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

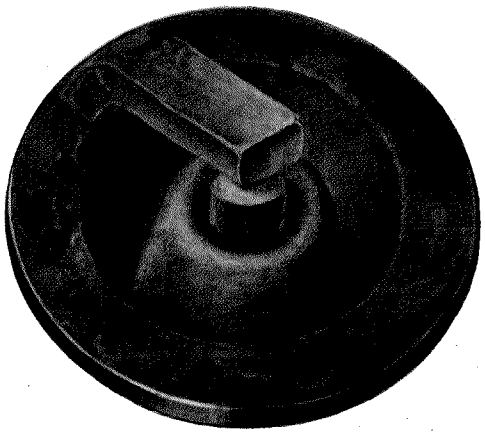


Fig. 01—3/5

Normal

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

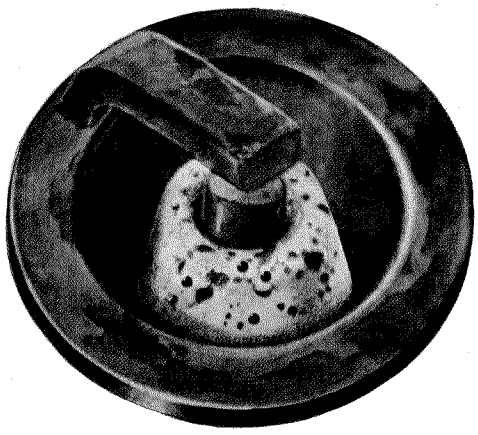


Fig. 01—3/6

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

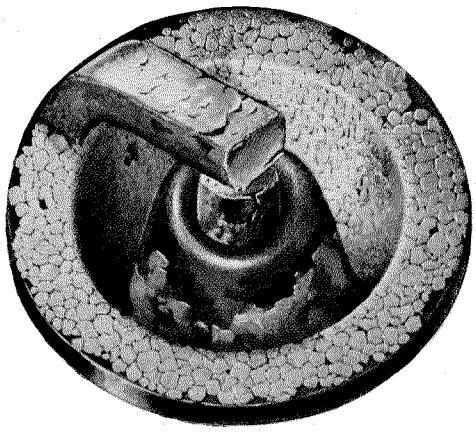


Fig. 01—3/7

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.

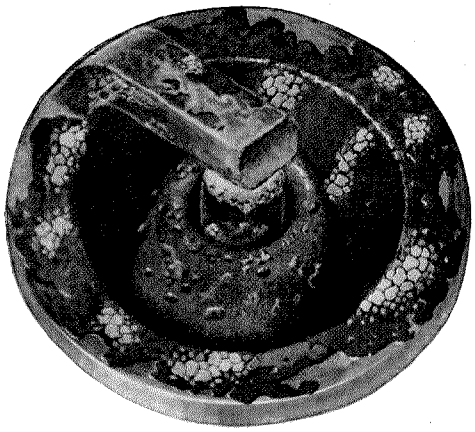


Fig. 01—3/8

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.

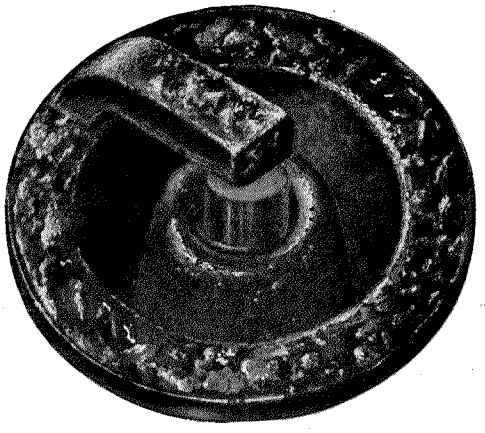


Fig. 01—3/10

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).

