Engine Tune-up

In general it is sufficient to carry out the checking and adjustment operations described in the procedures A—K below.

It is usually unnecessary to check the valve timing settings. This should only be undertaken in special cases.

An accurate adjustment of the tappets is impossible with the engine warm. All data on tappet clearance is therefore only valid for a **cold engine.**

For this reason, the checking and adjustment of tappet clearances should never be undertaken with the engine at working temperature.

Should it be necessary to begin adjustment operations with the engine at working temperature, procedures B—H should first be carried out. Then when the engine has become cold, the tappet clearance should be adjusted and finally, after the engine has been warmed up, the idle should be adjusted.

With the engine cold, operations should be carried out in the following order:

A. Tappet clearance adjustment

B. Compression measurement

C. Cleaning and testing of spark plugs

D. Measurement and adjustment of distributor contact gaps

E. Ignition setting

F. Checking of camshaft adjustment

G. Measurement and adjustment of fuel feed pump pressure

H. Measurement and adjustment of carburetor fuel level and injection amount

I. Trouble-shooting hints on carburetor system

K. Adjustment of idle

L. Checking of valve timing settings

A. Tappet Clearance Adjustment

Tappet clearance should only be adjusted or checked with engine cold!

Tappet clearance

Inlet: = 0.10 mm
Exhaust: = 0.20 mm

1. Remove air intake silencer and cylinder head cover.
2. Check tightness of cylinder head bolts and if necessary, tighten as specified. (See Job No. 01—4, Section C, Fig. 44.)
3. Move the cam (of the camshaft) which operates the tappet being adjusted to the position where the lobe of the cam is not pressed against the rocker arm but on the opposite side and at right angles to the sliding surface of the rocker arm — i. e. the base circle of the cam faces the sliding surface of the rocker arm.
   The crankshaft is turned by means of the shoulder screw which attaches the vee pulley and the counterweight to the crankshaft. Box Wrench SW 22 is used with a ratchet insert to do this (Fig. 01—3/2).
4. Slacken the hexagon nut of the tappet adjustment screw and adjust the screw, using Special Combination Wrench 187 589 01 09, to the specified clearance, using a tolerance feeler band.
   It must be **only just** possible to move the tolerance feeler band between the valve stem and the adjustment screw (Fig. 01—3/2a).

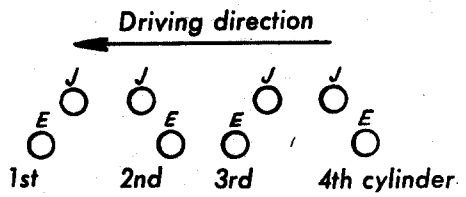


Fig. 01—3/1

Now re-tighten the hexagon nut, holding the adjustment screw steady. Check tappet clearance once again after having tightened up the adjustment nut.

5. Put back cylinder head cover and air intake silencer. When putting on the cylinder head cover, make sure that the gasket is properly seated!
6. Run the engine and check the cylinder head cover for leakage at the jointing surface.

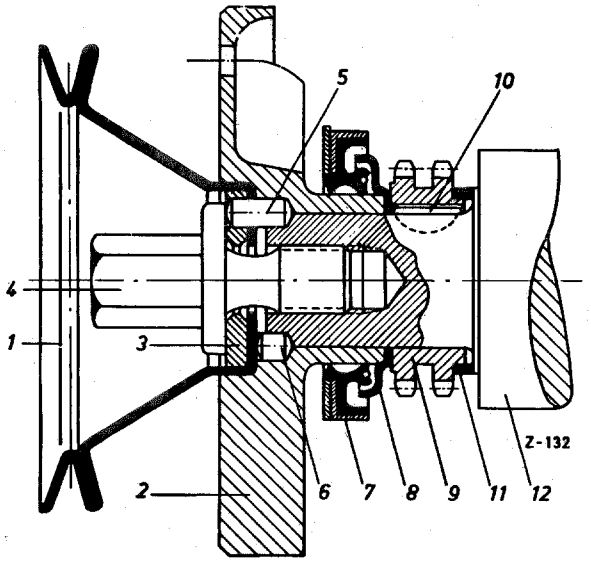


Fig. 01—3/2

1 Vee-pulley
2 Counterweight
3 Washer
4 Shoulder screw
5 Dowel pin
6 Dowel pin
7 Seal
8 Oil thrower disk
9 Crankshaft sprocket
10 Key
11 Compensating ring
12 Crankshaft

Note: When the cylinder head cover is replaced, the gasket must not be jammed out of position.

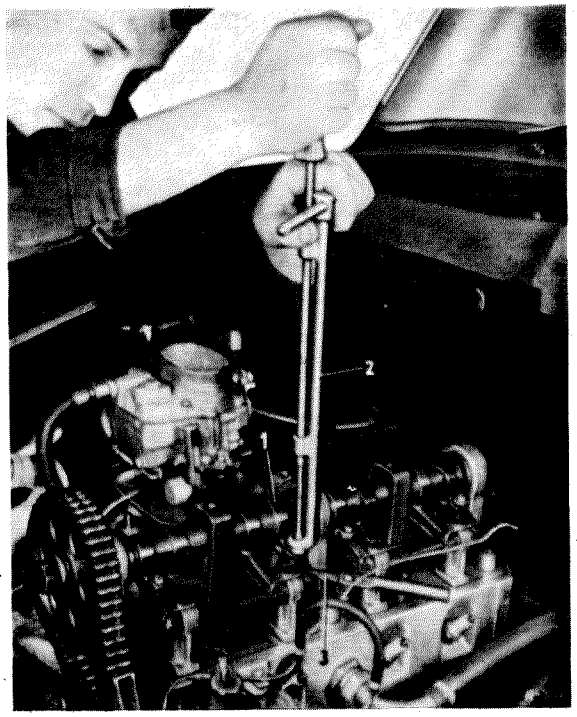


Fig. 01—3/2a

1 Position of cam
2 Special Combination Wrench 187 589 01 09
3 Tolerance feeler band

B. Compression Measurement

Compression ratio and capacity of compression chamber

Cylinder head	With normal compression ratio	With lower compression ratio on request SA 10250
Compression factor ε	Maximum permissible 7.8 : 1 Normal 7.5 : 1 Minimum permissible 7.25 : 1	7.0 : 1 6.8 : 1 6.6 : 1
Total capacity of compression chamber with cylinder head fitted	69.8 — 75.8 cm³	78.5 — 84.5 cm³
Capacity of compression chamber in cylinder head with valves fitted and spark plugs screwed in	62.3 — 63.3 cm³	70.3 — 71.3 cm³

1. Bring the engine to normal working temperature (cooling water temperature 70 to 80° C.

2. Remove spark plugs and turn the engine a few times with the starter to remove any oil carbon deposits.

3. Turn the ignition adjustment knob as far to the right as it will go.

   Remove distributor disk and rotor arm.

   Measurements can now be taken for all 4 cylinders on the compression recorder without using an extension tube or an elbow joint.

4. Press the rubber cone of Compression Recorder 000 589 18 21 into the spark plug bore of the cylinder to be measured. A second person should now be employed to open the throttle valve to its full extent by depressing the accelerator and to operate the starter (approx. 4—6 turns of the engine).

   The throttle valve must be wide open in order to ensure that the cylinder is completely filled!

5. Measure all 4 cylinders. The recorder card must be moved to a new position for each cylinder in turn (see operating instructions).

   Make sure that the duration of turning the engine remains approximately the same for the measurements on all 4 cylinders (Fig. 01—3/3).

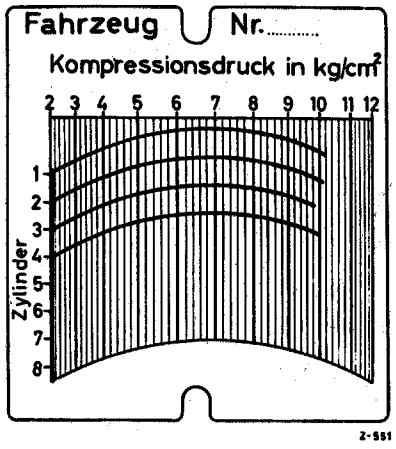


Fig. 01—3/3

6. When using Compression Recorder 000 589 18 21 a compression of approx. 8.5 atmospheres will usually be obtained in the case of new engines.

   The figures obtained for the individual cylinders should not vary by more than 1.0—1.5 atmospheres.

   If the discrepancy for any one cylinder exceeds this amount, a second measurement should be taken.

   If the compression is only 7 atmospheres or less, this indicates that the valves, pistons or piston rings are in need of repair. If the figures for two adjacent cylinders are appreciably lower than the rest it will usually be found that the cylinder head gasket between these two cylinders is leaky.

C. Cleaning and Testing of Spark Plugs

Approved spark plugs:

For Model 190 the following spark plugs are approved:

	Plugs without suppressors	Plugs with suppressors
Bosch	W 175 T 7 "N"	W 175 R T 7 "N"
Beru	175/14 Lu_3	E 175/14 Lu_3
Champion	730	X 730

Note: If fast driving is contemplated and especially where the vehicle is used for sporting purposes, we recommend the plug Bosch W 225 T 7 D or Beru 225/14 Lu_2.

If a radio is fitted to the vehicle, plug Bosch W 225 R T 7 or Beru E 225/14 Lu_2, both of which are suppressed, can be used.

