FIAT 126

Owners Workshop Manual

Autobook 853

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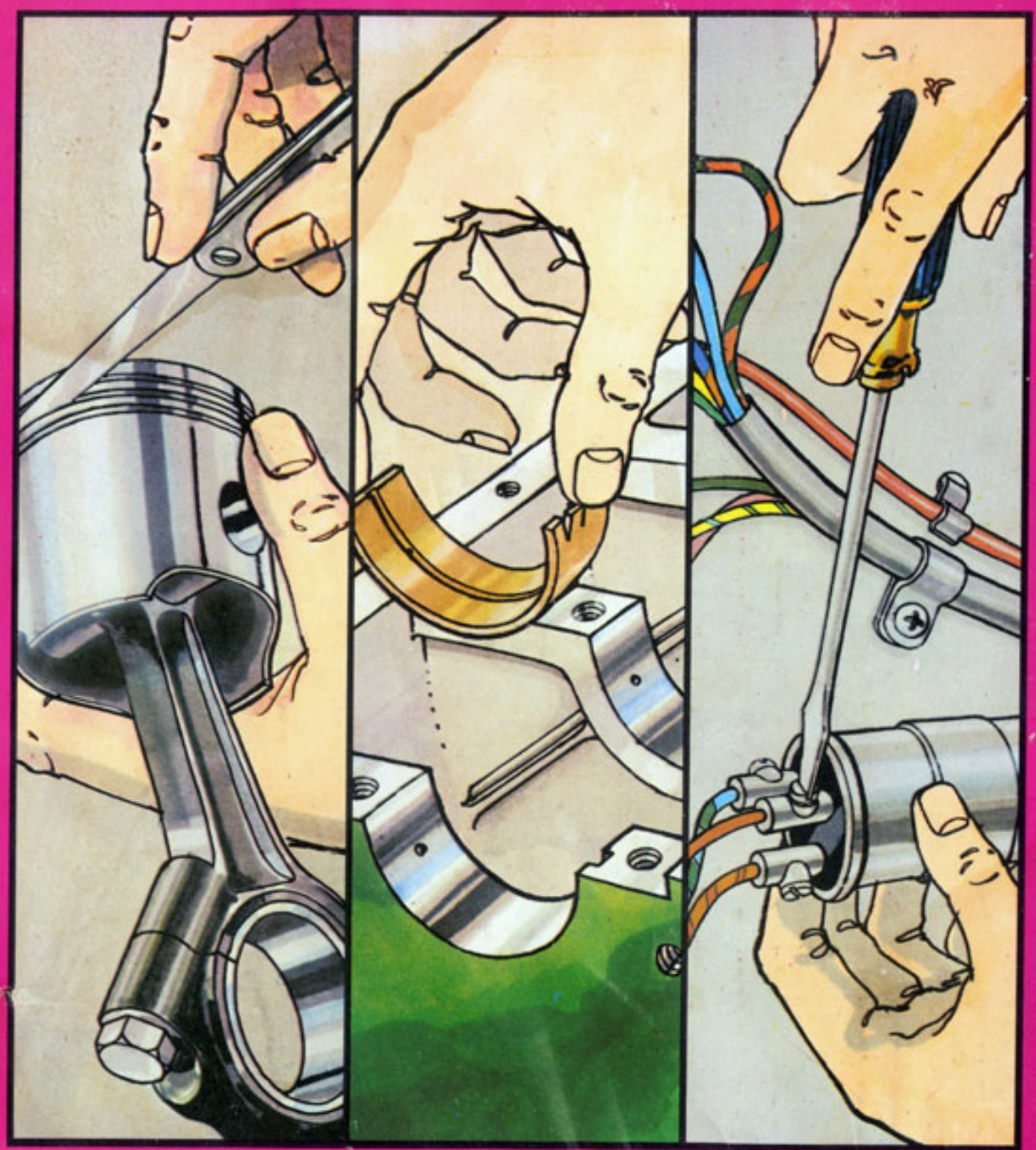

Autobooks

Fiat 126 1972-76 Autobook

by the Autobooks Team of Technical Writers

Fiat 126 1972-76
Fiat 126L 1972-76

Autobooks

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INTRODUCTION

This do-it-yourself Workshop Manual has been specially written for the owner who wishes to maintain his car in first class condition and to carry out his own servicing and repairs. Considerable savings on garage charges can be made, and one can drive in safety and confidence knowing the work has been done properly.

Comprehensive step-by-step instructions and illustrations are given on all dismantling, overhauling and assembling operations. Certain assemblies require the use of expensive special tools, the purchase of which would be unjustified. In these cases information is included but the reader is recommended to hand the unit to the agent for attention.

Throughout the Manual hints and tips are included which will be found invaluable, and there is an easy to follow fault diagnosis at the end of each chapter.

Whilst every care has been taken to ensure correctness of information it is obviously not possible to guarantee complete freedom from errors or to accept liability arising from such errors or omissions.

Instructions may refer to the righthand or lefthand sides of the vehicle or the components. These are the same as the righthand or lefthand of an observer standing behind the car and looking forward.

CHAPTER 1

THE ENGINE

1 :1 Description

The Fiat 126 engine is similar in design to the original 500 cc engine but the power output has been boosted by increasing the capacity to 594 cc. This has been done by increasing the cylinder bore from 67.5 mm to 73.5 mm, the stroke remaining at 70 mm as before. Redesigned cylinder heads, cam profiles, pushrods and rockers have, together with a rise in the compression ratio from 7.1 to 1 to 7.5 to 1 pushed up the output from 18 bhp (DIN) at 4500 rev/min to 23 bhp at 4800 rev/min.

The cylinder block comprises two cast iron cylinder barrels with cooling fins. The bottom of the cylinders fit into machined seats in the aluminium crankcase.

The aluminium crankcase carries eight studs on which are located the two cylinder barrels with the aluminium cylinder head on the top.

A two bush crankshaft of special cast iron is fitted into the lower half of the crankcase. The crankshaft is provided with a counterweight and is hollow to allow for lubrication.

The steel connecting rods have thin wall bearing halves on the big-end, and bronze bushes in the small-end. The offset piston pin is of steel and retained in the piston by two circlips.

Light alloy pistons are used and are of the taper-oval-shaped type with a maximum diameter at the base of the skirt, along an axis perpendicular to the piston pin. Pistons are fitted with three rings as follows: One compression at the top, one standard oil scraper ring and one side slotted oil scraper ring.

The one-piece aluminium cylinder head is finned to provide a larger cooling surface and carries the inlet and exhaust manifolds. The valve seats are cast iron inserts.

The inlet passages merge into a single centralised flange onto which is mounted the carburetter. The exhaust passages run almost parallel to the axis of the engine. Mounted on the top of the cylinder head is the overhead valve rocker mechanism that is operated by a chain driven camshaft through tappets and vertical pushrods.

The carburetter is of the downdraught type fitted with a starting device that is controlled by a lever on the central floor tunnel. A pleated paper element air cleaner and silencer is fitted to the carburetter air intake. A mechanical diaphragm type fuel pump operated from the camshaft by

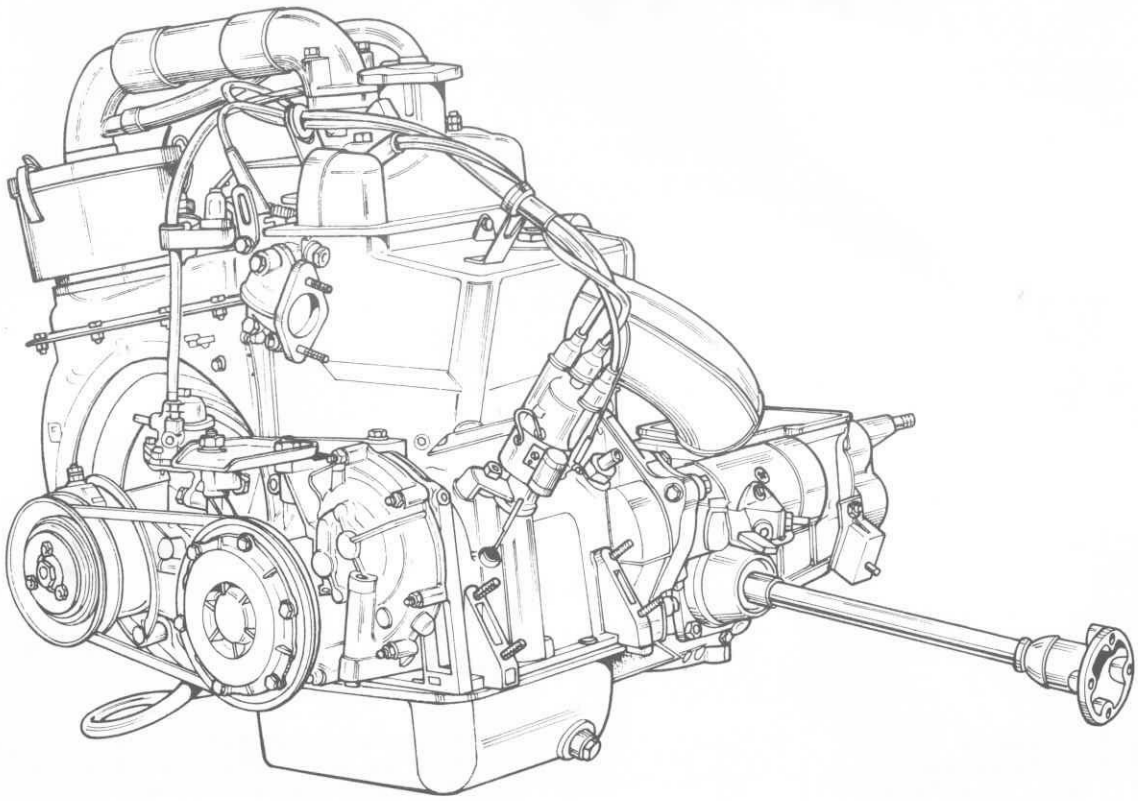

FIG 1:1 General view of the power plant seen from the rear

a pushrod, supplies petrol to the carburetter from a fuel tank located at the rear of the vehicle.

Engine lubrication is provided by a gear pump driven from the camshaft and mounted within the timing cover and drawing oil from the engine sump. The oil is cleaned by a centrifugal filter situated at the rear end of the crankshaft and pressure is controlled by a valve mounted on the pump body. Crankcase ventilation is provided for through a rubber hose connected to the top of the rocker cover.

The engine is cooled by air from a centrifugal blower mounted on the generator shaft and housed in a specially designed cowling conveying air to and around the engine. The air temperature is governed by a special thermostat fitted in the engine cowling.

The interior of the car can be heated by engine warmed air being ducted into the front compartment and controlled by a lever on the heating system tunnel.

Engine ignition is by a battery, ignition coil and by a distributor which is driven by a gear on the camshaft. The engine is started by an electric starter motor which is mounted on the gearbox casing and is controlled by a lever located behind the gearchange lever.

The complete power unit is mounted on a spring support at the centre of the rear body crossmember and by two rubber pads mounted laterally to the gearbox.

A general view of the unit is given in **FIG 1:1** and longitudinal and transverse sections in **FIGS 1:2** and **1:3**.

1:2 Engine removal and refitting

First disconnect the battery to avoid the risk of short-circuits. Chock the front wheels and jack-up the rear of the vehicle. Place stands under the side brackets provided. Make sure that the supports are quite stable before working underneath (see **'Hints on Maintenance and Overhaul'** at the end of this manual).

Prise out the plastic retainer and disconnect the check strap or retainer from the engine compartment lid. Remove the nut from one hinge pin, slide the lid sideways and remove it from the body.

Disconnect the cables from the generator, the distributor and the low oil pressure indicator. Disconnect the fuel pipes and the choke and accelerator linkages. Pull off the hoses supplying cool air to the fan and warm air to the interior. Remove the two engine side shields and the flywheel cover attached to the transmission case. Fit Fiat adaptor A.60587 to a trolley jack as shown in **FIG 1:4** and take the weight of the unit.

Remove all nuts connecting the engine to the starter motor and the transmission. Release the outer ends of the rear crossmember from the body, disconnect the lead for the number plate lamp and remove the unit complete with crossmember. The latter can now be detached as required. It is most important to ensure that the engine is kept level and square to the transmission during removal so that no undue stress is applied to the clutch driven plate (see **Chapters 5** and **6**).

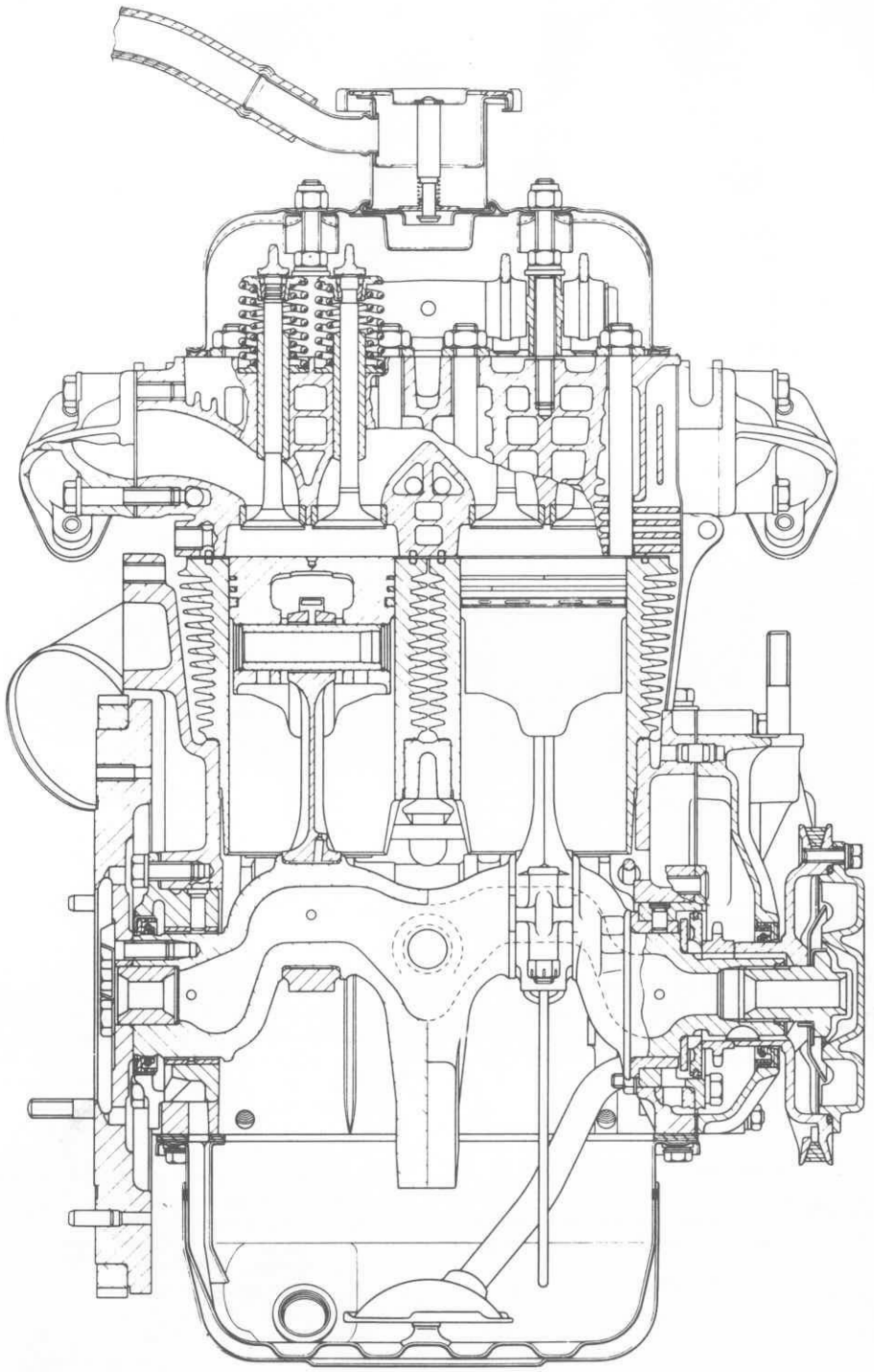

FIG 1:2 Section through the engine showing the big-ends on common centres with the crankshaft counterweight between. The centrifugal oil filter is on the right

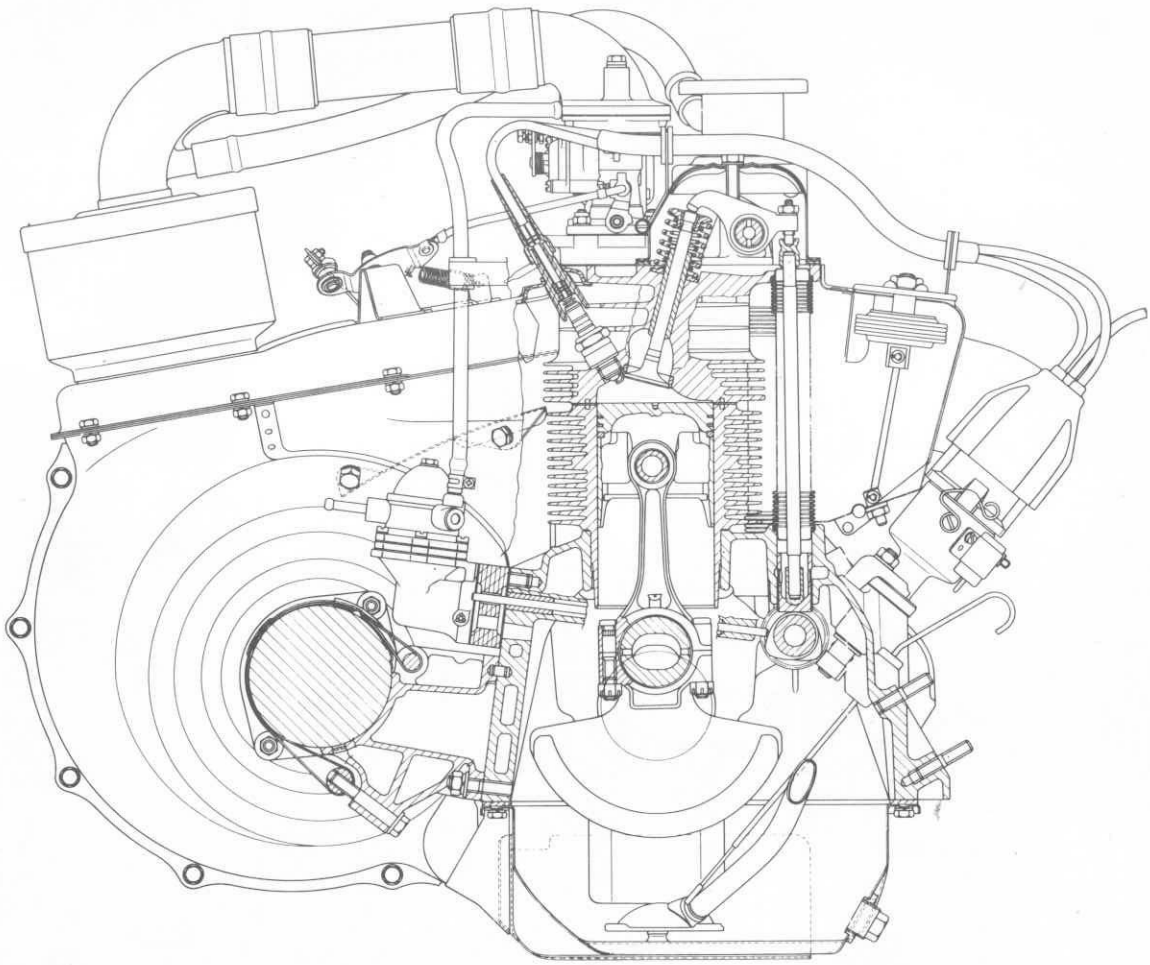

FIG 1:3 Cross-section through the engine showing the generator and fan housing on the left. Note the pushrod-driven fuel pump also on the left and the distributor on the right

Refitting is a reversal of the removal instructions. If the clutch has been removed, make sure that the driven plate is correctly centralised and avoid any side loads on the driven plate hub and gearbox input shaft while the engine is being slid into place. Centralising the clutch plate is covered in **Chapter 5**. This operation is not required if the clutch is not removed from the flywheel.

1:3 Dismantling the engine

Proceed as follows:

1 Release the silencer brackets and the two exhaust pipe flanges at the cylinder head elbows. Remove pipe and silencer assembly.

2 Remove the rocker cover (two nuts and washers). Release air inlet elbow from carburetter flange and remove air cleaner parts and inlet pipe (see **FIG 1:24**). Remove the generator driving belt by splitting the pulley (three nuts), taking care to keep the adjustment rings in the positions from which they were removed (see belt adjustment in **Chapter 4**).

3 Remove all bolts securing the cooling air ducting to the engine. Release one end of the accelerator control rod to the carburetter. Release the generator from the crankcase at the clamping strap (one bolt, see **FIG 1:3**). Lift away all the ducting and generator.

4 Detach plug leads. Remove distributor retainer (one nut, see **Chapter 3**) and lift out distributor. Remove the carburetter.

5 Remove the internal nuts and washers from the rocker cover studs and lift off the rocker assembly. Lift out the pushrods, making a note of their correct positions. Slacken the eight cylinder head nuts in the order shown in **FIG 1:5**.

6 The aluminium head needs some care in removal and the best way to tackle it is to use Fiat tool A.40051 as shown in **FIG 1:6**. With the head off, remove the four pushrod tubes and the fifth tube enclosing the oil feed tube to the rocker gear.

7 Remove the fuel pump and pull out the pump operating pushrod (see **Chapter 2**). Remove the

centrifugal oil filter cover 25 (see **FIG 1 : 24**). Unlock and unscrew crankshaft bolt 26 and remove pulley 28. Remove timing gear cover 12 (see **FIG 1 : 7**) complete with oil pump, making careful note of the correct positions of the various nuts, washers and lock-washers.

8 Unlock and unscrew the four bolts securing the large sprocket to the camshaft (see **FIG 1 : 27**). Remove the sprocket and chain. Draw off the crankshaft sprocket with a suitable puller.

9 Taking note of their correct positions, lift out the pushrod tappets. Withdraw the camshaft, taking particular care not to damage the crankcase bearing surface with the edges of the cams or the distributor drive gear.

10 After marking the flywheel and crankshaft for correct reassembly, remove the six bolts and lift off the flywheel. Lock the cylinder barrels in place with Fiat tool A.60156 (see **FIG 1 : 8**) or use two suitable lengths of tubing fitted on the central studs. Turn the engine upside down, keeping all weight off the studs.

11 Remove the sump and oil suction pipe. Mark the connecting rods and caps, unlock and remove the nuts, lift off the caps and push the rods off the crankpins. Place the engine on its side and remove the temporary clamp from the cylinder barrels. Remove each cylinder assembly complete with piston and connecting rod. Note correct location of pistons, connecting rods and cylinders before separating them. Mark them if necessary.

12 Release the rear main bearing housing from the crankcase (four bolts and two crosshead screws). Release the front bearing housing (six bolts). Carefully ease the crankshaft out of the crankcase. If there is any possibility of bending the long studs it is desirable to unscrew them from the crankcase.

1 : 4 Servicing the cylinder head

It is, of course, possible to remove the cylinder head without removing the engine. If it is simply a matter of decarbonising or attending to the valves, remove the head by detaching the air inlet elbow, removing the carburetter and the rocker cover. Also disconnect the exhaust pipes and all bolts securing the cooling air ducting to the head. Mark the plug leads and detach them from the plugs. Remove the nuts from the rocker pedestals and lift off the rocker gear. Making a note of their locations, lift out the pushrods. Remove the head nuts and lift off the head as described in the preceding section.

Removing the valves:

It is a good idea to remove the carbon in the combustion chamber before removing the valves. Avoid scratching the aluminium surfaces with a sharp-edged tool. Remove the valve springs with a suitable compressor or the special Fiat tool A.60084 as shown in **FIG 1 : 9**. Keep the springs and cotter parts in sets and make a note of their correct locations. It will be seen that the exhaust valve stems and cotters are grooved and that there is an oil seal on the inlet valve stem.

If there has been trouble with gas leakage between the head and the cylinders, have the head surface checked

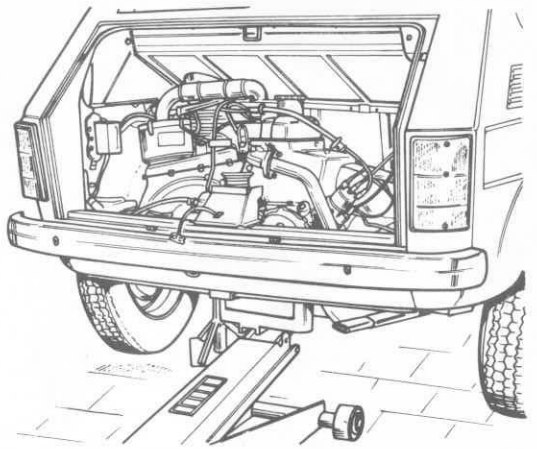

FIG 1 : 4 Removing the engine complete with rear crossmember

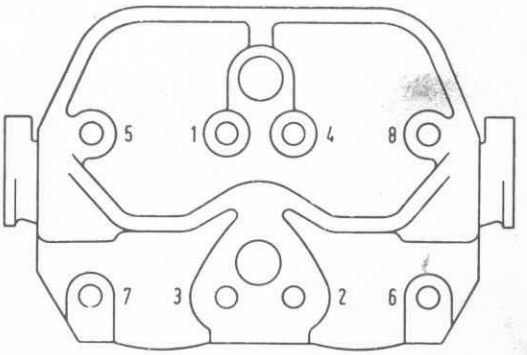

FIG 1 : 5 The numbered sequence for tightening and loosening the cylinder head nuts

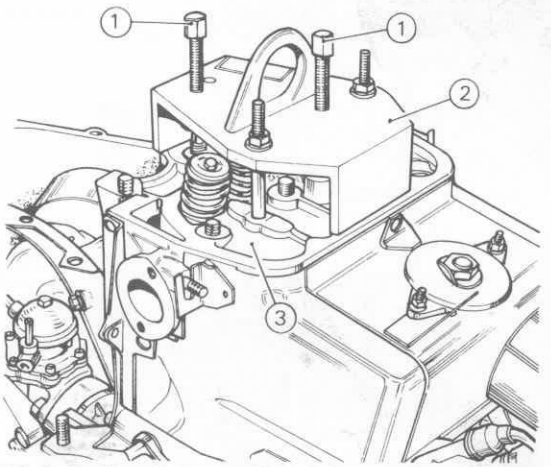

FIG 1 : 6 Fiat Puller A.40051 being used to lift the cylinder head 3. The puller screws are items 1 and the puller is part 2

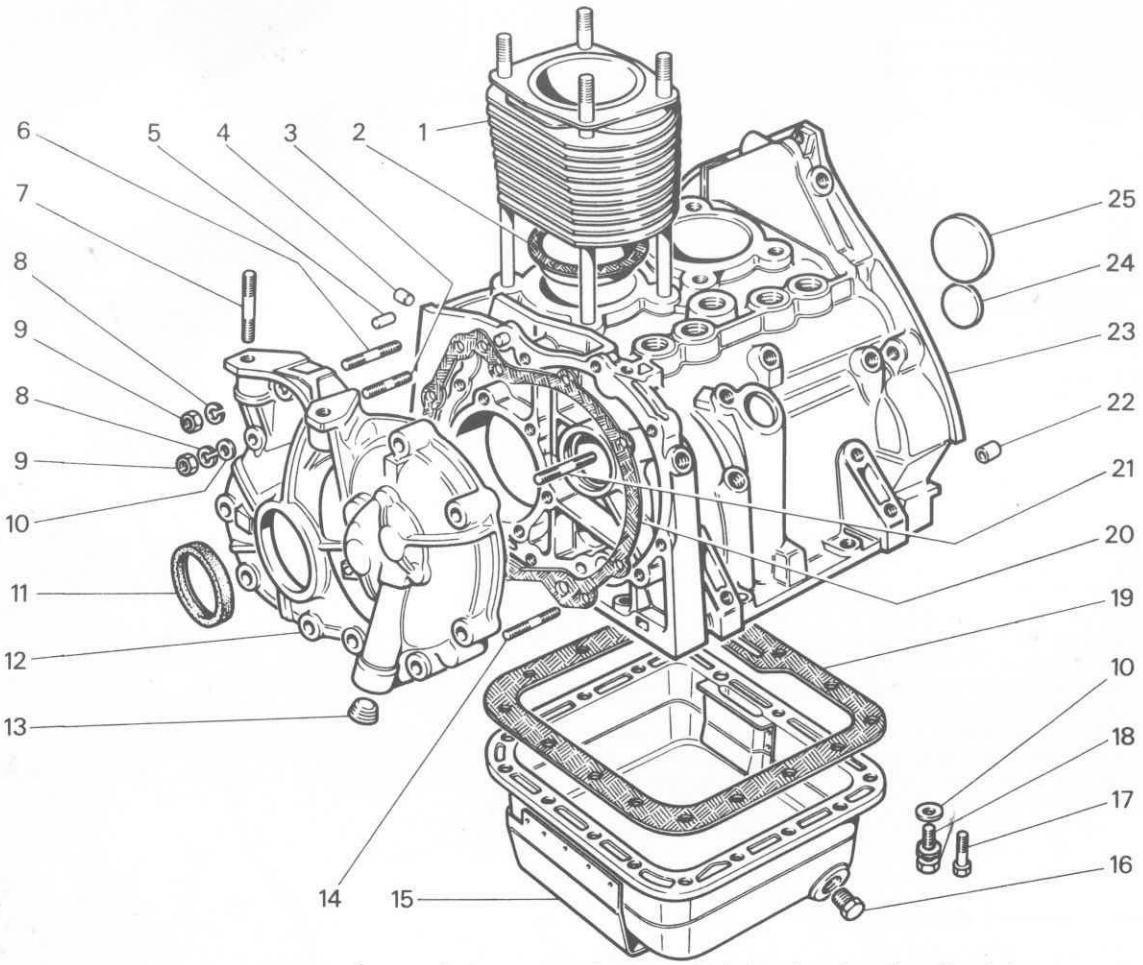

FIG 1:7 Cylinder, crankcase, timing cover and sump exploded to show location of gaskets

Key to Fig 1:7 1 Cylinder 2 Gasket 3 Stud 4 Dowel 5 Dowel 6 Stud 7 Mounting stud 8 Lockwasher 9 Cover nut 10 Flat washers 11 Cover seal 12 Timing cover 13 Plug, oil duct 14 Cover stud 15 Sump 16 Drain plug 17 Sump bolt 18 Bolt and washer 19 Sump gasket 20 Cover gasket 21 Cover stud 22 Dowel 23 Crankcase 24 Lower Welch plug 25 Upper Welch plug

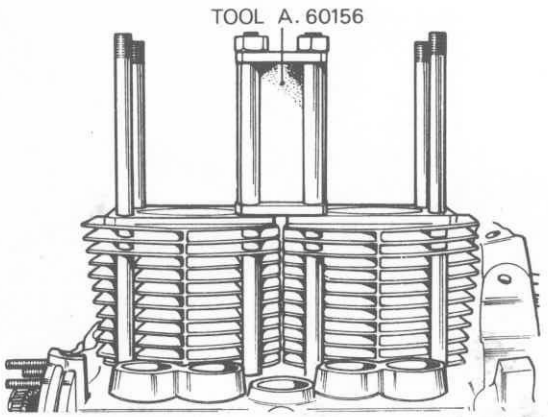

FIG 1:8 Using Fiat tool A.60156 on two studs to hold the cylinders in place

for distortion. Refacing can be arranged, removing as little aluminium as possible. It is essential to have the depth of the combustion chambers checked with Fiat tool A.96222 after refacing. The gap between the gauge and the gasket surface of the head should not exceed .02 inch (.50 mm).

The valve guides:

Clean the valves and the bores of the guides and check the clearance between valve stem and bore of guide. Both inlet and exhaust valves should have the same clearance of .0012 to .0026 inch (.03 to .066 mm). Excessive clearance calls for renewal of the valve, the guide, or both. Check valve stem and guide bore dimensions from **FIG 1:10.**

If the guides must be renewed and Fiat tool A.60153/1 with adaptor A.60153/6A is not available, measure the height of the guide above the head before removing. The

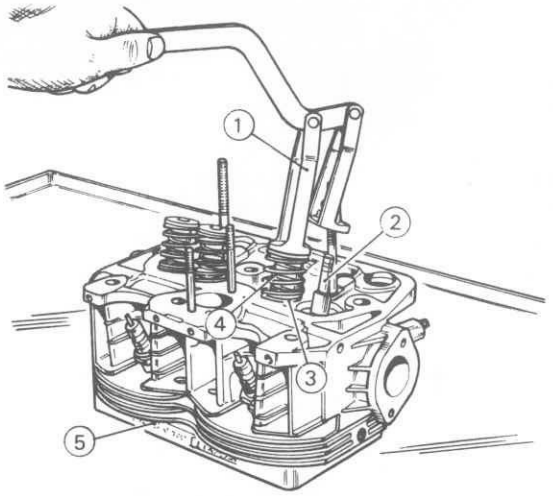

FIG 1:9 Compressing valve springs with Fiat tool A.60084

Key to Fig 1:9 1 Valve spring compressor A.60084
2 Valve stem 3 Outer valve spring 4 Inner valve spring
5 Board to protect head face

official tool automatically controls the correct depth of insertion of guide in head.

Drive out the defective guide. Check that bore in head is .5492 to .5503 inch (13.95 to 13.977 mm) in diameter. The interference fit of the guide in the bore must be .0025 to .0043 inch (.063 to .108 mm). In other words the guide outside diameter must exceed the head bore diameter by that amount to ensure a tight drive fit (see **FIG 1:11**). Drive in the new guide, preferably with the Fiat tool. The operation is shown in **FIG 1:12**. If the valve guide bore is undersize after fitting, the bore can be restored to the correct size with reamer A.90310.

Note that guides are available in standard size and in .5606 to .5621 inch (14.24 to 14.278 mm) oversizes on outside diameter.

The valves:

If the valves are otherwise satisfactory but the seating faces are pitted or burnt, have them reground to an angle of 45 deg. 30 min. ± 5 min. After grinding, the rim above the seat must have a width not less than .02 inch (.5 mm).

The valve seats in the head:

If these show signs of pitting, have them reground to an angle of 45 deg. ± 5 min. After grinding, the seats must be checked for width. This must lie between .071 and .083 inch (1.8 and 2.1 mm). A suitably-equipped service station will be able to use cutters that will reduce the width to the correct figure.

The valve springs:

Check these for cracks. Also check the height against the figures given in **Technical Data**. A spring that is shorter than the specification will be weak and must be renewed. After a long mileage it is always a good plan to renew the springs.

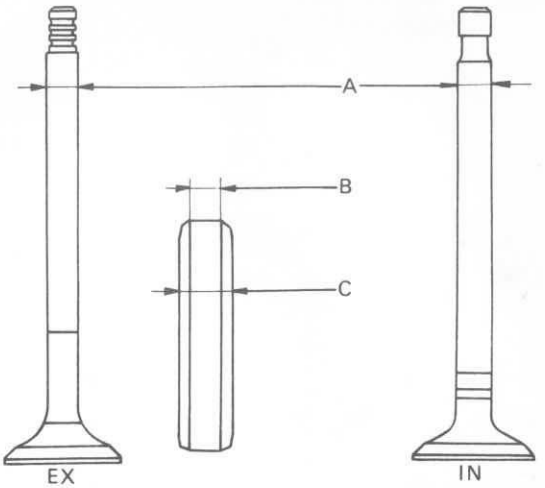

FIG 1:10 Tolerances on standard dimensions for valve stems. Those for valve guides are shown in the centre

Key to Fig 1:10 A .3139 inch (7.974 mm) to .3146 inch (7.992 mm)
B .3158 inch (8.022 mm) to .3156 inch (8.040 mm)
C .5527 inch (14.040 mm) to .5534 inch (14.058 mm)

Reassembling the head:

Lubricate the valve stems. Refit in the correct position and fit the springs and associated parts, not forgetting the oil seals on the inlet valve stems. Compress the springs and refit the cotters, taking care to fit the grooved cotters to the exhaust valve stems. The cotter grooves are shown in **FIG 1:10**.

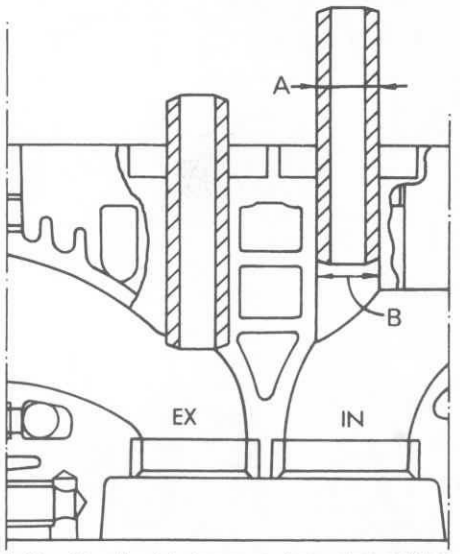

FIG 1:11 Standard tolerances for valve guides and guide bores in head, indicating the desired interference fit

Key to Fig 1:11 A .5527 inch (14.040 mm) to .5534 inch (14.058 mm)
B .5492 inch (13.950 mm) to .5503 inch (13.977 mm)

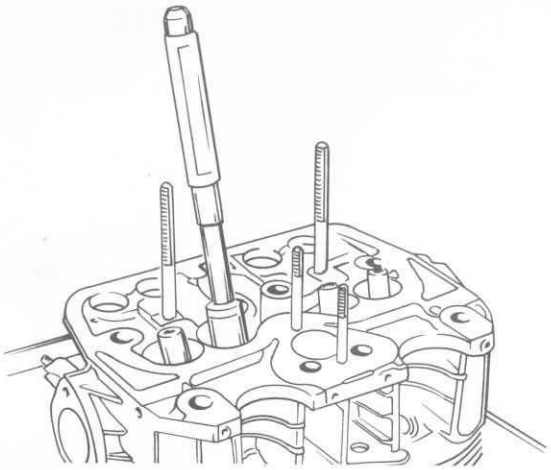

FIG 1:12 Driving valve guides into place using Fiat tool A.60153/1 with adaptor A.60153/6A

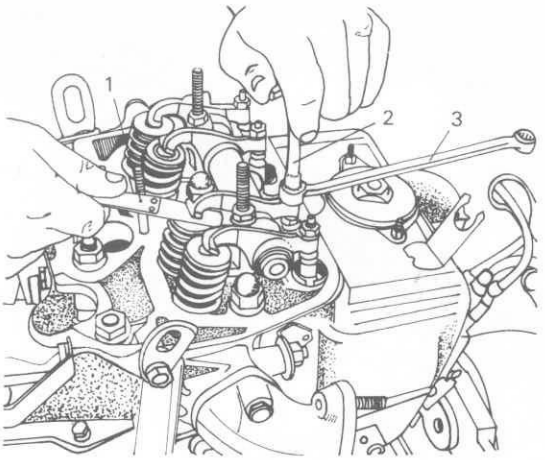

FIG 1:14 Adjusting valve clearances using feeler gauge 1, adjusting screw wrench 2 and locknut ring spanner 3

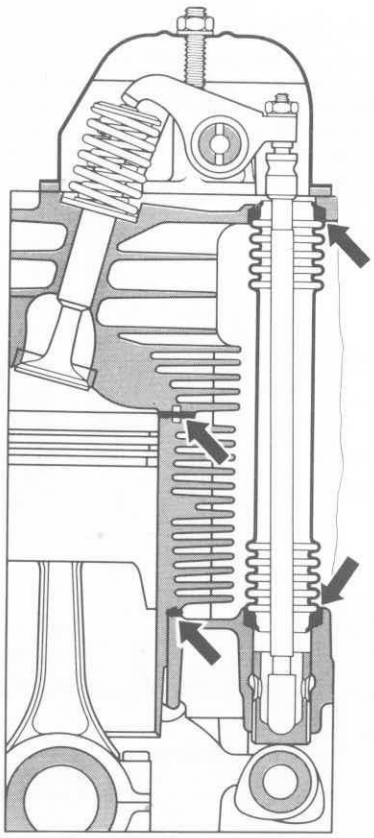

FIG 1:13 The arrows point to those engine seals that must be renewed at every overhaul. This ensures that fumes do not contaminate heated air to the interior

Refitting the head:

Clean the joint faces of the cylinder barrels and fit a new gasket. Renew the gaskets on the pushrod and lubricating pipe tubes (see **FIG 1:13**). Refit the head and make sure the tubes are correctly located. Refit the head nuts, the four domed nuts being adjacent to the valves. Tighten moderately at first and then go round them in the order shown in **FIG 1:5** with a torque wrench set to 29 lb ft (4 kgm). Refit the pushrods and the rocker gear and check the valve clearance as described in the next section. Refit the ducting. Refit the rocker cover, the carburetter and the exhaust pipes, using new gaskets in every case. Connect up the fuel pipes and accelerator controls. Fit the intake pipe to the carburetter.

1:5 Adjusting the valve clearance

It is important to set the clearances correctly. If they are excessive the engine will be noisy and if they are too close the valve seats may suffer. In both cases the valve timing will be incorrect. It is also important to note that it is impossible to set the clearances correctly if the rocker tips are pitted, or if wear is evident on valve stems, adjusting screws and pushrods.

Set the clearances with the engine cold. With the valve fully closed, insert a feeler gauge between the valve stem and the tip of the rocker arm as shown in **FIG 1:14**. The correct clearance is .008 inch (.20 mm) for inlet valves and .010 inch (.25 mm) for exhaust valves. If adjustment is necessary slacken the nut at the pushrod end of the rocker arm and turn the adjusting screw as required. Tighten the locknut and check again. It should be possible to withdraw the feeler gauge smoothly without it being tightly nipped or coming out too freely.

If it is difficult to carry out the check because the rocker arm is tight on its shaft, refer to **Section 1:6** which covers the timing gear and the fit of the various parts.

1:6 Servicing the timing gear

Removal of the camshaft and tappets is covered in **Section 1:3**. The rocker gear and pushrods can be

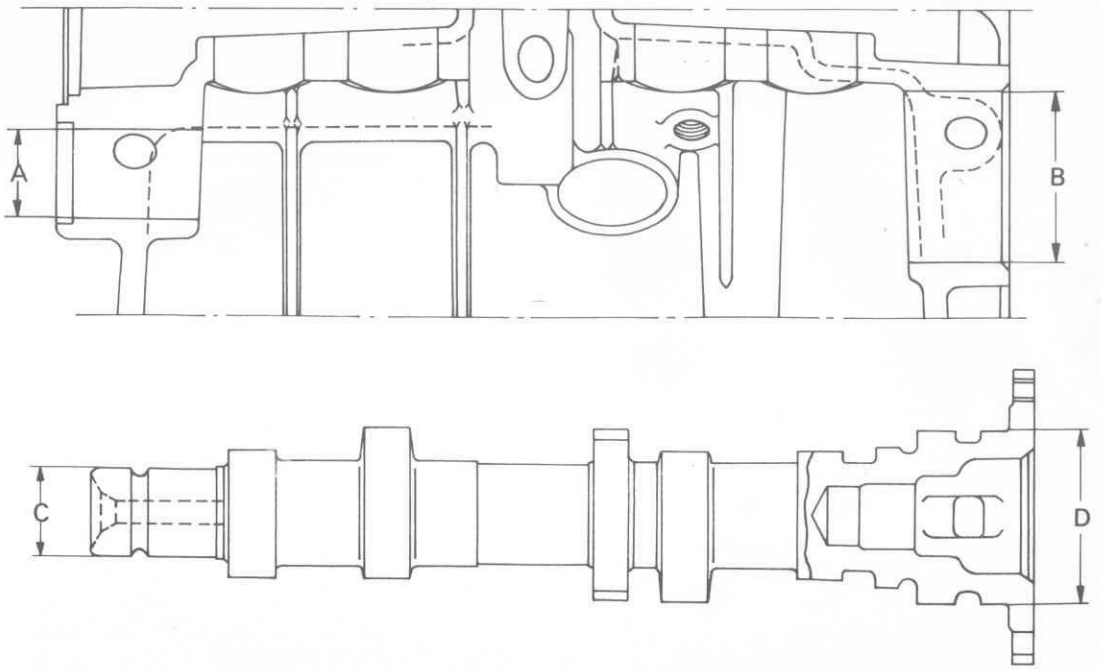

FIG 1:15 Tolerances on standard camshaft bores in crankcase (above) and on camshaft journals (below)

Key to Fig 1:15 A .8667 inch (22.015 mm) to .8675 inch (22.036 mm) B 1.6937 inch (43.020 mm) to 1.6947 inch (43.045 mm) C .8653 inch (21.979 mm) to .8661 inch (22.000 mm) D 1.6919 inch (42.975 mm) to 1.6929 inch (43.000 mm)

removed as described previously, by removing the rocker cover only, but the head must be removed if the pushrod tubes or rocker lubrication tube are to be serviced.

The camshaft:

After removal, clean thoroughly and check the wearing surfaces. The bearing surfaces must be bright and smooth with no sign of seizure or scoring. Slight blemishes may be dressed off with a fine abrasive stone. The correct dimensions are given in **FIG 1:15**, together with the bores in the crankcase. Running clearances are given in **Technical Data**.

Check the cams for excessive wear and inspect the distributor drive gear for wear and chipped teeth. If the equipment is available, the cam lobe lift can be measured. It should be .244 inch (6.2 mm).

The tappets:

Tappet bores in the crankcase should be .8662 to .8669 inch (22.003 to 22.021 mm) in diameter and tappets .8659 to .8652 inch (21.996 to 21.978 mm) in diameter, the running clearance being from .0003 to .0017 inch (.008 to .043 mm). If clearance exceeds this, the bores in the crankcase may be reamed out to take oversize tappets. Use reamer A.90338/1 for tappets that are .0019 inch (.05 mm) oversize, and reamer A.90338/2 for tappets that are .0039 inch (.10 mm) oversize.

Check tappet surfaces for wear and renew if necessary.

The pushrods and tubes:

Check that the rods are straight and the contact ends not worn. The tubes have compressible corrugations at each end and seat on seals that must be renewed at each overhaul (see **FIG 1:13**). Check that the tubes are of equal length and are not distorted.

The rocker gear:

Check the rocker shaft for wear and check the rocker arms for correct running clearance as specified in **Technical Data**. Reject rockers that are badly pitted at the tips. Renew adjusting screws that show signs of wear at the ball end.

The sprockets and chain:

Push and pull alternately on the chain links. Excessive movement calls for renewal of both chain and sprockets. It is not advisable to fit a new chain to sprockets with worn teeth.

1:7 The cylinders

Clean the cylinders and check the bores for excessive wear or scoring. The cylinders come in three bore sizes: A, B and C (see **FIG 1:16**). The illustration shows the measuring points. A further check on wear is to use feeler gauges to check the piston clearance. Select the correct piston for the bore and check the clearance at a point at right angles to the piston pin and a distance of 2.254 inch (57.25 mm) down from the piston

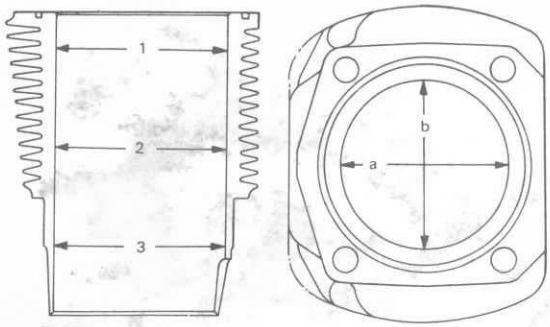

FIG 1:16 Checking cylinder bores showing micrometer positions (left) and positions a and b for measuring bores on cylinder centrelines (right)

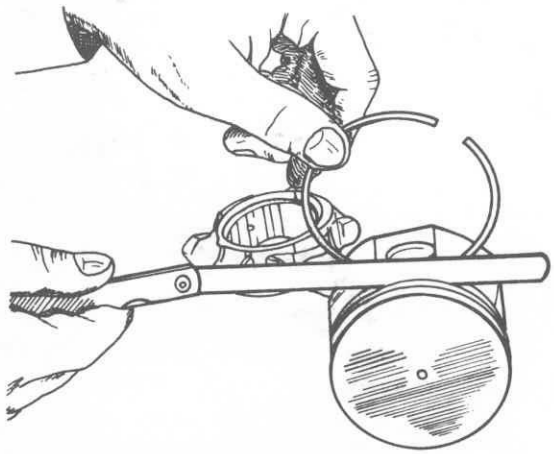

FIG 1:17 Using feeler gauges to measure side clearance of rings in piston grooves

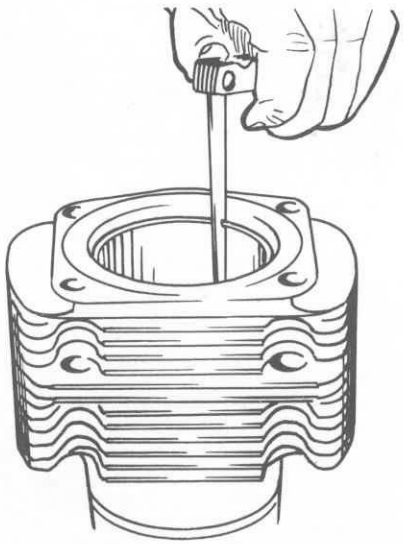

FIG 1:18 Using feeler gauges to measure gap of ring when ring is inserted squarely into cylinder bore

crown. The clearance at this point should be .0028 to .0035 inch (.07 to .09 mm). The clearance may be easier to check by measuring the bore and the piston diameter with micrometers.

Oversize pistons are available if the cylinder barrels need reboring. Oversizes are plus .0079, .0157 and .0236 inch (.20, .40 and .60 mm). Note that each piston and barrel must bear the same classification in the range of A, B or C. The piston class letter is stamped on a piston pin boss inside.

1:8 The pistons

Clean carbon from the crown and the ring grooves, taking care not to score the surfaces with a sharp-edged tool. Clean the piston inside and out and check carefully for cracks. Look for scores or signs of seizure on the running surface and in the bores for the pin. Check the clearance as instructed in the preceding section. Oversizes are also given.

The piston pin:

Check the fit of the pin in the piston by oiling it and pressing it into place by thumb pressure. With the pin vertical it should not fall out by its own weight. There is one oversize piston pin available which is plus .0078 inch (.20 mm). Normally it is wise to heat the piston in hot water before fitting the pin.

The piston rings:

Check the side clearance of each ring in its groove, using feeler gauges as shown in **FIG 1:17**. On major overhauls it is advisable to renew all rings. They are available in standard sizes and also in oversizes to suit oversize cylinder bores (see **Section 1:7**).

When fitting new rings, first check the gaps between the ends as shown in **FIG 1:18**. Press the ring squarely down the bore with a piston and then check the ring gap with a set of feeler gauges. Correct gaps are given in **Technical Data**. Reject rings with an excessive gap and file the ring ends if there is insufficient gap.

When the rings are installed, lubricate them and set the gaps approximately 120 deg. apart. This means spacing the gaps evenly round the circumference of the piston.

Refer to the next section for details of the operation of refitting the pistons to the connecting rods.

1:9 The connecting rods

Clean the rods and bearings. Check the bearing surfaces for wear, scoring or break-up. Bearing shells are renewable, but if wear is excessive it is necessary to check the crankpins with a micrometer to see whether they are oval and need regrinding. In this case, undersize shells are available. **Do not try to correct clearances by filing the rods or shells.** Undersizes of bearing shells are minus .01, .02, .03 and .04 inch (.254, .508, .762 and 1.016 mm).

Running clearance of the big-end bearing on the crankpin should lie between .0004 and .0024 inch (.011 and .061 mm) both for standard and reground crankshafts. Use 'Plastigage' to check the clearance. Lay a strip of 'Plastigage' in the big-end cap so that it is parallel to the centreline of the engine, keeping it clear of the hole in the shell. Do not oil the bearing or crankpin.

Assemble the big-end and tighten the nuts to 25 lb ft (3.5 kgm) without swinging the rod on the crankpin. Take off the cap and the flattened 'Plastigage' will be found adhering to either the cap shell or the crankpin. Using the gauge supplied with the material, measure the width of the flattened 'Plastigage' as shown in **FIG 1 : 19**. If the clearance is outside the limits, check the crankpin for wear and ovality. The standard crankpin diameter should lie between 1.7328 and 1.7336 inch (44.013 to 44.033 mm) as shown in **FIG 1 : 20**. If worn beyond these limits the crankshaft must be reground and undersize bearing shells fitted.

The small-end bush:

If satisfied with the fit of the piston pin in the piston, check the fit of the pin in the connecting rod small-end bush. Running clearance should be between .0002 and .0006 inch (.005 and .016 mm). The correct dimensions of pin and bore of bush are given in **FIG 1 : 20**. If the bush is worn it may be possible to open out the bore with expanding reamer A.90307 and fit a new piston pin that is .0078 inch (.20 mm) oversize.

If the bush must be renewed, press it out and press in a new one, using a suitable drift to keep the bush square. It is then necessary to cut the lubricating slot in the top of the bush. The bore will be undersized and must be opened out, preferably by a Fiat agent with the necessary equipment as it is essential that the big-end and small-end bores are parallel. At a pinch it is possible to use the reamer A.90307 but it is advisable to have the bores checked for parallel alignment afterwards.

1 : 10 Installing pistons and connecting rods

Having been marked or noted before dismantling, it should now be possible to mate each piston and connecting rod correctly. Note that the piston pin is offset from the axis of the piston (see **FIG 1 : 21**). The illustration shows the correct assembly of the piston relative to the cylinder number stamped on the side of the big-end and to the camshaft.

Expand the piston in hot water and dry it. Oil the piston pin and bores and fit the piston to the connecting rod. Heating the piston will make the pin a free fit. Fit the circlips, one at each end of the pin, and make sure they are properly seated. Oil the piston, the rings and the ring grooves preparatory to fitting the piston assembly into the cylinder barrel.

Using a ring compressor, fit each piston and connecting rod assembly into its cylinder barrel after lubricating the cylinder bore. Insert the assembly at the bottom end. Make sure that the connecting rod numbering will face the camshaft with the cylinder correctly located, as shown in **FIG 1 : 21**.

1 : 11 Servicing the crankshaft and main bearings

Clean the crankshaft thoroughly, injecting solvent under pressure through the oil passages, especially if a big-end bearing has 'run'. Inspect very carefully for cracks, paying particular attention to the places where there is a change in section, for example, the start of the radii at the ends of big-end journals. Scoring of the bearing surfaces will call for regrinding.

