Main Group E

Engine

E

General constructional details

The engine in the Lloyd 600 is an air-cooled, two-cylinder, four-stroke, Otto-cycle engine, with overhead valves and overhead camshaft. The cylinders are arranged in line. The cranks on the crankshaft project from the same side of the shaft. Therefore, the pistons are moving together; this results in an even firing order (twin design). The engine is inclined at a 40° angle towards the front, transversely to the direction of motion of the car. The complete power unit, comprising engine, transmission-differential, is connected to the frame by three rubber elements across the front axle carrier.

Crankcase

The crankcase is a horizontally split light-alloy casting. Both crankcase parts are machined together and, therefore, exchangeable only in company. The bottom part of the crankcase is designed to form an oil sump.

Crankshaft

The crankshaft consists of 5 separate parts, viz: the two crankshaft halves, the two counterbalanced crank webs inserted between them and the crankshaft journal in the centre of the shaft. The two crankshaft pins are integrally forged to the counterbalanced crank webs. The pins are finished to cylindrical fit, the shaft journal in the centre has been hardened. The crankshaft parts are hydraulically pressed together as usual on Lloyd cars and cannot be disassembled in a Repair Shop.
The crankshaft runs in three antifriction bearings,the ball bearing on the flywheel side taking up the axial thrust. The flywheel is tightened against the inner ring of the ball bearing by means of a large hexagon bolt, (until Engine No. 353 562 with a stud and hexagon nut) and kept in position by surface pressure. A Woodruff key serves to fix the flywheel in its proper position to the dead centre of the crankshaft. The gear wheel for the oil pump drive is fastened to one of the counterbalanced crank webs by a cylindrical pin and driven by the same web. The sprocket wheel to drive the timing chains is held in place on the cylindrical crankshaft journal on the V-belt pulley side, by means of splines. The V-belt pulley is secured to its seat by means of a hexagon screw, the pulley being kept from moving by a Woodruff key. Sealing of the crankshaft is effected by special type sealing rings on both sides.

Connecting rods

The connecting rods are of H-section, the small end of the connecting rod being undivided. Each connecting rod is attached to the crank pins by means of a roller bearing comprising two rowrs of caged short cylindrical rollers. On the crankshaft side the rollers run in a hardened inner ring, whereas on the connecting rod side they run directly on the hardened inner surface of the big end of connecting rod.

Pistons

Each light-alloy piston of the auto-thermic type carries three piston rings: two compression rings and one oil scraper ring. The piston pins float in their connecting rods, the pin has a sliding fit in the piston boss. Against axial displacement the pins are secured by wire snap rings inserted in the piston eyes. The pins are located eccentrically to ensure smooth running of the pistons.

Cylinders

The two separately arranged cylinders are made from special grey cast-iron; cooling fins are integrally cast with the cylinders for better heat dissipation. The cylinders are indentical in shape so that they can be interchanged together with their pistons.

Cylinder head

Each cylinder carries a detachable deeply ribbed cylinder head of light-alloy casting with shrunk-in valve seat inserts and valve guides of special highly wear-resisting grey cast-iron. The cylinder heads are interchangeable among each other. A gasket of laminated soft-iron sheet ensures a tight seal between each cylinder head and cylinder. Inlet and exhaust valves are of the inverted type and arranged in the cylinder head. The seating surfaces of the exhaust valves are specially armoured by highly heat-resisting chrome-nickel stell fixed by welding.

Camshaft housing, camshaft and valve operating gear

The monobloc camshaft housing is a light alloy casting forming a cover for both cylinder heads. The camshaft runs inside of the camshaft housing on two ball bearings and is driven by the crankshaft through a single-roller chain opposite to flywheel side. The crankshaft actuates the valves by means of double-armed rockers which have hard-chromed working surfaces. The ignition distributor with breaker are coupled with the camshaft. Proper tension of the timing chain is automatically maintained by an elastic clamp bracket lined with damping material.

Cooling

A centrifugal ventilator provides for air cooling. The impeller is mounted on the dynamo shaft and driven along with the dynamo from the crankshaft by means of an adjustable V-belt. The ventilator, through an opening in the ventilator casing, draws air which is led through the engine cover to the cylinders and cylinder heads.

Lubrication

The lubrication of the engine is a force-feed circulation system enabling the three main bearings to be provided with lubrication, while the lubrication of the connecting rod bearings, pistons, valve operating gear, rocker arms and camshaft is done by splash oil. The geared oil pump driven by the crankshaft has no relief valve and requires, apart from the strainer in the oil suction line, neither an additional oil filter nor an oil pressure indicator owing to the fact the crank gear is supported on anti-friction bearings. The pump forces lubricating oil through three oil passages, cast in the crankcase bottom, to the three main bearings. The baffle plates, secured to the two crankshaft halves at their outer ends by means of grooved dowel pins, lead the lubricating oil flowing through the two outer main bearings and hollow crank pins to the roller bearings in the connecting rods. Thence the oil sprayed through grooves provided in the small end of the connecting rods into the cylinder walls as well as to the inner side of the piston head, thus ensuring the lubrication of both piston working surface and piston pin. The oil delivered by the oil scraper rings into the interior of the piston flows back into the crankcase. Part of the oil from the front main bearing flows across the crankshaft journal to the timing chain. The latter feeds oil upwards to the camshaft housing whence, after being flung off, it runs onto the oil groove in the casing, thus ensuring the lubrication of the camshaft bearings. Dipping of the cams into special oil recesses causes the oil to splash about so that rocker arms and valves are provided with lubricating oil. The oil flows back via chain case to the crankcase.

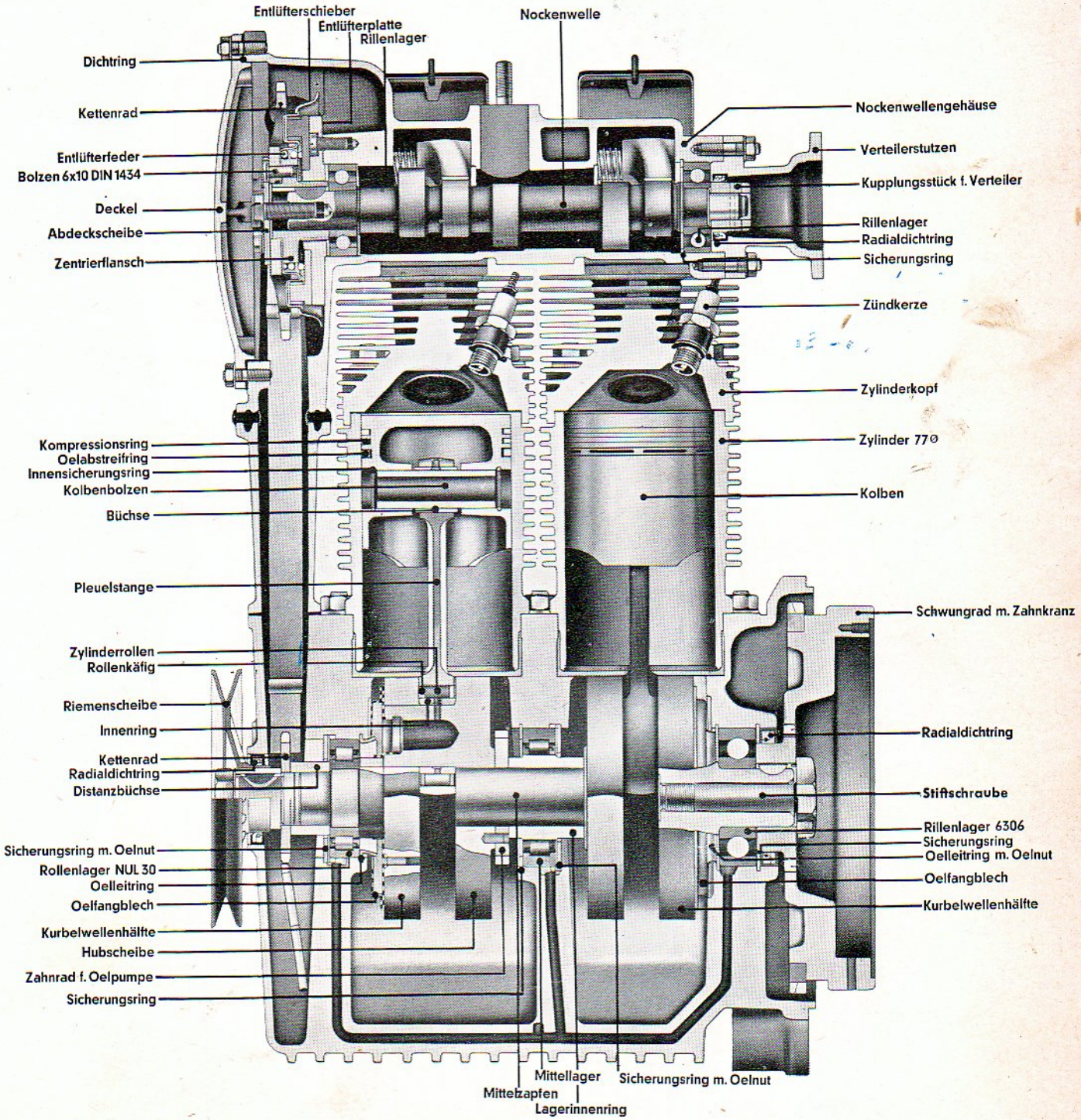
Venting of crankcase

A rotary slide revolving with the camshaft ensures the venting of the crankcase. Controlled equalization of pressure in the crankcase takes place through a passage in the camshaft housing and the vent pipe ending in the air cleaner casing.

Engine longitudinal section

Dichtring	= Sealing ring
Kettenrad	= Sprocket wheel
Entlüfterfeder	= Spring (Vent)
Bolzen 6 x 10 DIN 1434	= Bolt 6 x 10 DIN 1434
Deckel	= Cover
Abdeckscheibe	= Cover plate
Zentrierflansch	= Centering flange
Entlüfterschieber	= Vent slide
Entlüfterplatte	= Vent plate
Rillenlager	= Grooved ball bearing
Nockenwelle	= Camshaft
Nockenwellengehäuse	= Camshaft housing

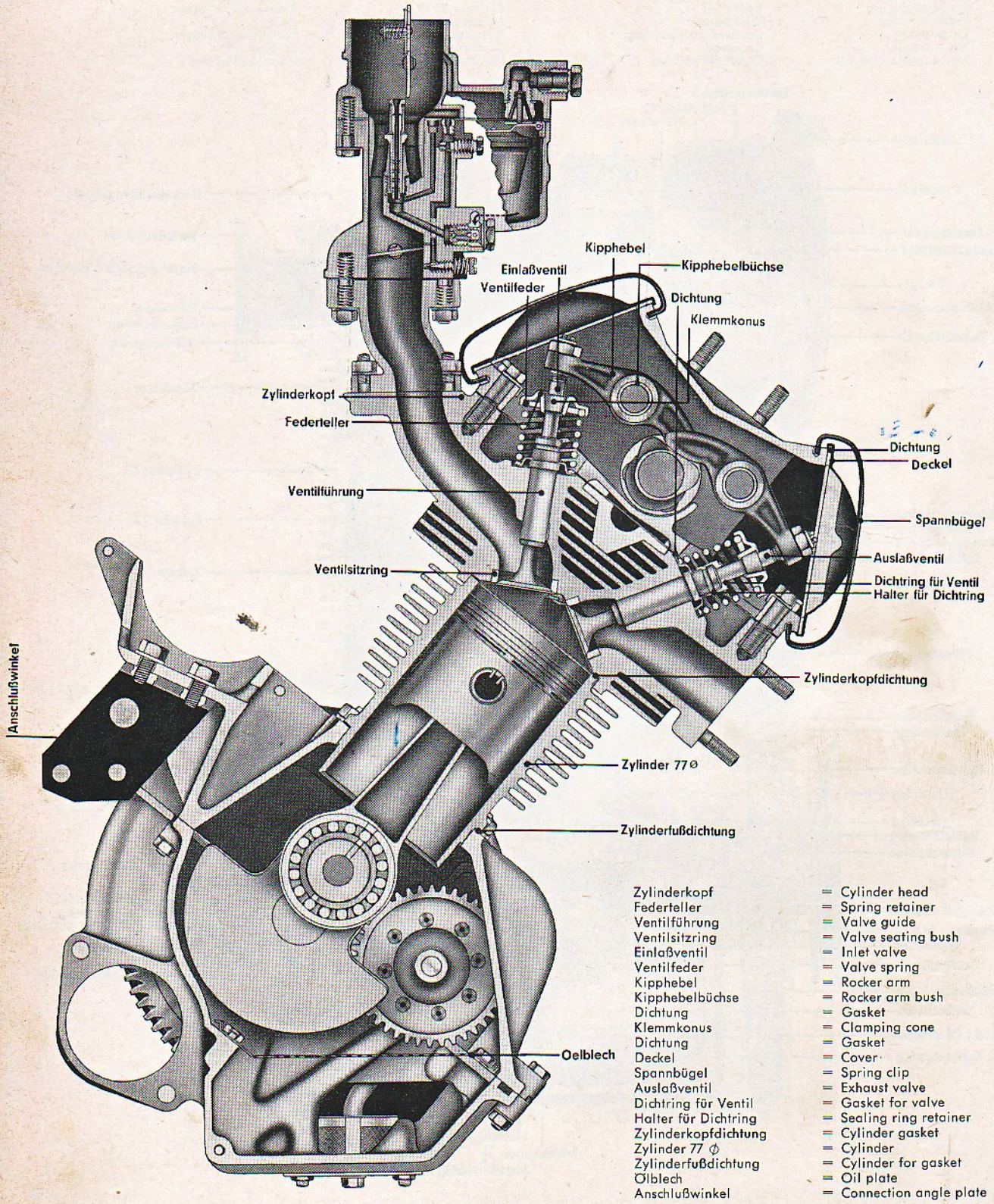
Verteilerstutzen	= Distributor housing
Kupplungsstück und Verteiler	= Distributor drive
Rillenlager	= Grooved ball bearing
Radialdichtring	= Radial oil seal
Sicherungsring	= Locking washer
Zündkerze	= Sparking plug
Zylinderkopf	= Cylinder head
Zylinder 77 Ø	= Cylinder 3 1/16" diam.
Kolben	= Piston
Kompressionsring	= Compression ring
Ölabstreifring	= Scraper ring
Innensicherungsring	= Inner locking ring



Kolbenbolzen	= Pistons pins
Büchse	= Bush
Pleuelstange	= Connecting rod
Zylinderrollen	= Cylindric roller
Rollenkäfig	= Roller cage
Riemenscheibe	= V-pully
Innenring	= Inside ring
Kettenrad	= Sprocket wheel
Radialdichtring	= Radial oil seal
Distanzbüchse	= Distance bush
Sicherungsring mit Ölnut	= Safety ring with oil groove
Rollenlager NUL 30	= Roller bearing NUL 30
Ölleitring	= Oil guide ring
Kurbelwellenhälfte	= Crankshaft half
Hubscheibe	= Balanced crank web

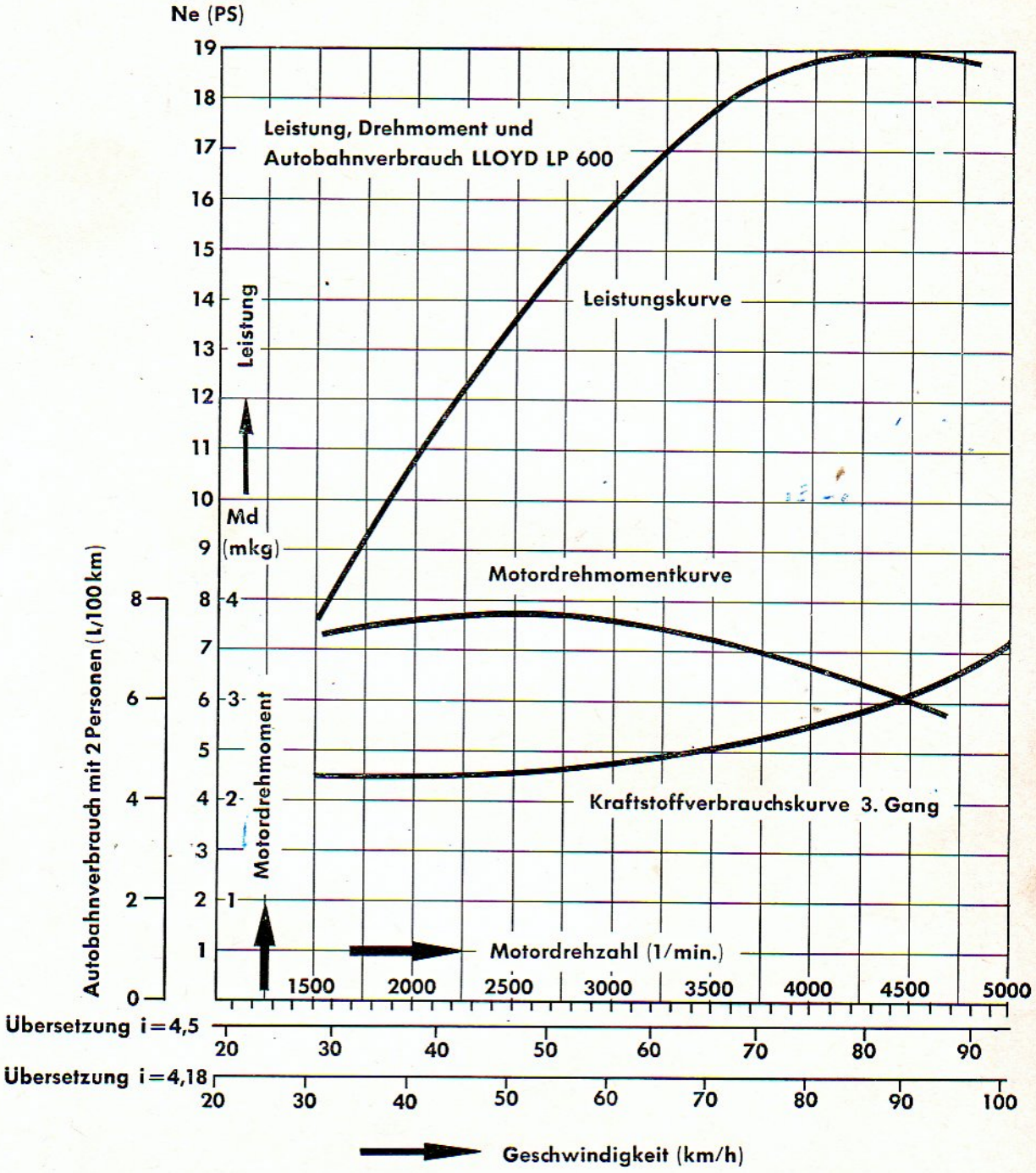
Ölfangblech	= Oil baffle plate
Zahnrad-Ölpumpe	= Geared oil pump
Sicherungsring	= Locking washer
Mittelzapfen	= Middle journal
Mittellager	= Middle roller bearing
Lagerinnenring	= Roller bearing bush
Sicherungsring mit Ölnut	= Locking washer with oil groove
Schwungrad mit Zahnkranz	= Flywheel with starter gear
Radialdichtung	= Radial oil seal
Rillenlager 6306	= Grooved ball bearing
Sicherungsring	= Locking washer
Ölleitring mit Ölnut	= Oil guide ring with oil groove
Ölfangblech	= Oil baffle plate
Kurbelwellenhälfte	= Crankshaft half
Stiftschraube	= Stud

Cross sectional view of engine



Zylinderkopf	= Cylinder head
Federteller	= Spring retainer
Ventilführung	= Valve guide
Ventilsitzring	= Valve seating bush
Einlaßventil	= Inlet valve
Ventilfeder	= Valve spring
Kipphebel	= Rocker arm
Kipphebelbüchse	= Rocker arm bush
Dichtung	= Gasket
Klemmkonus	= Clamping cone
Dichtung	= Gasket
Deckel	= Cover
Spannbügel	= Spring clip
Auslaßventil	= Exhaust valve
Dichtring für Ventil	= Gasket for valve
Halter für Dichtring	= Sealing ring retainer
Zylinderkopfdichtung	= Cylinder gasket
Zylinder 77 ⌀	= Cylinder
Zylinderfußdichtung	= Cylinder for gasket
Ölblech	= Oil plate
Anschlußwinkel	= Connection angle plate

The engine is fitted into the car at an inclination of 40°. To show the path of the intake flow the engine is shown with the down-draught carburettor fitted in place.



Ne (PS)	= Ne (HP)
Leistung, Drehmoment und Autobahnverbrauch LLOYD LP 600	= Performance, torque and consumption on the road for LLOYD LP 600
Leistungskurve	= Performance curve
Md (mkg)	= Md (mkg)
Motordrehmomentkurve	= Engine torque curve
Motordrehmoment	= Engine torque
Kraftstoffverbrauchkurve 4. Gang	= Fuel consumption curve 4th gear
Motordrehzahl i/min.	= Engine speed (r.p.m.)
Autobahnverbrauch mit 2 Personen 1/100 km	= Road consumption with 2 passengers (1/100 km)
Übersetzung 1 = 4,5	= Gear ratio 1 = 4,5
Übersetzung 1 = 4,18	= Gear ratio 1 = 4,18
Übersetzung 1 = 4,87	= Gear ratio 1= 4,87
Geschwindigkeit (km/h)	= Speed (km/h)
Vierganggefriebe	= 4-speed gearbox

The following tools will be required:

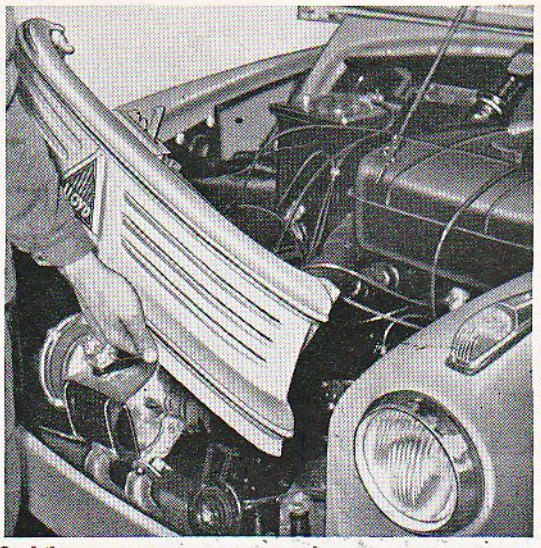
WO 53 – Socket wrench for starter and camshaft-case mounting.

Open-end spanners 7, 8, 9, 2 x 10, 12, 14 and 27 mm.; box spanners 10, 14, 17 mm, ring spanners 14 and 17 mm.; extension, ratchet, screw driver 5 mm, drift 2 mm, Poly-grip pliers, pointed pliers.

Unlike in Lloyd 400 the engine in the Lloyd 600 can be removed only together with the gearbox. For this operation you need not jack up the car at the front. The whole assembly (engine/gearbox) can be easily lifted out of the car while the car stands on its wheels.

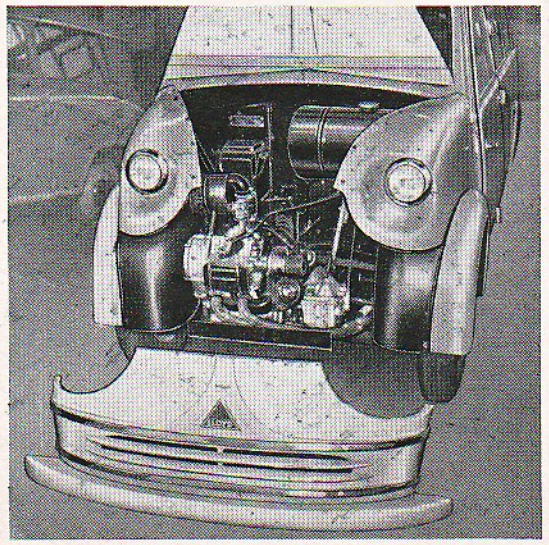
Removal

1. Shut off fuel cock.
2. Remove storage battery cover; unscrew cable from storage battery at the positive terminal.
3. On the LP/LS remove front decoration and put it aside, at best on top of the fuel tank. Wire cable for bonnet lock remains on the front decoration! (Fig. 2 - 1/1)



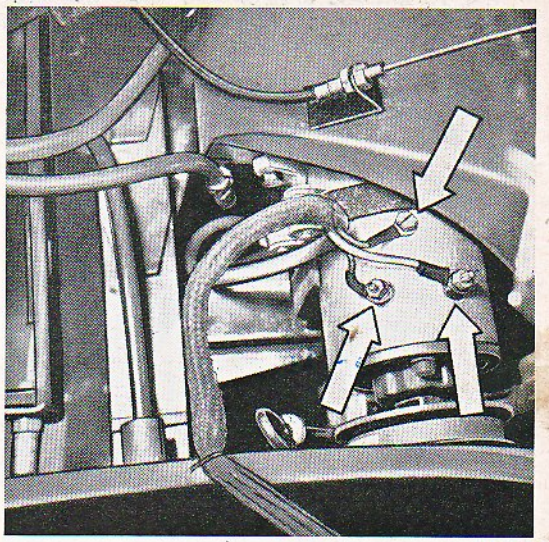
2 - 1/1

Attention! On LT/LTK remove first front bonnet with bumper. (Fig. 2 - 1/2)



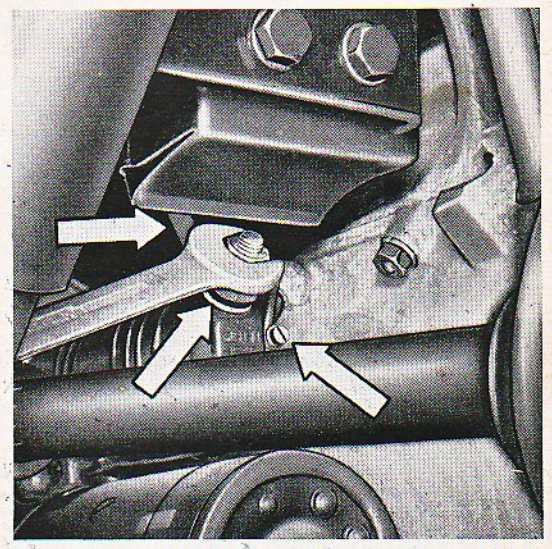
2 - 1/2

4. Unscrew low-tension cable (green) on terminal 1 of ignition distributor.
5. Remove high-tension cable from terminal 4 of ignition coil.
6. Unscrew ignition coil from holder on engine.
7. Loosen Bosch horn with holder from bracket on engine.
8. Unscrew the 3 cables on the dynamo leading to the regulator switch. (Fig. 2 - 1/3)



2 - 1/3

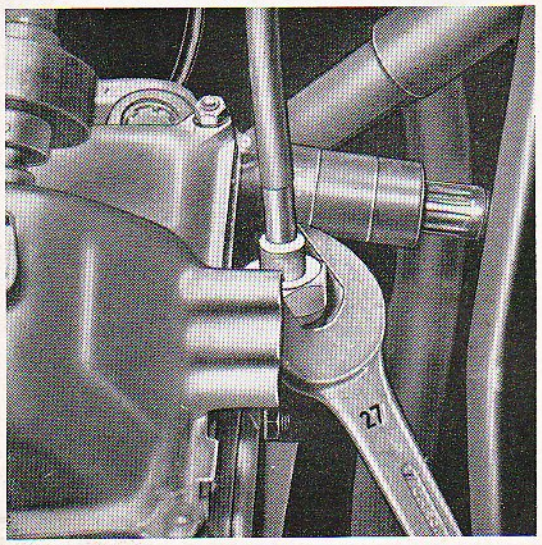
9. Remove battery cable and cable leading to regulator switch from terminal 30 of the starter. Remove cable to ignition switch from terminal 50 of the starter. (Fig. 2 - 1/4)



2 - 1/4

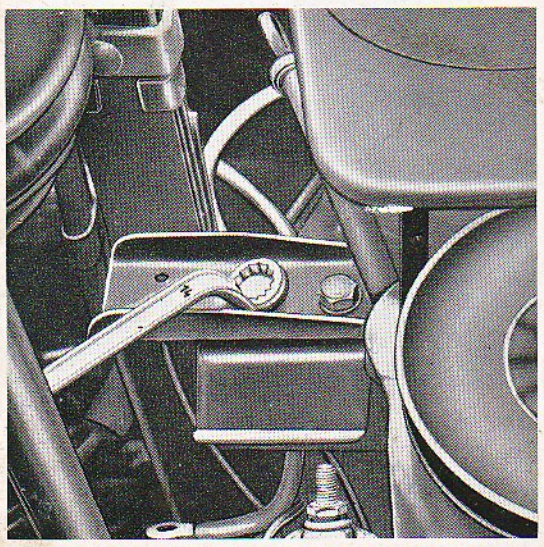
10. Bend upward clip on ventilator casing and free positive cable.
11. Remove fuel hose from pipe connection of fuel pump.
12. Loosen gas and starter wire cables on carburettor. Unscrew and loosen wire cables from fastenings on ventilator casing resp. air filter socket piece.
13. Unscrew wire cable for heating system from support on heating case. Unhook wire eyes from heating flap.

14. Remove heating hose from connection of engine cover.
15. Unscrew storage battery ground table on clutch housing flange.
16. Unhook tension spring for gear selector rod on transmission housing cover.
17. Unscrew lock screw on gear selector rod and push upwards gear selector rod.
18. Loosen speedometer spiral from transmission housing. To this end unscrew cap screw and take out speedometer spiral. Apply wrench below transmission housing. (Fig. 2 - 2/1)



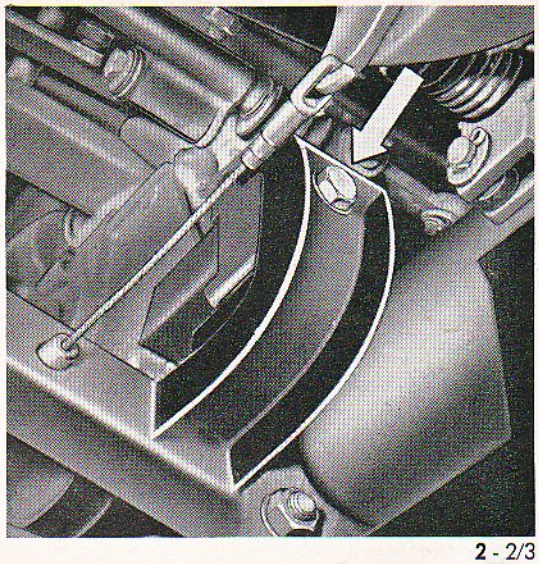
2 - 2/1

19. Loosen clutch cable and push it out of the clutch lever and butment.
20. Unscrew exhaust manifold at intermediate flange from exhaust pipe.
21. Unscrew lateral engine suspension (below dynamo bracket) from bearing arm of front axle carrier. Rubber buffer remains on the engine! (Fig. 2 - 2/2).



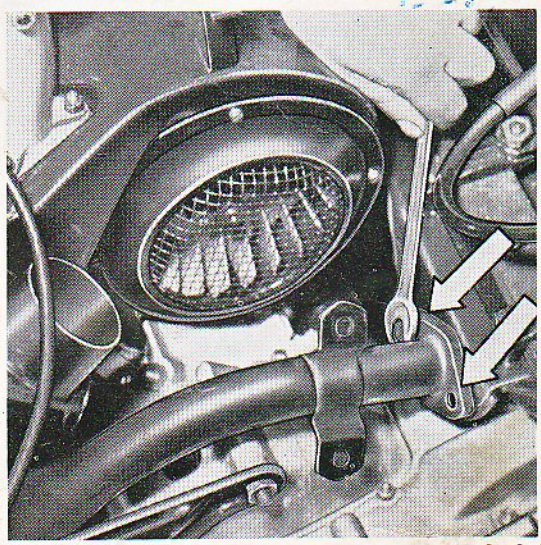
2 - 2/2

22. Unscrew rear engine suspension (at transmission outrigger) from front axle carrier. Bearing angles and rubber buffers remain on the transmission housing! (Fig. 2 - 2/3).



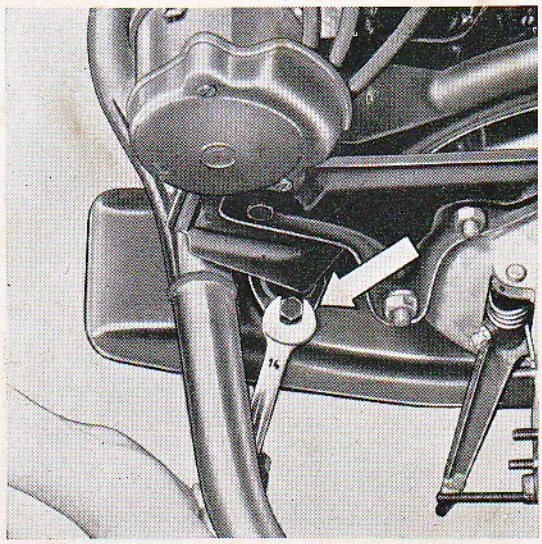
2 - 2/3

23. Unscrew engine bearing bracket at rear (top) from front axle carrier. (Fig. 2 - 2/4)



2 - 2/4

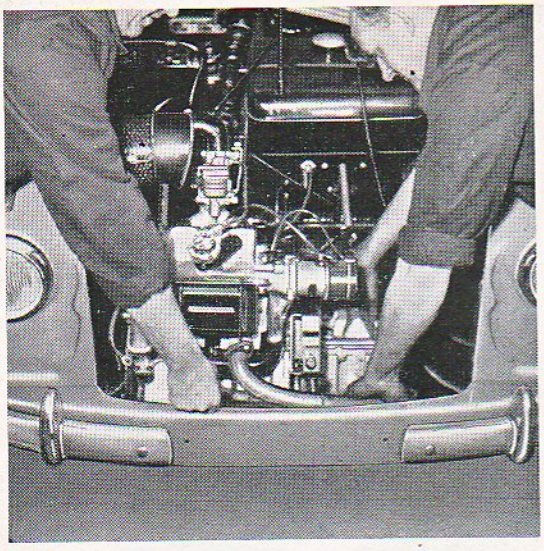
24. Unscrew engine bearing bracket at front (bottom) from front axle carrier. (Fig. 2 - 2/5).



2 - 2/5

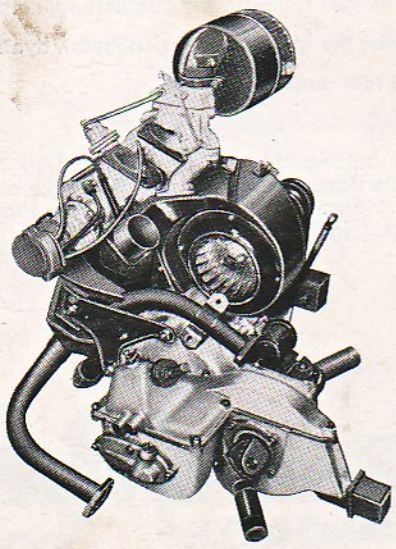
Attention! When dismantling the engine the bearing bracket remains on the engine!
The engine is now freed from all connections to the vehicle and can be lifted out of the engine compartment with the help of an assistant.

25. Lift out assembly. (One man grasps with his left hand under the dynamo, with his right hand the exhaust manifold. The outer man seizes with his left hand likewise the exhaust manifold, grasping with his right hand the rubber coupling for the gear selector rod. (Fig. 2 - 3/1).



2 - 3/1

a) Lift assembly on the left side so that the long propeller shaft slips out of the universal joint.
b) Lift now assembly on the right side so that the short propeller shaft glides out of the universal joint.
c) Lift up assembly at front, take it out of car and put it on the work bench. (Fig. 2-3/2 shows the complete engine after its removal).

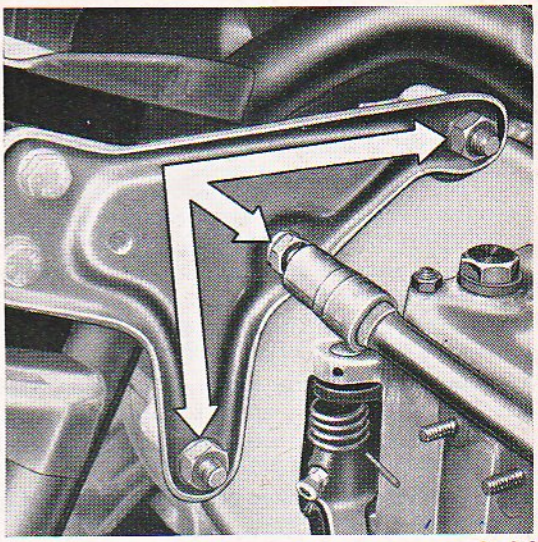


2 - 3/2

Before loosening the flanged joint between gearbox and engine, the following parts must be dismantled from the engine:

26. Unscrew exhaust manifold.

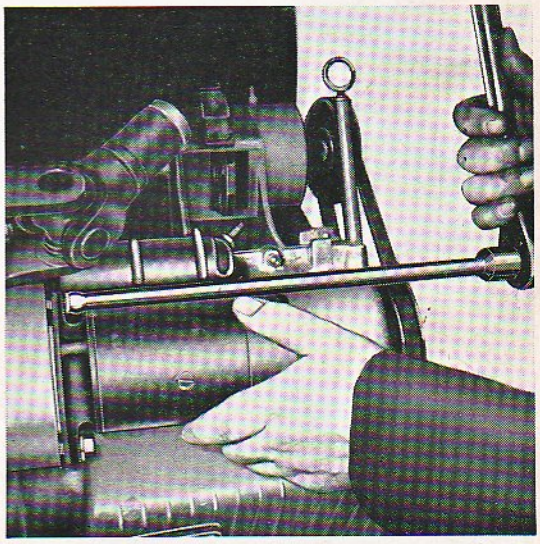
27. Remove engine bearing bracket. To this end loosen the three nuts on the gearbox support. (Fig. 2 - 3/3).



2 - 3/3

28. Unscrew starter. For this operation use special wrench WO 50 starter. Unscrew both nuts evenly. At the same time pull starter off the flange, and unscrew nuts entirely. (Fig. 2 - 3/4).

Note: Wrench WO 58 serves especially for the removal and installation of the starter with the engine fitted in the car. This wrench is, moreover, used when fitting the camshaft housing (together with a torque wrench). (See also Section E 9, page 9-2).



2 - 3/4

29. Remove gearbox from engine. For this purpose unscrew the last fastening nut still existing on the clutch housing.

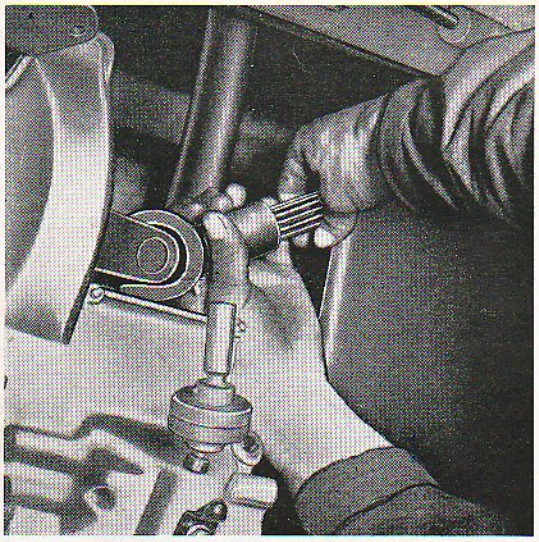
Attention! If there is some resistance felt on dismantling the housing flanges use, with care, a rubber hammer. Be sure not to damage flange contact areas with a screw driver!

Shall the engine be disassembled, it must be put and clamped either in the rotating engine stand or the repair shops may use, in the case of partial removal of parts and for the purpose of ensuring a proper storage of the engine, a home-made wooden engine stand likewise recommended for use in the shops (See under "Accessories for repair shop").

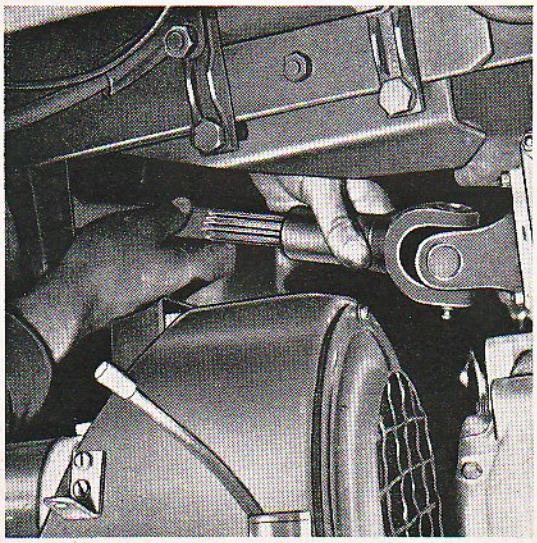
Refitting

The reassembly and the installation of the assembly in the car must be made in the reverse order by paying regard to the following points:

1. After a high mileage it is good practice to remove the clutch and to examine it for the sake of precaution when dismantling the engine.
   In any case before flanging the gearbox to the engine it is necessary to examine the centering of the clutch disc by means of assembly drift WO 22.
2. Examine graphite slip ring and replace it if clearly worn out.
3. Give splines on transmission drive shaft and starter pinion a light coat of graphite grease.
4. Inspect engine rubber blocks, if necessary replace.
5. Tighten brass nuts on the exhaust manifold connection to the cylinder head and apply a torque of 2 mkg. Renew flange gaskets.
6. Before reassembly clean carefully engine and gearbox flange contact areas.



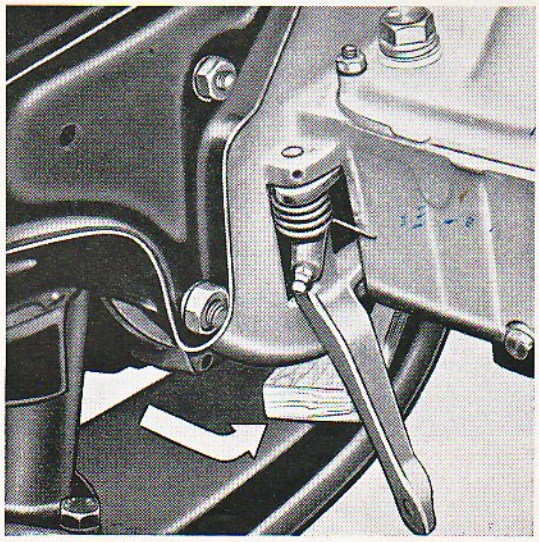
2 - 4/1



2 - 4/2

7. After the assembly has been lifted into the car and lowered down on the front axle carrier arm, the assistant must insert the propeller shaft into the universal joints. First insert the **short** propeller shaft by lifting the power unit and moving the universal joints back and forth; then the **long** propeller shaft is put in place in the same manner. (Figs. 2-4/1 and 2).

   In order to place the power unit in the proper position for the connection with the three rubber blocks it is good practice to insert a suitable wooden block between clutch casing and front axle carrier arm. Dimensions approx.: 10 x 10 x 2.5 cm, (3.9" x 3.9" x 1"). (Fig. 2 - 4/3).



2 - 4/3

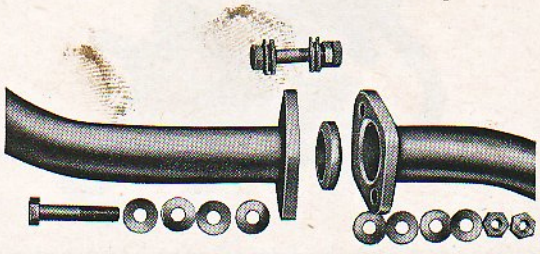
8. The engine rubber blocks on the front axle carrier must not be fastened in the reverse but in the same order as that followed for dismantling, i.e. first

   a) fasten the lateral suspension (below dynamo), then

   b) the rear suspension and,

   c) finally, the engine carrier arm.

9. When bolting the exhaust manifold to the intermediate flange of the exhaust pipe, take care of the proper arrangement of the convex-shaped cup springs. (Fig. 2 - 4/4).

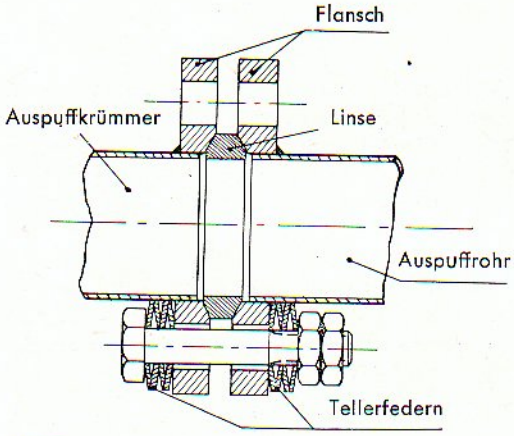


2 - 4/4

Attention! Do not overtighten nuts on the intermediate flange so that the necessary free movability of the exhaust piping is maintained at this point!

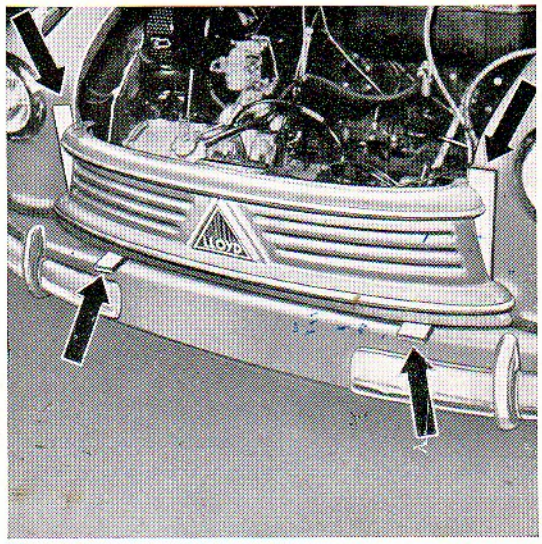
After the hexagon nuts are placed against their seatings by turning them down 1½ to 2 turns, set cup springs under initial tension; thereupon, lock with jam nuts. (Fig. 2 - 5/1).

Flansch	= Flange
Auspuff	= Exhaust manifold
Linse	= Gland
Auspuffrohr	= Exhaust pipe
Tellerfedern	= Cup springs



2 - 5/1

10. To enable the front decoration, on reinstalling the engine, to be adjusted quickly and uniformly, small wooden boards should be used as shims having the following dimensions:
    a) between side part (front decoration abt. 25 x 3 x 0.5 cm, (9.85" x 1.18" x .2")
    b) between bumper/front decoration abt. 10 x 3 x 1 cm, (3.93" x 1.18" x .39"). (Fig. 2 - 5/2).



2 - 5/2

Removal and installation of the engine

Model 600/1957

Since the 1957 series model is equipped with exhaust gas heating and preheating, there is a change in the above specified sequence for "Removal and reinstalment of the engine".

The following procedure is recommended:

Removal

1. Shut-off fuel cock.
2. Remove battery cover; unscrew positive cable on the battery.
3. Unscrew connection hose between air intake and heater on the latter. Remove air intake after loosening the three hexagon nuts SW 10 from front decoration.
4. Remove front decoration.
   With the LT 600 model remove front bonnet with bumper.
5. Loosen heating hose on the heater; bend sidewards heating hose (towards wheel case on the left).
6. Unscrew Bowden wire cable on heater holder (hexagon nut SW 9); unhook wire cable at the heating flap lever.
7. Remove low tension cable (green) from terminal 1 of ignition distributor.
8. Take out high tension cable from terminal 4 of ignition coil.
9. Unscrew ignition coil from engine bearing bracket.
10. Loosen the 3 cables on the dynamo leading to the governor switch.
11. Unscrew storage battery cable to governor switch from terminal 30 of starter. Loosen cable to ignition switch from terminal 50 of the starter.

12. Bend up clip on the ventilator housing and free positive cable.

13. Pull off fuel hose from pipe connection of fuel pump.

14. Loosen gas and starter wire cable on the carburettor; unscrew wires at their fastenings on ventilator housing or air filter pipe connection and remove them.

15. Unscrew Bowden wire cable for defroster on holder of engine bonnet; unhook wire cable on flap lever.

16. Remove defroster hose from pipe connection on engine bonnet and bend it sidewards (to the right wheel box).

Attention! Do not break off heating and defroster hoses in order to avoid impairing the heating and defroster effect by reducing the sectional area of the hose.

17. Unscrew battery ground cable on the clutch housing flange.

18. Unhook tension spring for gear selector rod on transmission case cover.

19. Loosen clamping screw at the gear selector rod and push gear selector rod upwards.

20. Loosen speedometer connection on transmission case connection. For this operation unscrew cap screw and take out speedometer spiral. Apply screw wrench below wheel box!

21. Loosen clutch wire cable and push it out of clutch lever and support.

22. Take off preheater hose on air cleaner pipe, unscrew intake scoop on exhaust manifold (2 hexagon nuts SW 10).

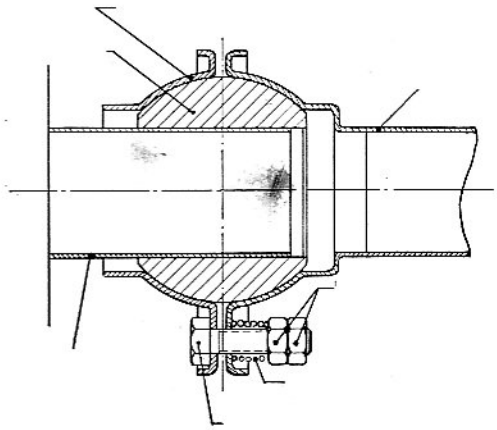
23. Unscrew heater on heater holder (do not remove heater holder on the bearing arm for transmission) (2 hexagon nuts SW 14, 1 item SW 17).

24. Unscrew brass nuts serving to fix exhaust manifold to cylinder heads.

25. Remove from below to the right heater with exhaust manifold (one complete unit). For this purpose withdraw exhaust manifold-sliding tube from spherical flange joint of exhaust pipe.

Attention! Generally, the bolted joint of both spherical flange halves needs not be loosened. Loosen flange joint only in the case of bad functioning of the spherical sliding piece; remove sliding piece, clean it with wire brush and give outer surface and bore a coat of gaphite grease.

After reassembly do not overtighten hexagon nuts SW 10. Be sure that the coils of the two compression springs do not touch each other so as to maintain the movability of the joint (Fig. 2 - 6/1).



2 - 6/1

The further steps to be taken in the removal of the engine are the same as with model 1956 (see pages E 2 - 2 and 3 items 21 to 29.

Installation

Reassembly and installation of the power unit should be done in the reverse order. The hints given for the 1956 model (pages E 2 - 4 and 5, items 1 to 8 and 10) should likewise be taken into account with the 1957 model.

In reinstalling the heating system the following order and hints should be taken into account:

1. Insert exhaust manifold-sliding tube into the spherical-shaped flange joint of the exhaust pipe.

In order to avoid overtightening which may result in a fracture of the flange at the cylinder head it is necessary:

2. to screw on **finger-tight** heater to holder
3. to **tighten** (at 2 m/kg) exhaust manifold on the cylinder heads.

4. **Tighten** heater on its holder.

5. After connecting the Bowden wire cable serving to operate the heating system check heating flap for full opening or closing.

When disassembling and reassembling the engine the following procedure has proved very useful in practice:

Disassembling

1. Drain out engine oil
2. Remove air cleaner
3. Remove carburettor
4. Remove protecting grid of ventilator housing
5. Remove ventilator impeller
6. Dismantle dynamo; remove V-belt
7. Take off heater casing
8. Remove ventilator housing
9. Dismantle fuel pump
10. Remove ignition distributor
11. Remove valve chamber cover
12. Remove cover for chain case
13. Dismantle sprocket wheel
14. Dismantle camshaft housing
15. Remove chain case
16. Remove intake manifold
17. Dismantle cylinder heads
18. Remove cylinders
19. Dismantle pistons
20. Dismantle flywheel
21. Withdraw belt pulley
22. Dismantle crankcase top
23. Dismantle oil strainer
24. Dismantle oil pump
25. Lift out crankshaft
26. Remove oil plates

Reassembling

Reassembling of the engine should be done in the reverse order.

Please refer to the following description of the different working precedures for all special hints to be taken into consideration in disassembling and reassembling the engine.