Appearance of spark plugs:

After a long period of use, the appearance of the plug, i. e. the parts of the plug which face the combustion chamber — especially the appearance of the conical end of the insulator — give an indication of whether the plug is operating properly or not.
Experienced servicing personnel are able to draw certain conclusions concerning the adjustment and condition of the engine from the appearance of the plugs.
Note: The spark plugs shown in the following illustrations (01—3/5 to 01—3/10) have "overhead" ground electrodes while the plugs for our engines have side electrodes (Figure 01—3/4).
The contructional form of the electrodes does not, however, affect the appearance of the plugs.
In general, the following rules are applicable when judging a plug from its appearance:

Fig. 01—3/4

Fuel without lead additive

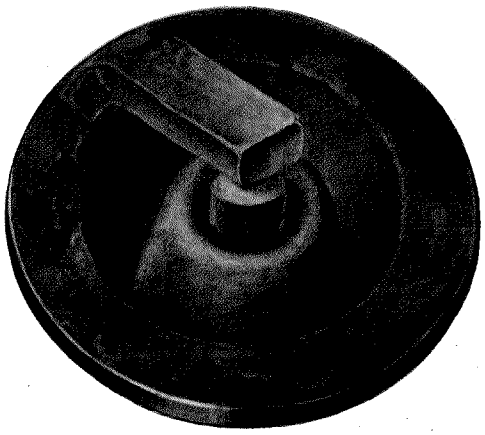


Fig. 01—3/5

Normal

Correct type of plug; carburetor correctly adjusted; insulator light-brown; body of plug dark grey; slight dry soot deposit on body.

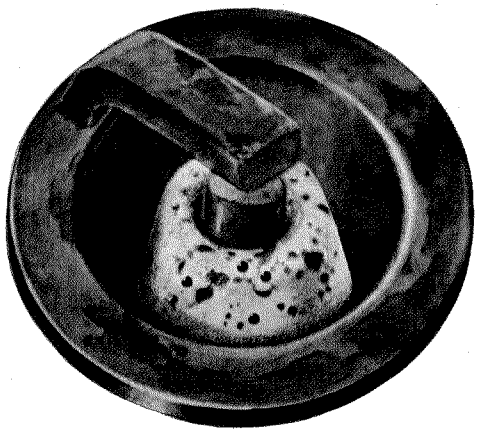


Fig. 01—3/6

Overheated

Plug of too low a thermal value; carburetor adjustment too lean; ignition too far advanced; insulator burned white with molten metal droplets; color "bloom" on threaded part and electrodes (plug has been heated to flash-point temperature causing spontaneous ignition).

Fuel with lead additive

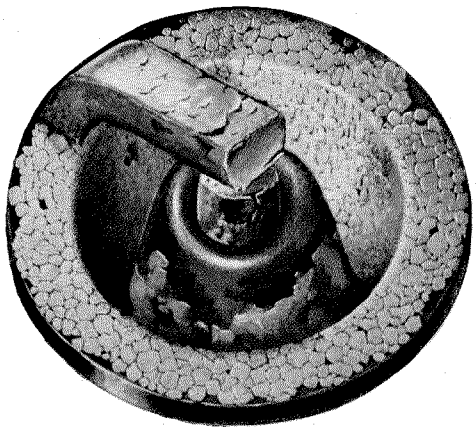


Fig. 01—3/7

Normal

After a long period of use or when fuel had high lead-content; considerable deposit, grey-yellow to brown, consisting of powdery lead compounds.

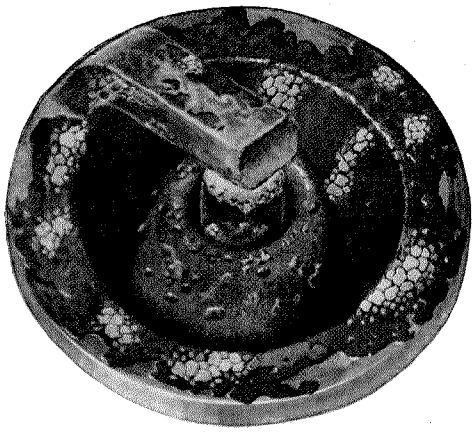


Fig. 01—3/8

Overheated

Plug of too low a thermal value; deposit of molten metal, consisting of lead compounds and electrode erosion deposits; molten metal droplets on insulator.

Fuel with or without lead additive

Fig. 01—3/9

Plug sooted up

Velvety, matt black soot deposit; mixture too rich; carburetor jet too large; insufficient air.

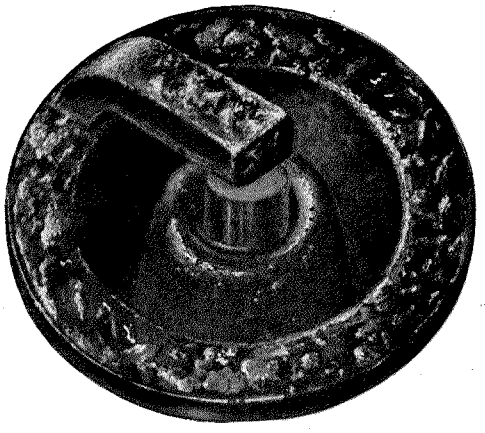


Fig. 01—3/10

Plug oiled up

Deposit of moist oil-carbon and soot; broken piston rings; excess piston clearance; excess oil in combustion chamber. Valve seals faulty!

Electrode gap:

In the case of all plugs without suppressors, the electrode gap is 0.7—0.8 mm. Suppressed plugs have a gap of 0.9—1.0 mm.

The electrode gap should in all cases be checked before fitting and if necessary, adjusted. It should be noted that the Champion plug, when new, has a spark gap of 0.65—0.7 mm. This plug must therefore always be adjusted to the specified gap. The same applies to the suppressed Bosch plug which is at present made with an electrode gap of 0.7—0.8 mm.

The gaps should be checked with Plug Adjustment Gage 000 589 03 23 (0.7—1.0 mm) and adjusted to the specified gap by bending the **"Ground" electrode** (Fig. 01—3/11).

Fig. 01—3/11

When the ground electrode is being bent into position, care must be taken not to strain either the center electrode or the insulator. If the insulator is damaged the plug is useless.
If the electrode gap is too small, the engine will idle irregularly and jerkily and will misfire; back-firing will occur when the idling engine is pulling the vehicle.
In the course of time, the electrode gap increases through electrode erosion and this can cause plug failure.
Maximum engine performance can only be attained with plugs of 100% efficiency. Faulty plugs, incorrect electrode gaps, plugs with too high or too low a thermal value cause engine trouble and may even result in serious damage to the engine.
Only plugs specified by the makers may therefore be used. All plugs deteriorate in time, owing to the high strains to which they are subjected. We therefore recommend that the plugs be replaced after 15 000 to 16 000 km.

Cleaning spark plugs:

When cleaning the outside of the plug, care must be taken to ensure that the glazed surface of the insulator is free from water, oil and dirt and that there are no moist deposits in the space between the plug body and the insulator.
The inside of the body-bore, and in particular the foot of the insulator, must be cleaned as a separate operation to rid these surfaces of any trace of deposits. It is useless merely to clean the electrodes.
The state of the interior of the plug can easily be seen with the aid of an ordinary commercial illuminated magnifier (Fig. 01—3/12).

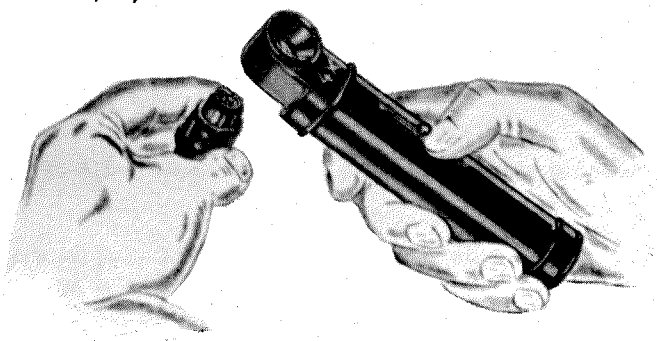
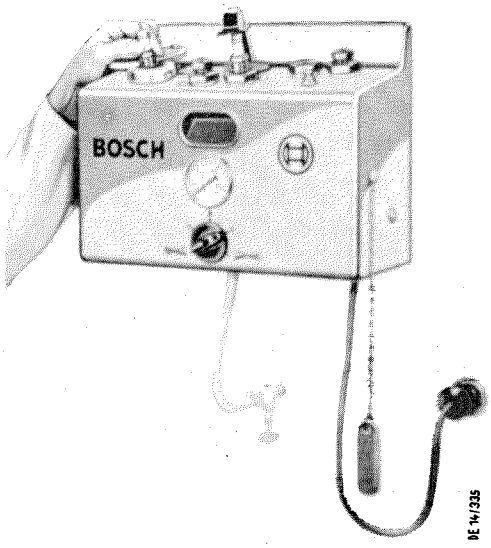


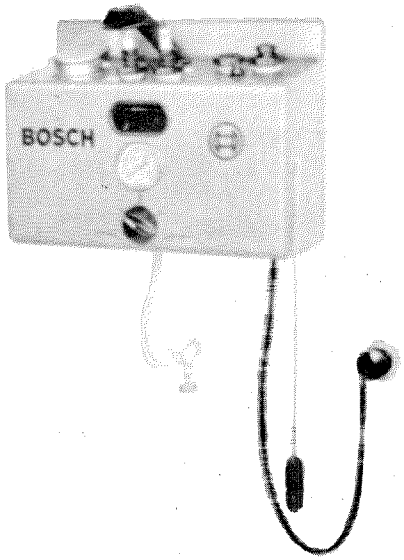
Fig. 01—3/12

The cleaning operation is best carried out with a suitable sand-blasting machine, such as for instance the type marketed by the firms of Beru or Bosch. The spark plug is inserted in a socket of the same diameter as the plug thread and is held by hand and turned during the blasting operation. "Wet" or oil-soaked plugs must first be washed with gasoline and dried with air-blast. The period of cleaning with sand-blast must not exceed that specified in the instructions of the makers of the machine as otherwise the electrodes will be blunted. Furthermore, only sand of the specified kind may be used. **After sand-blasting, the spark plug should be blown out with ordinary air-blast and if necessary, freed from sand residue with a small tool.**



Sand-blasting

Fig. 01—3/13



Testing for electrical efficiency

Fig. 01—3/14

If no sand-blasting machine is available, it is possible to clean the interior of the spark plug with Spark Plug Cleaner 000 589 01 68 or with a stiff steel wire brush, also using gasoline if necessary. Brass wire brushes or soft-metal objects must not be used to clean the insulator foot. Such objects leave traces of metal on the surface of the insulator and as this metal is a good conductor, it could lead to plug failure.

