

Removal and Installation of Engine

Job-No.

01 — 4

Normally when repairs are being carried out, only those assemblies and engine parts are removed which have to be repaired or tested. The procedures have therefore been subdivided and arranged so that in each section all the operations for removal and installation of the assembly or the part in question are given. If an engine has to be completely disassembled, the operations given in Sections A—Q must be carried out.

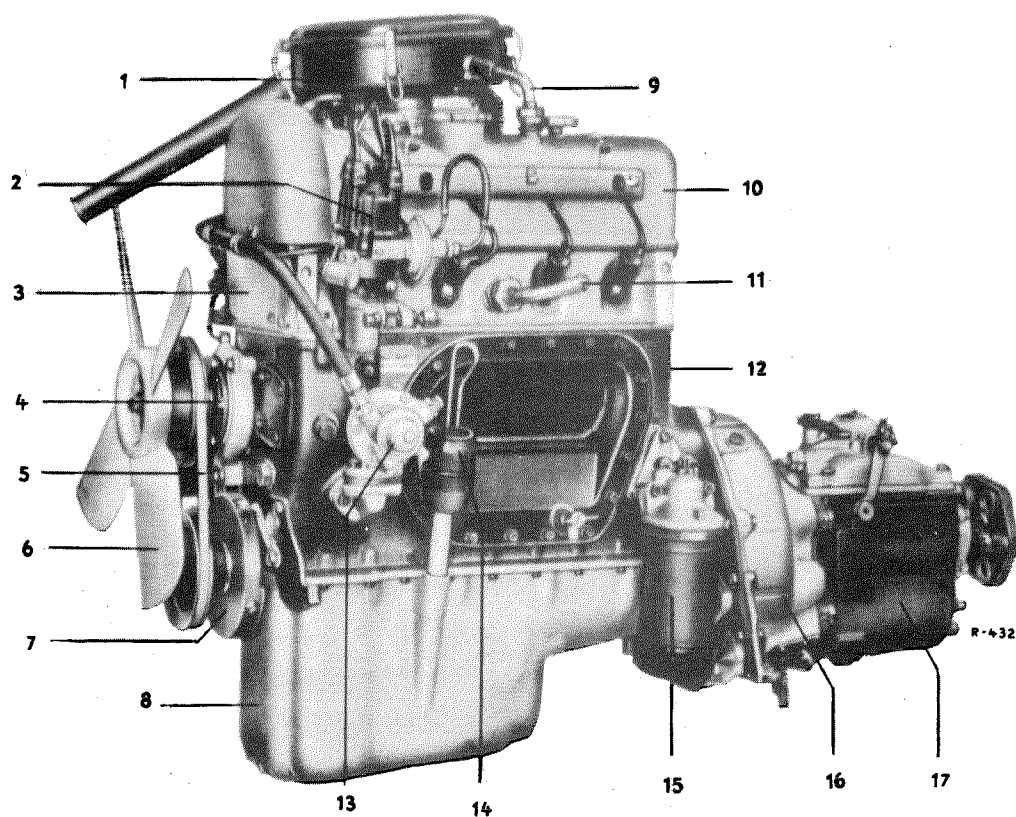
- A. Removal, installation and adjustment of carburetor
- B. Removal and installation of intake and exhaust manifold
- C. Removal and installation of cylinder head, valves, camshaft, chain tightener, tension sprocket and rocker arms
- D. Removal and installation of generator
- E. Removal and installation of water pump
- F. Removal and installation of distributor with bearing
- G. Removal and installation of distributor drive and oil pump drive
- H. Removal and installation of fuel feed pump
 - I. Removal and installation of oil filter
- K. Removal and installation of oil relief valve in crankcase
- L. Removal and installation of oil pan
- M. Removal and installation of oil pump
- N. Removal and installation of counterweight on crankshaft
- O. Removal and installation of crankshaft with flywheel
- P. Removal and installation of pistons connecting rods
- Q. Disassembly and assembly of crankcase
- R. Removal and installation of front sealing ring for crankshaft with engine in vehicle
- S. Removal and installation of flywheel
- T. Removal and installation of twin roller chain with engine in vehicle

Clean and test all parts and assemblies which have been removed. Any damaged small parts, such as screws, nuts, washers, lockwashers, etc. must be checked to see if they are fit for re-use. If necessary, they may be machined where practicable. They must not be reinstalled in damaged condition.

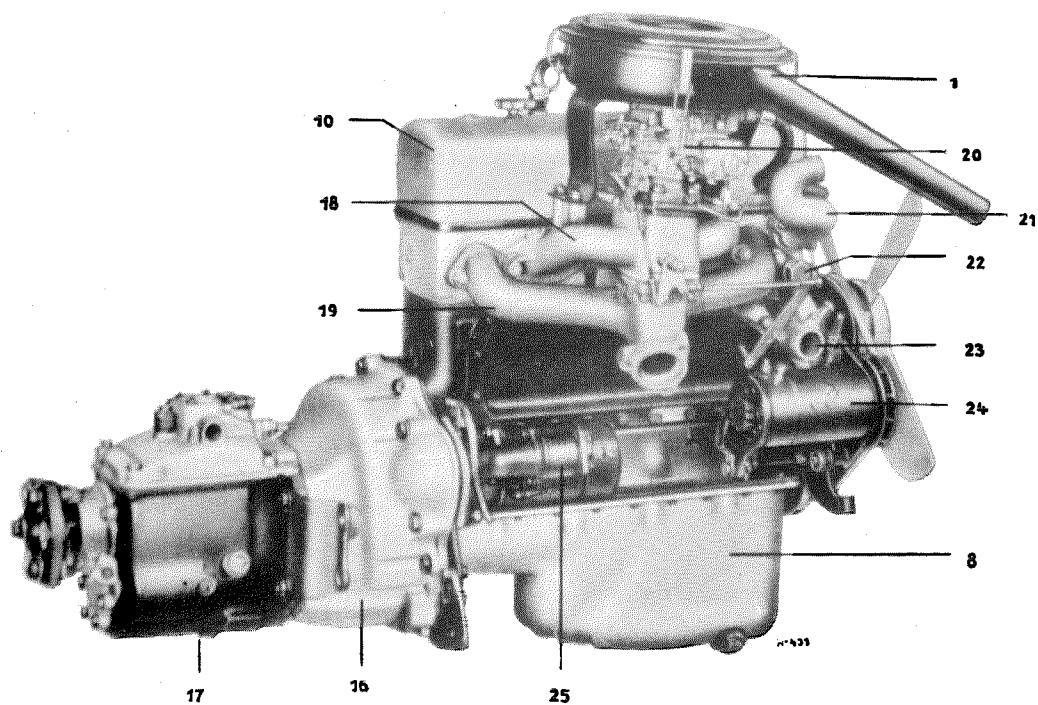
Gasket, sealing washers, locking plates, split pins, etc. must always be replaced.

All ground and precision parts — and in particular their bearing surfaces — must be examined before being reinstalled in the engine. Any damaged bearing surfaces must definitely be remachined. Check surfaces for burrs.

Engine M 121 B.I.



Spark plug side



Carburetor side

- 1 Air intake silencer
- 2 Distributor
- 3 Cylinder head
- 4 Water pump
- 5 Fan belt

- 6 Fan
- 7 Front counterweight on crankshaft
- 8 Oil pan
- 9 Vent tube

- 10 Cylinder head cover
- 11 Heater union
- 12 Crankcase
- 13 Fuel pump
- 14 Oil dipstick

- 15 Oil filter
- 16 Clutch housing
- 17 Transmission
- 18 Intake manifold
- 19 Exhaust pipe

- 20 Carburetor
- 21 Cooling water return pipe
- 22 Chain tightener
- 23 Cooling water feed pipe
- 24 Generator
- 25 Starter

A. Removal, Installation, and Adjustment of Carburetor

Repair procedure — see Job No. 07—0 and 07—4.

Removal:

1. Loosen the air vent line cap nuts at the cylinder head cover and the hose clamp for the connecting hose at the air intake silencer. Unscrew the fixing nuts for the air intake silencer brackets and remove the air intake silencer together with brackets.

2. Unscrew the fuel line and the vacuum line to the distributor, **holding steady the pipe unions** at the carburetor.

Disconnect the accelerator linkage and the return spring at the carburetor throttle valve lever.

If the engine is installed, disconnect the choke cable (see Job No. 30—6) (Fig. 01—4/1).

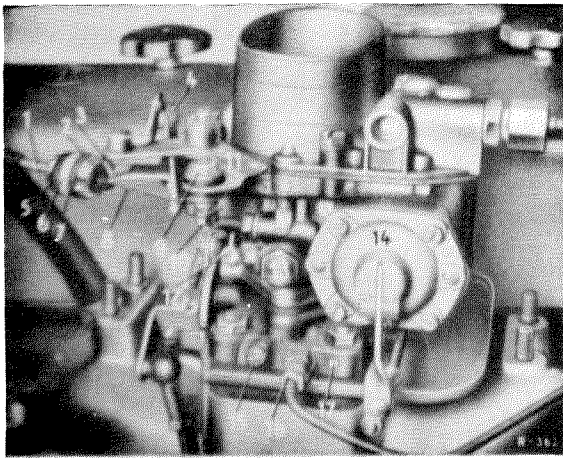


Fig. 01—4/1

- | | |
|------------------------------------|---|
| 1 Wire coil | 11 Relay lever |
| 2 Clamp | 12 Idle adjustment screw |
| 3 Hexagon screw | 13 Main jet plug with main jet of the Stage 1 |
| 4 Starter rotary slide valve lever | 14 Diaphragm pump |
| 5 Rubber grommet | 15 Idle mixture adjustment screw |
| 6 Adjusting nut | 16 Union for vacuum line to the distributor |
| 7 Rubber grommet | 17 Vacuum union for the tester |
| 8 Spring steel wire | |
| 9 Clamp screw | |
| 10 Hexagon nut | |

3. Unscrew the carburetor fixing nuts and remove the carburetor. Take care that the lock washers do not fall into the suction tube.

Installation:

4. Before the carburetor is installed, the insulating flanges and the protecting plate must be checked for planeness, and if necessary damaged parts must be replaced. Also check that the carburetor flange is perfectly plane.

Note: The two insulating flanges must be mounted without sealing compound.

5. Install the carburetor and tighten screws. **Tighten the screws evenly in order to prevent distortion of the carburetor flanges.**

6. Screw on the fuel line and the vacuum line to the distributor, **holding steady the pipe unions** at the carburetor.

Connect up the accelerator linkage and the return spring. Connect up the choke cable if engine is installed (see Job No. 30—6).

7. Fasten the brackets with the air intake silencer at the suction tube. Connect up the vent line from the cylinder head cover to the air intake silencer.

Adjustment:

8. If the engine is installed, turn the idle adjustment screw (12) until the throttle valve of Stage 1 is completely closed. Then bring the idle adjustment screw to rest against the idle stop and screw it in exactly one turn (Fig. 01—4/1).

Then check the accelerator pedal adjustment and if necessary correct (see Job No. 30—3).

Note: When adjusting the idle adjustment screw, the mechanical throttle valve of Stage 2 must be completely closed.

9. Adjust the idle (see Job No. 01—3, Section K).
10. After the initial engine warm-up, tighten up all unions, screws and nuts on the carburetor.

B. Removal and Installation of Suction Tube and Exhaust Manifold

Repair procedure — see Job No. 14—5

Removal:

Note: The suction tube and the exhaust manifold can only be removed as one unit. It is only necessary to unscrew the carburetor beforehand if the suction tube has to be replaced. In all other cases the suction tube and the exhaust manifold can be removed with the carburetor screwed on. On the other hand the air intake silencer together with the brackets must always be removed beforehand.

1. Unscrew the air vent line cap nuts at the cylinder head cover and the hose clamp for the connecting hose at the air intake silencer. Unscrew the fixing nuts for the air intake silencer brackets and remove the air intake silencer together with brackets.
2. Remove the fuel line and the vacuum line to the distributor, **holding steady the pipe unions** at the carburetor.
If the engine is installed, disconnect the choke cable (see Job No. 30—6) (see Fig. 01—4/1).
If an ATE T 50 power brake is fitted, the vacuum union at the suction tube must be disconnected if the repair is being done with the engine installed.
3. Disconnect the accelerator linkage at the accelerator pedal relay lever.
If the engine is installed, remove the exhaust pipe from the exhaust manifold.
4. After releasing the fixing nuts, remove the suction tube and the exhaust manifold from the cylinder head.
5. If necessary separate the suction tube and the exhaust manifold and remove the insulating flange.

Installation:

6. After inserting the insulating flange, screw together the suction tube and the exhaust

manifold loosely. After aligning the suction tube and the exhaust manifold, either on an alignment device or on the cylinder head, tighten up the stud screw nuts.

7. Using a new gasket, screw the suction tube and the exhaust manifold onto the cylinder head.

If the engine is installed, fit the exhaust pipe to the exhaust manifold. Use a new gasket!

8. Screw on the fuel line and the vacuum line to the distributor **holding steady the pipe unions** at the carburetor. Connect up the accelerator linkage. If the engine is installed, connect the choke cable at the carburetor (see Job No. 30—6) and the vacuum line for the ATE T 50 power brake — if one is fitted — at the suction tube.
9. Screw up the brackets with the air intake silencer at the suction tube. Connect up the vent line from the cylinder head cover to the air intake silencer.
10. If the engine is installed, back out the idle adjustment screw until the throttle valve of Stage 1 is completely closed. Then bring the idle adjustment screw to rest against the idle stop and screw it in exactly one turn (see Fig. 01—4/1).
Then check the accelerator pedal adjustment and if necessary correct (see Job No. 30—3).

Note: When adjusting the idle adjustment screw, the mechanical throttle valve of Stage 2 must be completely closed.

11. Adjust the idle (see Job No. 01—3, Section K).
12. After an initial engine warm-up, tighten up all the unions, screws and nuts on the carburetor.

C. Removal and Installation of Cylinder Head, Valves, Camshaft, Chain Tightener, Tension Sprocket, and Rocker Arms

Repair procedure — see Job No. 01—5 and 05—5.

Removal:

1. Remove suction tube and exhaust manifold with carburetor screwed on (see Job No. 01—4, Section B).

2. Disconnect the fuel line at the fuel pump and the vacuum line at the distributor and, after loosening the pipe fixing clips at the cylinder head, remove both lines.

Note: In order to avoid damage to the fuel pump when detaching the fuel line, the threaded union must always be held steady with a second wrench.

3. If the engine is installed, drain off part of the cooling water. Collect water if additives are present!

Then, after loosening the hose clamp, take the rubber hose, which connects the cooling water drain union at the cylinder head to the thermostat, off the drain union.

Loosen the clamp for the pre-flow line to the heat exchanger at the cylinder head and pull off the hose.

Back out the heat feeler for the radiator thermometer from the cylinder head.

4. Unscrew the cooling water drain union. Remove the two hollow bolts for the vent line from the water pump to the cylinder head and remove the line.

5. Remove the distributor together with bearing (see Job No. 01—4, Section F).

Disconnect the ignition lead connectors from the spark plugs and screw out the spark plugs with Toggle Wrench 186 581 03 36.

6. Remove the cylinder head cover after unscrewing the two clamp screws.

7. Unscrew the rocker arm block stretch screws and remove the blocks together with the rocker arms. When doing this, always turn

the camshaft so that the rocker arms are not under load (see Fig. 01—4/17).