Description of air cleaner

The air cleaner LP 411 of Knecht-Micronic make, which is installed in the engine, is a dry type filter which is distinguished by its high efficiency and easy maintenance. The filtering paper of the filter element is made insensitive to moisture and oil vapours by its special impregnation. Thanks to the special creasing of the filtering paper the greatest possible filtering area has been obtained within the space provided for the filter element. This type of filter enables dirt particles ranging in size to one micron (= 1/1000 mm = 0.00004") to be separated so that optimum filtering of the intake air is guaranteed. Thereby the rate of dust separation does not depend upon the air velocity or upon engine speed.

Apart from cleaning the combustion air, the function of the air cleaner in the Lloyd 600 is to supply dust-free air for airing the crankcase as the engine-air vent pipe likewise ends in the air cleaner. Inside of the air vent there is arranged a metal screen strainer which, moistened by the oil vapours of the engine lubricating oil, increases the effect of the filter element as regards the airing of the crankcase. This strainer must be cleaned every 12000 km (7500 miles) in accordance with manufacturers instructions.

The Micronic air cleaner has the particular advantage that it cleans itself under the vibrations of the engine. All the same, the filter cartridge should be removed and knocked clean at the intervals specified by the service instructions. After 12000 kilometers of driving the cartridge should be replaced by a new one.

4 - 1/1

Cleaning air filtering cartridge

1. Fold back quick-closing devices.
2. Remove cover and take out cartridge.
3. Remove dust from cartridge by striking it several times on wood (Fig. 4 - 1/1).

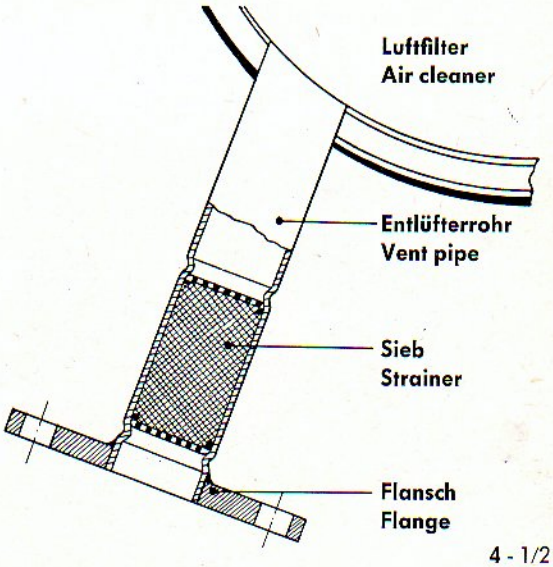
Attention! Our latest designs have filter elements firmly connected by vulcanisation with the air cleaner cover. On these new filter types do not try to forcibly separate cover and cartridge!

4. Reput filter cartridge in place.

Attention! Do not clean filter cartridge in gasoline and do not moisten it with oil!

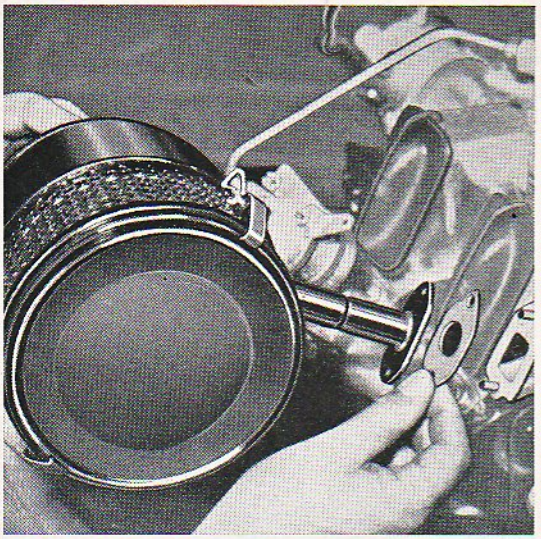
Clean strainer in the vent tube

1. Dismantle air cleaner. For this purpose loosen wire cable for starter flap on the support. Loosen spring washer on carburettor connection as well as the two hexagon screws SW 10 on the vent pipe flange.
2. Remove from filter the Micronic element and wash out vent pipe in gasoline.
   Fig. 4 - 1/2 shows the location of the strainer in the vent pipe.



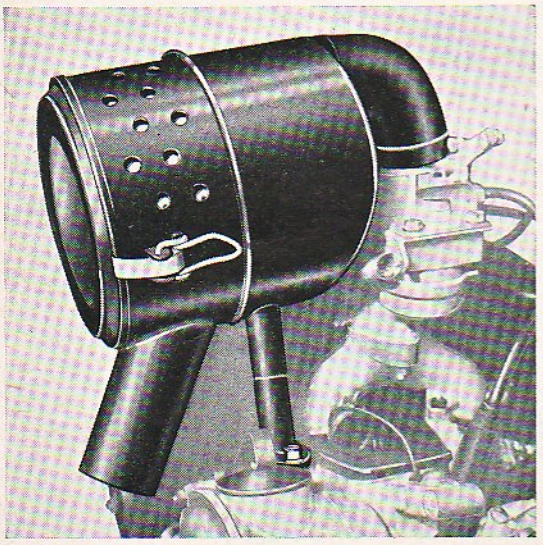
4 - 1/2

3. Reassemble cleaner with new flange gasket. (Fig. 4 - 2/1).



4 - 2/1

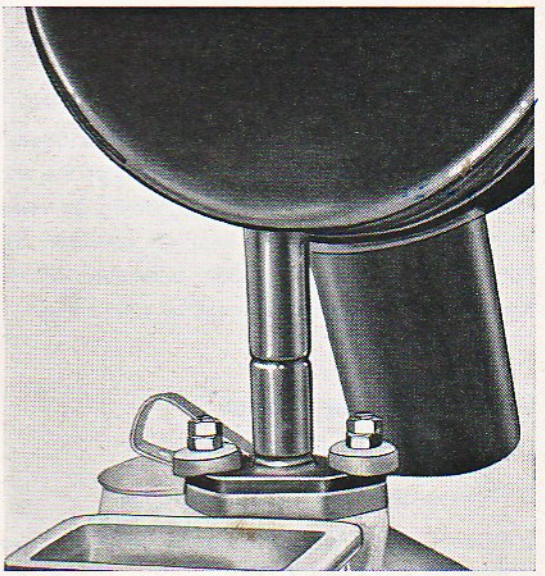
Note: From Chassis No. 6/256 847 and 6/113 848 an air cleaner capable of damping intake noise is fitted, its designation being LK 411/1. Its essential feature is a so-called Schnorchel tube. As regards the filtering cartridge, its maintenance and replacement there are no differences whatever for this type of air cleaner as compared with the type LP 411 (without Schnorchel). It may be used in all vehicles without any difficulty (Fig. 4-2/2).



4 - 2/2

After Engine No. 352 906 the filter LP 411/2 is fitted. This type has a shorter outlet pipe, therefore an 8 mm thick rubber gasket is fitted between the camshaft housing and the outlet pipe flange; also rubber washers are placed under the tightening nuts thus allowing an elastic movement (Fig. 4 - 2/3).

This type of filter can be exchanged with the LP 411 and LP 411/1 types. But care must be taken that the studs in the camshaft housing 6 x 12 must be replaced by studs 6 x 25 long.



4 - 2/3

Preheating

Vehicles equipped with an exhaust-type heating (from Chassis No. 6/263 022 or Chassis No. 6/114 456) are generally equipped with a preheater system (serving to preheat intake air).

Preheating has a favourable influence on the operational behaviour of the engine and has the following advantages:

Putting the engine more quickly into full operational condition at low outside temperatures.

Reduced use of starter flap.

Increased economy due to favourable influence upon fuel consumption. Avoidance of dilution of the lubricating oil by fuel cendensate. Prevention of ice formation inside of carburettor, a phenomenon that, owing to the use of today's fuels (high percentage of constituents of low boiling point) can be frequently noticed under certain atmospheric conditions.

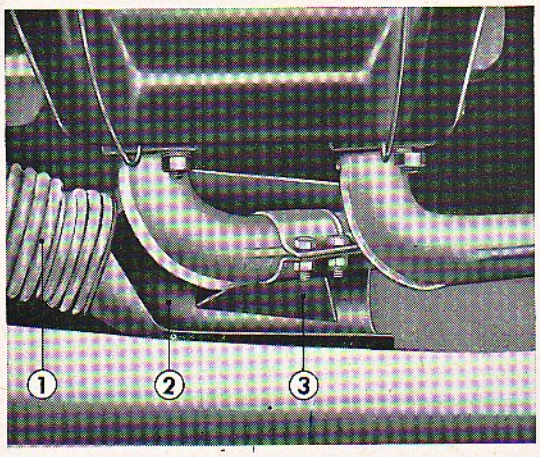
The preheater system of a special service type may also be installed later in all vehicles having no exhaust-type heating, provided they are equipped with an air filter with Schnorchel tube.

The service type of preheater system consists of the following components.

① Flexible heating hose.

② Intake scoop.

③ Holder of preheater.



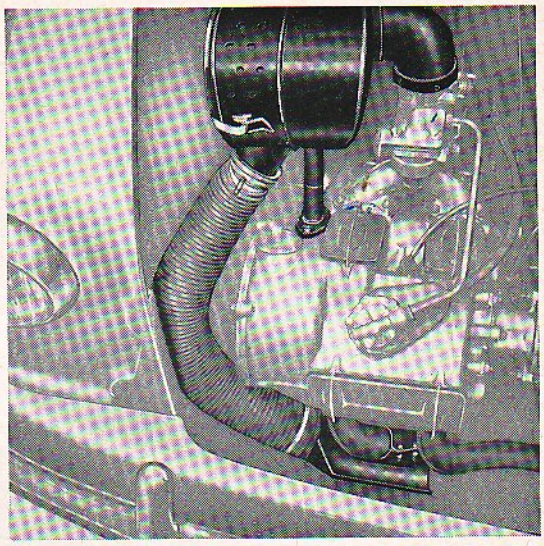
4 - 3/1

Installation

1. Screw holder of preheater on exhaust pipe of cylinder 2. The correct fitting position of the holder is given by the lateral welding seams on the exhaust pipe.

2. Screw intake scoop to the holder.

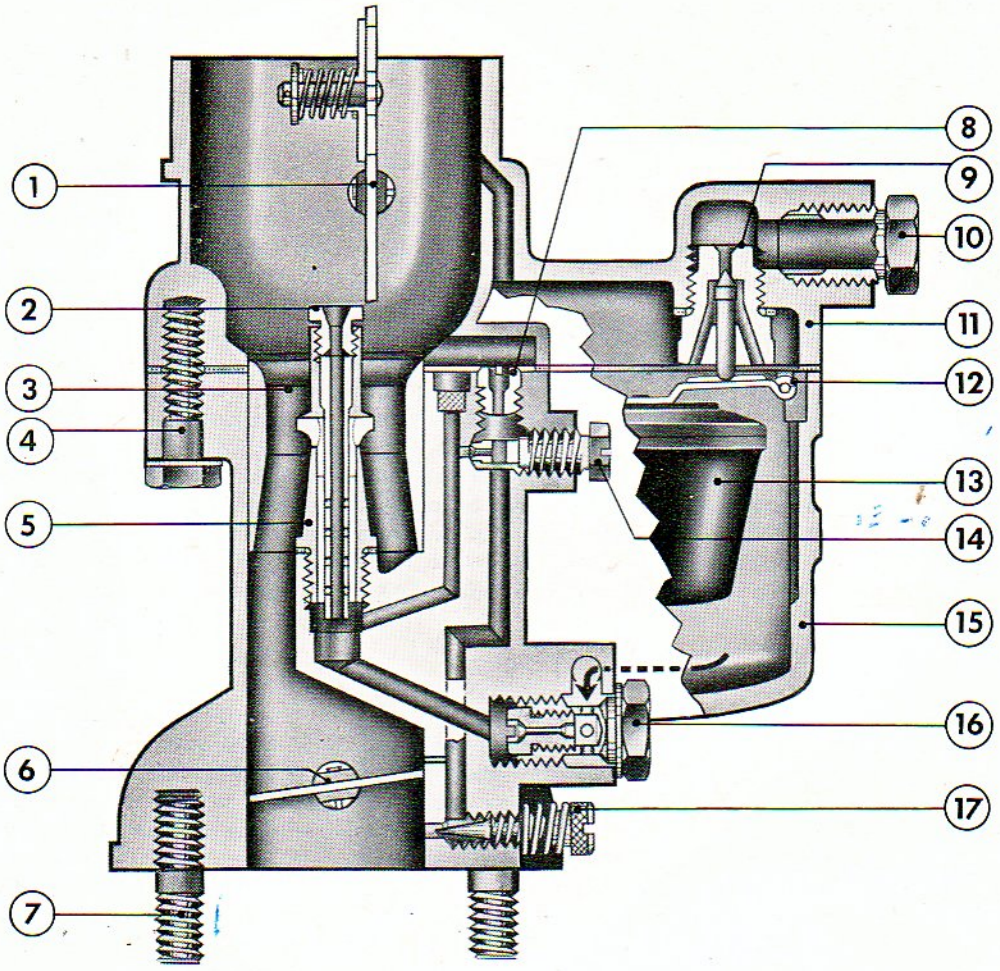
3. Put heating hose on the connections of the intake scoop and air cleaner and fasten with straps. (Fig. 4 - 3/2).



4 - 3/2

In order to avoid the unfavourable influence of the warm season on the engine performance and the engine (reduced output or lower top speed through loss of charge – risk of engine overheating through reduced antiknock rating of the fuel) the system should be put out of operation by removing the flexible hose during periods where the ambient temperature exceeds 15° C.

Solex 28 VFIS



1. Choke with flutter valve
2. Air regulating jet
3. Venturi tube
4. Dismounting screw
5. Mixing pipe support with mixing pipe
6. Throttle
7. Headless screw
8. Air idler jet
9. Carburettor float needle valve
10. Screw connection for fuel pipe with sealing cone
11. Carburettor cover
12. Float articulation
13. Float
14. Idler jet
15. Float bowl
16. Main jet support with main jet
17. Idler mixture regulating screw

Description of Carburettor

The Solex carburettor 28 VFIS is of the downdraught type having an intake width of 28 mm. The two main parts, carburettor casing and carburettor cover, are made by die casting.

The carburettor casing comprises the mixing chamber and float chamber, and embodies all parts needed for the preparation of the fuel-air mixture, the float and throttle with throttle spindle.

The carburettor cover is placed on the carburettor casing with a gasket. Connected to the cover is the fuel pipe arriving from the fuel pump by means of a screw. Furthermore, in the cover are located the float needle valve screwed into place from below. In the air intake the choke with flutter valve is located on a common shaft.

The float assembly comprises the plastic articulated float, and float needle valve. To the float is riveted a web whose extremity is rolled. The float is suspended in the bolt in a movable manner by means of a spindle pushed through the rolled web eye. The float needle valve is laterally displaced, this arrangement resulting in an increased transmission of the closing pressure to the float valve.

Carburettor

The carburettor has a **central air inlet,** that is, not only the air required for the preparation of the mixture (starting, idling, partial and full load) but also the air required for venting the float chamber is fed through the air intake into the carburettor. An air filter is placed in front of the carburettor, thereby any risk of air contamination inside of the carburettor being widely avoided and the rate of fuel consumption being, to a certain extent, not influenced by the rate of pollution of the air filter.

Principle of functioning

Starting device: When starting a cold engine a mixture rich in fuel is necessary as, firstly, fuel volatilisation is more difficult on cold days and, secondly, losses due to condensation on the cold walls of the intake as well as on the cold walls of the combustion chamber may occur so hat an ignitable mixture can be fed into the engine only thanks to a certain excess of fuel.
The starter device comprises the choke with butterfly valve and the choke control lever which is actuated by the driver by means of a cable. The choke is closed by pulling out the choke control button (starting position) and opened by pushing back the choke control button (operating position). The choke is connected to the throttle valve by a connecting rod. During cranking with the choke closed the vacuum in the mixing chamber of the carburettor increases so that a greater amount of fuel is admitted through the outlet openings in the mixing pipe support. The air required for the formation of the fuel mixture is fed and regulated through the butterfly valve which opens automatically. On closing the choke, the throttle valve will be mechanically opened a little by the connecting rod to cause the starting mixture to flow into the intake tube and simultaneously to attain a higher idling speed for the engine. After starting the engine, the choke – depending on the prevailing temperature later or earlier – must be reopened slowly, thus the throttle valve being closed again and the formation of fuel-air mixture being taken care of by the idling device.

Idling device: When idling, that is, when the engine rotates at abt. 750 r.p.m., the air velocity and thus the vacuum in the venturi is low so that no fuel is drawn from the outlet openings in the mixing pipe support. Therefore, the carburettor has a special idling device which acts as a small auxiliary carburettor and which first prepares an idling emulsion of fuel and air which is then prepared to form an idling mixture with the air drawn through the slits of the throttle valve. The amount of idling mixture is governed by the idler mixture adjusting screw, whereas the percentage of fuel in the mixture is regulated by the idling fuel jet, the percentage of air in the mixture finally by the air idler jet. By regulating the idling mixture regulating screw the width of the opening for the passage of the idling emulsion can be diminished or increased. By turning the screw down an idling mixture lean in fuel is provided whereas backing off the screws results in an enrichment of the idling mixture.
The idler regulating screw enables the idling speed of the engine to be adjusted. Adjusting this screw brings about either an increase or decrease of the throttle valve opening by turning in and out, respectively, the screw with the valve closed. Turning the screw into its seat causes the idling speed to increase, turning out the screw involving a reduction of the idling speed.

Main carburettor: For engine speeds of the medium and higher ranges the fuel-air mixture is generated in the main carburettor.

The preparation of the fuel-air mixture in the main carburettor is governed by:

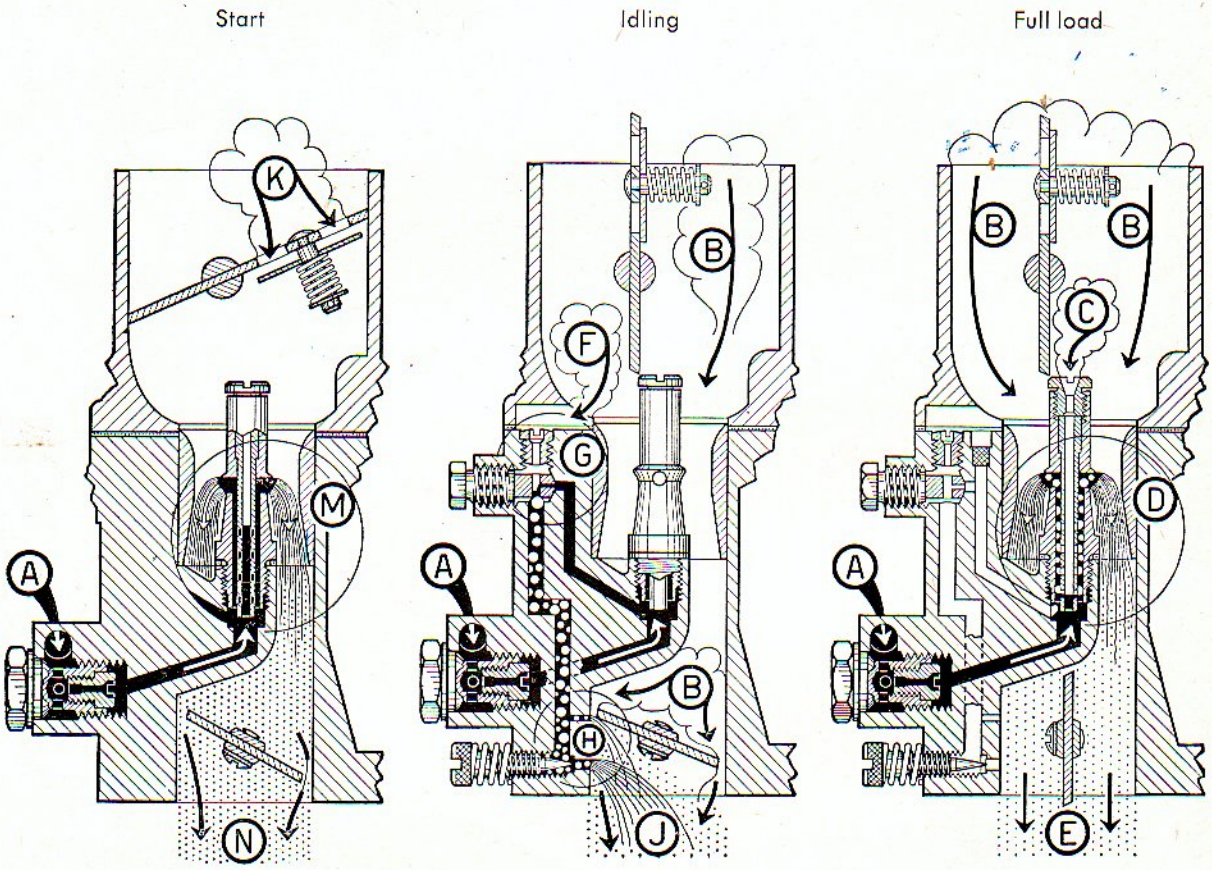
Main jet (regulates the quantity of fuel)

Air choke tube (governs the amount of air)

Air adjusting jet (functions as "compensating jet" governing the amount of "compensating air" to be added with increasing engine speeds.

Into the mixing pipe support whose outlet openings lie in the smallest sectional area of the choke tube, is inserted the mixing pipe which is clamped in position by the air regulating jet. Fuel flows from the float chamber via the main jet screwed into the main jet support to the mixing pipe support. Due to the vacuum existing in the intake line, fuel is drawn off through the outlet opening in the mixing pipe support and mixed with the air fed into the air intake. If there is a drop of fuel level in the mixing pipe support when the throttle valve is more and more opened, thus causing the vacuum to increase, then compensating air is admitted through the air regulating jet and forms, in the mixing pipe support, an air bubble mixture with the fuel flowing subsequently through the main jet. The air bubble mixture, whose air content becomes enriched with increasing engine speed, prevents overenriching, which otherwise might take place (brake type jet carburettor) and brings about a composition of the fuel-air mixture as uniform as possible within the entire speed range of the engine.

Functioning of the Solex carburettor VFIS



A Admission of fuel
B Entrance of main air
C Entrance of compensating air
D Outlet of air bubble mixture and formation of fuel air mixture
E Fuel air mixture to engine
F Entrance of idling air
G Formation of idling air bubble mixture
H Outlet of idling air bubble mixture and formation of idling mixture
I Idling mixture to engine
K Entrance of starting air
M Outlet of fuel and formation of starting mixture
N Starting mixture to engine

Cleaning carburettor

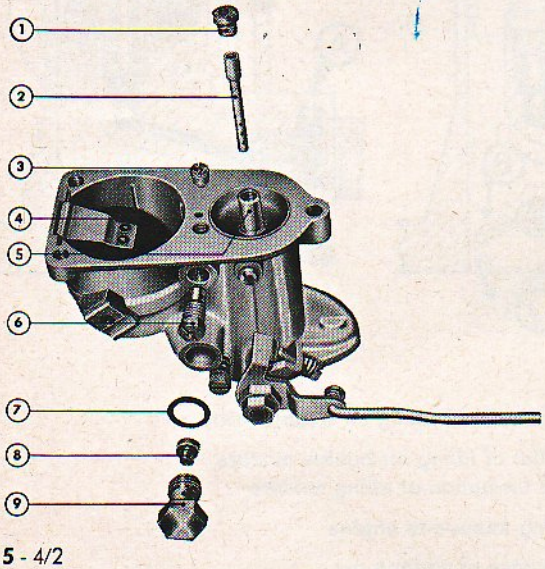
For cleaning the carburettor only the top part of the carburettor requires to be unscrewed. The carburettor need not be dismantled.

Dismantling

1. Dismantle air filter.
2. Remove fuel pipe between carburettor and fuel pump.
3. Unhook tensioning spring for throttle valve and remove.
4. Loosen hexagon fastening screws SW 10 for top of carburettor (Fig. 5 - 4/1).
5. Lift off top of carburettor and turn down.
   Shall the top be dismantled, wire cable for choke valver and connecting rod must to be loosened.
6. Remove float.

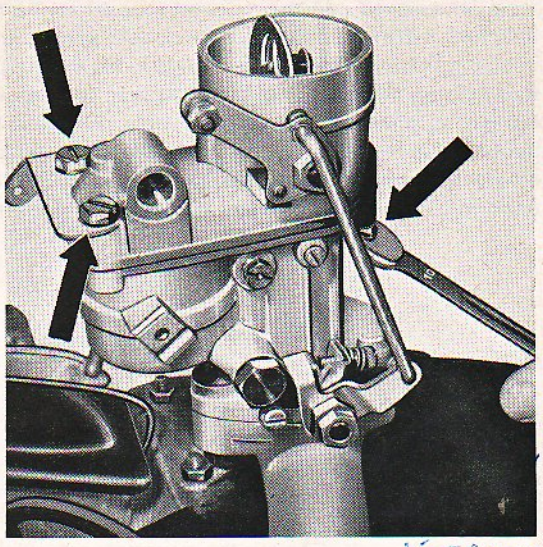
Attention! In lifting float out of its seating in the chamber greatest care must be taken to avoid damage to the web riveted to the float. Before inserting the float **check riveting for tightness.** If slightest slackness will be noticed, float must be replaced.

7. Unscrew air regulating jet and take out mixing tube.
8. Unscrew idling air jet.
9. Unscrew main jet carrier.



5 - 4/2

1. Air regulating jet
2. Mixing pipe
3. Idler air jet
4. Float
5. Mixing pipe carrier
6. Idler fuel jet
7. Gasket for main jet support
8. Main jet
9. Main jet support



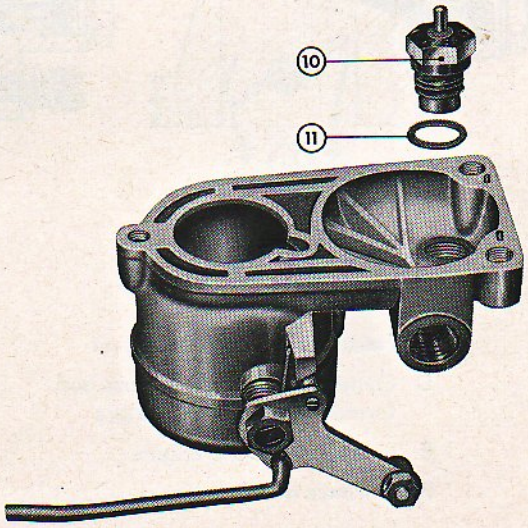
5 - 4/1

10. Screw out main jet from jet support.
11. Screw out idler fuel jet.
12. Remove float needle valve (Fig. 5 - 4/2 & 3).
13. Blow out float chamber, jets and passages in carburettor with compressed air.

Attention! For cleaning carburettor parts never use a wire or needle as otherwise jets might be damaged and the fine calibration get lost.

Reassembly

Reassembly and reinstalling the carburettor must be done in the reverse order. Do not forget to check engine at idling speed, eventually readjust.



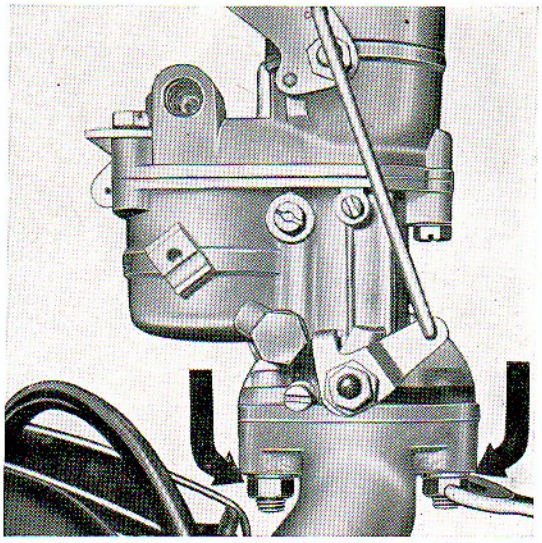
5 - 4/3

10. Float needle valve
11. Seal for float needle valve

Dismantling and reinstalling carburettor

Dismantling

1. Remove air cleaner.
2. Unscrew fuel pipe between carburettor and fuel pump.
3. Unclip carburettor and choke control cable.
4. Loosen hexagon nut SW 12 on intake manifold. (Fig. 5 - 5/1).



5 - 5/1

Reinstalling

Reinstalling must be effected in the reverse order. In doing so the following points should be taken into account:

1. Check carburettor and intake manifold for plane surfaces, if necessary, resurface faces.
2. Replace flange gasket.
3. Immobilise accelerator pedal in open throttle position; open throttle valve and fix gas throttle cable so that there is a clearance of abt. 1 mm between throttle valve lever and lever stop.
4. With fully opened choke valve fix cable so that the control button of the choke valve projects 1-2 mm (0.04 – 0.08") from the instrument panel to ensure in any case full opening of the choke valve.
5. Tighten hexagon nuts on intake manifold crosswise at a torque of 1.1 m/kg.
6. Adjust idling.

Adjustment of carburettor

General

The basic adjustment of the carburettor made at the manufacturer's works ensures optimum engine performance and economical consumption. The combination of carburettor jets as realized in our series production cars is the outcome of an exact test program.

Any change of jets, a change of choke tubes for other sizes than provided by the manufacturer, any change of fuel level in the float chamber will result in smaller engine performances and higher fuel consumption. Under circumstances such changes may be of severe consequence and should, therefore, be avoided.

The adjustment of carburettors on series type cars is effected by using trade mark gasolines. When using a gasoline-benzol mixture, however, the fundamental adjusting data of the carburettor require, in general, no change. Merely a new adjustment of the idling jet should be done.

A change of the following basic carburettor adjustment might become necessary only in case car owners wish to switch over to a fuel showing **strong differences** from the fuel previously used. In this case it is best to have the readjustment of the carburettor made by an authorized Solex servicing station.

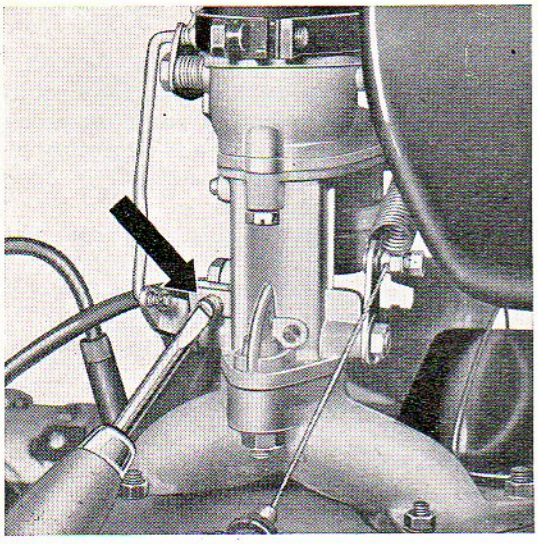
Adjusting Data

Main jet	120
Idling jet	0.50
Choke tube	24
Idling air jet	1.0
Air regulating jet	220
Mixing pipe support	5
Mixing pipe	36
Float needle valve	1.5
Weight of float	5.7 g (.201 oz)

Adjusting of carburettor for idling

Adjusting of the idler jet should be done only with the engine warmed up. As an engine running under no load fails to be warmed up to service temperature, it is best to warm it up during a run over a distance ranging from 2 to 3 km. (1.3 – 1.9 miles).

1. Tighten slightly idler regulating screw in order to increase the engine speed slightly above the usual idling speed (abt. 750 r.p.m.) (Fig. 5 - 6/1).



5 - 6/1

2. Turn down slowly idling mixture regulation screw (clockwise) until engine commences to "sputter" and is liable to stop.

3. Loosen again regulating screw until the engine turns "round" evenly.

4. A high idling speed should be slackened down by unscrewing idling regulating screw until the engine continues to run evenly and slowly with the clutch completely depressed. (abt. 750 r.p.m.).
   Proper slow idle is obtained if

a) when pulling up the choke valve suddenly, the engine does not fail to operate or if the engine speeds up without any undue delay,

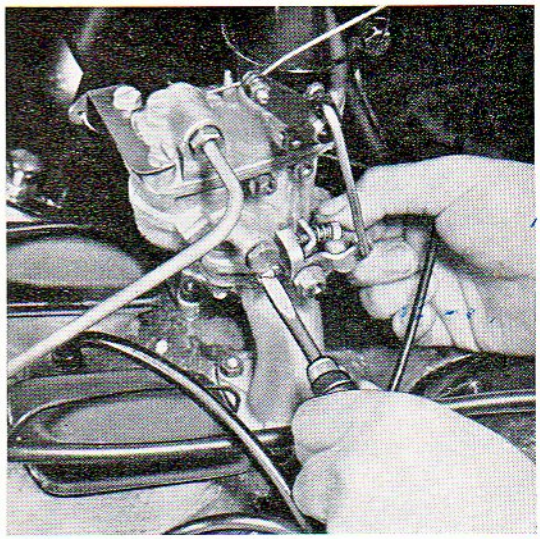
b) the engine draws gas, while the throttle valve is being opened slowly in one run, "free of holes" that means, the transition from the formation of idling mixture to main mixture takes place without any drop of engine speed.

In order to ensure such a transition free of speed drop it is best to proceed in the following manner:

Speed up engine by depressing throttle valve lever very slowly.

Should engine speed slow down when changing from one to the other speed range, maintain engine at this speed, at the same time varying, by carefully turning the idler mixture regulating screw, the quantity of the idling mixture.

Under circumstances it is necessary to repeat this regulation procedure from changing from one to other speed range so as to find the most favourable adjustment (Fig. 5 - 6/2).



5 - 6/2

According to experience the proper idler jet adjustment is obtained when the idling mixture regulating screw is opened by 1-2 turns.

Should the engine stop on opening suddenly the gas throttle, this indicates that the mixture is too poor. In this case you must continue to back out idling mixture regulating screw. If, however, the engine comes to a standstill after a sudden close of the throttle valve or during a test run while the brakes are being sharply applied, it may be assumed that the idling mixture is too rich. In such a case care must be taken to reduce the richness of the fuel air mixture by turning down the idling mixture regulating screw.

Be sure to carry out the idling adjustment always with greatest care as a properly adjusted idler is important not only for the entire behaviour of the engine but also the proper quantity of the idling mixture influences the fuel consumption to a not insignificant degree.

Of course, to ensure a slow regular idling speed of the engine a proper timing and valve adjustment, proper air gap between the electrodes of the spark plugs, gas-tight flange connections at carburettor and intake manifold and as uniform a compression pressure as possible on both cylinders are necessary.

Fuel consumption

If complaints are made about excessive fuel consumption, it must be thought that the cause of an increase lies in most cases outside of the carburettor and may only seldom be due to improper carburettor adjustment or to the carburettor itself.
In the following enumeration of causes first the factors are mentioned, which are of decivise importance on the fuel consumption of a vehicle.

1. Manner of driving and operating the car.
2. Speed.
3. Terrain (level ground, upland, high mountains)
4. Duty (city traffic, door to door traffic, touring, etc.)
5. Condition of car, particularly condition of engine and running gear.
6. Tyre pressure, tyre profile.
7. Seasonal influences, atmospheric influences.
8. Condition of the road (snow, slippery roads etc.)

The proper consumption figure may, therefore, be computed only when taking these factors into account. Furthermore, it must be taken into account that conditions for standard fuel consumption (for more details see following explanations about the term ("Standard fuel consumption") will be encountered only seldom in practical driving operation. In general, the average touring consumption is 10% above the standard consumption. Constant city traffic or driving in a very uneven terrain when driving frequently on the low gear, the consumption may eventually rise considerably above the aforementioned percentage.

Standard fuel consumption

(Ref.: Standard specification DIN 70030 of August 1956)

The fuel consumption figures stated by the car manufacturers are based on general directions for the evaluation of fuel consumption. They are shown in the Standard Specification DIN 70030 of the Standards Association of Motive Vehicle Industries. Therefore car owners are able to check fuel consumption figures for correctness when referring to the above Standard Specification. The standard fuel consumption may be determined in the following manner.

1. **Vehicle:** Series model with conventional carburettor adjustment and ignition timing. Tyre pressures, viscosity of the engine and gearbox oil must meet the manufacturer's specifications. The engine must be run in and brought to its usual operational temperature before the test is made.
2. **Load:** The vehicle must be loaded to a weight between full load and empty.
3. **Test road:** Level dry highway about 10 km long (6.214 miles). (Grades of short length and descents with a maximum gradient of 1.5%). Out and home without interruption. The correct distance covered without coasting should be determined in conformity with the roadside marking.
4. **Weather conditions:** Must be dry, no wind, (highest wind force 3 m /5).
   Air temperature + 10 to 30° C.
5. **Speed:** If possible drive at uniform speed at 3/4 of the stopped top speed throughout the entire test run.
6. **Fuel:** Commercial grade of fuel.
7. **Measuring device:** The fuel quantity consumed during the fuel consumption test run must be determined exactly to 0.1 Ltr. in a calibrated measuring vessel.
8. **Calculation of fuel consumed:** The consumption should be calculated according to the following formula:

$$K_n = 1.1 \cdot \frac{K}{W} \cdot 100$$

where:

K_n = Fuel consumption in litres/100 km.
W = Distance covered in km.
K = Quantity of fuel consumed.

The tolerance of 10% included in this formula serves to compensate for unfavourable conditions. For checking the standard fuel consumption a tolerance of + 5% is admissible.
Therefore, the consumption figure determined on a trial run may be compared with the standard consumption figure given by the car manufacturer only if the above described test conditions are prevailing.
In most cases a higher consumption will result as a consequence of wrong uneconomical driving methods or of unfavourable test run conditions.

Only if in spite of the observance of all test conditions as specified herein, the consumption stated exceeds the standard fuel consumption by more then 5%, it is good practice to make a new adjustment, or to check the engine and running gear for proper condition.

In doing so, care should be taken that

1. Leakages of fuel system
2. Leaky or loose carburettor float at the rivetted connexion with the float linkage
3. Leaky, or bridged float needle valve
4. Leaky or damaged fuel pump diaphragm
5. Excessive pump pressure
6. Loose, contaminated, worn out spark plug
7. Leaky or burned valves
8. Wrong camshaft adjustment
9. Worn or broken piston rings
10. Excessive piston clearance (loss of compression)
11. Engine oil of wrong viscosity rating
12. Dragging brakes (hand brake!)
13. Very thick tread of tyre e. g. cross country, M- and S-tyres.
14. Insufficient inflation pressure, etc.
    may be the cause of higher fuel consumption.

NOTE! Operation in winter. To prevent the engine from getting undercooled and the carburettor from freezing on cold days, resulting, e. g. in high fuel consumption, it is recommendable at low outside temperatures **as from + 10° C = 50° F** to make use of

1. slit covering below bonnet and
2. slit covering for front decoration.

ref.: LLOYD 600 Model 1957

The preheater system in the model 1957 prevents, under all atmospheric conditions, the carburettor from getting frozen. Both front coverings must be placed in position to maintain a favourable temperature of the engine, even on the Lloyd 600/1957 in the case of temperatures lower than + 10° C = 50° F.

Intake Manifold
(after Engine No. 373 002)

The intake manifold Part-No. 13 12 301 – 2 which is fitted after the above mentioned Engine No. is much different from the earlier type, owing to an improved inlet canal. In association with Bosch Distributor CT 2 BI 5 it has proved to be very economical in the fuel consumption of the engine.

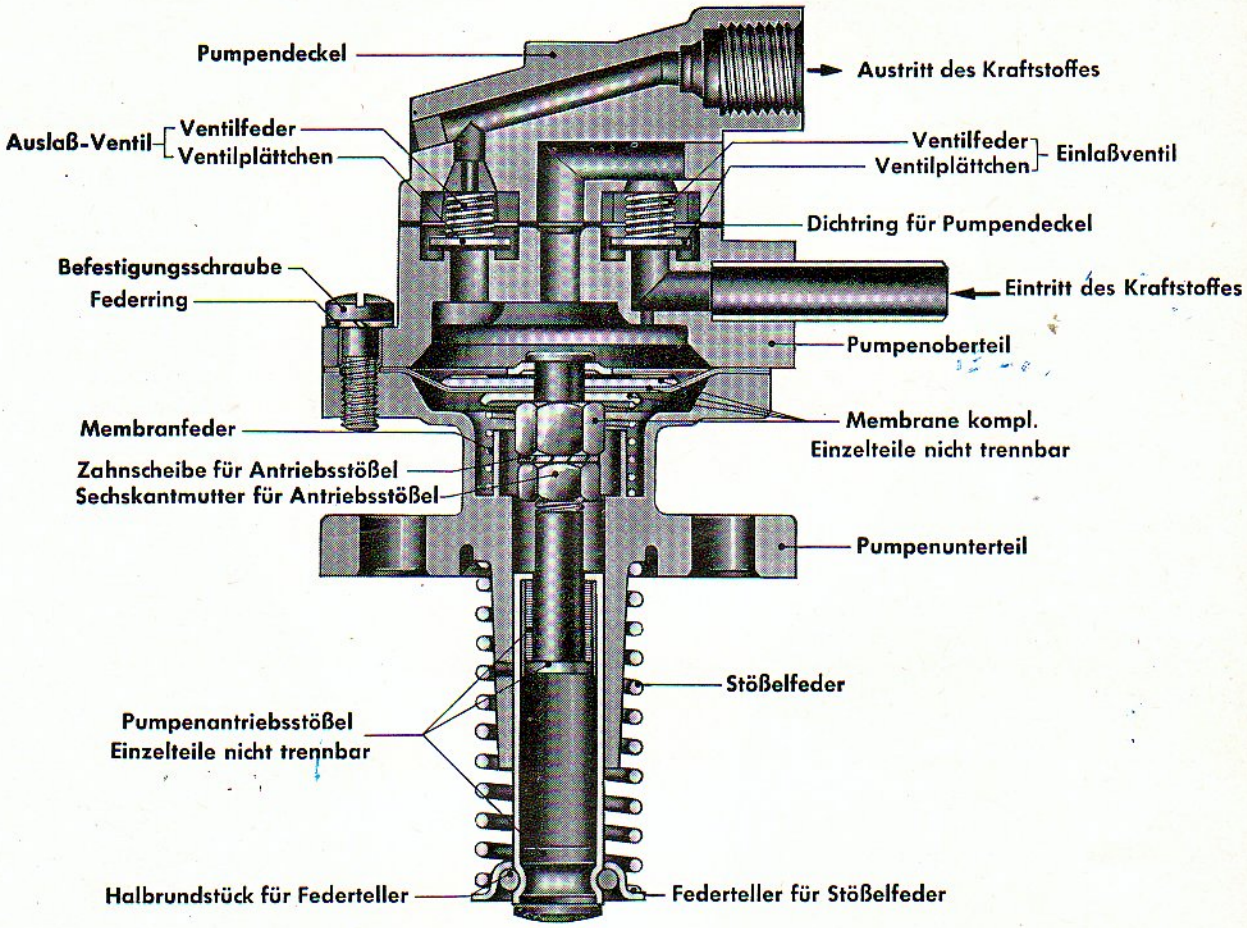
If the inlet manifold in an older car has to be repaired, it may also be replaced by the new type – 2.

Old

New

General

The downdraught carburettor is supplied with fuel by a Solex diphragm fuel pump PE 13 521 (with central ram drive) which is mounted on the camshaft housing. The pump is actuated through pump drive ram by means of a cam mounted on the camshaft, the amount of fuel supplied by the pump being automatically governed by the fuel consumption of the engine.



Auslaßventil	=	exhaust valve
Austritt des Kraftstoffes	=	fuel outlet
Befestigungsschraube	=	fastening screw
Dichtring für Pumpendeckel	=	gasket for pump cover
Einlaßventil	=	admission valve
Eintritt des Kraftstoffes	=	fuel inlet
Einzelteile nicht trennbar	=	component parts not separable
Federring	=	spring washer
Federteller für Stößelfeder	=	spring retainer for ram spring
Halbrundstück für Federteller	=	half-round piece for spring retainer
Membranfeder	=	diaphragm spring
Membrane komplett	=	diaphragm complete
Pumpenantriebsstößel	=	pump driving ram
Pumpendeckel	=	pump cover
Pumpenoberteil	=	pump top
Pumpenunterteil	=	pump bottom
Sechskantmutter für Antriebsstößel	=	hexagon nut for driving ram
Stößelfeder	=	ram spring
Ventilfeder	=	valve spring
Ventilplättchen	=	valve plate
Zahnscheibe für Antriebsstößel	=	tooth segment for driving ram

Description

The pump casing consists of the following three main parts: pump cover, pump top, and pump bottom. In the pump cover and pump top, which are screwed together with an interposed ring-shaped gasket, there are fitted a spring-loaded admission and outlet valve each and the pertinent passages and connections for fuel inlet and outlet. In the position of rest both valves are kept closed by the tension of their springs.

The diaphragm is arranged between pump top and pump bottom. It consists of two diaphragm laminations which are made from fuel-resisting rubber secured on a woven material ground. The diaphragm simultaneously serves as a gasket between bottom and top parts of the pump. The diaphragm laminations are firmly rivetted to the diaphragm plates and disphragm ram. The diaphragm ram consists of two parts which can be screwed asunder for replacing the diaphragm. Below the diaphragm is seated the diaphragm spring which is supported by the pump bottom part. The diaphragm ram is slidably located in the driving ram. Whilst the driving ram is set under the pressure of the ram spring, the diaphragm ram is actuated by the pressure exerted by the diaphragm spring. A positive drive of both parts is achieved by a damping spring (coasting). The ram spring is connected by two half-round pieces through the spring retainer to the driving ram and can be removed after taking out the half-round pieces.

Functioning

When the ram spring forces down the driving ram after the nose of the cam on the engine camshaft has passed it, the diaphragm ram pulls the diaphragm downwards against the action of the diaphragm spring. This is the suction stroke of the pump. Fuel is drawn into the filling chamber of the pump through the inlet valve which opens. The outlet valve remains closed during this operation.
If following this operation the driving ram is lefted again by the cam nose of the camshaft, its movement becomes separated from that of the diaphragm ram. On its upward stroke the diaphragm of the pump is moved only by the action of the diaphragm spring. On this delivery stroke the pump fuel is fed to the carburettor through the outlet valve which opens depending on the rate of fuel consumption, whilst the inlet valve is kept closed. The spring action of the disphragm spring is adjusted so that it cannot overcome the counter-pressure exerted by the filled fuel line, with the float needle valve closed (in the carburettor). As soon as this counter-pressure becomes effective, the pump diaphragm comes to a stand-still. The diaphragm ram, therefore, follows the movement of the driving tappet only according to the counterpressure prevailing in the fuel line to the carburettor. Thus, the fuel supply of the pump is automatically governed according to the actual fuel consumption of the engine. In normal service the movement of the diaphragm does generally not exceed a few tenths of a millimeter.
A vent through which any penetrated fuel may escape, serves the purpose of airing the space below the diaphragm.
To avoid troubles in the fuel supply owing to vapour lock, an insulating flange is provided between pump flange and camshaft housing to serve as a protective screen against the contact heat of the engine, whereas a metal sheating protects the cam against radiation heat.
The pump requires no maintenance whatever. The lubrication of the running parts is automatically effected from the camshaft housing.

Dismantling and reinstalling fuel pump

Dismantling

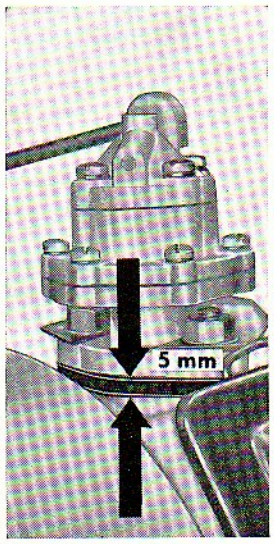
1. Shut-off fuel cock.
2. Take off fuel hose at the pump.
3. After loosening the cap screws SW 12 at the pump and carburettor take off fuel pipe.
4. Loosen hexagon nut SW 12 at the pump flange; lift out pump.
5. Remove insulating flange with both flange gaskets.

Reinstalling

Reinstalling must be done in the reverse order. Give care to the following points:

1. Check pump flange by means of a straight rule for plane surface. Eventually resurface warped flange.
2. Check measure of insulating flange together with both flange packings. Replace insulating flange pressed together.

Attention! According to manufacturer's directions only one flange gasket should be installed on either side of the insulating flange so that between pump flange and camshaft housing there is only a flange packing of 5 ± 0.2 mm (0.1969" $\pm$ 0.008") thick (Fig. 6 - 2/1).



6 - 2/1

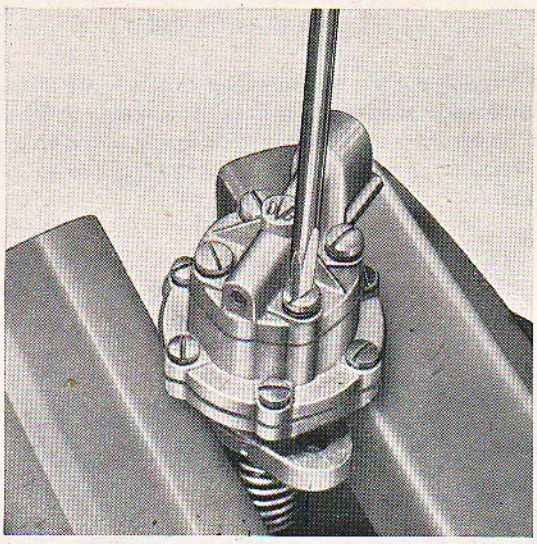
If the thickness of packings interposed between the flanges should be **smaller** than that specified in these instructions, the pump pressure and simultaneously the quantity of fuel delivered will **drop.** If, instead, **more** than 2 flange packings are employed or a pump flange of **excessive thickness** is fitted (no genuine Lloyd part!) this may result in an intolerable **increase of pressure.**

3. Check slotted head screws in the pump cover and pump top for tight fit.
4. Tighten uniformly nuts of fastening bolts.
   Let engine run until it is warmed up; thereafter re-tighten nuts.

Overhaul of fuel pump

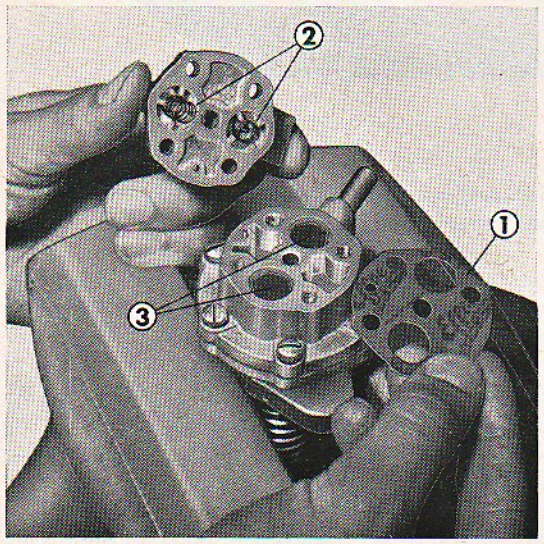
Disassembling

1. Remove fuel pump.
2. Loosen the four slotted head screws on the pump cover (Fig. 6 - 3/1).



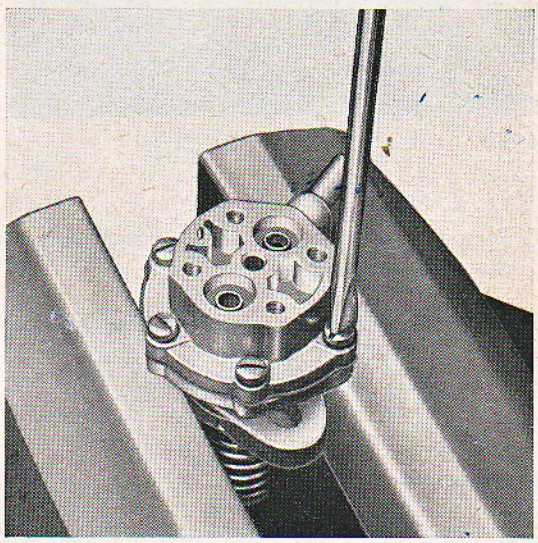
6 - 3/1

3. Remove cover; take out gasket; remove carefully valve springs and small valve plates (Fig. 6 - 3/2).



6 - 3/2

4. Loosen the 6 slotted screws on the pump top; take off top (Fig. 6 - 3/3).



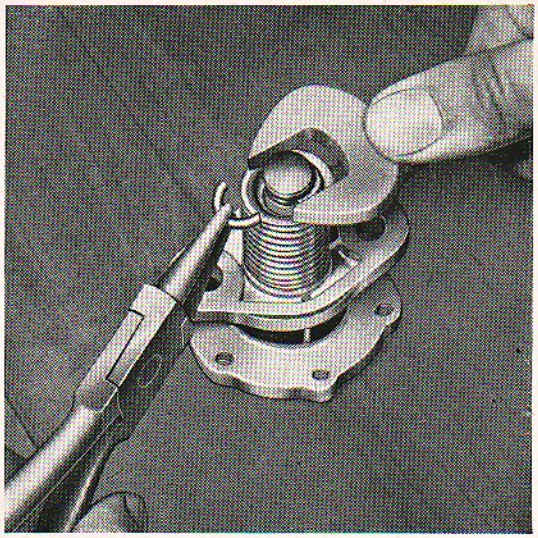
6 - 3/3

Attention! To facilitate reassembling of the pump mark edges of pump top and bottom parts with a reference line.

