Contents:

Engine

Clutch

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General Description

The air-cooled Volkswagen engine is of the 4-cylinder, 4-cycle, O. H. V.-type with two pairs of cylinders horizontally opposed. It is mounted on the recessed flange of the rubber-cushioned transmission case by means of four bolts.

Crankcase

The bipartite crankcase is cast of light-metal alloy. The crankcase halves are machined in pairs to very close limits and in consequence replacements must be made in pairs.

Crankshaft

The crankshaft rests in four precision-insert special light-metal alloy bearings and is heat-treated at its points of support. Main bearing No. 2 is of the split type. The end thrust is taken by main bearing No. 1. The flywheel with starter gear ring is held by a gland nut and additionally secured to the crankshaft by four dowel pins. Timing gear and distributor drive gear are secured in place by a Woodruff key. The fan pulley is bolted to the crankshaft. A noil seal is fitted to the clutch side of the crankshaft and an oil thrower to the pulley side.

Connecting Rods

The crank ends of the four connecting rods contain precision insert bearings of lead-bronze. The piston ends are provided with bronze piston pin bushings.

Pistons

The pistons are of light-metal alloy and have three rings, of which the bottom one il the oil scraper ring. The piston pins are fully floating and held in place by means of circlips.

Cylinders

The four cylinders of special cylinder casting are interchangeable and can be replaced separately together with the corresponding piston. The cylinders are provided with fins through which the air passes to effect a cooling.

Cylinder Head

Each pair of cylinders has one mutual detachable cylinder head of light alloy casting. The cylinder head is also provided with cooling fins and it incorporates pressed-in valve seat inserts, valve guides, and threaded steel inserts for the spark plugs. The valves are of the overhand type. No gasket is used between the jointing faces of cylinder and cylinder head. Copper-asbestos gaskets, placed between the flanges of cylinder and cylinder head, prevent an egress of combustion gas.

Valve Actuating Mechanism

The camshaft is carried in three bearings machined in the crankcase. It is driven from the crankshaft by helical gears. The camshaft timing gear is of light metal or of fiber. The valves are operated by the cams via push rods and rocker arms. Each cam operates in turn one of the valves of two opposed cylinders. The exhaust valves are plated with high quality chrome-nickel steel.

Cooling System

The air cooling is done by means of a fan, which is attached to the extended generator shaft. It is driven from the crankshaft by an adjustable V-belt at double the engine revolutions. The fan sucks in air through an opening in the fan housing, and the air cools the engine by being forced through the fins of the cylinders and cylinder heads. The air flow is directed by air deflector plates; some of them are situated in the fan housing, and the others cover the cylinders. The throttle ring at the air intake opening of the fan housing is controlled by a thermostat, insuring a quick attaining and steady maintaining of the operating temperature.

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Oil Circulation

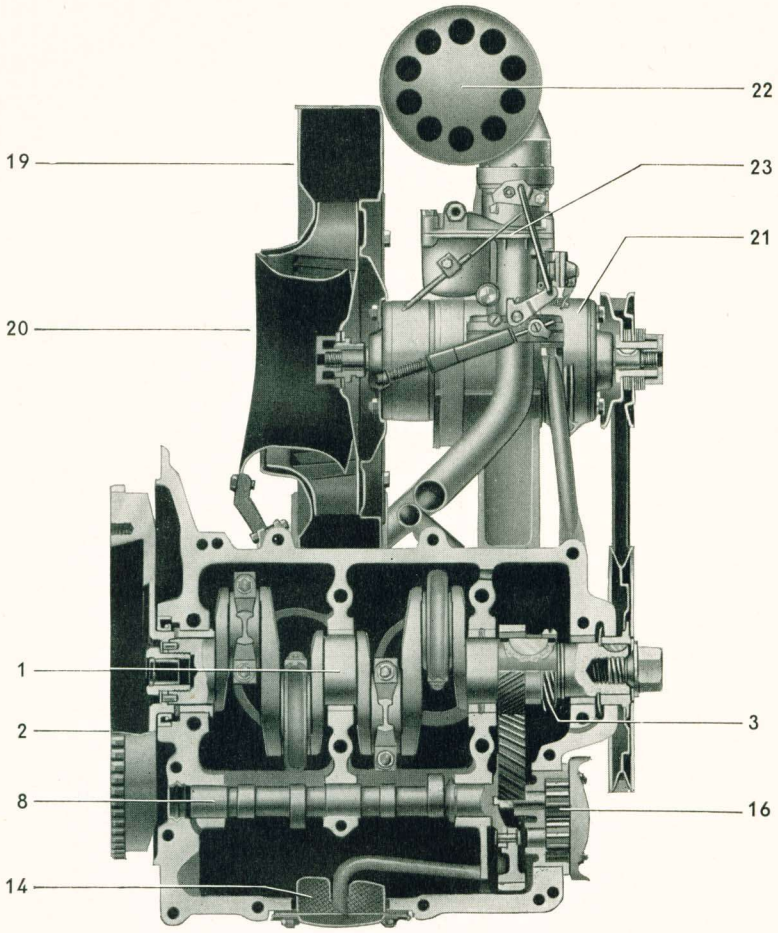
The pressure feed lubrication system includes a special oil cooler. The gear-type oil pump is situated at the gear side of the camshaft, from which it receives its drive. Oil is drawn from the lowest point of the crankcase and forced into the oil passages via the oil cooler. Part of the oil is feed via the crankshaft main bearings through the drilled passages in the crankshaft to the connecting rod bearings. Another part lubricates the camshaft bearings, and a third one is fed through the hollow push rods to the rocker arms, lubricating their bearings and the valve stems. Cylinder walls, pistons and piston pins are lubricated by splash. The returns to the crankcase bottom, where it is filtered by a gauze strainer at the lowest point before again entering the circulation.

Oil Cooling

The oil cooler on the crankcase is positioned in the ducted air flow. The situation of the oil cooler is such that the oil forced up by the pump must pass through it before reaching the lubrication points. The drop in temperature in the oil cooler amounts to 20 °C = 68 °F. This enables the oil to maintain its lubricating qualities even at high outside temperatures and at sustained high speed of the engine. In cold weather, when the oil is of higher viscosity, an oil pressure relief valve makes it possible for the engine to be lubricated directly, that is, by avoiding the oil cooling system.

Oil Pressure Control

An automatic oil pressure switch for the oil pressure warning lamp is fitted to the oil pipe between pump and cooler. This switch opens an electric contact at a pressure of 0.3—0.6 atm. (4.3—8.5 lbs./sq. in.) interrupting the supply of electric current to the warning lamp. The lamp lights up when switching on the ignition and when the oil pressure is insufficient.

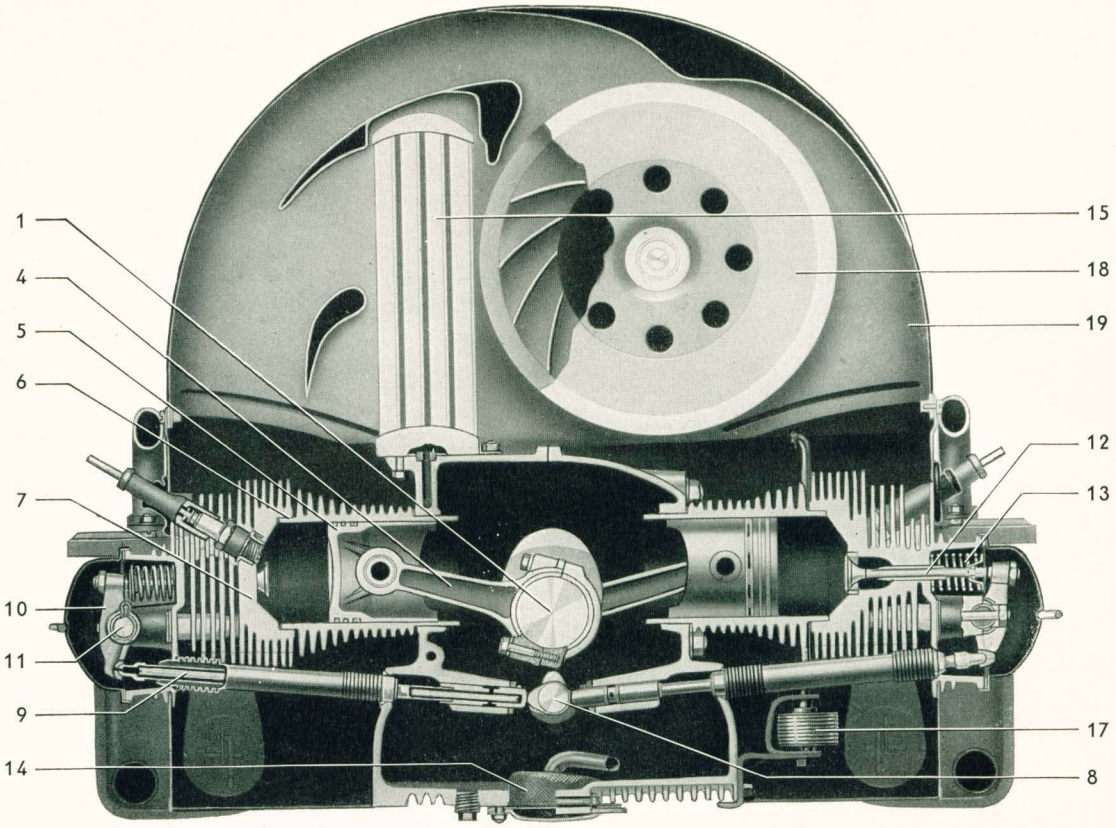


The Volkswagen Engine

1131 cc. — 25 B. H. P.

Sectional View

1 - Crankshaft
2 - Flywheel
3 - Distributor drive gear
4 - Connecting rod
5 - Piston
6 - Cylinder
7 - Cylinder head
8 - Camshaft
9 - Push rod
10 - Rocker arm
11 - Rocker arm shaft
12 - Valve
13 - Valve spring
14 - Oil strainer
15 - Oil cooler
16 - Oil pump
17 - Thermostat
18 - Fan
19 - Fan housing
20 - Throttle ring
21 - Generator
22 - Air cleaner
23 - Carburetor
24 - Fuel pump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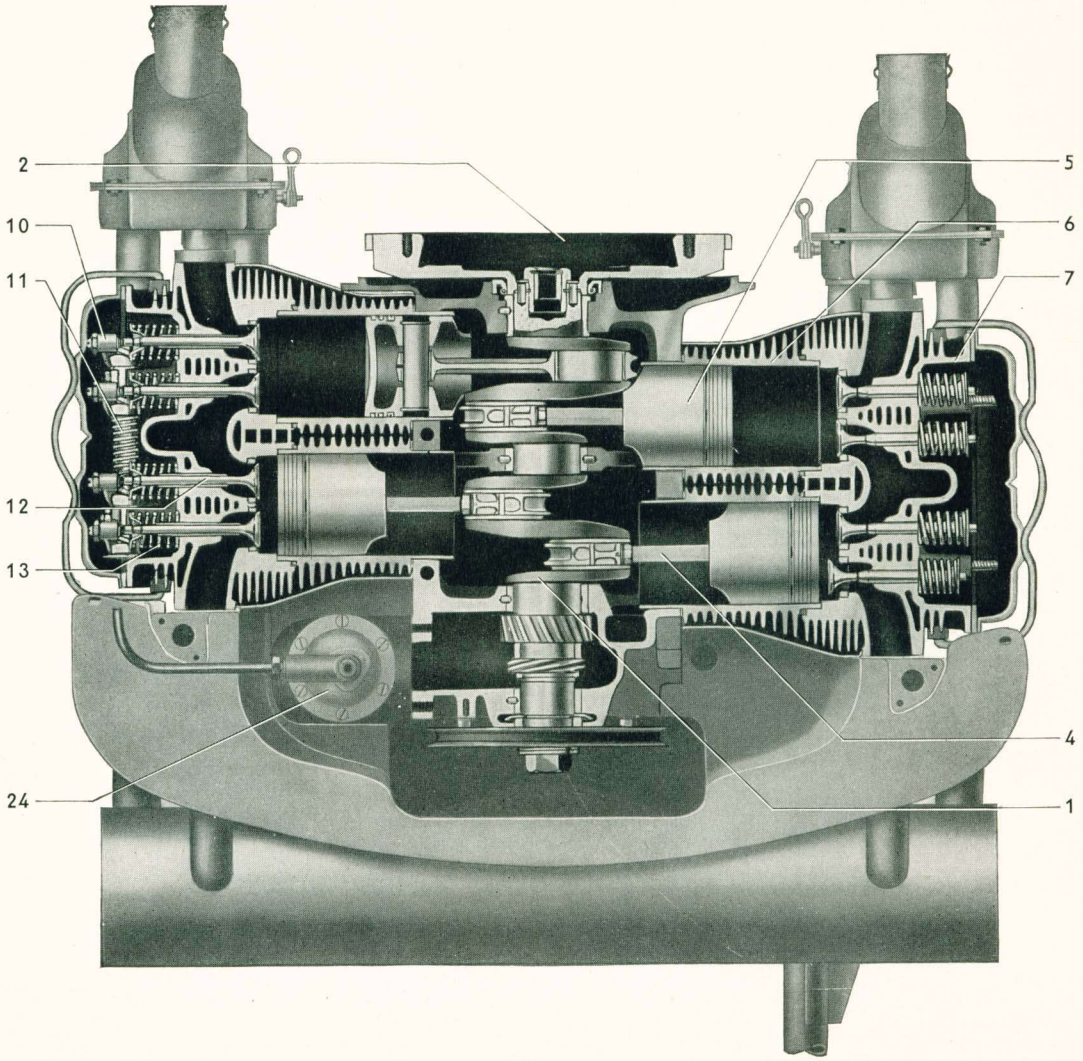
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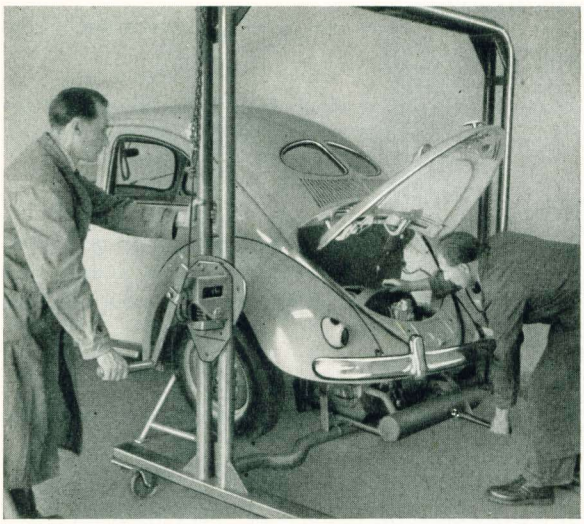
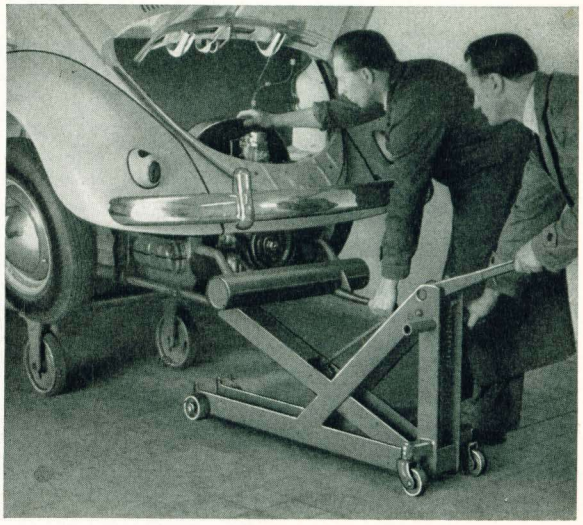
Engine Removal and Installation

M

Following is a list of the facilities which, depending on the equipment of the workshop, are available to remove the engine:

To lift car	To keep car in raised position	To remove engine
Gantry VW 301	Trestle VW 372 a	Gantry cross tube
Gantry VW 301	Trestle VW 372 a	Trolley jack
Free-wheel lift	—	Engine trolley VW 304
Free-wheel lift	—	Trolley jack
Roll-on lift	—	Engine trolley VW 304
Roll-on lift	Trolley stand VW 355/4	Trolley jack
Ramp VW 351/1	Trolley stand VW 355/4	Trolley jack

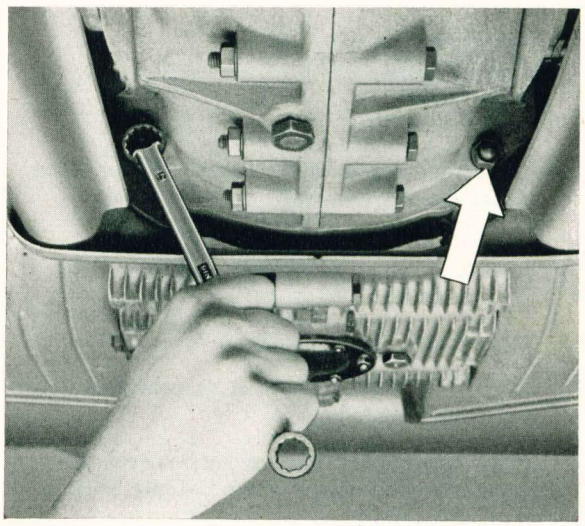




When jacking up, care should be taken that the rear end of the vehicle clears the ground about one yard prior to removing the engine.

Engine Removal

1 - Turn fuel tap to "off" position.
2 - Disconnect ground strap (copper braid) from battery.
3 - Open rear hood.
4 - Remove air cleaner and engine rear cover plate.
5 - Disconnect: cables from terminals 51 and 61 on generator, cable from terminal 15 on ignition coil, and cable from oil pressure warning light contact.
6 - Disconnect choke control cable and accelerator cable from carburetor.
7 - Raise vehicle at rear or lift it on trolley stand or trestle.
8 - Disconnect both heating control cables and loosen flexible heater pipes from engine.
9 - Disconnect fuel hose from engine.



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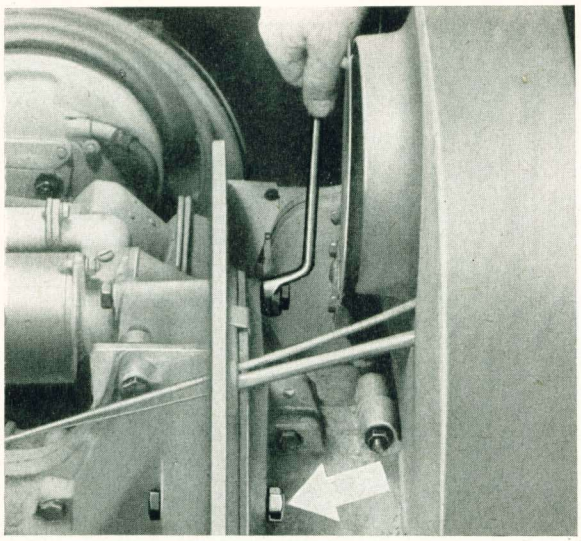
10 - Unscrew two nuts of the lower engine mounting bolts.

11 - Withdraw choke control cable and accelerator cable.

12 - Place engine trolley, or gantry cross tube, or trolley jack under engine.

13 - Have a helper to hold the upper two engine mounting bolts and remove nuts.



14 - Engine trolley:
Lower car until engine rests on trolley.

Trolley jack:
Raise jack until platform contacts engine.

15 - Withdraw engine until clutch release plate clears main drive shaft.

16 - Engine trolley: Lift up car, —

Trolley jack: Lower jack, —

and tilt the engine down at its rear end until it can be withdrawn.

When carrying out this operation, be sure not to distort or damage clutch release plate or main drive shaft.

Engine Installation

This is a reversal of the preceding operations, but attention should be paid to the following points:

1 - Install engine only with engine rear cover plate removed.

2 - Check central position of clutch plate, using special tool VW 219.

3 - Check main drive shaft for run-out. The main drive shaft is to be straightened if eccentricity exceeds 0.20 mm (0.0079″).

4 - Check clutch release bearing and clutch release plate for wear and cracks, renew if necessary.

5 - Examine pilot bush in flywheel gland nut for wear and fill it with 10 g (0.35 oz.). Special Grease VW — A 052.

6 - Lubricate main drive shaft splines and pilot, starter shaft bush, starter drive pinion, and flywheel gear ring with Special Grease VW — A 051.

7 - Thoroughly clean transmission case and engine flange.

8 - When replacing engine, care must be taken to prevent damage to gland nut bush and clutch release bearing and to avoid bending of main drive shaft.

To facilitate entry of main drive shaft into clutch plate and gland nut bush, rotate engine at V-belt (engage a gear to steady main drive shaft). Avoid jamming the choke control cable sleeve.

9 - When mounting engine, first insert the lower engine mounting bolts into their corresponding holes in transmission case flange. Press engine firmly against flange, paying attention to proper seating all around the flange. First slightly tighten the upper mounting bolt nuts and then the lower ones. After that, screw nuts fully tight in same order.

10 - Adjust choke control and accelerator cables.

Engine Disassembly and Assembly

It is recommended to adopt the following sequence of operations in disassembling and assembling the engine:

Disassembly

1 - Drain engine oil.

2 - Remove engine front cover plate.

3 - Remove fuel lines.

4 - Remove carburetor.

5 - Disconnect cable between distributor and ignition coil.

6 - Remove fan housing and generator as a unit.

7 - Remove intake manifold and ignition cable protection tube.

8 - Remove muffler and heater assy.

9 - Remove fuel pump cover plate.

10 - Remove heating channels and both cylinder cover plates.

11 - Remove clutch.

12 - Remove crankshaft pulley.

13 - Remove crankshaft pulley cover.

14 - Remove oil pump.

15 - Remove fuel pump.

16 - Remove ignition distributor.

17 - Remove distributor drive pinion.

18 - Remove cylinder head covers.

19 - Remove rocker arm shaft.

20 - Remove cylinder heads.

21 - Remove valve push rod tubes and valve push rods.

22 - Remove deflector plates below the cylinders.

23 - Remove cylinders.

24 - Remove pistons.

25 - Remove oil cooler.

26 - Remove flywheel.

27 - Remove oil strainer.

28 - Disassemble crankcase.

29 - Remove camshaft and crankshaft.

Assembly

Assembling the engine is a reversal of the above operations. Reference should be made, however, to the following pages containing detailed information and special hints as to the correct removal and installation of the individual parts.

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Removing and Installing Cover Plates

Removal

Sequence of operations:

1 - Take off engine rear cover plate prior to removing engine.

2 - Remove engine front cover plate.

3 - Remove fan housing and generator as a unit.

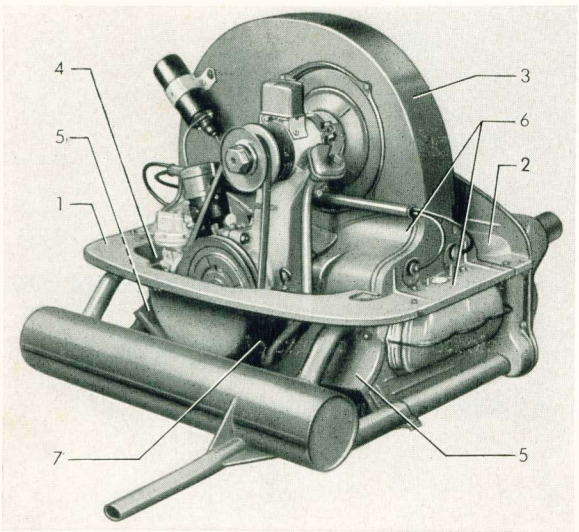
4 - Remove fuel pump cover plate.

5 - Remove heating channels after having removed the exhaust system.

6 - Remove both cylinder cover plates.

7 - Remove crankshaft pulley cover after having removed the pulley.

8 - Remove deflector plates after having taken off valve push rod tubes.

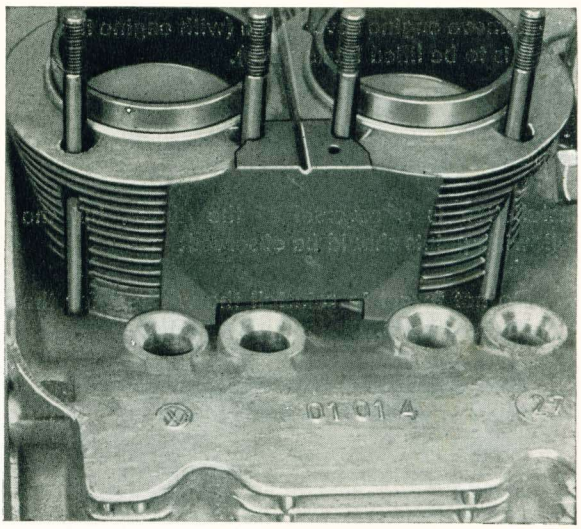


1 - Engine rear cover plate
2 - Engine front cover plate
3 - Fan housing
4 - Cover plate
5 - Heating channel
6 - Cylinder cover plate
7 - Cover plate

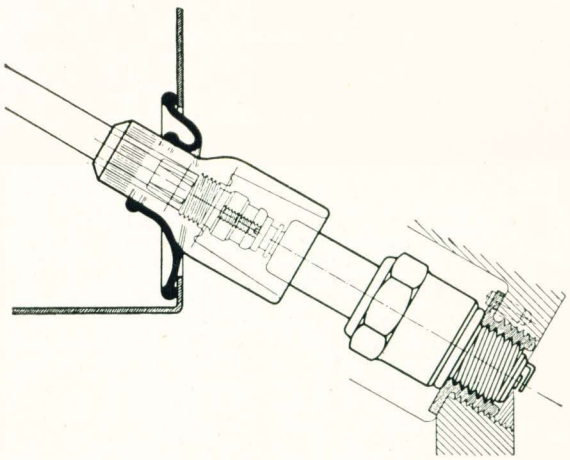
Installation

Installation is a reversal of the above, but the following points require attention:

1 - The deflector plates below the cylinders must be installed prior to the push rods and push rod tubes. Be sure of their proper position. If the necessity should arise, bend the plates until they tightly bear on the cylinder head studs to avoid a rattling noise and a working loose during operation.



2 - When replacing cylinder cover plates, attention should be paid to condition and sealing of spark plug rubber caps.



3 - The cylinder cover plates should fit snugly on the exterior of the fan housing to prevent loss of cooling air.

4 - Prior to installing the engine front cover plate, check condition of weatherstrip.

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Removing and Installing Engine Rear Cover Plate

(Engine in situ)

Removal

1 - Remove oil filler and oil level dipstick.

2 - Release slotted screws of engine cover plate.

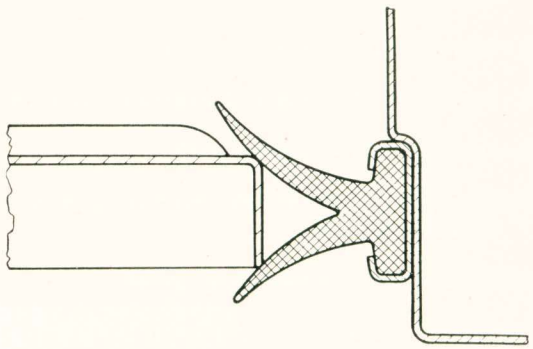
3 - Remove engine cover plate (with engine in situ, it is to be lifted backwards).

Installation

Installation is a reversal of the above, but the following points should be observed:

1 - Do not forget to reinstall the washers for the slotted screws.

2 - After engine has been installed, the weather-strip lips should be positioned as shown in the illustration.



Damaged weatherstrips are to be renewed.

Removing and Installing Heating Channel

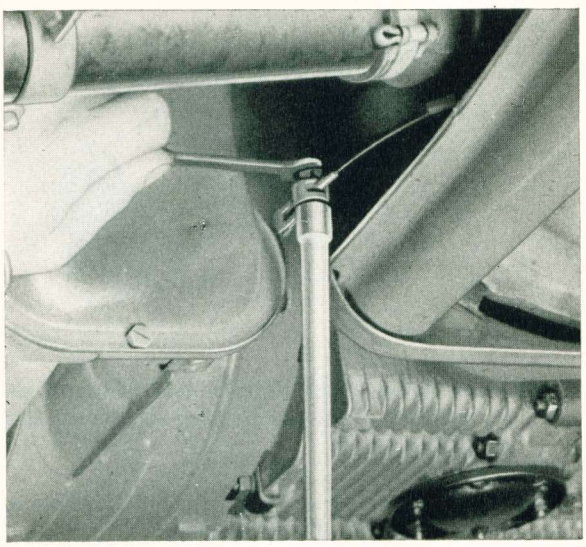
(Engine in situ)

Removal

1 - Remove engine rear cover plate.

2 - Remove muffler.

3 - Detach heating control cable.



4 - Remove heating junction box and exhaust pipe.

5 - Release slotted screws of heating channel.

6 - Remove heating channel.

Installing

Installation is a reversal of the above, but the following points should be observed:

1 - Check heating channel for damage prior to installation.

2 - Both the heat control valve and the control sheet at the rear should freely move and must fully open and close simultaneously to insure a correct heating control.

3 - Adjust heating control cable so that the valve at the front of the heating channel is fully closed with the heating control knob pushed in.

Removing and Installing Fan Housing

(Engine removed)

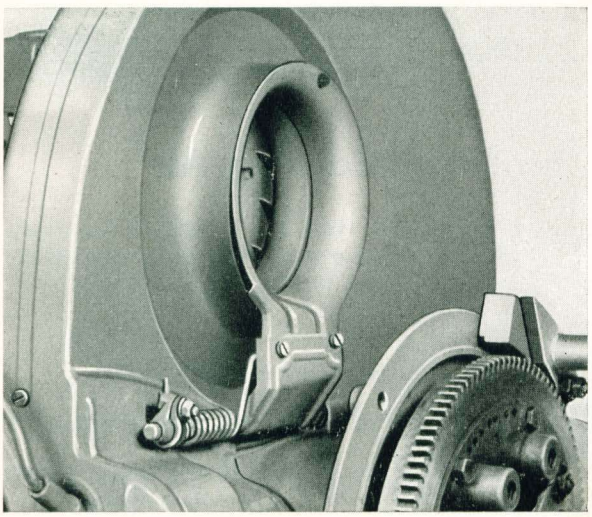
Removal

1 - Remove fan belt.

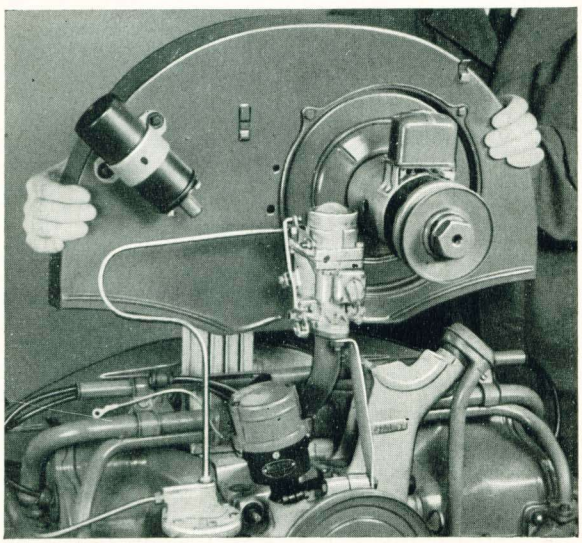
2 - Remove generator strap and disconnect cable from ignition coil.

3 - Release slotted screws on both sides of fan housing.

4 - Detach spring of automatic cooling air control and release throttle ring screws.



5 - Lift off fan housing and generator.



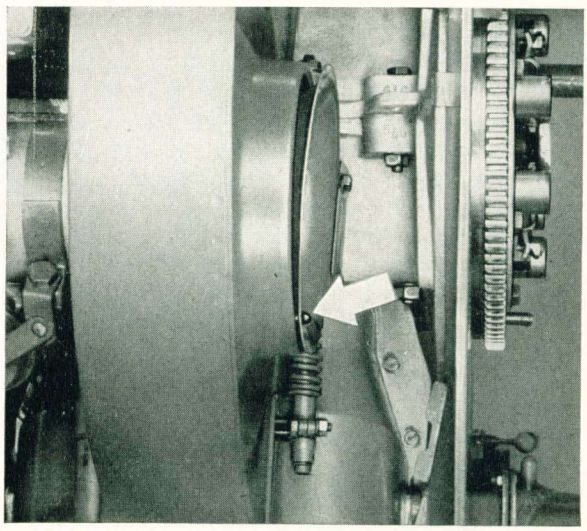
Installation

Installing is a reversal of the preceding operation, but the following points should be noted:

1 - Examine fan housing for damage and loose air deflector plates.

2 - There must be no "blow-past" between fan housing and cover plates of cylinders. If necessary, bend plates into correct position.

3 - Insert throttle ring and screw it to the holding plate on the operating shaft, taking care that there is no offset between the intake flange and the throttle ring. The throttle ring is designed to occupy a tilted position — as seen from the side and from above —, and no attempt should be made to bend the holding plate as such practice would result in a mal-functioning of the cooling system. The throttle ring is centered to the intake flange by moving it in its clearance holes.



4 - Connect return spring.

5 - Adjust throttle ring.

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Removing and Installing Fan Housing

(Engine in situ)

Removal

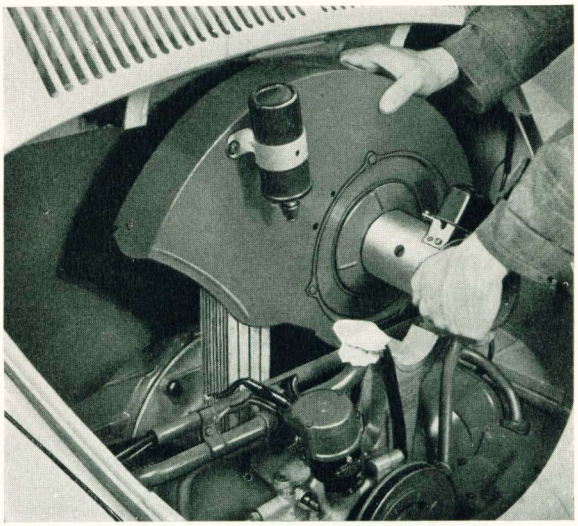
1 - Disconnect battery.

2 - Remove rear hood together with hinge bracket.

3 - Disconnect cables from generator and ignition coil and cable from oil pressure switch.

4 - Detach and pull out accelerator and choke control cables and remove conduit tube.

The other operations for removing and installing fan housing are the same as with the engine removed.



Thermostat-Controlled Intake of Cooling Air

Inspection and Adjustment

Regular attention should be paid to the adjustment of the cooling air intake in connection with the routine service. A through inspection is especially important when cold or warm seasons begin.

When adjusting the air cooling unit, it should be borne in mind that a premature opening or a permanent "open" position of the throttle ring are responsible for the engine attaining its operating temperature too slowly. These conditions are most liable to produce incessant carburetor spitting (flat spot) and an increased fuel consumption. If the throttle ring opens too far, it may foul the fan resulting in a considerable noise. A retarded opening of the ring in the warm season creates an excessive heat development when the engine is made subject to sustained high load.

If the throttle ring remains "open" whilst the engine il cold, the thermostat may be defective. To prevent an overheating of the engine, the throttle ring fully opens automatically when the cooling system is out of order.

Inspection

1 - When the engine is cold, the throttle ring should rest slightly pre-loated against the air intake flange.