Testing spark plugs:

Certain spark plug defects — e. g., gas-leakage, fine cracks in the insulator etc., are practically undetectable without test gear. Commercially-available test equipment has therefore been developed, enabling the electrical efficiency and gas-tightness of plugs to be checked.

As the spark plug must be checked under working conditions, that is to say, under pressure, the tester incorporates a special pressure chamber, which must be connected to a compressed-air supply (Fig. 01—3/14, Tester developed by the firm of Bosch).

The compressed air must be at a pressure of 5 atmospheres and not more than 8 atmospheres. A pressure gage indicates the pressure in the pressure chamber at all times. The pressure chamber has two apertures accessible from the outside. These apertures are threaded so that 2 spark plugs can be screwed in and tested simultaneously. The second aperture may also be used for purposes of comparison, in which case a second (new) spark plug of the same type is screwed in. Alternatively, a dummy (stopper) plug may be screwed in.

The sparks leaping across the electrodes can be observed through the inspection window. If the plug being tested is in good condition, a spark jumps the electrode gap every time. If it does not, this indicates that the high voltage is being dissipated along another path, e. g., the current is leaking along the ceramic of the insulator or passing to ground through an insulator crack.

When comparing the performance of 2 spark plugs, the high voltage hinged contact bracket is first connected to the first plug and after this has been tested, the bracket is moved over to the second plug and the spark observed.

A spark plug is in perfect working order when at the normally specified test pressure of 5 atmospheres, the sparks appear only at the electrodes of the spark plug or at the comparison spark gap or alternately and regularly at both. But they must not be visible, nor even audible, at any other point.

A spark plug is not in working order when at the specified test pressure of 5 atmospheres either no spark at all or only individual sparks appear at its electrodes or at the comparison spark gap. If the spark plug has been carefully cleaned beforehand so that dirt can be exluded as a possible cause, it can generally be assumed that the insulator is defective. Under these conditions, it is usually the case that the sparks are striking straight through the insulator and can be seen or heard passing through it. In the case of a spark plug which is badly fouled with soot or oil, the ignition current flows unseen via the foot of the insulator and the body of the plug to the ground.

Correct current flow

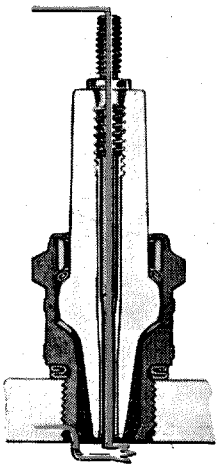


Fig. 01—3/15

The spark leaps across the gap between the electrodes.

Current flow diverted by fouling

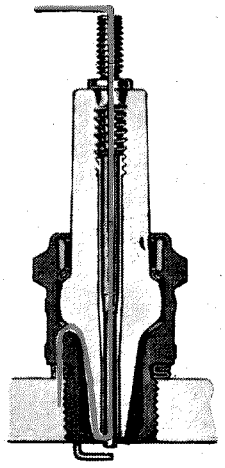


Fig. 01—3/16

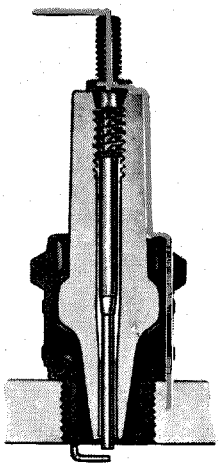


Fig. 01—3/17

Fouling

At foot of insulator

Clean plug by washing in gasoline and if necessary, by sand-blasting.

At upper part of insulator

Dirt or water on the surface of insulator. Keep insulator clean and dry.

Current flow diverted by fracture in insulator

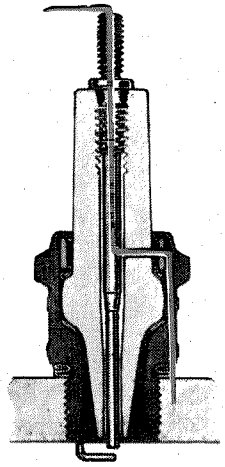


Fig. 01—3/18

The current takes the path of least resistance: The ignition spark is missing altogether! **Cause:** Insulator fractured, e. g., through use of unsuitable plug wrench or careless handling when screwing in. **Remedy:** Take new plug and screw it in with reasonable pressure. Avoid excess pressure.

Spark gap by-passed

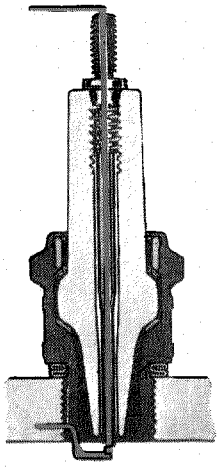


Fig. 01—3/19

The current takes the path of least resistance: The ignition spark is missing altogether! **Cause:** Oil-carbon, road dust etc., have bridged the gap and formed a conductor across it. **Remedy:** Remove obstruction between electrodes. Clean cylinder head.

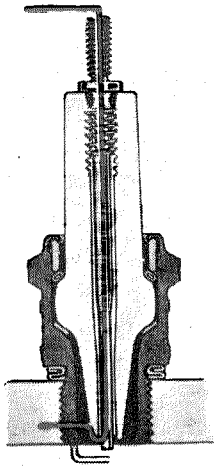


Fig. 01—3/20

When testing the spark plugs, it should be borne in mind that in the course of time, the use of fuels with lead additive causes a coating of lead oxides to form on the spark plugs. These lead oxides remain non-conductors of electricity while cold but become conductors from 400° C upward. As the lead oxide precipitate cannot normally be removed by sand-blasting, such spark plugs may work perfectly when being examined on the tester but may fail when in the engine. This is yet another reason why the spark plugs should be replaced after 15,000 to 16,000 km.

Removal and installation of spark plugs:

Removal:

If the spark plug has seized hard in the cylinder head, it should first only be unscrewed a little — to avoid damage to the thread in the cylinder head — and then a few drops of oil or kerosene should be run into the thread. The plug should then be screwed in again and only after a lapse of some time be completely removed. This is particularly important in the case of light-alloy cylinder heads as the threads in these can easily be damaged by careless handling.
Carefully clean thread in cylinder head. If the engine has been in use for some time, it is advisable to remove the oil-carbon deposits by carefully screwing in an M 14×1.25 tap. Before putting in the spark plugs, the engine should be turned over a few times with the starter so that the dislodged oil-carbon can be blown out.

Installation:

Smear the holding-thread of the spark plug with graphite. This prevents the thread from burning onto the head later. Take care that the other parts of the spark plug — especially the electrodes and the interior of the plug — are kept free of graphite. When slackening or tightening spark plugs, do not hold the wrench in a slanting position, otherwise the insulator may be broken off or pressed sideways, allowing the center electrode to come into contact with the ground electrode.
Take reasonable care when tightening spark plugs. Check value of tightening torque is 4 mkg.

D. Measurement and Adjustment of Distributor Contact Gaps

After adjusting the contacts, the ignition should always be re-set because an alteration of 0.1 mm in the contact gap corresponds to a movement of the ignition crankshaft setting of approx. 3°.

Measurement can be made either

a) with a feeler gage or

b) with the Closure Angle Meter 000 589 12 21 or with any suitable closure angle meter.

Measurement with the feeler gage:

1. Remove distributor cap and rotor.

2. Use Socket SW 22 with ratchet on shoulder nut of crankshaft to turn crankshaft until one of the cams on the distributor shaft lifts the moving contact at all points. The moving contact should not be lifted with the finger!

3. Measure contact gap with feeler gage. **The contact gap should be 0.4—0.5 mm.**

   Should existing instructions specify a contact gap of 0.30—0.40 mm, these should be rectified. In 4 cylinder — as opposed to 6 cylinder — engines, a greater contact gap is permissible.

   A true measurement can only be made with the feeler gage if the contacts are new or smooth and even. Moreover, the distributor drive shaft must not have too much radial play.

   After only a short period of running, a crater is formed on the moving contact and a cone on the stationary one; this is caused by the continual arcing due to the shifting of the actual point of contact. At this stage, accurate measurement cannot be made with the feeler gage (Fig. 01—3/21).

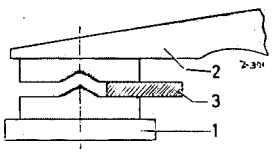


Fig. 01—3/21

1 Stationary contact
2 Moving contact
3 Feeler gage

The checking of the contact gap with the feeler gage should be made at a point beside the cone or the crater.

This shifting of the point of contact does not adversely affect the working of the distributor. The contact gap remains practically unchanged, despite the formation of cone and crater. It is therefore unnecessary to replace or grind the points before the ignition is noticed to be adversely affected.

Note: When measuring with the feeler gage, the distributor shaft must not be pressed against the contact breaker points.

Measurement with the closure angle meter:

Measurement with the closure angle meter is much more accurate and is preferable in all cases — particularly in view of the fact that it enables the test to be made with the engine running. Faults caused by excessive distributor shaft play or a loose base plate are detected by this method.

1. Connect up meter in accordance with the makers' instructions.

2. The angle of closure should be 46°—52° when the engine is running at idling speed and 44°—52° at an engine speed of 1500 to 4500 r. p. m.

   When measurements are being made, care must be taken to ensure that the angle of closure does not vary by more than 3° between the idle engine speed and an engine speed of 4500 r. p. m. Discrepancies in excess of this indicate that there is too much radial play in the drive shaft, that the base plate has worked loose or that there is some other fault in the distributor.

   If the angle of closure is too small, the contact gap is too large. If the angle of closure is too large, the gap is too small.

   After adjustment of the closure angle — by altering the contact gap — the contact gap must once more be checked with the feeler gage.

Both the angle of closure and the contact gap must lie within the specified tolerances!

If, after the angle of closure has been correctly adjusted, the contact gap is smaller than 0.3 mm, the points must be replaced. If, despite replacement of the points, the contact gap is still too small, even though the angle of closure is correct, the distributor must be replaced.

Under no circumstances must the angle of closure be corrected by reducing the contact gap below the specified value.

