Testing and Adjusting Injection Pump

Bosch Injection Pump, removed

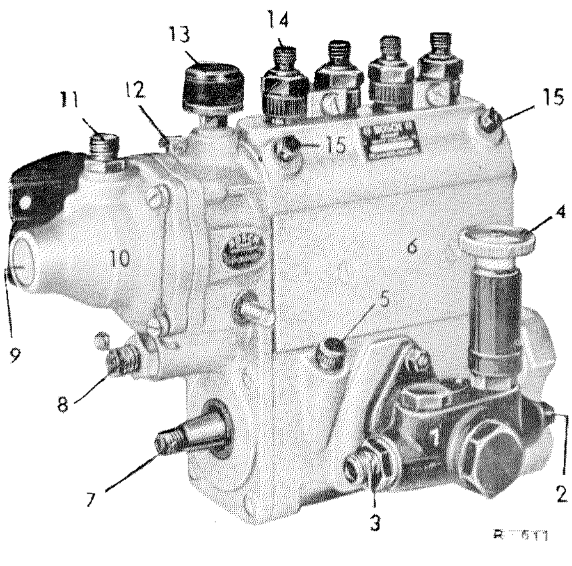

Figure 07–5/1

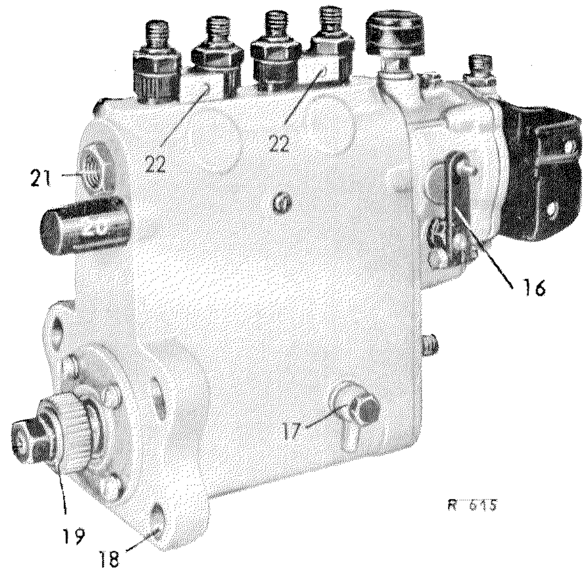

Figure 07–5/2

1 Fuel feed pump
2 Connector of suction line
3 Connector of pressure line
4 Handle of hand pump
5 Oil dipstick in housing
6 Cover plate to the pump elements
7 Injection pump shaft
8 Adjustable full load stop
9 End plate to additional spring adjusting screw
10 Diaphragm assembly housing
11 Connector of vacuum line
12 Cap oiler to lubricate control linkage
13 Air vent of atmospheric chamber
14 Injection line connectors
15 Bleeder screws
16 Adjusting lever
17 Adapter for oil overflow from the pump housing
18 Mounting flange with slot
19 Engaging dog on pump shaft
20 Cap on control rod
21 Connector to suction space, fuel inlet
22 Clamping jaws to secure connectors

An exact adjusting of the injection pump can only be done on the injection pump test stand. We would like to point out again that inexpert adjusting of the pump without testing facilities is not permitted.

The same is true for repairs. Damaged injection pumps must be sent in for repairing to the firm Bosch or a Bosch agency or to a Daimler-Benz agency. In this connection we make reference to the possibility that pumps can be obtained through our exchange system. We recommend keeping a stock of these exchange pumps, so that longer breaks of repair work can be avoided.

New injection pumps, exchange injection pumps and repaired injection pumps are delivered only after the specified adjusting has been made and are lead-sealed at the full load stop (8) (Figure 07–5/1). **The seal should only be damaged when the pump is adjusted on the injection pump test stand.** Afterwards the full load stop must be properly lead-sealed again.

The adjustment of the injection pump depends not only on the elevation and the atmospheric pressure prevailing there, but also on the temperature, the humidity and the available fuel quality.

The performance data contained in our literature, as is specified in DIN 70020 (German Industrial Standards) on vehicle engines, are calculated for an atmospheric pressure of 760 Torr (= mm mercury gauge) and a temperature of 20° C; or for built-in engines according to DIN 6270 for an atmospheric pressure of 736 Torr and a temperature of 20° C.