8. Remove the inner chain guides in the cylinder head. To do this, pull out the two pivot pins with Puller 187 589 07 33, lifting the lock wire on the chain guide with a hook (see Fig. 01—4/4).

Note: When pulling out the chain guide pivot pins use the correct threaded adapter of Puller 187 589 07 33. Originally the pivot pins had an M 5 thread and later an M 6 thread.

9. Unscrew the camshaft sprocket fixing screw (when doing so immobilize the camshaft sprocket). Remove the chain tightener and then take off the camshaft sprocket. If necessary pull off with Puller 187 589 01 33 (Fig. 01—4/2).

Pay attention to the compensating washer and the Woodruff key!

Then place the chain in the sprocket housing.

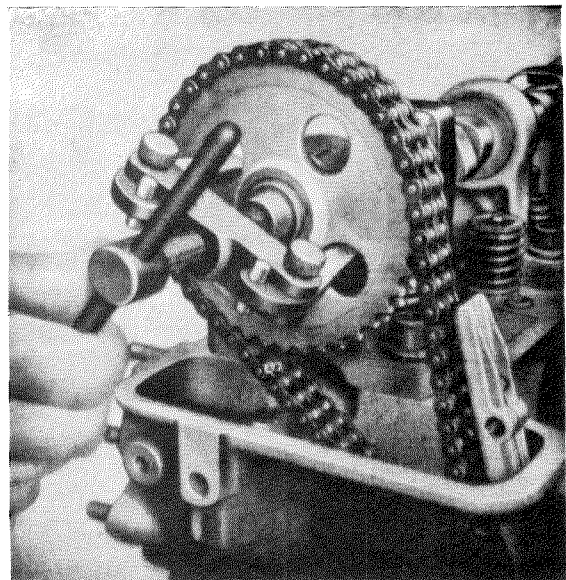


Fig. 01—4/2

Note: To avoid distortion, the cylinder head must only be removed cold.

10. Unscrew all cylinder head screws, starting at the ends and working inward, and remove them. At the same time remove the cylinder head cover clamps.

Do not omit the three hexagon socket screws at the front on the cylinder head (a, b and c in Fig. 01—4/3).

Screw d was already removed when the distributor bearing was removed. If a distributor bearing with no fixing lug is installed, screw d is removed together with screws a, b, and c.

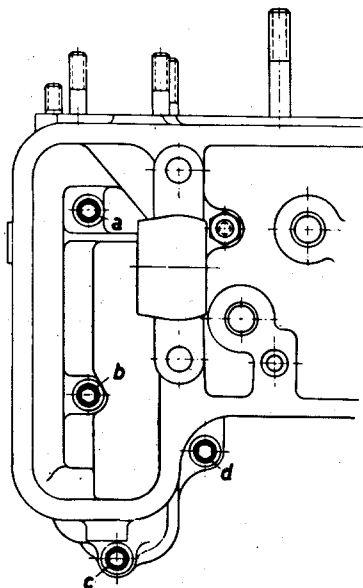


Fig. 01—4/3

- a and b Hexagon Socket Screw M 8×20 DIN 912—8 G with Washer 8.4 DIN 433.
c Hexagon Socket Screw M 8×30 DIN 912—8 G with Washer 8.4 DIN 433.
d Hexagon Socket Screw for distributor with no fixing lug M 8×20 DIN 912—8 G with Washer 8.4 DIN 433.
Hexagon Socket Screw for distributor with fixing lug M 8×45 DIN 912—8 G with Washer 8.4 DIN 125.

11. Raise the cylinder head and remove the gasket.

Where absolutely unavoidable remove the water distributor pipe from the crankcase with a pipe wrench. Pull out the camshaft toward the rear.

12. Remove the outer chain guide. To do this, pull out the two pivot pins with Puller 187 589 07 33, lifting the lock wire on the chain guide with a hook (Fig. 01—4/4).

Note: When pulling out the chain guide pivot pins, use the correct threaded adapter of

Puller 187 589 07 33. Originally the pivot pins had an M 5 thread and later an M 6 thread.

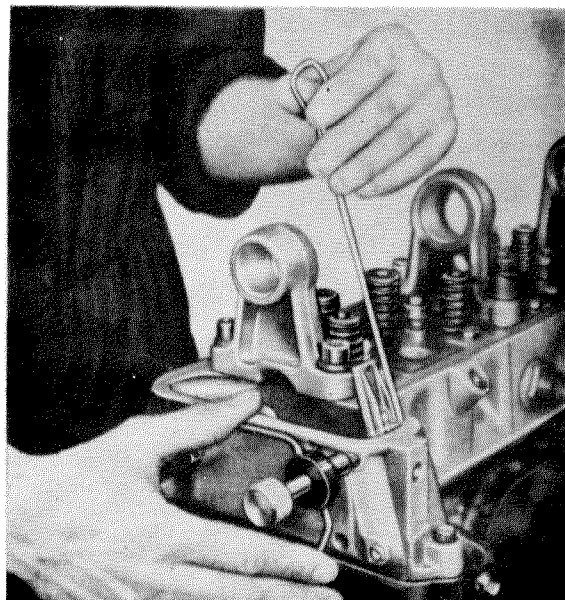


Fig. 01—4/4

13. Remove the tension sprocket bearing. To do this, pull out the pivot pins and remove the compression spring.

Note: To remove pivot pins which are jammed tight use Puller 187 589 07 33 for the chain guide pins with threaded adapter M 6.

14. Unscrew the camshaft bearing fixing nuts and remove the camshaft bearings.

The camshaft bearings should only be removed if this is unavoidable, e.g. for re-machining the cylinder head faces.

15. Remove the valve cone halves, the spring retainers, the outer and inner valve springs and take off their thrust collars. To do this, use Valve Lifter 186 589 02 31 and Valve Mounting Bridge 121 589 01 63 (Fig. 01—4/5).

Then turn cylinder head over and remove valves.

Note: Before removing the valves it is advisable to check them all for leakage with gasoline. Where valve leakage is found machine the valve seats in the cylinder head and also the valves (see Job No. 01—5, Section F and Job No. 05—5, Section A).

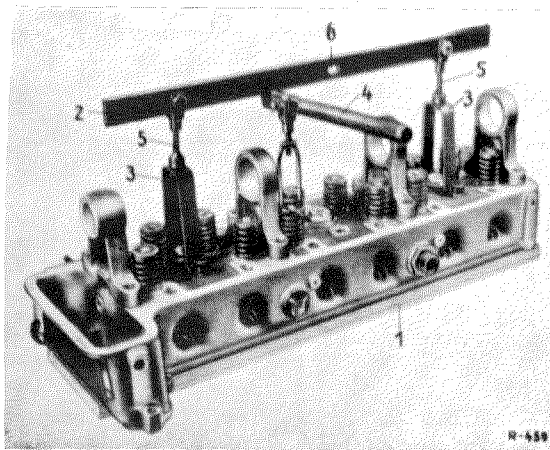


Fig. 01—4/5

- | | |
|-----------------------------|--------------------------|
| 1 Valve mounting bridge | 5 Fixing screw |
| 2 Bar | 6 Fixing screw (5) bore |
| 3 Cylinder head cover clamp | for four cylinder engine |
| 4 Valve lifter | |

Installation:

16. If the camshaft bearings were removed, check the contact surfaces of the cylinder head and camshaft bearing carefully; they must be absolutely plane and free of burrs.

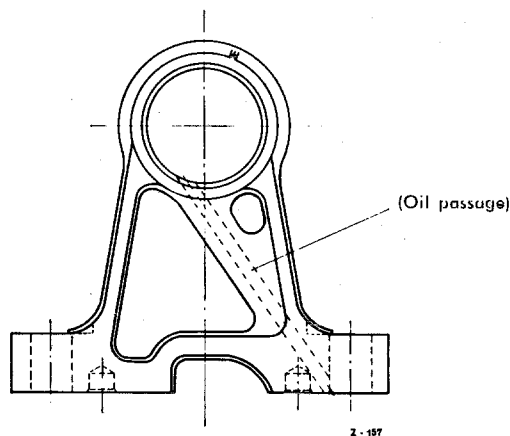


Fig. 01—4/6

1 Camshaft bearing front view

Use only dowel pins that are in perfect condition for the cylinder head. Place in position the camshaft bearings and install the fixing nuts, not forgetting their washers.

Note: An oil passage runs from the left screw shank bore in the first camshaft bearing to the camshaft lubrication bore (Fig. 01—4/6). There must be absolutely no leakage where the contact surfaces of the first camshaft bearing and the cylinder head meet. Leak-

age at this point causes loss of oil pressure. Before fitting the first camshaft bearing on the cylinder head, clean the oil passage in the camshaft bearing.

17. Check the camshaft bearing alignment. To do this, slide in the camshaft without oil; if the camshaft cannot be turned easily by hand, check to see which bearing is jamming.

For this purpose remove one of the outer camshaft bearings and again check the camshaft for freedom of movement. If the camshaft does not turn freely, install the bearing which has been removed and remove the other outer bearing to check if this bearing is jamming.

Slight bearing misalignment can be corrected by lightly tapping the base of the misaligned bearing with a plastic hammer.

It is essential that the camshaft should turn easily. This is particularly important when the cylinder head is installed and the cylinder head screws have been tightened.

18. Apply graphite oil to the valve stems and insert in the cylinder head.

Fit Valve Mounting Bridge 121 589 01 63 on the cylinder head and turn it over together with the cylinder head in order to fit the valve springs (see Fig. 01—4/5).

Apply oil to the sealing rings and press them into the valve spring retainers. Fit the thrust collars, the inner and outer valve springs, the valve-spring retainers and the valve cone halves, using Valve Lifter 186 589 02 31 (Fig. 01—4/7).

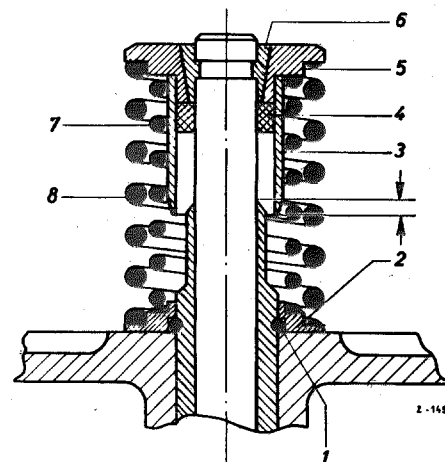


Fig. 01—4/7

- | | |
|-------------------------|-------------------------|
| 1 Snap ring | 5 Valve-spring retainer |
| 2 Thrust collar | 6 Valve cone half |
| 3 Sealing ring retainer | 7 Inner valve spring |
| 4 Sealing ring | 8 Outer valve spring |

19. Fit the tension sprocket bearing and drive in the pivot pins. When doing this, fit the compression spring between the tension sprocket bearing and the cylinder head.

20. Check whether the cylinder head screws can be screwed deeply enough into the crankcase blind bores. If this is not the case, the screw may be tightened but the cylinder head gasket will not be pressed on with sufficient force and this may cause it to become defective or leaky. For this reason before fitting the cylinder head check that:

1. The threaded bore is clean,
2. there is no oil pad at the base of the threaded bore,
3. the screw can be screwed in sufficiently deeply.

21. Apply graphite oil to the camshaft bearings and slide in the camshaft from the rear.

22. Check that the dowel pins in the crankcase are undamaged. If necessary, drive in new dowel pins. Insert the water distributor pipe in the bore in the crankcase and drive into position. Clean the crankcase and the cylinder head at their mating surfaces. Install a new cylinder head gasket and fit the cylinder head.

Do not confuse Model 190 cylinder head gasket with that of Model 190 SL or that of Model L and 0319!

Note: It is advisable to set the piston of the first cylinder at TDC before fitting the cylinder head. This is the position required for subsequent engine tune-up.

23. Fit the cylinder head cover clamps. Apply graphite oil liberally to the cylinder head fixing screw threads and the washer surfaces and screw in cylinder head fixing screws together with washers.

Tighten the cylinder head fixing screws in stages in the order indicated below in Fig. 01—4/8.

First tightening	4 mkg
Second tightening	6 mkg
Third tightening	8 mkg
Fourth tightening (check tightening)	8 mkg

See under Paragraph 42 for final tightening of cylinder head screws.

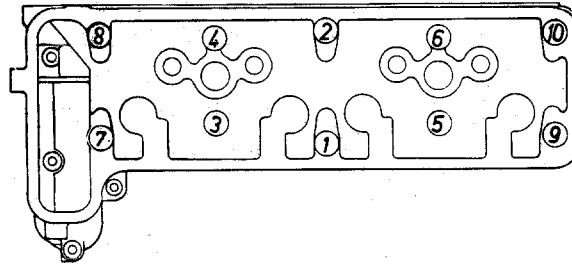


Fig. 01—4/8

Note: It must be possible to turn the camshaft freely by hand after the cylinder head fixing screws have been tightened.

24. Screw in the four hexagon socket screws at the front on the cylinder head and tighten up with Hexagon Socket Wrench 187 589 00 07 (see Fig. 01—4/3). In the case of distributor bearings fitted with fixing lugs, screw d (see Fig. 01—4/3) is fitted when installing the distributor bearing.

Note: When screwing in screw c, connect the distributor ground lead so that the cable tag makes perfect contact with the cylinder head at all points (see Fig. 01—4/8).

25. Install the distributor bearing (see Job No. 01—4, Section F).

26. Install the outer chain guide. Make sure that the pivot pins are of the correct length (58 mm).

Press in the pivot pins until the lock wire on the chain guide engages in the annular groove in the pivot pin.

27. Press the camshaft sprocket together with compensating washer but without the chain on to the camshaft and screw it up tight. Then check the alignment of the camshaft sprocket and the idling gear. To do this, use Tool 187 589 02 23 (Fig. 01—4/9 and 01—4/10).

The misalignment of all sprocket wheels, from the intermediate gear onward, must not be more than 1 mm. If this is not the case, another washer must be mounted on the camshaft.

When measuring misalignment push back all sprocket wheels as far as they will go.

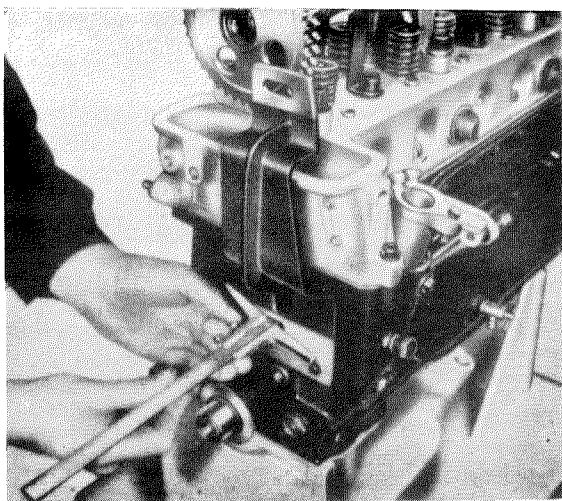


Fig. 01—4/9

Compensating washers are available in the following thicknesses: 2.5 mm, 2.75 mm, 3.00 mm, 3.25 mm and 3.50 mm.

28. Check the camshaft end play. The end play should measure between 0.05 mm and 0.128 mm (Fig. 01—4/11). If the end play exceeds this amount, regrind the face of the camshaft (see Job No. 05—5, Section D).