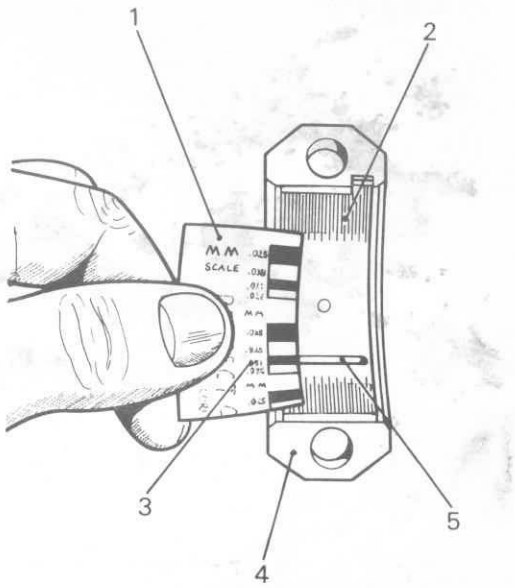

FIG 1 : 19 Checking big-end running clearance. The gauge is being used to measure the width of the 'Plastigage' after it has been flattened

Key to Fig 1 : 19 1 Graduated scale 2 Bearing shell 3 Clearance reading calibrated strip 4 Big-end bearing cap 5 Plastigage

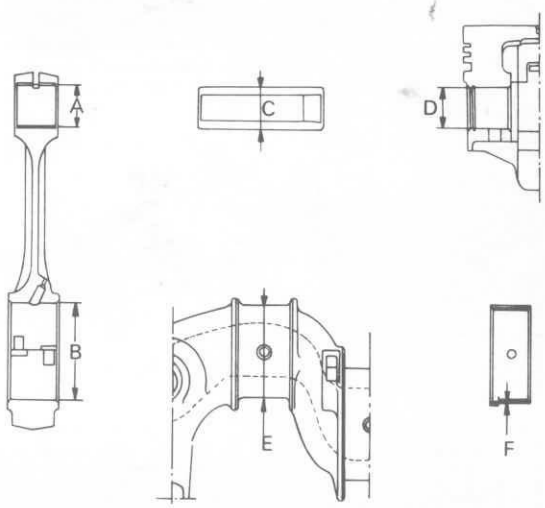

FIG 1 : 20 Standard tolerances on fits of small-ends, big-ends and piston pins. Note that bore of small-end bush (top left) is measured after the bush has been pressed in

Key to Fig 1 : 20 A .7874 inch (20.000 mm) to .7876 inch (20.006 mm) B 1.8555 inch (47.130 mm) to 1.8560 inch (47.142 mm) C .7870 inch (19.990 mm) to .7872 inch (19.995 mm) D .7872 inch (19.995 mm) to .7874 inch (20.000 mm) E 1.7328 inch (44.013 mm) to 1.7336 inch (44.033 mm) F .0604 inch (1.534 mm) to .0607 inch (1.543 mm)

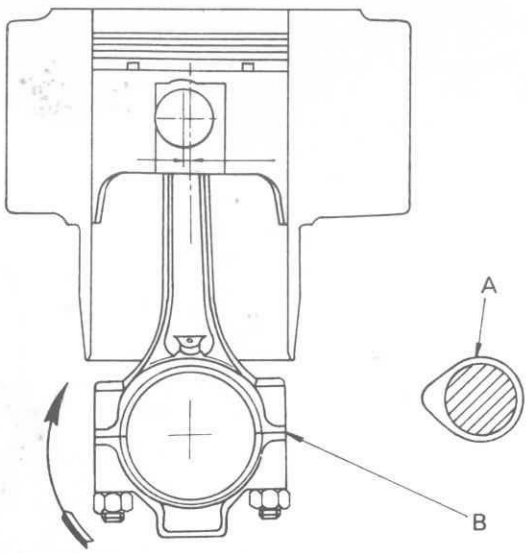

FIG 1:21 Correct assembly of connecting rod and piston. Note how piston pin is offset away from camshaft A, and cylinder numbering stamped on big-end at B faces the camshaft. The arrow shows the direction of engine rotation

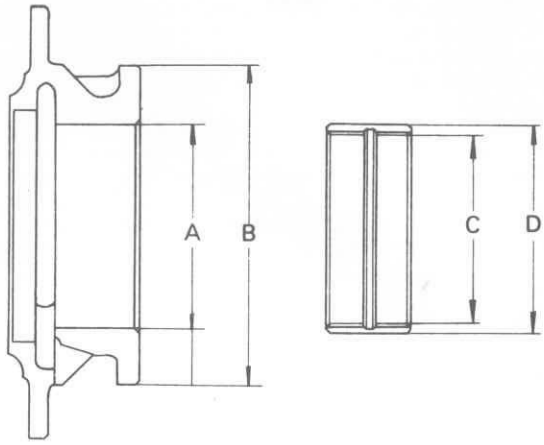

FIG 1:23 Tolerances on diameters and bores of main bearing and its support at the timing gear end of the crankshaft

Key to Fig 1:23	A 2.5173 inch (63.940 mm) to 2.5181 inch (63.960 mm)
	B 3.1484 inch (79.970 mm) to 3.1496 inch (80.000 mm)
	C 2.1063 inch (53.500 mm) to 2.1102 inch (53.600 mm)
	D 2.5185 inch (63.970 mm) to 2.5193 inch (63.990 mm)

Use a micrometer to check the journal diameters. If the mains are oval by more than .0002 inch (.005 mm) the crankshaft must be reground. Measure the bores of the main bearings in order to check the running clearances. **FIGS 1:22** and **1:23** indicate the correct diameters of supports and bearings. The correct running clearance lies between .0018 and .0031 inch (.045 and .080 mm). Clearances for big-ends are given in **Section 1:9**.

If the crankshaft is to be reground, undersize bearings are available in minus .0079, .0157, .0236, .0315 and .0394 (.20, .40, .60, .80 and 1.0 mm) sizes. These are complete with bearing support. No adjustment will be needed if the crankshaft has been ground to the correct undersize. In special cases it is possible to obtain bearing bushes with a machining allowance of .04 inch (1 mm) in the bore. The bush must be press-fitted into its support, a hole drilled for the dowel, the hole being opened out with reamer A.90334 and the dowel fitted. The bore must then be machined to obtain the correct running clearance.

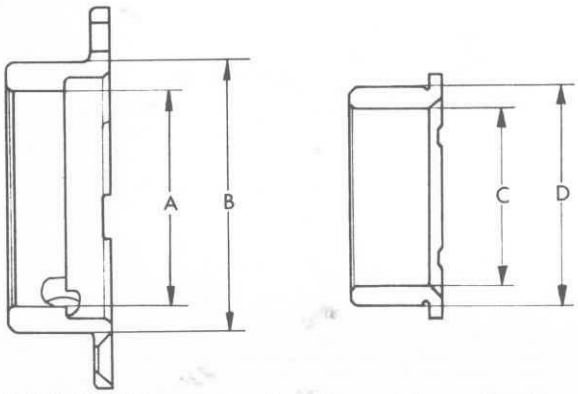

FIG 1:22 Tolerances on diameters and bores of main bearing and its support at the flywheel end of crankshaft

Key to Fig 1:22	A 2.3228 inch (59.000 mm) to 2.3240 inch (59.030 mm)
	B 3.6209 inch (91.970 mm) to 3.6220 inch (92.000 mm)
	C 2.1086 inch (53.557 mm) to 2.1184 inch (53.807 mm)
	D 2.3250 inch (59.057 mm) to 2.3270 inch (59.107 mm)

Crankshaft oil seals:

The front seal is pressed into the main bearing support and the rear seal is pressed into the timing cover as can be seen in **FIG 1:2**. Renew the seals if leakage past the crankshaft has been evident. The bearing surfaces for the seal lip must be highly polished. Press a new seal into place until it is flush, making sure that the open side faces inwards.

Transmission shaft bush:

A self-lubricating bush is fitted at the flywheel end of the crankshaft to support the transmission input shaft (see lefthand end of crankshaft in **FIG 1:2**). A worn bush must be removed with a suitable puller such as the slide-hammer type of Fiat tool A.40206/801 with adaptor A.40207/812. Use a shouldered drift to drive a new bush into place.

1:12 The flywheel and the starter ring gear

Check the mating faces of the flywheel and crankshaft for burrs. The working surface of the clutch driven plate must be smooth and free from scoring or cracks. Check the teeth of the starter ring gear and renew the ring if damaged. Split the ring with a cold chisel, taking great care not to damage the recess in the flywheel rim. Heat

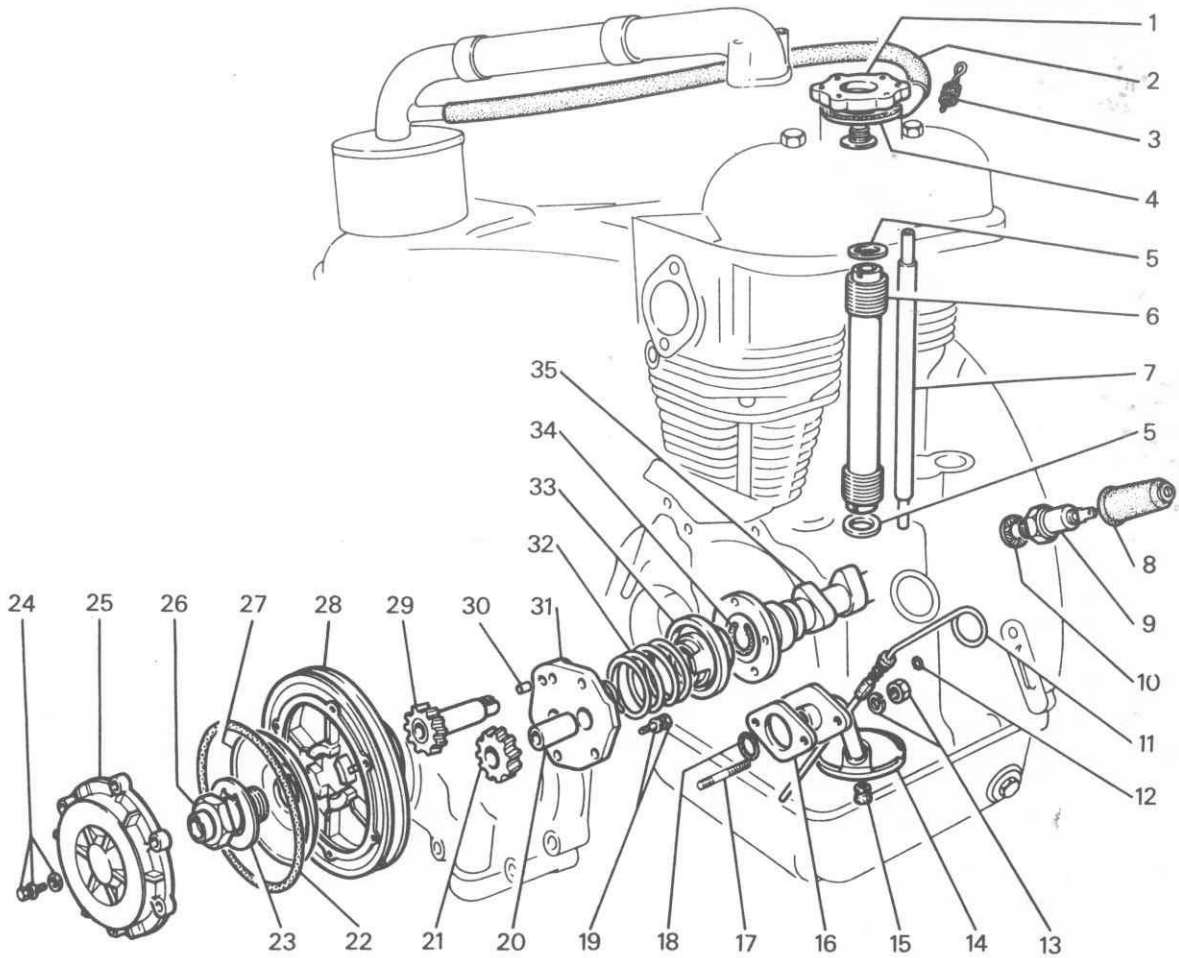

FIG 1:24 Exploded details of the lubricating system. The centrifugal oil filter is on the left with the oil pump in the centre

Key to Fig 1:24 1 Filler cap 2 Breather tube 3 Backfire suppressor 4 Gasket 5 Seals 6 Pushrod housing 7 Lubricating tube for rocker gear 8 Dust cover 9 Low oil pressure indicator 10 Seal 11 Dipstick 12 Seal 13 Nut and lockwasher 14 Oil pick-up 15 Damper 16 Spacer 17 Stud 18 Seal 19 Bolt and lockwasher 20 Driven gear shaft 21 Driven gear 22 Seal 23 Lockplate 24 Bolt, flat and lockwashers 25 Centrifugal filter cover 26 Bolt for pulley 27 Deflector 28 Pulley and centrifugal filter 29 Pump drive gear 30 Dowel 31 Pump cover 32 Oil pressure relief valve spring 33 Oil pressure relief valve 34 Circlip 35 Camshaft

the new ring evenly to a temperature of 80°C (176°F) and press it into place until it is fully home. When cool it will be a tight shrink fit. An oil bath is useful to give an even heat but work out of doors to avoid a fire.

1:13 The lubricating system

The components of the system are shown in **FIG 1:24** and the oil pump parts in **FIG 1:25**. Oil is picked up from the sump by pipe and screen 14 in **FIG 1:24**. It reaches the pump gears 21 and 29 and is pumped down the hollow shaft of gear 29 to reach the centrifugal filter 25 to 28. Dirt is flung out and retained in a recess in the filter and clean oil under pressure passes down the hollow crankshaft to reach all the bearings, drilled passages

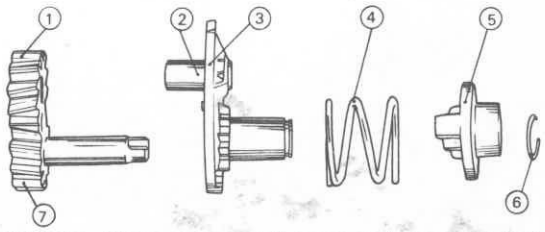

FIG 1:25 Components of oil pump and pressure relief valve

Key to Fig 1:25 1 Driven gear 2 Driven gear shaft 3 Cover 4 Spring 5 Relief valve 6 Circlip 7 Drive gear and shaft

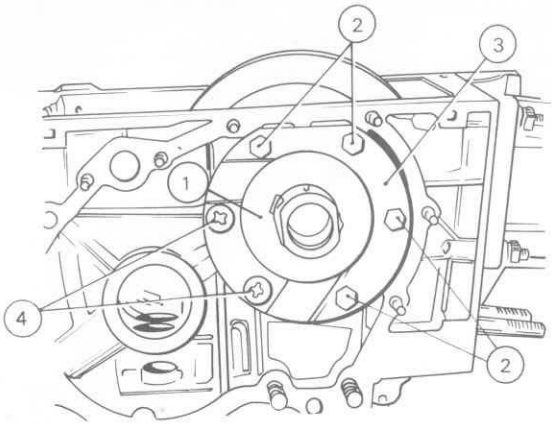

FIG 1:26 Crankshaft support at the timing gear end. 1 is a ring, 2 are the four bolts, 3 is the support and 4 are the two cross-head screws

conducting oil to the camshaft bearings, the tappets and by way of a vertical tube to the rocker gear. A concentric relief valve 33 is mounted on the pump housing, being spring-loaded to lift when pressure becomes excessive.

Removing oil pump:

This can be done with the engine in place. Take the weight of the engine on a jack and remove the rear cross-member (see **Section 1:2**). Remove the generator. Remove filter cover 25 (see **FIG 1:24**). Unlock and remove bolt 26, pull off pulley 28 and release the timing cover complete with oil pump (see 12 in **FIG 1:7**).

Servicing the pump:

Dismantle by removing lockring 6 (see **FIG 1:25**). Pull off relief valve 5 and spring 4. Detach the pump cover 3 from inside the timing cover (four bolts and a dowel). Lift out the gears.

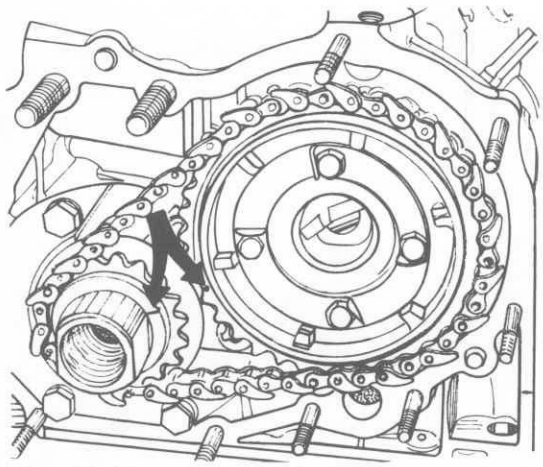

FIG 1:27 The arrows point to the line and dot index marks on the timing gear sprockets. These must face each other for correct valve timing

Clean all the parts and blow the passages clear with compressed air. Renew the parts if the shafts are worn or the gear teeth damaged. Assemble the gears in the housing and check the clearances. Between the gear teeth and the housing bore, the gap should lie between .0027 and .0051 inch (.07 and .13 mm). Clearance between gear faces and the mounting face for the cover should lie between .0012 and .0034 inch (.03 and .087 mm). Clearance between the gear teeth should be .006 inch (.15 mm). Excessive clearances at any point will lead to low oil pressure.

Check the fit of the shafts. Clearance of drive gear shaft in cover should lie between .0006 and .0021 inch (.016 and .053 mm). Clearance between driven gear and its pin should lie between .0008 and .0024 inch (.02 and .06 mm). Clearance between the relief valve and the spindle should be .0008 to .003 inch (.02 to .074 mm).

If the end cover is indented with wear the gears will have excessive end float. The cover must be renewed. Check the condition of the driving dogs at the end of the pump shaft and the camshaft. Check the oil relief valve spring for cracks or weakening. The spring should have a free height of 1.42 ± .04 inch (36.2 ± 1 mm). Under a load of 88 ± 4 lb (40 ± 2 kg) the spring should have a height of .689 inch (17.5 mm). Give extra care to cleaning the relief valve so that dirt or deposits do not cause it to bind.

Reassemble the parts in the reverse order of removal, lubricating where required. When the pump is assembled, check that the gears can be turned freely by hand. Make sure that the pick-up screen is quite clean before bolting into place and do not forget the seal (see **FIG 1:24**).

The centrifugal filter:

Clean all the internal surfaces where dirt and sludge have collected. It is essential to have no oil leaks between the filter halves, so renew the seal before bolting together (see part 22 in **FIG 1:24**). Tighten the crankshaft hollow bolt to 108 lb ft (15 kgm).

1:14 Valve timing

Normally the timing should be correct if the sprocket marks are brought into line as described during engine reassembly. If it is necessary to check the valve timing the valve clearance at the rocker tips must be set at .0246 inch (.625 mm) with a cold engine. The correct positions for valve opening and closing are given in **Technical Data**. These are given in degrees before and after top or bottom dead centre. The dead centre positions are at the points where the pistons stop moving before reversing direction. After checking, restore the valve clearances to the correct working clearances (see **Section 1:5**).

1:15 Engine reassembly

With all parts correctly serviced as described in the preceding sections proceed to reassemble as follows:

1 Fit new gaskets throughout (see **FIG 1:7**). With pistons and connecting rods fitted to their respective cylinder barrels, refit the barrels to the crankcase on new gaskets. If the holding-down studs were removed, these must be refitted before the barrels are inserted. Fit tubes or Fiat tool A.60156 to hold the cylinders in place.

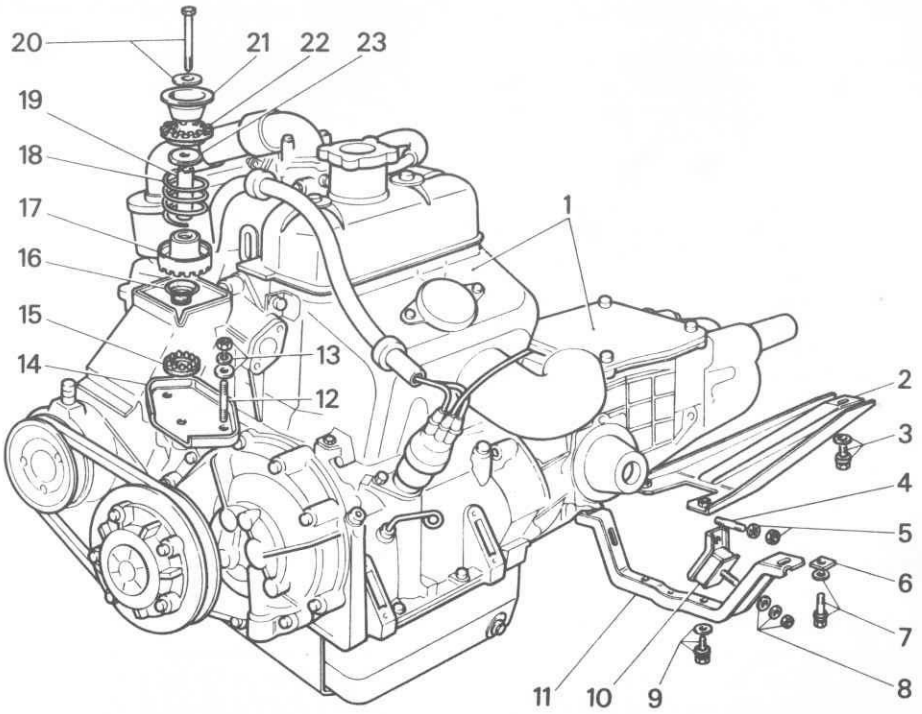

FIG 1:28 Details of the flexible mountings for the power unit

Key to Fig 1:28 1 Power unit 2 Bracket 3 Bolt, flat and lockwashers 4 Stud 5 Nut and lockwasher 6 Plate 7 Bolt, flat and lockwashers 8 Nut, flat and lockwashers 9 Bolt, flat and lockwashers 10 Insulator (rubber mounting) 11 Support bracket 12 Stud 13 Nut, flat and lockwashers 14 Rear mounting plate 15 Lower rubber pad 16 Rubber bush 17 Upper rubber pad 18 Spring 19 Spacer 20 Bolt and flat washer 21 Upper cup 22 Thrust ring 23 Flat washer

2 Fit the top-half shells to the connecting rods, making sure that the lugs are correctly located in the grooves in the rods. This will also apply to the caps. Slide the crankshaft into place, lubricate the journals and fit the main bearing supports (see **FIGS 1:2** and **1:26**). There is a gasket under the support at the flywheel end. Tighten the screws to 22 lb ft (3 kgm). Check that the crankshaft turns freely.

3 Oil the journals and fit the connecting rods and caps. Make sure that there is no dirt behind the big-end shells and that the lugs on the shells are correctly located in the grooves in the caps. Tighten the big-end nuts to 25 lb ft (3.5 kgm). Check that the connecting rod marking faces the camshaft as shown in **FIG 1:21**. Check for free movement.

4 Check that the camshaft bores are clean and free from burrs. Oil all running surfaces and slide the camshaft carefully into place. Fit the inner thrust ring to the timing gear end of the crankshaft. The inner bevel must face the crankshaft radius fillet as shown on the right in **FIG 1:2**. Fit the second and larger washer and the Woodruff key. Fit the camshaft drive sprocket. Turn the crankshaft until the index mark is approximately in the position shown in **FIG 1:27**.

5 Assemble the camshaft driven sprocket and chain with the tensioning levers pointing as shown in the illustration. Fit the chain to the crankshaft sprocket so that the index dot on the large sprocket faces the index line on the small sprocket as shown. Fit the sprocket bolts and locking plates, tighten to 7 lb ft (1 kgm) and lock.

6 Fit the timing cover on a new gasket (see **FIG 1:7**). The cover must be complete with oil pump and relief valve. Fit the various nuts and washers in the positions from which they were removed. Refit the oil suction pipe (see **FIG 1:24**). Align the marks made on dismantling and refit the flywheel. Check that the mating faces are perfectly clean. Fit the bolts and new lockplates, tighten to 25 lb ft (3.5 kgm) and lock.

7 Refit the centrifugal oil filter (see **FIG 1:24**) and tighten the crankshaft bolt on a new lockwasher to a torque of 108 lb ft (15 kgm). Fit a new seal 22. Fit the clutch to the flywheel, centralising the driven plate as described in **Chapter 5**. Holding a new gasket in place with a smear of grease, refit the sump (see **FIG 1:7**).

8 Turn the engine upright and clean the joint faces of the cylinders. Remove the device holding the cylinders in place and fit new head gaskets. Oil the tappets and fit them in their correct locations. Refit the pushrods and the housing sleeves, using new seals (see 5 and 6 in **FIG 1:24**). Fit lubrication tube 7 and its sleeve. Refit the cylinder head as described at the end of **Section 1:4**. Refit the rocker gear and adjust the

valve clearances (see **Section 1 : 5**). Fit the rocker cover, using a new gasket.

9 Refit the engine ducting for the cooling air. Refit the generator to the crankcase together with the fan ducting. Join up to the rest of the ducting. Refit the air ducting cover. Fit the fuel pump and carburetter (see **Chapter 2**). Reconnect the accelerator control rod.

10 Reassemble the generator pulley and belt, adjusting the tension as described in **Chapter 4**. Fit the distributor, checking for correct ignition timing as described in **Chapter 3**. Refit the exhaust system, using new gaskets at the top flanges. Fit the fuel line from pump to carburetter. Fit the air cleaner and intake pipe (see **Chapter 2**). Fit the sparking plugs and connect the leads. If the oil pressure transmitting unit was removed, refit it (see 9 in **FIG 1 : 24**).

11 Check that the sump drain plug is in place, fit the dipstick and fill the sump with fresh oil of the correct grade. There should be a hollow bolt at each end of the cylinder head immediately under each exhaust port. Check that these are in place as they form part of the safety system for heated air to the interior. Do not use solid bolts in place of them (see **Chapter 4**).

1 : 16 Power unit mountings

These are shown in **FIG 1 : 28**. When the unit is removed for overhaul, check the condition of the rubber pads 15, 16, 17, 22 at the rear mounting and insulator blocks 10 under the transmission. If any rubber parts are old or show signs of softening and deterioration, they must be renewed. This will avoid trouble with vibration and undue movement of the engine and transmission.

1 : 17 Fault diagnosis

(a) Engine will not start

1 Defective coil
2 Faulty distributor capacitor (condenser)
3 Dirty, pitted or incorrectly set contact breaker points
4 Ignition wires loose or insulation faulty
5 Water on sparking plug leads
6 Corrosion of battery terminals or battery discharged
7 Faulty or jammed starter
8 Sparking plug leads wrongly connected
9 Vapour lock in fuel pipes
10 Defective fuel pump
11 Overchoking
12 Underchoking
13 Blocked petrol filter or carburetter jets
14 Leaking valves
15 Sticking valves
16 Valve timing incorrect
17 Ignition timing incorrect

(b) Engine stalls

1 Check 1, 2, 3, 4, 10, 11, 12, 13, 14 and 15 in (a)
2 Sparking plugs defective or gaps incorrect
3 Retarded ignition
4 Mixture too weak
5 Water in fuel system
6 Petrol tank vent blocked
7 Incorrect valve clearance

(c) Engine idles badly

1 Check 1 and 6 in (b)
2 Air leak at manifold joints
3 Slow-running jet blocked or out of adjustment
4 Air leak in carburetter
5 Over-rich mixture
6 Worn piston rings
7 Worn valve stems or guides
8 Weak exhaust valve springs

(d) Engine misfires

1 Check1, 2, 3, 4, 5, 8, 10, 13, 14, 15, 16, 17 in (a); 2, 3, 4 and 7 in (b)
2 Weak or broken valve springs

(e) Engine overheats

1 Generator and fan drive belt too loose
2 Shutter or thermostat seized in closed position

(f) Compression low

1 Check 14 and 15 in (a), 6 and 7 in (c) and 2 in (d)
2 Worn piston ring grooves
3 Scored or worn cylinder bores

(g) Engine lacks power

1 Check 3, 10, 11, 13, 14, 15, 16 and 17 in (a), 2, 3, 4 and 7 in (b), 6 and 7 in (c) and 2 in (d). Also check (e) and (f)
2 Leaking joint washers
3 Fouled sparking plugs
4 Automatic centrifugal advance not operating

(h) Burnt valves or seats

1 Check 14 and 15 in (a), 7 in (b) and 2 in (d). Also check (e)
2 Excessive carbon around valve seat and head

(j) Sticking valves

1 Check 2 in (d)
2 Bent valve stem
3 Scored valve stem or guide
4 Incorrect valve clearance

(k) Excessive cylinder wear

1 Check 11 in (a) and see **Chapter 4**
2 Lack of oil
3 Dirty oil
4 Piston rings gummed up or broken
5 Badly fitting piston rings
6 Connecting rods bent

(l) Excessive oil consumption

1 Check 6 and 7 in (c) and check (k)
2 Ring gaps too wide
3 Oil return holes in piston choked with carbon
4 Scored cylinders
5 Oil level too high
6 External oil leaks
7 Ineffective valve stem oil seals

(m) Crankshaft and connecting rod bearing failure

1 Check 2 in (k)
2 Restricted oilways
3 Worn journals or crankpins
4 Loose bearing caps
5 Extremely low oil pressure
6 Bent connecting rod

(n) High fuel consumption (see **Chapter 2**)

(o) Engine vibration

1 Loose generator bolts
2 Blower blade assembly out-of-balance
3 Mounting rubbers faulty

NOTES

CHAPTER 2

THE FUEL SYSTEM

2:1 Description

The fuel tank has been moved from the front of the vehicle to a position on the lefthand side under the rear seat. Fuel is drawn from the tank and passed to the carburetter by a mechanically-driven pump which is shown in **FIG 2:1**. The carburetter, which is a Weber type 28 IMB, is shown in **FIG 2:4**. It has a single downdraught barrel and is fitted with a simple, cable-controlled, choke device. The air cleaner is mounted on the fan casing. A small secondary hose connects the rocker cover to the air cleaner so that blow-by gases are recirculated through the engine.

2:2 Fuel pump operation

Refer to **FIGS 2:2** and **2:3**. The section in **FIG 2:3** shows the operating pushrod which is reciprocated by a cam on the camshaft. This pushrod contacts a rocker in the pump (see 10 in **FIG 2:2**). This rocker pulls down flexible diaphragm 6, thus creating a depression in the chamber above it. This causes fuel to be drawn in through an inlet valve. As the pushrod reciprocates, the diaphragm starts to rise under the action of spring 8 and fuel is forced out of the chamber through an outlet valve and so to the carburetter float chamber. When the float chamber is full and its needle valve closed, the diaphragm is held in the depressed position by the fuel in the outlet system and the rocker and pushrod idle to and fro until there is a further demand for fuel.

2:3 Routine maintenance of pump

This is confined to checking the tightness of the screws connecting the flanges of the pump body and cleaning the filter. Refer to **FIG 2:2** and remove the cover 3. Clean filter gauze 4 with a brush and fuel. Do not use a piece of rag that may leave threads behind. Check the condition of the cover gasket and renew it if necessary.

2:4 Pump testing and servicing

If the pump fails to deliver fuel, or is suspected of failure, first check the output by removing the fuel line from the carburetter float chamber. Turn the end of the pipe down into a container. Use the starter to turn the engine **but do not switch on the ignition**. Fuel should spurt out of the pipe into the container in regular gushes. If it does not, then check that there is fuel in the tank and that the pipe lines from the tank are sound, that all connections are tight and that the pipes are not blocked. If compressed air is used to clear blocked pipes, do not

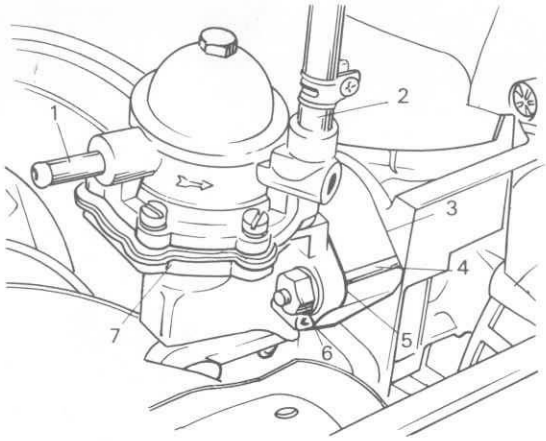

FIG 2:1 The mechanical fuel pump installed

Key to Fig 2:1 1 Fuel inlet from tank 2 Fuel outlet to carburetter 3 Pushrod stroke adjustment gasket 4 Insulator 5 Gasket .012 inch (.3 mm) thick 6 Nut 7 Pump

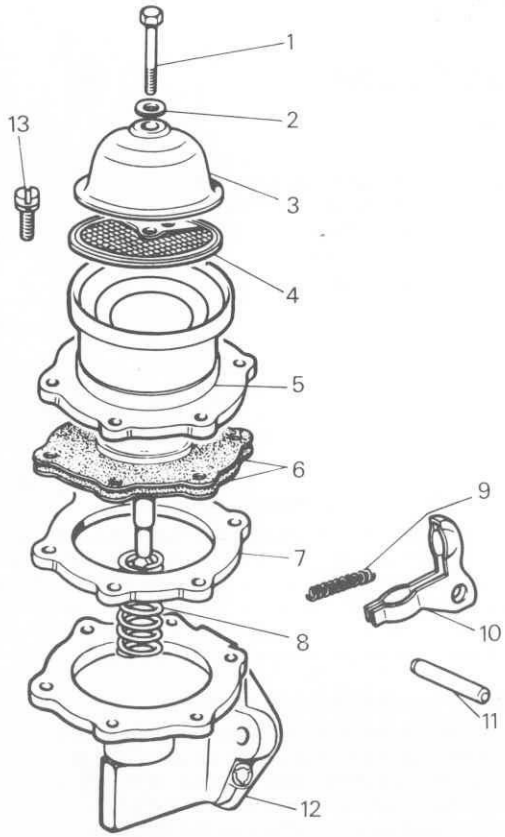

FIG 2:2 Mechanical fuel pump exploded

Key to Fig 2:2 1 Cover bolt 2 Washer 3 Cover 4 Filter 5 Upper body 6 Diaphragm 7 Spacer 8 Diaphragm spring 9 Rocker spring 10 Rocker 11 Rocker pivot pin 12 Lower body 13 Flange screw

pass it through the pump. Another check would be to see that the fuel tank filler vent is not blocked. This is quickly verified by leaving the cap off during the pumping test. At all times when dealing with fuel, take every precaution against fire.

Removing and dismantling pump:

If it is established that the pump is defective, remove it by undoing nuts 6 and lifting away the pump 7, insulator 4 and gaskets 3 and 5 (see **FIG 2:1**). The pushrod can be withdrawn from the crankcase just to check that the ends are not worn and should then be refitted the same way round if it proves to be in good condition.

Remove bolt 1 (see **FIG 2:2**) and screws 13 to dismantle the pump. Press down on diaphragm 6 and give a partial turn to disengage it from rocker 10. If the rocker and pivot pin 11 are worn they must be renewed by driving out the pin. A new pin must be secured in place by staking round the holes in the lower body.

Check the action of the valves in the upper body by sucking and blowing on the inlet and outlet connections with the cover in place. If the valves are at fault, renew the upper body complete. The valves are not renewable separately. Check that the diaphragm is not cracked or hardened and that the springs are in sound condition.

Reassembling pump:

This is a simple reversal of the dismantling procedure. Use new gaskets throughout.

2:5 Refitting fuel pump

With all mating surfaces clean, refit the insulator to the crankcase with an inner intermediate gasket of .027 inch (.7 mm) and an outer gasket of .012 inch (.3 mm) (see 3, 4 and 5 in **FIG 2:1**). Refer to **FIG 2:3** and check how much the end of the pushrod protrudes at the start of a pumping stroke. This dimension should be .039 to .059 inch (1 to 1.5 mm). If it is less, fit an inner gasket that is .012 inch (.3 mm) thick. If it is more, fit a gasket that is .047 inch (1.2 mm) thick. The outer gasket must always have a thickness of .012 inch (.3 mm).

Now turn the crankshaft until the pushrod has made a full stroke outwards and check that the stroke is .094 inch (2.4 mm) as shown in the illustration. Note that the initial measurements must be made with an inner gasket in place that has a thickness of .027 inch (.7 mm).

Having established the correct thickness of the inner gasket, the pump may be refitted and the pipes reconnected. Make sure the pushrod is correctly located in the rocker.

2:6 Description of carburetter

A section through the carburetter is given in **FIG 2:4** and four sections through the cold-starting device in **FIG 2:5**. Intake air passes downwards through venturis 24 and 21, taking with it fuel drawn from nozzle 25. This fuel is emulsified with air by tube 23 after it has reached the tube via the main jet 16 or idling jet 13. The level of fuel in bowl 15 is controlled by float 12 and needle valve 10. The strength of the idling mixture is controlled by needle screw 17 and the amount of fuel/air charge delivered to the engine is controlled by throttle valve 19. This valve is linked to the accelerator pedal.

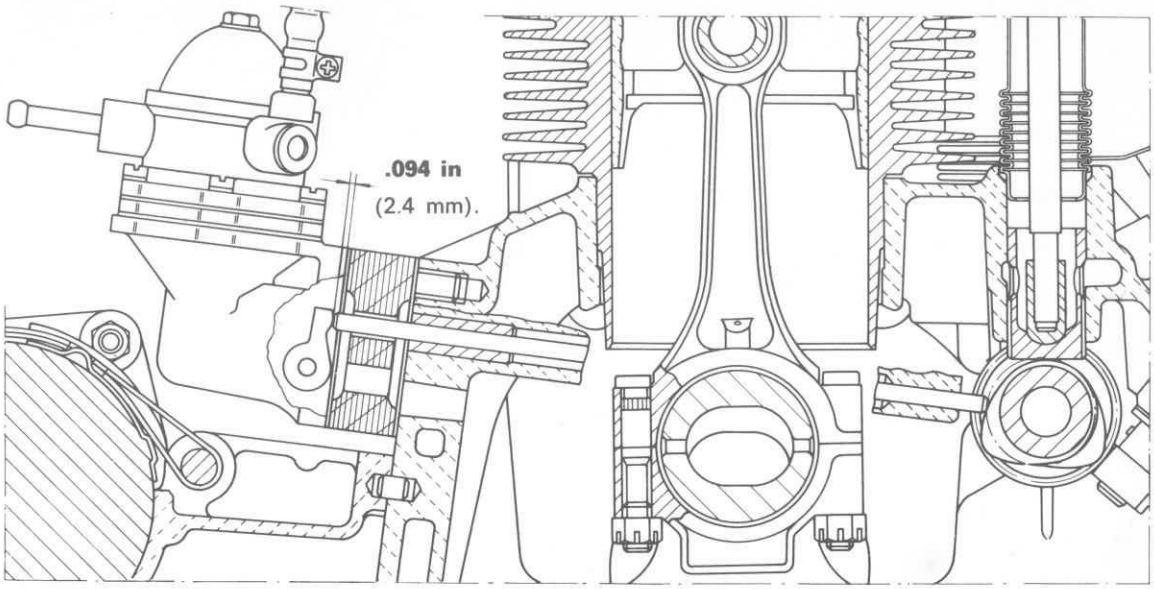

FIG 2:3 Part section of crankcase showing fuel pump pushrod. As shown, the pushrod stroke should be .094 inch (2.4 mm)

The choke lever is connected by cable to lever 35 (see **FIG 2:5**). Movement of this lever turns rocker pin 33 and this moves choke valve 31 up or down as desired. The position of the valve controls the amount of fuel drawn from starting jet 43 and the size of orifices 27, 28 and 29. The progressive action can be seen in the three views, that on the left showing the position of the valve 31 when full choke is needed for cold-starting. Rich mixture is delivered to passage 30 through holes 28 and 29, air to modify the mixture entering through passages 32, 40 and 41.

On half-choke the valve is in the position shown in the view marked 'B'. When the choke is no longer needed the valve is in the position shown on the extreme right and the passages for rich mixture are closed.

If the engine is cold, use the choke lever to put the valve in the 'A' position. Once the engine has fired, slowly move the lever to the central position and as the engine warms up push the choke right out, consistent with smooth running. Do not use the choke to start a hot engine, and do not let the engine idle with the choke fully engaged as the excess fuel will cause rapid cylinder wear.

2:7 Carburetter adjustment

The screws that control idling speed and idling mixture are shown in **FIG 2:6**. Do not make adjustments until the engine has reached its normal running temperature.

First turn the idling speed screw 3 until the engine runs slowly but steadily. Then turn idling mixture screw 4 until the engine runs smoothly, at which point it will almost certainly run faster. Now reduce engine speed at screw 3 until a satisfactory idling speed is reached. Do not try to make the engine run too slowly or it may have a tendency to stop unexpectedly and it may not pick up readily.

Adjusting fuel level:

The needle valve, seating and float are easily accessible for inspection by removing the carburetter top cover. Before checking the petrol level in the float chamber, ensure that the needle valve seat is screwed well home and that the gasket is in place. Also check that the calibrated orifice in the valve seat is unobstructed and not worn and finally check that the needle slides freely in its guide. Should the valve and seating be leaking, then the valve assembly must be renewed. Check that the float is not distorted or punctured and that it moves on its pivot without resistance or excessive play. Again renew the float assembly if there is any doubt. To check the level proceed as follows:

1 Check that the needle valve 3 (see **FIG 2:7**) is screwed tight on its seat.
2 Keep the carburetter cover 1 upright or else the weight of the float 9 will depress the ball 8 fitted on the needle 4. Check that with the cover held in the vertical position and the float arm 6 in slight contact with the ball 8 of the needle 4, the float is .315 inch (8 mm) away from the cover with its gasket 2 fitted flat against the cover face.
3 Check that the float travel is .315 inch (8 mm) and if necessary bend the lug 5 to give the required settings. Total float travel B will then be .630 inch (16 mm).
4 If the float 9 is not correctly positioned, bend the float arms 7 until the correct adjustment is obtained. Ensure that the arm 6 is perpendicular to the needle axis and does not show any rough spots or indentations which might impair free movement of the needle. Check that the float 9 freely moves about its pivot pin.

Every time a new float or needle valve assembly is fitted the above detailed adjustment operations must be completed to ensure correct fuel levels.

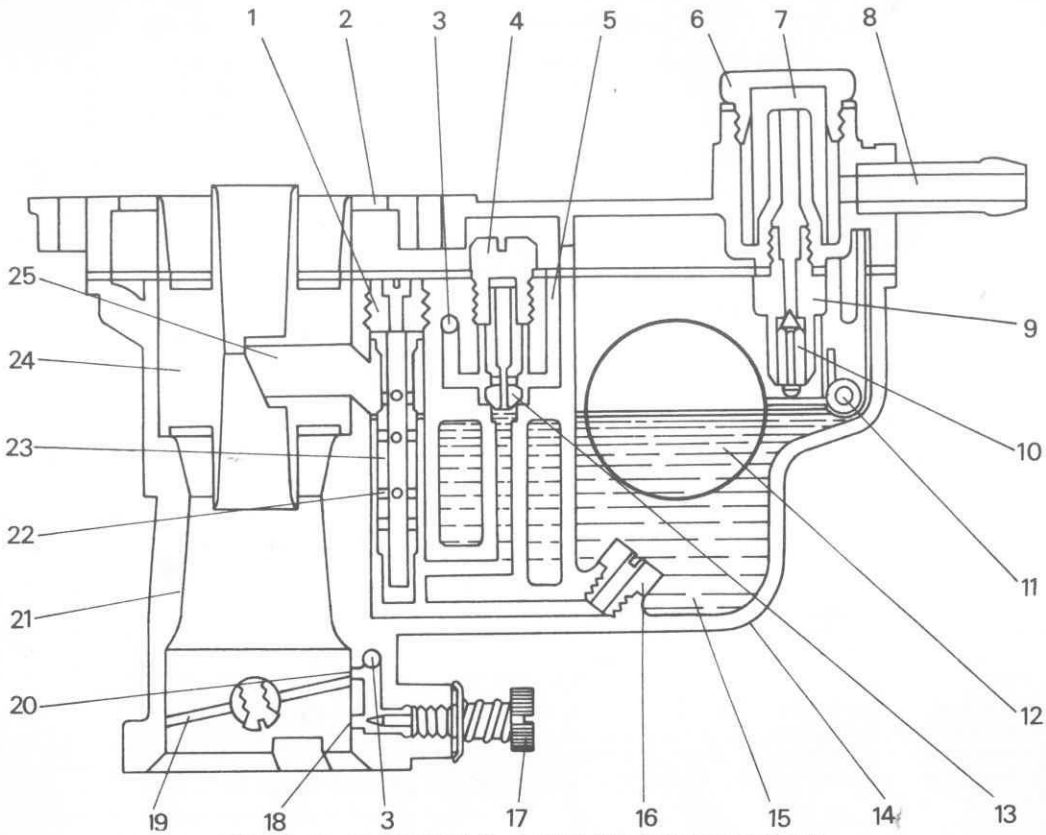

FIG 2:4 Section through the carburetter, type Weber 28 IMB

Key to Figs 2:4 and 2:5 1 Air correction jet 2 Air intake 3 Passage for idle mixture 4 Holder for idling jet 5 Air passage idling jet 6 Plug 7 Filter 8 Fuel inlet 9 Valve seating 10 Needle valve 11 Float pivot pin 12 Float 13 Idling jet 14 Body 15 Bowl 16 Main jet 17 Idling mixture screw 18 Idling passage 19 Throttle butterfly 20 Transfer orifice 21 Primary venturi 22 Emulsion holes 23 Emulsion tube 24 Auxiliary venturi 25 Nozzle 26 Mixture passage 27 Lean mixture hole 28 Mixture hole 29 Mixture hole 30 Mixture passage 31 Choke valve 32 Air holes 33 Rocker pin 34 Spring 35 Control lever 36 Choke cable screw 37 Cover 38 Spring 39 Spring retainer and guide 40 Starting jet emulsion air hole 41 Reserve well emulsion air hole 42 Reserve well 43 Starting jet

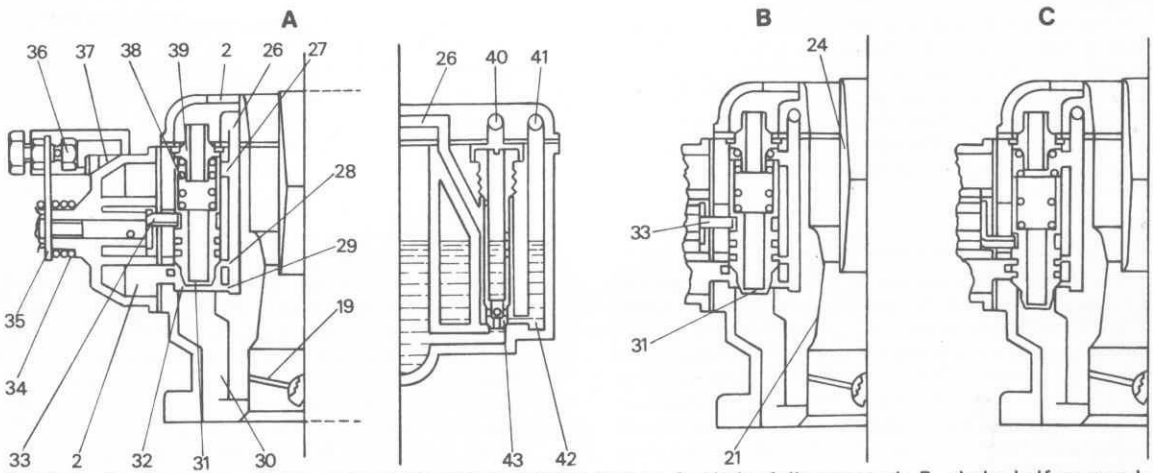

FIG 2:5 Sections through the carburetter choke starting device: A, choke fully engaged; B, choke half engaged; C, choke disengaged, normal running. Identification of the numbers will be found in the key FIG 2:4

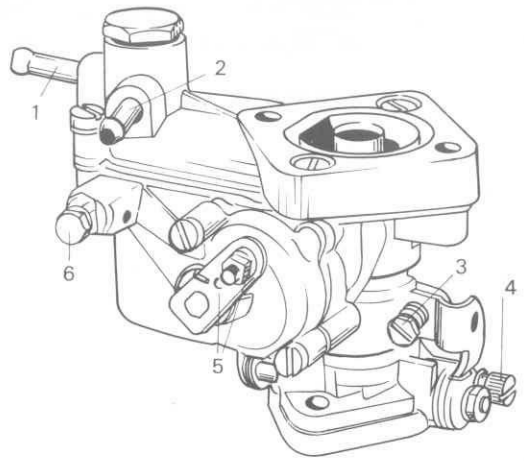

FIG 2:6 External view of the carburetter showing the main features

Key to Fig 2:6 1 Fuel overflow return 2 Fuel inlet 3 Idling speed adjusting screw 4 Idling mixture adjusting screw 5 Choke control lever and cable attachment 6 Choke outer cable attachment

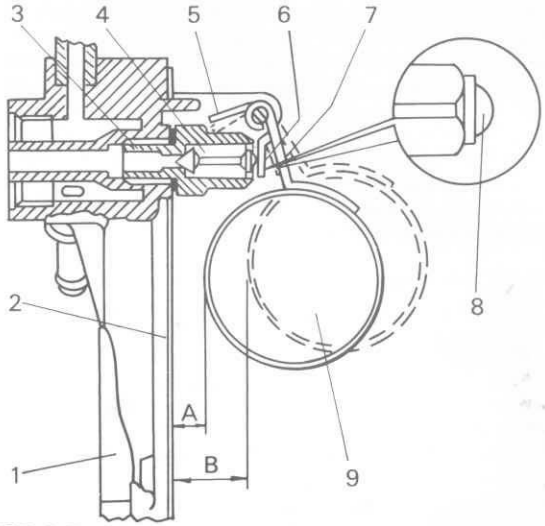

FIG 2:7 Section through float and needle valve in fuel level checking position

Key to Fig 2:7 1 Cover 2 Gasket 3 Needle valve seating 4 Needle valve 5 Lug 6 Tongue 7 Float arm 8 Moveable ball on end of valve 9 Float A .315 inch (8 mm) B .630 inch (16 mm)

A punctured float can be detected by immersing it in hot water, when a stream of bubbles from the expanding vapour inside the float will be seen emerging from the hole.

2:8 Carburetter servicing

Disconnect the throttle rod and the intake elbow and release the choke control cable from screw 6 and clamping nut 5 (see **FIG 2:6**). Make a note of the respective positions of the inner and outer choke cables. Release the fuel pipes and unscrew the nuts at the carburetter flange.

Take off the carburetter top cover (four screws). Check the throttle butterfly and shaft for wear (see 19 in **FIG 2:4**). Any air leaks at the shaft will cause erratic slow-running. If there is no wear it is not necessary to dismantle the shaft assembly. Referring again to **FIG 2:4**, remove plug 6, together with filter screen 7. Clean the filter with fuel and a brush. Do not use fluffy rag. Remove the jets and the float needle valve.

Clean all the passages with compressed air. Clean the jets with a sliver of pointed wood and then use compressed air. **Do not pass wire or drills through any jet or passage** as the orifices are very accurately calibrated and enlargement will upset performance.

Clean out the float chamber bowl 15 and check the pointed end of the needle valve 10. If it is ridged or if there has been trouble with flooding renew both needle and seating 9. Check the float 12 for a puncture as described in the preceding section. Make sure that it moves freely on its pivot pin 11.

Fit a new gasket when reassembling the cover to the body. Refit the carburetter on new gaskets (see 10 and 12 in **FIG 2:8**), and recouple the choke and accelerator controls, clamping the inner and outer choke cables in the position they occupied before removal. Check that the controls work smoothly. Connect the fuel pipes and refit the inlet elbow. Run the engine up to operating temperature and adjust the idling mixture and slow-running speed (see **Section 2:7**).

2:9 The air cleaner

The installation is shown in **FIG 2:8**, the body of the cleaner being mounted on the fan casing. It is recommended that the element is renewed every 6200 miles (10,000 km) but it may need servicing more frequently in unusually dusty conditions. To reach the element remove

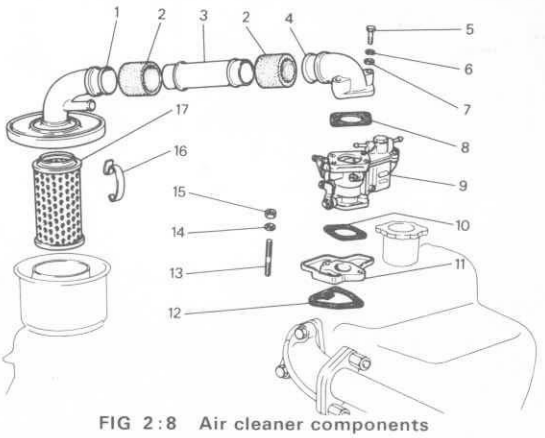

FIG 2:8 Air cleaner components

Key to Fig 2:8 1 Cover 2 Connectors 3 Intake pipe 4 Elbow 5 Bolt 6 Lockwasher 7 Flat washer 8 Gasket 9 Carburetter 10 Gasket 11 Insulator 12 Gasket 13 Stud 14 Flat washer 15 Nut 16 Clip for cover 17 Element

clips 16 and lift the cover to one side. Take out element 17 and wipe the inside of the body and the cover before fitting the new element. If the engine has covered a high mileage it is advisable to clean the rocker cover filler cap and the smaller hose connected to the air filter cover. The cap incorporates a valve and filter and may be cleaned with fuel and then blown dry with compressed air. There is a backfire suppressor in the smaller hose (see part 3 in **FIG 1 : 24** in **Chapter 1**). Clean this and the bore of the hose before reassembling.

2 : 10 The fuel tank

This is flange-mounted to the floor under the rear seat on the lefthand side. To remove it disconnect the inlet and air vent hoses and all pipe and electrical connections. It will be necessary to drain the tank first. Do not try to repair leaks, but leave this to experts who will take the necessary precautions against explosion. Wash out all sediment with fuel. Check that the pipe lines are clear by blowing through with compressed air but do not pass air through the fuel pump.

