

A. General

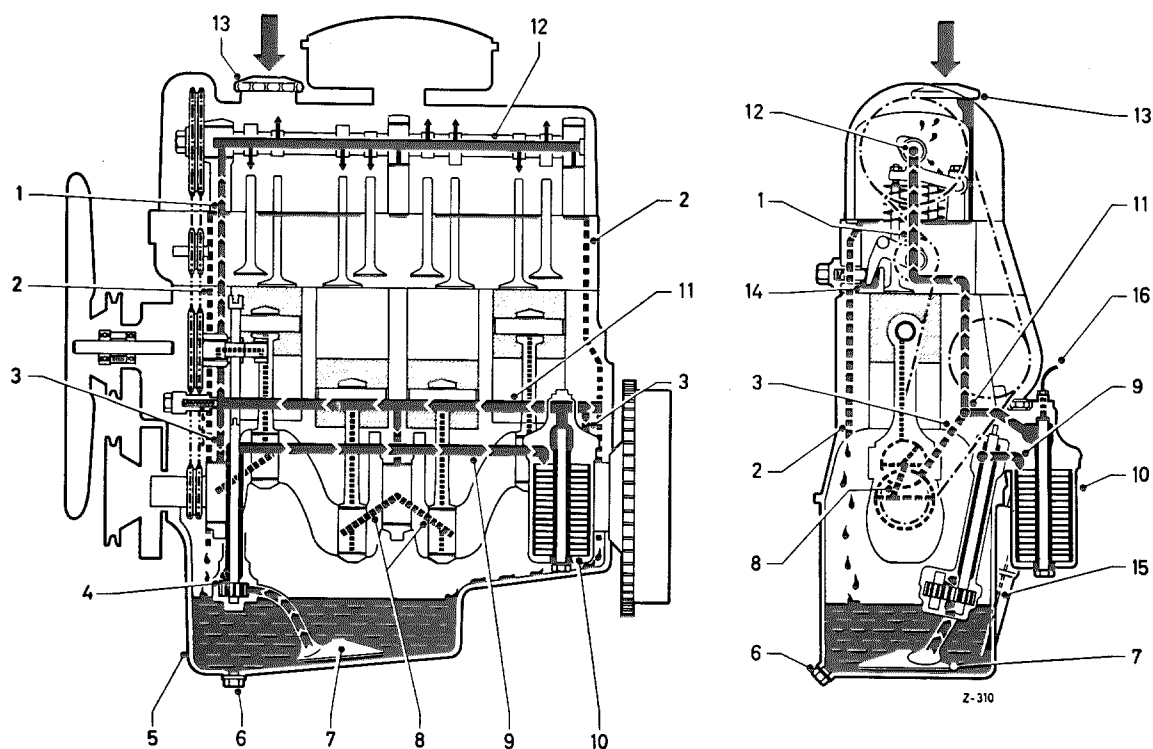


Fig. 18 — 5/1

- | | |
|-------------------------------------|---|
| 1 Oil passage to camshaft | 9 Main oil passage to oil filter |
| 2 Oil return | 10 Oil filter |
| 3 Oil passage to crankshaft bearing | 11 Main oil passage to lubrication points |
| 4 Oil pump | 12 Oil passage in camshaft |
| 5 Oil pan | 13 Screw cap for oil filling hole |
| 6 Screw plug | 14 Oil case for chain tensioner |
| 7 Suction strainer | 15 Oil dip-stick |
| 8 Oil bores in crankshaft | 16 Oil pressure gage line |

The engine lubrication is of the pressure-circulating type. From the oil pan (5) and via the suction strainer (7) the oil is pumped by the oil pump (4) through the main oil passage (9) to the oil filter (10) and from there passes in purified form to the main oil passage (11).

From the main oil passage (11) the oil passes through the bores (3) to the crankshaft bearings and from there through the bores (8) in the crankshaft to the connecting-rod bearings. For the lubrication of the connecting-rod bushings, the connecting rods are provided with a longitudinal bore.

As the oil flows through the oil passages (9) and (11), the heat from the oil is transferred to the cooling water which is maintained at a fixed temperature by means of a thermostat. As a result, both water and oil are always kept at the same temperature. On the other hand, when the engine is started from cold, the cold oil is heated by the cooling water which heats up more quickly and the optimum oil temperature is thus reached sooner.

The oil for the idling gear shaft is supplied via the vertical passage (1) in the front part of the crankcase. The vertical passage (1) in the front part of the crankcase has a hole drilled in the side for lubrication of the vertical distributor drive shaft.