5. Put pump bottom in overturned position on a clean work bench; depress ram spring with a 17 mm open-end wrench and take both ring halves out of the spring retainer with pointed pliers (Fig. 6 - 4/1).

See Fig. 6 - 3/2

1 – Gasket
2 – Valve springs
3 – Small valve plates



6 - 4/1

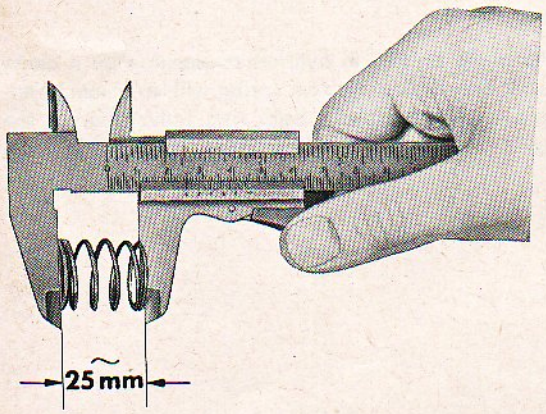
6. Remove ram spring and pull out ram from above. Remove diaphragm spring.

7. Unscrew complete diaphragm from driving ram.

8. Clean single parts of pump in fuel.

Reassembling

1. Measure diaphragm spring with a sliding caliper. The length of the decompressed spring shall be about 25 mm (0.9843") (Fig. 6 - 4/2).



6 - 4/2

The diaphragm spring compressed up to a length of 16 mm (0.6299") shall have a tension of from 1.1 to 1.3 kg (2.425 – 2.867 lb).
Replace slack spring.

Attention! Never correct faulty length of diaphragm springs by expanding or by compressing them!

2. Check diaphragm. Replace damaged or hardened diaphragm.

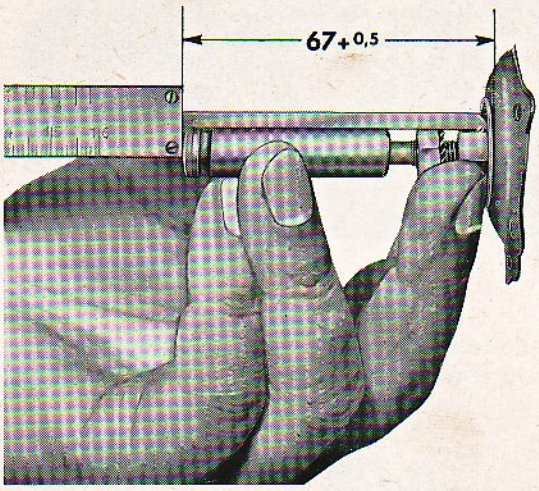
3. Screw together diaphragm with driving ram.

Attention! The diaphragm should be fastened to the diaphragm ram at the prescribed distance, otherwise pressure and the amount of fuel delivered by the pump will be adversely affected.

Pull diaphragm ram out of the driving tappet against the spring tension of the dampening spring and screw diaphragm with interposed toothed washer onto the driving tappet. The clearance between lower edge driving tappet and underface diaphragm plate shall be

67 + 0.5 mm (2.638" + 0.02")

In carrying out this measurement care is to be taken that the damping spring is to be compressed entirely int he coasting state, that is, diaphragm ram is to be pulled out of the driving tappet entirely (up to its stop).



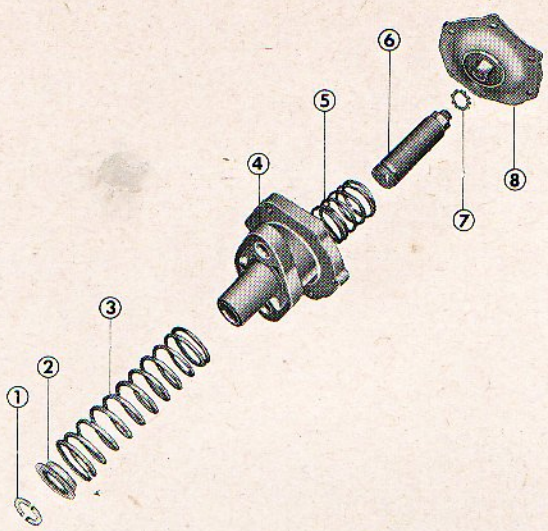
6 - 4/3

4. Secure diaphragm adjustment by tightening jam nut and repeat measuring procedure.

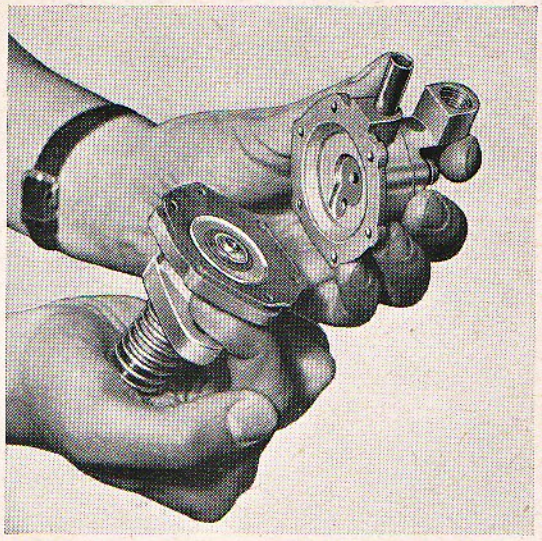
5. Put in position diaphragm spring and insert diaphragm with ram and driving tappet in the pump bottom part.

6. Put ram spring into place; place in position spring retainer. Press down spring retainer and insert the two half-ring segments. (For method of functioning see dismantling) (Fig. 6 - 4/1).

Fig. 6 - 5/1 shows component parts of the pump bottom part.



6 - 5/1



6 - 5/2

1 – Ring halves
2 – Spring retainer
3 – Ram spring
4 – Pump bottom part
5 – Diaphragm spring
6 – Driving tappet (with diaphragm ram and jam nut)
7 – Toothed washer
8 – Diaphragm

7. Check valve spring and small valve plates; if necessary, replace.

8. Place small valve plates – red side downwards – on the valve seat in the pump bottom part; insert valve spring in the pump cover and screw together both casing parts, using new gasket.

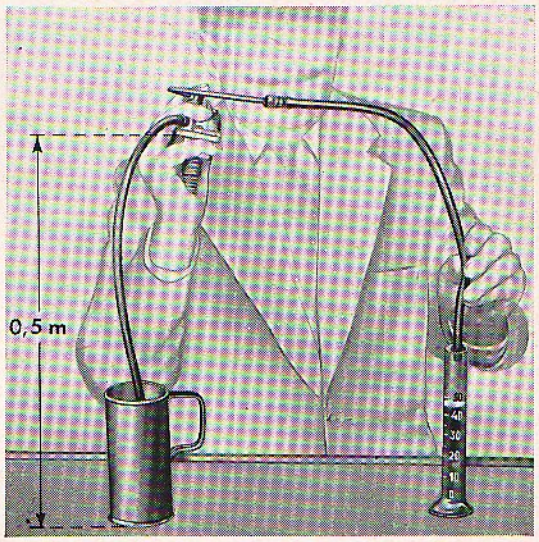
9. Check valves for proper functioning by carefully depressing small valve plates with an appropriate (not sharp) tool.

10. Grasp mounted pump bottom part so that driving tappet bears against the palm of the hand. Pull down pump flange with the finger until diaphragm lies flat and without creases on the flange contact surface of the pump bottom part and the diaphragm holes register with the screw holes in the casing.

    In this position put in place pump top part – take care that the reference line on the edge of top and bottom parts register – and fasten by crosswise tightening the slotted screws.

11. Prior to reinstallation check pump for proper suction and delivery. A perfectly functioning pump should deliver fuel against 0.5 m (19.685") suction lift after abt. 6 full strokes.

The minimum amount of fuel delivered by the pump should be abt. 45 cm³ (2.75 cu. in.) of fuel at 10 full strokes (Fig. 6 - 5/3).



6 - 5/3

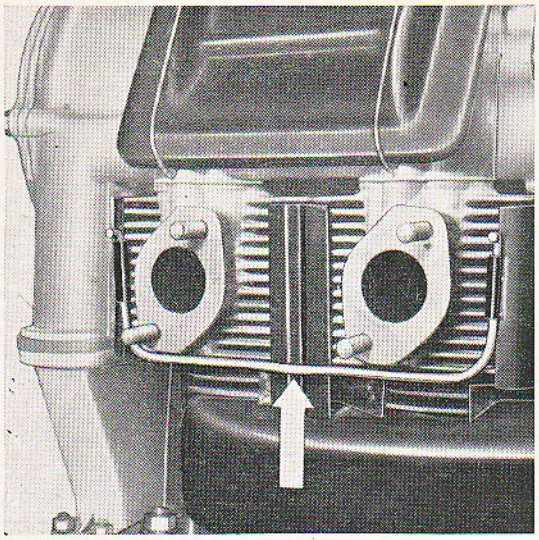
If the pump fails to deliver or if it delivers insufficient fuel, the following troubles may be the cause:

1. Leakages of the pump at the joints: cover – pump top part – pump bottom part.
2. Diaphragm fitted in an inappropriate manner, damaged or diaphragm material untight.
3. Valves leaky or jammed.

Dismantling and reinstalling ventilator casing and engine covering with heater and defroster connections in the 1957 model. (Engine removed from car).

Dismantling

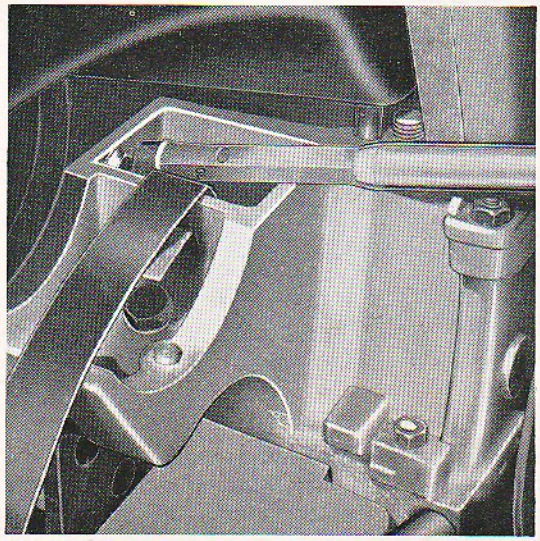
1. Dismantle dynamo.
2. Unhook clamping bracket of engine covering. (Fig. 7 - 1/1).



7 - 1/1

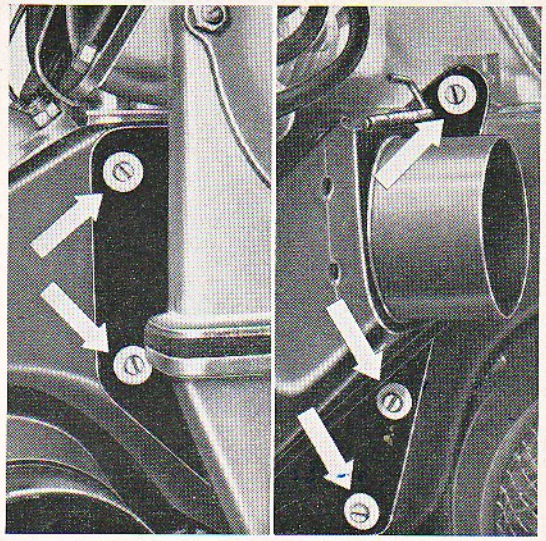
3. Loosen both hexagon screws SW 10 of ventilator casing fastening at dynamo support.

For unscrewing and screwing-on the internal hexagon screw on the dynamo support use a slim socket wrench with extension which should be applied at a slight inclination (Fig. 7 - 1/2).



7 - 1/2

4. Loosen both slotted head screws on ventilator casing fastening at the chain case side (Fig. 7 - 1/3 left) and the three slotted head screw at the ignition distributor side (Fig. 7 - 1/3 right).



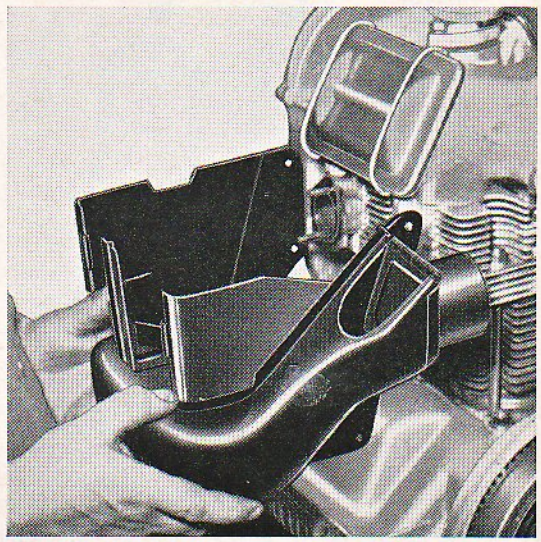
7 - 1/3

5. First remove ventilator casing; then
6. remove engine covering.

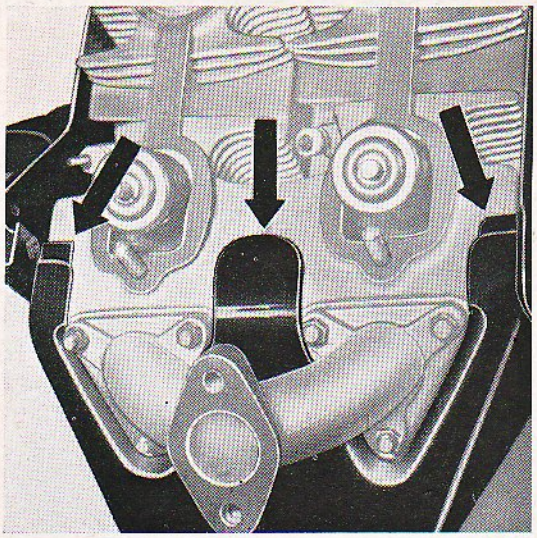
Reinstalling

Reinstalling must be done in the reverse order. Take care of the following points:

1. Check casing for unobjectionable condition. Straighten deformed panels.
2. First put in place engine covering (Fig. 7 - 1/4); then



7 - 1/4



7 - 2/1

3. Put in place ventilator casing.
   In doing so be sure that the two corners on top and the tongue in the centre of the casing are pushed over the upper cooling fins of the cylinder heads, making sure that the centre tongue has a slight bend towards the camshaft housing (Fig. 7 - 2/1).

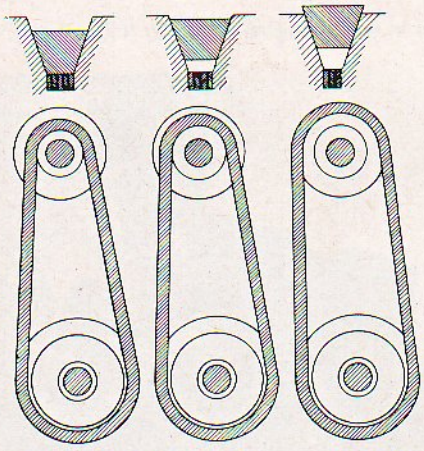
4. Check clamping bracket of the engine covering for tension, eventually rebend it.

Check for proper V-belt tension

The proper tension of the V-belt is of decisive importance for the proper functioning of the engine cooling.

As experience shows, new V-belts become extended after a short time and require to be examined in due time and retensioned according to instructions.

Fort his purpose the V-belt pulley at the dynamo is of the split type. Between the two pulley halves are arranged 5 to 6 spacer rings. By removing or adding spacer rings the tension of the V-belt may be altered. (Fig. 7 - 2/2).

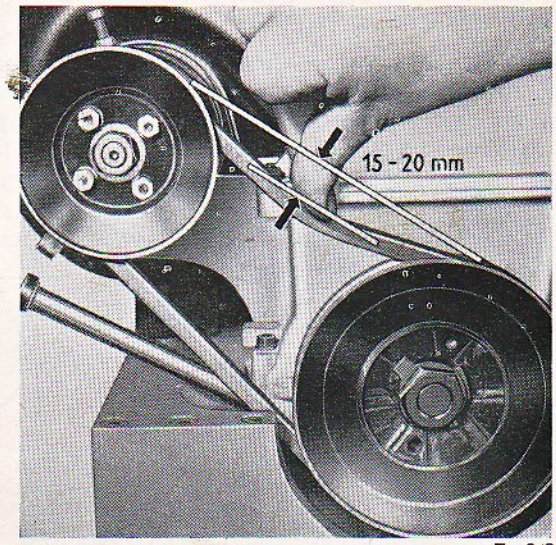


Wrong: belt too loose Correct Wrong: belt too tight

7 - 2/2

By taking out spacer rings the V-belt is tightened, by adding spacer rings the tension is diminished.

The proper tension of the V-belt is ensured when it can be thumbed down under slight pressure in the centre between engine and dynamo belt pulleys by 15-20 mm (0.6" - 0.8") (Fig. 7 - 2/3).



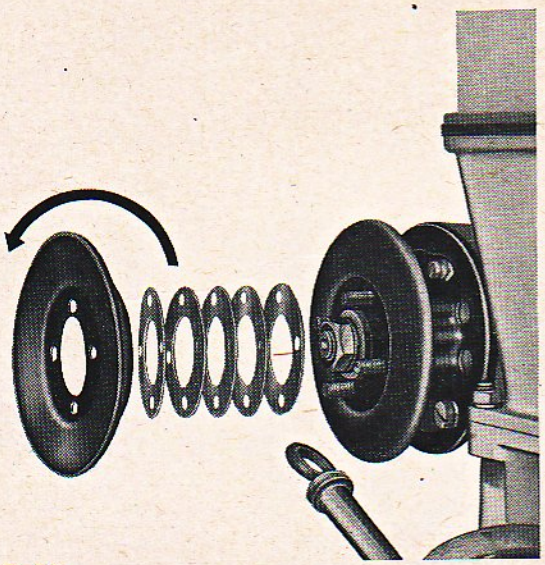
7 - 2/3

Excessive slackness of the V-belt results in belt slipping so that dynamo and ventilator do not run at the required speed or do not operate with the required output. Consequences are imperfect current supply and the risk of the engine becoming overheated.

If, on the other hand, the V-belt is overtightened, dynamo bearing and V-belt holding fixture are overloaded, moreover, the V-belt is overstretched with the consequent risk of breaking.

Adjusting V-belt tension

1. Jack up car at the front end.
2. Remove right front wheel.
3. Unscrew cover on wheel case.
4. Remove front pulley half.
5. Remove V-belt and put in place spacer rings ensuring the proper belt tension (Fig. 7 - 3/1).



7 - 3/1

6. Place in position front belt pulley half.

Attention! If spacer rings are taken out, it is good practice to put them outside to the forward belt pulley half and to screw them up when tightening belt pulley. Be sure that always the total number of spacer rings is available on the hub.

7. Tighten the four hexagon nuts SW 9 crosswise, but **do not exert force.**

The reassembly work must be done in the reverse order from that specified in the "Dismantling" section.

Attention! Never try to take a V-belt off or force it on the pulley by means of a screwdriver or similar tool. This would destroy the V-belt and damage the belt pulley.

Protect V-belt from fat and oil. Oily V-belts should not be washed in gasoline. Under circumstances an oily V-belt may be cleaned in a soap or P 3 solution and put up for reuse.

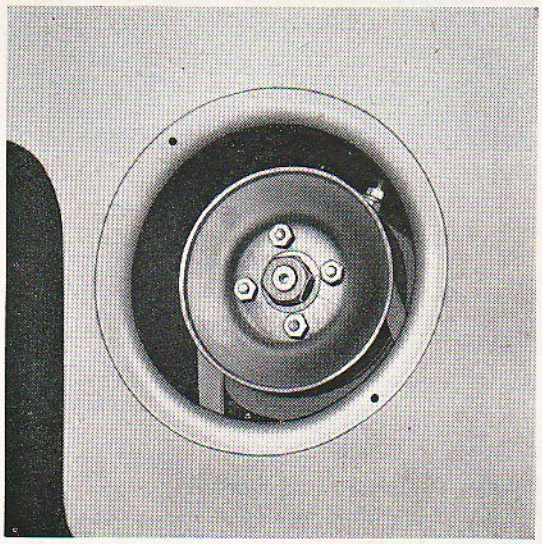
V-belts which were exposed to the influence of fat or oil for some time are, generally spoken, unfit for use and must be replaced.

Dismantling and reinstalling dynamo (in the car)

The following special service tools are required:
Flywheel and ventilator wheel remover WO 30.

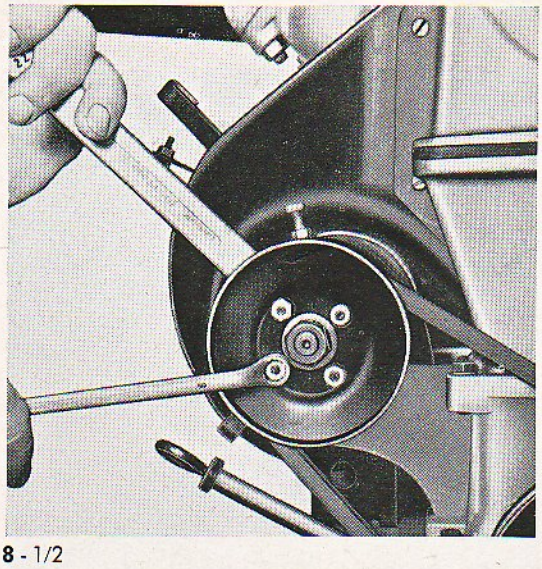
Dismantling

1. Jack up car in front.
2. Remove right front wheel.
3. Loosen ground cable from battery.
4. After unscrewing the two fastening screws, remove cover on right front wheel case (Fig. 8 - 1/1).



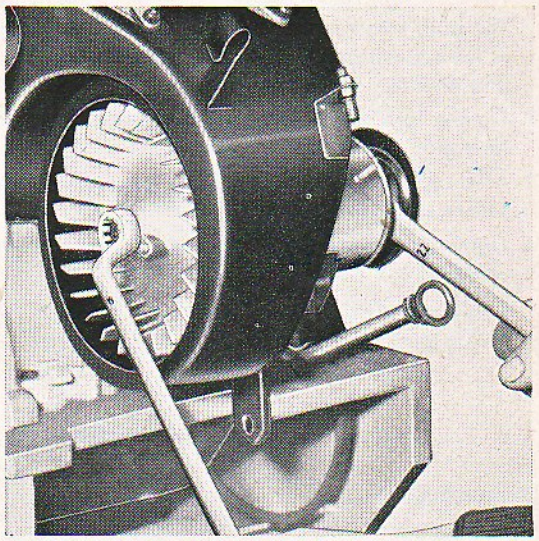
8 - 1/1

5. Remove front belt pulley half by loosening the four hexagon nuts SW 9. In doing so, hold up with a 22 mm. open-end wrench applied on the flattened boss of the inner pulley face (Fig. 8 - 1/2).



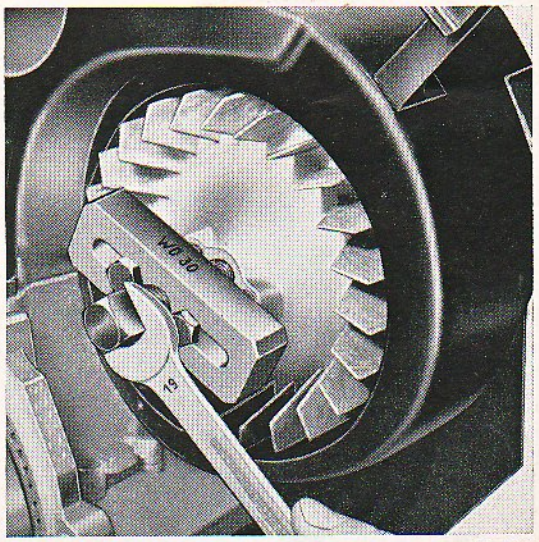
8 - 1/2

6. Remove V-belt.
7. Loosen the three cable connections on the dynamo.
8. Remove heater hose from socket piece of heater casing.
9. Remove protective grid covering ring after loosening the three slotted head screws.
10. Unscrew hexagon nut SW 19 of the ventilator wheel with set-off socket type wrench. In doing so, hold up (as said under item 5) with 22 mm. open-end spanner applied on the belt pulley (Fig. 8 - 1/3).



8 - 1/3

11. Pull off ventilator wheel with special service tool WO 30 (Fig. 8 - 1/4).

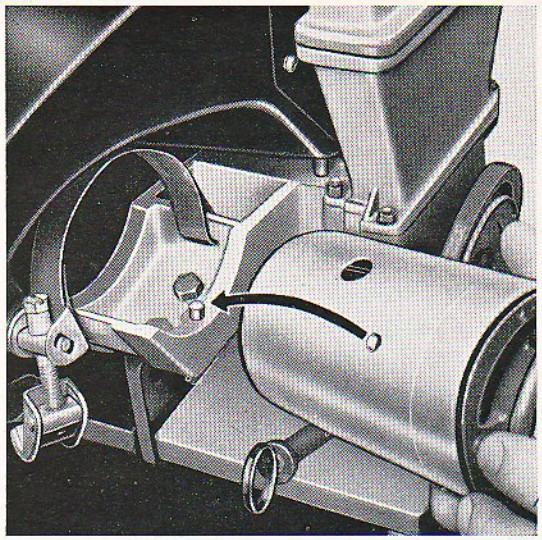


8 - 1/4

12. Loosen screw for dynamo clamp band (with slot); unhook clamp band on the dynamo bracket.

Note: On latest models the dynamo clamp band is provided with hooks on both ends so that it can be entirely removed after loosening tensioning screw.

13. Loosen fastening of dynamo – grub screw in the dynamo bracket – and lift it out through the wheel case window.
14. Loosen locking nut SW 19 on V-belt pulley. In doing so, hold up with a 22 mm. open-end wrench. Pull off inner half of belt pulley.



8 - 2/1

Installation

The dynamo is installed in the reverse order. For this operation take care of the following points:

1. Pay attention to the proper location of the dynamo! The grub screw in the dynamo bracket must engage in the countersunk hole of the dynamo casing. (Fig. 8 - 2/1).
2. Tighten lock nut of the inside belt pulley half at a torque of 6 ± 0.5 mkg.
3. After tightening dynamo clamp band (1 – 1.2 mkg) secure screw with jam nut.
4. Tighten hexagon retaining nut on the ventilator wheel at 6 ± 0.5 mkg.
5. Check condition of V-belt pulley and V-belt.
6. Check tension of V-belts, readjust if necessary.

Dismantling and reinstalling starter (in the car)

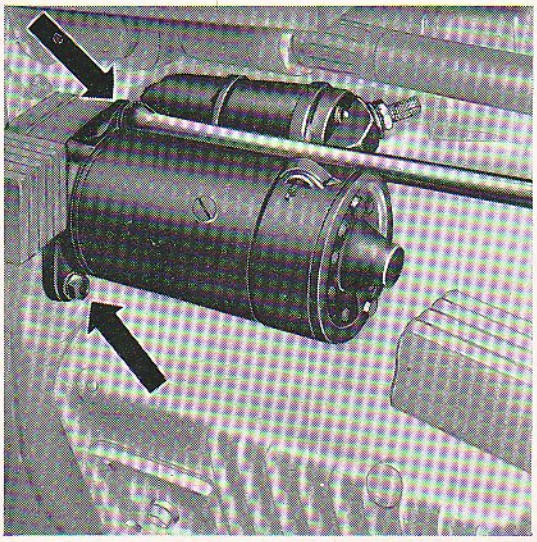
Dismantling

The following special service tools will be needed:
WO 58 – Special socket type wrench for starter and camshaft fastening screws.

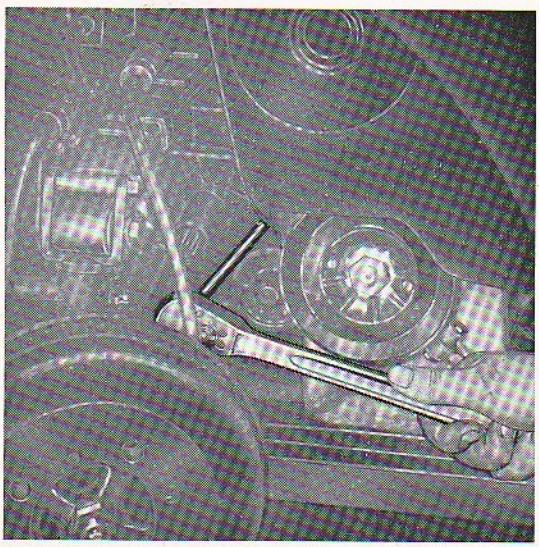
1. Jack up car in front.
2. Remove front wheel.
3. Loosen ground cable at the battery.
4. Loosen battery cable and cable to governor switch from terminal 30 of starter; loosen cable to ignition switch from terminal 50 of starter.
5. Unscrew starter with special socket type wrench WO 58 (two hexagon nuts SW 12). To this end loosen both nuts uniformly. Simultaneously pull off starter from flange and unscrew nuts entirely (Figs. 8 - 2/2 and 3).

Reinstallation:

Reinstall in the reverse order. Before installation grease slightly starter pinion with graphite grease.



8 - 2/2



8 - 2/3

Ignition

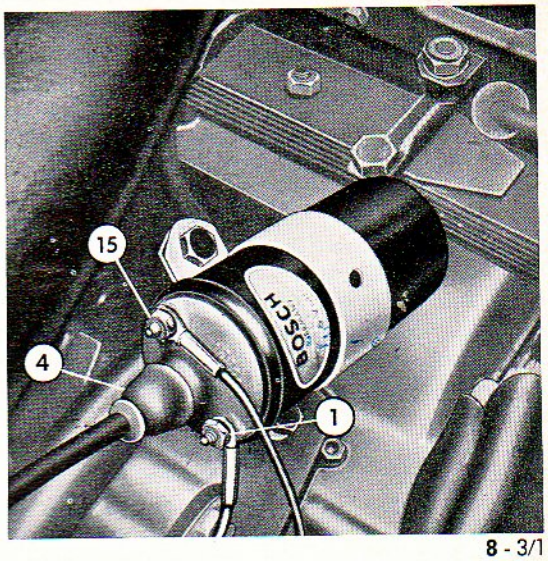
The ignition system in the Lloyd 600 is a 6-Volt battery ignition which works on an ignition coil and ignition distributor in combination with automatic timing by means of a centrifugal governor.

Ignition Coil

Make: Bosch Type T E 6 A 3

Constructional details

The ignition coil works on the transformer principle. It generally comprises an iron core on which is placed the secondary coil (a great number of turns of thin wire) and over it the primary coil (a few turns of thick wire). One end of the secondary winding is fastened to the iron core. The latter with the high-tension cable (terminal 4) is connected through the ignition distributor to the spark plugs. The other end of the secondary winding is connected to the beginning of the primary winding and with it to terminal 15 in the cover of the coil. The end of the primary winding is fastened to terminal 1. This terminal is connected with the breaker cable of the ignition distributor. With the contact points closed in the ignition distributor, the end of the primary winding is, therefore, grounded. (Fig. 8 - 3/1)



8 - 3/1

Functioning

After the ignition has been turned on, the battery current flows through terminal 15 to he primary winding. Just as one of the cylinders reaches ignition position, the battery current is broken in the distributor, and in the secondary winding a high-voltage surge of current is built up by induction; this high-voltage surge is led through the high-tension cable and distributor to the spark plug.

Maintenance

The ignition coil requires no maintenance. Care must be taken that the cover of the coil, consisting of insulating material, is kept in clean, grease-free and dry condition in order to avoid leakage currents.

Testing

If for testing the ignition coil no test stand is available, check the gap width of the ignition spark to make sure that the coil is in perfect order.

After making sure that battery, ignition distributor, condenser, cable and their connections are in perfect order, withdraw one of the sparking plug fasteners from one of the sparking plugs, insert in it, for example, an insulated screwdriver and hold it a distance of abt. 7 mm (0.28") from the mass. While with the ignition cut in, the engine is now being turned over by the starter a spark must jump over from screwdriver to mass. In failing so or if the spark will appear only at a smaller distance from the mass, it is necessary to repeat, for the sake of comparison, the test with an unobjectionable ignition coil before the ignition coil may be regarded with certainty as being defective.

Ignition Distributor

Construction and functioning:

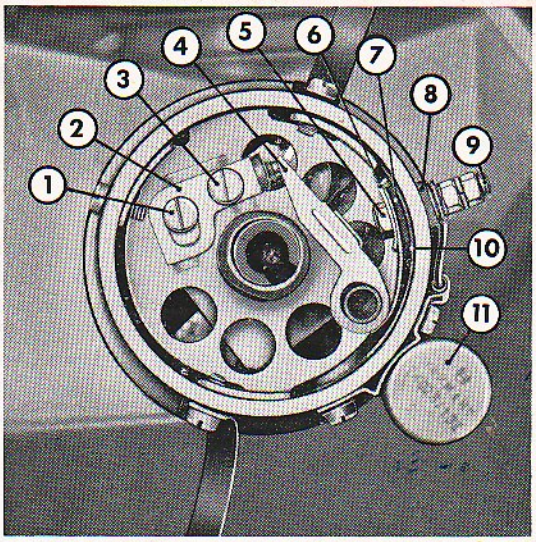
The ignition distributor is flanged to the camshaft housing through the distributor socket piece.
The distributor shaft is driven by the camshaft by means of a driving claw; it, therefore, rotates at half the engine speed. The cast-iron casing of the ignition distributor contains the centrifugal governor, the breaker plate with breaker lever, contact point carrier and the distributor proper. The breaker lever is controlled by two cams located on the distributor shaft (corresponding to the number of cylinders) which open and close, in a regular sequence, the breaker contact points. The prescribed gap between the contact points (0.4 mm = 0.0157") can be adjusted by shifting the contact point carrier or by rotating the adjusting bolt (eccentric screw).

The distributor itself is of the jump-spark type. It comprises the distributor rotor which is put onto the distributor shaft, and the distributor cap closing the casing on top. The high-tension cable from terminal 4 of the ignition coil and the two spark-plug cables are put onto terminals on the distributor cap and locked by a cover which can be screwed off. A resilient carbon brush leads the ignition voltage to the electrode of the revolving distributor rotor. There the ignition current jumps over to the two distributor segments of the distributor cap in the prescribed sequence and is led through the spark-plug cable to the two spark plugs on the engine.

1. Modification: Distributor VJ 2 BL 3 mk has a slotted head screw inserted in the rotor for securing to the distributor shaft (Fig. 8 - 4/2).

2. Modification: The difference between types VJ 2 BL 5 mk and BL 3 is only another timing line of the automatic centrifugal regulator. All distributor types are interchangeable (Fig. 8 - 4/3).

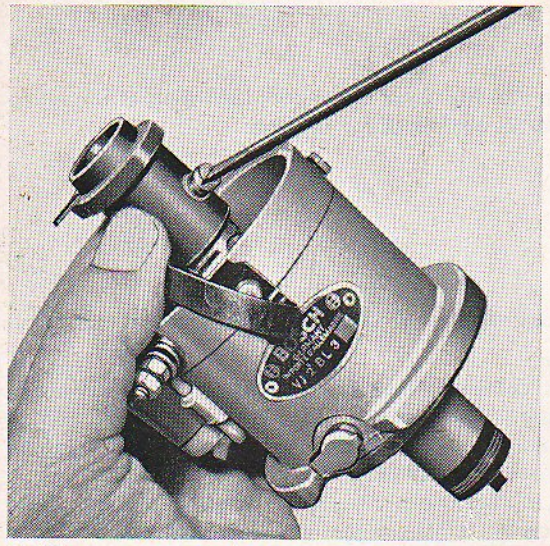
Make: Bosch Type VJ 2 BL 2 mk.
After Engine No. 359 872 VJ 2 BL 3 mk.
After Engine No. 378 560 VJ 2 BL 5 mk.



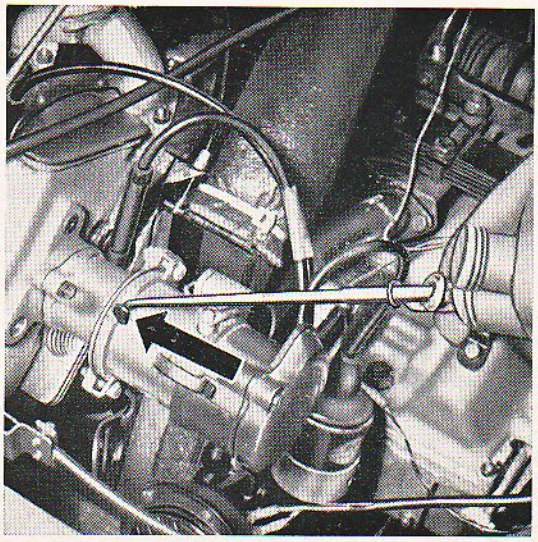
8 - 4/1

The numbered component parts of the ignition distributor shown in Fig. 8 - 4/1 are the following.

1 – Adjusting bolt
2 – Breaker contact
3 – Fastening screw
4 – Breaker lever
5 – Hexagon screw for fastening breaker lever
6 – Angular plate
7 – Insulating piece
8 – Insulating washer
9 – Terminal 1 (primary connection)
10 – Insulation
11 – Condenser



8 - 4/2



8 - 4/3

Keep clean the interior of the distributor and blow out from time to time with compressed air.

Be sure that the distributor cap is dry inside and outside and free of grease to avoid sparking and leakage currents. While carrying out the different routine inspection jobs it shall be wiped out with a clean dry rag. In doing so be sure that the elastic carbon brush inside the cap will suffer no damage.

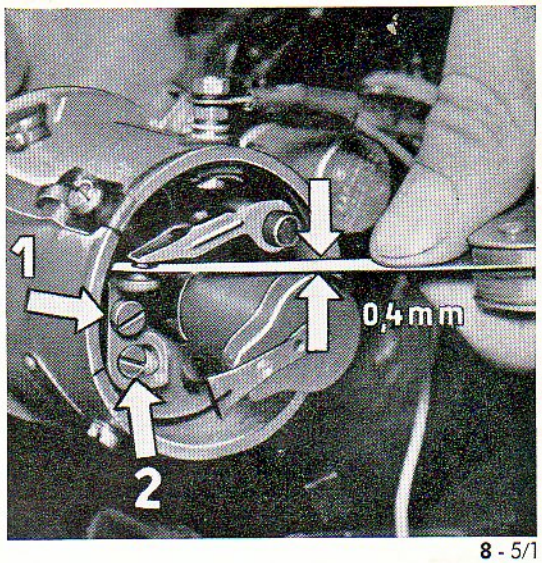
Should the breaker contact points show burned spots in the form of small rises and pits (due to wandering contacts), they may generally be left out of consideration since, as a rule, the proper functioning of the breaker will not be handicapped by them. More heavily burned contact points may give rise to ignition trouble and should be replaced by new breaker contact points.

Slightly burned contact points should be resurfaced by means of a special file. In order to ensure that the contact point surfaces, when closed, are entirely parallel press gently breaker lever against the contact arm (anvil).

After resurfacing contacts see that the specified gap is readjusted with the contact points opened.

Adjust air gap of breaker contact points

1. Remove distributor cap.
2. Pull off distributor rotor.
3. Crank engine until breaker lever is run up to the highest point of the cam, that is, where the cam entirely lifts off the breaker hammer.
4. Loosen fastening screw on contact lever (anvil). By rotating the adjusting bolt (eccentric screw) correctly adjust gap between contact points by means of feeler gauge to 0.4 mm (0.0157"). (Fig. 8 - 5/1).
5. Tighten fastening screw.
6. Continue to crank engine until the breaker hammer has been entirely lifted off by the second cam and check again gap between contact points.
7. Adjust ignition timing with the test lamp.
8. Put in place distributor rotor; replace distributor cap.



8 - 5/1

1 – Fastening screw
2 – Adjusting bolt (eccentric screw).

Attention! By varying the contact point gap by 0.1 mm (0.0039") the ignition timing will differ by several degrees of crank angle. Therefore, after every adjustment the gap between the contact points, it is absolutely necessary to readjust the ignition timing.

Replacing breaker contacts

1. Remove distributor cap.
2. Pull off distributor rotor.
3. Loosen low-tension cable (green) from terminal 1 at the distributor cap.
4. Loosen hexagon nut SW 7 on the clamp screw.
5. Take out breaker lever.
6. Remove breaker contacts after loosening fastening screw.
7. Install new breaker lever and new breaker contact.
8. Fix low-tension cable on the terminal.
9. Adjust contact points for proper gap; readjust ignition timing.

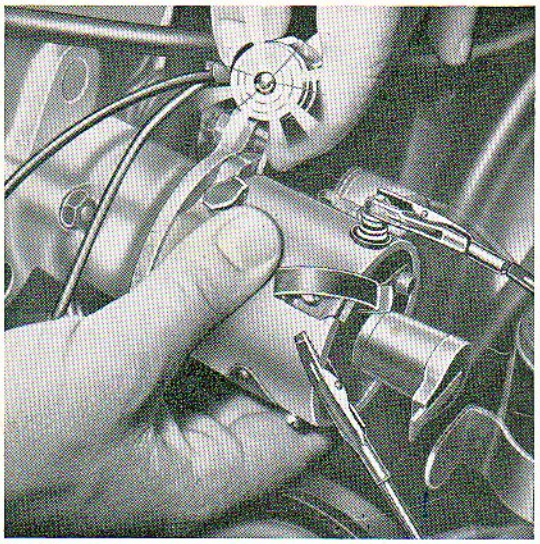
Attention! When installing the breaker lever special attention should be paid to the correct number and instalment of the insulations so as to prevent short circuits due to ground contact.

Adjusting ignition timing

Due to the natural wear of the fibre cam at the breaker lever and owing to the pitting of the contact points the ignition timing mechanically varies in time, eventually to "retarded spark". Therefore, while carrying out the prescribed routine inspection jobs the ignition timing must be checked and, if necessary, readjusted. Performance, fuel consumption, ease of starting, smooth running and, finally, service life of the engine depends, to a large extent, upon the proper adjustment of the ignition.

After checking or readjusting the gap between contact points, proceed with the adjusting of the ignition timing as follows:

1. Remove rubber plug from inspection hole in the transmission housing.
2. Screw out spark plugs to enable the engine to be cranked more easily.
3. Remove distributor cap.
4. Fix one terminal of test lamp (6 volts) to terminal 1 of the distributor and the other terminal to distributor casing (Fig. 8 - 6/1).

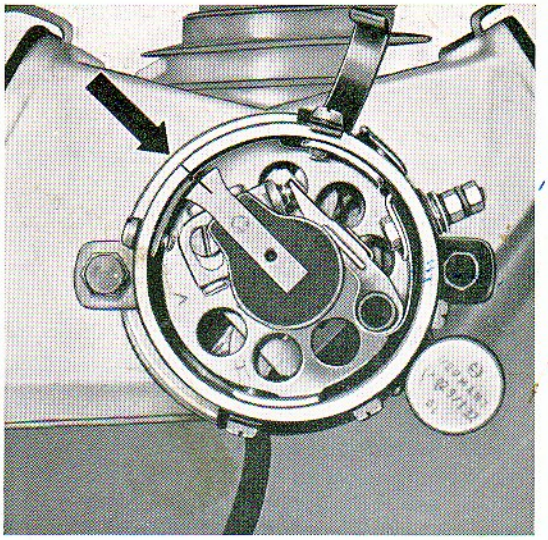


8 - 6/1

5. Adjust timing for cylinder 1 (flywheel side) according to the flywheel. For this purpose crank engine in its direction of rotation until reference line on the flywheel and reference line on the transmission housing register (Fig. 8 - 6/2).

8 - 6/2

In this position the distributor rotor must show to the reference line (notch) on the edge of distributor casing (Fig. 8 - 6/3).



8 - 6/3

Attention! Direction of rotation of the engine. Engine turns to the right – or in other words – in clockwise direction when facing the V-belt side.

6. Loosen fastening screws on ignition distributor.
7. Turn on ignition.
8. Turn distributor casing to the right (to the intake side) until breaker contacts are closed; then turn it back very slowly (to the exhaust side) until the contacts will just open. At this moment the test lamp should light up (Fig. 8 - 6/1).
9. Tighten fastening screw of ignition distributor and check again ignition timing – check also timing for No. 2 cylinder.

Note! If the ignition is advanced, turn distributor to the exhaust side. If the ignition is retarded, turn distributor contrary to the direction of rotation of the engine, that is, to the intake side.

10. Turn out ignition; remove test lamp; put on distributor rotor and distributor cap.

Attention! Crank engine for checking ignition timing only in the direction of rotation of the engine. If the reference marking on the casing has been passed, it is necessary to turn back engine correspondingly through the reference line on the casing. Readjust ignition timing by turning the engine in the direction of rotation until the markings register. Thus, it is possible to ensure that the proper adjustment of the ignition timing cannot be affected by an eventual play in the moving parts.

Automatic ignition timing

On the carrier plate of the ignition distributor two flyweights are located which move out under the action of the centrifugal force when the distributor shaft is rotating, this movement being transmitted to the driver and to the cam connected with it. Therefore, with increasing revolutions, the cam will be moved more and more in the direction of rotation of the driving shaft. Consequently, the breaker points will open earlier, the engine has advanced ignition.

This adjustment, i. e. the advance of the distributor cam increasing with higher engine speeds, is accurately set. See also under "Adjustments and Tolerances". When the engine speed decreases, the flyweights are retracted by springs into their position of rest. The centrifugal governor requires no attention. Under no circumstances should any adjustments to the governor be made.

Condenser

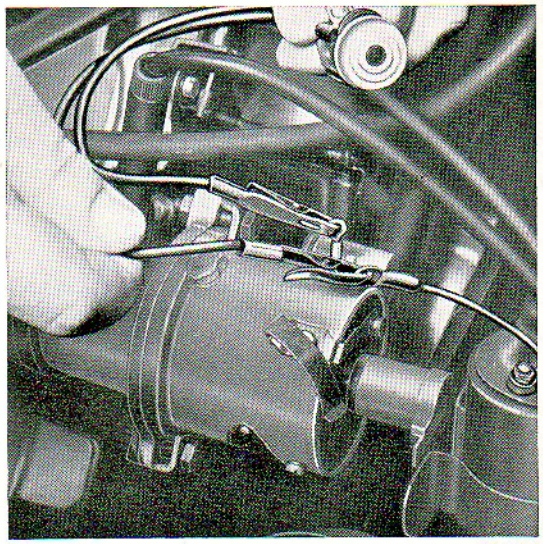
Make: Bosch Type: ZKO 29/13 Z.

The condenser prevents the formation of sparks when the breaker contact points open; otherwise they would burn away quickly. However, the condenser is of importance not only for the life of the breaker contacts but, with regard to the ignition coil, also for the formation of large ignition sparks.
Should the insulation in the condenser burn out, the primary current flows to the ground when the contacts are opened. Absence of sparks would be the result.

Testing condenser:

When heavily pitted breaker contact points and insufficient sparks are noticed or the engine fails to start, the condenser should be checked for proper functioning. If no test bench is available, checking of the condenser may be effected in a simple and reliable manner as follows:

1. Remove distributor cap.
2. Loosen low-tension cable (green) from terminal 1 of ignition distributor.
3. Remove condenser cable after loosening hexagon nut from terminal 1.
4. Connect test lamp (6 volts) with one of its poles to terminal 1 of ignition coil and with the other pole to condenser cable. (Fig. 8 - 7/1.)
5. Switch on ignition.



8 - 7/1

If the test lamp lights up, the condenser is defective (ground contact) and must be replaced.
If no defect can be located, connect condenser cable and low-tension cable to terminal 1 and test condenser for proper functioning by checking the ignition spark. (For this purpose proceed as described under the heading "Checking ignition coil").

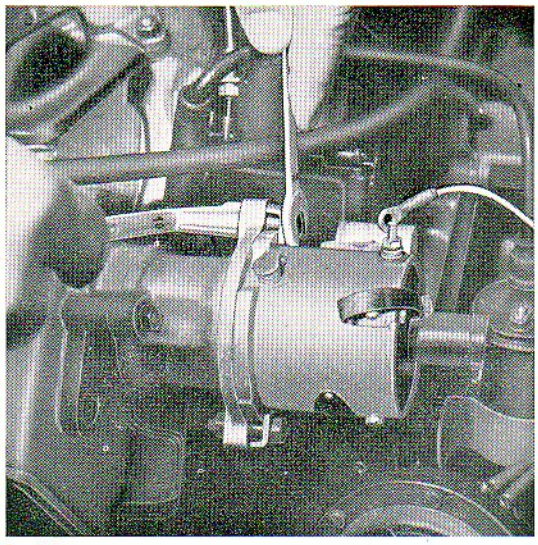
When the ignition spark does not jump over at a sufficient gap, it is sure the condenser is defective and the test must be repeated with another properly functioning condenser for the sake of comparison.

For replacement use only condensers with the above-mentioned type number.

Dismantling and reinstalling ignition distributor (In the car)

Dismantling

1. Dismantle distributor cap.
2. Loosen low-tension cable (green) from terminal 1 (breaker connection terminal).
3. Loosen hexagon nut SW 10 of the two fastening screws of distributor branch (Fig. 8 - 8/1).

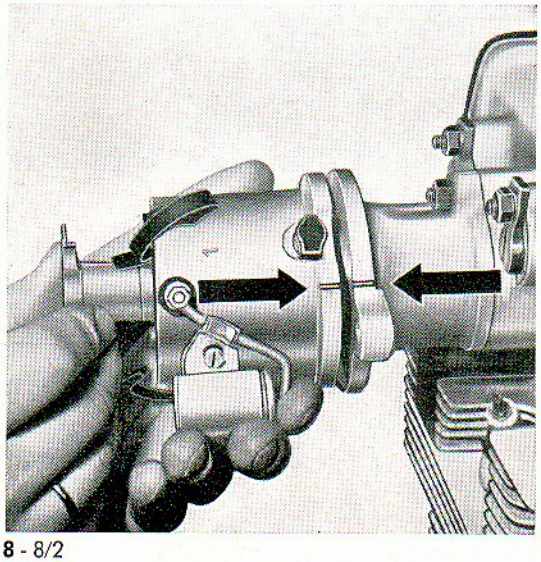


8 - 8/1

4. Pull out ignition distributor.

Reinstall in the reverse order by taking the following points into account:

1. After adjusting the ignition timing for the first time reference lines were recently cut in at our works on the flange edges of the distributor casing and distributor socket piece. In this case insert ignition distributor so that markings will register. For this job turn distributor rotor until the distributor shaft will engage with the coupling piece of the camshaft (Fig. 8 - 8/2).

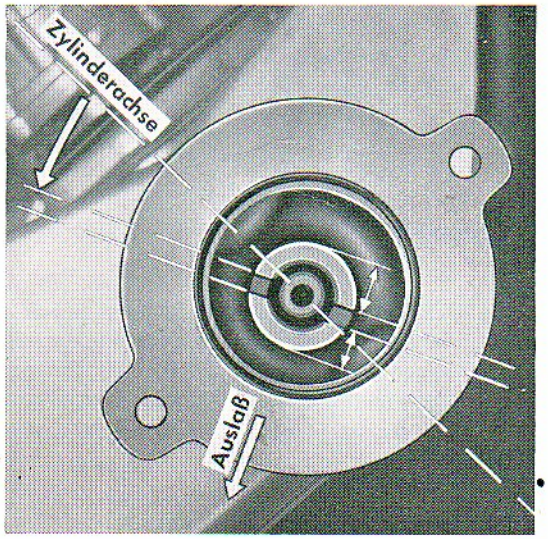


8 - 8/2

2. Slightly tighten hexagon nuts on both fastening screws.
3. Adjust ignition timing as prescribed with the help of test lamp and tighten hexagon nut firmly.