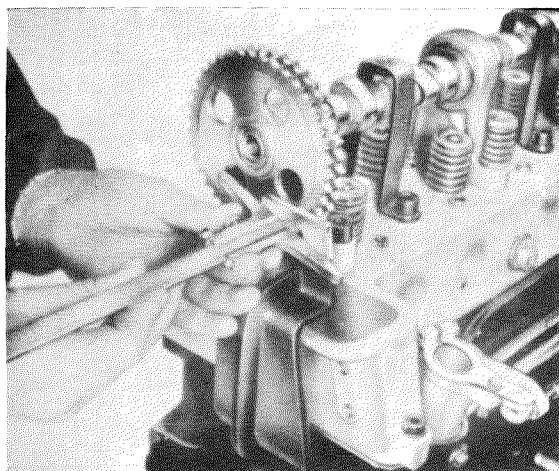


Fig. 01—4/10

29. Remove the camshaft sprocket again and insert the Woodruff key in the camshaft.

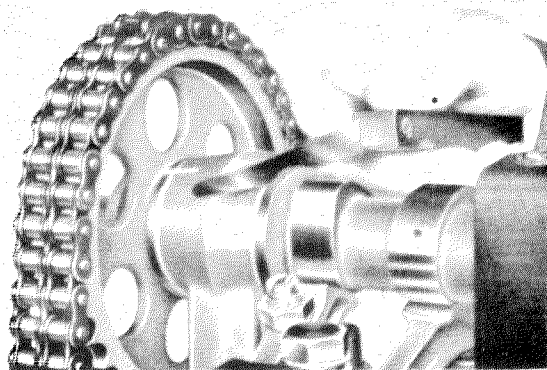


Fig. 01—4/11

If an offset Woodruff key was previously installed, care must be taken to ensure that this is again mounted in the correct position.

In this case, it is absolutely necessary to check the timing again (see Job No. 01—3, Section L).

30. Turn the camshaft, together with the compensating washer, so that the marking on the compensating washer and the first camshaft bearing coincide (Fig. 01—4/12).

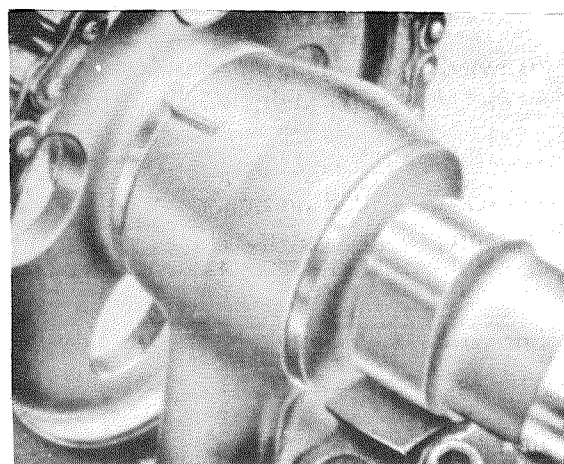


Fig. 01—4/12

Set the piston of the first cylinder to TDC. Now lift out the chain from the sprocket case with a hook and press the camshaft sprocket with the chain in position on to the camshaft.

Pay attention to the marking on the compensating washer and the camshaft bearing.

When this is done, the left half of the chain must be held taut to prevent the camshaft adjustment from altering after the engine has been cranked. Then fit the washer and the lock ring and tighten the screw.

31. Install the inner chain guide in the cylinder head. The pivot pins must be 58 mm in length.

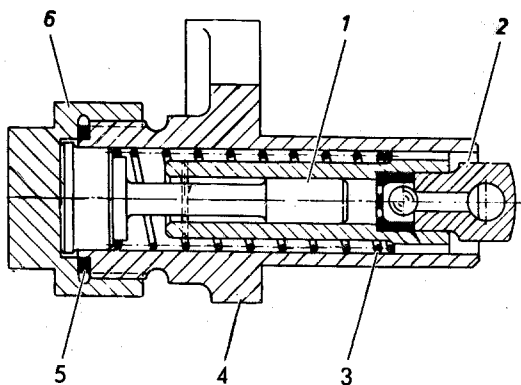


Fig. 01—4/13

- 1 Thrust pin
- 2 Pressure sleeve with head, ball retainer, ball and cylinder pin
- 3 Compression spring
- 4 Housing
- 5 Sealing ring
- 6 Cover cap

Press in the pivot pins until the lock wire on the chain guide engages in the annul groove in the pivot pin.

32. Fit a new seal to the chain tensioner and screw the chain tightener on to the cylinder head **with oil case empty**.
33. Press back the tension sprocket bearing as far as it will go, using Bleeder Lever 187 589 02 63 or if necessary a screwdriver, and fill up the cylinder head oil case with warm engine oil (Fig. 01—4/4). Now gradually release the sprocket bearing with the lever or screwdriver, at the same time continually filling up with oil, so that the oil case is always full of oil and the chain tensioner cannot suck in any air.

Then "pump" the tension sprocket bearing until no more air bubbles can be seen at the chain tensioner. The important thing is to maintain the necessary oil level in the oil case during the bleeding process.

When the chain tensioner is perfectly bled, further pumping becomes impossible; considerable force is required to compress the chain tensioner even at the beginning of the operation.

Bleeding of the chain tensioner should be carried out with great care, since imperfect bleeding leads to chain noises when the engine is idling.

See also "Checking of Chain Tensioner" (Job No. 05—5, Section F).

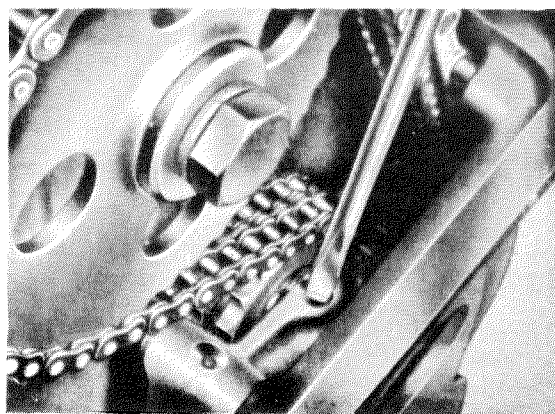


Fig. 01—4/14

34. Insert the rocker arm block guide sleeves in the bores in the cylinder head and drive them in. The guide sleeves must be seated firmly.

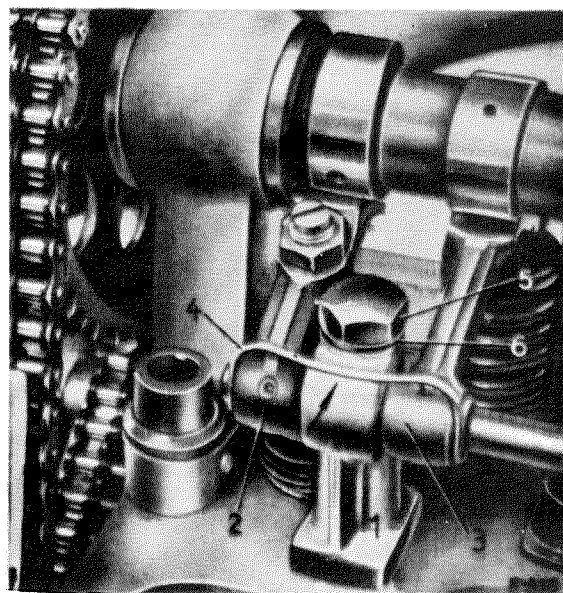


Fig. 01—4/15

- 1 Rocker arm block
- 2 Exhaust rocker arm
- 3 Inlet rocker arm
- 4 Spring clamp
- 5 Stretch screw
- 6 Washer

Install the assembled rocker arm blocks and tighten up the stretch screw to 3.75 mkg.

Check whether the spring clamps have engaged in the notches in the rocker arm blocks (see arrow in Fig. 01—4/15).

When installing the assembled rocker arm blocks turn the camshaft so that the rocker arms are not under load (see Fig. 01—4/17).

35. Adjust the tappet clearance with the engine cold.

Inlet: 0.10 mm
Exhaust: 0.20 mm

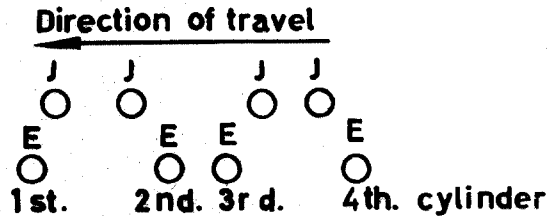


Fig. 01—4/16

When checking and adjusting tappet clearance, turn the appropriate cam so that the rocker arm is not under load. (Set the cam base circle against the rocker arm sliding surface.) (Fig. 01—4/17.)

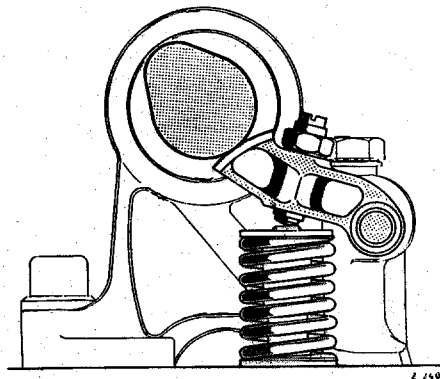


Fig. 01—4/17

Use Socket with Ratchet SW 22 on shoulder screw which fastens Vee-pulley and counterweight to the crankshaft.

Special tool for tappet clearance adjustment:

Combination Tappet Adjustment Wrench 187 589 01 09 or Special Wrench 187 589 00 01.

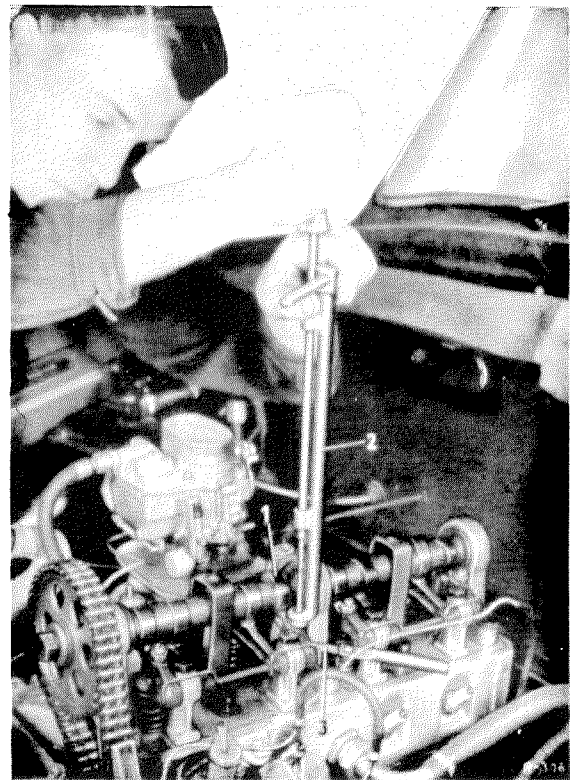


Fig. 01—4/18

Slacken the adjusting screw lock nuts and turn the adjusting screw until tolerance feeler band inserted between the adjusting screw and the valve shaft can just be moved between the surfaces.

Tighten up the adjusting screw lock nuts and again check the tappet clearance (Fig. 01—4/18 and 01—4/19).

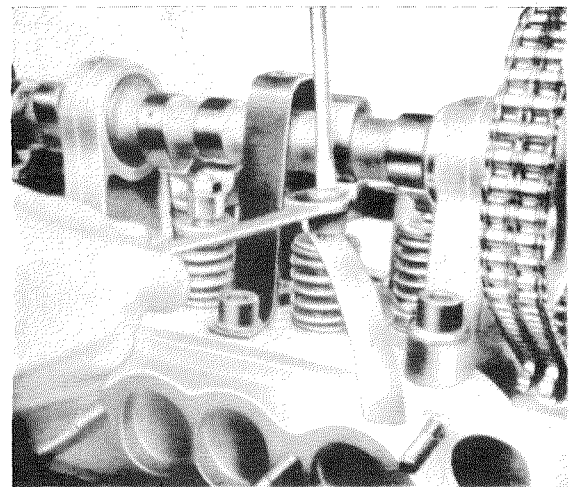


Fig. 01—4/19

36. Connect up the vent line from the water pump to the cylinder head. Do not omit the sealing rings; two for each union! Screw on the cooling water drain union using a new sealing ring.
37. Using Toggle Wrench 186 581 03 36, screw in the spark plugs and tighten with a torque of 4 mkg.
38. Install the distributor (see Job No. 01—3, Section E).
39. Fit the cylinder head cover and fasten with the clamp screws.
Put the distributor cap on the distributor and connect up the ignition cable connectors to the spark plugs.
40. Install the suction tube and the exhaust manifold with carburetor fitted (see Group 01—4, Section B).
41. Connect the fuel line to the fuel pump and the vacuum line to the distributor. Then anchor both lines to the cylinder head with a hose clip. The pivot pin locking screw serves also as a fixing screw for the hose clip. Do not omit the sealing ring between the cylinder head and hose clip!

Note: In order to avoid damage to the fuel pump when connecting up the fuel line, the threaded union must always be held steady with a second wrench.

42. If the engine is installed, connect up all cooling water lines and the thermostat heat feeler to the engine. Fill up with cooling water.
43. Set the timing (see Job No. 01—3, Section E).
44. Tighten up the cylinder head fixing screws: When tightening the cylinder head fixing screws proceed as follows:
Warm up the engine under slight load until the cooling water temperature reaches 80° C. Run the engine for a further five minutes at this temperature and then tighten the cylinder head fixing screws to 9 mkg in the sequence indicated in Fig. 01—4/8.

After a road test of not more than 20 km check the tightening torque of the cylinder head fixing screws (9 mkg). Do not force the engine during the road test.

After the road test also check all unions for leakage and all screws for tightness, and if necessary re-tighten.

Finally check tappet clearance once more with the engine **cold**.

After the car has run a further 500 km, carry out a third check on the tightening torque of the cylinder head fixing screws (9 mkg) with the engine at normal running temperature.

D. Removal and Installation of Generator

Repair procedure — see Job No. 15 — 13.

Removal:

1. If the engine is installed, disconnect the negative cable at the battery and the cables at the generator.
2. Remove the nuts of the generator mounting (1) and the clamping device nuts (2—6), and turn the clamp nut (4) far enough to the right to allow the generator Vee-belt to be removed (Fig. 01—4/20).

Unscrew the mounting nuts (1) and the fixing screw for the clamping piece (3) and remove the generator. If necessary remove the tensioning screw (6) at the crankcase.

Installation:

3. Fit the tensioning screw (6) at the crankcase. Place the generator in position, fit the clamping-piece fixing screw (3) and install all the nuts together with their lock washers, but do not tighten up.

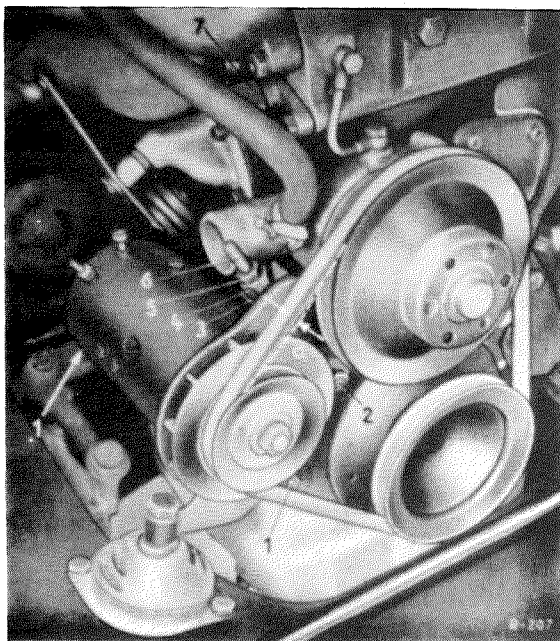


Fig. 01—4/20

- | | |
|---------------------------------|--------------------|
| 1 Generator mounting | 4 Tensioning nut |
| 2 Tensioning screw (6) mounting | 5 Hexagon nut |
| 3 Clamping piece | 6 Tensioning screw |
| | 7 Chain tensioner |

Do not omit the ground lead!