The vertical passage (1) continues through the cylinder head into the first camshaft bearing block. The oil passes through a radial bore in the front bearing journal of the camshaft (which is drilled hollow) into the camshaft and from there to the bearing surfaces.

When the oil filter elements are very dirty, the oil relief valves open and the oil filter is by-passed. In the same way the oil relief valves in the oil filter housing open if the resistance of the oil filter element is too high, e. g. when during starting the oil is still cold and viscous.

The opening pressure of the oil relief valve for the metal filter element is 2 atmospheres, that of the oil relief valve for the fine filter element, 1.2 atmospheres. The oil relief valve in the upper main passage in the crankcase is provided to ensure that a specified maximum oil pressure (6 atmospheres) is not exceeded.

The minimum oil pressure must not fall below 0.3 atmospheres with the engine warm and idling.

There may be various causes for any oil pressure difficulties, viz.:

- a) The oil relief valve in the oil passage (11) must close properly.
- b) There must be no leakage at the three plugs or at the oil relief valve in the oil passages (9) and (11).
- c) All oil passages must be free from obstructions.
- d) The oil pump must of course be in proper working order and there must be sufficient oil in the oil pan.
- e) The suction tube of the oil pump must not be broken.
- f) The crankshaft journals and the crankpins must not have too much radial play.
- g) The camshaft bearing journals must not have too much radial play.
- h) The oil passage in the camshaft must be closed at the rear side by a cover.
- i) The first bearing block for the camshaft must make a perfect seal with the cylinder head surface at the contact surface.
- k) The oil outlet hole at the separating surface in the crankcase and in the cylinder head must not be blocked by the cylinder head gasket.
- l) The cylinder head gasket must not be fractured at the oil slot (connecting passage from the oil outlet hole in the crankcase to the oil passage in the cylinder head).
- m) The fixing screw for the lower part of the oil filter housing must not be too long (see Section D, Para. 8, Note).

B. Repair of Oil Pump

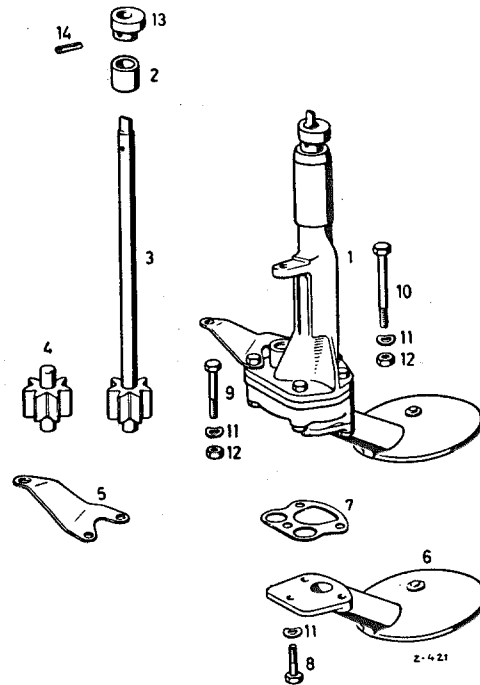


Fig. 18—5/2

- 1 Oil pump
- 2 Upper bearing bushing
- 3 Drive shaft with gear
- 4 Oil pump shaft with gear
- 5 Bracket
- 6 Suction strainer
- 7 Gasket
- 8 Hexagon screw M 6×22 DIN 931-8 G
- 9 Hexagon screw M 6×35 DIN 931-8 G
- 10 Hexagon screw M 6×55 DIN 931-8 G
- 11 Lock washer
- 12 Hexagon nut
- 13 Cam
- 14 Dowel pin

Disassembly:

1. Unscrew the suction strainer (6).
2. Unscrew the oil pump housing base and take out oil pump shaft with gear (4).
3. Tap out the dowel pin (14), pull off the cam (13) and pull out the drive shaft with gear (3).

Checking Parts:

4. Clean all parts and check for wear.
The bearing bushing (2) should be pressed out if it is worn and a new bushing pressed in. If the cast bushings in the housing base and top are worn, the whole housing must be replaced.

Worn shafts must be replaced together with the fitted gear. If the cam (13) is worn, it must also be replaced.

The separating surfaces should be checked

for evenness, using dye for this purpose. If necessary, they should be lightly machined.

Bearing Surfaces of the Oil Pump Shafts

Measurements in mm

	Diameter	Bore in oil pump housing
Drive shaft	$\frac{11.984}{11.973}$	$\frac{12.000}{12.018}$
Oil pump secondary shaft	$\frac{11.973}{11.964}$	$\frac{12.000}{12.018}$

Reassembly:

5. Before the oil pump is reassembled, the radial and end play of the gears should be carefully checked (Figs. 18—5/3 and 18—5/4).