The output Ne measured on the engine test stand is always converted by calculation for the standard conditions and is then called Ne_{red} = reduced output. The formula used for this purpose is:

a) Vehicle engines

$$Ne_{red} = Ne \cdot \frac{760}{b} \cdot \sqrt{\frac{273 + t}{293}}$$

b) Built-in engines

$$Ne_{red} = Ne \cdot \frac{736}{b} \cdot \sqrt{\frac{273 + t}{293}}$$

herein is b = atmospheric pressure in Torr,

t = temperature in °C (measured 1.5 m distant from the intake port and at the same height).

The mechanical rate of efficency of the engines and the humidity of the air are not taken into consideration, because the influence of these factors on the final result is irrelevant to engines of this size. By converting the formula the effective output of an engine can be calculated for every atmospheric condition:

a) Vehicle engines

$$Ne = Ne_{red} \cdot \frac{b}{760} \cdot \sqrt{\frac{293}{273 + t}}$$

b) Built-in engines

$$Ne = Ne_{red} \cdot \frac{b}{736} \cdot \sqrt{\frac{293}{273 + t}}$$

For simplicity reasons the formulae are plotted in the following diagram. For each air condition the available output can be read in % reduced output. For example at 650 Torr and 10°C the output of the engine according to DIN 70020 is only 87 % and according to DIN 6270 still 90 %.

The output data for vehicle engines according to DIN 70020 is based on an atmospheric pressure of 760 Torr (mm Hg) and a temperature of 20°C, for built-in engines according to DIN 6270 on an atmospheric pressure of 736 Torr (mm Hg) and a temperature of 20°C. These points are especially marked in the diagram (black dots).

Each elevation has a certain atmospheric pressure and a certain temperature; the annual average values were determined by the "CINA" (Commission Internationale de Navigation Aérienne).

These values were also plotted in the diagram, so that the mean reduction in output can be taken from the diagram, if the exact air pressure and temperature values are not known. For instance the engine output according to DIN 70020 at an elevation of 3000 m will only be 72 %.

The decrease in output is caused by the fact that the weight of the air aspirated by the engine is lower at higher elevations and with it the quantity of oxygen available for combustion.

It is quite obvious that an engine will then no longer have the original reduced output, e.g. the vehicle has a poorer acceleration, less climbing ability and lower max. speed.

This phenomenon, however, is a given factor and can therefore not be avoided by a changed adjustment of the injection pump.

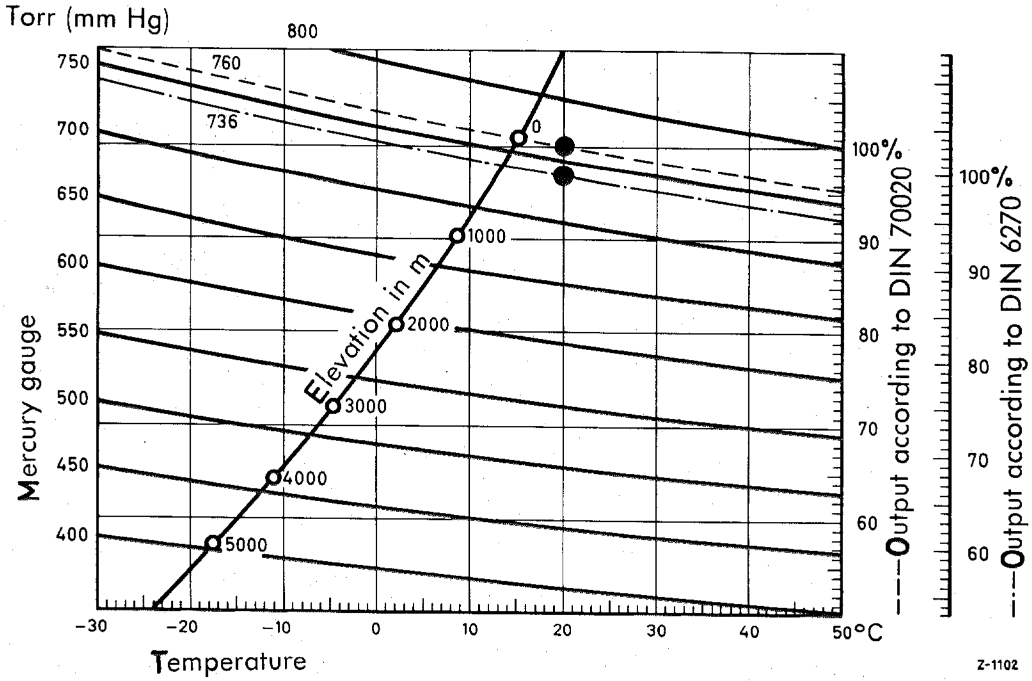

Figure 07–5/2a

For alternating operation in lower and higher elevations up to 2000 m there are generally no changes of adjustment required.