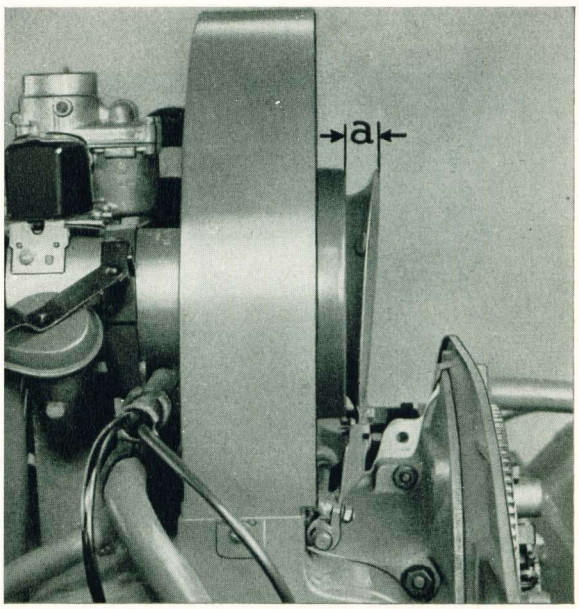
2 - The engine should be allowed to warm up until the upper end of the thermostat touches the stop of the support by the heat expansion (at normal outside temperature).

The distance from the middle of the intake flange to the edge of the throttle ring should measure 20 mm (0.79″) in this position.

Adjustment when Assembling Engine

1 - Lift thermostat to the upper stop of its support.

2 - Adjust throttle ring so that it opens 20 mm (a = 20 mm/0.79″) as described above.



3 - Tighten operating lever.

4 - Tighten thermostat in position. Be sure the faces milled in the tapped boss of the thermostat fit properly in the guide hole of the support. For this purpose it may become necessary to rotate the thermostat backward by max. half a turn. When the thermostat has been tightened, the throttle ring rests slightly pre-loaded against the intake flange.

Adjustment with Engine in Car

1 - Release throttle ring operating lever.

2 - Allow engine to warm up until upper end of thermostat touches upper stop of the support (at normal outside temperature).

3 - Adjust throttle ring so that it opens 20 mm (0.79″).

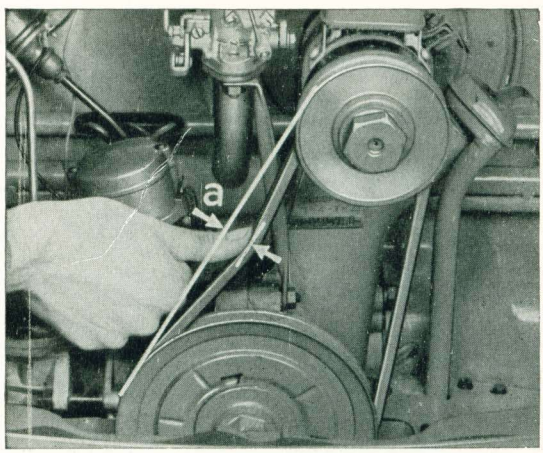
4 - Tighten operating lever.

Make sure that throttle ring and linkage are freely moving in each position.

Checking Fan Belt Tension

General Note

Generator and cooling system are driven by the fan belt. Due to the power absorbed by these two units, the fan belt is subjected to considerable stress, especially at high speed and when shifting down. To insure adequate cooling and long service life of the belt, it is of utmost importance to maintain the belt at correct tension. If the belt is too slack, a slippage occurs between pulley and belt, leading to an overheating of the engine. Excessive tension creates undue stress and is liable to cause breakage of the belt and damage to the generator bearings.



a = 15 mm (about 0.6 in.)

It is important to prevent oil getting on to the fan belt when lubricating the engine. Oily fan belts can in many cases be made serviceable again by washing them in an alkaline degreasing solution. Fuel must not be used.

Fan belts which have become impregnated with oil are generally unserviceable and must be renewed.

Examination

The belt, when firmly pressed with the thumb at midpoint, must yield approximately 15 mm (about 0.6″).

No traces of excess use, such as frayed edges and cracks, should be perceptible.

Adjusting Fan Belt Tension

1 - Remove nut from generator shaft pulley. When loosening or tightening nut, insert a screwdriver in the slot cut into the inner half of the pulley, and support it against upper generator housing bolt.

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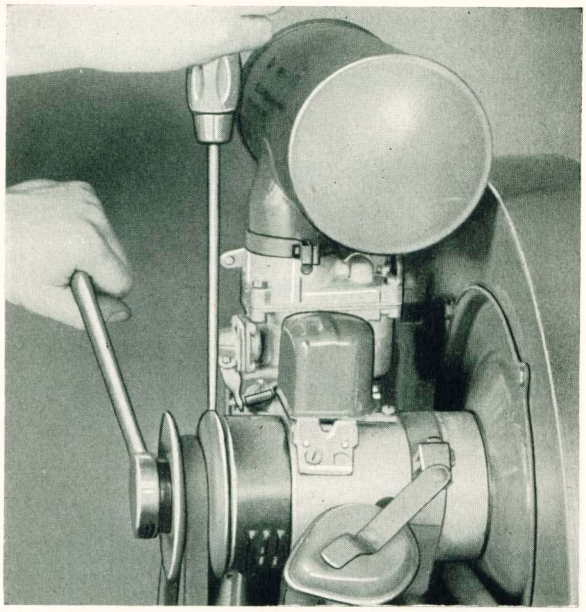
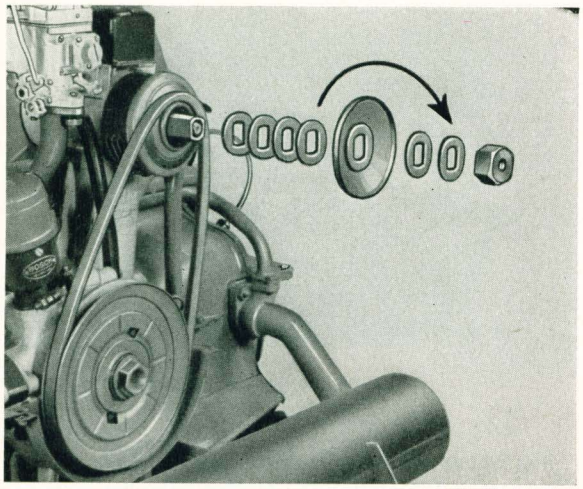


2 - Remove outer pulley half.

3 - Arrange spacer washers as required to correct the fan belt tension.

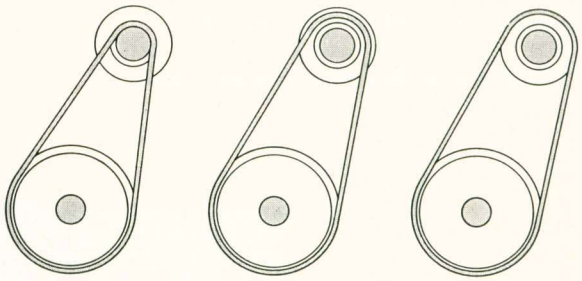


The tension of the fan belt is adjusted by fitting more or less spacer washers between the two pulley halves until the belt yields 15 mm (.6″) by a firm thumb pressure. Belt slackness is taken up by removing one or more washers, and if the belt is in too much tension, one or more washers should be added.

Note:

From Chassis No. 1—0575415 onwards, the fan belt allows a finer adjustment, as, beside the six spacer washers of 1.5 mm (.06″) thickness in front of the outer pulley half, there are further 8 washers of 0.5 mm (.02″) thickness between the two pulley halves.

When the belt has stretched itself, or is worn, to an extent where no washers remain between the pulleys to obtain the correct tension, the belt is to be renewed, as the amount of cooling air becomes then inadequate due to the reduced number of revolutions of the fan. It is also important that the belt does not bear on the base circle of the pulley, that is, on the washers.



Wrong Correct Wrong

4 - Install outer pulley half.

Note:

From Chassis No. 1—0753096 fan, generator and small fan pulley are balanced dynamically as a unit at 1000 r. p. m. The then remaining permissible unbalance amounts to max. 3 cmg. A balance weight is spot-welded to the inside of the flange around the circumference of the outer pulley half and to the fan as required. The flange of the outer pulley half is already made wider from Chassis No. 1—0722916, from 10.5 mm to 20 mm (.41″ o .8″). After the unit is balanced, both pulley halves are provided with a paint mark. These paint marks must be aligned when assembling. To maintain the true running of the dynamically balanced generator/blower unit with safety, the front half of the generator pulley is welded to the pulley hub from Chassis No. 1—0929746. The rear pulley half is held in place by lugs of different widths, allowing a reinstallation in its original position only. The pulley is secured to the generator armature shaft by means of a hex. nut (21 mm) (.82″).

5 - Place all surplus washers between outer pulley half and pulley nut so that all the spacer washers are retained on the pulley hub.

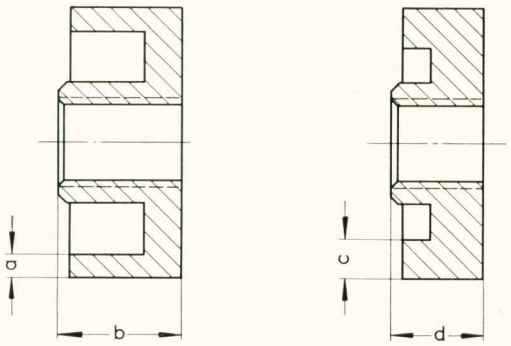
6 - Tighten pulley nut.

Loose pulleys of previous design cause considerable wear and damage to their hubs. The belt is thus subjected to excessive wear and tear due to the consequent wobbling of the pulley.

Worn pulleys must be renewed.

Note:

From Chassis No. 1408865 the overall thickness of the fan nut has been decreased by 4 mm.



Before

a - Width of nut face (3.12 mm)

b - 16.25 mm

New

c - Width of nut face (5.12 mm)

d - 12.25 mm

This modification is to prevent the nut from working loose under all operating conditions. The nut can be installed on all earlier engines.

Note:

Newly installed fan belts are apt to stretch to some extent and to yield slightly at their flanks, causing belt slackness no later than after the first 50—100 km (30—60 miles). It is, therefore, essential to check the fan belt in time and adjust it if necessary.

No attempt should be made to remove the fan belt by means of a screwdriver without backing off the pulley nut, as such practice will destroy the belt and damage the pulley.

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Removing and Installing Intake Manifold

Removal

1 - Remove fan housing.

2 - Remove carburetor.

3 - Remove nuts and bolts of intake manifold.

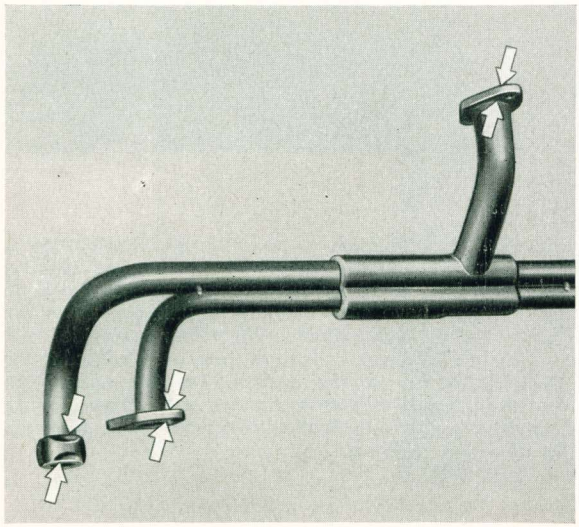
4 - Lift off distributor cap and detach spark plug connectors.

5 - Take off intake manifold.

Installation

Installation is accomplished by reversing the removal procedure, but the following hints should be noted:

1 - Check manifold flanges for clean and smooth contact surfaces. The manifold should also be inspected for cracks.

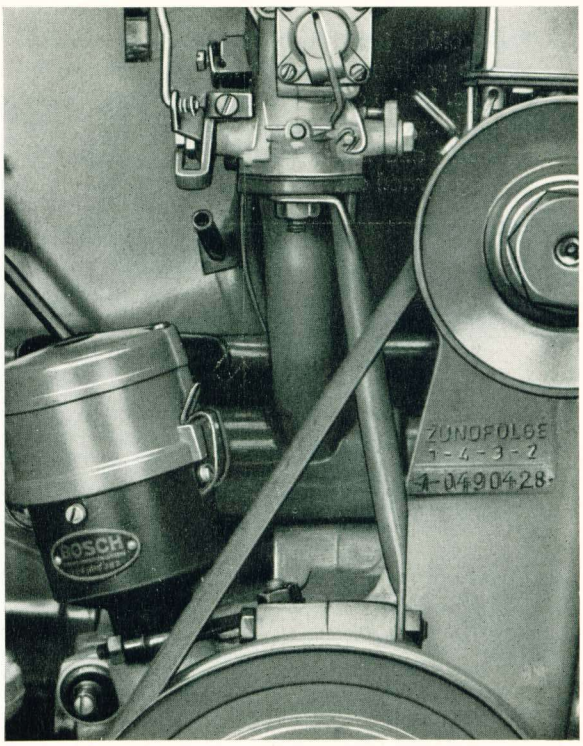


2 - Clean cylinder head filter element, replace if necessary.

3 - Use new gaskets.
Before installation of the manifold, a check should be made to assure that it is not warped.

If necessary, straighten the manifold. If it has been heated, make sure that no scales remain in the interior.

4 - Do not forget to reinstall intake manifold support between carburetor flange and crankcase.



5 - Tighten nuts and bolts evenly and securely to prevent leaks.

Removing and Installing Muffler (Silencer)

Removal

1 - Remove bolts of pre-heating pipe flanges.

2 - Release exhaust pipe clamps.

3 - Remove bolts of rear exhaust pipe flanges.

4 - Take off muffler.

Installation

Installation is accomplished by reversing the removal procedure, but the following points should be noted:

1 - Check muffler and exhaust pipes for cracks and damage. Bent or out-of-round exhaust pipes must be repaired.

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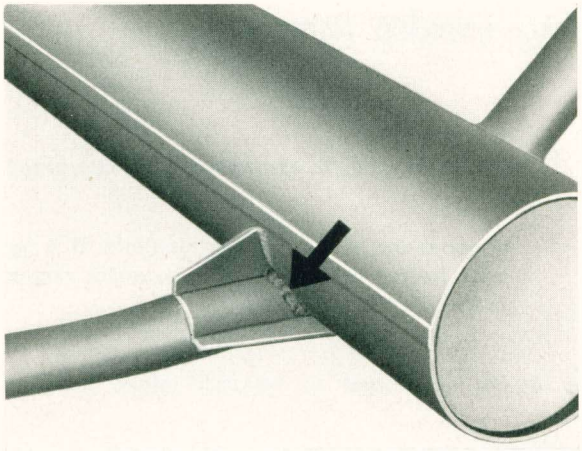
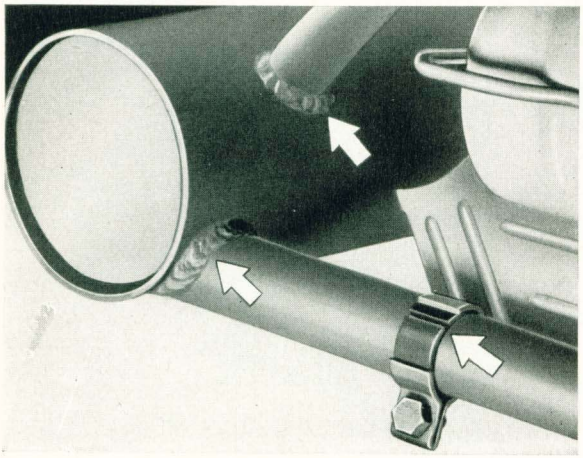


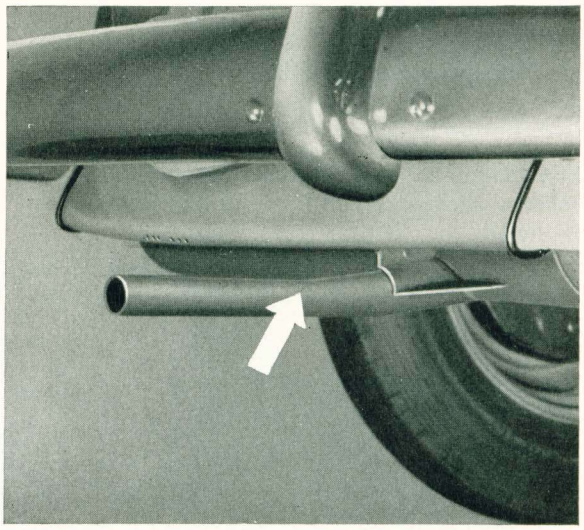
The welded joint of the muffler and the tail pipe is particularly susceptible to damage by impacts. Leaks at this point are liable to cause the exhaust fumes entering the engine compartment and the interior of the car with the heating turned on.



2 - Use new gaskets.

3 - There should be a perfect seal at conjunction to front exhaust pipes.

4 - With the engine in situ, the tail pipe must not touch the lower edge of the body. If necessary, the pipe is to be heated prior to bending it.



Note:

The muffler meets in every respect the operating conditions of the engine and the requirements of a good muffling of the noise caused by the engine exhaust. Thorough experiments have shown that it is unimportant to the function of the engine whether the muffler is provided with one or two tail pipes, as long as these are attached to the middle chamber of the muffler. The tail pipes must, however, never be fitted to the two outer chambers nor should any other modification be carried out in order not to affect the muffling.

Removing and Installing Heating Junction Box and Exhaust Pipe

Removal

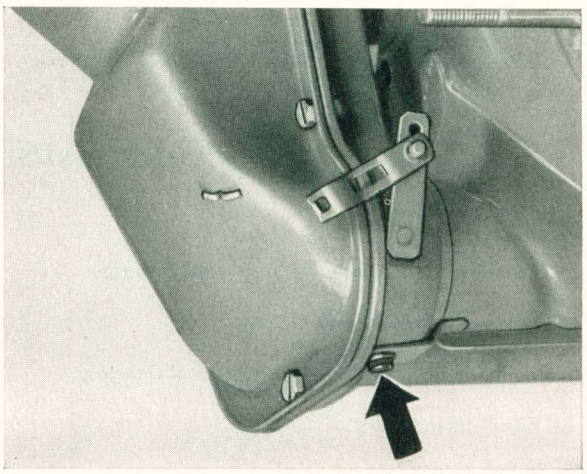
1 - Detach flexible heating pipe from junction box.

2 - Detach heating control cable.

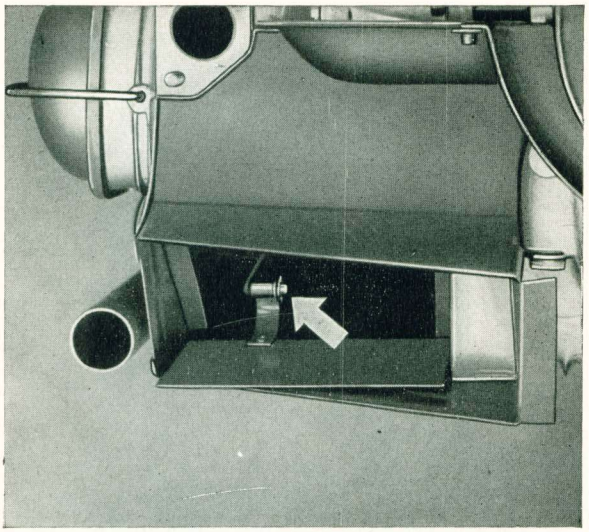
3 - Remove nuts from exhaust flange.

4 - Release exhaust pipe clamp.

5 - Remove slotted screw at the lower side of the junction box.



6 - Remove the cotter pin and unhook the connector rod from the heat control sheet.



7 - Take off heating junction box and exhaust pipe.

Installation

This is carried out in reverse order to removal, but the following points should be heeded.

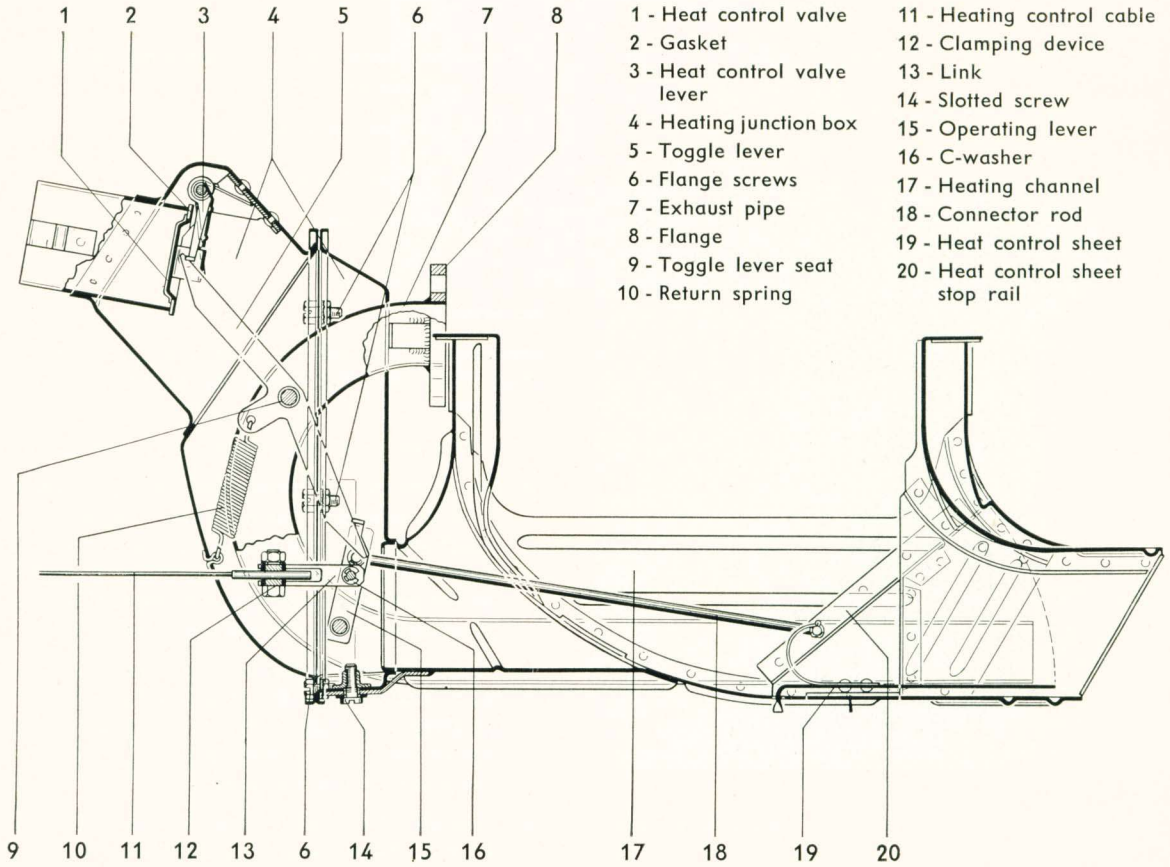
1 - Important! Check heating junction box and exhaust pipe for leaks and damage. Leaks at this points may lead to exhaust fumes entering the interior of the car through the warm air heating.

2 - The contact surfaces of the flanges must be clean and even. Distorted or bent flanges are to be repaired.

3 - Use new gaskets.

4 - All moving joints are to be lubricated with a mixture of graphite and high melting point grease.

Heating Junction Box Assembly and Disassembly



1 - Heat control valve
2 - Gasket
3 - Heat control valve lever
4 - Heating junction box
5 - Toggle lever
6 - Flange screws
7 - Exhaust pipe
8 - Flange
9 - Toggle lever seat
10 - Return spring
11 - Heating control cable
12 - Clamping device
13 - Link
14 - Slotted screw
15 - Operating lever
16 - C-washer
17 - Heating channel
18 - Connector rod
19 - Heat control sheet
20 - Heat control sheet stop rail

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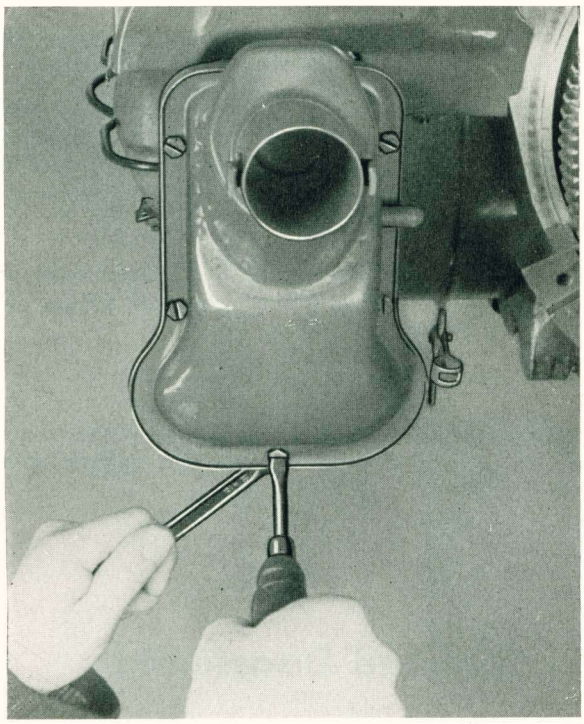
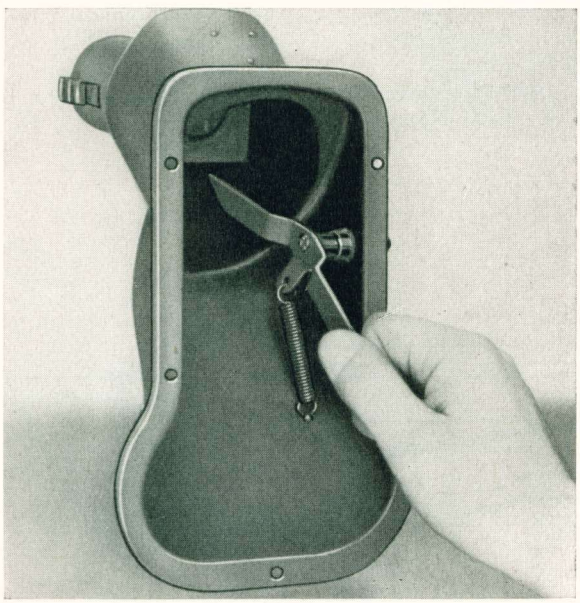
Disassembly

1 - Remove flange screws.



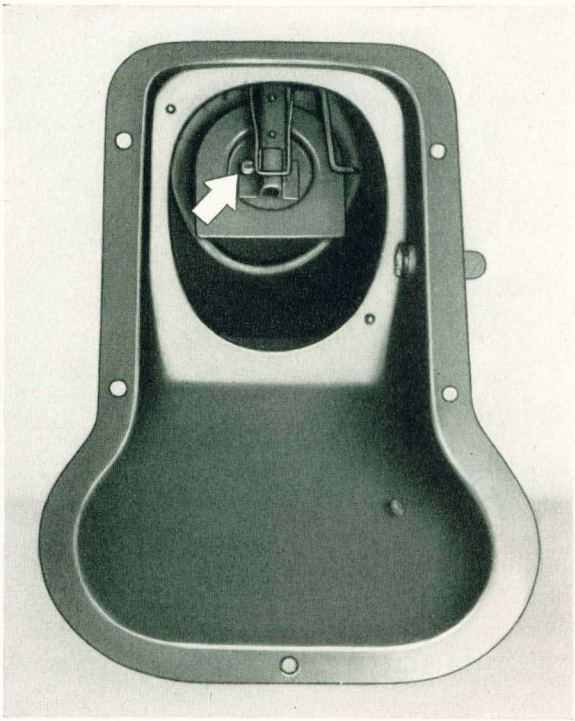
2 - Take off junction box half.

3 - Lift toggle lever from its seat.



4 - Unhook return spring from toggle lever and junction box.

5 - Remove cotter pin and withdraw heat control valve.



6 - Remove cotter pin at operating lever and unhook connector rod.

7 - Remove C-washer at link.

8 - Take off the link bolt.

9 - Take off the link.

Assembly

Assembly is effected by reversing the preceding operations, but the following points should be observed:

1 - Clean all parts and inspect them for damage.

2 - The heat control valve must fully close off the heating junction box outlet to assure that no warm air enters the interior of the car with the control knob in the closed position. Inspect the gasket for wear and damage and replace complete valve if either condition is evident.

3 - The seats of the toggle lever and operating lever are to be lubricated with a mixture of graphite and high melting point grease. Only use as much high melting point grease as is necessary to bind the graphite.

4 - Operate the heat control valve and control sheet to check for proper function.

Note:

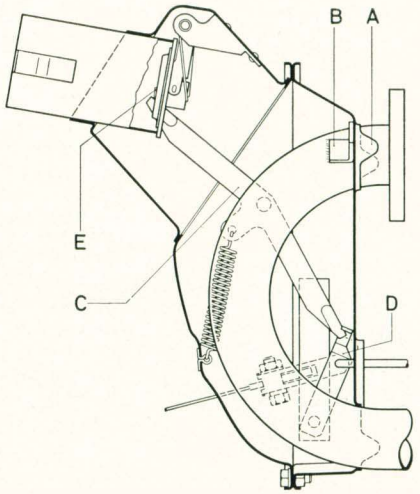
From Chassis No. 1429178 the connections between heating junction box and exhaust pipe and the control linkage in the junction box have been modified as detailed below:

1 - Heating Junction Box

The edges of the two holes in the junction box through which the exhaust pipe passes are flanged to take the form of a collar with two tabs (A) for spot-welding the junction box to the exhaust pipe. Apart from that, the bracket (B) is repositioned 20 degrees further towards the top. These modifications increase the strength of and provide a better seal between junction box and exhaust pipe.

2 - Toggle Lever and Hot Air Control Valve

The tips of the toggle lever (C) are reinforced and the edges rounded off. The contact surface of the now cranked operating lever (D) is wider to conform with the reinforced toggle lever. The contact surface for the toggle lever at the hot air control valve is curved and enlarged; a stop prevents the toggle lever from slipping off the curved surface (E).



The object of these mofications is to reduce the frictional resistance of the control linkage.

Removing and Installing Heating Control Cable

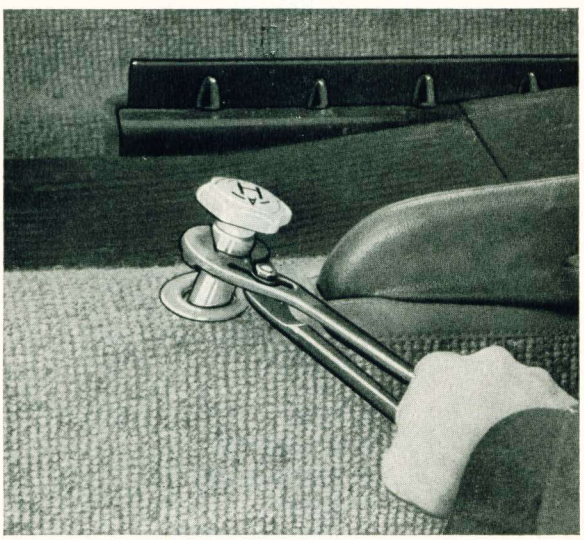
Removal

1 - Raise the car.

2 - Release nut of clamping device (use 9 and 10 mm open end wrenches to avoid breakage of cable consequent upon distortion of link).

3 - Disconnect control cable from clamping device.

4 - Remove rubber grommet from conduit tube and slide it off the cable.



5 - Release the threaded cap and pull out the knob and cable (note proper entry of cable ends into conduit tubes).

Installation

Installation is accomplished by reversing the removal procedure, but the following notes should be followed:

1 - Grease cable with Universal Grease VW A — 052.

2 - The longer end of the heating control cable must be inserted into the right-hand conduit tube (as seen in driving direction).

3 - Before installing the heating control knob unit, turn the knob anti-clockwise until stop can be and then turn it clockwise three turns.

4 - Insert heating control knob unit, taking care that the guide nose enters the slot in the

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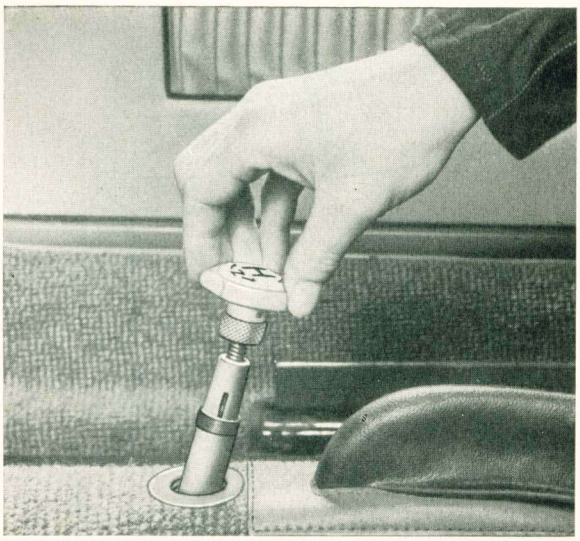
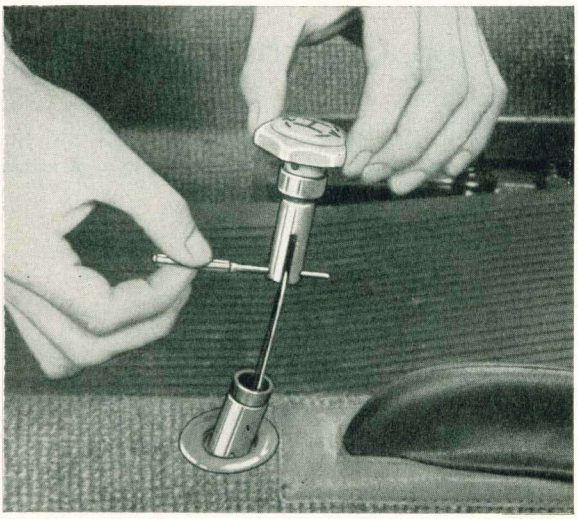


threaded sleeve. The heating control knob unit is properly installed if the threaded sleeve does not stick up above the edge of the conduit tube.

5 - Check rubber grommets for wear and replace as necessary.

6 - Check heating system for proper function.

Heating Control Knob Unit Disassembly and Assembly



Disassembly

1 - Release clamping device and withdraw the cable.

2 - Release threaded cap and pull out heating control knob unit until the cable can be seen.

3 - Remove the cable pin by means of a drift and take off heating control knob unit.

4 - Screw off the threaded sleeve.

5 - Drive out grooved pin and witheraw knob from the spindle.

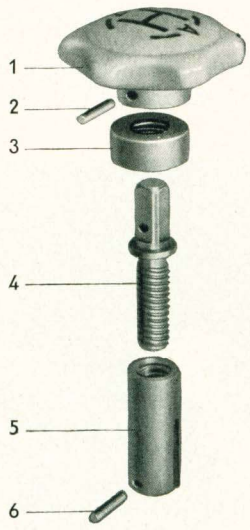
6 - Lift off threaded cap.

Assembly

Assembly is accomplished by reversing the above operations, but the following points should be observed.

1 - Clean all parts and lubricate them with Universal Grease VW A — 052.

2 - Carefully drive in the grooved pin in order not do damage the knob.