Note: In the first version, the generator is supported at the front and the rear between two rubber washers, and the tensioning screw at the bottom at the cylinder crankcase housing is similarly supported between two rubber washers. In the second version, however, (as of Engine No. 65 00476) the generator only is supported at the front between two rubber washers. (Fig. 01—4/22). With the introduction of the second version of the generator mounting, the ground cable (24) was no longer fitted (Fig. 01—4/21). As of Engine No. 65 02360, however, it was installed again and was later fitted to the front of the generator and lengthened. The ground lead on the front of the generator is now located between the washer (14), or alternatively the front generator lug (2), and the lock washer (6) (Fig. 01—4/22, 2nd version).

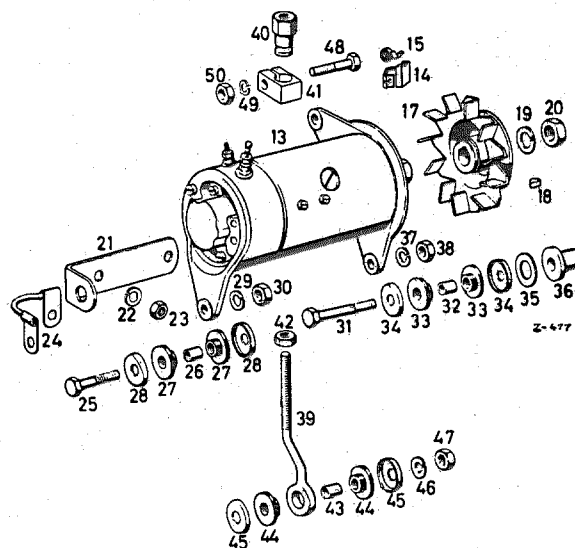


Fig. 01—4/21

- | | |
|---------------------------------|-----------------------------|
| 14 Carbon brushes | 32 Sleeve |
| 15 Compression spring | 33 Rubber washer |
| 17 Vee-pulley | 34 Cup washer |
| 18 Woodruff key | 35 Washer |
| 19 Lock washer | 36 Spacer sleeve 25 mm long |
| 20 Hexagon nut | 37 Lock washer |
| 21 Support | 38 Hexagon nut |
| 22 Lock Washer B 10 DIN 127 | 39 Tensioning screw |
| 23 Hexagon Nut M 10 DIN 934-5 S | 40 Tensioning nut |
| (previously M 8 DIN 934-5 S) | 41 Clamping piece |
| 24 Ground lead | 42 Hexagon nut |
| 25 Hexagon screw | 43 Sleeve |
| 26 Sleeve | 44 Rubber washer |
| 27 Rubber washer | 45 Cup washer |
| 28 Cup washer | 46 Lock washer |
| 29 Lock washer | 47 Hexagon nut |
| 30 Hexagon nut | 48 Hexagon screw |
| 31 Hexagon screw | 49 Lock washer |
| | 50 Hexagon nut |

If repairs are being carried out on an engine not fitted with ground lead, a ground lead should subsequently be installed on the

front of the generator. When replacing a ground lead which was fitted to the bracket and to the rear generator lug, the new ground lead should be fitted in the same way at the front of the generator.

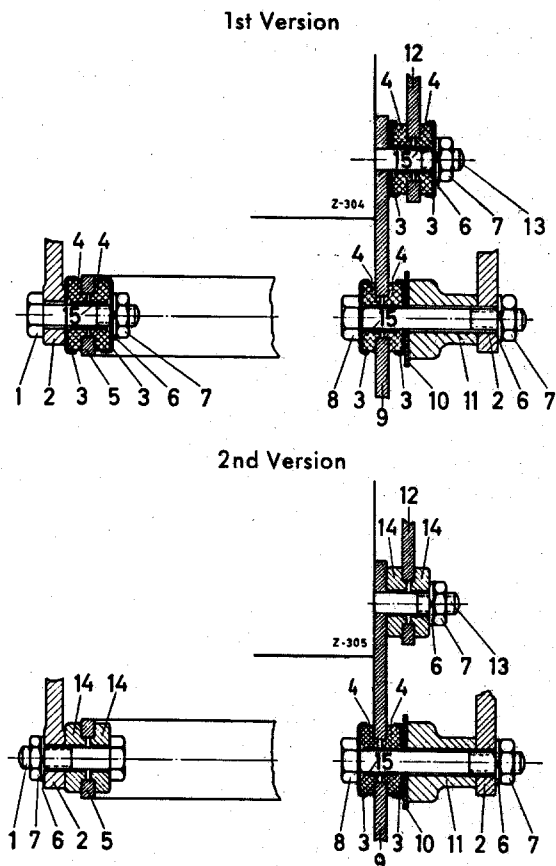


Fig. 01—4/22

- | | |
|-----------------|--------------------------|
| 1 Hexagon screw | 9 Engine support |
| 2 Generator | 10 Washer |
| 3 Cup washer | 11 Spacer sleeve 25.5 mm |
| 4 Rubber washer | 12 Tensioning screw |
| 5 Support | 13 Stud screw |
| 6 Lock washer | 14 Spacer |
| 7 Hexagon nut | 15 Sleeve |
| 8 Hexagon screw | |

Tightening Vee-belt:

4. Check the alignment of the pulley. Put on the Vee-belt and tighten by turning the tensioning nut (4) to the left. The distance at which the Vee-belt can be pressed out of the straight when moderate thumb pressure is applied from the generator side must measure at least 5 mm and not more than 10 mm (Fig. 01—4/20). When this operation is complete, tighten the lock nut (5) and the front and rear mounting nuts (1) and the tensioning screw (2).

5. Connect up the generator cable and the negative cable of the battery.

When connecting the electric cables, pay attention to the color coding.

Connect the black cable of the regulator harness (1.5 mm² section), fitted with tag, to terminal DF, the red cable (4 mm² section) to terminal D + (61), the brown cable (2.5 mm² section) to terminal D — of the generator.

Note: Be sure to connect cables to correct terminals! Incorrect connection of the terminals involves the danger of pole reversal to the generator and could result in the destruction of the regulator.

Subsequent Installation of a 300 Watt Generator

(Optional extra SA 10183)

In place of the standard 160 Watt generator, a 300 Watt generator can be supplied as an optional extra for vehicles which are mainly used for short journey work (taxis, doctors cars), or vehicles which have an increased electricity consumption due to the incorporation of additional electrically operated units. The increased battery drain which occurs especially during winter months, is more rapidly rectified by a larger generator.

When a 300 Watt generator is subsequently installed, the generator support must be replaced by a reinforced version. In addition, for reasons of space, the water pump must be replaced by another version. The arrangement of the clamp screws must likewise be modified.

The installation operation is carried out as follows:

1. Disconnect the negative cable at the battery and the cables at the generator.
2. Slacken the generator mounting nuts (1) and the clamping device (2—6) nuts and turn the tensioning nuts (4) far enough to the right to allow the Vee-belt to be removed. Unscrew the mounting nuts (1) and the clamping piece fixing screw (3) and remove the generator. Unscrew the mounting nut for the tensioning screw (6) and the engine support at the crankcase and remove the tensioning screw. Screw out the stud bolt (2) and in its place screw in Hexagon Screw M 8×18 DIN 933—8 G with lock washer and tighten up (see Fig. 01—4/20).
3. Drain part of the cooling water (collect water if additives are present!) and after releasing the hose clips remove the lines at the water pump and at the distributor pipe for the cooling water return flow. Remove the distributor pipe. Remove the fan.
4. Unscrew the vent line from the water pump to the cylinder head and remove it.
5. Remove the standard water pump and replace it by the new pump Part. No. 121 200 03 01 with curved suction pipe supports.
6. Fix the water pump on the engine. When doing this, replace the gasket and the sealing ring at the rear of the upper fixing lug. The fixing screw M 8×60 DIN 931—8 G (17) for the upper lug on the water pump (13) serves at the same time as a fixing screw for the new tensioning screw (15), Part No. 121 155 03 23, with spacer collar (14) Part No. 121 155 02 51 (Fig. 01—4/22 a).
7. Install the vent line without forcing. At each union use two new sealing rings.
8. Install the new distributor pipe (for cooling water return flow and heating), Part No. 121 500 08 91, with the existing rubber hoses and anchor all hose lines with hose clips. Refill radiator!
9. Remove the standard generator support from the crankcase and replace by reinforced support (2), Part No. 121 155 05 35, (Fig. 01—4/22 a).
10. After fitting the rubber washer (1), the cup washer (8) and sleeve (5) to the support (2), insert the new 300 Watt generator from the front and fix with two Hexagon Screws M 10×45 DIN 931—8 G (4) (Fig. 01—4/22 a). Also fit the new ground lead (10), Part No. 181 150 01 32, to the front of the generator.

11. Insert sleeve (20), Part No. 180 155 05 53, in the bore of the upper generator fixing arm and fix the existing clamping piece (23) with Hexagon Screw M 8×42 DIN 931—8 G with lock washer and nut. Now push the clamping piece onto the tensioning screw (15) and screw on the tensioning nut (22) (Fig. 01—4/22 a).

12. Check the alignment of the pulley and then put on the Vee-belt and tighten by turning the tensioning nut to the left.

Note: The distance *a*, which the Vee-belt can be pressed out of the straight when moderate pressure is applied from the generator side must measure at least 5 mm and not more than 10 mm (Fig. 01—4/20).

Now tighten up the lock nut (21), the nut (19), the front and rear mounting screw (6) nuts and the fixing screw (17) for the tensioning screw.

13. Disconnect the cables at the regulator and replace the regulator by a new one, Part No. 000 154 17 06.

14. Connect the cables to the correct regulator terminals, to the generator and the negative terminal of the battery (see Job No. 54—4, Section C).

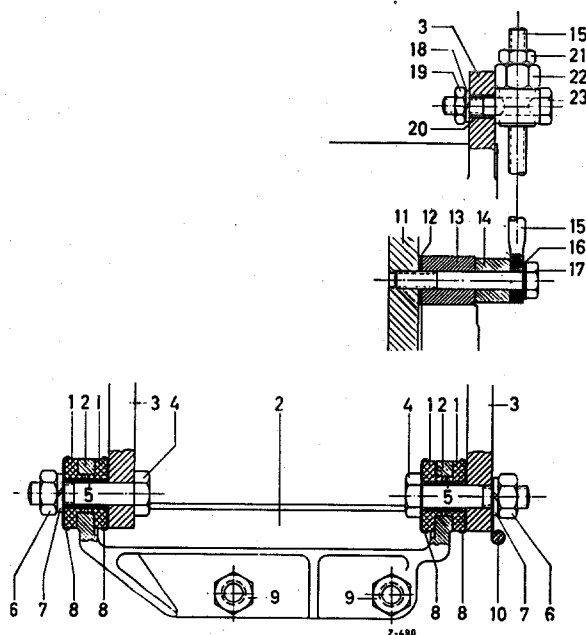


Fig. 01—4/22 a

- | | |
|-----------------|------------------------------------|
| 1 Rubber washer | 13 Water-pump housing |
| 2 Support | 14 Spacer ring |
| 3 Generator | 15 Tensioning screw |
| 4 Hexagon screw | 16 Lock washer |
| 5 Sleeve | 17 Hexagon screw |
| 6 Hexagon nut | 18 Lock washer |
| 7 Lock washer | 19 Hexagon nut |
| 8 Cup washer | 20 Sleeve |
| 9 Hexagon nut | 21 Hexagon nut |
| 10 Ground lead | 22 Clamp nut |
| 11 Crankcase | 23 Clamping piece with hexagon nut |
| 12 Sealing ring | |

List of available parts:

Quantity	Designation	Part No.
1	Generator LS/GKM 300/12/1450 AR	000 154 60 02
1	Regulator RS/UA 300/12/1	000 154 17 06
1	Pulley	121 150 00 60
1	Woodruff key	4×6.5 DIN 6888—St 60
1	Lock washer	B 14 DIN 127
1	Hexagon nut	M 14×1.5 DIN 936—5 S
1	Support	121 155 05 35
1	Ground lead	181 150 01 32
1	Water pump complete	121 200 03 01
1	Distributor pipe	121 500 08 91
1	Tensioning screw	121 155 06 23
1	Narrow Vee-belt	9.5×925 N 275
Engine support to crankcase		
1	Hexagon screw	M 8×18 DIN 933—8 G
1	Lock washer	B 8 DIN 127
Clamp screw to water pump		
1	Spacer ring	121 155 02 51
1	Hexagon screw	M 8×60 DIN 931—8 G
Generator to support		
4	Rubber washer	121 155 01 81
4	Cup washer	136 155 00 82
2	Sleeve	136 155 04 53
2	Hexagon screw	M 10×45 DIN 931—8 G
2	Lock washer	B 10 DIN 127
2	Hexagon nut	M 10 DIN 934—5 S
Clamping piece to generator		
1	Hexagon screw	M 8×42 DIN 931—8 G
1	Sleeve	180 155 05 53

E. Removal and Installation of Water Pump and Fan

Repair procedure — see Job No. 20—5.

Removal:

1. If the engine is installed, drain part of the cooling water (collect water where additives are present!) and after releasing the hose clips remove the lines at the water pump. Unscrew the fan.
2. Slacken the nuts of the generator mounting (1), the clamping device nuts (2—6) and turn the clamping nut (4) far enough toward the right to allow the Vee-belt to be removed (see Fig. 01—4/20).
3. Unscrew and remove the vent line from water pump to cylinder head.
4. Unscrew the water pump.

Installation:

5. When installing the water pump, replace the gasket and the sealing ring behind the upper fixing lug on the water pump.
6. Install the vent line without forcing and use two new sealing rings at each union.
7. Put on and tighten the Vee-belt (see Job No. 01—4, Section D).
Screw up all the Vee-belt clamping device and generator mounting nuts.
8. If the engine is installed, connect all lines at the water pump, refill the radiator and screw on the fan.
9. Check the fan clearance (see Job No. 50—1).

Subsequent Installation of a Tropical Fan (Optional extra SA 10113)

For tropical countries in which the normal fan is no longer sufficiently effective, a tropical fan with an increased cooling effect can be installed as an extra. The tropical fan can be installed in place of the standard fan simply by using a compensating washer.

List of available parts:

Tropical fan	Part No. 180 200 00 24
Compensating washer	Part No. 180 205 04 52

F. Removal and Installation of Distributor with Bearing

Repair procedure — see Job No. 15 — 23.

Removal:

1. Disconnect the vacuum line at the distributor, remove the distributor cap and disconnect the ground lead (1) at the condenser (Fig. 01—4/23).

Note: No ground leads were installed in the first engines.

If the engine is installed, disconnect the control cable at the timing lever clamping chuck and unscrew the low tension lead (2) at the distributor (Fig. 01—4/23).

Note: The ignition adjustment control cable has now been superseded.