Testing contacts:

If faulty ignition is caused by excessive burning of the contact breaker points, the point holders and contact breaker arm must always be replaced (see Job No. 15—23, Section C).

Grinding the points on an oil stone should only be undertaken in an emergency when no new parts are available.

The specified value of 400—500 g must be adhered to for the spring pressure of the contact breaker arm — otherwise the points may "flutter" at fairly high engine speeds and faulty ignition will result.

The test can be made with a spring pressure gage (Fig. 01—3/22).

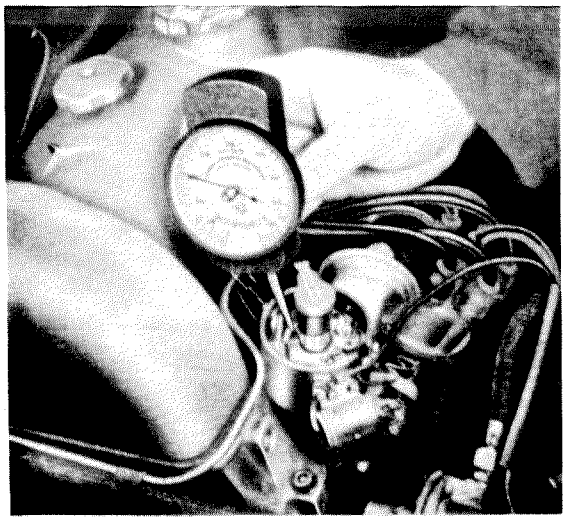


Fig. 01—3/22

Adjustment of the contacts:

Slacken set screw on stationary contact and turn eccentric adjustment screw either to the right or to the left as required. Tighten set screw after adjustment.

After adjusting the contacts, the ignition should always be re-set because an alteration of 1.0 mm in the contact gap corresponds to a movement of the ignition crankshaft setting of approx. 3°.

E. Ignition Setting

Before setting the ignition to 8° ± 1° TDC, the contact gap should always be checked (see Job No. 01 — 3, Section D).
Ignition adjustment can be carried out either

a) with the timing light or
b) with a suitable flash stroboscope.

a) Ignition adjustment, using timing light:

1. Adjust ignition control cable. To do this

a) move the timing lever (5) at the distributor bearing **right over to the advance stop** and fix it in this position with a clamp (15) (see Fig. 01 — 3/24).

b) Slacken the hexagon nut (8) and screw the adjustment screw (9) right home (Fig. 01— 3/23).

c) Move the rotary control of the control cable for the ignition adjustment to the left against the stop "früh" (advance) and turn it back from this position about 3 to 4 mm, measured around the circumference of the rotary control knob. This extra amount of travel is deliberately left at the control knob because the Bowden cable may stretch after a period of use and it is therefore necessary to make allowance for this.

d) Push the rubber damping (4) and the clamping chuck onto the Bowden cable as far as the timing lever (5). Grip the Bowden cable in the clamping chuck by tightening up the hexagon nut (1) (Fig. 01— 3/23).

e) The cable must be drawn taut by backing out the adjustment screw (9) **so that the timing lever (5) of the distributor is definitely lying against the advance stop.**
Then lock the adjustment screw (9) by tightening up the hexagon nut (8) (see Fig. 01— 3/23 and Fig. 01— 3/24) and then remove the clamp (15).

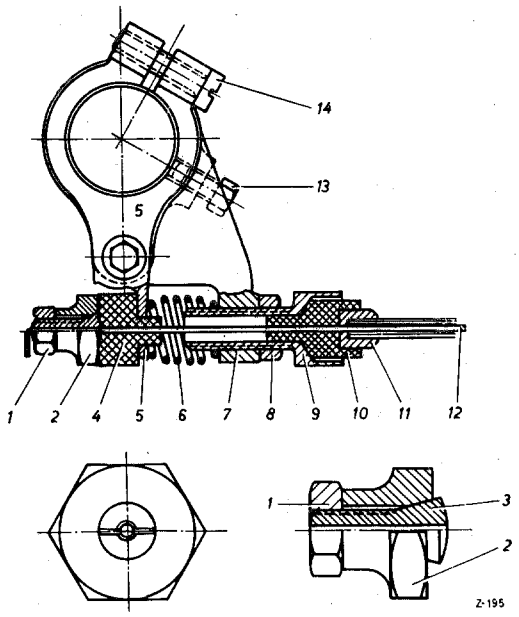


Fig. 01— 3/23

1 Hexagon nut
2 Clamping chuck
3 Wedge piece
4 Rubber damping
5 Timing lever
6 Compression spring
7 Distributor bearing
8 Hexagon nut
9 Adjustment screw
10 Rubber sleeve
11 Sleeve
12 Coil spring
13 Hexagon screw for fixing distributor
14 Clamping screw

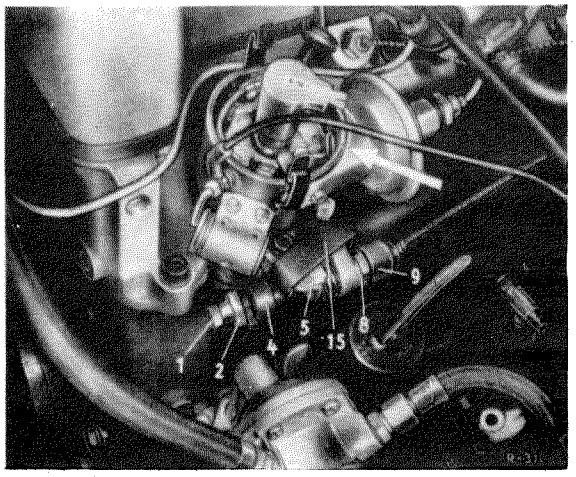


Fig. 01— 3/24

1 Hexagon nut
2 Clamping chuck
4 Rubber damping
5 Timing lever
8 Hexagon nut
9 Adjustment screw
15 Clamp

2. Remove distributor cap.

3. Use Socket SW 22 (with ratchet) on shoulder nut on the front of the crankshaft to turn crankshaft **in the direction in which the en-**

gine turns to the point where the timing pointer indicates 8° ± 1° BTDC on the scale on the counterweight (Fig. 01—3/25).

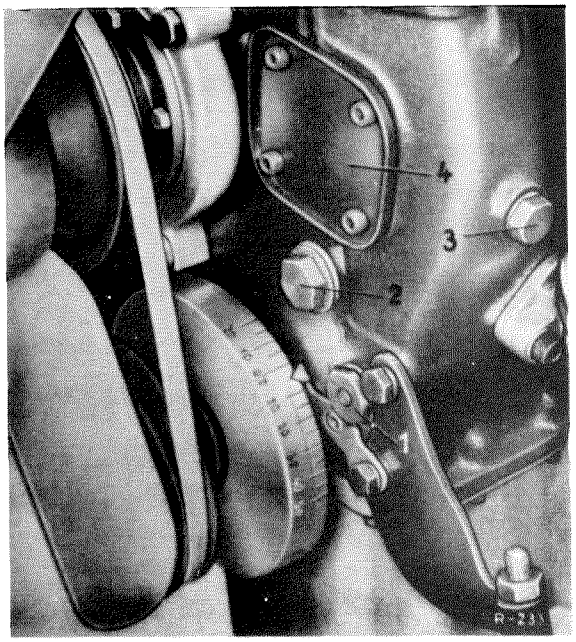


Fig. 01—3/25

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

At the same time the rotor arm (1) must point to the timing mark for Cylinder No. 1 on the edge of the distributor housing (Fig. 01—3/26).

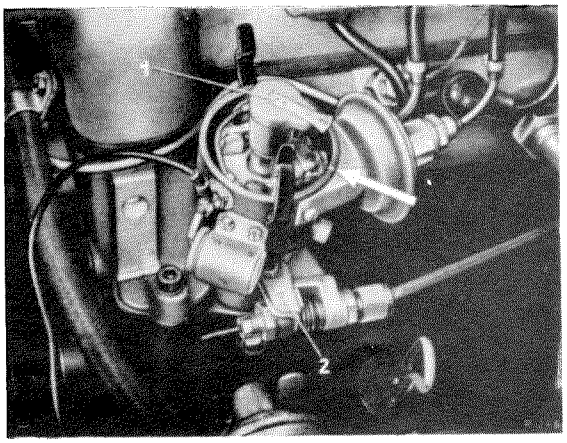


Fig. 01—3/26

1 Distributor rotor arm
2 Timing lever

4. Slacken clamping screw (14) at timing lever of distributor (see Fig. 01—3/23).

5. Connect one cable of a 12-Volt timing light to the terminal (1) of the distributor and the other cable to ground (Fig. 01—3/27).

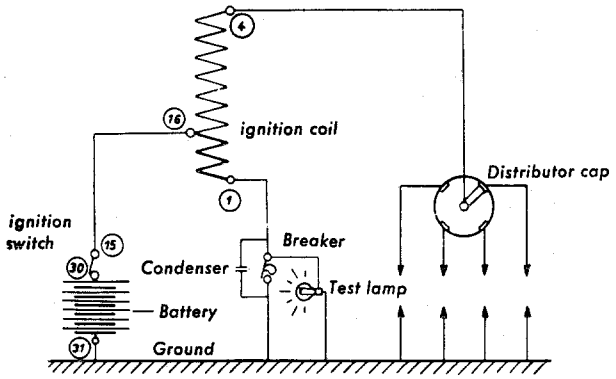


Fig. 01—3/27

6. Switch on ignition.

7. Turn the distributor in a clockwise direction until the points of the contact breaker are closed. Then turn it slowly in the opposite direction until the timing light lights up. At this point the breaker arm lifts off the contact holder.

8. Tighten the clamping screw (14) at the timing lever of the distributor.

9. Check the ignition setting once again. The ignition is properly adjusted if, when the crankshaft is slowly turned **in the direction in which the engine turns,** the timing light lights up exactly at the instant at which the timing pointer points to 8° ± 1° BTDC on the scale (see Fig. 01—3/25).