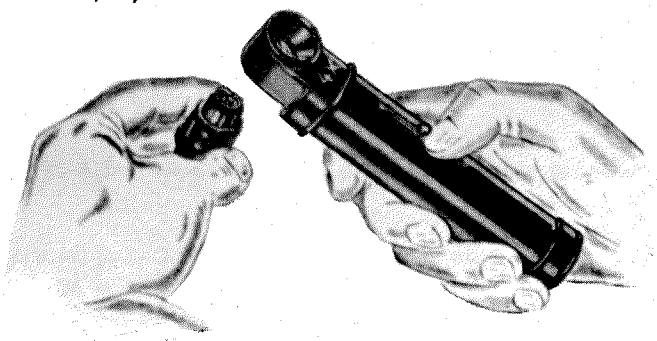
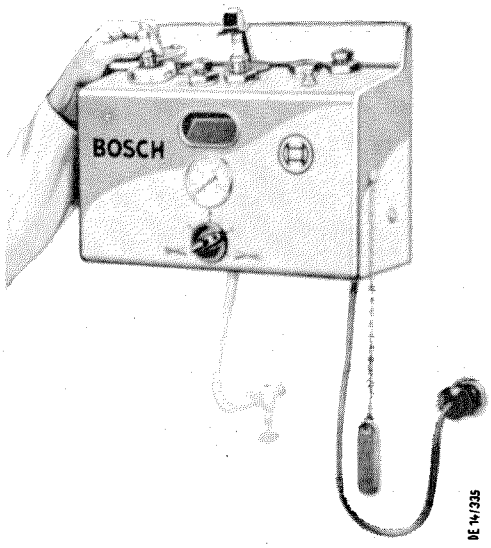


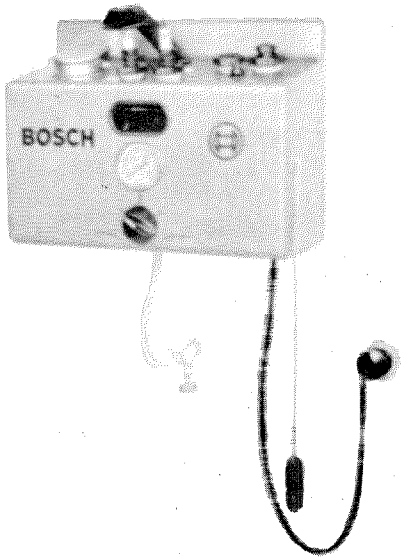
Fig. 01—3/12

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

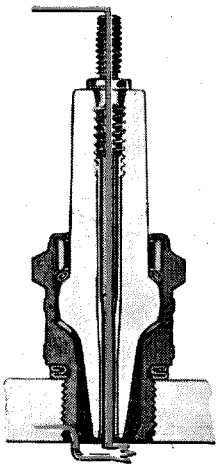


Fig. 01—3/15

The spark leaps across the gap between the electrodes.

Current flow diverted by fouling

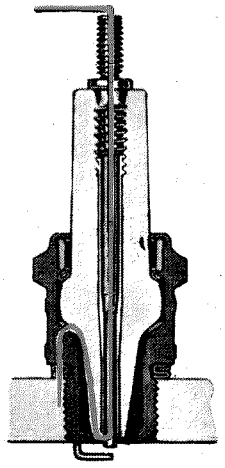


Fig. 01—3/16

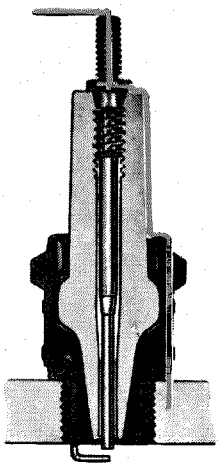


Fig. 01—3/17

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

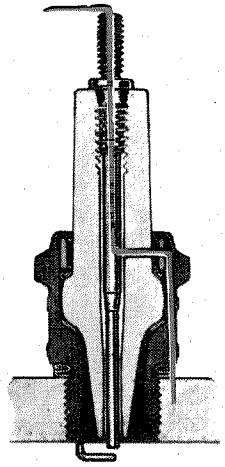


Fig. 01—3/18

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

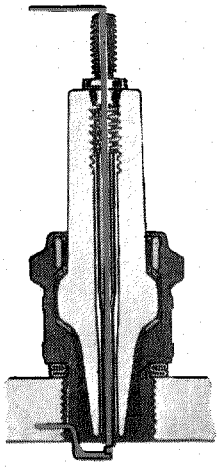


Fig. 01—3/19

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.

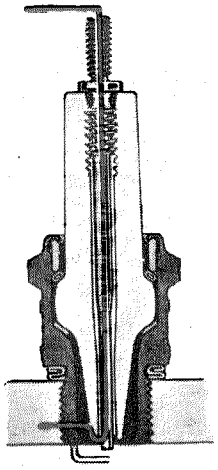


Fig. 01—3/20

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.