that the lock ring engages correctly in the differential side gear. Apply grease to the needle bearings and fit them to the shaft journals. Remove the protective cover from the rubber boot and install the shaft and needle bearings in the joint housing. Refit the rubber boot and secure with the clamp.

The remainder of the installation is the reverse of the removal procedure.

NOTE :– If the inner drive shaft has broken inside the transmission case it can be extracted without dismantling the transmission by the use of driving arbor, Tool No. 78412. First tap out the broken off portion of the shaft from the opposite side of the transmission with the short part of the tool. Reverse the tool and completely remove the broken part of the shaft with the forked part of the tool (Fig. F:19).

OUTER UNIVERSAL JOINT – Disassembly and Assembly :

Jack up the front of the car, fit safety stands and remove the relevant road wheel. Remove the brake calliper, disc and splash shield. Unbolt the steering arm and upper control arm ball joint from the steering knucke. Release the clamp bolt and detach the lower control arm ball joint from the steering knuckle. Remove the larger of the two clamps from around the rubber boot at the inner universal joint. Open up the inner universal joint and fit the protective cover, Tool No. 731762, in the rubber boot to stop the needle bearings falling out and to prevent the ingress of dirt. Fit the cover, Tool No. 783846, on the inner drive shaft. Pull the drive shaft out through the wheel arch panel (Fig. F:17).

Wash the assembly thoroughly. Prise up the nut retainer and, using pegged key tool No. 784020, unscrew the nut and shaft seals from the outer bore of the steering knuckle housing (Fig. F:26). Press the drive shaft out of the steering knuckle housing (Fig. F:21). If necessary, drive the bearing out of the housing from the inside. To separate the drive shafts, secure the middle drive shaft in a vice and strike off the outer shaft with the aid of arbor, Tool No. 784165 (Fig. F:30).

The outer universal joint hub, balls and ball holder can be removed from the outer drive shaft dome by turning the hub a quarter of a turn in a certain direction, but this disassembly should only be carried out if absolutely necessary.

The outer driver, joint hub, balls and ball holders are matched and must not be interchanged. In service these are supplied only as a complete unit. Balls are, however, supplied as separate items.

All parts should be inspected and replaced if worn or damaged. Particular attention should be paid to the shaft seals and the rubber boots.

Fit the grease seal to the steering knuckle housing with the lips facing inwards. Pack the ball bearing with SAAB special grease and, using tools No. 784075 & 784030, press the bearing into the knuckle housing. The number stamped on the outer race of the bearing must face outwards (Fig. F:23). Screw the nut and shaft seal into the outer bore of the housing and secure the nut with its retainer. Fill the space between the lips of the shaft seal with chassis grease and drive in the shaft until it abutts the bearing.

Fit the outer universal joint rubber boot and clamps onto the middle drive shaft. Also fit the rubber boot and small clamp for the inner universal joint onto the shaft. Fill the dome of the outer universal joint with SAAB special grease. Fit a new spring lock ring on the end of the middle drive shaft and compress it using pliers, Tool No. 784161 (Fig. F:24). The ring must be positioned with its ends under one of the jaws of the pliers during this operation. Insert the shaft into the joint hub and tap the end of the shaft lightly so that the lock ring enters into the bore of the hub (Fig. F:25). Remove the pliers and slide the shaft fully into the hub so that the lock ring engages the groove.

Reassemble the inner universal joint as described previously in "INNER UNIVERSAL JOINTS – Disassembly and Assembly ". The remainder of the reassembly is the reverse of the dismantling procedure.

Technical Data

Type	4 forward speeds & reverse
Gear ratios – overall	
1st gear	17.0 : 1
2nd gear	10.2 : 1
3rd gear	6.3 : 1
top gear	4.1 : 1
reverse	15.5 : 1
final drive	4.88 : 1

Road speed at 1.000 rev/min.

	Saab 95	Saab 96	Monte Carlo
Tyre size	5,60 x 15	5.20 x 15	155 x 15
1st gear	4.2 mph (6.8 km/h)	4.2 mph (6.8 km/h)	4.2 mph 6.7 km/h)
2nd gear	7.1 mph (11.4 km/h)	7.0 mph (11.2 km/h)	6,9 mph (11.1 km/h)
3rd gear	11.5 mph (18.5 km/h)	11.3 mph (18.2 km/h)	11.2 mph (18.0 km/h)
top gear	17.7 mph (28.4 km/h)	17.2 mph (27.8 km/h)	17.1 mph (27.6 km/h)
reverse	4.7 mph (7.5 km/h)	4.7 mph (7.4 km/h)	4.5 mph (7.3 km/h)

Lubricant capacity	2.5 imp.pts (1.4 US qts; 1.4 litres)
Recommended lubricant	SAE 80 EP gear oil

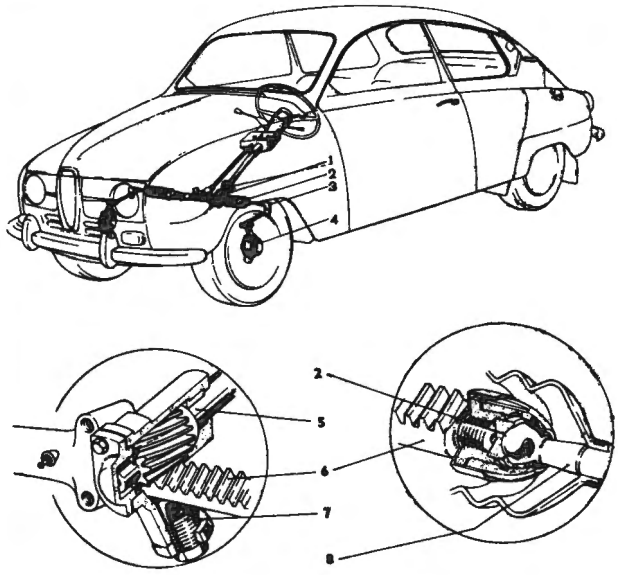


Fig. G:1
General view of the steering mechanism.

1. *Steering gear*
2. *Track rod inner ball joint*
3. *Track rod outer ball joint*
4. *Steering knuckle and steering arm*
5. *Pinion shaft*
6. *Rack*
7. *Rack adjustment nut*
8. *Track rod.*

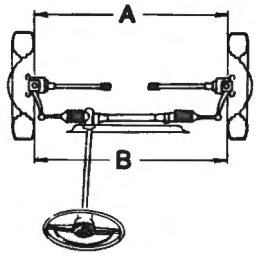


Fig. G:3 Checking the toe-in adjustment

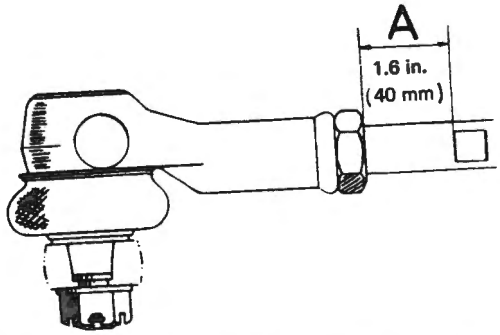


Fig. G:5 Track rod end setting (type with key flats)

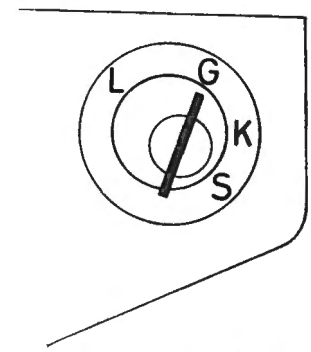


Fig. G:2 Ignition / Gear shift lock positions

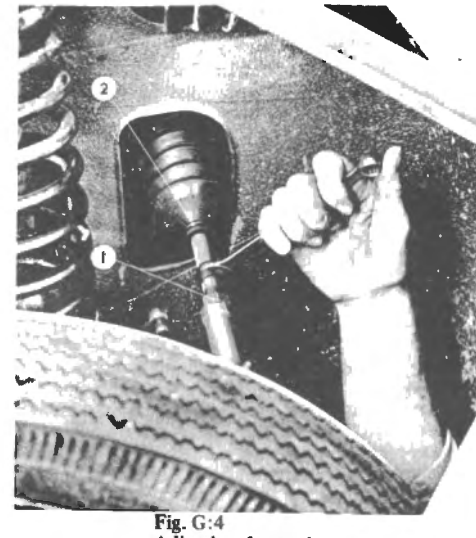


Fig. G:4
Adjusting the toe-in

1. *Track rod locknut*
2. *Bellows clamp*

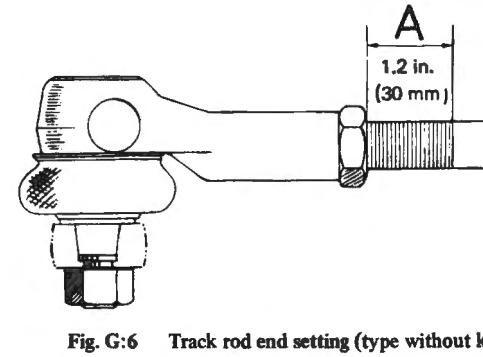


Fig. G:6 Track rod end setting (type without key flats)

Steering

GENERAL

The steering gear is of the rack and pinion type (Fig. G:1). Steering wheel movement is transmitted to the steering gear pinion by a solid steering shaft through a universal joint at the base of the shaft. The steering arms, attached to the steering knuckle housings, are operated by track rods connected to the ends of the steering rack. The track rods are fitted with ball joints at either end and are adjustable.

Both right and left hand drive cars are produced, but the steering gear and steering column is similar in principle on both versions. All models are fitted with a steering column gear shift. A gear lever lock which locks the gear shift lever in the reverse position is incorporated in the ignition switch. The horn push assembly is fitted to the steering wheel on models prior to 1968. As from 1968 a safety pad is fitted to the steering wheel centre.

ROUTINE MAINTENANCE

Every 6.000 miles (10.000 km) check the condition of the rubber bellows at the steering gear. Grease the steering gear using SAAB special grease. The steering should be turned to full right lock on RHD cars and full left lock on LHD cars during this operation. Check the rubber dust covers on the track rod ends and the steering knuckle upper and lower ball joints. Grease all six joints.

Every 12.000 miles (20.000 km) inspect the track rod ends for wear. Check the toe-in setting at the front wheels.

IGNITION SWITCH / GEAR LEVER LOCK

A combined ignition switch/gear lever lock is fitted to all models. When reverse gear is engaged and the ignition key is removed, the gear shift lever is locked. The lock has the following positions :–

L – Locked.	The key can be removed only when reverse gear is engaged.
G – Garage	The ignition is switched off but the gear shift lever is unlocked. The ignition key cannot be removed in this position.
K – Driving	The ignition is switched on. This is the normal driving position.
S – Starting	This position has a spring return action

TOE–IN SETTING

Before measuring the toe-in, the following preparations must be made :–

1. Check the tyre pressure.
2. Check the front wheel bearings, control arm bushes, steering knuckle joints and track rod joints and adjust or replace as necessary.
3. Check the steering gear and correct defects as described later in this section.
4. Check the suspension control arms for distortion and replace as necessary. No attempt should be made to straighten them.
5. Rock the car up and down a few times on its springs to settle the suspension.

The correct toe-in setting is 0.08 in (2 mm) with a tolerance of ± 0.04 in (1 mm). Check and adjust as follows :–

1. Roll the car straight forwards on a level floor and stop it without using the brakes. It must NOT be moved backwards after this.
2. Take a reading of measurement A between the front wheel rims, level with the drive shafts (Fig. G:3). Mark the measurement points with chalk. Roll the car forward until the chalk marks are level with, but behind the drive shafts. Take a reading B. Dimension B – A will give the present toe-in setting. Any necessary adjustment is made by altering the length of the track rods.
3. Release the locking nut on the outer end of the track rod and the clamp on the steering gear rubber bellows. Twist the track rod in the appropriate direction until the correct toe-in setting is obtained (Fig. G:4). Tighten the track rod lock nut and the bellows clamp.

The bellows must be slack enough to slide on the track rod.

After adjustment of the toe-in, dimension A (Figs. G:5 & G:6) on the track rod must not exceed 1.6 in (40 mm) on the type of track rod which has key flats, and 1.2 in (30 mm) on the type of track rod without key flats. The difference in dimension A for the track rods on either side of the car must not exceed 0.08 in (2 mm).

When the toe-in setting is correct and both front wheel are lined up in the straightahead position, both track rods should be the same length. The wheel clearance at both wheel arches of full LH and RH lock should also be the same. Check that the steering wheel spokes are symmetrical when the wheels are pointing straight ahead.

TRACK ROD ENDS – Replacement

Jack up the front end of the car, fit safety stands and remove the appropriate road wheel. Extract the spilt pin and unscrew the castellated nut and washer from the ball joint stud (Fig. G:8). Separate the ball joint stud from the steering arm using Tool No. 819540 or other suitable puller (Fig. G:9). DO NOT knock out the ball joint stud as this is liable to damage it and other parts. Release the lock nut at the outer end of the track rod and unscrew the track rod end. If necessary, hold the track rod by the flats, where provided to prevent it turning.

Fit the new track rod end in the track rod but do not tighten the lock nut at this time. Connect the ball joint to the steering arm. Fit the washer and castellated nut and tighten to the recommended torque setting. Secure with a new split pin. Mount the road wheel and lower the car. Check and adjust the toe-in as described above. Tighten the track rod lock nut.

NOTE :– The ball joint on both track rod ends is protected by a rubber dust cover. If damaged so that it no longer affords an effective seal, the cover must be replaced.

STEERING GEAR – Adjustment

The numbers in brackets in this section refer to Fig. G:10, except where stated otherwise.

Three adjustment are possible at the steering gear:–

1. Pinion axial play
2. Rack radial play
3. Track rod inner ball joints

Adjustment 1 & 2 can be performed with the steering gear installed in the car but 3 necessitates the removal of the steering gear. If adjustment 3 becomes necessary, it is recommended that the opportunity be taken to check the other adjustments while the steering gear is removed from the car.

NOTE :– If the steering gear is stiff in any position after adjustment of the rack and pinion, this is probably due to stresses incurred when tightening the retaining bolts. Release the two bolts at the end furthest from the pinion and insert a spacer under the steering gear at the bolt where it does not lie flush. A spacer may already have been fitted at the works.

Pinion Axial Play :

Provided that satisfactory lubrication of the steering gear is maintained, wear will normally be very slight and adjustment under these conditions will seldom be called for. However, the occurence of noise, knocking, etc., in the steering gear indicates the advisability of examining the pinion for radial and axial play.

Excessive axial play in the pinion shaft can be corrected by the insertion of shims (7) under the pinion bearing cover plate (8).

Jack up the front of the car so that both the wheels are clear of the ground and fit safety stands. Check the end play on the pinion shaft. This should be 0.004 - 0.008 in. (0.1 - 0.2 mm). If adjustment is required slacken the lock nut (12) on the rack adjustment nut and back off the nut (11)

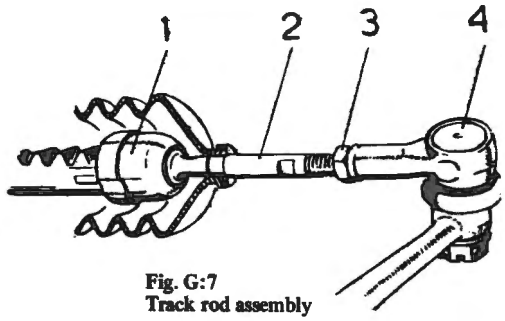


Fig. G:7
Track rod assembly

1. *Inner ball joint*
2. *Track rod*
3. *Lock nut*
4. *Track rod end.*

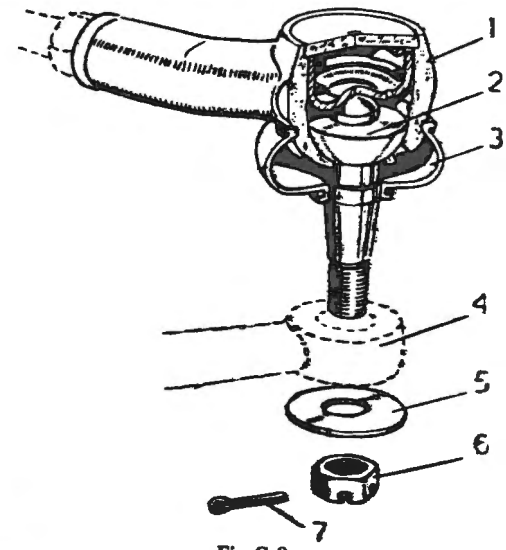


Fig. G:8
Cut-away view of the track rod end.

1. *Body*
2. *Ball joint and stud*
3. *Rubber dust seal*
4. *Steering arm*
5. *Plain washer*
6. *Castellated nut*
7. *Split pin.*

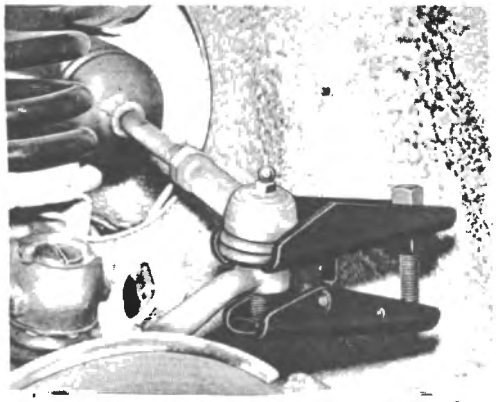


Fig. G:9 Detaching the track rod end ball stud

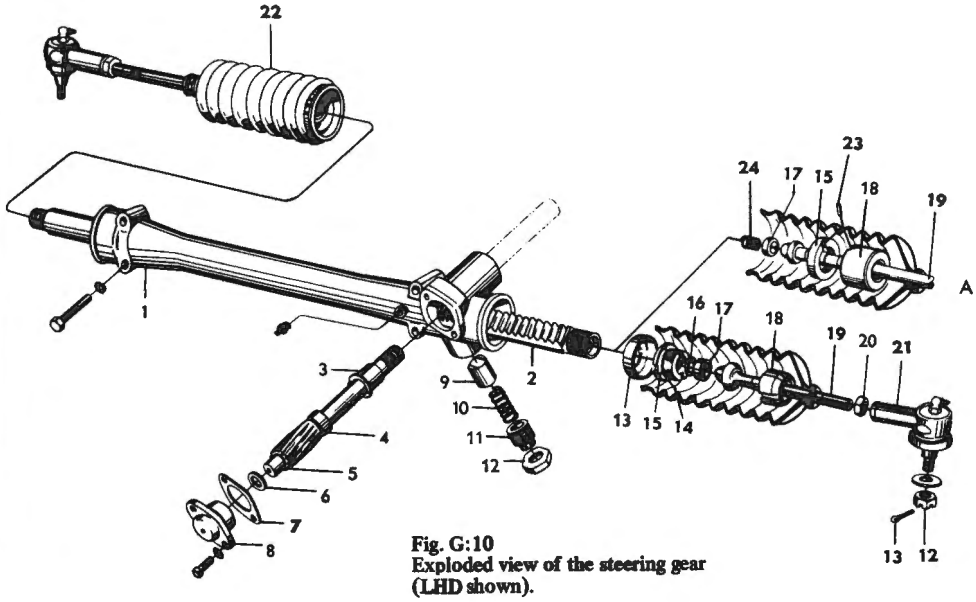


Fig. G:10
Exploded view of the steering gear (LHD shown).

1. *Housing*
2. *Rack*
3. *Pinion shaft bushing*
4. *Spacer sleeve*
5. *Pinion shaft*
6. *Plain washer*
7. *Shim*
8. *Pinion bearing and cover plate*
9. *Rack damper*
10. *Spring*
11. *Adjusting nut*
12. *Lock nut*
13. *Cupped lock washer*
14. *Shim*
15. *Rack end-nut*
16. *Spring washer*
17. *Ball inner seat*
18. *Ball outer seat*
19. *Track rod*
20. *Lock nut*
21. *Track rod end*
22. *Rubber bellows*
23. *Lock pin*
24. *Spring.*

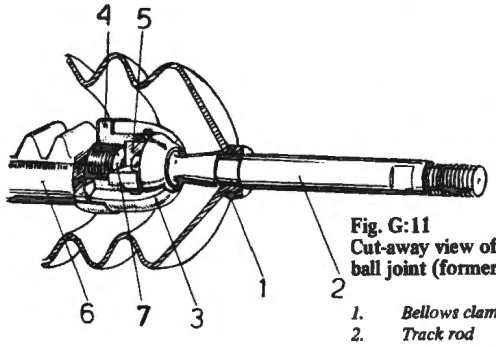


Fig. G:11
Cut-away view of the track rod inner ball joint (former type).

1. *Bellows clamp*
2. *Track rod*
3. *Ball outer seat*
4. *Rack end-nut*
5. *Ball inner seat*
6. *Rack*
7. *Spring washer.*

Fig. G:12 Removing the ball outer seat from the nut (former type joint)

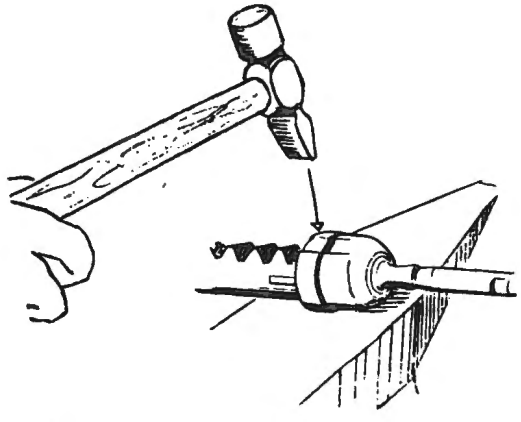


Fig. G:13 Securing the inner ball joint

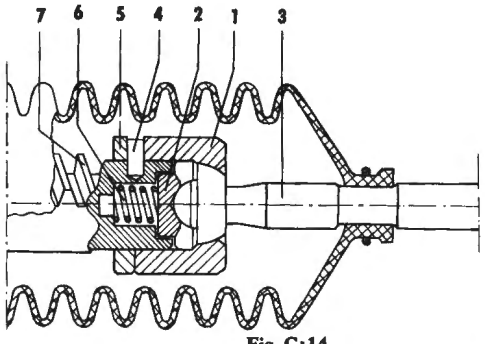


Fig. G:14
Sectioned view of the track rod inner ball joint (new type).

1. *Ball outer seat*
2. *Ball inner seat*
3. *Track rod*
4. *Lock pin*
5. *Lock nut*
6. *Spring*
7. *Rack*

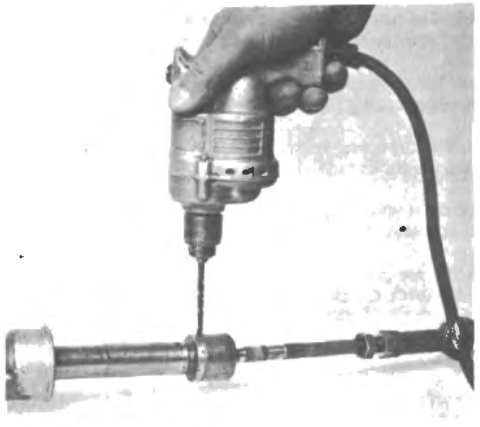


Fig. G:15 Boring out the ball joint lock pin (new type joint)

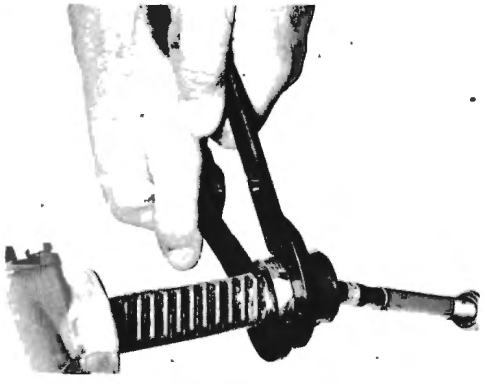


Fig. G:16 Removing the ball outer seat and locknut (new type joint)

sufficiently to release the spring tension. Unscrew the two retaining bolts and detach the pinion bearing cover plate (8), together with the shims (7) located under it. Adjust the shim thickness to bring the end float within specification. Check that the washer (6) is in position, apply a blob of SAAB special grease around the pinion stub and refit the cover plate. Ensure that the spring washers are fitted under the heads of the retaining bolts.

Check that the pinion moves freely. If the pinion is stiff, the shim thickness is too small and must be increased. Adjust the rack radial play as described below.

Rack Radial Play :

The pinion axial play must be correctly adjusted before performing the adjustment of the rack radial play. The rack radial play can be more easily adjusted with the steering gear installed in the car.

Slacken the locknut (12) on the adjustment nut (11) and screw in the nut until stiffness is felt when the rack is moved. Now back off the nut 1/8 of a turn and retighten the locknut. Turn the steering wheel to full lock in both directions and check that no stiffness of the rack exists in any position.

Track Rod Inner Ball Joints :

The inner ball joints fitted to late models are of a different disign from those used previously and a slightly different adjustment procedure is necessary.

The steering gear MUST be removed from the car before the track rod inner ball joints can be adjusted. The joints and track rods at either end of the steering gear are identical.

Former Type :

Refer to Fig. G:11 for a cut-away view of the components referred to in this section.

Release the securing clamps and detach the rubber belows from the ends of the steering gear. Pull the rack out at one side of the housing. Release the cupped lock washer and, using key Tool No. 784071, unscrew the ball joint assembly from the end of the rack. Separate the rack end nut (4) from the ball outer seat (3) and refit the nut and a new cupped lock washer to the end of the rack. Tighten the nut with Tool No. 784071 (Fig. G:19).

Place a suitable combination of shims on the nut. Insert the washer (7), with its concave side facing outwards, and the ball inner seat (5) inside the nut. Screw the ball outer seat (3) and track rod (2) onto the nut and tighten with Tool No. 784071.

If the shimming is correct the ball joint should have no play whatsoever but must not be so tight that it sticks or jams in any position. The track rod with track rod end attached should remain in any position to which it is moved without falling under its own weight. It should also be possible to move the track rod to its full limit of travel in any direction by applying light manual pressure. If the shimming is unsatisfactory the shim thickness must be adjusted as necessary.

Secure the ball outer seat in position with the lock washer (Fig. G:13). Repeat the adjustment for the ball joint at the other end of the rack. Refit the rubber bellows and secure with the clamps. The small clamp must not be so tight that the bellows moves with the track rod.

New Type :

Refer to Fig. G:14 for a sectional view of the components referred to in this section.

Release the securing clamps and detach the rubber bellows from the ends of the steering gear. Pull the rack out at one side of the housing. Drill out the lock pin securing the ball outer seat (Fig. G:15). Take every precaution to prevent the drillings from entering the steering gear. Release the lock nut and unscrew the ball outer seat from the end of the rack using Tools Nos. 784071 & 783962 (Fig. G:16). Inspect the parts and renew as necessary.

Screw the lock nut onto the end of the rack. Fill the ball outer seat with grease, fit the spring and the ball inner seat and screw the outer seat onto the rack.

The ball outer seat is correctly tightened when the ball joint has no play whatsoever but is not so tight that it sticks or jams in any position. The track rod with track rod end attached should remain in any position to which it is moved without falling under its own weight. It should also be possible to move the track rod to its full limit of travel in any direction by applying light manual pressure.

Tighten the lock nut to the ball outer seat with tools Nos. 783962 & 784071. Recheck the adjustment of the ball joint. Drill a new hole 3/16 in (4.75 mm) diameter, 0.448 in (12 mm) deep, and fit a new lock pin. Secure the pin with four centre punch marks at the edge of the hole. The new hole must be located at least 45^{O} from the key grip hole in the lock nut.

Repeat the adjustment for the ball joint at the other end of the rack. Refit the rubber bellows and secure with the clamps. The small clamp must not be so tight that the bellows moves with the track rod.

STEERING GEAR – Removal and Installation :

Disconnect the battery earth lead. Remove the retaining clips from the bonnet pivot pins, bend one of the hinge stays inwards to release it from its pivot bracket and, with the aid of an assistant, lift off the bonnet (see Fig. A:29). Jack up the front of the car so that both wheels are clear of the ground and fit safety stands. Remove both road wheels. Separate the track rod ends from the steering arm using Tool No. 784004. Slacken the locknut and unscrew the track rod end from the RH track rod (LH track rod on LHD cars).

Unscrew the nut at the lower universal joint on the gear shift shaft and drive out the tapered pin using Tool No. 784083. If the pin is threaded at both ends, remove the nut and transfer it to the other end of the pin. Tighten the nut thus loosening the pin. Separate the joint from the gear shift shaft on the transmission.

Disconnect the free wheel control at the transmission unit. Unbolt the clutch slave cylinder from the clutch housing, withdraw the push rod from the cylinder and hang the cylinder up on the heater hoses. Release the throttle return spring and attach it in some suitable way so that the throttle spindle is fully deflected. Disconnect the speedometer cable from the transmission.

Turn the steering onto full right lock (full left lock on LHD cars). Remove the clamp screw on the universal joint at the base of the steering shaft and lift the steering wheel to disconnect it from the steering gear pinion shaft. Detach the cardboard lining where the steering gear pinion shaft passes through the bulkhead. Unscrew the four bolts securing the steering gear. Remove the rubber grommet in the bulkhead. Lift the end of the steering gear forwards over the gear shift shaft on the transmission unit until the pinion shaft is clear of the bulkhead. Pass the steering gear out a little through the LH wheel arch until the RH track rod is clear of the wheel arch panel then remove it by lifting it forwards and upwards between the engine compartment stay tube and the bulkhead (Fig. G:18).

The installation procedure is the reverse of that described for the removal with special attention to the following points :–

1 Pull the LH track rod (RH track rod on LHD cars) to its furthest position before commencing the installation of the steering gear in the car.

2 Check that the speedometer cable is not trapped between the steering gear and the bulkhead before tightening the steering gear retaining bolts.

3 Set the front wheels and the steering wheel in the straight ahead position before reconnecting the steering shaft universal joint.

4 Check the toe-in of the front wheels, tighten the track rod end locknuts and then check the steering wheel for correct positioning and tighten the clamp bolt at the steering shaft universal joint.

STEERING GEAR – Overhaul :

The figures in brackets in this section refer to Fig. G:10 except where stated otherwise.

Slacken the locknut (20) and unscrew the track rod end (21) from each track rod. Release the clamps and detach the rubber bellows (22). Pull the rack out at one side of the housing.

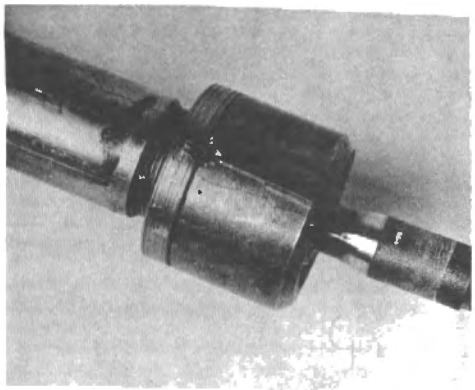


Fig. G:17 Lock pin secured with centre punches (new type joint)

Fig. G:18 Removing the steering gear

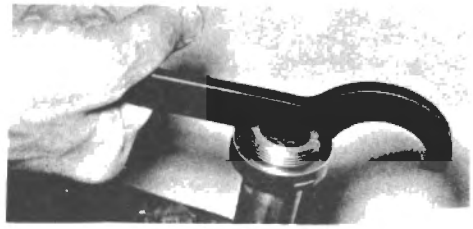


Fig. G:19 Removing/Installing the rack end-nut (former type joint)

Fig. G:20 Adjusting the gear shift twist stop

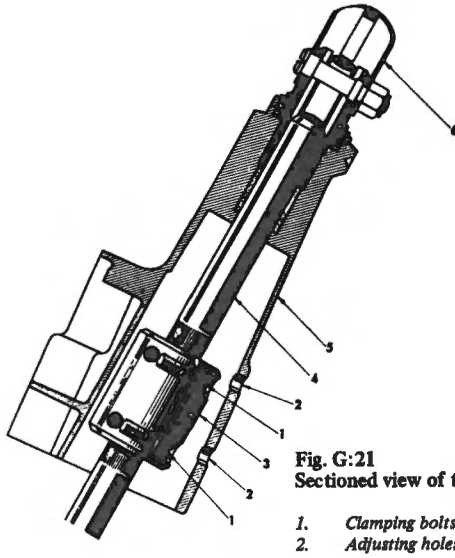


Fig. G:21
Sectioned view of the twist stop

1. *Clamping bolts (internal hexagon heads)*
2. *Adjusting holes*
3. *Twist stop*
4. *Gear shift shaft*
5. *Steering column shroud*
6. *Gear shift lever.*

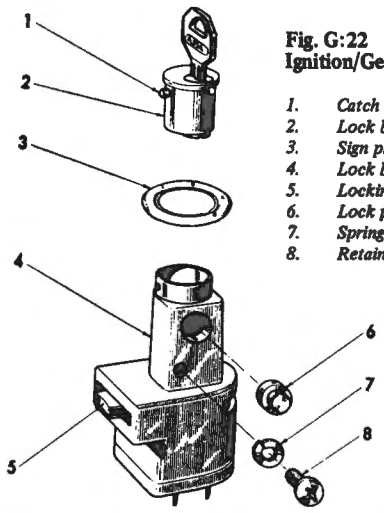


Fig. G:22
Ignition/Gear shift lock

1. *Catch pin*
2. *Lock barrel*
3. *Sign plate*
4. *Lock body*
5. *Locking tongue*
6. *Lock plug*
7. *Spring washer*
8. *Retaining screw*

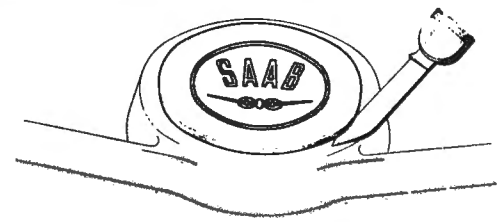


Fig. G:23 Removing the horn button

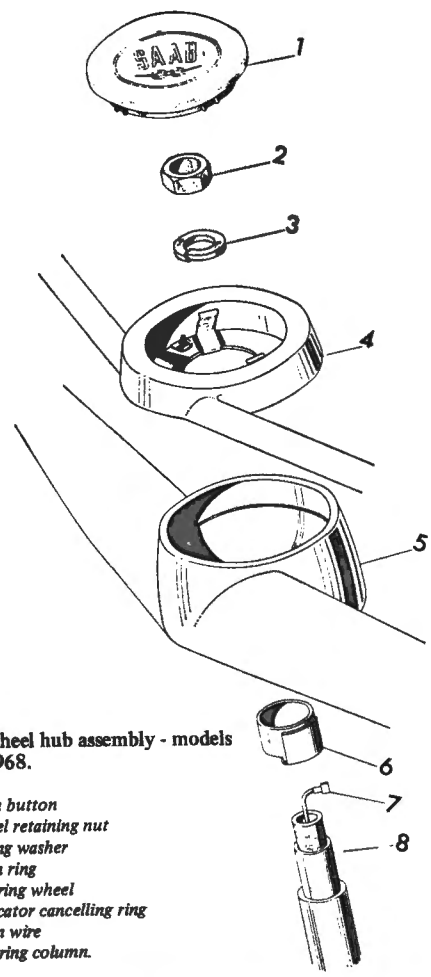


Fig. G:24
Steering wheel hub assembly - models prior to 1968.

1. *Horn button*
2. *Wheel retaining nut*
3. *Spring washer*
4. *Horn ring*
5. *Steering wheel*
6. *Indicator cancelling ring*
7. *Horn wire*
8. *Steering column.*

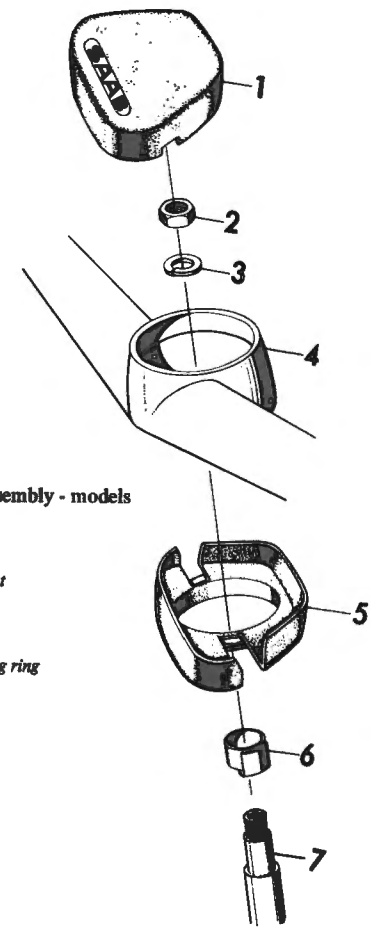


Fig. G:25
Steering wheel hub assembly - models 1968 - 69

1. *Safety pad*
2. *Wheel retaining nut*
3. *Spring washer*
4. *Steering wheel*
5. *Cover*
6. *Indicator cancelling ring*
7. *Steering column.*

Former type :

Release the cupped lock washer (13) and, using key Tool No. 784071, unscrew the ball joint assembly from the end of the rack. Separate the rack end nut (15) from the ball outer seat (18) and collect the inner ball seat (17), washer (16) and shims (14). Repeat for the ball joint at the other end of the rack.

New type :

Drill out the lock pin securing the ball outer seat (Fig. G:15). Take every precaution to prevent the drillings from entering the steering gear. Release the locknut and unscrew the ball outer seat from the end of the rack using Tools No. 784071 & 783962 (Fig. G:16). Remove the ball inner seat and spring from the rack end.

Slacken the locknut (12) on the rack adjustment nut (11) unscrew the nut and remove the spring (10) and rack damper piston (9) from the housing. Unscrew the two retaining bolts and detach the pinion bearing cover plate (8), together with the shims (7) located under it. The pinion shaft (5) can now be removed and the rack (2) withdrawn from the housing. Remove the pinion spacer (4) If the pinion shaft upper bushing (3) or the rack bushing at the opposite end of the rack from the pinion need replacing they can now be driven out. The rack bushing is secured in position by a retaining pin.

All components should be cleaned and carefully inspected. Replace any parts which are worn, damaged or in any way defective. Examine the teeth of the rack and the pinion for excessive wear. All the teeth do not get worn uniformly, and those which are in mesh when the steering is in the straight ahead position will be worn most. Moderate wear on the pinion may be corrected by refitting this item so that the teeth worn the most will be furthest away from the rack when the steering is in the straight ahead position.

Reassembly is the reverse of the dismantling procedure with special attention to the following points :—

1 The rack, pinion and all bearing points and sliding surfaces should be lubricated with SAAB special grease before reassembly.

2 The pinion space (4) must be refitted before the rack (2) is passed into the housing.

3 Adjust the pinion axial play, rack radial play, and the track rod inner ball joint as described previously under "STEERING GEAR — Adjustment".

4 Grease the steering gear using SAAB special grease. The left hand track rod (RH track rod on LHD cars) should be pulled out to its furthest position during this operation.

GEAR SHIFT MECHANISM — Adjustment :

Two adjustments of the gear shift mechanism are possible ; the gear shift position and the twist stop.

Gear Shift Positions :

To check the positionings of the gear shift mechanism, engage the gear shift lever in top gear and move it firmly, but not roughly, towards and then away from the fascia panel. The gear lever knob should move by 0.3 — 0.5 in (8 - 12 mm).

The gear shift positions are determined entirely by the adjustment of the steering column relative to the underside of the fascia panel. The steering column shroud is secured to a bracket under the fascia panel by means of two screws which are "waisted" (Fig. G:28). These screws are secured in position with roll pins but for adjustment purposes they can be slackened sufficiently without the need for removal of the pins.

Twist Stop :

The twist stop is part of the gear lever lock. It comprises a sleeve located on the gear shaft shaft and provides the engagement aperture for the lock tongue. Readjustment of the twist stop is essential whenever the gear shift mechanism has been dismantled. Adjustment should be carried out after the gear shift positions have been correctly set.

The twist stop is secured to the gear shift shaft by means of two clamping screws and one slip screw. These screws have internal hexagon heads and must be released and tightened with a 3/16 in. Allen key.

To release the twist stop, engage the gear shift lever in the first gear position and slacken the two clamping screws. Access to the screws is obtained through the two holes on the under side of the steering column shroud (Fig. G:20). Engage reverse gear and turn the ignition key to the locked (L) position. The stop screw on the twist stop can now be backed off through one of the holes. The hole to use is dependant on whether the car is fitted with a 3 speed or 4 speed transmission.

If not already engaged, engage reverse gear, push the twist stop up the gear shift shaft and turn the ignition key to the locked (L) position. Ensure that the lock tongue engages in the twist stop. The twist stop now hangs on the lock tongue. Move the twist stop up the shaft about 0.08 in. (2 mm) and tighten the stop screw LIGHTLY. Turn the ignition key to the G position, engage 1st. gear and ligntly tighten the two clamping screws on the twist stop. Engage reverse gear and slacken the stop screw. Re-engage 1st. gear again and tighten the clamping screws permanently. Finally engage reverse gear again and tighten the stop screw sufficiently to prevent it working loose.

NOTE :— On RHD cars, a spring loaded reverse catch is fitted to the gear shift shaft and must be in place when the twist stop is adjusted.

STEERING WHEEL — Removal and Installation :

On models prior to 1968 the horn push is incorporated in the steering wheel hyb as shown in Fig. 24. 1968 - 69 models are fitted with a safety pad in the centre on the steering wheel and in this case the horn is operated with the same lever as the windshield wipers beneath the steering wheel (Fig. G:25). Models from 1970 onwards incorporate the horn button in the safety pad on the steering wheel (Fig. G:26). The removal procedure varies slightly according to the type of hub used at the steering wheel.

On pre-1968 models, disconnect the horn cable at the connector under the fascia panel, pry the central button out gently with knife or other similar instrument (Fig. G:23) and disconnect the horn lead from the contact plate.

The safety pad on 1968 - 69 models is removed by unscrewing the pad anti-clockwise.

On models 1970 onwards, remove the four cross recess screws in the underside of the steering wheel spokes and detach the safety pad and horn contact.