Note: If there is any doubt about whether the ignition setting has been correctly adjusted, it must be re-checked. The spark plugs must be removed so that the engine can be easily turned. **Care must be taken to ensure that the left side of the twin roller chain is properly tensioned.**

10. Put on the distributor cap.

b) **Setting the ignition with the flash stroboscope.**

Setting the ignition with the flash stroboscope is preferable to the timing light method because the ignition setting can be checked and adjusted at higher engine speed.

1. Check the adjustment of the ignition control cable (see Section A, Paragraph 1).

Note: When adjusting the ignition setting with the flash stroboscope, the ignition control knob must be turned to the left (advance) as far as it will go.

2. Flash Stroboscope 000 589 48 21 is connected as follows: Ground lead 3 (black) to ground.

   Positive lead 2 (red) to a positive terminal, e. g. ignition coil, Terminal 15.

   Insert extension cable (4) between ignition cable and spark plug of Cylinder No. 1. Then connect Cable 5 (blue) of the stroboscope to the extension cable (Fig. 01—3/28).

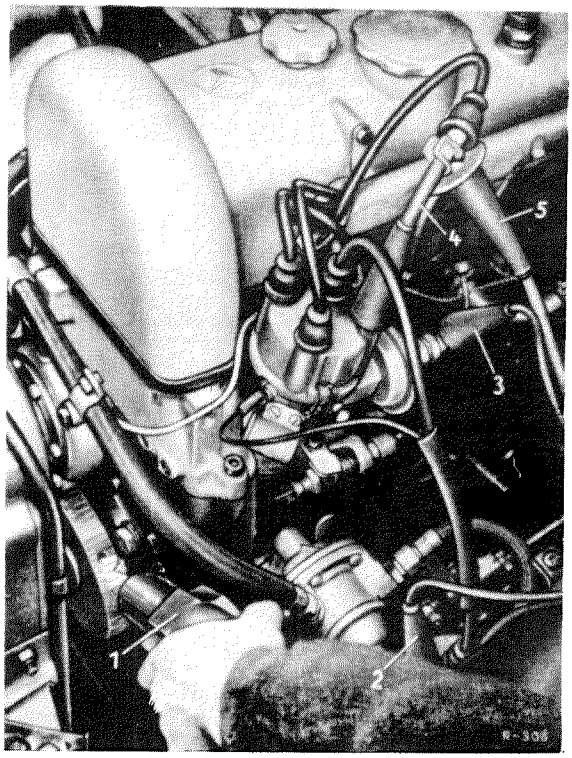


Fig. 01—3/28

1 Flash stroboscope
2 Positive cable
3 Ground cable (Black)
4 Extension cable
5 Main cable

3. Check ignition setting.

Note: Hold the flash stroboscope so that the timing indicator and the scale are illuminated (see Fig. 01—3/28). It is easier to take readings if the punched figures and marks on the scale are rubbed over with white paint.

4. The measured ignition settings should be:

engine speed	vacuum union	ignition setting in degrees BTDC
starter speed	with	8° ± 1° (basic initial setting)
n = 800 r.p.m.	with	15° — 23°
n = 800 r.p.m.	without	15° — 23°
n = 1500 r.p.m.	without	26° — 32°
n = 3000 r.p.m.	without	32° — 39°
n = 4500 r.p.m.	without	41° — 47°
n = 4500 r.p.m.	with	47° — 57°

Note: The engine speeds given must be strictly adhered to. Revolution Counter 000 589 12 21 should be used.

When checking the initial setting at starter speed the plug connectors should be pulled off.

5. If it is necessary to correct the ignition setting, slacken the clamping screw (14) at the timing lever of the distributor bearing (see Fig. 01—3/23) and turn the distributor so that the specified ignition setting is obtained.

6. In order to check the timing curve of the distributor accurately the distributor must

be removed and the ignition curve reflecting the vacuum and governor control movement checked on a suitable test stand.

7. The distributor is in proper working order if the ignition setting alters steadily and without jerking in accordance with the thickness of the tolerance feeler band used and in relation to the appropriate engine speed or alternatively the vacuum obtained at this speed (Fig. 01—3/29) and (Fig. 01—3/30).

Automatic governor control movement for distributor VJU 4 BR 14

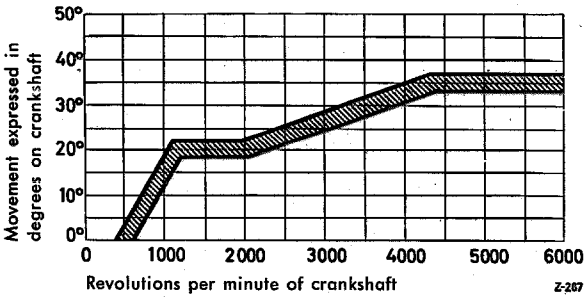


Fig. 01—3/29

Note: The governor control movement curve begins at 0° (see Fig. 01—3/29).

With the distributor installed in the vehicle, the degrees registered on the scale for the initial ignition setting (8°) must be added to the value read off the scale when making the test.

Furthermore the ignition setting can alter to some extent through the influence of the twin roller chain and the drive. Thus the values given in Fig. 6 cannot necessarily be compared with those shown on the movement curve.

Automatic vacuum control movement for distributor VJU 4 BR 14

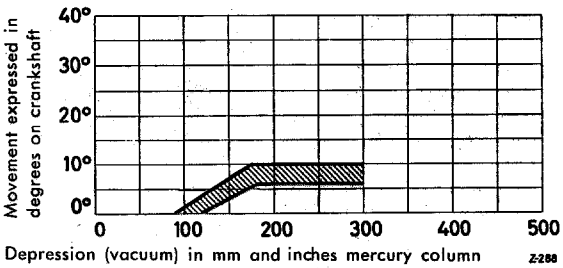


Fig. 01—3/30

Use of ignition control knob (octane number compensator)

The ignition timing and installation of the engine is carried out at the factory at the advance position and with a fuel specified by us and having a minimum anti-knock rating of 86 Octane according to the Research Method (F—1).

When the vehicle is in use, the control knob of the octane number compensator on the instrument panel must be turned to the left as far as it will go and must be left there!

The knob must only be turned to the right, i. e. in the direction "retard", if for any reason fuel of lower anti-knock rating than 86 F—1 is used or alternatively if in the course of time the engine should begin to "pink" owing to the presence of combustion deposits in the cylinders. The customer should be informed about the correct operation of the octane number compensator.

c) **New distributor bearing without ignition control cable**

The ignition control cable (octane number compensator) has recently been superseded because the general improvement in the quality of fuels has rendered it no longer necessary to adapt the ignition setting to the anti-knock rating of every individual fuel.

If for any reason fuels of lower anti-knock rating than 86 octane F—1 have to be used, the ignition setting can be retarded in the direction "spät" (retard) at the distributor bearing.

The following points should be taken into account when setting the ignition:

1. After slackening the milled nut (12), back out the adjustment screw (13) to the point where the timing lever (3) is definitely against the advance stop. Then lock with the milled nut (12) (Fig. 01—3/30a).
2. Adjust the ignition in the way shown in paragraphs (a) and (b)—i.e. to 8° ± 1 BTDC.
3. If the vehicle is using fuels of the prescribed anti-knock rating (86 Octane according to Research Method F—1) no changes should be made.

   If fuels of a lower anti-knock rating are used, the ignition setting should be retarded by screwing in adjustment screw (13) in the direction "spät" (retard) to the point where the engine operates without pinking.

Note:

a) A notch has been made at the edge of the adjustment screw. One turn is equal to an alteration of ignition setting corresponding to approx. 1 degree of movement on the camshaft or two degrees on the crankshaft.

b) The adjustment screw (13) and the cable (10) together with the nipple are supplied by the Spares Department as an assembly.

   When fitting, care must be taken to ensure that the slot in the disk (8) which holds the cable and the nipple is at the bottom because otherwise the disk might easily slip off and get lost.

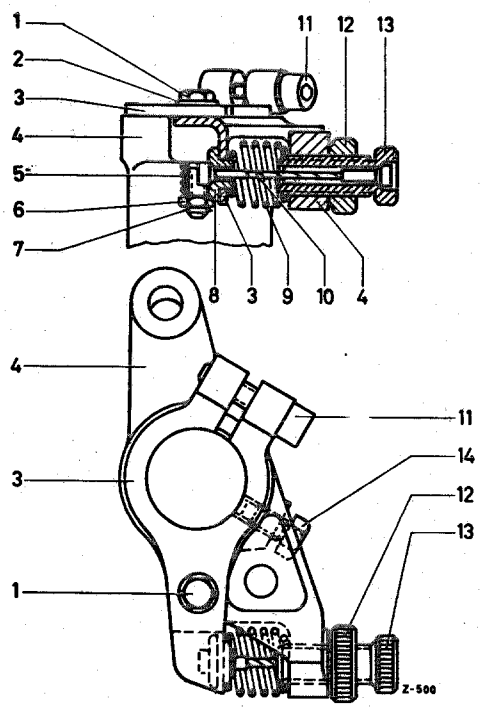


Fig. 01—3/30a

1 Hexagon screw M 5×30 S DIN 931-8 G
2 Disk 5.3 DIN 125 St.
3 Timing lever
4 Distributor bearing
5 Spring 136 993 08 01
6 Hexagon nut M 5 DIN 934-5 S
7 Cotter pin 1×12 DIN 94 St.
8 Disk 121 158 00 76
9 Compression spring 186 993 24 01
10 Cable A 1.6×50 DIN 719 87 with two nipples B 1.8 DIN 719 88
11 Clamping screw
12 Milled nut 121 990 00 57
13 Adjustment screw 121 150 00 84
14 Hexagon screw for fixing distributor

F. Checking Camshaft Adjustment

1. Use Socket SW 22 (with ratchet) on the shoulder nut to turn the crankshaft in the direction of rotation of the engine to the point where the timing pointer indicates TDC (Fig. 01—3/31).

Note: In the diagram the timing pointer indicates 5 degrees BTDC.