Gear Play

Measurements in mm

Radial play	0.025-0.057
End play	0.020-0.062
Backlash	0.05 -0.10

The radial play is the clearance between the top of the teeth and the housing (Fig. 18 — 5/3).

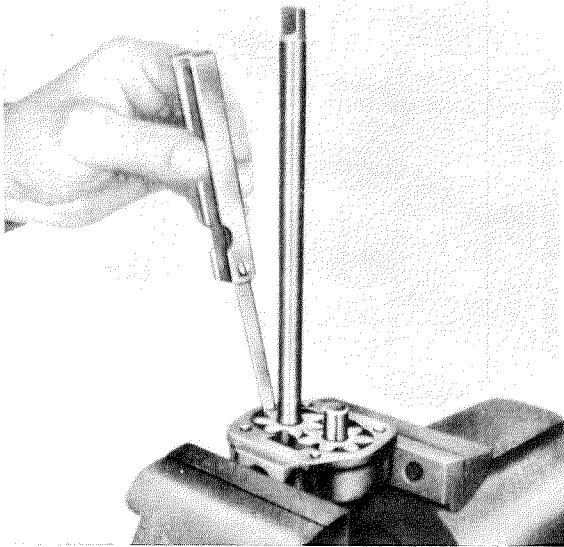


Fig. 18 — 5/3

The end play is the clearance between the face of the gear and the separating surface of the housing base (Fig. 18 — 5/4).

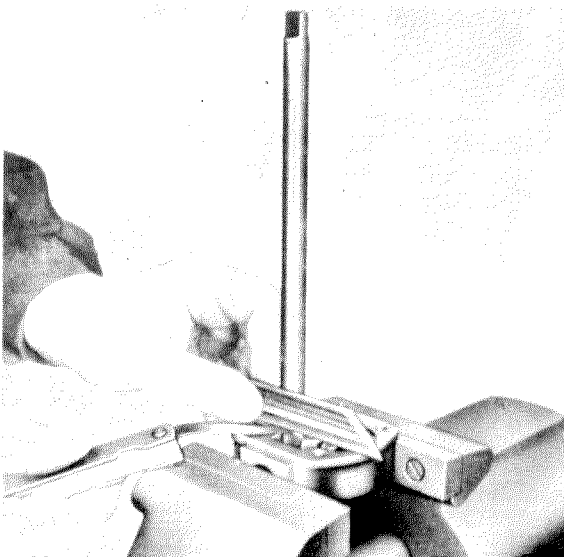


Fig. 18 — 5/4

When checking the radial and the end play, measurements should always be carried out on both gears.

6. If a new drive (3) was installed, a 4.000 to 4.075 mm diameter hole must be bored in the shaft for the dowel pin (14) after pressing on the cam (13). When doing this, a clearance of at least 0.2 mm must be maintained between the cam and the housing (Fig. 18 — 5/5).

Then drive in the dowel pin (14).

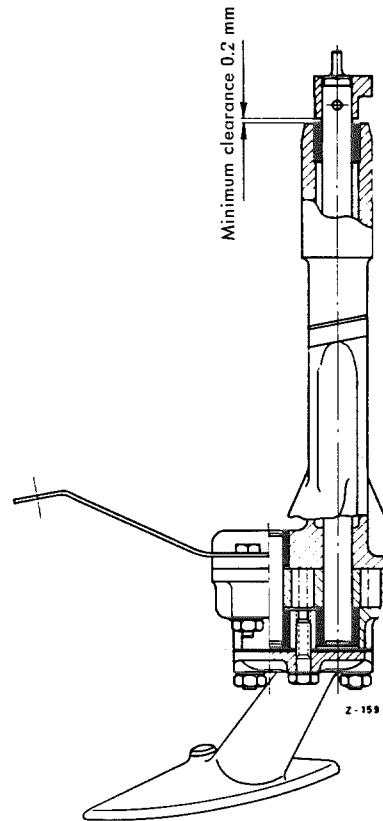


Fig. 18 — 5/5

7. Screw the housing base onto the housing top. Do not add a gasket.

When screwing on the housing base, the bracket (5) must be screwed on at the same time. Then check whether the gears can be easily turned.

8. Screw up the suction strainer (8), using a new gasket (7).

Checking of Output:

9. After assembly, the oil pump should be checked for leaks and delivery.

An oil pump is still serviceable if the minimum delivery is 80% of the specified delivery.

Pumps with a lower delivery must under all circumstances be replaced or repaired.