Unscrew the steering wheel retaining nut and remove the spring lock washer. Where fitted remove the horn ring (4, Fig. G:24). Draw off the steering wheel, using a suitable puller if necessary. If required the direction indicator cancelling ring can be removed from the steering shaft.

Before commencing the installation of the steering wheel ensure that the front wheels are in the straight ahead position. If removed, refit the direction indicator cancelling ring on the steering shaft with the centre line of the ring aligned with the centre line of the switch housing. Check the clearance between the ring and the tab on the switch. This should be 0.008 - 0.024 in. (0.2 - 0.6 mm) with the switch in the neutral position. If necessary, adjust the shim thickness between the switch and the steering column shroud to obtain the correct clearance.

Fig the steering wheel with the spokes positioned symmetrically, the smaller open section between the spokes to the bottom. On early models, refit the horn ring. Refit the spring lock washer and tighten the retaining screws.

On pre-1968 models, reconnect the horn lead to the contact plate. Fit the centre button so that the three notches on the under-side of the button engage the clips in the horn ring. Reconnect the horn cable at the connector.

On 1968 - 69 models, before installing the safety pad, smear the underside of the pad with a suitable lubricant where the pad comes into contact with the cover. Fit the pad by screwing it clockwise until resistance is felt, then tighten it another full turn so that the slots on the under-side of the pad engage tightly with the spokes of the steering wheel.

On 1970 and later models, fit the safety pad and horn contact to the

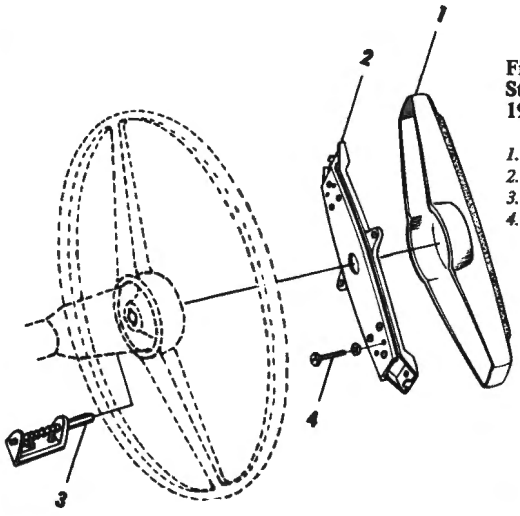


Fig. G:26
Steering wheel hub assembly - models 1970 onwards.

1. *Safety pad*
2. *Horn contact*
3. *Sliding contact*
4. *Retaining screws*

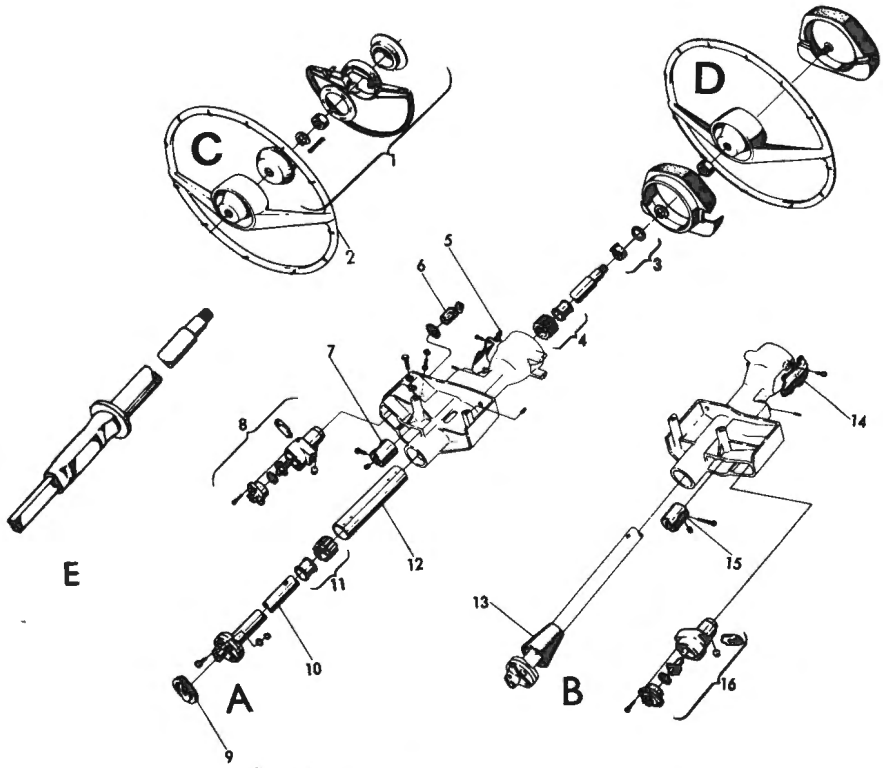


Fig. G:27
Exploded view of the steering column assembly.

A. LHD models
B. RHD models
C. Steering wheel assembly - models prior to 1968
D. Steering wheel assembly - models 1968 - 1969
E. Steering shaft - models 1969 onwards.

1. *Horn button.*
2. *Steering wheel*
3. *Washer and direction indicator cancelling ring*
4. *Column upper bushes*
5. *Cover plate*
6. *Lock barrel*
7. *Twist stop*
8. *Ignition switch/Gear lever lock*
9. *Rubber grommet*
10. *Steering shaft with universal joint*
11. *Column lower bushes*
12. *Cardboard sleeve.*
13. *Plastic cone*
14. *Cover plate*
15. *Twist stop*
16. *Ignition switch/Gear lever lock*

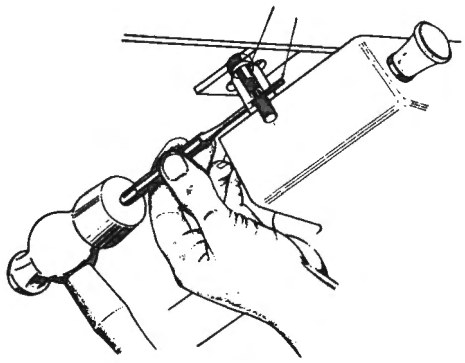


Fig. G:28 Removing the lock pins from the shroud retaining bolts

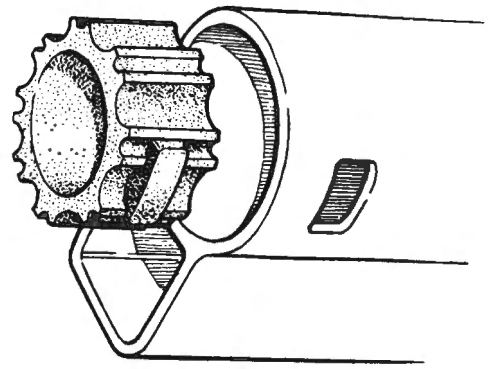


Fig. G:29 Steering column bushes

1. *Lever retaining screw*
2. *Gear shift lever*
3. *Leaf springs*
4. *Forked sleeve nut*
5. *Plain washer*
6. *Spring*
7. *Felt ring*
8. *Gear shift shaft*
9. *Bracket*
10. *Bushing*
11. *Bushing*
12. *Return spring*
13. *Tapered pin*
14. *Universal joint*
15. *Gear shift lever*
16. *Plastic ball*
17. *Spring*
18. *Turn guard*
19. *Pin*
20. *Plastic bearing*
21. *Lever housing.*
22. *Shims*
23. *Fibre washer*
24. *Chromed sleeve nut*
25. *Fibre washer*
26. *Snap ring*
27. *Plain washer*
28. *Spring*
29. *Bushing*
30. *Felt ring*

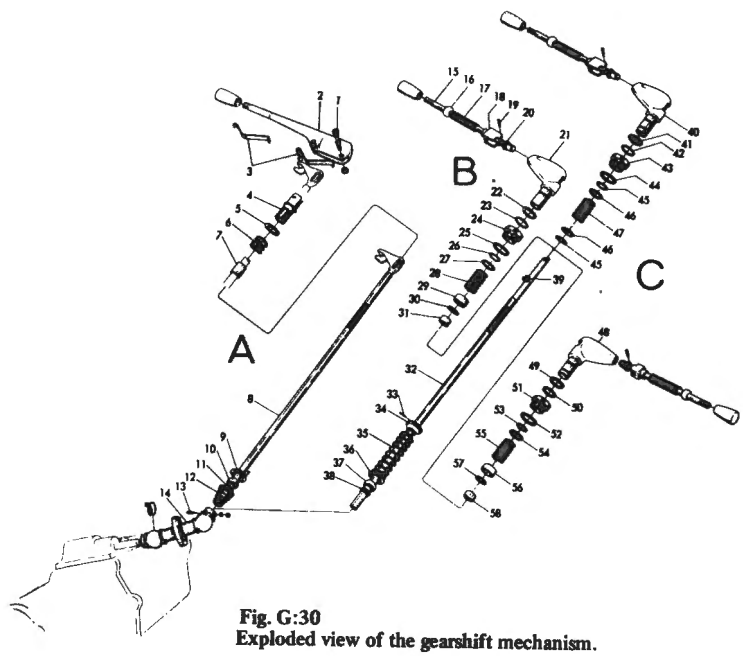


Fig. G:30
Exploded view of the gearshift mechanism.

31. *Felt ring*
32. *Gear shift shaft*
33. *Pin*
34. *Spring retainer*
35. *Spring*
36. *Bracket*
37. *Rubber bushing*
38. *Bushing*
39. *Rubber ball*
40. *Lever housing*
41. *Shim(s)*
42. *Fibre washer*
43. *Chromed sleeve nut*
44. *Fibre washer*
45. *Snap ring*
46. *Plain washer*
47. *Spring*
48. *Lever housing*
49. *Shim(s)*
50. *Fibre washer*
51. *Chromed sleeve nut*
52. *Fibre washer*
53. *Snap ring*
54. *Plain washer*
55. *Spring*
56. *Bushing*
57. *Plain washer*
58. *Felt ring.*

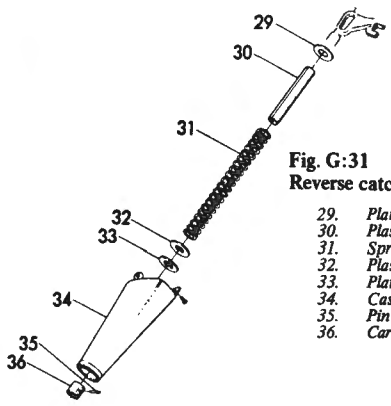


Fig. G:31
Reverse catch – RHD models.

29. Plain washer
30. Plastic sleeve
31. Spring
32. Plastic washer
33. Plain washer
34. Casing
35. Pin
36. Carrier sleeve.

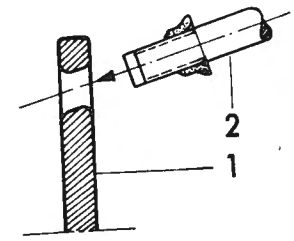


Fig. G:32
Location of the gear shift lever in the gear shift shaft.

1. Gear shift shaft
2. Gear shift lever

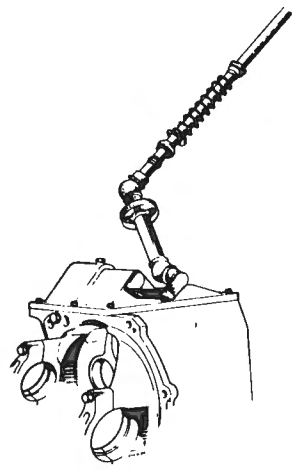


Fig. G:33 Gear shift universal joint (RHD models)

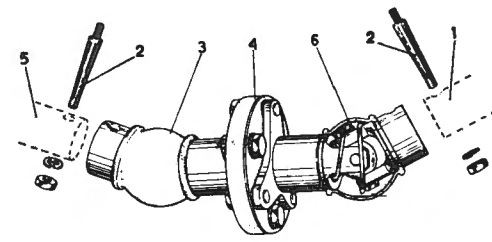


Fig. G:34
Gear shift universal joint (LHD models).

1. Gear shift rod
2. Conical pin with lock nut
3. Rubber boot
4. Rubber disc
5. Operating shaft, gearbox
6. Spring.

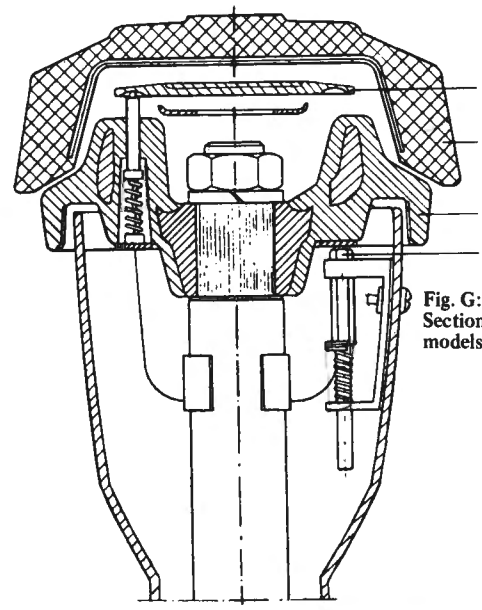


Fig. G:35
Sectional view of the direction indicator device - models 1970 onwards

1. Horn contact
2. Safety pad
3. Steering wheel
4. Sliding contact.

steering wheel and secure from the underside with the four cross recess screws.

STEERING COLUMN ASSEMBLY – Removal and Installation :

Disconnect the horn and direction indicator cables at the connectors under the fascia. Remove the steering wheel as described above. Remove the clamp screw on the universal joint at the base of the steering shaft.

Unscrew the nut at the upper universal joint on the gear shift shaft and drive out the tapered pin using Tool No. 784083. If the pin is threaded at both ends, remove the nut and transfer it to the other end of the pin. Tighten the nut thus loosening the pin. Separate the joint from the gear shift shaft and collect the return spring from above the joint if fitted.

Drive out the lock pins and unscrew the two bolts securing the steering column to the bracket at the fascia panel (Fig. G:28); The steering column assembly can now be lifted out.

Installation is the reverse of the removal procedure. Adjust the gear shift mechanism as described previously in this section before securing the waisted bolts with the lock pins.

STEERING COLUMN ASSEMBLY – Overhaul :

The steering column assembly incorporates the gear shift mechanism on all models. Overhaul of the gear shift mechanism is described later in this section under its own heading.

Once removed from the car, the steering shaft can be withdrawn from the steering column assembly (Fig. G:27). Remove the two rubber bushings together with the steering column bushings from inside the steering column tube. A cardboard sleeve is fitted between the column bushings and can now be removed. The upper rubber bushing is thinner then the lower one. Both bushings are tapered and must be fitted in the column tube with the arrow on the locating lug pointing towards the top of the column. Install the rubber bushings and the steering column bushings. The cardboard sleeve and the direction indicator switch cables must be fitted between the upper and lower bushings. RHD cars ensure that the plastic cone (13, Fig. G:27) is correctly installed on the steering shaft before installing the shaft. Pass the steering shaft into the column tube.

GEAR SHIFT MECHANISM – Overhaul :

Refer to Fig. G:30 for exploded view of the components referred to in this section.

The overhaul procedure for the gear shift mechanism differs slightly from models to model, dependant on whether the vehicle is RHD or LHD.

The gear shift lever and gear shift shaft can be removed with the steering column assembly still installed in the car. In this case the upper universal joints must first be separated from the gear shift shaft and the steering wheel removed.

Remove the direction indicator switch and cover from the steering column assembly before commencing the disassembly.

LHD Models :

Insert a suitable arbor through the square hole in the rear of the gear lever housing and press it against one edge of the turn guard. At the same time press in the gear lever and rotate it a quarter of a turn. Pull the gear shift shaft downwards so that the gear shift lever can be passed out through the square hole. Screw the knob off the end of the lever and withdraw the lever assembly. Collect the plastic bearing from the end of the lever and remove the plastic ball, spring and turn guard from the lever.

Release the lock screw and unscrew the chromed sleeve nut. The gear lever housing can now be removed from the steering column shroud. Collect the fibre washer and rubber grommet located between the gear shift shaft and the lever housing. If necessary, the chromed nut can be removed from the lever housing after extracting the snap ring from the groove in the housing. Collect the fibre washer and any shims located above the nut.

Extract the lock pin securing the return spring in position on the lower end of the shaft. The gear shift shaft can now be pulled downwards out of the steering column shroud and the washer, spring, bushing, washer and felt ring removed from the bore in the shroud. If required the clamping screws on the twist stop can be released and the twist stop removed from the shaft. In this case the spring retainer and return spring can then also be removed from the shaft.

Reassembly is the reverse of the dismantling procedure with special attention to the following points :–

1 If removed, the twist stop must be refitted on the gear shift shaft with the marking facing upwards.

2 Check the clearance between the chromed nut and the snap ring on the gear lever housing after assembly. The nut should have NO clearance and should be slightly stiff to turn. If necessary, adjust the shim thickness under the fibre washer to obtain this condition. Apply a moderate coating of SAAB special chassis grease to the fibre washer and the internal bearing surfaces of the nut.

3 Before refitting the gear lever housing in the steering column shroud, ensure that the gear shift shaft is positioned with the angled hole facing in the correct direction (Fig. G:32).

4 After assembling the gear lever, pull the gear lever outwards, align the plastic bearing on the end of the lever with the hole in the shaft and release the lever. Ensure that the bearing is correctly engaged. Press one side of the turn guard with a suitable arbor, at the same time turning the gear shift lever 1/4 of a turn ; thus locking the lever.

RHD Models :

Unscrew the nut and remove the screw securing the gear shift lever. The lever can now be removed. Release the two clamping screws and the stop screw securing the twist stop as described under "GEAR SHIFT MECHANISM – Adjustment".

A reverse catch (Fig. G:31) is incorporated and should be disassembled as follows :– Drive out the pin securing the carrier sleeve on the gear shift shaft. Using a piece of tubing about 9.85 in. (250 mm) long and 0.63 in. (16 mm) diameter, insert tubing up through the reverse catch casing at the same time as the gear shift shaft is withdrawn. The reverse catch spring will thus be retained in position and can be removed later by pulling the tubing downwards so that the upper washer can be extracted from the side. The spring must be compressed while this is being done. Release the spring carefully and collect the plastic washer, the tubing and the lower washer.

Withdraw the gear shift shaft from the steering column shroud. Unscrew the forked sleeve nut and remove the washer, spring and felt ring from the bore in the steering column shroud :

Reassembly is the reverse of the dismantling procedure with special attention to the following points :–

1 If a new felt ring is being fitted in the steering column shroud it should be lubricated with SAAB Special Chassis Grease before installation.

2 When screwing the forked sleeve nut into the steering column shroud leave about 0.04 in. (1 mm) clearance between the nut flange and the edge of the shroud.

3 Reassemble the reverse catch as follows :–
Pass the piece of tubing used on disassembly through the reverse catch casing and slide the lower washer, plastic washer and plastic sleeve over the tubing. Pass the spring onto the pipe. Compress the spring, insert the upper washer from the side to secure the spring and slide the tubing up through the washer. The complete assembly can now be secured to the steering column shroud with the retaining screws. When installing the gear shift shaft, gradually pull out the piece of tubing at the same time. Secure the carrier sleeve to the shaft with the lock pin.

4 The twist stop must be refitted on the gear shift shaft with the marking facing upwards. Hold the twist stop in position by turning the ignition key to the locked (L) position so that the lock tongue engages the recess in the twist stop.

5 When refitting the gear lever, ensure that the three leaf springs are correctly positioned.

6 Tighten the nut and bolt securing the gear lever sufficiently to eliminate all play but without impairing the free movement of the lever.

Technical Data

Steering Gear	Prior to 1969	From 1969
Type	Rack & Pinion	
Radio (Average)	14.0 :	15.5 : 1
Steering wheel travel (lock to lock)	2 1/4 turns	2.7 turns
Pinion shaft end – play	0.004 - 0.008 in(0.1 - 0.2 mm)	0.005 in (0.12 mm) max.
Rack radial clearance	0.012 in (0.3 mm) max.	0.01 in (0.25 mm) max.

Track-rod ends	
Type with key flats : Distance between flat & locknut	1.5 in (40 mm) max.
Type without key flats : Distance between end of thread & locknut	1.2 in (30 mm) max.
Max. permissible distance between LH & RH Dimension	0.08 in (2 mm)
Tightening torque, ball stud to steering arm	25 - 36 LB.FT (3.5 - 5.0 kg.m)
Toe-in at wheel rim	0.08 ± 0.04 in (2.0 ± 1.0 mm)
Toe-out on turns	22 1/2° ± 1 1/2° (inner) at 20° (outer)

Front Suspension

GENERAL

The front wheels are suspended independently by means of control arms and coil springs. The suspension assembly on each side consists of an upper and lower control arm, a steering knuckle pin, a coil suspension spring and a shock absorber (Fig. H:1).

The control arms are A-shaped, each being mounted in rubber bushes at two bearing brackets bolted to the body. Ball joints form the outer ends of the control arms, the upper ball stud being clamped to the steering knuckle housing by the steering arm. The lower ball stud is clamped in the knuckle by a single bolt (Fig. G:5).

A seat to locate the lower end of the suspension coil spring is provided on the upper control arm (Fig. H:7). The coil spring is located at its upper end on a seat in the wheel arch which also incorporates a rubber bump stop to limit suspension upward travel. Rebound travel is limited by two body mounted rubber buffers under the upper control arm. The lower control arm provides a mounting point for the telescopic shock absorber. The lower control arms on either side of the car are interconnected by means of a rubber insulated stabiliser bar (Fig. H:13).

The steering knuckle forms a bearing housing for the transmission outer drive shaft which is carried in a ball bearing. The wheel hub and brake drum or disc are splined to the outer end of the drive shaft and are retained by a castellated hub nut. The brake back plate or, in the case of models with disc front brakes, the brake calliper and splash shield are bolted to the steering knuckle.

ROUTINE MAINTENANCE

The only routine maintenance is a regular check of the tyre pressures. No definite period can be given for this procedure but it is recommended that they be checked at least weekly and before journeys of any length. The condition of the tyres should also be checked occasionally and the casing inspected for foreign bodies imbedded in the tread and cuts etc.

WHEELS & TYRES

Tyre Pressures :

The recommended inflation pressures are listed in the TECHNICAL DATA at the end of this section. The tyres should be checked and adjusted to the recommended pressures at least once a week. Check the pressures when the tyres are cold, a tyre pressure may increase by as much as 6 psi (0.4 kg/cm^3) when hot. Incorrect inflation pressure will result in abnormal tyre wear (Fig. H:2) and premature failure.

Tyre Wear :

Abnormal tyre wear can be caused by improper inflation pressures, wheel imbalance, mechanical irregularities or misaligned front suspension. When rapid or uneven tyre wear becomes apparent the fault should be saught and rectified. Some mechanical defects which could be a cause are worn wheel bearings, uneven brake adjustment, oval brake drums, distorted brake discs, excessive looseness or damage in the front suspension, loose steering connections or bent steering arms.

Tyre Rotation :

Front wheel drive causes greater wear on front tyres than on the rear ones. After considerable mileage, the tyres can be interchanged so that those which are least worn are fitted at the front. Always make sure that the tyres retain their original direction of rotation. A left front wheel should thus change places with a left rear wheel. Such interchange will ensure that all tyres will last roughly the same time.

Whenever tyres are interchanged, the inflation pressures should be re-adjusted, and if the tyres were balanced on the car they should be re-balanced.

Wheel Balancing :

Unbalance of the road wheels may cause wheel tramp, vibration in the steering or abnormal tyre wear.

To obtain the maximum ride confort and tyre life the balance of the wheels should be checked periodically. It is recommended that for an optimum result the wheels be balanced both statically and dynamically. Whenever the tyres are interchanged, the wheels should be re-balanced, if previously balanced on the car.

Since specialised knowledge and equipment are required to perform proper balancing, work of this nature should be entrusted to an authorised dealer or recognised specialist.

Wheel Alignment :

Specialised knowledge and equipment are necessary to check the alignment of the front suspension satisfactorily. Work of this nature should therefore be entrusted to an authorised dealer or recognised specialist.

A method of setting the front wheel toe-in is given in the STEERING section, but this should only be used as a temporary measure after the replacement of suspension or steering components. The toe-in should then be re-checked as soon as possible afterwards using proper equipment.

Wheel Bearings :

The front wheel bearings are located in the steering knuckle housing and also carry the transmission outer drive shafts. The bearing is of the ball bearing type. After considerable mileage, especially if lubrication has not been satisfactory; the bearings may become worn and develop play. The bearings must then be renewed.

To check the play in the bearings, jack up the front of the car so that the wheels clear the ground and fit safety stands. Grasp the road wheel at two diametrically opposite points, preferably at the top and bottom of the wheel, and rock the wheel on the drive shaft. If play at the rim exceeds 0.08 in (2 mm) the bearing must be renewed. Refer to the TRANSMISSION section for details of the replacement procedure as the steering knuckle and drive shafts must be removed to perform this operation. On reassembly, the axle shaft nut must be tightened to a torque of 1301 lb.ft (18 kg.m) and secured with a new split pin.

CONTROL ARM BALL JOINTS

Adjustment :

Slight play in the control arm ball joints can be adjusted by tightening the cap on the joint. The joint ball stud must be released from the steering knuckle housing before adjustment can be performed. The upper ball joint is secured to the knuckle by two bolts and the lower joint by one (Fig. H:5). Clean the joint and remove the rubber dust excluder. Release the flange which will have been peened over to secure the cap.

Tighten the cap using a suitable tool, until a slight resistance is felt in the ball joint. DO NOT overtighten the ball joint. It should still be possible to move the joint ball stud to the limit of its travel in any direction by applying light manual pressure. When the adjustment is completed, secure the cap by peening over the flange into the grooves on the cap on both sides. The joint cap MUST be secured effectively. Lubricate the joint copiously. Fit a new rubber dust excluder and then reconnect the joint ball stud to the steering knuckle.

Replacement :

If the ball joint has become worn or adjustment is ineffective, the joint must be replaced. No attempt should be made to dismantle the joint as the joint is serviced only as a complete assembly.

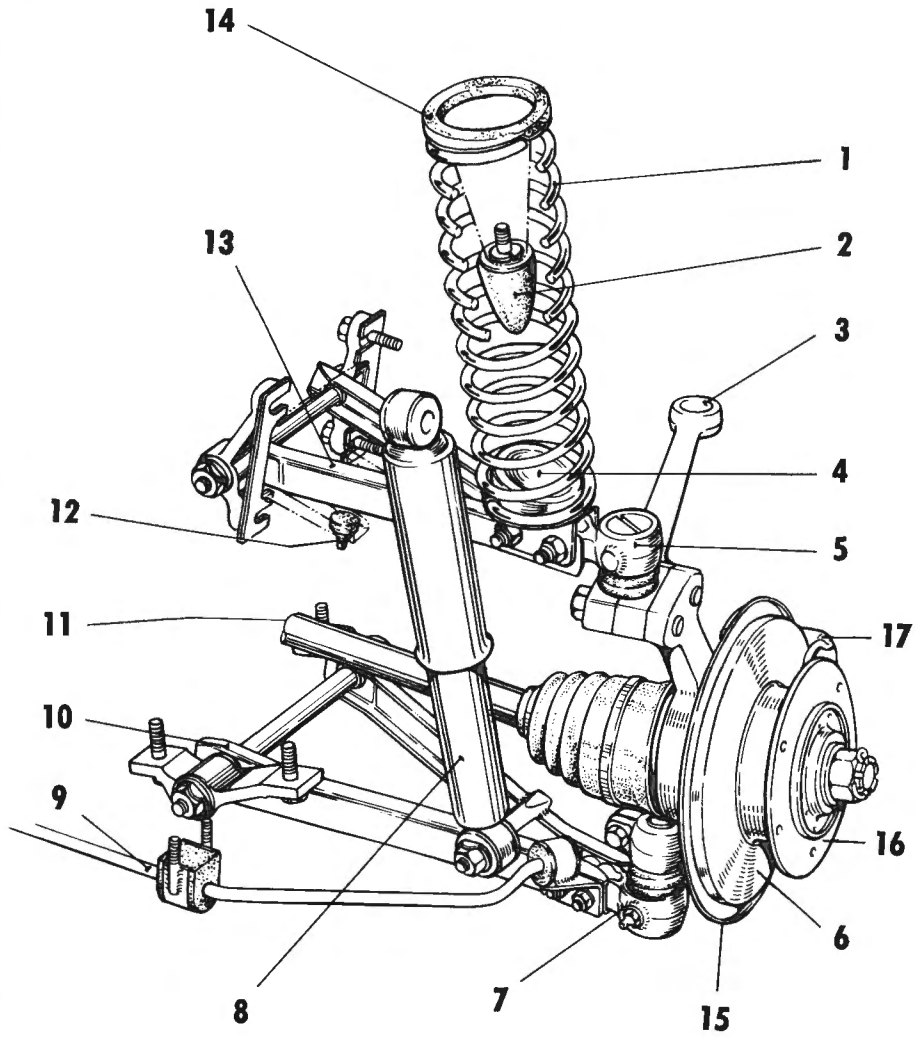


Fig. H:1
General view of the front suspension assembly (left side shown)

1. *Suspension coil spring*
2. *Rubber bump stop*
3. *Steering arm*
4. *Spring lower seat*
5. *Upper ball joint*
6. *Brake disc*
7. *Lower ball joint*
8. *Shock absorber*
9. *Stabiliser bar*
10. *Lower control arm*
11. *Connecting drive shaft*
12. *Rubber buffers*
13. *Upper control arm*
14. *Rubber insulator ring.*

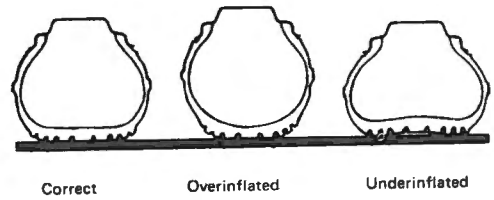


Fig. H:2 Effect of inflation pressure

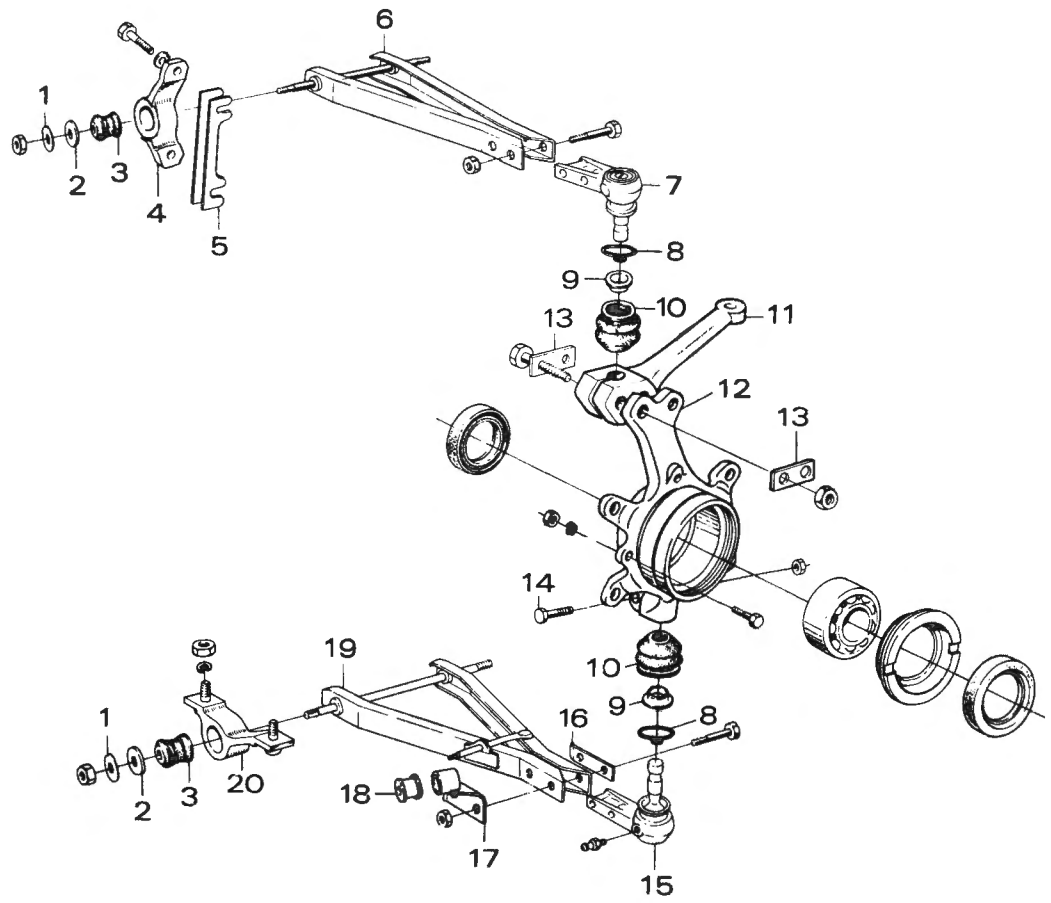


Fig. H:3
Exploded view of the front suspension assembly (left side shown)

1. *Lock washers*
2. *Plain washers*
3. *Rubber bush.*
4. *Upper arm bearing bracket*
5. *Caster/camber adjustment shims*
6. *Upper control arm*
7. *Upper ball joint assembly*
8. *Spring clip*
9. *Ring*
10. *Rubber dust cover*
11. *Steering arm*
12. *Steering knuckle housing*
13. *Lock plates*
14. *Clamp bolt, ball stud.*
15. *Lower ball joint assembly*
16. *Reinforcing plate*
17. *Stabiliser bar end mounting bracket*
18. *Rubber bush*
19. *Lower control arm*
20. *Lower arm bearing bracket*

Jack up the front of the car and fit safety stands. Remove the road wheel. If it is the upper ball joint which is to be replaced, the coil spring restrainer, Tool No. 784082, MUST be fitted to the suspension coil spring before detaching the joint from the control arm (Fig. H:6). Release the ball stud from the steering knuckle. The upper ball joint is secured to the knuckle by two bolts and the lower joint by one (Fig. H:5). Unscrew the two bolts and self-locking nuts securing the joint to the control arm and detach the joint. On the upper control arm, the coil spring lower seat is also secured by these two bolts (Fig. H:7). On the lower control arm the two bolts also secure the stabiliser bar and mounting bracket.

Fit the new joint to the control arm and reassemble the removed components. If the selflocking nuts have become worn with a resultant loss of locking effect, new nuts should be used. After reassembly is complete, release the spring restrainer tool, mount the road wheel and lower the car.

Rubber Dust Excluders :

If the rubber dust excluders on the ball joint become perished or damaged in any way so that they no longer prevent the ingress of dirt or other foreign matter, they must be replaced by new ones. Before fitting the new excluders, lubricate the joint copiously to force out all old grease and any dirt particles which may have penetrated into the joint.

SHOCK ABSORBERS

The shock absorbers are of the hydraulic type. They cannot be dismantled for overhaul and must therefore be replaced if defective. The condition of the unit can be checked by bouncing the relevant corner of the vehicle by hand and noting whether the motion is damped by the shock absorber when the hand is removed.

Replacement of the shock absorber unit is a straight forward procedure. Jack up the front of the car, fit safety stands and remove the road wheel. Remove the retaining nut, lock washer and plain washer from the upper and lower mounting pins and detach the shock absorbers (Fig. H:8). If the rubber insulating bushes are in any way defective they should be replaced by new ones. Before fitting the shock absorber to the car, bleed any air which may be present in the unit by holding it in its normal installed position and pumping it up and down for several strokes. Fit the unit immediately after this bleed procedure as air may re-enter if it is laid down again. Ensure that the rubber bushes are correctly installed. Tighten the retaining nuts securely.

SUSPENSION COIL SPRINGS

The front and rear coil springs are not interchangeable, the rear ones being shorter and softer than those at the front. In production, the springs are surface-treated to afford protection against corrosion. If the finish is damaged in any way it should be touched up before the spring is installed.

Removal :

To remove the coil spring, jack up the front of the car and fit safety stands. Remove the relevant road wheel. Unscrew the tip of the rubber bump stop by inserting Mole-grips or similar through between the coils of the spring and allow the stop to drop down inside the spring.

NOTE :– If the upper bump stop is rusted in position and cannot be unscrewed it is recommended that, to allow removal of the coil spring, the two rubber buffers (12, Fig. H:1) under the upper control arm be cut off, thereby allowing the control arm to drop downwards towards the support plate.

Detach the shock absorbers. Fit the coil spring restrainer, Tool No. 784082, to the spring and compress the spring (Fig. H:6). Unscrew the two bolts and self-locking nuts securing the ball joint and spring seat to the upper control arm and detach the spring seat. The compressed coil spring can now be removed.

Examine the rubber insulator at the spring upper seat and replace if necessary. Similarly examine the two rubber buffers under the upper control arm which form the rebound travel limit.

If the suspension spring is being exchanged, fit the removed spring in spring compressor Tool No. 784081, remove the restrainer tool and release the compressor (Fig. H:10). Compress the exchange spring and fit the restrainer tool, ensuring that it is fitted in the same position as on the previous spring. Release the compressor tool and remove the compressed new spring.

Installation :

Check that the rubber insulator and metal washer are fitted in the spring upper seat. Place the compressed spring in position against the upper seat, insert the previously removed upper bump stop in the spring and locate the spring lower seat on the lower end of the spring. Secure the spring seat and the ball joint to the control arm with the two bolts and self-locking nuts.

NOTE :– If the self-locking nuts have become worn with a resultant loss off locking effect, new nuts should be used.

Release the spring restrainer tool. Screw on the upper bump stop. Refit the shock absorber. Mount the road wheel and lower the car.

UPPER CONTROL ARMS

NOTE :– If the control arms have been subjected to severe strain in a collision or similar circumstance, they must be checked for failure or distortion. If the arms are out of true they must be exchanged.

Removal :

Jack up the front of the car, fit safety stands and remove the road wheel. Detach the shock absorber. Fit the coil spring restrainer, Tool No. 784082, to the suspension spring and compress the spring (Fig. H:6). Unscrew the two bolts and self-locking nuts securing the ball joint and spring lower seat to the control arm. Release the bolts securing the control arm bearing brackets to the body. Remove the compressed coil spring.Remove the control arm complete with bearing bracket, collecting the shims from under the brackets.

Replacing the bushes :

Release the tabs on the lock washers and unscrew the retaining nuts from both ends of the control arm pivot shaft (Fig. H:3). The brackets and rubber bushings can now be removed. Press out the bushings using Tool No. 784133. The same tool is used for installing the new bushings (Fig. H:11). Lubricate the bushings with soft soap and water before pressing them in. NEVER use oil or grease for this purpose.

Reassembly is the reversal of the dismantling procedure. When the two pivot shaft retaining nuts have been tightened and secured, the angle between the control arms and the brackets should be $70^{\circ} \pm 2^{\circ}$ (Fig. H:15).

Installation :

Place the control arm and brackets in position but do not insert the bracket bolts. Check that the rubber insulator and metal washer are fitted in the spring upper seat and that the rubber rebound buffers are in place under the control arm. Place the compressed coil spring against the spring upper seat and locate the spring lower seat on the lower end of the spring. Secure the spring seat and the ball joint to the control arm with the two bolts and self-locking nuts.

NOTE :– If the self-locking nuts have become worn with a resultant loss of locking effect, new nuts should be used.

Insert the shims in their original positions under the control arm bearing brackets and tighten the bracket bolts. Release the spring restrainer tool. Refit the shock absorber. Mount the road wheel and lower the car.

NOTE :– The wheel alignment MUST be checked after a control arm has been replaced. Refer to WHEEL ALIGNMENT earlier in this section.

LOWER CONTROL ARMS

NOTE :– If the control arms have been subjected to severe strain in a collision or similar circumstance, they must be checked carefully for failure or distortion. If the arms are out of true they must be exchanged.