1 - Knob
2 - Grooved pin
3 - Threaded cap
4 - Spindle
5 - Threaded spindle
6 - Cable pin

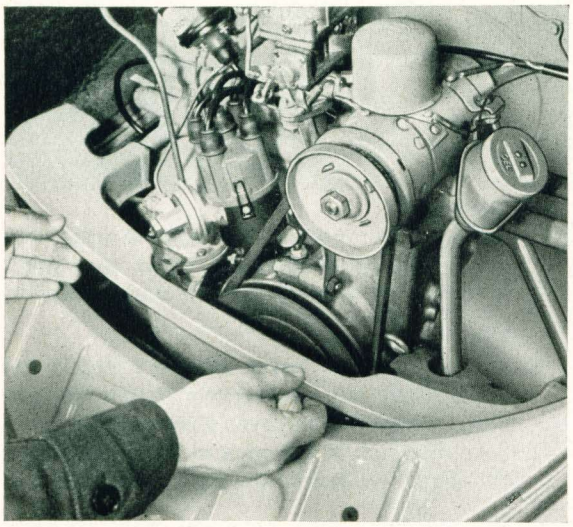
Muffler Removal and Installation

(With engine in situ)

Removal

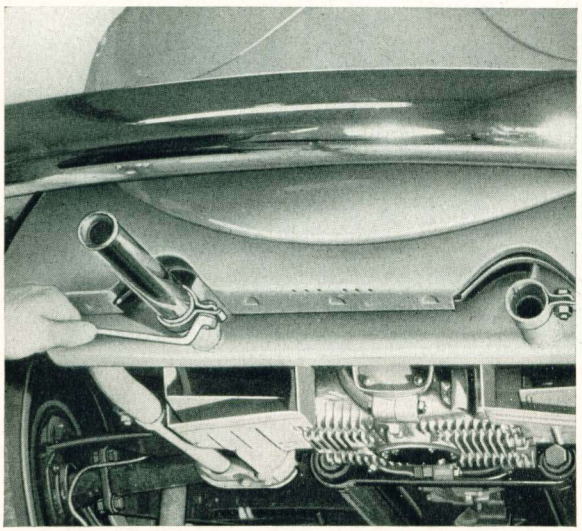
1 - Lift rear end of car and support it on trestles.

2 - Remove the five engine rear cover plate attaching screws and lift off cover plate rearward.



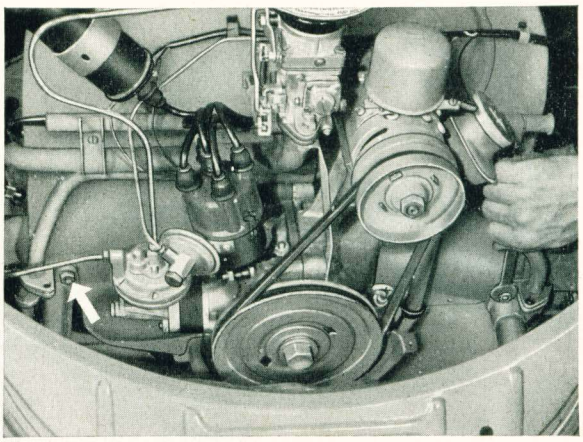
3 - Remove the four pre-heating pipe flange screws.

4 - Loosen tail pipe clamps and pull off the two tail pipes.



5 - Loosen the clamps at the front exhaust pipes.

6 - Remove the four nuts at the muffler flanges.

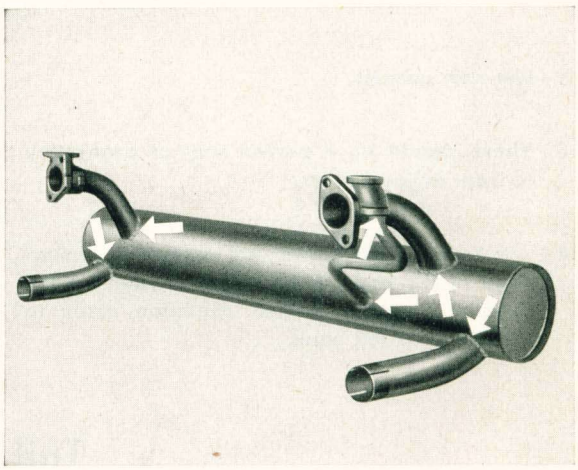


7 - Withdraw muffler and lower it for complete removal. Take off all flange gaskets.

Installation

Installation is accomplished by reversing the removal procedure, but the following points should be noted:

1 - Check muffler and exhaust pipes for cracks and damage prior to installation.



The pipes welded to the muffler can be straightened, if necessary.

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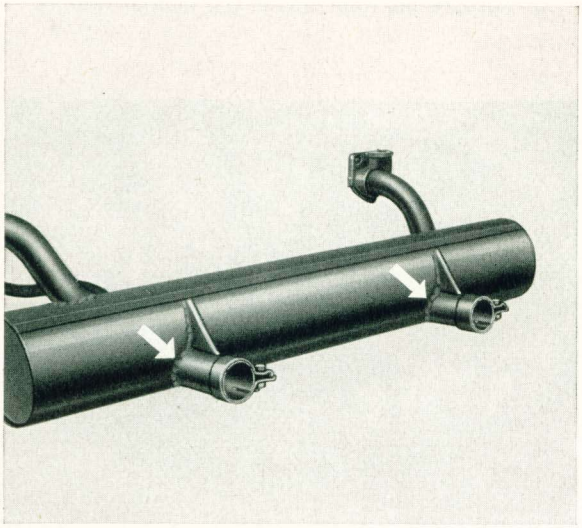
The welded joints at the muffler are particularly susceptible to damage by impacts. Leaks are liable to cause exhaust fumes



entering the engine compartment and the interior of the car when the heating is turned on.

Bent or out-of-round tail pipes should be replaced in all cases.

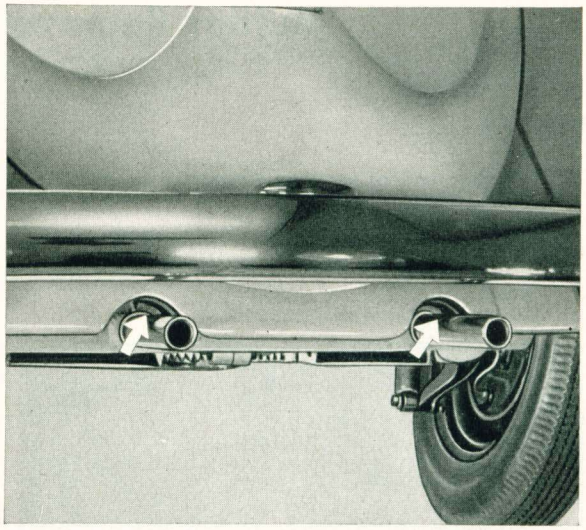
Note:

The muffler must only be used in conjunction with the corresponding intake manifold, as the preheating of the mixture would otherwise be impaired, leading to a loss in the engine output.

2 - Use new gaskets.

3 - There should be a perfect seal at connection to front exhaust pipes.

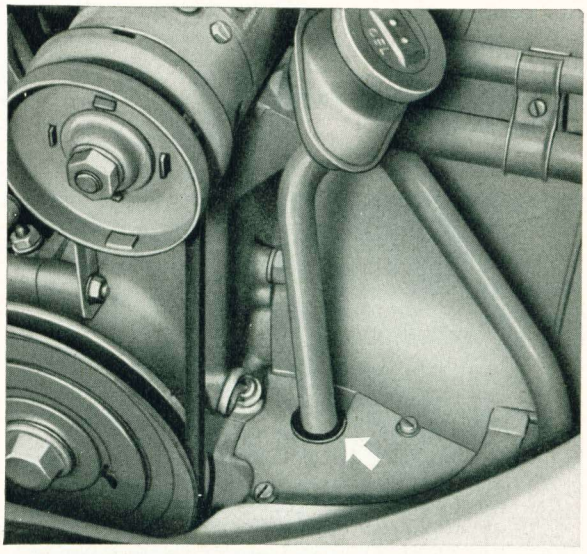
4 - The two tail pipes must not contact the lower edge of the body. If necessary, straighten the exhaust pipes in heated condition prior to installing the tail pipes.



5 - Push the tail pipes into the exhaust pipes until resistance can be felt and make sure there is a snug fit between tail pipes and exhaust pipes.

6 - After engine rear cover plate is installed, the upper lip of the weatherstrip should be positioned on top of the cover plate and the lower lip must bear on the edge of the plate flange. Damaged weatherstrips are to be replaced.

7 - The breather pipe grommet must squarely bear on the cover plate.



Tail Pipes

Strong evidence of blisters on tail pipes — as well as discoloration — is usually caused by exhaust tubing pushed over the tail pipes when the engine is tested on test stands or dynamometers.

It is, therefore, recommended to remove the tail pipes prior to such tests.

Heating

In order to insure satisfactory operation of the Volkswagen heating system, the following points should be observed:

a - Make sure the heating control linkage is properly adjusted.

b - To avoid excessive loss of heat, eliminate leaks in heating channels and body.

c - Make sure the engine is free from oil leaks.

d - Check for excessive pressure in crankcase (egress of oil at crankshaft fan pulley).

e - Check for oil leaks at oil filler and breather tube.

f - Check for leaks at flanges between exhaust pipes, muffler and pre-heating pipe.

g - Check for obstructions in cooling air duct to engine.

An unsatisfactory heating system should be carefully examined and especially so in the case of unpleasant fumes in the heating air. This can be caused by dirty cylinder and cylinder head cooling fins or a dirty oil cooler. Besides the fact that a dirty engine causes the operating temperature to rise, which in turn can damage the engine, fumes may arise which can have a more or less unpleasant effect on the passengers in the car.

If during routine checks or repair work an engine is found to be very dirty, it should — with the customer's consent — be cleaned immediately.

The various ways of dealing with complaints of this nature have been dealt with in Workshop Manual, Section M, in Service Bulletin No. 40—KDT 7 — of 16. 10. 1954, and in Technical Bulletin Z/9.

Gaskets for Exhaust and Pre-Heating Pipe Flanges

From Chassis No. 1 524 059 35,000 VW Engines are provided with iron-reinforced asbestos gaskets for the exhaust and pre-heating pipe flanges.

The new gaskets for the exhaust are provided with a 3 mm (.118″) thick bead, and those for the preheating pipe have an additional rim on the side pointing away from the engine besides the 3 mm (.118″) thick bead.

The purpose of this alteration is to improve the seal at the flanges.

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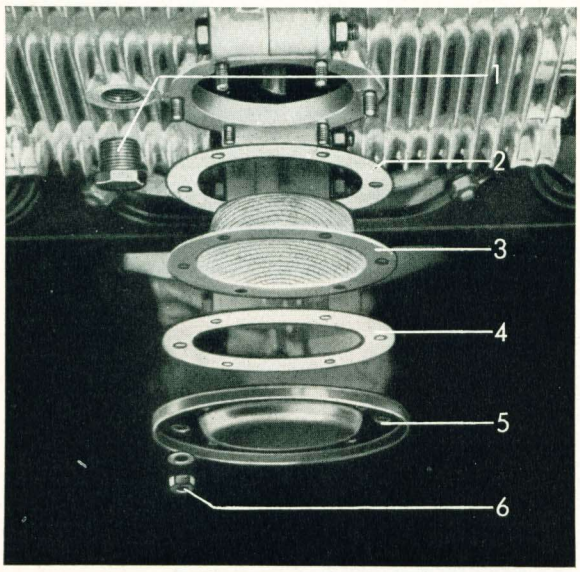
Removing and Installing Oil Strainer

Removal

1 - Remove nuts on oil strainer bottom plate.

2 - Remove oil strainer bottom plate.

3 - Remove strainer and gaskets.



1 - Oil drain plug
2 - Gasket
3 - Strainer
4 - Gasket
5 - Bottom plate
6 - Nut

Installation

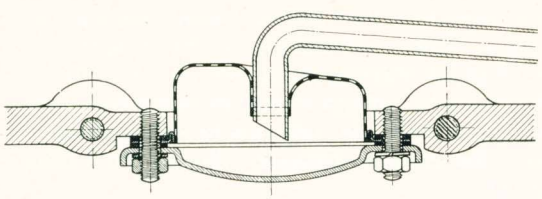
Installation is a reversal of the above procedure, but the following notes should be observed:

1 - Check suction pipe for proper and tight seating.

2 - Clean strainer and remove traces of old gaskets.

3 - Renew gaskets.

4 - Reinstall the strainer so that its lower side comes to rest below the bend of the oil suction pipe and the opening of the strainer snugly embraces the pipe.

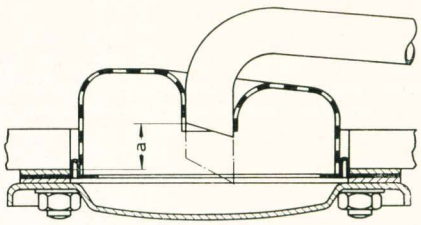


5 - Remove traces of old gasket from bottom plate contact face. Straighten bent or distorted bottom plates. Only a perfectly even contact face insures a proper seal.

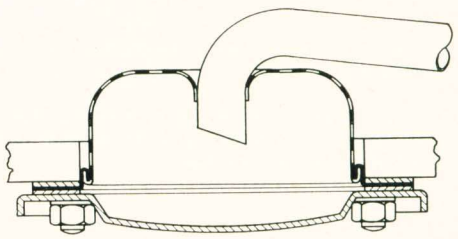
6 - Do not overtighten the nuts, especially when using thicker gaskets, to avoid bending the bottom plate.

Note:

From Chassis No. 1191375 the oil suction pipe in the crankcase has been shortened by 12 mm/.47″ (a = approx. 15 mm/.59″).



From Chassis No. 1252842 the thickness of the oil strainer wire has been increased from 0.25 mm (.009″) dia. to 0.26 mm (.010″) dia., while the mesh has been enlarged.



Earlier oil strainer: 16 meshes per 1 sq. cm.
New oil strainer: 12 meshes per 1 sq. cm.

The strainer top is now parallel to the strainer flange, so that the only point to be observed when installing is to make sure that the strainer tightly embraces the oil suction pipe. Bend the strainer as found necessary to obtain a snug fit. The new strainer can also be used on engines of earlier dates.

This modification is to avoid a deformation of the strainer by the suction of the oil pump when a larger amount of sludge and dirt has accumutated.

With the engine disassembled the oil suction pipe can be shortened as follows:

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1 - Clean right-hand half of crankcase and blow out with compressed air.

2 - Put clean rag over lower part of right-hand crankcase half below suction pipe.

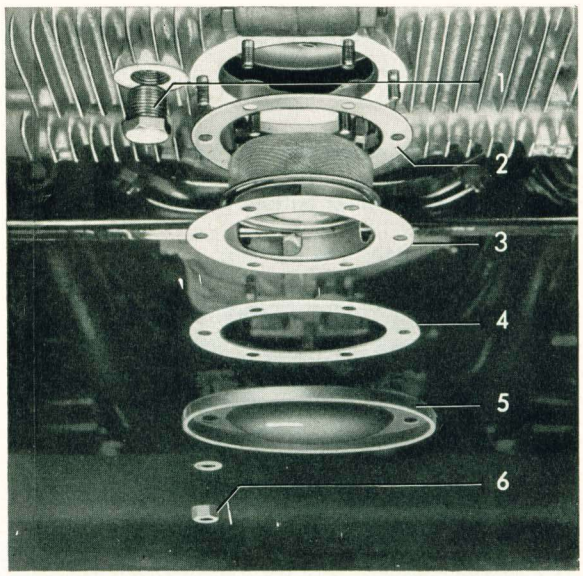
3 - Shorten suction pipe so that a is 15 mm (.59″).

4 - Remove any burr that might be apparent.

5 - Remove rag taking care that metal chips cannot fall into crankcase.

6 - Blow out crankcase and suction pipe with compressed air starting at oil pump bore.

Never shorten oil suction pipe with the engine assembled as metal chips might fall into the crankcase, which cannot be cleaned satisfactorily by additional flushing.



From Chassis No. 1397440 with initial exceptions some modifications have been carried ou on the oil suction pipe and oil strainer with a view to improving the oil circulation.

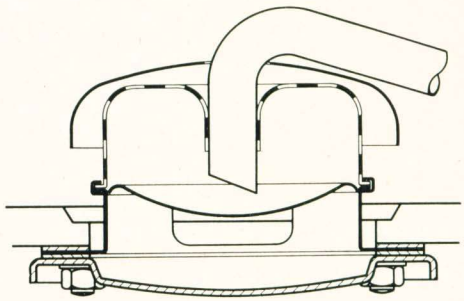
1 - A bell-shaped cap is soldered to the strainer as shown on the reverse side. This cap is to avoid the sucking in of air at a low oil level and if the oil is thick when starting in cold weather. Thus the cap insures a quick attaining of the full oil pressure under all operating conditions. Apart from the aforementioned advantages, the cap protects the oil strainer from foreign matter that will settle to the bottom of the crankcase.

2 - The new oil strainer has a separated chamber for excluding any water.

The suction pipe intake being at a higher level, the new oil strainer will hold a greater amount of water and dirt than the earlier type.

Attention!

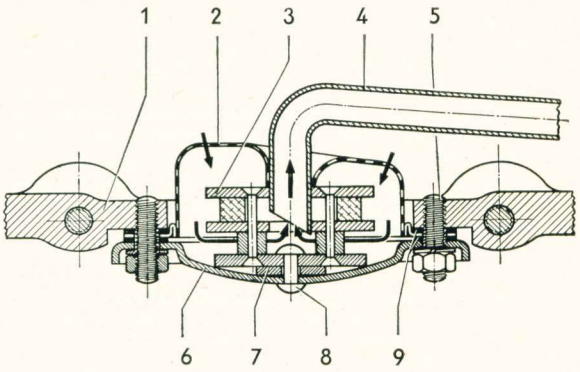
The new type oil strainer calls for a ringshaped recess in the bottom of the crankcase. Hence, it can only be installed on crankcases that are provided with such a recess. Earlier oil strainers are not suitable for the modified crankcases.



Magneto-Mechanical Oil Filter

(Service Installation)

An improved method of removing abrasive particles and other impurities from the engine oil has been achieved by the newly designed Magneto-Mechanical Oil Filter. The magnetic filter is fitted to the center of the oil strainer plate so that it embraces the oil suction pipe. Thus, after the initial cleaning by the strainer, the oil must pass through the magnetic system before it enters the lubrication system. The combination of the magnetic and mechanical filtering stops all ferrous abrasives. Additionally, foreign matter of nonferrous metals, carbon deposits, etc., will also be absorbed together with the ferrous abrasives due to the magnetic circuit.



1 - Crankcase
2 - Oil strainer
3 - Magnetic filter
4 - Oil suction pipe
5 - Stud
6 - Oil strainer bottom plate
7 - Spacer washer
8 - Rivet
9 - Gasket

Installation

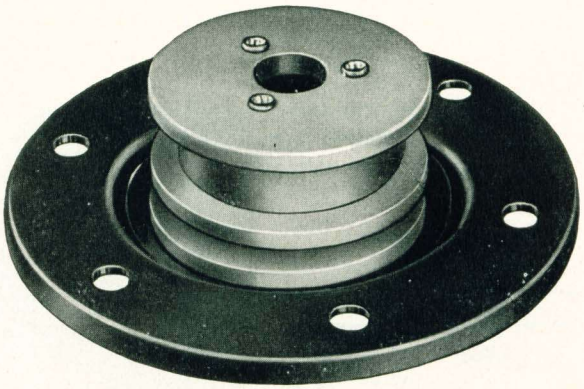
1 - Remove oil strainer plate, strainer and gaskets.

2 - Drill hole of 4 mm diam. (0.16″) into center of oil strainer plate.

3 - To fill up the hollow space between magnetic filter and oil strainer plate, install a washer of an adequate thickness.

4 - Attach magnetic filter to oil strainer plate by means of a buttonhead rivet.

5 - Reinstall strainer and plate, using new gaskets. Check riveting for leaks.

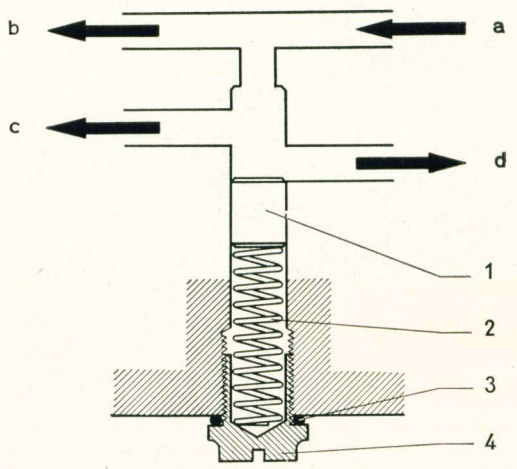


Removing and Installing Oil Pressure Relief Valve

Check the oil pressure relief valve when disturbances in the oil circulation occur, especially when the oil cooler is leaky. The sketch below illustrates the operation of the valve.

The oil is fed

a - from the oil pump,
b - through the oil cooler to the lubrication points,
c - directly to the lubrication points,
d - to the oil sump.



Oil Pressure Relief Valve (Schematic View)

1 - Plunger
2 - Spring
3 - Gasket
4 - Plug

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Removal

1 - Remove plug.

2 - Remove spring and plunger. A sticking plunger can be removed by screwing a tap M 10 (10 mm metric thread) into it.

Installation

Installation is accomplished by reversing the removal procedure, but the following notes should be observed:

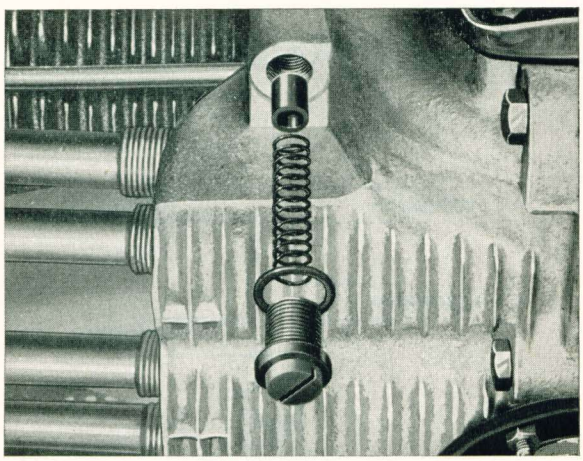
1 - Check plunger and bore in crankcase for signs of seizure. Carefully remove signs of seizure, renew plunger if necessary.

2 - Examine spring.

Condition	Length	Load in kg
unloaded	53—1 (2.08″—.04″)	0
assembled	39—1 (1.54″—.04″)	1.9 ± 10%
loaded	30.5—1 (1.2″ —.04″)	3.1 ± 10%

3 - Make sure that the upper end of the spring does not scratch on the bore wall.

4 - Renew gasket.



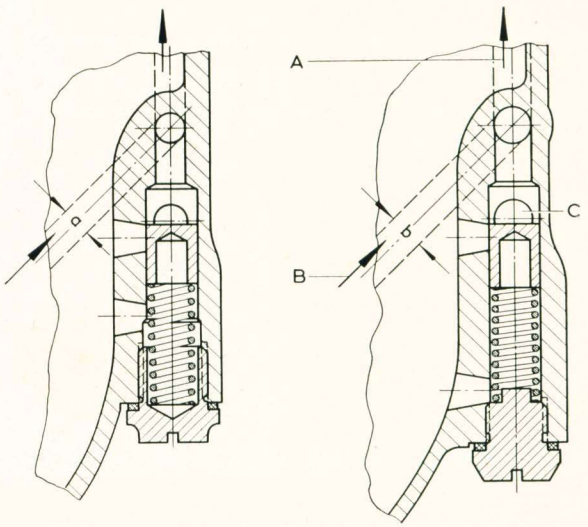
Note:

From Chassis No. 1 397 440 with initial exceptions several improvements have been carried out on the crankcase concerning the oil circuit and crankshaft bearings.

1 - Modifications have been made on the oil pressure relief valve, i. e., bore for plunger spring and arrangement of oil channels. At the some time the drain hole for the oil, which, in small quantities can escape between plunger and bore wall, has been repositioned at the lowest point of the oil pressure relief valve. The hollow plug has been discarded previously in favor of a solid one. Accumulation of dirt and water is thus no longer possible. (To two versions are not interchangeable.)

2 - The diameter of the oil channels from oil pump to oil pressure relief valve (B), to oil cooler (A) and lubrication points (C) has been increased from 8 to 9 mm (.315″ to .354″). The oil bore, through which some of the oil is permitted to return direct to the oil sump, has been placed slightly lower.

The increased diameter bores result in a smoother flow of the oil, especially so when the engine is cold. By altering the position of the oil return bore it is intended to prevent a premature draining back of the oil, which, especially with the engine cold, is of great importance for an adequate lubrication of the bearing points.



A - to oil cooler, with engine having attained operating temperature, i. e., thin oil

hitherto 7.8 mm ø (.307″)
now 8.8 mm ø (.346″)

B - from oil pump

a, b - oil bores

hitherto 8 mm ø (.315″)
now 9 mm ø (.354″)

C - direct to lubrication points without passing through oil cooler

hitherto 7.8 mm ø (.307″)
now 8.8 mm ø (.346″)

3 - The seat for main bearing No. 1 has been reinforced by additional ribs and strengthening of the crankcase.

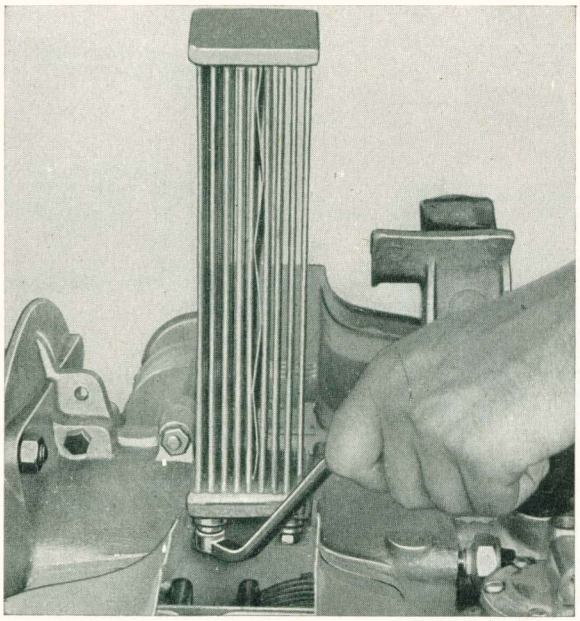
Oil Cooler Removal and Installation

(with engine in situ)

Removal

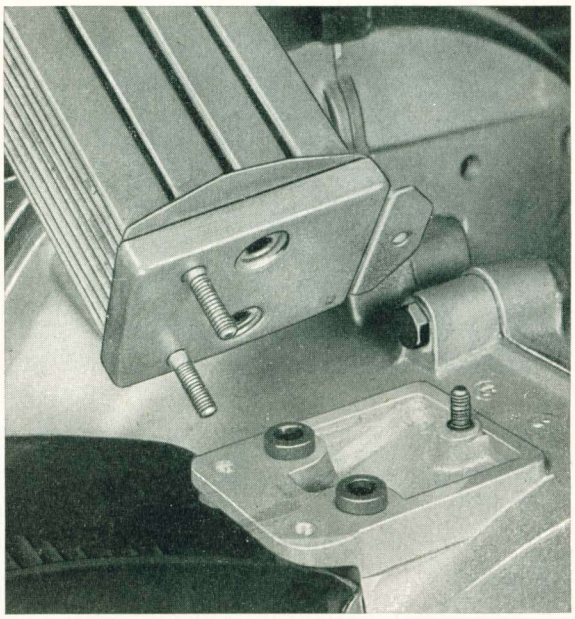
1 - Remove rear hood and bracket.

2 - Remove fan housing.



3 - Remove oil cooler retaining nuts by means of a 10 mm box wrench VW 109.

4 - Remove oil cooler and rubber seals.



Note:

From Chassis No. 1395146 the oil cooler has been provided with a prop.

The prop is screwed to a bracket welded to the top of the cooler. A 2 mm washer (outer diameter 24 mm/.94″) is placed between the prop and the fan housing. The bottom end of the prop is held by the first crankcase screw.

The upper end of the prop is to be detached from the oil cooler whenever removing the fan housing.

Installation

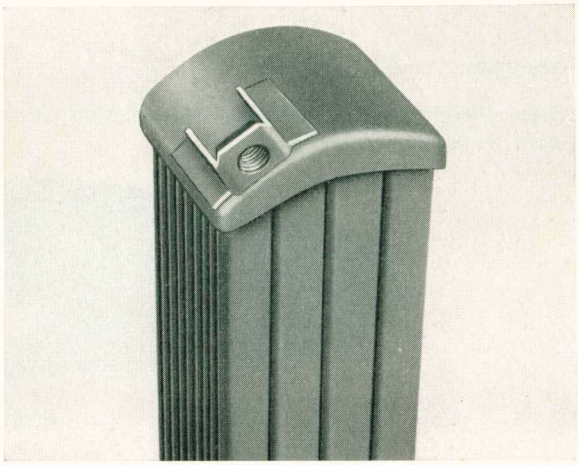
Installation is a reversal of the above operations, but the following points should be observed:

1 - Check oil cooler for leaks at a pressure of 6 kg/sq. cm (85 lbs./sq. in.) and see to it that the nuts and the retaining bracket are tight.

2 - In the event of a leaky oil cooler, check oil pressure relief valve.

3 - The hollow ribs of the oil cooler should not touch one another and the partition sheet should not be loose.

4 - Use new rubber seals.



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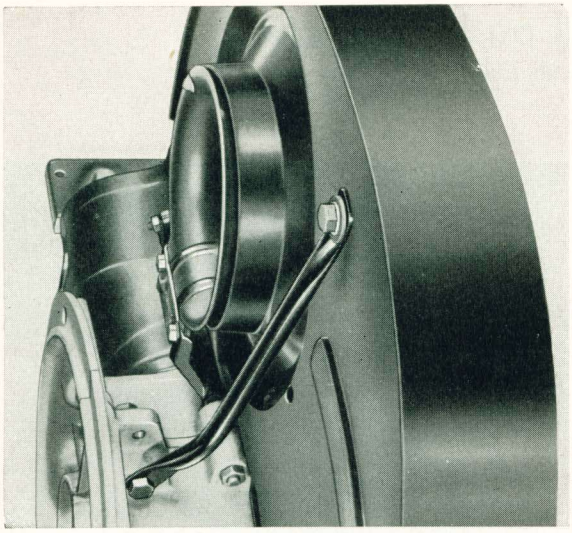
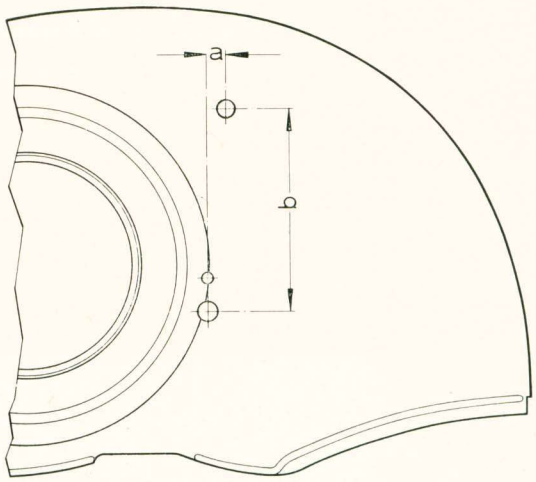


The modified oil cooler can be installed on all earlier engines, after the fan housing has been provided with a hole for the prop fixing screw as specified on the drawing to the right.



a = 13.5 mm (.531″)
b = 146 mm (5.75 ″)
Hole diameter = 12 mm (.47 ″)

This prop keeps the oil cooler free from vibrations, resulting in a longer life of the latter.

Oil cooler

From Chassis No.: 1655524.
Intermittently from Chassis No.: 1536250
Oil coolers in engines of VW Passenger Cars brazed.

The following modifications have been carried out:

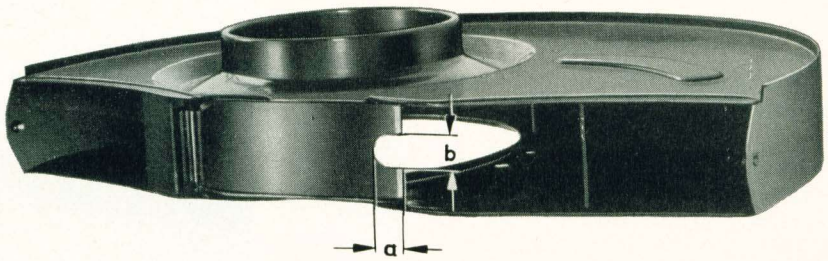
The oil cooler prop is omitted.
The same applies to the prop bore in the fan housing.
The lower baffle plate in the fan housing has been provided with a cutout to prevent the plate from resting on the modified nut which serves to mount the oil cooler on the crankcase. The nut has been modified only to facilitate assembly during production. In the event of repairs the nut used so far may, of course, be fitted togetwer with the corrugated washer.

The height of the oil cooler has been reduced from 254 mm (10″) to 226.5 mm (8.917″) while the number of oil tubes is now 32 as against 36 previously.

For protection, the new oil coolers are painted black. Thus they can easily be distinguished from the soldered coolers.

Attention.

When mounting a fan housing of older design on an engine fitted with a brazed oil cooler, first provide a cutout in the lower baffle.



a = 20 mm (25/32″)

b = 20 mm (25/32″)

When using a fan housing with an oil cooler prop bore, enlarge the bore to 15 mm (19/32″) diameter and then close it with a rubber plug.

Removing and Installing Oil Pump

(with engine in situ)

Removal

1 - Remove engine rear cover plate.

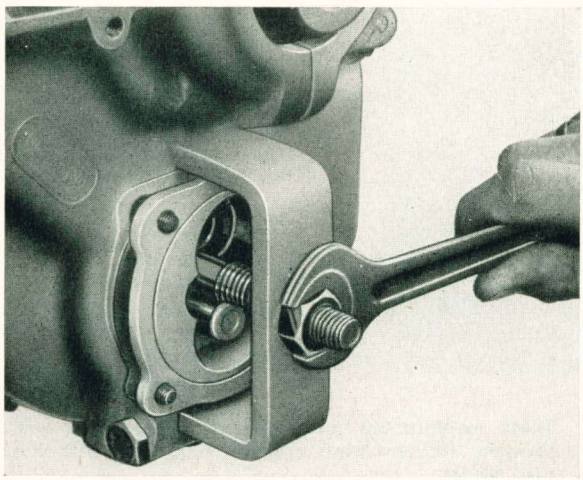
2 - Remove fan pulley.

3 - Remove pulley cover.

4 - Remove nuts on oil pump cover and take off cover and gasket.

5 - Remove the gears.

6 - Remove oil pump body by means of the extractor VW 201.



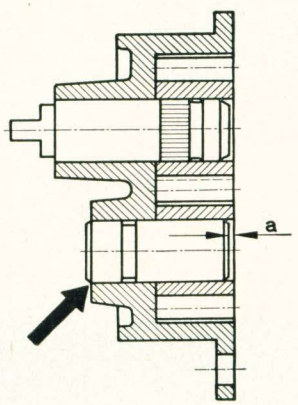
Installation

Installation is a reversal of the preceding operations, but the following points should be noted:

1 - Check oil pump body for wear, especially the gear contact points, prior to assembly. Loss of pressure will be the result of excessive wear in the pump body.

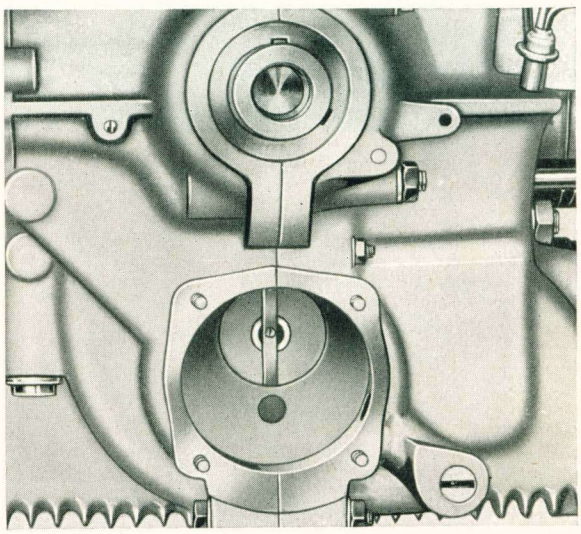
2 - Examine gears for wear.
Backlash: 0.03—0.08 mm (0.0012—0.0031″).
End play with cover removed: 0.066—0.183 mm (0.0026—0.0072″).
Wear limit: 0.20 mm (0.0079″).