Should there be no markings on the distributor casing and distributor socket piece (engines of older type, distributor branches were replaced, or exchange engines), the ignition distributor should be installed as follows.

1. Crank engine so that cylinder one (flywheel side) is in its ignition point. In this position the slot eccentrically arranged in the coupling piece for the distributor must lie on the camshaft somewhat displaced in relation to the cylinder axis towards the exhaust side, while the ignition timing mark on the flywheel and the mark on the distributor casing should register (Fig. 8 - 8/3).



8 - 8/3

2. Insert ignition distributor and simultaneously turn distributor shaft until the distributor rotor is in line with the marking for No. 1 cylinder on the edge of distributor casing and the driver of the distributor shaft engages with the coupling piece on the camshaft after it has been slightly turned back and forth.
3. Adjust ignition timing as prescribed with the help of a test lamp.

Spark plug

Easy start, idling speed, performance, and fuel consumption of the engine depend not only upon the choice of the proper spark plug which should conform to the operational conditions of the engine but also upon its condition.

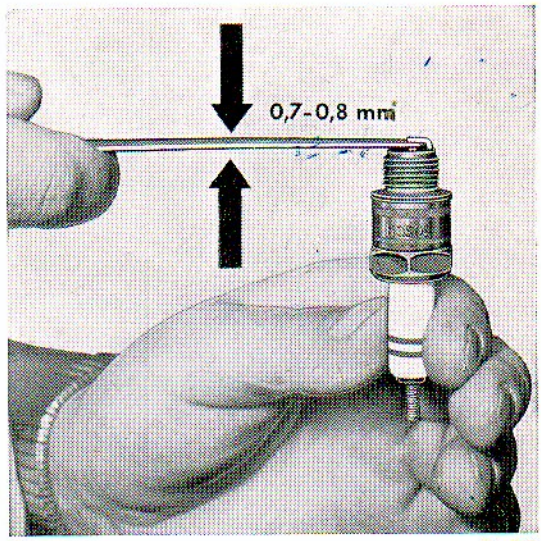
The type of spark prescribed for the 600 cc Lloyd engine has a thermal value of 225 and a thread of 14 mm diameter. The gap between electrodes shall range between 0.7 and 8 mm (0.0276" – 0.0315").

The following plug types conform to the above said conditions, for example:

Bosch	W 225 T 1
Beru	225/14 u 2
Champion	L – 7
Lodge	H N P

Maintenance

Along with the routine servicing jobs spark plugs should be screwed out for inspection, the gap between electrodes should be checked and, if necessary, readjusted by bending the outer electrode to the proper distance (Fig. 8 - 9/1).



8 - 9/1

Oiled plugs should be cleaned in gasoline and, thereafter, blown through with compressed air. Soot, carbon and lead deposits may be removed by sand blasting. After sand blasting clean the plug carefully of residual sand with compressed air and, if necessary, by means of an appropriate tool. The insulator shall, at its outside, be free from water, oil and dirt in order to avoid spark plug trouble due to leakage current. The same refers to the spark plug cables and ignition cable plugs.

Spark plugs should be left in the engine not longer than 15 000 km (9321 miles), even if their outer surfaces are in proper condition. Inserting new spark plugs will increase the operating efficiency of the engine.

Dismantling and installating camshaft housing

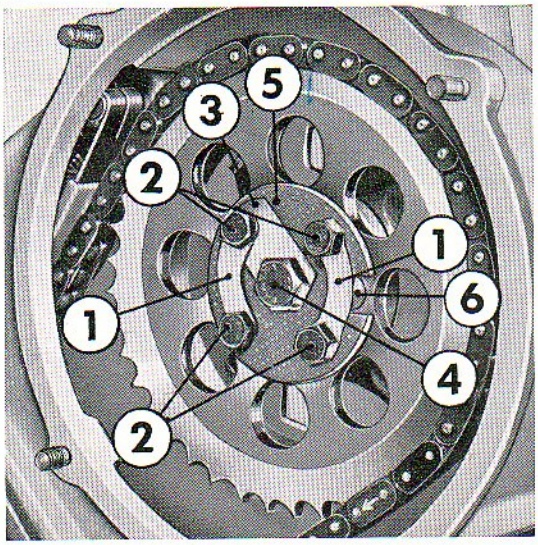
For this job the engine need not be dismantled!

The following special service tools will be needed:
WO 58 – Socket wrench for starter and camshaft case mounting.

Dismantling

1. Dismantle front decoration (on LT/LTK 600 remove front engine bonnet).
2. Dismantle air cleaner.
3. Dismantle fuel pump.
4. Remove ignition distributor.
5. Take off valve chamber cover.
6. Dismantle cover of chain case.
7. Remove chain wheel:

   a) Bend outwards segment locking plates.
   b) Loosen 4 hexagon nuts SW 10.
   c) Bend upwards locking plate of hexagon centre bolt.
   d) Loosen hexagon centre bolt SW 14.
   e) Remove cover plate.
   f) Pull out drive coupling bolt.
   g) Remove chain wheel (Fig. 9 - 1/1).



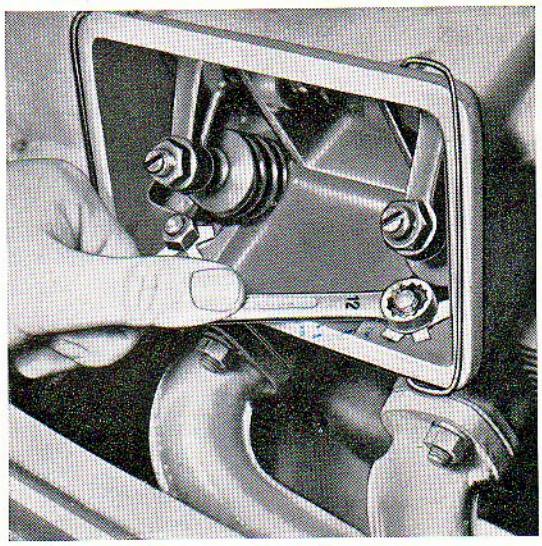
9 - 1/1

1. Segment locking plate.
2. Hexagon bolt M 6 x 15.
3. Locking plate for centre bolt.
4. Hexagon centre bolt M 8 x 20.
5. Cover plate.
6. Drive coupling bolt.

8. Remove chain wheel from the chain. Safeguard chain against falling down.

9. Loosen the four hexagon nuts of camshaft housing SW 12 after bending up locking plates (Fig. 9 - 1/2).

Note: From Engine No. 338 136 the camshaft housing is secured to the cylinder heads by means of special bolts M 8 x 28 of the same head size as the other hexagon nuts (SW 12).



9 - 1/2

10. Remove camshaft housing and secure chain against falling down into the engine.

Attention! When dismantling and refitting the chain wheel care is to be taken that no fastening pieces can fall down into the crankcase, as otherwise complete dismounting of the engine might become inevitable.

Installation

Install the camshaft housing in the reverse order, paying regard to the following points:

1. Clean carefully all flange surfaces of camshaft housing and cylinder heads of old packing material.

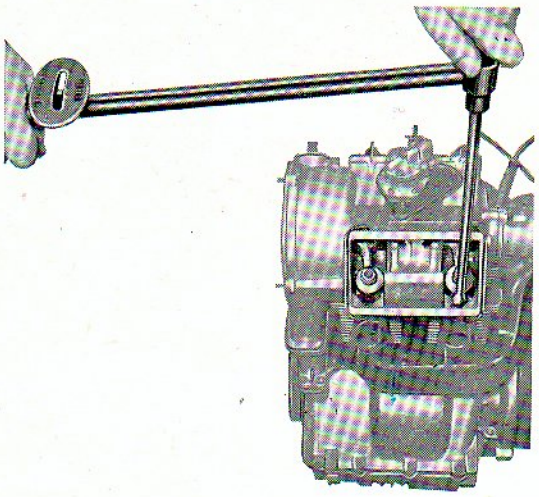
2. Check studs of cylinder heads for camshaft housing fixation for tight seat. (For this operation please refer to subgroup "Cylinder heads and valves" Installation of thread bushes, page 10 - 2).

3. Replace gasket (camshaft housing/chain case), spectacle - shaped gaskets (camshaft housing / cylinder heads), gasket (camshaft housing/chain case cover), gaskets of valve chamber cover. Gaskets of the spectacle type made from Polypyrit Selecta (you will find kind of material imprinted on the gasket) should be exchanged by special Buna packings.
   (For more details see under remarks at the end of this section).

Fasten valve chamber cover gaskets with liquid jointing compound "Wevolic" to the valve chamber cover.

Attention! To assure perfect oil tightness of the engine the use of gaskets of unobjectionable condition at the camshaft housing is of greatest importance. For this reason use only genuine gaskets of latest type!

4. Before putting camshaft housing into position loosen entirely valve adjusting screws so that the casing will mount flat on its seating. (See section "Adjusting Camshaft").
5. After putting camshaft housing into position secure chain against falling down into the crankcase.
6. Tighten crosswise hexagon nuts or cap screws on the camshaft housing SW 12 with torque wrench, in combination with special service socket wrench WO 58, at torque of 1.5 mkg (camshaft housings of older type existing on engines up to No. 318 600) or 3.0 mkg (camshaft housing of latest type on engines from No. 318 601). (Fig. 9 - 2/1)

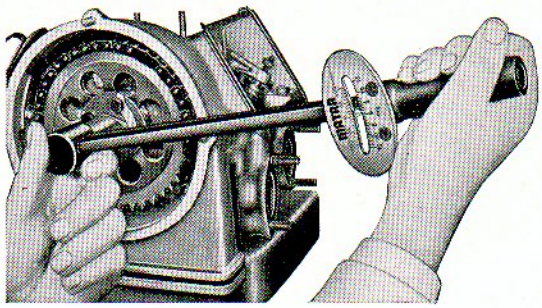


9 - 2/1

7. After adjusting camshaft and putting chain wheel in place fasten the latter to the centering flange as follows:

   a) first, firmly screw down cover plate with 4 hexagon screws SW 10 on the centering flange, then,

   b) tighten hexagon centre screw SW 14 at a torque of 1.5 mkg (Fig. 9 - 2/2).



9 - 2/2

Attention! The installation procedure in the aforesaid sequence and the observance of the torques specified is of great importance as otherwise there is the risk of warpage of the covering plate and thus the impossibility of getting a tight connection.

c) As a segment locking plate serves to prevent the drive coupling bolt from wandering, these locking plates should be so arranged that one of them comes to lie over the slot in the covering plate. (See also Fig. 9 - 1/1).

d) Fasten the locking plate for the centre screw always to one of the screws of the opposite pair of screws.

8. Adjust valves.

9. Regulate ignition timing with test lamp.

Note: From Engine No. 343 883, instead of camshaft housing gaskets made of "Polypyrit-Selecta", gaskets of "Buna" with wire mesh inserts are installed.
These gaskets are by 0.4 mm (0.0157") thicker than the gaskets used up to the present but have the same basic form (spectacle shape) – therefore total thickness = 1.0 mm (0.0394"). Thanks to their plasticity they warrant better oil-tightness between camshaft housing and cylinder heads.

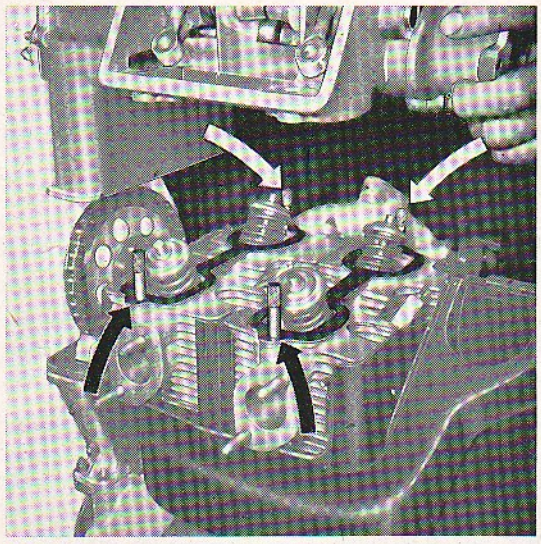
To balance the larger thickness of the new gasket on the bearing area of the camshaft housing on the chain case side, the chain case foot gasket is by 0.4 mm (0.0157") thicker on engines from a. m. Number (thickness of the chain case foot gasket used up to the present = 0.6 mm = 0.0236"). The camshaft housing gasket made from Buna carries the Part No. 1 314 015-2, the new 1 mm (0.0394") thick chain case foot gasket carrying the Part No. 1 314 336-1.

On repairs or engine overhauls where the camshaft housing must be dismounted it is advisable, even with engines of earlier type, to use **only** the a./m. gaskets, special attention being given to the fact that in any case the new 1 mm thick foot gasket for the chain case should be used with the Buna gasket.

Contrary to the "Polypyrit" gaskets the Buna gaskets should be put into position **without** cementing material.

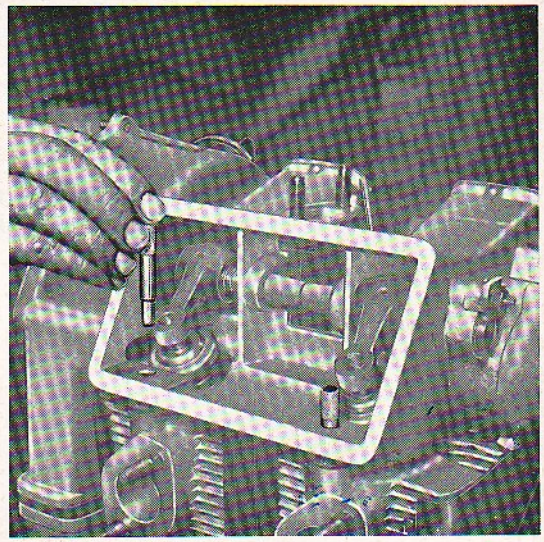
Hints for refitting

Before replacing the new Buna gaskets and putting into place the camshaft housing it is necessary, for the purpose of ensuring an unobjectionable fixation of both parts, particularly of the gasket, to insert set-off round pins (fitting bolts) into the thread bushings of the cylinder heads (Fig. 9 - 3/1).



9 - 3/1

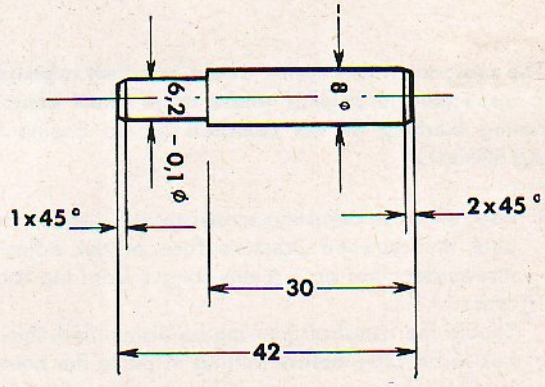
After the camshaft housing has been put into place, take out these fitting bolts and screw in hexagon screws M 8 x 28 (Fig. 9 - 3/2).



9 - 3/2

This measure serves to prevent gaskets from being displaced or damaged and to obtain a uniform jointing surface.

The said fitting bolts should be home made according to the sketch shown hereunder (Fig. 9 - 3/3).



9 - 3/3

All dimensions ar given in mm. 1 mm = 0.0394".

Adjusting camshaft

(Chain wheel on the camshaft **not** shown in the drawing)

The ignition timing depends upon the shape of the control cams and the position of the camshaft in relation to the crankshaft. Correct valve timing has an important bearing on the operation and performance of the engine. Therefore, camshaft adjustments should be made very accurately and in strict conformity with the instructions. In case of faulty adjustment severe damage to valves and pistons may result. Such damage is likely to ruin the engine in a very short time.

Up to Engine No. 336 588 (incl.) the data for the camshaft adjustment, referred to an **operating valve clearance:**

Inlet = 0.15 mm (0.006")
Outlet = 0.20 mm (0.008")

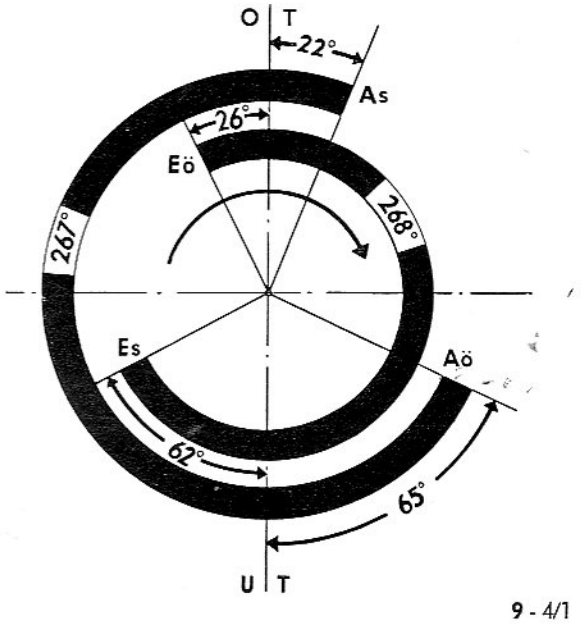
are the following:

Inlet

opens before T. D. C. . . . . 26°
closes after B. D. C. . . . . 62°

Outlet

opens before B. D. C. . . . . 65°
closes after T. D. C. . . . . 22°
(Fig. 9 - 4/1).



9 - 4/1

After all work on the engine, in the course of which the chain wheel has been dismantled, it is necessary to readjust the camshaft. Readjustment must be made at a **valve clearance of 1 mm.** (0.0394").
Taking this temporary check clearance as a basis, the inlet valve opens 0° before T. D. C. (For more details see instructions given on page M 9 - 5).

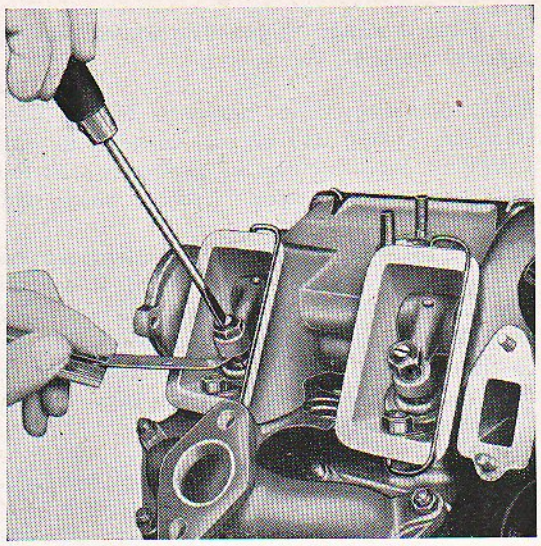
The subsequent description of the camshaft adjustment is applicable to engines whose chain wheel bears no timing marking on the camshaft (up to Engine No. 332 399 incl.).

1. Back off valve adjusting screws on the 4 rocker arms until the crowned pressure face of the adjusting screws does not project any longer from the rocker arm.
   Should the camshaft housing be dismantled, this job has to be done **before** putting in place the housing in order to ensure that it has a plane fit on the cylinder heads and is relieved of the pressure exerted by the valve spring while tightening the fastening nuts.
   Another advantage of completely loosening all adjusting screws is that the camshaft can be rotated more easily by hand for the adjustment.

2. Turn camshaft in the direction of rotation of the engine (clockwise towards the exhaust side) until both cams for cylinder 1 are directed downwards to ensure that the valves of No. 1 cylinder are entirely closed. (No. 1 cylinder – flywheel side).
   With the camshaft in this position the cams of No. 2 cylinder are directed upwards (overlap position).

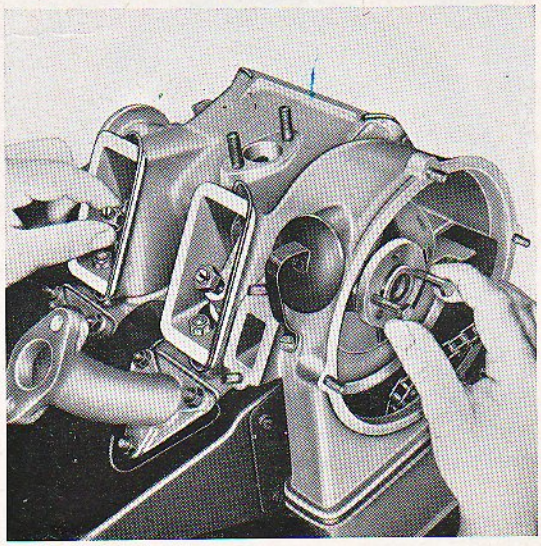
3. Adjust accurately valve clearance of **inlet valve for No. 1 cylinder** to 1 mm (0.0394") by means of feeler gauge and lock adjusting screw by means of jam nut.

Attention! The other valves or adjusting screws need not be taken into consideration when adjusting the camshaft, that is, the adjusting screws remain entirely loosened until the operational valve clearance will be adjusted at the termination of the adjusting operations. The clearance is correctly, adjusted when the gauge can be moved between adjusting screw and end of valve stem with some drag. Be sure that neither low nor excessive valve clearance are measured.
For this purpose it is good practice to use a single blade feeler gauge of 1 mm (0.0394") thickness, the end of which has been set at an angle according to the angular position of the valve so that the gauge, when checking the valve clearance, may be inserted in a true parallel plane between adjusting screw and end of valve stem, as otherwise the gauge would be strained, thus making accurate adjustment of valve clearance impossible (Fig. 9 - 5/1).



9 - 5/1

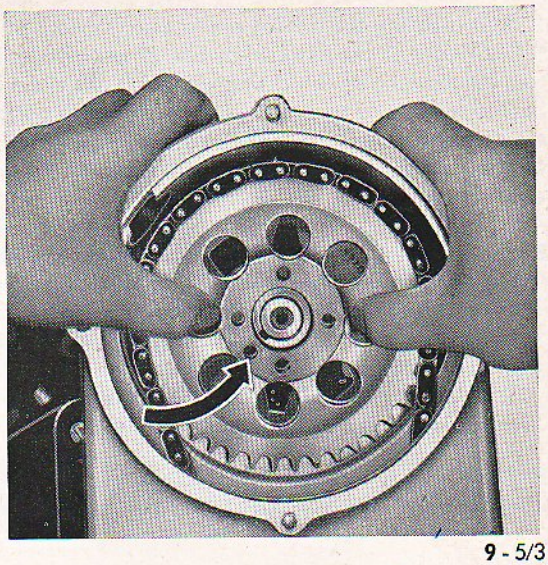
4. Continue turning camshaft in the direction of rotation until the adjusted valve clearance will disappear, that is, until inlet valve for No. 1 cylinder just commences to open.
   While slowly turning camshaft move rocker arm energetically up and down until no noise caused by the adjusting screw striking against the valve stem can be heard and the rocker arm cannot be moved any longer.
   The camshaft may be easily turned at the centering flange provided you use two long screws M 6 which serve as a grip (Fig. 9 - 5/2).



9 - 5/2

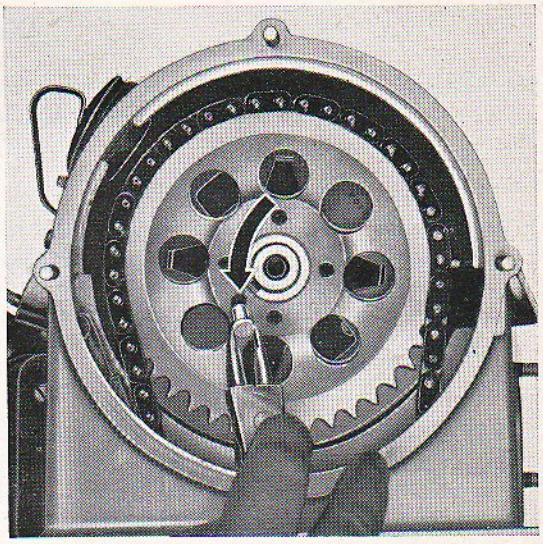
5. Turn crankshaft in the direction of rotation of the engine until the T. D. C. marking on the flywheel is in alignment with the marking on the case. During this operation secure chain from falling down.

6. In this camshaft and crankshaft position place chain wheel into the chain so that the fitting holes for the driving pin in the centering flange and chain wheel come to lie over each other. (Fig. 9 - 5/3)



9 - 5/3

7. Put chain wheel on the centering flange and insert driving pin (Fig. 9 - 5/4).



9 - 5/4

Attention! When placing the chain on the chain wheel and then putting the wheel into the centering flange, take care that neither the camshaft position nor that of the crankshaft is changed.

Should the fitting holes for the driver pin not register immediately, replace chain tooth by tooth on the chain wheel until true alignment is obtained.

Note: In case the admissible assembly tolerances of engine components responsible for the timing add up, a departure from the specified adjustment (0° before T. D. C.) up to 4° maximum behind or ahead of T. D. C. may result. Therefore, if in putting the chain wheel into place and fitting the driving pin, the pin should jam a little and the fitting holes can be brought into alignment only by displacing the crankshaft within the said limits, the adjustment is correct (1° of crank angle = 1.7 mm (0.067") on the flywheel circumference).

If after inserting the driving pin, a displacement of the T. D. C. mark on the flywheel by abt. 29 mm after or before the marking on the casing will result, the chain has been displaced by one tooth; it is necessary to perform a new adjustment (1 tooth on the chain wheel = abt. 17° of crank angle = abt. 29 mm (1.142") on the flywheel circumference).

8. Before placing the cover plate in position or screwing the chain wheel to the centering flange, check camshaft adjustment for a second time: turn crankshaft in the direction of rotation until the inlet valve of cylinder 1 just begins to open, taking care that the T. D. C. mark on the flywheel is in the same position again in relation to the marking on the casing.

9. Place into position cover plate and screw tight chain wheel. For this operation refer to the instructions given in section "Dismantling and reinstalling camshaft housing", Par. 6, a - d.

10. Adjust operating valve clearance of the inlet (0.15 mm) (0.006") and exhaust valves (0.20 mm) (0.008") on both cylinders in conformity with the instructions (see Subgroup "Cylinder heads and valves").
Note: As after the above-described adjustment the valves of cylinder No. 2 are closed, it will be convenient in this case – contrary to the usual practice – to begin first with the adjustment of the operational valve clearance of No. 2 cylinder. In other respects proceed as described under Section "Adjusting valves".

11. Adjust ignition timing with the help of test lamp according to instructions.

Adjusting camshaft

The following instructions relating to the adjustment of the camshaft are applicable to engines, the chain wheels of which carry a timing mark on the camshaft (from Engine No. 332 400)

1. Remove valve adjusting screws on the four rocker arms until the crowned pressure face of the adjusting screws does not project any more from the rocker arm. (See also Section "Adjusting camshaft" up to Engine No. 332 399" Item 1).

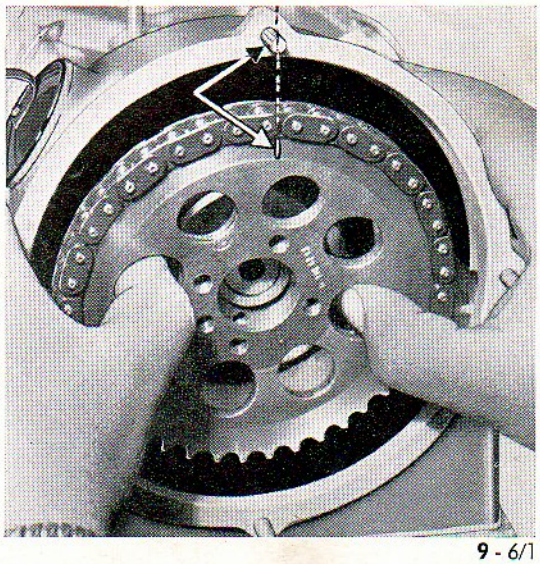
2. Turn crankshaft in the direction of rotation of the engine until the T. D. C. mark on the flywheel is in line with the marking on the case; in doing so secure chain from falling down into the engine.

3. Put chain wheel on the centering flange so that the fitting holes for the driving bolt are in register. Insert driving bolt.

4. Turn chain wheel (along with camshaft) until the cut-in mark on the chain wheel is directed to the centre of the upper stud in the camshaft housing. (Stud serves the purpose of fastening cover of chain case).

5. Take out driving bolts; remove chain wheel.

6. Put chain **without change of crankshaft position** on the chain wheel in such a manner that fitting holes in the chain wheel and centering flange will be in line **without rotating camshaft** (Fig. 9 - 6/1).



9 - 6/1

7. Insert driving bolt.

Attention! In placing the chain on the chain wheel and subsequently putting the wheel on the centering flange special care must be taken that neither the position of the camshaft nor that of the crankshaft will undergo any change.

If the fitting holes for the driving bolt fail to come into alignment at once, replace chain tooth by tooth until full alignment is achieved.

Note: In case admissible assembly tolerances of engine components responsible for the timing add up, a departure from the specified adjustment (0° before T. D. C. up to maximum 4° before or after T. D. C.) may result. If in putting the chain wheel into place and adjusting the driving pin, the pin should jam a little, and the fitting holes can be brought into alignement only by displacing the crankshaft within the said limits, the adjustment is correct.
(1° of crank angle = 1.7 mm (.067") on the flywheel circumference).

If after inserting the driving bolt, a displacement of the T. D. C. mark on the flywheel by abt. 29 mm (1.142") past or before the marking on the casing will result, the chain must be replaced by one tooth and it is necessary to perform a new adjustment (1 tooth on the chain wheel equals to abt. 17° of crank angle = abt. 29 mm (1.142") on the flywheel circumference).

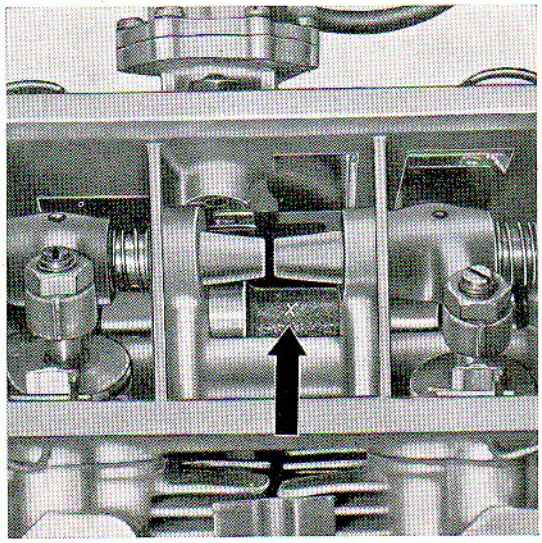
8. Put covering plate in place and tighten chain wheel. To effect this refer to the instructions given in Section "Dismantling and reinstalling camshaft housing" Paragraph 6 a - d.

9. Adjust operating clearance of inlet valves (0.15 mm) (0.006") and outlet valves (0.20 mm) (0.008") of both cylinders according to instructions. (See Subgroup "Cylinder heads and valves").

10. Adjust ignition timing with test lamp according to instructions.

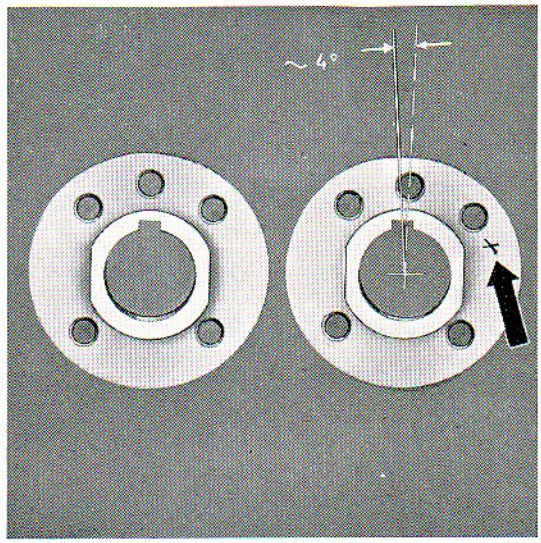
New camshaft
(From Engine No. 336 589)

On engines from the above-mentioned number a camshaft with cams different from other cams is fitted (Part No. 13 14 102 - 2). This camshaft comes with the centering flange (Part-No. 13 14 113-1) likewise modified owing to the displacement of the keyway of the Woodruff key (by abt. 4°).
To avoid mixing of the parts, camshaft and centering flange are marked by a cut-in "X". On the camshaft the marking is on the long piece between pump cam and exhaust cam of cylinder No. 1 and can be seen after removal of the valve chamber cover at the exhaust side (Fig. 9 - 7/1).



9 - 7/1

The new centering flange can be recognised by the displaced keyway, on the one hand, and on the flange surface opposite to the rotary slide it carries the same marking as the respective camshaft (cut-in "X"). (Fig. 9 - 7/2 shows on the left an old, on the right a new type of centering flange).



9 - 7/2

Attention! In carrying out repairs extreme care must be exercised to see that **only** the new centering flange ("X") will be mounted on a new camshaft ("X").
On the other hand the new centering flange ("X") should not be used with a camshaft carrying cams of an earlier type (Part No. 13 14 102–1).
In both cases mixing of these parts will result in bad engine performance and increased fuel consumption. For adjusting a new type of camshaft no alterations need be taken into account. Proceed for this operation as described in the preceding Section.

Valve operating mechanism

The change in the shape of cams on the new camshaft results in a change of the valve timing.

From Engine No. 336 589 the valve timing data, with respect to the **operational valve clearances,** viz:

Inlet =0.15 mm (0.006")
Outlet = 0.20 mm (0.008")

are as follows:

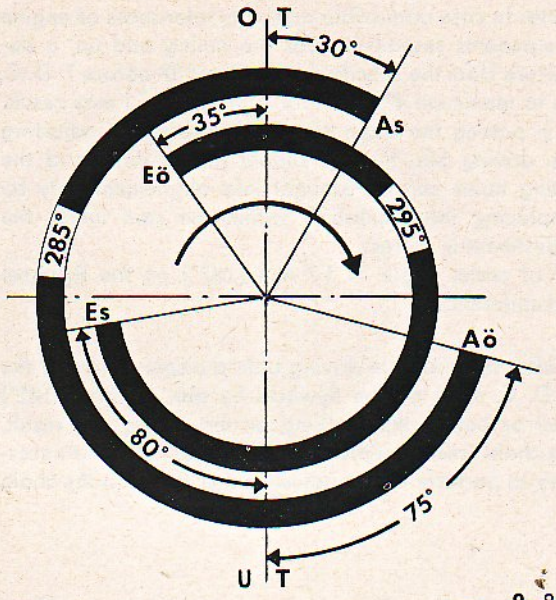
Inlet

opens before T. D. C. . . . . 35°
closes after B. D. C. . . . . 80°

Outlet

opens before B. D. C. . . . . 75°
closes after T. D. C. . . . . 30°

(Fig. 9 - 8/1)



9 - 8/1

Using a temporary test clearance of 1 mm (0.0394") between rocker arm and valve the inlet valve opens 6° ± after T. D. C.
Regarding a possible departure from the basic valve timing please refer to the Note on page E 9 - 5, which is applicable accordingly.

Disassembling and reassembling camshaft housing

The following special service tools will be required for this operation:

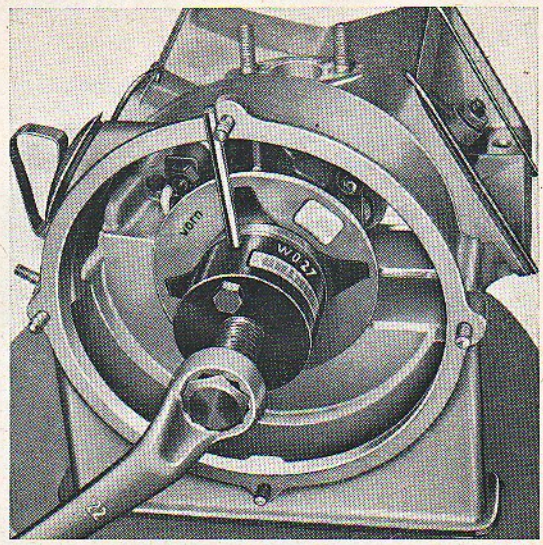
WO 27 – Camshaft centering flange remover

WO 38 – Inserting tool for radial seal

WO 42 – Rocker arm bolt remover

WO 56 – Assembly tool for radial seal of distributor pipe.

To carry out work on the dismantled camshaft housing, use the homemade assembly support recommended for use in repair shops (see "Auxiliaries for workshop" page W 2 - 2).



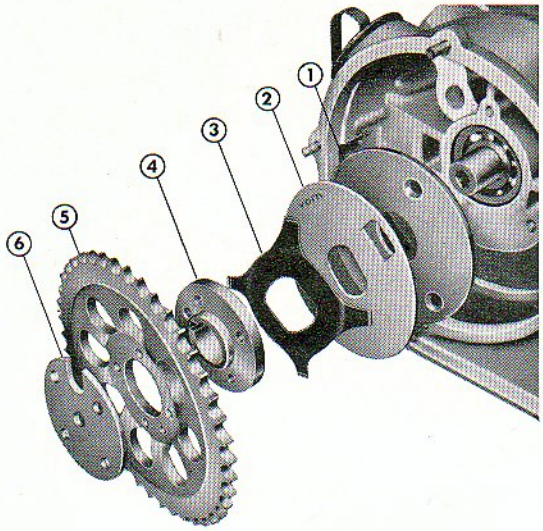
9 - 8/2

Disassembling

1. Remove ignition distributor pipe after loosening both hexagon nuts SW 10.
2. Dismantle rotary slide valve drive:
   a) Pull off centering flange with special service tool WO 27 (Fig. 9 - 8/2).
   b) Remove rotary slide valve spring and rotary slide valve.
   c) Remove rotary slide valve plate by loosening the three countersunk slotted head screws.

Attention! For this operation use only a proper and fitting screwdriver. Be sure that no burrs will appear at the screw head slots and on the countersunk holes.

Fig. 9 - 9/1 shows the component parts of the camshaft driving mechanism and rotary slide valve gear in their correct relationship for reassembly.



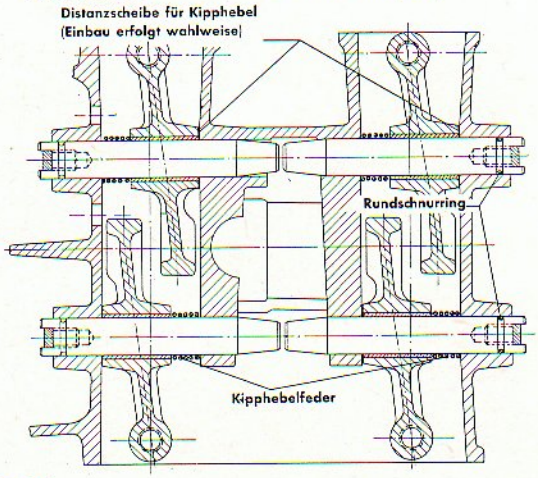
9 - 9/1

1 – rotary slide valve plate
2 – rotary slide valve
3 – rotary slide valve spring
4 – Centering flange
5 – Chain wheel
6 – Cover plate

3. Dismantling rocker arm:

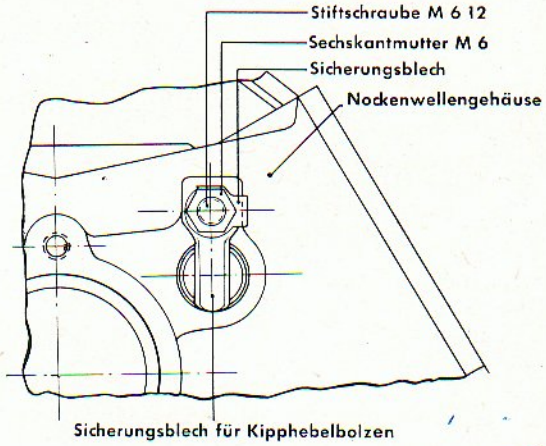
The four rocker arms are (with inserted bronze bushing) each mounted on a rocker arm bolt and held by the rocker arm springs in their proper operating position.
Each rocker arm bolt is kept from turning and lateral displacement by a locking plate externally screwed on to the casing and inserted in the slotted bolt. A rubber ring inserted into the bolt groove prevents, at both rocking arm bolts on the ignition distributor side (cylinder 1), an escape of oil through the bore in the housing. Both rocker arms and rocker arm bolts are of the same construction and exchangeable.
(Fig. 9 - 9/2).

Distanzscheibe für Kipphebel (Einbau erfolgt wahlweise) = Spacer ring for rocker arm (installed optionally)
Rundschnurring = Circular cord ring
Kipphebelfeder = Rocker arm spring



9 - 9/2

a) Remove locking plates of rocker arm bolts after loosening the hexagon nuts SW 10 (Fig. 9 - 9/3).

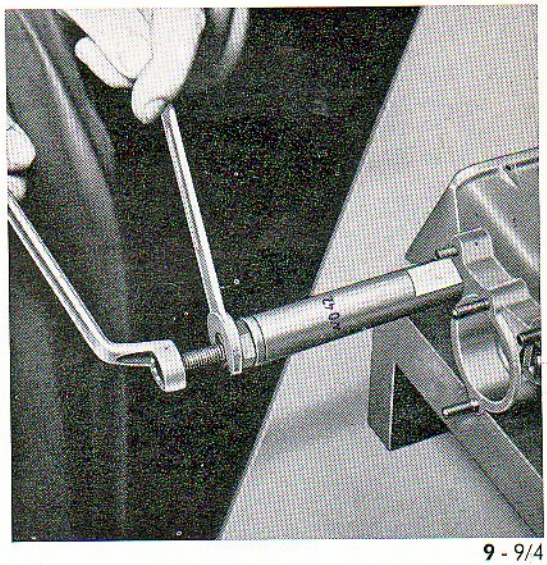


9 - 9/3

Locking plate for rocker arm bolt

Stiftschraube M 6 = Stud M 6 12
Sechskantmutter = Hexagon nut M 6
Sicherungsblech = Locking plate
Nockenwellengehäuse = Camshaft housing

b) Withdraw rocker arm bolt by means of remover SW 42 (Fig. 9 - 9/4).



9 - 9/4

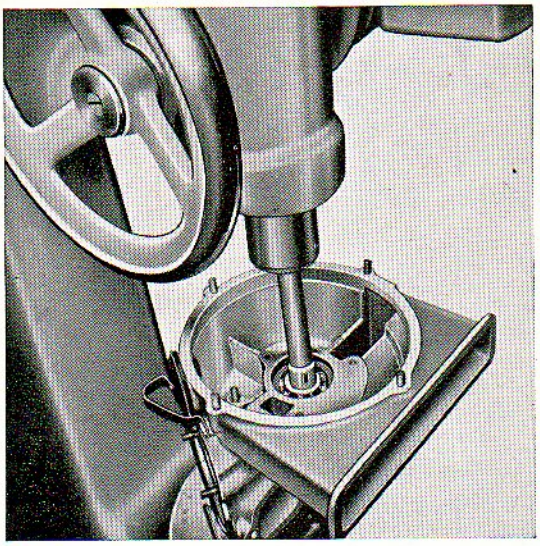
c) Take rocker arm, rocker arm springs and spacer rings (not existing on every rocker arm!) from the housing.

Attention! Remember which of the rocker arms is provided with a spacer ring as these rings should be reinstalled at the same place in the housing. For more details see under "Reassembling".

4. Dismantle camshaft.

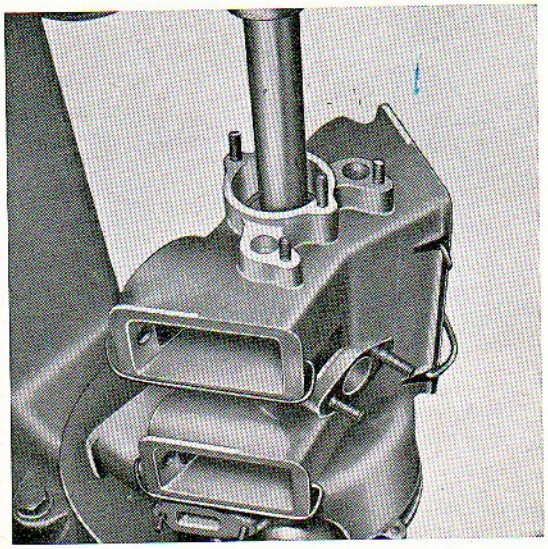
Attention! The camshaft should be dismantled or reinstalled only with the help of a press to avoid damage to shaft, bearing, and bores in the housing. The use of inappropriate tools, for example, driving the shaft out with a hammer, may render this shaft inappropriate for reuse.

a) Force out camshaft from the drive side by using a drift of abt. 20 mm dia. (0.7874"). The ball bearing on the drive side remains in the casing whereas the ball bearing on the distributor side and the coupling piece for the distributor remain on the shaft (Fig. 9 - 10/1).



9 - 10/1

b) Force out, from the distributor side, the ball bearing on the drive side. To effect this use a long drift (abt. 30 mm dia.) (1.1811") which acts on the inner bearing ring (Fig. 9 - 10/2).



9 - 10/2

c) Take from the housing SEEGER ring 47 x 1.75.
d) Remove tensioning pin for coupling piece.

Note: From Engine No. 339 626 a rubber ring, Part No. 13 14 2323–0 (the same as used on rocker arm bolt) is provided between coupling piece and ball bearing and serves to improve the oil tightness. For more details see "Reassembly of camshaft".

e) Pull off ball bearing on the distributor side, together with coupling piece for distributor, from the shaft. As for this operation pressure may be applied only to the outer bearing ring, extreme care must be taken to ensure that damage to the bearing is avoided.

Reassembly

1. Install camshaft:

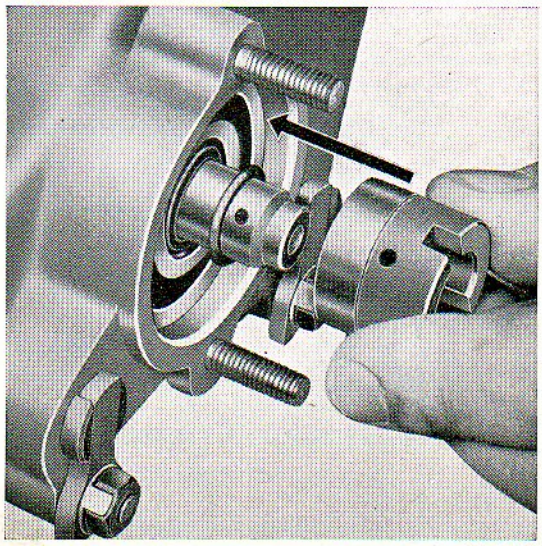
Before installing the camshaft examine:
the contact area and condition of cam faces,
the true running of the camshaft,
the condition of keyway for Woodruff key,
the condition of bearings,
the tight fit of the outer bearing rings in the housing as well as that of the inner bearings rings on the camshaft.

a) Force ball bearing on the ignition distributor side onto the camshaft.

Note: To safely prevent, under adverse conditions, oil from passing out through the clearance of 0.025 mm (0.001") – allowed for constructional reasons – of the coupling piece seat on the camshaft journal, a rubber ring, as mentioned above, is inserted between coupling piece and ball bearing from Engine No. 339 626 upwards. When dismantling the camshaft this sealing ring should be fitted also in earlier engine types!

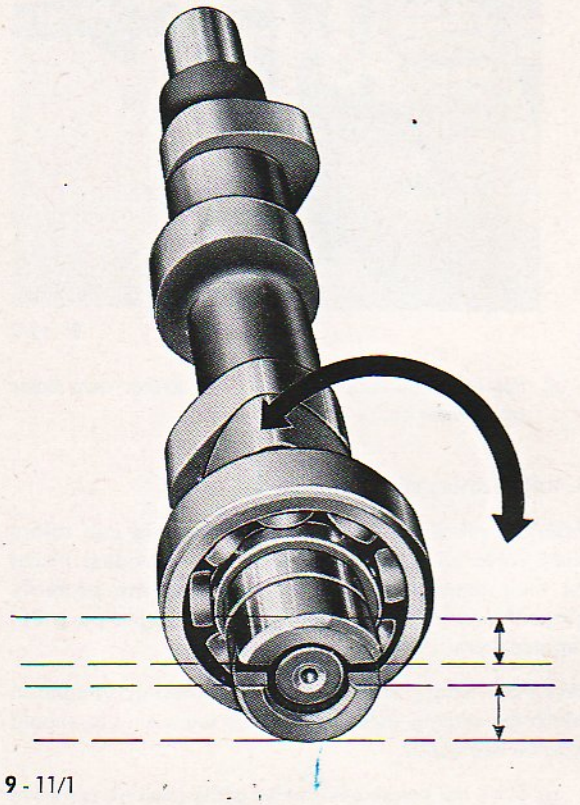
b) Put cord ring onto the camshaft journal and push it against the inner bearing ring (Fig. 9 - 10/3).

c) Force into place coupling piece for distributor and secure with a **new** tensioning pin. First check bearing surface of coupling piece for proper condition of the running surface for the radial sealing ring. In case the bearing surface is rough or damaged, the coupling piece should be replaced.



9 - 10/3

Attention! Put coupling piece in place so that the eccentrically arranged slot is angularly displaced in relation to the first cam (intake cam No. 1 cylinder) (Fig. 9 - 11/1).
To identify the true position of the coupling piece a punch mark is on the centering extension of he camshaft as well as on the outer surface of the coupling piece. The proper location of the coupling piece in relation to the camshaft according to Fig. 9 - 11/1 is



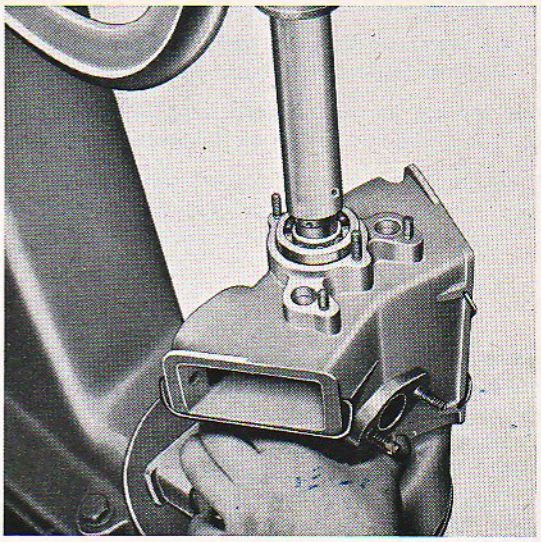
9 - 11/1

given when both punch marks are in line with each other.

d) Insert SEEGER retaining ring into the housing (Fig. 9 - 11/2).

e) Put camshaft into the housing from the ignition distributor side and force it into position until the ball bearing bears against the SEEGER retaining ring (Fig. 9 - 11/3).

f) Check radial sealing ring in the distributor pipe and, if necessary, replace.



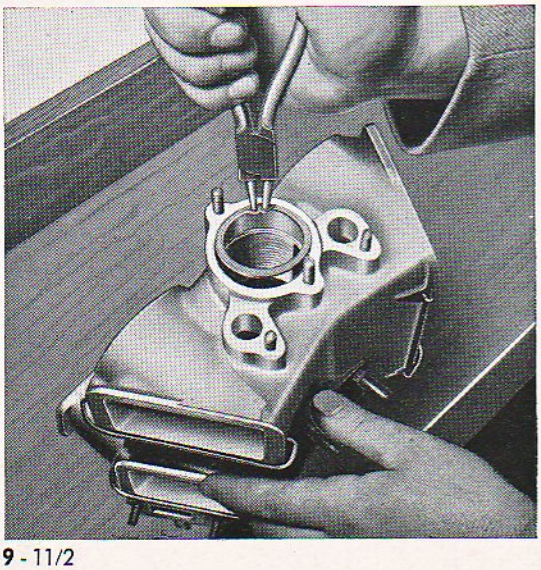
9 - 11/3

Note: From Engine No. 340 075 a sealing ring of greater width and larger outer diameter as well as a distributor pipe modified conforming to the new sealing ring are installed to improve oil tightness.
In performing repair work on the camshaft housing be sure that, in any case on engines of an earlier type, the distributor pipe (with sealing ring) is replaced by a new pipe and a new sealing ring. For this operation the special tool WO 56 must be used.
For more details see Section "Replacing radial sealing ring in the distributor pipe".

