

## Engine Timing

Types 220 and 220a

Accurate timing of the engine calls for the following operations:

1. Checking of camshaft adjustment.
2. Checking and, if necessary, readjustment of valve play.
3. Checking of valve settings or valve lift in cross-over dead center.
4. Checking and comparison of compression pressure.
5. Ignition timing.
6. Idling regulation.

In general it will suffice to make the checks and adjustments mentioned under 2, 4, 5 and 6.

### Ad 1.

Set piston of first cylinder to TDC. The marks on camshaft adjusting washer and first camshaft bearing bracket must register (see also Operation No. M 3, cf. 64).

To set the first piston to TDC, proceed as follows:

#### a) Engine removed:

In Type 220 an adjustment pointer 187 589 01 23 is used; in Type 220a the flywheel is

provided with a mark on its upper half in addition to the marks on the lower half. With piston in TDC position, the upper mark must register with the mark on the intermediate plate (see Figs. M 3/64 and 64/a).

The TDC can also be adjusted by positioning the front counterweight so that the mark on the counterweight coincides with the cast-on lug at the water pump housing (Fig. M 30/1). See also Fig. M 17/00.

#### b) Engine installed:

The mark on the flywheel must register with the mark at the peep hole provided in the clutch housing.

In Type 220 the peep hole is at the upper right of the clutch housing and in Type 220 at the bottom.

### Ad 2.

Check valve play when engine is cold and readjust play, if necessary (see Operation No. M 26c).

Valve play with engine cold:

Intake	0.08 mm (0.003")
Exhaust	0.20 mm (0.008")

### Ad 3.

With normal valve play the determination of the valve settings would be inaccurate. For this reason the checks are to be made at a valve play of both intake and exhaust valves of 0.4 mm (0.016"). In Section B of Table 22 the valve settings for checks are given.

To check the valve settings, proceed as follows: Fasten a graduated disc (360°) to the crankshaft and a pointer to the engine.

**Note:** When the engine is installed in the car, the graduated disc can be attached to the camshaft. In this case the readings must be doubled.

Set first piston to TDC and rotate graduated disc until pointer registers with the 0° mark. Fix graduated disc in this position.

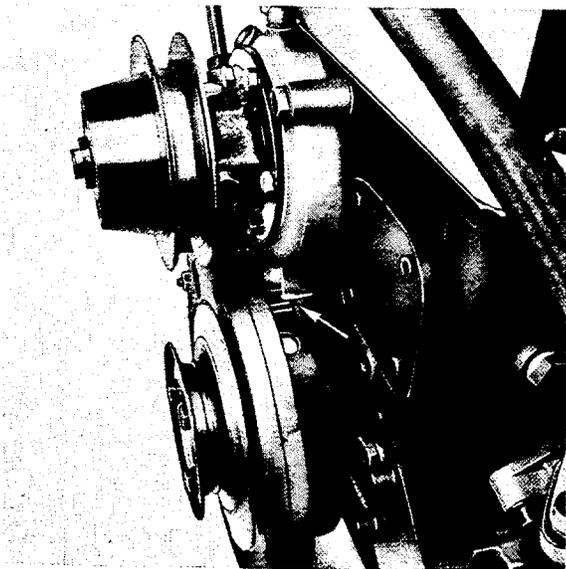


Fig. M 30/1

Rotate crankshaft until rocker arm for intake valve at first cylinder is free from any load. (Place cam base circle on sliding surface of rocker arm).

Eliminate the valve play by sliding a tolerance tape between valve stem and tappet screw.

**Note:** Be sure that the tolerance tape is sufficiently thick to eliminate the valve play completely. It does not matter if the valve is lifted somewhat.

Now mount a dial gauge on the cylinder head in such a way that biased feeler rests vertically on intake valve spring retainer of first cylinder. Set scale of dial gauge to 0.

Rotate crankshaft clockwise (as seen opposite the direction of travel) until the dial gauge reads 0.4 mm (0.016"). Now the begin of opening of the valve can be read from the graduated disc.

**Note:** This check at a valve lift of 0.4 mm (0.016") corresponds to the prescribed check at a valve play of 0.4 mm (0.016").