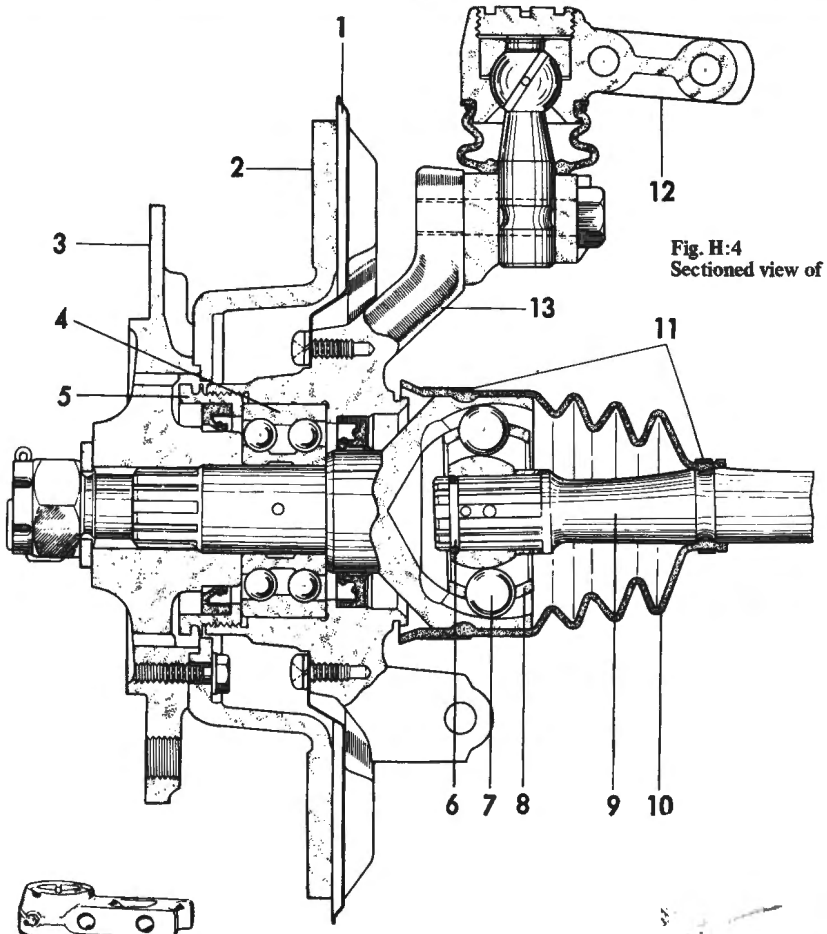


Fig. H:4
Sectioned view of the front hub assembly

1. *Brake disc splash shield*
2. *Brake disc*
3. *Wheel hub*
4. *Ball bearing*
5. *Sleeve nut*
6. *Drive shaft lock ring*
7. *Universal joint balls*
8. *Universal joint hub*
9. *Connecting drive shaft*
10. *Rubber bellows*
11. *Bellows clamps*
12. *Upper ball joint assembly*
13. *Steering knuckle housing.*

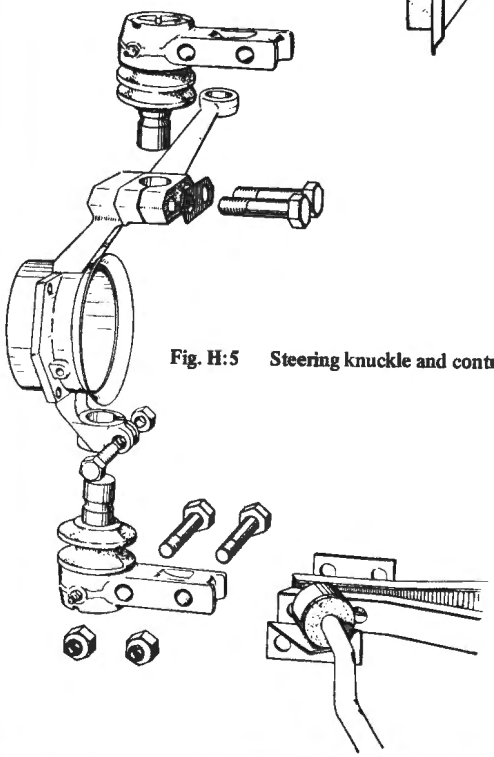


Fig. H:5 Steering knuckle and control arm ball joints

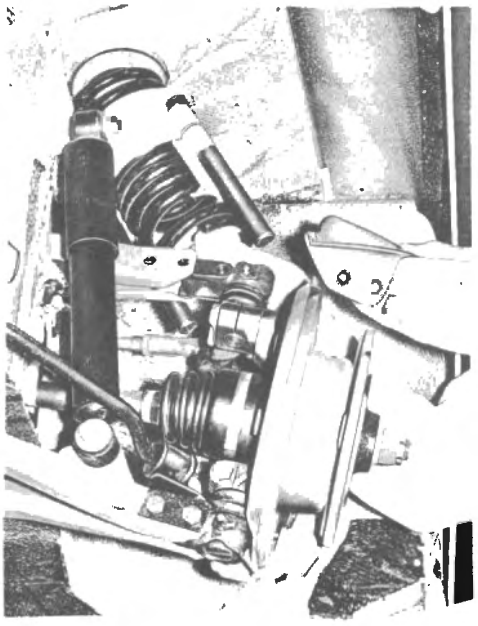


Fig. H:6 Coil spring restrainer, Tool No. 784082

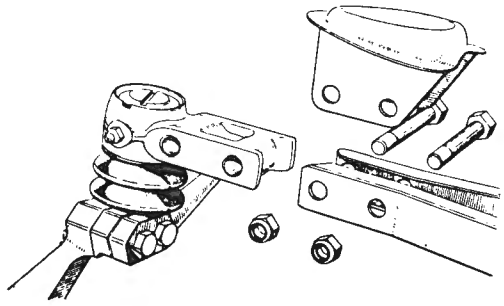


Fig. H:7 Upper ball joint and spring lower seat

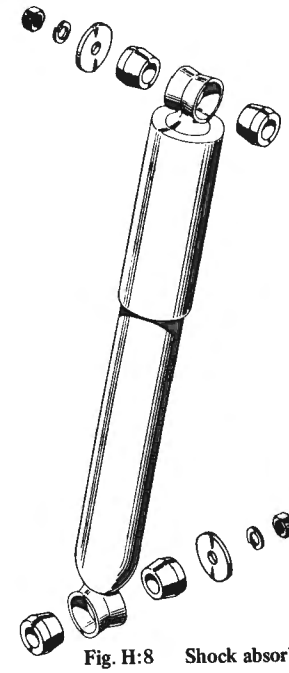


Fig. H:8 Shock absorber

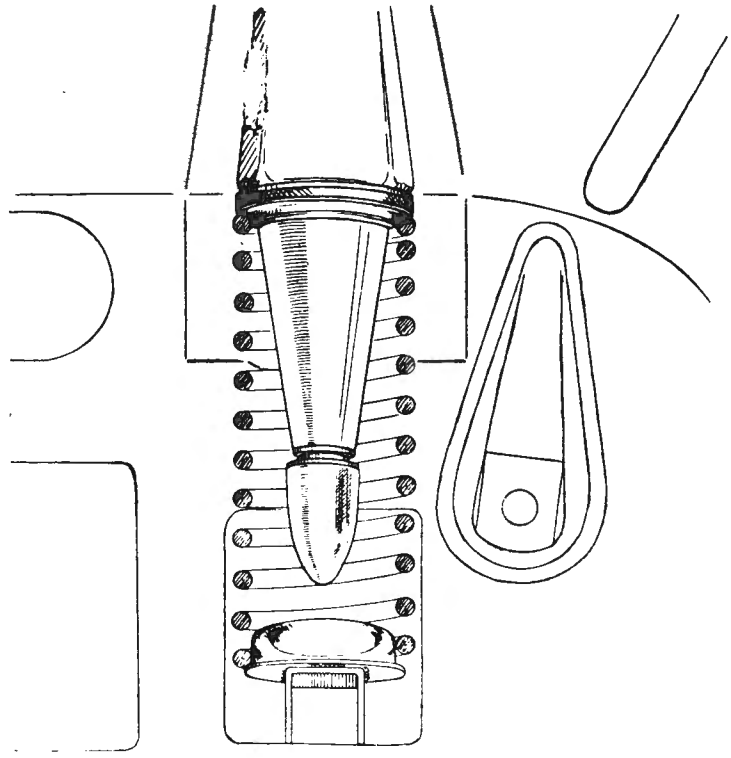


Fig. H:9 Suspension coil spring and rubber bump stop (right side shown)

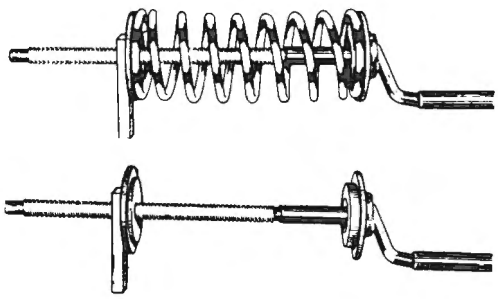


Fig. H:10 Coil spring compressor, Tool No. 784081

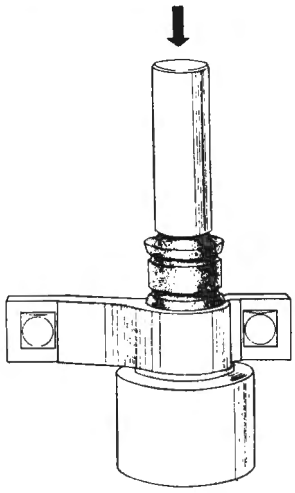


Fig. H:11 Installing a control arm bush

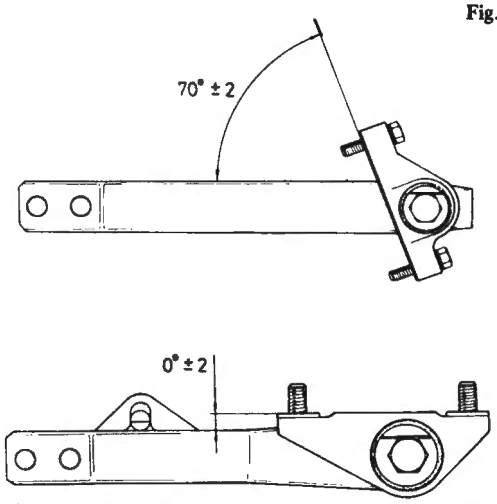


Fig. H:12 Control arm to bearing bracket angles after tightening the shaft nuts.

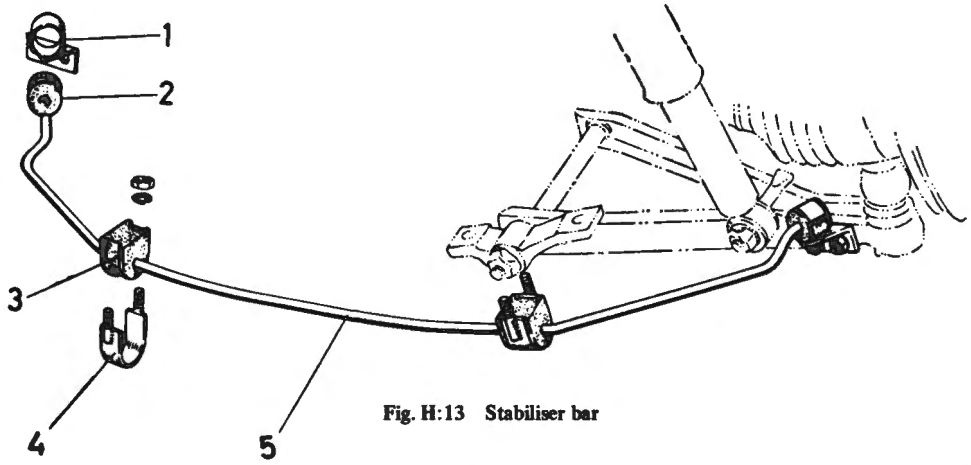


Fig. H:13 Stabiliser bar

Removal :

Jack up the front of the car and fit safety stands and remove the road wheel. Detach the shock absorber from its lower mounting point. Unscrew the two bolts and self-locking nuts securing the ball joint and stabiliser end bracket to the control arm. From inside the engine compartment, unscrew the nuts securing the control arm bearing brackets to the floor pan. The control arm complete with bearing brackets can now be removed.

Release the tabs on the lock washers and unscrew the retaining nuts from both ends of the control arm pivot shaft (Fig. H:3). The brackets and rubber bushings can now be removed. Press out the bushings using Tool No. 784134. The same tool is used for installing the new bushings (Fig. H:11). Lubricate the bushings with soft soap and water before pressing them in. NEVER use oil or grease for this purpose.

Reassembly is the reversal of the dismantling procedure. When the two pivot shaft retaining nuts have been tightened and secured, the angle between the control arm and the brackets should be $0^{o} \pm 2^{o}$ (Fig. H:12).

Installation :

Place the control arm and brackets in position and secure with the retaining nuts from inside the engine compartment. Secure the ball joint and the stabiliser bar end bracket to the control arm with the two bolts and self-locking nuts, ensuring that the reinforcing plate is fitted to the rear of the arm.

NOTE :– If the self-locking nuts have become worn with a resultant loss of locking effect, new nuts should be used.

Attach the shock absorber at its lower mounting point. Mount the road wheel and lower the car.

NOTE :– The wheel alignment MUST be checked after a control arm has been replaced. Refer to WHEEL ALIGNMENT earlier in this section.

STABILISER BAR

The stabiliser is mounted to the body under the floor of the engine compartment by two rubber insulator brackets. The ends of the bar are secured to the lower control arms by two mounting brackets, which are also rubber bushed (Fig. H:13).

Removal :

To remove the stabiliser bar, jack up the front of the car, fit safety stands and remove both road wheels. From inside the engine compartment unscrew the nuts securing the mounting brackets to the body. Unscrew the nuts securing the end brackets to the lower control arms. The bolts need not be withdrawn from the control arm and ball joint. Pass the bar out to the right-hand side.

Installation :

Pass the stabiliser bar in from the right hand side. Secure the body mounting first and then secure the end brackets to the lower control arms. Mount the road wheel and lower the car.

Replacing the Bushes

The stabiliser bar need not be removed from the car to replace the rubber bushes.

Jack up the front of the car and fit safety stands and remove both road wheels. Detach both end brackets from the lower control arms. Pull the ends of the bar down-wards and remove the two end brackets and bushings. Back off the nuts securing the body mounting brackets and detach one of the brackets from the body. Fit a new bushing to the bar and refit the bracket. Repeat this procedure for the other body mounting bracket. Secure the nuts on both body brackets. Fit new bushings in the end brackets and refit the brackets to the ends of the bar. Reconnect the end brackets to the lower control arms and secure with the bolts and self-locking nuts. Mount the road wheels and lower the car.

Technical Data

Type . . . . . Independent, with control arms & coil springs

Shock absorber	1967	From 1968
- Type	Hydraulic, telescopic, direct-acting	
- Length - closed	9.75 in (250 mm)	9.75 in (250 mm)
- extended . . .	15.375 in (390 mm)	15.375 in (390 mm)
- Stroke, fitted	3.25 in (82 mm)	3.33 in (85 mm)

Coil spring	1967	From 1968
- Length	15.4 in (391 mm)	15.9 in (405 mm)
- No. of coils	11	10.5
- Wire diameter	0.46 in (11.7 mm)	0.48 in (12.0 mm)
- Max. spring expansion . . .	5.5 in (140 mm)	5.5 in (140 mm)

Wheel alignment (No. load)

- Caster	$2^{o} \pm 1/2^{o}$
- Camber	$3/4^{o} \pm 1/4^{o}$
- "King pin" inclination	$7^{o} \pm 1^{o}$
- Toe-in at wheel rim	0.08 ± 0.04 in (2.0 ± 1.0 mm)
- Toe-out on turns	$22\ 1/2^{o} \pm 1\ 1/2^{o}$

Wheels

- Size	4J x 15"
- Depth of drop centre	1.77 in (45 mm)
- Bolt tightening torque	65 lb.ft (9 kg.m)

Wheel bolt thread

Monte Carlo, 1967	UNC 5/8 in
Monte Carlo from 1968, 95 and 96 . . .	UNC 9/16 in

Tyres

- SAAB 96 (tubeless)	5.20 x 15", 5.60 x 15" or 155 SR 15"
- SAAB 95 (tubeless)	5.60 x 15" or 155 SR 15"
- SAAB Monte Carlo (tube)	155 x 15" or 6.25 - 15 GP

Tyre pressures

	Front	Rear
SAAB 96		
Light load	24 psi (1.7 kg/cm^2)	24 psi (1.7 kg/cm^2)
Full load	27 psi (1.9 kg/cm^2)	27 psi (1.9 kg/cm^2)
SAAB 95 (Estate)		
Light load	24 psi (1.7 kg/cm^2)	24 psi (1.7 kg/cm^2)
Full load	27 psi (1.9 kg/cm^2)	30 psi (2.1 kg/cm^2)
SAAB Monte Carlo		
Light load	21 psi (1.5 kg/cm^2)	20 psi (1.4 kg/cm^2)
Full load	24 psi (1.7 kg/cm^2)	24 psi 1.7 kg/cm^2)
Fast driving (irrespective of load)	24 psi (1.7 kg/cm^2)	24 psi (1.7 kg/cm^2)

Rear Suspension

GENERAL

The rear suspension comprises a rigid axle tube located at its centre by a rubber-bushed bearing bracket and at each end by a leading link (Fig. I:1). Coil springs provide the suspension medium, the lower spring seat being bolted to the stub axle extension on the inside of the axle end plates. The upward travel of the axle is limited by a rubber bump stop incorporated in the spring upper seat. Rebound travel is restricted by stop straps. On Estate models the shock absorbers are of the arm type and are connected to the axle by links (Fig. I:2). Saloon models use telescopic type shock absorbers mounted directly to the axle at their lower end.

The stub axles for the rear hubs are a press fit in the axle end plates. The hub bearings are of the ball bearing type. The brake back plate assemblies are bolted directly to the axle end plates.

ROUTINE MAINTENANCE

On Estate models the fluid level in the arm-type hydraulic shock absorbers should be checked every 12.000 miles (20.000 km).

At the same regular intervals the shock absorbers bushes should be inspected and renewed if perished or damaged in any way.

WHEEL ALIGNMENT

The alignment of the rear wheels should not normally require adjustment. However, if the rear axle has been subjected to severe strain in a collision or similar circumstance it should be checked carefully for signs of failure or distortion and the wheel angles checked.

Specialised knowledge and equipment are necessary to check the alignment of the rear suspension satisfactorily. Work of this nature should therefore be entrusted to an authorised dealer or recognised specialist.

WHEEL BEARINGS

The rear wheel bearings are of the ball type and are a press fit in the wheel hub. Location of the bearing is effected by a lock ring adjacent to the inner bearing at outer face (Fig. I:4).

After considerable mileage, especially if lubrication has not been satisfactory, the bearings may become worn or develop play. The bearings must then be renewed.

Checking the Play :

To check the play in the bearings, jack up the rear of the car so that the wheels are clear of the ground and fit safety stands. Grasp the road wheel at two diametrically opposite points, preferably at the top and bottom of the wheel, and rock the wheel on the stub axle. If play at the rim exceeds 0.08 in (2 mm) the bearing must be renewed.

Replacing the Bearings :

Remove the dust cap, extract the split pin and unscrew the castellated hub nut. Check that the hand-brake is fully released and remove the brake drum and hub using a suitable puller (Fig. I:3). Extract the grease seal and the lock ring from the inside face of the hub and press out both bearings and the tapered spacer sleeve from the outside.

Press in the outer bearing using Tool No. 784033, until it is 0.5 in (12 mm) from the outer face of the hub (Fig. I:5). Turn the hub over and half fill the space between the bearings with SAAB special grease. Insert the spacer sleeve and press in the inner bearing using Tool No. 784032 (Fig. I:6). Refit the lock ring with the bevelled edge facing away from the bearing. Fit a new grease seal.

Refit the hub assembly, plain washer and hub nut. Tighten the nut to a torque of 65 lb.ft (9 kg.m) and secure with a new split pin. Refit the dust cover using Tool No. 784036. Mount the road wheel and lower the car.

SHOCK ABSORBERS

On Saloon models the shock absorbers are of the telescopic type whereas Estate models are fitted with lever type shock absorbers.

Testing :

The condition of the unit can be checked by bouncing the corner of the vehicle by hand and noting whether the motion is damped by the shock absorber when the hand is removed.

Replacement – Saloon :

Jack up the rear of the car, fit safety stands and remove the road wheel. Remove the lock nut, retaining nut, plain washer and rubber bushing from the upper end of the shock absorber. Remove the retaining nut, lock washer and plain washer from the mounting pin on the axle tube and detach the shock absorber (Fig. I:7).

If the rubber insulating bushes are in any way defective, they should be replaced by new ones. Before fitting the shock absorber to the car bleed any air which may be present in the unit by holding it at its normal installed position and pumping it up and down for several strokes. Fit the unit immediately after this bleeding procedure as air may re-enter if it is laid down again.

Fit the plain washer and lower rubber bushing to the mounting pin on the top of the shock absorber. Pass the pin through the hole in the body and fit the upper rubber bushing, plain washer and retaining nut. Ensure that the flange on the rubber bushing is correctly located in the body mounting hole and tighten the retaining nut. Secure with the lock nut. Attach the lower end of the shock absorber to the mounting pin on the axle tube, ensuring that the rubber bushes are correctly installed. Tighten the retaining nut securely.

Replacement – Estate :

Jack up the rear of the car, fit safety stands and remove the road wheel. Disconnect the shock absorber link from the axle tube. Unscrew the two retaining nuts and detach the shock absorber. Collect the washers and rubber bushings.

If the rubber bushings at the attachment plate mounting points require replacement, unscrew the three retaining nuts and detach the plate. Fit the new bushings and the spacer sleeves in the mounting holes and refit the plate on the three studs. Fit the plain and locking washers and secure with the three retaining nuts.

Install the shock absorber and secure with the two retaining nuts and lock washers. Attach the connecting link to the axle tube, ensuring that the bushes are correctly installed. Tighten the retaining nut securely.

COIL SPRINGS

To remove the coil spring jack up one side of the car, applying the jack under the rear end of the sill and remove the road wheel. On Estate models disconnect the shock absorber link at the axle tube. Unfasten the stop strap at its rear bracket and allow the axle to drop down. The spring can now be lifted out.

Check the condition of the rubber bump stop. If it requires replacement grip the steel washer at the thick end with a suitable pair of pliers and unscrew the stop. Ensure that the retaining washer is fitted between the stop and its seat when refitting.

Check the condition of the stop strap and replace if necessary. Fit the new one to the front bracket with 0.6 in (15 mm) of the end projecting (Fig. I:11).

Install the spring with the unground end facing downwards and turn the spring until it is correctly located in the lower seat. Refit the road wheel and lower the car. Secure the stop strap at its rear bracket leaving 0.6 in (15 mm) of the end projecting (Fig. I:11). On Estate models reconnect the

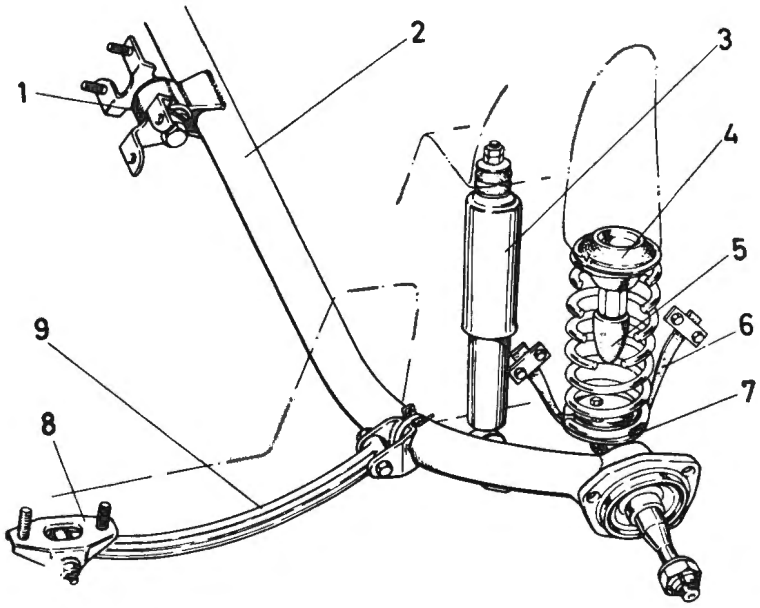


Fig. I:1
General view of the rear suspension - Saloon.

1. *Centre bearing*
2. *Axle tube*
3. *Telescopic shock absorber*
4. *Spring upper seat*
5. *Rubber bump stop*
6. *Stop strap*
7. *Spring lower seat*
8. *Link body bracket*
9. *Locating link.*

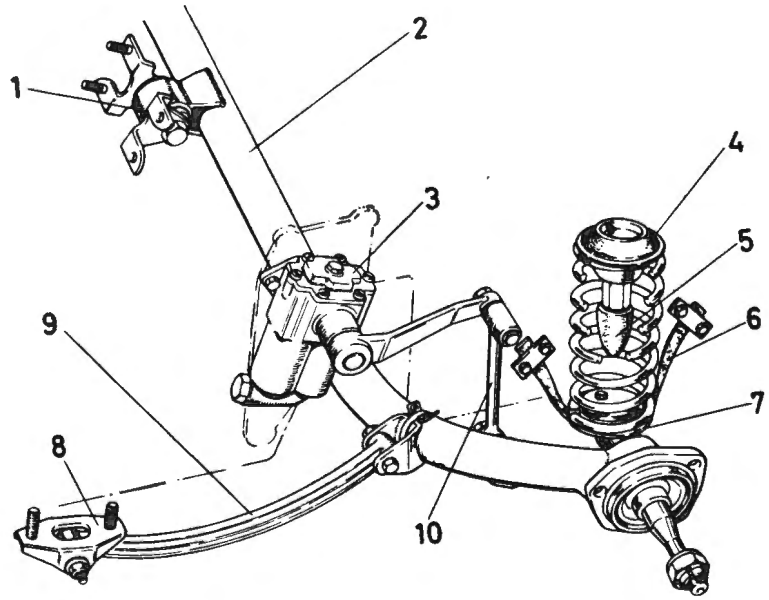


Fig. I:2
General view of the rear suspension - Estate.

1. *Centre bearing*
2. *Axle tube*
3. *Lever type shock absorber*
4. *Spring upper seat*
5. *Rubber bump stop*
6. *Stop strap*
7. *Spring lower seat*
8. *Link body bracket*
9. *Locating link*
10. *Shock absorber link.*

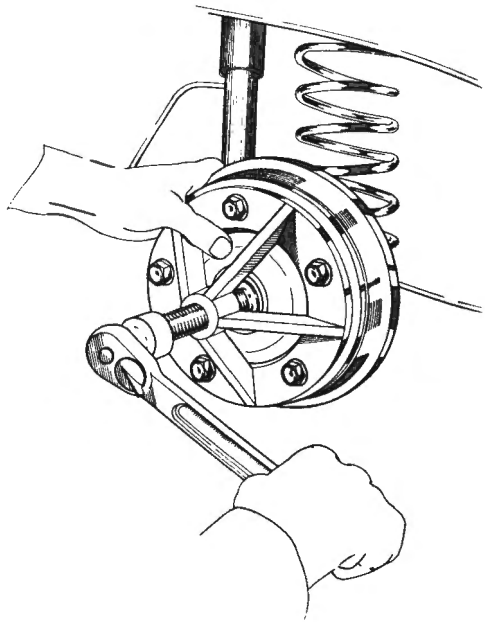


Fig. I:3 Removing the rear hub

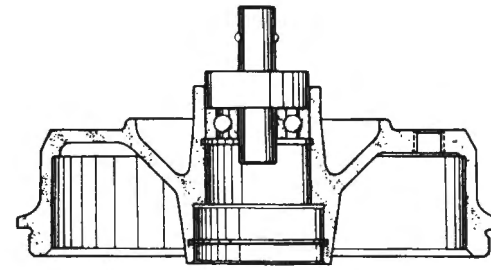


Fig. I:5 Installing the hub outer bearing

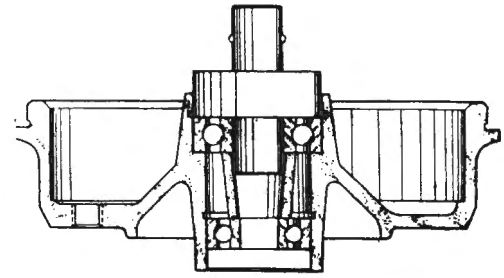


Fig. I:6 Installing the hub inner bearing

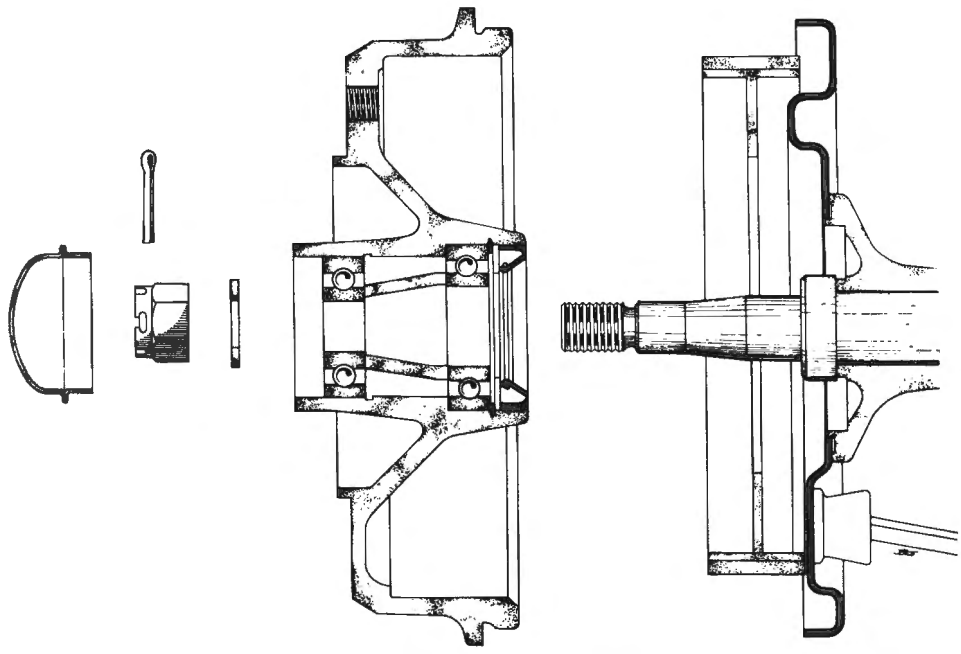
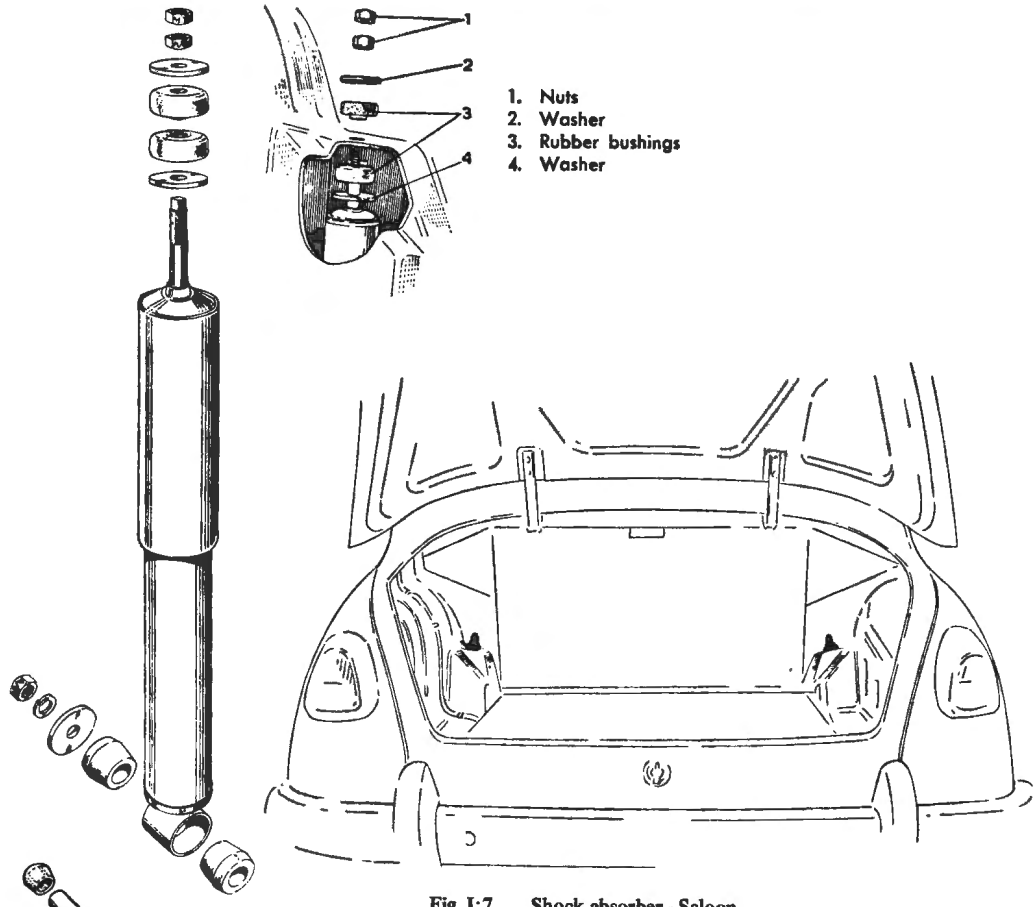


Fig. I:4 Rear hub and brake drum assembly



1. Nuts
2. Washer
3. Rubber bushings
4. Washer

Fig. I:7 Shock absorber - Saloon

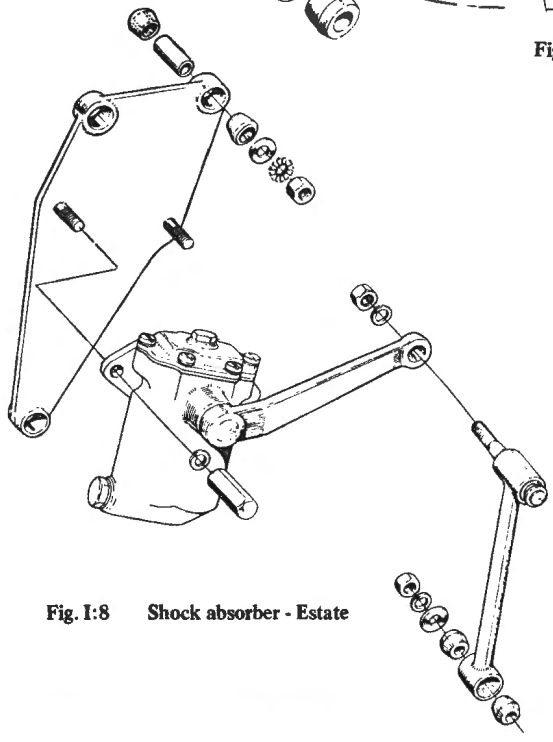


Fig. I:8 Shock absorber - Estate

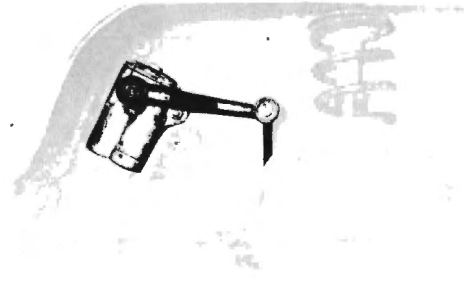


Fig. I:9 Shock absorber installation - Estate

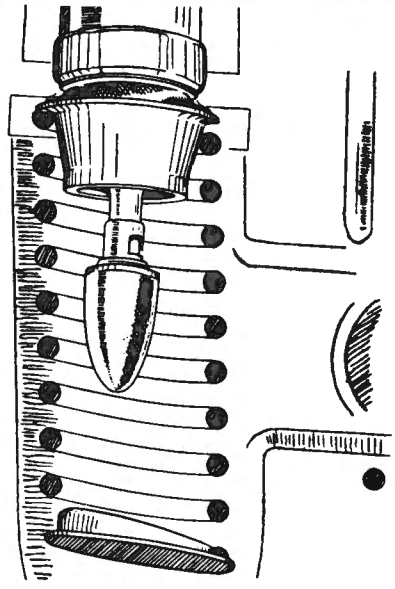


Fig. I:10 Coil spring and rubber bump stop

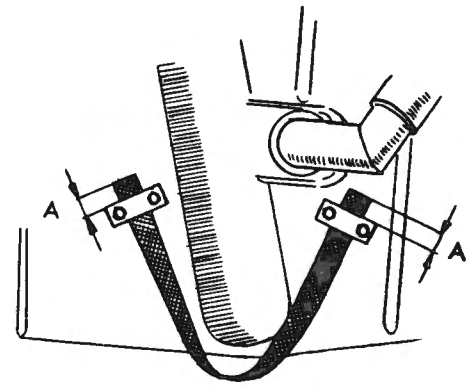


Fig. I:11 Axle stop strap fitting dimension
A = 0.6 in (15 mm)

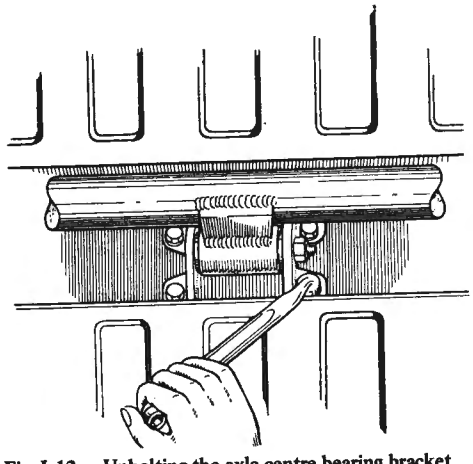


Fig. I:12 Unbolting the axle centre bearing bracket

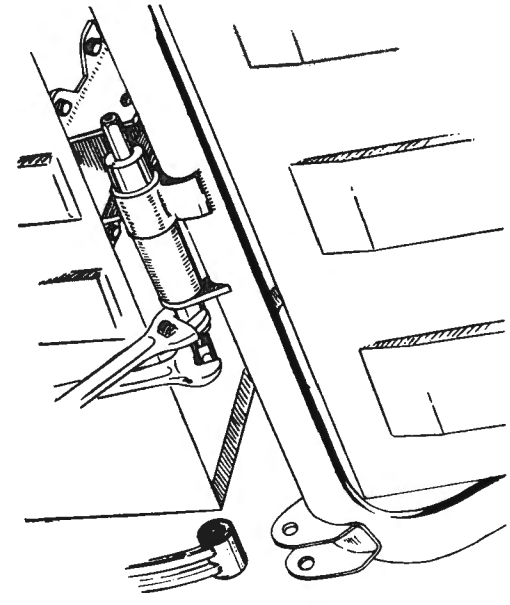


Fig. I:13 Replacing the centre bearing rubber bushing

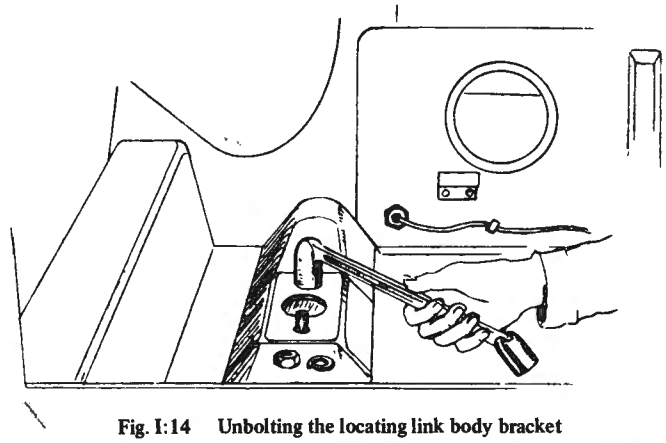


Fig. I:14 Unbolting the locating link body bracket

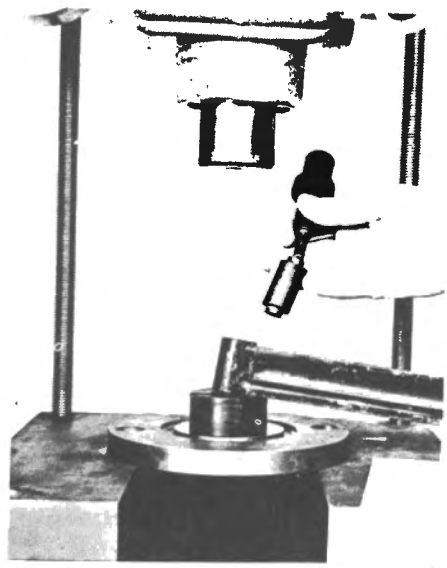


Fig. I:15 Installing the rubber bushing in the locating link

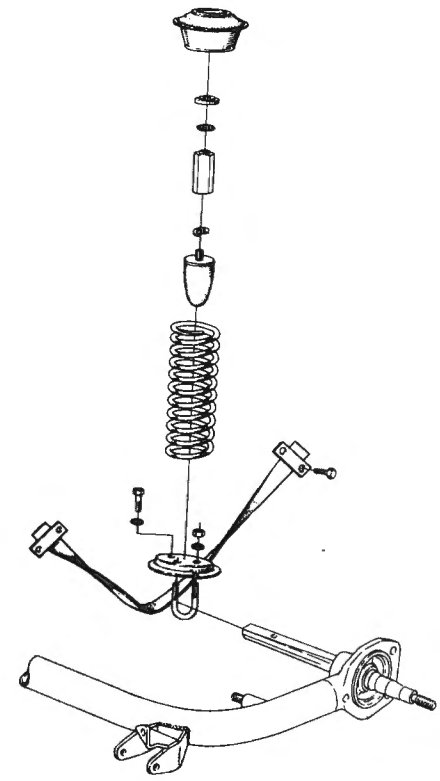


Fig. I:17 Exploded view of the coil spring assembly

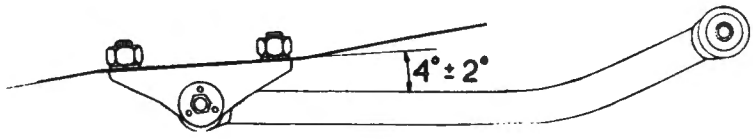


Fig. I:16 Correct angle between the locating link and body bracket

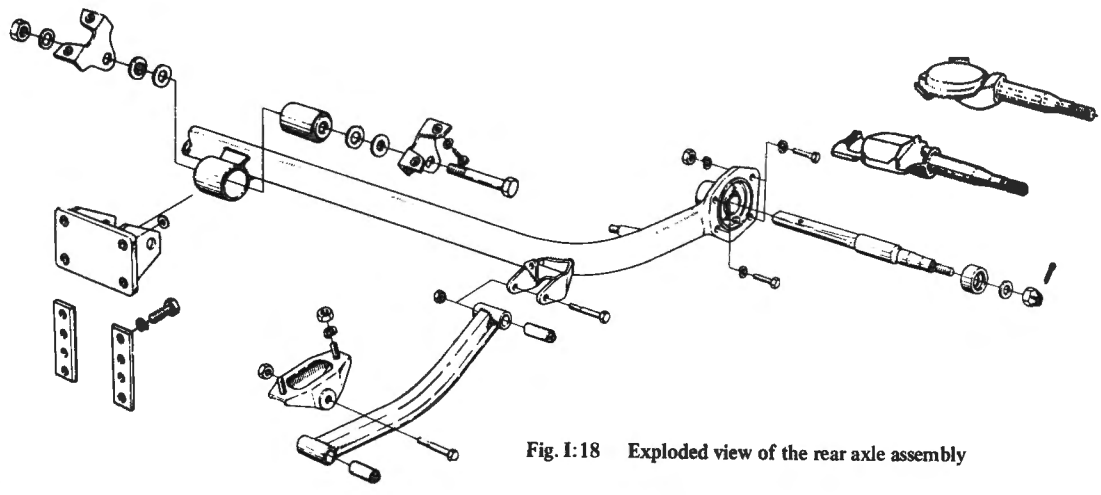


Fig. I:18 Exploded view of the rear axle assembly

shock absorber link to the axle tube.

AXLE TUBE

Replacing the Centre Bearing Bushes :

The rubber bushings in the centre bearing can be replaced either with axle tube removed from the car or while it is still in position.