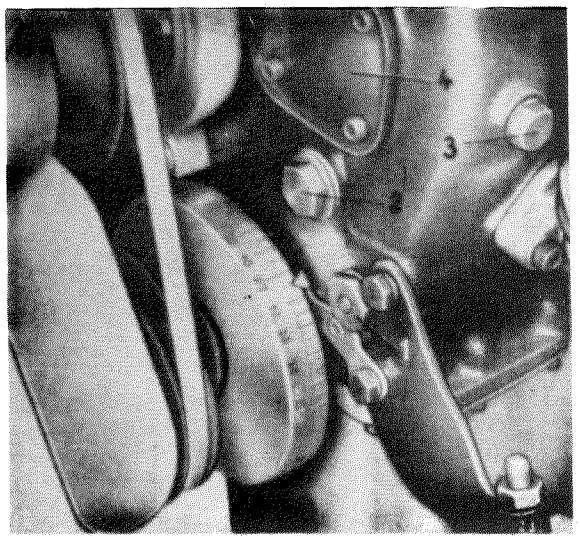


Fig. 01—3/31

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

The crankshaft must only be turned in the direction in which the engine turns. In this way the left side of the chain is kept taut.

2. The marks on the compensating washer of the camshaft and on the first camshaft bearing must now correspond (Fig. 01—3/32).

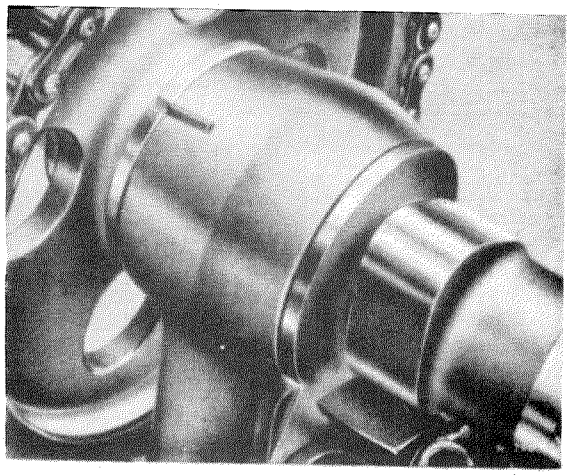


Fig. 01—3/32

In this position pistons number 1 and 4 are at TDC. The piston of number 1 cylinder is on the compression stroke.

3. Any necessary correction may be made by a transposition of the twin roller chain.

G. Measurement and Adjustment of Pressure of Fuel Feed Pump

1. The feed pressure of the fuel feed pump is measured with Pressure Gage (1) 000 589 30 21 (Fig. 01—3/33). Unscrew the fuel pipe (6) leading to the carburetor and connect the pressure gage (1) between the pump exhaust (4) and the carburetor fuel pipe (6) with the cock side (2) of the pressure gage toward the pump exhaust (4).

2. Open the cock (2) and start the engine (Fig. 01—3/33).

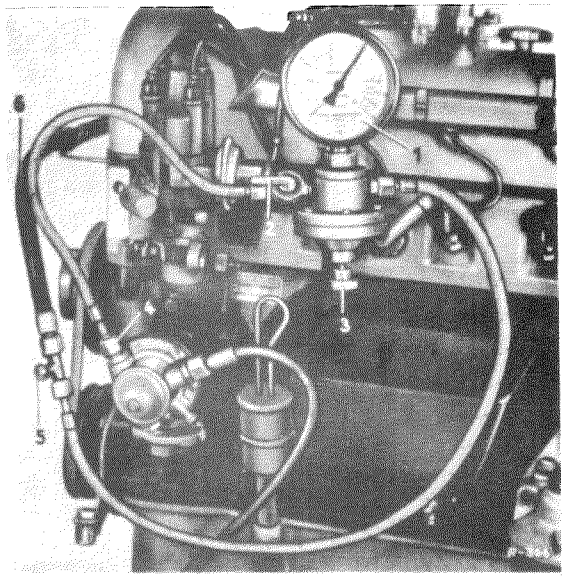


Fig. 01—3/33

1 Pressure gage 000 589 30 21
2 Cock on pressure gage
3 Milled nut
4 Feed pump exhaust
5 T-piece adapter
6 Fuel feed pipe to carburetor

3. Measure the feed pressure.

   The feed pressure should be 0.15 to 0.20 atmospheres at an idling speed of 700 to 750 r. p. m. with float needle valve closed.

Note: The feed pressure remains more or less constant throughout the whole engine speed range.

4. If necessary, correct the feed pressure. This is done by measuring the play between the tappet (4) of the fuel feed pump at the beginning of its power stroke and the BDC of the drive cam (7) (Fig. 01—3/34).

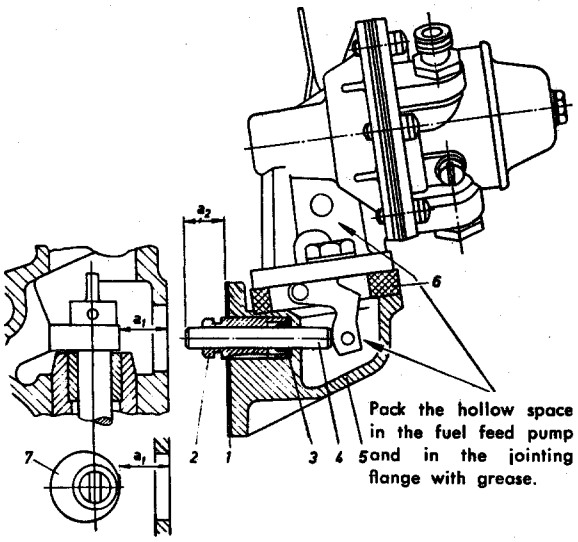


Fig. 01—3/34

a_1 = Distance from the crankcase to the drive cam at BDC.

a_2 = Distance between the sealing flange and the tappet at the beginning of the power stroke.

1 Sealing flange
2 Bushing
3 Shoulder sleeve
4 Tappet
5 Jointing flange
6 Insulation flange with gaskets
7 Cam of the oil pump drive shaft

Measure (at the crankcase) the distance a_1 between the separating surface and the drive cam at BDC (7), using depth gauge.

Then measure the distance a_2 between the end of the tappet — with the tappet at the beginning of the power stroke — and the sealing flange.

The difference between the two dimensions a_1—a_2 is equal to the play between the drive cam and the tappet.

The play must be 0.4—0.5 mm.

The play can be corrected by removing or by adding shims (sealing flange).

Note: If the feed pressure of the fuel feed pump is too high, the float needle valve may be forced and this could cause an unduly high fuel level in the carburetor.

The excessive feed pressure may be due to insufficient clearance between drive cam and pump tappet or hardening of the pump diaphragm.

If the pump pressure is too low the carburetor system will be fuel-starved. As an expedient shims may be added if the pump pressure is too high, or removed if the pump pressure is too low.

It must be remembered, however, that one shim at least is necessary in order to obtain a fuel-tight joint between the jointing flange of the fuel feed pump and the crankcase.

If in spite of the play between cam and tappet being correct, the feed pressure can still not be properly adjusted, the fault must lie in the fuel feed pump.

5. The float needle valve can also be checked with the pressure gage.

   Switch off the engine and close the cock (2). Turn the milled nut (3) to the right, until the feed pressure is increased to approx. 0.26 atmospheres.

   If the indicator moves backward slowly, this indicates that the float needle valve is leaking.

   If the pressure increases further, the float needle valve will be forced, even if it is in good condition. The opening pressure is approx. 0.28 atmospheres.

   If the float needle valve keeps the pressure constant the cock must be opened and the pressure thus conveyed to the fuel feed pump. The valves must be able to hold back the accumulated pressure for at least 3 minutes. If the valves are leaking, the indicator will move back quickly.

Note: A float needle valve can be tested for leakage by forcing gasoline through under pressure (see Job No. 07—3, Paragraph 17, Note).

Measurement and adjustment of fuel level:

1. Warm up engine (radiator temperature at least 70° C) and tighten up all pipe unions and screws on the carburetor.

2. If possible, place the vehicle on a perfectly horizontal floor.

3. Allow the engine to run for approx. 30 seconds at idle speed. This is in order to allow the fuel level to settle.

Note: This is particularly important if the manual lever of the fuel feed pump was previously used for filling the carburetor.

4. Switch off the ignition. Remove the air intake silencer, disconnect the fuel pipe at the carburetor and take off the carburetor cover.

5. Measure the fuel level with the aid of a depth gage inserted at the separating partition of the float chamber, the measured distance being between the upper face of the carburetor housing and the surface of the fuel (see Fig. 01—3/35).

Note: Measurement of the fuel level must be made **immediately** after switching off the engine and after removing the carburetor cover because otherwise, when the engine is hot, the fuel will evaporate and a false reading will be obtained.

The measurement of the fuel level must be made directly against the separating partition (1).

6. **The reading should be 19—21 mm.**

   The figures given take into account the fact that the surface tension causes the fuel to rise approx. 2 mm at the separating partition. Thus any measurement taken at other points would give a false fuel level adjustment.

7. Correct the fuel level if necessary. This can be done by adding a second sealing ring (1) for the float needle valve (2) or by carefully bending the float anchor strip (3) downward in order to make the fuel level lower (see Fig. 01—3/36).

   This additional sealing ring takes the form of a fiber sealing ring of the appropriate thickness, inserted between the carburetor cover and the copper sealing ring of the float needle valve.

   A further sealing ring of 0.5 mm thickness lowers the level of the fuel approx. 1 mm. The fuel level can be made higher by replacing the sealing ring (1) by a thinner sealing ring or by carefully bending the float anchor strip (3) upward (see Fig. 01—3/36).