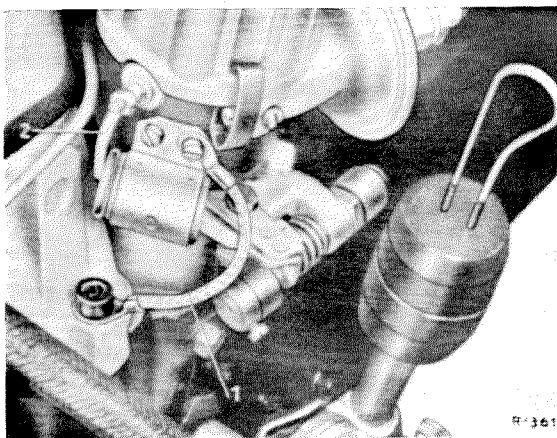


Fig. 01—4/23

1 Ground lead 2 Low tension lead

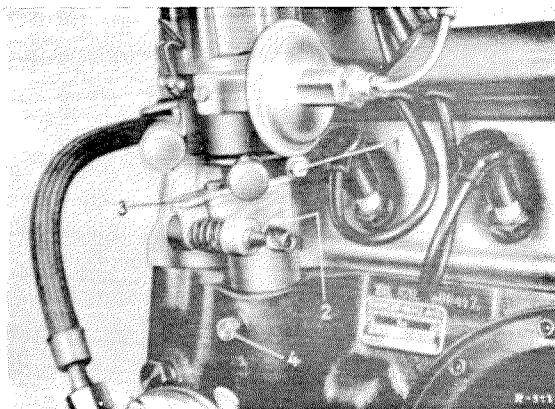


Fig. 01—4/23a

- 1 Hexagon socket screw
- 2 Trunnion screw
- 3 Distributor bearing with timing lever
- 4 Hexagon screw M 8 × 15 DIN 561-5 S for distributor bearing without fixing lug
Hexagon screw M 8 × 10 DIN 933-8 G for distributor bearing with fixing lug

Screw (4) is now no longer fitted.

2. Loosen screw (1) which holds in position the timing lever and the distributor trunnion screw (2) and pull out the distributor (Fig. 01—4/23a).
3. Unscrew the hexagon socket screw (1) and pull out the distributor bearing (Fig. 01—4/23b). Up to Engine No. 65 000 97 a distributor bearing with no fixing lug was installed. Up to this engine number the distributor bearing was fastened by the screw (4) (Fig. 01—4/23a).

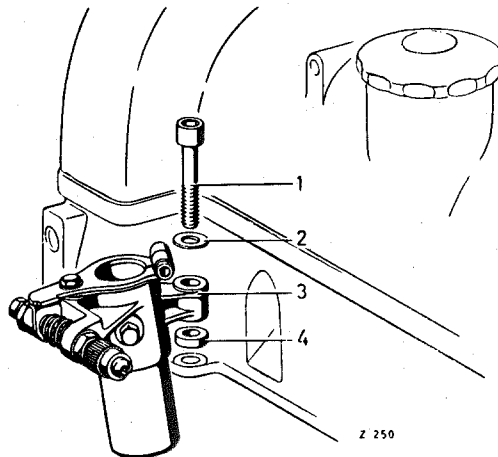


Fig. 01—4/23b

- 1 Hexagon socket screw M 8 × 45 DIN 912-8 G
- 2 Washer 8.4 DIN 125
- 3 Distributor bearing complete with fixing lug, Part No. 121 150 00 07
- 4 Spacer ring, Part No. 121 158 00 51

Installation:

4. Fit the distributor bearing and by means of hexagon socket screw (1) fasten the bearing on the cylinder head (Fig. 01—4/23b). Do not omit the spacer ring (4) between the fixing lug and the cylinder head!

Note: When replacing the distributor bearing with no fixing lug, it is only necessary to install a bearing with fixing lug together with the individual parts illustrated in Fig. 01—4/23b. In addition, distributor bearing hexagon fixing screw M 8 × 15 DIN 561—5 S should be replaced by Hexagon Screw M 8 × 10 DIN 933—8 G (Position 4 in Fig. 01—4/23a).

If a distributor bearing with no fixing lug is reinstalled, fasten it with screw (4) (Fig. 01—4/23a).

5. Fit the distributor bearing and secure it with trunnion screw (2) (Fig. 01—4/23a).

6. Set the ignition. To do this, turn the crankshaft at the front by means of the hexagon shoulder screw, using Socket with Ratchet SW 22, in the direction of rotation of the engine until the first piston is at compression stroke and the timing pointer is at $8^{\circ} \pm 1$ before TDC on the counterweight graduation scale (Fig. 01—4/24).

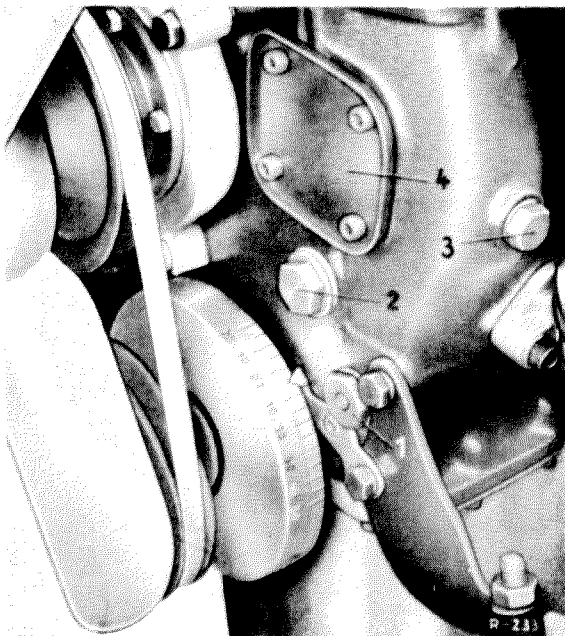


Fig. 01—4/24

- 1 Screw plug with pivot pin for chain guide
- 2 Screw plug for oil relief valve
- 3 Lock screw for chain drive
- 4 Cover plate

7. Press the timing lever on the distributor bearing hard over to the advance stop and clamp it in this position with a clamp (Fig. 01—4/25).

8. Unscrew the chain drive lock screw (3) and the cover plate (4) at the crankcase (Fig. 01—4/24). Then turn the idling gear (click it over the chain) until the rotor arm points to the contact for the first cylinder or to the timing marks on the distributor housing (Fig. 01—4/25). Now turn the distributor head so that the breaker contact at $8^{\circ} \pm 1$ before TDC just lifts from the contact holder.

Note: Whilst turning the idling gear, slacken the chain. To do this depress the tension sprocket bearing.

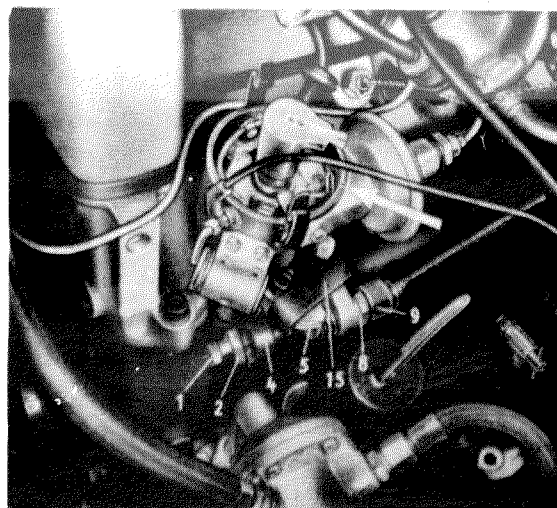


Fig. 01—4/25

- 1 Hexagon nut
- 2 Clamping chuck
- 4 Damper rubber
- 5 Timing lever
- 8 Hexagon nut
- 9 Adjusting screw
- 15 Retaining clamp

9. Tighten the screw (1) at the distributor bearing (Fig. 01—4/23a), screw in the lock screw with sealing ring (3) again and screw the cover plate, together with gasket (4), back on the crankcase (Fig. 01—4/24).

10. Connect the ground lead (1) to the distributor, using the right condenser screw (see Fig. 01—4/23).

Note: If ignition failure occurs because of faulty ground connection between the distributor and the engine block, the ground lead can be subsequently installed. When installing, care must be taken to ensure that the cable tag makes perfect contact with the cylinder head along its whole surface.

11. Reconnect the vacuum line at the distributor and fit the distributor cap.

If the engine is installed, connect to the distributor the low tension cable (2) which runs from the ignition coil to the distributor (see Fig. 01—4/23) and connect the ignition adjustment control cable (see Job No. 01—3, Section E).

Note: Recently the ignition adjustment control cable has been superseded.

12. Finally, the ignition setting must be checked and corrected, either with the aid of a timing light or a flash stroboscope (see Job No. 01—3, Section E).

G. Removal and Installation of Distributor Drive and Oil Pump Drive

Repair procedure — see Job No. 15—5

Removal:

1. Remove the chain tensioner, the camshaft sprocket and the distributor together with the bearing (see Job No. 01—4, Sections C and F).
2. Unscrew the sprocket housing cover plate (4) at the crankcase and unscrew the lock screw (3) for the chain drive (see Fig. 01—4/24). Slacken the idling gear fixing screw. Remove the distributor drive helical gear. Unscrew the idling gear fixing screw and use Puller 187 589 02 35 to pull the idling gear off the gear shaft.

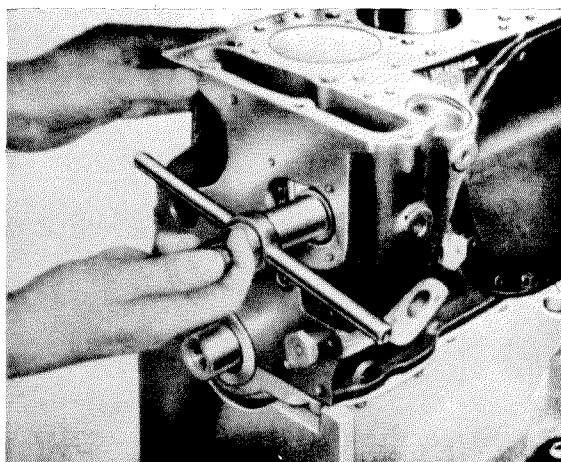


Fig. 01—4/27

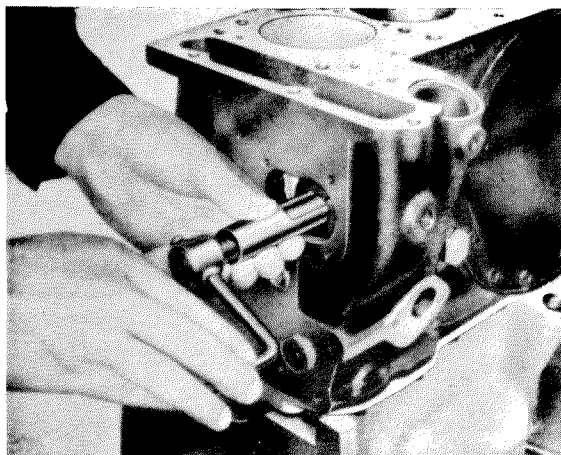


Fig. 01—4/26

3. Unscrew the retaining washer for the front bearing bushing of the idling gear shaft (see Fig. 01—4/30). Use Tool 187 589 07 61 to pull out the gear shaft together with the front bushing (Fig. 01—4/27).

If the rear bushing has to be replaced, use Puller 186 589 09 33 to pull it out.

If the vertical bearing bushing for the helical gear has to be replaced, either use Puller 189 589 09 33 to pull out the bushing or use a drift to drive it out from the oil pan side. To do this the oil pan and oil pump must be removed (see Job No. 01—4, Sections L and M).

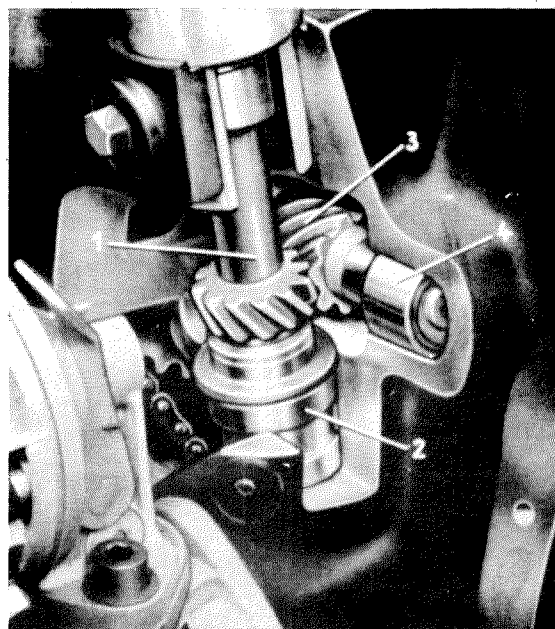


Fig. 01—4/28

- 1 Helical gear
- 2 Bearing with bushing
- 3 Idling gear shaft
- 4 Rear bearing bushing

Installation:

4. Use a suitable drift to press the vertical bearing bushing for the helical gear into the bore in the crankcase.

Use a suitable drift to drive in the rear bearing bushing for the idling gear. When doing this, care must be taken to ensure that the outer through-way groove in the bushing is on top. The open end of the inner groove must face toward the rear (Fig. 01—4/29).

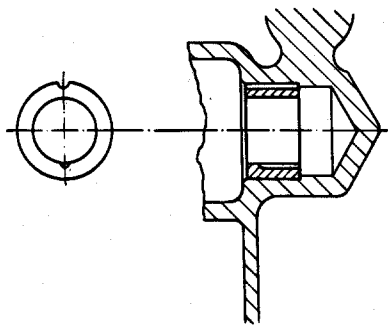


Fig. 01—4/29

5. Before installing the idling gear shaft; it is advisable to measure the end play with the bearing bushing pushed on and the idling gear in position. The end play should be 0.05—0.12 mm.

Use Tool 187 589 07 61 to press the idling gear shaft (apply oil to the bearing surfaces), together with the front bearing bushing, into the bore in the crankcase.

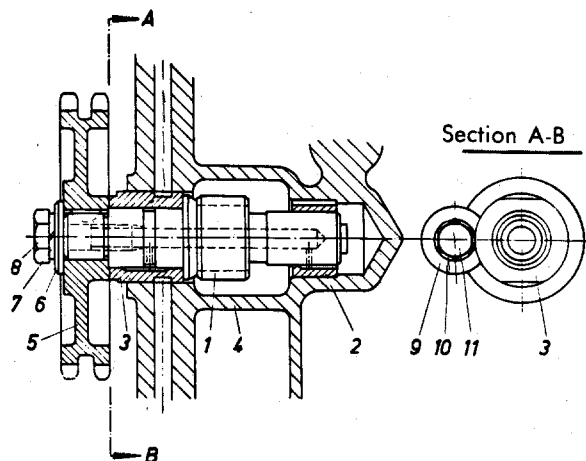


Fig. 01—4/30

- | | |
|---------------------------------------|--------------------|
| 1 Idling gear shaft with Woodruff key | 6 Washer |
| 2 Rear bearing bushing | 7 Lock washer |
| 3 Front bearing bushing | 8 Hexagon screw |
| 4 Crankcase | 9 Retaining washer |
| 5 Idling gear | 10 Lock washer |
| | 11 Hexagon screw |

Note: Make sure that the front bearing bushing is correctly positioned, in order to facilitate the fitting of the retaining washer (Sections A—B in Fig. 01—4/30).