For an operation at an elevation of more than 2000 m there are injection pumps available, which, compared to the standard version, operate with a reduced injection rate (see Table on serially installed injection pumps with governor and feed pump for operation in elevations of more than 2000 m above sea level, Page 07–2/19).

On serially produced injection pumps the injection rate can be reduced by clockwise turning of the full load stop screw (8) of the control rod after removing the lead seal and loosening the lock nut (see Figure 07–5/1).

The lock nut and the stop screw are secured by a lead seal to prevent inexpert adjusting.

The adjusting should always be done on the injection pump test stand. Clockwise turning of the stop screw gives a reduced injection rate; a 90 deg turn corresponds to approx. 5 % of the total volume of fuel injection.

In countries with an elevation of more than 2000 m a smokeless driving performance with the diesel engine OM 636 can be obtained by reducing the injection rate by approx. 15 % (corresponding to a 3/4 turn at the stop screw), if the adjustment has not already been done in the plant.

After completing the operation the injection pump must again be furnished with a Bosch or DB lead seal and the letter "z" must be marked at the end of the pump designation.

The test data on the injection pumps with attached governor can be taken from the respective test data sheets (see Job No. 07–1).

Below all operations are described in the consecutive order, by which the testing of the injection pump should be conducted on the test stand.

Some of these checks can be done while the injection pump is still installed in the vehicle, they are especially mentioned in the course of this description. Depending on the kind of failure such a checking will mainly be concentrated on the pump or the governor. The checking of the governor and the control rod travel, while the pump is installed, is separately described in Job No. 07–8.

The test data of the injection pumps are contained in the test data sheets. The description refers to the Bosch injection pump test stand. If another test stand is used the conditions valid for this test stand must first be clarified. Transferring the same conditions without making sure by checking can result in faulty measuring.