To replace the bushing with the axle tube in position, detach the rear silencer and exhaust pipe from the brackets at the wheel arch and the floor pan. Unscrew the retaining nut and remove the bolt through the centre bearing. Pull the axle tube down and insert a bar on each side of the centre bearing between the axle tube and the under body to hold it down.

Remove the rubber bushing, using Tool No. 784033 (Fig. I:13). Use the same tool to install the new bushing. Remove the two support bars, raise the axle tube and fit the bolt through the centre bearing. DO NOT tighten the nut at this stage. Refit the exhaust pipe and silencer to their brackets. Lower the car. Tighten the nut on the centre bearing bolt.

Removal :

Remove the squab and back rest from the rear seat. Jack up the rear of the car, fit safety stands and remove the road wheels. Detach the rear silencer and exhaust pipe from the brackets at the wheel arch and floor pan. Disconnect the shock absorber or link at the axle tube. Unclamp the hand-brake cables from the axle tube. Detach the cable ends from the levers on the brake backplates. Disconnect the brake hoses at the body. Unfasten the stop strap at its rear bracket and allow the axle to drop down. Lift out the suspension coil springs. Unscrew the four retaining bolts securing the centre bearing to the floor pan (Fig. I:12). From inside the car, unscrew the two nuts securing each of the locating link body brackets to the floor pan (Fig. I:14). The entire axle assembly can now be removed from the car.

Installation :

Installation is the reverse of the removal procedure with special attention to the following points :—

1 If new rubber bushings have been fitted to the axle assembly, the bearings concerned must not be tightened until the weight of the car is standing on its wheels.

2 The coil springs must be installed with the unground end facing downwards. Turn the spring until it is correctly located in the lower seat.

3 The end of the stop strap must project 0.6 in (15 mm) beyond the attaching bracket (Fig. I:11).

4 Bleed the brakes as described in the BRAKES section.

LOCATING LINKS

Replacing the Bushings :

Unscrew the retaining nut and remove the bolt securing the locating link to the axle tube. Similarly detach the link from its body bracket. Removal of the bushings will be facilitated if the eye around the bushing is first heated with a flame. Press out the bushing with driver, Tool No. 784076. Install the new bushing using the same tool (Fig. I:15).

Position the link in the body bracket and fit the bolt through the bushing. When the bolt and retaining nut is tightened the angle between the link and the bracket mounting face should be 4 ± 2° (Fig. I:16). Connect the link to the axle tube and insert the bolt into the bushing from the outside. DO NOT tighten the retaining nut until the weight of the car is on its wheels.

Technical Data

Type	Beam axle, located by centre bearing and side links, with coil springs
Shock Absorbers	
Type - Estate	Hydraulic, lever with link
- Saloon	Hydraulic, telescopic direct-acting
Estate - length of stroke	4.25 in (106 mm)
Saloon - length, closed	10 in (255 mm)
- length, extended	16.44 in (417 mm)
- length of stroke	4.25 in (106 mm)
Coil Spring	
Length	13.5 in (342 mm)
No. of coils	9
Wire diameter - Estate	0.45 in (11.4 mm)
- Saloon	0.43 in (11.0 mm)
Max. spring expansion	6.75 in (170 mm)
Wheel alignment	
Camber	0° ± 1°
Toe-in at wheel rim	0° ± 1°
Max. toe-in perwheel	0° ± 3/4°
Max. difference in wheel base, L.H. & R.H. (front wheels in straight-ahead position)	0.6 in (15 mm)

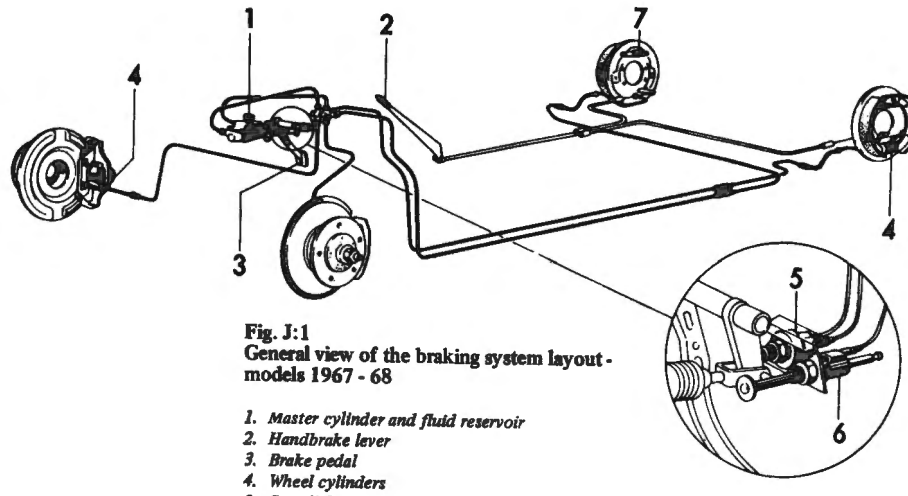


Fig. J:1
General view of the braking system layout - models 1967 - 68

1. *Master cylinder and fluid reservoir*
2. *Handbrake lever*
3. *Brake pedal*
4. *Wheel cylinders*
5. *Stop light switch*
6. *Brake warning light switch*
7. *Rear brake adjuster*

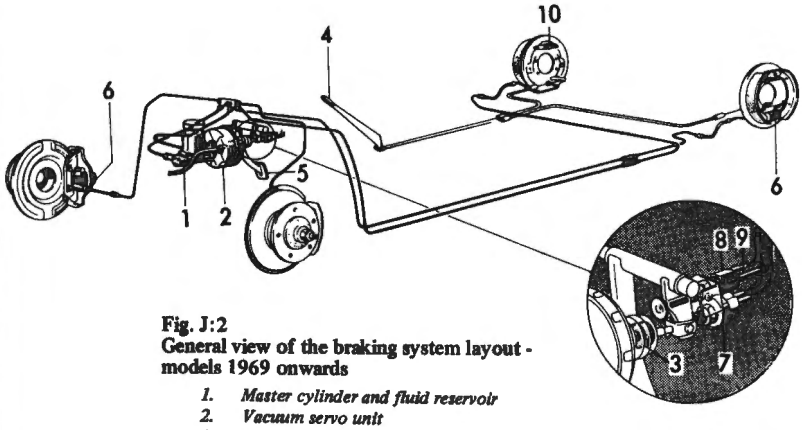


Fig. J:2
General view of the braking system layout - models 1969 onwards

1. *Master cylinder and fluid reservoir*
2. *Vacuum servo unit*
3. *Vacuum servo air filter*
4. *Handbrake lever*
5. *Brake pedal*
6. *Wheel cylinders*
7. *Stop light switch*
8. *Brake warning light switch*
9. *Moving piece, brake warning switch*
10. *Rear brake adjuster.*

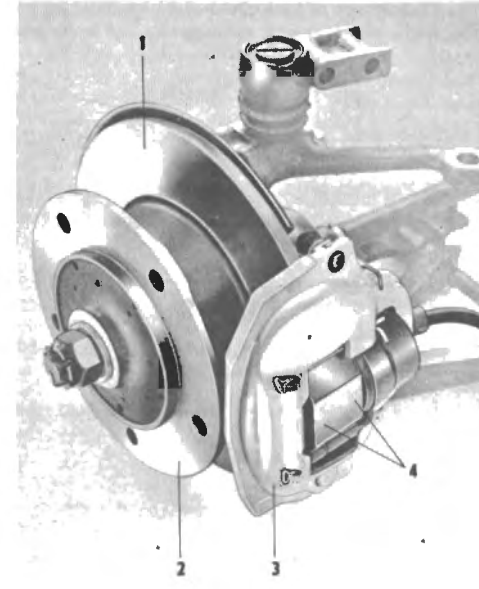


Fig. J:3
General view of the disc brake assembly

1. *Brake disc*
2. *Wheel hub*
3. *Floating housing*
4. *Friction pads*

Braking System

GENERAL

Disc brakes are fitted at the front wheels, and drum brakes at the rear on all models. The foot brake acts hydrauliccaly on all four wheels. The hydraulic system is of the dual-circuit type in which the wheels are paired diagonally. Should one circuit fail, the other is unaffected. From 1968, a brake warning system incorporating a warning light is fitted. The light illuminates if the brake pedal travel becomes abnormally long, indicating a hydraulic leakage or insufficient adjustment of the rear brakes. A tandem master cylinder which incorporates the fluid reservoir is used on all models. A vacuum servo unit is fitted to models from 1969 onwards.

The disc front brakes incorporate a single operating cylinder with a floating brake housing. The rear brakes are of the leading and trailing shoe type. The hand brake lever is situated between the two front seats and operates on the rear wheels only, through two Bowden cables.

ROUTINE MAINTENANCE

Every 6.000 miles (10.000 km).

Check the brake pads and brake linings for wear. Pads must be replaced when the thickness of the friction facing is 0.06 in (1.5 mm) or less. Shoes must be replaced when the thickness of the lining is 0.1 in (2.5 mm) or less.

Check the adjustment of the rear brakes.

Check the level of the hydraulic fluid in the master cylinder. Use only brake fluid to SAE 70R 3 specification for topping up.

Every 12.000 miles (20.000 km).

Check the adjustment of the hand-brake linkage.

Check the condition of all hoses, brake pipes, seals, etc.

Every 36.000 miles (60.000 km) or 3 years.

Replace ALL hydraulic hoses, seals, caps and other rubber components throughout the hydraulic system and change the hydraulic fluid completely.

HYDRAULIC SYSTEM OVERHAUL PROCEDURES

When overhauling any components of the hydraulic system this should be carried out under conditions of scrupulous cleanliness. Clean all dirt and grease from the exterior of components before removal. After disassembly, wash all parts in commercial alcohol, mehylated spirit or approved hydraulic fluid. DO NOT use mineral based oils such as petrol, paraffin or carbon tetrachloride. Blow out internal passages with compressed air.

Inspect piston and bore surfaces for scores, ridges or corrosion pits. The units MUST be exchanged if any of these conditions are present. It is recommended that only new seals be used when reassembling. These are generally available in the form of repair kits containing all the rubber parts required for the overhaul of a particular unit. The seals should be inspected carefully before fitting, even if they are new. Check that the sealing lips are perfectly formed, concentric with the bore of the seal, and free from "knife-edges", surface blemishes or marks. Any seal which does not appear perfect, no matter how minute the blemish may appear to be, should be discarded.

FRONT BRAKES

Disc brakes incorporating a single operating cylinder and a floating brake housing are fitted at the front wheels (Fig. J:3). The calliper assembly is attached to its mounting bracket by a pivot pin and a spring-loaded steady pin which means that the housing is free to move about the pivot. The friction pads are mounted one on either side of the brake disc, the outer one being mounted in the housing while the inner pad rests against the brake piston and is held in position by the calliper mounting bracket and calliper assembly. Movement of the piston forces the inner friction pad outwards against the brake disc. The moveable calliper assembly is then influenced and moves to press the outer pad against the disc as well. Retracting of the piston is effected by the action of the piston seal which returns the piston only sufficiently to maintain a constant clearance between the friction pad and the disc when the brakes are not in use. This action compensates for wear of the friction pads making the brakes self-adjusting in effect. The brake disc is bolted to the wheel hub and is protected from road dirt by the road wheel on the outside and a metal splash shield on the inside.

Inspecting the Friction Pads :

As the disc front brakes are self-adjusting, it is not possible to determine the amount of friction pad wear from the length of the pedal stroke. It is important, therefore, that a visual inspection of the friction pads be made regularly at the specified intervals. The front wheels must be removed to allow inspection of the pads. When new, the friction pads are wedge-shaped, but as they wear they tend to assume a shape where the friction face is practically parallel with the pressure plate (Fig. J:5). If the pad thickness is 0.06 in (1.5 mm), or less, or if the pads are contaminated by oil or grease, they must be replaced.

Replacing the Friction Pads :

Jack the front wheels clear of the ground and remove the road wheels. Depress the steady spring and withdraw the two retaining pins from the calliper (Fig. J:7). Extract the friction pads and shims.

NOTE :— If the friction pads are not being replaced, their respective locations must be noted before removal to ensure that they are refitted in their original positions.

Clean the end of the piston and, using screw vice Tool No. 786043, push the piston back into its bore in the brake housing (Fig. J:6). This will cause the brake fluid level in the master cylinder reservoir to rise and it may be necessary to syphon off some fo the excess to prevent it from overflowing.

Move the calliper about its pivot pin, towards the wheel and fit the outer friction pad. Push the calliper back as far as possible and check that the piston is correctly positioned with the recess in the contact face towards the bottom. Fit the damping shims to the back of the friction pad with the two recesses directed downwards so that they are centred on the ends of the piston recess. Install the friction pad and shim. Fit the steady spring with the recess in the spring as near as possible to the outer friction pad and secure with new retaining pins. Fit the upper retaining pin first and then the lower one, pressing the spring upwards with the aid of a screw-driver (Fig. J:7).

NOTE :— If the steady spring is worn or weak, a new one should be fitted.

Mount the road wheels and lower the car. Give the brake pedal several strokes to bring the pads into correct adjustment. Top up the brake fluid reservoir.

Removal and Installation of the Calliper :

Remove the friction pads as described above. Bend back the locking tabs and unscrew the two bolts securing the calliper mounting bracket to the steering knuckle. Detach the calliper assembly. Disconnect the brake hose from the calliper and fit a brake line plug in each aperture.

Installation is the reverse of the removal procedure. Use a new retaining plate at the calliper mounting bolts. Ensure that the brake hose is not twisted after being reconnected. Bleed the brakes as described later in this section.

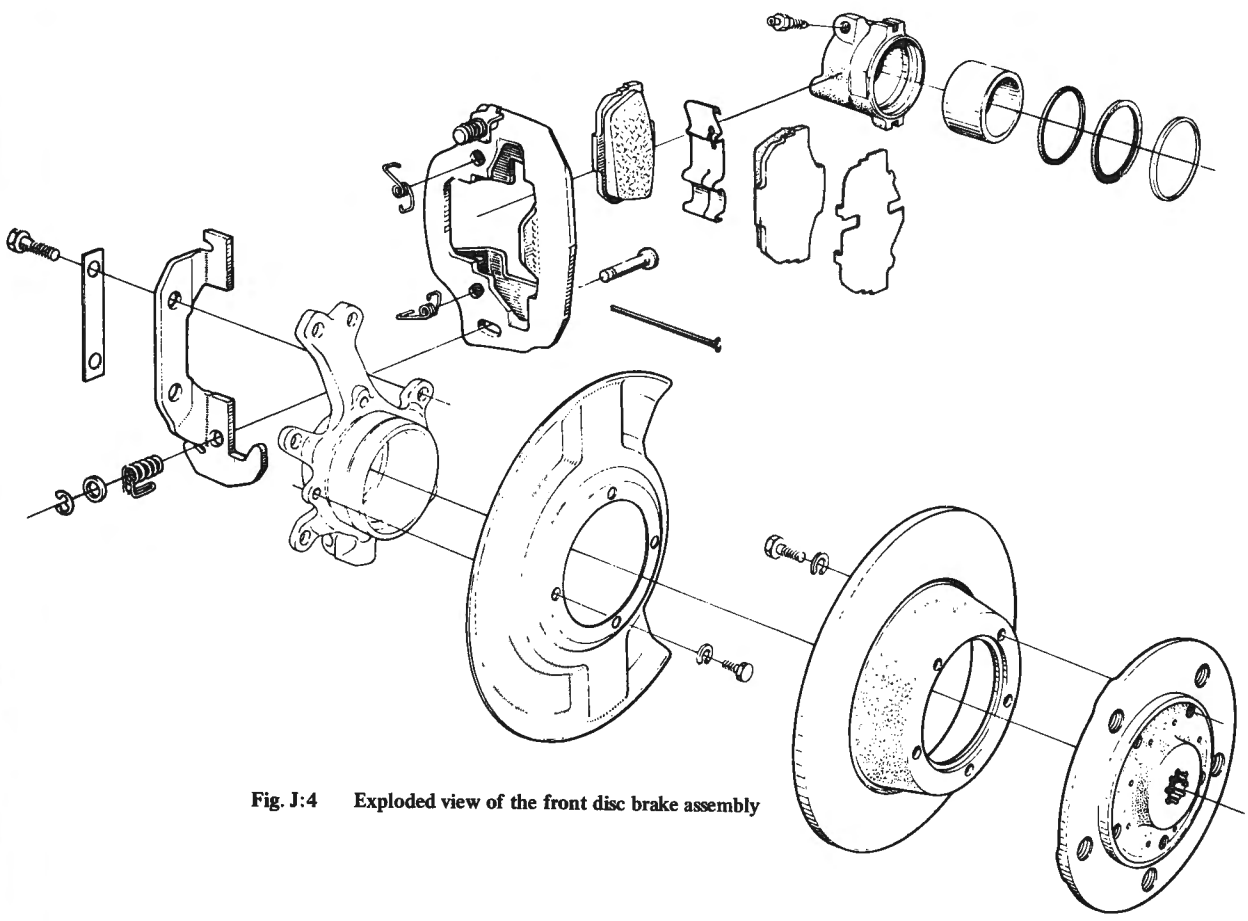


Fig. J:4 Exploded view of the front disc brake assembly

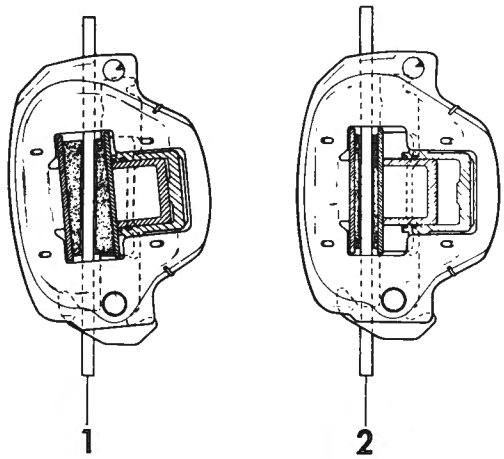


Fig. J:5
Brake pad wear.

1. New pads
2. Worn pads

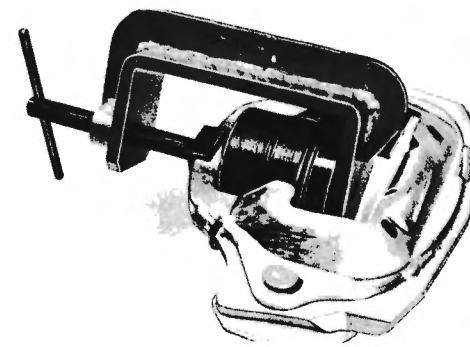


Fig. J:6 Screw vice for the brake piston, Tool No. 786043

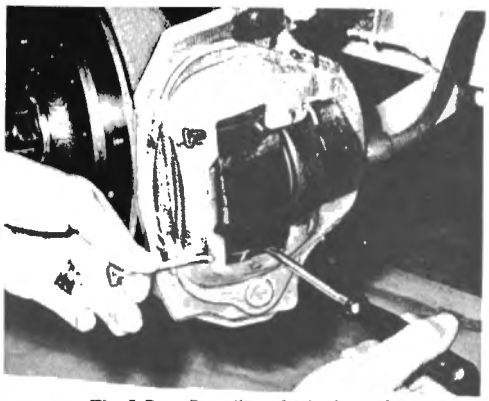


Fig. J:7 Installing the brake pads

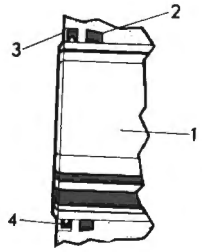


Fig. J:9
Wiper seal installation

1. *Piston*
2. *Piston seal*
3. *Retainer ring, wiper seal*
4. *Wiper seal.*

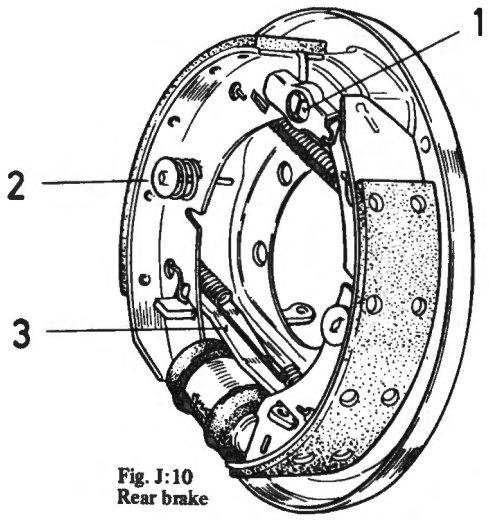


Fig. J:10
Rear brake

1. *Adjustment device*
2. *Shoe hold-down spring*
3. *Handbrake link.*

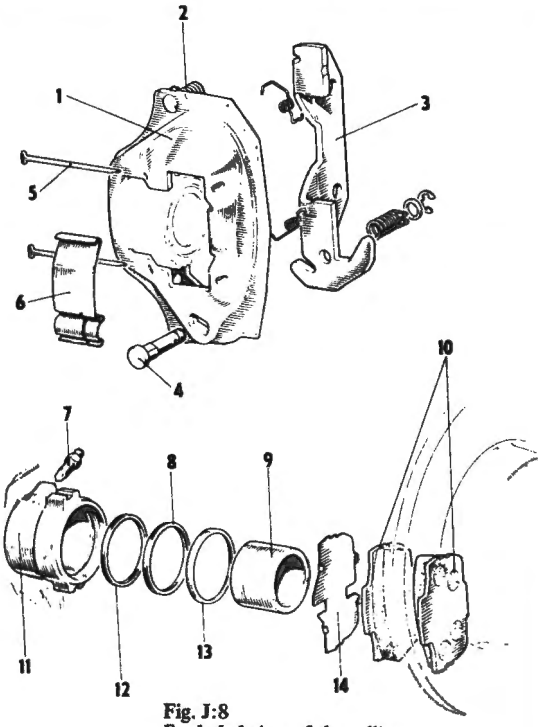


Fig. J:8
Exploded view of the calliper

1. *Calliper assembly*
2. *Spring-loaded steady pin*
3. *Calliper mounting bracket*
4. *Pivot pin*
5. *Pad retaining pins*
6. *Pad steady springs*
7. *Bleed valve*
8. *Wiper seal*
9. *Piston*
10. *Friction pads*
11. *Brake cylinder*
12. *Piston seal*
13. *Retainer ring, wiper seal*
14. *Shim.*

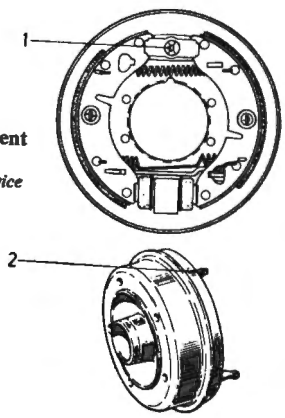


Fig. J:11
Rear brake adjustment

1. *Adjustment device*
2. *Adjuster.*

Replacing the Brake Disc :

If after considerable mileage the brake disc shows signs of heavy wear or scoring it must be replaced. Moderate scoring does not necessitate replacement.

Remove the brake calliper as described above but do not disconnect the brake hose from the calliper. Hang the calliper up to avoid damage to the brake hose. Unscrew the castellated hub nut and remove the wheel hub and brake disc using a suitable puller. Unscrew the retaining bolts and separate the brake disc from the hub.

Installation is the reverse of the removal procedure.

Overhauling the Calliper

When removing the calliper from the car, before disconnecting the brake hose from the calliper press the brake pedal down carefully to displace the piston sufficiently in the brake housing to allow it to be removed by hand. Now disconnect the brake hose and fit a brake line plug in each aperture.

Detach the two springs holding the cylinder in position in the calliper and remove the cylinder.

If it is required to dismantle the calliper assembly further, compress the spring on the hinge pin and remove the securing clip, spacer washer and spring. The calliper mounting bracket can now be detached from the calliper. Reassembly is the reverse of the dismantling procedure.

Before overhauling the brake cylinder, reference should be made to "HYDRAULIC SYSTEM OVERHAUL PROCEDURES" earlier in this section.

Remove the piston from the cylinder. Extract the piston seal from its groove in the cylinder bore, using a blunt tool. The wiper seal and retainer ring can now be removed with the aid of a screwdriver.

Coat the piston seal with special lubricant, e.g. Lockhead Disc Brake Lubricant, after first ensuring that the seal is perfectly dry. Fit the seal in its groove in the cylinder bore and rotate ti with the fingers to seat it properly. Smear the piston with the same special lubricant and fit into the bore with the recess in the contact face towards the bottom. Push the piston into the cylinder but leave 0.4 in (10 mm) of the piston protruding to facilitate fitting of the wiper seal. Coat the wiper seal with the special lubricant, again ensuring that the seal is perfectly dry first. Place the wiper seal in its retainer ring with the groove facing the piston (Fig. J:9). Press the retainer ring and seal home with the aid of screw vice and distance piece Tool No. 786043 (Fig. J:6).

Refit the cylinder in the calliper assembly and secure in position with the two springs. Install the calliper in the car as described previously.

REAR BRAKES

The rear brakes are of the drum type with one leading and one trailing shoe. Manual adjustment is required as no self-adjustment is incorporated. The hand-brake operates through the rear brakes.

Adjustment :

Excessive wear of the rear brakes shoes is normally indicated by excessive travel of the brake pedal or hand-brake lever before the brakes take effect (Fig. J:30 & J:31). The distance from the toe-board to the brake pedal should not be less than 2.5 in (65 mm). As the front wheel brakes are self-adjusting it will only be necessary to adjust the rear brakes.

With the rear wheels raised clear of the ground, release the hand-brake and check that the hand-brake levers at the brake backplates return fully. If necessary, release the levers by hand. Depress the brake pedal hard several times to centre the brake shoes.

The brake adjuster consists of a square peg located on the rear of the backplate at the top (Fig. J:11). A special adjuster spanner is included in the car tool kit. Turn the adjuster until the wheel locks then back off one or more "clicks" until the wheel rotates freely without dragging. Repeat for the other rear wheel.

NOTE :— If the adjuster cannot be tightened up enough to lock the wheel, the brake linings are excessively worn and must be renewed.

After adjustment is completed check that the free movement at the pedal is (3.6 mm) 0.12 - 0.24 in. Depress the brake pedal, release it and then check that the rear wheels still rotate freely.

Inspecting the Linings :

An inspection hole is provided in the brake drum for this purpose (Fig. J:33). If the thickness of the linings is 0.1 in (2.5 mm), or less, the shoes must be replaced.

Replacing the Brake Shoes :

As a rule the linings on the rear brakes will wear at different rates, the linings on the front shoes last longer than those on the rear ones. It may therefore be sufficient to replace the two rear shoes only. However it is necessary to replace a lining on one rear wheel, the corresponding lining on the opposite wheel must also be replaced to maintain proper braking balance.

Jack up the rear of the car and remove the road wheels. Check that the hand-brake is fully released. Unscrew the castellated hub nut and remove the brake drum using a suitable puller (see Fig. I:3). It may be necessary to release the adjustment on the brakes before the drum can be removed.

Remove the brake shoe hold-down springs from each shoe by pressing down on the upper retaining washer with pliers and turning the washer a quarter of a turn. Disengage the upper ends of the shoes from the adjustment device first and then the lower ends from the wheel cylinder and hand-brake levers. Place a brake cylinder clamp or rubber bend on each wheel cylinder to retain the piston in position.

It is recommended that exchange relined brake shoes be fitted as replacements, since the linings on these are correctly ground to match the brake drums.

Inspect the old linings and back plate for grease contamination as this may indicate a defective hub seal. Inspect the wheel cylinders for signs of leakage. If present, steps should be taken to investigate and, if necessary, rectify faults before fitting new linings. If grease contamination is present, clean the back plate and all removed components, except the brake drums, with mineral spirit such as petrol, paraffin, carbon tetrachloride etc., or other suitable solvent. If the brake fluid contamination is present, clean with alcohol. Finally clean all parts, especially the brake drums, with soap and water solution.

Check all springs for fracture stretching and evidence of overheating, indicated by discolouring. Examine the drums for scoring. Light scoring is permissable but more serious scoring will increase lining wear. Badly scored drums should be machined true or replaced. The drum may be machined to a maximum diameter of 8.059 in (204.7 mm). Inspect the wear pattern on old brake linings. If the wear across the width of the lining is uneven, inspect the drum for "belling" and the backplate for distortion.

Hock the retracting springs between the shoes, ensuring that the springs are fitted in their correct locations. Remove the clamp or rubber band from the wheel cylinders. Locate the front shoe so that the hand-brake lever engages in the slot in the shoe. Locate the rear shoe and engage the hand-brake lever in the large oval hole. Ensure that the lower retracting spring presses against the top face of the lever (Fig. J:12). Refit the shoe hold-down springs. Centre the shoes and refit the brake drums. Tighten the hub nut to a torque of 65 lb.ft (9 kg.m) and secure with a new split pin. Mount the road wheels and adjust the rear brakes as described above.

Overhauling the Wheel Cylinders

Saloon models prior to 1970 were fitted with smaller wheel cylinders at the rear than estate and later saloon models. These cylinders cannot be interchanged as the locating pins on the mounting face are differently positioned.

Remove the brake shoes as described above. Disconnect the hand-brake cable from the lever at the brake backplate. Disconnect the brake pipe at wheel cylinder. Unscrew the bleed valve. Extract the spring retaining clip securing the wheel cylinder at the rear of the back plate and detach the wheel cylinder.

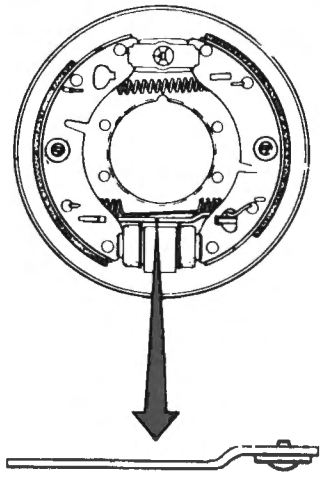


Fig. J:12 Fitting the handbrake lever

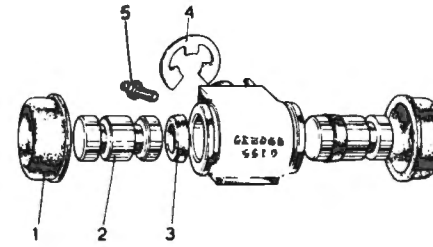


Fig. J:14
Exploded view of the rear wheel cylinder

1. *Rubber boot*
2. *Piston*
3. *Piston seal*
4. *Spring retaining clip*
5. *Bleed valve.*

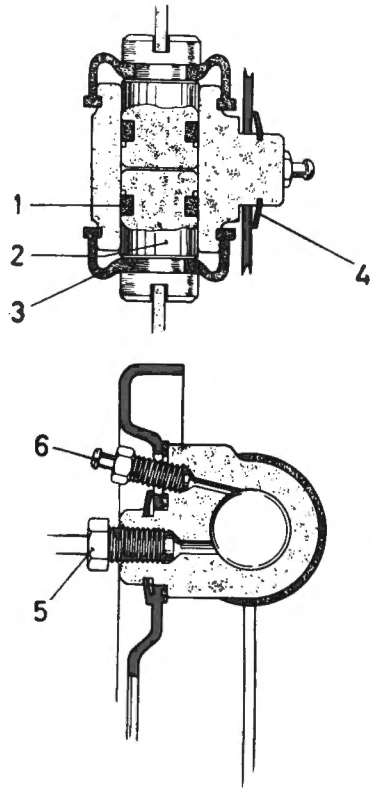


Fig. J:13
Sectional view of the rear wheel cylinder.

1. *Piston seal*
2. *Piston*
3. *Rubber boot*
4. *Spring retaining clip*
5. *Hydraulic union*
6. *Bleed valve.*

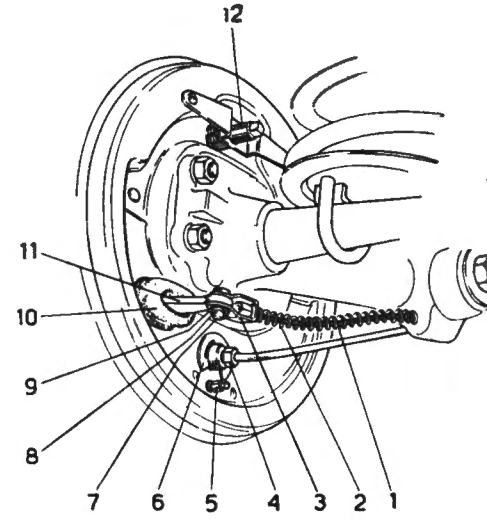
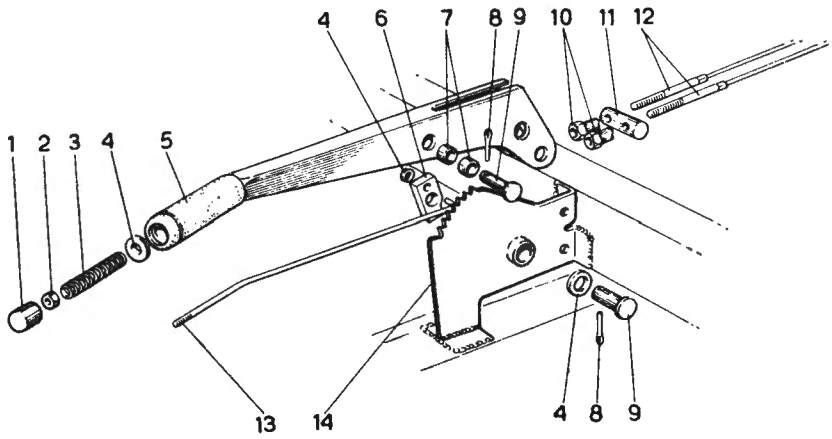


Fig. J:15
Rear brake back plate. (Left-hand side shown).

1. *Handbrake cable*
2. *Coil spring*
3. *Clevis*
4. *Hydraulic union*
5. *Bleed valve*
6. *Cylinder retaining clip*
7. *Split pin*
8. *Cotter pin*
9. *Plain washer*
10. *Rubber boot*
11. *Handbrake operating lever*
12. *Adjuster.*



1. *Release button.*
2. *Lock nut.*
3. *Return spring.*
4. *Washer.*
5. *Handbrake lever.*
6. *Pawl.*
7. *Spacer sleeves.*
8. *Split pin (or circlip).*
9. *Cotter pin.*
10. *Adjusting nuts.*
11. *Cable end pin.*
12. *Handbrake cables.*
13. *Pawl rod.*
14. *Ratchet.*

Fig. J:16
Exploded view of the handbrake components.

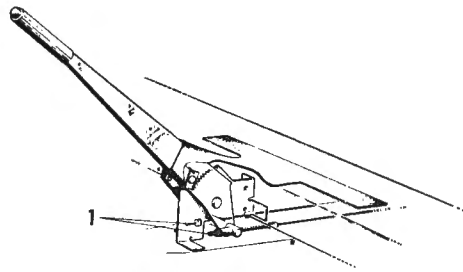
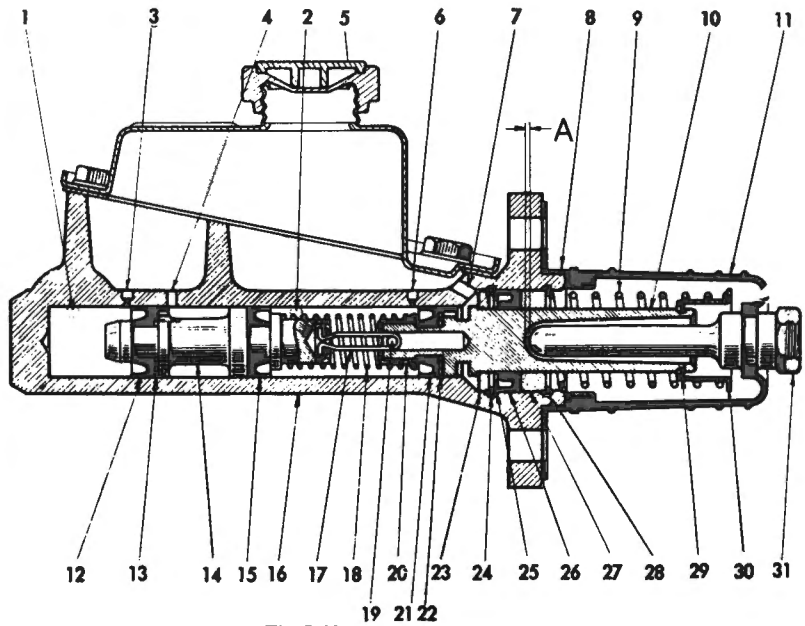


Fig. J:17 Handbrake adjusting nuts



1. *Fluid outlet, secondary circuit*
2. *Fluid outlet, primary circuit*
3. *By-pass port, secondary circuit*
4. *Fluid inlet port, secondary circuit*
5. *Fluid reservoir*
6. *By-pass port, primary circuit*
7. *Fluid inlet port, primary circuit*
8. *Boot retaining plate*
9. *Piston return spring*
10. *Primary piston*
11. *Rubber boot*
12. *Primary cup, secondary piston*
13. *Piston washer, secondary piston*
14. *Secondary piston*
15. *Secondary cup, secondary piston*
16. *Cylinder body*
17. *Clip*
18. *Spring*
19. *Clip retaining pin*
20. *Spring holder*
21. *Primary cup, primary piston*
22. *Piston washer, primary piston*
23. *Piston stop ring*
24. *Retaining clirclip, stop ring*
25. *Plain washer*
26. *Secondary cup, primary piston*
27. *Nylon guide bearing*
28. *Retaining circlip, guide bearing*
29. *'Spirolox' circlip*
30. *Spring retainer*
31. *Push rod.*

Fig. J:19
Sectional view of the master cylinder - models 1967 - 68.

Reference should be made to "HYDRAULIC SYSTEM OVERHAUL PROCEDURES" earlier in this section concerning the inspection and overhaul of the wheel cylinder.

Pull the rubber boot off each end of the cylinder and extract the piston assemblies from the cylinder bore. Remove the rubber seal from each piston (Fig. J:14).

Reassembly is the reverse of the dismantling procedure with special attention to the following points :—

1 Lubricate all the cylinder components with brake fluid before assembly.

2 Ensure that the seal is facing the right way when fitted to the piston.

3 The locating pin on the wheel cylinder must correctly engage the hole in the brake back plate.

4 The hand-brake lever must be installed with the bent part facing upwards (Fig. J:12).

5 Bleed the brakes as described later in this section.

Brake Backplate :

If required the brake back plate can be removed complete with the brake shoes from the axle end plate after removing the brake drum, disconnecting the brake pipe at the wheel cylinder and detaching the hand-brake cable at the lever on the brake back plate.

HAND-BRAKE

The hand-brake operates mechanically on the rear wheels through two Bowden cables. The cables are permanently lubricated and thus require no maintenance. The hand-brake lever is situated between the two front seats.

Adjustment :

Adjustment of the hand-brake is governed by the adjustment of the rear brakes. The rear brakes should therefore be correctly adjusted before attempting any adjustment of the hand-brake cables.

Raise the rear of the car so that both road wheels are clear of the ground. Remove the right front seat. Move the hand-brake lever to its fully released position. Tighten the hexagonal adjusting nut on one of the cables until the relevent rear wheel is locked (Fig. J:17). Back off the nuts sufficiently to allow the wheel to rotate freely without dragging and then back-off one more full turn. Repeat for the other cable.

Test the adjustment by fully applying the hand-brake lever and then releasing it again. The rear wheels should rotate freely when the lever has been pulled up two notches from the off position, but should be locked at the third notch. Check that the braking effect is equal at both wheels.

Removal and Installation of the Hand-brake Cable :

Remove one of the front seats and the rear seat cushions. Jack up the car and remove the rear wheel. Unscrew the adjusting nut at the hand-brake lever. Pull the cable out of the sleeve under the rear seat cushion. Release the clamps securing the cable to the rear axle tube. Extract the split pin and remove the clevis pin securing the cable end to the lever on rear of the brake back plate (Fig. J:15). Ease the grommet out of the inclined panel in the rear axle tunnel and pull the entire cable rearwards.

If removed, fit the grommet on the cable. Pass the cable, threaded end first, through the inclined panel in the rear axle tunnel and the sleeve under the rear seat. Secure the front end of the cable to the hand-brake lever with the adjusting nut. Reconnect the rear end of the cable to the lever on the brake back plate. Fit the grommet in the inclined panel in the rear axle tunnel and secure the cable to the rear axle tube with the two clamps. Mount the road wheel, lower the car and adjust the hand-brake as described above. Replace the cushions and seat.

MASTER CYLINDER (WITHOUT SERVO)

The tandem master cylinder is located on the engine compartment bulkhead directly in front of the driver.

Removal and Installation :

From inside the car, back off the locking nut and unscrew the push rod from the fork on the brake pedal. Place rags under the master cylinder to prevent damage to the paint work. Unscrew the two hydraulic pipes from the master cylinder and fit blanking plugs to prevent the ingress of dirt and loss of fluid. Unscrew the two master cylinder retaining bolts and remove the master cylinder. The lower one is a stud bolt and the nut is accessible from the engine compartment. The upper one is a screw bolt, accessible from inside the car.

Installation is the reverse of the removal procedure. Refill the system with brake fluid. Adjust the brake pedal free movement as described later in this section (Fig. J:32) and bleed the brakes.

Overhaul

The master cylinder should only be dismantled if an exchange unit is unobtainable. Refer to Fig. J:18 for an exploded view of the components referred to in this section.

Detach the rubber boot from its retaining plate and remove it complete with the push rod. Release the four tabs on the boot retaining plate and remove it from the cylinder mounting flange. Depress the spring retainer, extract the "Spirolex" circlip from the groove on the primary piston and remove the spring retainer and spring. Extract the circlip retaining the nylon guide bearing, tap the cylinder mounting flange lightly on the bench and remove the guide bearing, the secondary cup and the plain washer. Using long-nosed pliers, extract the circlip retaining the piston stop ring (Fig. J:21). Both pistons together with the stop ring can now be withdrawn from the cylinder.

Depress the spring holder between the two pistons sufficiently to allow the clip retaining pin to be driven out. The pistons can now be separated and the spring and spring holder removed. No attempt should be made to remove the link clip from the secondary piston as the clip is permanently peened in position. Remove the primary and secondary cups and piston washers from the pistons.

