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.

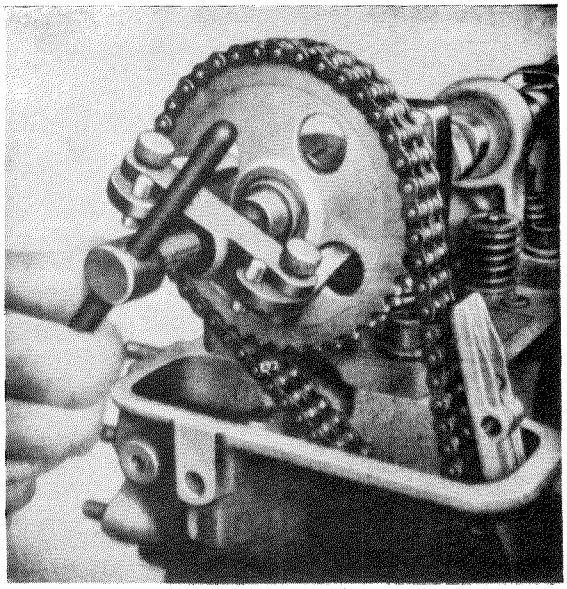

Fig. 01—4/2

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.

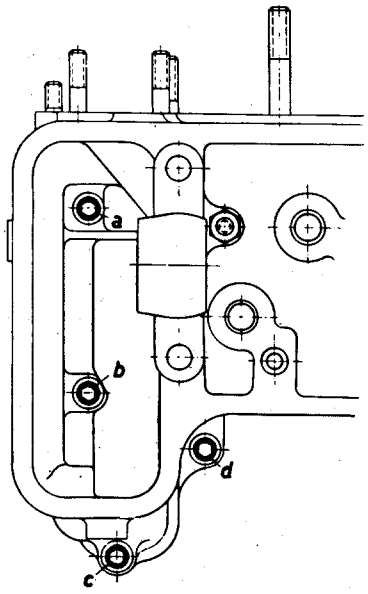

Fig. 01— 4/3

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.

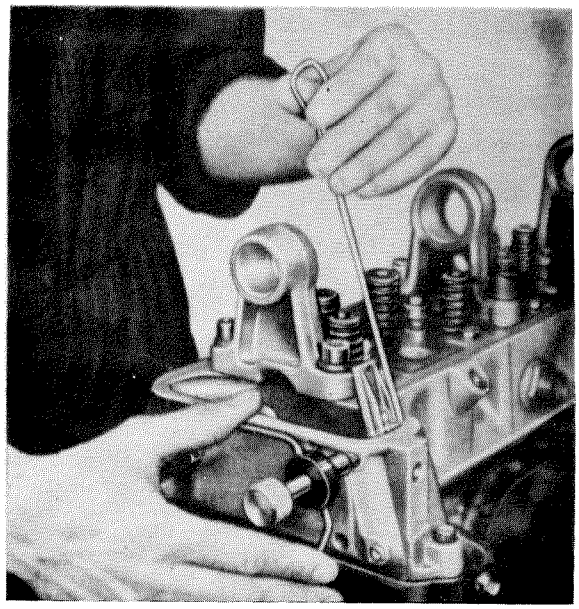

Fig. 01— 4/4

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 remachining 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).

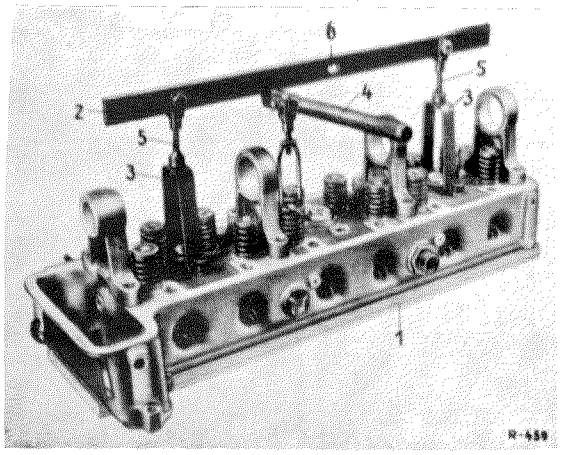

Fig. 01—4/5

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

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.