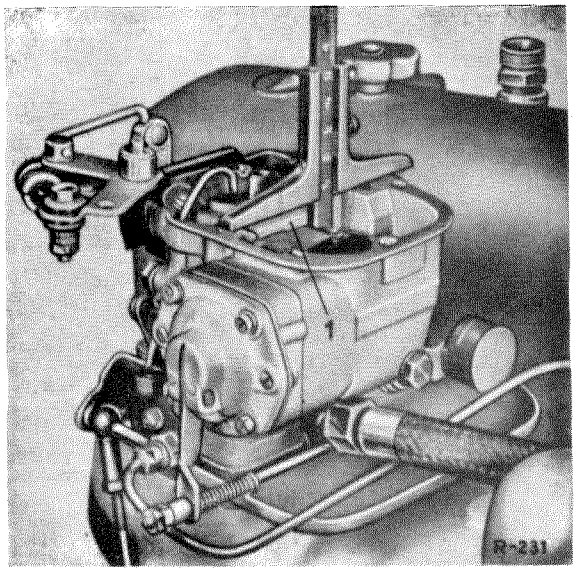
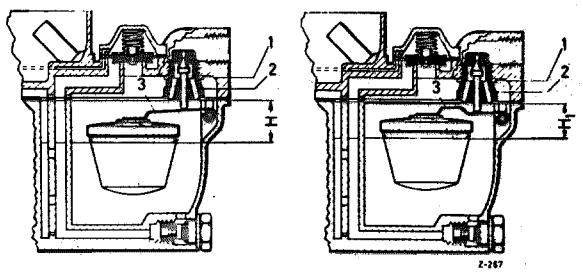


Fig. 01—3/35

1 Separating partition of float chamber



Fuel level unchanged.

Fuel level made higher by bending the float anchor strip upward.

Fig. 01—3/36

1 Sealing ring 12×16×1 Cu
2 Float needle valve 2 mm (M 12×1.25)
3 Float anchor strip
H Fuel level unchanged
H_1 Fuel level made higher

Measurement and adjustment of injection amount

8. Unscrew retaining screw of injection tube and remove injection tube.

9. Screw in a measuring tube in place of the injection tube.
   A normal injection tube, the neck of which projects sideways over the edge of the carburetor housing, can be used as a measuring tube. After turning the arched neck of the tube, there must be no leakage at the collar when the injection is done. If necessary, seal the collar with Teroson plastic solder.

   Under no circumstances must the injection tube normally fitted to the carburetor be turned outward and used to take the measurement.

10. Check the injection amount by repeating the injection five times. Use a suitable graduated tube or Graduated Tube (Burette) 000 589 31 21 (see Fig. 01—3/37).

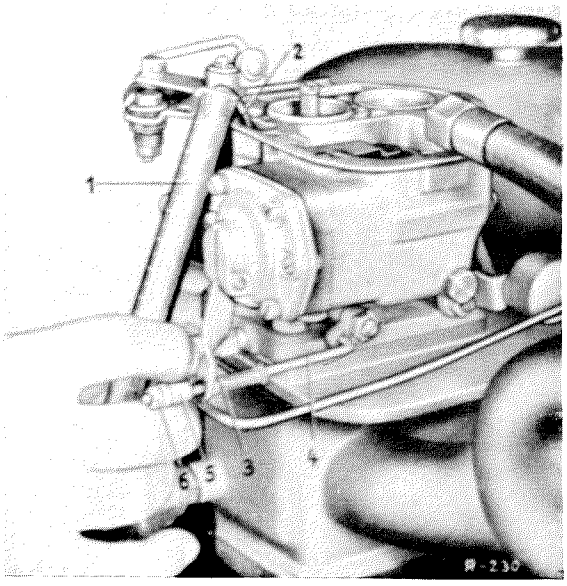


Fig. 01—3/37

1 Graduated tube (Burette)
2 Injection tube
3 Pump arm
4 Connecting rod
5 Shoulder nut
6 Hexagon nut

The accelerator linkage must be moved evenly and smartly to the maximum position and only released when the injection is over.

Caution! Wait at least two to three seconds between the individual strokes as otherwise the full fuel amount will not pass into the diaphragm bowl and the graduated tube reading will be too low.

11. When the measurement of the injection amount is being made, the following points must be taken into account:

a) The measuring tube must form a perfect seal with the collar.

b) The pump arm of the diaphragm pump must be working properly.

c) The slightest possible movement of the linkage from the idle position must produce an ample and even jet of fuel from the injection tube immediately.

12. **The injection amount should be 1.0 to 1.2 cm^3/stroke.**

13. If necessary, correct the injection amount. The injection amount can be increased by screwing in the hexagon nut (5) on the connecting rod (4) and decreased by screwing it out (see Fig. 01—3/37). After adjusting, lock with hexagon nut (6). The nuts (5) and (6) on the connecting rod (4) must not be screwed in to the point where the pump arm (3) rises above the diaphragm shaft in the idle position (see Fig. 01—3/37). When the accelerator is depressed, the injection would not begin at once because the pump arm must first take up the clearance between its own contact surface and the end of the diaphragm shaft.

    But it should be noted that immediate injection is necessary for smooth speed build-up and perfect acceleration.

14. Unscrew the measuring tube and fit the injection tube of the carburetor, using a new gasket.

    Caution! The retaining screw of the injection tube must be tightened after at the most 500 km because the gasket tends to shrink after the first tightening and could cause leakage.

15. Make a further check of the injection.

16. Screw on the carburetor cover and connect up the fuel pipe. Fit the air intake silencer.

Copper Sealings Rings for Float Needle Valve

For the adjustment of the fuel level, copper sealing rings are now available in various thicknesses as follows:

Part No. 000 997 81 40	0.5 mm thick
Part No. 000 997 28 40	1.0 mm thick (standard)
Part No. 000 997 82 40	1.5 mm thick
Part No. 000 997 83 40	2.0 mm thick

The fuel level can thus be corrected quite simply without bending the float anchor strip. An alteration of 0.5 mm in the thickness of the sealing ring is equivalent to an alteration in fuel level of approx. 1 mm (see also Job No. 01—3, Para. 7).

Trouble-Shooting Hints on Carburetor

Before beginning any work on the carburetor, a check should be made of the spark plugs, contact gaps, ignition adjustment, ignition leads, valve timing, compression and the feed pressure of the fuel pump (see Job No. 01—3, Sections A—G).

Faults are often ascribed to the carburetor instead of to these parts! Check any suppression devices which may be fitted. This applies in particular to distributor rotor arm, ignition lead connectors and spark plugs; the easiest way of checking is to temporarily replace these parts by others not fitted with suppressors.

If carburetor faults develop during running, these are usually caused by dirt, gum deposits, dried-up or faulty seals and gaskets. In such cases it is usually enough to thoroughly clean all jets, valves, injection tubes, bores and canals, blow out with compressed air and replace defective seals and gaskets. When this has been done, the carburetor will usually work perfectly again. If normal cleaning fails to remove the faults, it is advisable to completely disassemble the carburetor and to clean and examine all parts (see Job No. 07 — 3). It is often impossilble to determine with certainty the exact cause of a fault without checking all parts, since the same fault can have various causes. To assist in trouble-shooting, some faults and their causes are tabled below.

Faults	Cause	Remedy
Heavy fuel consumption	Leaking float needle valve	Clean or replace float needle valve
	Faulty float needle valve gasket	Replace gasket
	Fuel level too high	Adjust
	Fuel pump delivery pressure too high	Adjust
	Idle jet or main jet loose	Tighten
	Idle air jet or air correction jets blocked	Clean jets
	Carburetor cover loose	Tighten carburetor cover Check gasket
	Mixing tubes blocked	Clean — also clean side bores
	Starter slide valve leaking	Check starter slide valve for leaks and if necessary, re-face sliding surfaces
	Cable of starter slide valve incorrectly adjusted	Check cable and adjust correctly

Faults	Cause	Remedy
	Note: A leaking starter slide valve or a starter slide valve which is not quite closed can be detected by examining the vacuum valve of Stage 2. If the starter slide valve is leak-proof or if it is closed, the vacuum valve is completely closed when the engine is idling. Check by pressing on the counterweight of the vacuum valve. If the starter slide valve is leaking or is in operation, the vacuum valve is raised at idling engine speeds, because the engine is receiving the start mixture via Stage 2. When making this check, however, the mechanical throttle valve of Stage 2 must be completely closed, since otherwise the vacuum valve will be raised by the air flowing via Stage 2.	
Poor idling **Note:** Idling can only be adjusted when the engine is at normal working temperature	Idle fuel jet or idle air jet blocked	Clean jets
	Idle canal, by-pass bores blocked	Clean canal and bores
	Suction canals fouled	Clean suction canals
	Fuel level incorrect	Adjust fuel level
	Excessive delivery pressure of fuel pump	Correct fuel pump delivery pressure
	Float needle valve leaking	Replace float needle valve or gasket
	Idle mixture adjustment screw damaged or broken	Replace idle mixture adjustment screw
	Mixing tube holder loose	Carefully solder guide of mixing tube holder and press into position
	Worn throttle valve shafts	Replace throttle valve housing and throttle valve shafts
	Injection tube drips	Set fuel level to lowest permissible value
	Leaks in insulation flange, carburetor flange, intake manifold flange, in vacuum system of power brake (if fitted) and pneumatic ignition control	Test joints for leaks by smearing joints with soap and make leak-proof
	Note: For hot climates, the lower check valve on the diaphragm pump can be replaced by spring-assisted valve Solex No. ZK 3508. The spring raises the ball a little from its seat in the "rest" position so that, when the pressure in the fuel chamber of the diaphragm pump gradually increases, the fuel can flow back into the float chamber. When the outside temperature is low, however, and gradual acceleration is applied, some slight unevenness may be experienced.	