3 - Check idler gear pin for looseness and, if necessary, peen it securely in position, or replace pump body (a = 0.5—1.0 mm/0.02″—0.04″).



4 - Examine oil pump mating surface on crankcase for accumulation of dirt.

5 - Turn crankshaft until the slot in the camshaft is vertical, that is, parallel to the crankcase jointing faces.



6 - Insert oil pump body, gasket, and gears.

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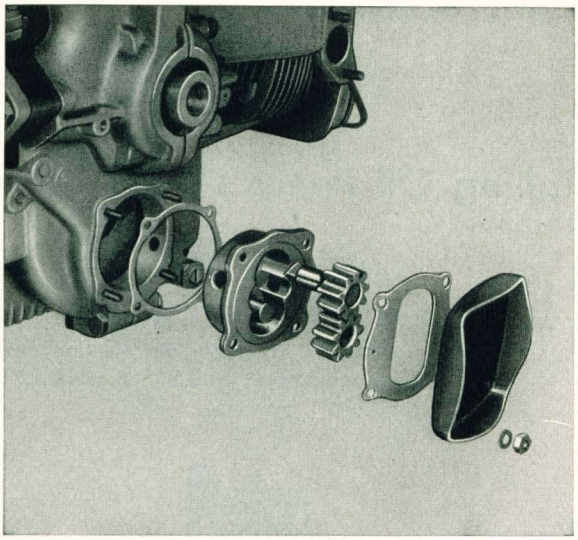
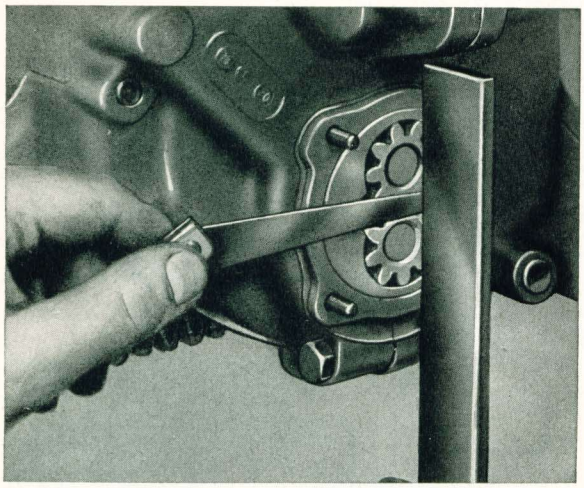


7 - Place a straight edge across the oil pump body and check the clearance between the straight edge and the gears either visually or by means of a feeler gauge. The clearance should never be in excess of 0.1 mm (0.004″) with the gasket removed.



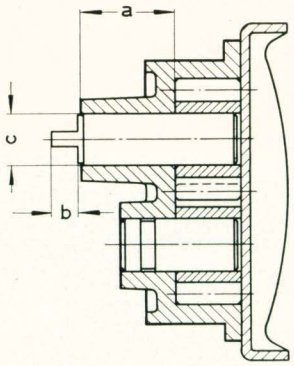
If the cover is worn from contact with the gears, plane it off evenly.

8 - Turn camshaft 360 degrees (one complete turn) = two turns of the crankshaft. By doing this, the oil pump shaft is properly centered to the slot in the camshaft.

9 - Use new VW gaskets (0.08 mm) without sealing compound. When tightening the nuts, make sure that the position of the oil pump body is not disturbed.

Note:

From Chassis No. 1294549 the bore accepting the oil pump drive shaft is 2 mm (.08″) longer. Coupled with this modification is a reduction in the clearance of the pump drive shaft and the use of aluminium alloy for the oil pump body.



a - Length of bore: earlier 23 mm
now 25 mm

b - Length of drive shaft tongue: earlier 10.2—0.5 mm
now 8 —0.5 mm

c - Diameter of bore: earlier 14.077—14.050 mm ⌀
now 14.068—14.050 mm ⌀

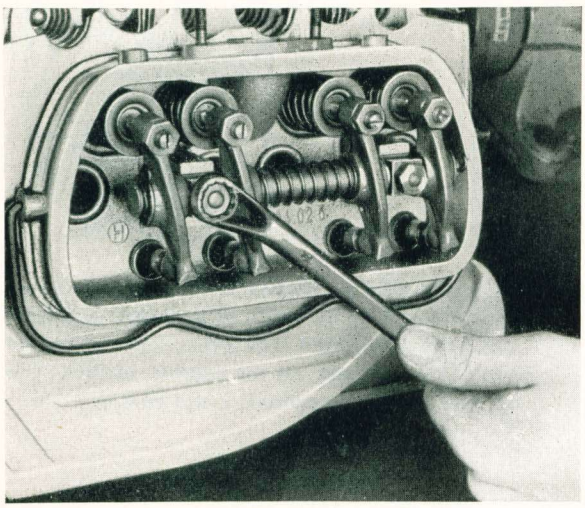
These modifications make the oil pump more wear resistant. The new parts are interchangeable with those used before.

Removing and Installing Valve Rocker Mechanism

Removal

1 - Remove cylinder head cover.

2 - Remove rocker arm shaft retaining nuts.



3 - Remove rocker arm shaft and rocker arms.

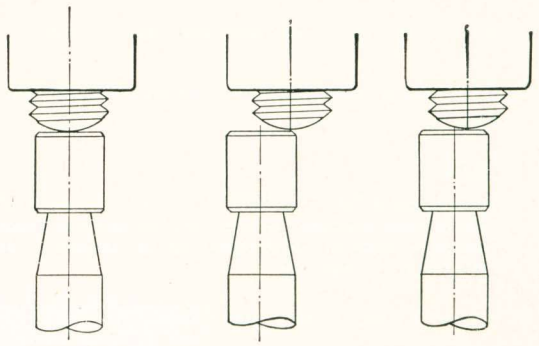
Installation

Installation is a reversal of the above procedure, but the following points should be noted:

1 - The ball ends of the valve push rods must rest centrically in the sockets of the rocker arms to avoid jamming of the push rods in their guides.

2 - To obtain a rotation of the valves, the rocker arm adjusting screws should contact the valve stem somewhat out of center (displaced to the right).

Wear on the stem face and a forming of deposits on the valve seating faces are thus reduced by the gradual turning of the valve.



wrong wrong correct

When conducting service inspections, or in assembly, attention should be paid to the above described position of the adjusting screws on the valve stems. This position can be reached by moving the rocker arm shaft sidewise in its clearance holes for the studs prior to tightening the nuts. If necessary, the length of the rocker arm spacers or the thickness of the washers should be altered or additional washers fitted to obtain the offset.

3 - Adjust the valves.

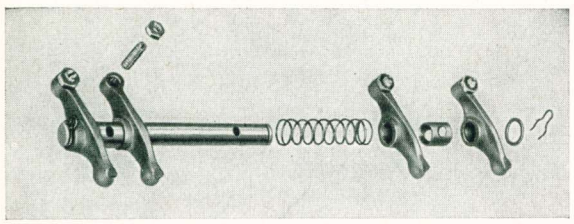
4 - Reinstall cylinder head cover, using a new gasket. The gasket is to be glued to the cover.

Disassembly and Assembly of Rocker Arm Mechanism

Disassembly

1 - Remove spring clips from rocker arm shaft.

2 - Remove washers, rocker arms, spacer tube, and spring.



Assembly

Reassembly is a reversal of the above procedure, but the following notes should be observed:

1 - Check rocker arm shaft for wear.

2 - Examine seats and ball sockets of rocker arms and valve adjusting screws for wear.

3 - Loosen adjusting screws prior to installing rocker arms.

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Removing and Installing Cylinder Head

Removal

1 - Remove cylinder head cover.

2 - Remove rocker arm shaft retaining nuts.

3 - Remove rocker arm shaft and rocker arms.

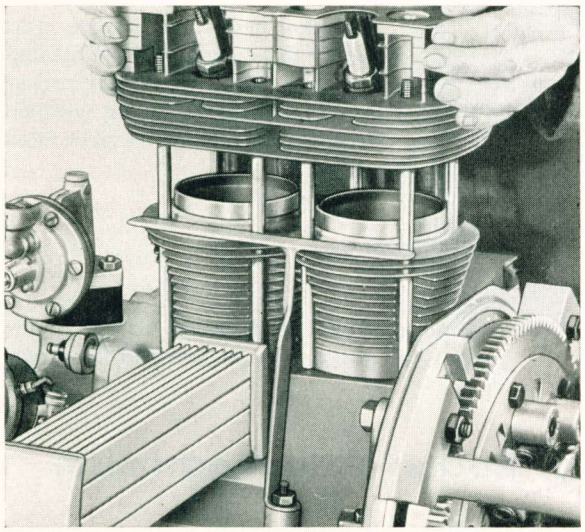
4 - Remove cylinder head nuts using a 10 mm hex. key.

Note:

From Chassis No. 1—0 029 746 onwards, 15 mm nuts (across flats) are used for attaching the cylinder heads. They are removed and tightened by means of the socket wrench VW 165.

5 - Screw off thermostat and remove link rod.

6 - Lift off cylinder head.
If it is intended to remove the cylinder heads only, the cylinder retainer VW 650 (local manufacture) prevents the cylinders from being withdrawn together with the head, thus avoiding ingress of dirt.

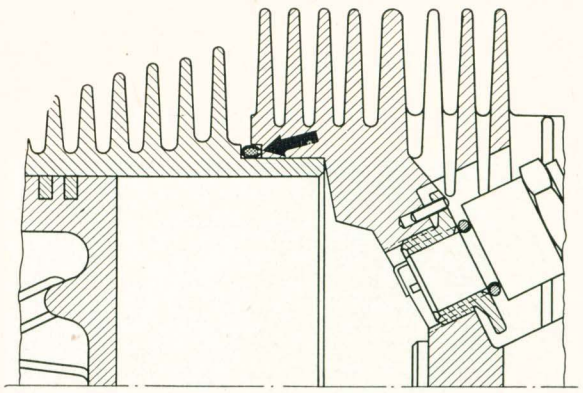


Installation

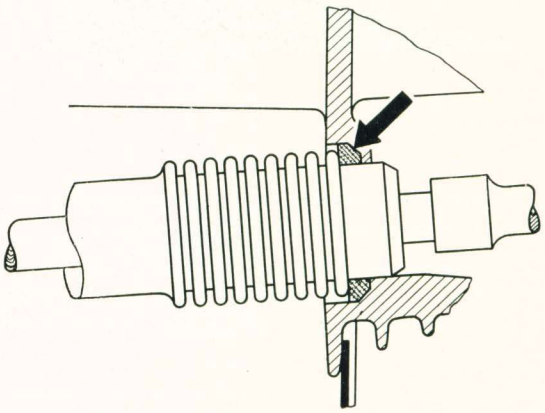
Installation is a reversal of the above operations, but the following hints should be noted:

1 - There is no gasket between upper edge of cylinder and the corresponding contact surface in cylinder head with the exception of "reconditioned cylinder heads".

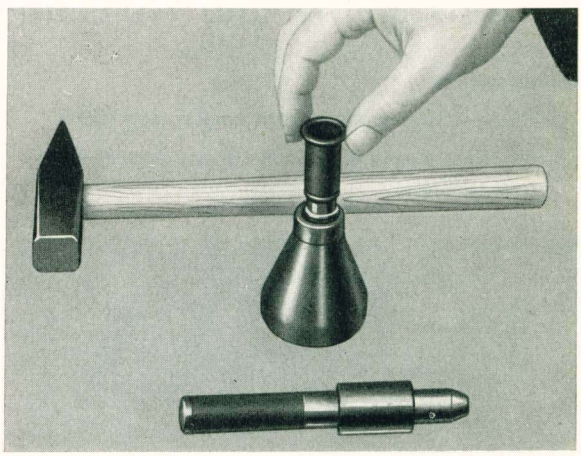
2 - Renew gasket between shoulder of cylinder and cylinder head.



3 - When installing cylinder head, make sure that the oil seals at the ends of the push rod tube are properly seated. The press seam of the oil seal must not bear on the seating surface. The oil seal has a trapeziform cross section.



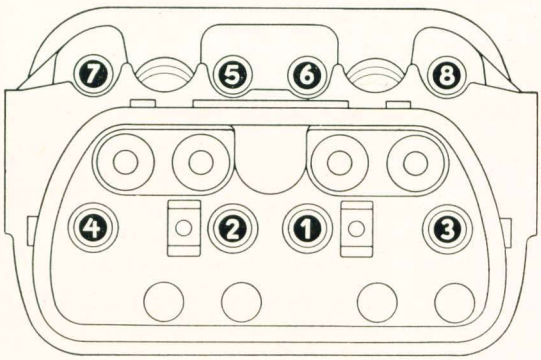
4 - Bent sealing sleeves for the lower cylinder head nuts can be straightened with the tool VW 660 (local manufacture).



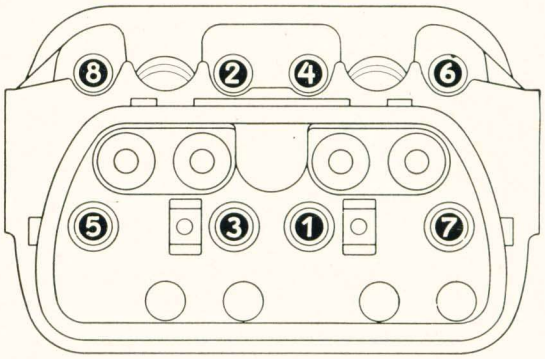
5 - Dip gaskets under cylinder head nut sealing sleeves into oil before installation.

Note:
From Chassis No. 0929746, a washer is used for each cylinder head nut.

6 - Coat cylinder head nuts with graphite paste and screw them down until resistance can be felt. Tighten to 1 mkg (7 ft. lbs.) by means of a torque wrench in the order indicated on the drawing below.



7 - Fully tighten to 3.6—3.8 mkg (26—27 ft. lbs.) torque in the following order:



8 - Reinstall rocker arm shaft and rocker arms. Take care that the ball ends of the valve push rods fit centrically in the rocker arm sockets to avoid jamming of the push rods in their guides.

9 - Adjust valve play.

10 - Install cylinder head cover, using a new gasket. The gasket is to be cemented to the cover.

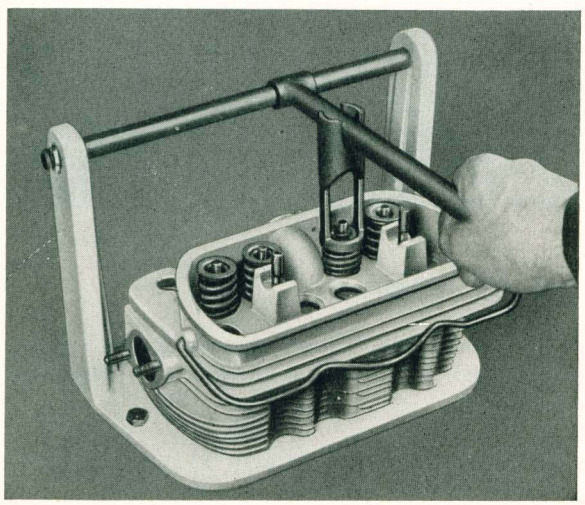
11 - Grease operating shaft of automatic cooling air control with Special Grease VW—A 051.

Removing and Installing Valves

Removal

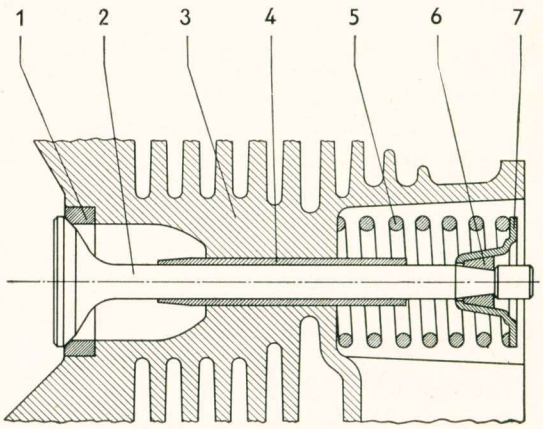
1 - Remove cylinder head.

2 - Place cylinder head in valve extractor VW 311, press down valve spring seat, remove valve cotters and valve spring seat.



3 - Remove valve springs.

4 - Extract valves.



1 - Valve seat insert
2 - Valve
3 - Cylinder head
4 - Valve guide
5 - Valve spring
6 - Valve cotter
7 - Valve spring seat

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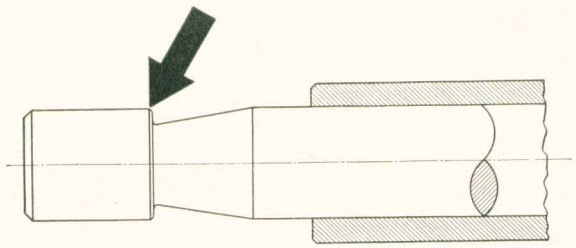
The shoulder of the cotters is likely to become feather-edged after a longer period of operation.



After the burr has been removed with a smoothing file, the valve can be extracted from its guide.

Installation

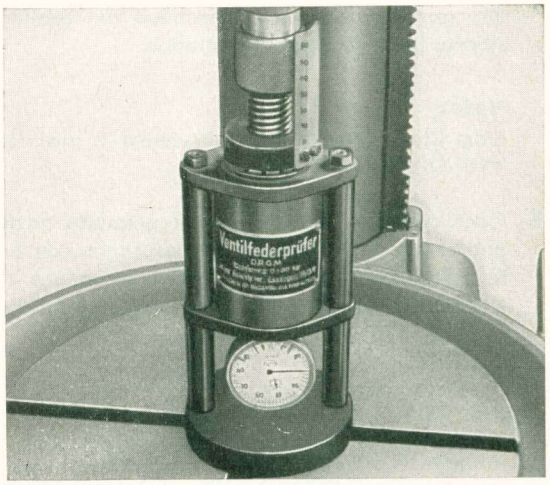
Installation is a reversal of the preceding operations, but the following points require attention:

1 - Test valve spring.

Conditions	Length	Load
Free length	43 mm (1.69″)	0
Loaded length	28 mm (1.10″)	33.4 kg ± 5%

A maximum loss of load of 10% on used springs is permissible.

2 - Check valve cotters prior to assembly.



3 - Check valve stem for run-out (Max. permissible run-out 0.01 mm = 0.0004″).

4 - Examine valve guides for wear.

5 - Examine valves for wear and check fit of valves in valve seats. Rough valve stems should be polished carefully with a very fine emery cloth.

Valve Springs

The wear-and-tear limit of the valve springs has been reduced **from 30 kg to 28 kg** at a loaded length of 28 mm (1.10″).
This does away with unnecessary or premature replacing of the springs. The service life of the parts connected with the springs is not affected.

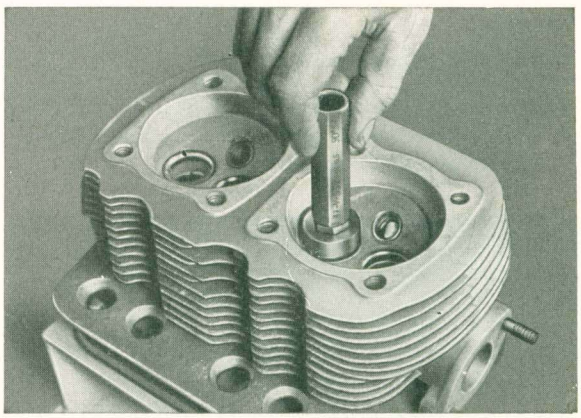
Testing Valve Seats

The valve seat must be concentric with the valve guide. A check is carried out by means of the marking gauge in the Valve Grinding Kit VW 311 b.

1 - Spread a thin film of prussian blue (engineers' marking) on the contact surface of the gauge.

2 - Insert pilot into valve guide and turn the gauge with light pressure one quarter turn in to the valve seat.

3 - Check valve seat. If the blue does not transfer evenly to the valve seat, the seat is to be refaced.



Checking Valve Guides

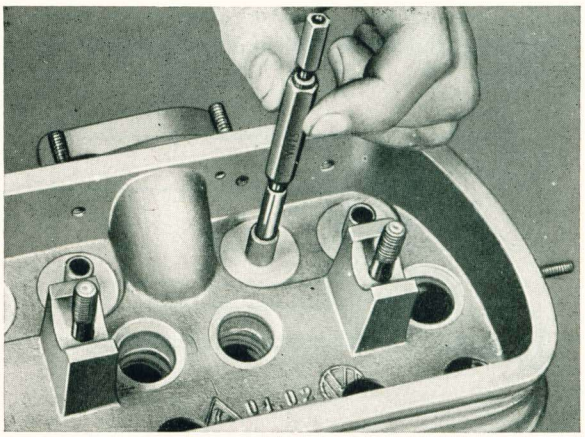
A replacement of the valve guides is not possible with the tools and appliances which are available in a workshop, as the guides are shrunk (chilled) into position by means of liquid air. The drifting out of the old guides is, therefore, liable to result in damage to the cylinder head.

To remove deposits, use a broach driven through the guides. The broach is clamped into a press or guide.

The broach should not be allowed to revolve when passing through the guide.

If the clearance should be near the wear limit of 0.15 mm (0.0059″) for the intake valve and 0.16 mm (0.0063″) for the exhaust valve, the cylinder is to be replaced by a new or reconditioned one.
A check is carried out with the Plug Gauge VW 253 after the valve guide has been cleaned from deposits that may have accumulated.
This is best done by a broach driven through the guides. The broach is clamped in a press or drill chuck and gradually forced through the guide, without being allowed to revolve.

Valve guide	Dimensions
Intake	7.008 dia. H 7 (0.2759″)
Exhaust	7.023 dia. H 7 (0.2765″)

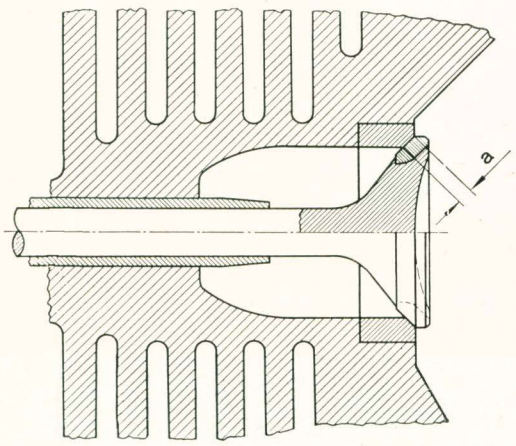


Refacing Valve Seat Inserts

Damaged or burnt inserts may be reconditioned by means of a seat cutter of 45° as long as the specified width of the seat face is maintained and the outer edge of the 15° chamfer does not exceed the outer diameter of the valve seat insert.

Seat width (a):

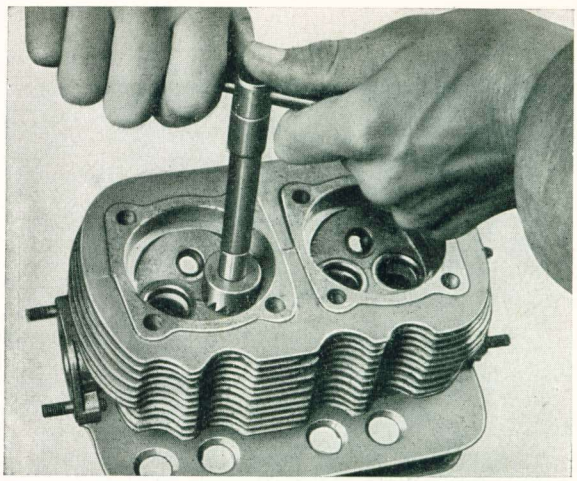
Intake: 1.3—1.6 mm (0.051—0.063″)
Exhaust: 1.7—2.0 mm (0.067—0.079″)



If the chamfer exceeds the outer diameter of the seat insert, the cylinder head is to be replaced by a new or reconditioned one. A replacement of the inserts is beyond the scope of a workshop, as they are shrunk (chilled) into position by means of liquid air.

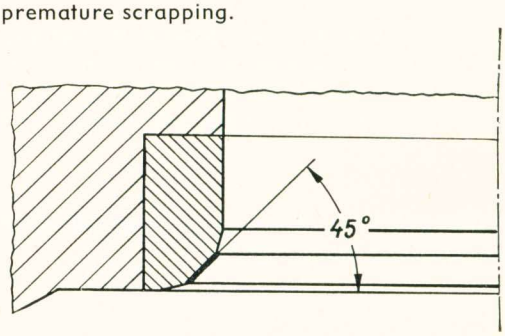
The cutters required for reconditioning the valve seat inserts will be found in the Valve Grinding Kit VW 311 b.

Steel inserts must be reground to obtain a new face.



Sequence of operations

1 - Cut the 45° seat face. Considerable care must be taken when cutting to obtain a concentric seating surface clear of chatter marks. It is important to exert the pressure exactly vertically. Take off only the minimum of metal required to clean up the seat face to avoid a premature scrapping.



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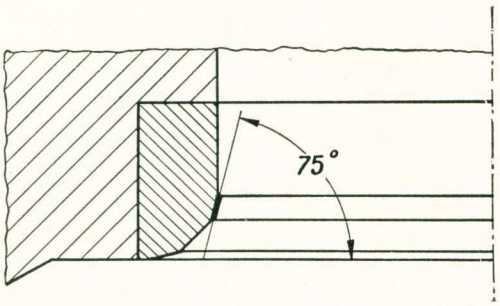
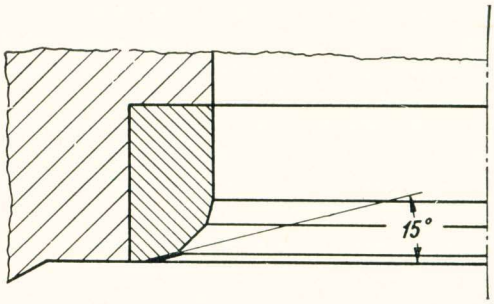
2 - Cut the 75° face: Slightly chamfer the lower edge of the valve seat face by means of the cutter.

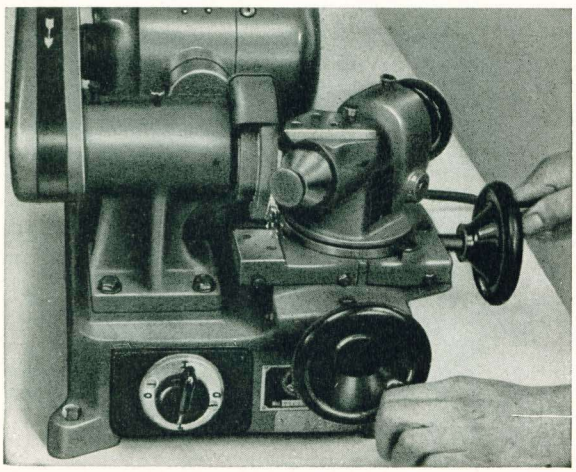


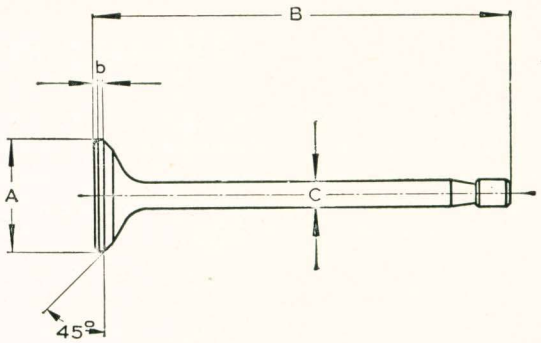
3 - Cut the 15° face: Chamfer the upper edge of the valve seat face by means of the 15° cutter until the correct seat width is reached.



Refacing Valves

No attempt should be made to lap badly pitted valves into their seats, they should be refaced with a valve refacing machine.





Intake Valve

A = 29.9 — 30.1 mm (1.177″ —1.185″)
B = 101.7 —102.3 mm (4.004″ —4.023″)
C = 6.955— 6.965 mm (0.2738″—0.2742″)
b = 1.10 — 1.60 mm (0.043″ —0.063″)

Exhaust Valve

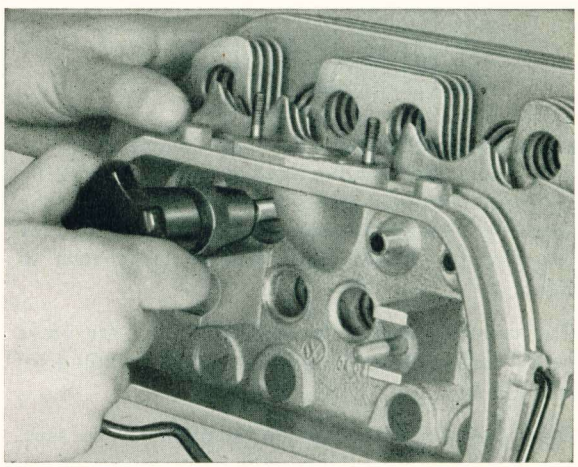
A = 27.9 — 28.1 mm (1.098″ —1.106″)
B = 101.7 —102.3 mm (4.004″ —4.023″)
C = 6.945— 6.955 mm (0.2734″—0.2738″)
b = 1.10 — 1.60 mm (0.043″ —0.063″)

Lapping (Grinding-in) Valves

Rotate the valves on their seats by means of a valve grinding tool.

The Chuck VW 311 c, or the tool in the Valve Grinding Kit VW 311 b may be used for this purpose. Frequently raise the valve and revolve it no more than a few degrees, or rings will form on the faces.

After grinding, thoroughly clean off all traces of grinding compound.



Inspecting Valves

1 - Thoroughly clean the valves of all traces of carbon, using a wire brush.

2 - Examine valve faces for wear and burns. Reface them if necessary.

Seat width	Intake valve	1.3—1.6 mm (0.051—0.063″)
	Exhaust valve	1.7—2.0 mm (0.067—0.079″)

Considering the high thermal stress imposed on the exhaust valves, it is important not to reduce the dimension "b" of the valve head more than specified.
If the valve face is badly burnt or pitted, the valve should be replaced.

3 - Valves having pitted stem faces must be replaced.

4 - Discard all valves showing a warped stem, signs of seizure, or a damaged valve cotter seat. No attempt should be made to straighten or grind valve stems.

Checking Fit of Valve in Valve Seat

With the use of new valves and accurately refaced seats, grinding-in (lapping) is not always necessary. A simple check can be made by applying prussian blue.

1 - Lightly coat the valve face with prussian blue.

2 - Insert valve into valve seat and, with light hand pressure, rotate the valve a quarter of a turn.

3 - Lift off the valve. If the valve is correctly seating, the blue should be completely reproduced on the valve seat face. If necessary, grind (lap) the valves.

Valve Adjustment and Valve Timing

An inspection or adjustment of the valves must only be carried out with the engine cold and at moderate outside temperature (approx. 20 °C = 68 °F).

Valve clearance:

Intake	0.10 mm (0.004″)
Exhaust	0.10 mm (0.004″)

The clearance increases when the engine warms up. It should carefully be checked at the prescribed intervals.

Valve clearance insufficient:

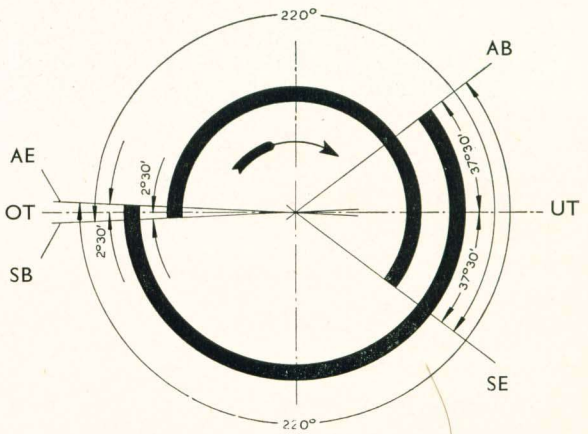
Burning of valves and valve seats.
Distortion of valves.
Poor performance by reduced compression.
Uneven engine running.
Unsteady valve timing.

Valve clearance excessive:

Noisy timing mechanism.
Uneven engine running.
Unsteady valve timing.

Valve adjustment gives the desired result only if:

the valves tightly seal, there is no undue clearance in the valve guides, and the stem face is not pitted.



Valve Timing Diagram

Intake opens	SB	2°30′ before T.D.C.
Intake closes	SE	37°30′ after B.D.C.
Exhaust opens	AB	37°30′ before B.D.C.
Exhaust closes	AE	2°30′ after T.D.C.

This diagram applies to a valve clearance of 1 mm (0.04″) with the engine cold. After having checked the valve timing, the normal valve clearance of 0.1 mm (0.004″) should be restored. A reduction of the clearance by 0.01 mm (0.0004″) increases angles by 3° each.

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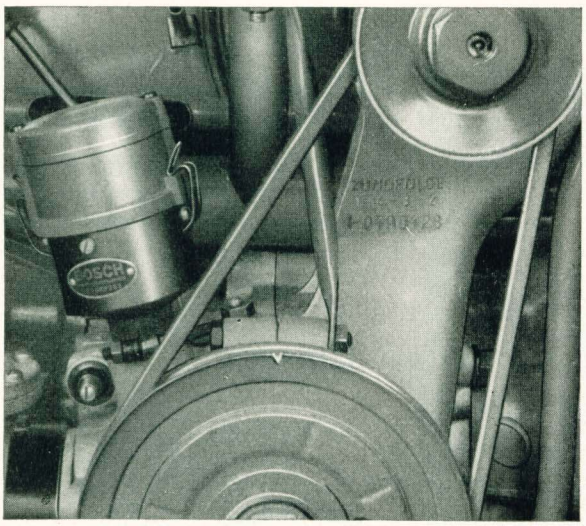
Adjusting Valves

Valve adjustment is best be effected in the following sequence: 1st—2nd—3rd—4th cylinder. Adjust the valves when the piston of the corresponding cylinder is on top dead center position of the compression stroke, as the two valves are then closed.

Starting with the 1st cylinder, crank the engine over slowly to the left at the fan pulley, until both valves are in fully closed position and the timing mark on the pulley is in line with the vertical jointing faces of the crankcase.



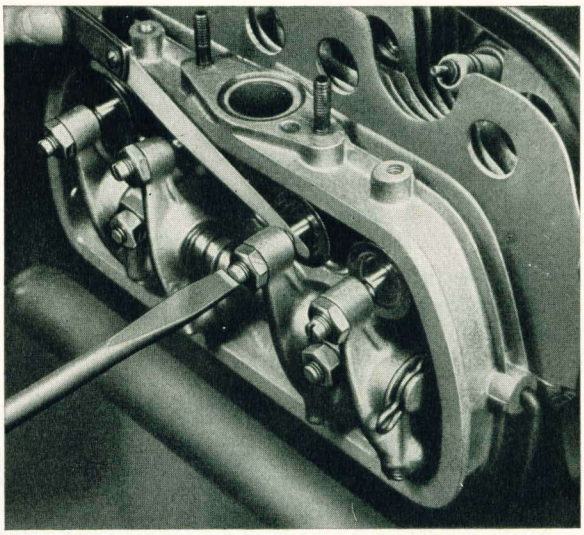
1 - Remove cylinder head cover.