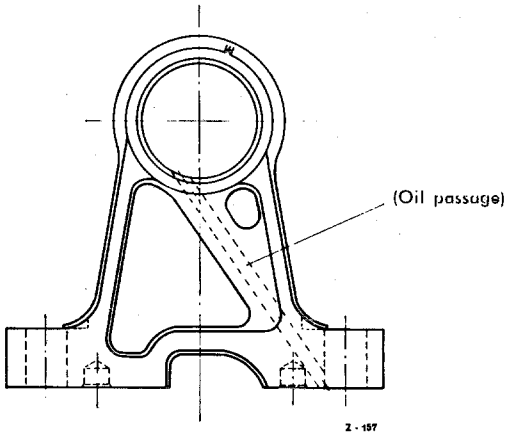

Fig. 01—4/6

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. Leakage 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).

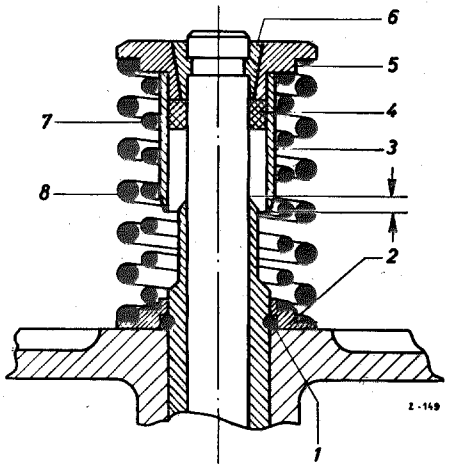

Fig. 01—4/7

1 Snap ring
2 Thrust collar
3 Sealing ring retainer
4 Sealing ring
5 Valve-spring retainer
6 Valve cone half
7 Inner valve spring
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 0 319!

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.

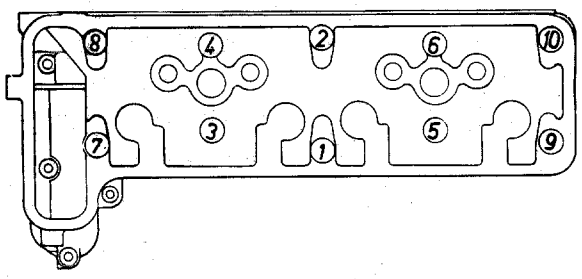

Fig. 01—4/8

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.

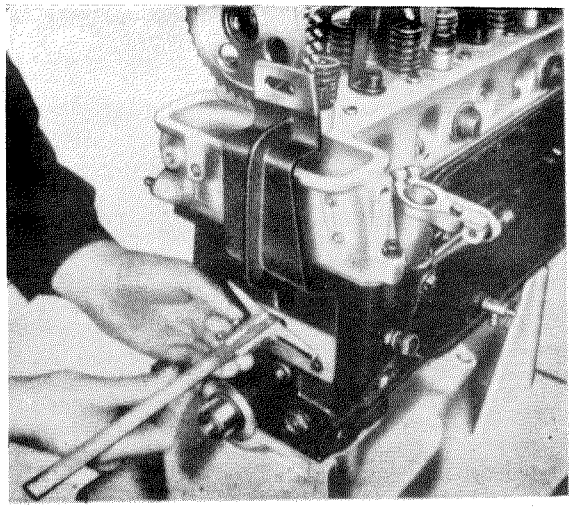

Fig. 01—4/9

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).