Unscrew the adaptors from the fluid outlets on the cylinder body (Fig. J:20). Remove the gaskets. Withdraw the non-return valves, comprising the spring, valve body and spring clip from the fluid outlets. Take care not to distort the spring clip when removing it from the valve body.

If necessary, the six retaining bolts can be unscrewed and the brake fluid reservoir cover and gasket detached from the cylinder body.

Reference should be made to "HYDRAULIC SYSTEM OVERHAUL PROCEDURES" earlier in this section concerning the inspection and overhaul of the master cylinder. Use a piece of thin steel wire to probe the by-pass ports. Dip all the components in clean brake fluid before reassembling.

Using fingers only, fit the secondary cup on the large end of the secondary piston so that the flat side of the cup abuts the shoulder of the piston. Locate the piston washer on the other end of the piston with the concave face towards the piston shoulder and fit the primary cup so that the flat side of the cup also faces the piston shoulder (Fig. J:22). Fit the primary cup and piston washer to the primary piston in the same way.

Fit the link clip retaining pin in the hole in the primary piston, but do not push it fully home. Fit the spring and spring holder to the secondary piston and compress the spring until the link clip is visible. Locate the end of the clip in the primary piston and secure with the retaining pin. Release the spring and spring holder and check that the holder is correctly positioned.

Dip the assembly in clean brake fluid and insert it into the cylinder. Slide the piston stop ring over the primary piston and using long-nosed clirclip pliers, fit the retaining circlip. Install the plain washer, secondary cup with the lip inwards, nylon guide bearing and outer retaining circlip. Fit the boot retaining plate on the mounting flange and bend over the four tabs to

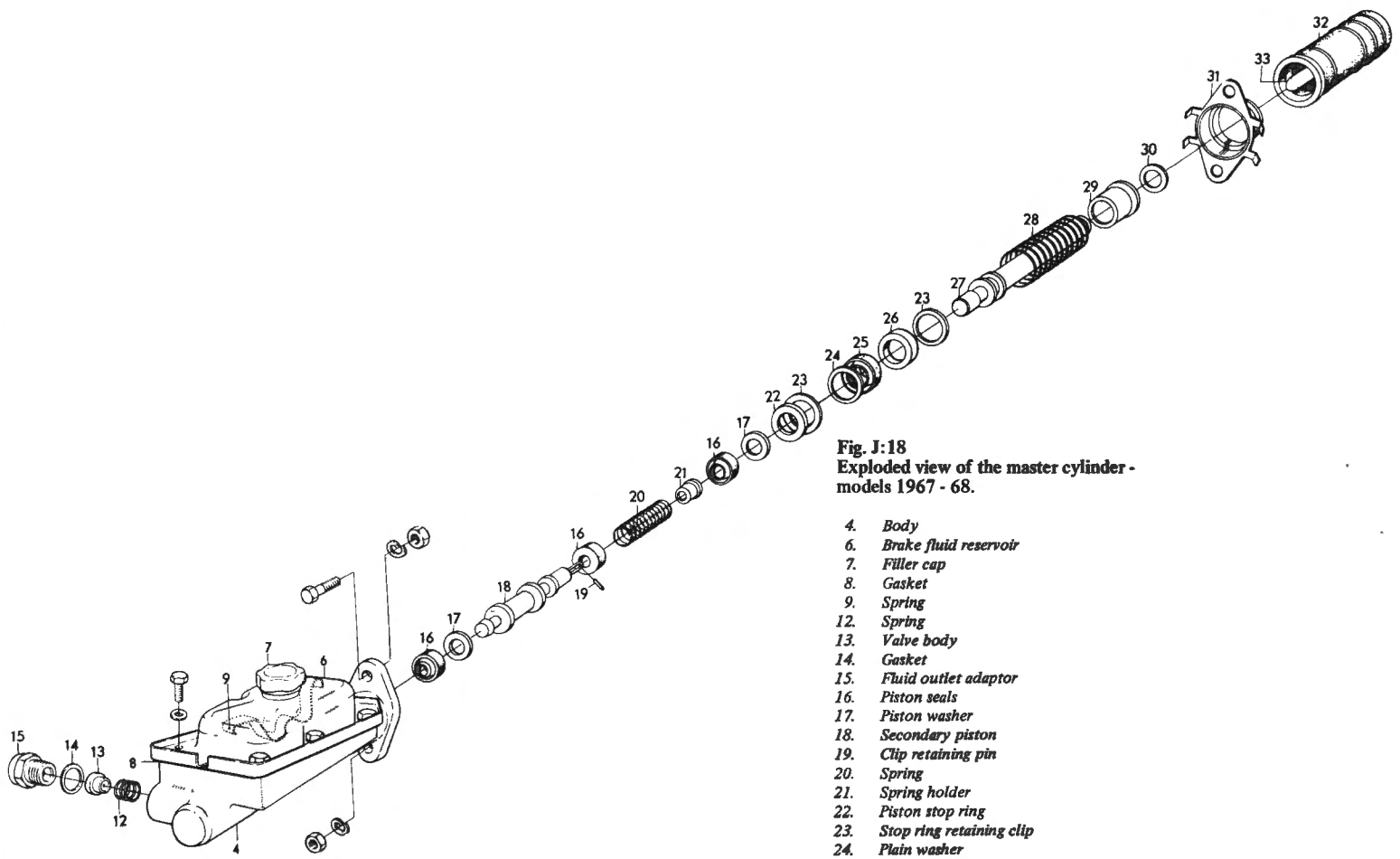


Fig. J:18
Exploded view of the master cylinder - models 1967 - 68.

4. Body
6. Brake fluid reservoir
7. Filler cap
8. Gasket
9. Spring
12. Spring
13. Valve body
14. Gasket
15. Fluid outlet adaptor
16. Piston seals
17. Piston washer
18. Secondary piston
19. Clip retaining pin
20. Spring
21. Spring holder
22. Piston stop ring
23. Stop ring retaining clip
24. Plain washer
25. Secondary cup, primary piston
26. Nylon guide bearing
27. Primary piston
28. Piston return spring
29. Spring retainer
30. "Spirolox" circlip
31. Boot retaining plate
32. Rubber boot
33. Push rod.

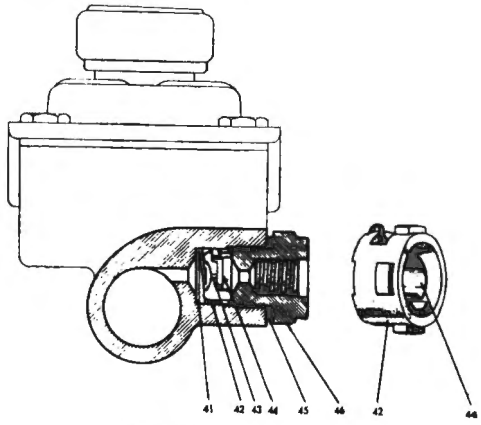


Fig. J:20
Master cylinder non-return valve - models 1967 - 68

41. Spring
42. Valve body
43. Equalising hole
44. Spring clip
45. Gasket
46. Fluid outlet adaptor.

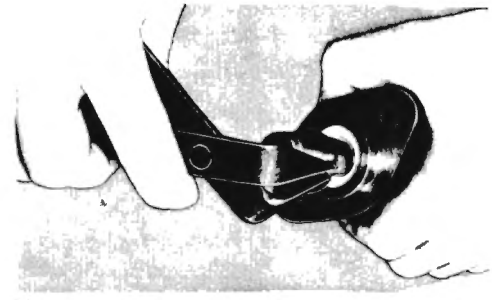


Fig. J:21 Removing the lockring using Tool No. 784199

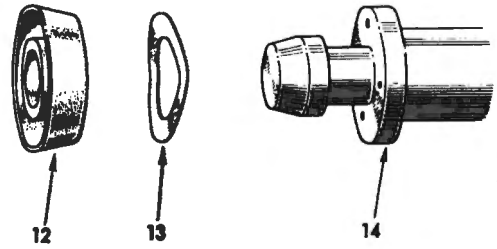


Fig. J:22
Piston washer installation

12. Primary cup
13. Dished washer
14. Secondary piston

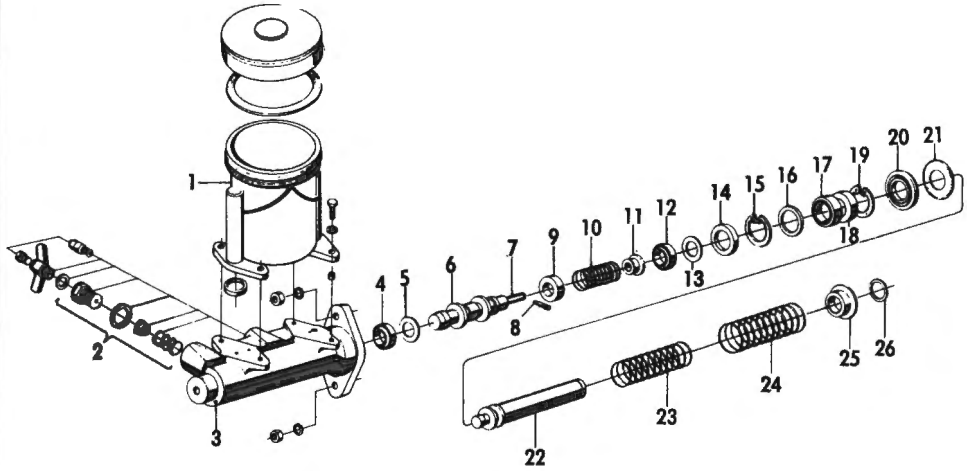


Fig. J:23
Exploded view of the master cylinder - models 1969 onwards.

1. Brake fluid reservoir
2. Non-return valve
3. Body
4. Primary cup, secondary piston
5. Piston washer, secondary piston
6. Secondary piston
7. Connecting link
8. Link retaining pin
9. Secondary cup, secondary piston
10. Spring
11. Spring holder
12. Primary cup, primary piston
13. Piston washer, primary piston
14. Piston stop ring
15. Retaining circlip, stop ring
16. Plain washer
17. Secondary cup, primary piston
18. Nylon guide bearing
19. Retaining clirclip, guide bearing
20. Gasket
21. Washer
22. Primary piston
23. Spring
25. Spring holder
26. "Spirolox" circlip.

secure. Fit the spring and spring retainer on the primary piston spigot, compress the spring and secure with the "Spirolex" circlip. Smear the inner end of the push rod with silicon grease, ease the push rod into the rubber boot and fit the boot to its retaining plate.

Ease the spring clip into the non-return valve body, fit the return spring over the valve body and insert the assembly, spring first, into the fluid outlet port. Fit the gasketto the outlet adaptor and screw the adaptor in the outlet port, tighten it to the specified torque. Repeat for the other non-return valve.

If removed, refit the cover to the brake fluid reservoir using a new gasket.

MASTER CYLINDER (WITH SERVO)

Removal and Installation

When removing and installing the master cylinder, it is not necessary to remove the vacuum servo unit.

Place rags under the master cylinder to prevent damage to the paintwork. Unscrew the two hydraulic pipes from the master cylinder unions and fit blanking plugs to prevent the ingress of dirt and loss of fluid. Unscrew the two master cylinder retaining bolts and separate the master cylinder from the vacuum servo unit.

Installation is the reverse of the removal procedure. Refill the system with the recommended brake fluid and bleed the brakes.

Overhaul :

The master cylinder should only be dismantled if an exchange unit is unobtainable. Refer to Fig. J:23 for an exploded view of the components referred to in this section.

Depress the spring retainer, extract the "Spirolex" circlip from the groove on the primary piston and remove the spring retainer, spring, washer and gasket. Extract the circlip retaining the nylon guide bearing, tap the cylinder mounting flange lightly on the bench and remove the guide bearing, the secondary cup and the plain washer. Using long-nosed pliers, extract the circlip retaining the piston stop ring (Fig. J:21). Both pistons together with the stop ring can now be withdrawn from the cylinder.

Depress the spring holder between the two pistons sufficiently to allow the clip retaining pin to be driven out. The pistons can now be separated and the spring and spring holder removed. No attempt should be made to remove the link clip from the secondary piston as the clip is permanently peened in position. Remove the primary and secondary cups and piston washers from the pistons.

Unscrew the adaptors from the fluid outlets on the cylinder body (Fig. J:25). Remove the gaskets. Withdraw the non-return valves, comprising the spring, valve body and spring clip, from the fluid outlets. Take care not to distort the spring clip when removing it from the valve body.

If necessary, the four retaining bolts can be unscrewed and the brake fluid reservoir cover and gasket detached from the cylinder body.

Reference should be made to "HYDRAULIC SYSTEM OVERHAUL PROCEDURES" earlier in this section concerning the inspection and overhaul of the master cylinder. Use a piece of thin steel wire to probe the by-pass ports. Dip all the components in clean brake fluid before reassembling.

Using fingers only, fit the secondary cup on the large end of the secondary piston so that the flat side of the cup abuts the shoulder of the piston. Locate the piston washer on the other end of the piston with the concave face towards the piston shoulder and fit the primary cup so that the flat side of the cup also faces the piston shoulder (Fig. J:22). Fit the primary cup and piston washer to the primary piston in the same way.

Fit the link clip retaining pin in the hole in the primary piston, but do not push it fully home. Fit the spring and spring holder to the secondary piston and compress the spring until the link clip is visible. Locate the end of the clip in the primary piston and secure with the retaining pin. Release the spring and spring holder and check that the holder is correctly positioned.

Dip the assembly in clean brake fluid and insert it into the cylinder. Slide the pison stop ring over the primary piston and using long-nosed pliers, fit the retaining circlip. Install the plain washer, secondary cup with the lip inwards, nylon guide bearing and outer retaining clirclip. Fit the gasket, washer, spring and spring retainer on the primary piston spigot, compress the spring and secure with the "Spirolex" circlip.

Ease the spring clip into the non-return valve body, fit the return spring over the valve body and insert the assembly, spring first, into the fluid outlet port. Fit the gasket to the outlet adpator and screw the adaptor into the outlet port. Tighten it to the specified torque. Repeat for the other non-return valve.

If removed, refit the cover to the brake fluid reservoir using a new gasket.

VACUUM SERVO UNIT

A vacuum servo unit is incorporated in the braking system on models as from 1969. The servo unit is mounted on the engine compartment bulkhead directly in front of the driver with the master cylinder mounted directly on the front of the unit.

Removal and Installation :

From inside the car, remove the protective cover from the steering wheel shaft. Remove the cotter pin and washer and disconnect the master cylinder push rod from the brake pedal. Place rags under the master cylinder to prevent damage to the paint work. Unscrew the two hydraulic pipes from the unions on the master cylinder and fit blanking plugs to prevent the ingress of dirt and loss of fluid. Disconnect the vacuum hose from the vacuum servo unit. Unscrew the four nuts retaining the servo unit to the bulkhead. These nuts are accessible from inside the car. Remove the vacuum servo unit and master cylinder.

Unscrew the two master cylinder retaining bolts and separate the master cylinder from the servo unit.

Installation is the reverse of the removal procedure. Refill the system with recommended brake fluid and bleed the brakes.

Air Filter Replacement :

Remove the protective cover from the steering wheel shaft. Remove the cotter pin and washer and disconnect the master cylinder push rod from the brake pedal. Remove the rubber bellows. Insert a screwdriver behind the air filter retaining washer and pry the washer off. Extract the old air filter. Insert the new filter and refit the washer by tapping gently with a hammer around the edge of the washer. Refit the rubber bellows and reconnect the push rod to the brake pedal.

Overhaul :

The vacuum servo unit is serviced as a complete assembly and no attempt should be made to dismantle or overhaul it.

BLEEDING THE BRAKES

As the master cylinder has tandem pistons, both rear wheels and both front wheels must be bled simultaneously. The positions of the bleed valves are shown in Figs. J:26 & J:27.

Top up the brake fluid reservoir. Fit a bleeder tube to the bleed valve at each of the rear brakes. Immerse the other end of the tube in a small quantity of hydraulic fluid in a clean jar (Fig. J:28). Open the bleed valves 1/2 – 1 turn, and depress brake pedal, quickly and then allow it to return slowly to its "OFF" position. Continue depressing the brake pedal, pausing after each return stroke, until the fluid coming from the bleed tubes is free from air bubbles. When the fluid above comes from the bleed tubes, close the bleed valve with the pedal in the depressed position.

Check the fluid level in the master cylinder and repeat the bleeding procedure for the front brakes. Top up the fluid reservoir and replace the reservoir cap after checking that the vent holes in the cap are clear. If the brake

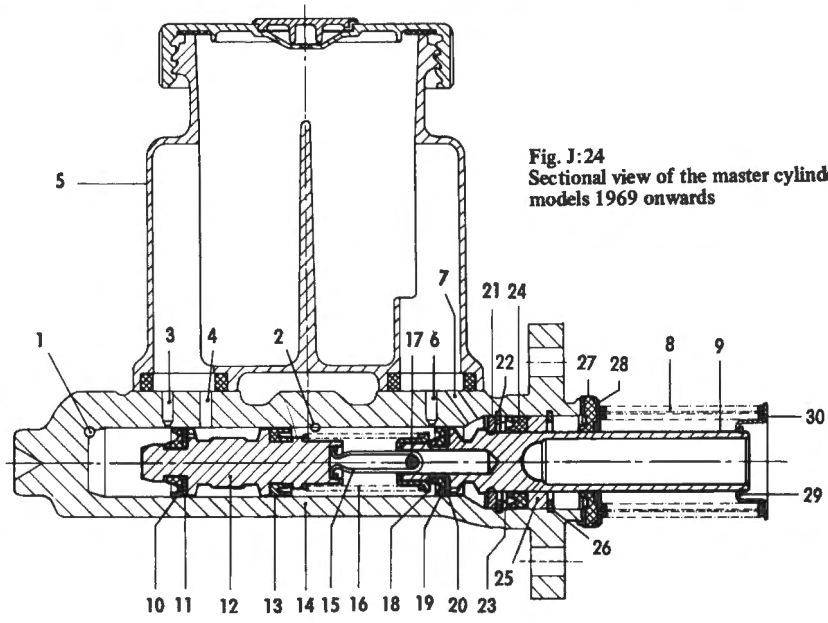


Fig. J:24
Sectional view of the master cylinder - models 1969 onwards

1. *Fluid outlet, secondary circuit*
2. *Fluid outlet, primary circuit*
3. *By-pass port, secondary circuit*
4. *Fluid inlet port, secondary circuit*
5. *Brake fluid reservoir*
6. *By-pass port, primary circuit*
7. *Fluid inlet port, primary circuit*
8. *Piston return spring*
9. *Primary piston*
10. *Primary cup, secondary piston*
11. *Piston washer, secondary piston*
12. *Secondary piston*
13. *Secondary cup, secondary piston*
14. *Cylinder body*
15. *Connecting link*
16. *Spring*
17. *Link retaining pin*
18. *Spring holder*
19. *Primary cup, primary piston*
20. *Piston washer, primary piston*
21. *Piston stop ring*
22. *Retaining circlip, stop ring*
23. *Plain washer*
24. *Secondary cup, primary piston*
25. *Nylon guide bearing*
26. *Retaining circlip, guide bearing*
27. *Gasket*
28. *Washer*
29. *"Spirolox" circlip*
30. *Spring holder.*

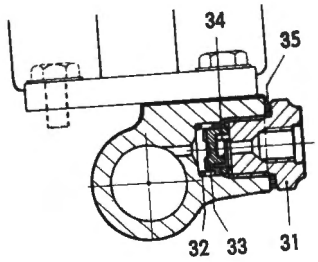


Fig. J:25
Master cylinder non-return valve - models 1969 onwards.

31. *Fluid outlet adaptor*
32. *Spring*
33. *Valve body*
34. *Valve spring*
35. *Gasket.*

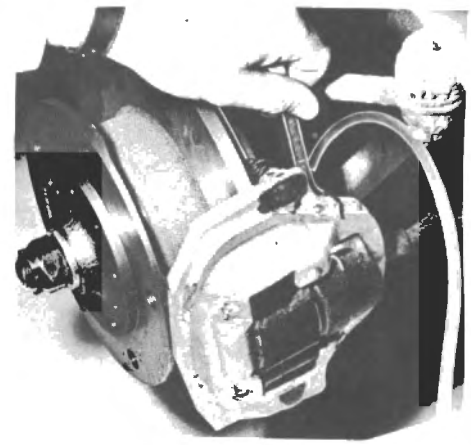


Fig. J:26 Front bleed valve

Fig. J:27 Rear bleed valve

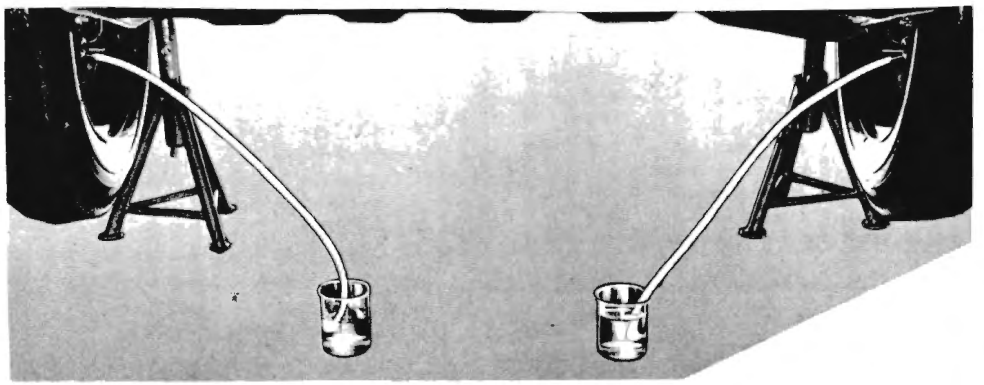


Fig. J:28 Bleeding the rear brakes

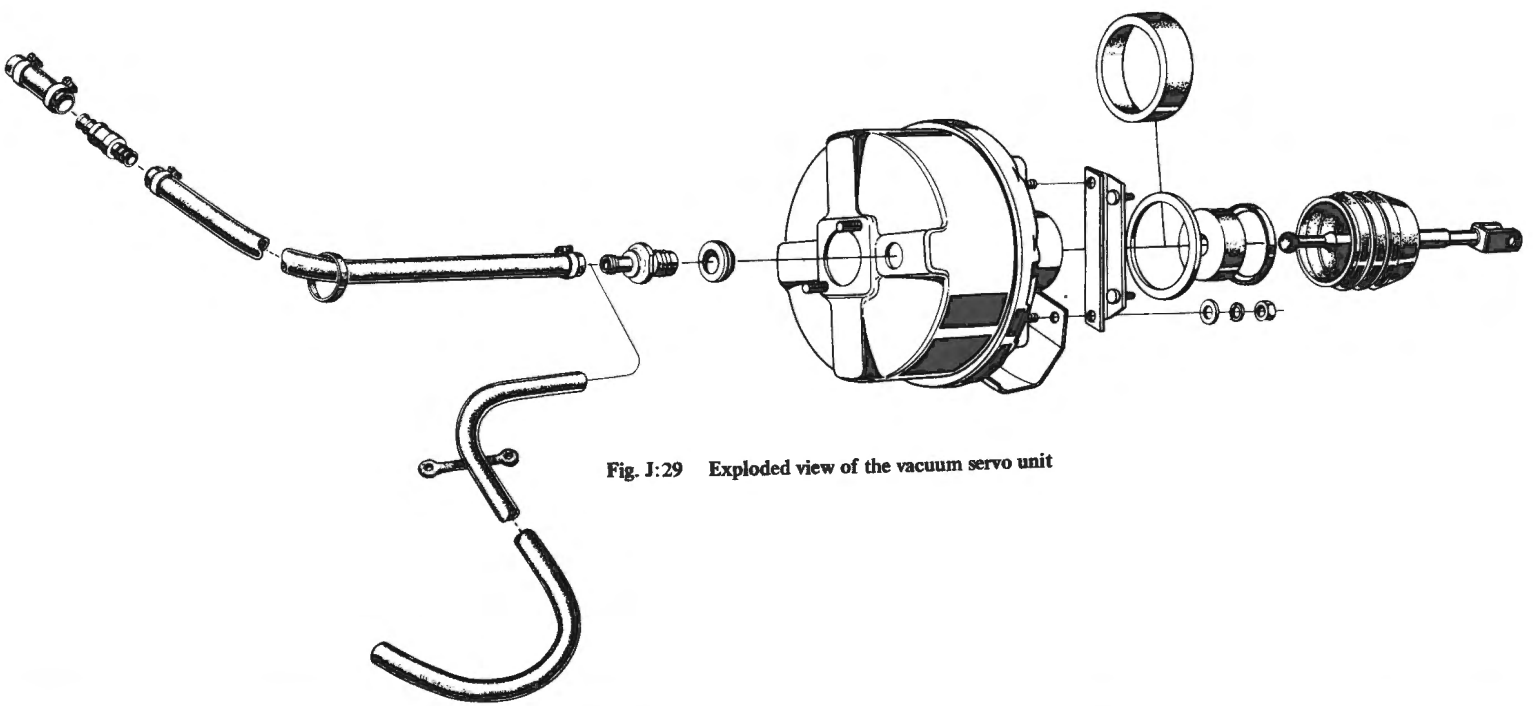


Fig. J:29 Exploded view of the vacuum servo unit

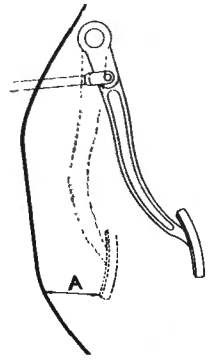


Fig. J:30 Minimum pedal to toe-board dimension - models 1967 - 68
A = 2.3 in (58 mm)

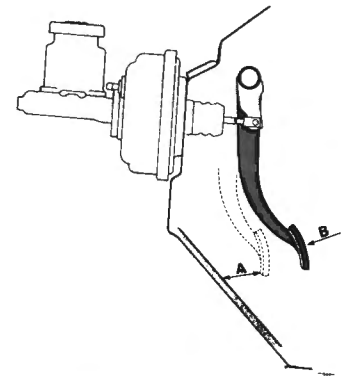


Fig. J:31 Minimum pedal to toe-board dimension - models 1969 onwards
A = 2.3 in (58 mm)

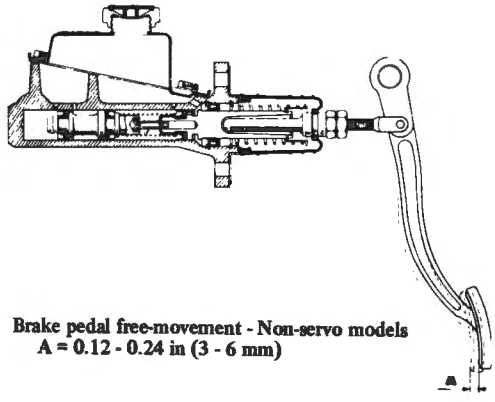


Fig. J:32 Brake pedal free-movement - Non-servo models
A = 0.12 - 0.24 in (3 - 6 mm)

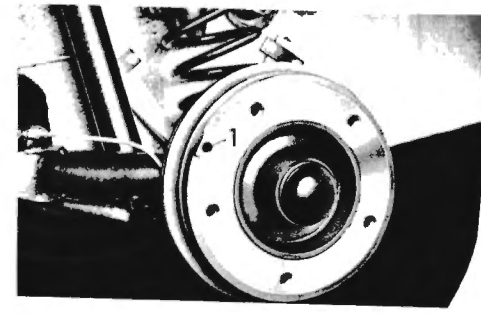


Fig. J:33 Rear brake inspection hole

pedal is still "spongy" or goes right down to the floor, it will be necessary to bleed the system again as this indicates that air is still present in the system.

BRAKE PEDAL

Non-Servo Models :

Free play, measured at the tip of the brake pedal, should be 0.12 - 0.24 in (3 - 6 mm). If adjustment is necessary, release the locknut on the master cylinder push rod and adjust the length of the push rod until the correct amount of free play is obtained (Fig. J:32). Tighten the locknut.

All Models :

The distance between the toe-board and the brake pedal when fully depressed should be a minimum of 2.3 in (58 mm). If the dimension is less than that specified this is indicative that the rear brakes require adjustment or the rear shoes are excessively worn (Figs. J:30 & J:31).

Technical Data

Foot brake	Disc front, drum rear (servo on LHD models from 1969)
Hand-brake	Operates mechanically on rear wheels only
Hydraulic system	Dual circuit, diagonal wheels paired
Type	Lockheed

FRONT BRAKES :

Type	Disc, single operating cylinder
Disc diameter	10.5 in (266.7 mm)
Max. permissible disc run-out	0.08 in (0.2 mm)
Operating cylinder bore	2 in
Min. permissible friction pad lining thickness	0.06 in (1.5 mm)
Brake hose length	8 1/2 in

REAR BRAKES :

Type	Drum, leading & trailing shoe
Drum diameter	8 in (203.2 mm)
Max. permissible drum out-of-round	0.006 in (0.15 mm)
Max. permissible drum taper	0.006 in (0.15 mm)
Max. permissible drum diameter	8.06 in (204.7 mm)
Brake shoe friction lining dimensions	8 x 1 1/2 in
Min. permissible friction lining thickness	0.1 in (1.5 mm)
Wheel cylinder bore :	
96 & Monte Carlo	5/8 in
95, prior to 1970	3/4 in
95, from 1970	5/8 in

BRAKE HOSE LENGTH :

96 & Monte Carlo	8 1/2 in
95	6 1/2 in

MASTER CYLINDER :

Cylinder bore :	
Prior to 1969	3/4 in
From 1969	13/16 in
Piston to push rod clearance	0.014 - 0.047 in (0.6 - 1.2 mm)
Freeplay at brake pedal	0.12 - 0.24 in (3 - 6 mm)
Vacuum - servo :	
Make	Lockheed
Type	4258 - 193
Brake fluid :	
Specification	SAE 70 R 3 (e.g. Lockheed Super Heavy Duty Brake Fluid).

Electrical Equipment

GENERAL

The electrical system is a 12 volt type with negative ground polarity. The system comprises an ignition system, a charging system, a starting system, a lighting system and an auxiliary equipment system. The ignition system has already been dealt with in the "IGNITION SYSTEM" section.

The charging system comprises a battery, an alternator and a voltage regulator. The battery is of the lead-acid type with a capacity of 44 amp/hr. The alternator is of Bosch manufacture and although the designation remains the same for all models, as from chassis Nos 95/47.296 and 96/443.387 the design was slightly modified as can be seen from the exploded views of the units included in this section. The voltage regulator is a separate unit.

A starter motor, a starter relay and a starter switch make up the starting system. The starter motor is of the pre-engaged type and, as the name implies, engages the ring gear on the engine flywheel before beginning to rotate and does not disengage until the starter control is released. The starter relay is incorporated in the starter motor, being energised with the start position of the ignition switch.

The lighting system consists of the driving lights, the direction indicator lights and the stop lights. The driving lights include the headlights, front parking lights, rear license plate light and the tail lights. The latter are combined in an assembly with the stop lights on estate models prior to 1969, and with the stop and rear direction indicator lights on all other models. On early estate models, the rear direction indicators are contained in a separate light assembly. As from 1969, on estate models, except USA versions, the rear light assembly also incorporates reversing lights. The front parking lights and direction indicator lights are also combined in a single assembly although the design of the unit has been altered during production. The headlights are normally of the asymmetric-beam type, but North American models are fitted with sealed-beam units. As from 1969, the former type of headlights are rectangular in shape. An emergency warning device which enables all the direction indicator lights to be operated simultaneously is fitted to all models from 1969 onwards.

ROUTINE MAINTENANCE

Every 6.000 miles (10.000 km)

Check the battery electrolyte level (this should also be checked frequently as a normal procedure during day-to-day running).

Clean the battery terminals and the exterior of the battery.

Check all lights for correct function and check the alignment of the headlights.

CHARGING SYSTEM – Precautionary Service Notes :

It is essential that the following notes be observed when carrying out maintenance or repairs on a charging system which includes an alternator.

1 Never remove the alternator without first disconnecting the battery.

2 Never disconnect or connect the battery while the alternator is running otherwise damage to the voltage regulator may occur.

3 Never run the alternator with the battery disconnected and the field winding energised otherwise the voltage regulator may be damaged.

4 When installing the battery, always ensure that the correct terminal is connected, to ground. Reversal of the battery connections may damage the alternator diodes.

5 Never allow the alternator output cable to ground if it is disconnected at the alternator. If this cable grounds with the ignition switched on, the voltage regulator and the associated wiring may be damaged.

6 Never allow the alternator output cable or terminal to ground as damage to the alternator and / or the alternator circuit may result, even when the ignition is switched off.

7 Never allow the field terminal of the alternator or the connecting lead to ground.

8 No attempt should be made to polarise the alternator. This is not necessary and any attempt to do so may result in damage to the alternator, voltage regulator or associated wiring.

9 Never use the regulator terminal on the alternator as a source for running lights or other accessories otherwise the voltage regulator will be adversly affected.

10 Never use an ohmmeter of the type incorporating a hand-driven generator to check the alternator diodes. Only D.C. not exceeding 24 volts should be used when testing.

11 If arc welding is to be carried out on the vehicle, disconnect the alternator and the voltage regulator to avoid possible damage.

12 Always disconnect the positive lead from the battery before using a fast battery charger. The charger must always be connected in parallel with the battery, positive to positive, negative to negative.

13 When using a starting unit, the voltage must not exceed the charging system voltage or damage to the battery, alternator or starter will result. A fast charger must never be used as a booster unit for starting because of the accompanying high voltage. After the engine has started, always disconnect the negative cable.

14 To avoid damaging the bearings when adjusting the drive belt tension, apply leverage only on the drive end bracket of the alternator, not on any other part.

BATTERY

Electrolyte Level :

The level of the electrolyte in the battery should be checked periodically and topped up with distilled water as required. In emergency it is possible to use melted snow, rain water or plain drinking water free of high mineral content. Add water as required to each cell so that the electrolyte is 0.4 in, (10 mm) above the plates. DO NOT OVERFILL. The engine should be operated immediately after adding water, particularly in cold weather, to assure proper mixing of the water and the acid.

Sulphuric acid of the correct concentration should be added only if the specific gravity of the electrolyte needs to be corrected as a result of leakage or drainage from the battery.

Exterior :

The external condition of the battery and the cable terminals should be checked periodically. If the top of the battery is contaminated by acid film and dirt between the battery terminals, wash with a diluted ammonia or soda solution to neutralise any acid present and then flush with water. Care must be taken to keep the vent plugs tight so that the neutralising solution does not enter the cells.

To ensure good contact, the battery cables should be tight on the battery posts. If the battery posts or cable terminals are corroded, the cables should be disconnected and the terminals and posts cleaned with a soda solution and a wire brush. After the cables are reconnected to the battery posts, a thin coating of petroleum jelly should be applied. The battery ground cable and the engine ground strap should be inspected for proper connection and condition.

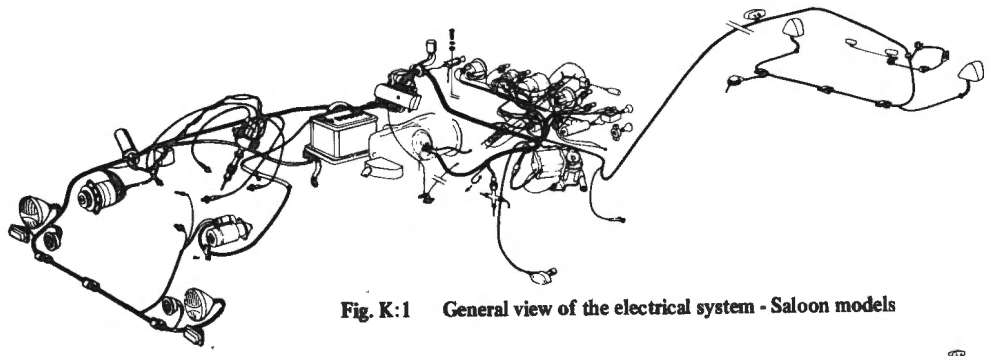


Fig. K:1 General view of the electrical system - Saloon models

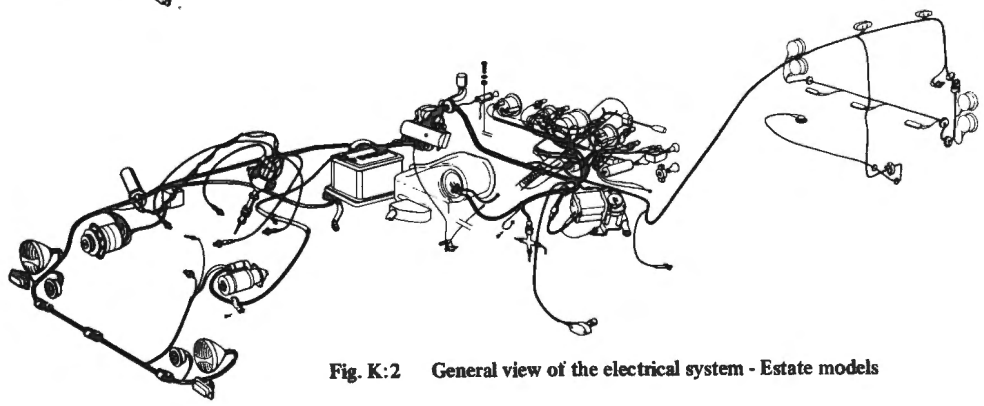


Fig. K:2 General view of the electrical system - Estate models

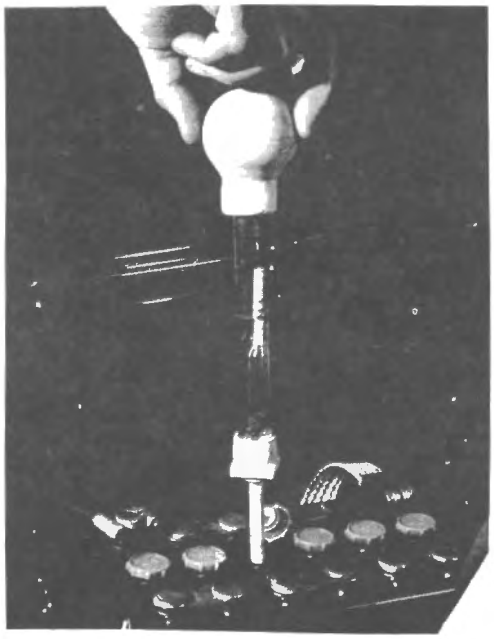


Fig. K:3 Checking the battery specific gravity

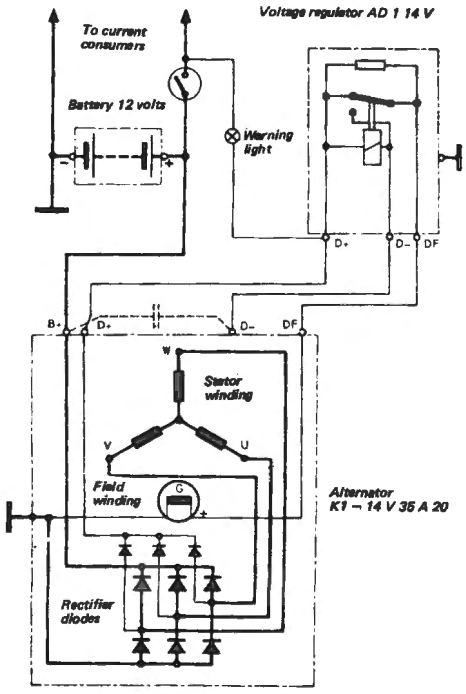


Fig. K:4 Alternator wiring diagram

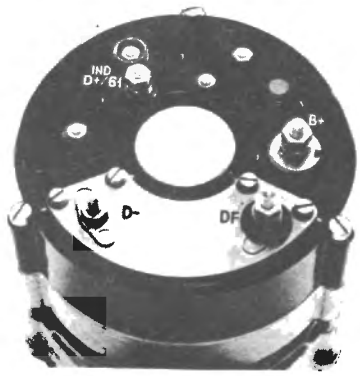


Fig. K:5 Alternator terminals - Early type alt.

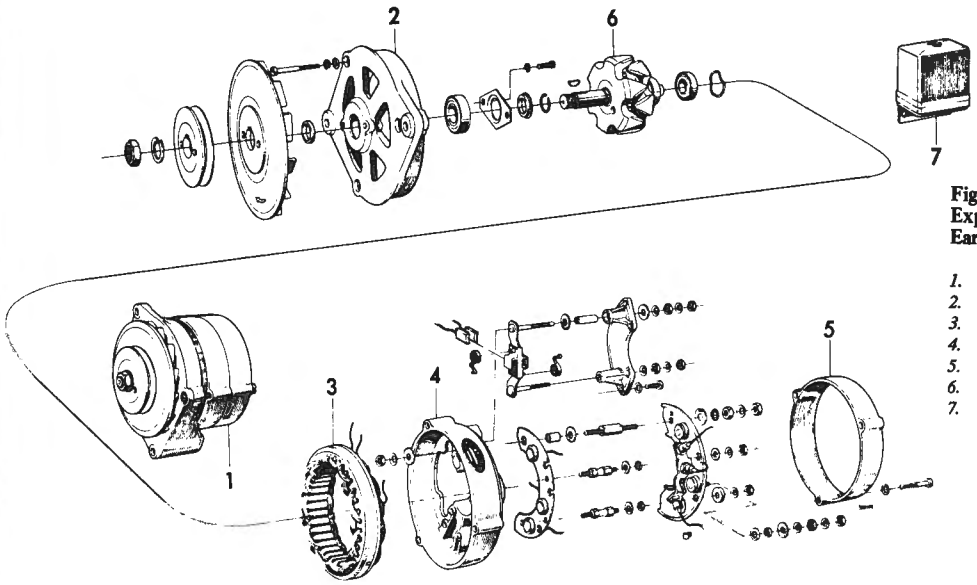


Fig. K:6
Exploded view of the alternator - Early type

1. *Alternator*
2. *Front housing*
3. *Stator*
4. *Rear housing*
5. *Protective cover*
6. *Rotor*
7. *Voltage regulator*

Fig. K:7 Removing the brush holder plate - Early type alt.