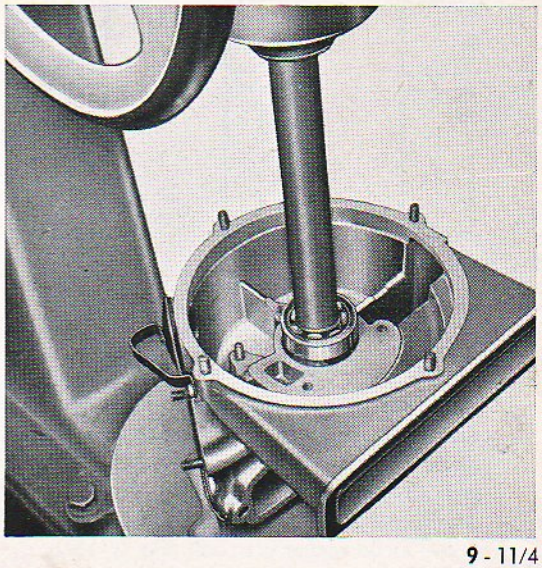
g) Fit distributor pipe, using special service tool WO 38.

Attention! To effect this refer to the fitting instructions given in Section "Replacing radial sealing ring in the distributor pipe".

h) Put ball bearing on the driving side in place on the camshaft journal and force it into place until it strikes against the bearing collar (Fig. 9 - 11/4).



9 - 11/2



9 - 11/4

2. Fitting rocker arm:

Before refitting rocker arm

check contact area and condition of rocker arm gliding path,

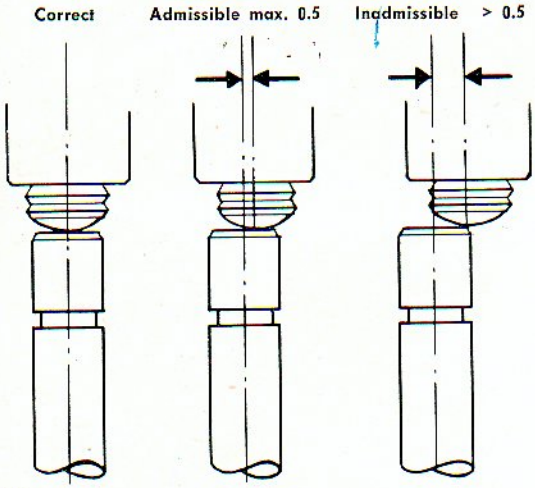
the clearance between rocker arm bolt and rocker arm bush (see table "Adjusting data and tolerances")

and replace the rubber cord rings of the rocker arm bolts to guarantee perfect oil tightness.

a) Place rocker arm, rocker arm springs and, if necessary, spacer rings into the housing according to the arrangement shown in Fig. 9 - 9/2.

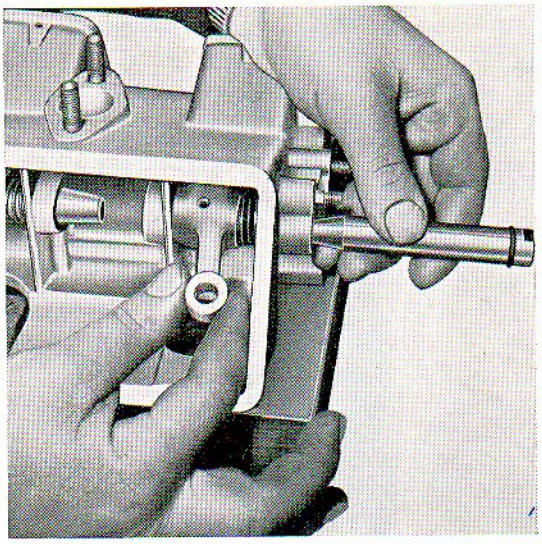
Attention! At the manufacturer's work rocker arms are mounted so that the valve adjusting screw located in the rocker arm centrically bears on the end of the valve stem with a lateral displacement of 0.5 mm (maximum) (0.02"). Should as a consequence of allowable oversizes the lateral displacement (eccentricity) exceed the aforementioned value, this undue eccentricity can be repaired by a spacer (Part No. 13 14 231 – 0) to be inserted between rocker arm and wall of housing.

Any lateral displacement of the adjusting screw exceeding the tolerable amount of 0.5 mm (0.02") outside the valve stem centre would result in premature wear of the valve guide with its resulting consequences for the valve itself (Fig. 9 - 12/1).



9 - 12/1

b) From the driving side, resp. from the ignition distributor side, drive in rocker arm bolt until lower edge of rocker arm slot for locking plate is flush with the housing wall. Be sure that slot stands perpendicularly to the bolt axis. Before doing so oil rocker arm bolt (Fig. 9 - 12/2).



9 - 12/2

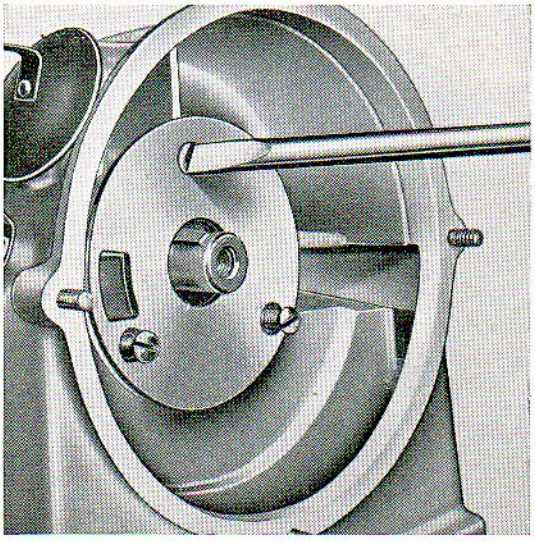
c) Put in place locking plates for rocker arm bolts and screw on.

3. Install rotary slide valve drive.

Take care that the rotary slide valve plate and rotary slide valve have neither scratches nor grinding traces on their lapped surface and that they are perfectly plane. Never regrind or straighten damaged parts but replace them.

Worn-out rotary slide valves or centering flanges in which the seating faces of the slide are worn out, should also be replaced.

a) First, the rotary slide valve plate must be centered by slightly tightening the counter-sunk slotted cap screws, than tighten crosswise screws evenly. Use only well-fitting screw driver and be ure that no burrs occur at the countersunk hole. Secure in position screws by punching (Fig. 9 - 12/3).



9 - 12/3

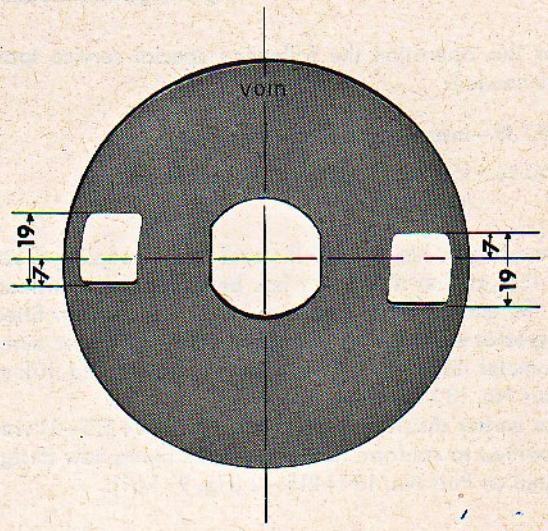
b) Put rotary slide valve spring and rotary slide onto the flattened boss of the centering flange and force centering flange onto the camshaft journal. In doing so take care that the Woodruff key will not be forced up rearwards! Before refitting oil rotary slide on its working surface.

Attention! To avoid the proper location of the rotary slide being confounded on refitting it slides from Engine No. 304 000 are marked "Vorn" (Front).

Be sure that inscription remains visible after installation!

For rotary slides, not marked, the following rules must be observed on fitting:
Grasp slide so that both rotary slide windows are opposite to each other in the horizontal plane.
If in this position the larger portion of the right hand window comes to lie below the horizontal center line, the slide may be mounted in that position, otherwise turn the slide round so that the other half is in front (Fig. 9 - 13/1).

c) Oil ball-bearings and cam faces on the camshaft.



9 - 13/1

Dimensions are given in mm. 1 mm = 0.0394".

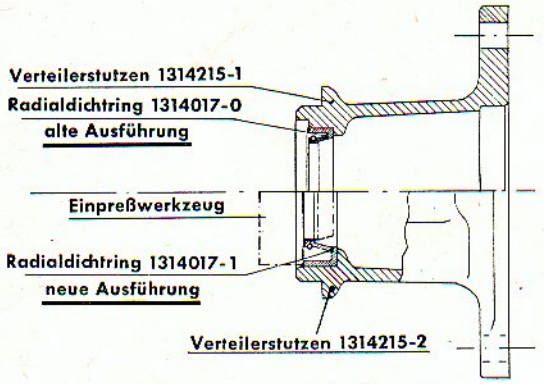
Replacing radial sealing ring in the distributor pipe

For this operation the following special service tools are needed:

WO 38 – Inserting tool for radial seal

WO 56 – Inserting tool for radial sealing ring (distributor pipe).

From Engine No. 340 075 the seal at the coupling piece of the ignition distributor has been improved. Instead of the earlier radial seal 26 x 35 x 7 there is now fitted a **special sealing ring** of larger width and larger outer diameter 26 x 40 x 9 with left-hand ground rifling (Part No. 13 14 017 – 1).
The earlier distributor pipe (Part No. 13 14 215 – 1) was modified to conform to the new seal, being now designated as Part No. 13 14 215 – 2 (Fig. 9 - 14/1).



9 - 14/1

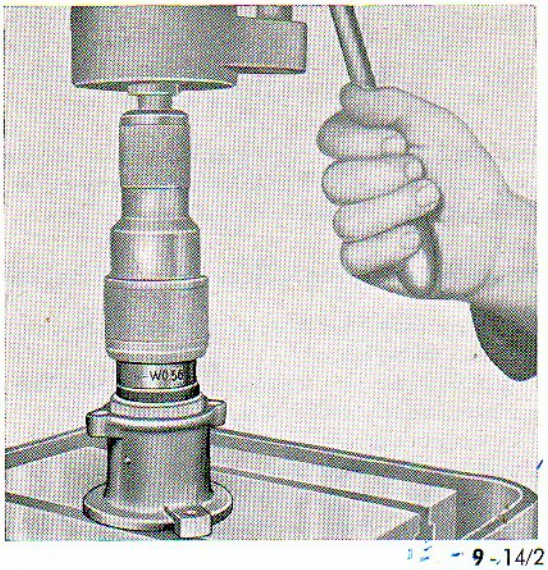
Verteilerstutzen	=	distributor pipe
Radialdichtring	=	radial seal
Alte Ausführung	=	earlier type
Einpreßwerkzeug	=	forcing tool
Radialdichtring	=	radial seal
Neue Ausführung	=	new type
Verteilerstutzen	=	distributor pipe

If with engines of earlier type oil leakages are found at the radial seal in the distributor pipe, the sealing ring and distributor pipe must be replaced by the above mentioned improved new types to assure permanent remedy.

1. Dismantle ignition distributor.
2. Remove distributor pipe after loosening both hexagon nut SW 10.

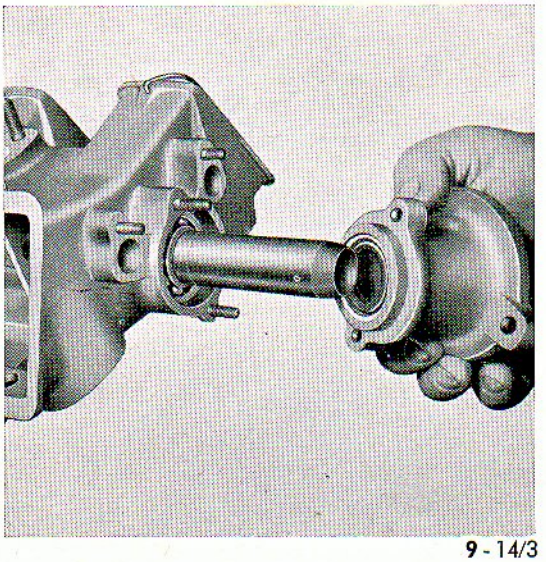
On engines from No. 340 075:

3. Remove special radial seal 26 x 40 x 9 without damaging its seating in the distributor pipe.
4. Break the edge of the sealing ring in the distributor pipe by means of a scraper slightly over the entire circumference. Carefully remove all scraper shavings!
5. Grease seating in the pipe, push new special seal onto the previously oiled extension of special tool WO 56 and force seal by means of a hand-operated press (e. g. a column drill) into place until it bears against the bottom of the recess.
   Be sure that the open side of the seal lies outside and is directed towards the camshaft, with the distributor pipe fitted (Fig. 9 - 14/2).



9 - 14/2

6. Check the working surface of the distributor coupling piece for proper condition. If the working surface is rough or damaged, replace coupling piece.
7. Put special tool WO 38 onto distributor coupling piece. Push forward distributor pipe, with inserted seal in proper position (with oil drain hole downwards!) over the assembling sleeve, which has been oiled previously, until it is tightly in place.
   During this operation press assembling sleeve firmly against shoulder of coupling piece to prevent tension spring from jumping off when the sealing ring is pushed into position (Fig. 9 - 14/2).



9 - 14/3

Fig. 9 - 14/3 shows the whole procedure with the camshaft housing dismantled. This job can be done also without dismantling the camshaft housing.

8. Screw on distributor pipe, take out assembling sleeve.

9. Mount distributor.

On engines up to No. 340 074 (incl.):

Do not replace leaky radial seal 26 x 35 x 7, but replace distributor pipe and seal by new distributor pipe with special seal (see above).

Installation as described, Item 4 to 9.

Attention!

Only applicable for engines up to No. 339 625 (incl.).

When dismantling distributor pipe check whether coupling piece for ignition distributor has a fixed oil-tight seat on the camshaft journal.

If after removal of tensioning pin the coupling piece can be easily withdrawn from the shaft, insert a rubber cord ring (Part No. 13 14 232 – 0) between the ball bearing and coupling piece. To ensure coupling piece use only **new** tensioning pin.

The rubber cord ring provides for oil-tightness on the extension. (See also Section "Disassembling and reassembling camshaft housing" under "Reassembly" Item 1 (a).

Vent operating mechanism

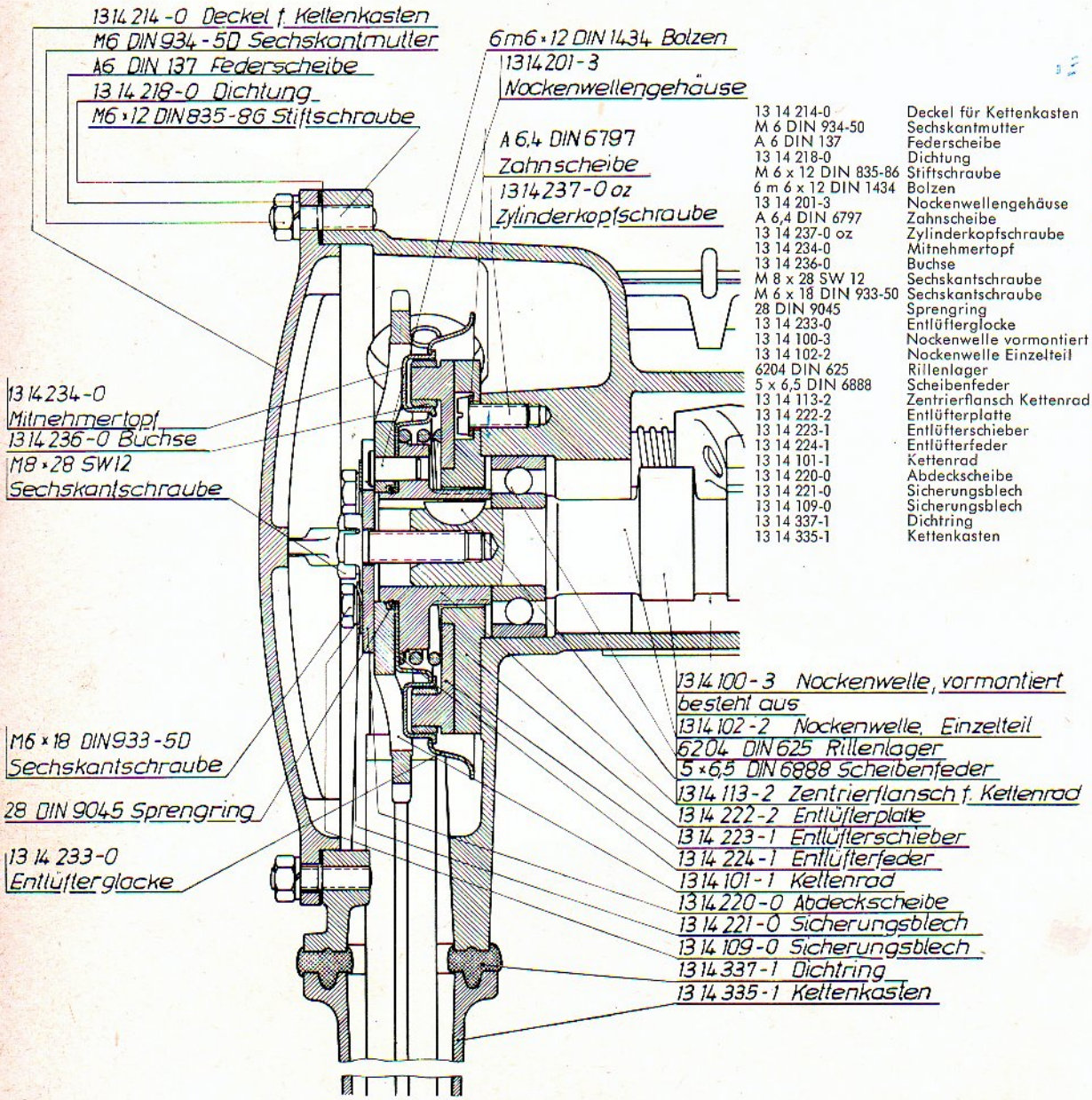
(From Engine No. 372 594)

General

This vent operating mechanism consists, mainly, of the flexible drive of the rotary slide valve and the vent cover. The rotary valve is no longer driven direct by the camshaft but by the vent cover, fastened to the centering flange, through two oil-resistant plastic bushes located at its outer edge. Since the driving force now bears upon a large base, small moments of force and a smoother drive are the result.

The vent cover keeps the oil splash from the vent window; furthermore, the rotating cover has the effect of removing, by centrifugal force, any oil droplets that might be carried along by the escaping air.

An oil return thread cut into the long (rear) hub side of the centering flange prevents lubricating oil from getting into the vent mechanism from the camshaft housing. A snap ring arranged on the short (front) hub side of the centering flange keeps the vent cover, which is acted upon by the pressure of the vent spring, down on its seat also after the sprocket wheel has been removed. In reassembling, the snap ring facilitates the assembly work in the same way (Fig. 9 - 16/1).



13 14 214-0	Deckel für Kettenkasten	= Chaincase cover
M 6 DIN 934-50	Sechskantmutter	= Hexagon nut
A 6 DIN 137	Federscheibe	= Spring washer
13 14 218-0	Dichtung	= Gasket
M 6 x 12 DIN 835-86	Stiftschraube	= Stud
6 m 6 x 12 DIN 1434	Bolzen	= Bolt
13 14 201-3	Nockenwellengehäuse	= Camshaft housing
A 6,4 DIN 6797	Zahnscheibe	= Serrated washer
13 14 237-0 oz	Zylinderkopfschraube	= Cylinder head screw
13 14 234-0	Mitnehmertopf	= Drive boss
13 14 236-0	Buchse	= Bush
M 8 x 28 SW 12	Sechskantschraube	= Hexagon screw
M 6 x 18 DIN 933-50	Sechskantschraube	= Hexagon screw
28 DIN 9045	Sprengring	= Snap ring
13 14 233-0	Entlüfterglocke	= Vent cover
13 14 100-3	Nockenwelle vormontiert	= Camshaft, assembled, consisting
13 14 102-2	Nockenwelle Einzelteil	= Camshaft, part [of
6204 DIN 625	Rillenlager	= Ball bearing
5 x 6,5 DIN 6888	Scheibenfeder	= Woodruff key
13 14 113-2	Zentrierflansch Kettenrad	= Centering flange for sprocket
13 14 222-2	Entlüfterplatte	= Rotary vent plate
13 14 223-1	Entlüfterschieber	= Vent slide
13 14 224-1	Entlüfterfeder	= Vent spring
13 14 101-1	Kettenrad	= Sprocket
13 14 220-0	Abdeckscheibe	= Cover plate
13 14 221-0	Sicherungsblech	= Safety washer
13 14 109-0	Sicherungsblech	= Safety washer
13 14 337-1	Dichtring	= Rubber gasket
13 14 335-1	Kettenkasten	= Chain case

Exchanging

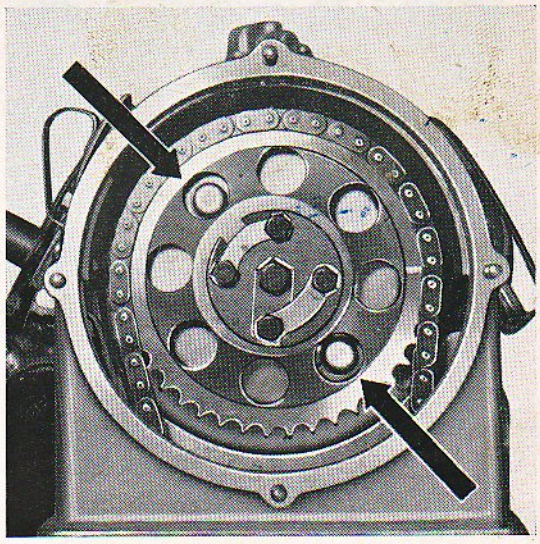
The old vent operating mechanism is exchangeable for the new valve operating mechanism if

1. the camshaft housing has **three** threaded holes for fastening the vent plate,

2. the new camshaft is of a type as fitted after Engine No. 336 589. (See page E 9 - 7).

The possible normal exchange is always after engine number 336 589.

With the chaincase cover removed the new vent operating mechanism can be recognized by the shape of the sprocket wheel (hub part now domed outward) and the two vent cover drive bosses visible in two opposite holes of the sprocket wheel (Fig. 9 - 17/1).



9 - 17/1

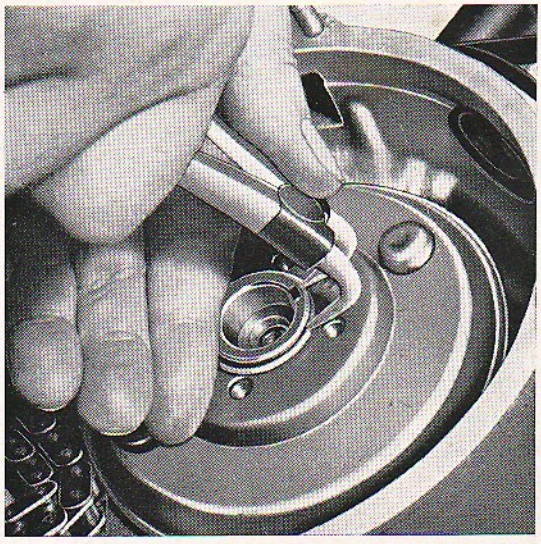
Dismantling:

The following special tools are needed:

WO 27 – Camshaft centering flange remover.

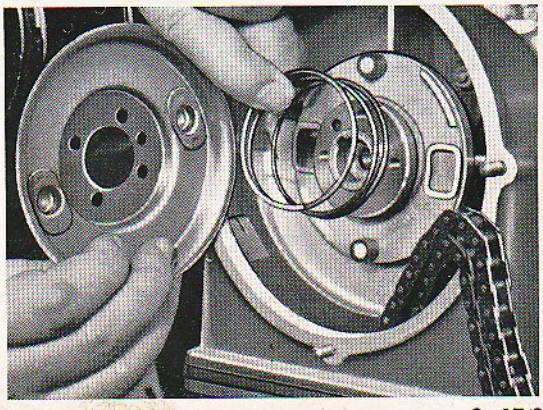
1. Remove sprocket wheel. Secure as in the old type, but with longer studs. Also the driving coupling dowel pin is longer. (See installation page E 9 - 1 and 2).

2. Remove the snap ring with outside snap ring pliers. (Fig. 9 - 17/2).



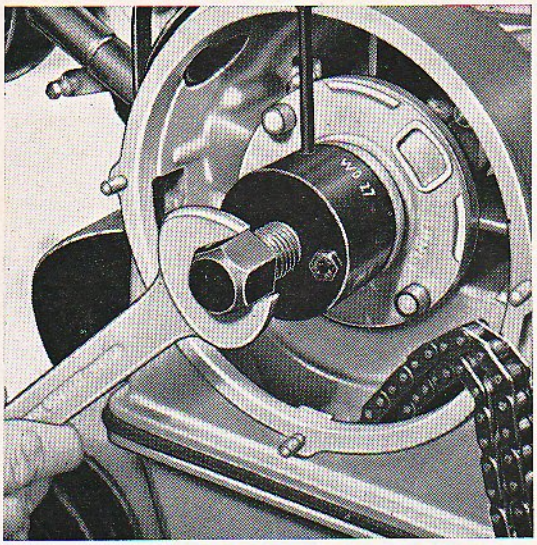
9 - 17/2

3. Remove the now free cover and spring. (Fig. 9 - 17/3).



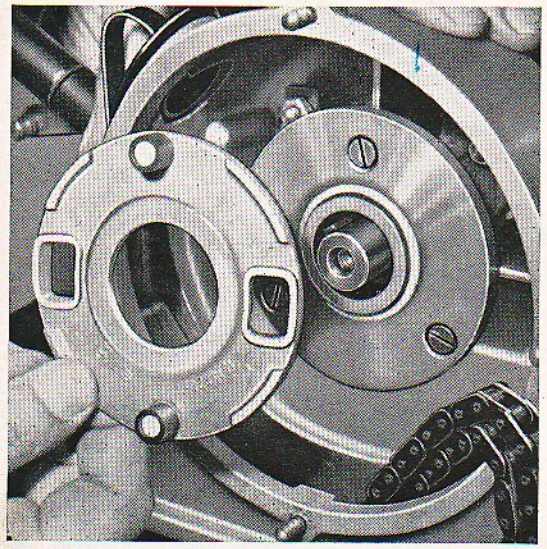
9 - 17/3

4. Remove the centering flange with special tool WO 27 (Fig. 9 - 18/1).



9 - 18/1

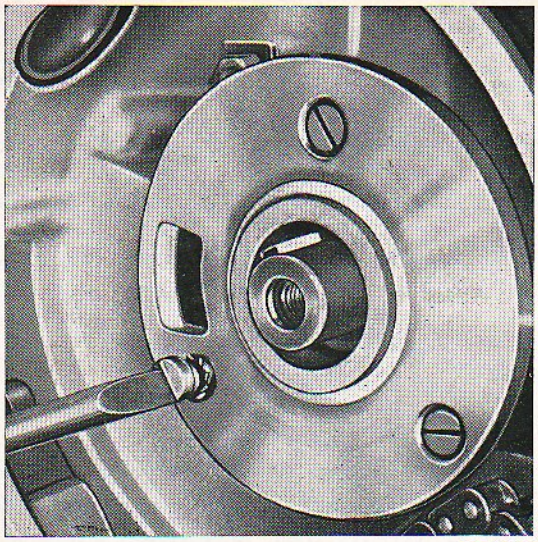
5. Remove the rotary vent slide (Fig. 9 - 18/2).



9 - 18/2

6. Unscrew the 3 slotted cylinder head screws from the vent plate, remove the vent plate.

Attention! Only use a correctly fitting screwdriver. (Fig. 9 - 18/3).



9 - 18/3

Assembling

Reassemble in the reverse order paying attention to the following points:

1. The vent plate and rotary vent slide must on no account be scratched or damaged on the running surfaces and should be perfectly plane.
   Damaged parts must on no account be reground or trued up but should be replaced by new parts.
   Slightly oil running surface of the rotary vent slide before fitting.

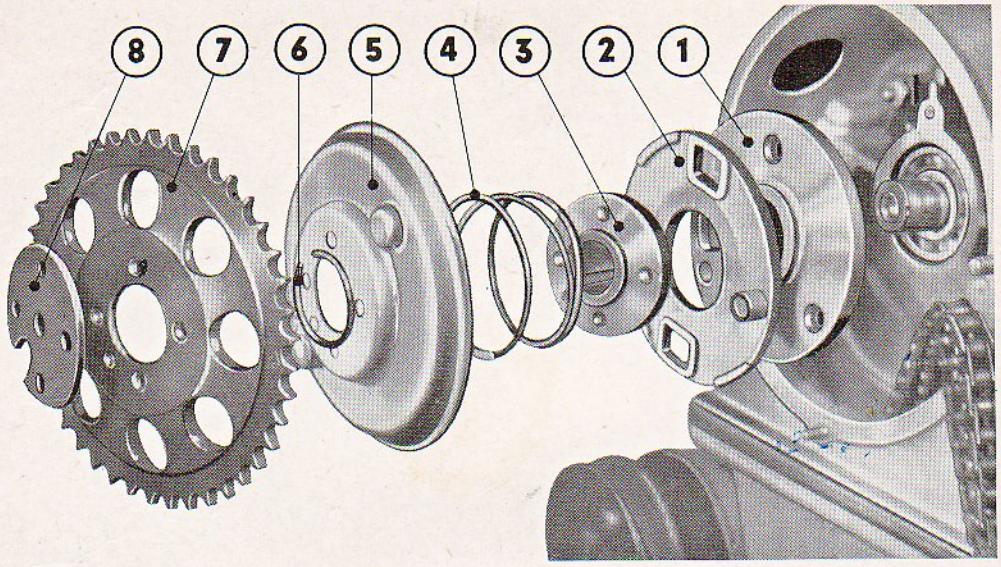
2. When securing the vent plate only the original M 6 x 15 screws (Part No. 13 14 237 – 0 with a head thickness of 3.3 mm) are to be used, with a serrated washer under each screw, then tighten.

3. Attention must be paid when fitting the centering flange that the Wodruff key is not pushed out of its position to the rear.

4. For fitting and securing the sprocket wheel the following new (longer) bolts and screws are required.

Coupling dowel pin	6 x 6 x 12
old type	6 x 6 x 10
Hexagon middle screws	M 8 x 28
old type	M 8 x 20
Hexagon screws	M 6 x 18
old type	M 6 x 15

Fig. 9 - 19/1 shows the different parts of the vent operating mechanism, in the order of fitting.



9 - 19/1

1 – Entlüfterplatte	=	Vent plate
2 – Entlüfterschieber	=	Rotary vent slide
3 – Zentrierflansch	=	Centering flange
4 – Entlüfterfeder	=	Vent spring
5 – Entlüfterglocke	=	Vent cover
6 – Sprengring	=	Snap ring
7 – Kettenrad	=	Sprocket wheel
8 – Abdeckscheibe	=	Cover plate

Dismantling and reinstalling cylinder heads

The following special service tools will be required for this operation:

WO 30 – Flywheel remover.

Dismantling

1. Dismantle engine.
2. Remove air cleaner.
3. Disconnect spark plug cable.
4. Remove fuel piping between pump and carburettor.
5. Remove valve chamber cover.
   Use oil collecting pan! (For more details see Section "Check valve clearance").
6. Dismantle camshaft housing.
7. Remove ventilator casing and engine covering.
8. Remove intake manifold with carburettor after loosening 6 hexagon nuts SW 10.
9. After loosening hexagon nuts SW 15 on cylinder head (4 nuts for each head) remove cylinder heads.

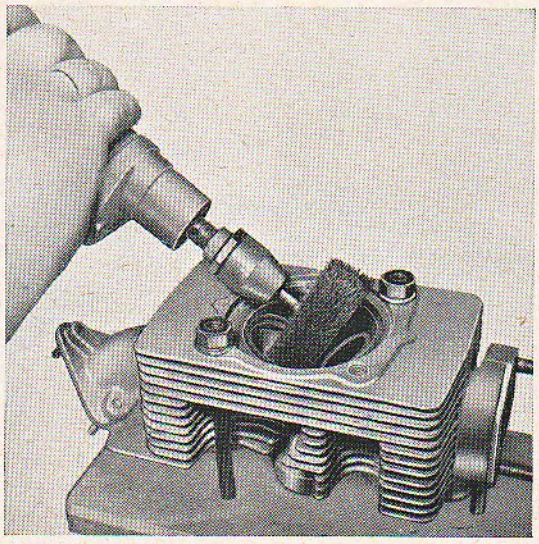
Attention! Should only the cylinder heads without the cylinders be dismantled take care that cylinders are not moved in loosening and removing cylinder heads to avoid cylinder foot gaskets being damaged.

10. Remove cylinder head gaskets.

Refitting

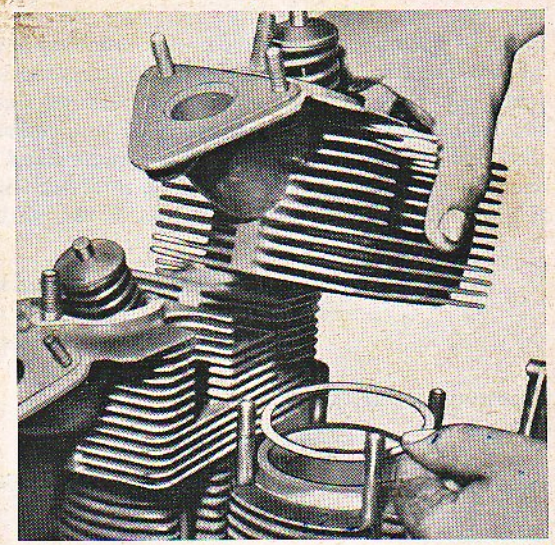
Refitting should be done in the reverse order and the following points should be taken care of:

1. Clean combustion chamber from residual carbon by means of a wire brush (Fig. 10 - 1/1).



10 - 1/1

2. Replace cylinder head gaskets (Fig. 10 - 1/2).

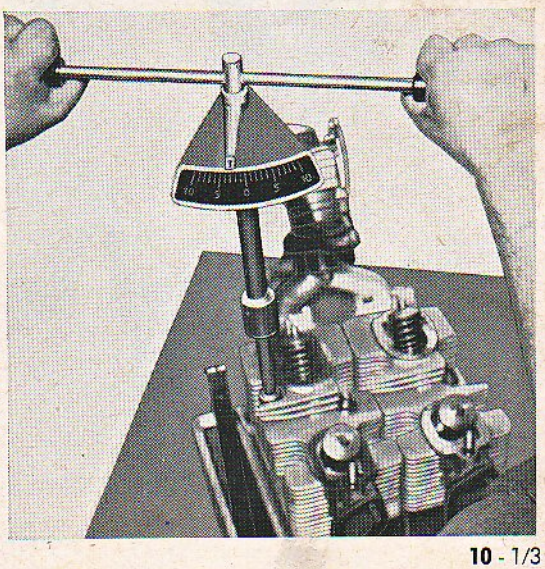


10 - 1/2

3. Put in place cylinder head and first turn on nuts finger tight, then:

4. Align heads by screwing on intake manifold.
   Tighten fastening nuts on intake manifold at a torque of **0.5 mkg!**

5. Tighten down fastening nuts on cylinder heads crosswise at a torque of **3 mkg** (Fig. 10 - 1/3).



10 - 1/3

6. Reassemble engine with new gaskets.

7. Adjust camshaft, valves and ignition timing according to instructions.

Note: From Engine No. 330 046 fastening of studs serving to fasten camshaft housing to cylinder heads has been improved.

To avoid studs becoming loose or the threading in the cylinder head being stripped owing to inappropriate tightening, studs are not any longer screwed direct into the metal of the head consisting of an aluminium alloy, but they are connected to the cylinder head by inserting a self-cutting and self-locking threaded insert of the "Ensat" type. If on engines up to No. 330 045 (inclusive) a loosening of the studs or damage to the threading in the cylinder head occurs, the cylinder head can be reused if a threaded insert is inserted.

When overhauling such engines it is urgently recommended to bring older cylinder heads up to date by inserting the new "Ensat" bushes in order to ensure a durable fastening of the camshaft housing on the cylinder heads as such a fastening is of great importance for an unobjectionable sealing against oil leakage at this point.

Installation of threaded insert bushes of the "ENSAT"-type

suitable for use with studs M 8 x 25 to fasten camshaft housing to cylinder heads.
Only applicable for engines up to Engine No. 330 045 (inclusive).

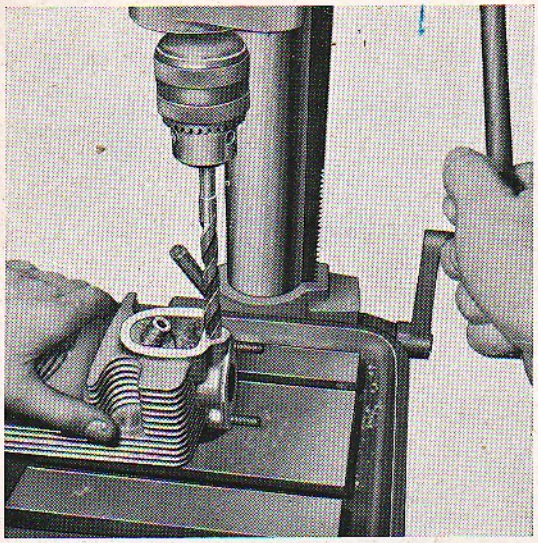
Necessary for this operation are:

WO 29 – Valve remover and installer.

4 each threaded insert bushes (Ensat) IN 22 b for M 8 inside thread.

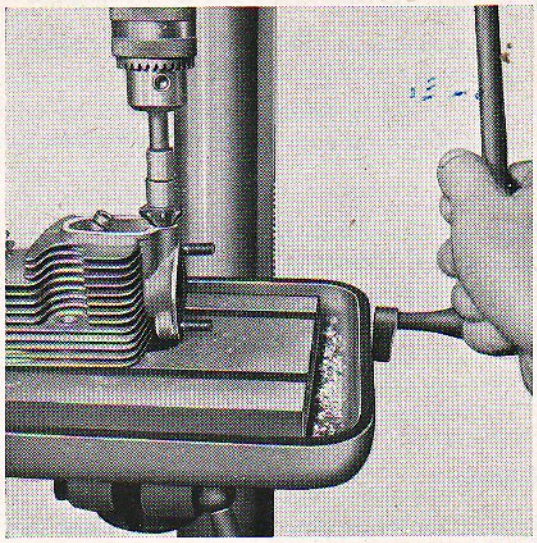
1 each screwing-tool type "S", size 800.

1. Dismantle cylinder heads.
2. Dismantle valves with special service tool WO 29.
3. Remove old studs.
4. Drill out threads.
   In order to ensure a threaded hole to be strictly vertical use a column type drill. Spiral drills 10.6 to 10.8 mm dia. Depth of hole 18 to 20 mm (Fig. 10 - 2/1).



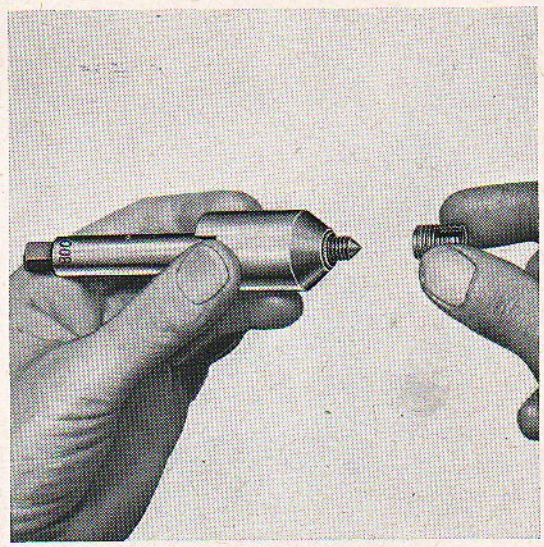
10 - 2/1

5. Countersink hole (Fig. 10 - 2/2).



10 - 2/2

6. Screw insert bush onto threaded pin of screwing-in tool (Fig. 10 - 2/3).



10 - 2/3

7. Screw in insert bush Ensat by means of screwing-in tool. In doing this job it is convenient to clamp cylinder head in the jig for dismantling and refitting valves WO 29 (Fig. 10 - 3/1).

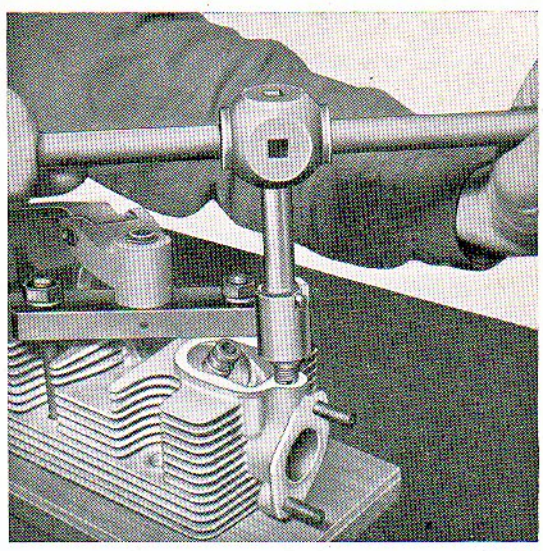
Attention! All metal thrown up by screwing - in the threaded insert should be removed to avoid elevations which prevent a tight seal, and to guarantee an unobjectionable seating surface for the camshaft housing.

8. Screw out screwing-in tool.

9. Blow away drilling chips with compressed air; clean cylinder head.

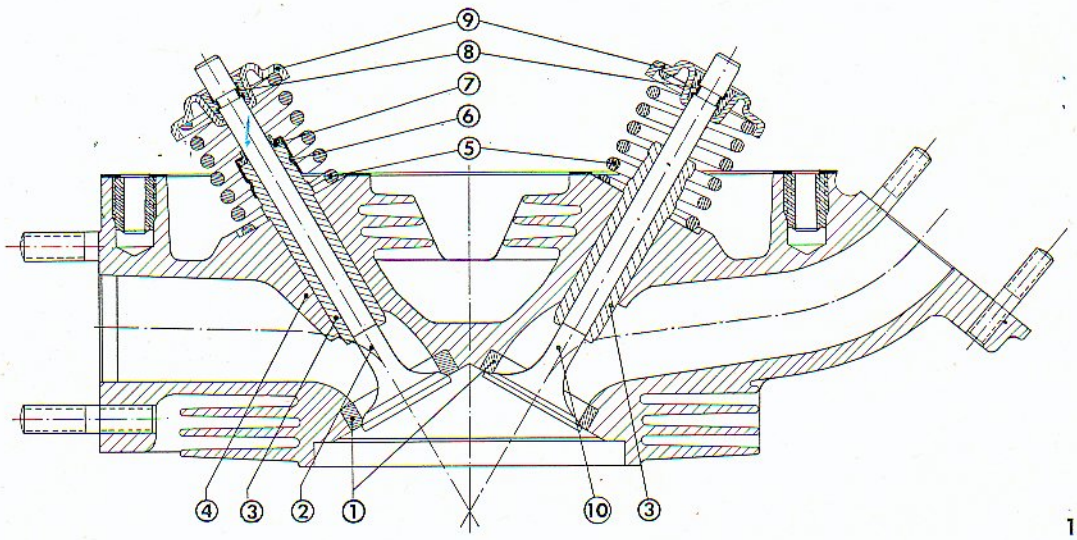
10. Replace older stud by head screw M 8 x 28.

Note: In a similar way the repair of all other threaded holes in the aluminium parts of the engine and gearbox can be performed by using insert bushes. For more details see remarks at the end of this Sub-group.



10 - 3/1

Dismantling and reinstalling valves



10 - 3/2

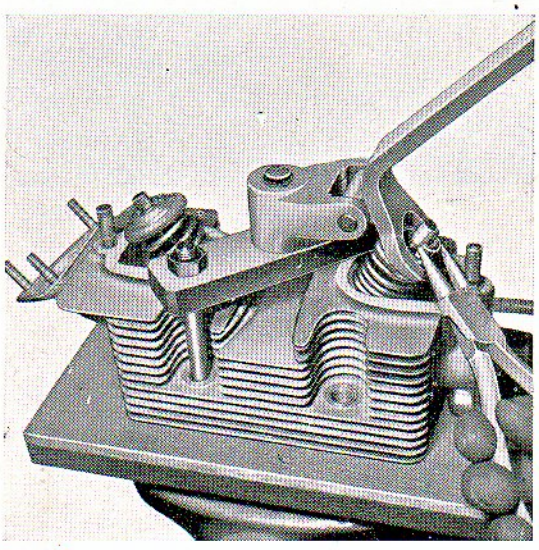
1 – Valve-seat insert
2 – Exhaust valve
3 – Valve guides
4 – Cylinder head
5 – Valve springs
6 – Holder for feal (exhaust)
7 – Seal for valve (exhaust)
8 – Clamping cones
9 – Valve spring retainer
10 – Intake valve

The following special service tool will be used:

WO 29 – Valve remover and installer.

Dismantling

1. Dismantle cylinder heads.
2. Clamp cylinder head on the valve remover and installer WO 29, depress valve spring retainer. Take out clamping cone halves and remove valve spring retainer (Fig. 10 - 4/1).



10 - 4/1

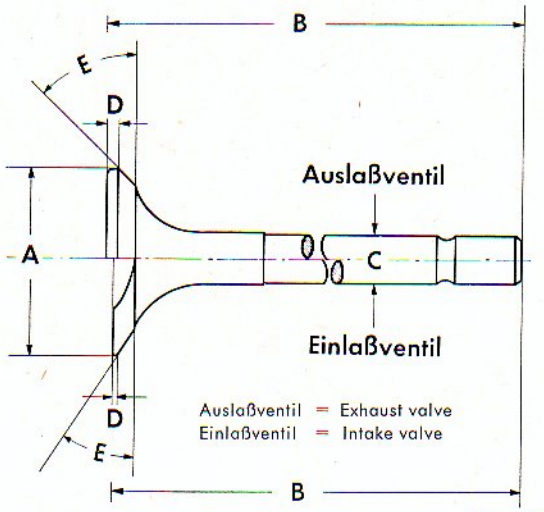
3. Remove valve springs.
4. Unclamp cylinder head from tool WO 29 and pull out valves from valve guide.

Reinstalling

Reinstall in the reverse order taking care of the following points:

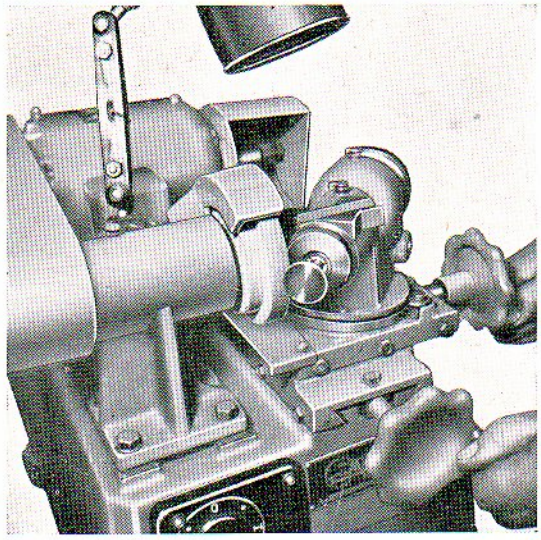
1. Check valve guides for wear. (See following Section).
2. Clean valves and remove deposits with wire brush.
3. Check valve stem for wear and warping. Small rough spots on the stem must be smoothened by means of polishing cloth.
4. Check tapered valve face for worn or burned spots.

If valve face shows worn-out or burned spots which cannot be removed by grinding it to the valve seat, the valve should be resurfaced, taking care of the prescribed refinishing limits, on a valve face grinder. (Figs. 10 - 4/2 & 3).



10 - 4/2

	Intake valve	Exhaust valve
A	31.8- 32.0 mm ⌀ (1.252 - 1.26")	28.8- 29.0 mm ⌀ (1.134 - 1.142")
B	112.9-113.1 mm (4.445 - 4.453")	113.9-114.1 mm (4.484 - 4.5")
C	7.963-7.975 mm ⌀ (0.3135- 0.314")	7.940-7.950 mm ⌀ (0.3126- 0.313")
D	0.9- 1.1 mm (0.0354-0.0433")	1.85- 2.15 mm (0.0728-0.0846")
E	29° 30'	44° 30'



10 - 4/3

Attention! In refinishing valve faces care should be taken that the width of the taper face is always 0.2 to 0.3 mm (0.008" - 0.012") wider than the corresponding width of the valve-seat insert to ensure an unobjectionable tight fit.

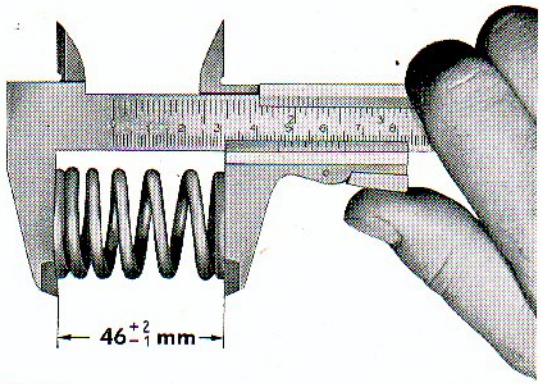
Futhermore, the measure "D" of the valve face is allowed to be reduced in regrinding only down to a definite limit. This especially refers to the exhaust valve which is more exposed to heat than the intake valve.

For refinishing valve faces the following limit values are applicable:

	Intake valve	Exhaust valve
D	0.4 mm (0.016")	1.2 mm (0.047")

Valves whose stems are warped or whose grooves for the clamping cones are worn out, should not be straightened or refinished but must be replaced.

5. Check clamping cones for usability and, if necessary, replace.
6. Check valve-seat inserts for proper seating faces. Valve faces must be precisely concentrical to the valve guide and should have the specified face widths. For more details see under Section "Remilling valve face".
7. Check valve springs:
   Measure length of valve springs with sliding caliper. Valve spring when dismantled shall have a length of $46 \pm \frac{2}{1}$ mm ($1.811'' \pm \frac{0.0787''}{0.0394''}$) (Fig. 10-5/1).



10 - 5/1

If a valve spring tester is available, the following data are applicable for the measuring operation:

Condition	Length in mm	Load in kg
dismantled unloaded	$46 \pm \frac{2}{1}$ ($1.811'' \pm \frac{0.0787}{0.0394}$)	0
fitted, valve closed	35 (1.378")	abt. 22 (48.5 lb)
fitted, valve entirely opened	27.4 (1.0787")	44-48 kg (97-106 lb) Admissible wear not under 40 kg (88 lb)

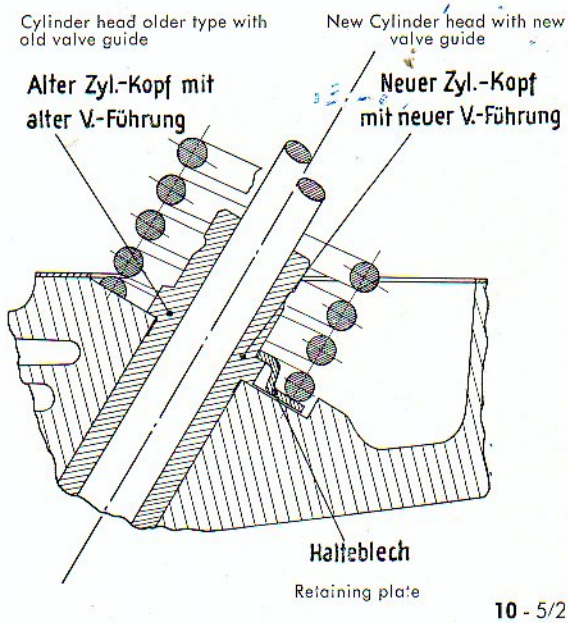
All valve springs are identical in type as far as their length and characteristics are concerned!

Attention! The valve springs are progressively coiled. Pay attention to the position of springs when taking them out. Replace springs so that the small-spaced coil end is directly towards the cylinder head.

8. Insert valve stem with oil into the valve guide.

NOTE: As an additional protective means for the valve guides a spring retaining plate is provided between head and valve spring (intake and exhaust) from Engine No. 341 772.

As the cylinder head and valve guide have been altered for this reason, this retaining plate cannot be fitted in cylinder heads of older types. New cylinder heads can be recognized by the altered shape of the valve guide collar; the latter is of smalier thickness and is set-off with sharp edges on which the retaining plate is placed.