2 : 11 Fault diagnosis

(a) Leakage or insufficient fuel delivered

1 Air vent in tank restricted
2 Petrol pipes blocked
3 Air leaks at pipe connections
4 Pump or carburetter filters blocked
5 Pump gaskets faulty
6 Pump diaphragm defective
7 Pump valves sticking or seating badly
8 Fuel vapourising in pipelines due to heat

(b) Excessive fuel consumption

1 Carburetter needs adjusting
2 Fuel leakage
3 Sticking controls or choke device
4 Dirty air cleaner
5 Excessive engine temperature
6 Brakes binding
7 Tyres under-inflated
8 Idling speed too high
9 Car overloaded

(c) Idling speed too high

1 Rich fuel mixture
2 Carburetter controls sticking
3 Slow-running screws incorrectly adjusted
4 Worn carburetter butterfly valve

(d) Noisy fuel pump

1 Loose mountings
2 Air leaks on suction side and at diaphragm
3 Obstruction in fuel pipe
4 Clogged pump filter

(e) No fuel delivery

1 Float needle stuck
2 Vent in tank blocked
3 Pipeline obstructed
4 Pump diaphragm stiff or damaged
5 Inlet valve in pump stuck open
6 Bad air leak on suction side of pump

CHAPTER 3

THE IGNITION SYSTEM

3:1 Description

The ignition system consists of an ignition coil, ignition distributor fitted with contact breaker points, a centrifugal automatic advance system, a capacitor (condenser), low- and high-tension wiring, spark plugs and a power supply provided by a generator and battery. The wiring diagram is shown in **FIG 3:1**.

1 The low-tension circuit which is sometimes called the primary circuit includes the power supply, contact breaker points, a capacitor and ignition coil primary winding.
2 The high-tension circuit which is sometimes called the secondary circuit includes the ignition coil secondary winding, distributor rotor, distributor cap with terminals and the central brush, high-tension cables and the spark plugs.

3:2 Operation

The contact breaker unit in the distributor interrupts the primary circuit by the points opening. The sudden stop in the flow of current in the primary winding does not cause arcing at the contact breaker points because it discharges into the capacitor connected in parallel with the contact breaker points. With the sudden collapse of the primary circuit, the intensity of the magnetic field drops causing an induced high-tension current in the ignition coil secondary winding. The high-tension current is distributed to the sparking plugs by the ignition distributor rotor.

The automatic advance mechanism comprises a plate carrying two weights which are symmetrically pivoted on the plate. Attached to the weights at opposite ends to the pivots is the cam carrier shaft with special tension return springs. Under the action of centrifugal force as the rotational speed increases, the weights move outwards causing the cam carrier shaft to move angularly compared to the distributor drive shaft thus causing advancement of the ignition timing.

The contact breaker assembly comprises the cam on the drive shaft and two contact points, one of which is stationary while the other is under the influence of the cam, the action of which is transmitted by a rubbing block. The cam has two lobes to control the opening and closing of contact points. The stationary contact point is mounted on an adjustable support to enable the contact breaker point gap to be adjusted.

The HT current reaches the distributor cap central terminal, from the ignition coil and is distributed to each of the spark plugs at the correct time by the rotor arm. The parts mentioned can be identified in **FIG 3:2**.

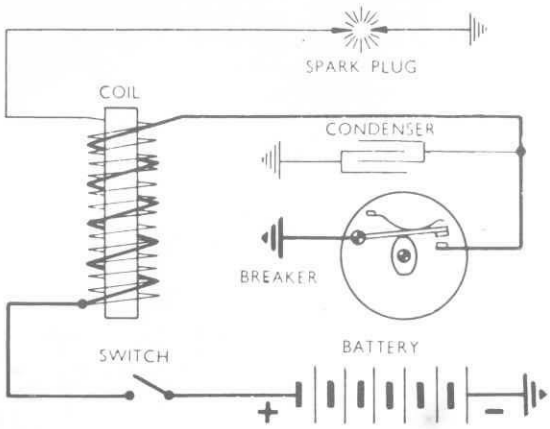

FIG 3:1 Wiring diagram of the ignition system

3:3 Routine maintenance

Refer to **FIG 3:2** and remove the distributor cap 1 and lift off the rotor arm 3. Lubricate the cam spindle felt pad 15 using Fiat VS oil. There is provision for the oil to make its way downwards. Smear a little grease on the cam and add a small drop of oil to the contact breaker point pivot.

Adjusting the contact breaker points:

Refer to **FIG 3:3** and slacken the stationary contact carrier adjusting screw. Slowly rotate the engine until one of the two cams has opened the points to the fullest extent so that the gap is measured at the position of the maximum opening. Reset the gap to a correct clearance of .018 to .021 inch (.47 to .53 mm) and tighten the contact carrier screw.

Cleaning the contact points:

If the contact points are dirty or pitted they must be cleaned by polishing them with a fine carborundum stone taking very great care to ensure that the contact faces are flat and square. Afterwards wipe away all dust with a cloth moistened in petrol. The contacts may be removed from the distributor body to assist refacing and cleaning referring to **Section 3:5**. If the moving contact is removed from its pivot, check that its operation is not sluggish. If it is tight, polish the pivot pin with a strip of fine emery cloth, clean off all dust and apply a tiny spot of oil to the top of the pivot pin. If a spring testing gauge is available, the contact breaker spring should have a tension of 16.75 ± 1.76 oz (475 ± 50 g) measured at the points.

3:4 Ignition faults

If the engine runs unevenly set it to idle at a fast speed Taking care not to touch any metal part of the sparking plug leads, pull up the insulator sleeve and short each plug in turn, using a screwdriver with an insulated handle. Connect the screwdriver blade between the plug top and the cylinder head. Shorting a plug which is firing properly will make the engine uneven running more pronounced. Shorting a plug in a cylinder which is not firing will make no difference.

Having located the faulty cylinder, stop the engine and remove the plug lead. Start the engine and hold the lead carefully to avoid shocks so that the metal end is about $\frac{3}{16}$ inch (5 mm) away from the cylinder head. A strong regular spark shows that the fault might be with the sparking plug. Remove and clean it according to the instructions in **Section 3:7**. Alternatively substitute it with a new plug.

If the spark is weak and irregular, check that the lead is not perished or cracked. If it appears to be defective, renew it and try another test. If there is no improvement, remove the distributor cap and wipe the inside clean and dry. Check the carbon brush located as shown in **FIG 3:2**. It should protrude from the cap moulding and be free to move against the pressure of the internal spring. Examine the surface inside the cap for signs of 'tracking' which can be seen as a thin black line between the electrodes or to some metal part in contact with the cap. This is caused by sparking and the only cure is to fit a new cap.

Testing the low-tension circuit:

Before carrying out electrical tests, confirm that the contact breaker points are clean and correctly set, then proceed as follows:

1 Disconnect the black low-tension cable from the ignition coil and from the side of the distributor. Connect a test lamp between the two terminals. Turn the engine over slowly. If the lamp lights when the contacts close and goes out when they open, the low-tension circuit is in order. If the lamp fails to light the contacts are dirty or there is a break or loose connection in the low-tension wiring.
2 If the fault lies in the low-tension circuit, switch on the ignition and turn the crankshaft until the contact breaker points are fully open. Refer to the wiring diagram in **Technical Data** and check the circuit with an 0-20 voltmeter. If the circuit is in order the meter should read approximately 12-volts.
3 **Battery to fuse box terminal B**. Connect the voltmeter between the terminal and earth. No reading indicates a faulty cable or loose connection.
4 **Fuse box.** Connect the voltmeter between the other auxiliary terminal and earth. No reading indicates a broken or loose connection.
5 **Fuse box terminal B to terminal number 30 on ignition switch.** Connect the meter between terminal number 30 on the ignition switch and earth. No reading indicates a damaged cable or loose connection.
6 **Ignition switch.** Connect the meter between terminal 15/54 and earth. Switch onto the ignition position, when no reading indicates a fault in the switch.
7 **Ignition switch to low-tension cable connection on the coil (light blue cable).** Connect the meter between ignition coil terminal and earth. No reading indicates a damaged cable or loose connection.
8 **Ignition coil.** Disconnect the black low-tension cable connecting the coil to the distributor side terminal at the coil and connect the meter between this terminal and earth. No reading indicates a fault in the primary winding of the coil and a replacement coil must be fitted. If the reading is correct remake the connections to the coil.

9 **Ignition coil to distributor.** Disconnect the thin black low-tension cable at the side of the distributor and connect the meter between the end of this cable and earth. No reading indicates a damaged cable or loose connections.

10 **Contact breaker and capacitor.** Connect the meter across the contact breaker points. No reading indicates a faulty capacitor.

Capacitor:

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

If a new capacitor is needed, fit a new one complete with bracket, but if necessary unsolder the original bracket and solder it onto the new capacitor using as little heat as possible. Capacitor capacity is .25 microfarads.

3:5 Removing and dismantling distributor

To remove the distributor proceed as follows:

1 Rotate the engine slowly until the distributor rotor arm is opposite the brass segment in the distributor cap connected to No. 1 plug lead. This will provide a datum for replacement. Do not turn the engine after this.

2 Disconnect the cable from the low-tension terminal on the side of the distributor body. Mark position of distributor on support. Release the distributor retaining nut and washer from the distributor retaining plate and carefully lift away the distributor. Now refer to **FIG 3:2.**

3 Pull off the rotor arm. Remove the insulated terminal assembly from the side of distributor body. Release the contact breaker carrier plate retaining screws and capacitor flange screw from the outside of the distributor body. Carefully lift out the contact breaker plate assembly 4, 5 and 6.

4 Take out the cam lubrication felt pad 15 recessed in the rotor arm housing on the end of the cam spindle. Remove the retaining screw, carefully disengage the springs 14 and lift out the cam spindle. Carefully lift away the weights 12.

5 Thoroughly clean all parts and inspect for excessive wear. The distributor cap must not be cracked or show signs of tracking. The cap terminals, rotor and contact breaker points can be cleaned with a very fine file. Emerypaper must not be used. If the clearance between the rotor and distributor cap segments exceeds .0118 inch both the rotor and distributor cap must be replaced. Inspect the contact breaker arm rubbing block for excessive wear and also the points for wear so that if the gap exceeds the last setting limit of .021 inch (.53 mm) and adjustment through the stationary contact carrier screw is no longer possible, the contact breaker set must be renewed.

If the distributor drive shaft side or vertical movement is excessive the distributor must be renewed. Weak centrifugal weight springs or damaged weights must be renewed using original Fiat spares otherwise the automatic ignition advance characteristics could be altered.

Check the driving gear for worn teeth. It is secured to the driving shaft by a cross-pin.

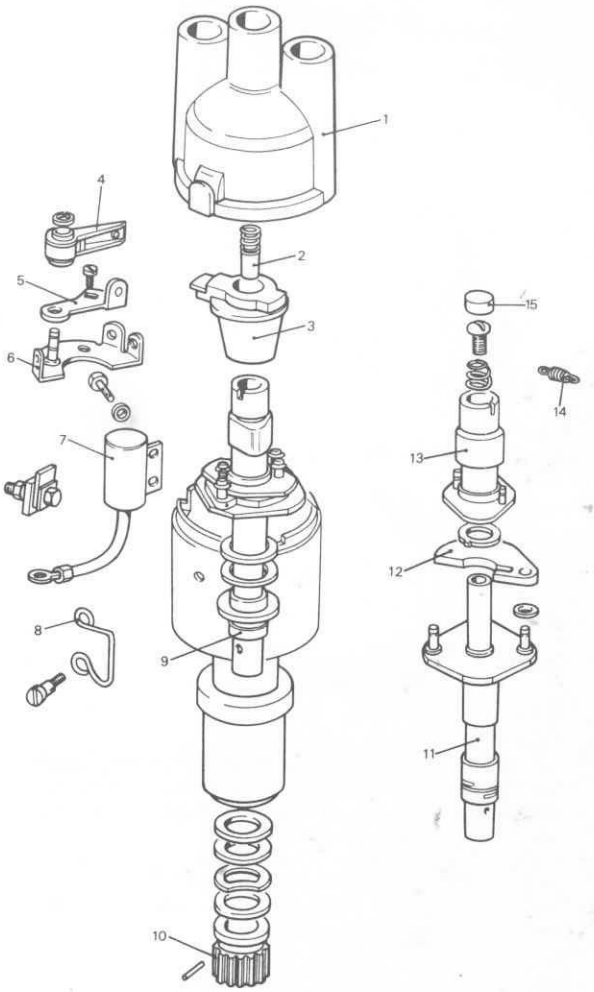

FIG 3:2 Components of the distributor

Key to Fig 3:2 1 Cap 2 Carbon brush 3 Rotor 4 Moving contact 5 Fixed contact 6 Contact plate 7 Capacitor 8 Clip for cap 9 Drive shaft assembly 10 Driving gear 11 Drive shaft 12 Weight 13 Cams 14 Spring 15 Felt pad

Reassembling distributor:

This is a reversal of the dismantling procedure. Use engine oil to lubricate the shaft and centrifugal advance mechanism. Turn the rotor arm to the position where it would be facing the brass segment in the cap that connects to No. 1 sparking plug lead with the contact points about to break. If the engine has not been turned, the distributor can now be dropped into place. Check that the rotor still points in the right direction, then secure the distributor with the forked retaining plate. Check the ignition timing as described in **Section 3:6.**

3:6 Timing the ignition

Check the ignition timing if the distributor has been removed or after a major overhaul of the crankcase in which the camshaft has been removed. Before carrying

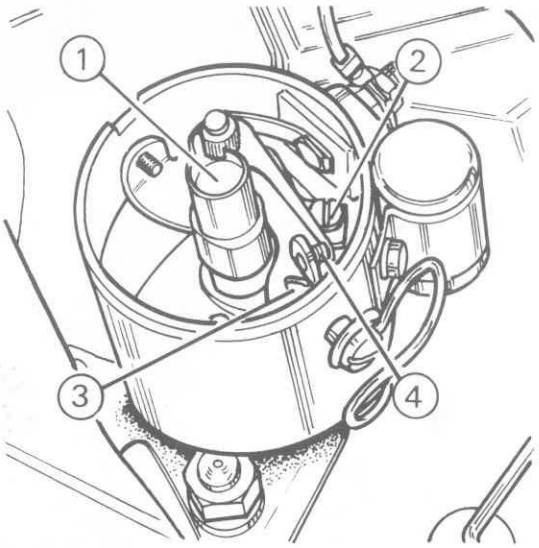

FIG 3:3 Distributor with cap removed to show the contact breaker. The contact breaker gap can be adjusted after slackening the screw that secures the fixed contact

Key to Fig 3:3 1 Oiler wick 2 Fixed contact securing screw 3 Screwdriver slot for adjustment 4 Contact points

out the check it is important to set the contact breaker gap as described in **Section 3:3** because excessive variations in the gap will lead to inaccurate timing if the gap is subsequently set correctly.

There are two ways to carry out the timing check, one is to use the timing marks shown in **FIG 3:4** when Fiat tool Ap 5030/1 is secured to the crankcase, and the other is to use the timing marks 1, 2 and 3 shown in **FIG 3:5**.

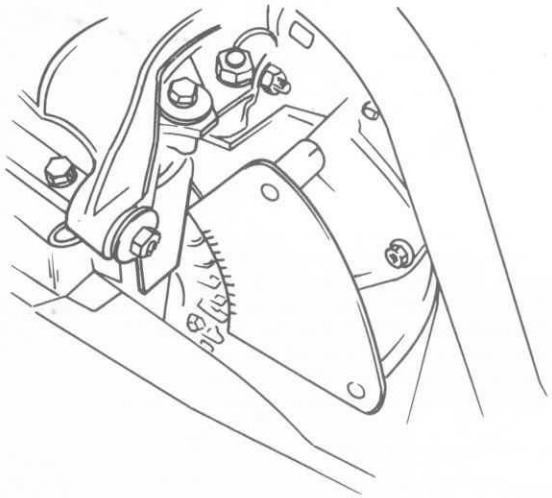

FIG 3:4 Fiat tool Ap.5030/1 mounted on the crankcase to provide markings in degrees for ignition timing

For static timing turn the engine until No. 1 piston is at TDC or at the top of its compression stroke with both valves closed. At this point mark 3 on the fan pulley cover should line up with the arrow 2 (see **FIG 3:5**) or with the 0 deg. mark on the checking plate shown in **FIG 3:4**. Now turn the engine back until the mark 3 is well past mark 1 (or 10 deg. on the plate in **FIG 3:4**) and then slowly bring the mark back until it lines up with the mark 1 or 10 deg. indication. The object of doing this is to take up any backlash in the distributor drive. As the static timing is 10 deg. before top dead centre (TDC) the contact breaker points should now be just breaking. If they are not, slacken the distributor retaining plate and turn the distributor bodily until the points are just beginning to open. Tighten the distributor retaining plate and check by carrying out the test all over again.

If a stroboscope is used for timing, mark the index line on the pulley and the 10 deg. line with chalk and check that the chalk marks line up with the engine running at 2000 rev/min. Speed the engine up to 3000 rev/min and check that the pulley mark is 18 deg. in advance of TDC. This will indicate that the centrifugal advance mechanism is working. Adjust for correct timing as described for static timing.

3:7 Sparking plugs and leads

Clean the sparking plugs regularly and check the gap between the electrodes. It is false economy to continue to use old sparking plugs and as they are relatively cheap it is sensible to renew them if there has been trouble with difficult starting or poor performance.

Before unscrewing the plugs, blow away any loose dirt in the plug recesses. If a box spanner is used, take care not to tilt it or it may crack the ceramic insulator. Have the plugs cleaned on an abrasive machine and then tested under pressure. Use a wire brush on the threads but do not use the brush on the electrodes or insulator.

If the electrodes are worn, file them to clean square surfaces. Adjust the outer electrode until the gap is .023 to .027 inch (.6 to .7 mm). **Do not try to adjust the gap by bending the central electrode.**

Before the plugs are cleaned, it is helpful to check on the kind of deposits to be found at the firing end. These will give a guide to working conditions inside the cylinders as follows:

Inspect the electrode end of the plugs and note the type and colour of the deposit. Normally it should be powder and range from brown to a greyish tan in colour. There will also be slight wear of the electrodes and the general effect described is one which comes from mixed periods of high-speed and low-speed driving. Cleaning and resetting the gap is all that will be necessary.

If the deposits are white or yellowish they indicate long periods of constant-speed driving or much low-speed city driving. Again, the treatment is straightforward.

Dry, black, fluffy deposits are usually the result of running with too rich a mixture. Incomplete combustion may also be a cause and this might be traced to a defect in the ignition system or excessive idling.

Overheated sparking plugs have a white blistered look about the centre electrode and the side electrode may be badly eroded. This may be caused by poor cooling, wrong ignition timing or sustained high speeds under heavy load.

Check that the plugs can be screwed into the cylinder head by hand. If they are tight, run a tap down the internal threads or use an old plug with cross-cuts down the threads. If the gaskets are not excessively flattened they may be used again but it is better to renew them. Do not tighten plugs beyond the recommended torque figure of 22 lb ft (3 kgm). The correct type of sparking plug to use is the Marelli CW 8 NP or Champion L 81 Y.

Sparking plug leads:

These, and the lead from the distributor cap to the ignition coil, should be checked for cracks or deterioration. Running the engine in the dark may be helpful in case of ignition trouble as leakage often shows up as a bluish discharge at the point of breakdown. When fitting new leads smear silicone grease on the socket ends to ensure that water cannot enter.

3:8 Fault diagnosis

(a) Engine will not fire

1 Battery discharged
2 Distributor contact points dirty, pitted or maladjusted
3 Distributor cap cracked, dirty or 'tracking'
4 Distributor cap contact brush not touching rotor
5 Faulty cable or loose connection in low-tension circuit
6 Cracked or damaged rotor
7 Faulty coil
8 Broken contact breaker spring
9 Contact points stuck open

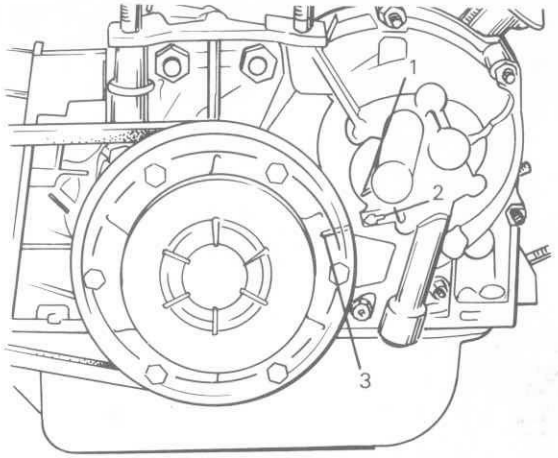

FIG 3:5 Rear view of engine showing 10 deg. index mark at 1 for advanced ignition timing. Arrow 2 indicates top dead centre (TDC) when pulley mark 3 is aligned with it as shown

(b) Engine misfires

1 Check 2, 3, 5 and 7 in (a)
2 Weak contact breaker spring
3 High-tension plug and coil leads cracked or perished
4 Sparking plug(s) loose
5 Sparking plug gap incorrectly set
6 Ignition timing too far advanced

NOTES

CHAPTER 4

THE COOLING SYSTEM

4:1 Description

The engine is air-cooled, the cylinder barrels being finned to assist in the dispersion of heat. Fresh air is drawn from inlets on each side of the body as shown at 1 in **FIG 4:1**. This air is ducted to a centrifugal fan 5, the fan being mounted on the front end of the belt-driven generator. Air from the fan is ducted through conveyor or casing 4 to the engine, and also to the carburetter intake through air filter 3. A small volume of air also passes from the fan casing to a duct that surrounds part of the sump to cool the lubricating oil for the engine. Air that is heated by the engine is then ducted to a thermostatically controlled shutter or throttle 7. If the engine is just starting up from cold, this throttle is closed and the air is recirculated round the engine to achieve a rapid warm-up. After this, the thermostat opens the throttle and the heated air is allowed to pass to atmosphere or may be used to heat the interior of the vehicle if required.

4:2 Adjusting fan belt tension

Referring to **FIG 4:3** it will be seen that belt 10 drives the generator 11 and cooling fan 8, the latter being secured to the front end of the generator shaft. It is essential, therefore, to ensure that the belt is correctly tensioned so that the generator and the fan will operate efficiently. A loose belt will cause slip and a belt that is too tight will impose an extra load on the generator bearings.

Check belt tension as shown at 1 in **FIG 4:2**. Press down on the belt halfway between the pulleys with moderate thumb pressure. The belt should deflect about .4 to .6 inch (1 to 1.5 cm). If adjustment is needed it will be necessary to alter the width between the flanges of the generator pulley (see adjusting rings 2 in **FIG 4:3**).

Undo nuts 2 (see **FIG 4:2**). Remove outer half of pulley. If the belt is too tight, add an adjusting ring from outside the flanges to the pack between them. If the belt is too slack, take one or more adjusting rings from between the flanges. If one ring is removed, refit it on the outside of the outer flange. If two rings are removed place one to the front of flange 3 and one to the rear of flange 4. This helps to keep the pulley alignment correct. Refit the outer flange and any adjusting ring removed from between the flanges as just described and secure with the three nuts and lockwashers. Check the belt tension again.

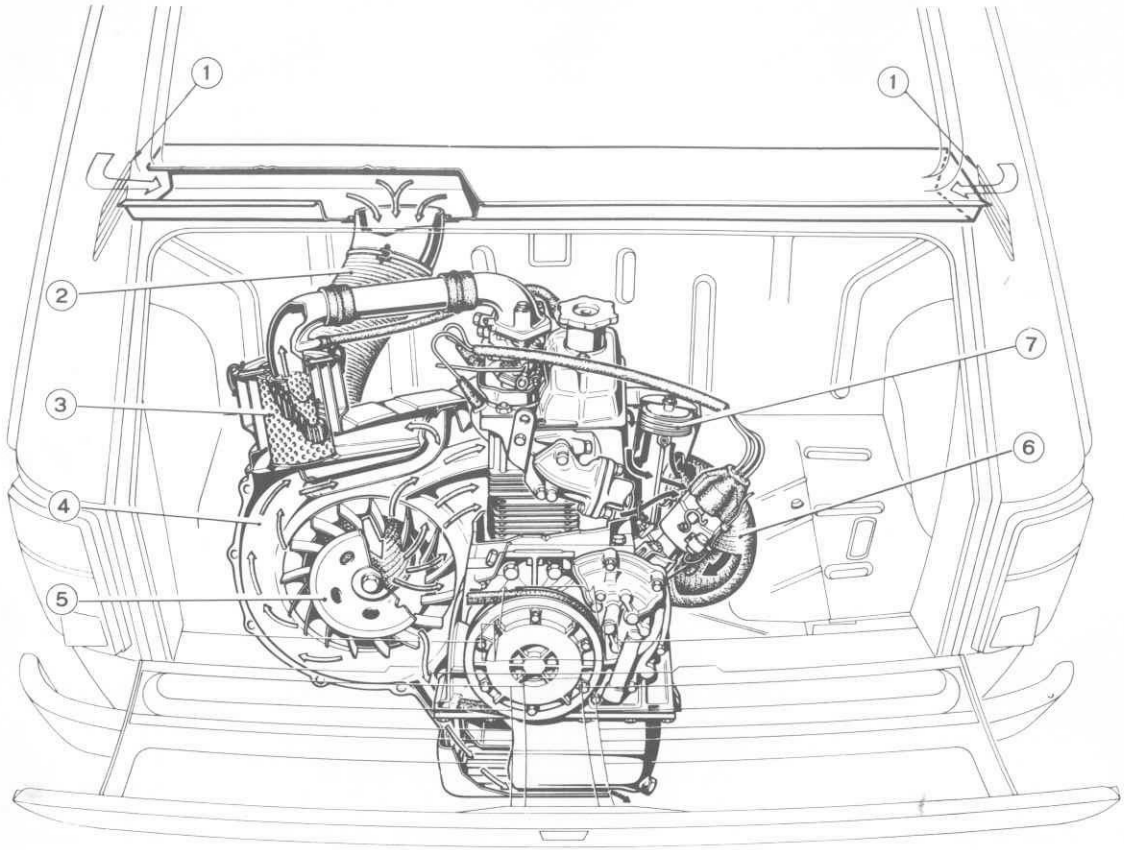

FIG 4:1 Air circulation system for engine cooling and interior heating

Key to Fig 4:1 1 Fresh air inlet 2 Hose to fan 3 Air filter element 4 Air from fan to engine and carburetter 5 Fan 6 Warm air hose to interior 7 Thermostat controlling air discharge

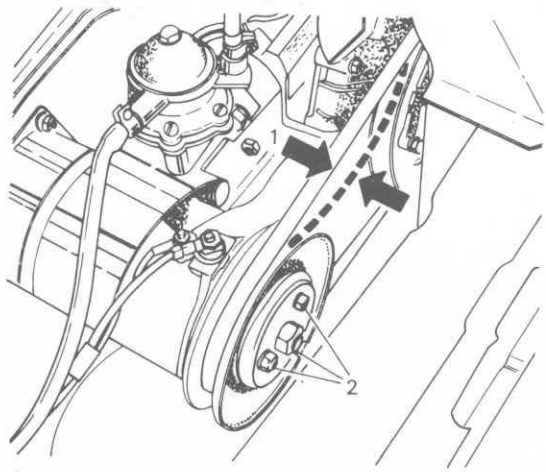

FIG 4:2 Test fan belt tension at 1. Pulley flange nuts are shown at 2

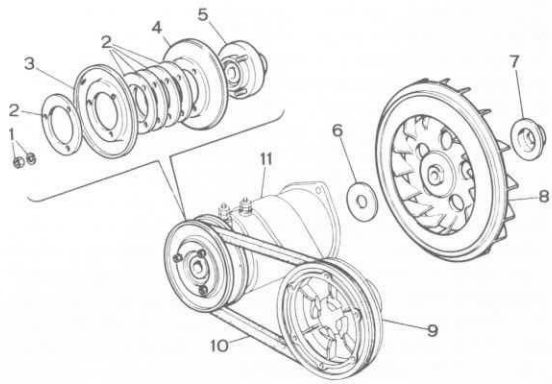

FIG 4:3 Components of belt drive to generator and fan

Key to Fig 4:3 1 Nut and lockwasher 2 Pulley adjustment rings 3 Rear flange of pulley 4 Front flange of pulley 5 Pulley hub 6 Flat washer 7 Spacer 8 Fan 9 Engine pulley 10 Belt 11 Generator

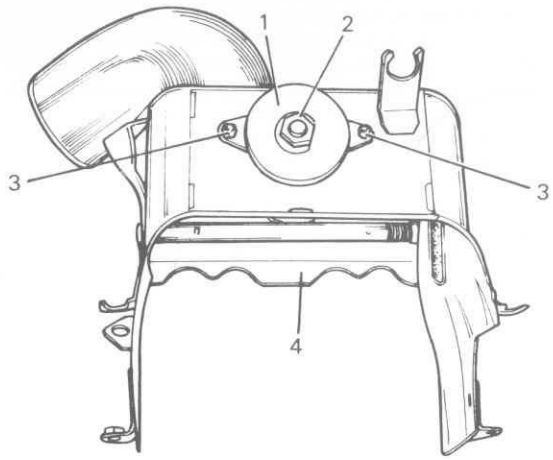

FIG 4:4 Top view of engine cowling showing thermostat

Key to Fig 4:4 1 Thermostat cover 2 Nut 3 Nuts, thermostat cover 4 Air discharge throttle (shutter)

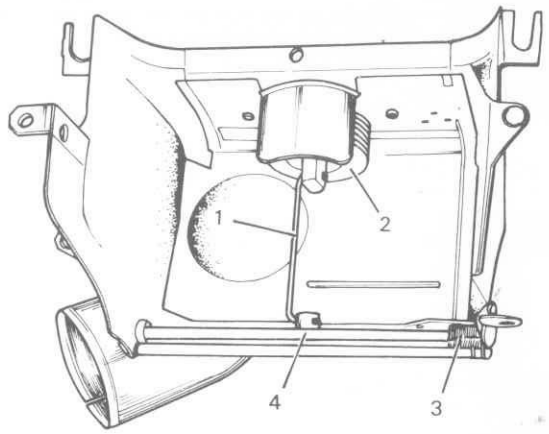

FIG 4:5 Inside view of thermostat control to throttle

Key to Fig 4:5 1 Link rod (thermostat to throttle) 2 Thermostat 3 Throttle return spring 4 Air discharge throttle shaft

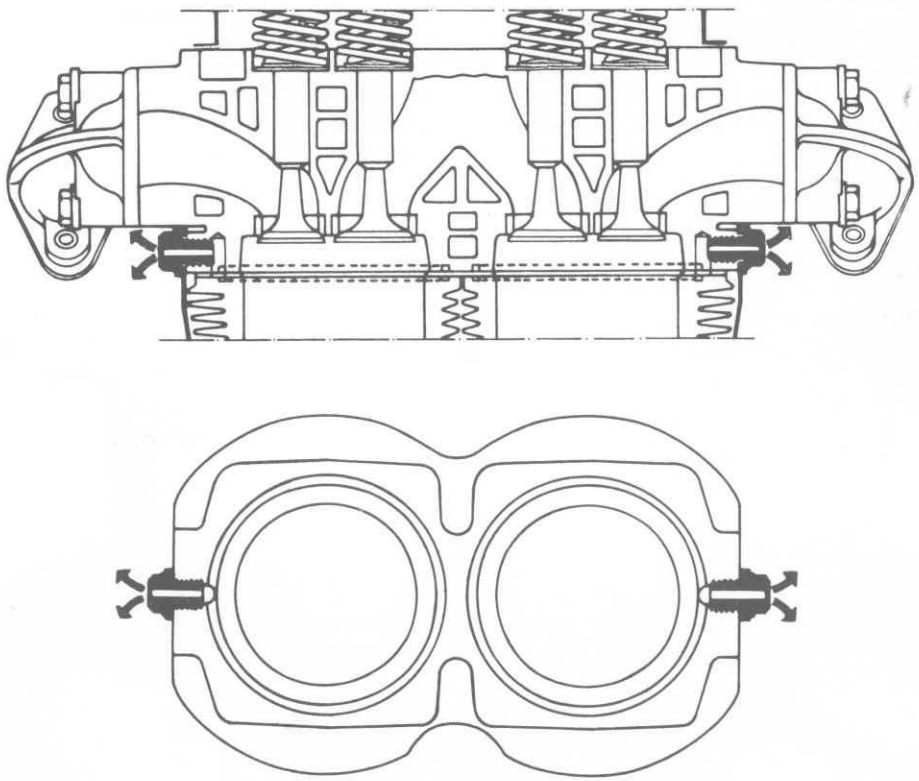

FIG 4:6 Grooves in cylinder head and barrels leading to hollow bolts for discharging leaking gases to atmosphere

If the generator and fan are removed for servicing, note that the fan and pulley nuts must be tightened to a torque of 25 lb.ft (3.5 kgm).

4:3 Air outlet thermostat and throttle

FIGS 4:4 and **4:5** show details of the cowling that conveys warm air from the engine either to atmosphere or to the car interior. As explained in **Section 4:1**, a thermostat 2 (see **FIG 4:5**) operates a shutter or throttle to give a quick warm-up from cold and subsequently to allow heated air to pass out as required.

If the thermostat opens too soon, the engine will be slow to warm up and if it does not open enough there will be danger of overheating. The cowling is readily removable from the engine at the attachment lugs seen in the illustrations.

If trouble with the thermostat is suspected, uncouple link 1 from the throttle (see **FIG 4:5**). Release the thermostat from the cowling at nuts 3 (see **FIG 4:4**). Using a thermometer, immerse the thermostat in hot water and raise the temperature to check the moment when the thermostat starts to open. This should be at 154° to 163°F (68° to 73°C). The valve should be fully open at 188° to 199°F (87° to 94°C). Renew the thermostat if it is faulty.

Before refitting the thermostat, check that the throttle flap moves freely and is a good fit in the cowling. Check the spring 3 and shaft 4.

4:4 Safety device against fumes

Because heated air for the interior is drawn from round the engine it is essential to ensure that all seals and gaskets are not leaking, otherwise there is a possibility that fumes will enter the vehicle. As the most likely place for gases to leak from the engine is at the cylinder head joint, the makers have provided a safety device that gives warning of such leakage. Referring to **FIG 4:6** it can be seen that there are grooves machined in the cylinder head and barrel faces about halfway across the gaskets. The head grooves communicate with hollow bolts by way of ducts. Thus any leakage from either face of the gaskets will pass to atmosphere and will not circulate in the heated air to the interior of the vehicle. A hissing sound from the hollow bolts is a sign of gasket leakage. **Do not replace the hollow bolts with solid ones or the device will become inoperative.**

4:5 Leaking engine seals

Refer to **FIG 1:13** in **Chapter 1**. This shows the seals that must be renewed at every engine overhaul. They are the cylinder barrel gaskets, top and bottom, and the seals at each end of the pushrod and lubrication tube covers. Any leakage at these points will mean that fumes will be able to pass into the vehicle interior when warmed air is required.

4:6 Fault diagnosis

(a) Engine overheats

1 Slipping fan belt
2 Defective throttle thermostat
3 Throttle shutter stuck in closed position
4 Shutter return spring broken
5 Air leakage from joints in ducting

(b) Engine slow to warm up

1 Check 2 in (a)

(c) Fumes in interior

1 Leaking engine seals

CHAPTER 5

THE CLUTCH

5:1 Description

The clutch cover and dry-plate disc are shown in **FIG 5:1** and the assembly with release bearing in **FIG 5:2**. The cover carries a dished diaphragm spring which is slotted radially to give the effect of spring tongues. The release bearing is pressed onto the inner ends of these tongues by the action of the clutch pedal. The flattening of the spring causes its outer rim to move in the opposite direction because a fulcrum ring is provided in the cover, as can be seen in the section in **FIG 5:2**. As the outer rim of the spring bears on a pressure plate that nips the clutch disc or driven plate against the flywheel, releasing the pressure will free the disc from the driving faces of the flywheel and pressure plate and it will no longer transmit power from the engine to the gearbox input or clutch shaft. The disc is splined to this input shaft and is free to slide on it, the hub being clearly seen on the left in **FIG 5:1**. Friction linings are riveted to the disc. The clutch pedal and release mechanism are shown in **FIG 5:4**.

5:2 Routine adjustment

The maintenance is confined to adjusting the amount of clutch pedal free travel. Press the pedal pad and measure the distance the pad moves freely before starting to operate the clutch release mechanism. This distance should be about 1.10 inch (28 mm). If the travel varies from this figure, adjust the threaded end of the release cable at the rear as shown in **FIG 5:3**. It will be necessary to work under the vehicle, the adjusting nuts 2 being on the lefthand side behind the drive shaft. Slacken the locknut and turn the adjusting nut as required until the pedal free travel is correct. Screw the nut in if the travel is too much and unscrew it if the travel is not enough. Tighten the locknut after adjusting. Check that spring 3 is in good condition and grease the cable and thread to prevent rust.

5:3 Servicing the clutch

In case of trouble affecting the clutch it will be necessary to separate the gearbox from the engine (see **Chapter 6**). The clutch will then be seen as in **FIG 5:6**. Gradually and evenly release the six bolts securing the clutch cover to the flywheel. The cover and clutch disc will then become free.

Check the disc for worn or broken linings, worn hub splines and a cracked plate. Do not attempt to rivet new linings in place but renew the disc as an assembly. Check the flywheel and pressure plate faces for scoring, pitting

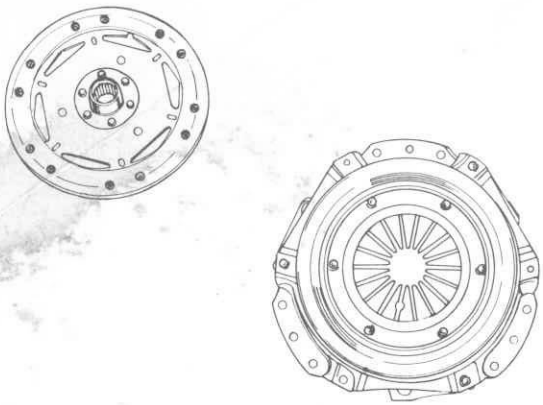

FIG 5:1 The clutch disc or drive plate on the left and the cover assembly on the right

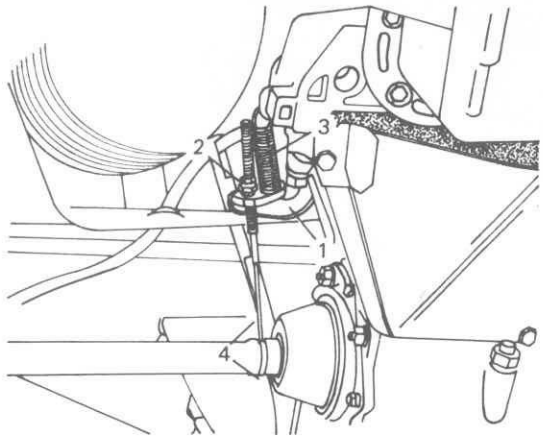

FIG 5:3 Clutch release cable and adjustment point

Key to Fig 5:3 1 Release fork lever 2 Adjusting nut and locknut 3 Return spring 4 Cable

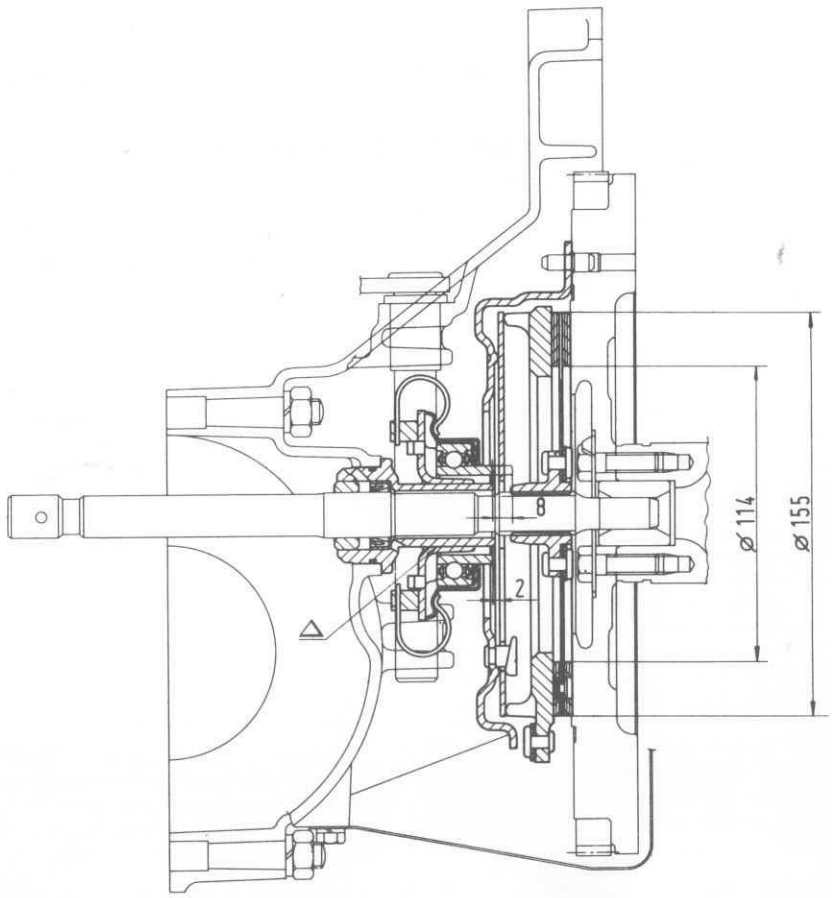

FIG 5:2 A section through the clutch assembly and flywheel. The travel of the release sleeve is shown as 8 mm (.315 inch) and the clearance to be maintained by adjusting the release cable is 2 mm (.079 inch). The small triangle indicates the point to apply grease

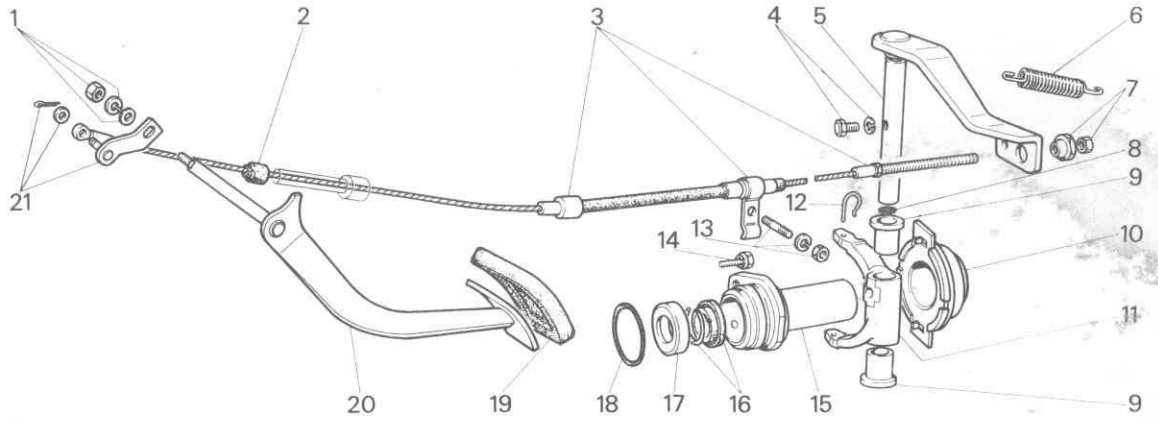

FIG 5:4 Clutch release mechanism exploded

Key to Fig 5:4 1 Nut, flat and lockwasher 2 Boot 3 Cable 4 Bolt and lockwasher 5 Release lever and shaft 6 Return spring 7 Adjusting nut and locknut 8 Seal 9 Bushes 10 Release sleeve and bearing 11 Fork 12 Clip 13 Nut, stud and lockwasher 14 Bolt and lockwasher 15 Support for release sleeve 16 Seal 17 Bush 18 Seal 19 Pedal rubber 20 Pedal 21 Lever, flat washer and splitpin

or cracks. Renew defective parts. Oil on the faces calls for renewal of the crankshaft and/or the gearbox oil seals.

To check the clutch assembly, mount it on a flat plate with a spacing ring .311 inch (7.9 mm) thick between the pressure plate 3 and the plate (see S in **FIG 5:5**). Apply a load of 180 lb (82 kg) at the inner ends of the diaphragm spring 4 in the direction of the arrow F. Check that a release travel of .315 inch (8 mm) at D gives a measurement at X of 1.075 to 1.142 inch (27.3 to 29 mm), which is equivalent to a lift of the pressure plate 3 of .067 inch (1.7 mm). Distance U, at .20 inch (5 mm) is the maximum permissible displacement due to wear of the disc linings. If all the measurements do not lie within the specified limits, the clutch cover assembly must be renewed. Do not try to dismantle the cover 1 as the parts are not separately renewable. A final check on the cover is to see that the pressure plate straps are sound.

Check the disc for runout by mounting it on a mandrel between centres and using a dial gauge. Total runout must not exceed .01 inch (.25 mm).

Pilot bush:

While the clutch is removed from the flywheel, check the condition of the pilot bush in the end of the crankshaft. Also check the pilot bearing on the end of the gearbox input shaft, and check the splines. If a new pilot bearing is required, remove the old one and press a new one into place as described in **Chapter 1, Section 1:11**.

The clutch release mechanism:

This is shown in section in **FIG 5:2** and in component form in **FIG 5:4**. Referring to **FIG 5:4** it can be seen that release sleeve 10 which carries the release bearing is retained against fork 11 by spring clips 12. The fork is secured to shaft 5. A lever on the shaft is external to the clutch casing and is connected by cable 3 to clutch pedal 20. To service the mechanism, remove the clips and pull off the release sleeve. Remove bolt 4 and pull out

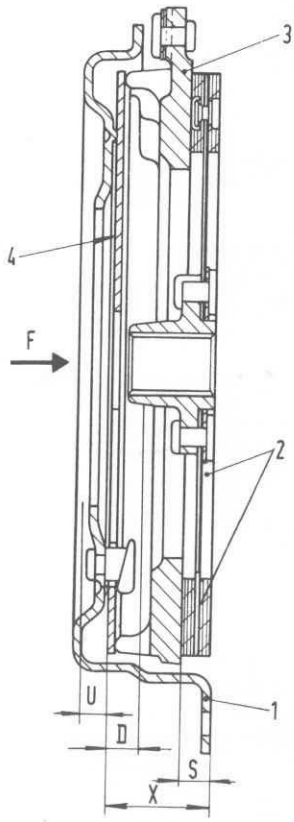

FIG 5:5 Section through clutch assembly showing checking points

Key to Fig 5:5 1 Cover 2 Disc 3 Pressure plate 4 Diaphragm spring S .311 inch (7.9 mm) X 1.075 to 1.142 inch (27.3 to 29 mm) D .315 inch (8 mm) U .20 inch (5 mm) F 180 lb (82 kg)

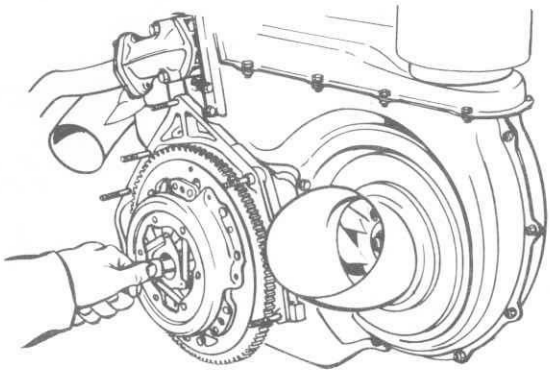

FIG 5:6 Pilot being used to centralise the disc when fitting clutch cover assembly to flywheel

the shaft 5. Sleeve support 15 can be released and pulled off the gearbox input or clutch shaft, taking care not to damage the seal 16 or bush 17 on the shaft splines.

Check all shafts, seals and bushes for wear and renew if necessary. Check that the release bearing turns smoothly and renew it if it is rough or noisy.

When reassembling, fit seal 18 to the outside of sleeve support 15. Apply Fiat KG 15 grease to the running surface of the support before refitting the sleeve bearing. When reassembling the fork and shaft, make sure seal 8 is in the shaft groove and apply the same type of grease to the shaft bushes. The spring clips must be correctly seated. Do not forget to attach the return spring 6.

5:4 Refitting the clutch

It is essential that the clutch disc be truly central on the flywheel face or it will be impossible to enter the gearbox input (clutch) shaft pilot into the bush in the end of the crankshaft. To ensure that it is central a temporary pilot is used until the clutch cover is bolted down. This can be Fiat tool A.70085 or an old clutch shaft. Alternatively, for a one-off job it would be sufficient to turn up a wooden mandrel that is a good fit in the pilot bush and the hub of the disc.

Fit the disc on the pilot so that the protruding part of the splined hub faces away from the flywheel and towards the release bearing. Now bolt the cover in place, tightening the bolts evenly and diagonally. Remove the pilot. Apply a thin smear of grease to the hub splines.

When refitting the transmission, take great care that the gearbox input shaft (clutch shaft) is kept square with the disc hub and do not let the weight of the transmission hang on the hub or the disc may be damaged. Tighten the nuts to a torque of 25 lb ft (3.5 kgm). Adjust the free travel of the clutch pedal as described in **Section 5:2**.

5:5 Fault diagnosis

(a) Drag or spin

1 Oil or grease on driven plate lining
2 Misalignment between engine and clutch shaft
3 Driven plate hub binding on clutch shaft splines
4 Binding of clutch shaft pilot bearing
5 Distorted clutch plate
6 Warped or damaged pressure plate or clutch cover
7 Broken driven plate linings
8 Dirt or foreign matter in clutch

(b) Fierceness or snatch

1 Check 1, 2 and 3 in (a)
2 Worn clutch linings

(c) Slip

1 Check 1, 2 and 3 in (a)
2 Check 2 in (b)
3 Weak diaphragm spring

(d) Judder

1 Check 1, 2 and 3 in (a)
2 Pressure plate not parallel with flywheel face
3 Contact area of driven plate linings not evenly distributed
4 Bent clutch shaft
5 Buckled driven plate
6 Faulty power unit mountings
7 Worn suspension mountings
8 Weak rear springs
9 Loose drive shafts

(e) Rattle

1 Check 3 in (c)
2 Worn release mechanism
3 Excessive backlash in transmission
4 Wear in transmission bearings
5 Release bearing loose on fork

(f) Tick or knock

1 Worn clutch shaft pilot or bearings
2 Badly worn splines in driven plate hub
3 Release bearing faulty
4 Faulty drive on starter motor
5 Loose flywheel

(g) Driven plate fracture

1 Check 2 and 3 in (a)
2 Drag and distortion due to hanging gearbox in plate hub

CHAPTER 6

THE GEARBOX AND DIFFERENTIAL

6:1 Description

A longitudinal section through the assembly is shown in **FIG 6:1**. The gearbox has four forward speeds with synchromesh engagement on all but first gear. Reverse is engaged by means of a sliding gear. The transmission casing is in three parts, having an extension at the front end which houses the selector mechanism and the front end of the countershaft. The main casing and clutch bellhousing are split on the centre line of the differential. The illustration shows how power is transmitted through the input or clutch shaft on the extreme right to the gearbox mainshaft. The parts are shown in **FIGS 6:4** and **6:5**. The drive from the mainshaft gears then goes to the countershaft gears according to the gear selected and thus transmits power to the drive pinion. The pinion engages with the differential ring gear as shown in **FIG 6:11**. The final drive is taken through the differential side gears to the drive shafts and universal joints and so to the rear wheels.

As can be seen in **FIG 6:4** the input or clutch shaft 7 is connected to mainshaft 10 by a coupling sleeve 8. The mainshaft carries the second-speed gear 12 at the front and and then the front bearing 11. After this comes the third-speed gear, the first-speed gear and the fourth-speed gear, followed by the rear bearing. These gears, apart from first-speed gear, are in constant mesh with the gears on the countershaft 11 (see **FIG 6:5**). In the case of first-speed, coupling the mainshaft drive gear to the gear 15 is made by sliding the latter along sleeve 10. Reverse is obtained by sliding gear 3 (see **FIG 6:4**) into mesh with first speed gear 15 (see **FIG 6:5**). Second, third and fourth gears are selected by sliding sleeves 18 and 10 sideways against the pressure of springs 7 and inserts 8, this pressure causing synchromesh cones to engage and speed up or slow down the engagement dogs inside the sleeves and on the driven gears. As the resistance of the springs and inserts is overcome the sleeve selected moves further and the dogs engage, to complete the drive from mainshaft to countershaft and so to the drive pinion (see 11 in **FIG 6:5**).

Gearshifting is carried out by forks and rods (see **FIGS 6:2** and **6:3**). There are three rods and the one selected by the gearchange lever can be moved to and fro against the detent action of a ball and spring. Each rod carries a fork engaging with the sleeve or gear to be moved. There are interlock rollers between the rods to prevent accidental engagement of two gears together (see **FIG 6:10**).