6. Use the screw (11) with the lockwasher (10) to fix the retaining washer (9) for the front bearing bushing (see Fig. 01—4/30).
7. Place the twin roller chain on the idling gear and use Tool 187 589 07 61 to press the gear onto the shaft (Fig. 01—4/31).

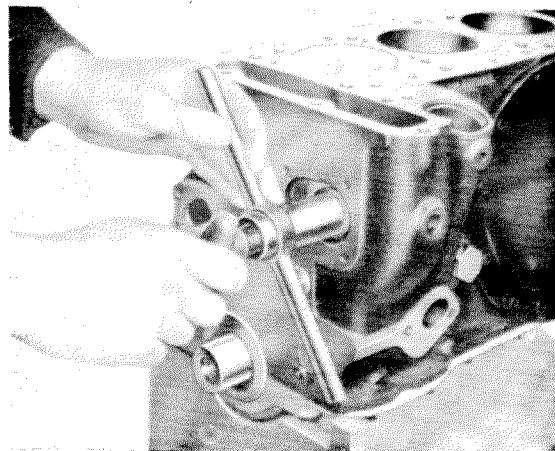


Fig. 01—4/31

In doing this do not omit the Woodruff key!

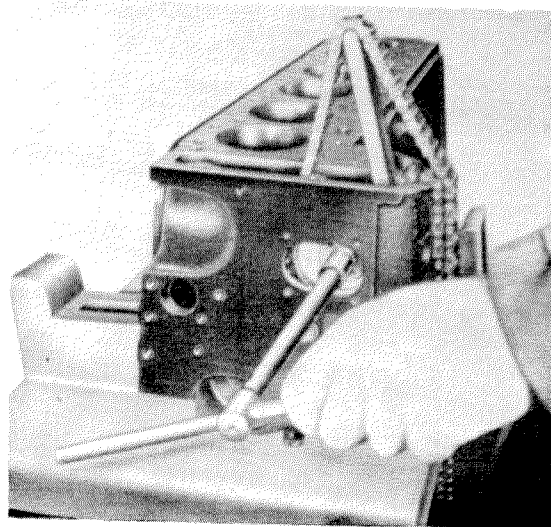


Fig. 01—4/32

In order to prevent the idling gear from turning when the screw is being tightened (do not omit the washer and the snap ring!), wedge a piece of hardwood approximately 15 cm long between the chain and the idling gear (Fig. 01—4/32).

8. Install the helical gear for the oil pump and distributor drive (apply oil to the bearing surface) (Fig. 01—4/33).
9. Screw the chain drive locking screw with sealing ring into the crankcase and screw the cover plate (with gasket) for the sprocket housing onto the crankcase.
10. Re-install the camshaft sprocket, the chain tensioner and the distributor with bearing (see Job No. 01—4, Sections C and F).

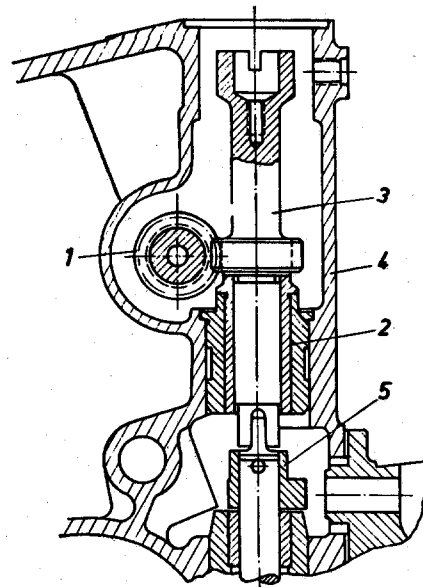


Fig. 01—4/33

- | | |
|------------------------|---------------------------------|
| 1 Idling gear shaft | 4 Crankcase |
| 2 Bearing with bushing | 5 Oil pump drive shaft with cam |
| 3 Helical gear | |

H. Removal and Installation of Fuel Pump

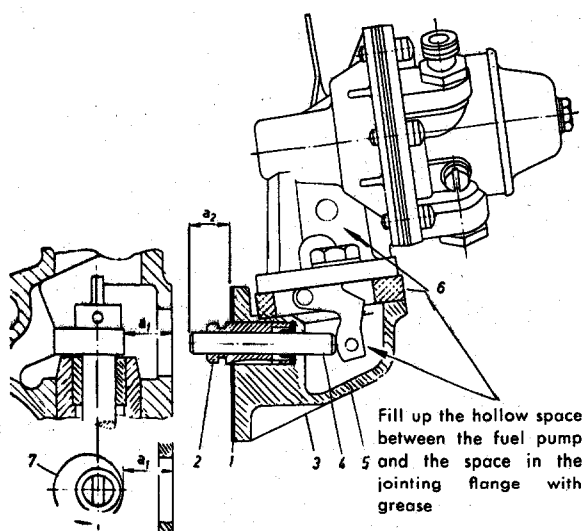


Fig. 01—4/34

- | | |
|-------------------|-----------------------------------|
| 1 Sealing flange | 5 Jointing flange |
| 2 Bushing | 6 Insulating flange with gaskets |
| 3 Shoulder sleeve | 7 Cam on the oil pump drive shaft |
| 4 Tappet | |

Repair procedure — see Job No. 9—5, Section B.

1. Unscrew the fuel lines.

Note: In order to avoid damage to the fuel pump when removing the fuel lines, always

hold the threaded union steady with a second wrench.

2. Remove the fixing screws at the jointing flange and take off the fuel pump, together with the jointing flange.

Installation:

3. Before installing the fuel pump, measure the play between the tappet when at the beginning of the power stroke and the cam when at BDC. The difference between the measurements a_1 — a_2 is equal to the play.

Play is corrected by removal or addition of shims (sealing flange 1).

At least one shim, however, is necessary to form a seal between the jointing flange and the crankcase.

4. Screw the fuel pump, together with the jointing flange, to the crankcase and connect up the fuel lines.

Note: When connecting up the fuel lines, hold the threaded union steady with a second wrench.

Subsequent Installation of a Dust-proof Fuel Pump (Optional extra SA 10 113)

For countries with dusty and sandy terrain, a fuel pump with two dust filters in the lower part of the case is available in place of the normal fuel pump with a ventilation bore. The dust-proof pump can be installed in place of the standard pump without further modification.

Fuel Pump with Dust Filter Part No. 000 091 53 01.

I. Removal and Installation of Oil Filter

Cleaning and checking procedure — see Job No. 18—5, Section D.

Removal:

1. In order to remove the oil filter assembly, the line to the oil pressure gage must be disconnected beforehand.
2. Remove the fixing screws (1) on the upper part of the oil filter case and remove the filter (Fig. 01—4/35).

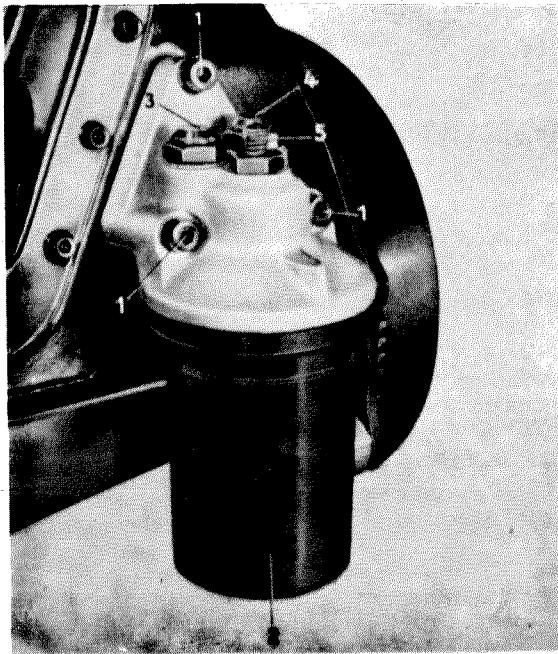


Fig. 01—4/35

- | | |
|--|---|
| 1 Hexagon socket screw
upper: M 8×30 DIN 912-8 G
lower: M 8×60 DIN 912-8 G | 4 Oil relief valve
2 atmospheres |
| 2 Lower part of oil filter case | 5 Threaded union for line to
oil pressure gage |
| 3 Oil relief valve
1.2 atmospheres | |

Note: If, however, the oil filter is being cleaned in the course of lubrication and servicing, it is sufficient to remove the lower part of the oil filter case. To do this, turn the road

wheels hard over to the right, remove the hexagon screw on the lower part of the oil filter case and take off the lower part (Fig. 01—4/36).

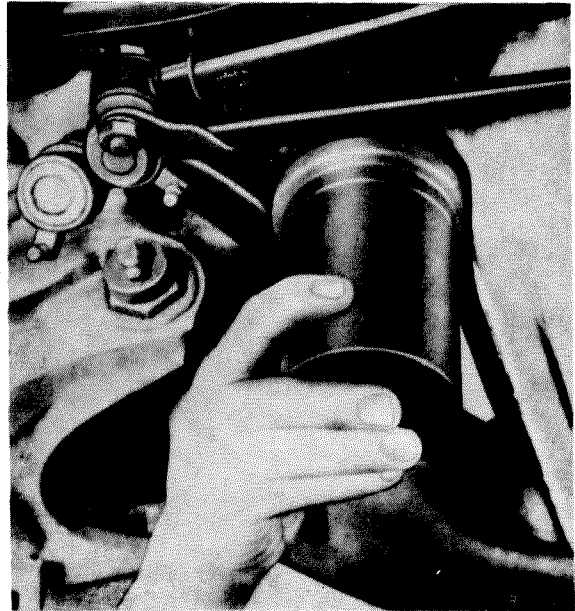


Fig. 01—4/36

Installation:

3. When installing the oil filter, replace the gasket between the upper part of the oil filter case and the crankcase.

Tighten up the screws on the oil filter and connect up the line for the oil pressure gage.

Note: If only the lower part of the oil filter case was removed, **care must be taken to ensure that when screwing the lower part onto the upper part the seal is not jammed.**

4. If the oil filter is removed with the engine in vehicle, and if no oil change is made, top up with 0.5 liter engine oil.

K. Removal and Installation of Oil Relief Valve in Crankcase

Cleaning and checking procedure — see Job No. 18 — 5, Section C.

Removal:

1. Remove the screw plug with seal. Then unscrew the oil relief valve (6 atmospheres) at the upper longitudinal oil passage (Fig. 01—4/37).

Installation:

2. Screw in the oil relief valve. Then screw in the screw plug together with a new seal.

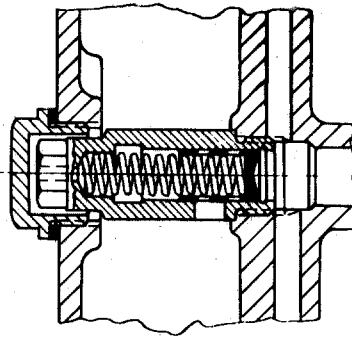


Fig. 01—4/37

L. Removal and installation of Oil Pan

Removal:

1. Take out the oil dipstick. Drain off oil.
2. Remove the clutch housing cover plate. Remove the two M 10 fixing screws for the clutch housing.
3. Remove the two hexagon socket screws which fix the oil pan to the crankcase and take off the oil pan. When removing the oil pan, care must be taken to ensure that the dowel pin in the partition plate does not protrude. If it does, tap back the dowel pin with a hammer.

Note: When the oil pan is removed with the engine in the vehicle, the following additional preliminary operations must be carried out:

- a) Unscrew the center tie-rod at the steering relay arm and turn it on its side.

- b) Use a jack to raise the engine transmission assembly about 8 cm at the rear of the transmission before removing the oil pan.

Installation:

4. Before installing the oil pan, check the crankshaft oil seal at the rear. Apply sealing compound to the separating surface of the oil pan and the sealing surface of the front gasket and then fit the oil pan and screw up.
5. Fit the cover plate for the clutch housing, screw in the two M 10 fixing screws and reinsert the oil dipstick.
6. If the oil pan is removed with the engine in the vehicle, re-connect the center tie-rod to the steering relay arm and then put 4 liters of engine oil in the engine.

M. Removal and Installation of Oil Pump

Repair procedure — see Job No. 18—5, Section B.

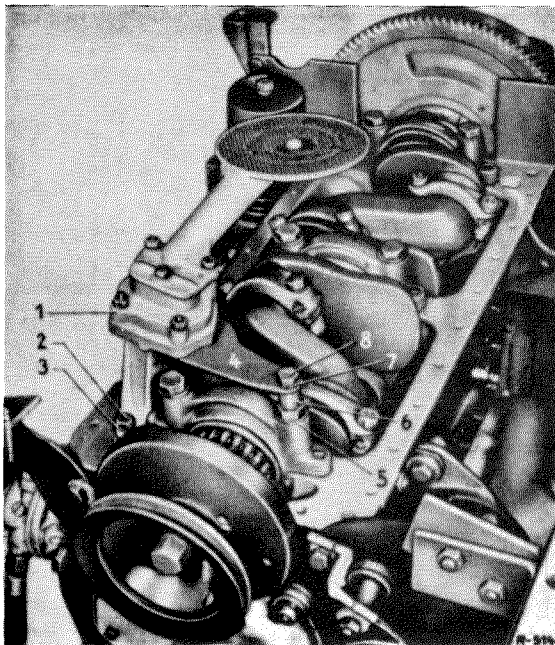


Fig. 01—4/37 a

- | | |
|-----------------|-----------------|
| 1 Oil pump | 5 Washer |
| 2 Hexagon screw | 6 Screw |
| 3 Lock washer | 7 Lock washer |
| 4 Bracket | 8 Hexagon screw |

Removal:

1. Remove the oil pan (see Job No. 01—4, Section L).
2. Remove the fixing screws (2 and 8) for the oil pump at the crankcase and for the bracket (4) at the screw (6) and take off the oil pump.

Note: In the first version of the engine, the bracket (4) is fixed directly to the crankshaft bearing cap with Hexagon Screw M 12×75 DIN 931—10 K.

Installation:

3. Before installing the oil pump, remove the fuel pump (see Job No. 01—4, Section H), as otherwise when the oil pump is being fitted, the cam on the oil pump drive shaft will catch against the fuel pump tappet.
4. Fit the oil pump with bracket and screw up. In the case of oil pumps which are screwed directly onto the crankshaft bearing cap, tighten the hexagon screw to 8 mkg. In this case do not install washer (5).
5. Reinstall the oil pan (see Job No. 01—4, Section L).

N. Removal and Installation of Counterweight on Crankshaft

Removal:

1. If the counterweight has to be removed with the engine in the vehicle, the radiator must be removed beforehand (see Job No. 50—1).
2. Remove the shoulder screw (4) which fixes the pulley and the counterweight to the crankshaft, and take off the washer (3) and the pulley (1), then pull the counterweight (2) using Puller 000 589 17 33 off the crankshaft (Fig. 01—4/38).

Note: In later versions the washer (3) was welded to the pulley (1).

Installation:

3. Fit the counterweight to the crankshaft extension pin and turn the counterweight so that the bores for the dowel pins are lined up. Then drive in the two dowel pins.
4. Fit the pulley (1) with washer (3) and tighten up the fitted parts firmly by means of the shoulder screw (4).