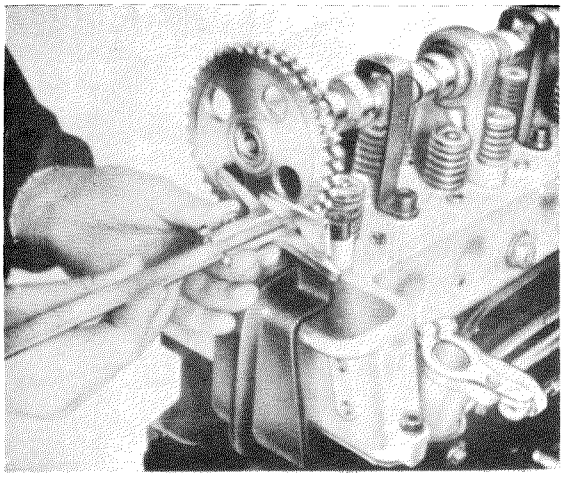

Fig. 01—4/10

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

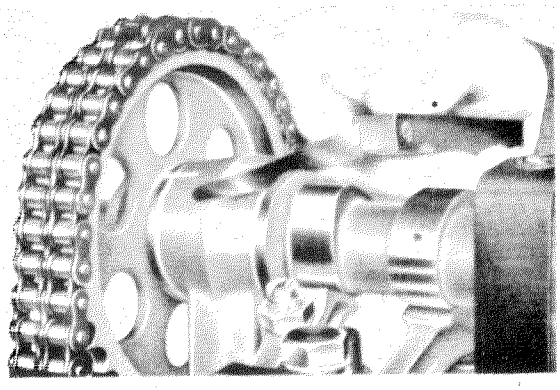

Fig. 01—4/11

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).

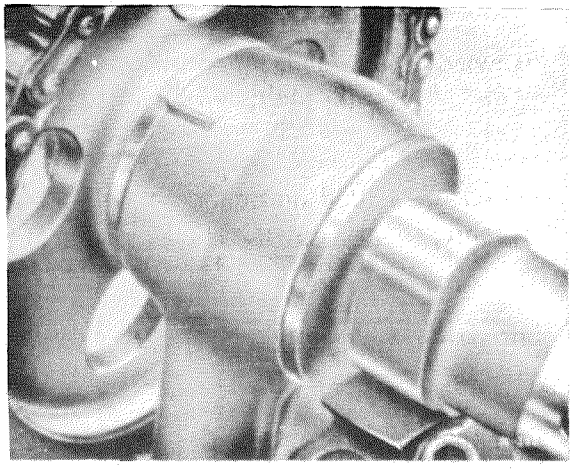

Fig. 01—4/12

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.

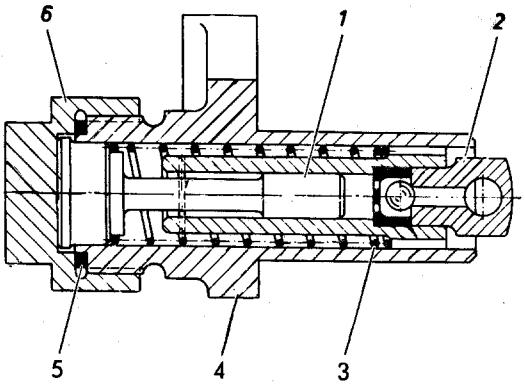

Fig. 01—4/13

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).

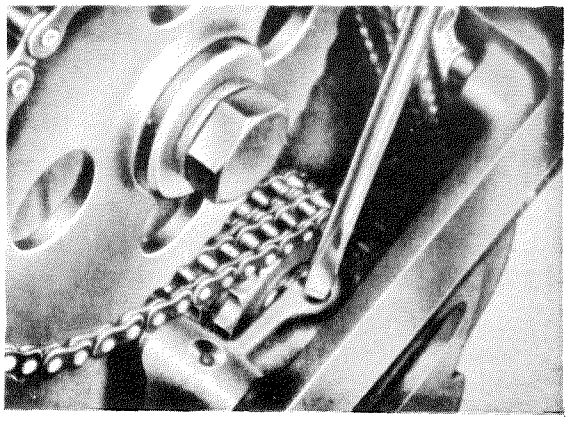

Fig. 01—4/14

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.