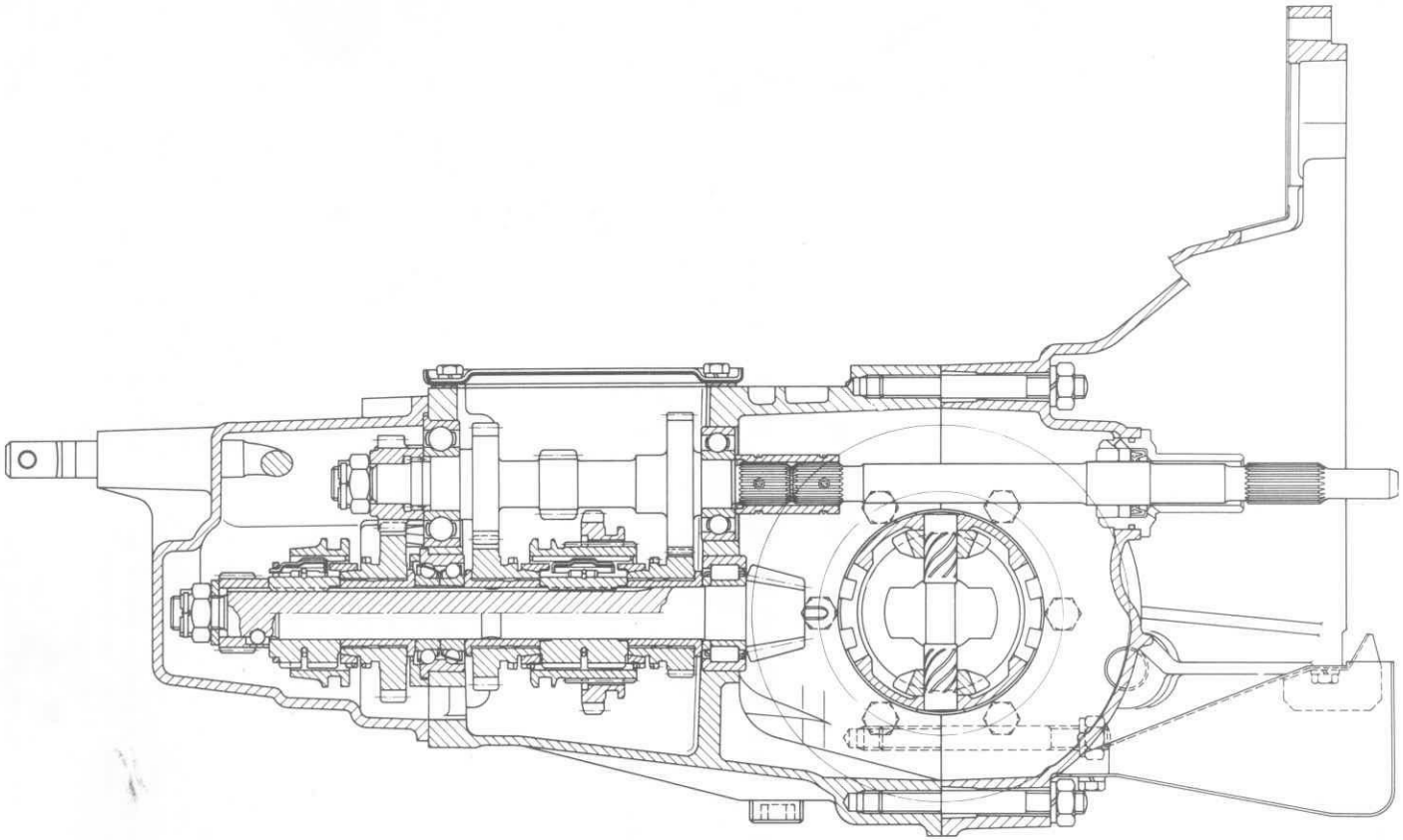

FIG 6:1 Longitudinal section through the transmission with the input shaft on the right. The circles indicate the ring gear

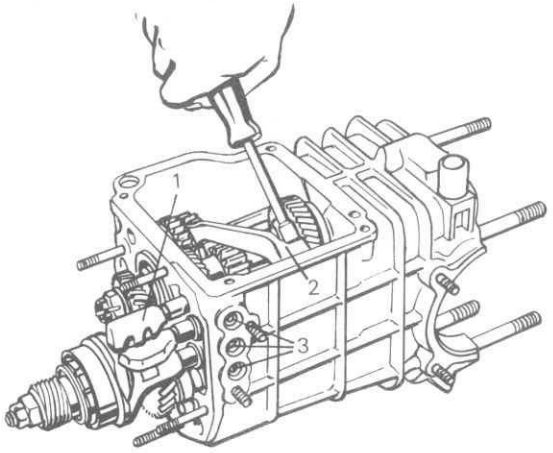

FIG 6:2 Removing the securing bolt from reverse fork 2. The reverse shift rod is 1 and 3 indicates the location of the three detent balls and springs

6:2 Routine maintenance

Every 6200 miles (10,000 km) check the oil level at the transmission filler plug. Top up if necessary with Fiat ZC 90 oil or an equivalent until it just appears at the bottom of the filler hole. Replace the plug.

6:3 Removing and refitting the transmission

1 Disconnect the two starter motor cables after taking off the battery earthing cable. Disconnect starter control link and remove starter.
2 Disconnect clutch cable from lever on transmission. Remove the power plant anchoring bracket. Remove the clutch protection cover and disconnect the speedometer cable.
3 Disconnect the gearshift rod from the gear selection lever. Remove the bolts attaching the axle shaft splined sleeves to the flexible joint and slide out the inner spring (see **Chapter 7**). Remove the nuts securing the clutch bellhousing flange to the engine.
4 Remove the mounting bracket at the front end of the transmission (see **Chapter 1, Section 1:16**). Support the transmission unit and pull it forward until the clutch shaft is clear. **Make sure that the weight of the unit is fully supported and kept square.** This will ensure that there is no damage to the clutch disc hub or spring centre.

Refitting transmission:

This is a simple reversal of the removal procedure. Take care to follow the last instructions in the preceding notes on removal.

6:4 Dismantling the transmission

Drain the oil from the casing. Remove circlip 14 and sleeve 15 from each drive shaft (see **Chapter 7, FIG 7:6**). Remove boot and flange 17. Remove the bearing housings from each side. Split the transmission casing and lift out the differential assembly and drive shafts.

Remove the gearbox top cover and the cover at the front end. Remove the screw securing the reverse shift fork 2 (see **FIG 6:2**). Remove the side cover and shake out the detent springs and balls from holes 3. Pull out the reverse rod and turn the box upside down to shake out the detent roller from bore 5 in **FIG 6:3**. Continue by

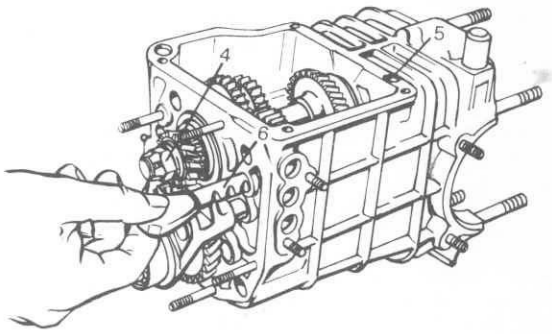

FIG 6:3 The mainshaft nut is 4, the bore for the detent rollers is 5 and 6 is the 3rd and 4th selector rod

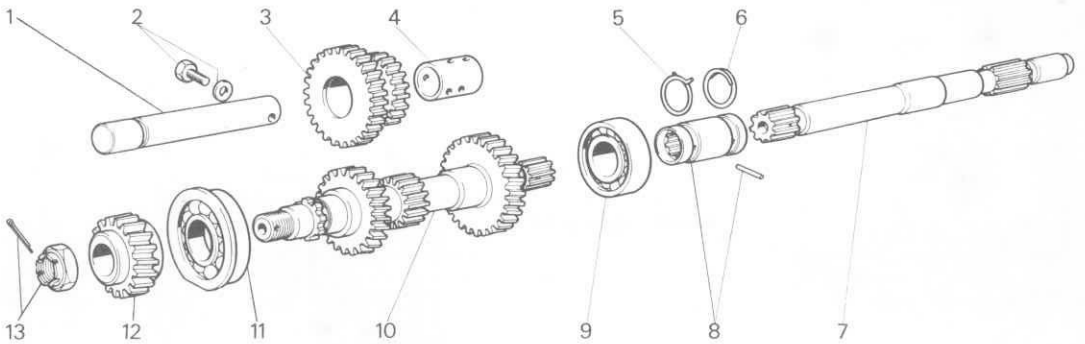

FIG 6:4 The components of the mainshaft and the reverse gear shaft

Key to Fig 6:4 1 Reverse shaft 2 Bolt and flat washer for shaft 3 Reverse gears 4 Bush 5 Snap ring 6 Snap ring 7 Input shaft 8 Sleeve and pin, input to mainshaft 9 Rear ballbearing 10 Mainshaft 11 Front ballbearing 12 2nd-speed drive gear 13 Nut and splitpin

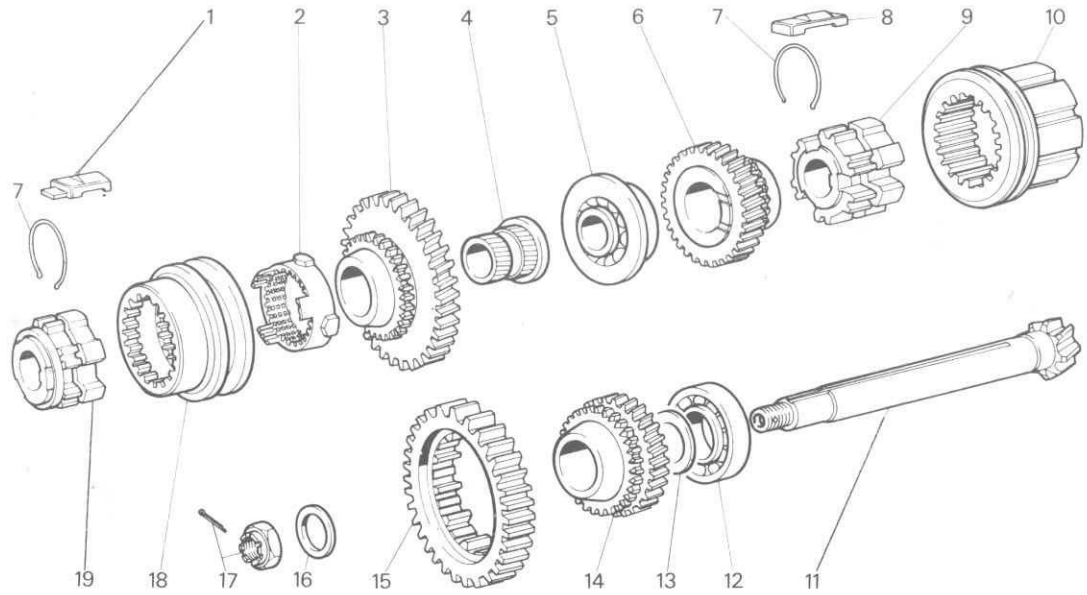

FIG 6:5 The components of the countershaft

Key to Fig 6:5 1 Insert for sleeve 2 2nd-speed synchroniser ring 3 2nd-speed driven gear 4 Bush 5 Front ballbearing 6 3rd-speed driven gear 7 Springs 8 Insert for sleeve 9 Hub for sleeve 10 3rd- and 4th-speed sleeve 11 Pinion shaft 12 Rear roller bearing 13 Pinion adjusting shim 14 4th-speed driven gear 15 1st-speed and reverse sliding gear 16 Flat washer 17 Nut and splitpin 18 2nd-speed sleeve 19 Hub for sleeve

removing the remaining two forks and selector rods. There will be a second detent roller between the bottom two rods.

Engage two gears simultaneously to lock the shafts and unscrew mainshaft nut 4 (see **FIG 6:3**), and also the countershaft nut after removing the splitpins. Remove the plain washer and speedometer driving gear from the front end of the countershaft, taking care of the driving ball let into the shaft. Pull the second-speed gear off the mainshaft (see 12 in **FIG 6:4**). Tap the rear end of the mainshaft to drive the assembly forwards so that the bearings are out of their housings. Working from the top cover opening, it will now be possible to remove the front spring ring 5 and the pin 8 so that the input shaft 7 can be uncoupled (see **FIG 6:4**). Remove bearings 9 and 11 and lift out the mainshaft 10. Removing screw 2 will release the rear end of the reverse shaft 1. Push out the shaft and lift out the reverse gears 3.

Drive out the countershaft to the rear and lift out the gears and sleeves. Take particular note of the pinion adjustment shim 13 (see **FIG 6:5**). Drive out the front bearing after removing the retaining plate. Use an impact screwdriver on the cross-head screws.

Clean all the parts and check for wear or damage. Check the casings for cracks, for burrs on the mating faces and check that the bearing outer races have been

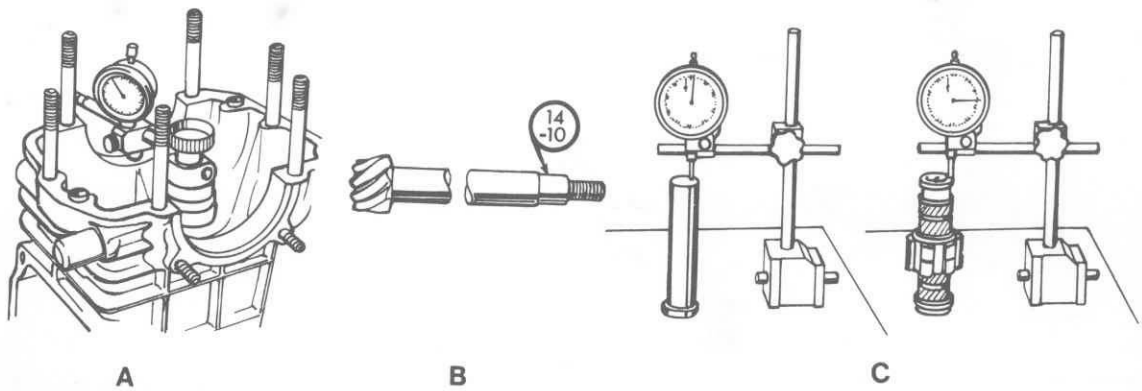

FIG 6:6 How the calculations are made to establish the correct thickness of the pinion shaft shim

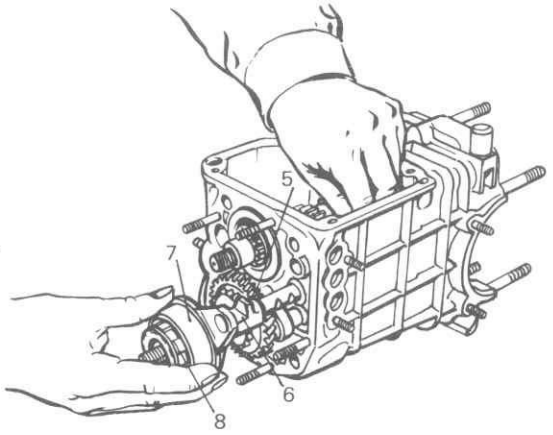

FIG 6:7 Reassembling the front end of the countershaft

Key to Fig 6:7 5 2nd-speed driven gear 6 1st- and 2nd-speed fork and selector rod 7 2nd-speed sleeve 8 Hub for sleeve

tight in their housings. Check the bearings when dry. Renew them if they feel rough when spun or if slackness can be felt. Check the shaft splines and the sliding sleeves on their hubs. Look for worn synchromesh cones and inserts. Check the gear teeth for wear and chipping. Inspect the striker rods and forks and check that the rods slide freely in the casing. If there has been trouble with jumping out of gear it is possible that the detent spring for that particular gear is weak, or that the detent grooves in the rods are worn. It is also possible that there is wear of the synchromesh engaging dogs. Renew defective parts.

6:5 Reassembling gearbox

Before this can be done it is necessary to decide on the correct thickness of adjustment shim 13 on the pinion shaft, if any parts such as the casing, the bearings or the shaft have been renewed. The thickness of the shim decides the extent of the meshing between the pinion and the ring gear in the differential assembly.

The determination of the correct shim calls for the use of Fiat special tools, and if the owner does not feel competent to carry out the use of the tools and the calculations involved, he is recommended to leave the work to a properly-equipped service station.

Finding the thickness of adjustment shim:

Adjustment shims are available in three thicknesses from .004 to .006 inch (.10 to .15 mm) and the necessary thickness of the shim pack is calculated by means of the following formula:

$$S = 0.9 + a - (\pm \frac{b}{100}) - c$$

The 0.9 is a fixed number.

To determine the value 'a' use tool A.70036 with dial gauge A.95690. Refit the countershaft front bearing and secure it in place with the retainer plate, tightening the screw fully. Assemble tool A.70036 to the bearing as shown in **FIG 6:8**. Place the dial gauge and top pad of

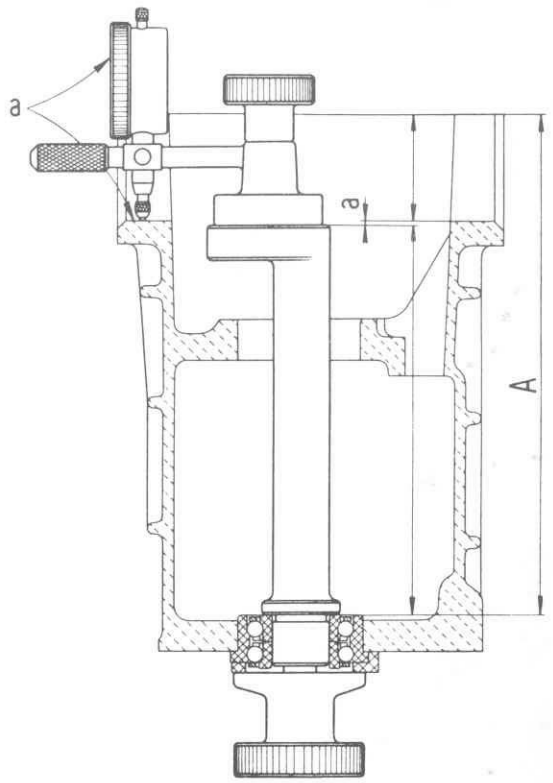

FIG 6:8 How tool A.70036 is set up so that dial gauge A.95690 can be used to determine the value of 'a' (see FIG 6:6)

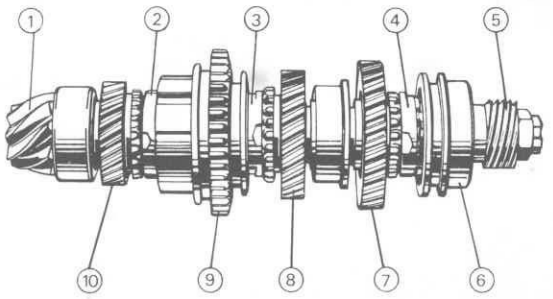

FIG 6:9 The countershaft assembly with bevel pinion on the left

Key to Fig 6:9 1 Pinion 2 4th-speed synchroniser ring 3 3rd-speed synchroniser ring 4 2nd-speed synchroniser ring 5 Speedometer drive gear 6 2nd-speed sliding sleeve 7 2nd-speed driven gear 8 3rd-speed driven gear 9 1st-speed and reverse sliding gear 10 4th-speed driven gear

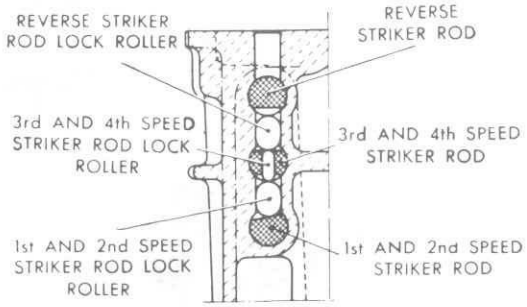

FIG 6:10 How the interlock detent rollers are positioned between the selector rods to prevent engagement of two gears at once

the tool on a surface plate and zero the gauge. Set the dial gauge assembly on the face of the tool as shown and determine the lowest reading in the differential bearing housings, measuring both sides and averaging the result (see **FIG 6:6**).

The countershaft drive pinion is stamped with two numbers as shown at B in **FIG 6:6**. '14' is the matching number of the pinion and ring gear, '– 10' is the centesimal value for calculating the correct adjustment between pinion and ring gear. If this value is negative, as in the diagram, the formula becomes:

$$S = 0.9 + a + (\frac{b}{100}) - c.$$

If the 'b' value is positive, the formula will read:

$$S = 0.9 + a - (\frac{b}{100}) - c.$$

The value of 'c' is the difference in millimetres between the height of the dummy shaft tool A.70037 and the total height of the parts to be installed on it, as measured by a dial indicator (see C in **FIG 6:6**). These parts are: 3rd speed driven gear bush, 3rd and 4th speed sleeve hub, 4th speed driven gear bush and the drive pinion roller bearing inner race.

The calculation can now be completed and the correct adjustment shim selected.

Reassembling gearbox:

Insert the pinion shaft into the various inside components in the order shown in **FIGS 6:5** and **6:9**. Fit the front bearing retainer and tighten the cross-head screws with an impact hammer. Insert the mainshaft, couple up the input shaft after fitting the rear bearing and then fit the front bearing. For the front end of the countershaft, assemble the second-speed gear 5 on the shaft, followed by the synchromesh assembly 7 and 8 (see **FIG 6:7**). Before fitting the synchromesh assembly, slide

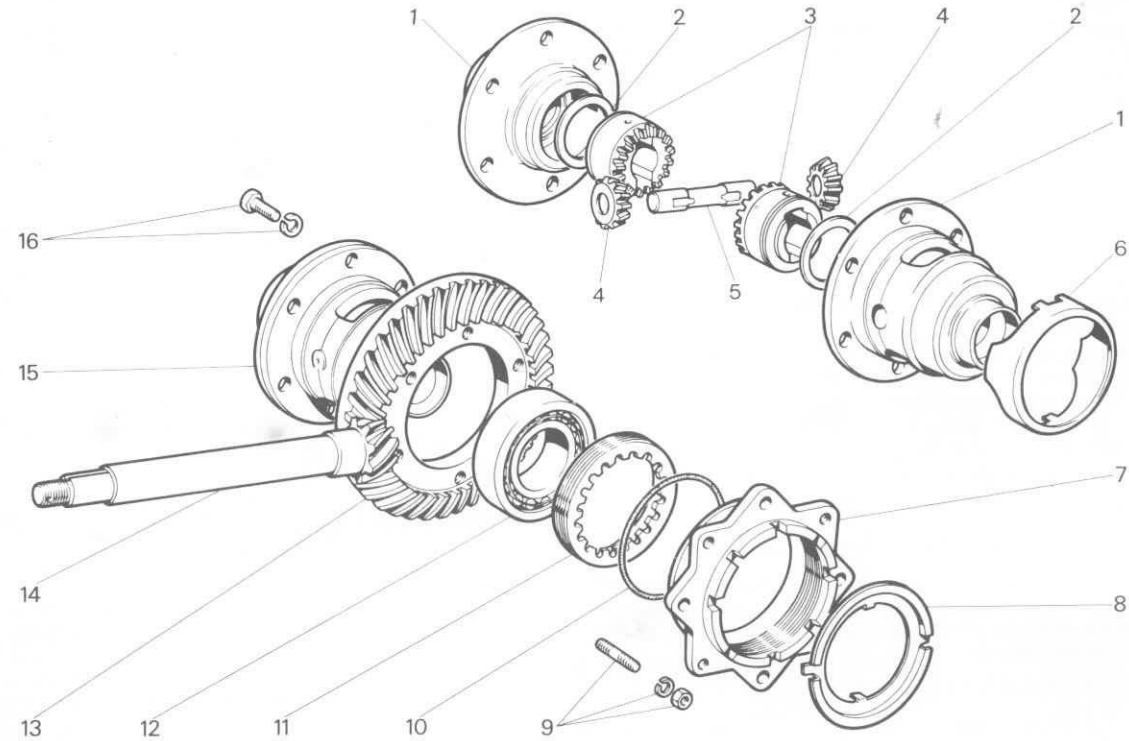

FIG 6:11 Components of the final drive and differential

Key to Fig 6:11 1 Differential casings 2 Thrust washer for side gear 3 Side gears 4 Differential pinions 5 Shaft 6 Shaft retainer 7 Bearing housing 8 Lockring for adjuster 9 Stud, nut and spring washer 10 Seal 11 Adjuster 12 Roller bearing 13 Ring gear 14 Pinion and shaft 15 Differential case assembled 16 Bolt and spring washer, ring gear

the lowest selector rod 6 into the casing, engage the fork correctly and then slide the whole assembly into place. Fit the speedometer gear and driving ball. Fit the plain washer and the nut. Fit the mainshaft drive gear and nut and then select two gears to lock the shafts. Tighten the nuts to 36 lb ft (5 kgm) and lock with new splitpins. If the holes do not line up, tighten the nut further.

Drop a detent roller into hole 5 (see **FIG 6:3**). The location of the selector (striker) rods and detent rollers is shown in **FIG 6:10**. Fit the third- and fourth-speed rod and fork. Drop in another detent roller and then fit the reverse rod and fork after refitting the reverse gears and shaft. Replace the detent balls and springs in the side holes and refit the cover plate (see 3 in **FIG 6:2**).

Line up the selector rods and refit the front casing, taking care that the selector lever in the casing engages the slots in the selector rods. Fit the top cover on a new gasket.

6:6 Servicing the differential assembly

The components of the assembly are shown in **FIG 6:11. Note that the pinion and ring gear are a matched pair and cannot be renewed separately.** If it is necessary to dismantle the differential casing to inspect the gears, remove bolts 16. Clean the parts and check the gears for worn or chipped teeth. Check shaft 5 for wear. Turn the bearings when dry. Renew them if they feel slack or rough. Check the fit of the side gears 3 and check the thrust washers 2 for wear. Renew the parts if the slots in the side gears and the blocks on the drive shafts show excessive wear.

When reassembling the differential it will be necessary to check the rolling torque of the gears as shown in **FIG 6:12**. The degree of torque required is determined by the thickness of thrust washers 2 (see **FIG 6:11**). These are available in thicknesses of .027, .031, .035, .039, .043, .047 and .051 inch (.7, .8, .9, 1.0, 1.1, 1.2 and 1.3 mm). Assemble the differential case and gears and tighten the ring gear bolts to 32.5 lb ft (4.5 kgm). Check the rolling torque with tool A.70315 and dynamometer A.95697 as shown in **FIG 6:12**. The correct torque should lie between 17 and 43 lb inch (20 to 50 kgcm). Adjust if necessary by using thrust washers of a different thickness. Refit the drive shafts during reassembly.

When satisfied, refit the differential assembly into the gearbox casing. Assemble the clutch bellhousing to the gearbox and tighten the stud nuts to a torque of 25 lb ft (3.5 kgm). Refit the bearing housings. To check the backlash between the pinion and the ring gear it will be necessary to set the two adjusters 11 (see **FIG 6:11**). Screw these in until they just make contact with the outer bearing races. Now clamp a dial indicator fitted with a long probe, such as tool A.95708, in such a position that the probe enters the hole in the bellhousing just below the input shaft and touches one of the teeth of the ring gear. Because the action of preloading the differential bearings may also affect the backlash between the pinion and ring gear, the two following operations must be carried out in close relationship to each other. First lock one drive shaft to the differential case by means of tool A.70315 (see **FIG 6:13**). Turn the drive shaft until all backlash is taken up and zero the dial gauge. Gently turn the shaft in the opposite direction until the backlash is taken up and then

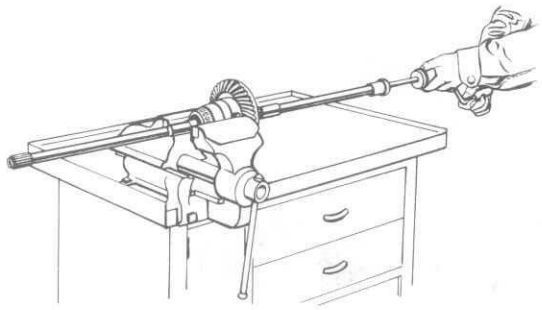

FIG 6:12 Checking the rolling toque of the differential gears using tool A.70315 and dynamometer A.95697

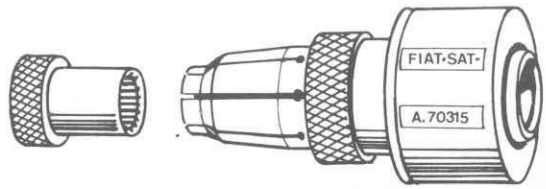

FIG 6:13 A drive shaft is locked to the differential case with tool A.70315

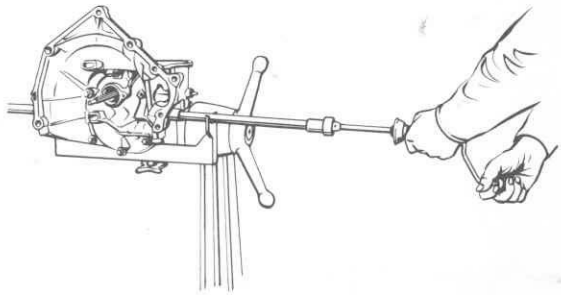

FIG 6:14 Checking the rolling torque of the differential roller bearings using tool A.70315 and dynamometer A.95697

read the gauge. The correct backlash is .003 to .005 inch (.08 to .13 mm). If incorrect, adjust by turning the adjuster rings as required but keeping them both in firm contact with the bearing races. Now use tool A.95697 to measure the rolling torque of the differential bearings as shown in **FIG 6:14**. The tool, which is a dynamometer, is locked to the drive shaft, and this in turn is locked to the differential case. Rolling torque should be 11 to 13 lb inch (13 to 15 kgcm). Adjust by turning the adjusters as required. It will then be necessary to recheck the backlash. **If any adjustment is needed, always turn one adjuster one way and the opposite one in the reverse direction so that the preload setting is not altered.** Always check the readings after each adjustment,

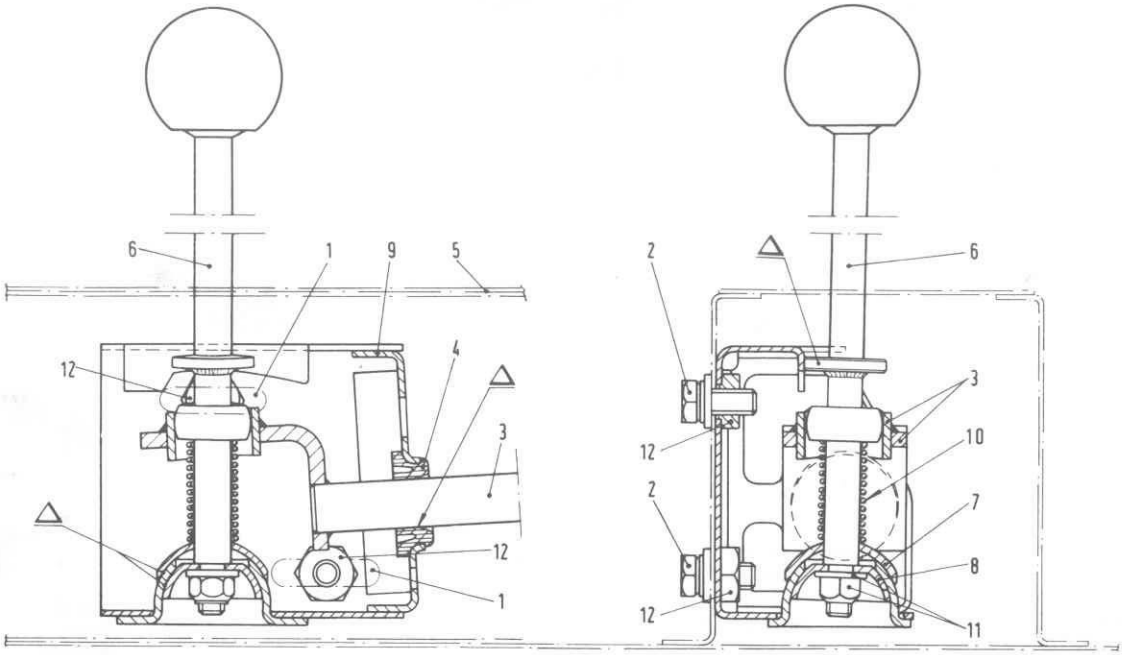

FIG 6:15 Sections through the gearlever mounting bracket. The small triangle indicates greasing points

Key to Fig 6:15 1 Elongated holes 2 Bolts 3 Rod to gearbox 4 Rubber bush 5 Tunnel 6 Gearlever 7 Spherical spring seat 8 Inner cup 9 Lever support 10 Spring 11 Self-locking nut and flat washer 12 Attachment nuts

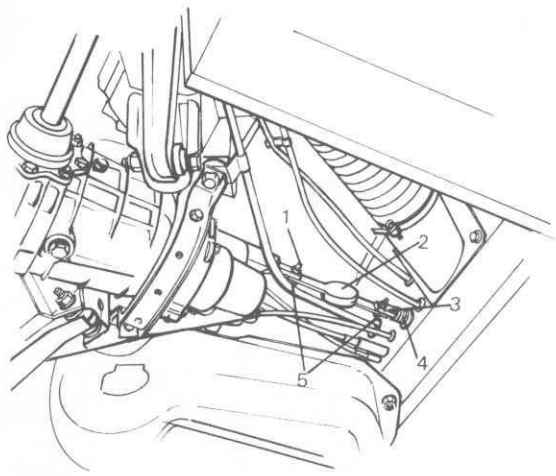

FIG 6:16 Underneath view showing connection between gearlever shift rod and gearbox

Key to Fig 6:16 1 Gearbox selector rod 2 Link with flexible joint 3 Control rod from gearlever 4 Boot 5 Connecting bolts and nuts

turning the differential assembly several times to settle the bearings. When adjustment is completed, fit the lock rings 8 and the rubber boots. Note that there is an oil seal in the sleeve of each boot. If leakage has been apparent fit a new seal with the open side facing inwards. Make sure that the contact surface of the seal on the axle shaft is clean and smooth.

Check the condition of the splines and junction sleeve at the outer end of each drive shaft (see **Chapter 7, FIG 7:6**). Apply grease to the splines on reassembly and make sure that the circlip is properly seated. Refit the clutch sleeve support inside the bellhousing (see **Chapter 5, Section 5:3** and **FIG 5:4**, part 15). Refit the transmission as described in **Section 6:3**. Refill with fresh oil (see **Section 6:2**).

6:7 The gearchange mechanism

Adjustment:

If there is difficulty in changing gear it is possible to move the gearlever position until full engagement of the gears can be made. The bracket supporting the lever is bolted to the side of the central tunnel (see bolts 2 in **FIG 6:15**). These bolts pass through elongated holes in the righthand side of the tunnel. To carry out adjustment, remove the screws securing the gearlever rubber boot and lift the boot out of the way. By peeling the tunnel covering back, it will be possible to see the two bolts. Slacken these and move the gearlever and supporting bracket backwards or forwards as required. Move the

bracket forward if first and third gears have not been engaging fully. Move it to the rear if second and fourth and reverse gear have not been engaging properly. Retighten the bolts and refix the boot.

Removal:

To remove the gearchange lever mechanism, work under the vehicle to release the control rod 3 from link 2 (see bolts 5 in **FIG 6:16**). Detach the gearlever supporting bracket from the tunnel by removing the bolts described in the preceding section on adjustment. This will allow the mechanism to be pulled forward and out.

Dismantling:

To remove the gearlever, unscrew self-locking nut 11. Clean the parts and check spring 10 for weakening. Check the working surfaces of the spherical joint at cups 7 and 8. Also check the gearlever and control lever 3 for worn contact surfaces. Renew bush 4 if deteriorated.

Reassembling and refitting:

When reassembling, apply Fiat MR 3 grease to the parts indicated by the small triangle in **FIG 6:15**. Refit the assembly into the tunnel and adjust for correct gear selection as described under '**Adjustment**'.

6:8 Fault diagnosis

(a) Noisy transmission

1 Worn gears and excessive backlash
2 Worn bearings or bushes
3 Bent shafts, worn splines
4 Worn synchromesh assemblies
5 Dirt or metal chips in lubricant
6 Low oil level

(b) Jumping out of gear

1 Check 4 in (a)
2 Gearlever bracket needs adjusting
3 Worn selector rods and forks
4 Detent balls and rollers worn or missing
5 Detent springs weak or broken

(c) Oil leakage

1 Oil level too high
2 Gaskets defective, faces damaged
3 Faulty seals at input and drive shafts
4 Damaged drive shaft boot

(d) Gearshifting difficult

1 Defective link in shift mechanism
2 Badly adjusted gearlever bracket
3 Worn gearlever mechanism
4 Selector rods tight in casing
5 Synchromesh assemblies worn or defective
6 Clutch release wrongly adjusted
7 Wrong grade of lubricant

NOTES

CHAPTER 7

THE REAR SUSPENSION

7:1 Description

The rear wheels are independently sprung by means of coil springs, and restrained by V-shaped control arms and telescopic hydraulic dampers. The inner ends of the control arms pivot on rubber bushes (see **FIG 7:1**). The outer end of the control arm carries the wheel hub bearing housing and the brake backplate.

The inner pivots of the control arms are so placed that vertical wheel movements have little effect on drive shaft length. For this reason there are no universal joints at the wheel ends of the drive shafts. Instead, there is a flexible joint at the outer end of each drive shaft (see 11 in **FIG 7:6**). The bearing housing or hub carries two roller bearings 7 separated by a collapsible spacer 8 that allows preloading of the bearings. The axle shaft 9 is flanged to take the brake drum.

7:2 Removing rear suspension

Raise the rear end of the vehicle and support it firmly on stands, then proceed as follows after jacking-up the control arm on the side selected.

1 Remove the road wheel. Peel back the floor lining at the rear and work inside the vehicle to release the top mounting of the damper. When undoing the nut it is helpful to hold the stud stationary by means of the flats at the top. Remove the washers and rubber bush. Detach the lower end of the damper from the control arm.

2 Release drive shaft sleeve 15 from coupling 11, pull back the sleeve and retrieve spring 13 (see **FIG 7:6**). Move to the front and identify the outlet from the brake master cylinder reservoir that feeds the rear brake circuit (see **Chapter 10**). Plug this outlet and then uncouple the hose at connector 1 (see **FIG 7:2**). Disconnect handbrake link 3. Release the handbrake cable by slackening the adjustment nuts at the bracket on the control arm.

3 Lower the control arm so that the spring becomes unloaded. Push up the lower sleeve of the damper and then slide out the spring complete with rubber insulators (see 3 and 4 in **FIG 7:3**). The parts are also shown in **FIG 7:4**.

4 Release support 1 from the body (see **FIG 7:3**). remove pin 3 from the other pivot of the control arm (see **FIG 7:5**). When pulling out the control arm, take careful note of the number and position of the adjustment shims 1. **These affect wheel alignment**.

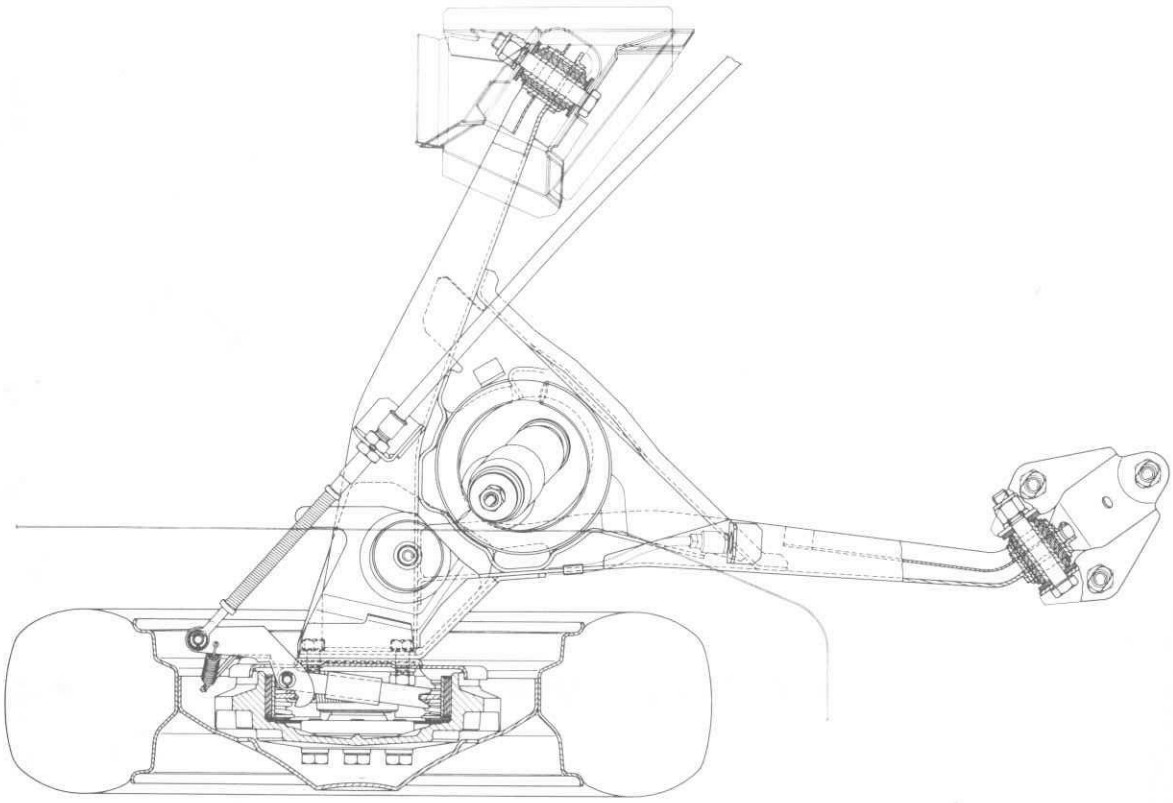

FIG 7:1 Plan view of suspension showing control arm pivots and brake drum in section

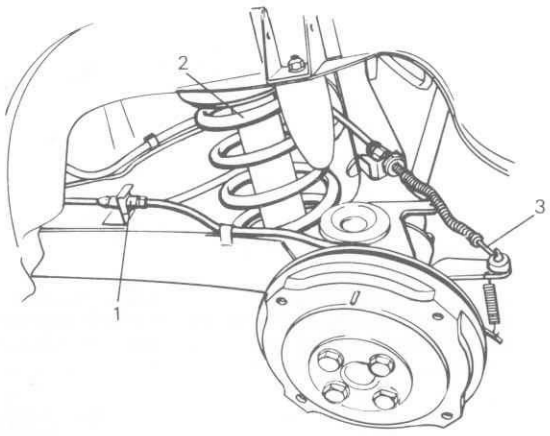

FIG 7:2 View of rear suspension with wheel removed. Brake fluid hose connection is 1, the coil spring is 2 and the handbrake link is 3

7:3 Servicing control arms

Check the pressings for cracks. If an accident has led to possible damage to the arms, have them checked for alignment by an agent equipped with the necessary jigs.

Check the condition of the rubber bushes (see 12 in **FIG 7:4**). The bushes should be tight in their housings and the rubber should be firm and without signs of softening or break-up. Old bushes may be removed using a press and Fiat drift A.74053. Use the same tool to press in new bushes. An equal amount should protrude on either side of the arm.

7:4 Servicing coil springs

The spring and insulator parts are shown as 1, 2 and 3 in **FIG 7:4**. Check the springs for cracks or corrosion damage. Check for weakening by compressing them under a load of 875 ± 35 lb (397 ± 16 kg). The height should be 6.22 inch (158 mm). At this height, the minimum permissible load is 805 lb (365 kg).

Note that springs come in two classes. Always fit a pair of springs of the same class. Springs marked yellow must have a height of 6.22 inch (158 mm) or **less** under a load of 875 lb (397 kg). Those marked green must have the same height or **more** under the same load.

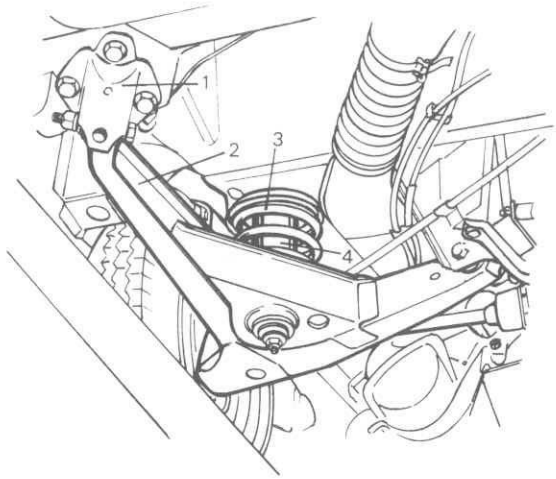

FIG 7:3 Underneath view of suspension showing front support 1, control arm 2, spring 3 and damper 4

Renew rubber insulators if damaged. There is an auxiliary rubber buffer secured to the body (see 18 in **FIG 7:4**). Check that this is in good condition.

7:5 Servicing dampers

A rough check of the action is to compress and extend the damper to find out whether there is steady resistance or whether there is jerky action with no resistance at times. Proper testing must be left to an agent who is suitably equipped. Renew dampers if there has been any falling-off in rear wheel adhesion or undue liveliness from the springing. It is possible to have the dampers reconditioned, the seal, piston and valve assemblies being available as spare parts.

Check the rubber mounting bushes (see parts 22 and 25 in **FIG 7:4**). Renew them if distorted or softened.

7:6 Servicing the hubs

The components of the hub are shown in **FIG 7:6**. To dismantle a hub, first remove the brake drum. Assuming that the drive shaft has been uncoupled at sleeve 15 (see

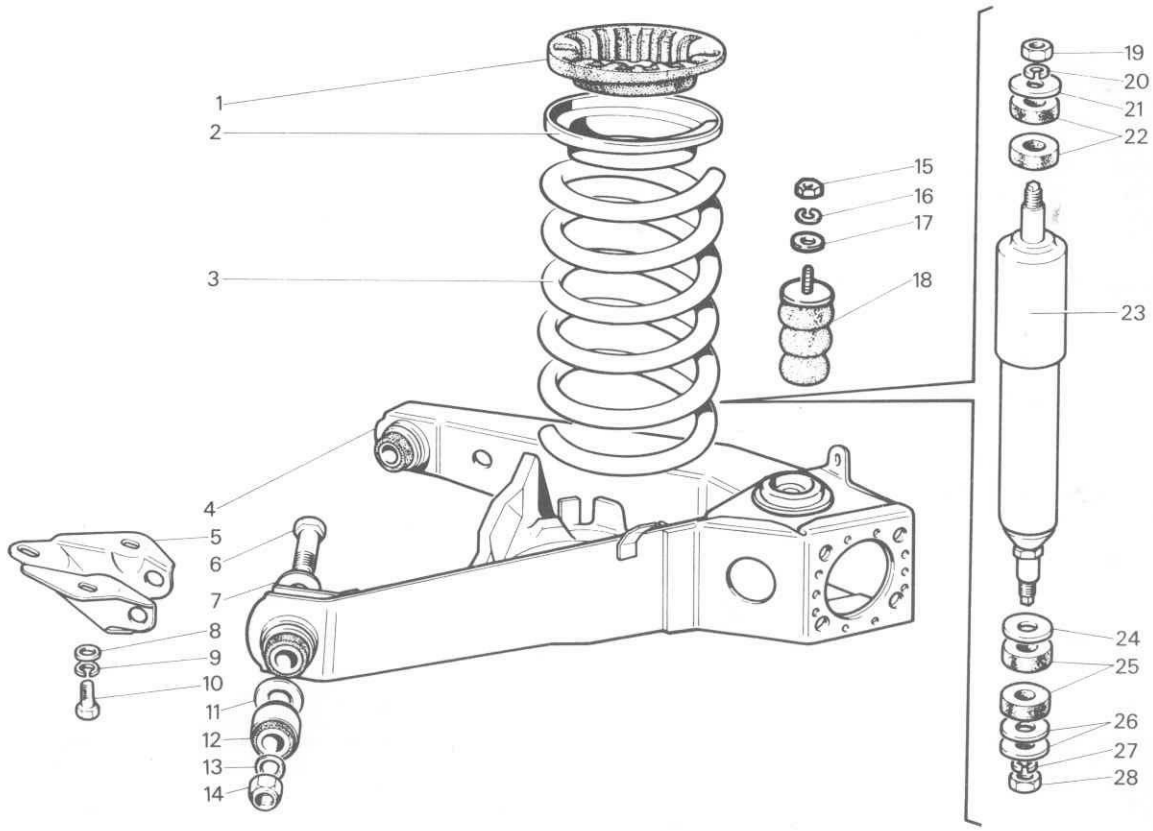

FIG 7:4 Some components of the rear suspension system

Key to Fig 7:4 1 Insulator for spring 2 Seat 3 Spring 4 Control arm 5 Support 6 Pin 7 Flat washer 8 Flat washer 9 Lockwasher 10 Bolt 11 Flat washer 12 Rubber bush 13 Lockwasher 14 Nut 15 Nut 16 Lockwasher 17 Flat washer 18 Rubber buffer 19 Nut 20 Lockwasher 21 Flat washer 22 Rubber bushes 23 Damper 24 Flat washer 25 Rubber bushes 26 Flat washers 27 Lockwasher 28 Nut

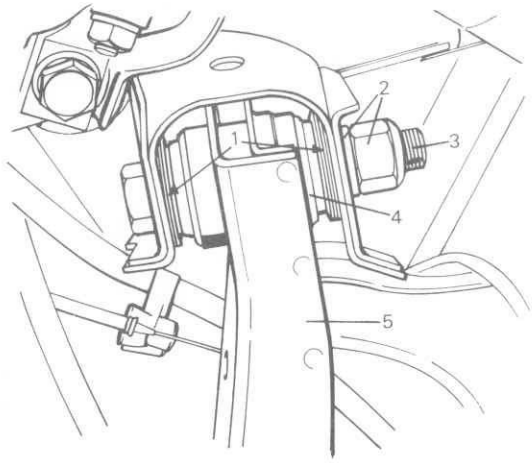

FIG 7:5 Rear mounting and pivot for control arm

Key to Fig 7:5 1 Adjustment shims 2 Nut and lockwasher 3 Pin 4 Rubber bush 5 Control arm

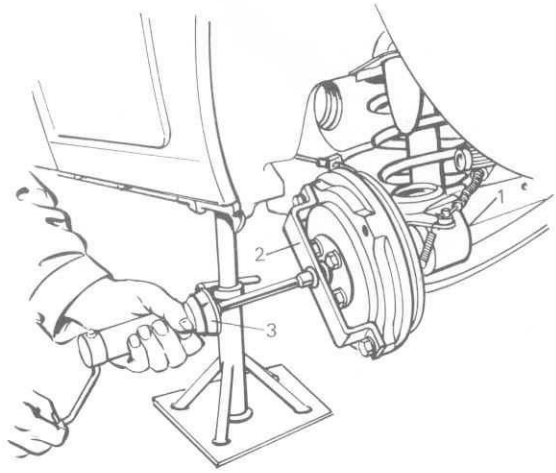

FIG 7:7 Checking the rolling torque of the rear axle shaft with drive disconnected. The axle shaft nut is 1, the tool 2 is part A.95697/2 and the dynamometer 3 is part A.95697

Section 7:2), unlock nut 12 and unscrew it from axle shaft 9. Withdraw the shaft and flange using slide hammer A.47017. Release hub 10 from the control arm. This will also make it possible to withdraw the brake backplate.

If lubricant has been leaking from the hub, prise out the seals 4. As this will damage them, make sure that new ones are available. Remove the inner bearing races, the spacer 8 and inner spacer 5. The last item is best removed before trying to prise out the inner seal.

The outer races must be driven out after removing the snap rings, by drifting from the inside, working evenly to avoid tilting. Check the bearings after cleaning them. Races must be tight in hub housing and on shaft. Renew races if pitted or worn and check rollers and cages. Scrap the spacer. **Always fit a new spacer and also renew the axle nut 12.** Reject the flexible joint if bonding of rubber to metal seems defective. Make sure that axle surfaces are smooth and polished where the lips of the seals make contact.

Reassembling hubs:

Drive the outer races into place with drift A.74041 and fit the snap rings. Fit the new spacer, the rollers and the inner races. Partially fill the hub with Fiat MR 3 grease. Do not overpack. Fit the new seals with open sides facing inwards. Refit the brake backplate and the hub to the control arm. Fit the inner spacer and flexible joint and tighten the axle nut moderately. Do not connect to the drive shaft until the bearing rolling torque has been

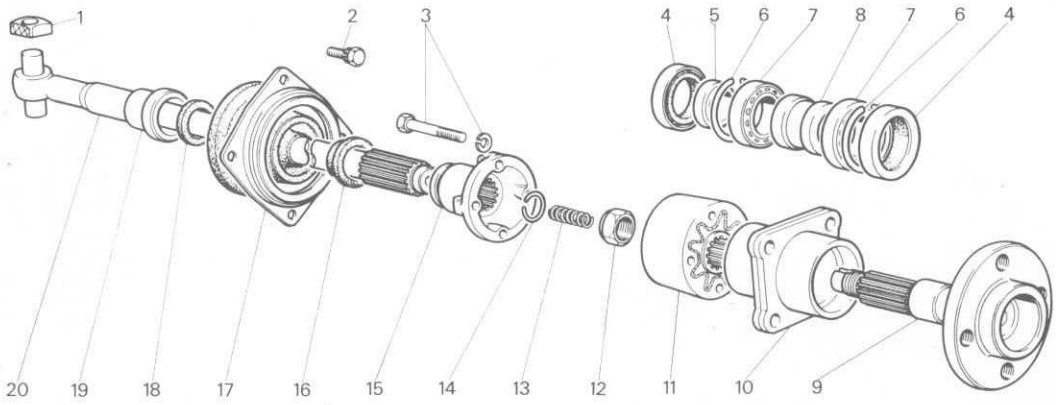

FIG 7:6 The components of the drive shaft (left) and the rear hub (right)

Key to Fig 7:6 1 Block for joint 2 Bolt 3 Bolt and lockwasher 4 Hub seals 5 Spacer 6 Snap rings 7 Roller bearings 8 Spacer 9 Axle shaft 10 Hub 11 Flexible joint 12 Nut 13 Spring 14 Circlip 15 Junction sleeve 16 Sleeve boot 17 Cover 18 Seal 19 Seal retainer 20 Drive shaft

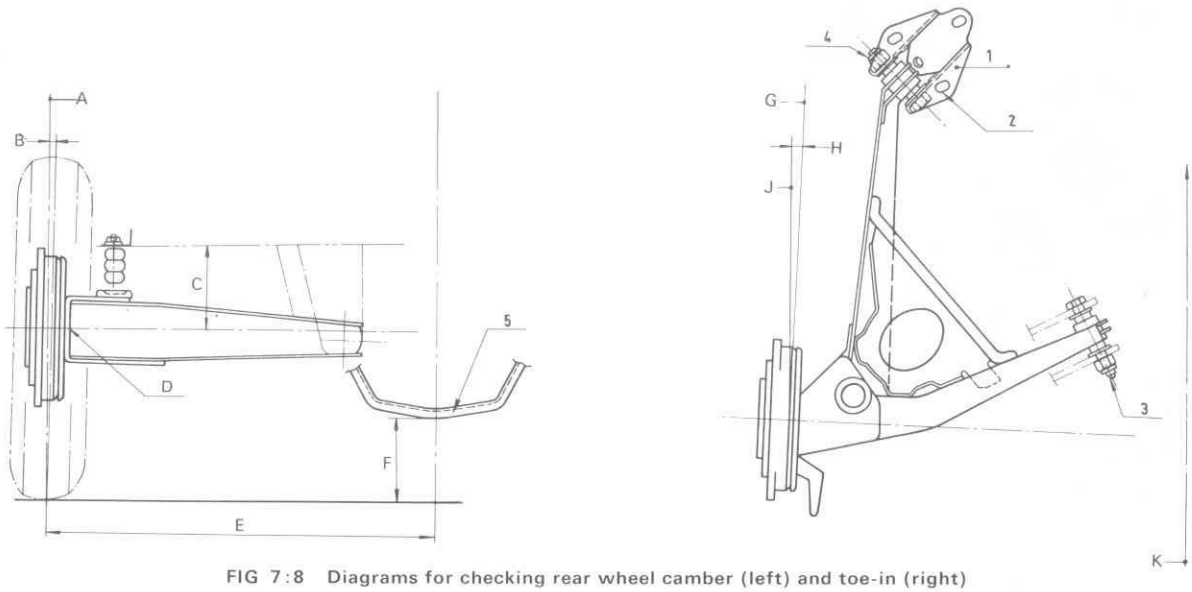

FIG 7:8 Diagrams for checking rear wheel camber (left) and toe-in (right)

Key to Fig 7:8 A Vertical B Camber angle, 0 deg. 22 min. to 1 deg. 22 min. C = 5.35 inch (136 mm) between buffer bracket and axle shaft centre D Axle shaft centre E = 23.68 inch (601.5 mm) F = 5.23 ± .39 inch (133 ± 10 mm), engine mounting to ground G Wheel plane H Toe-in, .20 to .35 inch (5 to 9 mm) J Parallel to car centre line 1 Front control arm support 2 Slotted holes 3 Rear pivot pin 4 Front pivot pin 5 Front engine mounting

measured. This is done by fitting the brake drum and then bolting tool A.95697/2 to the drum as shown in **FIG 7:7**. Dynamometer A.95697 is then applied and the rolling torque checked. This is the point when the axle just starts to turn. Continue tightening the axle nut until the torque figure is 4.3 lb inch (5 kgcm). When satisfied, stake the nut extension into the groove in the shaft.