2 - Set engine to the firing position of the cylinder to be adjusted.

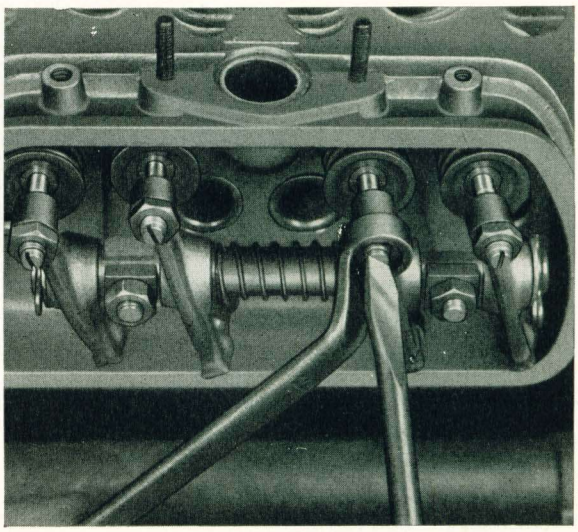
3 - Check valve clearance with a feeler gauge 0.10 mm (0.004″).

4 - Loosen lock nut of the adjusting screw.

5 - Turn adjusting screw as required to obtain the proper clearance.



6 - Hold adjusting screw with screwdriver while tightening lock nut.



7 - Recheck adjustment.

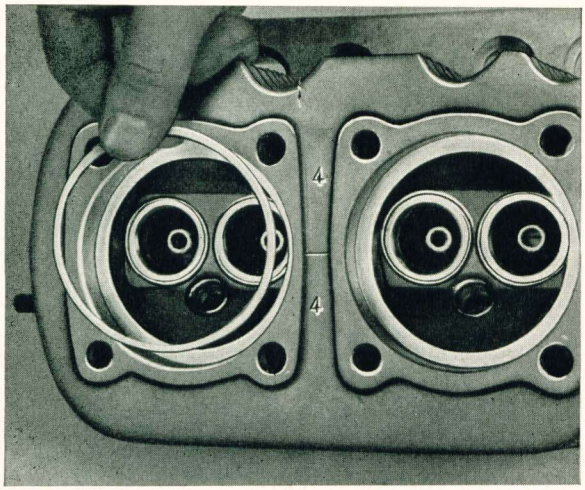
8 - Check and adjust the other valves in the same manner by turning the crankshaft anticlockwise another 180° for each cylinder.

9 - Replace cylinder head cover, using a gasket which is in good condition.

Reconditioned Cylinder Heads

There is no gasket between the mating faces of the cylinder and the cylinder head.
Cylinder heads reconditioned by the factory are remachined at the mating surfaces, if these are found to be damaged.
The cylinder seating depth — standard 12.9—13.0 mm (0.507—0.512″) — is then increased by 0.4, 0.8, 1.0, or 1.5 mm (0.0157, 0.0314, 0.0393, or 0.0590″). A remachining up to 1.0 or 1.5 mm (0.0393 or 0.0590″) becomes rarely necessary. The difference of the seating depths in one cylinder head must not be in excess of 0.1 mm (0.004″).

The amount of remachining is marked between the cylinder seats of each cylinder by $^1/_{10}$ mm (tenths of a millimeter), for example: 4, 8, 10 or 15.



These cylinder heads are to be fitted with shims compensating the amount of remachining. The shims are delivered in the thicknesses: 0.4, 0.8, 1.0, 1.5 mm (0.0157, 0.0314, 0.0393, or 0.0590″). To insure a square seating of the cylinder head, the compensating shims of one head must, of course, be of the same thickness. A falling out of the shims when fitting the cylinder head is prevented by applying a little grease on the seating surface prior to assembly.

To maintain the proper compression ratio of reground cylinders, the corresponding oversize pistons (77.5 or 78.0 mm ⌀) are lower than the standard pistons (distance from piston top to piston pin hole). Compensating shims should in this connection only be fitted, if remachined cylinder heads are used at the same time.

Prior to installing reconditioned cylinder heads, the valves must be ground (lapped) and checked for a proper fit in the valve seats.

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Removing and Installing Cylinders

Removal

1 - Remove cylinder head.

2 - Remove valve push rods and valve push rod tubes.

3 - Remove deflector plate below the cylinders.

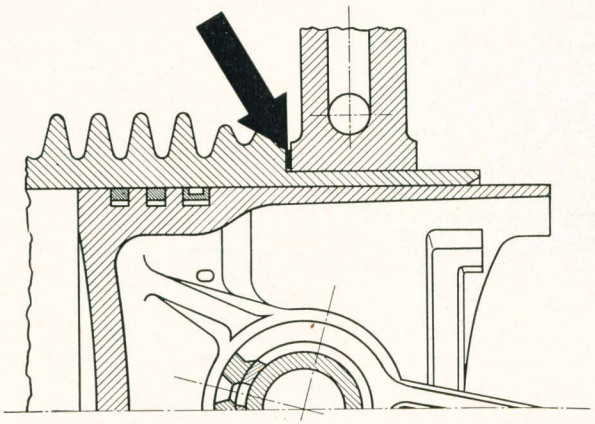
4 - Take off cylinders.

Installation

Reverse the preceding operations while observing the following points:

1 - Check cylinder for wear and, if necessary, replace by another matched pair of cylinder and piston of the same size.

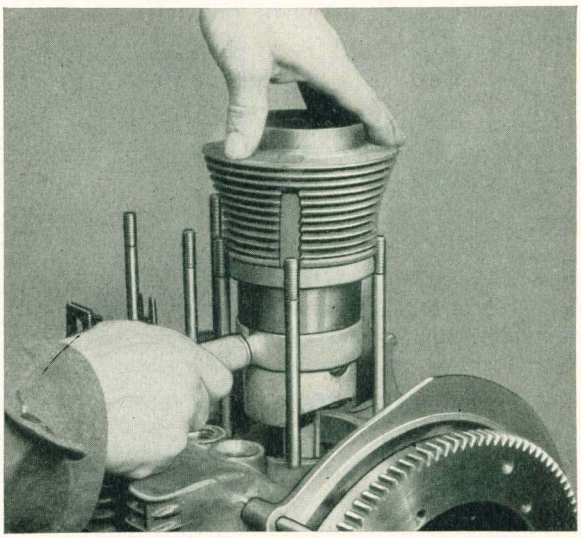
2 - Cylinder seating surface on crankcase, cylinder shoulder, and gasket must be perfectly clean. Foreign matter at this point may cause distortion of cylinder.



3 - Always use new gasket between cylinder and crankcase.

4 - Apply some oil to piston and piston pin.

5 - Compress the rings by means of the compressing tool VW 123 a. Ring gaps must be staggered so that they are not in line vertically. The oil ring gap must always be at the top when the pistons are in their horizontal position in the engine.



6 - Oil the cylinder wall and slide the cylinder over the piston. The crankcase studs must not contact the cylinder cooling fins.

Inspecting Cylinders

An inspection of the cylinders is carried out by means of a dial gauge for inside diameters and gauge rings corresponding with the cylinder sizes.

Cylinder	Gauge ring
75.0 mm	VW 252 a
75.5 mm	VW 252 b
76.0 mm	VW 252 c

The fitting clearance between cylinder and piston amounts to 0.035—0.055 mm (0.0014—0.0022″).

The selective assembly of cylinders and pistons is greatly facilitated by the following scheme:

Permissible wear limit:

Clearance cylinder/piston	max. 0.20 mm (0.008″)
Cylinder out-of-round	max. 0.01 mm (0.0004″)

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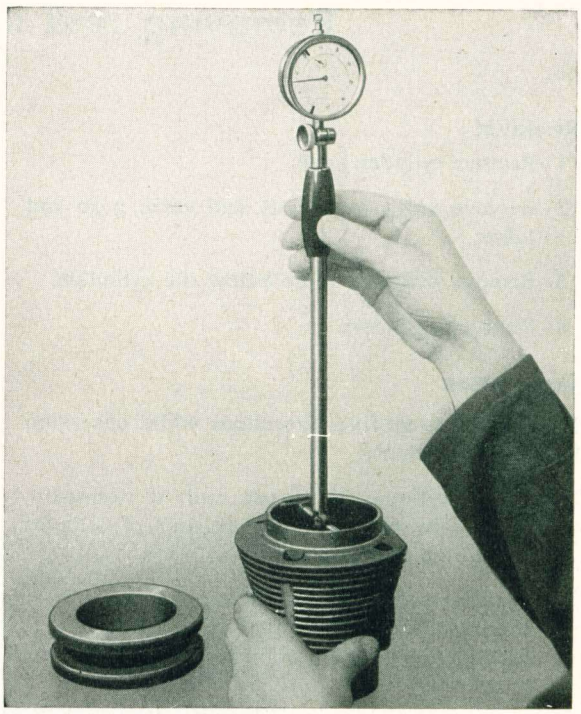
The clearance must not be checked with a feeler gauge, but should be determined by measuring cylinder and piston.

The cylinder should be measured 10—15 mm (0.4—0.6″) below the upper edge. Cylinders which are nearly or completely worn to the specified wear limit must be replaced together with the corresponding pistons by those of the same size. The cylinders and pistons in one engine must be of the same size.

Apart from wear, the oil consumption of the engine is an important factor in deciding whether or not a new cylinder and piston must be installed. If the oil consumption is in excess of 1 liter per 1000 km (0.26 U. S. gals per 620 miles) the engine needs an overhaul.

An oil of a higher viscosity, for example SAE 30, can be used during the warmer season with engines having a marked oil consumption.



From Chassis No. 1597047.
Cylinders of all VW engines have been provided with a 8 mm (.3149″) shorter working surface. This measurement applies to that part of the cylinder which protrudes from the cylinder seating surface into the crankcase. This alteration results in improved breathing of the crankcase.
Cylinders of previous design can be exchanged for cylinders of new design.

Dimensions and Grading Marks of Cylinders

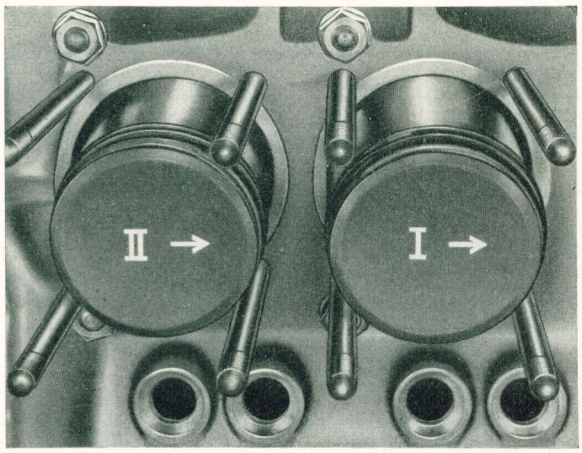
	Colour	Cylinder mm dia.	Corresponding Piston mm dia.
Standard Size	Blue	74.990—76.999	74.95
	Pink	75.000—75.009	74.96
Nominal Dimension 75 mm dia.	Green	75.010—75.020	74.97
1st Oversize	Blue	75.490—75.499	75.45
	Pink	75.500—75.509	75.46
Nominal Dimension 75.5 mm dia.	Green	75.510—75.520	75.47
2nd Oversize	Blue	75.990—75.999	75.95
	Pink	76.000—76.009	75.96
Nominal Dimension 76 mm dia.	Green	76.010—76.020	75.97

Removing and Installing Pistons

Removal

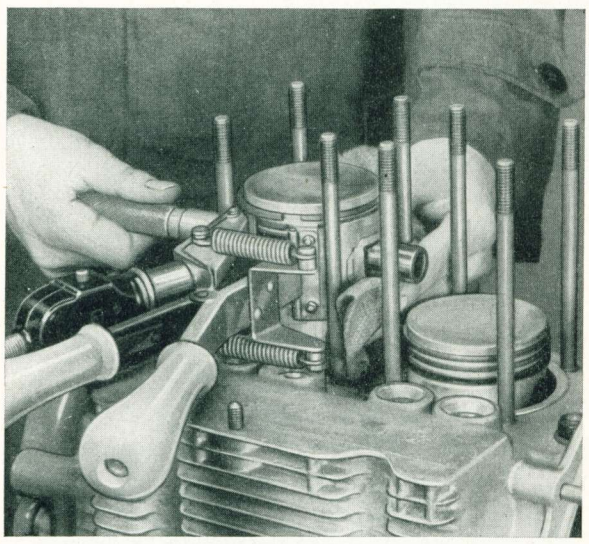
1 - Remove cylinder.

2 - Mark the piston to make sure that it is reinstalled in original position.



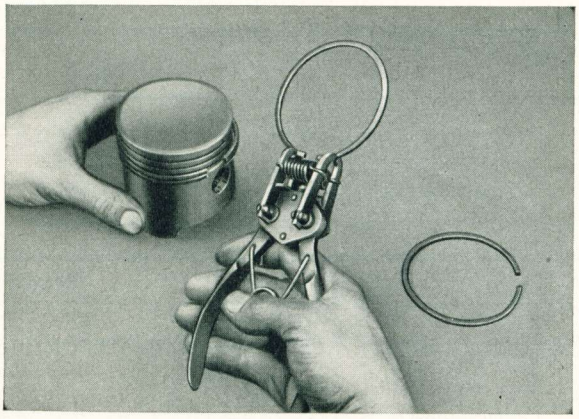
3 - Remove piston pin circlip, using circlip pliers VW 122 b.

4 - Heat the piston to 80 °C (176 °F) with Electric Piston Heating Tool VW 205.



5 - Remove piston pin, using pilot drift VW 207 or tool VW 207 a.

6 - Remove piston rings, if required, by means of the piston ring tool. The piston rings should, if possible, remain on the piston to avoid damage.



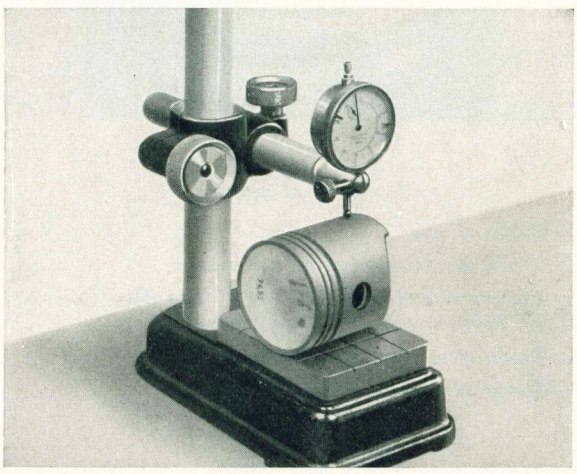
Installation

Reverse the removal procedure while observing the following points:

1 - Check connecting rod alignment, using gauge VW 250.

2 - Clean piston. Remove carbon from piston tops and piston ring grooves. No sharp instruments must be used in order not to damage the metallic surface. Do not use emery cloth to remove carbon from piston skirts (if necessary, use a fine corundum stone with oil). If the piston does not bear squarely on the cylinder wall, this can be seen on the skirt, especially by a one-sided forming of carbon deposits, indicating a twisted connecting rod.

3 - Check and measure pistons. The nominal diameter is stamped on the piston top. The reading must be taken at the bottom end of the skirt parallel to the piston pin axis.



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Dimensions, Weights, and Grade Marking of Pistons

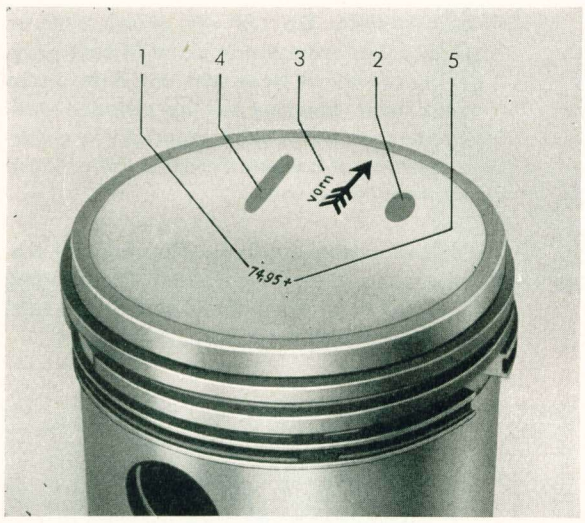
Size Grading			
	Paint Dot		
	Blue	Pink	Green
Standard Size 75.0 mm ⌀	74.95 mm ⌀	74.96 mm ⌀	74.97 mm ⌀
1st Oversize 75.5 mm ⌀	75.45 mm ⌀	75.46 mm ⌀	75.47 mm ⌀
2nd Oversize 76.0 mm ⌀	75.95 mm ⌀	75.96 mm ⌀	75.97 mm ⌀

Weight Grading	
Paint Line	Weight
Brown	250—260 grammes
Grey	260—270 grammes

The fitting clearance between piston and cylinder is 0.035—0.055 mm (0.0014—0.0022″). If, on measuring the piston and the corresponding cylinder, it is found that the clearance is near the amount of 0.20 mm (0.008″), replace piston and cylinder by another pair of the same size and weight grading. The piston must not be fitted separately, if the corresponding cylinder shows signs of wear.

If the corresponding cylinder of a damaged piston does not show any signs of wear, it is often sufficient to fit a new piston of the same size and weight grading.

4 - Check gap clearance with a feeler gauge after the ring has been inserted in the cylinder and squarely pushed down about 5 mm (0.2″) by the piston.



Marking of pistons

1 - Grade of size.

2 - Grade of size marked by paint dot.

3 - The arrow and the word "vorn" must point towards the flywheel when installing the piston.

4 - Grade of weight marked by paint line.

5 - Grade of weight marked by symbols.

Grey = + weight.

Brown = — weight.

Gap clearance of all three rings:
0.30—0.45 mm (0.012—0.017″); max. 0.95 mm (0.037″).

When reinstalling cylinder, be sure that no ring gaps are in line. The gap of the oil scraper ring must always be at the top.

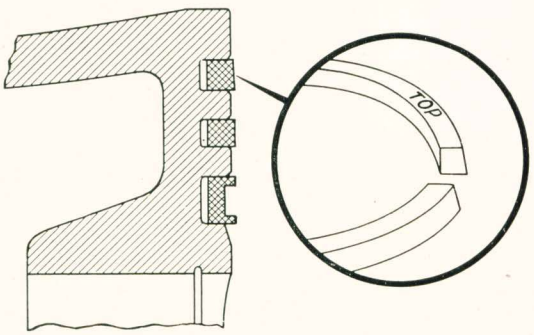
Check piston ring side clearance in grooves using a feeler gauge when the piston is in its horizontal position in the engine.

Compression ring
0.035—0.062 mm;
max. 0.1 mm
(0.0014—0.0024″;
max. 0.004″).

Oil ring
0.025—0.052 mm;
max. 0.1 mm
(0.001—0.002″;
max. 0.004″).

The rings must only be installed by means of the piston ring tool to avoid damage to the piston and overstraining or fracture of the rings.

Make sure that the upper compression ring is installed with the marking "Top" or "Oben" on the ring toward the top of the piston.



Note:

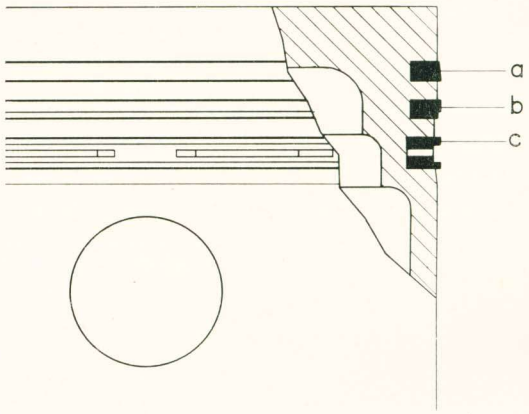
The following piston ring sets are available for service installation in engines having an excessively high oil consumption:

Engine	Bore	Part No.
1131 c. c.	75 mm	SP 101 A
	75.5 mm	SP 105 A
	76 mm	SP 109 A
1192 c. c.	77 mm	SP 103 A
	77.5 mm	SP 107 A
	78 mm	SP 111 A

The installation of these special piston ring sets is justified if

1 - the oil consumption is actually found to exceed 1 liter (about 1 quart) per 1000 km (600 miles), or if

2 - the cylinder is not yet out-of-round in excess of 0.02 mm (.0008″). This refers roughly to engines of a mileage below 19,000 (30,000 km).



a - Top ring
b - Narrow face contact ring
c - Oil scraper ring

The installation is useless if

1 - it is no definitely known whether an oil leak is involved,

2 - the engine has not covered more than 5,000 km (3,000 miles). New pistons often have a higher oil consumption than those already worn in, or if

3 - the engine shows excessive wear or has covered considerably more miles than stated.

The installation calls for attention to:

1 - the tolerance limits specified for the side clearance and gaps of the rings,

2 - proper fit of pistons in cylinders,

3 - uniform contact of piston with the cylinder wall (see impression on piston skirt).

Special piston ring sets of other designs should not be used for the following reasons:

1 - Substantially higher cost.

2 - Shorter service life on account of heavy wear on cylinders and rings (pressure against cylinder wall, matching of materials!).

3 - Loss of power by higher frictional resistance.

4 - The VW engine does not require breaking-in instructions, even when fitted with narrow face contact rings. Most of the special piston ring sets of other origin call for a careful breaking-in.

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5 - First insert the piston pin circlip which faces towards the flywheel.

6 - A certain amount of selective assembly may be necessary when fitting the piston pin. The pin should be a push fit in the piston after the piston has been heated. If the pin can be pushed in with the piston cold, use a larger pin. The correct size is indicated by paint markings in the piston at the piston pin boss and on the piston pin.

Colour	Piston Pins mm ⌀
Black	19.994—19.996
White	19.997—20.000
Green (only pins)	20.001—20.004

The clearance between piston pin and connecting rod bush is 0.005—0.026 mm (0.0002—0.0010″). If the clearance is near the wear limit of 0.05 mm (0.002″), renew the piston pin and the connecting rod bush. No oversize piston should be fitted in this case.

The correct clearance will be indicated by a light finger push fit with the piston pin oiled after the piston has been heated to 80 °C (176 °F) in oil or by the Piston Heating Tool VW 205. Push pin up to the stop of the circlip without pausing.

7 - Insert the other circlip. It is important that the circlips fit in their grooves perfectly.

The operations do not differ from those laid down for the 1131 c. c. engine so that in all cases the illustrations and instructions also apply to the 1192 c. c. engine. All dimensions and weights which have been altered in connection with the increased cylinder charge are given below.

Inspecting Cylinders

An inspection of the cylinders is carried out by means of a dial gauge for inside diameters (cylinder bore indicator) and gauge rings conforming with the cylinder sizes.

Cylinder	Gauge Ring
77.0 mm diam.	VW 252 d
77.5 mm diam.	VW 252 e
78.0 mm diam.	VW 252 f

The fitting clearance between cylinder and piston amounts to 0.036—0.055 mm (0.0014'' — 0.0022'')

Wear Limit:

Clearance cylinder/piston	max. 0.20 mm (0.008'')
Cylinder out-of-round	max. 0.01 mm (0.0004'')

When installing the cylinders, the piston rings are compressed by means of the tool VW 123 a.

Dimensions and Grading Marks of Cylinders

	Colour	Cylinder mm dia	Corresponding Piston mm dia
Standard Size	Blue	76.990—76.999	76.95
Nominal Dimension 77 mm dia	Pink	77.000—77.009	76.96
	Green	77.010—77.020	76.97
1st Oversize	Blue	77.490—77.499	77.45
Nominal Dimension 77.5 mm dia	Pink	77.500—77.509	77.46
	Green	77.510—77.520	77.47
2nd Oversize	Blue	77.990—77.999	77.95
Nominal Dimension 78 mm dia	Pink	78.000—78.009	77.96
	Green	78.010—78.020	77.97

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Dimensions, Weights, and Grade Marking of Pistons

Size Grading			
	Paint Dot Blue	Pink	Green
Standard Size 77.0 mm ⌀	76.95 mm	76.96 mm	76.97 mm
1st Oversize 77.5 mm ⌀	77.45 mm	77.46 mm	77.47 mm
2nd Oversize 78.0 mm ⌀	77.95 mm	77.96 mm	77.97 mm

Weight Grading	
Paint Line	Weight
Brown (—Weight)	265—270 grammes
Grey (+Weight)	270—275 grammes

The fitting clearance between piston and cylinder is 0.036—0.055 mm (0.0014—0.0022″). If, on measuring the piston and the corresponding cylinder, it is found that the clearance is near the amount of 0.20 mm (0.008″), replace piston and cylinder by another pair of the same size and weight grading. The piston must not be fitted separately, if the corresponding cylinder shows signs of wear. If the corresponding cylinder of a damaged piston does not show any signs of wear, it is often sufficient to fit a new piston of the same size and weight grading. Heat the piston to 80 °C (176 °F) with Electric Piston Heating Tool VW 205 prior to removal or installation.

Piston rings

Width of compression rings 2.5 mm (0.098″)
Width of oil ring 4.0 mm (0.16″)

Gap clearance of all three rings: 0.30—0.45 mm (0.012″—0.018″); max. 0.95 mm (0.037″). Check ring side clearance in grooves:

Compression rings 0.035—0.062 mm (0.0014″—0.0024″)
max. 0.1 mm (0.004″)

Oil ring 0.025—0.052 mm (0.001″—0.002″)
max. 0.1 mm (0.004″)

Disassembling and Assembling Crankcase

Disassembly

1 - Remove oil strainer.

2 - Remove oil pressure switch.

3 - Remove oil pressure relief valve.

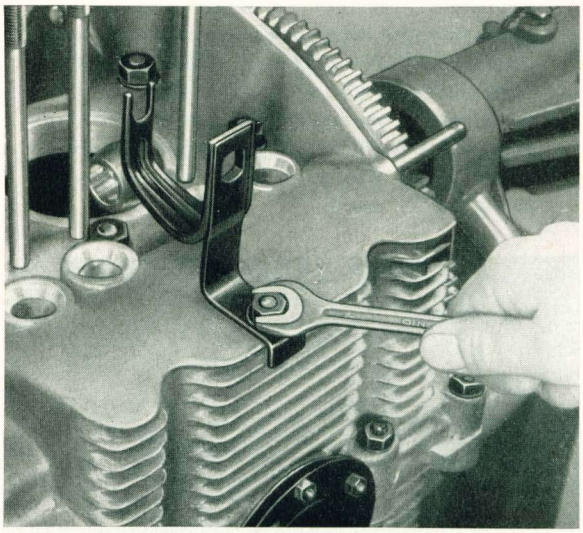
4 - Remove crankcase nuts.

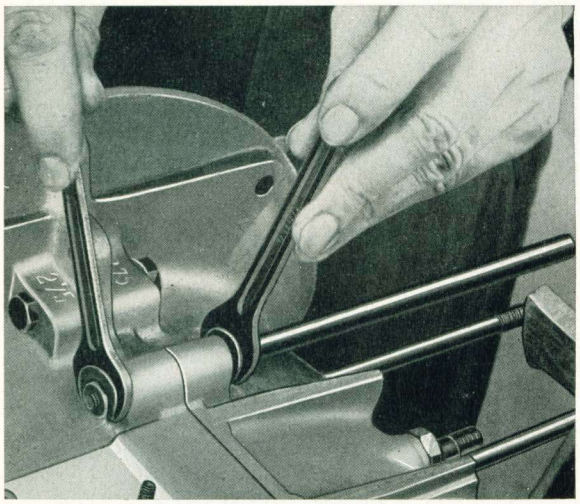
3 nuts M 6,

9 nuts M 8,

6 nuts M 10.

5 - Remove the throttle ring shaft of the automatic cooling air control.





Assembly

Reassembly of crankcase takes place in the reverse order to the instructions on disassembly, but the following points should be watched closely:

1 - Examine crankcase for damage and cracks.

2 - Remove all traces of the old sealing compound from the jointing faces, using a solvent. The jointing faces must be deadly even and free of burring. The edges at the main bearing points should, if necessary, be slightly chamfered to obtain an accurate matching of the crankcase halves. The oil passages should be flushed and cleaned out by the use of a compressed air line.

3 - Check oil suction pipe for secure seating and leaks.

6 - Take off right crankcase half, using a rubber mallet to loosen it. Do **not** insert tools or levers between the jointing faces.

7 - Take off camshaft and crankshaft.

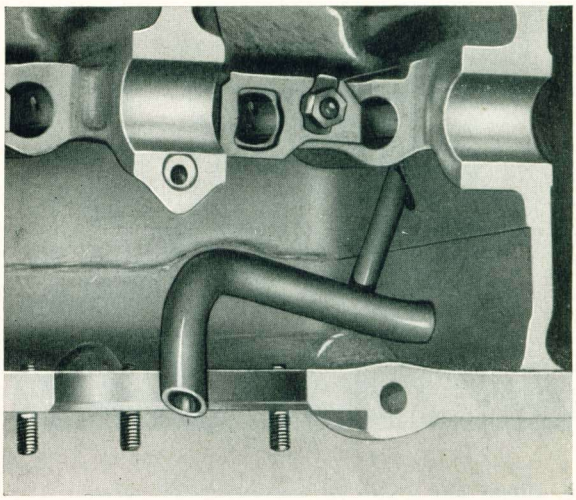
8 - Remove camshaft end plug.

9 - Remove crankshaft oil seal.

10 - Remove gasket on generator support.

11 - Remove valve push rod guide plates.

12 - Remove support for thermostat of the automatic cooling air control.



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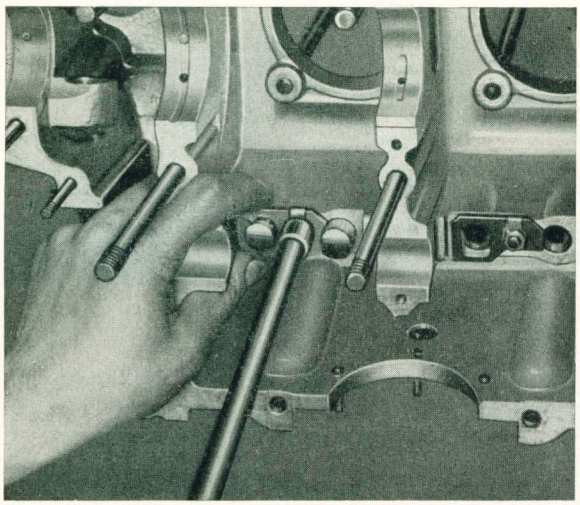
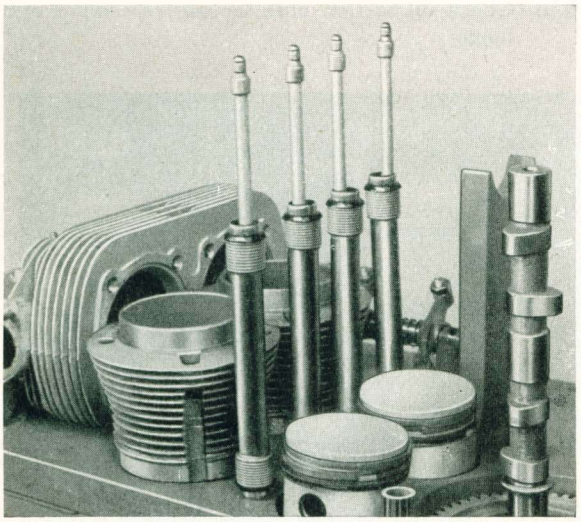
4 - Adjust valve push rod guide plates. The push rods should, in oiled condition, glide in the guide holes by their own weight and no marked clearance must be felt when attempting to rotate the push rods back and forth. Permissible clearance: 0.01—0.02 mm (0.0004—0.0008″). Care must be taken not to turn the guide plates out of place when tightening, as the push rod ends will otherwise not bear squarely on the cams. Noisy operation and increased wear would be the result.



If the push rods produce a noise due to excessive lateral clearance, replace them by oversize push rods.

5 - It is advisable to mark or handle the push rods in a way which will assure proper installation when assembling the engine.



6 - Check and install oil pressure relief valve.

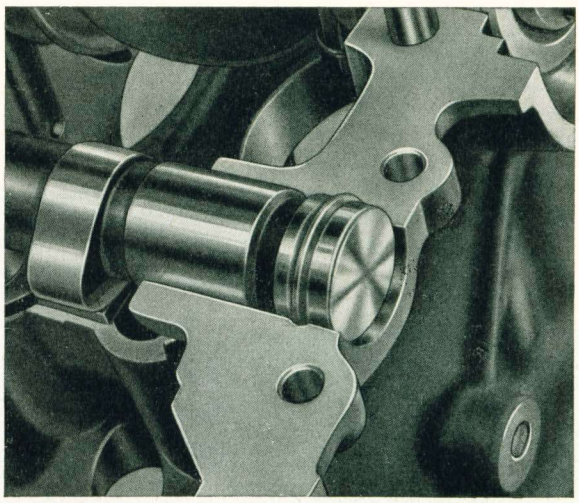
7 - Check and install oil pressure switch.

8 - Note position of timing marks on timing gears and make sure the crankshaft oil thrower is correctly installed.

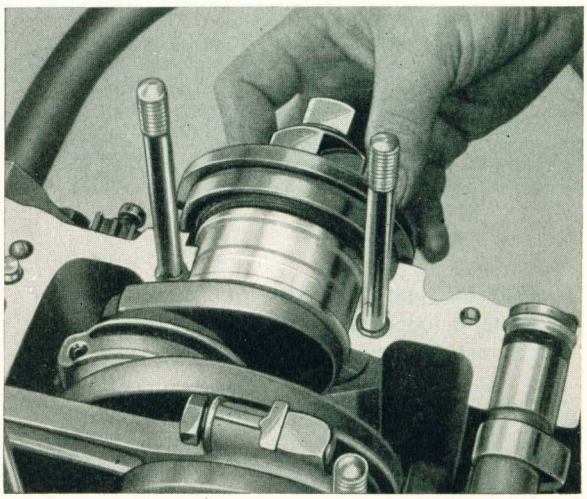
9 - Install crankshaft and bearings after having oiled the bearing points.

10 - Install camshaft.

11 - Install camshaft end plug, thrust washer, and



crankshaft oil seal by means of the Tool VW 204. Use sealing compound.



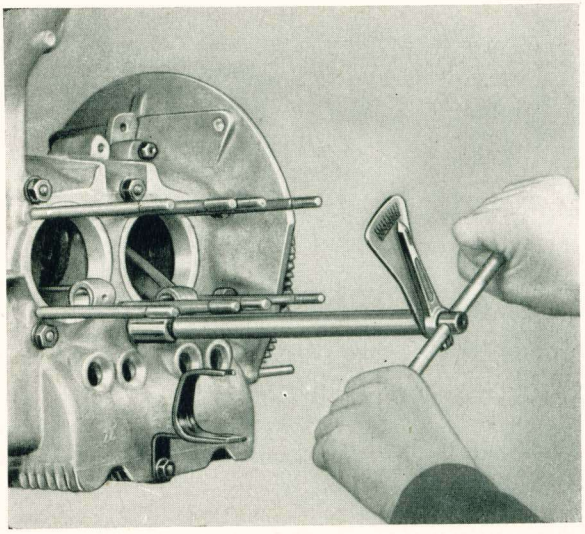
The oil seal must rest squarely on the bottom of its recess in the crankcase.

12 - Evenly spread a thin film of sealing compound on the crankcase jointing faces. On no account must the sealing compound enter the oil return passages of crankshaft and camshaft bearings.