Continue to turn the crankshaft until the dial gauge reading is again 0.4 mm (0.016") when the valve is closing. The reading on the graduated disc represents the valve closing angle.

Check exhaust valve settings in the same way. Never turn crankshaft backward when making the check, as this would lead to inaccurate results. To check, continue to turn camshaft to cam base circle after the closing angle has been read; the dial gauge must return to 0.

**Note:** After a lengthy period of operation the valve settings may shift slightly due to a stretched camshaft drive chain or reworked mating surfaces at cylinder crankcase or cylinder head. In general this will have little effect on the engine performance. If necessary, an offset key may be installed in the camshaft. An offset of 0.2 mm (0.008") will result in approx. 1°30' at the crankshaft.

If the key is offset to the right (as seen in direction of travel), the opening and closing times will be advanced; if the key is offset to the left, they will be retarded.

For making a quick check of the valve settings it will suffice to check the valve lift in cross-over dead center (see Section C of Table 22).

#### Ad 4.

Check compression pressure with a compression gauge when engine is at operating temperature. The variation of readings between the cylinders should not be more than 0.5 atü (7 p.s.i.).

#### Ad 5.

Firing order: 1-5-3-6-2-4

Spark plug electrode gap:

0.7 + 0.1 mm (0.027 + 0.004")

Breaker point gap:

0.35 — 0.40 mm (0.014 — 0.016")

Ignition timing:

Type 220

5° after TDC

Type 220a

2° after TDC

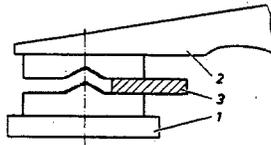
a) Check and adjust breaker point gap.

The gap between movable and fixed breaker point should be 0.35 to 0.40 mm (0.014 to 0.016").

The check can be made with a feeler gauge or a closing angle gauge (000 589 12 21).

When using a feeler gauge, note the following: Due to the fetal transfer caused by the electric spark a crater will form on the movable breaker point, and a dome will appear on the fixed point after a short time. This has no adverse effect on the operation of the distributor and the production of a proper spark. In spite of crater and dome formation the gap remains practically constant. It is therefore not recommended to rework the points, unless ignition trouble is experienced. As a rule reworking of the points will only be necessary after the car has covered a distance of approx. 10 000 km (6 200 miles). It is, however, recommended to replace the breaker points instead of reworking them.

Do not check the gap in the center, that is on the dome, but beside the dome. Push the feeler gauge downward from above without touching the dome. A measurement on the dome will yield an incorrect result (Fig. M 30/5). Do not use your fingers to lift off the movable breaker point, but turn the rotor.



- 1 Fixed breaker point
- 2 Movable breaker point
- 3 Feeler gauge

Fig. M 30/5

When using a closing angle gauge, note the following:

Check made with a closing angle gauge are much more accurate than checks with a feeler gauge. Connect the gauge to terminals 16 and 1 of ignition coil and to ground. The breaker point gap is correct when the closing angle is  $38^{\circ}$ – $41^{\circ}$ . A smaller angle indicates an excessive gap, whereas a greater angle indicates an inadequate gap.

To readjust the gap, loosen set screw at fixed breaker point and turn eccentric screw clockwise or anti-clockwise, as required. Tighten set screw again.

For checking, readjusting and replacing the breaker points, see also Operation No. E 31.

b) Ignition timing.

Set first piston  
of Type 220 to  $5^{\circ}$  after TDC  
of Type 220a to  $2^{\circ}$  after TDC

Loosen clamping screw at adjusting lever and turn distributor so that movable breaker point just lifts off. The check is made with a test lamp (Fig. M 30/5b).

To retard the spark, turn distributor head clockwise.

To advance the spark, turn distributor head anti-clockwise.  
Tighten clamping screw again.