This work on the hub may also be carried out with the control arm assembly removed from the vehicle

7:7 Refitting control arms

This is the reverse of the removal procedure. Fit the outer support bracket and position the control arm so that the bolts securing the outer bracket can be fitted but not fully tightened until after the toe-in has been checked. Fit the inner end and insert the adjusting shims. Line up the parts with a suitable peg with a tapered end. Fit the pin but do not fully tighten the nut until the toe-in check.

Compress the damper and fit a washer and one rubber bush to the lower end and a bush to the top end (see **FIG 7:4**). Insert the lower end into the control arm and loosely fit the remaining parts at the lower end. Fit the spring and insulators. Extend the damper and insert the top stud through the hole in the body. Use a jack to lift the control arm until the spring is properly seated and then fit the top rubber bush, washers and nut to the damper, working inside the vehicle. Tightening of all rubber bush fixings, especially those in the control arms, should be left until the suspension system is standing normally so that the rubber is evenly stressed when the suspension is working.

Refit the brake backplate and the hub to the control arm, tightening the nuts to a torque of 40 lb ft (5.5 kgm). Refit the brake drum. Connect the handbrake link and the brake fluid hose and unplug the fluid connection at the master cylinder. Bleed the brakes as described in **Chapter 10**. Connect the axle shaft to the flexible joint after smearing the shaft splines with suitable grease. Do not forget the spring. Refit the road wheel and lower the vehicle to the ground. It is now time to check the toe-in as follows.

7:8 Checking rear wheel toe-in

It must be understood that the checking needs special equipment not normally available to the amateur and is an operation best left to a service station suitably equipped. However, the principles will be covered in this section.

Reference to **FIG 7:8** will show on the left that each rear wheel has a negative camber angle, that is, it leans inwards. The righthand view shows that each wheel toes-in. In other words the distance between the rear wheels is less at the front of the wheels than it is at the back.

The camber angle is not adjustable. Toe-in is adjusted by altering the position of support bracket 1, the fixing holes being slotted, and also by altering the position of the shims on either side of the bush on pin 3 (also see **FIG 7:5**). Note that all measurements must be made with the tyres correctly inflated to a pressure of 20 lb/sq inch (1.4 kg/sq cm) at the front and 28.5 lb/sq inch (2 kg/sq cm) at the rear. The vehicle must also be loaded with four people.

When the adjustments have been made, tighten the bolts at support 1 (see **FIG 7:3**) to a torque of 36 lb ft (5 kgm) and nut 2 (see **FIG 7:5**) to a torque of 58 lb ft (8 kgm). Also tighten the damper fixings to a torque of 22 lb ft (3 kgm).

7:9 Fault diagnosis

(a) Irregular or abnormal tyre wear

1 Incorrect tyre pressures
2 Wheels not balanced
3 Brakes out of adjustment
4 Weak or broken coil spring
5 Excessive loading
6 Wheel alignment incorrect
7 Wheel not running true

(b) Suspension down on one side

1 Check 1 and 4 in (a)
2 Defective damper

(c) Rattles

1 Check 4 in (a)
2 Loose control arm supports
3 Worn or loose damper bushes
4 Defective rubber bushes in control arms
5 Unlubricated wheel bearings

(d) Vibration

1 Check 2 and 7 in (a)
2 Worn flexible joint to drive shaft

(e) Pulling to one side

1 Check 1, 3 and 6 in (a)
2 Bent control arm

CHAPTER 8

FRONT SUSPENSION AND HUBS

8:1 Description

The independent front wheel suspension system consists of a transverse leaf spring that is not bolted to the body, but is restrained by the rubber head of the central bolt and by two rubber-lined mountings (see 6 in **FIG 8:1**). The outer eyes of the spring are linked to knuckle pillars 5 and 8, the top ends of the pillars being pivoted to wishbones or control arms (see 3 in **FIG 8:2**). Telescopic dampers are fitted between the top ends of the pillars and the body. Each knuckle pillar carries a wheel spindle 6 (see **FIG 8:6**). The spindle is secured to a kingpin 16. An arm on each spindle is connected to the steering tie-rods. Control arm and spring eye pivots are rubber-bushed.

8:2 Routine maintenance

Every 6200 miles (10,000 km) apply a grease gun filled with Fiat JOTA 1 (lithium-base No. 1) grease to the grease nipples on the steering knuckles (see 2 in **FIG 8:6**). Every 18,500 miles (30,000 km) the front hubs must be lubricated with Fiat MR 3 (lithium-base No. 3) grease.

8:3 Front suspension removal

Slacken the wheel bolts a turn before lifting the front end of the vehicle. Jack-up and fit widely spaced stands, making sure all is firm. Remove the front wheels and proceed as follows:

1 Disconnect the outer steering ball joints from the steering arms, using a suitable tool such as Fiat A.47035. **Do not try to hammer the ballpin out of the arm.** From inside the vehicle, disconnect the top end of the dampers. Hold the stud by the flats provided, unscrew the nut and lift off the washers and rubber bush (see parts 1, 2, 3 and 4 in **FIG 8:4**).
2 Disconnect lower end of damper from knuckle pillar (see **FIG 8:3**). Remove nuts 4 and slide the assembly off the studs. **Take particular note of the number and position of the shims 2.** These are used to adjust castor and camber angles.
3 Plug the outlet in the master cylinder reservoir that supplies the front brake circuit. Disconnect the pipelines at the brackets just above control arm shaft 5. Do not twist the hoses.
4 Fit a suitable crossbeam across the spring eyes or use two jacks and just take the weight without lifting. This will keep the spring compressed while the spring mounts are removed (see 6 in **FIG 8:1**). Gradually lower the jacks until the spring loses all tension and remove the spring complete with knuckle pillar assemblies.

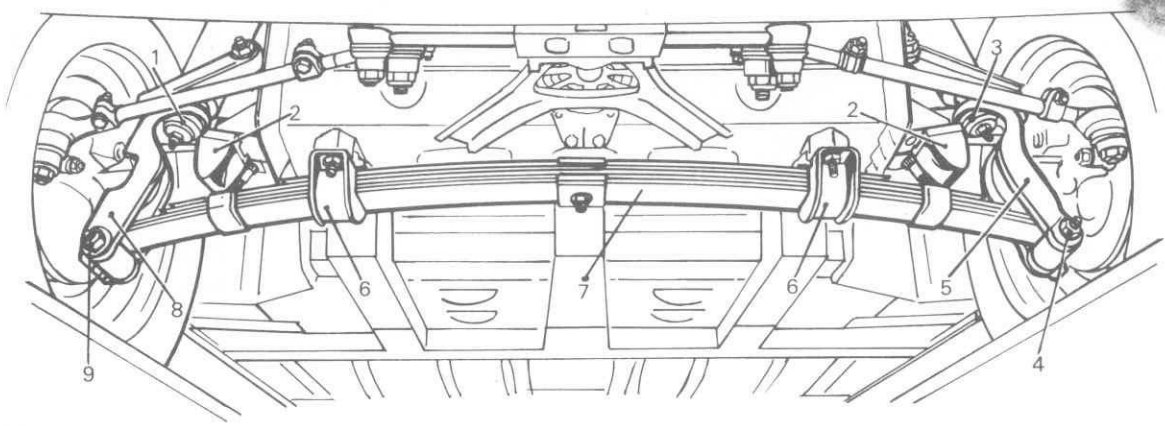

FIG 8:1 Underneath view of front suspension

Key to Fig 8:1 1 Nut, damper to knuckle pillar 2 Rubber buffers 3 Nut, damper to knuckle pillar 4 Nut, spring eye pin 5 Lefthand knuckle pillar 6 Spring mounts 7 Spring 8 Righthand knuckle pillar 9 Nut, spring eye pin

8:4 Dismantling front suspension

The components of the suspension system are shown in **FIGS 8:4** and **8:5**. Dismantling is a straightforward removal of the bolts or pins securing the spring eyes and control arms to the knuckle pillar, and the nuts at the outer ends of the control arm shaft. The spring may be dismantled by removing the centre bolt and the two side clips. Withdraw control arms with a puller.

Clean the parts and check for wear or damage. Servicing of the parts is covered in **Sections 8:5** and **8:6**.

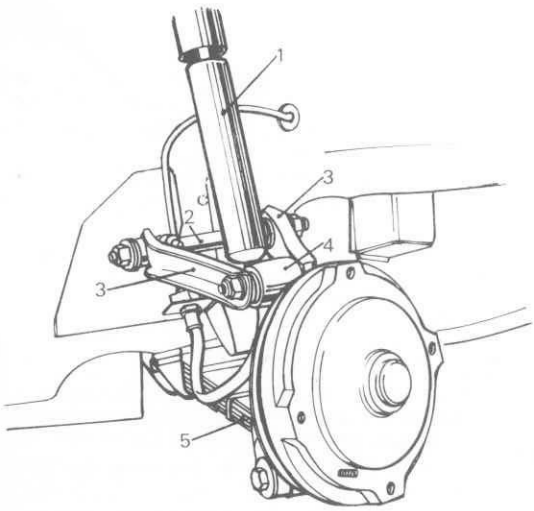

FIG 8:2 Front suspension linkage details

Key to Fig 8:2 1 Damper 2 Control arm shaft 3 Control arms 4 Knuckle pillar 5 Spring

8:5 Servicing control arms, knuckle pillars and hubs

Control arms:

Check the pressings for cracks or distortion. The rubber bushes must be firm and show no signs of tearing. Press in new bushes using a suitable drift or tool A.74058. Check that the mounting pads on the control arm shafts are free from burrs. The bushes are part 9 and the shaft is part 11 in **FIG 8:4**.

Knuckle pillars:

The pillar is part 27 in **FIG 8:4**. Check the condition of rubber bush 33. If the rubber is torn or has softened, press out the old bush and fit a new one, using a drift, or tool A.70456. Let an equal amount project at each side.

Hubs:

This section will also cover the spindle or axle 6 and the kingpin 16 (see **FIG 8:6**). To service the parts the brake drum must be removed. Pull off the hub cap, preferably by using slide hammer A.47023. Remove the axle nut 12 after prising up the staking. Discard the nut. **Whenever this nut is removed, a new one must be refitted.** Remove washer 11 and then use a suitable puller to withdraw the brake drum and hub. Remove the brake backplate from the steering arm fixings.

It is always a good plan to renew seal 7. In any case it must be prised out if circlip 8 and the outer race of bearing 9 are to be removed from the hub. This will ruin the seal.

Clean all the parts and check the bearings for roughness when turned in an unlubricated state. Check rollers and cages for wear or cracks. Check the axle for evidence of inner races turning on their seatings and inspect the hub for a similar defect in the fit of the outer races. Check the axle for cracks.

The kingpin 16 must be a good fit in the bushes in knuckle pillar 1 and there must be no up and down play at

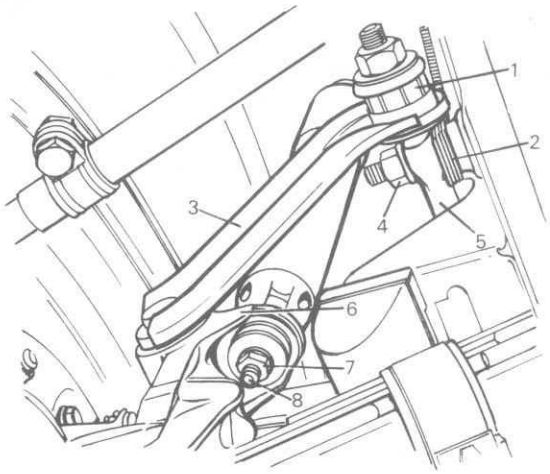

FIG 8:3 Underneath view of control arm and damper mountings

Key to Fig 8:3 1 Rubber bush for control arm shaft 2 Shims for adjusting camber and castor angles 3 Control arm 4 Nut, shaft to body 5 Control arm shaft 6 Knuckle pillar 7 Nut, damper to knuckle pillar 8 Damper stud

thrust and adjustment washers 4, 13 and 14. If there is wear, drive out roll-pin 3 and then drive out the kingpin. Press the bushes out of the knuckle pillar (see parts 29 in **FIG 8:4**). The bottom plug will probably come away when the kingpin is removed. Fit the new bushes so that their inner faces do not project beyond the thrust washer faces. Drift A.74016 may be used to drive them into place. The specified bore of the bushes is .5911 to .5922 inch (15.016 to 15.043 mm). Use reamer A.90316 to obtain this result. After fitting new bushes it is advisable to have the alignment of the knuckle assembly checked by a Fiat agent who has the necessary gauges. These will check that the top and bottom eyes are parallel and that the kingpin bores are correctly aligned.

When reassembling the axle to the knuckle pillar, check that there is no appreciable play between the two parts. Any play may be eliminated by fitting a thicker shoulder ring 4. The ring is available in oversize thicknesses. Grease the parts before reassembling.

Fit the hub bearing outer races and circlip to the hub. They must be a tight press fit. Fit a new oil seal with the open side facing inwards. Drift A.74259 is available for refitting the inner race and drift A.74046 for the outer race in the drum. Fill the space between the bearings with the appropriate grease (see **Section 8:2**), but do not overpack.

Refit the brake backplate. Press the brake drum and hub onto the axle after applying a light smear of grease to the spindle. If the inner bearing inner race was removed, make sure it is drifted home and is tight on the spindle. Fit the inner race of the outer bearing, followed by the lockwasher. Fit a new nut and tighten to 5 lb ft (.70 kgm). Refer to **FIG 8:7** and back off the nut as shown. At this point the axial play in the bearings should be .001 to .004 inch (.025 to .10 mm). Stake the nut by punching the extension into the groove in the spindle. Refit the hub cap.

8:6 Servicing the spring

Having dismantled the spring as described in **Section 8:4**, clean all the leaves. Referring to **FIG 8:5**, check the interliners 13 for wear or damage. Check each leaf very carefully for cracks, and for pitting due to corrosion. This is a likely cause of spring breakage, particularly in cold weather. **It is not possible to renew spring leaves singly.** The whole spring must be renewed.

Check the condition of the rubber bushes 6. If the rubber is torn or soft, press out the defective bush and press in a new one using drift A.74056. An equal amount should protrude from each side of the spring eye. Renew rubber parts 2, 3, 5, 8 and 20 if the rubber is soft or damaged.

Reassemble the spring and, if possible, test it as shown in **FIG 8:8**. The spring must be loaded as shown in the data and the deflections measured.

8:7 Reassembling and refitting front suspension

The spring must be compressed on tool A.74061 as shown in **FIG 8:9**. In this position the distance between a line joining the spring eye centres and the lower face of the main spring leaf at a point opposite the two mounting points should be 1.10 ± .12 inch (28 ± 3 mm). Refer to **FIG 8:4** and refit the control arms 14 to the shaft 11 in the position the arms would take up with the spring in the static load condition (see 2 in **FIG 8:8**). Tighten the shaft nuts to 18 lb ft (2.5 kgm). Connect the knuckle pillar assemblies to the control arms. Set the axis of the

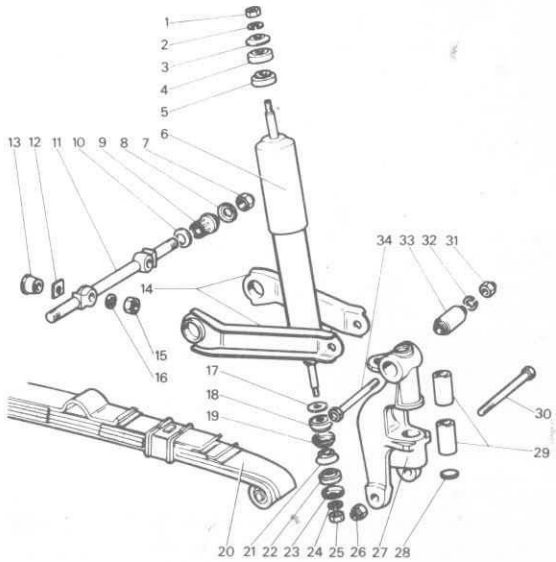

FIG 8:4 Components of the front suspension

Key to Fig 8:4 1 Nut 2 Lockwasher 3 Upper cup 4 Upper bush 5 Lower bush 6 Damper 7 Nut 8 Cup 9 Bush 10 Spacer 11 Shaft 12 Shim 13 Spacer 14 Control arms 15 Nut 16 Lockwasher 17 Flat washer 18 Upper bush 19 Upper cup 20 Spring 21 Lower cup 22 Lower bush 23 Flat washer 24 Lockwasher 25 Nut 26 Nut 27 Knuckle pillar 28 Plug 29 Bushes, kingpin 30 Pin 31 Nut 32 Lockwasher 33 Rubber bush 34 Pin

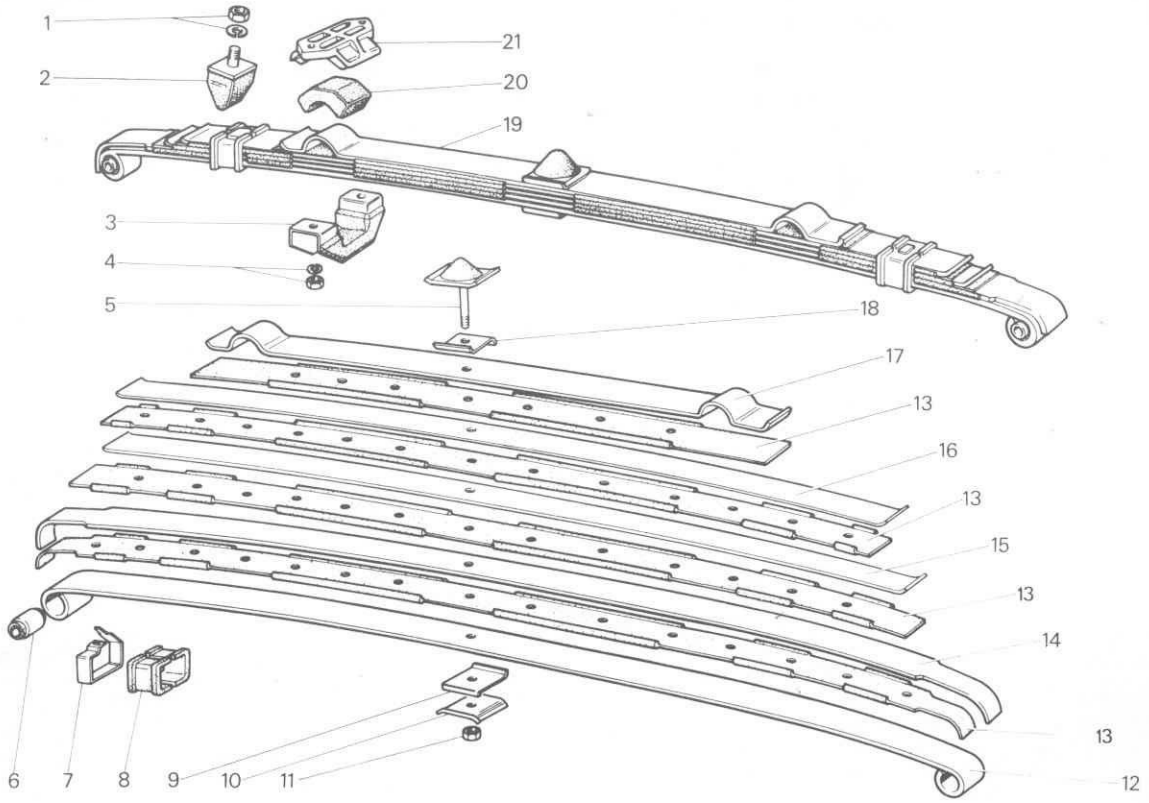

FIG 8:5 Front leaf spring assembly and components

Key to Fig 8:5 1 Nut and lockwasher 2 Rubber buffer 3 Rubber-lined mount 4 Nut and lockwasher 5 Centre bolt 6 Rubber bush, spring eye 7 Clip 8 Insulator 9 Upper plate 10 Lower plate 11 Nut 12 Main leaf 13 Interliners 14 Second leaf 15 Third leaf 16 Fourth leaf 17 Top leaf 18 Top plate 19 Spring assembly 20 Top insulator, mount 21 Insulator support

knuckle to that of the control arms at an angle of approximately 95 deg. Tighten nut 31 to 43 lb ft (6 kgm). Compress the dampers and refit to the knuckle pillars without fully tightening the nut.

Refit the spring assembly to the body, tightening the nuts of the mounts to 22 lb ft (3 kgm). Fit the adjustment shims 12 in the positions they occupied before dismantling. Fit the shaft 11 and tighten the nuts to 22 lb ft (3 kgm). Connect each knuckle pillar to its spring eye with bolt 30 and tighten the nuts to 29 lb ft (4 kgm). Connect the top ends of the dampers to the body. Tighten top and bottom nuts to 14.5 lb ft (2 kgm). Remove the spring compressing tool.

Reconnect the brake pipes, remove the reservoir plug, and bleed the brakes (see **Chapter 10**). Refit the ball joints to the steering arms. When refitting the road wheels, tighten the bolts to 36 lb ft (5 kgm). Check the geometry as described in the next section.

8:8 Checking suspension geometry

If there has been accident damage, if parts have been renewed or if excessive and unusual tyre wear is evident, then the settings of the suspension system must be checked. This should also be done if steering has become erratic. Special equipment is needed to check the angles accurately but the principle is as follows:

The test must be carried out with the vehicle loaded with four people and the tyres correctly inflated. Refer to **FIGS 8:10** and **8:11**. The first of these is a diagrammatic section which also shows angles for wheel camber and knuckle pin inclination. The diagrams in the second illustration show how the camber and castor angles are measured and how the adjustment is made.

If the wheel camber angle is not the specified 1 deg. ± 30 min., disconnect the damper from the body, and the control arm shaft from the studs. To decrease the camber angle remove an **equal number** of shims from both studs. Add shims to increase the angle (see 8 in **FIG 8:11**).

Check the castor angle, which should lie between 8 deg. and 10 deg. If adjustment is needed, move adjustment shims as just described. To increase the castor angle move shims from the rear stud to the front one. If the angle must be decreased move the shims from the front stud to the rear.

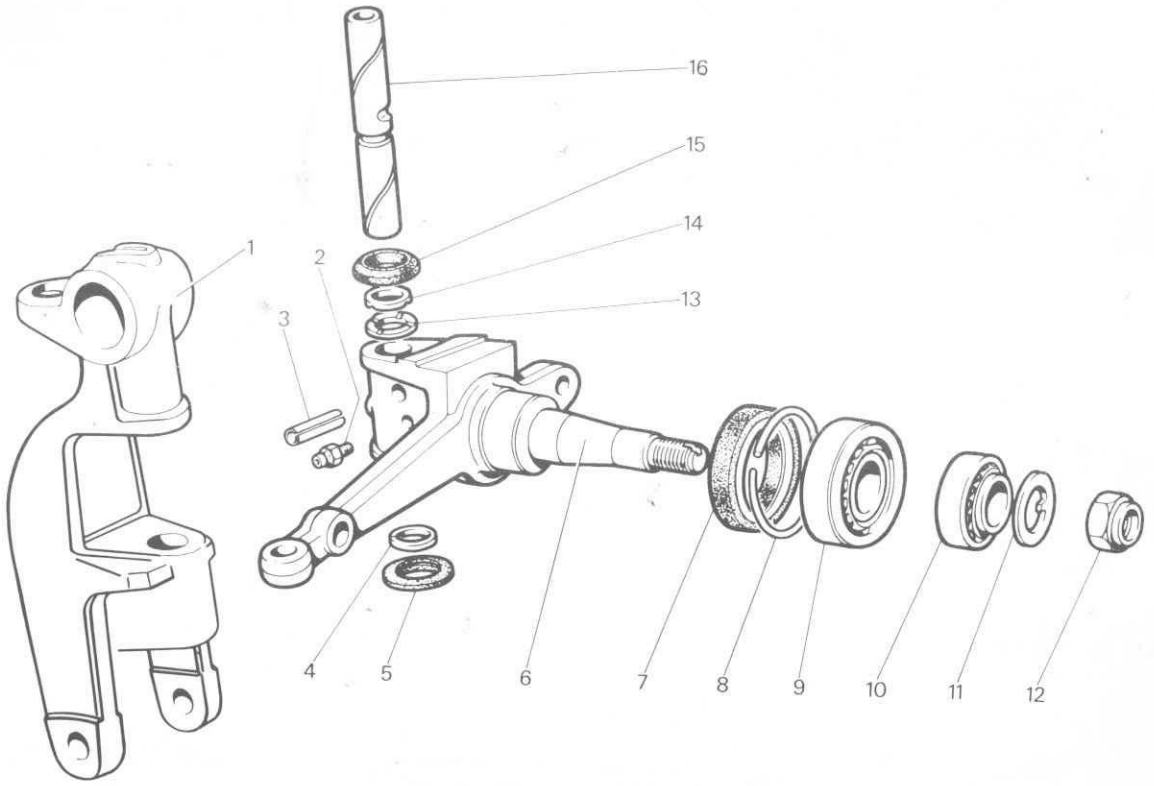

FIG 8:6 Components of steering knuckle and spindle

Key to Fig 8:6 1 Knuckle pillar 2 Grease nipple 3 Retaining pin, kingpin 4 Lower shoulder ring 5 Rubber washer 6 Spindle 7 Seal 8 Circlip 9 Inner bearing 10 Outer bearing 11 Lockwasher 12 Nut 13 Lower thrust washer 14 Upper thrust washer 15 Upper rubber washer 16 Kingpin

Note that these settings must be carried out, not only with the load specified, but with a check on the distance between front spring mounts and the ground (see 'h' in **FIG 8:11**). The correct distance is 6.73 ± .47 inch (171 ± 12 mm).

Toe-in:

The operation of measuring and adjusting for front wheel toe-in is covered in **Chapter 9, Section 9:7**.

8:9 Servicing dampers

FIG 8:12 is a section through one of the telescopic hydraulic dampers. Briefly, the action is one of allowing fluid to pass valves more freely on the compression than on the rebound stroke. The system is primed with fluid that is stored in the chamber surrounding the working cylinder, so that any loss does not lead to air pockets and consequent failure in operation. Loss of fluid or failure of the piston rod seal, the piston or the valve assemblies may lead to erratic action or total loss of damping. This leads to greater liveliness of the springing, with the attendant problems of wheel bounce, difficult steering and poor road-holding.

It is possible to service dampers, the seals, the piston and the valve assemblies being available as spare parts. Special fluid is needed for filling.

Dismantling and inspection:

Normally during service if a damper becomes weak in operation then a new unit should be fitted. Should however, it be necessary for the original unit to be overhauled proceed as follows:

1 Thoroughly clean the outer casing in solvent and blow dry using a compressed air jet.
2 Firmly clamp the lower shank of the damper in a vice, lift the outer casing and using Fiat wrench A.57034 unscrew the upper threaded ring 3 (see **FIG 8:12**).
3 Remove the damper from the vice and carefully remove the inner cylinder 15 using a screwdriver inserted in the cylinder bottom chamfer and remove the lower plug 32 which carries the compression and compensation valves.

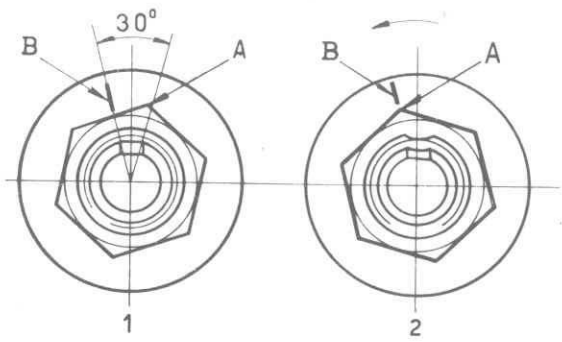

FIG 8:7 To adjust front wheel bearings, the spindle nut is backed off after tightening to correct torque

Key to Fig 8:7 A Edge of nut B Reference mark on lockwasher 1 Nut tightened to 5 lb ft (.70 kgm) 2 Nut backed off by 30 deg.

4 Push the rod into the cylinder 15 and clamp the upper shank in a vice. Unscrew the plug 29, and carefully remove the piston 22 together with the inlet and rebound valves. Withdraw the rod 2 from the cylinder 15 and remove the seal gasket, the housing, and threaded ring. Thoroughly wash all parts in solvent and carefully blow dry using a compressed air jet. The following parts should be inspected as follows. Check that the inlet, rebound and compensation valve discs are not deformed or show signs of cracking. Inspect the surfaces of the piston, the seal ring and the compression valve to ensure that they are smooth and hydraulic fluid tight. Check that the rebound and compression valve springs and upper seal gasket springs are not broken or weak. Carefully inspect the two seal gaskets for damage or wear and it is recommended that they are renewed upon reassembly. Check that the rod and the cylinders show no sign of deformation and that the air pocket evacuating

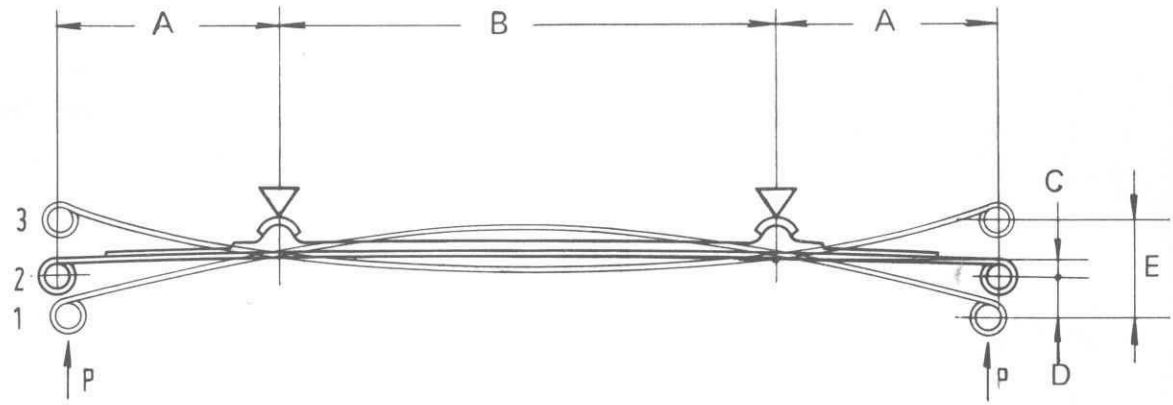

FIG 8:8 Figures for front spring deflection under various loads

Key to Fig 8:8 A = 9.37 inch (238 mm) B = 20.88 inch (530 mm) C = .79 ± .12 inch (20 ± 3 mm) D = .94 ± .08 inch (24 ± 2.2 mm) E = 1.34 ± .12 inch (34 ± 3 mm) P = Direction of applied load

Position	*Load*	*Deflection from position 1*
1 Initial load	220 lb	
2 Static load	324 lb	D
3 Maximum load for test	330 lb	E

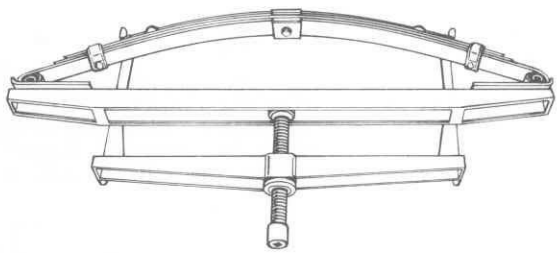

FIG 8:9 To refit the front spring it must be compressed using tool A.74061 as shown

passage is not blocked. Also check that the capillary hole 12 is not blocked. Any parts which show signs of wear or damage must be renewed.

Reassembly:

Reassembly of the damper is the reverse procedure to dismantling. Special care must be taken when refilling the shock absorber with Fiat SAI oil otherwise its operating characteristics will be altered.

The hydraulic fluid capacity for the front dampers is 4.5 fl oz (.13 litre, 4.4 US fl oz).

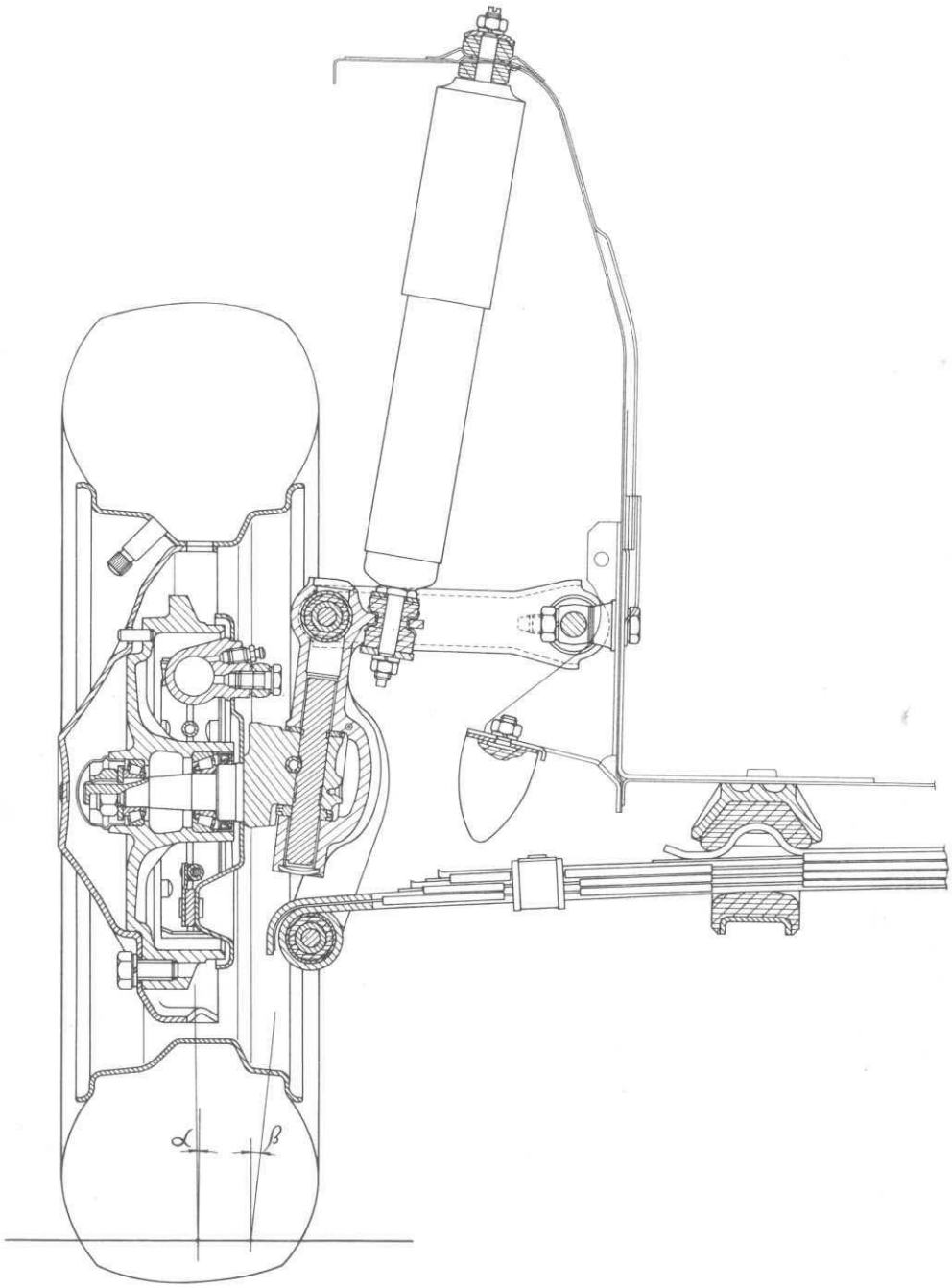

FIG 8:10 Sectioned view of front suspension showing camber and kingpin inclination angles

Key to Fig 8:10 α Camber of 0 deg. 30 min. to 1 deg. 30 min. (loaded) β Kingpin inclination angle of 6 deg.

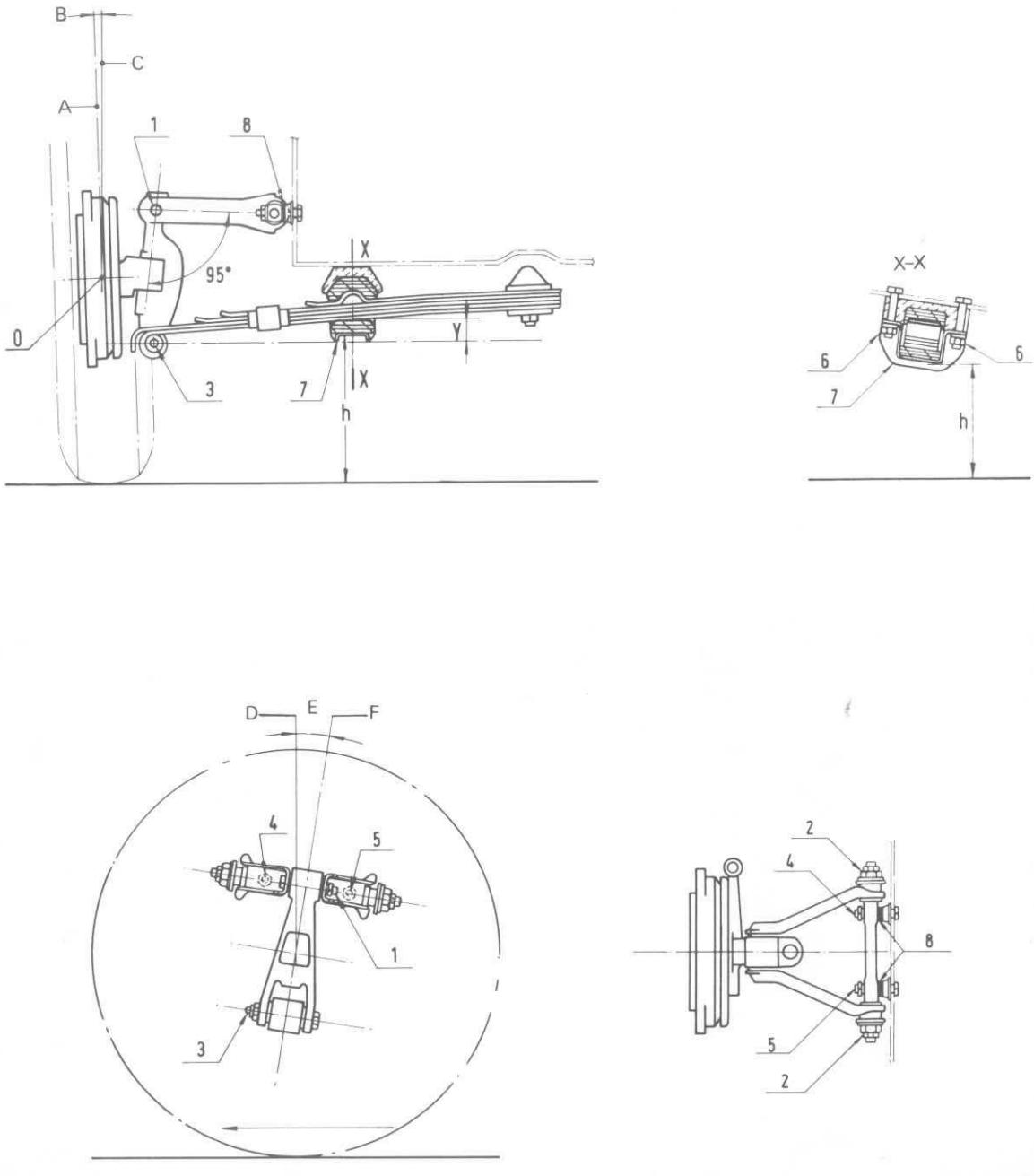

FIG 8:11 Diagrams for checking and adjusting camber and castor angles

Key to Fig 8:11 1 Pin, control arm to kingpin 2 Nuts, control arm shaft 3 Pin, spring eye to kingpin 4, 5 Bolts and nuts, control arm to body 6 Spring mounting to body, bolts and nuts 7 Leaf spring mounting 8 Adjustment shims A Wheel plane B Camber angle, 1 deg. ± 30 min. C Vertical D Vertical E Kingpin inclination, 9 deg. ± 1 deg. F Kingpin axis O Wheel centre Y = 1.10 ± .12 inch (28 ± 3 mm) in static load position h = 6.73 ± .47 inch (171 ± 12 mm) in static load position

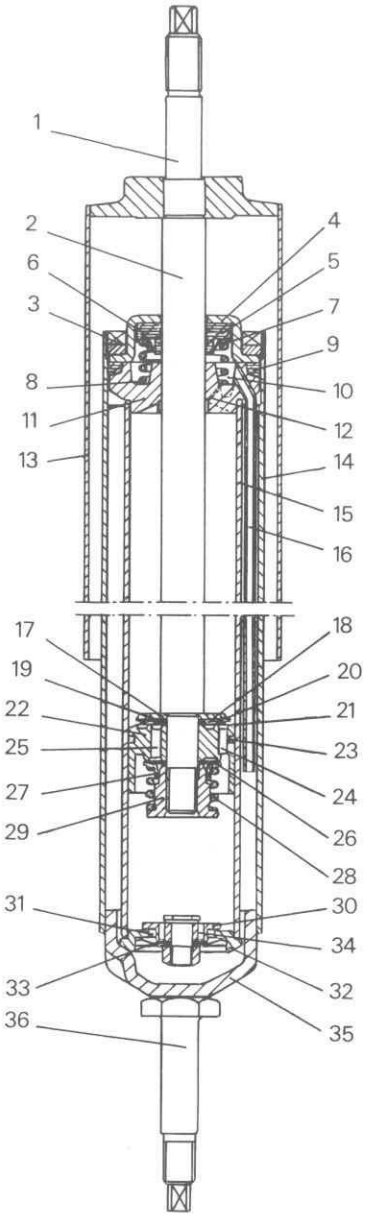

FIG 8:12 Sectional view of telescopic damper

Key to Fig 8:12 1 Top stud or shank 2 Piston rod 3 Threaded ring 4 Seal housing 5 Seal 6 Tab spring 7 Spring cup 8 Spring 9 Gasket 10 Drainage chamber 11 Bush 12 Drainage capillary hole 13 Dust shield 14 Casing 15 Cylinder 16 Drainage tube 17 Valve lift limiter 18 Fluid passage 19 Valve lift adjustment washer 20 Valve spring 21 Inlet valve 22 Piston 23 Compression ring 24 Inlet valve holes 25 Rebound valve holes 26 Rebound valve 27 Valve guide cup 28 Spring 29 Plug 30 Compensating valve 31 Valve passage 32 Valve carrier plug 33 Compression valve 34 Valve holes 35 Lower plug 36 Lower stud or shank

The hydraulic capacity for the rear dampers is 3.8 fl oz (.11 litre, 3.7 US fl oz). **Only Fiat—SAI oil must be used.**

To insert the components into the damper body proceed as follows:

1 Mount the piston on the rod, and insert the piston and rod assembly into the cylinder 15.
2 Push the piston against the bush 11 and then very carefully pour the correct amount of hydraulic fluid up to about $\frac{1}{2}$ inch (13 mm) from the edge.
3 Press fit the plug 32 and pour the remaining fluid into the casing 14.
4 Insert the cylinder 15 into the casing 14 and tighten the upper threaded ring 3.

8:10 Fault diagnosis

(a) Wheel wobble

1 Worn hub bearings
2 Uneven tyre wear
3 Worn suspension linkage
4 Loose wheel fixings
5 Unbalanced wheels
6 Uneven tyre pressures
7 Defective damper

(b) 'Bottoming' of suspension

1 Check 7 in (a)
2 Rebound rubbers worn or missing
3 Weak or broken spring leaves

(c) Heavy steering, pulling to one side

1 Tyres under-inflated
2 Geometry incorrect
3 Bent control arms
4 Binding brake
5 Worn or unlubricated kingpin

(d) Excessive tyre wear

1 Check 3, 5, 6 and 7 in (a) and check (c)
2 One brake cylinder seized

(e) Rattles

1 Check 1, 3 and 4 in (a), 3 in (b) and 5 in (c)
2 Damper mountings worn or loose
3 Control arm mountings loose

NOTES

CHAPTER 9

THE STEERING GEAR

9:1 Description

The steering gear incorporates a 3-piece steering column with two universal joints, the lower joint being connected to a steering gearbox mounted on the scuttle as shown in **FIG 9:1**. Note that a lefthand drive vehicle is illustrated. The Pitman arm 3 on the steering gearbox is connected by tie rod 5 to the arm on the adjacent steering knuckle assembly and also by central link 4 to an idler arm 3. This idler arm spindle is carried in rubber bushes pressed into a bracket bolted to the scuttle. A second tie rod connects the idler arm to the steering knuckle arm on the adjacent road wheel assembly.

The steering ratio is 13 to 1. The link rod and tie rod ball joints are lubricated for life.

9:2 Routine maintenance

Every 6200 miles (10,000 km), check the steering gear for tightness of all fixings. Check the steering gearbox for loss of oil through defective seals (see **FIGS 9:6** and **9:7**). To check the oil level in the steering gearbox, remove the filler/level plug 14 (see **FIG 9:6**) and if topping up is required, use Fiat W 90/M (SAE 90 EP) oil, filling to the bottom edge of the hole. The ball joints are sealed and do not need regular maintenance, but check the rubber boots for damage every 3000 miles (5000 km).

9:3 Servicing the steering column

Removing steering wheel:

Disconnect battery earth terminal. Prise out horn push cover from wheel centre. Disconnect horn cable. Use Fiat tool A.57005 or a suitable box spanner to remove the steering wheel nut (see 7 in **FIG 9:2**). Tapping with the palms of the hands on the back of both spokes simultaneously will force the wheel hub off the shaft.

Removing the column:

Referring to **FIG 9:3**, remove the upper support shield at screws 1 and 2. Screw 2 is recessed and secures the turn signal switch to the support. **FIG 9:4** shows the column with the shield removed. Remove bolts and nuts 1. Remove nut and bolt 2 securing the upper steering shaft to the yoke of the top universal joint (see 9 and 13 in **FIG 9:2**). The column is then free for removal, after disconnecting the wiring connectors.

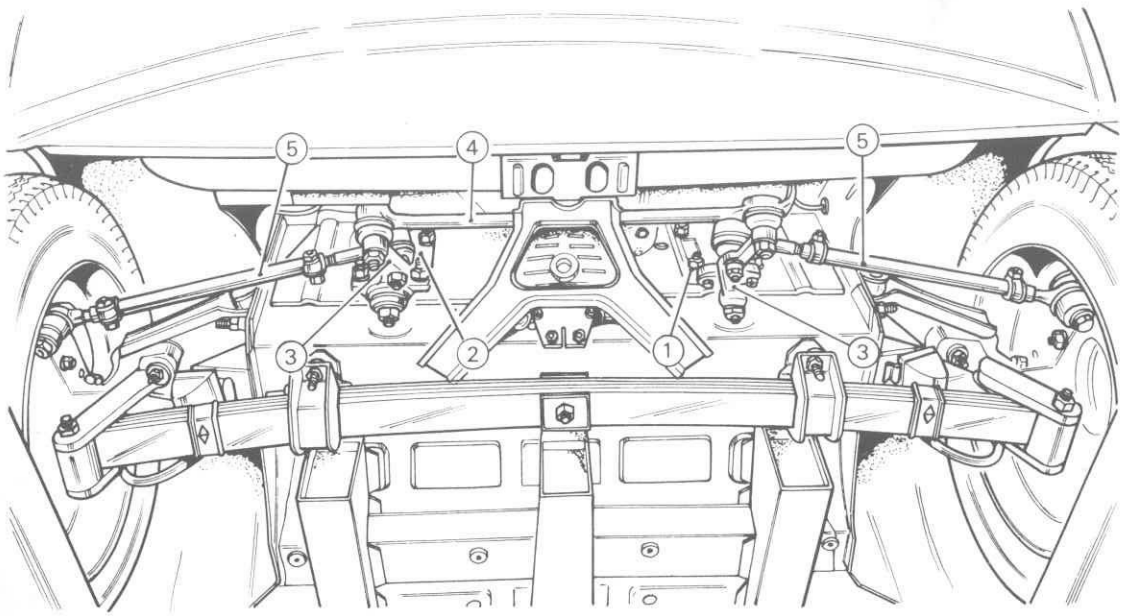

FIG 9:1 A view from below of the steering linkage. A lefthand drive vehicle is illustrated

Key to Fig 9:1 1 Steering gearbox 2 Support for idler arm 3 Idler arm (left), Pitman arm (right) 4 Centre link 5 Tie rods

Servicing the column:

Refer to **FIG 9:2**. Bushes 5 may need renewal. When new bushes are being pressed into place, make sure that the slits in the outer surfaces are not in line with the small tongues pressed inwards on support 3. These are intended as stops for the bushes.

Reassembling column:

Reverse the removal procedure. When refitting the upper shaft to the yoke, and the steering wheel to the top end, lubricate the serrations of the splines with graphited oil. Tighten the yoke nut to a torque of 18 lb ft (2.5 kgm).

Before fitting the steering wheel, set the front wheels in the straight-ahead position. Fit the wheel with the spokes level, refit the nut and then tighten it to a torque of 36 lb ft (5 kgm). Stake the nut after tightening.

9:4 Servicing the steering gearbox

Removal:

Working inside the vehicle, remove bolt 9 from the lower yoke (see 9 in **FIG 9:2**). It is not enough just to loosen the nut. Refer to **FIG 9:5** and remove nuts 1 from the ball joints. Press the ball pins out of the Pitman arm, using Fiat tool A.47044 or any suitable device. **Do not hammer on the ball pins in an attempt to drive them out.** Release the steering gearbox from the scuttle at lower nuts 4.

Dismantling:

Sections through the steering gearbox are shown in **FIGS 9:6** and **9:7**. Start by removing the Pitman arm from the sector shaft, using puller A.47033. Remove the top cover and drain out the oil. Remove the splitpin from adjusting ring 4 and unscrew the ring (see **FIG 9:7**). Remove bolts 6 and lift away the seal cover 8 and seal 9, gasket 4, plate 5 and seal 10 (see **FIG 9:6**).

Lift out the sector and shaft 12 and shim washer 3. Drive out worm and shaft 1 (see **FIG 9:7**). If seal 2 or the upper bearing outer race need renewal, prise out the seal and drift out the race squarely.

Clean the parts and check the bearings for roughness when turned in an unlubricated state. Look for signs of chipping, scoring or wear on the contact surfaces of the worm and the sector. Also make sure that the sector and worm have been mating correctly at the centre of the worm. If the sector is obviously too high or too low with respect to the worm, adjustment can be made by fitting a new shim washer to the sector shaft (see 3 in **FIG 9:6**). Check the fit of the shaft in the bush, renewing defective parts. The correct clearance is .0002 to .0018 inch (.005 to .047 mm). Wear limit is .004 inch (.10 mm). The bore of the bush is eccentric to the outside diameter so that turning the bush can be used to adjust the backlash between the worm and sector. The bush can be turned by moving plate 1 (see **FIG 9:8**).

Reassembling:

When satisfied with the condition of the parts, reassemble in the reverse order of dismantling. Fit seal 2 with the open side facing inwards (see **FIG 9:7**). After refitting the worm, without sector but with the seal, tighten ringnut 4 to 22 lb ft (3 kgm) and check the rolling

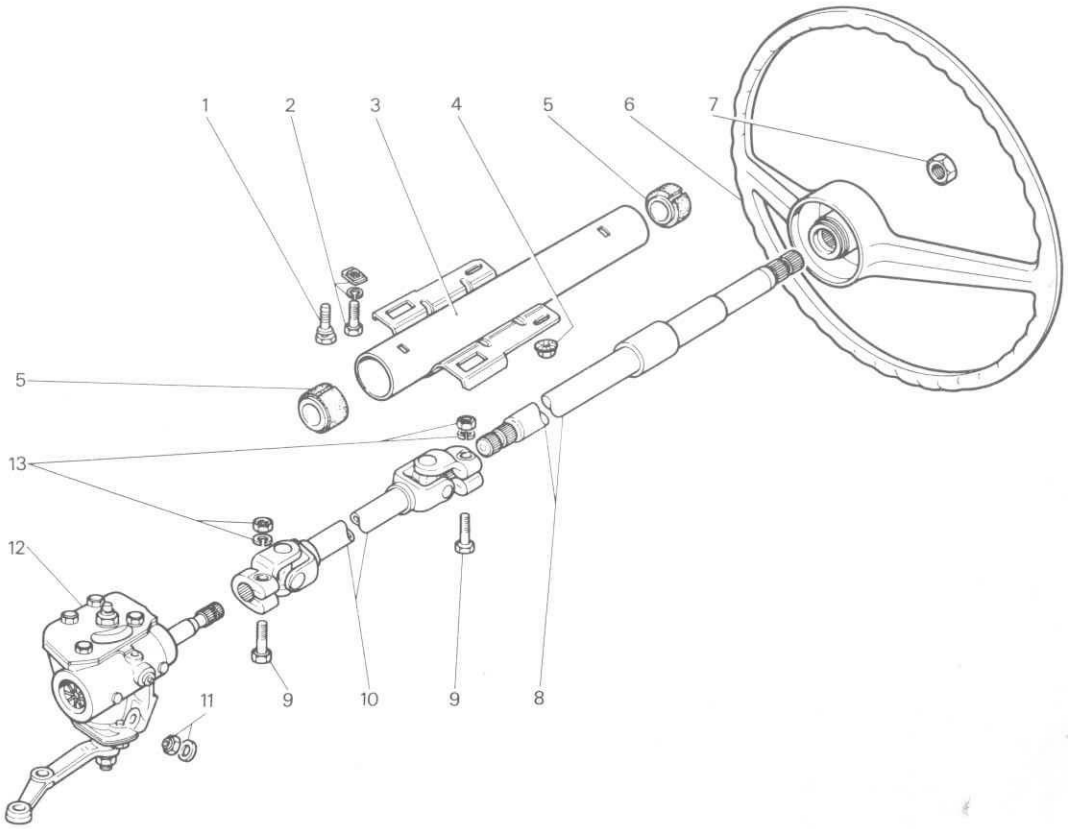

FIG 9:2 Components of steering column

Key to Fig 9:2 1 Anti-theft switch bolt 2 Bolt, lockwasher and lockplate 3 Upper shaft support 4 Nut 5 Rubber bushes 6 Steering wheel 7 Nut 8 Upper shaft 9 Bolt 10 Lower shaft 11 Nut and washer 12 Steering gearbox 13 Nuts and spring washers

torque. This is done by attaching dynamometer A.95697 to the shaft. The shaft should start to move under a torque of 1.7 lb inch (2 kgcm) and no more. If the ringnut needs tightening, turn the worm whilst doing so. Now check the rolling torque with the sector fitted. The correct figure should be 8.7 lb inch (10 kgcm). When satisfied, fit the splitpin to the ringnut. If the holes do not line up, back the ringnut off until the pin can be inserted.