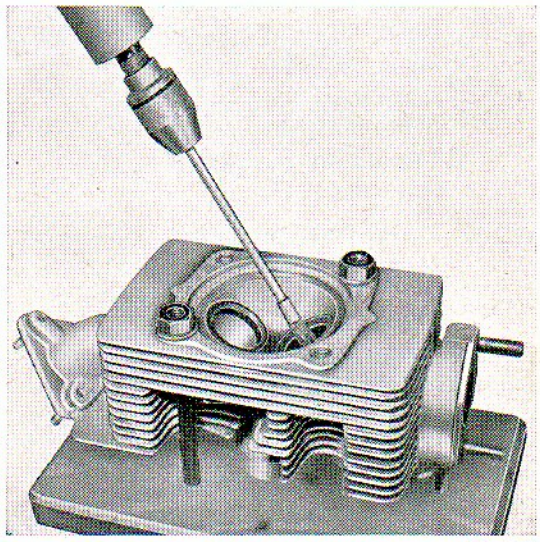
10 - 5/2

Checking valve guides

The following special tools are required for this job:

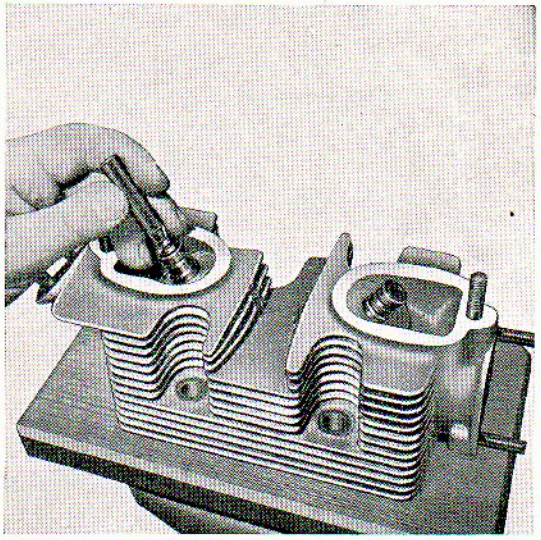
WO 47 – Valve guide cleaning brush
WO 45 – Valve guide limit gauge.

1. Clean valve guides. Coked deposits which fail to be removed with petrol, should be eliminated with a cleaning brush (clamp guide in a drill press).
   Actuate drill press only for a short time and be sure that the sealing ring on the exhaust guide is not damaged. (Fig. 10 - 5/3).



10 - 5/3

2. Check valve guides for wear or for out-of-roundness by means of limit plug gauge WO 45. Apply gauge cross-wise and measure down to mid-length of guide (Fig. 10 - 6/1).



10 - 6/1

On new valves the clearance between valve guide and valve stem should be:

Intake . .	0.013 – 0.047 mm	(0.0005 – 0.0019")
Exhaust . .	0.038 – 0.070 mm	(0.0015 – 0.0028")

If the limit plug gauge can be inserted into the valve guide, the limit wear of the valve guide has been reached or exceeded so that cylinder head and valve must be replaced.

Attention! At the manufacturer's works the valve guides are shrunk into the cylinder head at a very low temperature. Replacing of valve guides can, therefore, not be done with the conventional means available in a service shop. Considering the fact that the operation of forcing out a worn-out valve guide may result in damage to the bore in the cylinder head, it is necessary to replace worn-out parts or to install a replacement cylinder head when the wear of the valve guide has attained its limit value.

Resurfacing valve seats by milling

The following special tools are needed:

WO 48 – Valve seat cutter, intake valve 32.30 mm dia.
Matra tool R 30°/34

WO 49 – Valve seat cutter, outlet valve 29.45 mm dia.
Matra tool R 45°/32

WO 50 – Correction cutter
Matra tool R 15/34

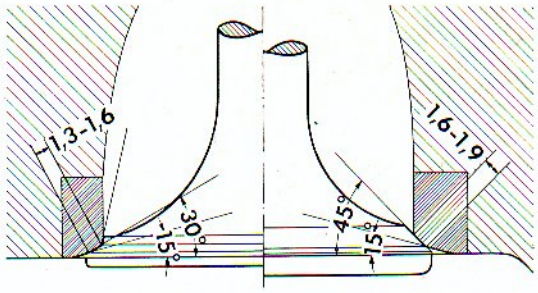
WO 51 – Cutter pilot, complete, consisting of:
Guide shank with adapter sleeve 7.75–8.25 mm.
Matra tool R 209
Cutter shank
Matra tool Q 15
T-handle with square drive
Matra tool W 67

WO 52 – Knock-off tube for cutters
Matra tool S 753

WO 29 – Valve remover and installer

If valve seats in the cylinder head are worn out at one side, pitted or burned, they must be refaced to obtain a gastight seat. For this operation the specified width of valve seats (intake 30° = 1.3 to 1.6 mm (0.051 – 0.063"), exhaust 45° = 1.6 to 1.9 mm) (0.063 – 0.075") must be considered.
The procedure may be repeated as long as in reducing the width of valve seat, owing to the 15° bevel, the outer circumference of this bevel does not exceed the outer circumference of the valve-seat insert, otherwise the cylinder head must be replaced. As the valve-seat inserts are shrunk into the head at a very low temperature, replacement of inserts with the conventional shop means is impossible.

Attention! Gas-tight valve seats can be achieved only if seats in the cylinder head are concentrically arranged in relation to the valve stem and the valve face bear evenly with the same width around the entire valve seat. Prior to the remilling of valve seats check the valve guides for wear since they serve to guide the milling cutter shank during the milling operation and are able to influence the accuracy of refacing to a considerable extent. In the same manner check also the valve faces for further usability before they are reinstalled.
For the necessary information for refacing valve seats please refer to Fig. 10 - 7/1.



Intake Exhaust

10 - 7/1

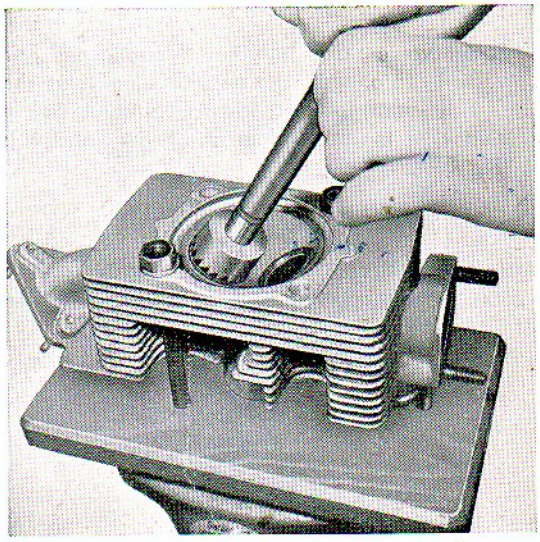
Sequence of operation

1. Mill out an area of 30° (intake) or 45° (exhaust)
2. Mill out an area of 15° (intake and exhaust).
   For resurfacing valve seats it is convenient to have the cylinder head clamped in the jig WO 29.

Attention! Prior to the resurfacing of the seat the taper guide shank with adapter sleeve must be adaped to every single valve guide so as to achieve an unobjectionable play-free guide of the milling cutter. Insert guide shank after coating it with oil. The cutters are struck off the cutter shank with the knock-off tube WO 52. All refacing should be done with extreme care. In performing the job, care must be taken that pressure is applied accurately from above so as to ensure a concentrical seat without chatter marks.

At short intervals stop milling operation to make sure that only a minimum quantity of metal has been removed. In any event it must be avoided to resurface the seat broader than it is absolutely necessary as otherwise the valve-seat insert becomes unserviceable.

After an unobjectionable cut has been secured, the upper seat edge must be cut off with the 15° correction cutter until the specified width of the valve seat has been attained (Fig. 10 - 7/2).



10 - 7/2

Checking valves for tightness

With the valve seats properly milled and the valve faces accurately resurfaced or when using new valves, an additional resurfacing of the valves by means of emery paste should be unnecessary.
Prior to the reinstallation of the overhauled cylinder heads examine in any case the correct bearing of the valve on its seating in the head.

To do this proceed as follow:

1. Give valve face a slight coat of ink and put valve in place.
2. Turn slightly valve to and fro between fingers.
3. Press on the valve from the stem end and lift it from its seat.

If the valve shows points left untouched by the ink, decide in every case whether the seat should be slightly recut or whether the valve must be ground to a good finish by means of emery paste.

Attention! A test for proper tightness, effected only by filling petrol into the combustion chamber, without checking the correct finish of the valve, does not show clearly whether a proper permanent bearing could be achieved.

Grinding-in valves

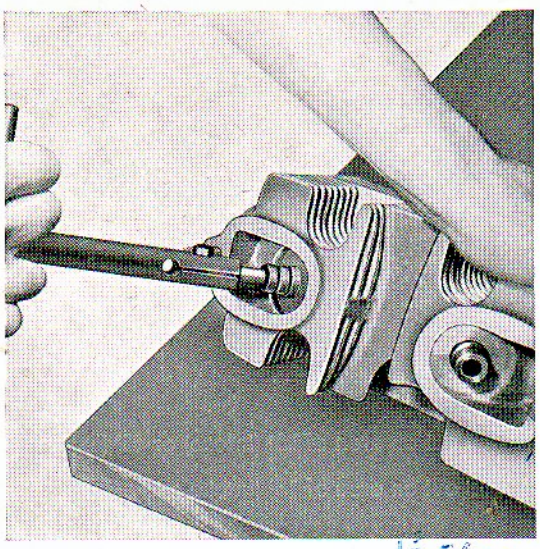
The following special tools will be required:

WO 41 – Valve clamp.

Resurfacing of a valve by means of emery paste should be effected only in the case where remilling fails to give a gas-tight seat.

1. Give valve face a coat of emery paste.
2. Push compression spring (e.g. rocker arm spring) over the valve stem. Push valve into the valve guide.
3. Fasten valve clamp on valve stem end and grind-in valve by rotating it back and forth (not more than 1/6 of a full turn) in order to avoid grooves being formed – at the same time lifting the valve slightly. (Fig. 10 - 8/1)
4. Check valve for proper contact on its seat.

Attention! Upon completing the grinding operation clean valves, valve seats, guides, and cylinder head carefully of emery deposited on these parts.



10 - 8/1

Checking valve clearance – adjusting valves

In order to achieve a proper closing of the valves with the engine warmed up and to avoid leakages which might occur when valves after a definite running time happen to stick, make sure that a small clearance is always left between valve stem and adjusting screw.
For this reason special attention should be paid to examining the valve clearance at the specified times and making any adjustment with greatest care.
Carry out any check or adjustment of the valve always with a **cold** engine. Therefore, these checks for proper adjustment should always be made at the end of any servicing job.

The specified valve clearances are:

Intake	0.15 mm (0.006")
Exhaust	0.20 mm (0.008")

Too small valve clearance mean:

Loss of compression, lower engine performance
Bad idling,
Burned valves and valve seats
Warped valve stems
Variation of timing.

Excessive valve clearance may result in the following inconveniences:

Valve noise
Bad idling speed
Variation of timing.

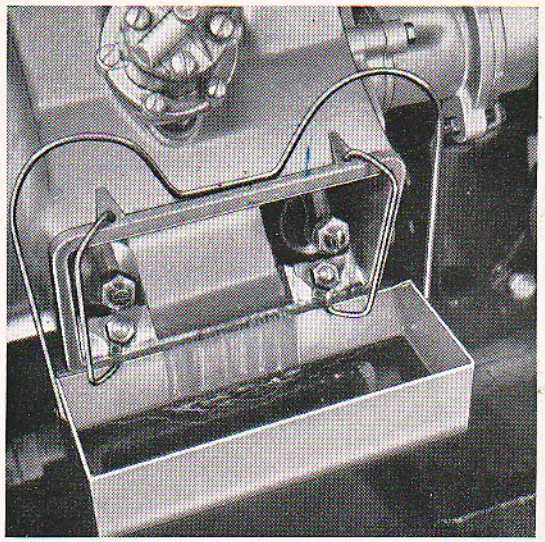
When examining or adjusting valve clearances have in no case valve opened, but make sure that it is entirely closed. Therefore, be sure that the piston of the respective cylinder is always on T. D. C. of the compression stroke. When adjusting valves it is best practice to commence with No. 1 cylinder (flywheel side) and proceed as follows:

1. Remove front decoration
   (on LT/LTK 600 remove decoration.grid rods in the front engine hood)

2. Screw out spark plugs.

3. Remove valve chamber cover.

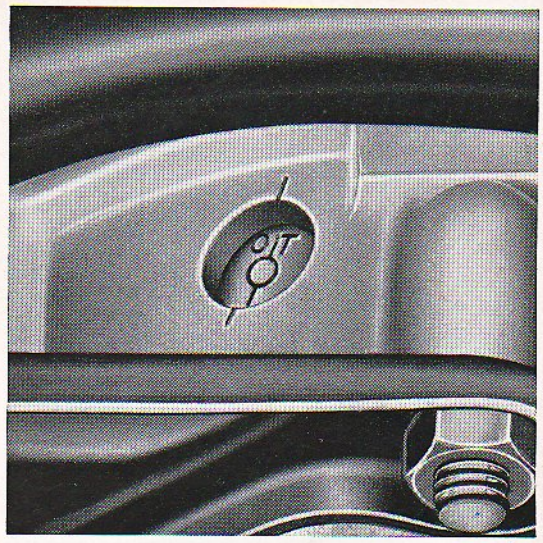
NOTE: The valve chamber always contains a little amount of engine oil which can drip down to the exhaust manifold after removal of the cover on the exhaust side when the engine is inclined. To avoid this inconvenience use an oil collecting tray (recommended for home construction) as shown in Fig. 10 - 9/1.



10 - 9/1

4. Remove screw plug from inspection hole in the transmission housing.

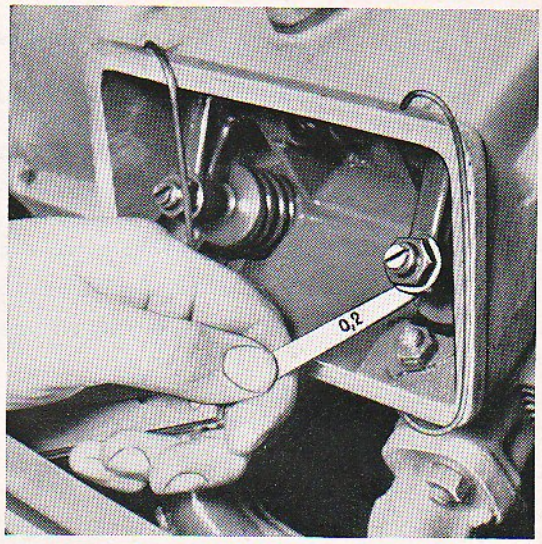
5. Move piston of cylinder No. 1 to the upper dead center position of the compression stroke. To do this, turn over engine until intake valve of cylinder No. 2 just commences to open and the T. D. C. mark on the flywheel is in line with the marking on the transmission housing (Fig. 10 - 9/2).



10 - 9/2

6. Check clearance of intake valve (Cylinder No. 1) by means of a feeler gauge (0.15 mm) (0.006") and

7. check clearance of exhaust valve with feeler gauge (0.20 mm) (0.008"). (Fig. 10 - 9/3)



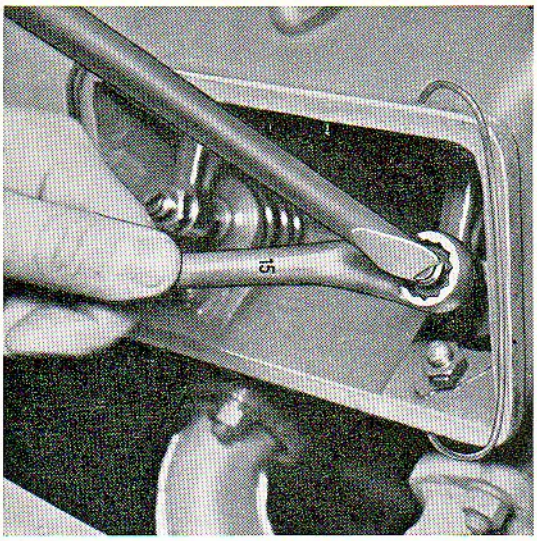
10 - 9/3

If the valve clearance does not conform with the said timing data, it must be corrected as follows:

8. Loosen hexagon nut of adjusting screw SW 15 with socket wrench.

9. By turning the adjusting screw by means of a screw driver adjust clearance according to the respective feeler gauge.

10. Hold fast adjusting nut in the position thus found and tighten jam nut; then check again valve clearance. (Fig. 10 - 10/1)



10 - 10/1

11. Repeat the same operation for valves of cylinder No. 2.

    Piston of cylinder No. 2 is on upper dead center of the compression stroke when the intake valve of the cylinder commences to open and the upper dead center mark on the flywheel is in line with the marking on the transmission housing.

12. Check gaskets on valve chamber cover and, if necessary, replace.

13. Put valve chamber cover in place, screw in spark plugs and reinstall front decoration, or decoration grid rods.

Attention! After each routine inspection carried out on the fastening of the camshaft housing or after each retightening of the fastening nuts or screws take care to check the valve clearance and readjust if necessary!

Repair of threaded holes in aluminium alloys

Not only damaged cylinder heads may be repaired by installing "ENSAT" bushes as described on page 10-2, but these inserts may also be used for all repair work of this kind, for example, for the repair of destroyed or stripped threaded holes of studs in the engine casing, camshaft or transmission housings.

It is now also possible to repair cylinder heads in 250, 400, and 600 cc engines which so far could not be used again when the spark plug threading was damaged, by inserting threaded spark plug bushes of the type "Gripp" ZN 42, type 14/9 or 18/9. The pertinent screwing-in tool is marked "SZ 14" or "SZ 18".

In all cases the procedure of installing is the same as described on page 10-2.

Orders for threaded inserts and the corresponding screwing-in tools should be directed to our Spare Parts Department.

The following threaded holes and spark plug threadings may be repaired by the application of threaded inserts of the "ENSAT" and "GRIPP" types:

Designation Components	Threaded Hole	Designation and Dimension of Screw	Application	Threaded Insert required	Pertinent Turning-in Tool
Housing Bottom Part	M 5	Hexagon Screw M 5 x 8	Oil Plates	Ensat M 5 Steel, hardened, cadmium-plated IN 226	Type "S" Size 500
	M 6	Stud M 6 x 10	Oil Strainer	Ensat M 6 a Steel, hardened, cadmium-plated IN 22 b	Type "S" Size 600
		Stud M 6 x 22	Housing Fastening		
		Stud M 6 x 40	Oil Pump		
Housing Top Part	M 6	Stud M 6 x 15	Chain Case		
		Stud M 6 x 22	Housing Fastening		
	M 8	Stud M 8 x 75	Connect. Engine/ Gearbox	Ensat M 8 Steel, hardened, cadmium-plated IN 22 b	Type "S" Size 800
Cylinder Head	M 6	Stud M 6 x 20	Intake Manifold	Ensat M 6 a Steel, hardened, cadmium-plated IN 22 b	Type "S" Size 600
	M 8	Stud M 8 x 22	Exhaust Flange	Ensat M 8 Steel, hardened, cadmium-plated IN 22 b	Type "S" Size 800
		Stud M 8 x 25	Camshaft Housing		
	M 14x1.25	–	Spark Plug	Gripp 14/9 ZN 42	Type "SZ" Size 14
Camshaft Housing	M 6	Stud M 6 x 12	Chain Case Cover	Ensat M 6 a Steel, hardened, cadmium-plated IN 22 b	Type "S" Size 600
		Stud M 6 x 12	Ventilator Pipe		
		Stud M 6 x 12	Rocker Arm Bolt Locking		
		Countersunk Screw M 6 x 18	Distributor Pipe		
		* Stud M 6 x 15	Vent Plate		
	M 8	M 8 x 22	Fuel Pump	Ensat M 8 Steel, hardened, cadmium-plated IN 226	Type "S" Size 800

* Should the threaded hole centres be displaced in relation to the outer configuration of the casting, the use of insert bushings is not possible.

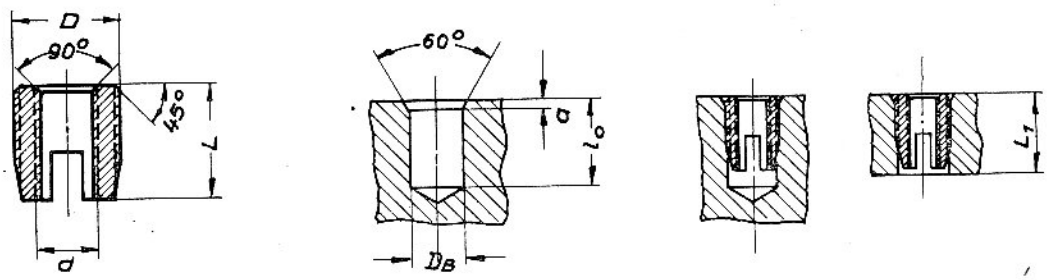
Designation of Components	Threaded Hole	Designation and Dimension of Screw	Application	Threaded Insert required for	Pertinent Screwing-in Tool
Gearbox Housing (LLOYD 600)	M 6	Stud M 6 x 15	Differential Bearing Cap	Ensat M 6 a Steel, hardened, cadmium-plated IN 22 b	Type "S" Size 600
		Stud M 6 x 15	Speedometer Housing		
		Stud M 6 x 22	Gearbox Housing Cover		
	M 8	Stud M 8 x 32	Connection Engine Gearbox	Ensat M 8 Steel, hardened, cadmium-plated IN 22 b	Type "S" Size 800
		Stud M 8 x 60			
	M 10	Stud M 10 x 18		Ensat M 10 Steel, hardened, cadmium-plated IN 22 b	Type "S" Size 1000
Gearbox Housing (LLOYD 400)	M 6	Stud M 6 x 15	Differential Bearing Cap	Ensat M 6 a Steel, hardened, cadmium-plated IN 22 b	Type "S" Size 600
		Stud M 6 x 15	Speedometer Housing		
		Stud M 6 x 15	Holding Bracket/Exhaust		
		Stud M 8 x 18	Rubber Buffer	Ensat M 8 Steel, hardened, cadmium-plated IN 22 b	Type "S" Size 800
		Stud M 8 x 28	Engine/ Gearbox Connection		

For data and references to be taken into account in installing threaded inserts please refer to the indications given on the LM Standards Specifications 8100, Sheets 1 and 2, which follow:

Lloyd Motoren Werke	of steel for use in aluminium alloys **Threaded insert bushes** of steel for use in aluminium alloys	**LMN 8100** Sheet 1

Dimensions in mm

Insert Bush | Hole | Example of Installation



Designation of threaded insert bush Type "ENSAT" for M 8 internal thread (1)

ENSAT M 8 – Steel, hardened, cadmium-plated – IN 22 b

Model Ensat	Type	Internal Thread d	Internal Thread h	External Thread D	External Thread H	External Thread as per DIN	Length L-L_1	Hole Diameter DB	Minimum Depth	Bevel a
IN 22 b	M 5	5	0.8	8	1	517	10	7.12 – 7.24	13	1
	M 6a	6	1	9	1	517	12	8.12 – 8.24	15	1
	M 8	8	1.25	12	1.5	516	15	10.6 – 10.8	18	1.5
	M 10	10	1.5	14	1.5	516	18	12.6 – 12.8	22	1.5

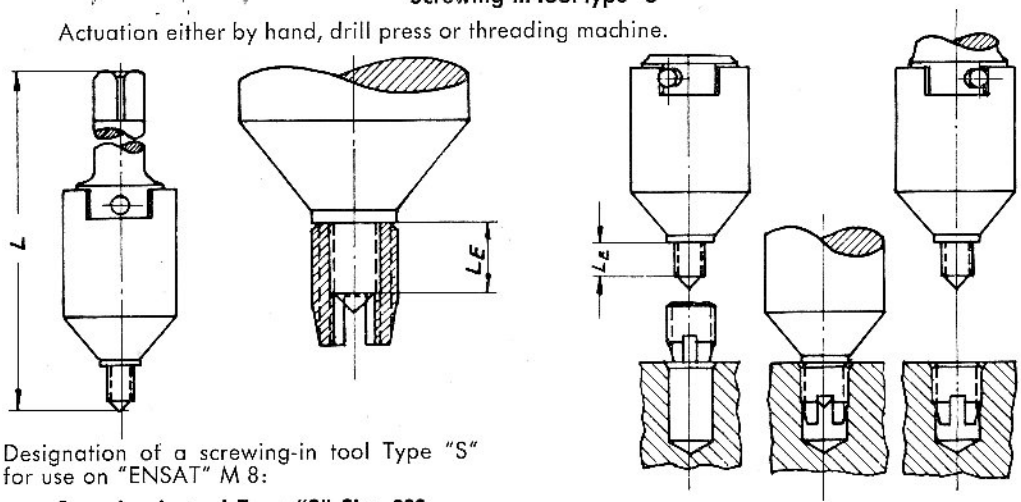
Material: Free-cutting steel 9 S 20 k

(1) Execution: not hardened, hardened, bonderized, chromium-plated, cadmium-plated, nickel-plated.

Tolerance of internal thread as per DIN 13; medium quality.

Screwing-in tool type "S"

Actuation either by hand, drill press or threading machine.



Designation of a screwing-in tool Type "S" for use on "ENSAT" M 8:

Screwing-in tool Type "S" Size 800

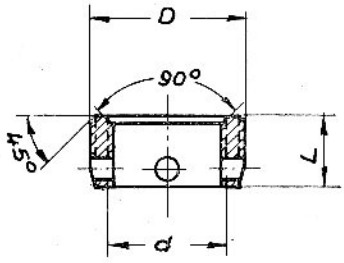
The threaded pin of the screwing-in tool is replaceable and adjustable. The adjustment of the threaded pin must be made so as to ensure that the threaded portion of the pin does not project within the slotted region of the insert.
For proper length to be set for the pin of the tool see table on the right.

Size	for "Ensat"	Adjustable Length LE	Total Length L ca.
500	M 5	5.3	107
600	M 6a	6.1	115
800	M 8	8.0	122
1000	M 10	10.3	141

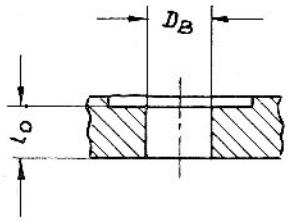
Lloyd Motoren Werke	Self screwing **Threaded spark plug insert bush** of steel for use in aluminium alloys	LMN 8100 Sheet 2

Dimensions in mm

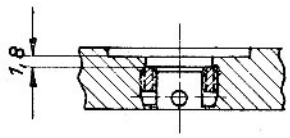
Insert Bush



Hole



Example of Installation



Designation of threaded insert bush type "Gripp" for M 14 spark plug threading:

Gripp 14/9 – ZN 42

Model Gripp	Type	Internal Thread d	h	as per DIN	External Thread D	H	L	Hole Diameter D 8	Thickness of Material LO
ZN 42	14/9	14	1.25	72502	17.5	1.25	9	16.6 +0.05	10.8
ZN 42	18/9	18	1.5	72501	21.5	1.25	9	20.6 +0.05	10.8

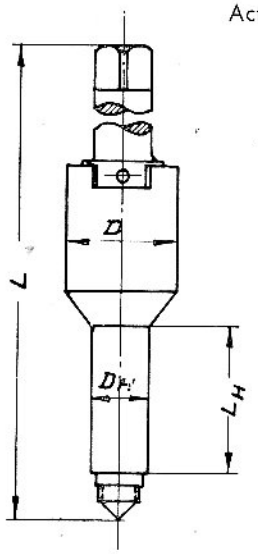
Material: Free-cutting steel 9 S 20 k

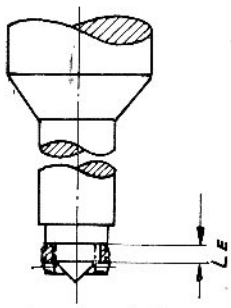
Execution: case-hardened and cadmium-plated

Tolerance of the internal thread as per DIN 72 501 or 72 502

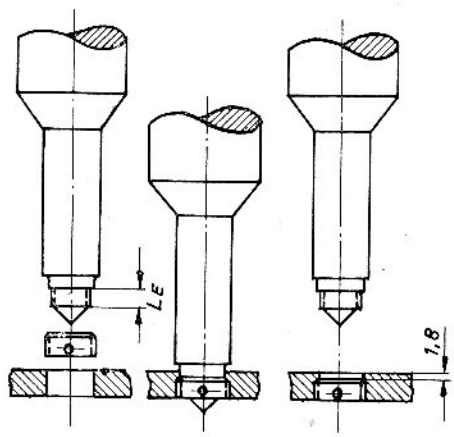
Screwing-in tool type "SZ"

Actuation either by hand, drill press or threading machine





The threaded pin of the screwing-in tool is replaceable or adjustable, but care must be taken that it does not cover the side holes of the Gripp" tool to allow metal chips to escape. See table below.



Screw in "Gripp" until its upper edge is 1.8 mm below the metal surface.

Designation of a screwing-in tool Type "SZ" for "Gripp" 14/9:

Screwing-in tool type "SZ" Size 14

Size	For Spark Plug Inserts	Length of Throat LH	Diam. of Throat DH	Total Length L abt.	D	Adjustable Length of threaded Pin LE
SZ 14	14/9	71	20	224	39	max. 5.0
SZ 18	18/9	71	25	241	46	max. 5.0

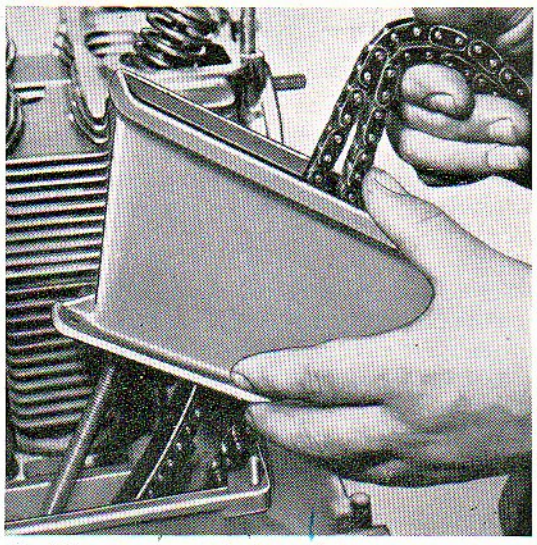
Dismantling and Reinstalling Cylinders

The following special tools are required:

WO 30 – Remover for flywheel and ventilator wheel
WO 31 – Piston ring compressor.

Dismantling

1. Proceed as indicated in Sub-group "Cylinder Heads and Valves", Section: Dismantling and reinstalling cylinder heads, Item 1 to 10.
2. Remove chain case after loosening the four hexagon nuts SW 10. Secure chain from falling down (Fig. 11 - 1/1).



11 - 1/1

3. Pull off cylinder.
   Cylinders which are burned fast on the crankcase seat should be loosened by gently striking with a rubber hammer!
4. Remove cylinder foot gasket.

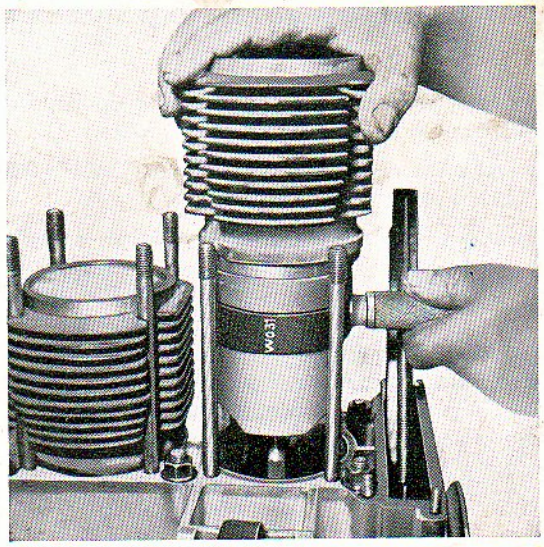
Installation

Install in the reverse order, taking care of the following points:

1. Check wearing face of piston, finish of piston rings and seat of piston pin.
2. Check cylinder for wear by means of a dial gauge; if necessary, install replacement cylinder with pertinent piston (pay attention to colour identification). For more details see section "Checking cylinders".

Attention! Be sure that in an engine only cylinders (with their respective pistons) with the same nominal diameter are installed. The replacement of a single cylinder with its piston by an oversize cylinder is not permitted.

3. Clean cylinder cooling fins from oil and dirt.
4. Clean seating areas of cylinder head and crankcase. Any rests of gaskets on the cylinder foot and crankcase joint must be removed.
5. Give piston, piston rings, and piston pin a light coat of oil.
6. Place piston ring compressor WO 31 over the ring portion of the piston, simultaneously turning piston ring so that ring joints are staggered by 120°.
7. Renew cylinder foot gasket, oil cylinder working area and put in place cylinder (Fig. 11 - 1/2).



11 - 1/2

8. Reassemble engine with new gaskets, at the same time adjusting camshaft, valve and ignition timing according to instructions. Take care in tightening screws to apply the proper torque.

Checking cylinders

The following special service tool will be required:

WO 46 – Adjustment ring for cylinder bores 77 mm dia. (3.0315")

Cylinder diameter:

Series	77.0 mm dia. (3.0315")
1st oversize	77.5 mm dia. (3.0512")
2nd oversize . . .	78.0 mm dia. (3.0709")

In new cylinders the clearance between piston and cylinder walls will be:

0.046 to 0.054 mm (0.0018 – 0.0021")

Admissible wear . . . . . 0.16 mm (0.0063")

To achieve unobjectionable performances it is good practice to determine the clearance between wall and piston by controlling the dimensions of cylinders and pistons. Measurings taken by means of a feeler gauge give no correct result.

When measuring the rate of wear on cylinders with oversizes I and II the adjustment ring 77 mm. dia. can be used to obtain proper zero position on the dial indicator.

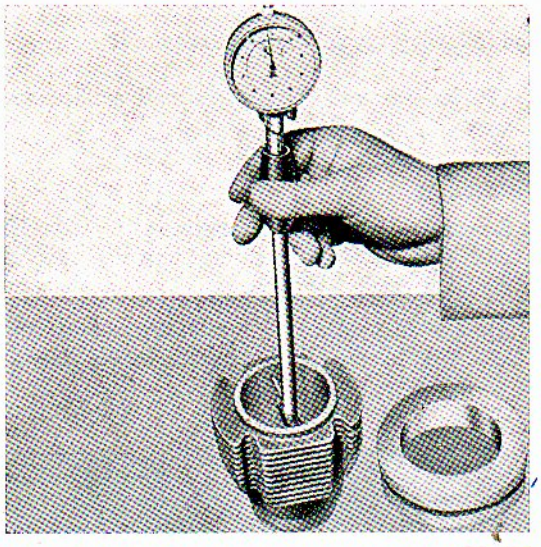
The cylinder-bore dial gauge is to be applied in the cylinder at three measuring points as follows:

a) first measuring point 10 to 15 mm. (0.0394 – 0.591") below upper edge of cylinder

b) second measuring point at mid-height of cylinder

c) third measuring point 10 to 15 mm (0.394 – 0.591") above lower edge of cylinder.

Two measuring must be taken – each displaced at 90° – in each measuring plane (Fig. 11 - 2/1). If it is found that – with due consideration to the result obtained in measuring the piston – the piston clearance approches



11 - 2/1

the admissible wear, the respective cylinder with its piston should be renewed or replaced by exchangeable parts.

In addition to the measuring of the rate of wear, any increased oil consumption of the engine may be a sign that cylinders and pistons apparently must be changed. Generally it may be assumed that with an oil consumption exceeding 1 litre per 100 km. (0.22 imp. gall. per 621.4 miles) the engine should be overhauled and the cylinders and pistons replaced.

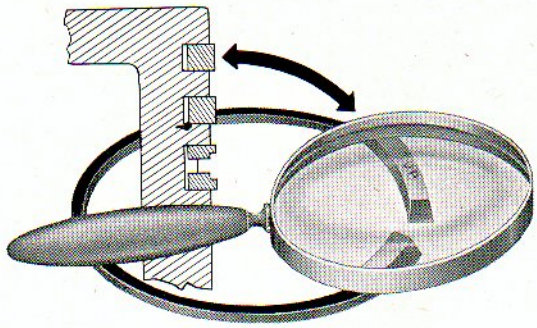
It must be taken into account that in an engine only cylinders and pistons of the same size or of the same colour identification may be installed. For more details on the correct sizes of pistons and cylinders within the different size ranges see under Section "Identification of pistons and cylinders".

Dismantling and Reinstalling pistons

General

The two types of piston of Messrs. Mahle & Karl Schmidt (KS) used in the car are light-metal pistons with steel inserts of the autothermic type.

Both types have a flat head and carry three piston rings. The upper piston ring is a so-called "Taper Ring", that means, the ring face bearing against the cylinder wall is tapered by some angular minutes to accelerate the running-in procedure. Since the slight taper cannot be detected with the naked eye, the rings have on its top side the mark "top" or "oben". Be sure that the rings are inserted so that this marking shows towards the piston head (Fig. 11 - 3/1).



11 - 3/1

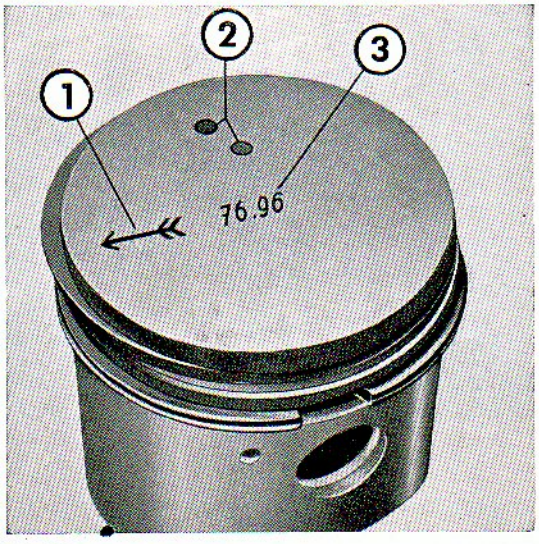
The second ring is a standard compression ring, the third ring being an oil scraper.

The rings have the following dimensions:

1st compression ring	77 x 70.2 x 2.5 mm
2nd compression ring	77 x 70.2 x 2.5 mm
Oil scraper	77 x 70.2 x 4.0 mm

On both piston types the piston pins are displaced at a distance of 1.5 mm from centre line of piston. Therefore, the pistons carry on their tops, besides the indication of the nominal dimension, a cut-in arrow to designate the true fitting position of the piston. In fitting be sure that the arrow points to the exhaust side of the engine.

Thus, it is achieved that the piston wall with its shorter distance from the displaced piston pin centre is always directed towards the thrust side of the cylinder. Thrust side of cylinders is on the right seen from the flywheel side! (Fig. 11 - 3/2).



11 - 3/2

Attention! Engines of older type are partly fitted with pistons (Mahle) whose identification marks differ from those existing on the new types. In case such a piston must be dismantled and refitted, the following instructions must be followed:

If the arrow on the piston top is in line with the pin axis, fit piston so that the arrow points to the belt pulley side af the engine.

If, instead, the arrow is arranged perpendicularly to the pin axis, it always points to the exhaust side.

The piston pins have cylindrical inside bore (standard form) and the following dimensions:

Outer diameter . .	20.000 – 0.006 mm (.7874 – 0.002")
Inner bore	14 mm (0.551")
Length	63 mm (2.48")

The pins in the connecting rod and piston eye are of the floating type.

To enable the proper size of piston pin to be determined, the piston carries a colour mark inside at the pin eye – and the piston pin in its inside bore.

Pistons and pins should always show the same colour marks!

Colour	Piston Pin Dia. mm	Piston Eye Dia. mm	Clearance Piston Pin/Piston Eye
white	19.997–20.000 (0.78728–0.78740")	19.999–20.002 (0.78736–0.78748")	0.001 (0.00004") Pin thicker than bore – 0.005 (0.0002") Pin thinner than bore
black	19.994–19.997 (0.78716–0.78728")	19.996–19.999 (0.78724–0.78736")	0.001 (0.00004") Pin thicker than bore – 0.005 (0.0002") Pin thinner than bore

At room temperature (20° C = 68° F) the pin can be pushed in with moderate finger pressure. However, in order to avoid any inappropriate pressure, the piston should be heated on a hotplate or in an oil bath to abt. 50° C (122° F), before the piston pin is fitted.
The clearance between connecting rod bush and piston pin is 0.017 – 0.029 mm (0.0007 – 0.001").

Key to Fig. 11 - 3/2:

1 – Arrow gives fitting position
2 – Coloured points indicate size of piston
3 – Cut-in nominal diameter

	Connecting Rod Bush	Piston Pin	Clearance
New	20.017 – 20.023 mm dia. (0.7881" – 0.7883")	19.994 – 20.000 mm dia. (0.7872" – 0.7874")	0.017 – 0.029 mm (0.0007" – 0.0001")
Admissible wear	20.038 mm dia. (0.7889")	19.988 mm dia. (0.7869")	0.05 mm (0.002")

If clearance are nearing the admissible wear of 0.05 mm (0.002"), piston pin and connecting rod bush should be replaced. For more details see section "Replacing connecting rod bush". No oversize piston pins should be used.
The piston pins are secured inside of piston by round wire locks from moving out.
The complete piston weighs 410 ± 5 g (0.904 lb. ± 0.176 oz.). The difference in the piston weights of a crankshaft shall not exceed 10 g (0.353 oz.).

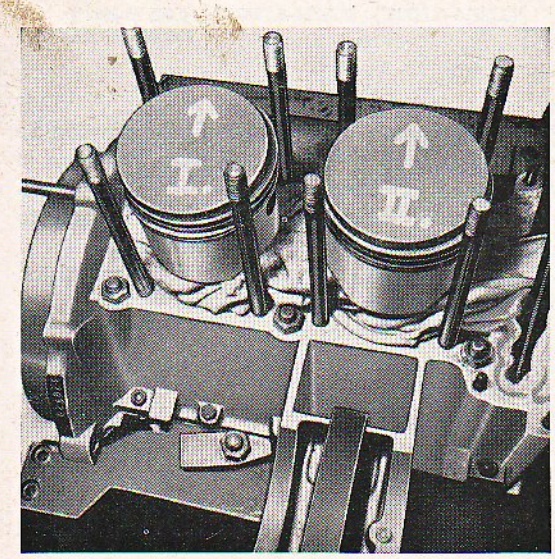
Dismantling

The following special service tools are required:

WO 30 – Remover for flywheel and ventilator wheel
WO 31 – Piston ring compressor
WO 32 – Piston pin remover
WO 33 – Piston pin drift
WO 53 – Piston ring pliers

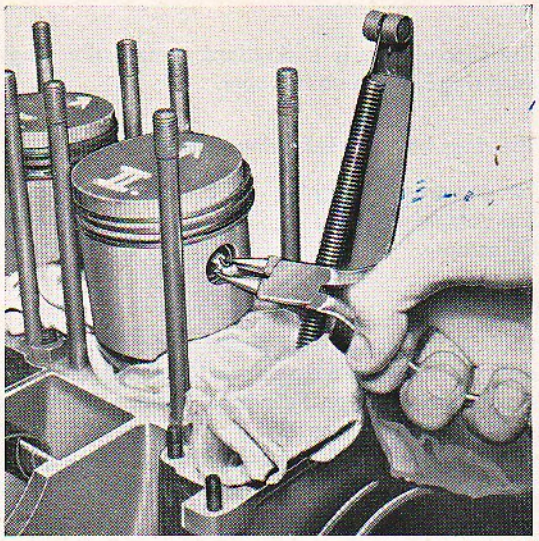
When working on a piston always take care to cover the engine casing by a rag to protect it from getting dirtied and to prevent small parts from falling down into the engine!

1. Proceed as under section "Dismantling and Reinstalling cylinders", Dismantling, Items 1 – 4.
2. Prior to dismantling mark pistons to avoid mixing them up in reinstalling them and to ensure correct fitting position (Fig. 11 - 4/1).
   Piston I – flywheel side; arrow (points to the exhaust side).



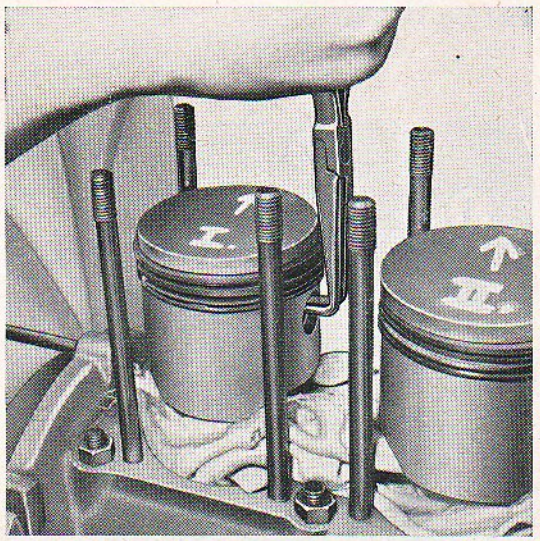
11 - 4/1

3. Take out round wire locks with pointed pliers (Fig. 11 - 4/2).



11 - 4/2

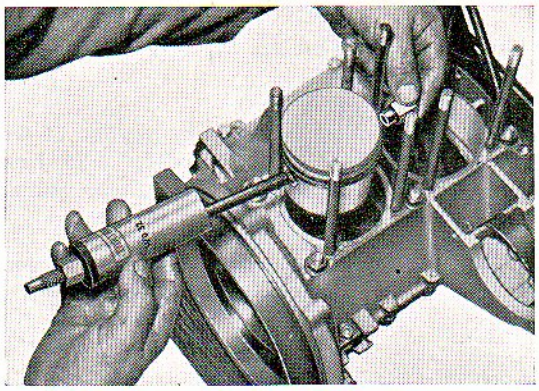
For inner locking ring use bent pointed pliers (Fig. 11 - 4/3).



11 - 4/3

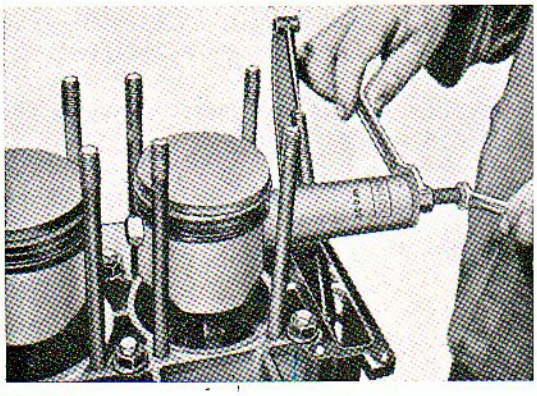
4. Any existing carbon residue liable to handicap the withdrawal of the piston pin, must be removed cautiously.

5. Apply piston pin remover WO 32 (Fig. 11 - 5/1).



11 - 5/1

6. Pull out piston pin (Fig. 11 - 5/2). Take off piston.



11 - 5/2

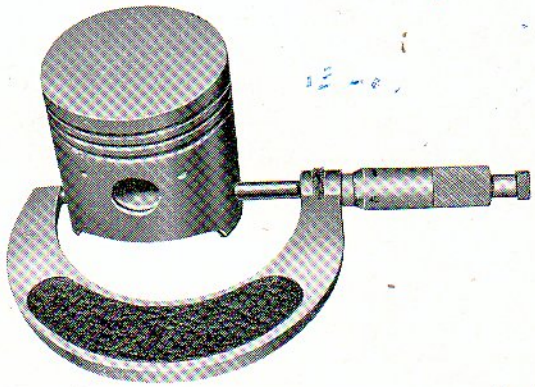
7. If necessary, remove piston rings with piston ring pliers WO 53 (Fig. 11 - 5/3).

11 - 5/3

Installation

Installation must be done in the reverse order by taking care of the following points:

1. Clean piston in gasoline used for cleaning purpose. Scrape off carbon deposits on piston top with flat scraper, smoothen piston top with emery cloth and following this operation polish with polishing cloth. Remove carbon residues in way of the piston rings as well as in the piston grooves with care. When cleaning the piston any removal of metal should be absolutely avoided.
2. Check whether piston skirt bears uniformly. Remove oil coke only by means of corondum stone immersed in oil.
3. Verify piston for wear. For this operation measure piston pin diameter at the end of the piston skirt squarely to the piston pin axis (Fig. 11 - 5/4).



11 - 5/4

The height of the measuring point to determine the nominal measure of the piston differs on both piston types.

Mahle-piston = measuring point 14 mm (0.551") from lower edge of piston

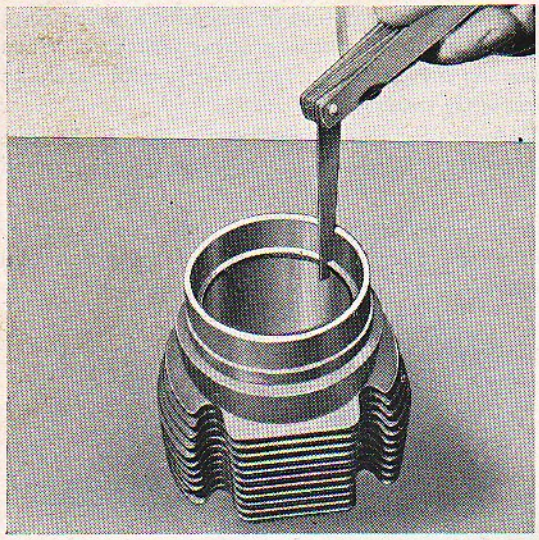
KS-piston = measuring point 6 mm (0.236") from lower edge of piston

Note: In the case of repair measuring of the piston to determine the piston clearance can be effected with sufficient accuracy by means of a micrometer.

If the clearance has to be checked with greatest accuracy it is necessary to measure the piston in an appropriate fixture with the help of a dial indicator. If the measurement of piston and cylinder shows that the piston clearance is nearing the allowable wearing limit, piston and cylinder should be replaced or exchanged in common.

Attention! Be sure that only cylinders (with pertaining pistons) of the same nominal diameter are fitted. It is not permitted to replace a single cylinder with its piston by oversize parts. Under circumstances a damaged piston whose cylinder shows no signs of wear or damage may be replaced by a new piston of the same nominal diameter and the same paint marking. Pistons, whose pertinent cylinders show-down traces should be replaced only together with the cylinder.

4. Check piston rings for wear:
   a) Measure ring-gap clearance. For this operation insert piston ring into the cylinder at a distance of 20 to 25 mm (0.787"–0.984") from the lower edge of cylinder, put it in true horizontal position with the piston and measure gap by means of feeler gauge (Fig. 11 - 6/1).



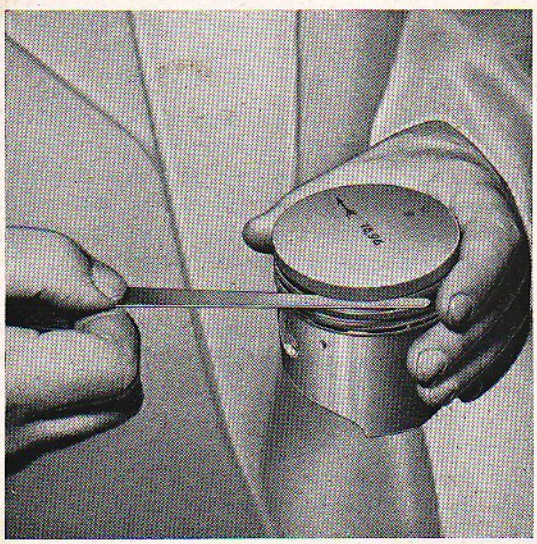
11 - 6/1

With new rings the piston ring gap will be:

compression rings 0.30 to 0.45 mm (0.0118–0.0177")
oil scraper ring 0.25 to 0.40 mm (0.0098–0.0157")

As allowance for wear max. 0.95 mm (0.0374") is admissible for all rings.

   b) Measure ring-groove clearance. Put piston rings compressor WO 53 in place on the piston and measure groove clearance with feeler gauge. (Fig. 11 - 6/2).



11 - 6/2

On new rings the ring-groove clearance will be:

compression rings 0.035–0.072 mm (0.0014–0.0028")
oil scraper ring 0.025–0.052 mm (0.001– 0.002")

The max. admissible limit for wear is abt. 0.1 mm (0.0039") for all rings.

Attention! Pay attention to the fitting position of the upper piston ring. Marking "oben" or "top" must show forwards piston top. For all other rings it is of no matter how the rings will be fitted in place.