Faults	Cause	Remedy
Idle too fast	Mechanical throttle valve of Stage 2 sticking	Test throttle valve shaft and relay lever
	Note: The mechanical throttle valve of Stage 2 must close completely in the idle position. If the throttle valve is not completely closed, a greatly increased idle speed results; in this case, the idle will not react to adjustment of the idle mixture adjustment screw.	
Carburetor floods	Float needle valve leaking	Replace float needle valve
	Faulty float needle valve gasket	Replace gasket
Uneven speed build-up	By-pass bores blocked	Clean bores
	Injection tube gasket leaking	Tighten injection tube or replace gasket
	Injection tube blocked	Replace injection tube
	Injection amount incorrect	Correct injection amount
	Check valve of diaphragm pump leaking	Replace check valve
	Pump jet blocked	Clean pump jet
	Pump diaphragm faulty	Replace pump diaphragm
Engine difficult to start when cold	Starter fuel jet blocked	Clean jet
Engine uneven after cold start	Mechanical throttle valve of Stage 2 not closing	Free up
	Starter air valve fails to open and in consequence, start mixture too rich	Check starter air valve Blow out vacuum canal to Stage 1
Engine difficult to start when hot	Fuel level too high	Correct fuel level. Check float needle valve and if necessary, replace it Replace gasket Check pump pressure and if necessary, correct it
	Air leakage	See under Poor idle

K. Adjustment of Idle

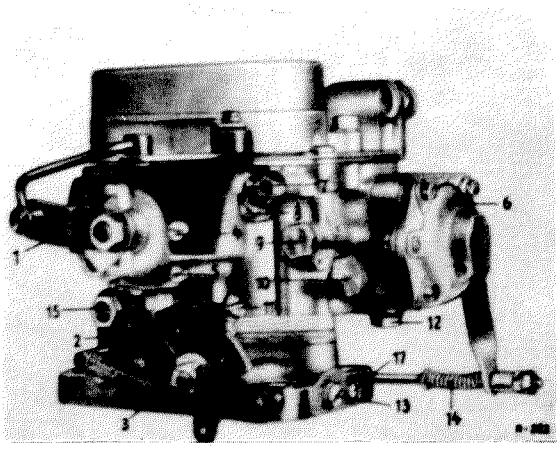


Fig. 01—3/38

1 Relay lever for operating starter device
2 Connecting linkage
3 Return spring
4 Fixing screw for relay lever
5 Fixing screw for starter device
6 Accelerating pump
7 Idle fuel jet of Stage 1
8 Retaining screw for air horn of Stage 1
9 Pump jet
10 Main jet holder with main jet of Stage 1
11 Idle adjustment screw
12 Ball valve with screen
13 Idle mixture adjustment screw
14 Connecting rod to accelerating pump
15 Hexagon nut for linkage
16 Hexagon nut for throttle valve shaft of Stage 1
17 Union for distributor vacuum control (closed with a screw)

Note: When the idle is adjusted, the mechanical throttle valve of Stage 2 and the starter mechanism must be completely closed.

1. Back out the idle adjustment screw (11) to the point where the throttle is completely closed. Then bring the idle adjustment screw up until it touches the idle stop and give it exactly one further turn (Fig. 01—3/38).

2. Screw the idle mixture adjustment screw (13) right in and then back it out exactly two turns.

3. Warm up the engine to normal working temperature (at least 70° C cooling water temperature) and adjust the idle, (using Revolution Counter 000 589 12 21) to an idle speed of n = 700—750 r. p. m.

4. Adjust the idle mixture adjustment screw by turning it in or out so that:

   a) the engine turns smoothly and
   b) the highest possible idle engine speed is reached.

   Then readjust the idle engine speed once more to n = 700—750 r. p. m. by adjusting the idle adjustment screw.

5. By making a further slight correction with the idle mixture adjustment screw try to improve the idle. If necessary, adjust the idle speed once more with the idle adjustment screw.

L. Testing Valve Timing

After a considerable period of use, the valve timings may alter somewhat, due to stretching of the twin roller chain or to machining or facing of the separating surfaces of the crankcase or the cylinder block and head. This will usually make no appreciable difference to the engine performance but if necessary, it can be corrected by fitting an offset Woodruff key on the camshaft.

Since the ignition point alters in the same way, the ignition should also be checked and corrected in such cases (see Job No. 01—3, Section E).

Checking of the valve timing is too inaccurate at the prescribed tappet clearance (normal running tappet clearance). Thus for test measurements, the timings are given at a tappet clearance of 0.4 mm.

The timing is, however, not adjusted to this test clearance of 0.4 mm but instead, the test measurement is made with the valve raised 0.4 mm, because this method is much more accurate.

The timing obtained with the valve raised 0.4 mm is the same as that obtained with a tappet clearance of 0.4 mm.

In practice, it is usually sufficient to measure the timings with the inlet and exhaust valves of No. 1 Cylinder.

The test measurement is made in the following way:

1. If the engine is not installed in the vehicle, a suitable graduated disk divided into 360° is fixed to the crankshaft and a pointer is fixed to the crankcase (see Fig. 01—3/39).

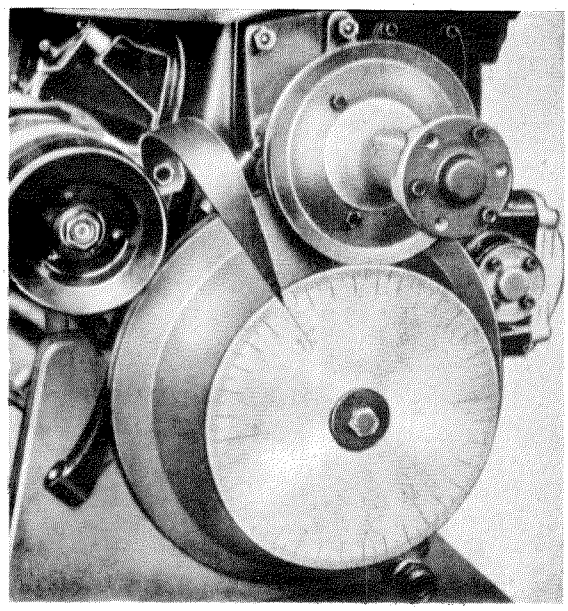


Fig. 01—3/39

2. If the engine is installed in the vehicle, Disk 180 589 07 23, divided into 360°, should be fixed to the camshaft (see Fig. 01—3/40).

   When the test is made in this way, it must be remembered that the values read off from the camshaft must be doubled!

3. Remove all spark plugs.

4. Set No. 1 piston to TDC.

5. Now turn the graduaded disk (1) so that the pointer (2) points to the 0° mark. Fix the graduated disk in this position (see Fig. 01—3/40).

6. In order to take up the normal running tappet clearance, a tolerance feeler band is inserted between the valve stem and the adjustment screw.

   The tolerance feeler band must be thick enough to ensure that the normal tappet clearance is definitely taken up. It does not matter if the valve is slightly raised in consequence.

7. Screw the feeler (3) into the dial micrometer and fix the dial micrometer by means of Dial Gage Holder 198 589 01 21 (4) to the saddle bracket (5) which holds the cylinder head cover, in such a way that the feeler (3) is placed vertically on the valve head of the inlet valve of No. 1 cylinder and is at the same time depressed by 2.0 mm (see Fig. 01—3/40).

   The feeler of the dial micrometer must be exactly perpendicular to the head of the valve otherwise appreciable errors in measurements will be made!

   In addition, the chain tightener must be properly bled.

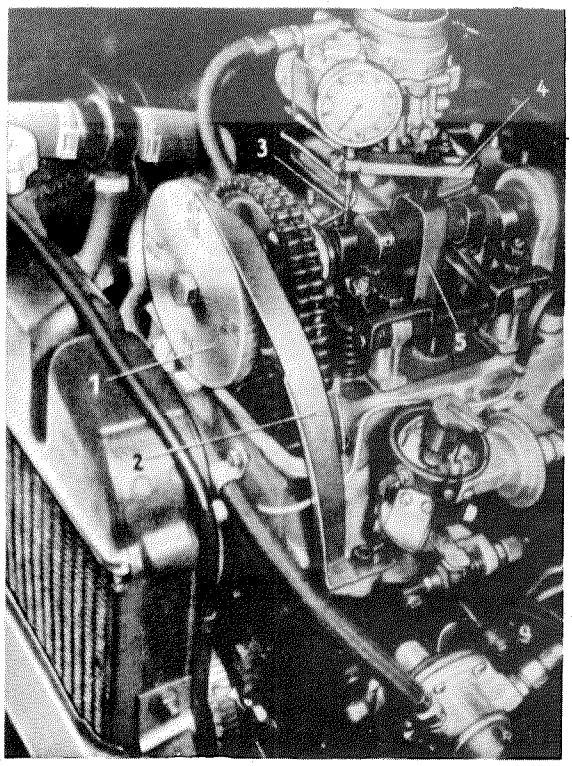


Fig. 01—3/40

1 Graduated Disk 180 589 07 23
2 Pointer (may be hand-made)
3 Feeler
4 Dial Gage Holder 198 589 01 21
5 Saddle bracket for cylinder head cover

8. Set the scale of the dial micrometer to 0.

9. Now turn the crankshaft in the direction in which the engine turns to the point where the dial micrometer measures 0.4 mm less — i. e., the valve is raised 0.4 mm.

   Now read off the value indicated on the graduated disk.

   If the graduated disk has been fixed to the camshaft, the value read off must be doubled. This value is the beginning of opening of the valve!

10. Continue to turn the crankshaft in the direction in which the engine turns until the valve is raised 0.4 mm when the valve closes — i. e., when the dial micrometer gage registers once more the same value as at the moment of opening. Make sure that the dial gage feeler is depressed the requisite 2.0 mm.

    Read off the value indicated on the graduated disk. **The value indicated is the end of closing of the valve.**

Note: While measurements are being taken, the engine must under no circumstances be turned backward since this would cause considerable errors in measurement. Measurements must be checked, after reading off the angle of closure, by turning the crankshaft still further until the base circle of the cam is reached. At this point the dial micrometer must once more register 0.

11. **The valve timings of the exhaust valve are checked in the same way.**

Valve Timings for Test Measurements:

Camshaft	Inlet		Exhaust		Test clearance
	opens	closes	opens	closes	inlet and exhaust
121 051 11 02	12° BTDC	44° ABDC	51° BBDC	15° ATDC	0.4 mm

Note: If an offset Woodruff key has to be used, the following points must be taken into account:

a) If the key is offset to the right (seen in the direction of travel) the valve opening instant is advanced and if it is offset to the left, the opening instant is retarded.
If the Woodruff key is offset 0.20 mm, this corresponds to a crankshaft movement of approximately 1° 30'.

A movement of one tooth on the timing gear corresponds to a crankshaft movement of 18°.

b) If an offset Woodruff key is fitted, the ignition point must be readjusted (see Job No. 01—3, Section E).