Delivery

Engine speed r.p.m.	Delivery kg/min.	Vacuum suction side mm Hg	Pressure delivery side atm.	Oil temperature °C.	Type of oil
5000	24.5	400	5	100°	Engine oil SAE 10

C. Cleaning and Checking of Oil Relief Valve

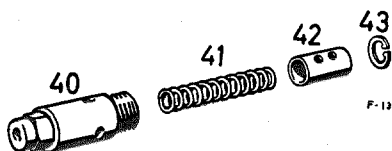


Fig. 18—5/6

40 Oil relief valve 6 atm.
41 Spring

42 Piston
43 Retainer ring

1. Disassemble the oil relief valve, removing the retainer ring (43), the piston (42) and the spring (41) from the valve housing.
2. Clean and check all parts, and check in particular the contact surfaces of the piston and cylinder. Test the spring on a spring tester.

The opening pressure is 6 ± 0.5 kg/cm².

Test Values for the Springs of the Oil Relief Valve

Length L and Pressure P					Gage of wire d mm	External diameter D mm
free length L mm	valve closed		valve open			
	L ₁ mm	P ₁ kg	L ₂ mm	P ₂ kg		
43.6	39	2.4	25	9.6	1.4	9.1—9.4

3. Reassemble the oil relief valve.

D. Disassembly, Cleaning and Reassembly of Oil Filter

The oil filter is located in the main flow and is provided with two filter elements:

- a) a metal filter element and
- b) a fine filter element (micronic element).

The filter housing top has two oil relief valves corresponding to the two filter elements.

If one of the filters is clogged, the oil passes directly through the appropriate oil relief valve so that oil circulation is not impeded.

The metal filter must be cleaned after every 4000 km; the fine filter on the other hand must be replaced after every 8000 km.

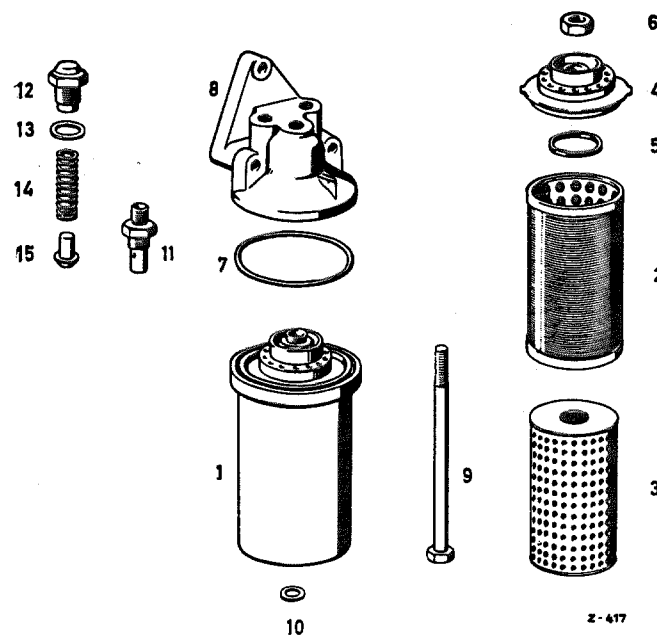


Fig. 18—5/7

- | | |
|--|--|
| 1 Oil filter housing base assembly | 9 Hexagon screw M 10×1×160 DIN 960-8 G |
| 2 Metal filter element | 10 Seal |
| 3 Fine filter element (micronic element) | 11 Threaded union |
| 4 Discharge ring | 12 Screw plug |
| 5 Seal | 13 Seal |
| 6 Hexagon nut | 14 Spring |
| 7 Seal | 15 Valve cone |
| 8 Oil filter housing top | |

Disassembly:

1. Screw out the hexagon screw (9) and remove the oil filter housing base from the housing top.

Caution! Keep the housing base vertical as it is filled with oil.

Note: The oil filter housing top (8) should not normally be unscrewed from the engine.

2. Take off the nut (6), then take out the discharge ring (4) and the metal filter and fine filter elements (2) and (3) (Fig. 18—5/8).

3. Clean the metal filter element thoroughly inside and outside with a soft brush in clean gasoline (do not use a wire brush) (Fig. 18—5/9). Then blow out with compressed air from the inside and check to ensure that all the interstices are perfectly clean. If the metal filter element is damaged, it must be replaced.