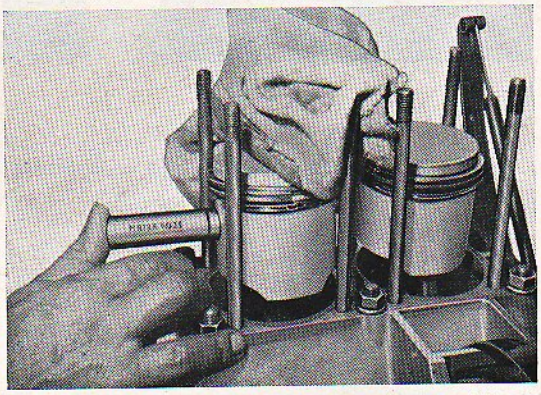
First put in place oil scraper ring, thereafter, second compression ring and, finally, first compression ring.

5. Rotate piston ring when fitted so that the joints are staggered at 120°.

6. Insert locking wire ring for piston pin, which, after installation of the piston in cylinder I, must be directed to the chain side, with pointed pliers.
   As far a piston of cylinder II is concerned proceed in the reverse order. First put in place locking ring which shows, when fitted, to the flywheel side.

7. Check piston pin. For fitting instructions and pin fits see page 11 - 3.

8. Oil piston pin and push it into the heated piston until it bears against the locking ring. To do this use fitting drift WO 33 (Fig. 11 - 6/3).



11 - 6/3

9. Insert second locking ring. Make sure that all locking rings are properly placed in their groove and have sufficient elastic tension.

10. Oil piston and rings and put in place in the cylinder by using compressor WO 31.

11. Assemble engine with new gaskets. Adjust camshaft, valves, and ignition according to instructions.

Indentification of pistons and cylinders

Pistons

Four different piston sizes are fitted in series engines; their respective nominal diameters are cut-in on the piston head and marked by different colour points:

Group	Piston Nominal Size	Colour
1	76.94 (3.0291")	yellow
2	76.95 (3.0295")	blue
3	76.96 (3.0299")	red
4	76.97 (3.0303")	green

Within each of these four groups of colour markings the pistons are subdivided: All pistons built with a plus-tolerance of max. 0.04 mm (0.00016"), are marked by **one** colour point, those built with a minus-tolerance of max. 0.005 mm (0.0002") with **two** colour points.

	Nominal Size		Colour Points
Example:	76.96 (3.0299")	+ Tolerance 76.960 – 76.964 (3.0299 – 3.0301")	1 x red
		– Tolerance 76.955 – 76.959 (3.0297 – 3.0299")	2 x red

Cylinders

In sorting out cylinders proceed in the same way. Due to differences in the rough finish there are four cylinder groups whose standard diameters differ in every case by 0.01 mm (0.0004") after precision boring and honing.

Therefore, in finishing the cylinder bore, there are cylinders whose basic measures are determined and marked in the following manner:

Group	Cylinder-Basic Measure	Colour
1	76.99 (3.0311")	yellow
2	77.00 (3.0315")	blue
3	77.01 (3.0319")	red
4	77.02 (3.0323")	green

To maintain the specified clearance from 0.046 to 0.054 (0.0018–0.0021") in pairing the cylinders with pistons, these four cylinder groups – in the same manner as the pistons – are subdivided, that is, cylinders built with a plus-tolerance of max. 0.004 mm (0.00016") are marked with **one** colour point, those with a minus-tolerance of max. 0.005 mm (0.0002") with **two** colour points.

	Basic Measure		Colour Points
Example:	77.01 (3.0319")	+ Tolerance 77.010 – 77.014 (3.0319 – 3.0320")	1 x red
		– Tolerance 77.005 – 77.009 (3.0317 – 3.0318")	2 x red

When fitting pistons and cylinders it will be necessary to ensure that pistons and cylinders must show the **same colour markings** and the **same number** of colour points.

	Colour Marking	Cylinder	Piston	Clearance
Example:	2 x blue	76.995 – 76.999 (3.0313 – 3.0314")	76.945 – 76.949 (3.0293 – 3.0295")	0.046 – 0.054 (0.0018 – 0.0021")
	1 x red	77.010 – 77.014 (3.0319 – 3.0320")	76.960 – 76.964 (3.0299 – 3.0301")	0.046 – 0.054 (0.0018 – 0.0021")
	2 x green	77.015 – 77.019 (3.0321 – 3.0322")	76.965 – 76.969 (3.0301 – 3.0303")	0.046 – 0.054 (0.0018 – 0.0021")

Example of **smallest** clearance:

Cylinder . . .	77.010 mm (3.0319") dia.	1 x red on piston and cylinder
Piston	76.964 mm (3.0301") dia.	
Clearance . . .	0.046 mm (0.0018")	

Example of **largest** clearance:

Cylinder . . .	77.019 mm (3.0322") dia.	2 x green on piston and cylinder
Piston	76.965 mm (3.0301") dia.	
Clearance . . .	0.054 mm (0.0021")	

Oversizes

For repair and replacement purpose there are two oversizes of pistons and cylinders.
Pistons and cylinders of the 1st oversize are by 0.5 mm (0.0197") dia. larger, those of the 2nd oversize are by 1.0 mm (0.0394") dia. larger than the four actual nominal or basic measures on the series part.

The two oversizes can be detected by their nominal measures stamped on piston heads.
In addition to the colour points oversize pistons are provided with **one** (1st oversize) or **two** (2nd oversize) white lines on the upper cooling fin.

By taking the greater basic or nominal dimension as basic, the tolerances and identification marks on oversize cylinders and pistons are the same as with series units.

Replacing Connecting Rod-Bush
(with engine dismantled)

The following special service tools are required:

WO 35 – 1-3 Remover and installer for connecting rod bushings.

WO 34 – Reaming device for connecting rod bushings.

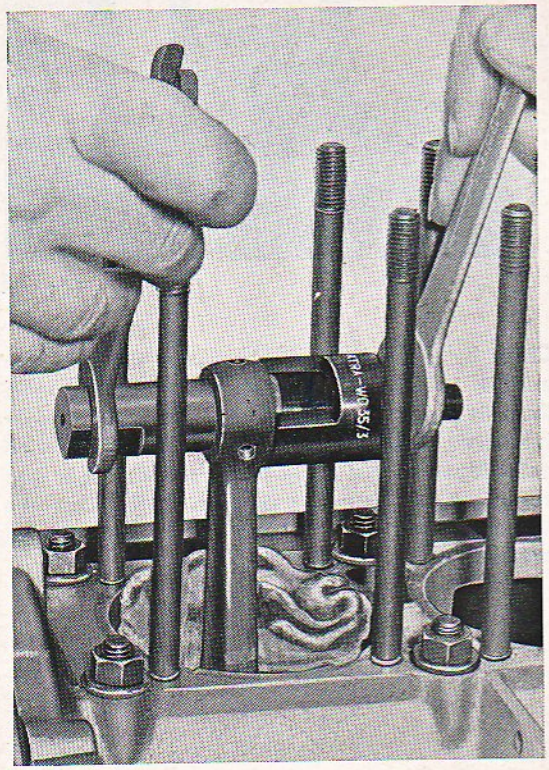
WO 34/7 – Guide bars for.

Reamer "Hunger" P 19.5 – 21.5 mm (0.7677 – 0.8465") dia.

Connecting rod bushings can be replaced after removal of cylinders and pistons, with the crankshaft fitted in place.

Dismantling

1. Cover crankcase with rag.
2. Apply device WO 35/1 and 3 in order to force out the old connecting rod bushing (Fig. 11 - 9/1).



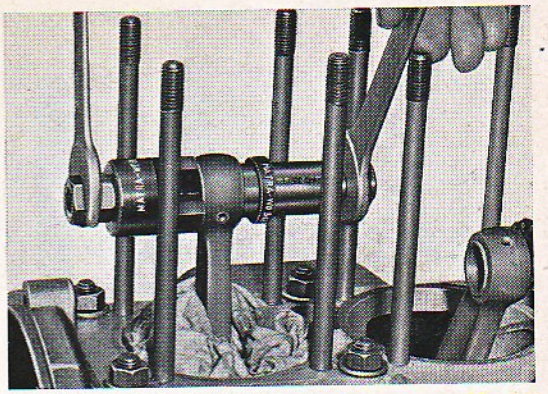
11 - 9/1

Installation

1. Insert new connecting rod bushing by means of tool WO 35/1-3 until it bears against the off-set ring (WO 35/2) at the small end of the connecting rod.

   By turning the pressure bolt until it strikes against the off-set ring at the small end of connecting rod a uniform distance of the bushing on both sides is thus obtained in the connecting rod eye.

   Be sure in inserting not to tilt connecting rod bushing! (Fig. 11 - 9/2).

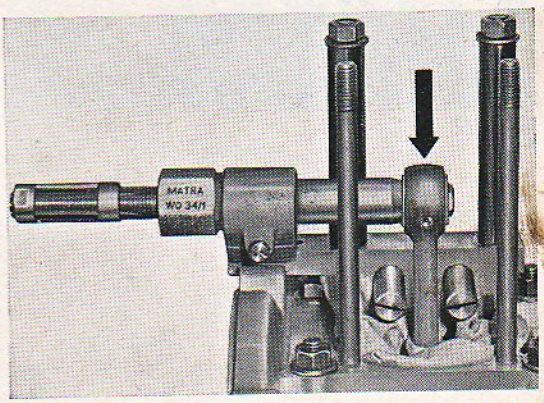


11 - 9/2

2. The three lubricating holes in the small end of the connecting rod are to be drilled through the bushing by means of twist drill of 3.5 m/dia.
3. On the inner side of the connecting rod bushing countersink slightly the three holes with a 8 mm spherical cutter in order to provide for the necessary oil pockets. Round off well countersunk holes so as to avoid interruption of the oil film.

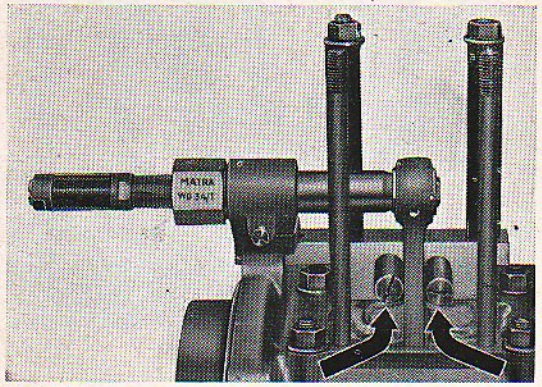
Reaming procedure

1. Carefully clean finished surface of engine casing top part.
2. Put reaming device WO 34 over the tie-rods of the cylinder head fastening and align with the taper portion at the reamer head (Fig. 11 - 9/3).



11 - 9/3

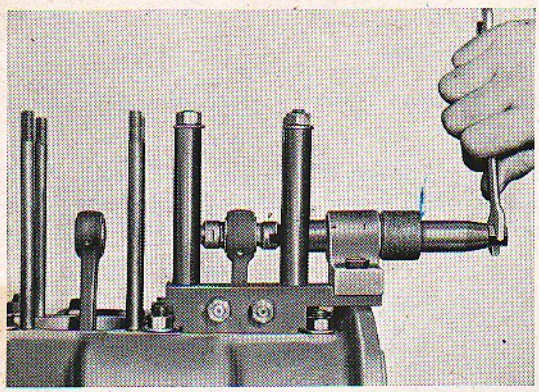
3. Immobilise connecting rod so that it is in line with the reaming tool axis by turning the two eccentric pins (Fig. 11 - 10/1).



11 - 10/1

Attention! Careful alignment and immobilisation of the connecting rod is of decisive importance for the results of the subsequent reaming procedure.

4. Insert reamer and ream bushing. Pull reamer through evenly and with large feed, turning it slightly.

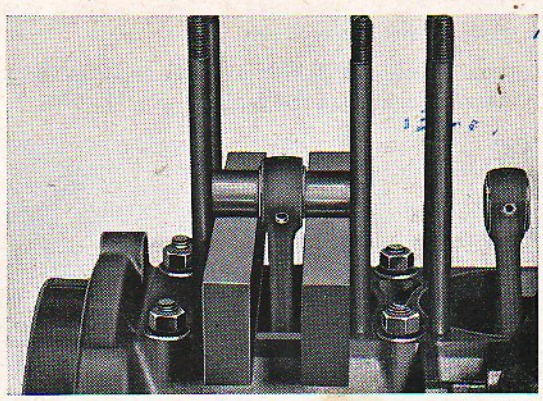


11 - 10/2

5. Oil piston pin and check clearance. If necessary, repeat reaming procedure until the proper clearance is attained.
   For data relating to connecting rod bushing and piston pin see Section "Dismantling and reinstalling piston".

6. Dismantle reaming device and put both guide bars. WO 34/7 on the resurfaced area of the crankcase top part on both sides of the connecting rod.

7. Put piston pin in the connecting rod bushing and turn crankshaft until the piston pin, which must project equally from both sides of the connecting rod eye, bears on the ground edge of the guide bar. (Fig. 11 - 10/3).



11 - 10/3

8. Check by the light-gap test whether the bolt runs parallel to the crankshaft in its new bushing and, thus, the proper location of the piston in the cylinder is ensured. Should the piston pin not bear evenly on both edges of the guide bars or if the light gap varies, no parallelism is existing. In this case the bushing should be replaced again and reamed precisely.

Disassemble and reassemble crankcase

Engine is removed. Camshaft housing, cylinder heads, cylinders and pistons, chain case, belt pulley and flywheel are removed. (For proper succession of jobs see individual sections).

The following special tools will be required:

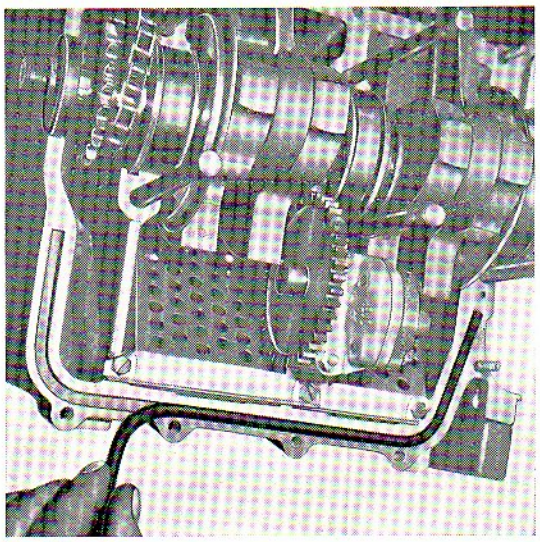
WO 39 – Assembly tool for radial seal (flywheel side)

WO 40 – Assembly tool for radial seal (belt pulley side)

WO 44 – Guide bolt remover.

Disassembling

1. Remove clamp bracket for chain. For more details see respective section.
2. Loosen hexagon nuts SW 10 on crankcase flange joints.
3. Loosen hexagon nut SW 15 of tie-rods for crankcase fastening.
4. Loosen crankcase top part from bottom part with a rubber hammer and remove.
   Do not drive sharp tools such as screw drivers in the parting line of the crankcase!
5. Remove radial seals for crankshaft.
6. Remove rubber sectional cord.



12 - 1/1

7. Remove oil strainer. For more details see Subgroup "Engine Lubrication".
8. Dismantle oil pump. For more details see Subgroup "Engine Lubrication".
9. Dismantle crankshaft. For more details see Subgroup "Crankshaft".
10. Unlock and loosen fastening screws SW 9 on oil plates. Remove oil plates.

Reassembling

Reassembling must be made in the reverse order by taking care of the following points.

1. Clean crankcase jointing faces from old sealing material with an appropriate solvent. The jointing faces must be perfectly plane and should show no ridges.
2. Check crankcase for external damage and formation of cracks.
3. Flush out oil passages and blow through with compressed air.
4. Check whether fitted bolts in the bottom part of crankcase are existing.
5. Tighten fastening screws on oil plates at a torque of 0.6 mkg.
6. Check tie-rods of cylinder head and crankcase fastenings for tight fit. Torque, 3 mkg.
7. Check bearing surface of antifriction bearings of the crankshaft in the casing.
   Bright bearing surfaces are a sign that bearings in the crankcase have lost their tight fit and outer rings of the bearings have turned in the casing. In this case it is not permitted to restore the specified tight fit of the bearings by resurfacing the crankcase seating areas or by knurling bearing seats owing to the eventual risk of the anti-friction bearings being subjected to high pressure and thus becoming unserviceable in a short time while screwing together both crankcase parts. If it is stated that the outer ring of the bearing are moving, top and bottom part of crankcase must be replaced.
8. Replace sectional rubber cord.
9. Clean, check, lubricate crankshaft and install it with properly placed chain. For more details see Subgroup "Crankshaft".

10. Insert new radial seals.

Attention! Use only special seals of latest type.

Flywheel side: Seal 56 x 72 x 10 with left-hand turn grinding, Part-No. 13 13 031 – 1.

Belt pulley side: Seal 35 x 47 x 9 with right-hand turn grinding, Part-No. 13 13 030 – 1.

For more details see Subgroup "Crankshaft".

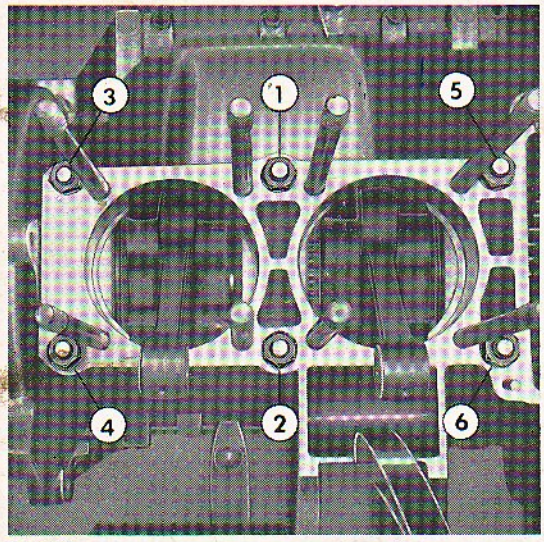
11. Clean oil pump and reinstall with new foot packing. (Check, giassemble, and reassemble oil pump. See Subgroup "Engine Lubrication").

Attention! Make sure that gearwheels of oil pump have small clearances.

If gears are fitted too tight, a second foot packing may be placed underside oil pump.

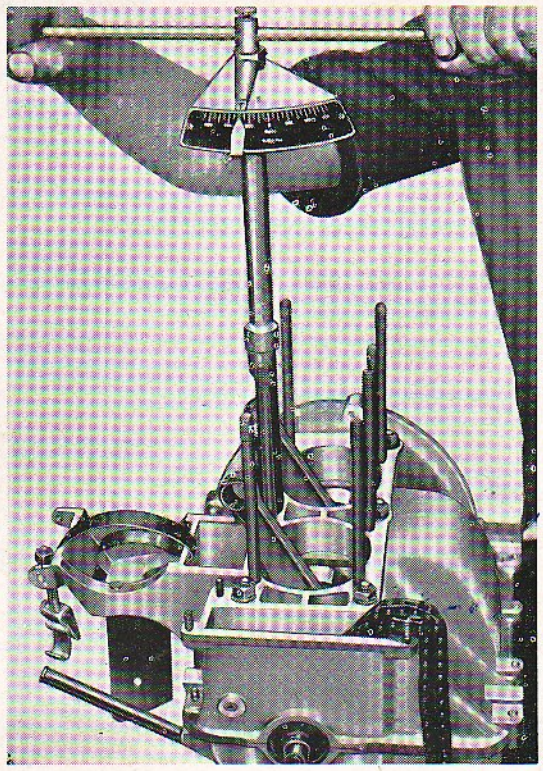
12. Give jointing surface of crankcase parts an even and thin coat of fluid "Wevolic"-luting compound.

13. Joint together both crankcase parts, place washers on tie-rods and tighten nuts provisionally at a torque of 1.5 mkg in the sequence as shown in Fig. 12 - 2/1.



12 - 2/1

Tighten nuts in the same order at a torque of 3 mkg. (Fig. 12 - 2/2).



12 - 2/2

13. Check crankshaft for easy running and check whether gearwheels of oil pump have the necessary clearance, even after tightening up both crankcase parts.

14. Screw both crankcase parts to the outer flange.

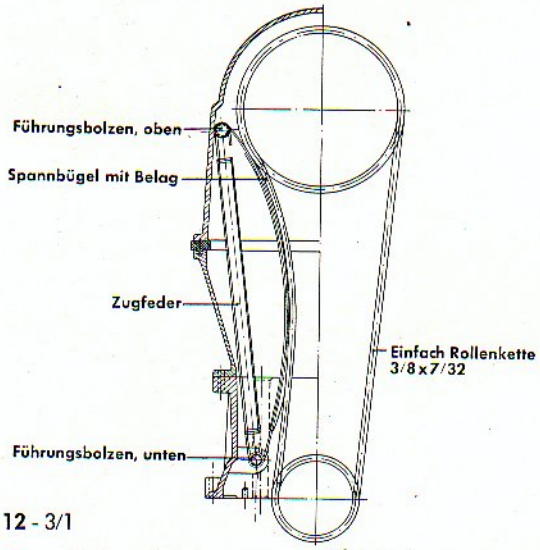
15. Place both radial seals in running position by using fitting tools WO 39 and WO 40.

16. Mount clamp bracket for timing chain. Install only clamp brackets with sufficient initial tension, if necessary, take a straight clamp bracket, setting it under initial tension by hand. For more details see Section "Dismantling and reinstalling clamp bracket for timing chain".

Dismantling and reinstalling clamp bracket for timing chain
(with engine dismantled)

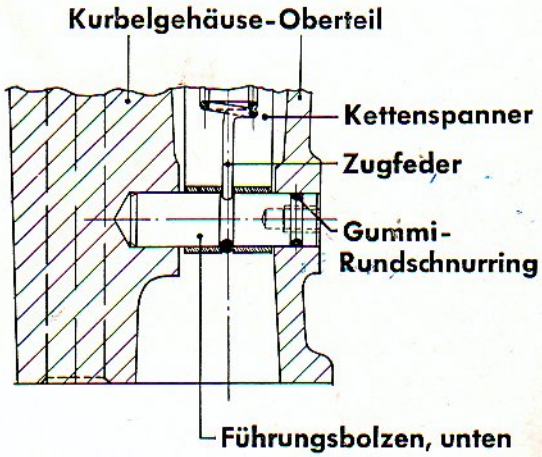
General

The timing chain is automatically maintained under tension by a flexible contact rail (clamp bracket). The chain tightener consists of a leaf spring lined with noise dampening material and is set under initial tension by a "Wendel" spring. The tensioning device acts on the back of the "slack" part of the chain.
The clamp bracket is suspended at bottom by the guide bolt arranged on top of crankcase so that it can move freely and adapt itself to the chain motion. In the upper and lower guide bolts is placed the tensioning spring which at the same time protects both bolts against slackening. Rubber sealing ring on the lower guide bolt serves to provide a tight seal against any escape of oil (Figs. 12 - 3/1 and 2).



12 - 3/1

Führungsbolzen, oben	=	guide bolt, top
Spannbügel mit Belag	=	clamp bracket with lining
Zugfeder	=	tensioning spring
Führungsbolzen, unten	=	guide bolt, bottom
Einfach Rollenkette 3/8 x 7/32	=	single roller chain 3/8 x 7/32

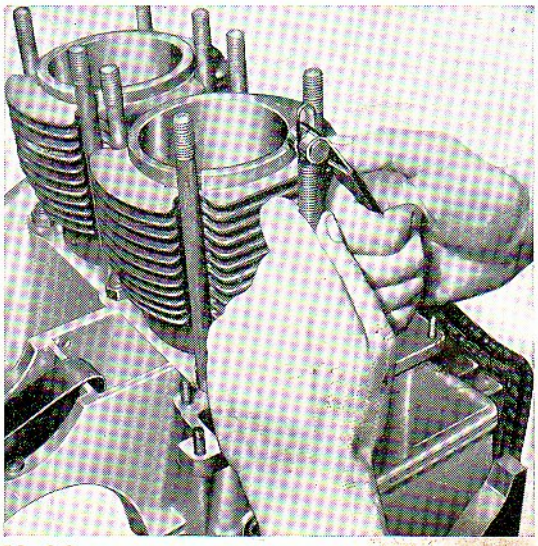


12 - 3/2

Kurbelgehäuse-Oberteil	=	Crankcase top part
Kettenspanner	=	chain tightener
Zugfeder	=	tensioning spring
Gummi-Rundschnurring	=	Circular-shaped rubber ring
Führungsbolzen, unten	=	Guide bolt, bottom

The following special service tools will be required:
WO 44 – Guide bolt remover.

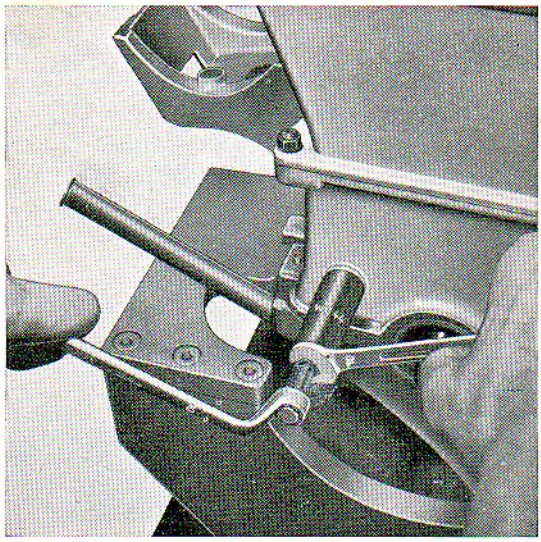
The tool WO 44 comprises two spindles of different threads. Spindle M 5 belongs to the guide bolt of latest type (with circular-shaped rubber ring).
Spindle M 6 is needed for removing guide bolts of older types (without circular-shaped rubber ring).



12 - 3/3

Dismantling

1. Unhook tensiong spring at upper guide bolt. (Fig. 12 - 3/3)
2. Unhook tensioning spring at lower guide bolt. Take out tensiong spring.
3. Remove lower guide bolt with tool WO 44. Remove clamp bracket. (Fig. 12 - 3/4)



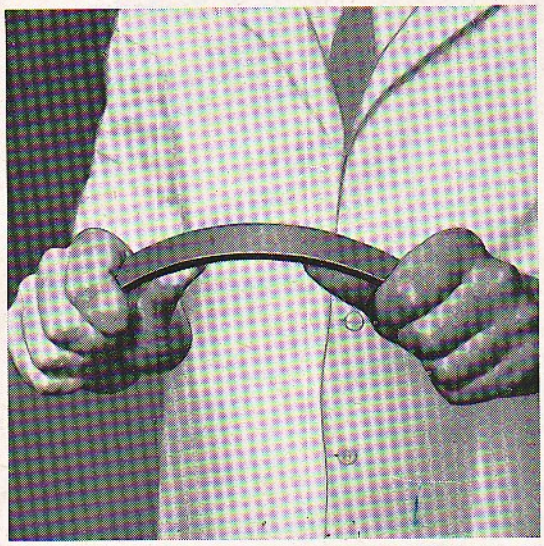
12 - 3/4

Installation

Installation must be made in the reverse order by taking care of the following points:

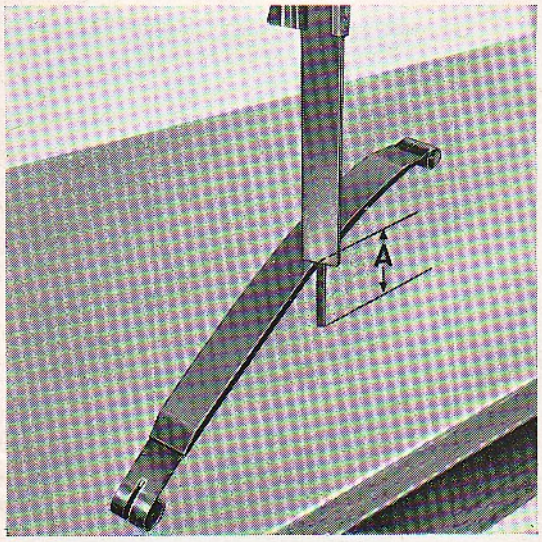
1. Check running face of clamp bracket for wear. If wear can be clearly seen, replace clamp bracket.

Attention! From engine No. 335 234 there are fitted clamp brackets to improve smooth running of the chain, they are already bent and in conjunction with the tensioning spring are able to exert a higher pressure on the timing chain.
If the old clamp bracket becomes unserviceable due to wear, use as replacement bracket only such one of latest type.
Clamp bracket which shows no wear can be bent by hand before installing it so that it conforms in shape to the latest type. (Fig. 12 - 4/1)



12 - 4/1

During bending stop several times bending procedure and measure bend. The measure "A" between camber and chord shall be 41 mm (1.6142"). The bend shall be perfectly uniform and shall not show any buckling. Risk of buckling in way of the covered holes at both ends of leaf spring! (Fig. 12 - 4/2)



12 - 4/2

2. Replace circular-shaped rubber ring for lower guide bolt.

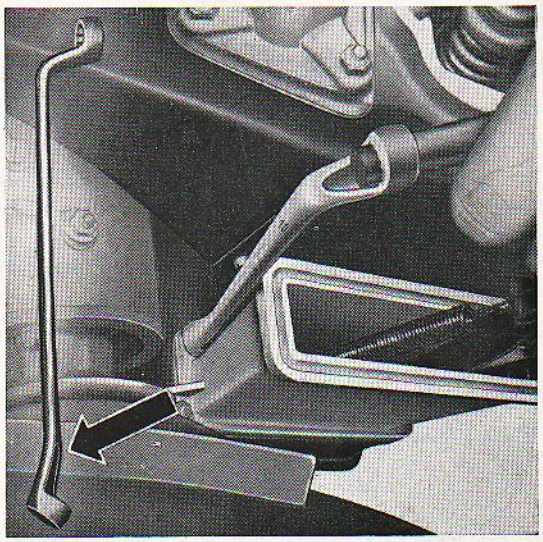
Attention! Guide bolt of clamp bracket of older type being not provided with a circular-shaped rubber ring should be replaced by rings of the latest type.

In such a case, while forcing in the new guide bolt, to avoid shearing off of the rubber ring, it is necessary first to provide the bore in the crankcase top part with a clear chamfer.

NOTE: The clamp bracket for the timing chain can be removed and reinstalled even with the engine put into place.

For this operation have the car front jacked up, then remove the right front wheel and camshaft housing, chain case, Vee-belt, and Vee-belt pulley.

To loosen the upper right hexagon nut on chain case fastening at the crankcase, use a 10 mm socket wrench which should be bent for this job according to Fig. 12-4/3.



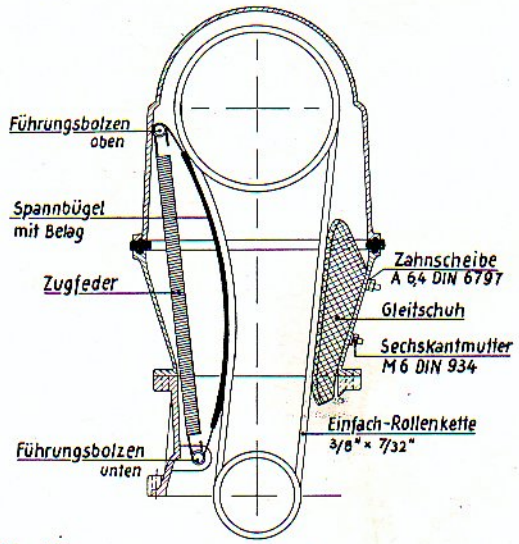
12 - 4/3

Sliding Shoe for Timing Chain

From Engine-No. 337 108 the tensioning device is fitted with a sliding shoe which serves to ensure smooth running of the chain drive.

The sliding shoe consists of the same wear-resisting plastic material a the lining of the tensioning spring and serves the purpose of preventing any still possible "vibrating" of the driving chain end.

As represented in Fig. 12 - 5/1 the sliding shoe is screwed to the chain case opposite the chain tightener by means of 2 hexagon nuts SW 10 which are secured by external tooth lock washers or elastic washers (Fig. 12 - 5/1).



12 - 5/1

Führungsbolzen, oben	=	guide bolt, top
Spannbügel m/Belag	=	clamp bracket w/lining
Zugfeder	=	tensioning spring
Führungsbolzen, unten	=	guide bolt, bottom
Zahnscheibe	=	toothed washer
Gleitschuhe	=	sliding shoe
Sechskantmutter	=	hexagon nut
Einfachrollenkette	=	single roller chain

The sliding shoe can be fitted subsequently on all engines.

For this purpose the chain case must be dismantled and two holes of 7 mm are to be drilled in the centre of the narrow side of chain case. These holes serve to receive the fastening studs of the sliding shoe.

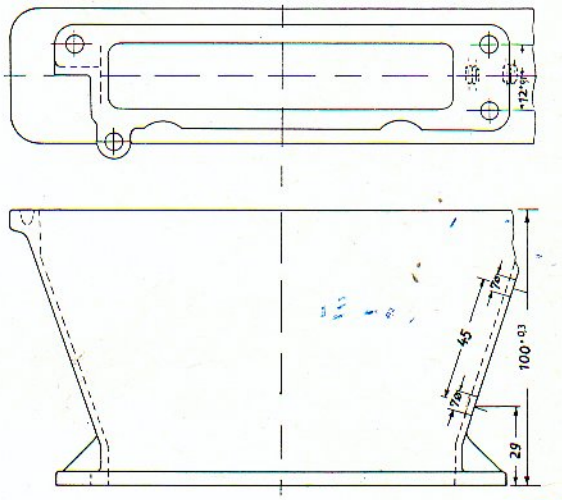
Sliding Shoe
(from Engine-No. 373 543)

From a/m engine number a sliding shoe of material-saving type is installed. This sliding shoe is exchangeable against the old type.

As far as the repair of this new type of sliding shoes is concerned there are no differences whatever (Fig. 12-5/3).

Any noticeable seam projecting from the surface of the casting in way of fastening nuts must be planed and ridges removed after drilling.

The two sealing rings of soft plastic material, which form parts of the sliding shoe and must be placed under the studs, serve to ensure tight sealing against oil leakage.



12 - 5/2

Optimum smooth running of the chain drive can be ensured only in conjunction with a properly bent clamp bracket.

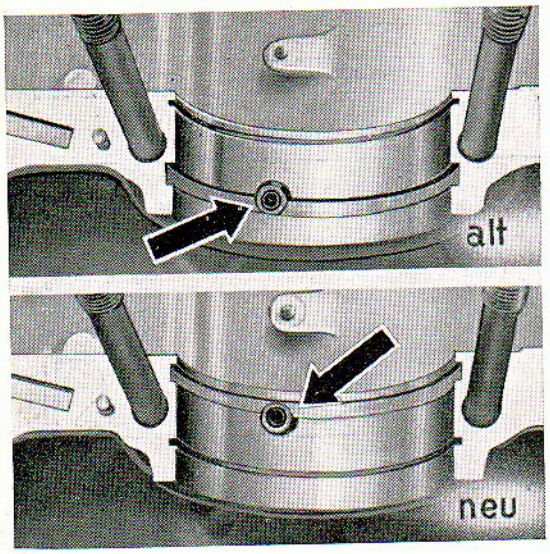
If it is intended to install subsequently a sliding shoe, the old clamp bracket must, therefore, be replaced by a new type or, as described in the preceding section, the old clamp bracket must be bent by hand.

12 - 5/3

Crankcase
(From Engine-No. 348 514)

From a/m Engine-Number the oil supply to the crankshaft bearing on the flywheel side has been displaced from outside to inside in order to relieve the radial seal of load.

Grooves in the case for oil guide and locking ring on both sides of ball bearing seat are altered correspondingly (Fig. 12 - 6/1).



12 - 6/1

Attention! In the case of repair give care to ensure that

1. in a **new crankcase** with a new system of oil supply no crankshaft with old oil guide ring without oil groove will be installed. In this case it is necessary to pull grooved bearing 6306 C 3 DIN 625 off the crankshaft and to replace the old oil guide ring without oil groove (Parts-No. 13 13 118–1) by a new oil guide ring with oil groove (Parts-No. 13 13 118–2). If not damaged, the ball bearing must be reput in place. If necessary, it should be replaced by a new part. In placing the crankshaft into a new crankcase use the new locking ring without oil groove (Parts-No. 13 13 116–1) – 2 mm thick.

2. In a **crankcase of old type a crankshaft** with new oil guide ring (Parts-No. 13 13 118–2) may be readily installed. The old existing locking ring with oil groove (3 mm thick) should be reused in this case (Fig. 12-6/3).

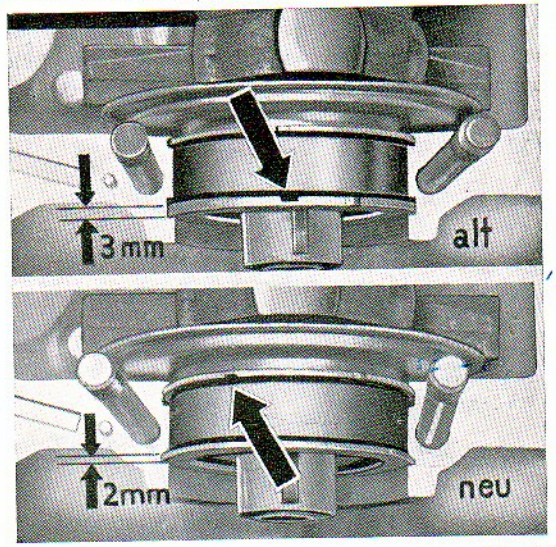
13 13 118–1
Oil guide ring
(without oil groove)

13 13 118–2
Oil guide ring
(with oil groove)

13 13 116–0
Locking ring
(with oil groove)

13 13 116–1
Locking ring
(without oil groove)

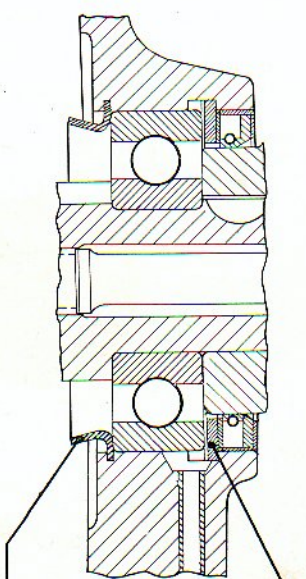
To enable the lubricating oil to enter the ball bearings from the interior, the oil guide ring crankshaft has now two oil grooves. The locking ring enclosing externally the ball bearing – previously 3mm thick and provided with oil grooves – has been replaced by a locking ring of 2 mm thickness without oil grooves (Fig. 12 - 6/2).



12 - 6/2

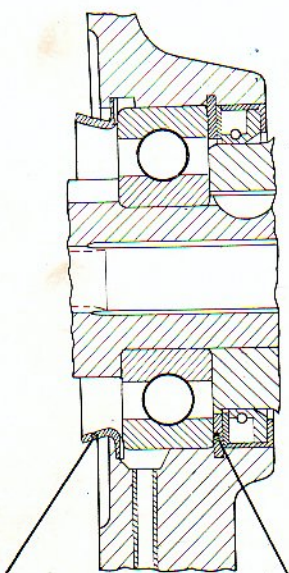
Alte Ausführung

Neue Ausführung



1313118-1, Ölleitring (ohne Ölnut)

1313116-0, Sicherungsring (mit Ölnut)



1313118-2, Ölleitring (mit Ölnut)

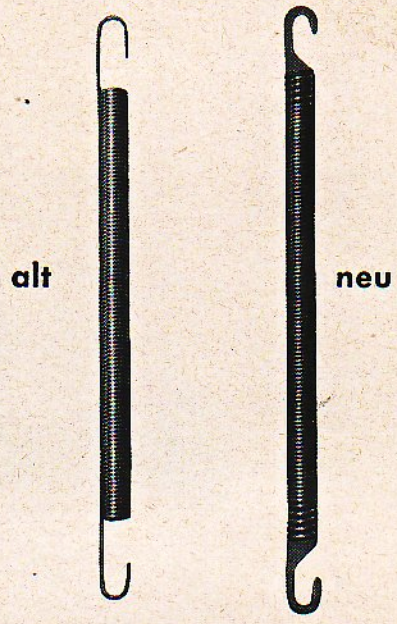
1313116-1, Sicherungsring (ohne Ölnut)

12 - 6/3

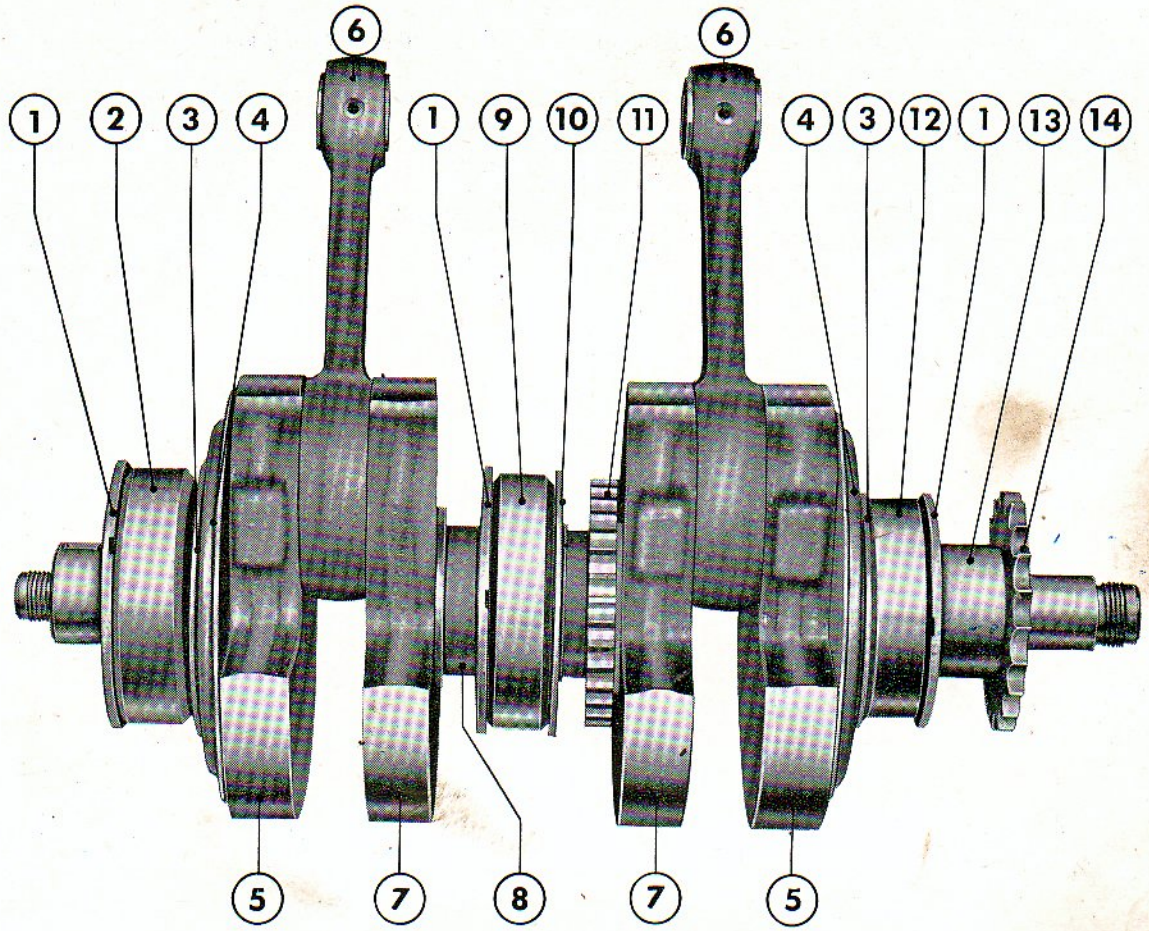
Tension Spring for Chain Tightener

From engine No. 362 491 a modified type of tension spring for chain tightener has been provided. As shown in Fig. 12 - 7/3, the new spring differs from the old type by the engaging hooks consisting of steel sheet metal and screwed into the coiled section of the spring. The new type of springs is exchangeable against the old spring. As far as the technique of repair is concerned, there are no differences.

Attention! In case of repair only springs of the new type should be used.



12 - 7/3



1 – Lock ring with oil groove (3 pces)
2 – Ball bearing 6306 C 3 DIN 625
3 – Oil guide ring (2 pces)
4 – Oil catch plate (2 pces)
5 – Crankshaft half (2 pces)
6 – Connecting rod (2 pces)
7 – Counterbalanced cranks (2 pces)
8 – Centre journal
9 – Roller bearing R NUL 35 DIN 5412
10 – Locking ring
11 – Gear wheel for oil pump drive
12 – Roller bearing NUL 30 DIN 5412
13 – Spacer bushing
14 – Chain wheel

Description

The crankshaft consists of 5 main parts: The two crankshaft halves, the two interposed counterbalanced cranks and the centre journal. The crankpins are forged in one unit with the counterbalanced crank. These individual parts are hydraulically pressed together by interposing the connecting rods (with their roller bearings), the centre main bearing (with locking rings) and gear wheel for oil pump drive.

The shaft runs on three antifriction bearings. The bearing at the belt pulley side as well as the centre bearing are roller bearings designated NUL 30 or NUL 35. The bearing at the flywheel side is a ball bearing of the 6306 C 3 type *). This bearing serves as an axial guide bearing of the crankshaft.

The bearings are kept in position by their snug fit on the shaft and in the crankcase: moreover they are secured in place by locking rings.

The chain wheel of the timing chain is located on splines. Between chain wheel and roller bearing NUL 30 there is located a spacer bushing.

The centre roller bearing has a special inner ball race which simultaneously serves a spacer bushing between gear wheel for oil pump and counterbalanced crank. The gear wheel of the oil pump is fastened to the counterbalanced crank by a cylindrical head pin.

The oil catch plates externally fitted to the two crankshaft halves by means of notched pin serve to conduct the lubricating oil to the connecting rod bearing.

*) Denomination C 3 or 3 points (indicated on the outer ring of bearing by etching) means: bearing with increased clearance 17-32 My (0.00067 – 0.00126").

The connecting rods are of the double-T-section, the big end being of the undivided type. Each connecting rod runs on two rows of short cylindrical rollers.
The two cylindrical crankshaft journals are provided with keyways for the Woodruff keys serving to fasten the flywheel and belt pulley. In the hollow journal at the flywheel side is screwed the stud for fastening the flywheel.
Disassembling of the crankshaft into the aforementioned main parts or dismounting the component parts located between crankshaft halves and counterbalanced cranks such as connecting rod and centre bearings, cannot be carried out in a skilful manner with the customary shop tools. Moreover, as the working of component parts and its reassembly must be done with high precision which can be performed only with equipment at disposal at the manufacturer's work, it is convenient to have overhauls of the crankshaft generally carried out at the manufacturer's work.
In the case of damage to or wear of connecting rods, connecting rod bearing and centre main bearing or damage to or wear of the shaft itself it is necessary to install a replacement shaft.

Dismantling and reinstalling crankshaft
(Including replacement of timing chain)

Engine is dismantled, camshaft housing, cylinder heads, cylinder and piston, chain case, belt pulley, flywheel, crankcase housing upper part and oil pump are dismantled. (For working procedure see respective sections).

Dismantling

1. Remove radial seals at the crankshaft.

2. Press from below against the two crankshaft pins with a hammer handle so as to ensure loosening of the shaft. Lift crankshaft out of the bottom part of crankcase.

3. Remove timing chain.

4. Remove on the belt pulley side:
   Woodruff key, chain wheel, spacer bushing, bearing outer ring with cage and oil distributing ring.
   On the flywheel side:
   Woodruff key and locking washer from the crankshaft.

Attention! Until reinstalment of the crankshaft oil it and store under cover, otherwise there is the risk of getting dirtied and rusted.

Refitting

Refitting must be made in the reverse order by taking care of the following points:

1. Flush crankshaft carefully in gasoline and blow over all parts with compressed air. First remove any existing oil mud deposited in the "pocket" in the oil catch plates.

NOTE: The function of the two oil catch plates is not only to conduct lubricating oil to the connecting rod bearings, but also to clean the lubricating oil.

Constituents liable to contaminate oil and which are not retained by the oil sieve, are separated by centrifugal force during operation of the engine in the oil catch plates and becoming deposited in the pocket of the oil catch plates provided for this purpose. Cleaning of the oil catch plates under normal conditions is necessary only during engine repairs.

2. Check connecting rod and main bearings for wear.

3. Check tight fit of oil catch plates and gearwheel of oil pump drive.

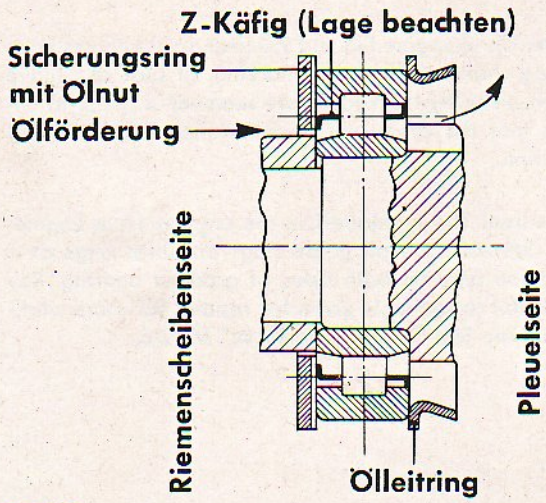
4. Check timing chain and chain wheel for wear, if necessary, renew chain and chain wheel.

5. Check condition of keyway for Woodruff keys in the crankshaft journals.

6. Put in place oil guide ring (belt pulley side) so that the angular collar is directed towards roller bearing. (Fig. 13 - 3/1)

7. On putting in place the bearing outer ring (with roller cage) at the belt pulley side, give care to the following instructions:

The Z-cage has to be fitted in such a manner that oil is being supplied away from the safety ring to the oil guide ring in order to avoid intermittent oil supply to the crankpin bearing (Fig. 13 - 3/1).

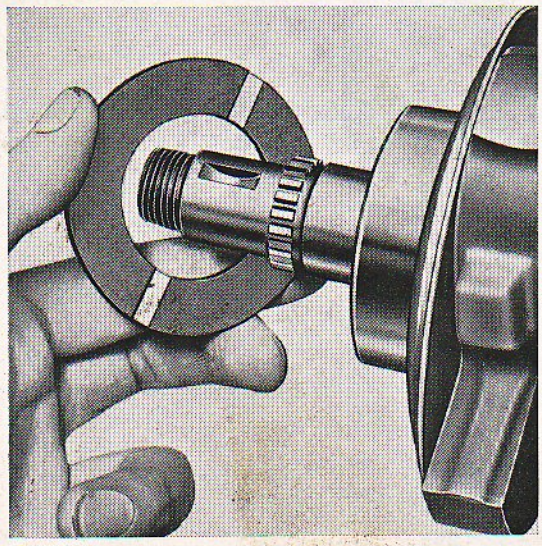


13 - 3/1

Z-Käfig (Lage beachten)	= Z-cage (watch for proper position)
Sicherungsring mit Ölnut	= locking washer with oil groove
Ölförderung	= oil supply
Riemenscheibenseite	= belt pulley side
Pleuelseite	= connecting rod side
Ölleitring	= oil guide ring

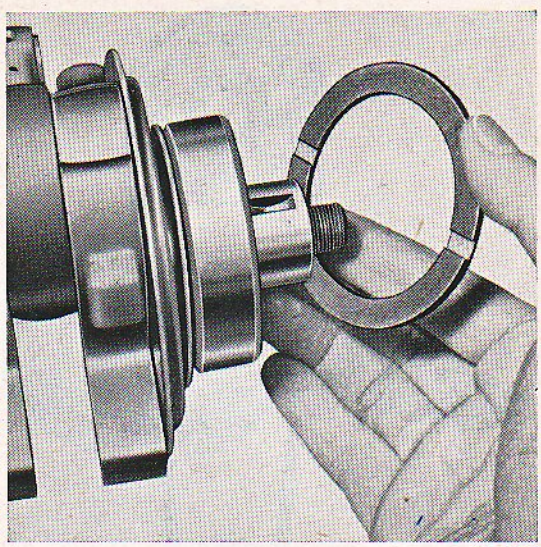
In case the complete roller bearing NUL 30 (with inner ring) has been pulled off, additional care must be given to ensure that on refitting or replacing the bearing the stamped marks on outer and inner rings should lie on the same side!

8. Put in place both locking washers (with oil groove) – one at the outside of the two outer main bearings so that oil grooves face the bearing (Fig. 13-3/2 and 3).