Check for minimum backlash between the worm and sector at the central position. If adjustment is needed, refer to **FIG 9:8**. Turn the eccentric bush by means of plate 1 until the backlash is correct. Set the plate so that the fixing bolts can be inserted.

After the cover has been refitted, slacken nut 2 (see **FIG 9:6**). Take up any end play in the sector shaft by turning screw 1. Do not overtighten. Tighten the nut to lock the screw.

When refitting the Pitman arm, check that the lock on each side of the centre line shown in **FIG 9:7** is equal. Tighten the nut to 72 lb ft (10 kgm). Fill the box with the correct grade of oil (see **Section 9:2**). Check the level after installation.

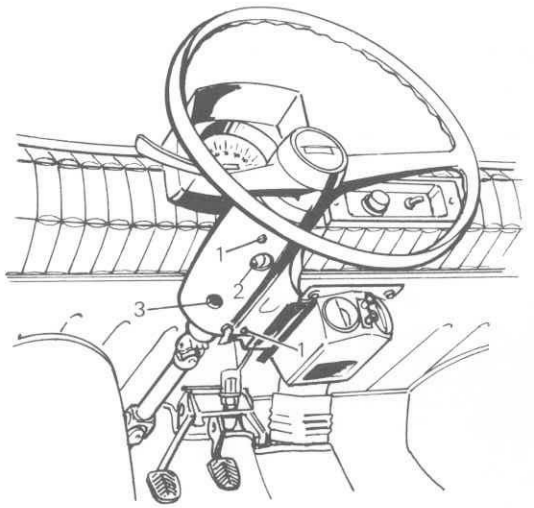

FIG 9:3 Removing the steering column support shield

Key to Fig 9:3 1 Screws for shield 2 Screw for turn signal switch 3 Shield

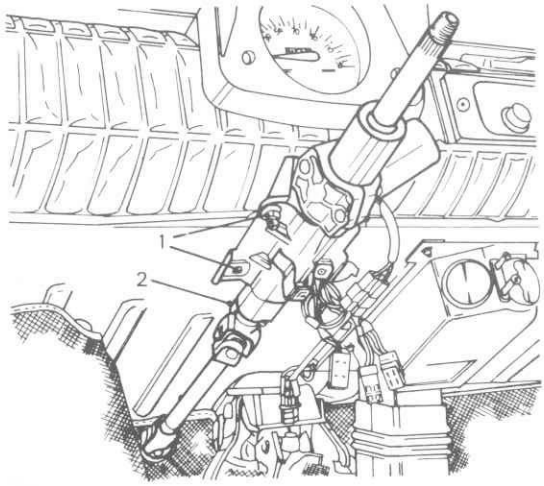

FIG 9:4 Removing the upper steering shaft support

Key to Fig 9:4 1 Bolts and nuts, support 2 Bolt and nut, universal joint to upper shaft

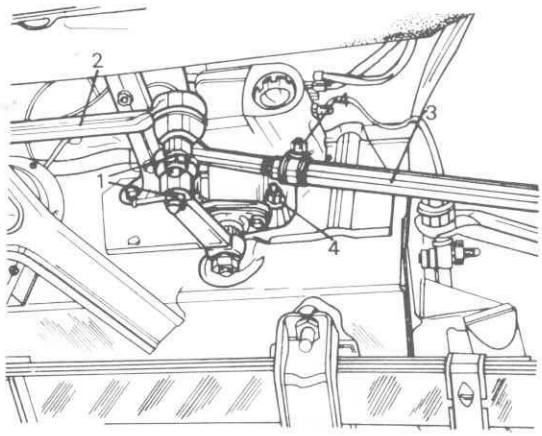

FIG 9:5 The steering gearbox and linkage from below

Key to Fig 9:5 1 Nuts, ball joint pins 2 Centre link 3 Lefthand tie rod 4 Nuts, tie rod clamp and steering gearbox

Refitting steering gearbox:

Reverse the removal procedure. Set the road wheels straight-ahead. Set the steering wheel with spokes level and refit the steering gearbox with the Pitman arm in the central position (see **FIG 9:7**). Tighten the nuts securing the box to 22 lb ft (3 kgm). Tighten the ball joint nuts to 25 lb ft (3.5 kgm). Tighten the yoke fixing nut to 18 lb ft (2.5 kgm).

Concerning adjustment:

In connection with the adjustment of the steering gearbox it is important to note the following. If there is a steering defect, do not try to correct it by making adjustments to the steering gearbox until it has been established that there is no defect such as faulty geometry in the steering linkage and suspension system.

9:5 Servicing the idler arm

FIG 9:1 shows how the idler arm support is bolted to the scuttle. To remove the assembly, release the link 4 and tie rod 5 at the ball joints secured to arm 3 (see the start of the preceding section). Undo the nuts securing the support to the scuttle.

If there is excessive play between the pin and the bushes, remove the nut and drive out the pin. Press in new bushes if the old ones are found to be defective. The rubber must not be softened by age, nor should it be torn. Check the condition of the pin and renew it if defective.

When reassembling, do not tighten the nut until after the fitting of the unit has taken place. Then set the road wheels straight-ahead and tighten the nut to 50.5 lb ft (7 kgm). Tighten the nuts securing support flange to the scuttle to 22 lb ft (3 kgm).

9:6 Tie rods and ball joints

These can be seen as part 5 in **FIG 9:1**. Note that the shanks of the ball joints are screwed into the tie rod ends and secured by clamps. It is therefore a simple matter to renew defective ball joints, and adjustment to the steering

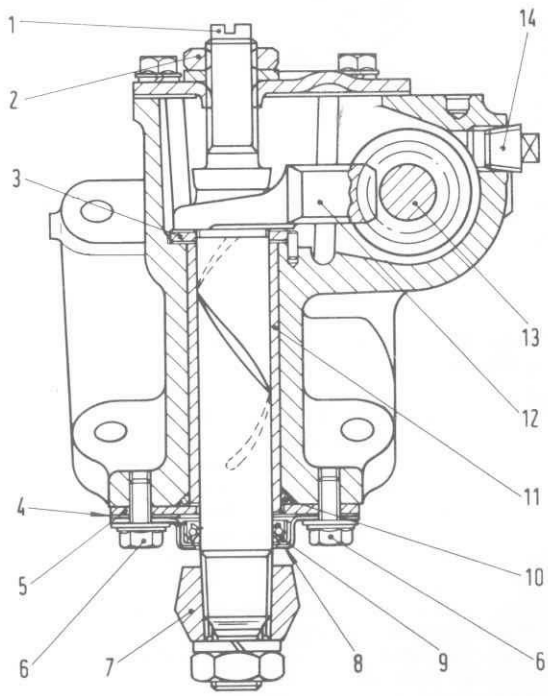

FIG 9:6 Section through steering gearbox showing sector and shaft

Key to Fig 9:6 1 Sector adjusting screw 2 Locknut 3 Shim washer 4 Gasket 5 Adjustment plate for eccentric bush 6 Bolts 7 Pitman arm 8 Cover for seal 9 Seal 10 Upper seal 11 Eccentric bush 12 Sector 13 Worm 14 Oil filler and level plug

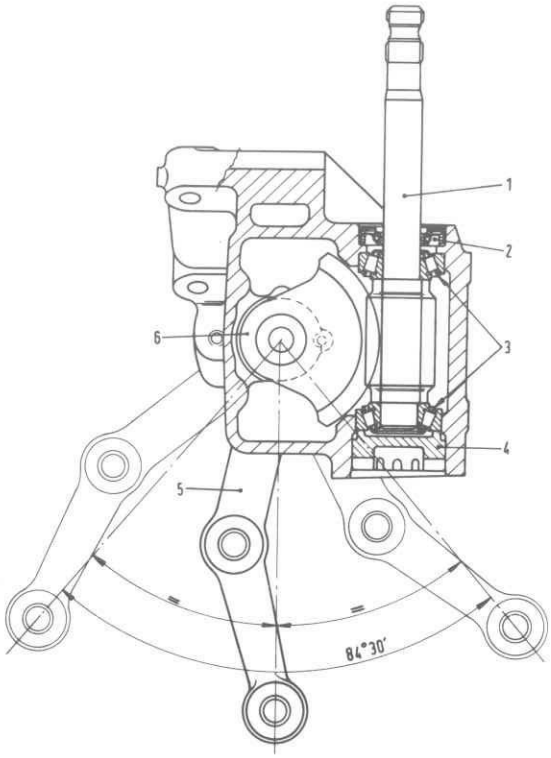

FIG 9:7 Section through steering gear showing worm

Key to Fig 9:7 1 Worm and shaft 2 Seal 3 Taper roller bearings 4 Adjusting ringnut 5 Pitman arm 6 Sector Total lock of Pitman arm 84 deg. 30 min.

angle or toe-in is readily made by slackening the clamps and turning the rods.

Check the ball joints by jacking-up the front end and by pushing the wheels apart and then drawing them together again at the front. Backlash will be apparent. Worn ball joints will also have a bad effect on steering. There is no provision for extra lubrication of the joints.

Joints may be renewed by removing them as described at the beginning of **Section 9:4**. Slacken the adjacent tie rod clamp and count the number of turns required to unscrew the shank. Screw in the new joint by the same number of turns to avoid upsetting the amount of toe-in. Tighten the ball pin nuts to 25 lb ft (3.5 kgm). Do not forget to tighten the tie rod clamp after setting the ball joints in the same plane.

It is recommended that ball joints are renewed if the dust covers or rubber boots are found to be torn. If the joint is unworn and no dirt is present, it is possible to fit a new boot after wiping the joint clean and free from old grease. Fill the new boot with Fiat MR 3 grease (lithium-base No. 3) before fitting it.

9:7 Setting front wheel toe-in

The checking must be made with the tyres correctly inflated and loaded with four passengers. The first operation is to bounce the front end of the vehicle up and

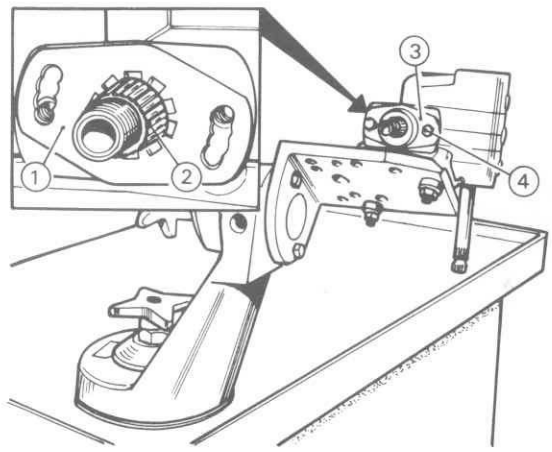

FIG 9:8 Turning the eccentric bush to adjust the backlash between worm and sector

Key to Fig 9:8 1 Adjustment plate 2 Sector shaft 3 Cover and seal 4 Bolt, adjustment plate

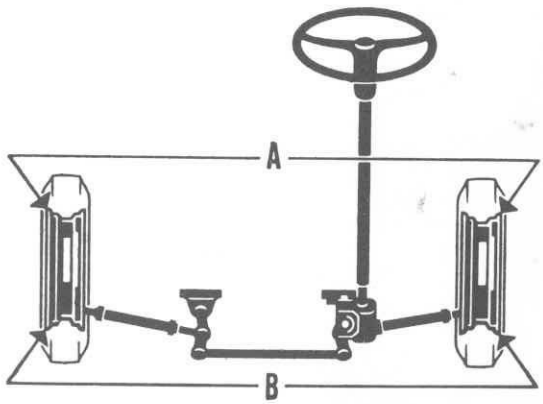

FIG 9:9 Measurements to be taken when checking wheel tracking for toe-in, where the difference between A and B gives the required figure

down to settle the suspension. Roll the vehicle forward a few feet. Set the wheels straight-ahead.

Reference to **FIG 9:9** will show that it is desired to measure distances A and B. It may be found easier to make up a simple beam and measuring points to check on the inside of the rims instead of the outside. First check dimensions A and B at wheel centre height and mark the points with chalk. Roll the car until the chalk marks have made half a turn and re-measure. Take an average of the two measurements to eliminate error through bent rims.

Distance B at the front may be less than distance A by .04 inch (1.0 mm) or it may be more by .12 inch (3 mm).

To adjust, slacken the four tie rod clamps (see 5 in **FIG 9:1**). Turn the rods equally in the same direction until the tracking is correct. When tightening the clamps after setting, make sure that the gap between the clamp lugs coincides with the slot in the rod. When the clamp is fully tightened there should still be a gap at this point.

9:8 Fault daignosis

(a) Wheel wobble or shimmy

1 Wrong tyre pressures
2 Unbalanced wheels
3 Slack ball joints
4 Worn hub bearings and steering linkage
5 Loose column connections or mountings
6 Backlash in steering gearbox

(b) Heavy steering

1 Check 1 and 4 in (a)
2 Very low tyre pressures
3 Neglected lubrication
4 Front wheels incorrectly aligned
5 Column bent, bushes tight

(c) Wander

1 Check (a) and 4 in (b)
2 Faulty suspension or geometry

(d) Pulling to one side

1 Check 1 and 4 in (a) and 4 in (b)
2 Unequal braking
3 Bent suspension due to accident damage

(e) Excessive lost motion

1 Check 3, 4, 5 and 6 in (a)
2 Loose steering wheel, worn splines

CHAPTER 10

THE BRAKING SYSTEM

10:1 Description

There is a dual circuit hydraulic braking system, the master cylinder and reservoir providing for separate operation of the front brakes and the rear brakes (see **FIG 10:1**). This ensures that failure in one circuit does not make the other circuit inoperative and a good measure of braking is still available. The handbrake operates the rear brakes mechanically through cables. There is no provision for regular adjustment of the brake shoe clearance. Automatic devices are fitted that take up normal wear on the brake linings (see **FIG 10:2**).

10:2 Routine maintenance

Every 300 miles (500 km) check the fluid levels in the master cylinder reservoir (see 2 in **FIG 10:1**). Top up to the indicating mark with Fiat blue label fluid DOT 3 or an equivalent universal brake fluid. Clean all round the cap before unscrewing it.

Every 6200 miles (10,000 km) check the thickness of the brake linings. If the thickness is down to .06 inch (1.5 mm) the shoes must be renewed. At the same mileage, check and adjust the handbrake linkage.

10:3 Renewing brake shoes and linings

The illustration shows a front brake (see **FIG 10:2**), but the procedure is the same for rear brakes. Relined shoes are available as replacement spares.

Removing shoes:

FIG 10:2 shows a front brake with the drum removed. To remove the drum, refer to **Chapter 8, Section 8:5**. Note that when the spindle nut has been removed, a new one must be refitted.

When the shoes are removed, there is nothing to prevent the wheel cylinder pistons from coming out of the wheel cylinder (see **FIG 10:6**). Before removing the shoes it is therefore necessary to fit tool A.72235 over the pistons or retain them with a strong rubber band or wire. Make sure that the brake pedal is not depressed while the shoes are off. The tool is shown in **FIG 10:3**.

Pull on one end to unhook the shoe retracting springs 5. Lift the shoes off the backplate pins for the self-adjusting gear.

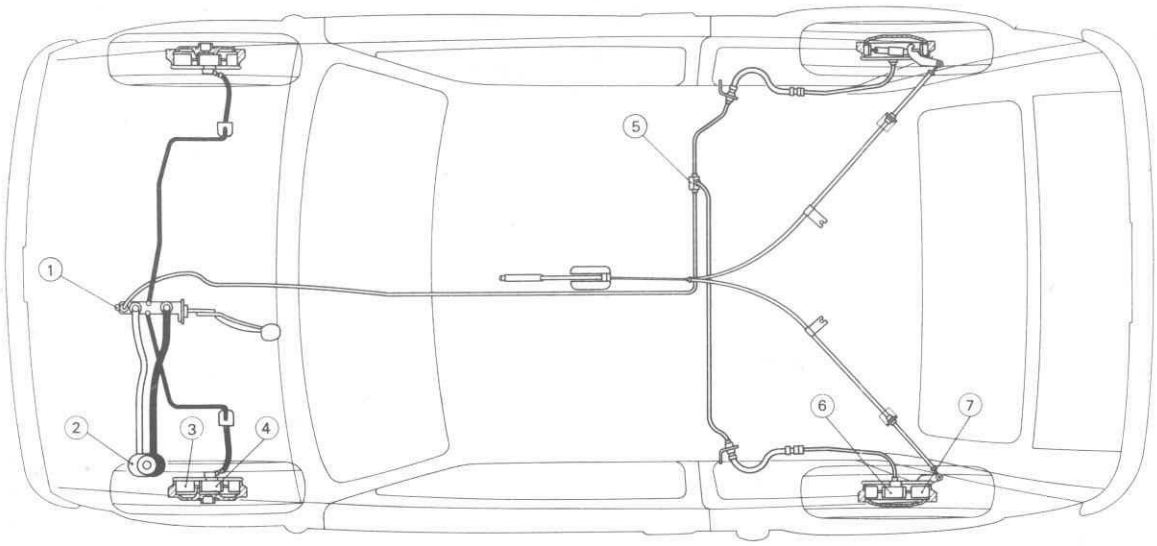

FIG 10:1 Layout of the brake pipes showing the dual system

Key to Fig 10:1 1 Master cylinder 2 Brake fluid reservoir 3 Front brake shoe 4 Front wheel cylinder 5 Three-way connector 6 Rear wheel cylinder 7 Rear brake shoe

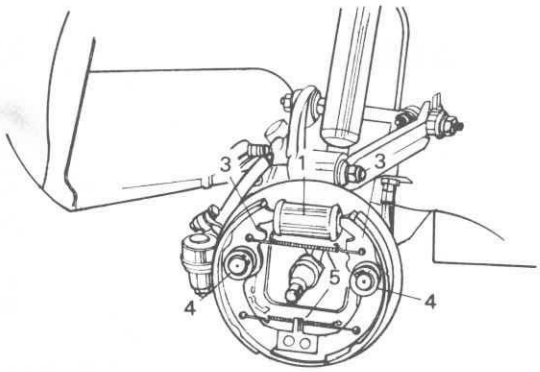

FIG 10:2 Front brake details with drum removed

Key to Fig 10:2 1 Wheel cylinder 3 Brake shoes with linings 4 Self-adjusting devices 5 Shoe retracting springs

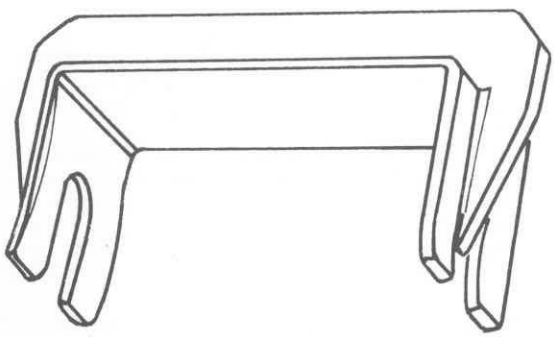

FIG 10:3 Tool A.72235 for retaining the wheel cylinder pistons when the shoes are removed

The self-adjusters:

The components are shown in **FIG 10:4**. To dismantle, compress the spring with tool A.72246, or it may be possible to use a valve spring compressor. Remove circlip 1 and release the spring tension.

Check the parts for wear and renew any that are defective. Check the spring by loading it with a weight of 101 ± 9.3 lb (46 ± 4.2 kg), when the height of the spring should be .37 inch (9.5 mm). Renew a weak spring.

The device works by friction between the washers 4 and the web of each shoe. A section can be seen on the left in **FIG 10:5** which shows that bush 6 in **FIG 10:4** is a loose fit over a stud riveted to the brake backplate. The clearance allows the shoe to operate. When wear makes the clearance excessive, braking pressure forces the shoe into contact with the drum and the friction device slides on the web of the shoe. The friction is high enough to prevent the retracting springs from pulling the shoes farther from the drum than the correct working clearance between hollow bush and stud.

The self-adjusting device is reassembled in the reverse order of dismantling. Make sure the circlip is firmly seated.

Lining wear:

If the linings are worn to a thickness of .06 inch (1.5 mm) the shoes must be renewed. If the linings are contaminated with oil or brake fluid it is not possible to restore them to full braking efficiency by using solvents. Do not renew one brake alone, but always fit in sets, front or rear, otherwise uneven braking will result.

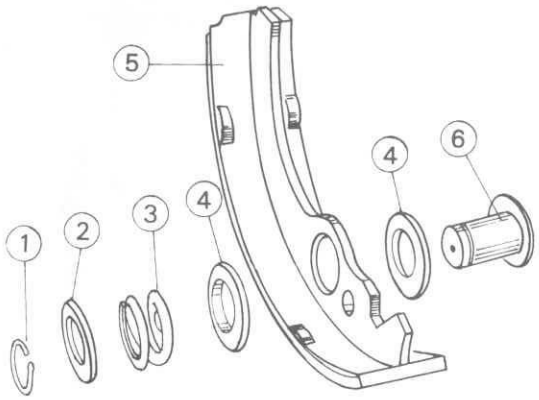

FIG 10:4 A brake shoe with the parts of the self-adjusting device

Key to Fig 10:4 1 Circlip 2 Flat washer 3 Spring 4 Friction washers 5 Shoe and lining 6 Bush

Reassembling:

Before reassembling, check brake drum condition as described in **Section 10:6**. Fit the shoes and retracting springs, pulling on one end of each spring with a pair of pliers. Tap each shoe inward against the action of the self-adjusting devices until the brake drum can be refitted. Follow the instructions in **Chapter 8, Section 8:5** when tightening the spindle nut.

10:4 Servicing wheel cylinders

Removal:

Remove the drum and brake shoes as described in the preceding section. Plug the outlet at the brake fluid reservoir to prevent fluid loss in the particular circuit involved. Release the brake hose from the bracket on the body adjacent to the brake (see **Section 10:8**). Unscrew the hose at the backplate end. Do not try to unscrew the hose by twisting it. Release the wheel cylinder from the backplate.

Dismantling:

Refer to **FIG 10:6**. Release the flanges of the rubber boots from the cylinder grooves and pull out the pistons. Shake out the internal parts. Clean everything in brake fluid. **Do not use petrol or solvents that may soften rubber parts.** Check the cylinder bore. It must be smooth and bright, with no sign of wear, scoring or pitting. Always renew seals 4 at every overhaul. Renew worn pistons or defective rubber boots.

Reassembling:

Make sure that all parts are perfectly clean. Dip the internal components in brake fluid and reassemble in the reverse order of dismantling. When inserting the seals take care not to trap or turn back the lips. Refit the assembled cylinder to the backplate and reconnect the hose. Refit the shoes and drum. Remove the plug at the master cylinder end. Bleed the brake circuit involved, as described in **Section 10:7**.

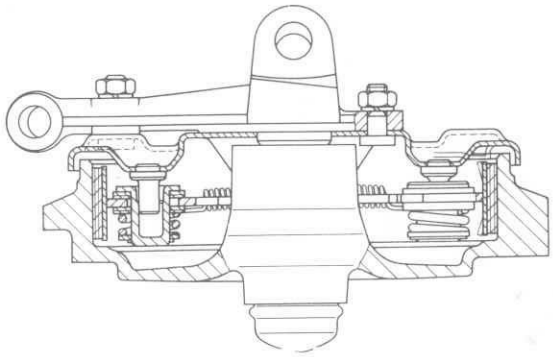

FIG 10:5 A section through a front brake. The self-adjusting device is shown in section on the left

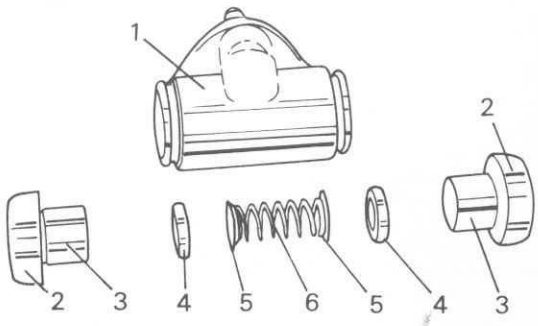

FIG 10:6 Components of a wheel cylinder

Key to Fig 10:6 1 Cylinder 2 Rubber boots 3 Pistons 4 Seals 5 Thrust washers for spring 6 Spring

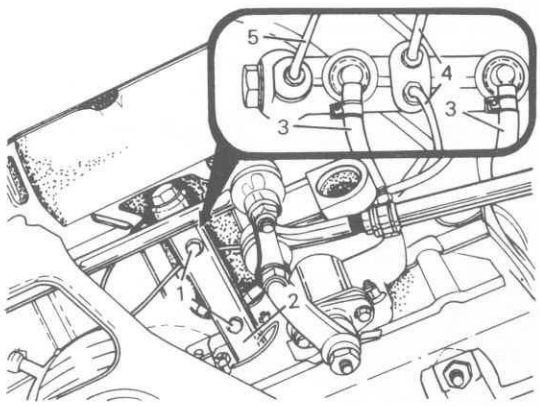

FIG 10:7 Installation view of master cylinder. The inset is a plan view

Key to Fig 10:7 1 Stop bolts 2 Master cylinder 3 Fluid pipes from reservoir 4 Pipes to front brakes 5 Pipe to rear brakes

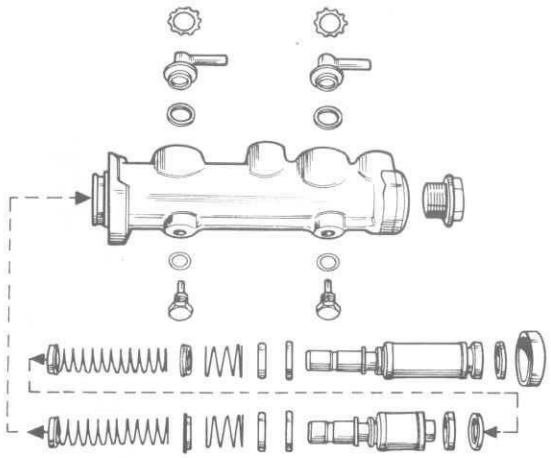

FIG 10:8 Master cylinder parts exploded. These may be identified in FIG 10:9

10:5 Servicing the master cylinder

The brake master cylinder is shown installed in **FIG 10:7**, in pieces in **FIG 10:8** and in section in **FIG 10:9**. Turning to the sectioned view in **FIG 10:9** it can be seen that pressure on the brake pedal and pushrod will force ring holder 14 down the cylinder bore. This movement forces fluid out of connector 4 and so to the front brake circuit. This pressure also pushes the secondary piston down the bore to force fluid out of connector 2 into the rear brake circuit. Lost fluid is replenished by connections to the reservoir through holes 3 and 5. Sealing rings are provided to prevent leakage past the pistons.

If one brake circuit fails, for example the front brakes, then the primary piston is pushed right down the bore until it touches the secondary piston and the rear brake circuit then becomes operative.

Removal:

Refer to **FIG 10:7**. Disconnect and plug the fluid lines 3. Disconnect brake pipes 4 and 5. Release the flange of master cylinder 2 (two nuts).

Dismantling:

Clean the outside of the cylinder and remove the rubber boot from the open end. Remove stop bolts 9. Remove plug 1. Push out the internal parts as shown in **FIG 10:8**.

Clean all the parts in brake fluid. **Do not use a solvent such as petrol or the rubber components may be softened.** Check that the bore of the cylinder is smooth and bright. Reject it if worn, scored or pitted. Note that the cylinder and pistons are not available as spare parts. If these are defective the whole assembly must be renewed.

Check that the springs are in good condition and renew all seals or rings.

Reassembling:

Dip all internal parts in brake fluid. Keep all parts perfectly clean and take care not to damage the sealing rings as they are inserted. Line up the slots in the pistons so that the stop bolts may be fitted. Fit new sealing washers to the bolts. **Aways fit new sealing rings at each overhaul.**

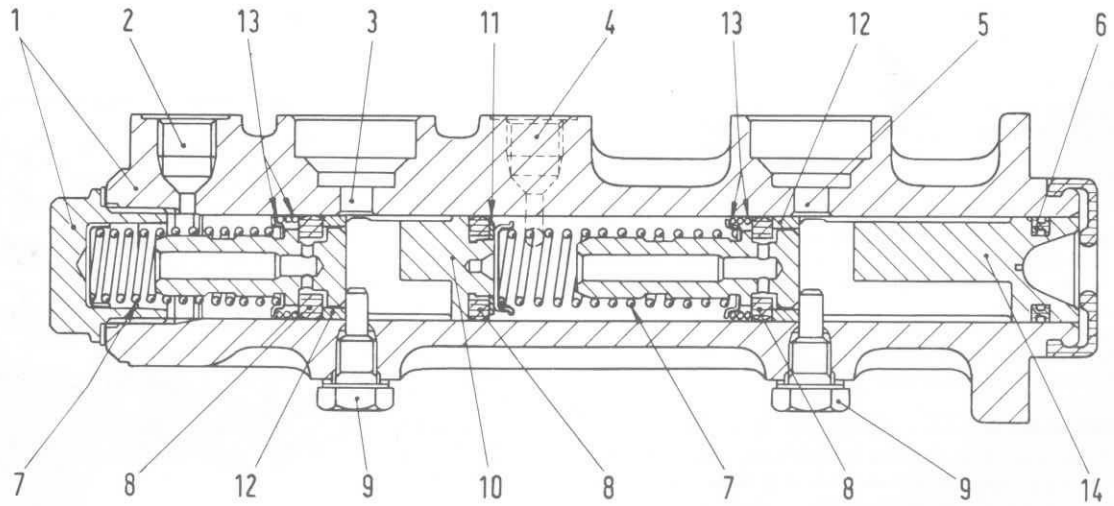

FIG 10:9 Section through master cylinder

Key to Fig 10:9 1 Cylinder and end plug 2 Connection to rear brakes 3 Connection to rear brake reservoir 4 Connection to front brakes 5 Connection to front brake reservoir 6 Seal 7 Spring 8 Floating rings 9 Stop bolts 10 Front floating ring holder or secondary piston 11 Flat washer 12 Spacers 13 Spring and cup 14 Rear floating ring holder or primary piston

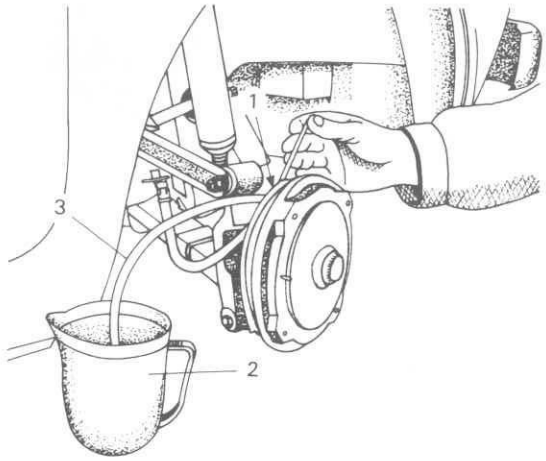

FIG 10:10 Bleeding a brake showing location of bleed screw at 1, a container at 2 and a rubber or plastic tube 3

Refitting:

When refitting the master cylinder assembly, make sure the brake pedal pushrod enters correctly. Tighten the flange nuts to 11 lb ft (1.5 kgm). Reconnect the pipe lines and bleed the system as described in **Section 10:7**.

10:6 Servicing brake drums

After a drum is removed as described in **Chapter 8, Section 8:5**, clean it thoroughly and check the braking surface for cracks, pitting or excessive wear. Use measuring equipment to check for ovality. Standard inside diameter should be 6.697 to 6.708 inch (170.1 to 170.4 mm). If there is enough metal, the drum may be skimmed in a lathe, the maximum oversize on diameter being .04 inch (1 mm). Accurate turning is essential to avoid upsetting the balance and true running of the drum.

10:7 Bleeding the brake system

If the fluid level in the reservoir has dropped so low that air has entered the system or if any part has been dis-

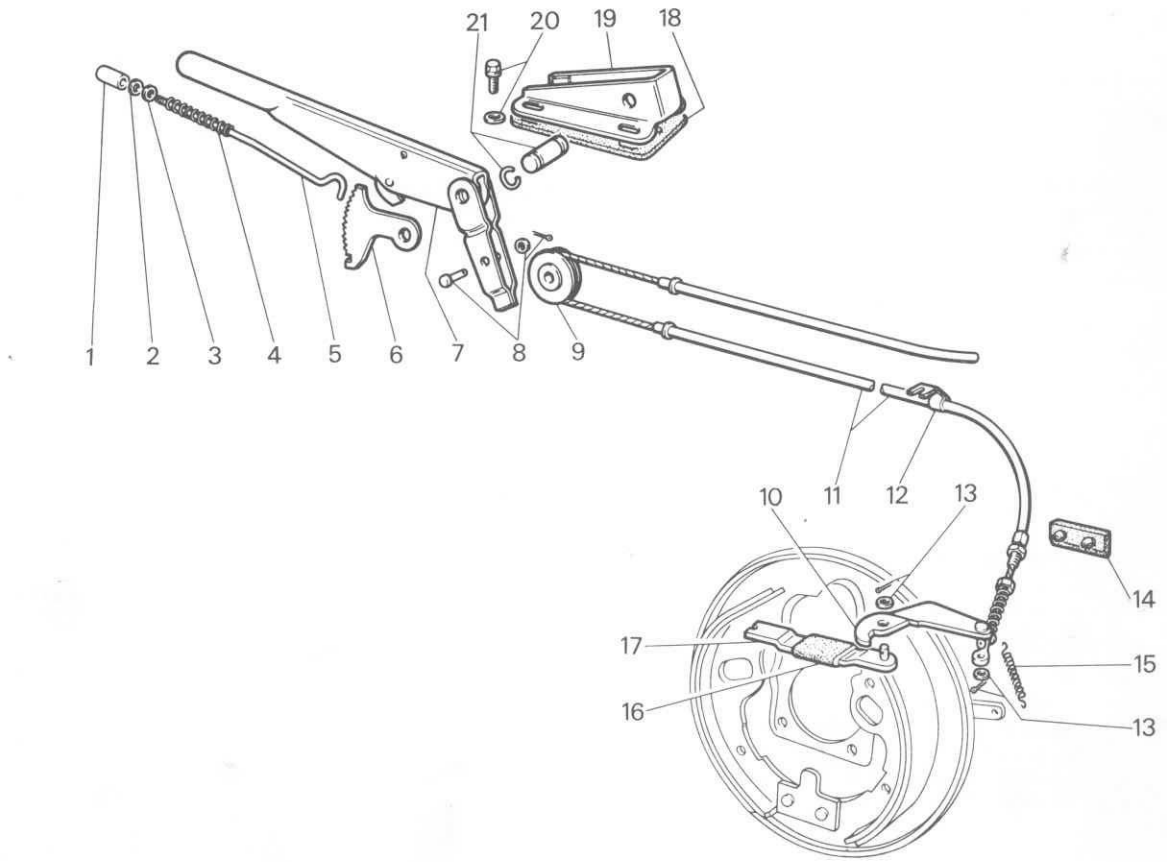

FIG 10:11 The handbrake system showing a rear brake on the right

Key to Fig 10:11 1 Release button 2 Grommet 3 Flat washer 4 Spring 5 Rod 6 Ratchet 7 Lever 8 Pin, washer and splitpin 9 Pulley 10 Lever at brake 11 Cable and casing 12 Clip 13 Flat washer and splitpin 14 Rubber pad 15 Spring 16 Rubber for strut 17 Strut 18 Gasket 19 Lever bracket 20 Bolt and flat washer 21 Lever pivot pin and circlip

connected and fluid lost, it is necessary to bleed the system. Air being compressible, there is a 'spongy' feeling to the brake pedal and this air must be removed by bleeding.

Two people are needed for this operation. First, top up the reservoir and make sure that it is kept full while carrying out the operation. If the level falls very low, air may enter the system and bleeding must be started all over again. Do not replenish with fluid that has been bled from the system.

Start at the brake farthest from the master cylinder. Clean the bleed screw to be found behind the brake backplate near the pipe line and attach a length of rubber or plastic tubing to it (see **FIG 10:10**). Immerse the open end in a small quantity of clean brake fluid in a glass container. Loosen the bleed screw by a turn or two and get the second operator to pump the brake pedal slowly down and up. At first, air bubbles will be seen to emerge from the submerged tube. When the bubbles cease, keep the brake pedal depressed and tighten the bleed screw.

Do all the brakes, finishing with the one nearest to the master cylinder. Top up the reservoir. Apply the brakes firmly to check that all the air has been expelled. If any parts of the brake system have been disconnected, apply the brakes and check all pipe connections for leaks.

10:8 Removing a flexible hose

Never try to release a flexible hose by turning the ends with a spanner. The correct procedure is as follows:

Unscrew the metal pipeline union nut from its connection with the hose. Hold the adjacent hexagon on the hose with a spanner and remove the locknut which secures the hose to the brackets. The hose can now be turned without twisting the flexible part, by using a spanner on the hexagon at the other end.

10:9 The handbrake

The layout of the system and one brake is shown in **FIG 10:11**. Note the continuous cable passing round pulley 9 and leading to levers on the rear brake backplates. Each lever engages with a strut 17 so that the lever presses the rear shoe outwards and the strut presses on the front shoe.

Adjustment:

If travel of the handbrake has become excessive, adjust as follows: Pull the lever on by three notches of the ratchet 6. Locate the cables attached to the levers on the rear brakes. Just inboard of the brakes will be found brackets welded to the suspension arm and carrying adjusters through which the cables pass. Undo the locknuts. Chock the front wheels. Jack-up the rear wheels and try to turn them by hand, pulling on the tyres to do so. If necessary, turn the adjusters out of the brackets until the wheels are locked. Tighten the locknuts.

Pull the handbrake lever hard on several times. Upon release, the rear wheels should turn freely. The handbrake should be fully applied at the fourth or fifth notch on the ratchet.

If there is any problem such as one brake staying on or not operating on the handbrake, disconnect at the rear brake levers and check that the cables move freely in their casings. The cable can be readily detached by releasing from the clips and adjustment points and by removing pin 8. Clean the cable free from dirt and rust then grease it well, pulling it to and fro through the casing. Lubricate all parts of the handbrake lever and check for freedom of action before reassembling. The only other cause of failure of a brake to work will be seizure of the pistons in the wheel cylinder.

10:10 Fault diagnosis

(a) 'Spongy' pedal

1 Leak in the system
2 Worn master cylinder
3 Leaking wheel cylinders
4 Air in the system
5 Gaps between shoes and underside of linings

(b) Excessive pedal movement

1 Check 1 and 4 in (a)
2 Excessive lining wear
3 Very low fluid level in supply reservoir
4 Too much free movement of pedal

(c) Brakes grab or pull to one side

1 Brake backplate loose
2 Scored, cracked or distorted drum
3 High spots on drum
4 Unbalanced shoe adjustment
5 Wet or oily linings
6 Worn or loose spring fixings
7 Front suspension or rear suspension anchorages loose
8 Worn steering connections
9 Mixed linings of different grades
10 Uneven tyre pressure
11 Broken shoe return springs
12 Seized handbrake cable

CHAPTER 11

THE ELECTRICAL EQUIPMENT

11 : 1 Description

The 12-volt electrical system has the negative terminal of the battery earthed. A belt-driven generator supplies the charging current, regulation of the output being obtained by three units mounted in a regulator box. One unit is the cut-out, the second is a current regulator and the third is a voltage regulator. These units are adjustable providing accurate moving-coil meters are available. It is useless to make adjustments with unreliable moving-iron instruments.

There is a wiring diagram in **Technical Data** at the end of this manual to enable those with electrical experience to trace and correct wiring faults. Servicing instructions are given in this chapter, but note that it is not reasonable to try to repair equipment that is seriously defective, both mechanically and electrically. It is better to replace such equipment with new units obtained on an exchange basis.

11 : 2 Routine maintenance

Every 1500 miles (2500 km) check the level of the battery electrolyte (see **Section 11 : 3**). Every 6200 miles (10,000 km) check the tension of the generator driving belt. Adjustment of the tension is covered in **Chapter 4, Section 4 : 2**. At the same mileage, clean the battery terminal posts and coat with Vaseline (petroleum jelly). Also check headlight aiming.

Every 18,500 miles (30,000 km) lubricate the generator bearings with Fiat MR 3 grease or a lithium-base grease No. 3. At the same mileage, lubricate the starter motor bearings with engine oil. Also renew the generator driving belt, clean the generator and starter motor commutators and renew the brushes (see **Sections 11 : 4 and 11 : 5**).

11 : 3 The battery

This is mounted adjacent to the spare wheel as shown in **FIG 4 : 1**. Note that the negative terminal is earthed. Always disconnect the negative lead before disconnecting or connecting the positive lead.

Keep the top of the battery and surrounding parts dry and clean, as dampness can cause leakage. Clean off any corrosion from the metal parts of the battery mounting with diluted ammonia and paint them with an anti-sulphuric paint. If the terminal posts are corroded, remove the cables and clean with diluted ammonia. Smear the posts with petroleum jelly before remaking the connections and fit the terminals securely. High electrical resistance due to corrosion at the terminal posts is often

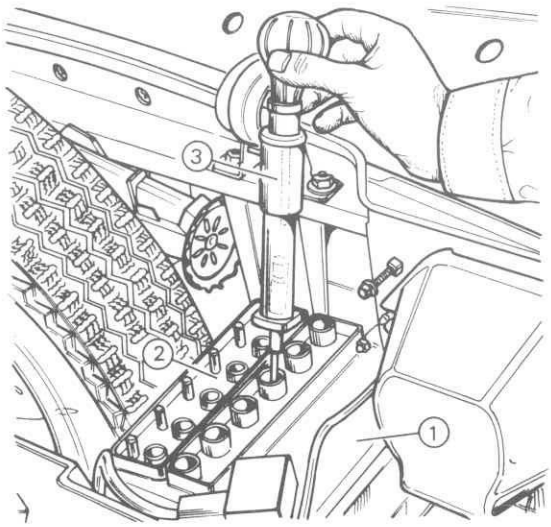

FIG 11:1 Checking battery 1 for specific gravity of electrolyte using hydrometer 3. The battery cover is item 2

responsible for lack of sufficient current to operate the starter motor.

Test the condition of the cells after topping up the electrolyte level with distilled water to just above the tops of the separators as shown in **FIG 11:1. Never add neat acid. If it is necessary to make new electrolyte due to loss by spillage add sulphuric acid to the distilled water. It is highly dangerous to add water to acid.**

Check the specific gravity of the electrolyte with a hydrometer as shown in **FIG 11:1**. At a temperature of 60°F (15°C) the specific gravity will indicate the state of charge of the battery as follows:

Fully charged .. Specific gravity 1.28
Half charged .. Specific gravity 1.22
Fully discharged .. Specific gravity 1.11

All six cells should read approximately the same. If one differs radically from the rest it may be due to an internal fault or to spillage or leakage of the electrolyte.

If the battery is in a low state of charge take the car for a long daylight run or connect it to an external battery charger set at an output of 4 amps until it gases freely. When putting the battery on a charger, remove the vent plugs and ensure that no naked lights are in the vicinity. If the battery is to stand unused for long periods give a freshening up charge every month. It will deteriorate rapidly if it is left in a discharged state.

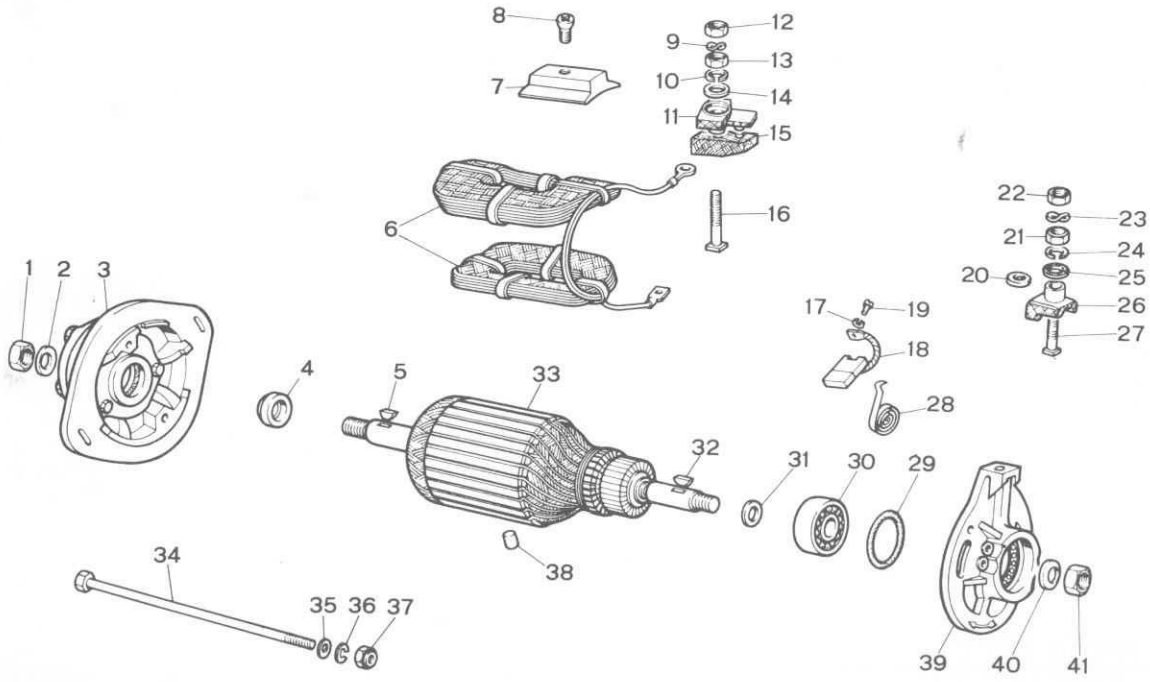

FIG 11:2 Components of generator. Field coils 6 are normally secured to the yoke or body which is not shown

Key to Fig 11:2 1 Nut for fan 2 Lockwasher 3 Frame at fan end 4 Ring 5 Woodruff key 6 Field coils 7 Pole piece 8 Screw 9 Spring washer 10 Lockwasher 11 Insulator 12 Nut 13 Nut 14 Flat washer 15 Insulator 16 Terminal 67 17 Lockwasher 18 Brush 19 Screw 20 Flat washer 21 Nut 22 Nut 23 Spring washer 24 Lockwasher 25 Insulator 26 Insulator 27 Terminal 51 28 Brush spring 29 Rubber seal 30 Bearing 31 Flat washer 32 Woodruff key 33 Armature 34 Through-bolt 35 Flat washer 36 Lockwasher 37 Nut 38 Dowel 39 Frame, commutator end 40 Flat washer 41 Nut for pulley

11 : 4 Servicing the generator

Tests on a generator that is not charging:

1 Check that the trouble is not due to belt slip. The tension of the belt must be checked and adjusted as described in **Chapter 4, Section 4 : 2.**

2 Check the generator connections. Generator terminal 51 must be connected to the generator regulator terminal 51 and the generator terminal 67 to the regulator terminal 67. Switch off all lights and accessories and disconnect the cables from the generator terminals 67 and 51. Connect the two terminals with a short length of wire. Run the engine at normal idling speed and clip the negative lead of a 0–20 volt moving coil meter to one generator terminal and the other lead to a good earth on the generator body. Gradually increase the engine speed up to about 1000 rev/min. The voltmeter reading should rise steadily and without signs of fluctuation, but do not let it reach 20 volts and do not race the engine in an attempt to increase the reading.

3 If there is no reading check the brush gear. If the reading is about $\frac{1}{2}$–1 volt the field winding may be faulty. If approximately 4–5 volts the armature may be faulty.

4 If the generator is in good order leave the temporary link in position between the terminals and restore the original connections correctly. Remove the terminal 51 from the regulator and connect the voltmeter between this lead and a good earth on the car. Run the engine as before. The reading should be the same as that measured directly on the generator. No reading indicates a break in the cable from the generator to regulator. Repeat the test on terminal 67. Finally, remove the temporary link from the generator. If the readings are correct, test the regulator as described in **Section 11 : 6.**

Removing generator:

1 Disconnect the leads from the generator.

2 Remove the drive belt as described in **Chapter 4, Section 4 : 2.**

3 Release the mounting bracket at the side of the power unit.

4 Remove the air cooling ducting from around the fan and generator area and lift away the unit.

5 Release the blower from the end of the armature shaft and finally, the mounting bolts from the air ducting.

Dismantling generator:

1 Release the pulley self-locking nut and slide the pulley off the armature shaft.

2 Remove the two Woodruff keys 5 and 32 from armature shaft (see **FIG 11 : 2**).

3 Unscrew the two through-bolt nuts and pull out the bolts 34.

4 Partially remove the commutator end frame 39 to the point where the brushes are still seating on the commutator. Using a piece of hooked wire relieve the load of the springs on the brushes by arranging the spring ends on the brush sides. The brushes will be locked in their holders and cannot be chipped by striking against the armature shaft during the commutator end frame removal.

5 Gently ease the commutator and fan end frames apart and slide out the armature 33.

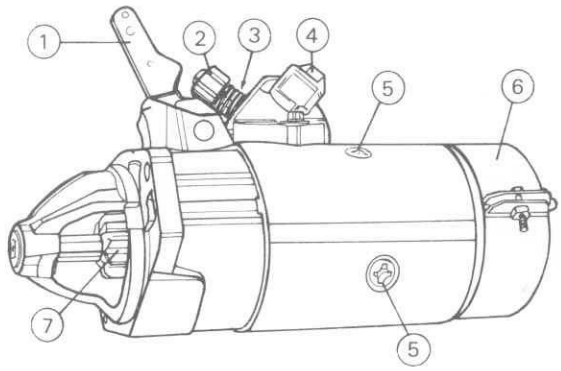

FIG 11 : 3 The starter motor showing external features

Key to Fig 11 : 3 1 Shifter lever 2 Moveable contact 3 Spring 4 Cable connection 5 Screw securing pole piece 6 Dust cover 7 Pinion

Servicing brushes:

Lift the brushes up in the boxes and hold them in that position by letting each brush spring bear on the side of its brush. Fit the commutator end bracket over the commutator end of the armature shaft and release the brushes by hooking up the springs using a thin screwdriver. Hold back each spring in turn and move the brush by pulling gently on the flexible connector. If the brush moves sluggishly remove it and polish the sides using a smooth file. Before this operation is actually carried out it is suggested that the brush is marked before removal so that it is replaced in its original working position.

The minimum permissible length of a brush is $\frac{9}{32}$ inch (7 mm), so renew any that are less than this figure. Test the brush springs using a spring tension scale. New springs should have a tension of 1.3 to 1.6 lb. In service this value could fall slightly before performance is affected. Always bed in new brushes by wrapping fine sandpaper round the commutator, pressing down on the brush and rotating the commutator under it, or draw the paper to and fro. If new brushes are fitted always fit genuine Fiat replacements.

Servicing the commutator:

A commutator in good condition should be smooth and free from pitting or signs of the segments burning. Clean with a rag moistened in petrol. If necessary, polish using fine glasspaper whilst rotating the armature. **Never use emerycloth.**

If the commutator is badly worn it may be skimmed using a centre lathe. Use a high speed and take a light cut using a sharp tool. Remove only enough metal to clean up the commutator face and then polish with fine glasspaper. To undercut the insulation between the segments, it is suggested that a hacksaw blade is ground on its sides until it is the thickness of the insulation and then carefully worked between each pair of segments until the insulation

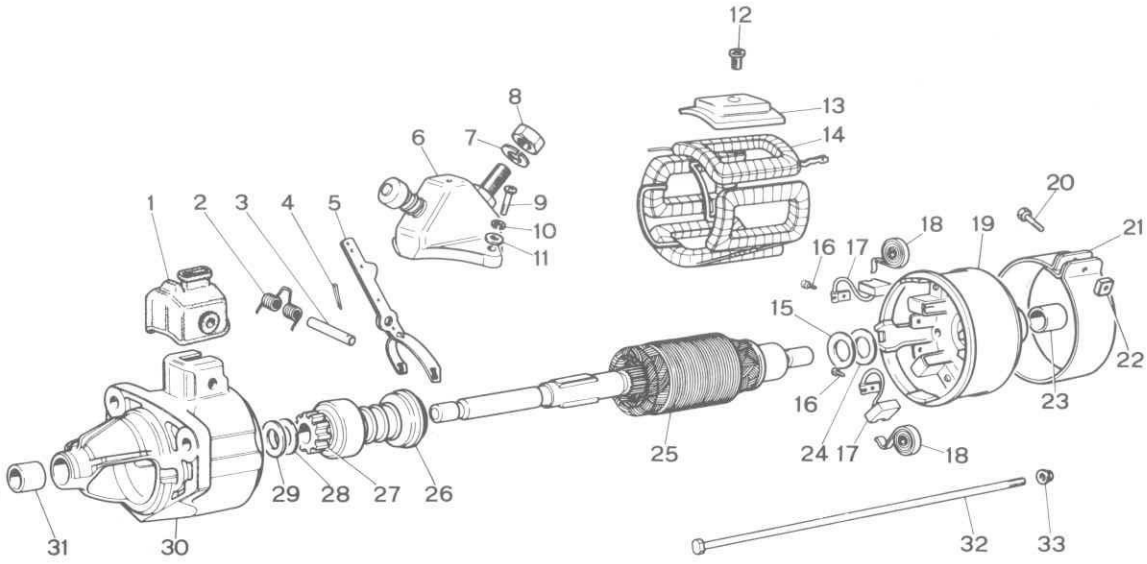

FIG 11:4 Components of the starter motor. The yoke or body is not shown

Key to Fig 11:4 1 Rubber boot 2 Spring 3 Pin 4 Splitpin 5 Lever 6 Switch 7 Lockwasher 8 Cable nut 9 Screw 10 Lockwasher 11 Flat washer 12 Screw 13 Pole piece 14 Field coils 15 Flat washer 16 Screw 17 Brush 18 Spring 19 Frame, commutator end 20 Screw 21 Dust cover 22 Nut 23 Bush 24 Flat washer .059 inch (1.5 mm) thick 25 Armature 26 Clutch sleeve 27 Pinion 28 Flat washer 29 Flat washer 30 Frame, pinion end 31 Bush 32 Through-bolt 33 Nut

has been cut to a depth of .04 inch (1 mm) below the surface.