13 - Join the crankcase halves and evenly tighten the nuts with a torque wrench as follows:

Metric Thread	Torque
6 Nuts M 10	3 mkg (22 ft. lbs.),
10 Nuts M 8	2 mkg (15 ft. lbs.).

Then proceed to tighten the 3 nuts M 6.



Oversize Crankcase Studs

The tapped stud holes in the crankcase may become damaged due to overstraining, or some other reason, leading in some cases to oil leaks.

It is then permissible to re-tap the holes 2 mm oversize. To ensure a correct sealing, the thread should be cut, however, to the following unorthodox dimensions:

Female Thread in Crankcase			
Nominal Diameter	Major Diameter (mm)	Pitch Diameter (mm)	Minor Diameter (mm)
M 8	7.630— 7.705	7.188— 7.300	6.416— 6.731
M 10	9.616— 9.698	9.026— 9.138	8.097— 8.452
M 12 x 1.5	11.616—11.698	11.026—11.138	10.097—10.452

The following drills must be used for boring up the holes:

6.7 mm drill for thread M 8
8.4 mm drill for thread M 10
10.5 mm drill for thread M 12 x 1.5

The threads are cut by single thread machine taps (DIN 376), the major diameters of which should be ground down to the following dimensions (VW Works Norm ZN 7038):

Taps			
Nominal Size	Major Diameter		
	Lower Limit (mm)	Upper Limit (mm)	Permissible Wear up to (mm)
M 8	7.660	7.680	7.630
M 10	9.640	9.660	9.616
M 12 x 1.5	11.640	11.660	11.616

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Removing and Installing Distributor Drive Pinion

Removal

1 - Disconnect cable No. 1 from distributor.

2 - Remove distributor cap.

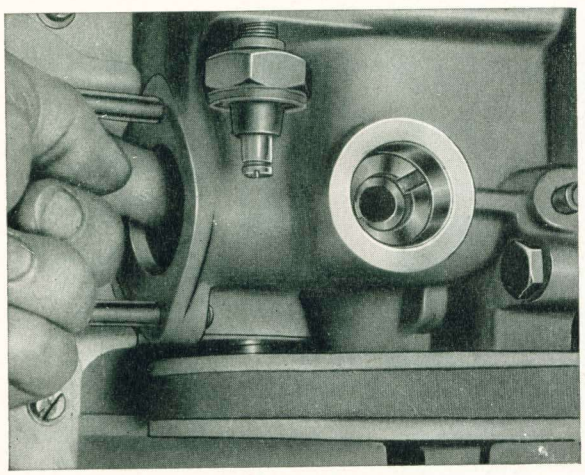
3 - Release distributor retainer clamping bolt.

4 - Lift off distributor.

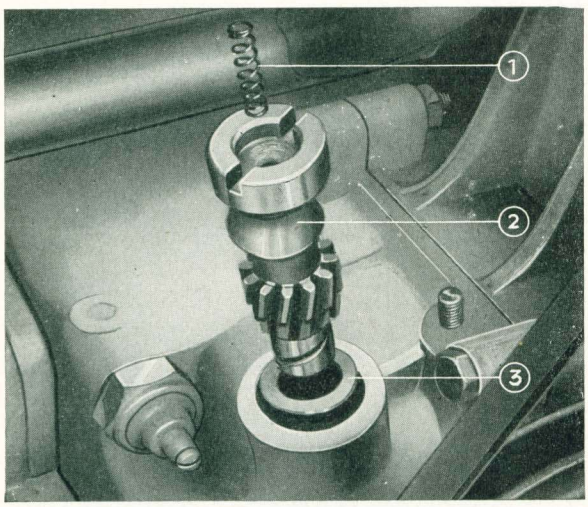
5 - Remove fuel pump and intermediate flange, gaskets, and fuel pump push rod.

6 - Remove coil spring on distributor drive pinion.

7 - Grip distributor drive pinion through the opening of the fuel pump jointing flange and lift it up while turning it anti-clockwise.



8 - Take out washer under distributor drive pinion. (Do not let it drop into the timing gear chamber!)



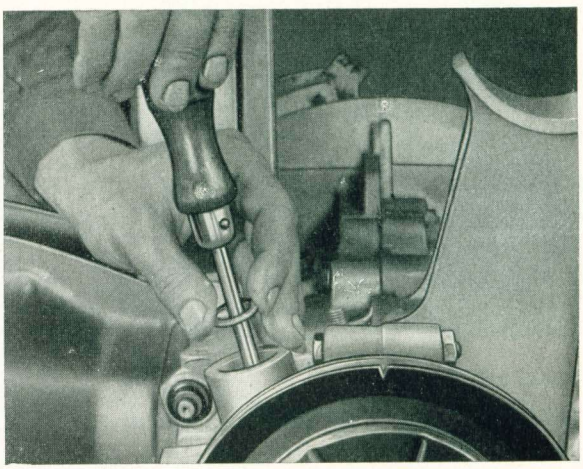
1 - Distance spring
2 - Distributor drive pinion.
3 - Washer

Installation

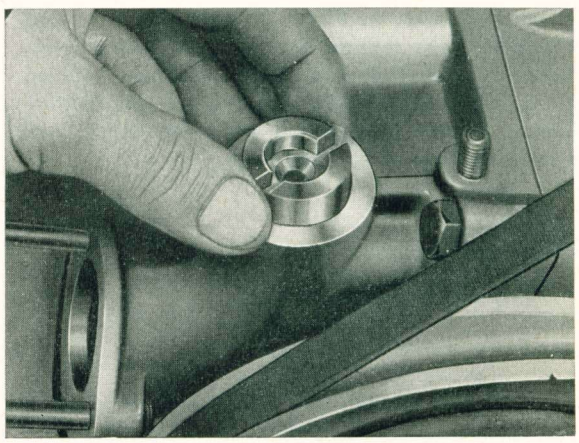
Installation is a reversal of the removal procedure. The following points should be observed:

1 - Check eccentric and spiral gear for wear. Replace distributor drive pinion if found necessary. In the case of a badly worn spiral gear, examine also the teeth of distributor drive gear.

2 - Inspect washer under distributor drive pinion for wear. Renew if necessary. (Do not let the washer drop into timing gear chamber when installing!)



3 - Reinstall distributor drive pinion after cylinder No. 1 has been set to firing position (note timing mark on fan pulley). With the pinion in the proper position, the slot in the top must be approximately parallel to the fan pulley. The narrow side of the top is towards the pulley.



4 - Reinstall distance spring.
5 - Set ignition.

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Removing and Installing Crankshaft Fan Pulley

(with engine in situ)

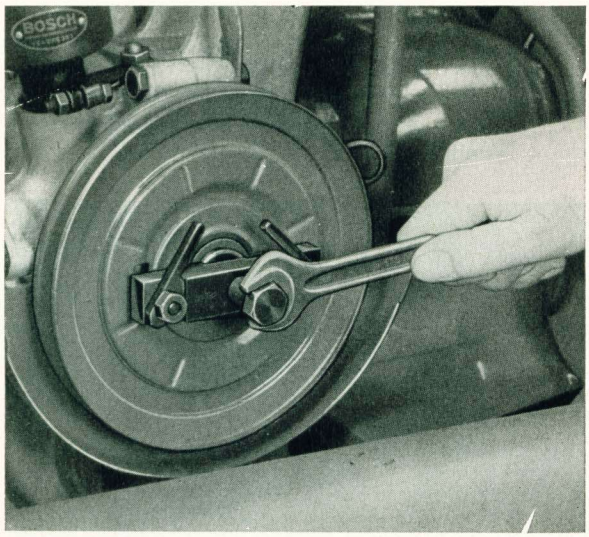
Removal

1 - Take off fan belt.

2 - Remove engine rear cover plate.

3 - Unscrew pulley mounting bolt.

4 - Extract pulley using tool VW 203 b.



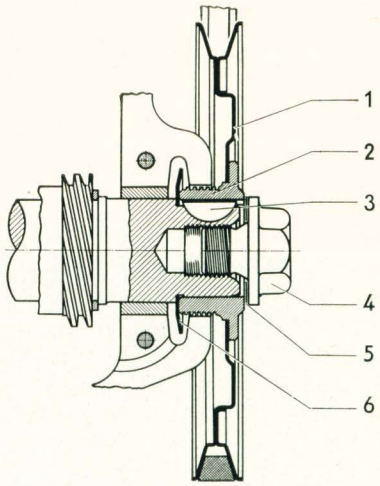
Installation

This is a reversal of the above operations, but it is important to observe the following points:

1 - Carefully inspect pulley for damage prior to installation. Clean oil return thread.

2 - Make sure the pulley is running true.

3 - In the case of oil leaks, use a pulley with bigger oil return thread (oversize).

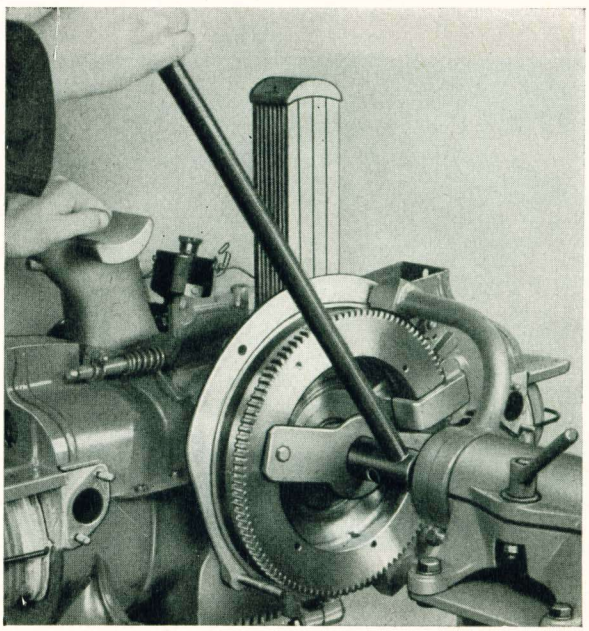


1 - Crankshaft pulley
2 - Oil return thread
3 - Woodruff key
4 - Mounting bolt
5 - Spring washer
6 - Crankshaft oil thrower

Removing and Installing Flywheel

General Description

The flywheel is attached to the crankshaft by means of a gland nut and dowel-located by 4 dowels. A paper gasket is fitted between flywheel and crankshaft. Oil sealing is done by an oil seal recessed in the crankcase casting at main bearing No. 1. The oil sea lip fits over the flywheel jointing flange. A bush, supporting the main drive shaft pilot, is situated in the gland nut.



Removal

1 - Remove clutch pressure plate.

2 - Remove clutch driven plate.

3 - Unscrew gland nut, using 36 mm Special Wrench VW 112. Remove guide plate of the special wrench.

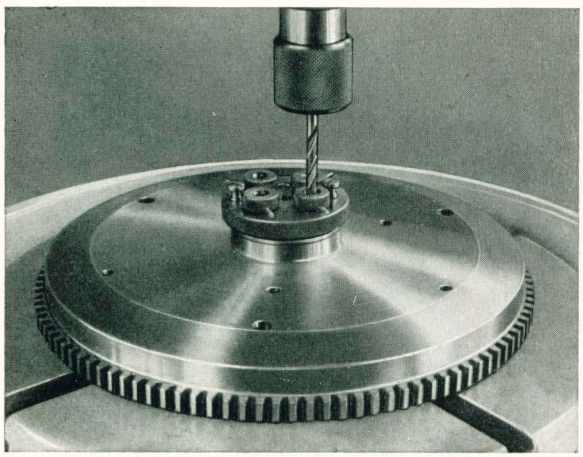
4 - Withdraw flywheel.

Installation

Installing the flywheel is a reversal of the above, but the following points should be noted:

1 - Check flywheel teeth for wear and damage. Lightly damaged gear rings may be remachined, removing 2 mm (0.08″) metal at the clutch side of the gear ring. Rechamfer the teeth to assure a proper engagement with the starting motor pinion.

2 - Check dowel holes in flywheel. If they are worn, place Drill Jig VW 231 b on flywheel, drill new holes of 5.8 mm ⌀ (0.228″) 45° away from the



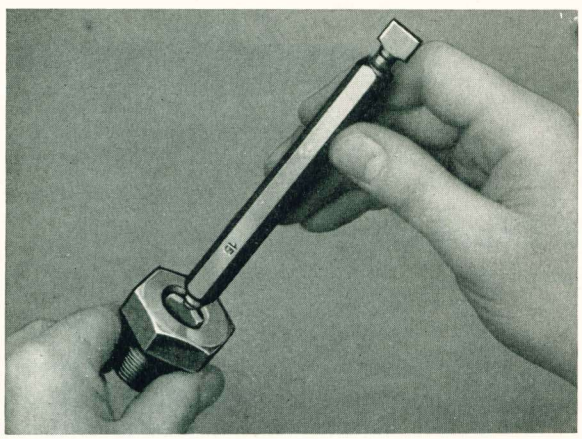
original holes, and ream them to 6 mm (0.236″). Plug up one of the old holes to avoid confusion.

3 - Inspect dowel holes in crankshaft for wear. If they are worn, remove crankshaft, drill new holes of 5.8 mm ⌀ (0.228″) 45° anway from the original holes, and ream them to 6 mm (0.236″).

4 - Renew dowels if these are worn.

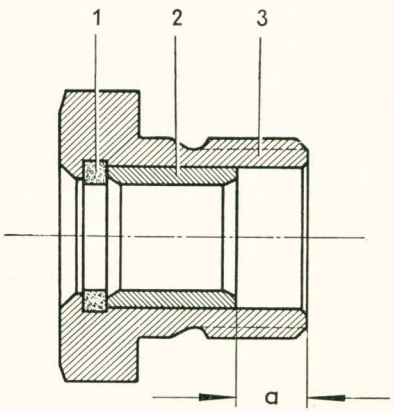
5 - Adjust crankshaft end play.

6 - Check pilot bush in gland nut for wear, using Plug Gauge VW 246.



If excessively worn, renew the pilot bush and the gasket, using Pilot Drift VW 218.

Seating depth of bush: a = 10 mm (.39″).

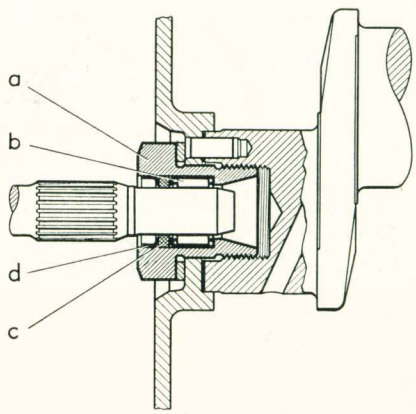


1 - Gasket
2 - Bush
3 - Gland nut

Fill the bush with about 10 grammes (.35 oz.) of Universal Grease VW — A 052.

Note:

From Chassis No. 1 — 0 929 746 onwards, a needle bearing has been used in the gland nut. The needle bearing is also lubricated with about 10 g (0.35 oz.) Universal Grease VW — A 052; the larger amount should be used to fill the needle cage.



a - Gland nut
b - Needle bearing
c - Oil seal
d - End ring

The needle bearing cannot be used in earlier type gland nuts. That is why the bronze bush is still obtainable as a spare part.

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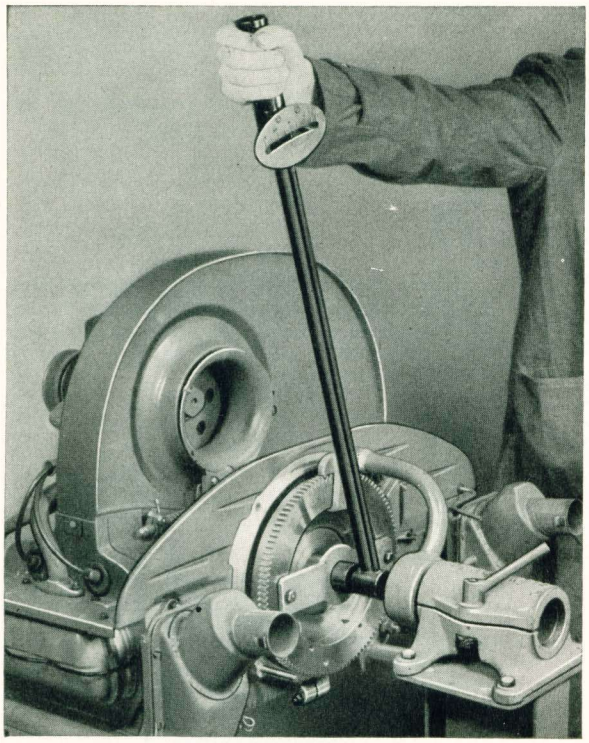
7 - In order to counteract the existing permissible unbalance of crankshaft, flywheel, and clutch, the heaviest points of these parts are marked. In assembly, it should be made sure that these marks are 120 deg. apart. If only two of the three parts are marked, the marks should be 180 deg. apart.

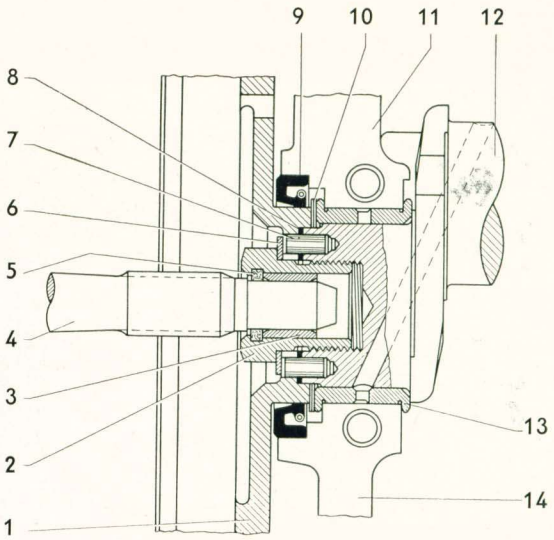
Parts	Mark
Crankshaft	Paint dot in crankshaft tapped hole which accepts flywheel gland nut.
Flywheel	Paint dot and 5 mm dia. (0.2″) hole on the face which is towards the clutch.
Clutch	Paint line at the outer edge of the clutch cover.



8 - Tighten gland nut to 30 mkg (217 ft. lbs.), using a torque wrench in conjunction with VW 163 a and the guide plate of the tool VW 112.

9 - Check flywheel for true running:

Lateral run-out-max. 0.3 mm (0.012″).
Radial run-out max. 0.4 mm (0.016″).



1 - Flywheel
2 - Gland nut
3 - Pilot bush
4 - Main drive shaft
5 - Gasket
6 - Lockwasher
7 - Dowel pin
8 - Gasket
9 - Oil seal
10 - Shims
11 - Crankcase
12 - Crankshaft
13 - Crankshaft bearing
14 - Crankcase

Removing and Installing Crankshaft Oil Seal

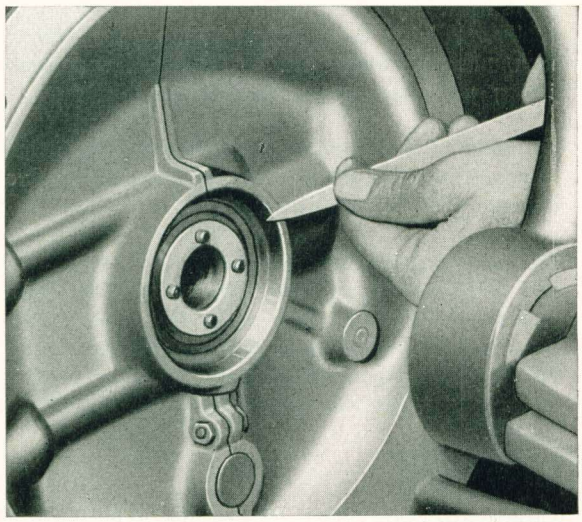
(with engine assembled)

1 - Remove flywheel. Inspect oil seal lip contact surface on flywheel jointing flange.

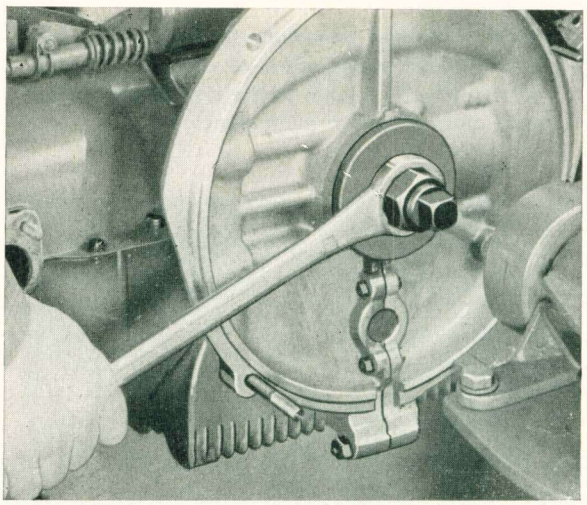
2 - Remove old oil seal.

3 - Clean oil seal recess in crankcase and coat it with a thin film of sealing compound. Should it become necessary, slightly chamfer the outer

edge by means of a scraper. Clean the recess from metal chips.



4 - Install new oil seal using Tool VW 204. Screw the tool into crankshaft and insert oil seal by tightening the guide piece. The oil seal must bed squarely on the bottom of its recess.



5 - Remove the tool.

6 - Reinstall flywheel. The oil seal lip contact surface is to be lubricated with oil.

Removing and Installing Camshaft

Removal

1 - Open the crankcase.

2 - Lift off camshaft.

Installation

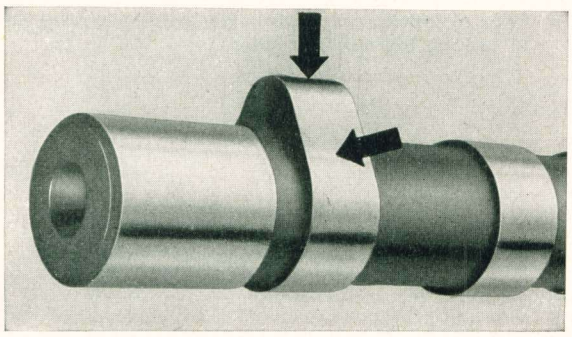
This is a reversal of the above, but it is important to observe the following points:

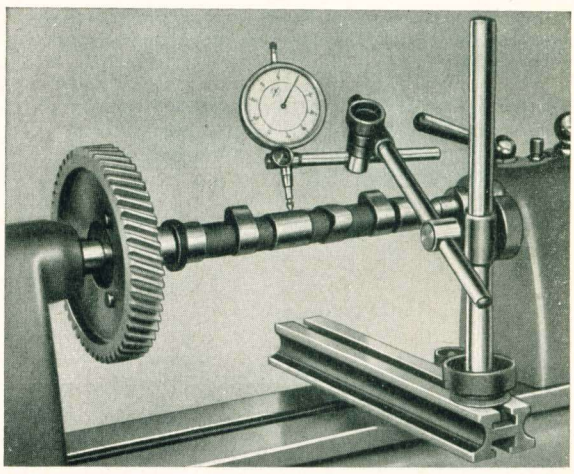
1 - Examine riveted joint between camshaft timing gear and camshaft.

2 - Check camshaft bearing points and cam faces for wear. The cam faces must not be scored and must be perfectly smooth and square.

See "List of Tolerances and Wear Limits" for permissible end play.

3 - Check camshaft for run-out.





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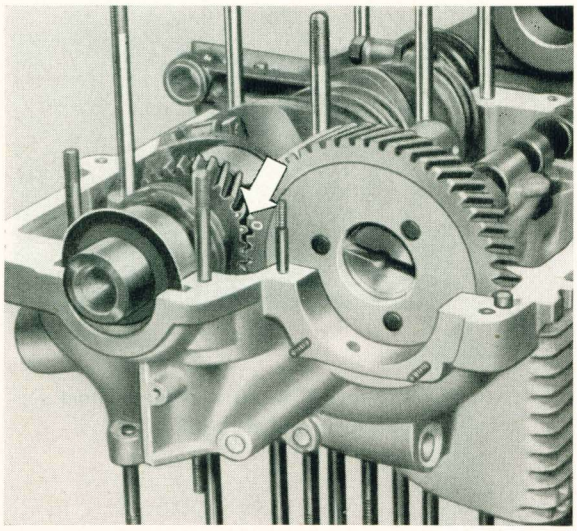
4 - Examine camshaft timing gear for wear and correct tooth contact.

5 - When installing camshaft, take care that the timing gear tooth marked "0" is situated between the two teeth of the crankshaft timing gear marked with a prick punch.



6 - Check backlash of camshaft timing gear (0.010—0.035 mm/.0004″—.0014″).

Note:

From Chassis No. 1033950 with initial exceptions and from Chassis No. 1266671 all current production camshafts are equipped with timing gears of light metal alloy.

Following the introduction of the new timing gears, the backlash tolerance has been increased from 0.0—0.025 mm (.001″) to 0.0—0.052 mm (.002″). When installing camshafts with light metal alloy gears, the lower backlash tolerance limit should be approached. To obtain the correct backlash, camshafts are available with plus or minus deviations of the timing gears:

Part No. 111109027	= + 3	111109019 = — 1
111109025	= + 2	111109017 = — 2
111109023	= + 1	111109015 = — 3
111109021	= 0	

To obtain a silent and smooth running of the timing gears, the specified backlash should be strictly adhered to. A check is carried out by rocking the gears back and forth with both hands, while gradually revolving the camshaft timing gear, until it has made a complete turn. The teeth of the camshaft timing gears used on the Deluxe are of fiber.

To assist in obtaining the specified backlash, the camshaft are available with timing gears in five sizes under different part numbers.

The timing gears are marked 0, + 1, + 2, — 1 and — 2, etched on their inner face. The digits indicate in $^1/_{100}$ mm how much the pitch radius departs from the standard pitch radius denoted by "0". The oversizes are marked "+ 1" or "+ 2", while undersizes can be identified by "— 1" or "— 2".

Caution. — The mark "0" on the outer face of each camshaft timing gear is to insure correct installation of the camshaft in relation to the crankshaft timing gear and has nothing to do with the aforementioned size markings.

The crankshaft timing gear is obtainable in one site only.

Note:

The following points should be observed whenever installing a camshaft:

a - Check bearing journals, cams, and timing gear for damage. Slight damage may be smoothed down with an oilstone (silicon carbide) — a 100—120 grain stone should be used before polishing with a 280—320 grain stone.

b - Remove any burr from the cam edges, using an oilstone of the grain mentioned under a —. Carefully clean camshaft from abrasive particles.

Important!

No attempt should be made to remove burr by grinding, as such practice would excessively reduce the cam width.

c - Prior to installation, apply a few drops of engine oil to bearing journals and cams.

Removing and Installing Crankshaft and Connecting Rods

Removal

1 - Open the crankcase.

2 - Take off camshaft.

3 - Remove crankshaft and connecting rods as a unit.

4 - Take off crankshaft oil thrower and main bearings 1 and 4.

Note:

Removed crankshaft must not be stored without having applied a rust preventive to their surface, as oil, grease, etc.

Installation

This is a reversal of the above procedure. The following points should be noted:

1 - The crankshaft bore in the crankcase must have no sharp edges at the jointing faces. Slightly chamfer the edges.

2 - Check dowels for tightness.

3 - The oil passages in the crankshaft must have no sharp edges. Should foreign matter be embedded in the main bearings, it may be removed by means of a scraper which must be free from burr. Care must be exercised not to remove metal from the bearing shell itself.

4 - Place one half of main bearing No. 2 in crankcase.

Note:

From Chassis No. 1 381 245 the thickness of the main bearing wall has been increased by 0.02 mm (.0008″) at the points subjected to the highest pressure, i. e., midway between the jointing faces of each bearing half. When the crankcase nuts are tightened to the specified torque, the ovalness of the bearing is removed by virtue of the pressure imposed on it by the crankcase. The modified bearing (Part No. 111 105 531 A) can be installed in all engines previously manufactured.

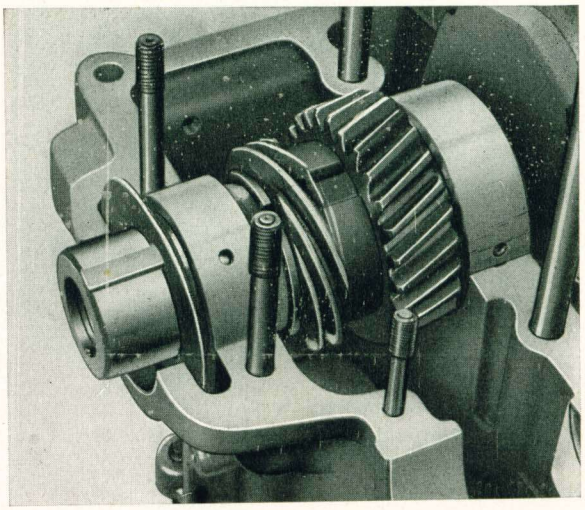
The reinforced bearing will soon be available in undersizes under the following part numbers:

0.25 mm undersize — Part number 111 105 537 A
0.50 mm undersize — Part number 111 105 543 A
0.75 mm undersize — Part number 111 105 549 A
1.00 mm undersize — Part number 111 105 555 A

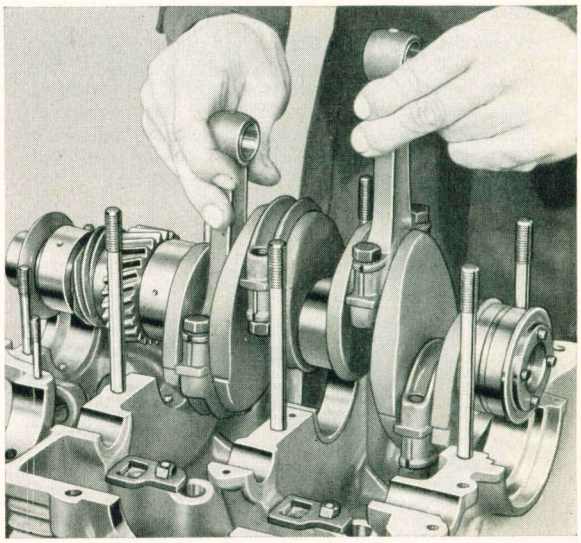
The modified bearing offers less friction to the crankshaft journal.

5 - Place main bearing No. 1 on crankshaft, taking care that the dowel hole is offset towards the flywheel.

6 - Install crankshaft oil thrower, the concave surface of which must face the pulley side of the crankcase.



7 - Reinstall crankshaft. Starting at main bearing No. 1, make sure that all bearings are properly dowel-located.



8 - Note marks on timing gears when installing camshaft.

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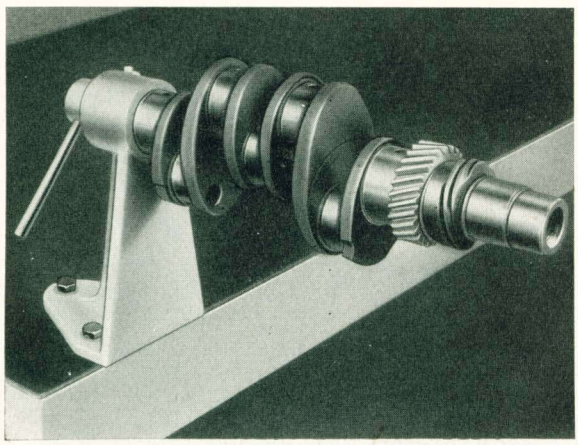
Removing and Installing Connecting Rods

Removal

1 - Remove crankshaft and attach it to the Holding Fixture VW 310.



2 - Unscrew connecting rod bolts and remove connecting rods and caps.

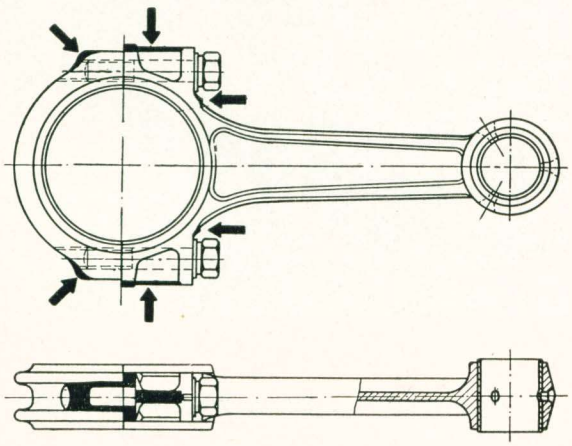
Installation

This is a reversal of the above, but the following points should be observed.

1 - Check weight of connecting rods. The difference in the weight of the connecting rods in one engine must not be in excess of 11 g (0.39 oz.) to maintain proper engine balance.

Note:

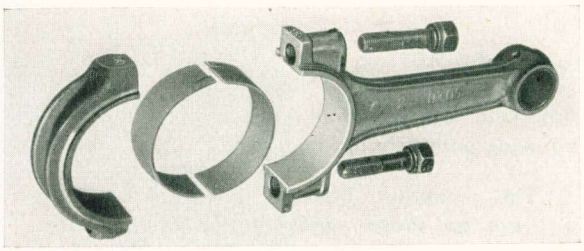
When dealing with 1192 c. c. engines, a difference of 5 g (.18 oz.) in the weight of the connecting rods in one engine should not be exceeded. If necessary, metal should be removed from the overweight connecting rods at the points indicated below. In following this method, the weight of one connecting rod may be reduced by about 6 g (.21 oz.).



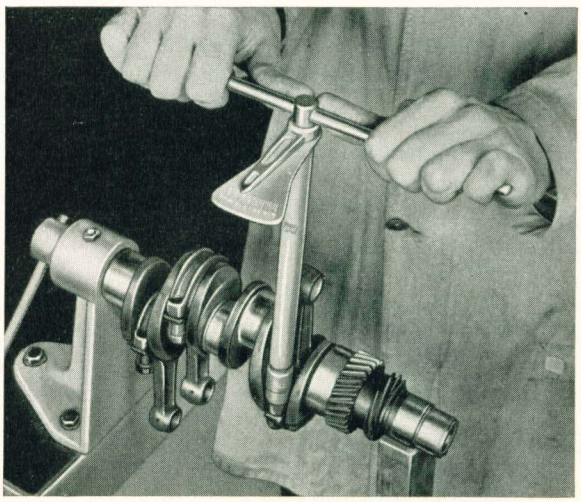
2 - Inspect piston pin bearing for damage and wear. With a new bearing, the correct clearance is indicated by a light finger push fit of the pin at room temperature.

3 - Check and, if necessary, correct connecting rod alignment.

4 - Reinsert connecting rod bearing shells after all parts have been thoroughly cleaned and assemble connecting rods on crankshaft. The identification numbers stamped on connecting rods and bearing caps must both be on one side.



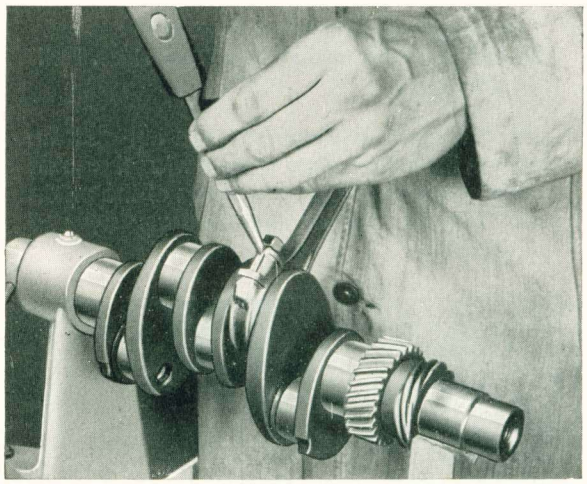
5 - Tighten connecting rod bolts to a torque of



5 mkg = 36 ft. lbs., using a torque wrench with a 14 mm socket. A slight pretension between the bearing halves, which is likely to occur when tightening the connecting rod bolts, can be eliminated by light hammer taps. The connecting rods, lubricated with motor oil

prior to assembly, must slide on the crank pin by their own weight. No scraping, reaming, or filing is permissible in the assembly of the connecting rod bearings.