Equipment and Test Conditions

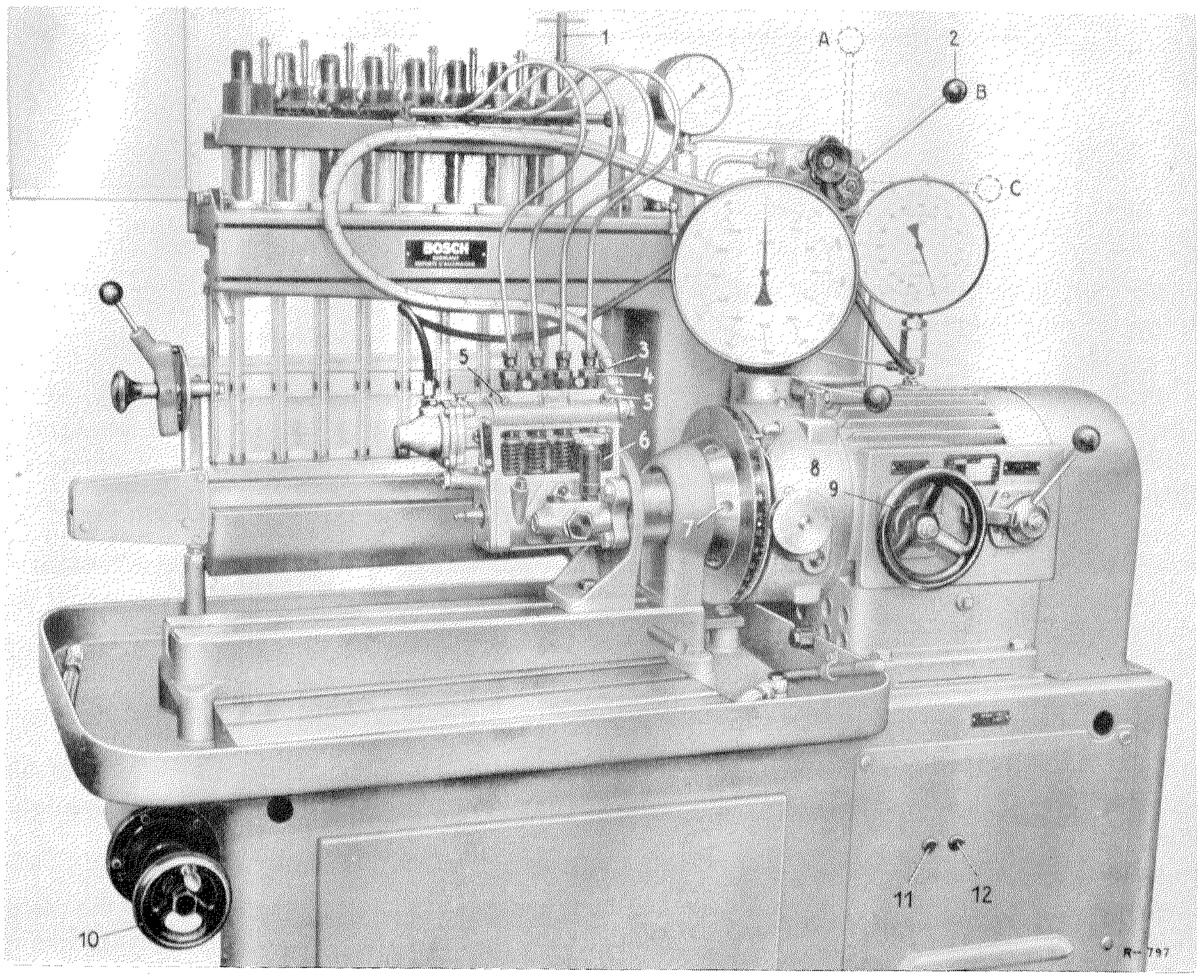

Figure 07–5/3

Bosch Injection Pump Test Stand

1 Bleeder screw at nozzle holder
2 Change-over tap { A in position feed beginning test / B in position feed quantity test / C in position feed pump test
3 Fuel feed line
4 Pipe connector (pressure valve holder)
5 Bleeder screws
6 Pump plunger next to drive
7 Hole for cranking of drive
8 Needle at the graduation scale
9 Hand wheel to adjust the speed
10 Hand wheel of vacuum unit
11 ON-switch of test stand (green)
12 OFF-switch of test stand (red)

Bosch Injection Pump Test Stand EFEP 25 or Bosch EFEP 5 (or EF 8500).

Nozzle holder: EF 8511/9A

Nozzles: EFEP 182, adjusted to 175 atm.

The nozzles should be checked once a week if the test stand is used frequently, if not, check after testing approx. 20 injection pumps.

Pressure lines for . . . A and M . . . pumps
6 × 2 × 600 mm.

After a certain period check the clearance of the pressure lines, bore if necessary (2.0 mm). The cross section of the pipe greatly influences the discharge rate.

Test oil: OI 61 v 1 or Shell AB 11 4½° Engler, mixed with the same quantity of kerosene. In countries outside of Germany Shell Fusus Oil A can also be used or a mixture of 50 % kerosene and 50 % Shell Glavus Oil 17.

During the operation care has to be taken that the test oil is not mixed with the luboil of the injection pump and contaminated with dirt.

The test oil must be replaced after testing approx. 200 injection pumps. The specified test data are valid for a test oil temperature of approx. **20°C.** Higher temperatures will cause lower discharge rates, lower temperatures will induce higher discharge rates.

I. Conducting Visual Inspection before Beginning of Checking

It must be determined whether the pump and governor designations correspond with the entries in the Bosch test data sheet.

At least half of the normal oil capacity must be in the injection pump and the governor during testing.

Check operational ease of the control rod. An exact adjusting of the injection pump is impossible if the control rod runs stiffly.

Check the injection order 1-3-4-2, observing correct sense of rotation (clockwise).

The sense of rotation character **R** in the type designation of the injection pump (see type plate) means that all checks should only be carried through in the specified sense of rotation – seen on the driving side –.

On the "A"-Pump of Model OM 636 check on all four elements whether the plungers in highest cam position (top dead center) still have a travel (safety clearance) of at least 0.3 mm.

Observing this distance is very important. (Also see Adjusting and Checking Feed Beginning.)

On the "A"-Pump of Model OM 636 check whether the pinion segments are tightly seated on the control sleeves and whether the line marks still coincide (Figure 07–5/10), adjust and tighten if necessary. Displaced pinion segments cause unequal discharge rates, irregular running of the engine, heavy smoking or backfires.

This check can also be done while the pump is still installed in the vehicle.

We further recommend to check the pressure valves and the pressure valve springs before the beginning of testing; replace if necessary. Poor sealing of the pressure valves or broken valve springs can cause a failure of the respective cylinder. If there is similar trouble, the check should also be done in the vehicle.