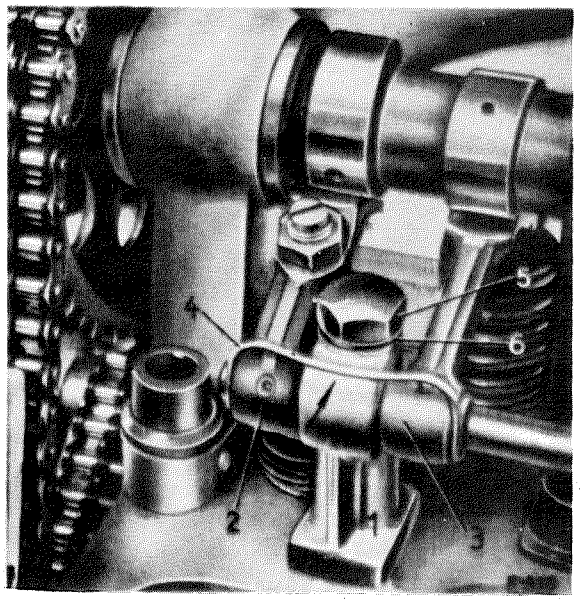

Fig. 01—4/15

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

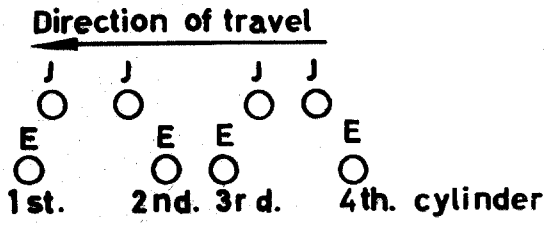

Fig. 01— 4/16

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.)

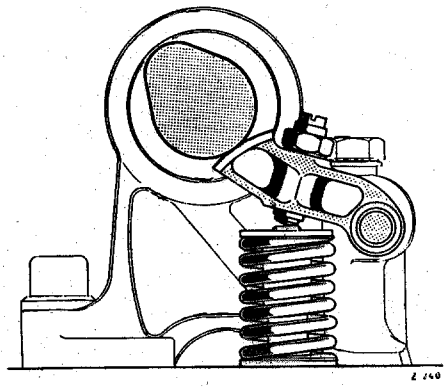

Fig. 01— 4/17

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.

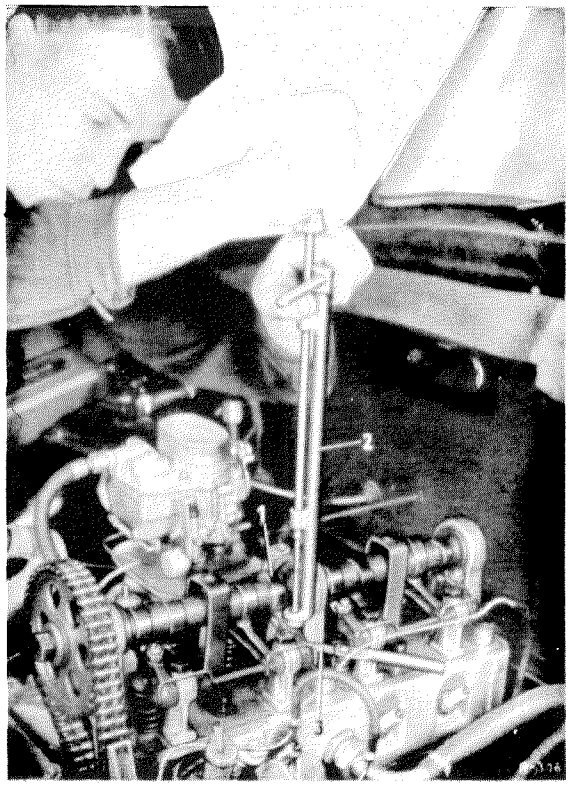

Fig. 01— 4/18

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).

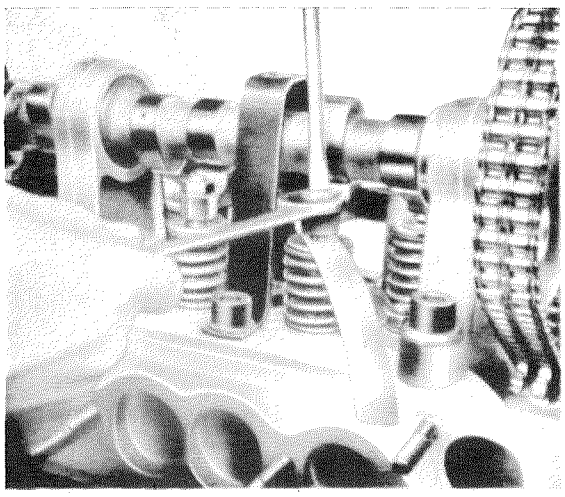

Fig. 01— 4/19

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.