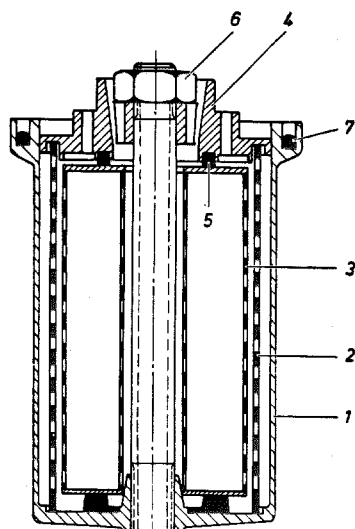


Fig. 18—5/8

- | | |
|---------------------------|---------------|
| 1 Oil filter housing base | 5 Seal |
| 2 Metal filter element | 6 Hexagon nut |
| 3 Fine filter element | 7 Seal |
| 4 Discharge ring | |

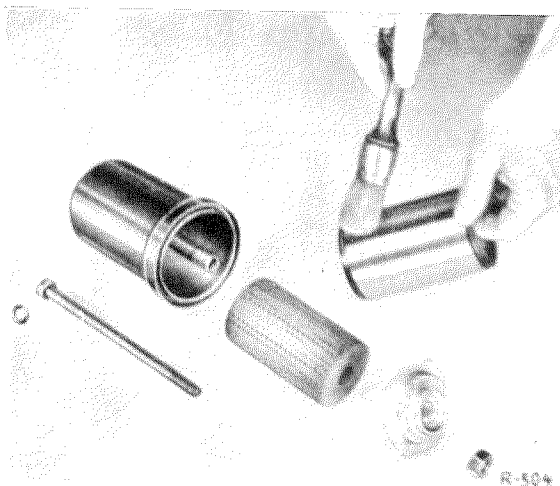
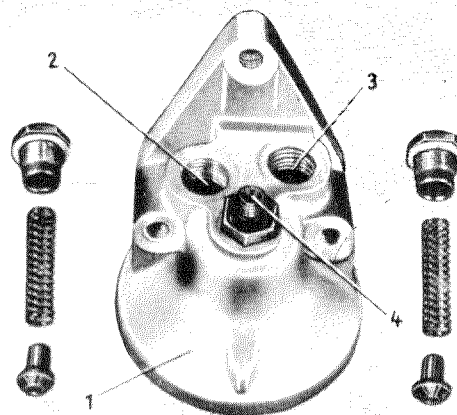


Fig. 18—5/9

Then carefully clean the base and the discharge ring in the same way. The oil from the paper filter element should only be shaken off. The paper filter element cannot and must not be cleaned; it must in any case be replaced by a new one after 8000 km. If a new fine filter element is not available it can, if necessary, be left out altogether but then the filtering will obviously be rather less effective.

4. Screw out the oil relief valves from the housing top and disassemble and clean them.



R-239

Fig. 18—5/10

- | |
|--------------------------------------|
| 1 Oil filter housing top |
| 2 Bore for oil relief valve 1.2 atm. |
| 3 Bore for oil relief valve 2 atm. |
| 4 Threaded union |

5. Check the valve springs, the valve cones and the valve seats. The springs are identical for both oil relief valves. The different opening pressures of the valves are obtained by means of a different initial tension of the springs.

The opening pressure for the oil relief valves is:

- | | |
|----------------------|-------------------------------|
| for the metal filter | $2 \pm 0.2 \text{ kg/cm}^2$ |
| for the paper filter | $1.2 \pm 0.2 \text{ kg/cm}^2$ |

Test Values for the Springs of the Oil Relief Valves

Length L and Pressure P					Gage of wire d mm	External diameter D mm
free length L mm	valve closed		valve open			
	L ₁ mm	P ₁ kg	L ₂ mm	P ₂ kg		
49	32	2.5	24	3.30	1.25	12.25

Reassembly:

6. Install the valve cones (15) and the valve springs (14) in the housing top, then screw in the screw plugs (12) together with a new seal (13) (see Fig. 18 — 5/7).
 7. Install the fine filter and metal filter elements (2) and (3) in the base. Place the seal (5) in the discharge ring (4) and after fitting the discharge ring onto the base, screw up with the nut (6) (see Fig. 18 — 5/8).
- Note:** When fitting the discharge ring make sure that it is centered in the bore of the base.
8. Insert the seal (7) in the groove in the base and screw the top and the base together

with the screw (9). Do not forget the seal (10) between the screw and the base (see Fig. 18 — 5/7).

The screw must be tightened up sufficiently for the base to be secured against leakage. But under no circumstances must the screw be tightened up too much as otherwise the bottom of the base will be collapsed.

Note: Only a 160 mm screw (9) and a new seal (10) between the base and the fixing screw may be used; if a longer screw is used, the bores for the oil pressure gage line in the top (8) might be covered and this would result in a false indication of the oil pressure.