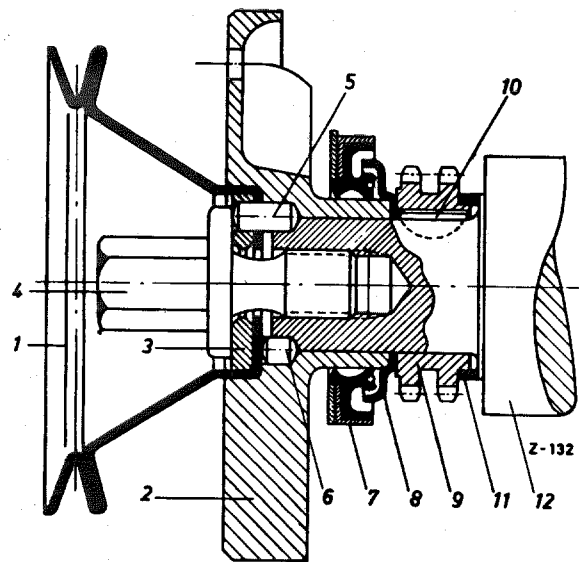


Fig. 01—4/38

- | | |
|----------------------------|-----------------------|
| 1 Pulley | 7 Oil seal |
| 2 Counterweight | 8 Oil thrower |
| 3 Washer | 9 Crankshaft sprocket |
| 4 Shoulder screw | 10 Woodruff key |
| 5 Dowel Pin 8 h 8×16 DIN 7 | 11 Compensating ring |
| 6 Dowel Pin 8 h 8×8 DIN 7 | 12 Crankshaft |

O. Removal and Installation of Crankshaft and Flywheel

Repair procedure see Job No. 03—5.

Removal:

1. Remove the camshaft timing gear (see Job No. 01—4, Section C).
2. Remove the counterweight (see Job No. 01—4, Section N).
3. Remove the oil pan (see Job No. 01—4, Section L).
4. Remove the oil pump (see Job No. 01—4, Section M).
5. Remove the connecting rod nuts. Use a plastic hammer slightly to knock back the connecting rod pins, and then loosen and remove the bearing caps. Remove the crankshaft bearing caps in the same manner.

Note: When disassembling note the order of the bearing shells and the bearing caps.

6. Pull out the lower pivot pin for the right chain guide (seen in the direction of travel) with Puller 187 589 07 33. In doing this lift the lock wire on the chain guide with a suitable hook.

Note: When pulling out the pivot pins for the chain guide use the correct thread adapter of Puller 187 589 07 33. The pivot pins originally had an M 5 thread and were later provided with an M 6 thread.

7. Remove the grease seal and oil thrower-ring from the crankshaft. Pull off the crankshaft timing gear with Puller 187 589 00 33 (Fig. 01—4/39). In doing this it is essential to lift the twin roller chain. Remove the Woodruff key and the compensating ring.

8. Remove the crankshaft and the flywheel. Then remove the bearing shell halves from the crankcase and the bearing caps.

If necessary take off the check plate halves from the center crankcase bearing cap.

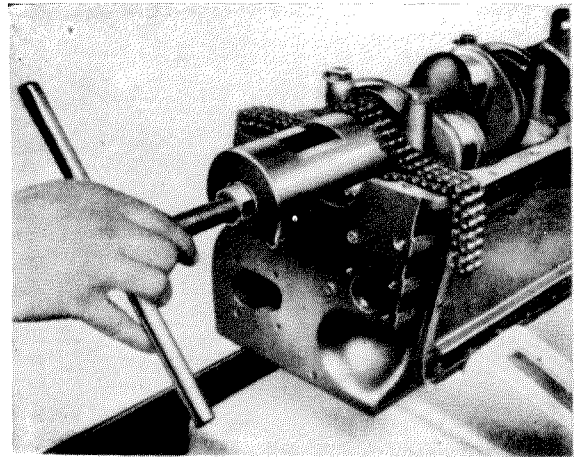


Fig. 01—4/39

Installation:

9. Remove all dirt from the base bores and bearing shell halves with a clean, soft chamois leather, before installing the bearing shell halves in the base bores.

The upper and lower bearing shell halves are fitted with lugs. When fitting, therefore, the bearing shell must first be placed in the base bore so that the lug fits into the groove which is made to receive it. Only then is the bearing shell pressed into the base bore. The shells must be seated perfectly in the base bore (Fig. 01—4/40 and 01—4/41).

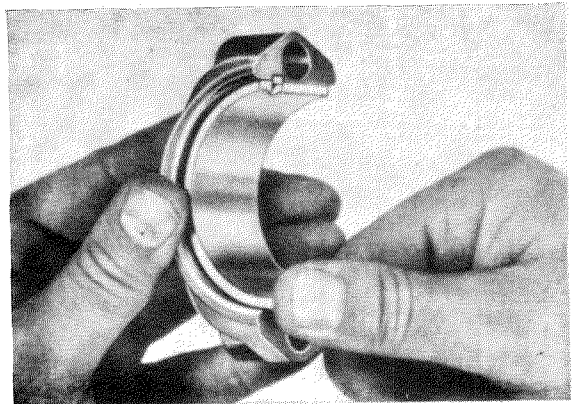


Fig. 01—4/40

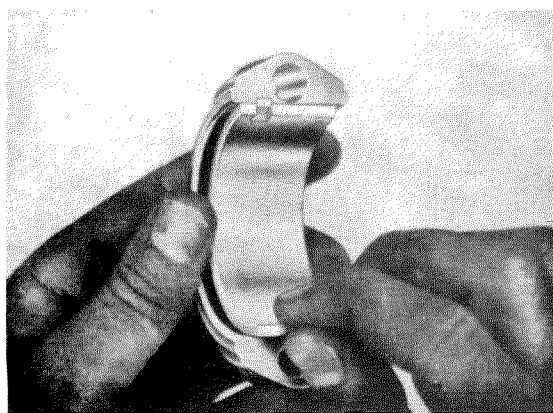


Fig. 01— 4/41

10. Fit the check plate halves on the center crankshaft bearing caps.

Note: The center crankshaft bearing is the locating bearing. In place of bearing shells with a shoulder on the side, normal bearing shells are installed and a check plate half is fitted at each side of the bearing cap (Fig. 01— 4/42).

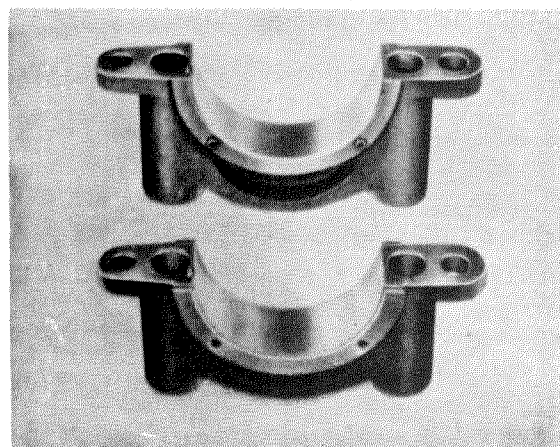


Fig. 01— 4/42

The check plate halves are fixed to the bearing cap with two heavy dowel pins. Care must be taken to ensure that these do not protrude. When the check plates are removed the heavy dowel pins should protrude 1.5 ± 0.1 mm beyond the level of the bearing cap (Fig. 01— 4/43).

In order to facilitate adjustment of crankshaft end play, the check plates are available in the following thicknesses:

2 mm (standard), 2.05 mm, 2.10 mm, 2.15 mm, 2.20 mm, 2.25 mm, 2.30 mm and 2.35 mm.

Select check plate halves so as to allow an end play of from 0.040 to 0.096 mm. For further details (see Job No. 03—5, Section B).

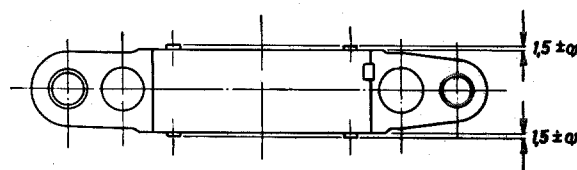
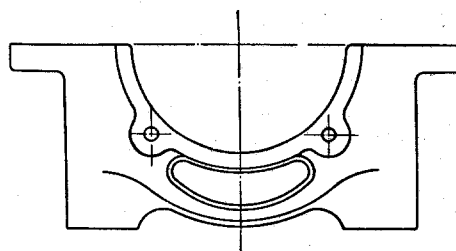


Fig. 01— 4/43

11. Clean the fitted bearing shells and the crankshaft bearing surfaces (use a clean soft chamois leather), and then apply graphite oil and place the crankshaft in position.

12. Fit the main bearing caps. Then apply graphite oil to the main bearing screws and the washers, screw them in and then tighten them in stages to the following torque:

First tightening	2 mkg
Second tightening	5 mkg
Third tightening	8 mkg
Fourth tightening (check)	8 mkg

The main bearing screws are not locked.

Note: The right front crankshaft bearing cap screw serves at the same time as a fixing screw for the oil pump bracket. In this case do not install a washer. Fit washers to all other screws on the crankshaft bearing caps. In the second version the oil pump bracket is fixed by a hexagon screw on the right screw for the front bearing cap. For this reason the screw has a deeper head with a M 8 internal thread and must be fitted with a washer (see Fig. 01— 4/37a).

13. Turn crankshaft by hand and check that it turns freely.

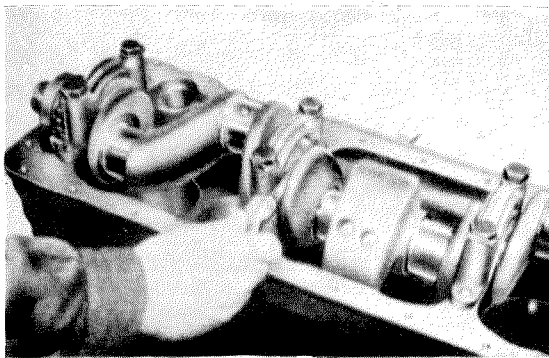


Fig. 01—4/44

Check end play at locating bearing (0.040 to 0.094 mm) by moving the crankshaft sideways. The end play can be measured with either a dial gage or tolerance feeler band (Fig. 01—4/44).

If the crankshaft is difficult to move, check the alignment of the bearing caps and, if necessary, correct by lightly tapping with a plastic hammer. To ascertain which bearing is binding, the bearings should be loosened in turn while the crankshaft is being turned until the fault is discovered. If the faulty bearing shell is a new one, it must be replaced.

14. Remove the bearing caps and take out the crankshaft.

The fabric sealing ring half on the flywheel side should only be fitted in the crankcase after the crankshaft has been checked for freedom of movement.

Apply talc, or if necessary oil, to the fabric sealing ring and fit in the crankcase. The fabric sealing ring must not be inserted under too great pressure.

Note: Do not snap the locking pin for the fabric sealing ring! Oil all contact surfaces and after placing the crankshaft in position, replace the bearing caps and tighten to the specified torque.

15. Screw on the oil pan with fabric sealing ring fitted and check whether the crankshaft can be turned easily.

The fabric sealing ring must not exert too much pressure. Then unscrew the oil pan again. If the shaft does not turn freely, the high spots on the fabric sealing ring must be

removed by rolling out with a suitable piece of rod. Take care not to damage the sealing ring when doing this!

16. Press the compensating ring and the crankshaft timing gear onto the crankshaft extension pin. Do not omit the Woodruff key!
17. Check alignment of crankshaft timing gear to idling gear. This is done by means of a depth micrometer or a depth gage which is used to measure the distance from the front face of the crankcase to the crankshaft timing gear and to the idling gear (Fig. 01—4/45). To obviate the error caused by end-play, both the crankshaft and the idling gear must be pushed to the rear as far as they will go while measurement is taking place.

The permissible degree of misalignment (difference between the two measurements) is 0.1 mm.

If the misalignment exceeds this figure, the compensating ring behind the crankshaft timing gear must be replaced.

Compensating rings are available in the following sizes:

5.45 mm, 5.60 mm, 5.75 mm, 5.90 mm and 6.05 mm.

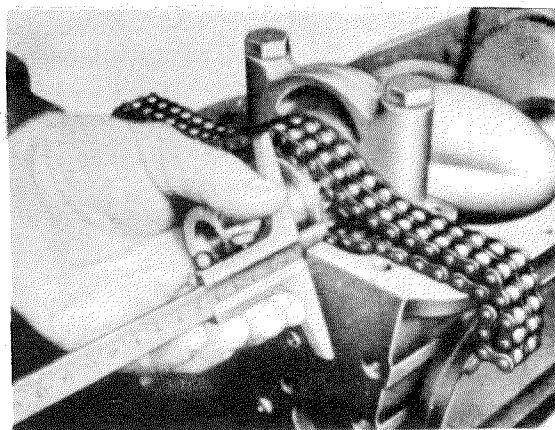


Fig. 01—4/45

When finally fitting the crankshaft timing gear do not omit the Woodruff key!

18. Fit the connecting rod bearing caps and tighten up nuts. Make sure that the nuts are the right way up.

The connecting rod pins are tightened up to a "stretch" (i.e. the difference between tightened and untightened length) or 0.1 mm. They are not locked. Measure the "stretch" of 0.1 mm with a dial gage or a micrometer (Fig. 01—4/46).

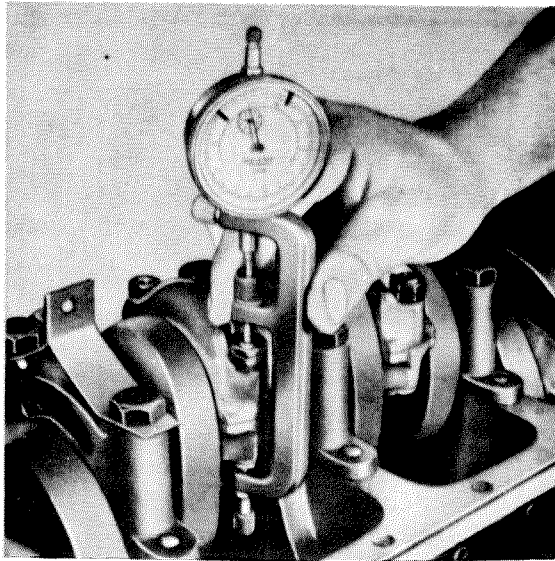


Fig. 01—4/46

Carry out the measurement in accordance with the following procedure:

First measure the length of the connecting rod pins without the nuts screwed on. The nuts are then fitted and tightened to the point where the pins are 0.1 mm longer than the original measured length (Fig. 01—4/47).

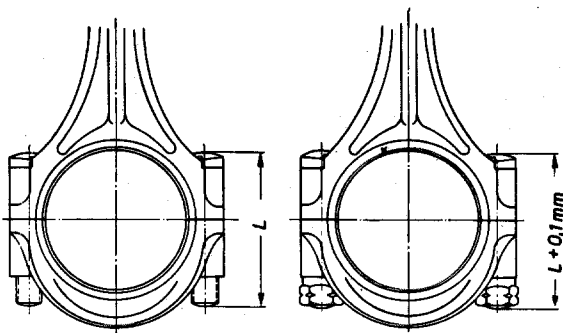


Fig. 01—4/47

When tightening the connecting rod pins, care must be taken to ensure that the pins are not stretched too much or overtightened. If necessary, use new pins. In exceptional cases the nuts can be tightened up with a torque wrench to a tightening torque of 3.75—3.80 mkg. Care must however be taken to ensure that graphite oil is liberally applied beforehand to the threads of the connecting rod pins and the contact surfaces of the nuts.