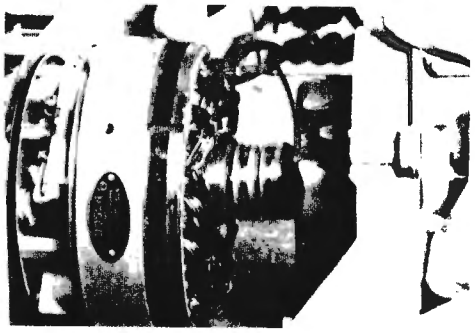


Fig. K:8 Removing the front housing and rotor - Early type alt.

Specific Gravity :

The specific gravity of the electrolyte is a good indication of the state of charge of the battery. Prior to testing, inspect the battery for any damage (broken casing, cover, loose post etc.) that would make the battery unserviceable. Check the specific gravity of each cell with a hydrometer, drawing enough electrolyte into the hydrometer to make the scale float (Fig. K:3). If the electrolyte level is less than 0.4 in (10 mm) above the plates, distilled water should be added and the battery charged for at least one hour before carrying out the check.

The following table relates the specific gravity to the battery condition at 16°C (60°F).

Hydrometer Reading	Battery Condition
1.280	Fully charged
1.240	75% charged
1.200	50% charged
1.160	25% charged
1.120	Discharged

If the electrolyte temperature varies from 16°C (60°F), adjust the reading obtained by adding 0.004 ° for every 5 1/2 °C (10°F) above 16°C and by substracting 0.004° for every 5 1/2°C below 16°C.

If the readings are reasonably uniform, the battery is probably healthy, although low readings indicate charging is required. If one cell is about 0.030 lower than the rest it is probalby failing. An extended charge may revive it. If the readings are irregular with one or more cells 0.050 lower than the rest, the battery is not fit for further use and should be replaced.

Charging :

Slow charging is the preferred method of recharging a battery as it may be safely used regardless of the charge condition of the battery, provided that the electrolyte is at the proper level in all the cells. The charging rate should not exceed 2.5 amps. A minimum of 24 hours is required when using this method. The vent plugs must be removed when charging is being effected as the electrolyte boils due to decomposition of the water. A battery is fully charged when all the cells are gassing freely and three corrected readings of the specific gravity, taken at hourly intervals, indicate no increase in specific gravity. The cell voltage should be 2.5 - 2.7 volts without load.

If fast-charging the battery, the precautions given above for slow-charging are even more important. A battery may be charged at any rate which does not cause the electrolyte temperature to exceed 52°C (125°F) and which does not cause excessive gassing and loss of electrolyte.

DO NOT attempt to charge a battery with frozen electrolyte as this may cause the battery to explode.

FAULTS IN THE CHARGING SYSTEM

The charging indicator light on the instrument cluster can give a reasonable indication of the operation of the charging system. If the bulb goes out when the ignition is switched off, on when the ignition is switched on and extinguishes again once the engine is running. The circuit is operating normally.

If the bulb remains brightly illuminated with the engine running at speed, check the condition and adjustment of the alternator drive-belt. Check the lead connections at the voltage regulator.

If the bulb is now off, test the state of charge of the battery and recharge as required. Persistant illumination of the indicator bulb indicates a fault in the voltage regulator or the alternator. Alternator output tests will isolate a faulty voltage regulator but, since specialised knowledge and equipment are necessary to perform these tests, the work should be entrusted to an automotive electrician. A cure MAY be effected by replacing the alternator brush assembly and/or substituting the voltage regulator for a known good unit, otherwise the alternator must be removed for further inspection and testing.

If the indicator bulb is dimly lit with the engine running at speed, a high resistance in the circuit is indicated. Check for loose or corroded terminals or damaged wires. Otherwise check the alternator and regulator as above.

ALTERNATOR OUTPUT TESTS

Specialised knowledge and equipment are required to perform these tests. It is recommended therefore, that if a fault is suspected in the charging system reference should be made to an automotive electrical specialist.

VOLTAGE REGULATOR

Although a separate component, the regulator is an integral part of the charging system. As for the alternator, any testing procedures should be entrusted to a specialist. Should a fault be suspected in the regulator, first check the battery condition, the drive belt tension and all connections. If the fault persists, professional advice should be sought.

ALTERNATOR – General :

Reference should be made to the Precautionary Service Notes given at the beginning of this section before carrying out any maintenance or overhaul procedures on the charging system.

Because of its design, the alternator requires little maintenance. Although the complete overhaul procedure is detailed below, work of this nature should only be attempted by competent personnel as even a minor inadequacy could result in serious damage to the alternator. If in doubt, refer any repair operations to an automotive electrical specialist.

At the rear of the alternator are four terminals (Fig. K:5 - early type; Fig. K:12 - late type). The leads to these four terminals must NOT be interchanged otherwise serious damage to the alternator may result. The terminals are as follows :—

D+/61	:	Diode output terminal, connects to regulator D+ terminal and the charge indicator light.
DF	:	Field terminal, connects to the regulator DF terminal.
B+	:	Main output terminal, connects to battery + terminal.
D–	:	Ground terminal, connects to regulator D– terminal.

Removal and Installation :

With the engine stopped and the ignition switched off, disconnect the battery leads. Disconnect the leads from the terminals at the rear of the alternator. Slacken the two mounting bolts and the adjusting bolt. Push the alternator towards the engine and lift the drive belt off the pulley. Fully remove the adjusting and mounting bolts and lift out the alternator.

Installation is the reverse of the removal procedure. Adjust the position of the alternator so that the drive-belt has a total free-movement of 0.3 in (7 mm) on the longest span, midway between the two pulleys (see Fig. B:6). To avoid damaging the bearings, apply leverage only on the drive end bracket, not on any other part. Tighten the adjusting and mounting bolts securely.

ALTERNATOR – EARLY TYPE (Fig. K:6)

Inspection and / or Replacement of the Brushes :

Remove the protective cover ring from the rear of the alternator. Remove the four bolts and detach the brush holder plate complete with brushes (Fig. K:7). If the brushes are worn to a length of 0.34 in (9 mm) or less, they must be replaced. Unsolder the brush leads and remove the brushes. When soldering on the new brush connections ensure that the solder does not flow into the cable (Fig. K:10). Assemble in the reverse order of removal.

Overhaul :

Unscrew the pulley retaining nut and withdraw the drive pulley and cooling fan from the rotor shaft. Remove the protective cover ring from the rear of

Fig. K:9 Pressing in the slip-ring end bearings

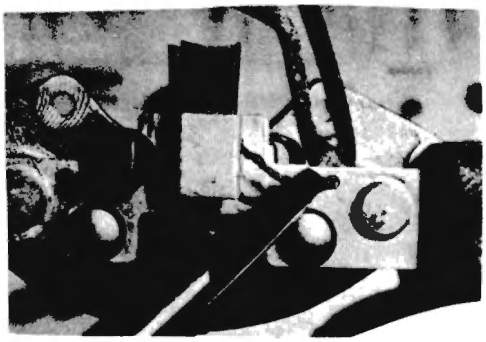


Fig. K:10 Soldering the brush connections - Early type alt.

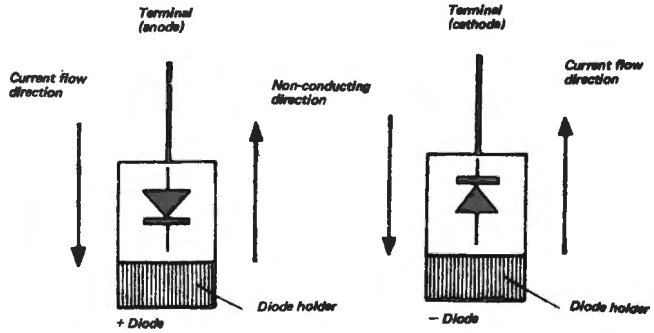


Fig. K:11 Checking the current flow in the rectifier diodes

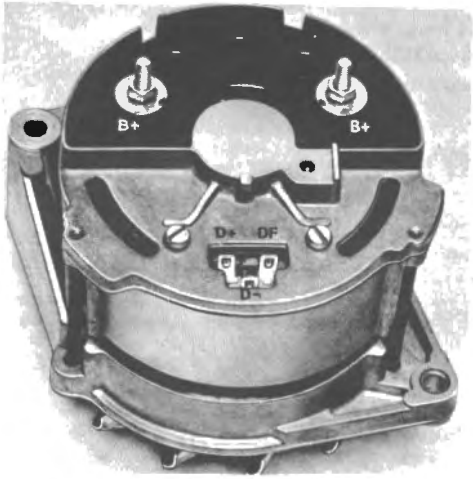


Fig. K:12 Alternator terminals - Late type alt.

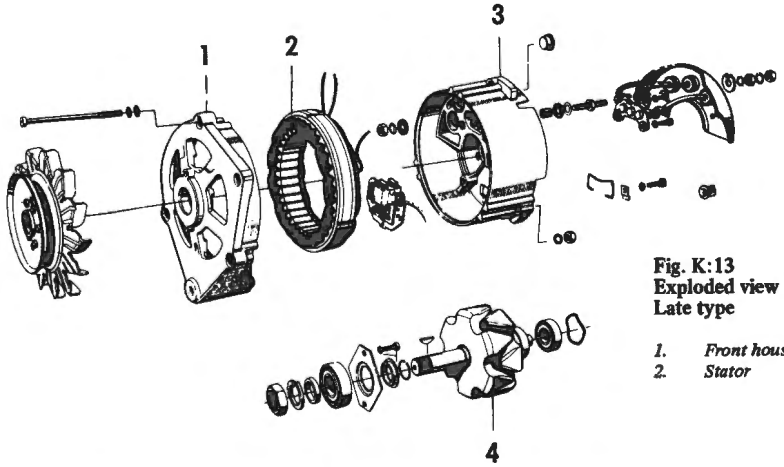


Fig. K:13
Exploded view of the alternator - Late type

1. *Front housing*
2. *Stator*
3. *Rear housing*
4. *Rotor*

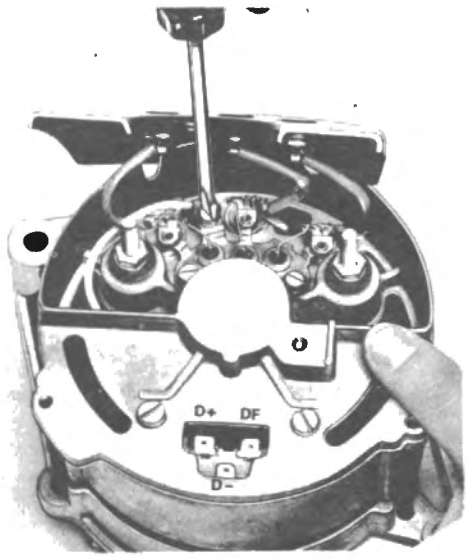


Fig. K:14 Disconnecting the brush holder leads - Late type alt.

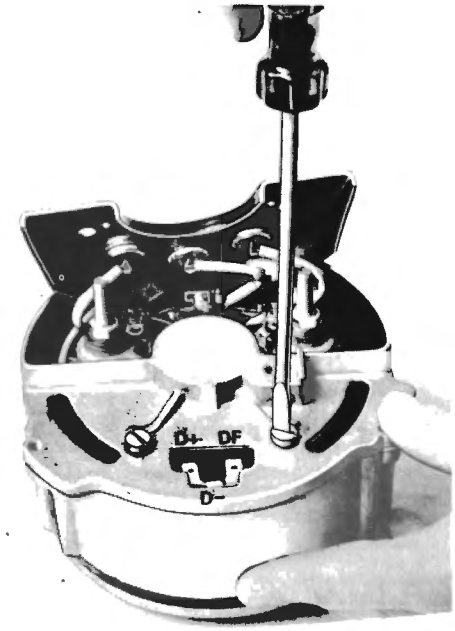


Fig. K:15 Releasing the brush holder retaining screws - Late type alt.

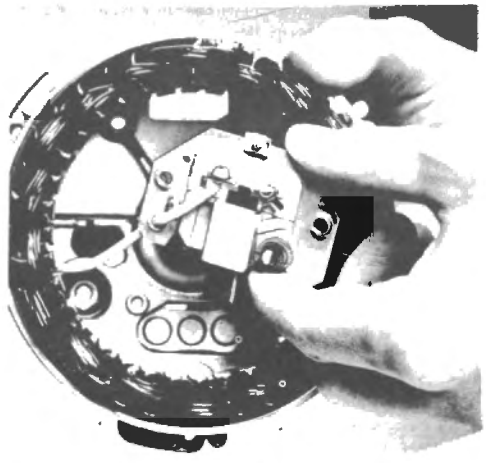


Fig. K:16 Removing the brush holder - Late type alt.

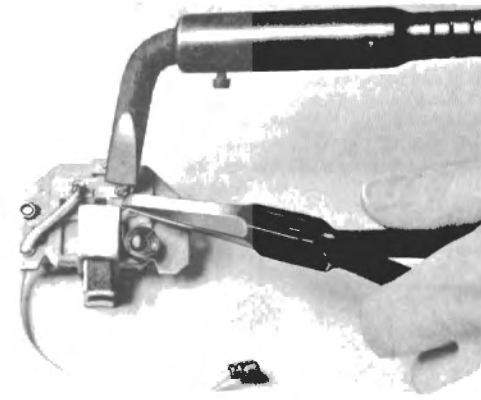


Fig. K:17 Unsoldering the brush connections - Late type alt.

the alternator. Detach the brush holder plate complete with brushes (Fig. K:7). Mark the relative positions of the front housing, rear housing and stator with a centre punch or file to facilitate alignment on reassembly. Remove the three retaining screws from the front housing and separate the rotor and front housing from the stator and rear housing (Fig. K:8).

If necessary, press the rotor out of the front housing. The bearing can then be removed from the housing by unscrewing the four bolts securing the bearing retainer plate. The bearing at the slip ring end of the rotor can be removed using a suitable puller.

Rotor :

Check the resistance of the rotor windings by connecting an ohmmeter between the slip rings. The resistance should be 4.0 ± 0.40 ohms. If an ohmmeter is not available, an ammeter and a 12 volt battery can be used instead. The ammeter reading should be 2.8 amps.

Next test the rotor insulation, using a 110 volts A.C. supply and a 15 watt test lamp. Connect the lamp between one of the slip rings and one of the rotor poles. The lamp should not light. If it does, replace the rotor.

Stator :

The stator leads must be disconnected before carrying out the following tests.

Test the stator windings for continuity using a 12 volt battery and a test lamp of at least 36 watts. Connect the lamp and battery in series with any two of the three stator leads. Repeat the test with the two other combinations of leads. The test lamp must light during all three tests. Replace the stator if this is not the case.

Using the same test equipment, connect one lead to one of the stator cables and the other to the stator casing. If the lamp lights up, the stator windings are earthed and the stator must be replaced.

Diodes :

The diode leads must be completely detached from the phase terminals before performing the following tests. Use a pair of long-nose pliers as a heat sink when unsoldering the connections, as the diodes are heat-sensitive and can be easily damaged. Release the connections quickly with a hot soldering iron.

Connect each of the diodes in turn in series with a 1.5 watt test lamp and 12 volt battery. Connect one of the test leads to one of the diode leads and the other test lead to the diode heat sink. Note the behaviour of the test lamp. Reverse the connections and repeat the test. The test lamp should light up in one direction only. A diode that passes current in both directions has brobably been subjected to excessive voltage and must be replaced.

Slip Rings :

The faces of the slip rings must be smooth and clean. If necessary, polish the contact faces with very fine glass paper. Never attempt to machine the slip rings.

Reassembly of the alternator is the reverse of the dismantling procedure. When pressing the bearing into the front housing, the enclosed side of the bearing should face towards the outside of the housing. The rotor bearing at the slip ring end of the shaft should also be fitted with the enclosed side facing the slip rings (Fig. K:9). Ensure that the marks made previously on the two end housings and the stator are aligned before securing the assembly with the retaining screws. Tighten the drive belt pulley retaining nut to a torque of 25 - 29 lb.ft (3.5 - 4.0 kg.m).

ALTERNATOR – LATE TYPE (Fig. K: 13)

Inspection and / or Replacement of the Brushes

Mark the relative positions of the front housing, rear housing and stator with a centre punch or file to ensure correct alignment on reassembly. Remove the three retaining screws from the front housing and separate the rotor and front housing from the stator and rear housing. The brushes can now be inspected from inside the rear housing. If the brushes are worn to a length of 0.34 in (9 mm) or less, they must be replaced.

To replace the brushes, undo the two nuts securing the diode heat sink plate to the rear housing. Release the screw securing the brush plate lead (Fig. K:14). Release the two screws securing the brush holder plate to the rear housing (Fig. K:15) and remove the brush holder plate from inside the housing (Fig. K:16). Unsolder the brush leads from the plate and remove the brushes. When soldering on the new brushes ensure that the solder does not flow into the cable (Fig. K:17). Assemble in the reverse order of removal. When installing the rotor, care should be taken to avoid damaging the brushes.

Overhaul :

Unscrew the pulley retaining nut and withdraw the drive pulley and cooling fan from the rotor shaft. Mark the relative positions of the front housing, rear housing and stator with a centre punch or file to ensure correct alignment on reassembly. Remove the three retaining screws from the front housing and separate the rotor and front housing from the stator and rear housing.

If necessary, press the rotor out of the front housing. The bearing can be removed from the housing by unscrewing the four bolts securing the bearing retainer plate. The bearing at the slip ring end of the rotor can be removed using a suitable puller.

The brush holder and brushes can be removed as described above for replacement of the brushes.

Testing :

The rotor, stator and diodes are tested in the same manner as already described for the early type alternator.

Reassembly of the alternator is the reverse of the dismantling procedure. When pressing the bearing into the front housing, the enclosed side of the bearing should face towards the outside of the housing. The rotor bearing at the slip ring end of the shaft should also be fitted with the enclosed side facing the slip rings (Fig. K:9). When installing the rotor in the rear housing, care should be taken to avoid damaging the carbon brushes. Ensure that the marks made previously on the two end housings and the stator are aligned before securing the assembly with the retaining screws. Tighten the drive belt pulley retaining nut to a torque of 25 - 29 lb.ft (3.5 - 4.0 kg.m).

STARTER MOTOR (Fig. K:18)

Removal and Installation :

Disconnect the battery leads. Disconnect the leads from the terminals on the starter motor and solenoid. Unscrew the two retaining nuts and bolts and withdraw the starter motor.

Installation is the reverse of the removal procedure. Make sure that the terminals are clean and that the leads are securely tightened.

Inspection and / or Replacement of the Brushes :

Remove the two screws securing the protective end cap to the commutator end cover and remove the end cap, U-shaped washer, shims and rubber sealing ring. Unscrew the two through-bolts at the commutator end cover and remove the cover. Check the condition of the brushes. If the brushes are so worn that the spring rests against the stop, new ones must be fitted.

To replace the brushes, lift the brush springs using a piece of hooked wire and pull the brushes out of their holders. Remove the brush holder plate. Unsolder the brush leads from the brush holder plate and the field windings and remove the brushes. Solder the leads of the new brushes to the brush holder plate and the field windings (Fig. K:19).

Check the condition of the commutator. The contact should be smooth and dark grey in colour. If the surface is contaminated with oil or grease, clean it with a cloth moistened in white spirit, drying thoroughly afterwards. If necessary, the surface can be polished with very fine glass paper. NEVER use emery cloth for this purpose.

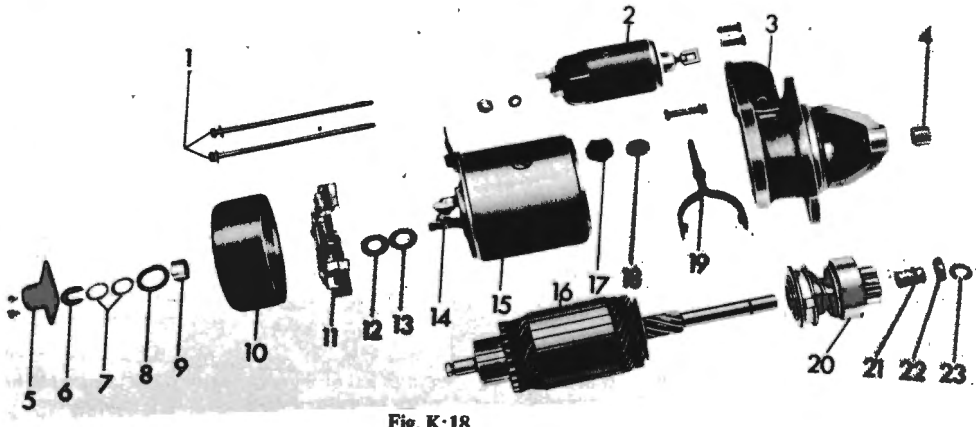


Fig. K:18
Exploded view of the starter motor

1. *Through-bolts*
2. *Solenoid switch*
3. *Drive end bracket*
4. *Drive end bearing bush*
5. *End cover*
6. *U-shaped washer*
7. *Shims*
8. *Rubber sealing ring*
9. *Commutator end bush*
10. *Commutator end cover*
11. *Brush plate assembly*
12. *Fibre washer*
13. *Steel washer*
14. *Field winding*
15. *Frame*
16. *Armature*
17. *Rubber plug*
18. *Steel washer*
19. *Pinion engagement lever*
20. *Drive pinion*
21. *Pinion bearing bush*
22. *Circlip retaining ring*
23. *Circlip.*

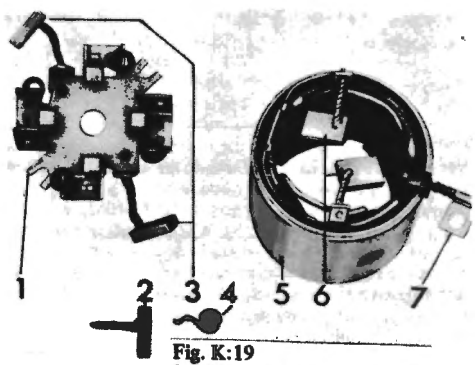


Fig. K:19
Starter motor brush assembly

1. *Brush holder plate*
2. *Brush*
3. *Ground brushes*
4. *Brush spring*
5. *Starter frame*
6. *Field brushes*
7. *Field winding lead.*

Fig. K:20 Tapping down the circlip retaining ring

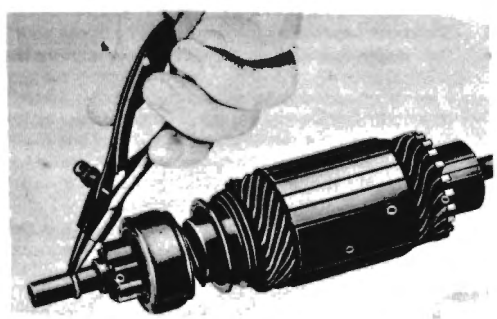


Fig. K:21 Removing the drive pinion circlip

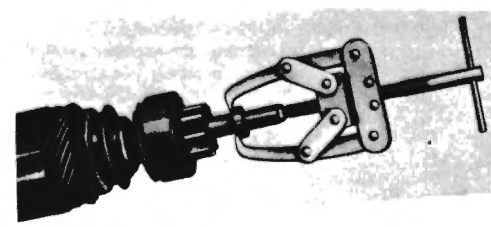


Fig. K:22 Pulling the circlip retaining ring up into position

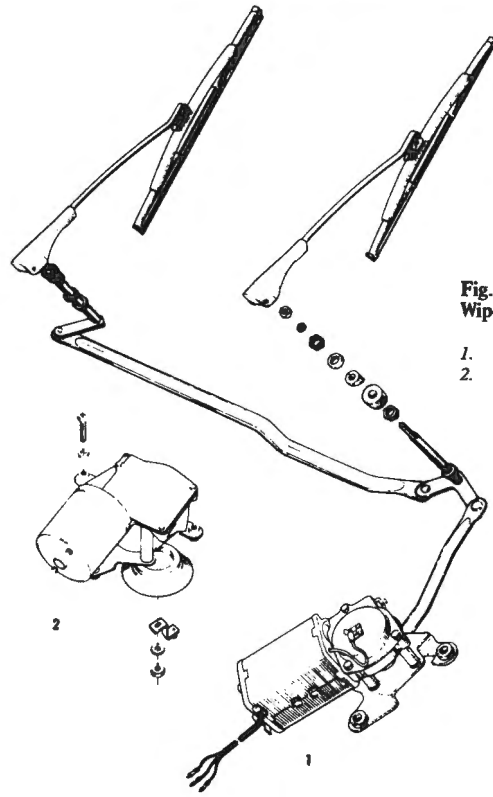


Fig. K:23
Wiper assembly

1. *Wiper motor prior to 1970*
2. *Wiper motor 1970 onwards.*

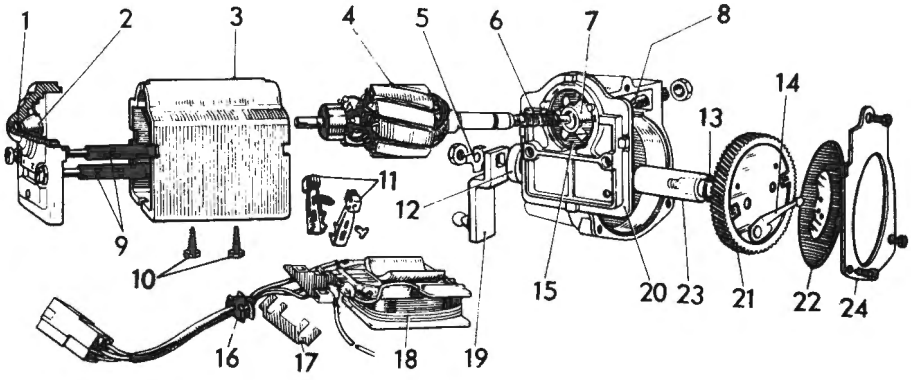


Fig. K:24
Exploded view of the wiper motor - Models prior to 1970

1. *Thrust pad*
2. *Self-aligning spherical bearing*
3. *Frame*
4. *Armature*
5. *Tab lock washer*
6. *Worm gear*
7. *Self-aligning spherical bearing*
8. *End-play adjuster and thrust pad*
9. *Through-bolts and insulating sleeves*
10. *Pole piece securing screws*
11. *Brush gear*
12. *Bushing*
13. *Washer*
14. *Limit switch moving contact*
15. *Bearing retaining ring*
16. *Grommet*
17. *Brush lever retainer*
18. *Field windings*
19. *Linkage operating crank*
20. *Drive end bracket*
21. *Drive gear*
22. *Limit switch fixed contact plate*
23. *Porous bronze bushing*
24. *Gearbox cover*

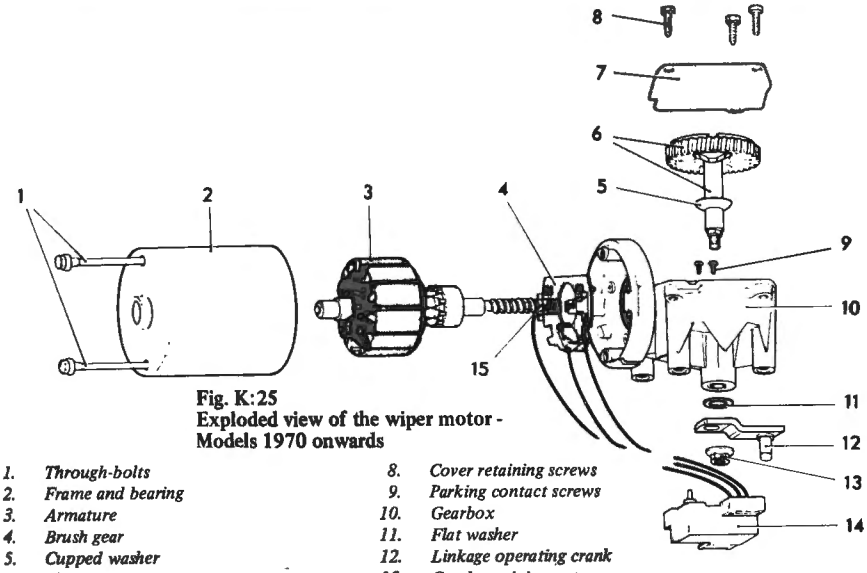


Fig. K:25
Exploded view of the wiper motor - Models 1970 onwards

1. *Through-bolts*
2. *Frame and bearing*
3. *Armature*
4. *Brush gear*
5. *Cupped washer*
6. *Shaft and drive gear*
7. *Gearbox cover*
8. *Cover retaining screws*
9. *Parking contact screws*
10. *Gearbox*
11. *Flat washer*
12. *Linkage operating crank*
13. *Crank retaining nut*
14. *Parking contact.*

Fig. K:26 Fuse block

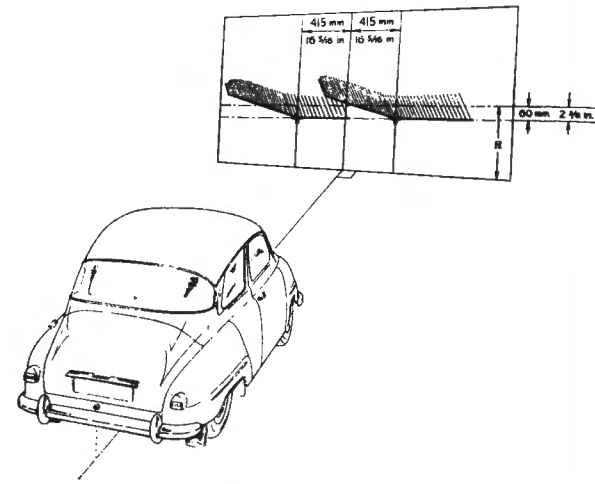


Fig. K:27 Alignment diagram for left-dipping asymmetric headlights - models prior to 1969
H = Height of headlight centre-line

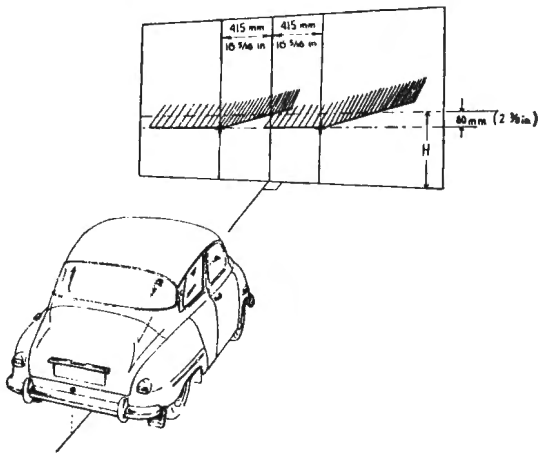


Fig. K:28 Alignment diagram for right-dipping asymmetric headlights - models prior to 1969
H = Height of headlight centre-line

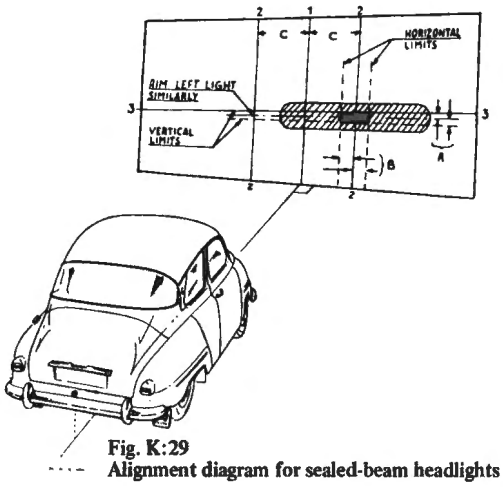


Fig. K:29
Alignment diagram for sealed-beam headlights

1. *Vehicle centre-line*
2. *Headlight vertical centre-line*
3. *Headlight horizontal centre-line*
   A = 2 in (50 mm)
   B = 6 in (150 mm)
   C = 16 5/6 in (415 mm).

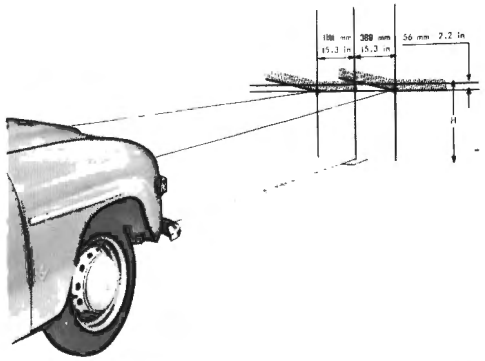


Fig. K:30 Alignment diagram for left-dipping asymmetric headlights - models 1969 onwards
H = Height of headlight centre-line

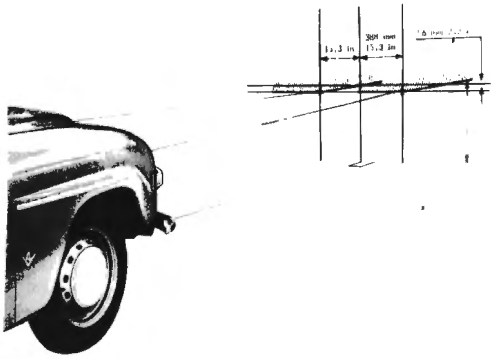


Fig. K:31 Alignment diagram for right-dipping asymmetric headlight - models 1969 onwards
H = Height of headlight centre-line

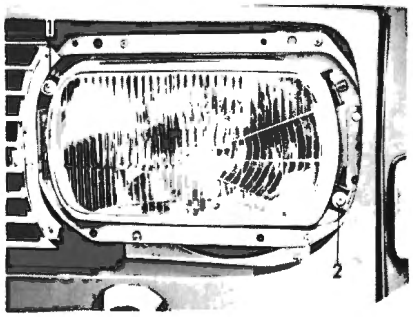


Fig. K:32
Headlight adjusting screws - Models 1969 onwards.

1. *Horizontal adjustment screw*
2. *Vertical adjustment screw.*

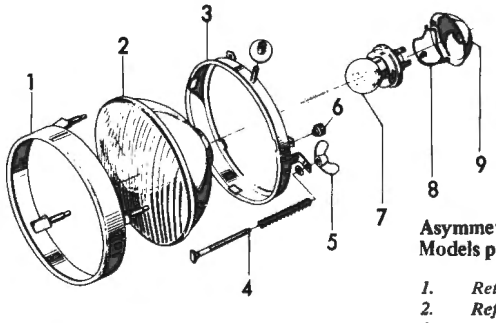


Fig. K:33
Asymmetric headlight assembly - Models prior to 1969.

1. *Retainer ring*
2. *Reflector unit*
3. *Adjusting ring*
4. *Adjusting screw*
5. *Adjusting nut*
6. *Retaining nut*
7. *Twin-filament bulb*
8. *Retaining spring*
9. *Rubber seal.*

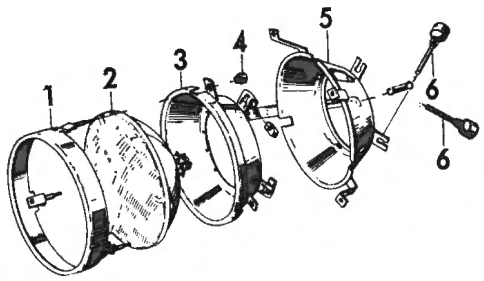


Fig. K:34
Sealed-beam headlight assembly - Models prior to 1969

1. *Retainer ring*
2. *Sealed-beam unit*
3. *Adjusting ring*
4. *Retaining nut*
5. *Cradle*
6. *Adjusting screws.*

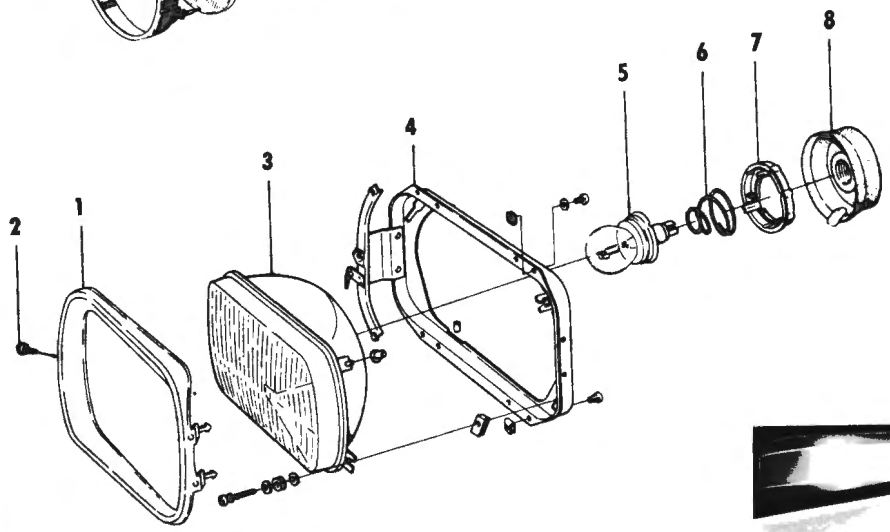


Fig. K:35
Asymmetric headlight assembly - Models 1969 onwards.

1. *Bezel*
2. *Bezel retaining screw*
3. *Reflector unit*
4. *Cradle*
5. *Twin-filament bulb*
6. *Spring*
7. *Bayonet ring*
8. *Rubber sealing cap.*

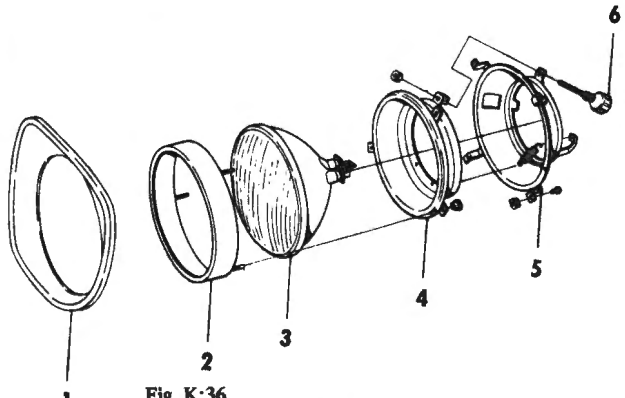


Fig. K:36
Sealed-beam headlight assembly - Models 1969 onwards.

1. *Bezel*
2. *Light unit retaining ring*
3. *Sealed-beam unit*
4. *Adjustment ring*
5. *Cradle*
6. *Adjusting screw.*

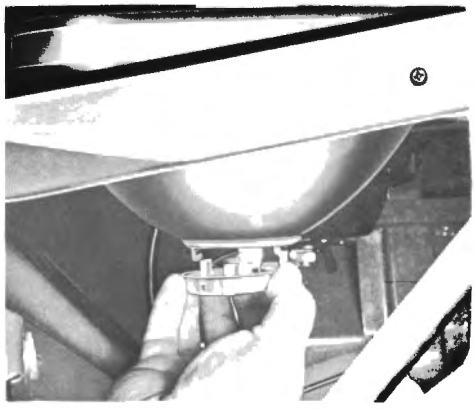


Fig. K:37 Changing the bulb, asymmetric type headlights - models 1969 onwards

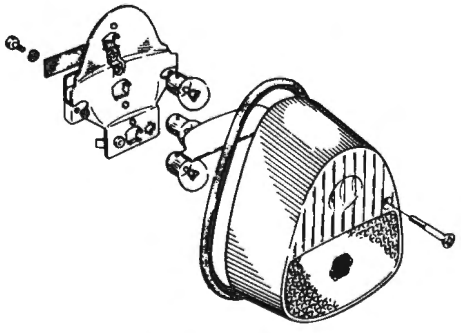


Fig. K:38 Rear light assembly - Saloon models

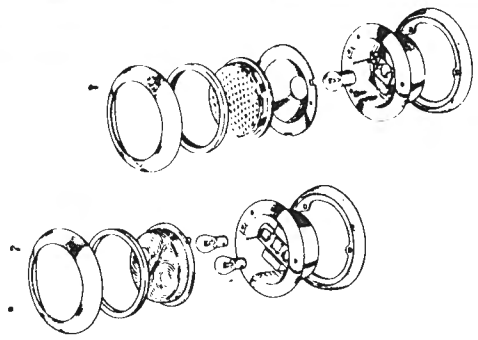


Fig. K:39 Rear light assembly - Estate models prior to 1969

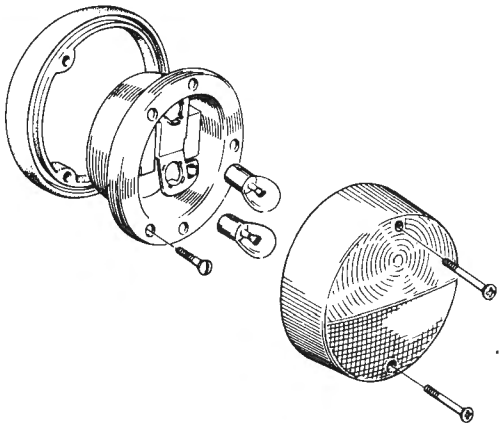


Fig. K:40 Rear light assembly - Estate models 1969 onwards

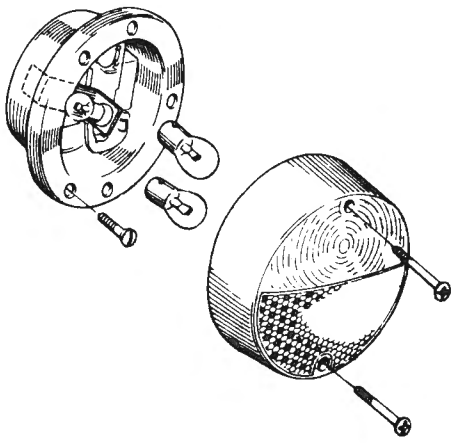


Fig. K:41 Rear light assembly - USA version estate car models 1969 onwards

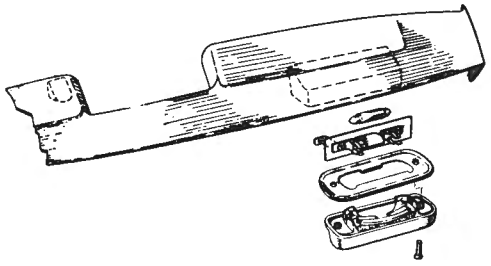


Fig. K:42 License plate light - Saloon models

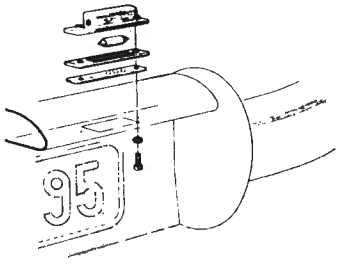


Fig. K:43 License plate light - Estate models

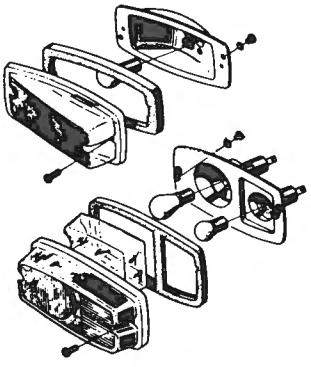


Fig. K:44 Front light assembly, standard and export versions - models prior to 1969

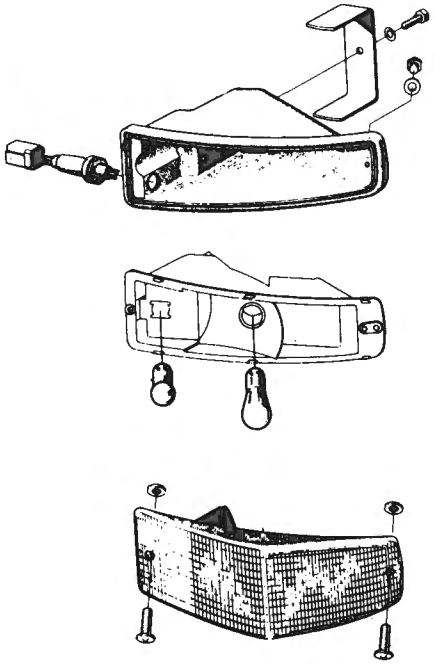


Fig. K:45 Front light assembly - models 1969 onwards

Fit the brush holder plate and check the new brushes for freedom of movement in their holders. If a brush tends to seize in its holder, wipe both the brush and holder clean with white spirit. DO NOT wipe the contact surface of the brush. Check the brush springs and renew if weak.