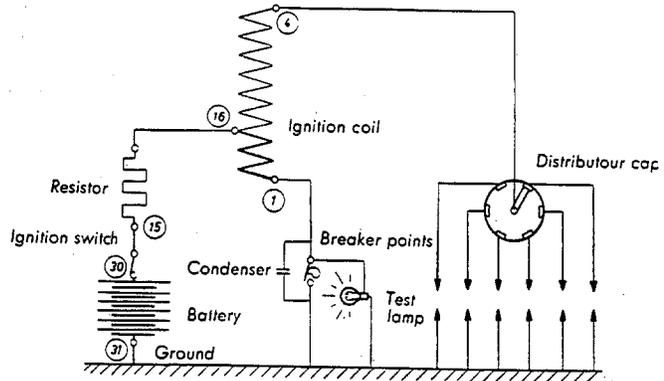


Fig. M 30/5b

**Note:** With engine installed in the car, adjust control cable of octane value compensator so that at  $5^{\circ}$  after TDC (Type 220) or at  $2^{\circ}$  after TDC (Type 220a) the knob on the control panel is at right-hand stop for retarded ignition.

The octane value compensator permits to advance the ignition while driving. In this way it is possible to compensate for differences in the anti-knock properties of the fuel and to select the most favourable ignition point.

Advance octane value compensator until engine starts pinging, then turn compensator back until the pinging noise just vanishes.

For timing the ignition, see also Operation No. E 30.

**Ad 6.**

For idling regulation, see Operation No. M 31, cf. 19–23.

## Valve Settings

**Table 22**

		Type 220 ( $\epsilon = 6.5$ )	Type 220a ( $\epsilon = 7.6$ ) Camshaft with number	
			14	14/1
<b>A</b> Settings at normal valve play	Intake opens	44° before TDC	33° before TDC	41° before TDC
	Intake closes	84° after BDC	65° after BDC	73° after BDC
	Exhaust opens	55° before BDC	71° before BDC	71° before BDC
	Exhaust closes	27° after TDC	35° after TDC	35° after TDC
<b>B</b> Settings for checks at a valve play of 0.4 mm (0.016")	Intake opens	8°30' before TDC	9° before TDC	12° before TDC
	Intake closes	48°30' after BDC	41° after BDC	44° after BDC
	Exhaust opens	36°30' before BDC	51° before BDC	51° before BDC
	Exhaust closes	8°30' after TDC	15° after TDC	15° after TDC
<b>C</b> Valve lift in cross-over dead center	Intake	0.68 ± 0.2 mm (0.027 ± 0.008")	0.68 ± 0.2 mm (0.027 ± 0.008")	0.75 ± 0.2 mm (0.029 ± 0.008")
	Exhaust	0.54 ± 0.2 mm (0.021 ± 0.008")	0.64 ± 0.2 mm (0.025 ± 0.008")	0.64 ± 0.2 mm (0.025 ± 0.008")
<b>D</b> Valve play cold	Intake	0.08 mm (0.003")	0.08 mm (0.003")	0.08 mm (0.003")
	Exhaust	0.20 mm (0.008")	0.20 mm (0.008")	0.20 mm (0.008")

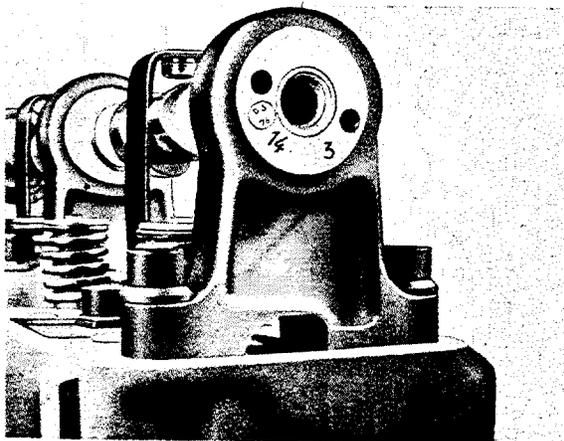


Fig. M 30/01

**Note:** Type 220a is today provided with a camshaft that has a modified intake valve cam. This camshaft has the number 14/1 punched into the end face of the rear bearing journal. The formerly used camshaft bears the mark 14 (Fig. M 30/1). Before attempting to check the valve settings determine whether a camshaft with number 14 or 14/1 is installed in the engine.

If in Type 220a with old camshaft (14) the valves are noisy when the intake valve play is set to 0.08 mm (0.0032"), the play may be reduced to as little as 0.06 mm (0.0024"). However, this measure is recommended in warm weather only. When temperatures are low and the intake valve play is only 0.06 mm (0.0024") starting trouble may develop owing to the valves not closing completely.