19. Press in the lower pivot pin for the chain guide (51 mm) until the lock wire on the chain guide engages in the annular groove in the pivot pin.
20. Press the oil thrower ring and the seal onto the crankshaft extension pin. To avoid damage to sealing lips of seal, use a suitable mounting sleeve with pressure block when fitting the seal.

Note: Before pressing the seal onto the crankshaft extension pin, fill the space between the two sealing lips with high-viscosity grease.

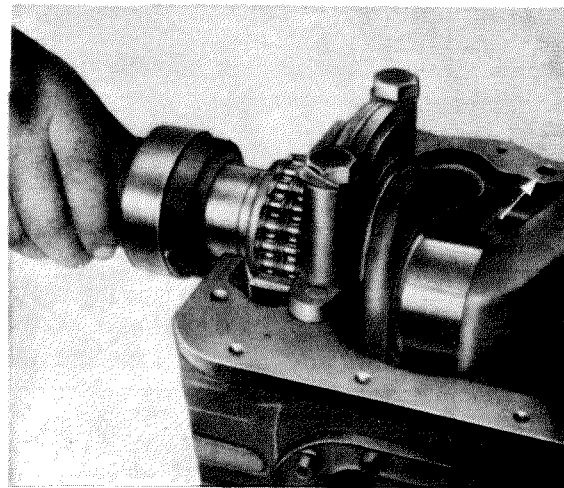


Fig. 01—4/48

21. Reinstall the oil pump, the oil pan, the counterweight and the camshaft timing gear (see Job No. 01—4, Section C, M, N and L).
22. Set the ignition (see Job No. 01—3, Section E).

P. Removal and Installation of Pistons and Connecting Rods

Removal:

1. Remove cylinder head (see Job No. 01—4, Section C).

Remove crankshaft and flywheel (see Job No. 01—4, Section O).

Note: If the pistons are removed with the crankshaft installed, unscrew connecting rod nuts and knock back connecting rod pins slightly by lightly tapping with a plastic hammer. Loosen and remove bearing caps.

3. Take out pistons and connecting rods upward.

Note: Combustion deposits on the upper end of the cylinder bores should be removed with a scraper in order to avoid damage to the piston rings. Before pressing out the connecting rods with pistons, the bearing shells must be taken out of the connecting rods.

When removing the bearing shell halves, mark them so that they can be refitted in the right order.

4. Remove the snap rings from the grooves in the piston pin eyes. Heat the pistons on a hot plate to approx. 60° C and press out the piston pins.

Installation:

5. Place the pistons, with the piston-head down, on a hot plate and heat up to about 60° C.

Thoroughly clean the oil passage and the connecting rod eye, hold the heated piston over the connecting rod and pass a locating drift through the piston eyes and the connecting rod eye. Then apply oil to the piston pins and press them in, if necessary tapping them with a plastic hammer. Make sure that the piston pins are centrally positioned!

Note: When installing the connecting rod with the piston attached, care must be taken to ensure that the off-center oil passage in the connecting rod is at the right, seen in the direction of travel.

6. Press the snap rings into the piston pin eyes.

7. Check the axial parallelity and squaring error of the connecting rods (see Job No. 03—5, Section C).

The permissible departure from axial parallelity is 0.03 mm and the permissible squaring error is 0.1 mm, over a length of 100 mm.

Correct greater deviations by squaring the connecting rods.

8. Before the pistons with connecting rods attached are installed, check and if necessary correct the attitude of the piston rings (Fig. 01—4/49).



Fig. 01—4/49

The connecting rods are numbered 1 to 4, corresponding to the four cylinders (Fig. 01—4/50).

Then apply graphite oil to the pistons and cylinder wall surfaces and insert the pistons with the aid of Piston Ring Tightening-Band 136 589 02 61 in the bores in the crankcase. When this is done, care must be taken to ensure that the cylinder wall surfaces are not damaged. When the pistons, with connecting rods attached, are correctly installed the numbers on the connecting rods must be on the left side, and the arrow on the piston-head must point in the direction of travel (Fig. 01—4/51).

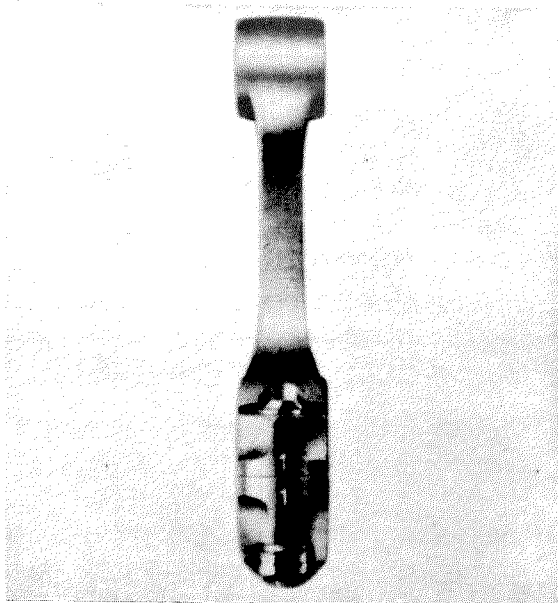


Fig. 01—4/50

9. Install the crankshaft and the flywheel (see Job No. 01—4, Section O).

10. Install the cylinder head (see Job No. 01—4, Section C).
11. Check the camshaft and ignition adjustment and, if necessary, correct (see Job No. 01—3, Sections E and F).

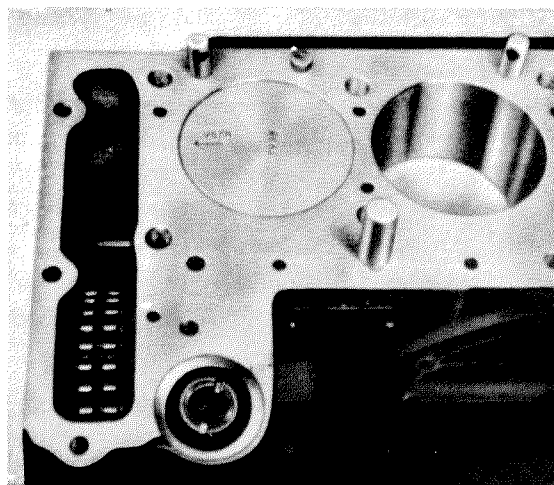


Fig. 01—4/51

Q. Disassembly and Assembly of Crankcase

Disassembly:

1. Disassemble the engine (see Job No. 01—4, Sections A to P).
2. Remove the two front engine supports at the left and at the right.
3. Remove the partition plate.
4. Remove the chain guides. To do this use Puller 187 589 07 33. When pulling out chain guide pivot pins, lift the lock-wire of the chain guide with a hook.

Note: When pulling out the pivot pins for the chain guide use the correct thread adapter of Puller 187 589 07 33. The pivot pins had originally an M 5 thread and now have an M 6 thread.

5. Unscrew the screw plugs at the ends of the longitudinal oil passages.
6. Pull out the rear bearing bushing for the idling gear shaft with Puller 186 589 09 33. Pull out the vertical bearing bushing for the helical gear with Puller 186 589 09 33 or drive out with a suitable drift from the oil pan side.
7. Take off the two cylinder covers which cover the engine water jacket compartments after removing the hexagon socket screws. Remove any fragments of the old gasket from the sealing surfaces on the crankcase and the two cylinder covers.

Assembly:

8. Fit the two cylinder covers which cover the engine water jacket. Use a new gasket and smear sealing compound on both sides. The cylinder covers must form a perfect seal. It is therefore essential to test for leakage after doing this (see Job No. 01—5, Section A).

Note: The bearing block for the twin lever of the carburetor linkage should be installed at the same time as the right cylinder cover.

9. Smear the threads of the screw plugs for the oil passages with sealing compound and screw in at the end of the oil passages. In doing this, care must be taken to ensure that no sealing compound enters the oil passages.
10. Press the vertical bearing bushing for the helical gear into the crankcase bore with a suitable drift.

Press in the rear bearing bushing for the idling gear shaft with a suitable drift. In doing this, care must be taken to ensure that the outer through-way groove in the bushing faces upward. The open end of the inner groove must point toward the rear (Fig. 01—4/29).

11. Install the chain guides. The left chain guide in the crankcase is shorter. The pivot pins are 51 mm long. Press the pivot pins in far enough for the lock wire on the chain guide to engage in the annular groove in the pivot pin.

The upper pivot pin (for the left chain guide) has an external thread and hexagon head.

12. Fit the partition plate.
13. Screw the two front engine supports to the crankcase. The left engine support serves at the same time for the fixing of the timing pointer. The upper screw on the right engine support serves at the same time for the fixing of the generator tensioning screw and the lower screw for the fixing of the ground lead to the generator.
14. Assemble the engine (see Job No. 01—4, Sections A to P).

R. Removal and Installation of Front Grease Seal for Crankshaft with Engine installed in Vehicle

Removal:

1. Remove the radiator (see Job No. 50 — 1).
2. Remove the counterweight (see Job No. 01 — 4, Section N).
3. Pry out the sealing ring with a suitable tool. Care must be taken to ensure that when doing this the guide, the bore and the oil thrower ring are not damaged.

Installation:

4. When installing the new grease seal, smear it with sealing compound at its circum-

ference, fill the space between the two sealing lips with high-viscosity grease and press in the sealing ring with a suitable insertion sleeve with pressure block (see Fig. 01—4/48).

The shoulder half of the grease seal must rest firmly against the face of the crankcase.

5. Install the counterweight (see Job No. 01—4, Section N).
6. Install the radiator (see Job No. 50 — 1).

S. Removal and Installation of Flywheel

Repair procedure (see Job No. 03 — 5, Sections E to H).

Removal:

Note: This operation is performed either with engine removed altogether or, if the engine is in the vehicle, with clutch and transmission removed.

1. After removing the fixing screws, the flywheel is taken off the crankshaft.
2. Check the annular grooved bearing assembly on crankshaft. If on examination the annular grooved bearing assembly is found to be defective, the bearing cover and the bearing itself should be pulled off with Puller 136 589 07 33 (Fig. 01—4/52).

Installation:

3. When installing the new annular groove bearing, do not omit the spacer sleeve between the crankshaft and the annular grooved bearing!
4. Screw the flywheel onto the crankshaft. The flywheel is fixed in position on the crankshaft by means of a dowel pin.

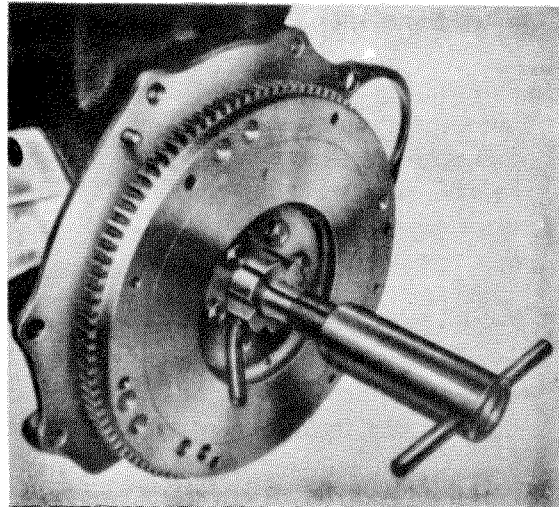


Fig. 01—4/52

The above picture shows the removal of the annular grooved bearing assembly on engine Model 220

Tighten the flywheel fixing screws (stretch screws) to a tightening torque of 4.4—5 mkg.

Note: If a new flywheel is installed, it must be balanced beforehand (see Job No. 03—5, Section H).

T. Removal and Installation of Twin Roller Chain with Engine installed in Vehicle

Removal:

Note: If repair should be necessary, a chain with a jointing link (spare link) can be installed as a substitute for the endless chain. This enables the chain to be replaced without disassembling the engine.

When the engine is being overhauled, however, an endless chain should always be fitted.

1. Unscrew the cap nuts on the vent line at the cylinder head cover and unfasten the hose clip on the connecting hose at the air intake silencer. Unscrew the fixing nuts for the air intake silencer brackets and remove the air intake silencer together with brackets.
2. Unscrew the clamp screws and take off the cylinder head.
3. Unscrew stretch screws for fixing the rocker arm blocks and remove blocks together with rocker arms. When removing the rocker arm blocks, turn camshaft each time to the position where the rocker arms are not under load (see Fig. 01—4/17).

Note: Removal of the rocker arm blocks is necessary in order to avoid damage to the valves, pistons etc. in the event of the chain sliding off a sprocket when the crankshaft is turned.

Installation:

4. To remove the old chain, file off one of the rivet heads and press the rivet out with Link Extractor 000 589 03 35. Connect the new chain to the old one by means of a jointing link (spare link).

Fit spring clip (locking clip).

5. Now turn the crankshaft slowly and feed the new chain in.

Note: The crankshaft can be turned over at the hexagon shoulder screw which attaches the pulley. Use Box Wrench SW 22 for this.

6. Depress the chain tension sprocket and turn engine until the jointing link with the spring clip can be fitted at the other end of the new chain.

Caution!

Insert jointing link (2) from front to rear (contrary to direction of travel). Fit spring clip (1) with its closed end pointing in the direction the timing gear turns (Fig. 01—4/53).

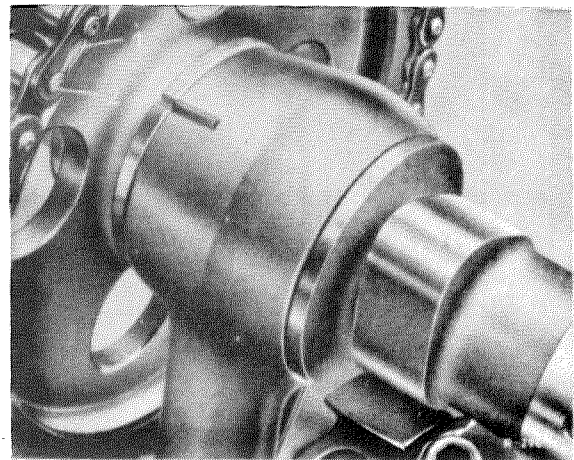


Fig. 01—4/53

1 Spring clip
2 Jointing link

7. Press back the tension sprocket bearing as far as it will go, using Bleeder Lever 187 589 02 63, or, if necessary, with a screwdriver, at the same time continually topping up the oil case in the cylinder head with warm engine oil (see Fig. 01—4/14). Now gradually release the sprocket bearing with the lever or screwdriver, at the same time continually topping up with oil, so that the oil case is always full of oil and the chain tensioner cannot suck in any air. Then "pump" the tension sprocket bearing until no more air bubbles can be seen at the chain tensioner. The important thing is to maintain the necessary oil level during the bleeding process.

When the chain tensioner is perfectly bled further pumping becomes impossible. Considerable force is required to depress the

chain tensioner even at the beginning of the bleeding operation. Bleeding of the chain tensioner should be carried out with great care, since imperfect bleeding leads to chain noises when the engine is idling. See also "Checking of Chain Tensioner" (Job No. 05—5, Section F).

8. Insert the rocker arm block guide sleeves in the bores in the cylinder head and drive them in. The guide sleeves must be seated firmly.

Install the assembled rocker arm blocks and tighten up the stretch screws to 3.75 mkg.

Check whether the spring clamps have engaged in the notches in the rocker arm blocks (see arrow in Fig. 01—4/15).

When installing the assembled rocker arms, turn the camshaft to the position where the rocker arms are not under load (Fig. 01—4/17).

9. Check the ignition adjustment and the timing (see Job No. 01—3, Sections E and L).
10. Install the cylinder head cover and the air intake silencer.