6 - Secure connecting rod bolts in place, using chisel VW 124.



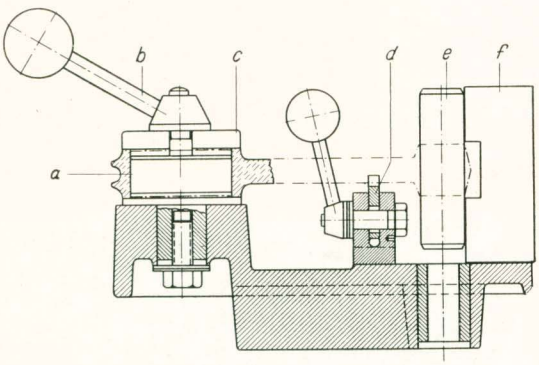
Reconditioning Connecting Rods

In the case of excessively worn piston pin bearings, renew the bearings and check connecting rods for alignment.

1 - Remove piston pin bearing, using tool VW 212 a.

2 - Place connecting rod in the Device VW 214.

3 - Place the C-washer (c) in position and tighten the lever (b) to such an extent as to still allow the connecting rod to have sufficient play to be moved one way or the other. The support (d) is released.

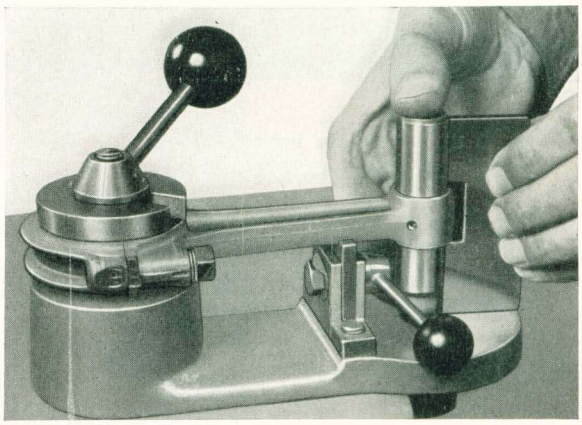


Device VW 214

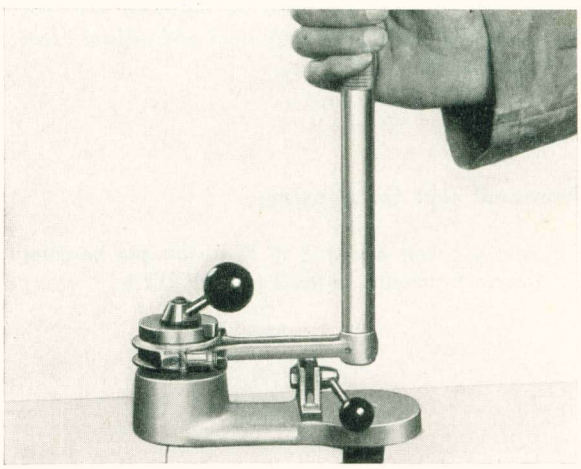
a - Mandrel
b - Locking lever
c - C-washer
d - Support
e - Pin
f - Gauge

4 - Then insert pin (e) in little end bore pressing it with two fingers towards the mandrel (a) so that there is no tilt between mandrel (a) and connecting rod bearing nor between little end bore and pin.

5 - Check connecting rod for twist and parallelism by means of the gauge (f).



If correction is necessary, fully tighten locking lever (b) and straighten connecting rod by means of the bar.



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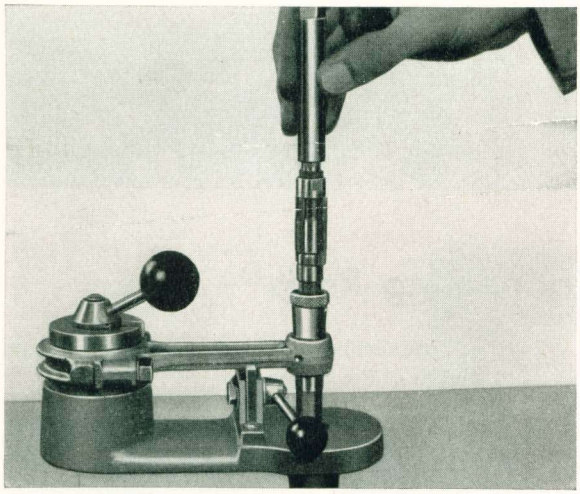
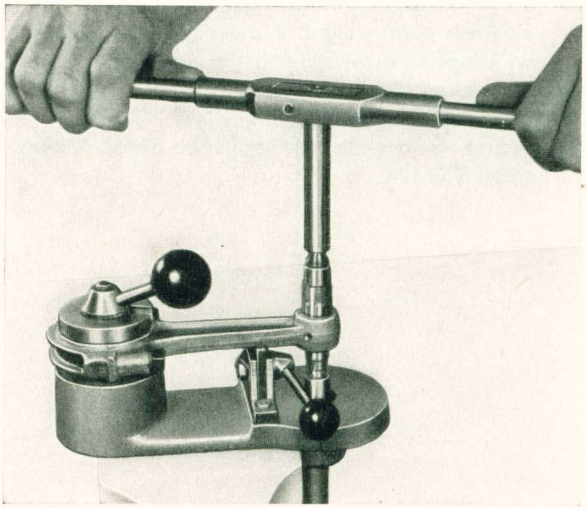
6 - The new bearing must be pressed in centrally so that it evenly projects on both sides. Drill oil passages.

7 - Insert reamer in piston pin bearing and the hole in the bottom plate of the device, the guide bush ensuring a correct centring of the piston pin bearing. Tighten locking lever (b) and support (d).





The piston pin must be fitted at room temperature. It is wrong practice to fit an oversize piston pin in order to eliminate undue clearance between piston and bearing. A new bush must in all cases be installed and reamed to size.

8 - Ream up piston pin bearing. Inner diameter: 20.005—20.02 mm (0.7876—0.7881″).

The bearing bore must be free from scores and chatter marks after reaming. Without applying oil, the piston pin must be a light finger push fit in the bearing.

9 - Recheck connecting rod for parallelism and twist as mentioned previously, but this time with the piston pin in lieu of the pin of the device. Correct, il necessary, with a bar inserted in the piston pin.

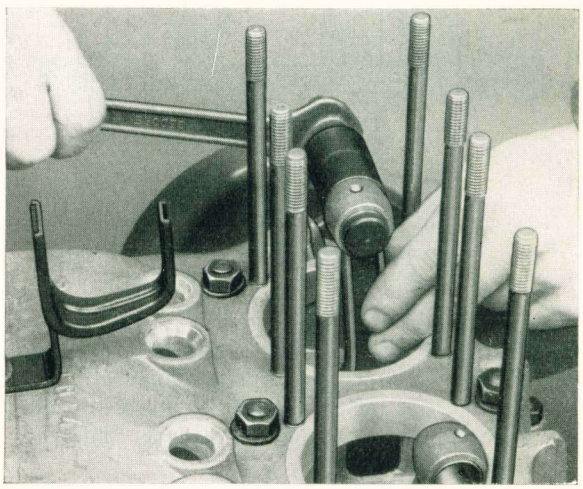
Renewing Piston Pin Bearing

(with crankshaft installed)

Piston pin bearings can also be renewed with the crankshaft in place, after cylinders and pistons have been removed.

Removal and Installation

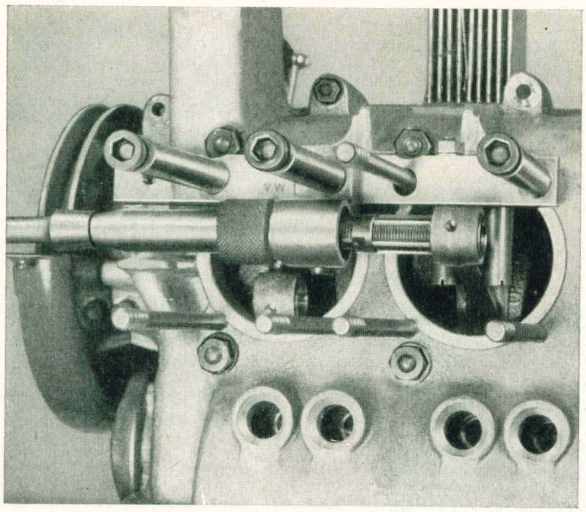
Driving out and pressing in of piston pin bearing is effected by means of the Tool VW 212 a.



Reaming to Size

The Tool VW 260 has been designed for reaming piston pin bearings with the crankshaft in place.

Arrangement of reaming tool on cylinder No. 1 (same as on cylinder 3):

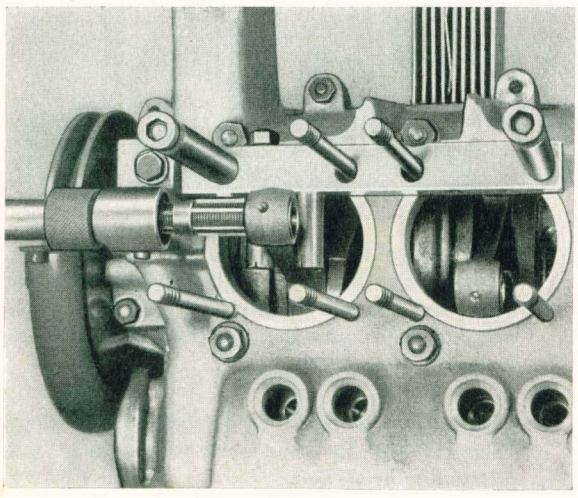


a - Place the straight edge in position, taking care that the two stop pins rest against the cylinder seat when tightening.

b - The two eccenters in the straight edge must hold the connecting rod so that there is no play in the reaming direction. The connecting rod is centered by the tapered guide pin at the reamer shaft.

c - Insert reamer and ream bush to size. The two eccenters take up the pressure when reaming.

Arrangement of reaming tool on cylinder No. 2 (same on cylinder No. 4):



Connecting Rod Alignment

After reaming, the connecting rod must be checked for alignment, using Gauge VW 250.

Note:

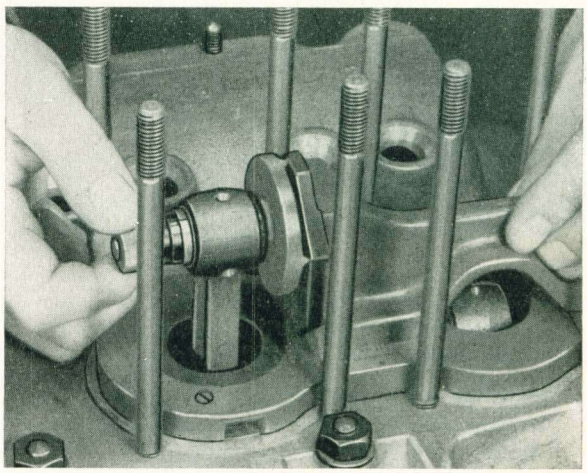
The Gauge VW 250 is only suitable for 1131 cc. engines.

a - Place base plate on the cylinder seats on one side of the crankcase so that the annular guide is situated at the connecting rod to be checked.

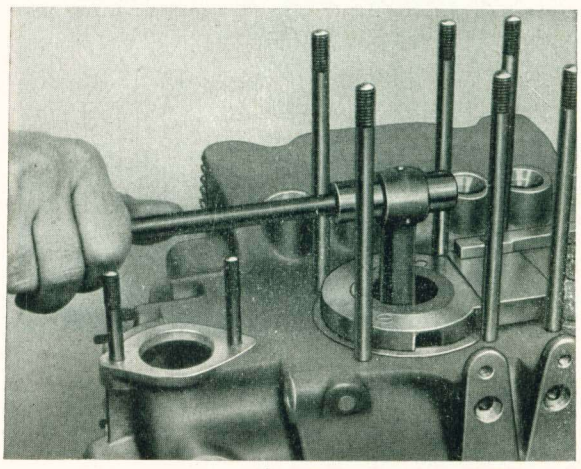
b - Rotate crankshaft until connecting rod has reached top dead center position.

c - Insert test plate into piston pin bearing and tighten at the knurled-head screw.

d - The angular piece on the base plate is then to be moved along the guide bar against the test plate. Check connecting rod for twist and bends.



e - Should it become necessary, rectify connecting rod alignment by fitting a piston pin and straightening by means of a bar inserted in the piston pin as shown in the photo below.



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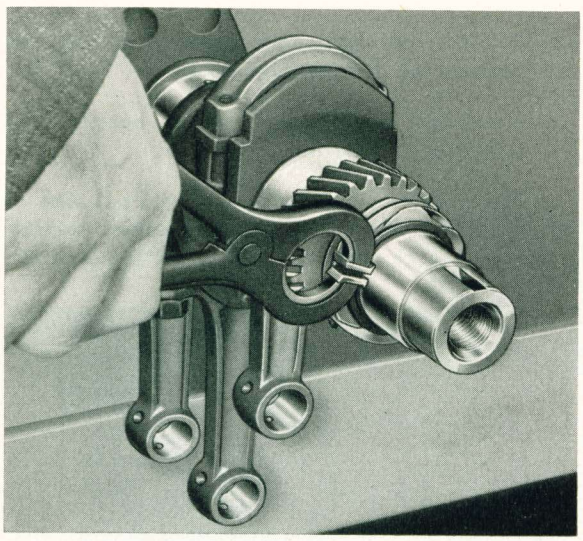
Disassembling and Assembling Crankshaft

Disassembly

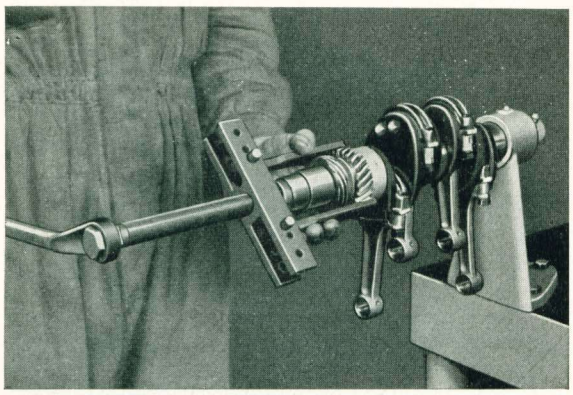
1 - Attach crankshaft to Holding Fixture VW 310.

2 - Remove distributor drive gear retaining ring, using Tool VW 161 a.



3 - Remove distributor drive gear, spacer, and crankshaft timing gear, using Extractor VW 202 in conjunction with VW 202 a and VW 202 f.

Heat the gears in oil to approx. 80 °C (176 °F) before removing them to avoid damage to the seating surface. Light signs of seizure can be removed, provided that the press fit will not be affected.



4 - Remove main bearing No. 3.

5 - Remove connecting rods.

Important!

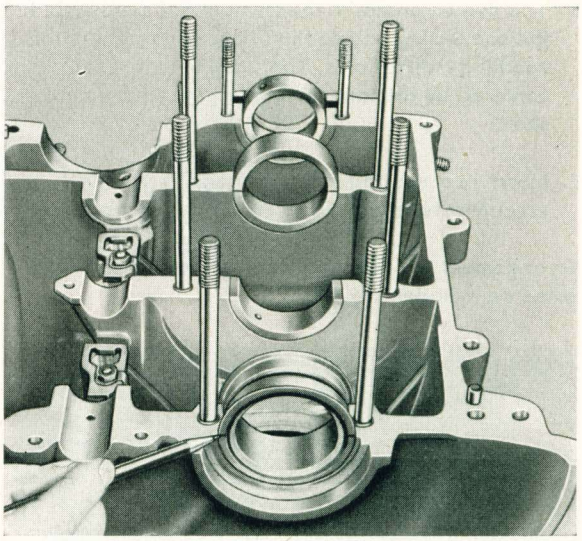
Do not store crankshafts without applying a rust preventive to their surface, as oil, grease, etc.

Assembly

This is a reversal of the preceding operations, but the following points should be observed:

1 - Check crankshaft for run-out, cracks ("ringing" test), and wear. Should it become necessary, regrind or renew crankshaft and install new main bearings. To assure a correct assembly, first place main bearings 1, 3, and 4 in left-hand half of crankcase, noting proper position of dowel holes and oil holes which must register with the oil passages in the crankcase. The dowel hole in main bearing 1 must be towards the flywheel.

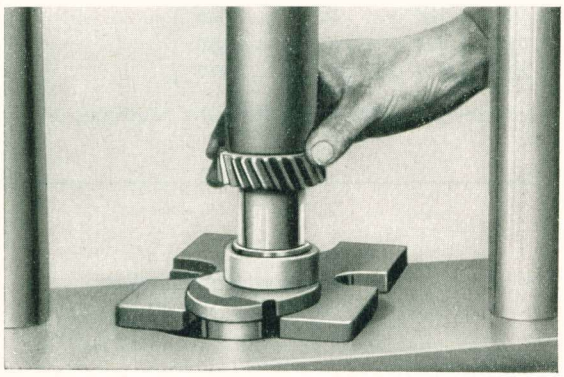
To facilitate fitting of main bearings on the dowels when installing crankshaft, it is recommended to mark the bearings at the crankcase jointing face level with a pencil.



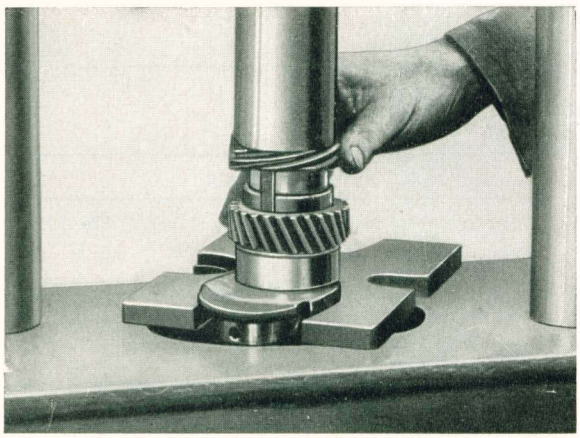
2 - Check dowel holes in crankshaft face for wear. If they are worn, remove crankshaft, drill new holes of 5.8 mm ø (0.228") 45° away from the original holes (use drill jig 231 a), and ream them to 6 mm (0.236").

3 - Slide main bearing No. 3 in position and insert Woodruff key for crankshaft timing gear and distributor drive gear.

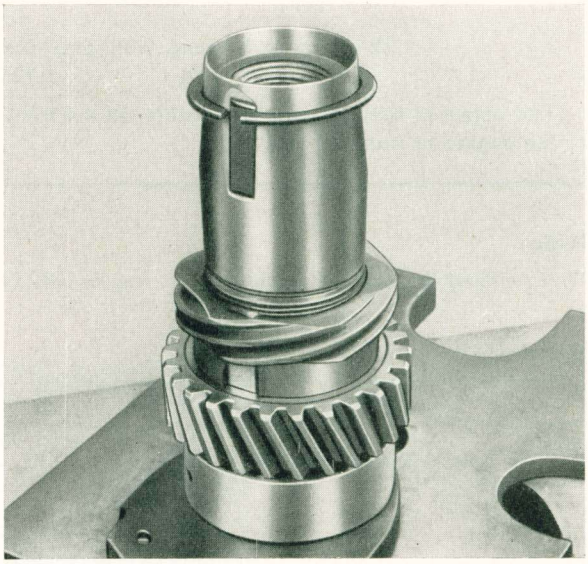
4 - Check crankshaft timing gear for wear and check tooth contact. Heat the gear to about 80 °C (176 °F) in an oil bath and press it in position using Guide Tube VW 427. Slide spacer on crankshaft.



5 - Check distributor drive gear for wear. Heat the gear to about 80 °C (176 °F) and press it in position, using Guide Tube VW 427.



6 - Install retaining ring, using Tapered Guide Tube VW 284 to avoid damage to the crankshaft journal Check gears for secure seating after they have cooled down.



7 - Clean out oil passages, using compressed air.

8 - Assemble connecting rods.

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Important!

From Chassis No. 1 299 842 the clearance of main bearing 4 on the crankshaft journal has been brought into line with that of the remaining main bearings.

Clearance previously: 0.031—0.083 mm (.0012″—.0033″)
now: 0.047—0.102 mm (.0019″—.0040″)
Thickness of bearing wall previously: 4.989—4.979 mm (.1884″—.1880″)
now: 4.883—4.972 mm (.1882″—.1877″)

The object of this measure is to minimize the frictional resistance, thereby promoting the readiness of the engine to start.

Note:

The crankshaft/flywheel unit of the 1192 c. c. engine differs from that of the 1131 c. c. engine as detailed below:

Crankshaft

1131 c. c. engine	1192 c. c. engine
The hole accepting the flywheel gland nut is chamfered	The hole accepting the flywheel gland nut is chamfered and incorporates a cylindrical portion of about 5 mm (.2″) in front of the thread
Part No. 105101 has not been changed	

Flywheel

1131 c. c. engine	1192 c. c. engine
Hole inside dia. 28.5/28.0 mm (1.122″/1.102″)	Hole inside dia. 29.0/28.6 mm (1.142″/1.126″)
Part No. 105171 has not been changed	

Gland Nut

1131 c. c. engine	1192 c. c. engine
Length 34.4/34.0 mm (1.354″/1.339″) Diameter of shoulder 27.98/27.80 mm (1.102″/1.094″)	Length 35.2/34.8 mm (1.386″/1.370″) Diameter of shoulder 28.500/28.487 mm (1.1220″/1.1215″) The gland nut shoulder fits into the crankshaft hole
Part No. 105205	Part No. 105205 a

Interchangeability

The assembly of the crankshaft includes the following four possibilities:

	Engine	Crankshaft		Flywheel		Gland Nut
1	1131 c. c.	old	+	old	+	old
2	1131 c. c.	old	+	new	+	old
3	1131 c. c.	new	+	old	+	old
4	1131 c. c. and 1192 c. c.	new	+	new	+	new

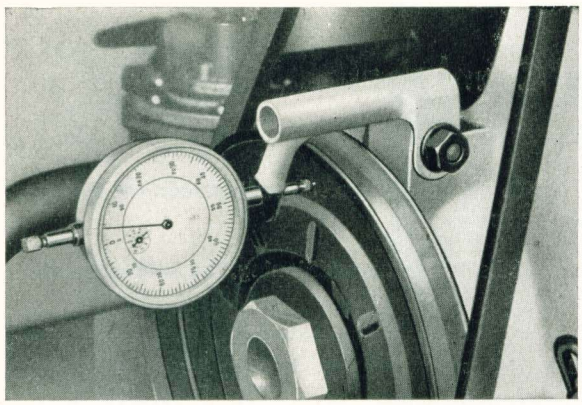
Crankshaft End Play

Checking Crankshaft End Play

Crankshaft end play should be within 0.07 mm and 0.12 mm (0.0028″ and .0047″), the wear limit being 0.15 mm (.006″). The end play can conveniently be checked with the engine installed or removed. A bracket (local manufacture VW 659) has been designed to hold a dial indicator.

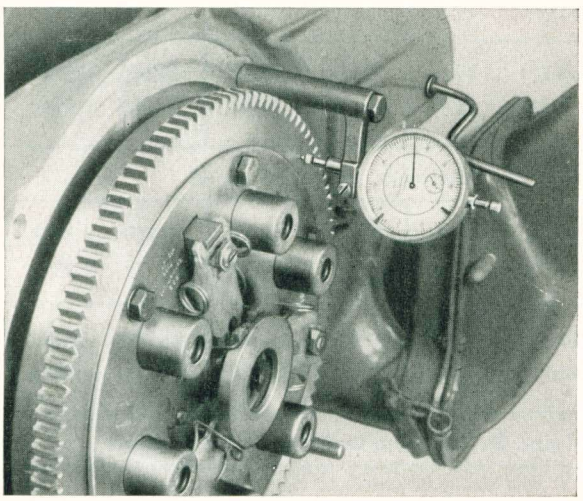
Engine Installed in Vehicle

The end play reading is taken at the pulley. The dial indicator bracket is mounted on the rearmost crankcase stud that holds intake manifold support. An end play reading is obtained by rocking the crankshaft back and forth at the pulley hub.



Engine Removed

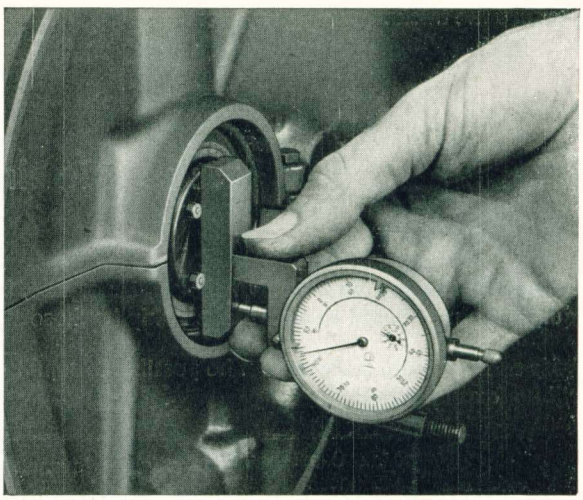
The end play reading is taken at the flywheel. The dial indicator is held by one of the engine mounting bolts.



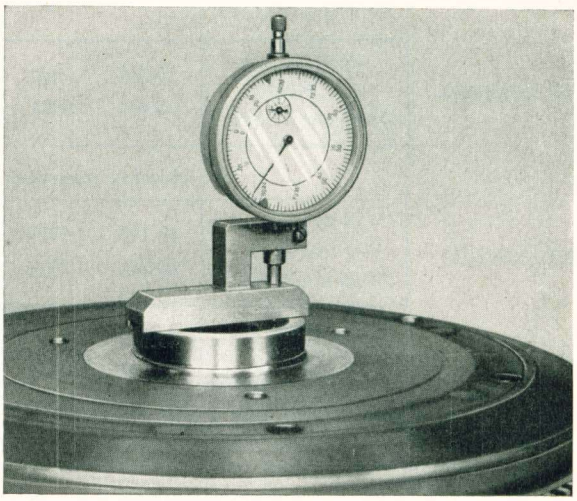
Adjusting End Play

1 - Force the installed crankshaft against the flywheel side of the engine (with flywheel, paper gasket, oil seal, and shims removed) to take up the play.

2 - Insert Dial Gauge VW 292 in flywheel seat so that it contacts the crankshaft and measure distance from crankshaft face to outer face of main bearing No. 1.



3 - Place Gauge VW 292 on flywheel jointing flange and measure depth of crankshaft seat.



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4 - The thickness of the shims to be used is decided by the difference in both readings (taking into account the paper gasket). The thickness of the paper gasket is 0.2 mm (0.0078″) and is compressed by 0.05 mm (0.0019″) in assembling, leaving 0.15 mm (0.0059″) to be considered when deciding thickness of shim.

Shims of the following thicknesses are available:

0.30 mm (0.28—0.30 mm)
0.32 mm (0.30—0.32 mm)
0.34 mm (0.32—0.34 mm)
0.36 mm (0.34—0.36 mm)
0.38 mm (0.36—0.38 mm)

The thickness is etched on each shim. If necessary, measure the thickness with a micrometer.

Three shims of the required thickness are to be installed in each case.

Never use more than one paper gasket.

Example:

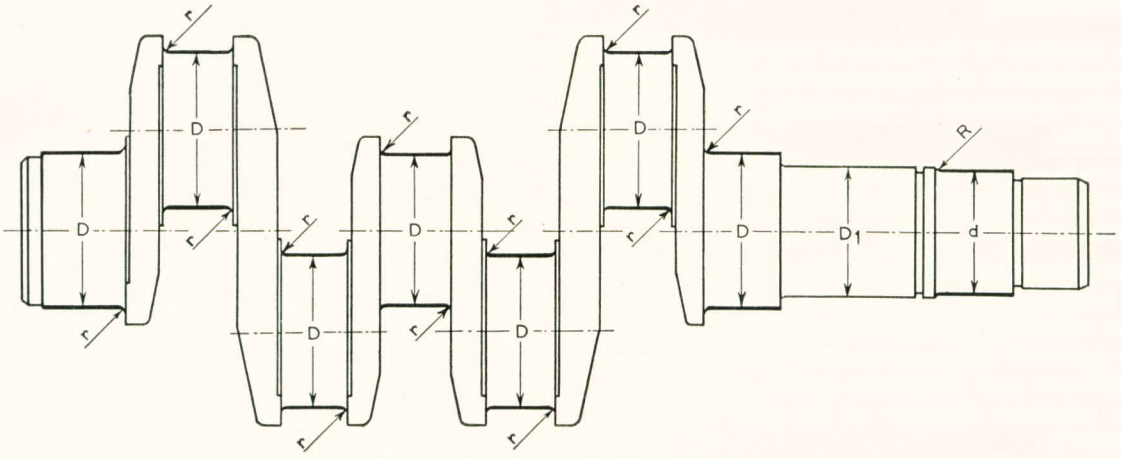
Distance crankshaft face/main bearing No. 1	4.265 mm
Depth of crankshaft seat in flywheel	— 3.215 mm
	1.050 mm
Thickness of paper gasket when installed	+ 0.15 mm
	1.200 mm
Shims to be used: two shims of 0.36 mm each, one shim of 0.38 mm.	— 1.100 mm
End Play	0.100 mm

Reconditioning Crankshaft

Crankshaft needing an overhaul should, if possible, be sent to the factory, as regrinding requires first class equipment and should be undertaken only by those skilled in such work.

If, for some reason, it should not be possible to send in the crankshaft for reconditioning, the following details will be found helpful:

	Main Bearings 1-3 Connecting Rod Bearings (Main Bearing 4)	Bearing Journals and Crank Pins D				Bearing Journal d			
		Ground Diameter		Lapped Diameter		Ground Diameter		Lapped Diameter	
		mm	ins.	mm	ins.	mm	ins.	mm	ins.
Standard	50.00 mm ⌀ 1.9685″ (40 mm/1.5748″)	—		49.991 49.975	1.9681 1.9675	—		40.000 39.984	1.5748 1.5742
1st Undersize	49.75 mm ⌀ 1.9586″ (39.75 mm/1.5649″)	49.750 49.741	1.9586 1.9583	49.741 49.725	1.9583 1.9577	39.760 39.750	1.5653 1.5649	39.750 39.734	1.5649 1.5643
2nd Undersize	49.50 mm ⌀ 1.9488″ (39.50 mm/1.5551″)	49.500 49.491	1.9488 1.9484	49.491 49.475	1.9484 1.9478	39.510 39.500	1.5555 1.5551	39.500 39.484	1.5551 1.5545
	Re-Harden Journals and Pins! Minimum Hardness Rc 48								
3rd Undersize	49.25 mm ⌀ 1.9390″ (39.25 mm/1.5453″)	49.250 49.241	1.9390 1.9386	49.241 49.225	1.9386 1.9380	39.260 39.250	1.5457 1.5453	39.250 39.234	1.5453 1.5446
4th Undersize	49.00 mm ⌀ 1.9291″ (39.00 mm/1.5354″)	49.000 48.991	1.9291 1.9288	48.991 48.975	1.9288 1.9281	39.010 39.000	1.5358 1.5354	39.000 38.984	1.5354 1.5348
	The crankshaft is lapped to final size. Strictly keep to the dimensions given.								



D 1 $= \frac{42.006}{41.995}$ mm ⌀ (1.6538″/1.6533″) R = 4.0 mm (0.16″) r $= \frac{2.0}{1.5}$ mm (0.08″/0.06″)

The thorough grinding of the radii (r) is of great importance to the life of the crankshaft. If necessary, repolish the radii.

The bearings are marked for easy identification. The numbers in parenthesis indicate the undersize.

	Main Bearing 1	Main Bearing 2	Main Bearing 3	Main Bearing 4	Connecting Rod Bearing
Standard	01.14.1.	01.16.1.	01.18.1.	01.20.1.	03.09
1st Undersize	KD.01.(1).14.1.	KD.01.(1).16.1.	KD.01.(1).18.1.	KD.01.(1).20.1.	KD.03.(1).09
2nd Undersize	KD.01.(2).14.1.	KD.01.(2).16.1.	KD.01.(2).18.1.	KD.01.(2).20.1.	KD.03.(2).09
3rd Undersize	KD.01.(3).14.1.	KD.01.(3).16.1.	KD.01.(3).18.1.	KD.01.(3).20.1.	KD.03.(3).09
4th Undersize	KD.01.(4).14.1.	KD.01.(4).16.1.	KD.01.(4).18.1.	KD.01.(4).20.1.	KD.03.(4).09

Regrinding

On no account must the bearing shells be remachined.

After grinding, remove sharp edges on oil passages by slightly chamfering them. Crankshaft timing gear and distributor drive gear must be a press fit on the crankshaft.

$$\frac{41.995 \text{ mm } ⌀}{42.006 \text{ mm } ⌀} = \frac{1.5633''}{1.6538''}$$

In the case of wear, due to the gears having been removed and installed several times, the press fit can be restored by chromium plating or applying the metal spraying method.

To make sure the crankshaft is free from internal cracks, it is recommended to carry out a "ringing test" prior to installation.

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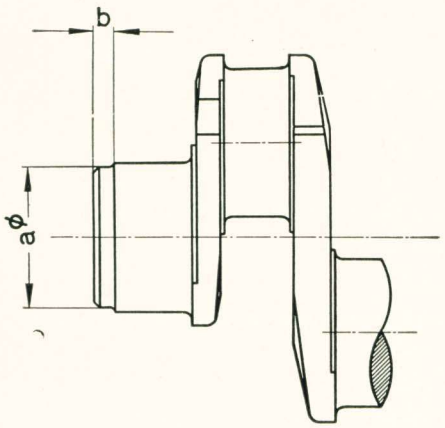
Re-Hardening

The hardness of the reground bearing points must not be below Rc 48. Regrinding to the 3rd undersize usually necessitates a re-hardening of the journals and pins.

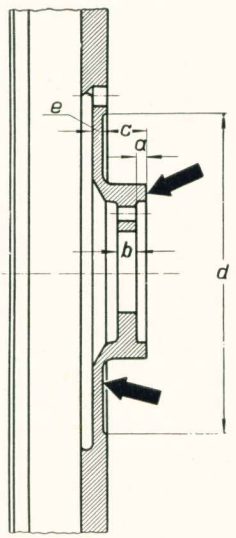
Workshops not having adequate equipment to carry out a correct re-hardening should send the crankshaft to the factory.

Generally, the shouldered flywheel seating is found to have shrunk by the re-hardening process. In such cases, the flywheel seat must be reground to the undersize 48.0_{h6} mm (1.8898″) that is, between 47.984 mm and 48.000 mm (1.8891 and 1.8897″). The standard diameter of the seat is 48.5 mm (1.9094″).



a = 48.0_{h6} mm (1.8898″)
b = 5.9—6.1 mm (0.23—0.24″)

A compensating ring (Local Manufacture) is to be inserted into the flywheel and machined to 48.000—48.025 mm ⌀ (1.8897″—1.8807″).



Should a remachining of the inner crankshaft contact surface in the flywheel become necessary, the same amount of metal must be removed from the outer contact surface so that the seating depth (a) 3.22—3.25 mm (0.1267″—0.1279″) is retained. The distance (b) must, however, never be below 5 mm (0.2″).