A thorough visual inspection may determine the cause of armature failure. Breaks in armature windings cause burnt commutator segments. Shortcircuited windings are discoloured by overheating, with badly burnt commutator segments.

Testing field coils:

When tested with an ohmmeter the reading should be 7.7 to 8.1 ohms at 68°F (20°C). Failing an ohmmeter use a 12-volt supply and connect it in series with an ammeter across the field terminal and the yoke or body. The meter should read approximately 2 amps. If there is no reading the field coil winding has a break in it. If the reading is much more than 2 amps or the ohmmeter records much less than 8 ohms it shows that field coil insulation has broken down. Renewal of the field coils is a specialist operation best left to a service station.

The armature:

Apart from reconditioning the commutator, there is little which can be done to the armature itself. Never try to straighten a bent shaft and do not machine the armature core. Armature windings are tested with equipment normally not available to the car owner. The only check for a suspected faulty armature which the owner can do is to substitute an armature which is known to be satisfactory.

The bearings:

Refer to **FIG 11:2**. Bearing 30 may be pressed out of frame 39 if it proves to be rough when turned. Note that there is a rubber sealing ring 29 fitted into a groove in the bore of the frame. The bearing in the fan end frame 3 is located endwise by plates and rivets or bolts. These fixings must be removed before the bearing can be pressed out. When fitted, or when the stipulated mileage is up (see **Section 11:2**), pack the bearings with Fiat MR 3 grease or lithium-base grease No. 3. Do not forget the rubber sealing ring when fitting the bearing at the commutator end.

Reassembling the generator:

At the fan end, press the frame and bearing into place on the armature. Do not forget spacer 4. Fit the brushes into the boxes on the commutator end frame, with the springs pressing on the brush sides so that the brushes are held up above their normal running position. Start pressing the frame and bearing onto the armature shaft. When within about $\frac{1}{2}$ inch (13 mm) of the generator body, use a wire hook to lift the springs and push the brushes down into contact with the commutator. Release the springs onto the tops of the brushes. Continue pressing the frame into place and when fully home, fit and tighten the two through-bolts. Fit the key and fan and tighten the nut to 25 lb ft (3.5 kgm).

Refitting:

This is a reverse of the removal procedure. After fitting the belt, adjust the tension as described in **Chapter 4**,

Section 4 : 2. The correct tightening torque for the pulley nut is 25 lb ft (3.5 kgm).

11 : 5 Servicing the starter motor

The starter motor is bolted to the clutch bellhousing low down on the righthand side of the final drive casing. The starter control beside the driver is connected by cable to a lever on the motor. The first part of the lever movement engages the starter pinion in the flywheel ring gear and the final part of the movement closes heavy contacts in the switch to complete the electrical circuit to the motor. The parts can be seen in **FIG 11 : 3**.

Starter tests before removal:

If the starter motor refuses to turn the engine, first check that the battery is well-charged. If satisfied, remove both cables from the battery terminals and clean them to bright metal contact surfaces. Tighten the connections securely and check that the earth cable is firmly connected to the body. Disconnect the earth cable first and connect it last. Try the starter again. If nothing happens, switch on the headlamps and make another test. If the lights go dim when the switch is operated, it shows that current is reaching the starter. If the lights do not go dim, check all cable connections. If these are clean and tight it will be necessary to remove the starter for further checks.

Removal:

Disconnect the battery earth lead. Disconnect the starter cable and the control cable at the switch on the motor (see 1 and 4 in **FIG 11 : 3**). Release the motor flange from the bellhousing (two bolts). Withdraw the motor.

Checking before dismantling:

Before doing a major job on the motor, try the effect of cleaning the brush gear. Refer to **FIG 11 : 4** and slacken bolt 20. Slide cover 21 off the body of the motor. Pull on the flexible leads of the brushes 17. If the brushes do not slide freely in their boxes against the pressure of the springs, lift the springs with a wire hook and remove the brushes. Mark them for correct replacement. Clean the brush sides and the boxes and check for free movement. If still tight, ease the brushes by rubbing the sides on a smooth file.

Using a fuel-moistened cloth over one finger, clean the commutator on the end of armature 25. Finish off with fine glasspaper. Do not clean the copper segments with emery paper. Refit the brushes and clamp the motor between soft jaws in a vice. Using heavy cable, connect a 12-volt battery to the motor, taking one lead to the body or yoke and the other to the switch terminal. Switch on. The motor should run at high speed. If it does not, dismantle the motor as follows:

Dismantling:

1 Remove the coverband 21 (see **FIG 11 : 4**) and hold back the brush springs and take out the brushes.
2 Remove the starter switch 6 by releasing the two mounting screws and lift away the switch.
3 Remove the commutator end frame 19, slide off the armature assembly 25 from the drive unit and from the pole shoes.

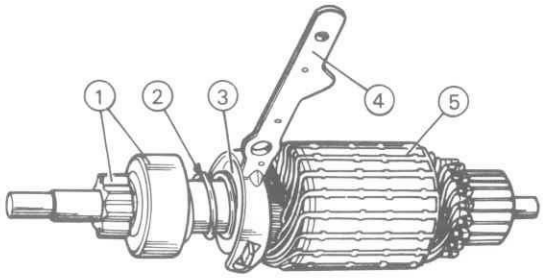

FIG 11 : 5 The starter motor armature assembly showing over-running clutch and shifter lever

Key to Fig 11 : 5 1 Pinion 2 Clutch sleeve spring 3 Clutch sleeve 4 Shifter lever 5 Armature

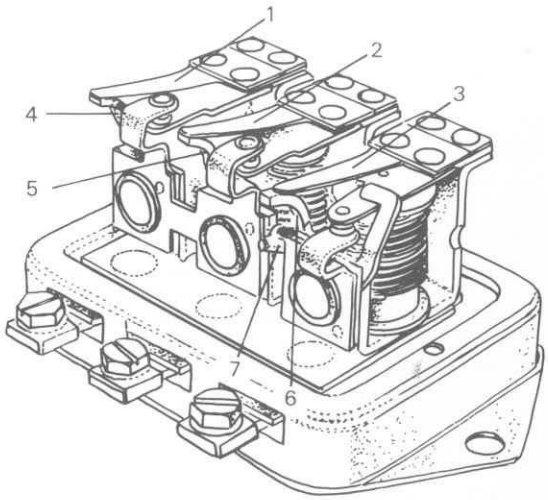

FIG 11 : 6 Cover removed from regulator showing the three control units

Key to Fig 11 : 6 1 Voltage regulator adjusting spring 2 Current regulator adjusting spring 3 Cut-out adjusting spring 4 Voltage regulator adjustment arm 5 Current regulator adjustment arm 6 Cut-out adjustment blade spring 7 Soldered union of shunt and series windings

4 Release the engagement lever pin 3 and spring 2 from the lever operating bracket on the drive end head. Lift away the lever and withdraw the pinion assembly complete which is shown in **FIG 11 : 5**.

Servicing the brushes:

Test the brush springs with a balance, the correct tension is 2.5 to 2.9 lb according to the wear of the brushes. Fit a new spring if the tension is low.

The life of the brushes depends on the type of service in which the vehicle is being used. In normal circumstances even when the starter is being used frequently, the brushes should last more than 18,000 miles. If the wear is found to be abnormal it will probably be found that the commutator is either damaged or excessively worn. Only Fiat replacement brushes must be used.

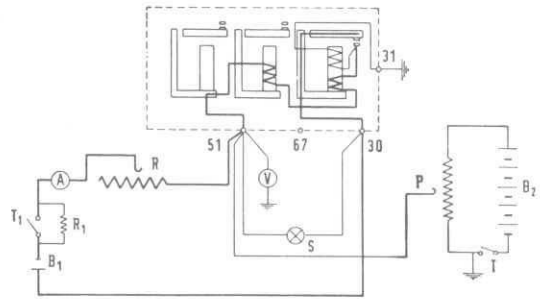

FIG 11 : 7 Wiring diagram of test equipment for setting the cut-out unit

Key to Fig 11 : 7 B_1 2-volt battery B_2 20-volt battery A 20 amp ammeter of 1% accuracy P Potentiometer S 2-volt, 3 watt test lamp R 4 ohm, 12 amp rheostat R_1 Voltage drop resistor V 20v voltmeter to .5% accuracy Setting before connecting unit: P at zero; T open; R full resistance; and T_1 open

Testing the field coils:

Use a 12-volt bulb in one lead of a 12-volt battery. Connect one lead to the brush connection joint to the coil field and the other to the field coil current supply lead. If the bulb does not light there is a break in the field coil windings. This is not a complete test as it is still possible for a coil to be earthed. Check this by moving the lead from the brush connection and holding it on a clean metal surface on the yoke or body. If the bulb lights it shows that the field coils are earthed.

The only sure way of curing faulty field coils is to take the starter motor to a service station.

Examining the armature:

The armature shaft may be bent due to the starter being operated whilst the engine is running. Do not try to straighten a bent shaft or machine the armature core to obtain the correct clearance.

If the commutator is damaged or any wires or segments have lifted from it, the assembly will have to be renewed.

Starter bearings:

Bearing bushes are of the porous bronze type and must not be reamed after fitting. Worn bearings should be withdrawn by screwing a tap into them and pulling on the tap. New bushes must be immersed in engine oil for approximately 24 hours before fitting. Press them into place using a suitably sized drift which has a spigot the length of the bearing and the diameter of the starter shaft. When this is withdrawn after fitting, the bore of the bush should be correct to size.

The pinion drive:

This unit is shown in **FIG 11 : 5**. The chief sources of trouble are a dirty unit or a broken starting engagement spring 2. Should any defect be found then the pinion assembly must be renewed as one complete unit. After examining to ensure that there are no defects thoroughly clean using petrol.

Reassembling and refitting the starter:

In both cases this is a simple reversal of the dismantling procedure. Grease the drive splines and the engagement lever groove in the sleeve.

11 : 6 The control box

The unit is illustrated in **FIG 11 : 6** and there is a wiring diagram in the top part of **FIG 11 : 7**. The unit is mounted on the lefthand side panel at the rear.

The following instructions are given to show the method of setting the three components of the unit for correct performance. As can be seen from **FIG 11 : 7**, there is a need for accurate instruments, potentiometers and a 20-volt battery, so that it is recommended that the owner takes his vehicle to a service station in the event of trouble.

Before carrying out tests, make sure that the unit is well earthed to the body of the vehicle. Note that damage may be caused if radio interference suppressors are fitted between terminal 67 and earth or between terminals 67 and 51, both of the unit and the generator.

Setting the cut-out:

The opening and closing of the cut-out contact points, breaks or completes the connection between the generator and the battery. The breaking of the circuit is set so that the battery cannot discharge through the generator when output from the generator has fallen below a certain figure. Refer to **FIG 11 : 7**.

1 Contact closing voltage:

This test should be carried out at an ambient temperature of 25° ± 10°C (77° ± 18°F). Close the switch T and stabilise the regulator thermally by feeding current into it for approximately 10 minutes at 16.5 volts which is

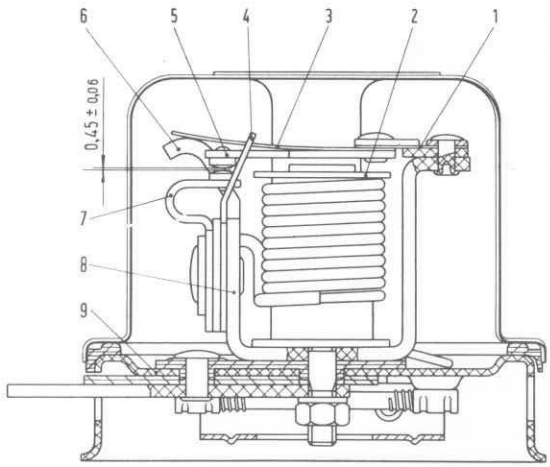

FIG 11 : 8 Section of regulator showing cut-out unit and contact points gap

Key to Fig 11 : 8 1 Bi-metal strip 2 Core 3 Setting spring 4 Armature stop 5 Armature 6 Setting tongue 7 Stationary contact bracket 8 Body 9 Baseplate. Contact gap .018 ± .002 inch (.45 ± .06 mm)

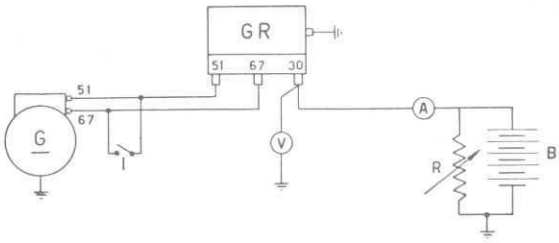

FIG 11 : 9 Wiring diagram of test equipment for setting voltage and current regulator units

Key to Fig 11 : 9 GR Regulator G Generator V 20-volt voltmeter (.5% accuracy) A Ammeter (20 amp for voltage regulator and 40 amp for current regulator) R Rheostat (25 amp, 3 ohm) B 50 amp/hr battery, fully charged I Switch

obtained by adjusting P for initial regulator operating temperature of between 15° to 20°C (59° to 68°F) or at 15 volts for initial operating temperatures of 20° to 35°C (68° to 95°F). Once the stabilising of the regulator has been completed bring the voltage to 12.6 ± .2 volts by adjusting P. Adjust the load on the setting spring by bending the relevant arm until the pilot light S is extinguished. Reset P to minimum and again increase the voltage by P and check that the pilot lamp is extinguished at the specified voltage.

Check that the contact gap is as shown in **FIG 11 : 8** and adjust if necessary. The contacts must be clean and unburnt.

2 Reverse current:

This test must be carried out at a temperature of 25° ± 10°C (77° ± 18°F) and it is recommended that it is carried out as soon as possible after the closing voltage test so as to maintain minimum regulator thermal stability. With the switch T closed bring the voltage to 12.4 to 12.8 volts by operating P. The contacts of the cut-out should be closed and the pilot lamp S off. Close T_1 and increase the reverse current by means of the rheostat R and check that the pilot lamp S glows as the contacts part. The opening may also be unsteady which will be indicated by a slight buzz from the unit. Check the value of the ammeter of the reverse current causing the opening of the contacts and this should not exceed 16 amps. If the reading is unstable or S lights up at the recommended limit reset the reverse current to the minimum value and repeat the test once more. Finally, open the switches T and T_1 and again adjust rheostat R and P to the minimum settings.

Voltage regulator adjustment:

This test should be carried out at a temperature of 50° ± 3°C. Connect the unit as shown in **FIG 11 : 9** and load the voltage regulator adjusting springs by bending the relevant arm. With the unit at the required test temperature close 1, start the generator and stabilise the regulator thermally by feeding a current for 30 minutes at 15 volts, which is obtained by adjusting the generator speed. The generator should then be stopped, I opened and the generator restarted and gradually

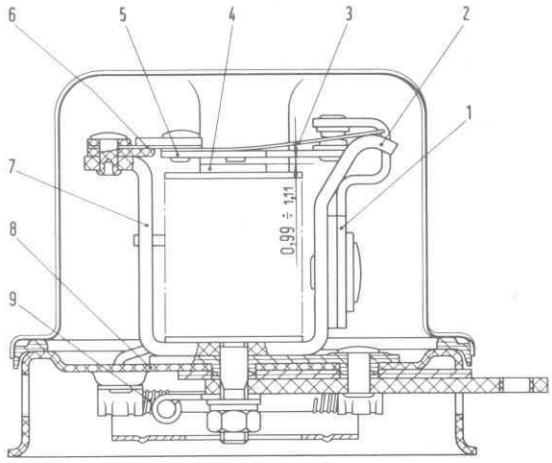

FIG 11 : 10 Section showing voltage and current regulator unit construction

Key to Fig 11 : 10 1 Stationary contact bracket 2 Setting tongue 3 Adjusting spring 4 Core 5 Armature 6 Hinge spring of steel and bi-metal 7 Body 8 Baseplate 9 Series resistor (on voltage regulator)

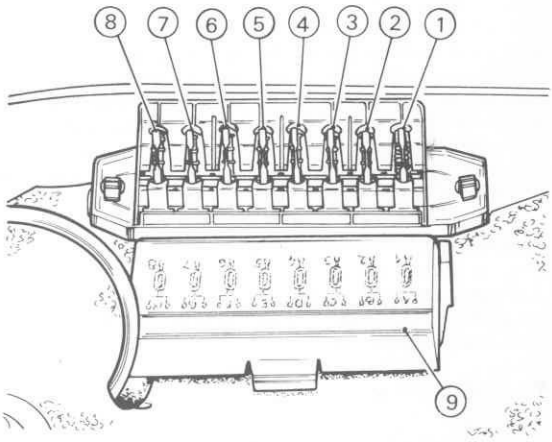

FIG 11 : 11 The fusebox with cover 9 removed. The circuits connected to the numbered fuses can be traced in the wiring diagram FIG 13 : 1

speeded up to 4500 rev/min. The voltage regulator spring load adjustment should be set by suitably bending the relevant adjusting arm and by rheostat R so as to have a voltage of 14.2 ± .3 volts and a half load current of 8 ± 2 amps. Finally, check the steadiness and accuracy of the voltage regulator setting by stopping the generator and restarting after approximately two minutes and gradually speeding up to 4500 rev/min.

Current regulator adjustment:

This test should be carried out immediately after adjusting the voltage regulator using the same wiring diagram (**FIG 11 : 9**) and instruments except the

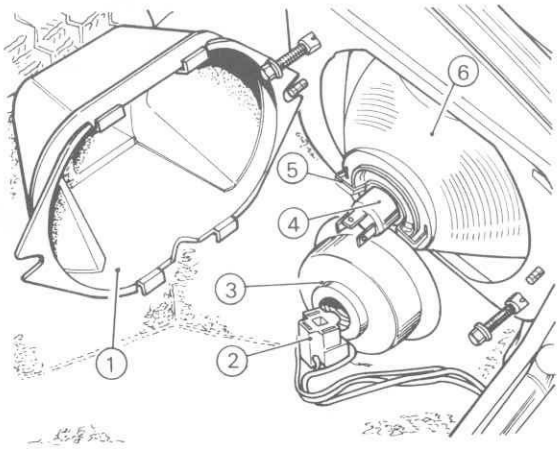

FIG 11:12 How to remove a headlamp bulb

Key to Fig 11:12 1 Plastic shield 2 Connector 3 Rubber boot 4 Double-filament bulb 5 Spring ring 6 Headlamp

ammeter which should have a full scale deflection of 40 amps. With the regulator at the required temperature close I and start the generator and set its speed at rheostat R for a 13-volt output and 16 ± 1 amp output. Allow the unit to operate to the set conditions for 10 minutes with the regulator at its test temperature and then stop the generator and open I. Gradually speed up the generator to maximum speed of 4500 rev/min and adjust the current regulator setting spring by bending the spring tab and operating rheostat R in order that the regulated current and voltage are respectively 16 ± 1 amps and 13 volts. Finally, check the regulated current for stability and accurate setting by stopping the generator and repeating the test.

Finally, operate the regulator for 10 minutes with the cover on and check that the setting data still fall within the specified limits.

11:7 The fuses

These will be found on the lefthand side in the luggage compartment and **FIG 11:11** shows the fuses displayed when the cover is removed. The fuses are numbered 1 to 8 and the input terminals are marked alphabetically from A to H (see wiring diagram in **Technical Data**). All fuses are 8 amp. **Do not use fuses of a higher rating.** If a fuse blows, find out whether a shortcircuit is the cause before inserting a new one. **Never substitute wire, silver paper or any solid metal object for a blown fuse.**

11:8 The headlamps

Renewing bulb:

The 45/40 watt double-filament bulb in each headlamp is accessible from inside the luggage compartment. To renew a bulb, refer to **FIG 11:12**. Remove plastic shield 1 and pull off connector 2. Remove rubber boot 3. Press on the wings of spring ring 5 and turn clockwise. This will release bulb 4.

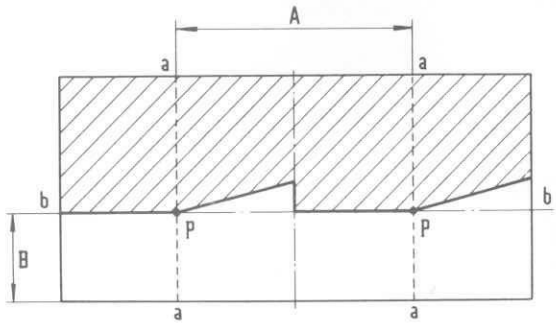

FIG 11:13 Diagram for aiming headlamps on lefthand drive vehicle. Screen is set 16.5 ft (5 m) from the vehicle. A is the distance between headlamp centres. B is height of headlamp centres from ground level, minus 1.38 inch (3.5 cm). The dark area is shaded

To fit a bulb, slide the spring ring into place and make sure that the dowel on the bulb coincides with its seating. Refit the parts in the reverse order of dismantling.

Headlamp alignment:

The screws for setting headlamp alignment are shown in **FIG 11:12**, being the long spring-loaded screws on either side of the headlamp aperture. The one (top-left) is for setting the beam vertically and the other (bottom-right) is for setting horizontally.

It is preferable for the lamps to be aimed accurately by using optical equipment. If this is not available, refer to **FIG 11:13** and proceed as follows:

Set a vertical screen 16.5 ft (5 m) from the unladen vehicle and make sure it is squarely on the centre line. A is the distance between the headlamps and B is the height of the headlamp centres above ground minus 1.38 inch (3.5 cm).

Turn the lights on to low beams and adjust, if necessary, at the two screws. The object is to obtain a horizontal line between dark and light areas that coincides with line 'bb'. The upward sloping lines must be at about 15 deg. and start from intersecting points P between the vertical and horizontal centre lines. Reverse the diagram when setting righthand drive vehicles.

11:9 Side, tail and number plate lights

Access to front and rear sidelights is by removing the lens. There are two fixing screws at the front and three at the rear. All bulbs have bayonet fixings, so press and turn to release.

To reach the number plate lamps, squeeze on the tabs at both ends of the bulb holder. Slide out the holder complete with two bulbs. These are also bayonet-fixing.

The cover over the interior light is of the press-on type. The bulb is a 5W festoon type.

In the case of the indicator repeater lights at the sides it is necessary to prise out the complete holder. Use a flat-bladed screwdriver inserted in the slot in the bezel. The whole unit must be renewed in the case of bulb failure.

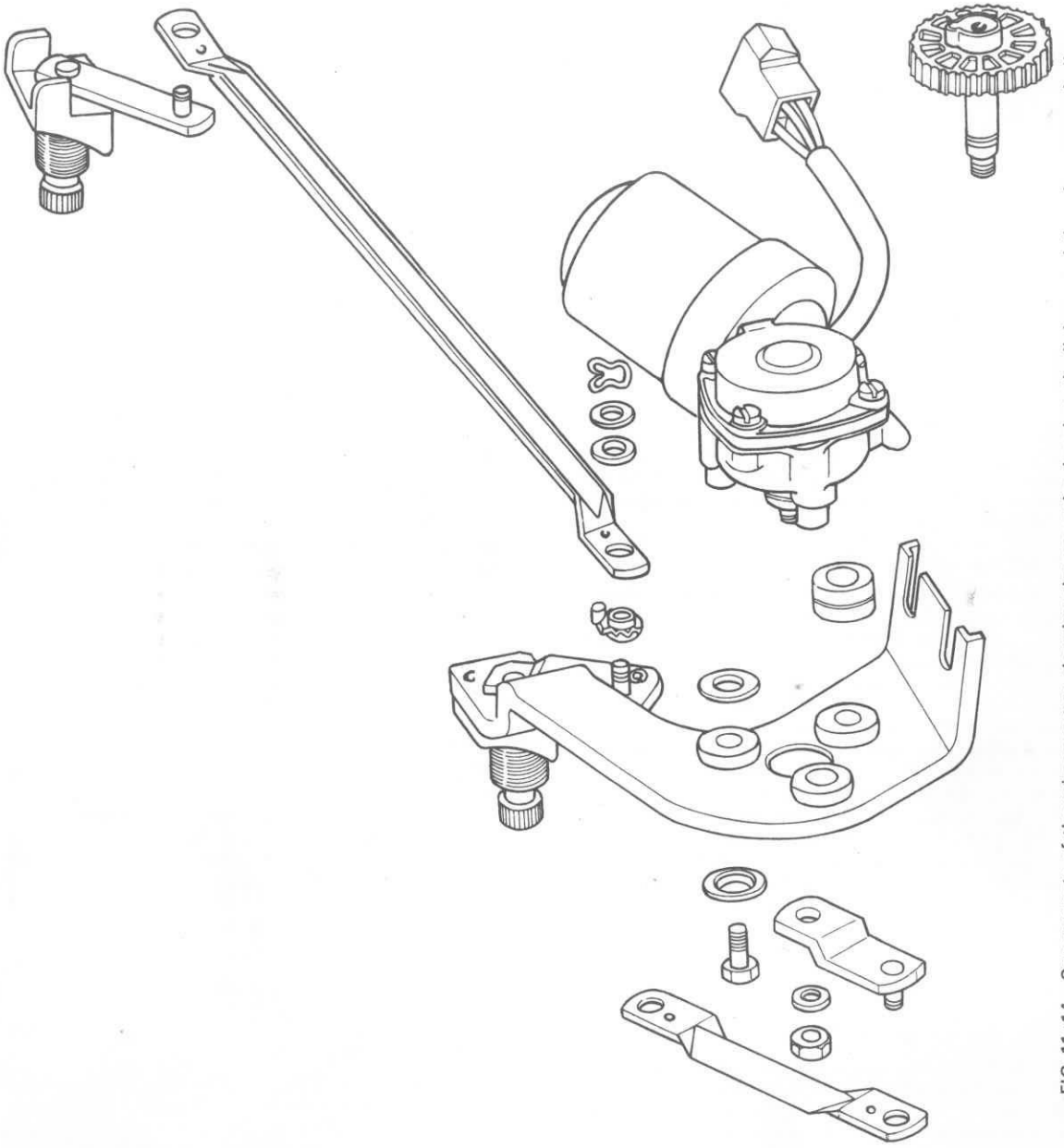

FIG 11:14 Components of the wiper motor, showing the mounting bracket, the linkage and the wiper arm spindles

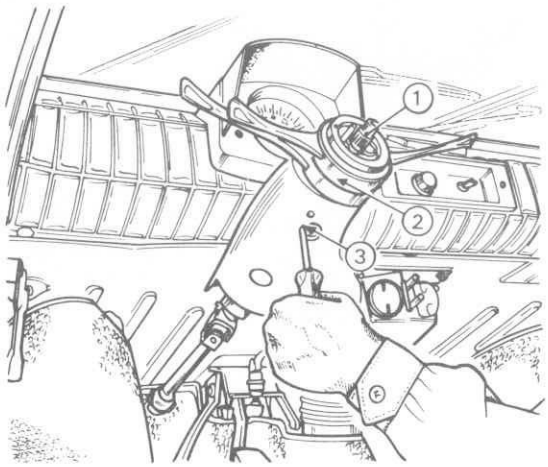

FIG 11:15 To remove the indicator switch 2, remove the steering wheel from upper column at 1 and remove screw 3

Instrument lights:

The bulbs are of the push-in type and are accessible behind the speedometer. Each bulb coincides with the warning spot on the dial. The bulb for the parking light indicator is 3W. The remainder of the warning lights have 1.2W bulbs.

11:10 The wipers

The mechanism is shown in **FIG 11:14**. If there is trouble with the motor or the linkage, servicing is relatively simple, the motor bracket being accessible from inside the luggage compartment.

To dismantle the assembly, prise the wiper arms off their spindles. Unscrew the fixings that hold the spindle housings to the body. Remove the bolts holding the bracket foot to the body (see slotted holes in illustration). Lift the assembly clear, complete with linkage, detaching the wiring connector while doing so. Remove the motor from the bracket if necessary. Note the rubber grommets.

Check the motor and grease the gearing. Check the linkage for worn spindles and link pivots, renewing if necessary. Lubricate the working parts on reassembly. Refitting, after securing the motor to the bracket and assembling the linkage, is a reversal of the removal procedure. Note that the good condition of the rubber grommets for the motor mounting is important in damping out transmitted noise.

11:11 The flasher unit

This will be found in the luggage compartment, being mounted in a bracket secured to the scuttle a little to the left of centre. The unit is readily detached, being a press-fit in the bracket. The unit and its connections are shown as item 9 in the wiring diagram **FIG 13:1**.

Rapid flashing is generally a sign of bulb failure. If trouble persists, check the fuse in the circuit concerned. If intact, switch on the ignition and connect a voltmeter between the positive terminal of the unit and earth. Battery voltage should be indicated.

Connect together flasher unit positive terminal and L and operate the direction indicator switch. If the flasher lamps now light, the flasher unit is defective and must be renewed. It is not possible to dismantle and repair a faulty flasher unit. Before removing make a note of the connections so that they will be replaced correctly when the new unit is being installed.

Before making the connections it is advisable to check the circuits to ensure that the new flasher unit is not damaged by wrong connection. Test by joining the cables normally connected to the unit and operate the switch. If the connections are wrong the appropriate fuse will blow but no damage will be done to the flasher unit.

Never insert terminal L directly to earth without having first connected in series the bulbs specified, otherwise the flasher unit will be damaged. For the same reason terminal L must never be shorted to ground nor must there be any shortcircuits in any of the leads from the L terminal to the bulbs. The flasher unit must never receive blows of any kind since it is a very delicate component and easily damaged.

11:12 The combination switch

The switch is shown as item 2 in **FIG 11:15**. To remove the switch, pull off the steering wheel (see **Chapter 9, Section 9:3**). Release screw 3. This secures the combination switch to the upper steering shaft support. Separate the connectors and pull off the switch, after disconnecting the battery. It is wise, before starting the operation, to set the steering wheel straight-ahead and check that the position of the indicator lever is in neutral. By keeping these positions unchanged, it will be possible to reassemble without difficulty.

11:13 The horn

This is mounted underneath the vehicle, behind the front bumper. If a horn gives trouble, check that all electrical connections are complete, and all contact surfaces are clean. The pushbutton contacts in the steering wheel hub can be checked by prising out the hub centre. Remove the combination switch (see preceding section) and check the contact with the steering column drum. Use a voltmeter or test bulb to check the continuity of the leads.

If the horn still proves inoperative after all the tests, it is best renewed rather than an attempt be made to repair it.

11:14 Fault diagnosis

(a) Battery discharged

1 Lighting circuit shorted
2 Terminals loose or dirty
3 Generator not charging
4 Regulator or cut-out units not working properly
5 Battery internally defective

(b) Insufficient charging current

1 Loose or corroded battery terminals
2 Generator driving belt slipping

(c) Battery will not hold a charge

1 Low electrolyte level
2 Battery plates sulphated
3 Electrolyte leakage from cracked casing or top sealing compound
4 Plate separators ineffective

(d) Battery overcharged

1 Voltage regulator needs adjusting

(e) Generator output low or nil

1 Belt broken or slipping
2 Regulator unit out of adjustment
3 Worn bearings, loose pole pieces
4 Commutator worn, burned or shorted
5 Armature shaft bent or worn
6 Insulation proud between commutator segments
7 Brushes sticking, springs weak or broken
8 Field coil wires shorted, broken or burned

(f) Starter motor lacks power or will not operate

1 Battery discharged, loose cable connections
2 Starter pinion jammed in mesh with flywheel gear
3 Starter switch faulty
4 Brushes worn or sticking, leads detached or shorting
5 Commutator dirty or worn
6 Starter shaft bent
7 Engine abnormally stiff

(g) Starter motor inoperative

1 Check 1 in (f)
2 Armature or field coils faulty

(h) Starter motor rough or noisy

1 Mounting bolts loose
2 Damaged pinion or flywheel gear teeth

(i) Lamps inoperative or erratic

1 Battery low, bulbs burned out
2 Faulty earthing of lamps or battery
3 Lighting switch faulty, loose or broken wiring connections

(j) Wiper motor sluggish, taking high current

1 Faulty armature
2 Bearings out of alignment
3 Commutator dirty or shortcircuited

(k) Wiper motor operates but does not drive arms

1 Gearbox components worn
2 Defective linkage

NOTES

CHAPTER 12

THE BODYWORK

12:1 Bodywork finish

Large scale repairs to body panels are best left to expert panel beaters. Even small dents can be tricky, as too much hammering will stretch the metal and make things worse instead of better. Filling minor dents and scratches is probably the best method of restoring the surface. The touching up of paintwork is well within the powers of most car owners, particularly as self-spraying cans of paint in the correct colours are now readily available. It must be remembered, however, that paint changes colour with age and it is better to spray a whole wing rather than try to touch up a small area.

Before spraying it is essential to remove all traces of wax polish with white spirit. More drastic treatment is required if silicone polishes have been applied. Use a primer surfacer or paste stopper according to the amount of filling required, and when it is dry, rub it down with 400 grade Wet or Dry paper until the surface is smooth and flush with the surrounding area. Spend time on getting the best finish as this will control the final effect. Apply the retouching paint, keeping it wet in the centre and light and dry round the edges. After a few hours of drying, use a cutting compound to remove the dry spray and finish with liquid polish.

12:2 Interior and chrome cleaning

Cloth upholstery and the rear compartment lining must be regularly cleaned to ensure long life and preserve its attractive appearance. Any dust or dirt that is blown into the car will settle on the upholstery and will tend to wear the cloth causing an unsightly appearance. It is recommended that the dust is wiped off using either a vacuum cleaner or a stiff brush. To remove ordinary soiling of the upholstery cloth proceed as follows:

1 Using lukewarm water and a neutral soap and a piece of clean cloth wipe over the upholstery in the direction of the nap.
2 Repeat the operation using a clean damp cloth and warm water but no soap.
3 Allow the upholstery cloth to dry, use a stiff brush against the direction of the upholstery nap to restore its original fluffy look.

To obtain best results, any stains must be removed as soon as possible otherwise as time passes they will become more difficult, if not impossible to remove. Certain stains require specific solvents and the instructions must be strictly adhered to.

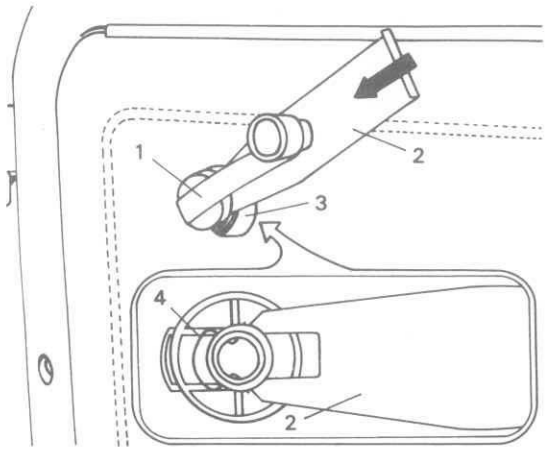

FIG 12:1 Tool A.78034 being used to remove the spring clip that secures the window regulator handle

Key to Fig 12:1 1 Handle 2 Tool A.78034 3 Escutcheon plate 4 Spring clip

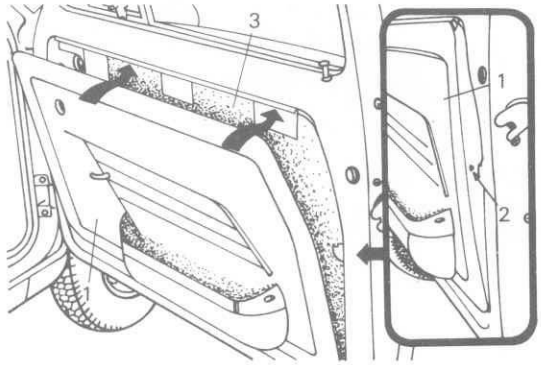

FIG 12:2 Removing the door trim panel. The top edge fits under a channel as shown by the arrows

Key to Fig 12:2 1 Trim panel 2 Panel fastener 3 Plastic water shield

Cleaning imitation leather:

To keep imitation leather clean wash in lukewarm water and a neutral soap applied with a soft cloth. Wipe clean with a clean moistened cloth with no trace of soap and finally rub with a clean dry cloth until the original lustre is restored.

Chrome plated parts:

To ensure long life from the chrome plated parts these should be periodically washed using a cloth dampened with petrol and dried with a soft cloth. Rub with a cloth moistened in clean oil especially around the edges of the components and finally rub using a clean dry cloth until all traces of oil have apparently been removed.

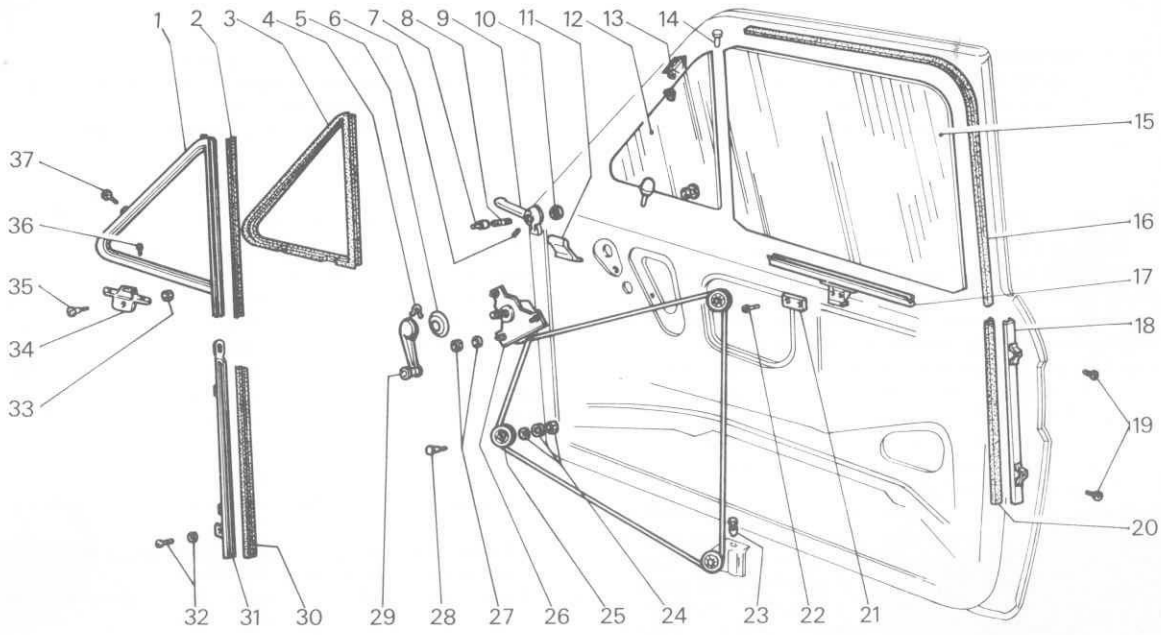

FIG 12:3 Door windows and regulator parts exploded

Key to Fig 12:3 1 Ventilator 2 Front rubber channel 3 Weatherstrip 4 Spring clip 5 Escutcheon 6 Dowel 7 Lock button 8 Spring 9 Lever 10 Lockwasher 11 Rubber stop 12 Ventilator glass 13 Top hinge 14 Rivet 15 Window glass 16 Top rear rubber channel 17 Lift channel 18 Rear channel 19 Screws 20 Lower rubber channel 21 Cable clamp for lift channel 22 Screw 23 Stop buffer 24 Nut, flat and lockwashers 25 Pulley 26 Window regulator 27 Nut and washer 28 Pulley pivot pin 29 Handle 30 Front lower rubber channel 31 Front channel 32 Screw and spring washer 33 Nut 34 Lower hinge 35 Screw 36 Rivet 37 Screw

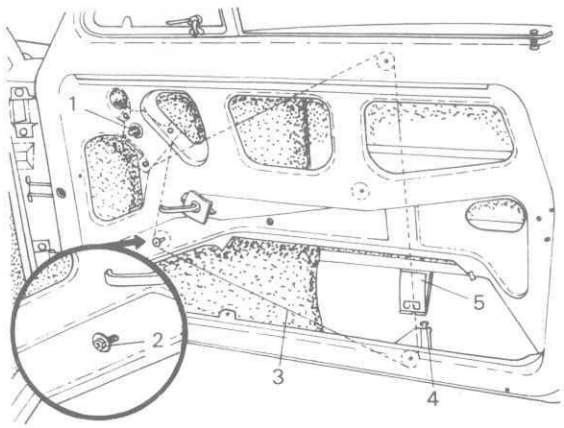

FIG 12:4 Ghosted view of window regulator mechanism

Key to Fig 12:4 1 Shaft for handle and regulator 2 Nut securing tensioner pulley 3 Cable 4 Rubber stop 5 Cable clamp and window lift channel

12:3 Removing door trim panels

Access to the interior of the door is obtained by removing the trim panel as shown in **FIG 12:2**. First remove the window regulator handle (see **FIG 12:1**). If the tool is not available it should be possible to pull out the wire clip with a small hook. Using two flat-bladed screwdrivers, prise out the circular escutcheon plate that surrounds the inner end of the lock control handle (see 4 in **FIG 12:5**). Remove the top two screws from the map pocket. The inset to **FIG 12:2** shows how the panel must be prised away at the clips 2, front and rear, and then the panel bowed until the top edge is clear of the door channel. The plastic water shield under the panel is held by strips of masking tape at the top. Refit the trim panel in the reverse order of removal.

12:4 Servicing door controls and windows

Window components and controls are shown in **FIG 12:3**. With the trim panel removed as in **Section 12:3** it will be possible to remove the window and the regulator, but note that the window glass may also be removed without dismantling the regulator. This is done by jamming two blocks of wood down the sides of the drum which is housed in part 26 so that the cable cannot unwind.

Removing window glass:

Remove the front channel 31 (see **FIG 12:3**). Screw 32 is just to the rear of the lock control handle. Now refer to **FIG 12:4** and release the cable clamp 5 (two screws). The window must be wound down to the bottom. Pull the bottom of the window glass down and out until clear of the door. Refit in the reverse order.

If a new glass is needed, cut a strip of rubber 18.9 inch (480 mm) long to fit the channel. This is Silstrip No. 4030255. Wet it with petrol and fit channel and rubber to the glass, making sure that it is exactly central.

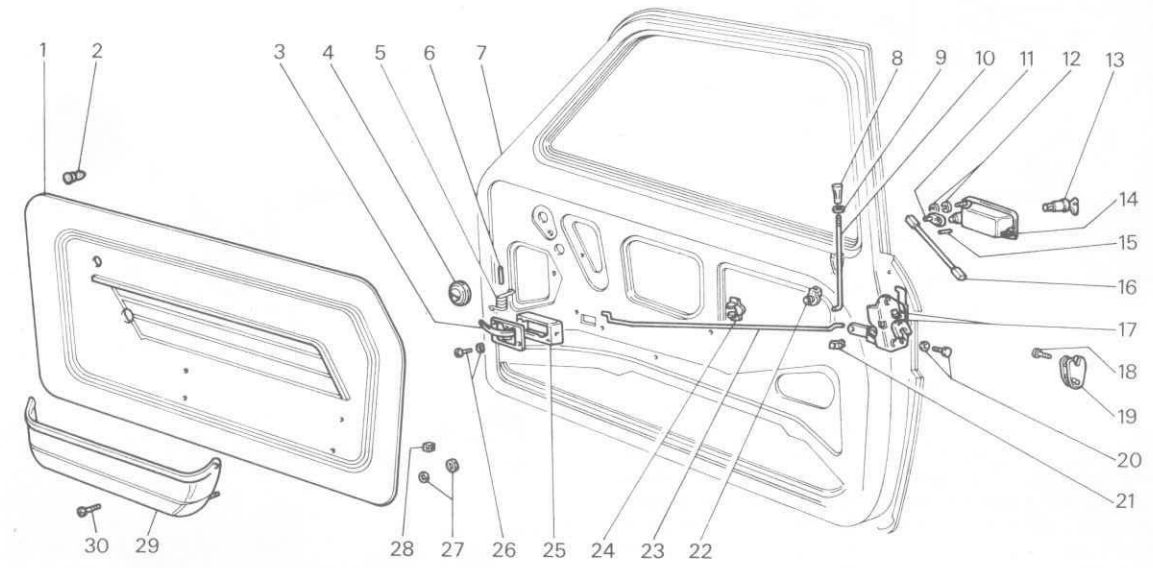

FIG 12:5 Door lock and remote control components

Key to Fig 12:5 1 Trim panel 2 Fastener 3 Lock remote control handle 4 Escutcheon plate 5 Spring 6 Pin 7 Door 8 Lock button 9 Grommet 10 Lock rod 11 Lock lever 12 Flat and spring washers 13 Lock cylinder 14 Outside handle 15 Pin 16 Connecting link 17 Lock 18 Screw 19 Striker 20 Screw and washer 21 Fastener for link 22 Fastener for link 23 Link rod 24 Link fastener 25 Bezel 26 Screw and lockwasher 27 Nut and washer, map pocket 28 Tapping block 29 Map pocket 30 Screw

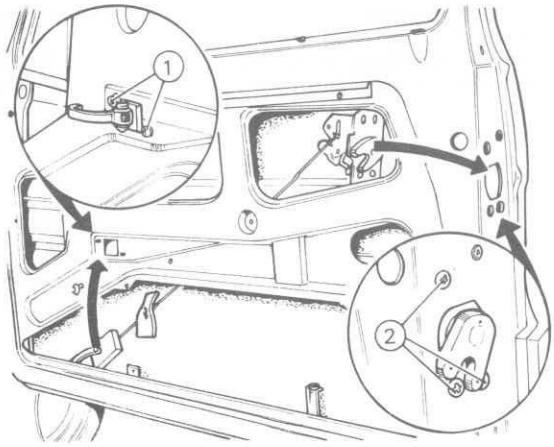

FIG 12:6 Fixing screws for door lock remote control 1 and lock mechanism 2

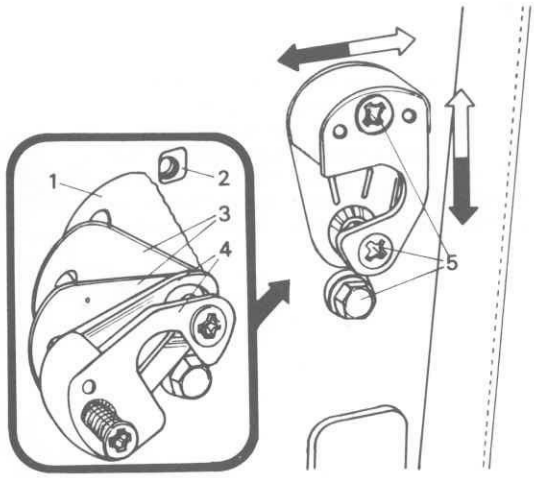

FIG 12:7 Fitting and adjusting door lock striker plate

Key to Fig 12:7 1 Gasket 2 Moveable tapped plate for screws 3 Spacer 4 Striker plate 5 Fixings

Removing window regulator:

The cable is tensioned at pulley 25 (see **FIG 12:3**), the pivot pin being secured in a slotted hole to permit adjustment. The nut can be seen at 2 in **FIG 12:4**. Releasing this pulley will allow the cable to be lifted free. The regulator 1 is secured by three screws. When refitting the cable, tension it by adjusting the position of pulley at nut 2. Check position of cable on drum so that a full range of up and down movement is obtained when the window channel clamp is tightened.

Servicing door lock:

The components are shown in **FIG 12:5**. Lock removal is shown in **FIG 12:6**. If it is necessary to remove the outside handle, one nut is reached through the large aperture and the rear nut will be seen through the hole in the door panel just above the top arrow on the right in **FIG 12:6**.

The lock and remote control are readily removed by undoing the fixings shown in **FIGS 12:5** and **12:6**. Lubricate all linkage before replacement.

Adjusting door lock striker:

The striker assembly is shown in **FIG 12:7**. To adjust for correct door closing, slacken screws 5 half-a-turn and tap the plate in the direction of the arrows until satisfied. It may be found that moving the door inwards will cure rattles and draughts, in which case the striker plate must be tapped inwards too. At each adjustment, tighten the fixings and check by opening and closing the door.

Removing door:

The hinge fixings present no problem. If the door has been closing correctly, mark the hinge positions for correct replacement. To release the door check fixing to the body pillar, squeeze together the two wire legs with a pair of pliers so that the ends are released from the tubular housings on the pillar. When refitted, check door closing and fitting to body aperture, adjusting at hinges and striker as required.

Removing door ventilator:

The principle is shown in **FIG 12:8**. Remove two cross-head screws from the outside framing at the front edge of the door. Remove the drop window (see

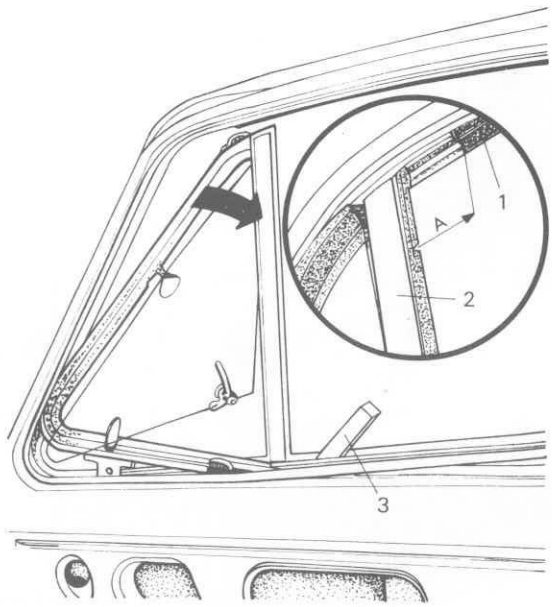

FIG 12:8 Removing a door ventilator in the direction of the arrow

Key to Fig 12:8 1 Top rubber channel 2 Ventilator frame 3 Wedge to spread mouldings A 1.18 inch (30 mm)

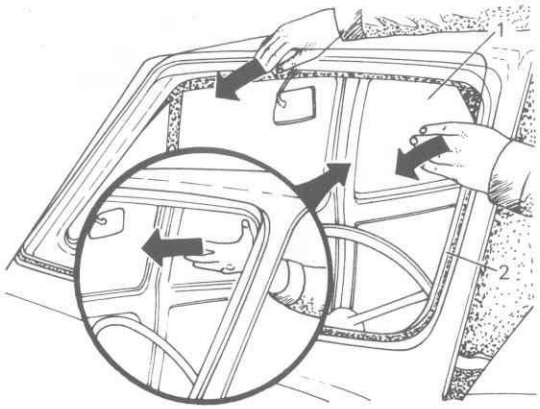

FIG 12:9 Removing a windscreen glass 1. The weatherstrip is item 2. The inset show the initial pressure from inside at the top corners

arrows in **FIG 12:10**). Cross the ends of the twine as shown.

Clean the flange of the screen aperture with petrol. Position the screen from the outside and apply hand pressure. A second operator should now pull both ends of the twine out of the channel and the weatherstrip flange should curl over into place. Now run a screwdriver all round the weatherstrip groove, particularly along the bottom so that the lip will overlap the instrument panel pad. Starting at the lower corners, use a screwdriver to insert the courtesy light wires under the lip.

The rear window glass may be removed and refitted in a similar fashion, but pull the glass away at the bottom first when removing. Note that there is a small cover over the two ends of the Mylar moulding. This must be prised off before the moulding can be pulled out.

12:6 Luggage compartment lid and latch

There are two lid hinges with slotted holes for adjustment. Because the slots are open-ended, the lid is

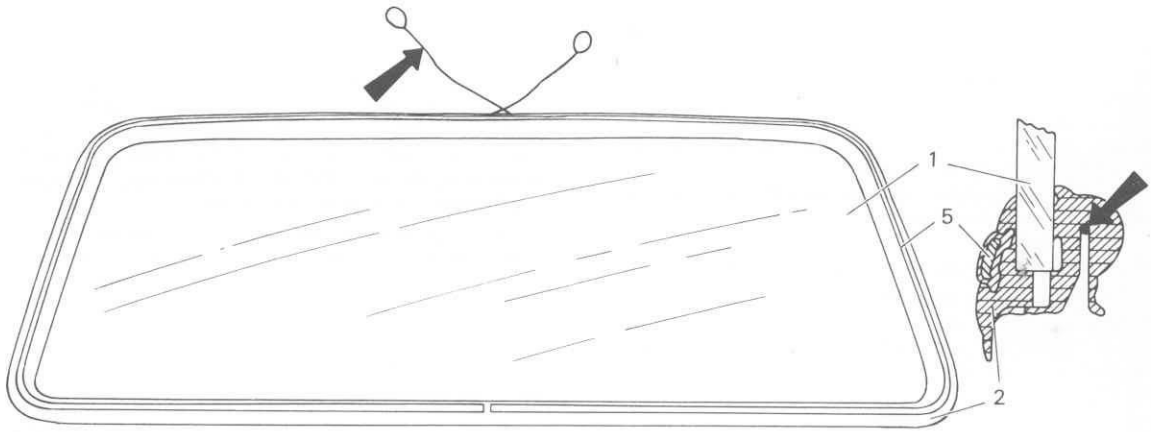

FIG 12:10 The lefthand arrow indicates the crossed ends of the twine used to refit windscreen. The section on the right shows the twine (arrowed). The windscreen is 1, the weatherstrip is 2 and the Mylar moulding is 5

Section 12:4). The rear channel 18 must also be removed (see **FIG 12:3**). This will allow the rubber channel 1 to be pushed 1.18 inch (30 mm) to the rear (see inset to **FIG 12:8**). Detach the inside and outside waistline mouldings up to the vent frame and insert a wooden wedge 3 to keep the mouldings apart. The vent assembly can now be tilted and removed as shown by the arrow. Refit in the reverse manner.

12:5 Removing and refitting windscreen

First prise off the wiper arms at the spindles. Remove the Mylar strip from the channel in the rubber weatherstrip round the screen (see 5 in **FIG 12:10**). Working inside, push with both hands at the upper corners of the screen. Lift the glass away as shown in **FIG 12:9**.