Position the spring ends on the brushes and check that the brushes locate correctly on the armature. Fit the commutator end cover, position it with the rubber insulator at the field winding lead and fit the rubber sealing ring, shims and U-shaped washer. Fit the protective end cap and secure it with the two retaining screws. Insert the two through-bolts and tighten securely.

Replacing the Drive Pinion :

Disconnect the field winding lead from the solenoid switch. Release the two screws securing the solenoid to the drive end bracket, unhook the switch plunger from the pinion engagement lever and remove the solenoid switch.

Remove the protective end cap, U-shaped washer, shims and rubber sealing ring from the commutator end cover. Unscrew the two through-bolts and remove the commutator end cover. Remove the pinion drive end bracket, armature and pinion from the starter frame. Release the locknut and withdraw the pinion engagement lever pivot pin. Remove the rubber plug and steel washer located at the solenoid switch mounting flange. Withdraw the armature, drive pinion and pinion engagement lever from the end bracket and lift the lever off the pinion assembly.

Hold the armature, suitably protected, in a vice and tap down the circlip retaining ring (Fig. K:20). Remove the circlip with a pair of circlip pliers (Fig. K:21) and withdraw the retaining ring and pinion assembly from the armature shaft.

Check the spiral threads on the armature shaft which engage the pinion for scores. If present, these may be removed by filling. The drive pinion and clutch assembly are serviced as an assembly and no attempt should be made to separate them. Lubricate the spiral threads on the armature shaft with silicon grease before fitting the new pinion.

Reassembly is the reverse of the above procedure. Lubricate the circlip retaining ring with silicone grease. Pull the ring up over the circlip on the armature shaft, once fitted, using a suitable puller (Fig. K:22). Remove the brushes from their holders before fitting the armature into the starter frame. Once installed, refit the brushes in EXACTLY the same positions as originally and lift the spring ends onto the brushes. Insert the steel washer first, at the solenoid mounting flange, and then the rubber plugs with the lug turned to face the starter frame.

Overhaul :

Dismantle the components as described above for replacing the brushes and drive pinion. If either of the bearing bushes are to be replaced, the new bushes should be soaked in warm engine oil for an hour before installation. After reassembly of the starter motor is complete, check the end-play of the armature shaft. This should be 0.004 - 0.012 in (0.01 - 0.033 mm). If necessary the end-play can be adjusted by altering the shim thickness at the commutator end of the shaft. Finally refit the protective end cap and secure with the two retaining screws.

WINDSHIELD WIPER MOTOR

The windshield wipers are driven by an electric motor mounted on the engine compartment bulkhead (Fig. K:23). The wiper motor is of Lucas make but as from 1970 models onwards the type of motor fitted was changed (Figs. K:24 & K:25). Periodic maintenance is not required as both types of motors are equipped with self-lubricating bearings.

The parking position of the wiper mechanism can be adjusted by slackening the gear housing bolts on the motor and turning the cover slightly.

HEADLIGHT ALIGNMENT

Before attempting to set the alignment of the headlight beams, adjust the tyre pressures. Place the car unladen on level ground, at right angles to a vertical surface. The car should be 16 1/2 ft (5 metres) from the surface in the case of asymmetric headlights and 24 1/2 ft (7.5 metres) in the case of sealed-beam headlights. Switch the headlights on main beam and mask one of the headlights. Check and adjust the other headlight beam in accordance with the relevant diagram (Figs. K:27 - K:31). Repeat for the other headlight.

In the case of asymmetric headlights, if the beams are unevenly distributed, or if it proves difficult to get correct dipped-beam settings, check that the bulb is correctly fitted or, if necessary, fit a new bulb (Fig. K:37).

With sealed-beam headlights, check both headlights and make sure that the beam is symmetrical. If not, or if it proves difficult to get a correct setting, fit a new sealed-beam unit.

Technical Data

BATTERY :

Type	Lead acid
Voltage	12 volts
Polarity	Negative ground
Capacity	44 amp/hr.

ALTERNATOR :

Type	Bosch K1 14V 35 A 20
Rated voltage	14 volts
Max. permissible continuous load	35 amps
Direction of rotation	Clockwise or counter-clockwise
Brush spring pressure	10.5-14 oz (300-400 gms)
Min permissible brush length	0.34 in (9 mm)
Drive belt tension (total free movement)	0.3 in (7 mm) approx.

REGULATOR :

Type	Bosch ADN 1 14 V (radio supressed) or AD 1 14 V (non-supressed)

STARTER MOTOR :

Type :	
Prior to 1969	Bosch EF (R) 12 V 0,8 PS 0 001 208 029
From 1969	Bosch GF 12 V 1,0 PS 0 001 311 024
Number of teeth on drive pinion	9
Number of teeth on flywheel ring gear	138
Brush spring pressure	40.5 - 46 oz (1150 - 1300 grms)
Output :	
Early type	0.8 HP
Late type	1.0 HP
Armature shaft end-play	0.004 - 0.012 in (0.01 - 0.03 mm)
Flasher unit	Lucas FL 5 12V 42W or Hella 91 PST 2 x 32 Cp 12V
Horn	Hella B 32/5 - 12V

FUEL GAUGE SENDER UNIT :

SAAB 95 up to chassis No. 57.023	Veglia 67 - 8011
SAAB 95 as from chassis No. 57.024	VDO 38/20
SAAB 96 up to chassis No. 475.599	VDO 20/228
SAAB 96 as from chassis No. 475.600	VDO 38/228

WINDSHELD WIPER MOTOR :

Prior to 1970	Lucas DL 3 A
From 1970	Lucas 15 W

WINDSHIELD WASHER :

Monte Carlo, 1967	Dahlberg
All models from 1968	Meab

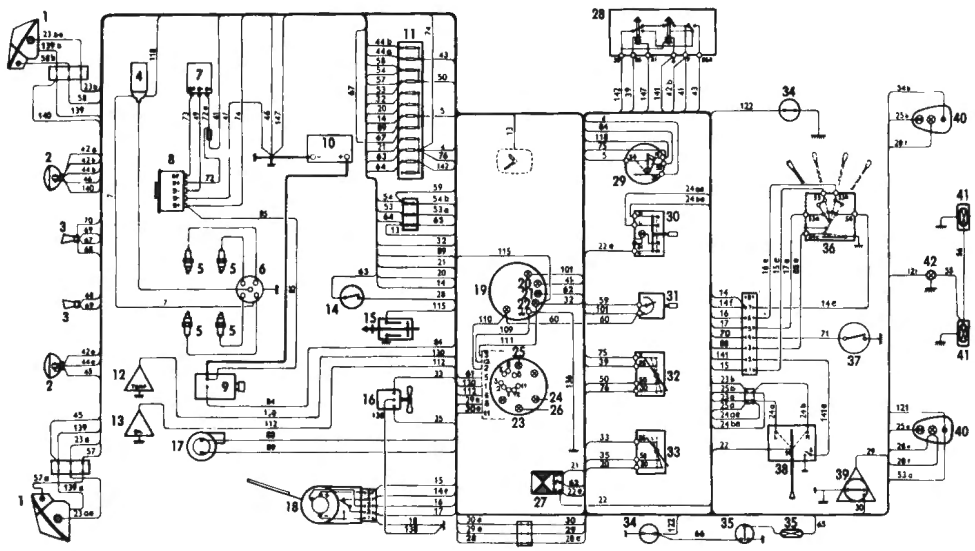


Fig. L:1 Saab 96 (Saloon) RHD, 1967

No.	Color	Area mm²
4	grey	1,5
5	red	1,5
7	green	1,5
13	blue	0,75
14	brown	1,0
14e	brown	1,0
14f	brown	1,0
15	red	1,0
15e	red	1,0
16	grey	1,0
16e	grey	1,0
17	blue	1,0
17e	blue	1,0
18	black	1,0
20	white	1,0
21	red	1,0
22	green	1,0
22e	green	1,0
23a	yellow	1,0
23ae	yellow	1,0
23b	white	1,0
23be	white	1,0
24a	yellow	1,0
24ae	yellow	1,0
24b	white	1,0
24be	white	1,0
25a	blue	1,0
25b	grey	1,0
28	red	1,0
28e	red	1,0
28f	red	0,75
29	grey	0,75
29e	green	0,75
30	brown	0,75
30e	brown	0,75
32	red	0,75
33	yellow	1,0
35	grey	1,0
39	yellow	0,75
41	blue	0,75

No.	Color	Area mm²
42a	blue	1,5
42b	white	2,5
43	yellow	2,5
44a	grey	1,5
44b	yellow	1,5
45	black	1,5
46	black	2,5
47	black	4,0
49	black	1,0
50	green	1,0
53	blue	0,75
53a	blue	0,75
53e	green	0,75
54	green	0,75
54b	green	0,75
54e	green	0,75
57	blue	0,75
57a	blue	0,75
58	green	0,75
58b	green	0,75
59	green	0,75
60	green	0,75
61	red	0,75
62	grey	0,75
63	red	1,0
64	grey	0,75
65	red	0,75
66	white	0,75
67	red	1,5
68	red	1,0
69	black	1,0
70	black	1,5
71	black	1,5
72	red	1,0
72e	red	1,0
73	yellow	1,0
74	grey	4,0
75	red	1,0
76	grey	1,0
80	black	1,0

No.	Color	Area mm²
82	white	0,75
83	white	0,75
84	yellow	1,5
85	grey	4,0
86	green	0,75
86e	green	0,75
86f	green	0,75
88	black	0,75
88e	black	0,75
89	brown	0,75
92	red	0,75
95	white	1,5
97	white	1,5
98	white	1,0
101	green	0,75
104	green	0,75
105	black	0,75
109	black	0,75
110	green	0,75
111	red	0,75
112	blue	1,0
115	yellow	0,75
118	white	1,0
122	white	0,75
130	brown	1,0
131	white	1,5
136	black	1,0
138	black	1,0
139	black	1,5
139a	black	1,0
139b	black	1,0
140	black	1,5
141	brown	0,75
141e	brown	0,75
142	grey	2,5
147	black	0,75
190	yellow	0,75
191	grey	0,75
192	black	0,75

1. Parking light and direction indicators
2. Headlights
3. Horn
4. Ignition coil
5. Spark plugs
6. Distributor
7. Voltage regulator
8. Alternator
9. Starter
10. Battery
11. Fuse box
12. Temperature transmitter
13. Oil pressure switch
14. Back-up light switch
15. Stop light switch
16. Brake warning contact
17. Heater fan motor
18. Windshield washer pump
19. Windshield wiper motor
20. Cigarette lighter
21. Contact for warning buzzer
22. Buzzer
23. Clock
24. Speedometer and odometer
25. High beam indicator light
26. Direction indicator repeater light
27. Brake warning light
28. Temperature and fuel gauges
29. Indicator light, fuel amount
30. Oil pressure warning light
31. Charge indicator light
32. Flasher unit
33. Dimmer relay
34. Ignition and starter switch
35. Hazard warning flasher switch
36. Instrument illumination rheostat
37. Headlight switch
38. Heater fan switch
39. Dome lamp switch
40. Dome lamp with switch
41. Switch for windshield wiper, and washer
42. Signal horn contact
43. Direction indicator switch with headlight flasher and dimmer switch
44. Fuel transmitter
45. Back-up light and direction indicators
46. Tail light and stop light
47. Number plate light

Black	7, 18, 19, 45, 46, 47, 49, 71, 105, 109, 125, 135, 136, 138, 139, 140.
Red	5, 21, 28, 28e, 28f, 32, 39, 61, 63, 65, 67, 68, 72, 111, 113, 126, 129.
Green	16, 22, 50, 51, 52, 53, 54, 55, 56, 57, 58, 60, 101, 104, 110, 121, 133.
Grey	4, 25b, 29, 35, 44a, 62a, 62b, 64, 69, 70, 74, 75, 85, 142.
White	20, 23b, 24b, 40, 40c, 42b, 66, 118, 122, 122e, 128a.
Yellow	17, 23a, 24a, 33, 43, 44b, 73, 84, 128b.
Brown	14, 30, 130, 137, 137c.
Blue	13, 25a, 41, 42a, 112.

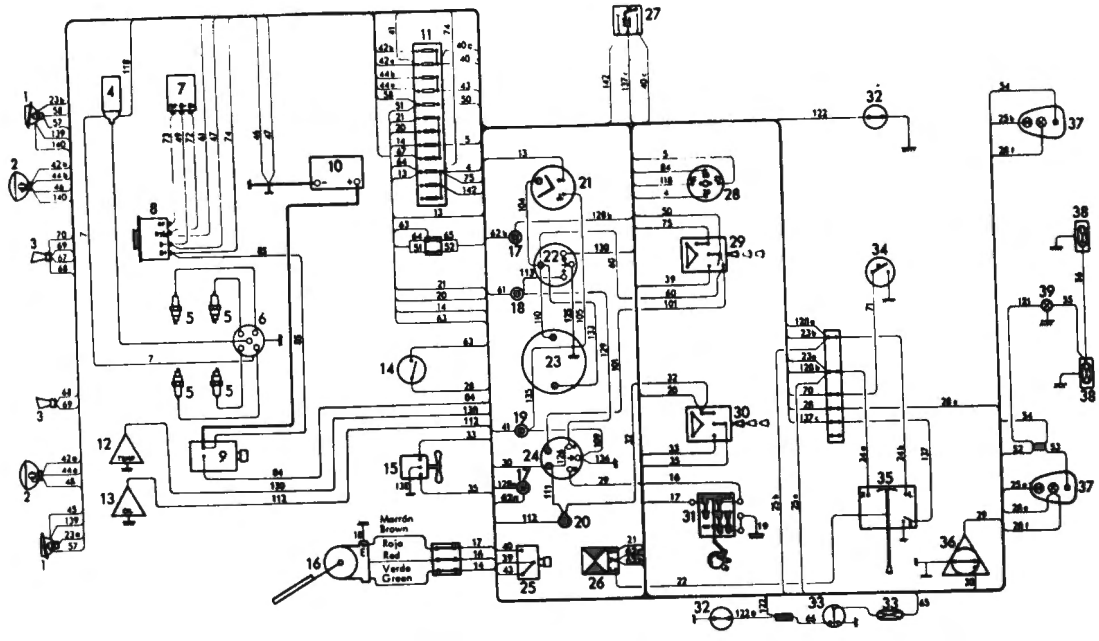


Fig. L:2 Saab 96 (Saloon) LHD, 1967

1. Direction indicators and side lights
2. Headlights
3. Horn
4. Ignition coil
5. Spark plugs
6. Distributor
7. Voltage regulator
8. Alternator
9. Starter
10. Battery
11. Fuse box
12. Temperature gauge, sending unit
13. Oil pressure switch
14. Stop light switch
15. Heater fan motor
16. Wiper motor
17. Direction indicator repeater lights
18. Charge indicator light
19. High beam indicator light
20. Oil pressure warning light
21. Electric clock
22. Temperature gauge
23. Speedometer with odometer
24. Fuel gauge
25. Dimmer switch
26. Flasher
27. Control relay for headlight flasher
28. Ignition and starter switch
29. Headlight switch and instrument illumination rheostat
30. Heater fan switch
31. Windshield wiper switch
32. Courtesy light switch
33. Courtesy light with switch
34. Horn button
35. Direction indicator switch with headlight flasher
36. Fuel tank gauge
37. Stop lights, direction indicators and tail lights
38. Number plate lights
39. Trunk light

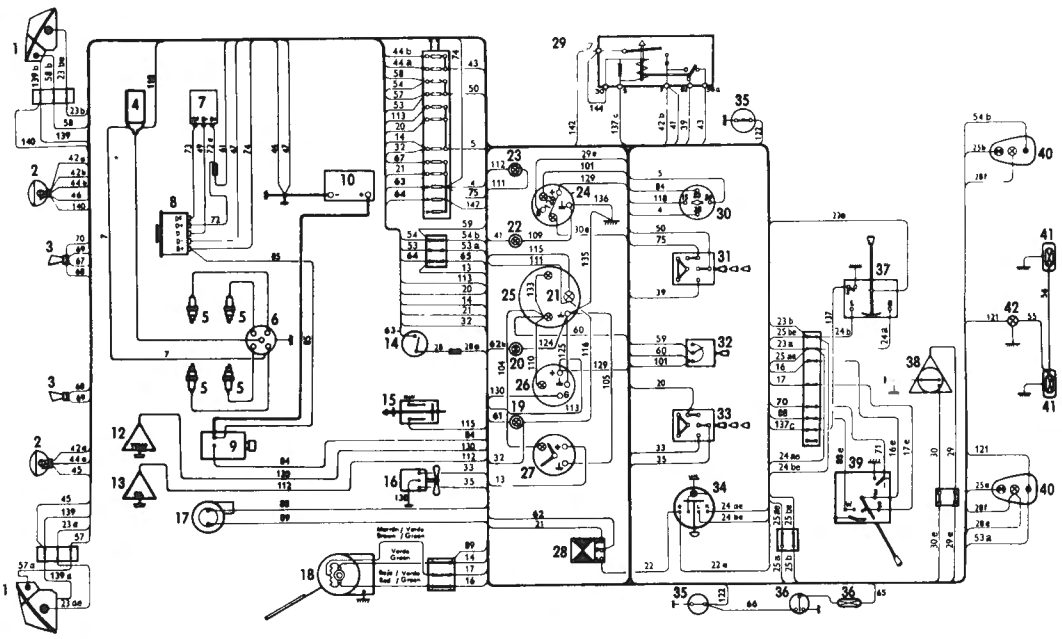


Fig. L:3 Saab 96 (Saloon) RHD, 1969

No.	Color	Area mm2
4	grey	1,5
5	red	1,5
7	black	1,5
13	blue	0,75
14	brown	1,0
16	grey	1,0
16e	grey	1,0
17	blue	1,0
17e	blue	1,0
20	white	1,0
21	red	1,0
22	green	1,0
22e	green	1,0
23a	yellow	1,0
23ae	yellow	1,0
23b	white	1,0
23be	white	1,0
24a	yellow	0,75
24ae	yellow	0,75
24b	white	0,75
24be	white	0,75
25a	blue	1,0
25ae	blue	1,0
25b	grey	1,0
25be	grey	1,0
28	red	1,0
28e	red	1,0
28f	red	0,75
29	grey	0,75
29e	grey	0,75
30	brown	0,75
30e	brown	0,75
32	red	0,75
33	yellow	1,0
35	grey	1,0
39	red	2,5
41	blue	0,75

No.	Color	Area mm2
42a	blue	1,5
42b	white	2,5
43	yellow	2,5
44a	grey	1,5
44b	yellow	1,5
45	black	1,5
46	black	2,5
47	black	4,0
49	black	1,0
50	green	1,0
53	blue	0,75
53a	blue	0,75
54	green	0,75
54b	green	0,75
55	green	0,75
56	green	0,75
57	blue	0,75
57a	blue	0,75
58	green	0,75
58b	green	0,75
59	green	0,75
60	green	0,75
61	red	0,75
62	grey	0,75
63	red	0,75
64	grey	0,75
65	red	0,75
66	white	0,75
67	red	1,5
68	red	1,0
69	black	1,0
70	black	1,5
71	black	1,5
72	red	1,0
72e	red	1,0
73	yellow	1,0
74	grey	4,0

No.	Color	Area mm2
75	grey	2,5
84	yellow	1,5
85	grey	4,0
88	black	0,75
88e	black	0,75
89	brown	0,75
101	green	0,75
104	green	0,75
105	black	0,75
109	black	0,75
110	green	0,75
111	red	0,75
112	blue	1,0
113	white	0,75
115	yellow	0,75
116	red	0,75
118	white	1,0
121	green	0,75
122	white	0,75
124	black	0,75
125	black	0,75
126	white	0,75
129	white	0,75
130	brown	1,0
133	green	0,75
135	black	0,75
136	black	0,75
137	brown	0,75
137c	brown	0,75
138	black	1,0
139	black	1,0
139a	black	1,0
139b	black	1,0
140	black	1,5
142	grey	1,5
144	grey	0,75

1. Parking light and direction indicators
2. Headlights
3. Horn
4. Ignition coil
5. Spark plugs
6. Distributor
7. Voltage regulator
8. Alternator
9. Starter
10. Battery
11. Fuse box
12. Temperature transmitter
13. Oil pressure switch
14. Stop light switch
15. Brake warning contact
16. Heater fan motor
17. Windshield washer pump
18. Windshield wiper motor
19. Charge indicator light
20. Direction indicator repeater light
21. Brake warning light
22. High beam indicator light
23. Oil pressure warning light
24. Fuel gauge
25. Speedometer with odometer
26. Temperature gauge (coolant)
27. Electric clock (De Luxe only)
28. Flasher unit
29. Dimmer relay
30. Ignition and starter switch
31. Headlight switch
32. Instrument illumination rheostat
33. Heater fan switch
34. Warning flasher switch
35. Courtesy light switch
36. Courtesy light with switch
37. Direction indicator switch with headlight flasher and dimmer switch
38. Fuel transmitter
39. Switch for windshield wiper, -washer and signal horn
40. Stop lights, direction indicators and tail light
41. Number plate light
42. Trunk light

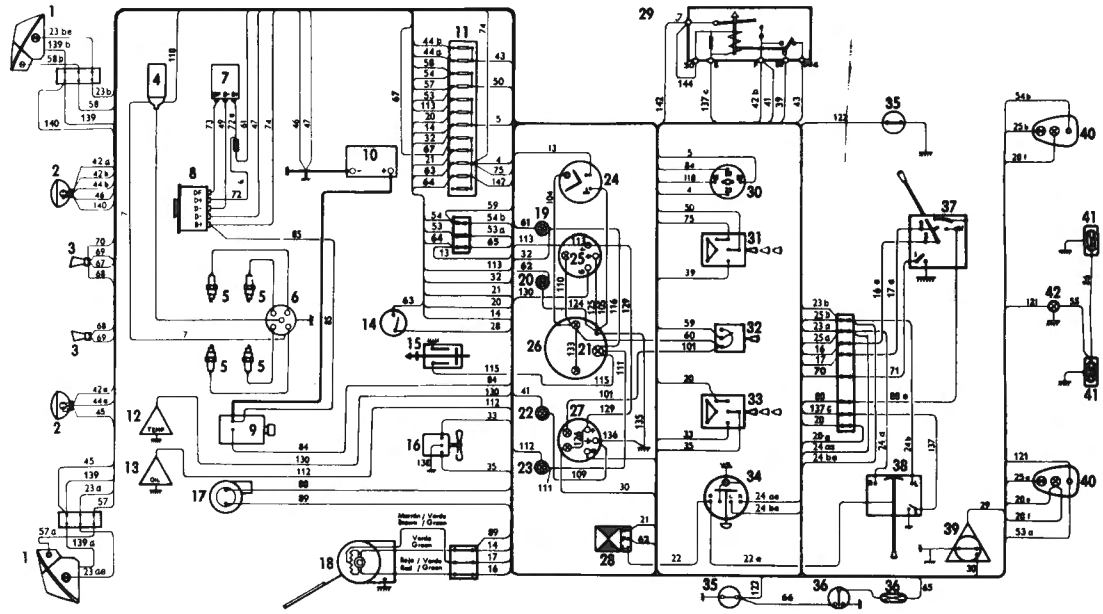


Fig. L:4 Saab 96 (Saloon) LHD, 1969

No.	Color	Area mm2
4	grey	1,5
5	red	1,5
7	black	1,5
13	blue	0,75
14	brown	1,0
16	grey	1,0
16e	grey	1,0
17	blue	1,0
17e	blue	1,0
20	white	1,0
21	red	1,0
22	green	1,0
22e	green	1,0
23a	yellow	1,0
23ae	yellow	1,0
23b	white	1,0
23be	white	1,0
24a	yellow	0,75
24ae	yellow	0,75
24b	white	0,75
24be	white	0,75
25a	blue	1,0
25b	grey	1,0
28	red	1,0
28e	red	1,0
28f	red	0,75
29	grey	0,75
30	brown	0,75
32	red	0,75
33	yellow	1,0
35	grey	1,0
39	red	2,5
41	blue	0,75
42a	blue	1,5
42b	white	2,5

No.	Color	Area mm2
43	yellow	2,5
44a	grey	1,5
44b	yellow	1,5
45	black	1,5
46	black	2,5
47	black	4,0
49	black	1,0
50	green	1,0
53	blue	0,75
53a	blue	0,75
54	green	0,75
54b	green	0,75
55	green	0,75
56	green	0,75
57	blue	0,75
57a	blue	0,75
58	green	0,75
58b	green	0,75
59	green	0,75
60	green	0,75
61	red	0,75
62	grey	0,75
63	red	0,75
64	grey	0,75
65	red	0,75
66	white	0,75
67	red	1,5
68	red	1,0
69	black	1,0
70	black	1,5
71	black	1,5
72	red	1,0
72e	red	1,0
73	yellow	1,0
74	grey	4,0

No.	Color	Area mm2
75	grey	2,5
84	yellow	1,5
85	grey	4,0
88	black	0,75
88e	black	0,75
89	brown	0,75
101	green	0,75
104	green	0,75
105	black	0,75
109	black	0,75
110	green	0,75
111	red	0,75
112	blue	1,0
113	white	0,75
115	yellow	0,75
116	red	0,75
118	white	1,0
121	green	0,75
122	white	0,75
124	black	0,75
125	black	0,75
126	white	0,75
129	white	0,75
130	brown	1,0
133	green	0,75
135	black	0,75
136	black	0,75
137	brown	0,75
137c	brown	0,75
138	black	1,0
139	black	1,5
139a	black	1,0
139b	black	1,0
140	black	1,5
142	grey	1,5
144	grey	0,75

1. Parking light and direction indicators
2. Headlights
3. Horn
4. Ignition coil
5. Spark plugs
6. Distributor
7. Voltage regulator
8. Alternator
9. Starter
10. Battery
11. Fuse box
12. Temperature transmitter
13. Oil pressure switch
14. Stop light switch
15. Brake warning contact
16. Heater fan motor
17. Windshield washer pump
18. Windshield wiper motor
19. Charge indicator light
20. Direction indicator repeater light
21. Brake warning light
22. High beam indicator light
23. Oil pressure warning light
24. Electric clock (De Luxe only)
25. Temperature gauge (coolant)
26. Speedometer with odometer
27. Fuel gauge
28. Flasher unit
29. Dimmer relay
30. Ignition and starter switch
31. Headlight switch
32. Instrument illumination rheostat
33. Heater fan switch
34. Warning flasher switch
35. Courtesy light switch
36. Courtesy light with switch
37. Switch for windshield wiper, -washer and signal horn
38. Direction indicator switch with headlight flasher and dimmer switch
39. Fuel transmitter
40. Stop lights, direction indicators and tail light
41. Number plate light
42. Trunk light

Black	7, 7b, 18, 45, 46, 47, 49, 71, 80, 105, 106, 107, 108, 109, 123e, 124, 135, 138, 139, 140.
Red	5, 21, 28, 28e, 28f, 32, 39, 61, 63, 65, 67, 68, 72, 83, 86, 86e, 126, 129.
Green	16, 22, 50, 51, 52, 53, 54, 55, 56, 57, 58, 60, 82, 101, 102, 103, 104, 110, 119, 121, 133, 143.
Grey	4, 25b, 25be, 29, 29e, 35, 44a, 62a, 64, 69, 70, 74, 75, 85, 89, 113, 7, 142, 144.
White	20, 23b, 24b, 40, 42b, 66, 95, 97, 98, 118, 122, 122e, 128a, 131.
Yellow	17, 23a, 24a, 33, 43, 44b, 62b, 73, 81, 84, 99, 100, 100e, 112, 112e, 128b, 130.
Brown	14, 14c, 15, 30, 30e, 137, 141.
Blue	13, 25a, 25ae, 41, 42a, 145.

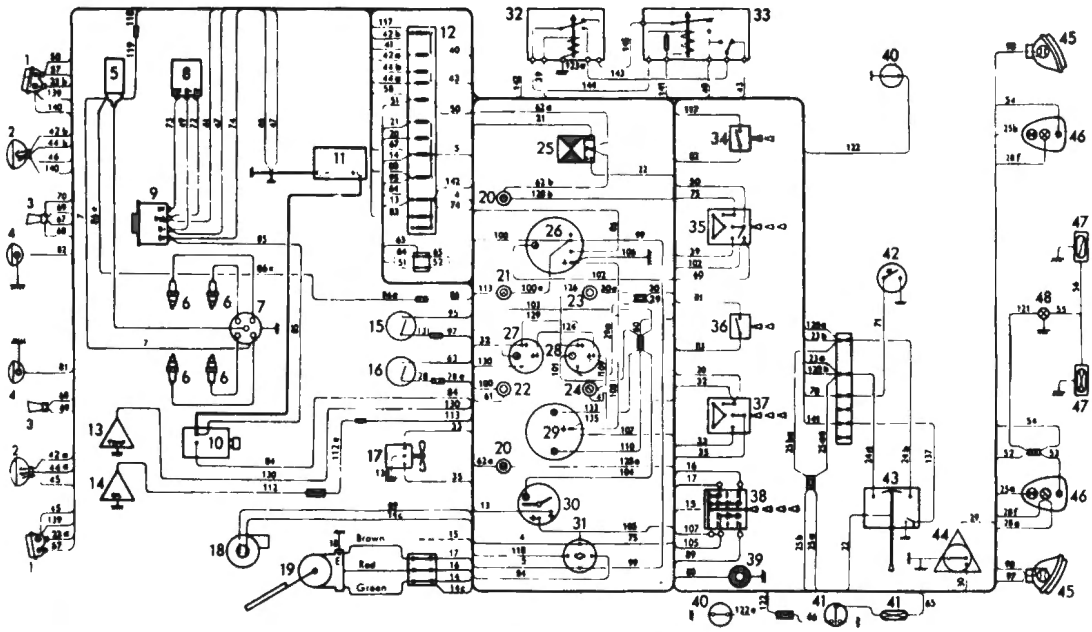


Fig. L:5 Saab Monte Carlo, RHD 1967

1. Direction indicators and side lights
2. Headlights
3. Horn
4. Foglight and spotlight
5. Ignition coil
6. Spark plugs
7. Distributor
8. Voltage regulator
9. Alternator
10. Starter
11. Battery
12. Fuse box
13. Temperature meter
14. Oil gauge
15. Back-up light switch
16. Stop light switch
17. Heater fan motor
18. Windshield-washer pump
19. Wiper motor
20. Direction indicator repeater lights
21. Charge indicator light
22. Indicator light, oil pressure
23. High beam indicator light
24. Indicator light, fuel
25. Flasher
26. Tachometer
27. Temperature gauge
28. Fuel gauge
29. Speedometer, odometer and trip meter
30. Electric clock
31. Ignition and starter switch
32. Manoeuvre relay, light
33. Dimming relay
34. Spotlight switch
35. Headlight switch and instrument illumination rheostat
36. Fog light switch
37. Heater fan switch
38. Windshield wiper and washer switch
39. Cigarette lighter
40. Courtesy light switch
41. Courtesy light with switch
42. Horn button
43. Direction indicator switch with headlight flasher and dimmer switch
44. Fuel tank gauge
45. Back-up lights
46. Stop lights, direction indicators and tail lights
47. Number plate lights
48. Trunk light

Black	7, 7b, 18, 45, 46, 47, 49, 71, 80, 105, 106, 107, 108, 109, 123e, 124, 135, 138, 139, 140.
Red	5, 21, 28, 28e, 28f, 32, 39, 61, 63, 65, 67, 68, 72, 83, 86, 86e, 126, 129.
Green	16, 22, 50, 51, 52, 53, 54, 55, 56, 57, 58, 60, 82, 101, 102, 103, 104, 110, 119, 121, 133, 143.
Grey	4, 25b, 29, 35, 44a, 62a, 62b, 64, 69, 70, 74, 75, 85, 89, 113, 117, 142, 144.
White	20, 23b, 24b, 40, 42b, 66, 95, 97, 98, 118, 122, 122e, 128a, 131.
Yellow	17, 23a, 24a, 33, 43, 44b, 62b, 73, 81, 84, 99, 100, 100e, 112, 112e, 128b, 130.
Brown	14, 14c, 15, 30, 137, 141.
Blue	13, 25a, 41, 42a, 145.

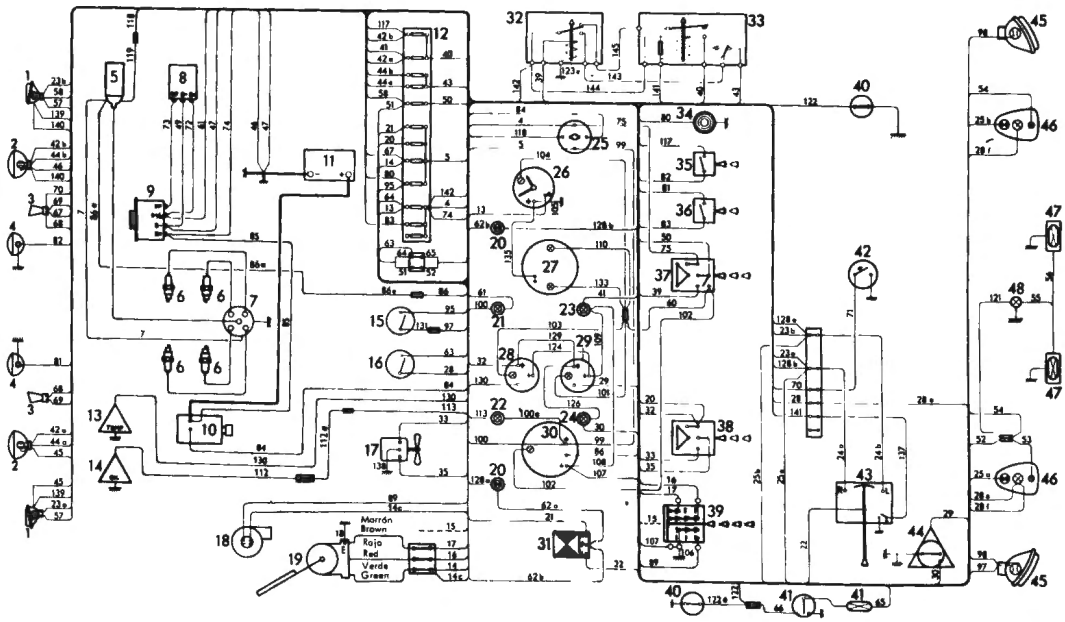


Fig. L:6 Saab Monte Carlo LHD, 1967

1. Direction indicators and side lights
2. Headlights
3. Horn
4. Foglight and spotlight
5. Ignition coil
6. Spark plugs
7. Distributor
8. Voltage regulator
9. Alternator
10. Starter
11. Battery
12. Fuse box
13. Temperature meter
14. Oil gauge
15. Back-up light switch
16. Stop light switch
17. Heater fan motor
18. Windshield-washer pump
19. Wiper motor
20. Direction indicator repeater lights
21. Charge indicator light
22. Indicator light, oil pressure
23. High beam indicator light
24. Indicator light, fuel
25. Ignition and starter switch
26. Electric clock
27. Speedometer, odometer and trip meter
28. Temperature gauge
29. Fuel gauge
30. Tachometer
31. Flasher
32. Manoeuvre relay, light
33. Dimming relay
34. Cigarette lighter
35. Spotlight switch
36. Fog light switch
37. Headlight switch and instrument illumination rheostat
38. Heater fan switch
39. Windshield wiper and washer switch
40. Courtesy light switch
41. Courtesy light with switch
42. Horn button
43. Direction indicator switch with headlight flasher and dimmer switch
44. Fuel tank gauge
45. Back-up lights
46. Stop lights, direction indicators and tail lights
47. Number plate lights
48. Trunk light

Black 7, 19, 23a, 45, 46, 47, 49, 71, 80, 88, 88e, 105, 107, 108, 109, 124, 135, 138, 139, 140.

Red 5, 21, 28, 28e, 28f, 32, 39, 61, 63, 65, 67, 68, 72, 72e, 83, 86, 86e, 111, 116, 126, 129.

Green 22, 50, 51, 52, 53, 54, 55, 56, 57, 58, 59, 60, 82, 101, 102, 103, 104, 110, 121, 133, 143.

Grey 4 16, 16e, 25b, 29, 35, 44a, 62a, 62b, 64, 69, 70, 74, 75, 85, 117, 142, 144.

White 20, 23b, 24b, 40, 42b, 66, 95, 97, 98, 118, 122, 122e, 128a, 131.

Yellow 24a, 33, 43, 44b, 73, 81, 84, 99, 100, 115, 128b.

Brown 14, 30, 89, 130, 137, 141.

Blue 13, 17, 17e, 25a, 41, 42a, 112, 145.

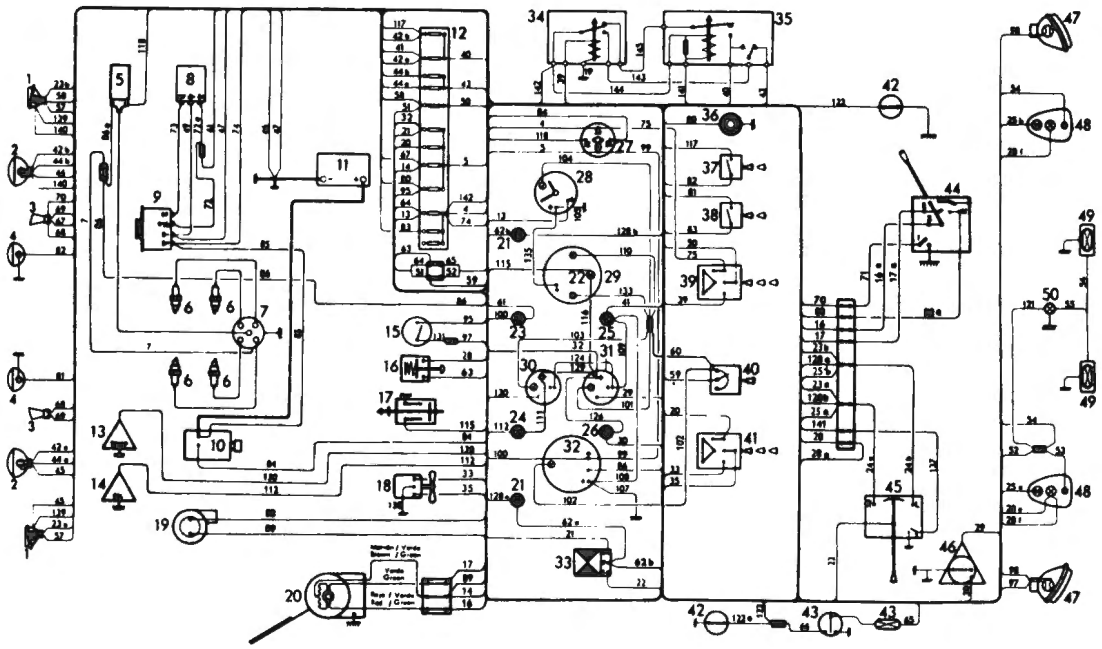


Fig. L:7 Saab Monte Carlo LHD, 1968

1. Direction indicators and side lights
2. Headlights
3. Horn
4. Foglight and spotlight
5. Ignition coil
6. Spark plugs
7. Distributor
8. Voltage regulator
9. Alternator
10. Starter
11. Battery
12. Fuse box
13. Temperature gauge, sending unit
14. Oil pressure switch
15. Back-up light switch
16. Stop lamp switch
17. Brake warning contact
18. Heater fan motor
19. Windshield-washer pump
20. Wiper motor
21. Direction indicator repeater light
22. Brake warning light
23. Charge indicator light
24. Indicator light, oil pressure
25. High beam indicator light
26. Indicator light, fuel
27. Ignition and starter switch
28. Electric clock
29. Speedometer, odometer and trip meter
30. Temperature gauge
31. Fuel gauge
32. Tachometer
33. Flasher
34. Manoeuvre relay, light
35. Dimmer relay
36. Cigarette lighter
37. Spotlight switch
38. Fog light switch
39. Headlight switch
40. Instrument illumination rheostat
41. Heater fan switch
42. Courtesy light switch
43. Courtesy light with switch
44. Switch for windshield wiper, -washer and signal horn
45. Direction indicator switch with headlight flasher and dimmer switch
46. Fuel tank gauge
47. Back-up lights
48. Stop lights, direction indicators and tail lights
49. Number plate light
50. Trunk light

Black	7, 7b, 18, 19, 45, 46, 47, 49, 71, 105, 109, 125, 135, 136, 138, 139, 140.
Red	5, 21, 28, 28e, 28f, 28g, 32, 39, 61, 63, 65, 67, 68, 72, 92, 111, 113, 126, 129.
Green	16, 22, 50, 51, 53, 54, 55, 57, 58, 60, 86, 87, 88, 101, 104, 110, 133, 143.
Grey	4, 25b, 25be, 29, 29e, 35, 44a, 62a, 62b, 64, 69, 70, 74, 75, 85, 93, 142, 144.
White	20, 23b, 24b, 40, 42b, 66, 82, 83, 118, 122, 122e, 128a.
Yellow	17, 23a, 24a, 33, 43, 44b, 73, 84, 128b.
Brown	14, 30, 30e, 130, 137, 141.
Blue	13, 25a, 25ae, 41, 42a, 112, 145.