13 - 3/2

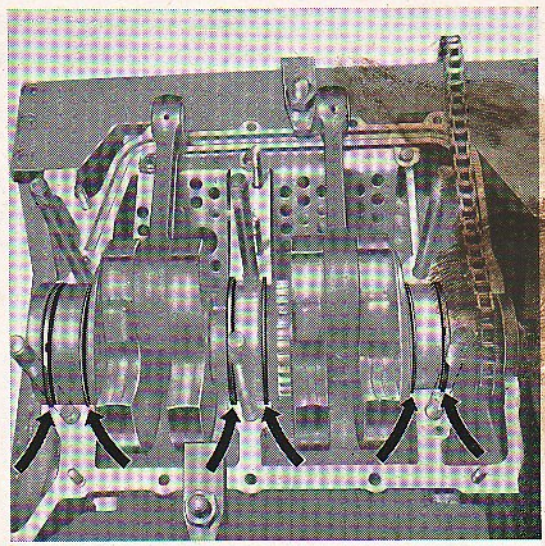
Fig. 13 - 3/2 shows the crankshaft journal ready to take the vee-belt pulley.



13 - 3/3

Fig. 13 - 3/3 shows the crankshaft journal for fastening the flywheel.

9. After pushing spacer bushing into place and putting in place the chain wheel with timing chain, install crankshaft in the lower part of crankcase.
Give care that locking washers and oil guide rings are put in place completely and fit well at the bottom of the grooves cut in the casing (Fig. 13-3/4).

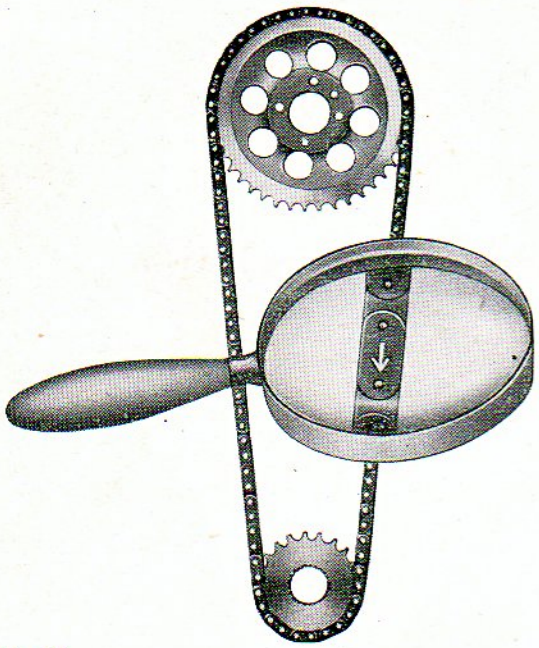


13 - 3/4

10. Push Woodruff keys in the groove of crankshaft journal. Oil well crankshaft.

Note: For obtaining a tight fit in the crankcase each of the locking and oil guide rings on the outer circumference is provided with 3 small noses from Engine-No. 349 865.

If in engines up to a/m Engine-Number a loose fit of rings is stated (polished grooves due to the chamfering movement of rings) the rings in the dismountable outer main bearings may be replaced by rings of the new type.



13 - 4/1

Positioning of Timing Chain

Put timing chain in place so that the arrow stamped on one of the chain straps chows in the direction of rotation of the engine (Fig. 13 - 4/1).

Note: Up to engine No. 314 953 (inclusive) engines have timing chains **without** any marking. In such case have chain distinctly marked **before removal** in order to ensure that the chain will be reinstalled in its original position.

Attention! The crankshaft in the engines from Engine-No. 348 514 have oil guide rings and lock rings of a modified type on both sides of grooved bearing. Pay attention to the hints given for repair! For more particulars see Sub-Group "Crankcase" M 12-6.

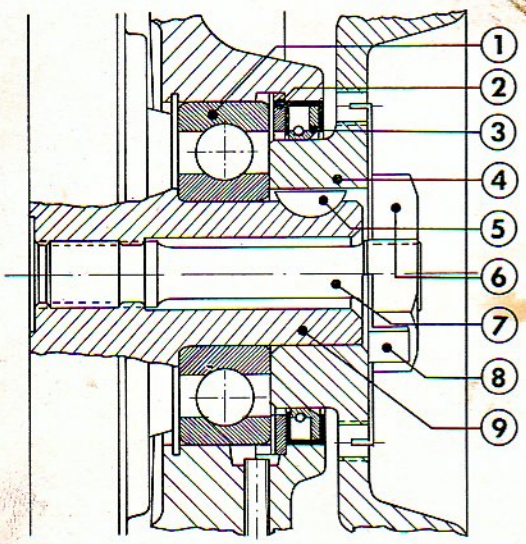
Dismantling and Reinstalling Flywheel

General

The flywheel is mounted with a Woodruff key on the cylindrical crankshaft journal and fastened with hexagon nuts SW 36 on a threaded bolt a socalled "tension" bolt, fitted in the hollow crankshaft journal!

The tension bolt is provided on the inner side with a threading of 1.5 mm pitch and on the flywheel side a threading of 1.0 mm pitch. When refitting the engine the tension bolt is to be screwed in the crankshaft journal with a special tool WO 37 (Pressing nut) at a torque of 13 mkg. The holding nut of the flywheel should likewise be tightened with a torque of 12 mkg. By this measure the bolt is set under initial tension which ensures a tight fit of the connection (Fig. 13 - 4/2).

At the same torque subdivided on the flywheel side in frictional torque between nut and flywheel and tractive force in the bolt, the fit of the nut threading is smaller than that in the crankshaft half. When loosening the nut the tight fit of the tension bolt will not be influenced. Repair shops, should, therefore, pay strict attention to the indicated torque for tightening the tension bolt.



13 - 4/2

From Engine-No. 353 563 modified flywheel fastening! For more particulars see Sub-Group "Crankshaft" Page M 13 - 10.

1 – Ball bearing
2 – Locking washer
3 – Radial seal
4 – Flywheel
5 – Woodruff key
6 – Hexagon nut SW 37
7 – Tension bolt
8 – Locking plate
9 – Crankshaft

The following special tools are required:

WO 4 – Flywheel clamping fixture

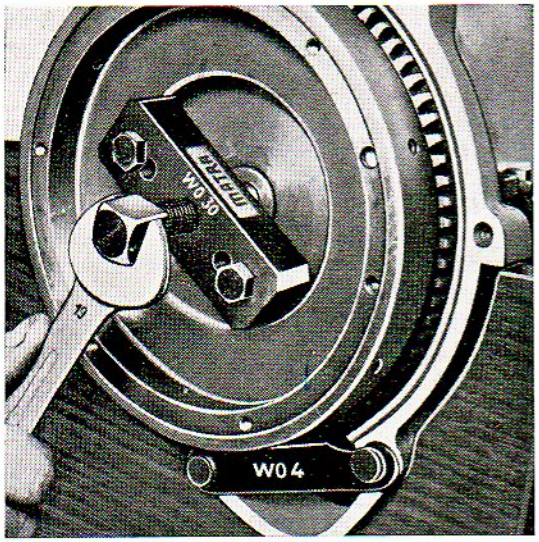
WO 25 – Flywheel trueing-up tool

WO 30 – Flywheel remover

WO 37 – Pressing nut for expander screw on flywheel.

Dismantling

1. Dismantle engine.
2. Flange transmission.
3. Dismantle clutch.
4. Insert flywheel clamping fixture WO 4, loosen hexagon holding nut SW 36, remove locking plate.
5. Pull off flywheel with flywheel remover (Fig. 13 - 5/1).



13 - 5/1

Installation

The installation is made in the reverse order by taking care of the folllowing points:

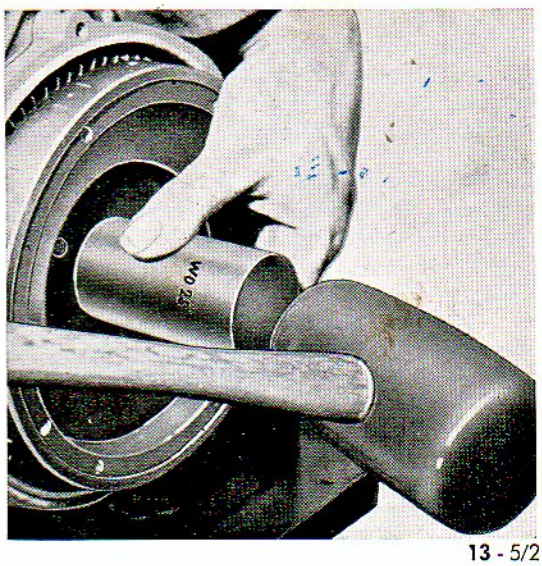
1. Check teeth of toothed rim of flywheel of the starter for proper condition. Remove any ridge by filing. In the case of heavy wear, replace toothed rim.

2. Check seat, keyway and working surface of seal ring.

Attention! For perfect oil tightness of the engine it is absolutely necessary that the working surface of the seal ring should be in perfect condition. If the ground surface shows the slightest damage flywheel must be replaced.

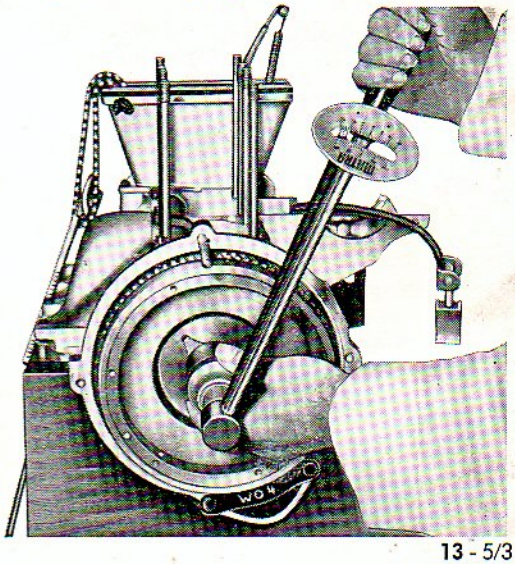
Before installation check also working surface of the new flywheel as eventually the surface might suffer damage during transport or owing to careless storage.

3. Clean bearing surface of clutch disk on the flywheel and check for wear, if necessary, resurface by grinding and smooth with polishing clotch. If necessary, replace flywheel.
4. Before installation of the flywheel check expansion bolt in the crankshaft journal by means of special tool SW 37 for tight fit (12 mkg!).
5. Drive flywheel with the help of driver tube SW 25 onto the shaft until its striking against the inner ring of bearing. Use only rubber hammer for this operation job! (Fig. 13 - 5/2).



13 - 5/2

6. Tighten holding nut at a torque of 12 mkg. In doing so, secure flywheel by means of flywheel clamping fixture against turning (Fig. 13 - 5/3).



13 - 5/3

7. In removing and installing clutch use special service tool WO 20 and 21.

Dismantling and reinstalling Vee-belt pulley

The following special tools are required:

WO 26 – Driver tube for Vee-belt pulley

WO 28 – Belt pulley remover

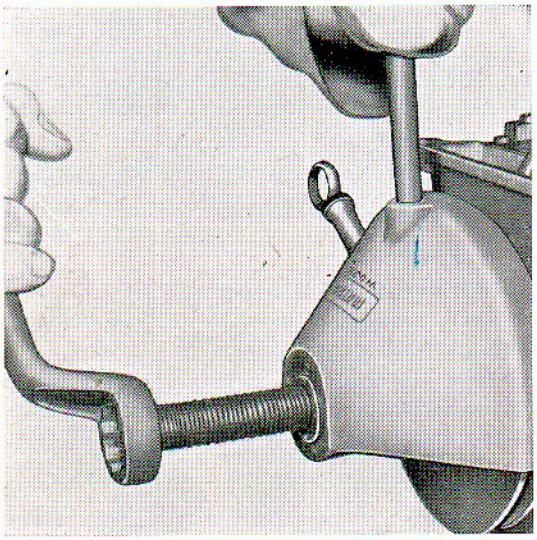
WO 43 – Special wrench for belt pulley.

Dismantling

1. Loosen holding nut for Vee-belt pulley SW 27. For this operation use special wrench for belt pulley to hold the nut.

NOTE: The diameter of bolt circle for both bores in the Vee-belt pulley has been increased to 60 mm. (2.3622") from engine No. 340 010 (previously 52 mm) (2.0472"). Special wrench WO 43 can be used for both types!

2. Put belt pulley remover WO 28 on belt pulley; insert appropriate pin into the hole in the bell-shaped casing provided for that purpose to immobilise the belt pulley in its position. Withdraw belt pulley. (Fig. 13 - 6/1).



13 - 6/1

Installation

The installation must be effected in the reverse order by taking care of the following points:

1. Check state of the belt pulley sides for unobjectionable running of the Vee-belt.

2. Check belt pulley for excentricity.

3. Check seat of belt pulley on crankshaft journal and proper condition of keyway. Replace belt pulleys which are in an inappropriate condition as far as the 3 aforementioned points are concerned.

4. Check working surface for radial seal.

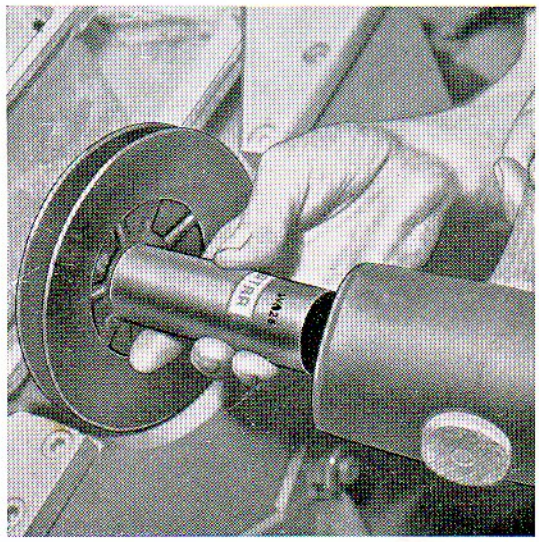
   In the case of oil leakage smooth eventually working surface with polishing cloth. In doing so, pay special attention to the transition from finished running surface to unfinished part of the boss. Eventually renew radial seal. (For more details see Section "Radial Seal (Belt pulley side").

Attention! To ensure full oil tightness of the engine at this point, the working surface of the sealing ring must be fully intact. Should it show slightest damage on its ground surface, have belt pulley replaced.

Check also working surface of the new belt pulley before its installation as eventually damages to the belt pulley may occur during transport or due to inappropriate storage.

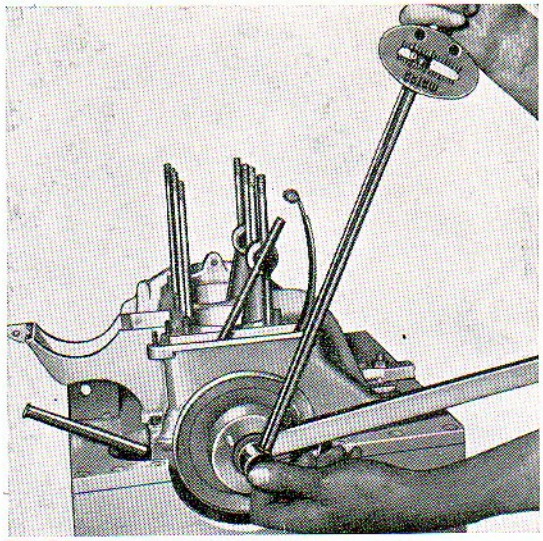
5. Give working surface os sealing ring a thin coat of oil and drive belt pulley into place until its striking against chain wheel. Use for this operation driver tube WO 26!

   Give care that Woodruff key will not forced out of its keyway and the latter comes to lie inside of crankcase (Fig. 13 - 6/2).



13 - 6/2

6. Tighten holding nut at 6-8 mkg. In doing so, secure belt shaft with special wrench WO 43 (Fig. 13 - 7/1).

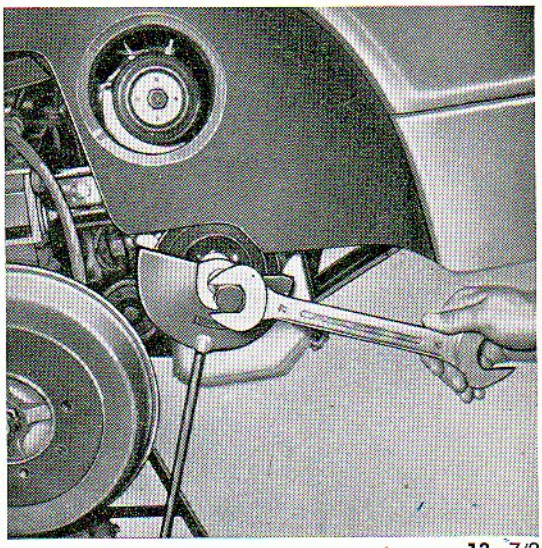


13 - 7/1

The belt pulley may be removed and reinstalling without the engine being removed from the car.

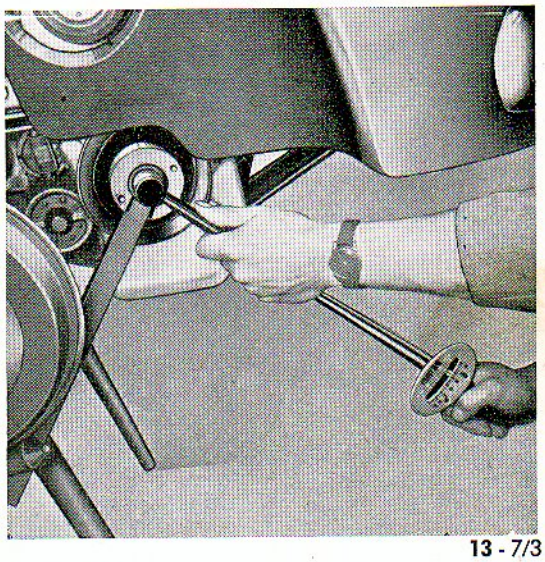
After jacking up the front part of the car as well as after removal of the right front wheel and Vee-belt proceed with the work as described above.

For this operation put belt pulley remover from below over the belt pulley. The holding pin bears against the stand or against the floor (Fig. 13 - 7/2).



13 - 7/2

For tightening holding nut SW 27 with the specified torque, a torque wrench may likewise be used for this job.
Special wrench WO 43 prevents crankshaft from being driven with (Fig. 13 - 7/3).



13 - 7/3

Renewal of radial seal (flywheel side)

Following special tools are needed:

WO 4 – Flywheel clamping fixture
WO 25 – Driver tube for flywheel
WO 30 – Flywheel remover
WO 39 – Assembly tool for radial seal (flywheel side).

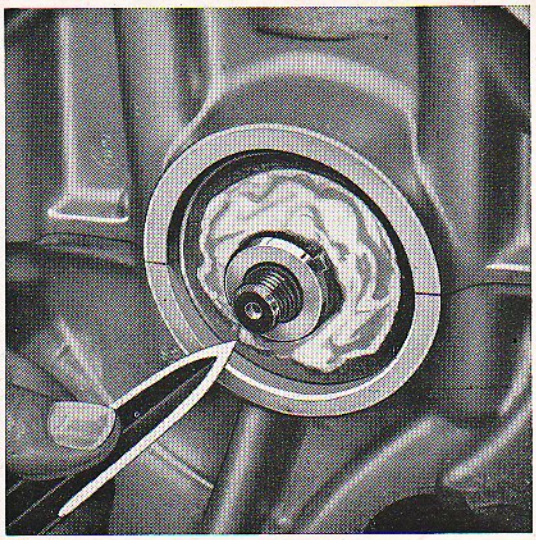
1. Remove flywheel. (For more details see respective Section).

2. Remove old seal. Give strict care to see that seating surface in the crankcase will suffer no damage!

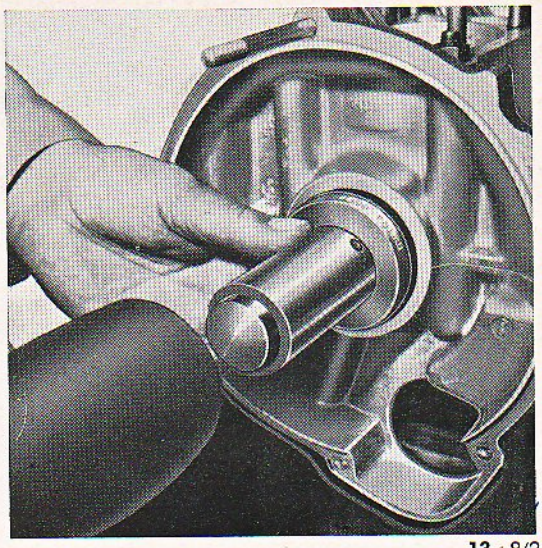
3. Carefully remove residual sealing material, if any, on the crankcase joint.

NOTE: At the manufacturer's work seal is inserted **without** sealing compound. The remarks under (3) will apply only if seal has been already changed. If for this job sealing compound has been used it is recommendable to give the new seal and the seating in the casing, before installation of the seal, another light coat of "WEVOLIC" liquid!

4. Break outer edge of crankcase bore uniformly by means of a scraper. Before doing so, cover ball bearing well with a linen cloth coated with fat and give seating face of seal ring a coat of fat so as to avoid chips falling into the bearing. Smooth cutting edge with polishing cloth (Fig. 13 - 8/1).



13 - 8/1



13 - 8/2

5. Remove chips, fat and wiping cloth.

6. Put new seal onto tool WO 39 (make sure that open side of seal is directed to the bearing!) Oil seal and drive into place until its striking against locking washer of crankshaft bearing. Be sure not to tilt seal when driving into place! (Fig. 13 - 8/2).

7. Remove fitting tool.

8. Oil working surface of seal on the flywheel. Install flywheel. (For more details see respective Section).

NOTE: From engine No. 339 950, instead of seals (56 x 72 x 8), a broader **special seal ring** 56 x 72 x 10 with left-hand rotation polish – Part-No. 13 13 031-1 is installed in the crankcase at the flywheel side. This new seal may also be used on engines of older types.

In the case of oil leakages and if repair should become necessary, install only the aforementioned special seal!

Replacing radial seal (belt pulley side)

This work can be appropiately carried out only with dismantled engine.

The following special tools are required:

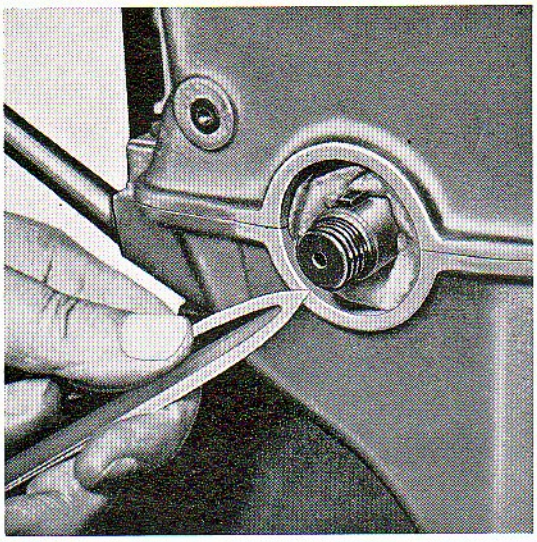
WO 26 – Driver tube for belt pulley
WO 28 – Belt pulley remover
WO 40 – Assembly tool for radial seal (belt pulley side)

Removal and installation of the belt pulley as described in the respective section.

1. Remove old seal. Give strict care to see that seating surface in crankcase will suffer no damage whatever!
2. Carefully remove residal sealing compound, if any, on the crankcase joint.

NOTE: At the manufacturer's work seal is inserted without sealing compound. The instructions given under item 2 shall therefore apply only if seal would have been already changed. If sealing compound has been used on that occasion, it is recommendable to give the new seal and seating in the casing, before installation, a thin coat of liquid sealing compound "WEVOLIC".

3. Brake uniformly outer edge of crankcase bore by means of a scraper. First cover crankcase opening with wiping cloth coated with fat and give seating surface of seal likewise a coat of grease so as to prevent the entrance of chips into the crankcase. Smooth cutting edge by means of polishing cloth (Fig. 13 - 9/1).

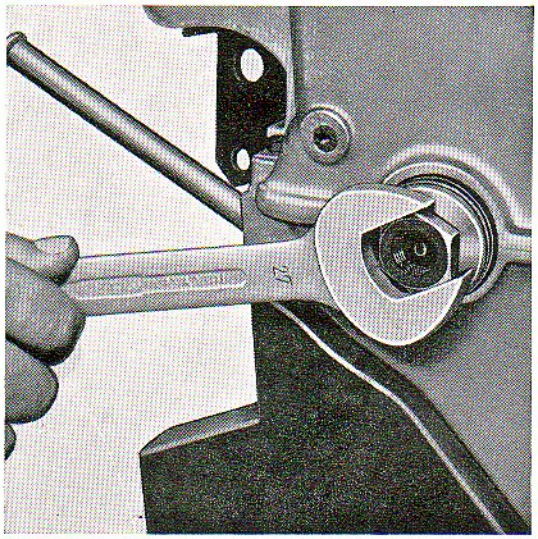


13 - 9/1

4. Remove chips, fat and wiping cloth.

5. Put new seal onto the fitting tool WO 40 (be sure that the open side of the ring is directed to the chain wheel!). Oil seal and put it into the crankcase bore.

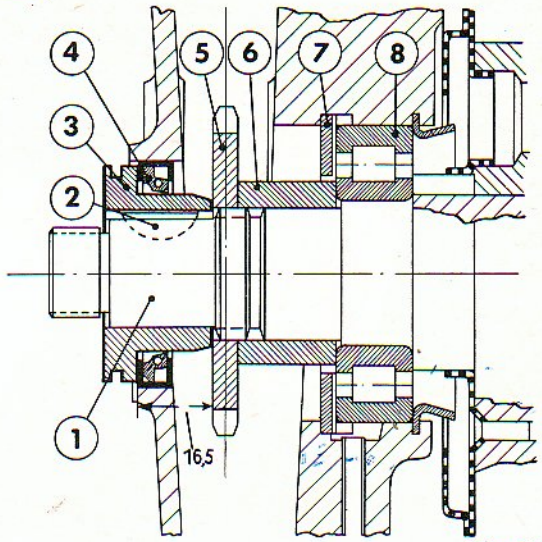
6. Screw-on holding nut SW 27 and force seal into place until the fitting tool strikes against crankcase. Give care not to tilt seal while putting it into place! (Fig. 13 - 9/2).



13 - 9/2

In using a special seal ring of latest type the clearance between outer edge of seal and chain wheel will be 16.5 mm (Fig. 13 - 9/3).

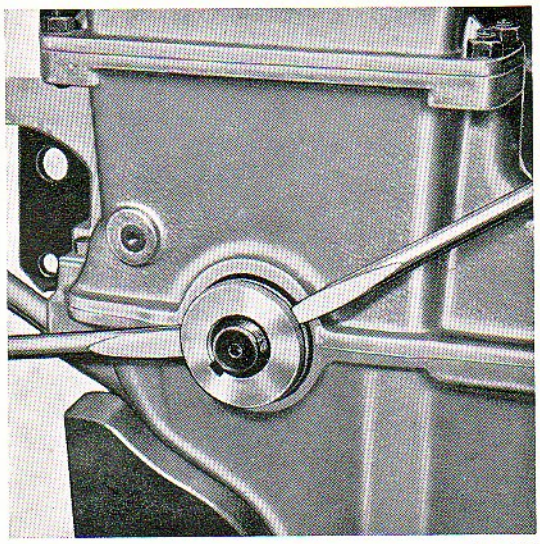
(For special radial seal see remarks at the close of this section!)



13 - 9/3

1 – Crankshaft
2 – Woodruff key
3 – Fitting tool WO 40
4 – Radial seal
5 – Chain wheel
6 – Spacer bushing
7 – Locking washer
8 – Roller bearing

6. Press out fitting tool by means of two screw drivers (see Fig. 13 - 9/4).



13 - 9/4

Note: From Engine-No. 339 950, instead of previous seal (35 x 47 x 7), a broader **special seal** (35 x 47 x 9) with right-hand rotation polish, Part-No. 13 13 030 – 1, is fitted on the belt pulley side in the crankcase. This special seal may also be used on engines of older type.

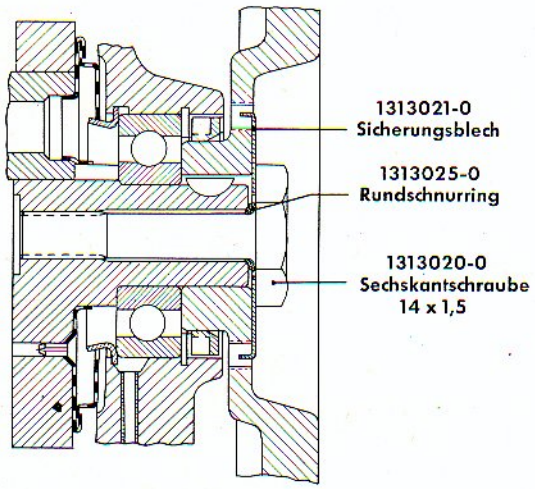
In case of oil leakages and if repair should become necessary, only the aforementioned special seal should be installed!

Fastening Flywheel

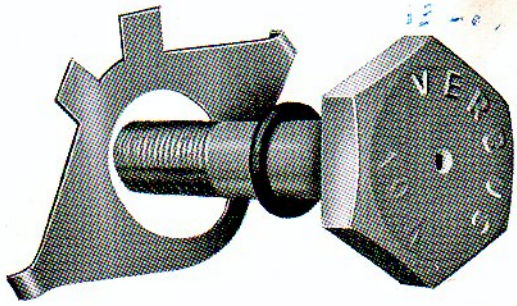
(From Engine No. 353 563)

From a/m Engine-Number the fastening of the flywheel on the crankshaft has been simplified. Instead of the stud (tension bolt) and hex nut SW 36 (Fig. 13 - 4/2) a hex head bolt M 14 x 1.5 has been provided. Width of jaws of screw wrench the same as previously. As with the stud the hex head bolt for fastening in the crankshaft half has been provided with snug fit thread and is made oil tight. A rubber cord ring (Part-No. 13 13 025–0) is fitted between shaft and head of bolt to serve as additional precaution against oil leakage through the crankshaft bore. The pertaining lock plate (Part-No. 13 13 021–0 as previously) is provided with an inner bore increased in diameter to 24 mm in order to enable free passage of the rubber cord ring. The necessary initial tension of the bolt shaft and thus the close fit of the connection is attained by increasing the torque to **18.5 mkg** (torque of stud and hex nut: 12 mkg).

In the case of repair stud and nut may be readily exchanged against a hex head bolt. Do not forget rubber cord ring. Use only new lock plate! (Fig. 13 - 10/1 and 2).



13 - 10/1



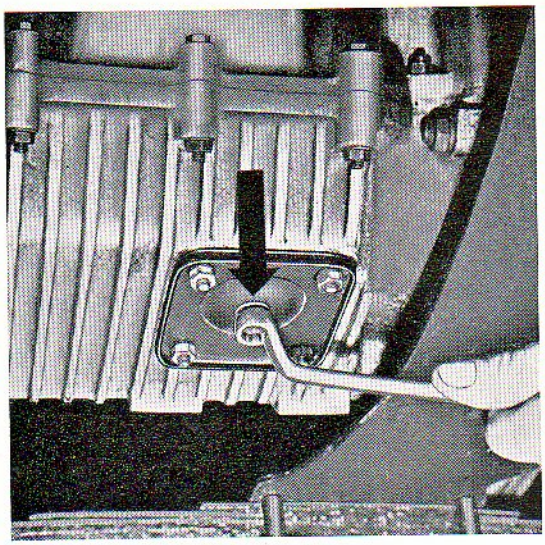
13 - 10/2

13 13 021 – 0	Sicherungsblech	=	Lock plate
13 13 025 – 0	Rundschnurring	=	Rubber cord ring
13 13 020 – 0	Sechskantschraube 14 x 1.5	=	Hex head bolt

Change of engine oil

For the change of oil see lubrication chart and Customers Service Coupon Booklet.

1. Drain out engine oil. For this operation screw out oil drain plug SW 10 at the bottom of oil strainer. (Open oil filling cover!)



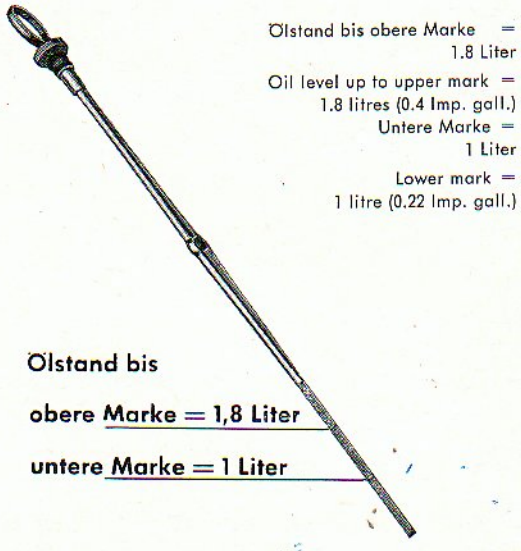
14 - 1/1

Attention! Change oil only with engine warmed up to service temperature. We recommend to flush engine with oil, using for this operation about 1 liter of the **same grade of motor oil that will be used for refilling.** To this end let engine run at higher idling speed for an interval of about 10 minutes.

2. Refil with 1.8 litre motor oil (0.4 Imp. gall.) (for oil specification see lubrication chart).

   Note: The first filling for a new engine will be 1.25 litres (0.275 Imp. gall.) special motor oil.
   When changing oil for the first time after a mileage of 500 km (310 miles), refill with the standard quantity of oil = 1.8 litres motor oil (0.4 Imp. gall.).

3. Check for proper oil level with oil gauge stick. (Fig. 14 - 1/2).



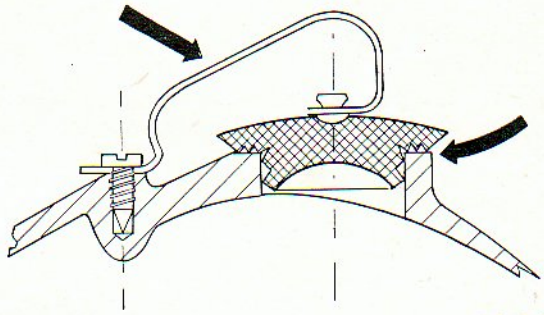
Ölstand bis obere Marke = 1.8 Liter
Oil level up to upper mark = 1.8 litres (0.4 Imp. gall.)
Untere Marke = 1 Liter
Lower mark = 1 litre (0.22 Imp. gall.)

14 - 1/2

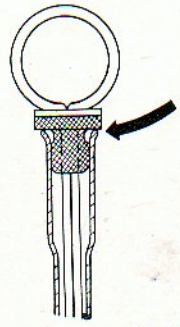
The following hints should be taken into account:

a) At every change of oil replace seal below oil drain screw plug. Tighten with caution oil drain screw plug.

b) Press **firmly** into place oil filling plug. Check for proper clamping spring tension. Bend deformed clamp bracket (Fig. 14 - 7/3).



14 - 1/3



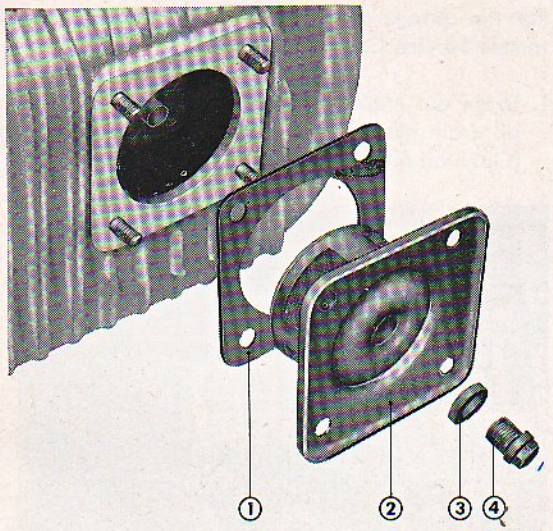
c) Press into place oil dip stick until it bears against the stop.

14 - 1/4

Removal and installation of oil strainer

According to the instructions given in the customer's Service Booklet the oil strainer must be removed for cleaning after a mileage of 500, 3000, 12000 km (appr. 300, 1865, 7460 miles), thereafter, at each interval of 12000 kilometers.

1. Drain out engine oil.
2. After loosening four hexagon nuts SW 10 take out oil strainer (Fig. 14 - 2/1).
3. Wash strainer in gasoline.
4. Clean seating face of closing cover. Straighten bent covers, if necessary, renew oil strainer.
5. Renew cover gasket.
6. When reinstalling oil strainer be sure not to overtighten hexagon nut to avoid deformation of the cover.



14 - 2/1

1 – Gasket for oil strainer
2 – Oil strainer
3 – Seal
4 – Screw plug

Removal and installation of oil pump

This job is to be effected with engine, camshaft housing, cylinder heads, cylinder and piston, chain case and upper part of crankcase removed.

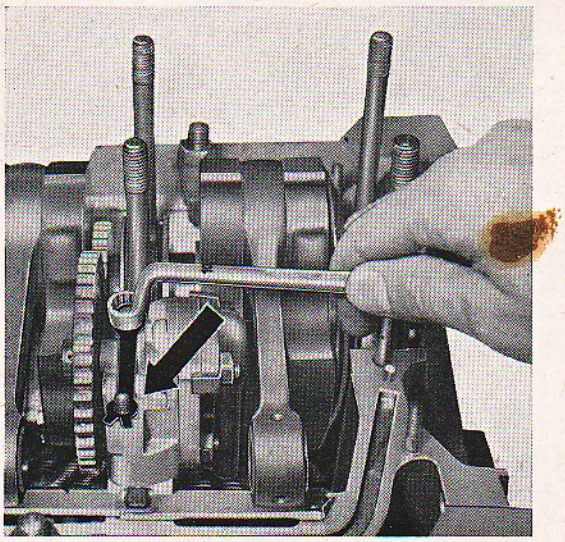
Removal

1. Dismantle oil strainer.
2. Take out locking washer and loosen both hexagon nuts SW 10 on oil pump fastening. Remove locking plate (Fig. 14 - 2/2).
3. Take out oil pump. Remove foot gasket.

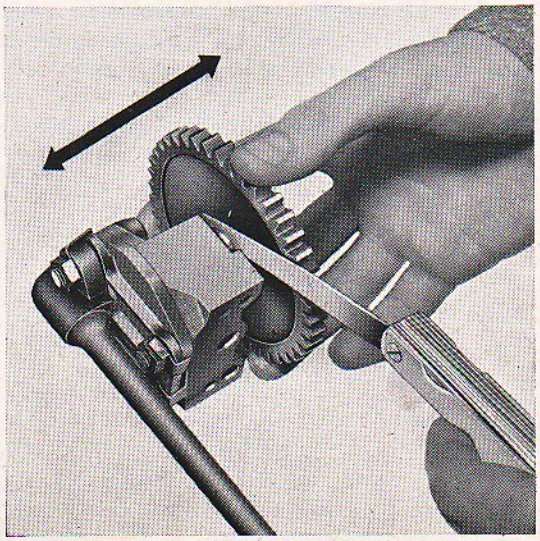
Installation

Installation is to be effected in the reverse order by giving attention to the following points:

1. Check oil pump for wear:
   Measure height clearance of the driven delivery wheel by alternately applying pressure on the driving gearwheel, by means of a feeler gauge (Fig. 14 - 2/3).



14 - 2/2



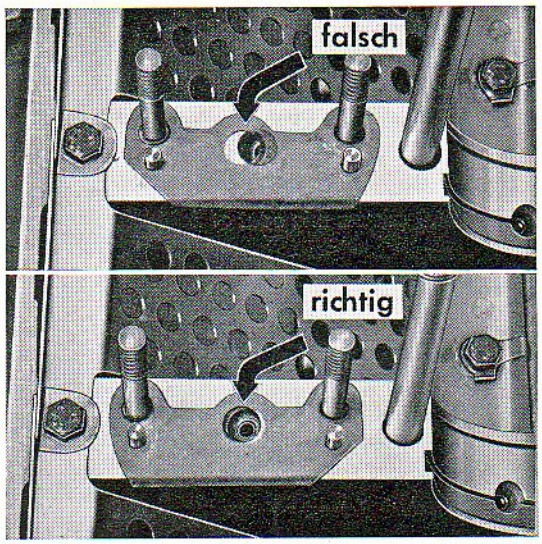
14 - 2/3

If the clearance is nearing the admissible allowance of wear of 0.15 mm, the pump requires to be overhauled, if necessary, to be exchanged. (For more details see under section "Disassembling and Reassembling Oil Pump).

2. Check bearing surfaces at pump casing and lower part of crankcase for clearances.
3. Replace oil pump foot gasket.

Attention! Replace foot gasket into place so that entire sectional area of oil passage in the casing supports is kept free! (Fig. 14 - 3/1)

4. Tighten hex nuts SW 10 of oil pump fastening with a tension of 1 m/kg.
5. After installation of the pump check clearance of gears. If they run too closely, remedy eventually by placing a second foot gasket below the pump.
6. After reinstalling crankcase-upper-part and tightening tie-rod nuts at 3 m/kg, check whether between gears for oil pump drive the necessary clearance still exists.



14 - 3/1

Disassembling and Reassembling Oil Pump

(With the oil pump removed from car)

Disassembling

1. Drive out tension pin in the hub of driving gearwheel with a drift; pull gearwheel off the shaft.
2. Clamp pump casing with its narrow sides in a vice **without pressure.**
3. Remove locking washer and loosen hex nuts SW 10 serving to fasten suction pipe connection to the pump casing. Remove suction pipe with connection. Remove pipe connection gasket.
4. Take out locking plate and loosen hex nuts SW 10 on fastening of casing cover. Remove pump casing cover.
5. Take gearwheels out of pump casing.

Reassembling

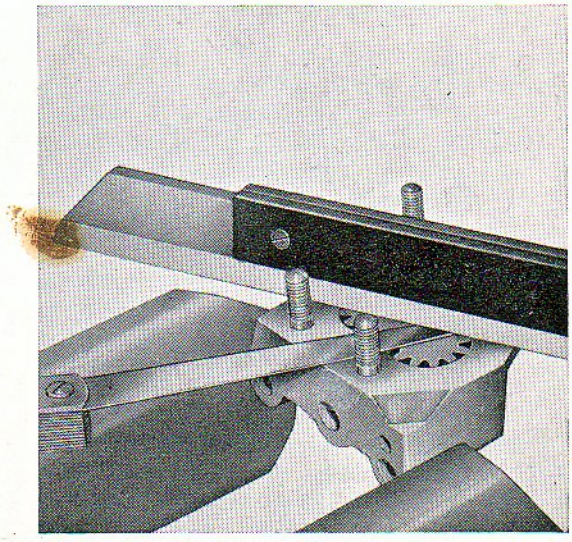
In reassembling proceed in the reverse order by taking care of the following points:

1. Check conditions of teeth of pump gearwheels and that of the driving wheel.
2. Check contact surface of pump gearwheels in the casing and casing cover for wear.

By running-in gearwheels inside casing and casing cover the axial clearance of gears may become too large so that the capacity of the pump drops away below the admissible limit!

Axial clearance when new 0.005 – 0.062 mm; wear limit max. 0.15 mm.

3. By placing a straight rule on the pump casing (with pump wheels inserted) measure proper axial clearance of gearwheels by light gap test or by means of a feeler gauge (Fig. 14 - 3/2).



14 - 3/2

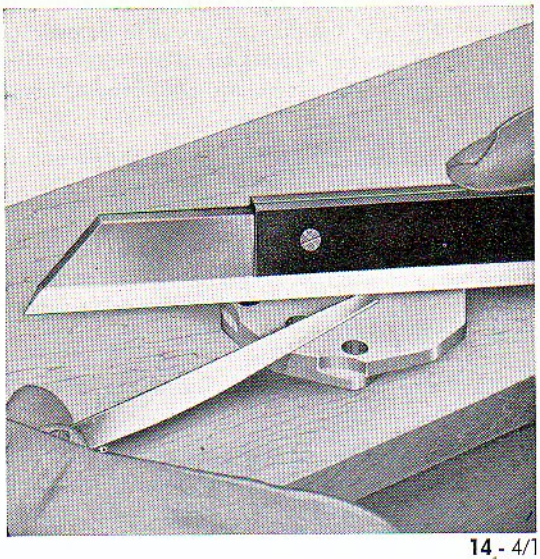
4. In the same way check also running-in depth of gearwheels in the casing cover and add both results of the measurement procedure. Should the sum exeed the admissible wear allowance of 0.15 mm, pump casing and cover should be replaced (Fig. 14 - 4/1).

5. Give pump cover and seating of casing in way of the outer edge a thin coat of liquid "WEVOLIC".

6. Replace gasket for suction pipe connection.

7. Screw pump cover (with suction pipe connection put in place) to pump casing. Tighten nuts evenly and crosswise at a torque of 1 mkg and lock them into place. Fasten driving gearwheel by means of new clamping pin.

8. Check pump for easy running.



14 - 4/1

Note:

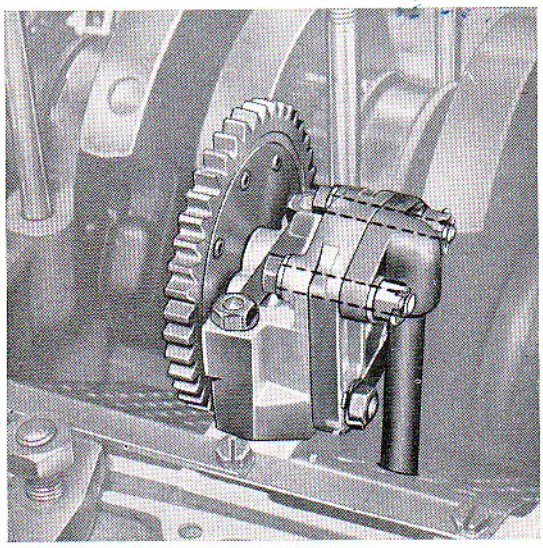
1. From Engine-No. 338 885 the studs M 6 x 22 in the pump casing (for fastening cover and suction pipe) are replaced by 2 hex head bolts M 6 x 35 with washers and castellated nuts (locked by cotter pins).

   In the case of repairs it is advisable to adapt pump of old type to the new condition by removing studs, reaming threaded holes to 6.8 mm dia. and inserting through-bolts.

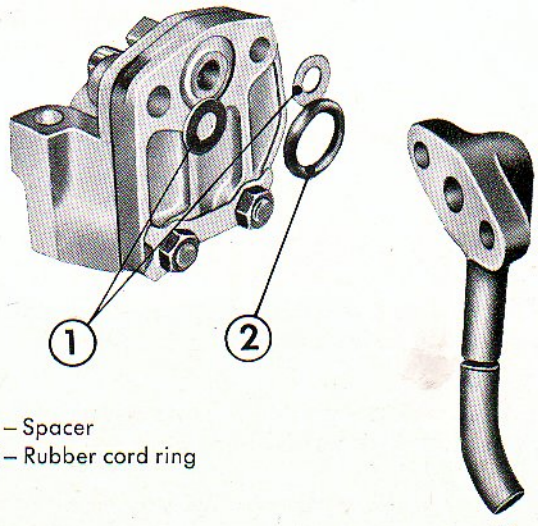
2. The oil pump provided as from Engine-No. 353 793 has an enlarged free pump space (from a manufacturing point of view). For compensation the gearwheels are kept wider by 1 mm (previous width 8 and present width 9 mm). The complete oil pump is exchangeable against the types of earlier construction.

3. From Engine-No. 371 370 the driving gear of the oil pump is fitted with a toothed rim of Novotext. The Novotext gear contributes to improve the smooth running of the engine and is exchangeable against a steel gear (Fig. 14 - 4/2).

4. From Engine-No. 384 000, instead of the flange gasket between casing cover and suction pipe a rubber cord ring (the same as employed for tightening at the flywheel) is used as seal. The altered casing cover has – concentrically to the oil inlet bore – a groove of 4 mm wide and 1 mm deep, which serves to take the rubber cord ring. The necessary distance or the necessary initial tension of the rubber ring depends upon two washers 0.75 mm thick (6.25 dia. x 13 dia. x 0.75), which is put on two hex head bolts between cover and suction pipe flange (Fig. 14 - 4/3).



14 - 4/2



1 – Spacer
2 – Rubber cord ring

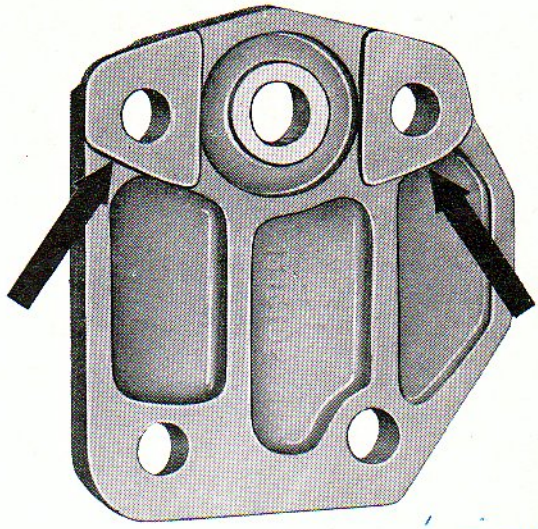
14 - 4/3

5. From Engine-No. 395 485 the two spacers between cover and suction pipe flange (6.25 dia. x 13 dia. x 0.75) are abolished.

   Instead of it, the cover has cast-on faces increased in height by 0.75 mm (Fig. 14 - 5/1).

   With this type of cover no spacers require to be interposed!

   Attention! In case of repair – up to Engine-No. 383 999 including – the flange gasket shall be – as a rule – replaced by a rubber gasket. Interchangeable cover!



14 - 5/1

Oil-Tightness of Engine

In all instructions given herein under the respective headings, attention has been directed to an unobjectionable seating of all casing parts and joints responsible for oil-tightness of the engine.

A prerequisite to a proper sealing of the engine from a technical point of view is the use of new gaskets or of liquid sealing compound "WEVOLIC" prescribed for some sealing joints, strict cleanness of all separation joints and the appropriate tightening of bolts and nuts on all component parts at the proper torque.

The knowledge of theoretical principles in connection with the structural design of a four-stroke cycle engine of the twin type which requires a controlled venting of the crankcase, will contribute to facilitate to a considerable extent not only the detection and localisation of troubles which might eventually cause leakages, but also the practical and appropriate execution of the different dismantling and reassembling work.

Just as with the well-known two-cylinder boxing-engines venting of the crankcase on a parallel two-cylinder type with equal-running pistons (twin system) must be made by a special control means, since both engine types have no automatic pressure equalisation in the crankcase as this is the case with four-cylinder engines. Just as on the said boxing-engines, venting is effected by means of a rotary slide with the 600 c.c. LLOYD engine. It is calculated so that pressure fluctuations which may occur in the crankcase as consequence of the piston motion will result – on an average – in a depression which prevents any escape of oil. The peculiarity of these engines demands for an absolutely airtight sealing of the crankcase. Any entrance of air into the crankcase would, otherwise, cause the vacuum in the crankcase to break down and allow an overpressure to build up, which, in the majority of cases, is the principal cause why oil escapes at another point.

For this reason a perfectly tight fit of contact surfaces of all engine casing covers and separation joints is of greatest importance.

To avoid oil leakages special attention should be paid to the following hints when carrying out service and repair work:

1. Be sure that oil level in the engine does not exceed the top mark on the dipstick (1.8 litres).
2. Insert dipstick until its stop.
3. Tighten oil filler cap. Replace metal cap (on earlier types) eventually by a rubber type. Straighten bent clamping springs.
4. Check tight fit of air breather tube and of fuel pump. After removal, use new flange gaskets.
5. Check valve chamber cover gaskets for proper condition, eventually replace. Fasten gaskets with "WEVOLIC" on the cover. Never put cover inaccurately on the opening. Replace warped covers.
6. Check fastening of camshaft housing. Retighten nuts or bolts at the specified torque. Use only gaskets of latest type.
7. After removal of camshaft housing it is good practice to have also gaskets of chain case replaced.
8. Be sure that camshaft adjustment is made properly. Wrong adjustment will result in inadequate venting control which, under circumstances, might cause oil losses.
9. Properly reassemble rotary slide drive. Worn-out rotary slides, worked-out centering flange and venting plate that fails to bear evenly must be replaced.
10. For tightening camshaft and crankshaft use only special seals.
11. After removal of cylinder heads it is good practice to fit new cylinder head gaskets.
12. After dismounting crankcase, replace packing cord and prior to reassembling give flange surfaces a coat of "WEVOLIC".
13. Retighten nut on tie-rods for cylinder head and crankcase at the specified torque.