To refit, place the weatherstrip round the glass and then refit the Mylar strip. This is much easier if tool A.78024 is used. Rub some strong twine with talcum powder and insert it in the deep groove in the weatherstrip (see

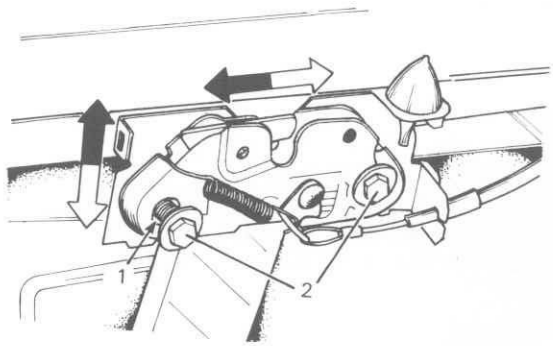

FIG 12:11 The latch for the lid of the luggage compartment is adjustable in the direction of the arrows because of enlarged holes 1. The fixing bolts are shown at 2

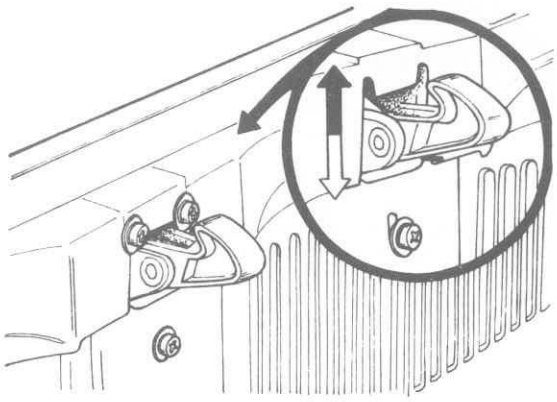

FIG 12:12 The latch for the lid of the engine compartment. By slackening the three cross-head screws the latch may be adjusted as shown by the inset

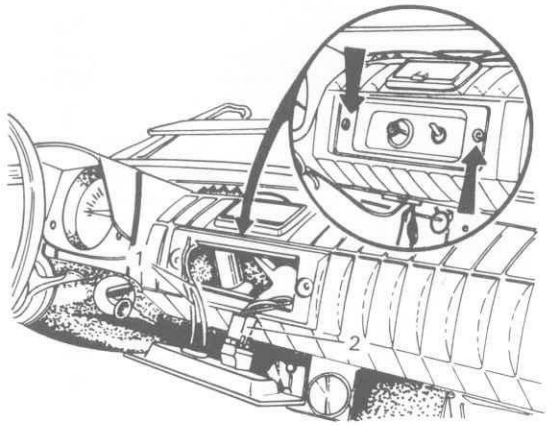

FIG 12:13 Removing the centre panel from the facia. The windscreen washer hoses are at 1 and the light switch connector is at 2. The arrows in the inset point to the attachment screws

quickly removed by slackening the four nuts and pushing the hinges to the rear. The lid can be made to open and shut smoothly by using the slotted holes to position the hinges.

The latch is also adjustable (see arrows in **FIG 12:11**). Slacken bolts 2 and move the latch as required. Lubricate the moving parts for easy action.

The weatherstrip that seals the edge of the lid is held in place by press-fitted studs.

12:7 Engine compartment lid and latch

To remove the lid, unscrew the nut from one hinge pin. Release the check cable from the lid by prising out the plastic retainer with a screwdriver. The latch is adjustable by means of slotted holes for the fixings (see **FIG 12:12**).

12:8 Removing instrument cluster and panel pad

Remove the instrument cluster by unscrewing the two cross-head screws near the speedometer. Pull the cluster partly out and disconnect the speedometer cable and the wiring connectors. The cluster will now be free for removal. Remove the ashtray and detach the centre panel at the two screws shown in **FIG 12:13**. Disconnect the screen-wash hoses 1 and switch connector 2.

The panel pad is secured along the underside by seven plastic fasteners. These must be prised out and new ones fitted on replacement of the pad. Disengage the pad along the top edge by releasing the rubber strips from the brackets on the panel.

Refit all the parts in the reverse order of removal. The pad must be attached at the top edge first.

APPENDIX

NOTES

TECHNICAL DATA

Dimensions are in inches unless otherwise stated, followed by metric dimensions in brackets

ENGINE

Type	126.A.000, 2 cylinder in line, OHV
Details:	
Capacity	36.23 cu inch (594 cc)
Compression ratio	7.5 to 1
Bore	2.894 (73.5 mm)
Stroke	2.756 (70 mm)
Cylinders:	
Bore:	
Class A	2.8937 to 2.8941 (73.500 to 73.510)
Class B	2.8941 to 2.8945 (73.510 to 73.520)
Class C	2.8945 to 2.8949 (73.520 to 73.530)
Crankshaft:	
Main bearings:	
Journal diameter	2.1248 to 2.1256 (standard) (53.970 to 53.990)
Bore in supports	2.1274 to 2.1279 (standard) (54.035 to 54.050)
Range of undersizes in supports	.0079, .0157, .0236 and .0394 (.2, .4, .6, 1.0)
Running clearance	.0018 to .0031 (.045 to .080)
Big-end journal diameter	1.7328 to 1.7336 (standard) (44.013 to 44.033)
Connecting rods:	
Big-end bore diameter	1.8555 to 1.8560 (47.130 to 47.142)
Bearing shell thickness	.0592 to .0607 (1.534 to 1.543)
Bearing shell undersize range	.01, .02, .03 and .04 (.254, .508, .762, 1.016)
Small-end bore diameter in rod	.8637 to .8650 (21.939 to 21.972)
Bore of small-end bush (standard)	.7874 to .7876 (20.000 to 20.006)
Undersize bores of small-end bush	−.0078 to .0196 (.2 to .5)
Fit of bush in rod	Interference
Small-end running clearance	.0002 to .0006 (.005 to .016)
Maximum misalignment of bores at 4.92 inch (125) apart on centre line of connecting rod	± .0078 (± .20)
Pistons:	
Standard diameter at right angles to pin and 2.254 inch (57.25) from crown:	
Class A	2.8905 to 2.8909 (73.420 to 73.430)
Class B	2.8909 to 2.8913 (73.430 to 73.440)
Class C	2.8913 to 2.8917 (73.440 to 73.450)
Oversizes available	+ .0079, .0157 and .0236 (.2, .4, .6)
Clearance in bore measured at right angles to piston pin	.0028 to .0035 (.070 to .090)
Piston pin:	
Standard diameter	.7870 to .7872 (19.990 to 19.995)
Fit in piston	0 to .0004 (0 to .010)
Oversize available	+ .0079 (.20)
Piston rings:	
Thickness:	
Top ring	.0582 to .0587 (1.478 to 1.490)
Second ring	.0778 to .0783 (1.978 to 1.990)
Bottom ring	.1544 to .1549 (3.925 to 3.937)

Side clearance:	
Top ring	.0018 to .003 (.045 to .077)
Second ring	.0016 to .0028 (.040 to .072)
Bottom ring	.0012 to .0024 (.030 to .062)
Fitted gap:	
Top ring	.0098 to .0157 (.25 to .40)
Second ring	.008 to .0136 (.20 to .35)
Bottom ring	.008 to .0136 (.20 to .35)
Oversizes available	+ .0079, .0157 and .0236 (.2, .4, .6)
Camshaft:	
Bore diameter in crankcase:	
Timing gear end	1.6937 to 1.6947 (43.020 to 43.045)
Flywheel end	.8667 to .8675 (22.015 to 22.036)
Journal diameter:	
Timing gear end	1.6919 to 1.6929 (42.975 to 43.000)
Flywheel end	.8653 to .8661 (21.979 to 22.000)
Running clearance:	
Timing gear end	.0008 to .0027 (.020 to .070)
Flywheel end	.0006 to .0022 (.015 to .057)
Tappets:	
Diameter (standard)	.8652 to .8659 (21.978 to 21.996)
Bore diameter in crankcase	.8662 to .8669 (22.003 to 22.021)
Oversizes available	+ .0019 to .0039 (.05 to .10)
Running clearance	.0003 to .0017 (.007 to .043)
Rocker gear:	
Shaft diameter	.7081 to .7087 (17.988 to 18.000)
Bore for shaft in support	.7089 to .7096 (18.005 to 18.023)
Clearance, shaft in support	.0002 to .0014 (.005 to .035)
Rocker bore diameter	.7093 to .7104 (18.016 to 18.043)
Running clearance on shaft	.0006 to .0021 (.016 to .055)
Valves:	
Head diameter:	
Inlet	1.26 (32)
Exhaust	1.10 (28)
Face angle	45 deg. 30 min. ± 5 min.
Seat angle in head	45 deg. ± 5 min.
Seat width in head	.071 to .083 (1.8 to 2.1)
Inside diameter of seat in head:	
Inlet	1.10 (28)
Exhaust	.94 (24)
Stem diameter	.3139 to .3146 (7.974 to 7.992)
Clearance in guide	.0012 to .0026 (.030 to .066)
Valve guides:	
Diameter (standard)	.5527 to .5534 (14.040 to 14.058)
Diameter (oversize)	.5535 to .5543 (14.060 to 14.078)
Bore (guide fitted)	.3158 to .3165 (8.022 to 8.040)
Bore in head	.5492 to .5503 (13.950 to 13.977)
Guide in head fit	.0025 to .0043 interference (.063 to .108)
Valve springs:	
Part number:	
Inner	4301739
Outer	4301740
Height under load of 13.4 ± .9 lb (6.1 ± .4 kg)	1.397 (inner) (35.5)
Height under load of 57.3 ± 3.3 lb (26 ± 1.5 kg)	1.516 (outer) (38.5)
Minimum permissible load at these heights	11.4 lb (inner) (5.2 kg) and 52 lb (outer) 23.6 kg)

Valve clearances:	
Inlet	.008 (cold) (.20)
Exhaust	.010 (cold) (.25)
Valve timing:	
All angles are with rocker clearance set at .0246 (.625) (cold):	
Inlet opens	26 deg. BTDC
Inlet closes	56 deg. ABDC
Exhaust opens	66 deg. BBDC
Exhaust closes	16 deg. ATDC
Restore to running clearance after testing	
Lubricating system:	
Oil pump	Gear type
Pressure at 100°C (212°F)	35.5 to 43 lb/sq inch (2.5 to 3.0 kg/sq cm)
Filter	Centrifugal
Pump running clearances:	
Between gears and housing	.0027 to .0051 (.070 to .13)
Between gears and face for cover	.0012 to .0034 (.030 to .087)
Drive shaft in bore	.0006 to .0021 (.016 to .053)
Between driven gear and pin	.0008 to .0024 (.02 to .06)
Backlash between gears	.006 (.15)
Between relief valve and shaft	.0008 to .003 (.020 to .074)
Relief valve:	
Spring part No.	4127852
Spring height under load of 88 ± 4 lb (40 ± 2 kg)	.689 (17.5)
Minimum permissible load at test height	81.6 lb (37 kg)

FUEL SYSTEM

Fuel pump:	
Type	Mechanical
Plunger stroke	.09 (2.4)
Carburetter:	
Type	Weber 28 IMB
Bore diameter	1.102 (28)
Primary venturi diameter	.905 (23)
Auxiliary venturi diameter	.157 (4)
Main jet	.049 (1.25)
Idling jet	.018 (.45)
Choke jet	.035 (F5) (.90)
Air correction jet	.085 (2.15)
Needle seat diameter	.049 (1.25)
Emulsion tube	F8
Idling air orifice	.079 (2.0)
Float to cover (with gasket)	.315 (set vertically) (8)
Float travel	.315 (8)

IGNITION SYSTEM

Distributor:	
Type	Marelli S.152.A
Static advance	10 deg.
Centrifugal advance	18 deg. at 3000 rev/min
Pressure on contact points	16.75 ± 1.76 oz (475 ± 50 g)
Contact gap	.0196 ± .0012 (.5 ± .03)
Opening angle	102 deg. ± 3 deg.
Dwell angle	78 deg. ± 3 deg.
Capacitor (condenser) capacity	.25 microfarad

Ignition coil:	
Type	Marelli BE.200.B or Martinetti G.52.S
Winding resistance in ohms at 20°C (68°F):	
Primary	3.1 to 3.4 (Marelli), 3 to 3.3 (Martinetti)
Secondary	6750 to 8250 (Marelli), 6500 to 8000 (Martinetti)
Sparking plugs:	
Type	Marelli CW.8.NP or Champion L.81.Y
Thread	14 × 1.25 metric
Electrode gap	.023 to .027 (.6 to .7)

CLUTCH

Clutch:	
Type	Single dry plate with diaphragm spring
Disc:	
Lining size	Outside diameter 6.10 (155), Inside diameter 4.49 (114)
Maximum runout of linings	.01 (.25)
Pedal free travel	1.10 (28)
Travel of release sleeve	.315 (8)

GEARBOX AND DIFFERENTIAL

Gearbox:	
Type	4 forward speeds and reverse
Synchromesh	On 2nd, 3rd and 4th
Gears:	
2nd, 3rd and 4th	Helical teeth, constant mesh
1st and reverse	Straight teeth, sliding mesh
Countershaft	Integral with final drive pinion
Ratios:	
1st	3.25 to 1
2nd	2.067 to 1
3rd	1.30 to 1
4th	.872 to 1
Reverse	4.024 to 1
Final drive	4.875 to 1 (8/39)
Differential and final drive:	
Bearings	2 taper roller, adjustable
Rolling torque of bearings	.94 to 1.1 lb ft (.13 to .15 kgm)
Pinion and ring gear:	
Backlash	.0031 to .0051 (.08 to .13)
Adjustment	By shims
Thickness of shims available	.0039 to .0059 (.10 to .15)
Pinion and ring gear must be a matched pair	

STEERING

Steering:	
Ratio	13 to 1
Steering wheel turns, lock to lock	3
Linkage	Central link rod, relay lever and two tie rods
Wheel angles:	
Inner wheel	33 deg.
Outer wheel	25 deg. 40 min.

Steering gearbox:	
Type	Worm and helical sector
Bearings for worm	2 taper roller, adjustable by ringnut
Rolling torque of worm	1.7 lb inch (2 kgcm) and not more
Worm to sector backlash	Adjustable by eccentric bush
Steering column:	
Type	3-piece with 2 universal joints

FRONT SUSPENSION

Front suspension:	
Type	Independent, with leaf spring and control arms
Spring:	
Number of leaves	1 main and 4 auxiliary
Camber under static load of 324 lb (147 kg)	.787 ± .12 (20 ± 3)
Control arms:	
Pivots	Rubber bushes
Pivot pin nuts	Tighten in static load position
Knuckle pillars:	
Adjustment for castor and camber angles	By shims under control arm shaft
Inclination angle	6 deg.
Geometry:	
Camber angle (loaded)	0 deg. 30 min. to 1 deg. 30 min.
Castor angle (loaded)	8 deg. to 10 deg.
Toe-in (loaded)	− .04 to + .12 (− 1 to + 3)
Toe-in adjustment	Threaded tie-rod ends
Dampers:	
Type	Hydraulic, telescopic, double-acting

REAR SUSPENSION

Rear suspension:	
Type	Independent, triangular control arms and coil springs
Control arm pivots	Rubber bushes
Coil springs:	
Part No.	4297957
Test height under load of 875 ± 35 lb (397 ± 16 kg)	6.22 (158)
Minimum permissible load at test height	805 lb (365 kg)
Springs marked yellow:	
Under test load must have height equal to or less than	6.22 (158)
Springs marked green:	
Under test load must have height of more than	6.22 (158)
Matched pairs of springs must be fitted	
Geometry:	
Camber angle (loaded)	− 0 deg. 20 min. to − 1 deg. 20 min.
Toe-in (total, when loaded)	.197 to .354 (5 to 9)
Adjustment	By moving control arm mountings
Dampers:	
Type and part No.	RIV (4317672) or BOGE (4317135)

HUBS, WHEELS AND TYRES

Hubs:	
Front:	
Bearing end play	.001 to .004 (.025 to .100)
Rear:	
Rolling torque of bearings	4.34 lb inch (5 kgcm)
Wheels:	
Rim size	4.00 × 12
Tyres:	
Size	135 × 12 radial ply
Inflation pressure:	
Front	20 lb/sq inch (1.4 kg/sq cm)
Rear	28 lb/sq inch (2.0 kg/sq cm)

BRAKES

Brakes:	
Type	Hydraulic, dual-circuit, drum, with self-centring shoes
Handbrake	Cable to rear brakes, with adjusters
Drum diameter	6.697 to 6.708 (170.1 to 170.4)
Maximum drum oversize permissible	+ .04 (1.0)
Linings:	
Width	1.18 (30)
Developed length	7.08 (180)
Finished thickness	.165 to .177 (4.2 to 4.5)
Cylinder bore:	
Master	.75 (19.05)
Wheel	.9375 (23.80) (front), .625 (15.70) (rear)
Brake fluid	Fiat special blue label DOT 3 or NHTSA Standard No. 116.S6 DOT 3

ELECTRICAL EQUIPMENT

Battery:	
Voltage	12
Capacity at 20 hr discharge rate	34 amp/hr
Earthing	Negative
Generator:	
Type	Fiat DSV.90/12/16/3.S
Maximum steady output	230 watts
Maximum steady current	16 amp
Speed for maximum steady current output at 12 volts	2550 to 2700 rev/min at 20°C (68°F)
Minimum speed to start charging with lights off	1200 rev/min (engine) or 17 mile/hr (27 kg/hr) in top gear
Armature resistance	.145 ± .01 ohms at 20°C (68°F)
Field coil resistance	7.7 to 8.1 ohms at 20°C (68°F)
Commutator out-of-round	.0004 maximum (.01)
Commutator mica undercutting	.04 deep (1.0)
Lubrication	Fiat MR 3 grease or lithium-base No. 3

Starter motor:	
Type	Fiat B.76-0.5/12.S
Rated output	.50 kW
Engagement	Pre-engaged, with overrunning clutch
Control	By cable
No-load test (at 25°C or 77°F)	Current 26 amp, at 12-volts giving speed of 10,000 rev/min
Brush pressure (unworn)	2.5 to 2.9 lb (1.15 to 1.30 kg)
Armature end float	.0059 to .0256 (.15 to .65)
Commutator mica undercutting	.04 deep (1.0)
Lubrication:	
Pinion splines and end bearings	Fiat VS.10W oil (SAE 10W)
Lever contact faces	Fiat MR 3 grease or lithium-base No. 3
Regulator:	
Type	Fiat GN.2/12/16
Cut-out:	
Cut-in voltage after 30 minutes of temperature stabilisation	12.4 to 12.8
Reverse current	16 amp
Points gap	.018 ± .002 (.45 ± .06)
Voltage regulator:	
Battery for testing	50 amp/hr
Regulated voltage on battery after 30 minute temperature stabilisation on half load	13.9 to 14.5
Pole piece air gap	.039 to .044 (.99 to 1.11)
Current regulator:	
Regulated current on battery after 30 minute temperature stabilisation	15 to 17 amp
Voltage for testing regulated current	13
Pole piece air gap	.039 to .044 (.99 to 1.11)
Light bulbs:	
Headlamps (double filament type):	
High beam	45W
Low beam	40W
Front parking	5W
Direction indicator (front)	21W
Indicator repeaters	4W tubular
Direction indicator (rear)	21W
Tail and stop lights (double filament):	
Tail	5W
Stop	21W
Number plate lamp	5W
Interior light	5W
Instrument cluster and parking light indicator	3W (all glass)
Indicator repeater, no-charge warning, low oil pressure and high beam indicator	1.2W (all glass)
Fuses:	
Eight in all	8 amp

CAPACITIES

Fuel tank	4.6 gal. (5.5 US gal. or 21 litres)
Inclusive reserve supply	1.1 gal. (1.3 US gal. or 5 litres)
Sump	4.4 pints (5.3 US pints or 2.5 litres)
Transmission and differential	2 pints (2.3 US pints or 1.10 litres)
Steering gearbox	4.2 fl oz (4 US fl oz or .12 litre)
Brake circuits	12.2 fl oz (12 US fl oz or .35 litre)

TIGHTENING TORQUES (lb ft, with kgm in brackets)

Engine:	
Bolt, main bearing support	22 (3)
Bolt, flywheel to crankshaft	25 (3.5)
Nut, cylinder head	29 (4)
Cap nut, cylinder head	29 (4)
Nut, connecting rod cap	25 (3.5)
Bolt, camshaft sprocket	7 (1)
Nut, rocker shaft support	18 (2.5)
Bolt, engine pulley	108 (15)
Nut, fan to generator	25 (3.5)
Nut, pulley to generator	25 (3.5)
Gearbox and differential:	
Nut, clutch cable bracket	11 (1.5)
Nut, bellhousing to engine	18 (2.5)
Nut, transmission to bellhousing	25 (3.5)
Nut, countershaft	36 (5), tightening further to align slot
Nut, mainshaft	36 (5), tightening further to align slot
Bolt, reverse shaft	11 (1.5)
Bolt, gearlever support	11 (1.5)
Nut, inner cup to gearlever	11 (1.5)
Bolt, ring gear	32.5 (4.5)
Nut differential bearing housing	11 (1.5)
Bolt, sleeve to axle shaft joint	18 (2.5)
Front suspension:	
Wheel bolt	36 (5)
Nut, leaf spring to knuckle pillar	29 (4)
Nut, control arm to shaft	18 (2.5)
Nut, rubber buffer	11 (1.5)
Nut, leaf spring insulator	22 (3)
Nut, control arm shaft to body	22 (3)
Nut, control arm to knuckle pillar	43.5 (6)
Nut, damper fixing	14.5 (2)
Nut, brake backplate to knuckle pillar	14.5 (2)
Rear suspension:	
Wheel bolt	36 (5)
Nut, control arm buffer	11 (1.5)
Bolt, control arm support (front)	36 (5)
Nut, control arm shaft	58 (8)
Nut, damper fixing	22 (3)
Bolt, brake drum	61.5 (8.5)
Nut, brake backplate to control arm	40 (5.5)
Steering:	
Nut, steering wheel	36 (5)
Nut, column universal joint	18 (2.5)
Nut, upper column rear attachment	11 (1.5)
Nut, steering gear housing	22 (3)
Nut, Pitman arm	72 (10)
Nut, idler arm support	22 (3)
Nut, idler arm	50.5 (7)
Nut, tie rod clamp	11 (1.5)
Nut, ball joint stud	25 (3.5)

Brakes:	
Nut, master cylinder and pedal support	11 (1.5)
Connector, hose to wheel cylinder	14.5 (2)
Nut, backplate (rear)	40 (5.5)
Bolt, rear brake drum	61.5 (8.5)
Bolt, handbrake support	11 (1.5)
Bolt, wheel cylinder to backplate	7 (1)
Sparking plugs	22 (3)

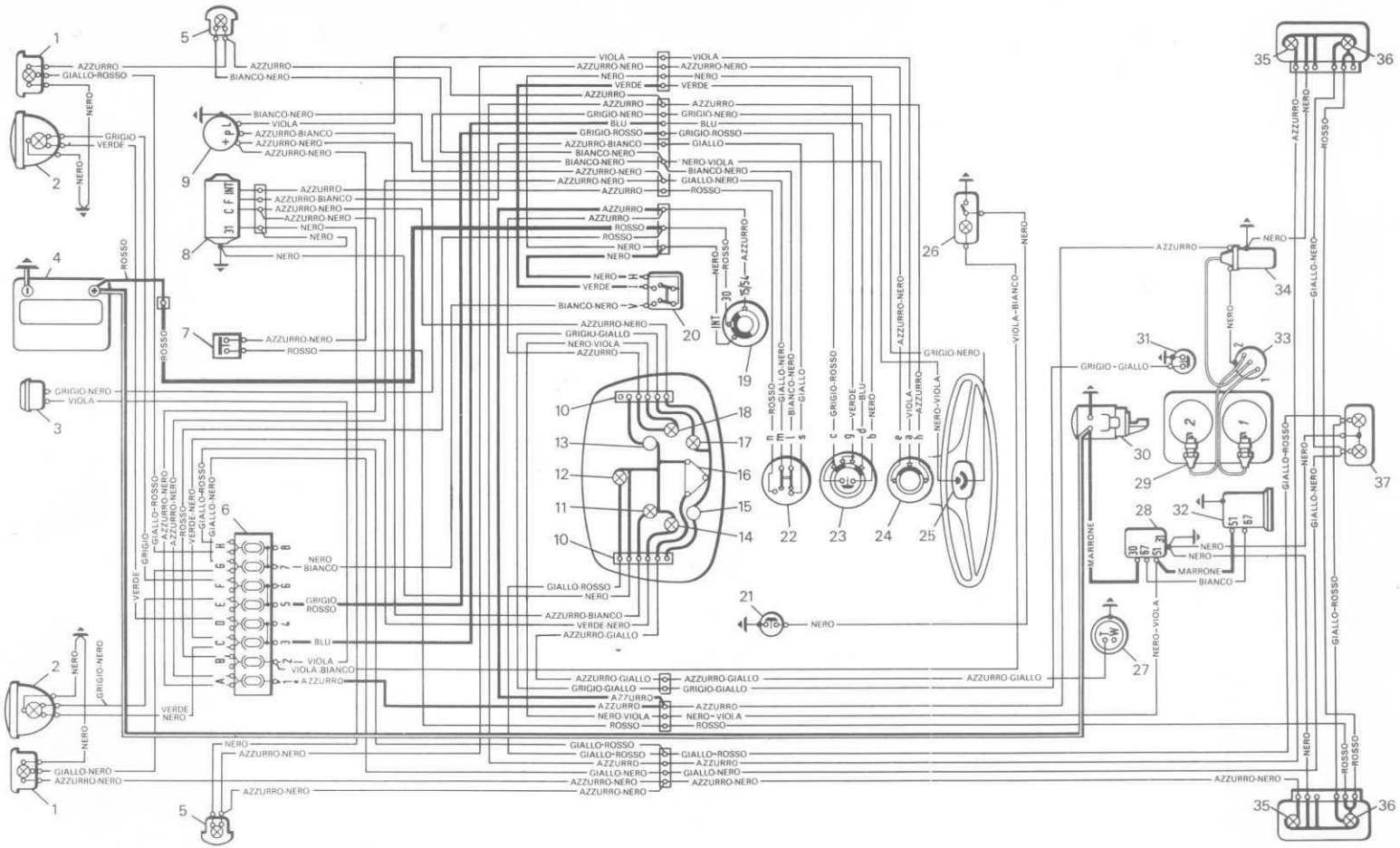

FIG 13:1 Wiring diagram for Fiat 126

Key to Fig 13:1 1 Front parking and indicator lights 2 Headlamps 3 Horn 4 Battery 5 Indicator repeaters 6 Fuses 7 Stoplight switch 8 Wiper motor 9 Flasher unit 10 Junctions 11 Indicator warning (green) 12 Parking warning (green) and instrument light 13 Spare indicator 14 High beam warning (blue) 15 Spare indicator 16 Fuel gauge 17 Oil pressure warning (red) 18 No-charge warning (red) 19 Ignition and starting switch 20 Exterior lights switch 21 Courtesy light switch 22 Wiper switch 23 Dipswitch and headlamp flasher 24 Indicator switch 25 Horn button 26 Courtesy light 27 Fuel gauge sender 28 Regulator 29 Sparking plugs 30 Starter motor 31 Low oil pressure sender 32 Generator 33 Distributor 34 Ignition coil 35 Rear indicators 36 Tail and stoplights 37 Number plate lights

Key to Cable Colour Code: Azzuro (light blue) Giallo (yellow) Rosso (red) Nero (black) Grigio (grey) Verde (green) Bianco (white) Viola (violet) Blu (dark blue)

Inches	Decimals	Milli-metres	Inches to Millimetres		Millimetres to Inches	
			Inches	mm	mm	Inches
1/64	.015625	.3969	.001	.0254	.01	.00039
1/32	.03125	.7937	.002	.0508	.02	.00079
3/64	.046875	1.1906	.003	.0762	.03	.00118
1/16	.0625	1.5875	.004	.1016	.04	.00157
5/64	.078125	1.9844	.005	.1270	.05	.00197
3/32	.09375	2.3812	.006	.1524	.06	.00236
7/64	.109375	2.7781	.007	.1778	.07	.00276
1/8	.125	3.1750	.008	.2032	.08	.00315
9/64	.140625	3.5719	.009	.2286	.09	.00354
5/32	.15625	3.9687	.01	.254	.1	.00394
11/64	.171875	4.3656	.02	.508	.2	.00787
3/16	.1875	4.7625	.03	.762	.3	.01181
13/64	.203125	5·1594	.04	1.016	.4	.01575
7/32	.21875	5.5562	.05	1.270	.5	.01969
15/64	.234375	5.9531	.06	1.524	.6	.02362
1/4	.25	6.3500	.07	1.778	.7	.02756
17/64	.265625	6.7469	.08	2.032	.8	.03150
9/32	.28125	7.1437	.09	2.286	.9	.03543
19/64	.296875	7.5406	.1	2.54	1	.03937
5/16	.3125	7.9375	.2	5.08	2	.07874
21/64	.328125	8.3344	.3	7.62	3	.11811
11/32	.34375	8.7312	.4	10.16	4	.15748
23/64	.359375	9.1281	.5	12.70	5	.19685
3/8	.375	9.5250	.6	15.24	6	.23622
25/64	.390625	9.9219	.7	17.78	7	.27559
13/32	.40625	10.3187	.8	20.32	8	.31496
27/64	.421875	10.7156	.9	22.86	9	.35433
7/16	.4375	11.1125	1	25.4	10	.39370
29/64	.453125	11.5094	2	50.8	11	.43307
15/32	.46875	11.9062	3	76.2	12	.47244
31/64	.484375	12.3031	4	101.6	13	.51181
1/2	.5	12.7000	5	127.0	14	.55118
33/64	.515625	13.0969	6	152.4	15	.59055
17/32	.53125	13.4937	7	177.8	16	.62992
35/64	.546875	13.8906	8	203.2	17	.66929
9/16	.5625	14.2875	9	228.6	18	.70866
37/64	.578125	14.6844	10	254.0	19	.74803
19/32	.59375	15.0812	11	279.4	20	.78740
39/64	.609375	15.4781	12	304.8	21	.82677
5/8	.625	15.8750	13	330.2	22	.86614
41/64	.640625	16.2719	14	355.6	23	.90551
21/32	.65625	16.6687	15	381.0	24	.94488
43/64	.671875	17.0656	16	406.4	25	.98425
11/16	.6875	17.4625	17	431.8	26	1.02362
45/64	.703125	17.8594	18	457.2	27	1.06299
23/32	.71875	18.2562	19	482.6	28	1.10236
47/64	.734375	18.6531	20	508.0	29	1.14173
3/4	.75	19.0500	21	533.4	30	1.18110
49/64	.765625	19.4469	22	558.8	31	1.22047
25/32	.78125	19.8437	23	584.2	32	1.25984
51/64	.796875	20.2406	24	609.6	33	1.29921
13/16	.8125	20.6375	25	635.0	34	1.33858
53/64	.828125	21.0344	26	660.4	35	1.37795
27/32	.84375	21.4312	27	685.8	36	1.41732
55/64	.859375	21.8281	28	711.2	37	1.4567
7/8	.875	22.2250	29	736.6	38	1.4961
57/64	.890625	22.6219	30	762.0	39	1.5354
29/32	.90625	23.0187	31	787.4	40	1.5748
59/64	.921875	23.4156	32	812.8	41	1.6142
15/16	.9375	23.8125	33	838.2	42	1.6535
61/64	.953125	24.2094	34	863.6	43	1.6929
31/32	.96875	24.6062	35	889.0	44	1.7323
63/64	.984375	25.0031	36	914.4	45	1.7717

UNITS	Pints to Litres	Gallons to Litres	Litres to Pints	Litres to Gallons	Miles to Kilometres	Kilometres to Miles	Lbs. per sq. In. to Kg. per sq. Cm.	Kg. per sq. Cm. to Lbs. per sq. In.
1	.57	4.55	1.76	.22	1.61	.62	.07	14.22
2	1.14	9.09	3.52	.44	3.22	1.24	.14	28.50
3	1.70	13.64	5.28	.66	4.83	1.86	.21	42.67
4	2.27	18.18	7.04	.88	6.44	2.49	.28	56.89
5	2.84	22.73	8.80	1.10	8.05	3.11	.35	71.12
6	3.41	27.28	10.56	1.32	9.66	3.73	.42	85.34
7	3.98	31.82	12.32	1.54	11.27	4.35	.49	99.56
8	4.55	36.37	14.08	1.76	12.88	4.97	.56	113.79
9		40.91	15.84	1.98	14.48	5.59	.63	128.00
10		45.46	17.60	2.20	16.09	6.21	.70	142.23
20				4.40	32.19	12.43	1.41	284.47
30				6.60	48.28	18.64	2.11	426.70
40				8.80	64.37	24.85		
50					80.47	31.07		
60					96.56	37.28		
70					112.65	43.50		
80					128.75	49.71		
90					144.84	55.92		
100					160.93	62.14		

UNITS	Lb ft to kgm	Kgm to lb ft	UNITS	Lb ft to kgm	Kgm to lb ft
1	.138	7.233	7	.967	50.631
2	.276	14.466	8	1.106	57.864
3	.414	21.699	9	1.244	65.097
4	.553	28.932	10	1.382	72.330
5	.691	36.165	20	2.765	144.660
6	.829	43.398	30	4.147	216.990

NOTES

HINTS ON MAINTENANCE AND OVERHAUL

There are few things more rewarding than the restoration of a vehicle's original peak of efficiency and smooth performance.

The following notes are intended to help the owner to reach that state of perfection. Providing that he possesses the basic manual skills he should have no difficulty in performing most of the operations detailed in this manual. It must be stressed, however, that where recommended in the manual, highly-skilled operations ought to be entrusted to experts, who have the necessary equipment, to carry out the work satisfactorily.

Quality of workmanship:

The hazardous driving conditions on the roads to-day demand that vehicles should be as nearly perfect, mechanically, as possible. It is therefore most important that amateur work be carried out with care, bearing in mind the often inadequate working conditions, and also the inferior tools which may have to be used. It is easy to counsel perfection in all things, and we recognize that it may be setting an impossibly high standard. We do, however, suggest that every care should be taken to ensure that a vehicle is as safe to take on the road as it is humanly possible to make it.

Safe working conditions:

Even though a vehicle may be stationary, it is still potentially dangerous if certain sensible precautions are not taken when working on it while it is supported on jacks or blocks. It is indeed preferable not to use jacks alone, but to supplement them with carefully placed blocks, so that there will be plenty of support if the car rolls off the jacks during a strenuous manoeuvre. Axle stands are an excellent way of providing a rigid base which is not readily disturbed. Piles of bricks are a dangerous substitute. Be careful not to get under heavy loads on lifting tackle, the load could fall. It is preferable not to work alone when lifting an engine, or when working underneath a vehicle which is supported well off the ground. To be trapped, particularly under the vehicle, may have unpleasant results if help is not quickly forthcoming. Make some provision, however humble, to deal with fires. Always disconnect a battery if there is a likelihood of electrical shorts. These may start a fire if there is leaking fuel about. This applies particularly to leads which can carry a heavy current, like those in the starter circuit. While on the subject of electricity, we must also stress the danger of using equipment which is run off the mains and which has no earth or has faulty wiring or connections. So many workshops have damp floors, and electrical shocks are of such a nature that it is sometimes impossible to let go of a live lead or piece of equipment due to the muscular spasms which take place.

Work demanding special care:

This involves the servicing of braking, steering and suspension systems. On the road, failure of the braking system may be disastrous. Make quite sure that there can be no possibility of failure through the bursting of rusty brake pipes or rotten hoses, nor to a sudden loss of pressure due to defective seals or valves.

Problems:

The chief problems which may face an operator are:

1 External dirt.
2 Difficulty in undoing tight fixings.
3 Dismantling unfamiliar mechanisms.
4 Deciding in what respect parts are defective.
5 Confusion about the correct order for reassembly.
6 Adjusting running clearances.
7 Road testing.
8 Final tuning.

Practical suggestion to solve the problems:

1 Preliminary cleaning of large parts—engines, transmissions, steering, suspensions, etc.,—should be carried out before removal from the car. Where road dirt and mud alone are present, wash clean with a high-pressure water jet, brushing to remove stubborn adhesions, and allow to drain and dry. Where oil or grease is also present, wash down with a proprietary compound (Gunk, Teepol etc.,) applying with a stiff brush—an old paint brush is suitable—into all crevices. Cover the distributor and ignition coils with a polythene bag and then apply a strong water jet to clear the loosened deposits. Allow to drain and dry. The assemblies will then be sufficiently clean to remove and transfer to the bench for the next stage.

   On the bench, further cleaning can be carried out, first wiping the parts as free as possible from grease with old newspaper. Avoid using rag or cotton waste which can leave clogging fibres behind. Any remaining grease can be removed with a brush dipped in paraffin. If necessary, traces of paraffin can be removed by carbon tetrachloride. Avoid using paraffin or petrol in large quantities for cleaning in enclosed areas, such as garages, on account of the high fire risk.

   When all exteriors have been cleaned, and not before, dismantling can be commenced. This ensures that dirt will not enter into interiors and orifices revealed by dismantling. In the next phases, where components have to be cleaned, use carbon tetrachloride in preference to petrol and keep the containers covered except when in use. After the components have been cleaned, plug small holes with tapered hard wood plugs cut to size and blank off larger orifices with greaseproof paper and masking tape. Do not use soft wood plugs or matchsticks as they may break.
2 It is not advisable to hammer on the end of a screw thread, but if it must be done, first screw on a nut to protect the thread, and use a lead hammer. This applies particularly to the removal of tapered cotters. Nuts and bolts seem to 'grow' together, especially in exhaust systems. If penetrating oil does not work, try the judicious application of heat, but be careful of starting a fire. Asbestos sheet or cloth is useful to isolate heat.

   Tight bushes or pieces of tail-pipe rusted into a silencer can be removed by splitting them with an open-ended hacksaw. Tight screws can sometimes be started by a tap from a hammer on the end of a suitable screwdriver. Many tight fittings will yield to the judicious use of a hammer, but it must be a soft-faced hammer if damage is to be avoided, use a heavy block on the opposite side to absorb shock. Any parts of the

steering system which have been damaged should be renewed, as attempts to repair them may lead to cracking and subsequent failure, and steering ball joints should be disconnected using a recommended tool to prevent damage.

3 If often happens that an owner is baffled when trying to dismantle an unfamiliar piece of equipment. So many modern devices are pressed together or assembled by spinning-over flanges, that they must be sawn apart. The intention is that the whole assembly must be renewed. However, parts which appear to be in one piece to the naked eye, may reveal close-fitting joint lines when inspected with a magnifying glass, and, this may provide the necessary clue to dismantling. Left-handed screw threads are used where rotational forces would tend to unscrew a righthanded screw thread.

Be very careful when dismantling mechanisms which may come apart suddenly. Work in an enclosed space where the parts will be contained, and drape a piece of cloth over the device if springs are likely to fly in all directions. Mark everything which might be reassembled in the wrong position, scratched symbols may be used on unstressed parts, or a sequence of tiny dots from a centre punch can be useful. Stressed parts should never be scratched or centre-popped as this may lead to cracking under working conditions. Store parts which look alike in the correct order for reassembly. Never rely upon memory to assist in the assembly of complicated mechanisms, especially when they will be dismantled for a long time, but make notes, and drawings to supplement the diagrams in the manual, and put labels on detached wires. Rust stains may indicate unlubricated wear. This can sometimes be seen round the outside edge of a bearing cup in a universal joint. Look for bright rubbing marks on parts which normally should not make heavy contact. These might prove that something is bent or running out of truth. For example, there might be bright marks on one side of a piston, at the top near the ring grooves, and others at the bottom of the skirt on the other side. This could well be the clue to a bent connecting rod. Suspected cracks can be proved by heating the component in a light oil to approximately 100°C, removing, drying off, and dusting with french chalk, if a crack is present the oil retained in the crack will stain the french chalk.

4 In determining wear, and the degree, against the permissible limits set in the manual, accurate measurement can only be achieved by the use of a micrometer. In many cases, the wear is given to the fourth place of decimals; that is in ten-thousandths of an inch. This can be read by the vernier scale on the barrel of a good micrometer. Bore diameters are more difficult to determine. If, however, the matching shaft is accurately measured, the degree of play in the bore can be felt as a guide to its suitability. In other cases, the shank of a twist drill of known diameter is a handy check.

Many methods have been devised for determining the clearance between bearing surfaces. To-day the best and simplest is by the use of Plastigage, obtainable from most garages. A thin plastic thread is laid between the two surfaces and the bearing is tightened, flattening the thread. On removal, the width of the thread is compared with a scale supplied with the thread and the clearance is read off directly. Sometimes joint faces leak persistently, even after gasket renewal. The fault will then be traceable to distortion, dirt or burrs. Studs which are screwed into soft metal frequently raise burrs at the point of entry. A quick cure for this is to chamfer the edge of the hole in the part which fits over the stud.

5 **Always check a replacement part with the original one before it is fitted.**

If parts are not marked, and the order for reassembly is not known, a little detective work will help. Look for marks which are due to wear to see if they can be mated. Joint faces may not be identical due to manufacturing errors, and parts which overlap may be stained, giving a clue to the correct position. Most fixings leave identifying marks especially if they were painted over on assembly. It is then easier to decide whether a nut, for instance, has a plain, a spring, or a shakeproof washer under it. All running surfaces become 'bedded' together after long spells of work and tiny imperfections on one part will be found to have left corresponding marks on the other. This is particularly true of shafts and bearings and even a score on a cylinder wall will show on the piston.

6 Checking end float or rocker clearances by feeler gauge may not always give accurate results because of wear. For instance, the rocker tip which bears on a valve stem may be deeply pitted, in which case the feeler will simply be bridging a depression. Thrust washers may also wear depressions in opposing faces to make accurate measurement difficult. End float is then easier to check by using a dial gauge. It is common practice to adjust end play in bearing assemblies, like front hubs with taper rollers, by doing up the axle nut until the hub becomes stiff to turn and then backing it off a little. Do not use this method with ballbearing hubs as the assembly is often preloaded by tightening the axle nut to its fullest extent. If the splitpin hole will not line up, file the base of the nut a little.

Steering assemblies often wear in the straight-ahead position. If any part is adjusted, make sure that it remains free when moved from lock to lock. Do not be surprised if an assembly like a steering gearbox, which is known to be carefully adjusted outside the car, becomes stiff when it is bolted in place. This will be due to distortion of the case by the pull of the mounting bolts, particularly if the mounting points are not all touching together. This problem may be met in other equipment and is cured by careful attention to the alignment of mounting points.

When a spanner is stamped with a size and A/F it means that the dimension is the width between the jaws and has no connection with ANF, which is the designation for the American National Fine thread. Coarse threads like Whitworth are rarely used on cars to-day except for studs which screw into soft aluminium or cast iron. For this reason it might be found that the top end of a cylinder head stud has a fine thread and the lower end a coarse thread to screw into the cylinder block. If the car has mainly UNF threads then it is likely that any coarse threads will be UNC, which are not the same as Whitworth. Small sizes have the same number of threads in Whitworth and UNC, but in the $\frac{1}{2}$ inch size for example, there are twelve threads to the inch in the former and thirteen in the latter.

7 After a major overhaul, particularly if a great deal of work has been done on the braking, steering and suspension systems, it is advisable to approach the problem of testing with care. If the braking system has been overhauled, apply heavy pressure to the brake pedal and get a second operator to check every possible source of leakage. The brakes may work extremely well, but a leak could cause complete failure after a few miles.

Do not fit the hub caps until every wheel nut has been checked for tightness, and make sure the tyre pressures are correct. Check the levels of coolant, lubricants and hydraulic fluids. Being satisfied that all is well, take the car on the road and test the brakes at once. Check the steering and the action of the handbrake. Do all this at moderate speeds on quiet roads, and make sure there is no other vehicle behind you when you try a rapid stop.

Finally, remember that many parts settle down after a time, so check for tightness of all fixings after the car has been on the road for a hundred miles or so.

8 It is useless to tune an engine which has not reached its normal running temperature. In the same way, the tune of an engine which is stiff after a rebore will be different when the engine is again running free. Remember too, that rocker clearances on pushrod operated valve gear will change when the cylinder head nuts are tightened after an initial period of running with a new head gasket.

Trouble may not always be due to what seems the obvious cause. Ignition, carburation and mechanical condition are interdependent and spitting back through the carburetter, which might be attributed to a weak mixture, can be caused by a sticking inlet valve.

For one final hint on tuning, never adjust more than one thing at a time or it will be impossible to tell which adjustment produced the desired result.

NOTES

GLOSSARY OF TERMS

Allen key Cranked wrench of hexagonal section for use with socket head screws.

Alternator Electrical generator producing alternating current. Rectified to direct current for battery charging.

Ambient temperature Surrounding atmospheric temperature.

Annulus Used in engineering to indicate the outer ring gear of an epicyclic gear train.

Armature The shaft carrying the windings, which rotates in the magnetic field of a generator or starter motor. That part of a solenoid or relay which is activated by the magnetic field.

Axial In line with, or pertaining to, an axis.

Backlash Play in meshing gears.

Balance lever A bar where force applied at the centre is equally divided between connections at the ends.

Banjo axle Axle casing with large diameter housing for the crownwheel and differential.

Bendix pinion A self-engaging and self-disengaging drive on a starter motor shaft.

Bevel pinion A conical shaped gearwheel, designed to mesh with a similar gear with an axis usually at 90 deg. to its own.

bhp Brake horse power, measured on a dynamometer.

bmep Brake mean effective pressure. Average pressure on a piston during the working stroke.

Brake cylinder Cylinder with hydraulically operated piston(s) acting on brake shoes or pad(s).

Brake regulator Control valve fitted in hydraulic braking system which limits brake pressure to rear brakes during heavy braking to prevent rear wheel locking.

Camber Angle at which a wheel is tilted from the vertical.

Capacitor Modern term for an electrical condenser. Part of distributor assembly, connected across contact breaker points, acts as an interference suppressor.

Castellated Top face of a nut, slotted across the flats, to take a locking splitpin.

Castor Angle at which the kingpin or swivel pin is tilted when viewed from the side.

cc Cubic centimetres. Engine capacity is arrived at by multiplying the area of the bore in sq cm by the stroke in cm by the number of cylinders.

Clevis U-shaped forked connector used with a clevis pin, usually at handbrake connections.

Collet A type of collar, usually split and located in a groove in a shaft, and held in place by a retainer. The arrangement used to retain the spring(s) on a valve stem in most cases.

Commutator Rotating segmented current distributor between armature windings and brushes in generator or motor.

Compression ratio The ratio, or quantitative relation, of the total volume (piston at bottom of stroke) to the unswept volume (piston at top of stroke) in an engine cylinder.

Condenser See capacitor.

Core plug Plug for blanking off a manufacturing hole in a casting.

Crownwheel Large bevel gear in rear axle, driven by a bevel pinion attached to the propeller shaft. Sometimes called a 'ring gear'.

'C'-spanner Like a 'C' with a handle. For use on screwed collars without flats, but with slots or holes.

Damper Modern term for shock-absorber, used in vehicle suspension systems to damp out spring oscillations.

Depression The lowering of atmospheric pressure as in the inlet manifold and carburetter.

Dowel Close tolerance pin, peg, tube, or bolt, which accurately locates mating parts.

Drag link Rod connecting steering box drop arm (pitman arm) to nearest front wheel steering arm in certain types of steering systems.

Dry liner Thinwall tube pressed into cylinder bore

Dry sump Lubrication system where all oil is scavenged from the sump, and returned to a separate tank.

Dynamo See Generator.

Electrode Terminal, part of an electrical component, such as the points or 'Electrodes' of a sparking plug.

Electrolyte In lead-acid car batteries a solution of sulphuric acid and distilled water.

End float The axial movement between associated parts, end play.

EP Extreme pressure. In lubricants, special grades for heavily loaded bearing surfaces, such as gear teeth in a gearbox, or crownwheel and pinion in a rear axle.

Fade Of brakes. Reduced efficiency due to overheating.

Field coils Windings on the polepieces of motors and generators.

Fillets Narrow finishing strips usually applied to interior bodywork.

First motion shaft Input shaft from clutch to gearbox.

Fullflow filter Filters in which all the oil is pumped to the engine. If the element becomes clogged, a bypass valve operates to pass unfiltered oil to the engine.

FWD Front wheel drive.

Gear pump Two meshing gears in a close fitting casing. Oil is carried from the inlet round the outside of both gears in the spaces between the gear teeth and casing to the outlet, the meshing gear teeth prevent oil passing back to the inlet, and the oil is forced through the outlet port.

Generator Modern term for 'Dynamo'. When rotated produces electrical current.

Grommet A ring of protective or sealing material. Can be used to protect pipes or leads passing through bulkheads.

Grubscrew Fully threaded headless screw with screwdriver slot. Used for locking, or alignment purposes.

Gudgeon pin Shaft which connects a piston to its connecting rod. Sometimes called 'wrist pin', or 'piston pin'.

Halfshaft One of a pair transmitting drive from the differential.

Helical In spiral form. The teeth of helical gears are cut at a spiral angle to the side faces of the gearwheel.

Hot spot Hot area that assists vapourisation of fuel on its way to cylinders. Often provided by close contact between inlet and exhaust manifolds.

HT High Tension. Applied to electrical current produced by the ignition coil for the sparking plugs.

Hydrometer A device for checking specific gravity of liquids. Used to check specific gravity of electrolyte.

Hypoid bevel gears A form of bevel gear used in the rear axle drive gears. The bevel pinion meshes below the centre line of the crownwheel, giving a lower propeller shaft line.

Idler A device for passing on movement. A free running gear between driving and driven gears. A lever transmitting track rod movement to a side rod in steering gear.

Impeller A centrifugal pumping element. Used in water pumps to stimulate flow.

Journals Those parts of a shaft that are in contact with the bearings.

Kingpin The main vertical pin which carries the front wheel spindle, and permits steering movement. May be called 'steering pin' or 'swivel pin'.

Layshaft The shaft which carries the laygear in the gearbox. The laygear is driven by the first motion shaft and drives the third motion shaft according to the gear selected. Sometimes called the 'countershaft' or 'second motion shaft.'

lb ft A measure of twist or torque. A pull of 10 lb at a radius of 1 ft is a torque of 10 lb ft.

lb/sq in Pounds per square inch.

Little-end The small, or piston end of a connecting rod. Sometimes called the 'small-end'.

LT Low Tension. The current output from the battery.

Mandrel Accurately manufactured bar or rod used for test or centring purposes.

Manifold A pipe, duct, or chamber, with several branches.

Needle rollers Bearing rollers with a length many times their diameter.

Oil bath Reservoir which lubricates parts by immersion. In air filters, a separate oil supply for wetting a wire mesh element to hold the dust.

Oil wetted In air filters, a wire mesh element lightly oiled to trap and hold airborne dust.

Overlap Period during which inlet and exhaust valves are open together.

Panhard rod Bar connected between fixed point on chassis and another on axle to control sideways movement.

Pawl Pivoted catch which engages in the teeth of a ratchet to permit movement in one direction only.

Peg spanner Tool with pegs, or pins, to engage in holes or slots in the part to be turned.

Pendant pedals Pedals with levers that are pivoted at the top end.

Phillips screwdriver A cross-point screwdriver for use with the cross-slotted heads of Phillips screws.

Pinion A small gear, usually in relation to another gear.

Piston-type damper Shock absorber in which damping is controlled by a piston working in a closed oil-filled cylinder.

Preloading Preset static pressure on ball or roller bearings not due to working loads.

Radial Radiating from a centre, like the spokes of a wheel.

Radius rod Pivoted arm confining movement of a part to an arc of fixed radius.

Ratchet Toothed wheel or rack which can move in one direction only, movement in the other being prevented by a pawl.

Ring gear A gear tooth ring attached to outer periphery of flywheel. Starter pinion engages with it during starting.

Runout Amount by which rotating part is out of true.

Semi-floating axle Outer end of rear axle halfshaft is carried on bearing inside axle casing. Wheel hub is secured to end of shaft.

Servo A hydraulic or pneumatic system for assisting, or, augmenting a physical effort. See 'Vacuum Servo'.

Setscrew One which is threaded for the full length of the shank.

Shackle A coupling link, used in the form of two parallel pins connected by side plates to secure the end of the master suspension spring and absorb the effects of deflection.

Shell bearing Thinwalled steel shell lined with anti-friction metal. Usually semi-circular and used in pairs for main and big-end bearings.

Shock absorber See 'Damper'.

Silentbloc Rubber bush bonded to inner and outer metal sleeves.

Socket-head screw Screw with hexagonal socket for an Allen key.

Solenoid A coil of wire creating a magnetic field when electric current passes through it. Used with a soft iron core to operate contacts or a mechanical device.

Spur gear A gear with teeth cut axially across the periphery.

Stub axle Short axle fixed at one end only.

Tachometer An instrument for accurate measurement of rotating speed. Usually indicates in revolutions per minute.

TDC Top Dead Centre. The highest point reached by a piston in a cylinder, with the crank and connecting rod in line.

Thermostat Automatic device for regulating temperature. Used in vehicle coolant systems to open a valve which restricts circulation at low temperature.

Third motion shaft Output shaft of gearbox.

Threequarter floating axle Outer end of rear axle halfshaft flanged and bolted to wheel hub, which runs on bearing mounted on outside of axle casing. Vehicle weight is not carried by the axle shaft.

Thrust bearing or washer Used to reduce friction in rotating parts subject to axial loads.

Torque Turning or twisting effort. See 'lb ft'.

Track rod The bar(s) across the vehicle which connect the steering arms and maintain the front wheels in their correct alignment.

UJ Universal joint. A coupling between shafts which permits angular movement.

UNF Unified National Fine screw thread.

Vacuum servo Device used in brake system, using difference between atmospheric pressure and inlet manifold depression to operate a piston which acts to augment brake pressure as required. See 'Servo'.

Venturi A restriction or 'choke' in a tube, as in a carburetter, used to increase velocity to obtain a reduction in pressure.

Vernier A sliding scale for obtaining fractional readings of the graduations of an adjacent scale.

Welch plug A domed thin metal disc which is partially flattened to lock in a recess. Used to plug core holes in castings.

Wet liner Removable cylinder barrel, sealed against coolant leakage, where the coolant is in direct contact with the outer surface.

Wet sump A reservoir attached to the crankcase to hold the lubricating oil.

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