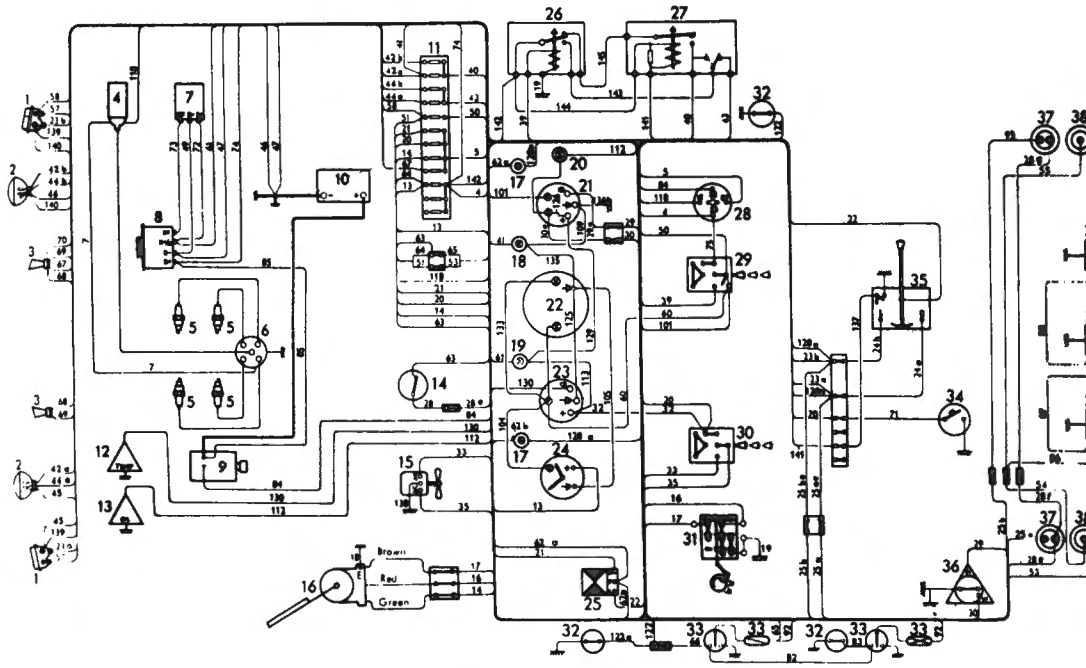


Fig. L:8 Saab 95 (Estate) RHD, 1967

1. Direction indicator lights and side lights
2. Headlights
3. Horns
4. Ignition coil
5. Spark plugs
6. Distributor
7. Voltage regulator
8. Alternator
9. Starter motor
10. Battery
11. Fuse box
12. Temperature sender
13. Oil pressure switch
14. Stop light switch
15. Heater motor
16. Windshield wiper motor
17. Direction indicator warning lights
18. High beam warning light
19. Generator warning light
20. Oil pressure warning light
21. Fuel gauge
22. Speedometer with odometer
23. Temperature gauge
24. Electric clock
25. Flasher
26. Headlight control relay
27. Dimmer relay
28. Ignition and starter switch
29. Headlight and side light switch with instrument illumination rheostat
30. Heater switch
31. Windshield wiper switch
32. Courtesy light switches
33. Interior light with switch
34. Horn ring
35. Direction indicators switch with headlight flasher and dimmer switch
36. Fuel tank gauge
37. Stop lights and direction lights
38. Rear lights
39. Number plate light

Black	7, 18, 19, 45, 46, 47, 49, 71, 105, 109, 125, 135, 136, 138, 139, 140.
Red	5, 21, 28, 28e, 28f, 28g, 32, 39, 61, 63, 65, 67, 68, 72, 92, 111, 113, 126, 129.
Green	16, 22, 50, 51, 53, 54, 55, 57, 58, 60, 86, 87, 88, 101, 104, 110.
Grey	4, 25b, 29, 35, 44a, 62a, 62b, 64, 69, 70, 74, 75, 83, 93, 142.
White	20, 23b, 24b, 40, 40c, 42b, 66, 82, 83, 118, 122, 122e, 129a.
Yellow	17, 23a, 24a, 33, 43, 44b, 73, 84, 128b.
Brown	14, 15, 30, 130, 137, 137c.
Blue	13, 25a, 41, 42a, 112.

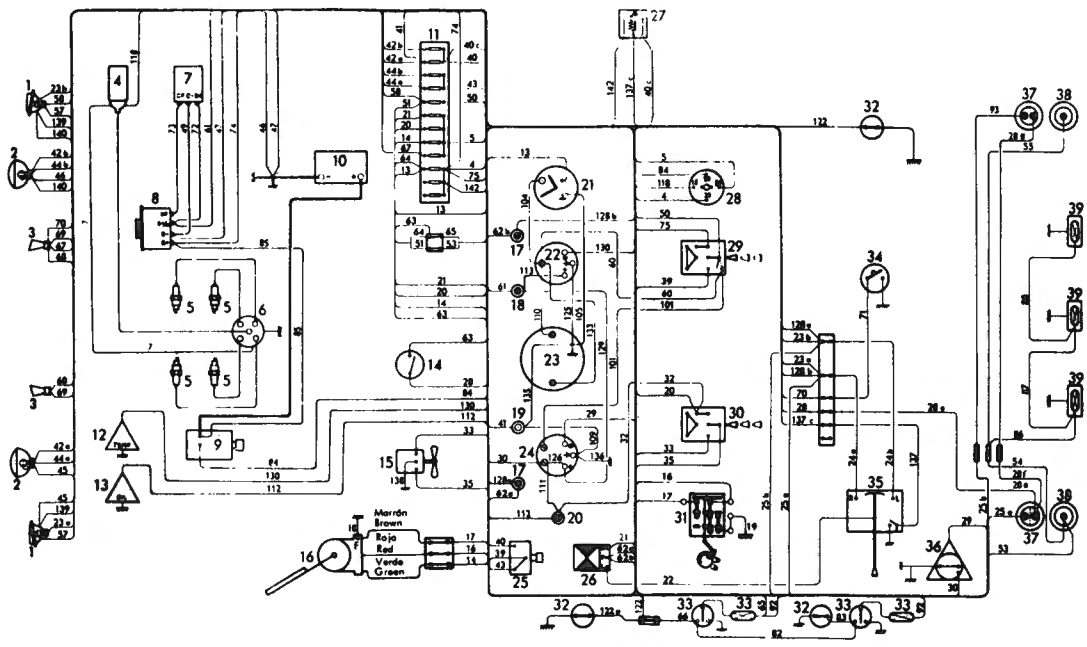


Fig. L:9 Saab 95 (Estate) LHD, 1967

1. Direction indicators and side lights
2. Headlights
3. Horn
4. Ignition coil
5. Spark plugs
6. Distributor
7. Voltage regulator
8. Alternator
9. Starter
10. Battery
11. Fuse box
12. Temperature gauge sending unit
13. Oil pressure switch
14. Stop light switch
15. Heater fan motor
16. Wiper motor
17. Direction indicator repeater lights
18. Charge indicator light
19. High beam indicator light
20. Oil pressure warning light
21. Electric clock
22. Temperature gauge
23. Speedometer with odometer
24. Fuel gauge
25. Dimmer switch
26. Flasher
27. Control relay for headlight flasher
28. Ignition and starter switch
29. Headlight switch and instrument illumination rheostat
30. Heater fan switch
31. Windshield wiper switch
32. Courtesy light switch
33. Courtesy light with switch
34. Horn button
35. Direction indicator switch with headlight flasher
36. Fuel tank gauge
37. Stop lights and direction indicators
38. Tail lights
39. Number plate lights

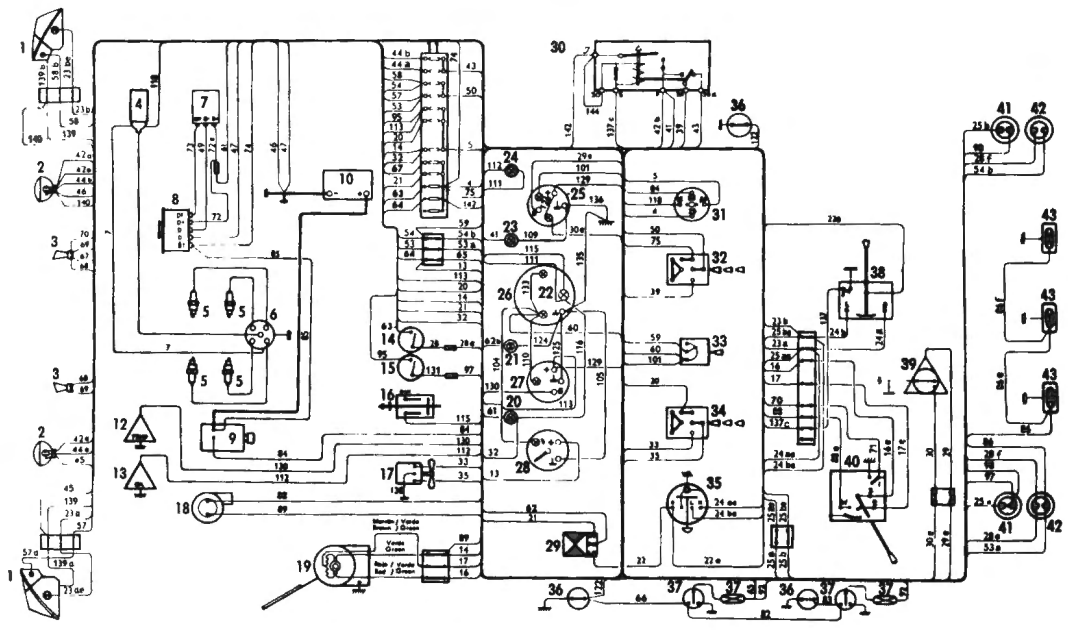


Fig. L:10 Saab 95 (Estate) RHD, 1969

No.	Color	Area mm2	No.	Color	Area mm2	No.	Color	Area mm2
4	grey	1,5	43	yellow	2,5	86e	green	0,75
5	red	1,5	44a	grey	1,5	86f	green	0,75
7	black	1,5	44b	yellow	1,5	88	black	0,75
13	blue	0,75	45	black	1,5	88e	black	0,75
14	brown	1,0	46	black	2,5	89	brown	0,75
16	grey	1,0	47	black	4,0	92	red	0,75
16e	grey	1,0	49	black	1,0	95	white	1,5
17	blue	1,0	50	green	1,0	97	white	1,5
17e	blue	1,0	53	blue	0,75	98	white	1,0
20	white	1,0	53a	blue	0,75	101	green	0,75
21	red	1,0	54	green	0,75	104	green	0,75
22	green	1,0	54b	green	0,75	105	black	0,75
22e	green	1,0	57	blue	0,75	109	black	0,75
23a	yellow	1,0	57a	blue	0,75	110	green	0,75
23ae	yellow	1,0	58	green	0,75	111	red	0,75
23b	white	1,0	58b	green	0,75	112	blue	1,0
23be	white	1,0	59	green	0,75	113	white	0,75
24a	yellow	0,75	60	green	0,75	115	yellow	0,75
24ae	yellow	0,75	61	red	0,75	116	red	0,75
24b	white	0,75	62	grey	0,75	118	white	1,0
24be	white	0,75	63	red	0,75	122	white	0,75
25a	blue	1,0	64	grey	0,75	124	black	0,75
25ae	blue	1,0	65	red	0,75	125	black	0,75
25b	grey	1,0	66	white	0,75	126	white	0,75
25be	grey	1,0	67	red	1,5	129	white	0,75
28	red	1,0	68	red	1,0	130	brown	1,0
28e	red	1,0	69	black	1,0	131	white	1,5
28f	red	0,75	70	black	1,5	133	green	0,75
29	grey	0,75	71	black	1,5	135	black	0,75
29e	grey	0,75	72	red	1,0	136	black	0,75
30	brown	0,75	72e	red	1,0	137	brown	0,75
30e	brown	0,75	73	yellow	1,0	137c	brown	0,75
32	red	0,75	74	grey	4,0	138	black	1,0
33	yellow	1,0	75	grey	2,5	139	black	1,0
35	grey	1,0	82	white	0,75	139a	black	1,0
39	red	2,5	83	white	0,75	139b	black	1,0
41	blue	0,75	84	yellow	1,5	140	black	1,5
42a	blue	1,5	85	grey	4,0	142	grey	1,5
42b	white	2,5	86	green	0,75	144	grey	0,75

1. Parking light and direction indicators
2. Headlights
3. Horn
4. Ignition coil
5. Spark plugs
6. Distributor
7. Voltage regulator
8. Alternator
9. Starter
10. Battery
11. Fuse box
12. Temperature transmitter
13. Oil pressure switch
14. Stop light switch
15. Back-up light switch
16. Brake warning contact
17. Heater fan motor
18. Windshield washer pump
19. Windshield wiper motor
20. Charge indicator light
21. Direction indicator repeater light
22. Brake warning light
23. High beam indicator light
24. Oil pressure warning light
25. Fuel gauge
26. Speedometer and odometer
27. Temperature gauge (coolant)
28. Electric clock (De Luxe only)
29. Flasher unit
30. Dimmer relay
31. Ignition and starter switch
32. Headlight switch
33. Instrument illumination rheostat
34. Heater fan switch
35. Warning flasher switch
36. Courtesy light switch
37. Courtesy light with switch
38. Direction indicator switch with headlight flasher and dimmer switch
39. Fuel transmitter
40. Switch for windshield wiper, -washer and signal horn
41. Back-up light and direction indicators
42. Tail light and stop light
43. Number plate light

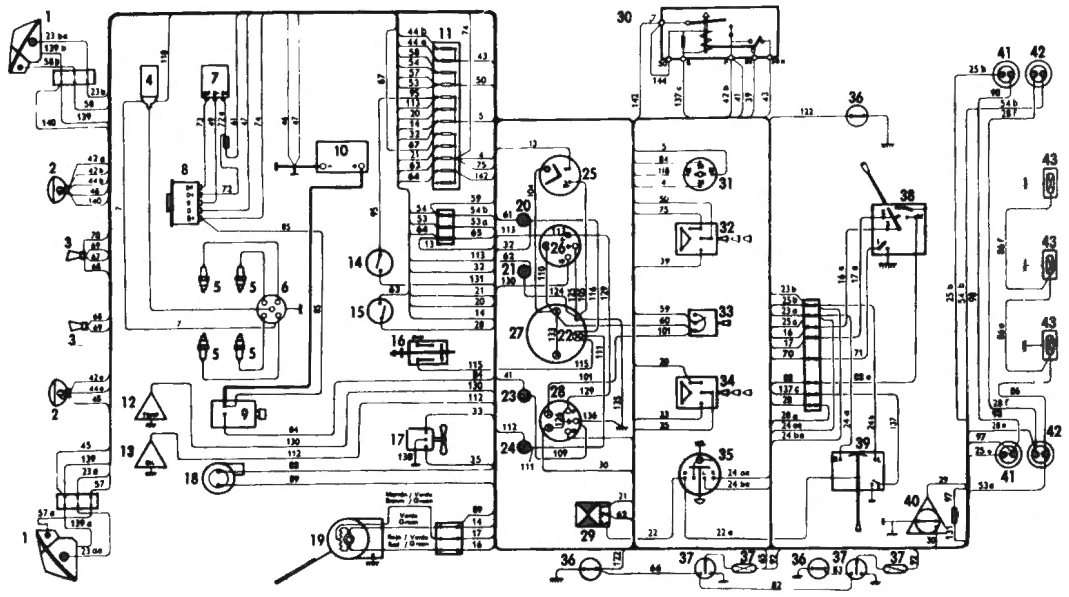


Fig. L:11 Saab 95 (Estate) LHD, 1969

No.	Color	Area mm2	No.	Color	Area mm2	No.	Color	Area mm2
4	grey	1,5	45	black	1,5	88	black	0,75
5	red	1,5	46	black	2,5	88e	black	0,75
7	black	1,5	47	black	4,0	89	brown	0,75
13	blue	0,75	49	black	1,0	92	red	0,75
14	brown	1,0	50	green	1,0	95	white	1,5
16	grey	1,0	53	blue	0,75	97	white	1,5
16e	grey	1,0	53a	blue	0,75	98	white	1,0
17	blue	1,0	54	green	0,75	101	green	0,75
17e	blue	1,0	54b	green	0,75	104	green	0,75
20	white	1,0	57	blue	0,75	105	black	0,75
21	red	1,0	57a	blue	0,75	109	black	0,75
22	green	1,0	58	green	0,75	110	green	0,75
22e	green	1,0	58b	green	0,75	111	red	0,75
23a	yellow	1,0	59	green	0,75	112	blue	1,0
23ae	yellow	1,0	60	green	0,75	113	white	0,75
23b	white	1,0	61	red	0,75	115	yellow	0,75
23be	white	1,0	62	grey	0,75	116	red	0,75
24a	yellow	0,75	63	red	0,75	118	white	1,0
24ae	yellow	0,75	64	grey	0,75	122	white	0,75
24b	white	0,75	65	red	0,75	124	black	0,75
24be	white	0,75	66	white	0,75	125	black	0,75
25a	blue	1,0	67	red	1,5	126	white	0,75
25b	grey	1,0	68	red	1,0	129	white	0,75
28	red	1,0	69	black	1,0	130	brown	1,0
28e	red	1,0	70	black	1,5	131	white	1,5
28f	red	0,75	71	black	1,5	133	green	0,75
29	grey	0,75	72	red	1,0	135	black	0,75
30	brown	0,75	72e	red	1,0	136	black	0,75
32	red	0,75	73	yellow	1,0	137	brown	0,75
33	yellow	1,0	74	grey	4,0	137c	brown	0,75
35	grey	1,0	75	grey	2,5	138	black	1,0
39	red	2,5	82	white	0,75	139	black	1,5
41	blue	0,75	83	white	0,75	139a	black	1,0
42a	blue	1,5	84	yellow	1,5	139b	black	1,0
42b	white	2,5	85	grey	4,0	140	black	1,5
43	yellow	2,5	86	green	0,75	142	grey	1,5
44a	grey	1,5	86e	green	0,75	144	grey	0,75
44b	yellow	1,5	86f	green	0,75			

1. Parking light and direction indicators
2. Headlights
3. Horn
4. Ignition coil
5. Spark plugs
6. Distributor
7. Voltage regulator
8. Alternator
9. Starter
10. Battery
11. Fuse box
12. Temperature transmitter
13. Oil pressure switch
14. Back-up light switch
15. Stop light switch
16. Brake warning contact
17. Heater fan motor
18. Windshield washer pump
19. Windshield wiper motor
20. Charge indicator light
21. Direction indicator repeater light
22. Brake warning light
23. High beam indicator light
24. Oil pressure warning light
25. Electric clock. (Extra equipment)
26. Temperature gauge (coolant)
27. Speedometer with odometer
28. Fuel gauge
29. Flasher unit
30. Dimmer relay
31. Ignition and starter switch
32. Headlight switch
33. Instrument illumination rheostat
34. Heater fan switch
35. Warning flasher switch
36. Courtesy light switch
37. Courtesy light with switch
38. Switch for windshield wiper, -washer and signal horn
39. Direction indicator switch with headlight flasher and dimmer switch
40. Fuel transmitter
41. Back-up light and direction indicators
42. Tail light and stop light
43. Number plate light

Trouble Shooting

ENGINE

SYMPTOMS

	a	b	c	d	e	f	g	h	i	j	k	l	m	n	o	p	q	r	s	t	u	v
ENGINE WILL NOT CRANK	*	*	*	*																		
ENGINE CRANKS SLOWLY	*	*	*																			
ENGINE CRANKS BUT DOES NOT START					*	*	*	*					*									
ENGINE STARTS BUT RUNS FOR SHORT PERIODS ONLY					*	*			*	*												
ENGINE MISFIRES AT LOW SPEED					*	*			*		*											
ENGINE MISFIRES AT HIGH SPEED					*	*					*	*										*
ENGINE MISFIRES AT ALL SPEEDS					*	*	*				*	*	*	*	*						*	*
ENGINE MISFIRES ON ACCELERATION AND FAILS TO REV.					*	*			*			*										*
ROUGH IDLE					*	*		*	*	*	*		*		*	*					*	*
RUNS ROUGH AT HIGH SPEED					*	*	*	*	*	*	*	*	*	*	*	*					*	*
LACK OF POWER			*		*	*	*	*	*	*	*			*	*	*						*
POOR ACCELERATION					*	*	*	*				*		*	*	*						*
LACK OF TOP SPEED					*	*	*	*		*		*		*	*	*						*
EXCESSIVE FUEL CONSUMPTION			*		*	*									*	*						
EXCESSIVE OIL CONSUMPTION																*	*	*	*			
PINKING					*	*																
COMPRESSION LEAK							*				*	*	*			*					*	*	*
	a	b	c	d	e	f	g	h	i	j	k	l	m	n	o	p	q	r	s	t	u	v

PROBABLE CAUSE

a. Fault in the starting system – Refer to the ELECTRICAL EQUIPMENT section for diagnosis.
b. Engine oil too thick.
c. Stiff engine.
d. Mechanical seizure.
e. Fault in the ignition system – Refer to the IGNITION SYSTEM section for diagnosis.
f. Fault in the fuel system – Refer to the FUEL SYSTEM section for diagnosis.
g. Incorrect valve timing.
h. Compression leak.
i. Air leak at inlet manifold.
j. Restriction in exhaust system.
k. Poor valve seating.
l. Sticking valves.
m. Leaking cylinder head gasket.
n. Worn camshaft lobes.
o. Incorrect tappet clearance.
p. Worn or damaged cylinder bores, pistons and/or piston rings.
q. Worn valve guides.
r. Damaged valve stem seals.
s. Leaking oil seal or gasket.
t. Incorrectly installed spark plug.
u. Cracked cylinder.
v. Broken or weak valve springs.

REMEDIES

b. Drain oil and replace with correct oil.
c. Add small quantity of oil to the fuel and run engine gently.
d. Strip engine and renew parts as necessary.

g. Retime engine.
h. Trace and seal.
i. Trace and seal.
j. Remove restriction.
k. Regrind seats.
l. Free and trace cause.
m. Renew gasket.
n. Fit new camshaft.
o. Adjust tappets.
p. Exchange engine.
q. Replace valve guides.
r. Replace seals.
s. Replace gasket.
t. Replace plug with correct one.
u. Renew cylinder block.
v. Replace springs.

NOTE:– Items g, k, l, n, o, q, r & v do not apply to 2-stroke engines

Trouble Shooting

COOLING SYSTEM

SYMPTOMS

	a	b	c	d	e	f	g	h	i	j	k	l	m	n	o
OVERHEATING	*	*	*	*	*	*		*	*	*	*	*	*	*	
ENGINE FAILS TO REACH NORMAL OPERATING TEMPERATURE							*								*

PROBABLE CAUSE

a. Insufficient coolant.
b. Drive belt slipping or broken.
c. Radiator fins clogged.
d. Cooling fan defective.
e. Water pump defective.
f. Thermostat jammed shut.
g. Thermostat jammed open.
h. Ignition timing too far retarded.
i. Excessive vehicle load or dragging brakes.
j. Internal passage in the engine and/or radiator blocked.
k. Hoses blocked.
l. Carburetter mal-adjustment.
m. Excessive carbon deposit in the cylinders.
n. Insufficient engine oil or use of inferior grade of oil.
o. Excessive radiator area.

REMEDIES

a. Top up radiator.
b. Tighten belt or renew.
c. Unclog fins.
d. Trace fault, rectify or renew.
e. Replace water pump.
f. Replace thermostat.
g. Replace thermostat.
h. Retime ignition.
i. Unload car, check brakes.
j. Trace and clear.
k. Trace clear blockage.
l. Adjust correctly.
m. Decarbonise engine, top overhaul.
n. Top up with correct grade. Drain if necessary.
o. Partially blank off in winter only.

IGNITION SYSTEM

SYMPTOMS

	a	b	c	d	e	f	g	h	i	j	k	l	m	n	o	p	q	r
ENGINE CRANKS BUT DOES NOT START	*	*	*		*	*		*	*	*	*	*	*	*				
ENGINE STARTS BUT RUNS FOR SHORT PERIODS ONLY	*	*	*		*	*			*	*	*	*	*	*				
ENGINE MISFIRES AT LOW SPEED	*				*	*	*											
ENGINE MISFIRES AT HIGH SPEED		*	*	*	*	*	*		*	*	*	*		*				
ENGINE MISFIRES AT ALL SPEEDS		*	*	*	*	*	*		*	*	*	*	*	*				
ENGINE MISFIRES ON ACCELERATION AND FAILS TO REV.		*	*	*	*	*	*		*	*	*	*		*				
ROUGH IDLE	*	*	*		*	*	*	*	*	*	*	*	*	*	*		*	
ENGINE RUNS ROUGH AT HIGH SPEED		*	*	*	*	*	*		*	*	*	*		*	*		*	
LACK OF POWER		*	*	*	*	*	*	*	*	*	*	*		*	*		*	
POOR ACCELERATION		*	*	*	*	*	*	*	*	*	*	*		*	*		*	
LACK OF TOP SPEED		*	*	*	*	*	*	*	*	*	*	*		*	*		*	
EXCESSIVE FUEL CONSUMPTION		*	*	*	*	*	*	*	*	*	*	*			*	*	*	
PINKING		*	*		*	*		*			*	*			*	*		*
	a	b	c	d	e	f	g	h	i	j	k	l	m	n	c	p	q	r

PROBABLE CAUSE

a. Battery discharged or defective.
b. Contact breaker points need cleaning or renewing.
c. Incorrect contact breaker points.
d. Contact breaker spring weak.
e. Spark plugs need cleaning or renewing.
f. Incorrect spark plug gaps.
g. Wrong type of spark plug fitted.
h. Static ignition timing incorrect.
i. Coil or capacitor defective.
j. Open circuit or loose connection in the L.T. circuit.
k. Open circuit, short to earth or loose connection on the coil H.T. lead.
l. Open circuit, short to earth or loose connection on the spark plug leads.
m. Plug leads incorrectly connected.
n. H.T. leak on coil, distributor cap or rotor, due to oil, dirt, moisture or damage.
o. Centrifugal advance not functioning correctly.
p. Vacuum advance not functioning correctly.
q. Worn distributor cam or distributor shaft bush.
r. Using wrong grade of fuel.

REMEDIES

a. Recharge or replace battery.
b. Clean or renew.
c. Fit correct points.
d. Renew contact breaker set.
e. Clean or renew plugs.
f. Adjust gaps.
g. Fit correct plugs.
h. Retime ignition.
i. Replace as necessary.
j. Trace and rectify.
k. Trace and rectify.
l. Trace and rectify.
m. Connect correctly.
n. Clean with dry lint free rag.
o. Examine and oil sparingly.
p. Check and rectify.
q. Replace defective parts.
r. Change to correct grade of fuel.

Trouble Shooting

FUEL SYSTEM

SYMPTOMS

	a	b	c	d	e	f	g	h	i	j	k	l	m	n	o	p	q	r	s	t	u	v
ENGINE CRANKS BUT DOES NOT START	*	*	*	*	*	*	*	*														
ENGINE STARTS BUT RUNS FOR SHORT PERIODS ONLY	*		*	*	*	*		*	*	*	*	*	*						*	*		
ENGINE MISFIRES AT LOW SPEED			*	*				*	*													
ENGINE MISFIRES AT HIGH SPEED	*		*	*				*	*					*								
ENGINE MISFIRES AT ALL SPEEDS	*	*	*	*	*	*		*	*			*	*	*								
ENGINE MISFIRES ON ACCELERATION AND FAILS TO REV.	*		*	*				*	*		*	*	*	*	*	*	*				*	
ROUGH IDLE				*				*	*	*	*	*	*	*					*	*	*	*
ENGINE RUNS ROUGH AT HIGH SPEED				*				*	*		*	*	*	*						*		*
LACK OF POWER				*				*			*	*	*	*						*	*	*
POOR ACCELERATION				*				*			*	*	*	*	*	*				*	*	*
LACK OF TOP SPEED				*				*			*	*	*	*	*		*			*	*	*
EXCESSIVE FUEL CONSUMPTION			*	*							*	*				*	*			*	*	*
PINKING															*						*	*
BACKFIRE				*					*		*			*	*							
	a	b	c	d	e	f	g	h	i	j	k	l	m	n	o	p	q	r	s	t	u	v

PROBABLE CAUSE

a. Fuel tank empty.
b. Fuel line blocked.
c. Fuel pump defective.
d. Blockage in carburetter.
e. Air lock in fuel line.
f. Fuel filter blocked.
g. Carburetter needle valve jammed.
h. Water in carburetter.
i. Erratic fuel flow due to blockage.
j. Idling speed too low.
k. Incorrect setting of choke control.
l. Incorrect carburetter fuel/float level.
m. Carburetter icing.
n. Air leak at inlet manifold.
o. Incorrect grade of fuel.
p. Carburetter accelerator pump defective.
q. Throttle linkage mal-adjusted.
r. Incorrect adjustment of idling mixture.
s. Air filter clogged.
t. Incorrect ignition timing.
u. Carburetter piston sticking.
v. Wrong carburetter jets fitted.

REMEDIES

a. Fill tank.
b. Blow out obstruction with compressed air.
c. Replace pump.
d. Remove blockage.
e. Trace and bleed out.
f. Clean filter.
g. Free needle.
h. Drain out water, dry out.
i. Remove blockage.
j. Adjust throttle stop screw.
k. Reset control.
l. Adjust level.
m. Wait for ice to melt. If persistent, trace cause.
n. Trace leak and seal.
o. Dilute fuel with highest octane rating obtainable.
p. Trace fault and rectify.
q. Adjust correctly.
r. Adjust mixture control.
s. Clean filter.
t. Retime ignition.
u. Oil carburetter.
v. Replace with correct jets.

Trouble Shooting

CLUTCH

SYMPTOMS

	a	b	c	d	e	f	g	h	i	j	k	l	m	n	o	p	q	r
CLUTCH SLIPPING (WILL NOT ENGAGE PROPERLY)	*	*	*	*	*	*												
CLUTCH DRAG (WILL NOT DISENGAGE PROPERLY)			*		*		*	*	*	*	*	*					*	*
CLUTCH JUDDER	*	*	*				*		*	*	*	*	*	*				
CLUTCH GRAB (ON ENGAGEMENT)		*	*	*	*		*	*		*	*		*	*				*
CLUTCH NOISE – SQUEAL WHEN DEPRESSING THE PEDAL																*		
CLUTCH NOISE – RATTLE WHEN IDLING				*						*				*				
CLUTCH NOISE – CHATTER ON ENGAGEMENT										*				*				
	a	b	c	d	e	f	g	h	i	j	k	l	m	n	o	p	q	r

PROBABLE CAUSE

a. Insufficient free-play in release linkage.
b. Clutch disc facing worn or hardened.
c. Grease or oil on clutch disc facing.
d. Weak or broken pressure plate coil springs or diaphragm spring.
e. Air in hydraulic system.
f. Insufficient free-travel at clutch pedal.
g. Excessive free-play in release linkage.
h. Misalignment of clutch housing.
i. Clutch disc hub binding on splines of gearbox input shaft.
j. Clutch disc facing loose or broken.
k. Pressure plate mating surface warped.
l. Clutch cover distorted.
m. Looseness in transmission or suspension.
n. Clutch disc distorted.
o. Loose drive plate hub.
p. Release bearing defective.
q. Release arm bent.
r. Low hydraulic fluid level.

REMEDIES

a. Adjust linkage.
b. Replace clutch disc.
c. Clean and remedy cause.
d. Renew springs.
e. Bleed system.
f. Adjust travel.
g. Adjust or renew worn parts.
h. Realign housing.
i. Remove cause of binding.
j. Replace clutch disc.
k. Fit new parts.
l. Replace cover.
m. Take up play.
n. Renew disc.
o. Replace hub.
p. Renew bearing.
q. Straighten or renew.
r. Top up hydraulic fluid.

STEERING

SYMPTOMS

	a	b	c	d	e	f	g	h	i	j	k	l	m	n	o	p	q	r	s
STEERING STIFFNESS	*	*	*	*	*	*													
STEERING SLACK					*		*	*	*		*	*	*						
STEERING WANDER	*	*	*	*	*		*	*	*	*	*	*	*	*	*	*			
WHEEL SHIMMY				*	*		*	*	*		*	*	*	*	*	*			
CAR PULLS TO ONE SIDE	*			*				*		*				*	*	*	*	*	
POOR RECOVERY OF STEERING WHEEL TO CENTRE	*	*	*	*	*	*												*	
EXCESSIVE OR ABNORMAL TYRE WEAR	*			*			*	*	*					*	*	*	*	*	*
	a	b	c	d	e	f	g	h	i	j	k	l	m	n	o	p	q	r	s

PROBABLE CAUSE

a. Tyre pressures incorrect or uneven.
b. Lack of lubricant in steering gear.
c. Lack of lubrication at steering linkage ball joints.
d. Incorrect wheel alignment.
e. Incorrectly adjusted steering gear.
f. Steering column bearings too tight or column bent or misaligned.
g. Steering linkage joints worn or loose.
h. Front wheel bearings worn or incorrectly adjusted.
i. Slackness in front suspension.
j. Road wheel nuts loose.
k. Steering wheel loose.
l. Steering gear mounting bolts loose.
m. Steering gear worn.
n. Shock absorbers defective or mountings loose.
o. Road wheels imbalanced or tyres unevenly worn.
p. Suspension springs weak or broken.
q. Brakes pulling on one side.
r. Chassis frame or suspension misaligned.
s. Improper driving.

REMEDIES

a. Inflate and balance tyres.
b. Inject lubricant.
c. Lubricate.
d. Check steering geometry.
e. Adjust correctly.
f. Adjust renew defective parts.
g. Tighten or replace joints.
h. Adjust or renew bearings.
i. Tighten to correct torque.
j. Tighten nuts to correct torque.
k. Tighten to correct torque.
l. Tighten to correct torque.
m. Replace worn parts.
n. Replace with new.
o. Balance wheels.
p. Renew springs.
q. Balance brakes.
r. Realign.
s. Arrange tuition on driving.

Trouble Shooting

BRAKING SYSTEM

SYMPTOMS

	a	b	c	d	e	f	g	h	i	j	k	l	m	n	o	p	q	r	s	t	u	v	w
BRAKE FAILURE			*		*	*		*		*										*			*
BRAKES INEFFECTIVE	*	*	*	*	*	*	*	*	*	*							*			*			
BRAKES GRAB OR PULL TO ONE SIDE	*	*	*	*					*		*	*	*	*		*							*
BRAKES BIND					*										*		*	*	*		*		*
PEDAL SPONGY					*	*	*	*												*			*
PEDAL TRAVEL EXCESSIVE	*			*						*		*	*	*			*			*			*
EXCESSIVE PEDAL PRESSURE REQUIRED	*	*	*		*				*	*										*		*	*
HYDRAULIC SYSTEM WILL NOT MAINTAIN PRESSURE							*	*												*			*
BRAKE SQUEAL DEVELOPS	*	*	*	*												*		*					
BRAKE SHUDDER DEVELOPS	*	*	*	*								*	*	*		*		*					*
HANDBRAKE INEFFECTIVE OR REQUIRES EXCESSIVE MOVEMENT	*	*	*	*													*						
	a	b	c	d	e	f	g	h	i	j	k	l	m	n	o	p	q	r	s	t	u	v	w

PROBABLE CAUSE

a. Brake shoe linings or friction pads excessively worn.
b. Incorrect brake shoe linings or friction pads.
c. Brake shoe linings or friction pads contaminated.
d. Brake drums or discs scored.
e. Incorrect brake fluid.
f. Insufficient brake fluid.
g. Air in the hydraulic system.
h. Fluid leak in the hydraulic system.
i. Fluid line blocked.
j. Mal-function in the brake pedal linkage.
k. Unequal tyre pressures.
l. Brake disc or drum distorted or cracked.
m. Brake back plate or calliper mounting bolts loose or looseness in the suspension.
n. Wheel bearings incorrectly adjusted.
o. Weak, broken or improperly installed shoe return springs.
p. Uneven brake lining contact.
q. Incorrect brake lining adjustment.
r. Pistons in wheel cylinder or calliper seized.
s. Weak or broken brake pedal return spring.
t. Master cylinder defective.
u. Fluid reservoir overfilled or reservoir air vent restricted.
v. Servo vacuum hose disconnected or restricted, or servo unit defective.
w. Wheel cylinder or calliper defective.

REMEDIES

a. Replace linings or pads.
b. Replace with correct linings or pads.
c. Clean thoroughly.
d. Renew drums or discs.
e. Bleed out old fluid and replace with correct type.
f. Top up reservoir.
g. Bleed brake system.
h. Trace and seal.
i. Trace and clear blockage.
j. Correct as necessary.
k. Adjust and balance tyre pressures.
l. Renew disc or drum.
m. Tighten as necessary to correct torque.
n. Adjust wheel bearings.
o. Renew or install correctly.
p. Trace cause and remedy.
q. Adjust correctly.
r. Free and clean.
s. Renew spring.
t. Replace master cylinder and seals.
u. Lower fluid level. Clear air vent.
v. Check and replace hose. Renew servo unit if defective.
w. Replace as necessary.

Trouble Shooting

LUBRICATION SYSTEM

SYMPTOMS

	a	b	c	d	e	f	g	h	i	j	k	l	m	n
EXCESSIVE OIL CONSUMPTION	*	*	*	*								*	*	
LOW OIL PRESSURE					*	*	*	*	*	*	*	*		*

PROBABLE CAUSE

a. Worn or damaged cylinder bores, pistons and/or piston rings.
b. Worn valve guides.
c. Damaged valve stem seals.
d. Leaking oil seal or gasket.
e. Faulty oil pressure gauge, switch or wiring.
f. Relief valve defective.
g. Oil pick-up pipe strainer blocked.
h. Oil filter over-flow valve defective.
i. Worn oil pump.
j. Damaged or worn main and/or big-end bearings.
k. Incorrect grade of engine oil.
l. Oil level low.
m. Oil level too high.
n. Oil leak or the pressurised side of the lubrication system.

REMEDIES

a. Regrind cylinder bores and fit new oversize pistons and rings.
b. Replace valves and guides.
c. Replace seals.
d. Seal leak or replace gasket.
e. Trace and rectify.
f. Check and replace if necessary.
g. Remove blockage.
h. Check and replace if necessary.
i. Replace pump or parts.
j. Renew bearings.
k. Replace oil with correct grade.
l. Top up oil.
m. Drain off surplus oil.
n. Trace and remedy.

ELECTRICAL EQUIPMENT

SYMPTOMS

	a	b	c	d	e	f	g	h	i	j	k	l	m	n	o	p	q	r
STARTER FAILS TO OPERATE		*	*	*	*			*	*									
STARTER OPERATES BUT DOES NOT CRANK ENGINE	*	*	*		*	*	*											
STARTER CRANKS ENGINE SLOWLY	*	*	*															
STARTER NOISY IN OPERATION					*		*	*										
IGNITION WARNING LIGHT REMAINS ILLUMINATED WITH ENGINE AT SPEED			*							*	*	*						
IGNITION WARNING LIGHT FAILS TO ILLUMINATE WHEN IGN. IS SWITCHED ON		*	*						*		*		*					
IGNITION WARNING LIGHT STAYS ON WHEN IGN. IS SWITCHED									*		*	*						
LIGHTS DIM OR WILL NOT ILLUMINATE		*	*								*		*			*	*	*
BULBS BLOW FREQUENTLY AND BATTERY REQUIRES FREQUENT TOPPING-UP											*							
DIRECTION INDICATORS NOT FUNCTIONING PROPERLY		*	*						*				*		*			*
	a	b	c	d	e	f	g	h	i	j	k	l	m	n	o	p	q	r

PROBABLE CAUSE

a. Stiff engine.
b. Battery discharged or defective.
c. Broken or loose connection in circuit.
d. Starter pinion jammed in mesh with flywheel ring gear.
e. Starter motor defective.
f. Starter pinion does not engage with flywheel ring gear due to dirt on screwed pinion barrel.
g. Starter drive pinion defective or flywheel ring gear worn.
h. Starter solenoid switch defective.
i. Ignition/starter switch defective.
j. Broken or loose drive belt.
k. Regulator defective.
l. Generator/alternator defective.
m. Bulb burned out.
n. Mounting bolts loose.
o. Fuse blown.
p. Light switch defective.
q. Short circuit.
r. Flasher unit defective.

REMEDIES

a. Add a small quantity of oil to the fuel and run the engine carefully.
b. Recharge or replace battery.
c. Trace and rectify.
d. Release pinion.
e. Rectify fault or replace starter motor.
f. Clean and spray with penetrating oil.
g. Replace defective parts.
h. Trace fault, renew if necessary.
i. Renew switch.
j. Replace belt.
k. Adjust or replace.
l. Adjust or replace.
m. Renew bulb.
n. Tighten bolts to correct torque.
o. Replace fuse after ascertining cause of blowing.
p. Renew switch.
q. Trace and rectify.
r. Replace unit.