Remachining Crankshaft and Flywheel

In carrying out the above operations, care must be taken that the length of the flywheel jointing flange (c) 12.50—13.25 mm (0.492″—0.521″) is retained to prevent the flywheel fouling the oil seal or the crankcase. If the length cannot be kept at the specified dimension, the flywheel body should be machined around the flange 110 mm (4.33″) as indicated by (d). The minimum thickness of the flywheel at this point (e) 4.4 mm (0.173″) must, however, be maintained.

The crankshaft end face and the contact surface in the flywheel must be absolutely smooth and square to insure a correct oil sealing. An incorrect mating may also cause a flywheel run-out.

In the case of worn or damaged dowel holes, new holes should be drilled 45° away from the original holes.

Diameter of holes: 6.000—6.012 mm ⌀ (0.2362—0.2367″). Drill holes, using drill 5.8 mm ⌀ to a depth of 10.0—10.5 mm (0.39″—0.41″). Ream holes to the above specified size and to a depth of 8.0—8.5 mm (0.314—0.334″).

The specified depth of the holes must be strictly adhered to as otherwise the dowels either go too far into the crankshaft or project too far from the flywheel surface. The following tools should be used to carry out these operations:

Jig VW 231 a for Drilling and Reaming Crankshaft.

Jig VW 231 b for Drilling and Reaming Flywheel.

As the mounting diameter of both jigs amounts to 48.5 mm ⌀ (1.9024″), the dowel holes should be drilled and reamed prior to re-hardening the crankshaft.

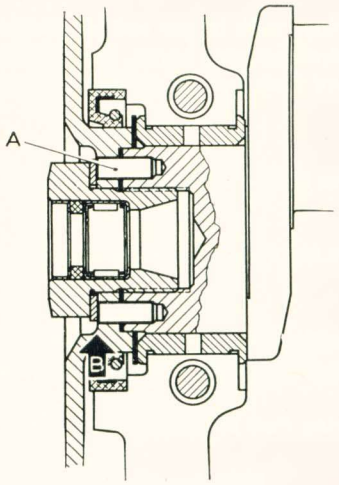
A remachining of the flywheel and a drilling of new dowel holes necessitate in all cases a re-balancing of crankshaft and flywheel.

Flywheel Dowel Pins

From Chassis No. 1569912 the length of the flywheel dowel pins has been increased from 12.5—0.3 mm (.488″—.012″) to 14.0—0.3 mm (.546″—.012″) (A).

This measure will insure greater safely against premature wear of the dowel pin holes in the flywheel.

Should it become necessary to overhaul the flywheel, i. e., if the friction area for the crankshaft must be remachined, the dowels should be ground down to 13.0—0.3 mm (.512″—.012″) as otherwise the dowel pin ends will protrude over the friction area for the gland nut (B). This would result in a loose fit of the flywheel.



Oversize Main Bearings for Exchange Engines

Since October 1st, 1956, main bearings with larger outer diameters, according to wear of crankcase bores, are being in stalled in Exchange Engines. The outer diameter of these bearings is 0.50 mm larger than that of the standard bearings. The main bearing bores in the crankcase have also been enlarged by 0.50 mm.

	Standard	Oversize
Bore for main bearings 1, 2, 3	60.000—60.019 mm	60.500—60.519 mm
Bore for main bearing 4	50.000—50.025 mm	50.500—50.525 mm

This modification makes it possible to re-use crankcases on which the main bearing bores are excessively worn. It should be observed that oversize main bearings in exchange engines are only installed for the first undersize of the crankshaft.

Exchange Engines provided with oversize main bearings are marked "0" below the engine number.

Part Numbers of main bearings:

Main bearing 1	111105509	Main bearing 3	111105569
Main bearing 2	111105539 A	Main bearing 4	111105599

From Chassis No. 1538617 all VW engines are now provided with an improved main bearing No. 1. The bearing is provided with a lead coating 0.03 mm (.001″) thick and can be recognized by its dull dark-grey colour. On the flywheel side the bearing is provided with four oil pockets.

Bearings of this design have better running qualities.

When engine repairs are carried out the specified play between main bearing No. 1 and the crankpin must not be decreased (0.047—0.102 mm/.0019″—.004″).

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Oversize Main Bearings

Main bearings with larger outside diameters are available for service installation to make up for wear in the crankshaft bearing bores. The outside diameter of these bearings is 0.5 mm (.0197″) larger than that of the standard bearings, necessitating the crankshaft bearing bores to be reamed up as specified below:

	Standard size	Oversize
Bores for main bearings 1, 2 and 3	60.000—60.019 (2.3622″—2.3629″)	60.500—60.519 (2.3819″—2.3826″)
Bore for main bearing 4	50.000—50.025 (1.9685″—1.9695″)	50.500—50.525 (1.9882″—1.9892″)

Bearings with larger outside diameter are available for standard size and 1st undersize crankshafts only. Engines on which such oversize main bearings are used should be marked "0" below the engine number.

Main Bearing Part Numbers:

Main bearing	Standard size	First undersize
1	111105503 A	111105509 A
2	111105533 A	111105539 A
3	111105563	111105569
4	111105593	111105599

Crankcase

From Chassis No. 1587435 the arrangement of main bearing II in the crankcase has been improved as detailed below:

1 - The web for main bearing II has been modified by reducing the size of the recess underneath the bearing. This results in increased web strength and rigidity.

2 - To compensate for thrust, a 25 mm deep recess has been provided between the set screw of main bearing II and the top parting line.

Breaking-in (Running-in) and Inspection

The service life and efficiency of an engine greatly depends on the way it is treated during the first hours of operation. Great importance should, therefore, be attached to the breaking-in of new or reconditioned engines. The breaking-in is to give all moving parts the final and finest surface treatment. The slightest uneveness in the surface of bearings, cylinders, pistons, etc., will be removed and the parts being exposed to a direct friction prepared to the requirements of an evenly spread oil film, which is a decisive factor for good and lasting engine operation.

The fundamental rules for breaking-in an engine are the following:

1 - Let the engine break-in by its own power.

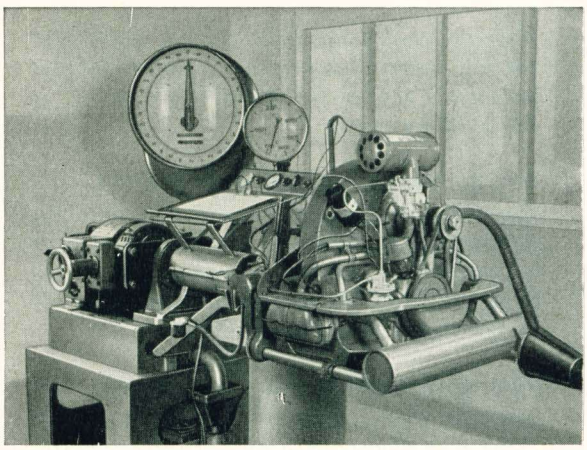
2 - Let the engine warm up gradually.

3 - Let the engine pick up speed gradually.

4 - Let the engine run at higher speed only as long as is necessary to check it for oil leaks, oil pressure, proper functioning of air cooling system, and performance.

5 - Let the engine break-in with thin-bodied motor oil of the specification SAE 10 W, 20, or 20 W.

The best means of breaking-in is a test bench provided with a water-brake.



Air brakes are generally cheaper, but the noise caused by the fans in the test room is disadvantageous, especially when trying to locate engine noises. Moreover, air type brakes often do not provide for a checking of the engine torque. On the brake, the engine load can be adjusted within an extensive range, thus meeting the requirements of the breaking-in as well as of performance and fuel consumption tests.

Major Overhauled Engines

Major overhauled engines have, beside some other renewals, new pistons, cylinders and bearings.

Pre-Inspection

a - Adjust valve clearance.

b - Adjust contact points and set ignition.

c - Check fan belt tension.

d - Fill in at least 1 1/2 liter (1 1/2 quart) motor oil of the specification SAE 10 W, 20, or 20 W. Colloidal graphite is not recommended for use during the initial breaking-in period, as it unnecessarily lengthens the breaking-in process. After 1500 km (900 miles) of engine service, colloidal graphite has certain advantages as an additive to regular engine oil. Additive type oils should not be added with graphite.

e - Check compression.
After warming up the engine, remove all spark plugs. Insert an accredited compression gauge in a spark plug hole and with the throttle in a wide-open position, crank the engine several revolutions with the starting motor and record the reading, which should be between 6.0 and 7.5 atm. (85 lbs./sq. in. — 106 lbs./sq. in.).

Starting the Engine

Prior to starting, crank the engine several revolutions by hand. If the engine has been standing for a longer period, it is good practice to inject a few drops of oil through the spark plug holes before starting the engine or through the air intake opening of the carburetor while starting the engine.

After the engine has been started, the green oil pressure warning light must go out when the engine picks up speed. The oil circulation has otherwise not attained the correct running pressure to insure an adequate lubrication of the bearings and moving parts.

The red generator warning light must go out no later than at fast idle speed.

Breaking-in on Test Bench

The breaking-in time of the engine on the test bench may generally be limited to 30 minutes. The engine should run:

Load:

10 minutes at 1500 r. p. m. 2 kg (4.4 lbs.),
20 minutes at 2000 r. p. m. 4 kg (8.8 lbs.).

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Inspecting Engine on Test Bench

a - Fuel System

After the engine has been started, make sure the fuel pump, fuel lines, and carburetor are leak-proof and test fuel pump pressure.
Adjust idling speed.

b - Fuel Consumption Test at Part-Load

Check fuel consumption towards the end of the half hour of breaking-in. With 8 HP part-load (= 4 kg/8.8 lbs. at the brake) and at 2000 r. p. m., 50 cu. cm. (3 cu. ins.) fuel should be consumed by the engine in 44—48 seconds.

c - Fuel Consumption and Performance Test

After the engine has been running on the test bench for half an hour, it must be made subject to full load for only 30 seconds at 3000 r. p. m. As soon as this speed has been attained, check fuel consumption. 50 cu. cm. (3 cu. ins.) fuel should be consumed in 19—20.5 seconds corresponding to 25—27 miles/U. S. or 30—32 miles/Imp. gal.

Let the engine slow down no later than after 30 seconds of running at full load, as otherwise the pistons will seize up. Under full load, the performance should not be below 21 HP at 3000 r. p. m. (= 7 kg/15.43 lbs. at the brake).

d - Generator, Voltage Regulator, Fan

Check generator and voltage regulator for correct function. The fan must not whine at 3000 r. p. m. and must not foul the housing.

An engine is actually broken-in only after 12—15 hours by slowly increasing the load and the speed and can then be made subject to three quarters of the full load for a longer time. After a breaking-in period of 30 hours, the engine may run at full load.

Final Inspection

a - Checking for Oil Leaks

After the full load and fuel consumption test, the engine should be checked for oil leaks. Special attention should be paid to valve push rod tubes, oil pump, oil radiator, and crankcase jointing faces.

b - Oil Change

Drain the engine oil, clean oil strainer and fill in 2 1/2 litres (2 1/2 quarts) of motor oil (breaking-in oil or Motor Oil VW—A 001).

c - Re-Check

Prior to installation in the car, inspect the engine for correct adjustment of ignition, valve clearance, and fan belt tension. The air cleaner must be clean.

d - Storage of Engines

Engines, which will be left standing for a longer time, must be specially treated to prevent damage due to corrosion. Remaining traces of fuel and combustion gas will become chemically aggressive to cylinder walls, valve guides, etc. To prevent damages of this kind, it is recommended to inject corrosion-fighting oil through the air intake opening of the carburetor or the spark plug holes during the last revolutions of the engine before the standstill.

Partly Reconditioned Engines

If an engine has only been partly reconditioned, e. g., valves renewed and ground-in, the full load test must be carried out not earlier than after 30 minutes of breaking-in time on the engine test bench.

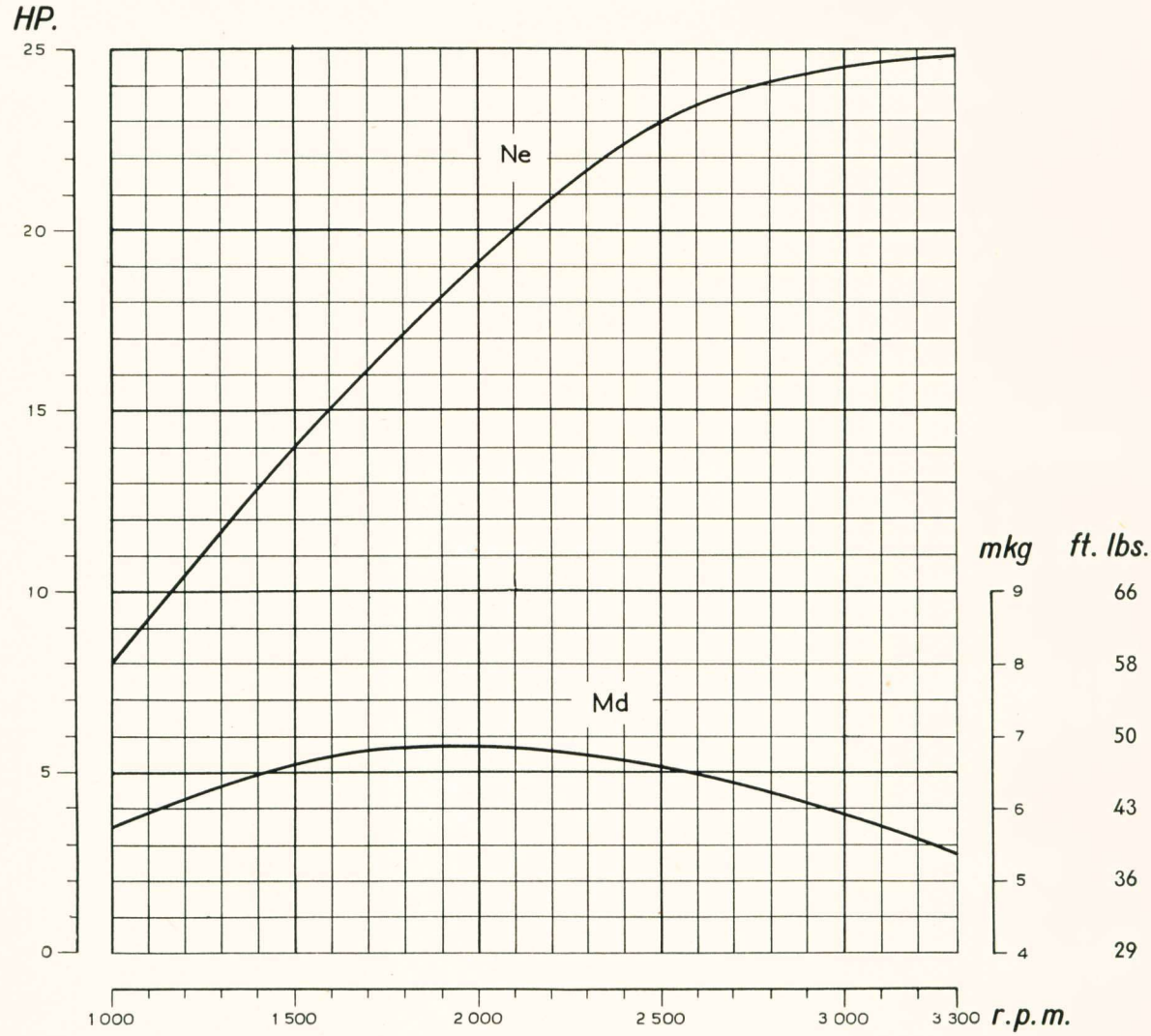
The max. performance must also not be tried before several hours of breaking-in at moderate speed and part-load.

With partly reconditioned engines — especially if crankshaft, bearings, cylinders, and pistons have not been renewed — it is not absolutely necessary to change the oil after the breaking-in on the test bench.

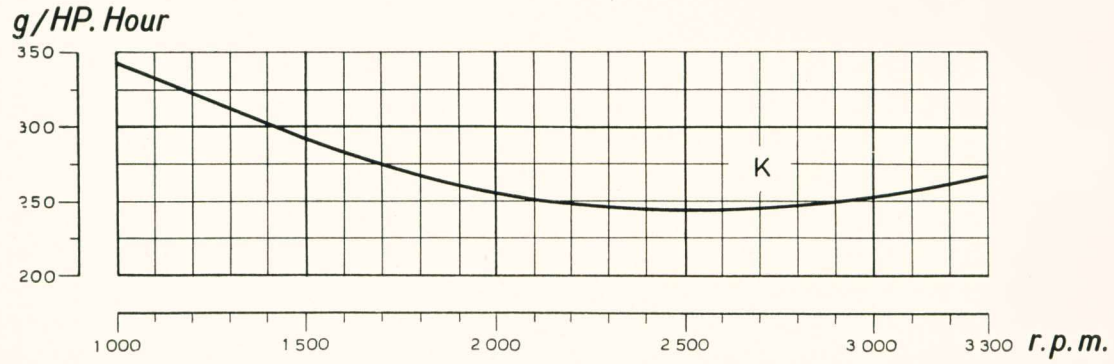
The following points also apply to partly reconditioned engines:

1 - Pre-inspection.
2 - Checking of fuel system.
3 - Fuel consumption test at part-load.
4 - Fuel consumption and performance test at full load. Only the fuel consumption figures also apply to partly reconditioned engines. The performance will, according to the engine condition, be higher.
5 - Checking for oil leaks.
6 - Final inspection.

Power Curves



Ne = Performance (HP.) Md = Torque (mkg)



Fuel = Consumption (g/HP. = grams per hr. and per HP.)

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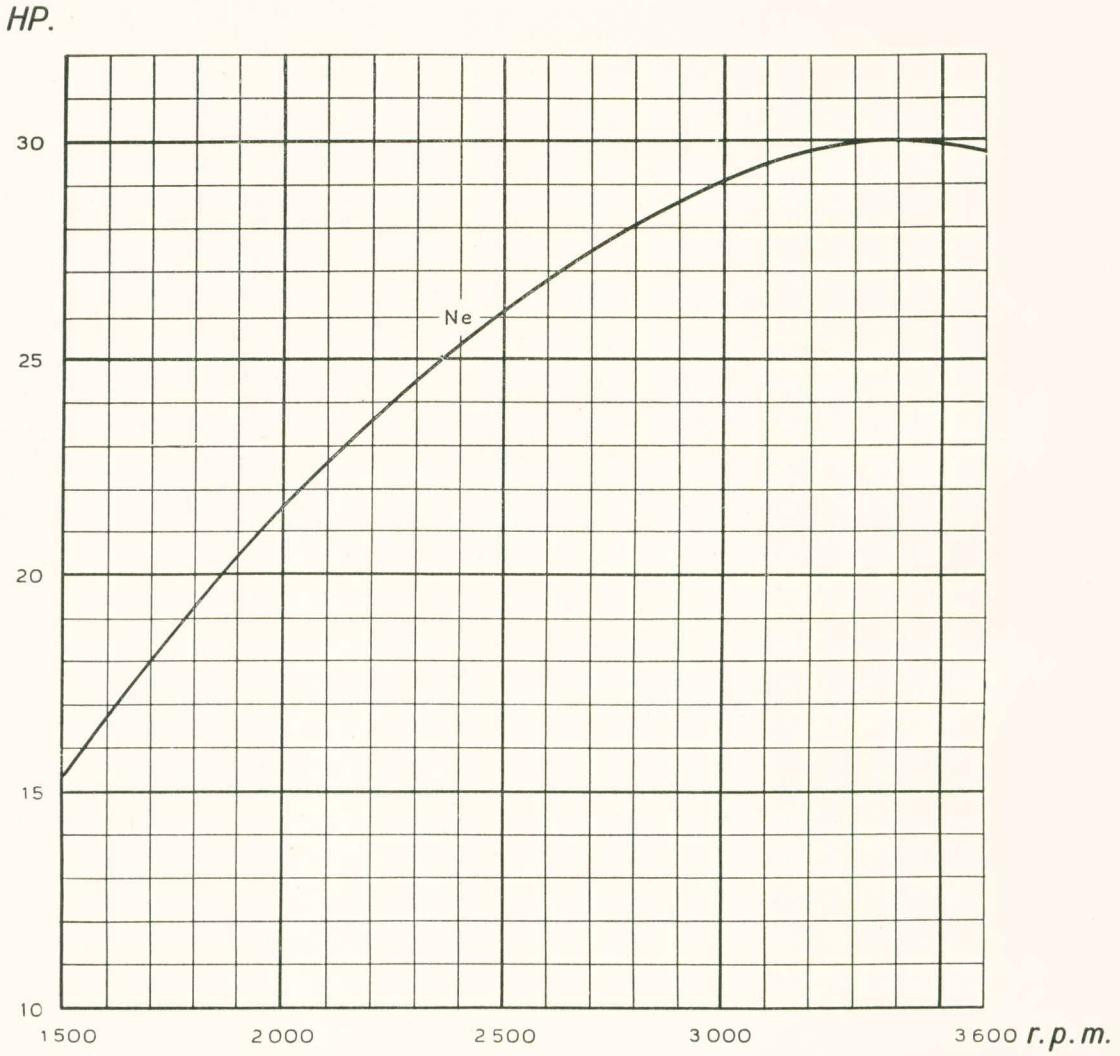
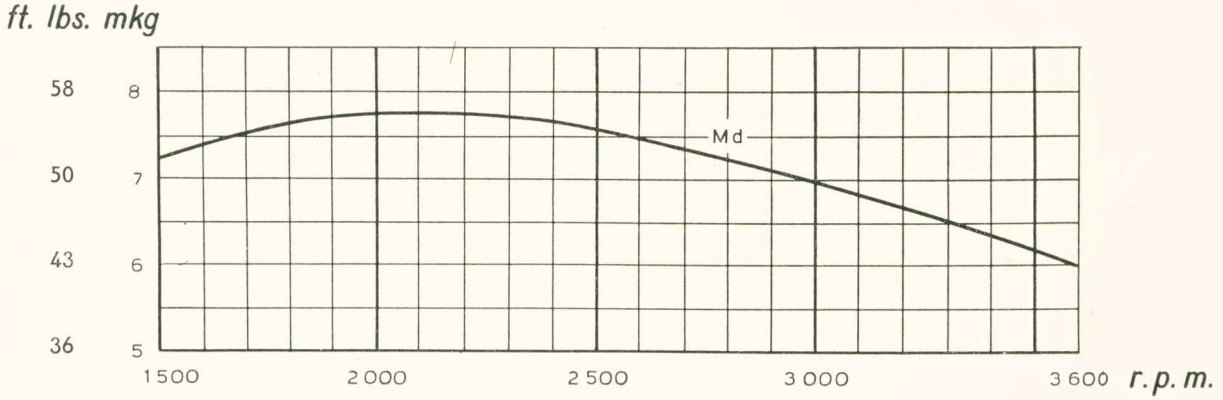
Power Curves



Ne = Performance (HP.)



Md = Torque

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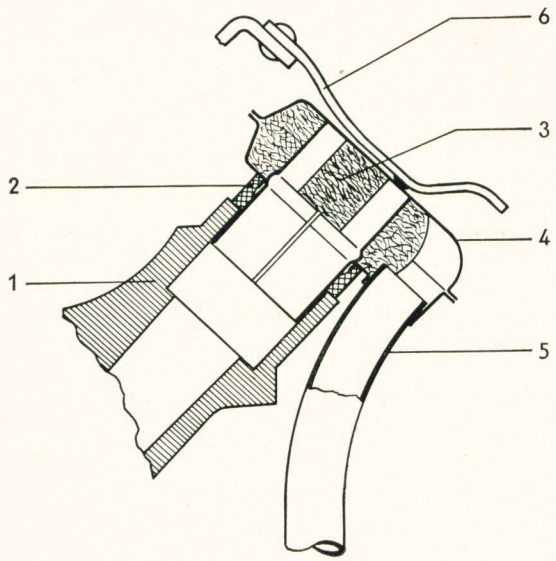
Crankcase Breathing

The breather at the oil filler tube is to allow oil fumes to escape from the crankcase. Up to Chassis No. 1—0678201, the filler cap was provided with a filter element. Filler caps, both with and without filter elements, should be cleaned in benzine at intervals depending on the operating conditions of the cars and each time the engine comes in for an overhaul.

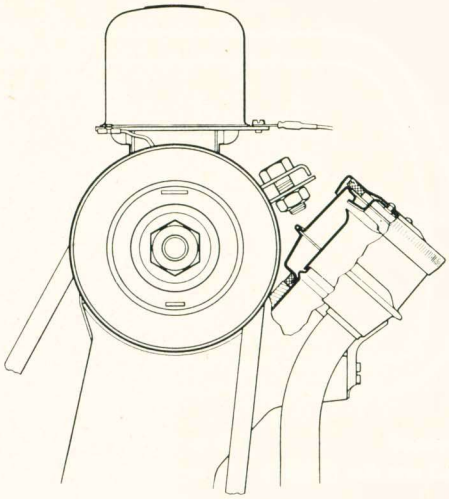
Note:

From Chassis No. 1—0931501 the new breather tube is screwed to the crankcase. To fill the engine with oil, only the filler cap is removed instead of the whole breather tube as before.

A rubber grommet between breather tube and engine rear cover plate avoids ingress of dust and frictional noise. The cover plate flange has been altered to facilitate the installation of the plate.



1 - Oil filler tube
2 - Rubber seal
3 - Filter element
4 - Oil filler cap
5 - Breather pipe
6 - Hold-down spring



Note:

The breather hole at the valve chamber of the cylinder heads and the corresponding filter element were omitted with effect from Chassis No. 1—0678201.

Breathers that are clogged up by dust or corrosion lead to excess pressure in the crankcase, resulting in loss of oil at the fan pulley. If a thorough cleaning of a filler cap with filter element does not stop the oil leak, the filter element should be removed from the cap and discarded.

If the oil continues to be forced out at the fan pulley, although the breathing passage is free, the below specified breather can be made locally and fitted to the cylinder head cover. The cover, complete with breather, is also obtainable as a spare part.

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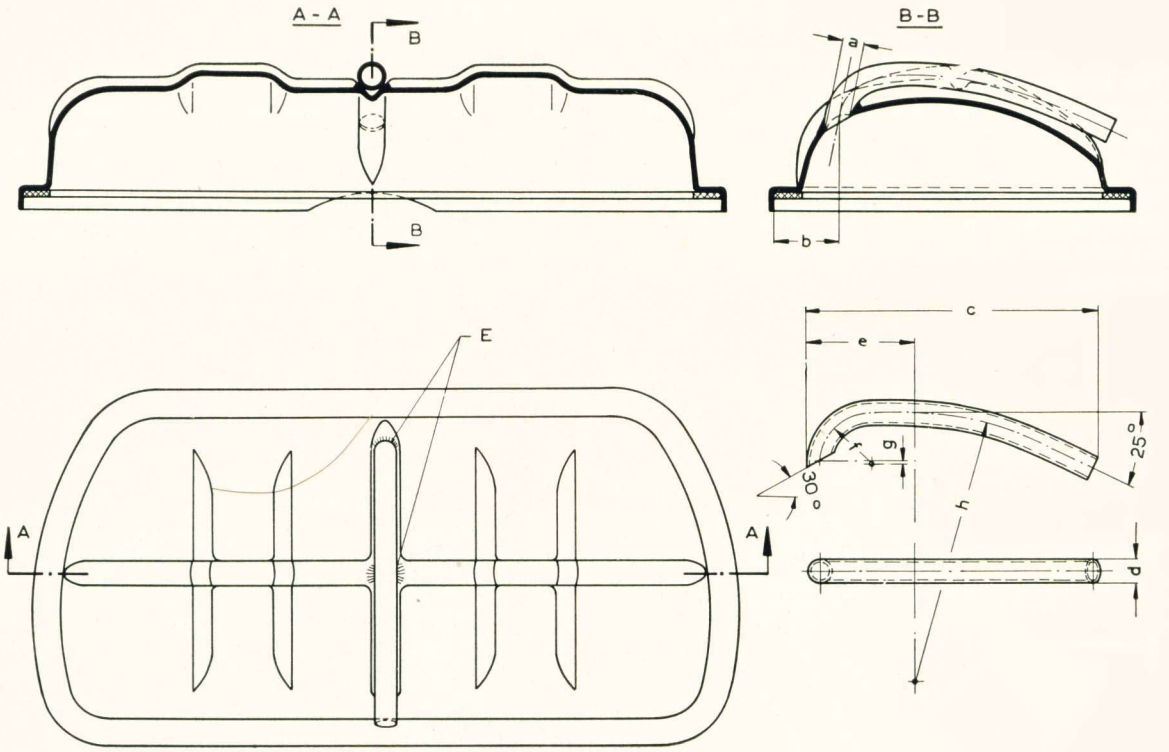

E = brazed
a = 8.5 mm dia. (0.335″)
b = 20.0 mm (0.787″)
c = 94.0 mm (3.7008″)
d = 8.0 x 1.0 mm (0.315 x 0.04″)
e = 34.0 mm (1.339″)
f = 16 r
g = 1.0 mm (0.04″)
h = 87 r

Interchangeability of Engine Parts

The parts of the 1192 c. c. engine listed below cannot be used on 1131 c. c. engines:

Description	Part No.
Crankcase	101 021 a
Cylinder head	101 315 d
Cylinder head stud — AM 10 x 216	101 133 b
Cylinder head stud — AM 10 x 195	101 135 b
Cylinder 77 mm dia., standard	101 301 c
Piston 77 mm dia., standard	105 451 d
Compression ring, upper, 77 mm dia.	105 461 b
Compression ring, lower, 77 mm dia.	105 471 b
Oil ring 77 mm dia.	105 481 b
Intake valve 30 mm dia.	109 601 a

Description	Part No.
Gasket between crankcase and cylinder	101 309 b
Gasket between cylinder and cylinder head	101 311 a
Flywheel gland nut	105 205 a
Crankshaft pulley	105 151 b
Crankshaft pulley, complete	903 109 a
Fan belt	903 137 b
Carburetor 28 PCI	129 021 d
Intake manifold	129 501 d
Gasket for intake manifold	N 13 821
Ignition distributor VJU 4 BR 3 mk	11 919 021

Intake Manifold with Special Jacket to Intensify Pre-Heating

The above induction manifold intensifies the pre-heating of both engine sides by the pre-heating tube running parallel with the induction manifold and by an aluminium jacket embracing both tubes. It provides a better fuel/air mixture at extremely low temperatures and permits a more economical fuel consumption.

This type induction manifold may be installed, if an excessive fuel consumption should occur on account of special operating conditions (e. g., if exclusively using the car in dense city traffic or over short distances) at low outside temperatures.

At the beginning of the warmer season the throttle should be placed under the lefthand flange of the pre-heating tube, as the engine will otherwise tend to pink.

With engines having a connecting pipe (up to Chassis No. 1—338058) between the lefthand rear exhaust pipe and the low pressure chamber of the silencer, the throttle should be placed under the righthand flange of the pre-heating tube.

The above induction manifold for intensified pre-heating can be obtained on request from the Spare Parts Department under the number 111129703. The flange throttle can be obtained under the number 111129715.

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Description of Clutch

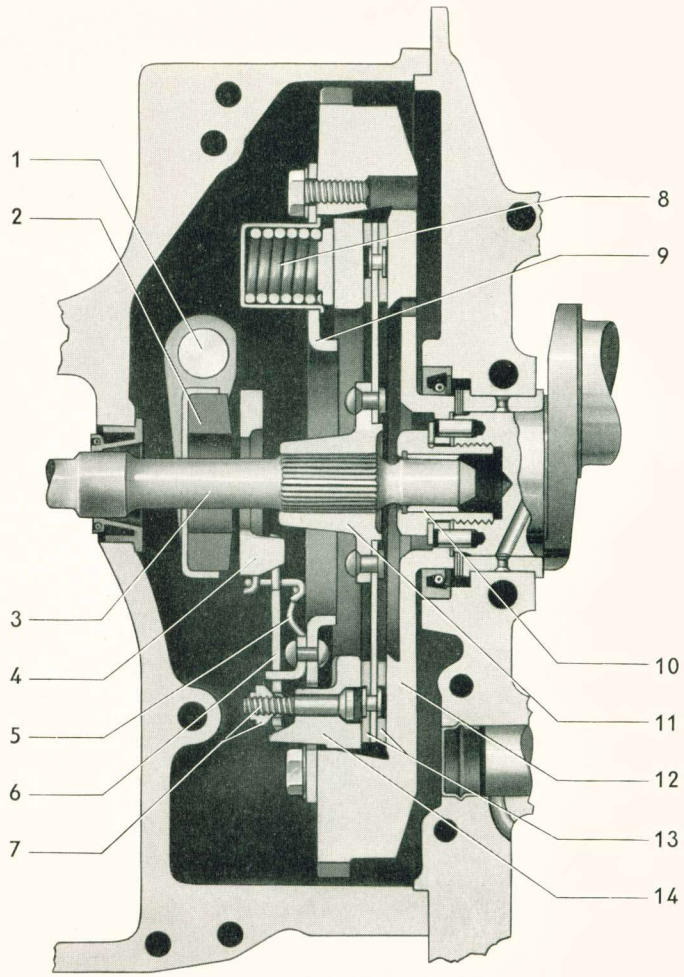
General Description

The single-plate, dry disc type clutch between engine and transmission is fitted to the flywheel. The driven plate (disc) to which the friction linings are riveted is splined to the main drive shaft. The clutch cover, which carries pressure plate, thrust springs, release levers and release plate, is bolted centrically to the flywheel. When engaged, the driven plate is forced against the flywheel by the spring-loaded clutch pressure plate. Thus the engine power is transmitted to the transmission.

Clutch operating shaft and clutch release bearing are located in the transmission case. The release bearing carries a carbon thrust ring and requires no service or maintenance attention.

Sectional View

1 - Operating shaft
2 - Carbon thrust ring
3 - Main drive shaft
4 - Release plate
5 - Release lever spring
6 - Release lever
7 - Bolt and special nut
8 - Thrust spring
9 - Cover
10 - Pilot bush
11 - Driven plate (disc)
12 - Flywheel
13 - Lining (facing)
14 - Pressure plate



Operation

Release is accomplished by depressing the clutch pedal. The pedal movement is transmitted through the clutch pedal shaft and a cable in the frame tunnel to the release mechanism. As pressure is applied to the pedal, the release levers are moved inward by the release bearing and the pressure plate is moved away from the driven plate, disengaging the clutch.

Adjustment

A readjustment of the clutch pedal free play (10—20 mm/0.4″—0.8″) is called for from time to time as the clutch lining wears away. An adjustment of the clutch itself is only necessary when the clutch is disassembled for replacement of parts. This adjustment is carried out at the flywheel or by means of the Clutch Adjustment Gauge VW 254.

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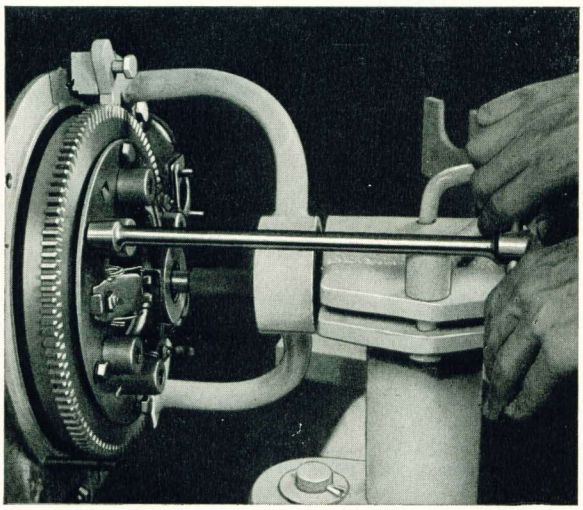
Removal

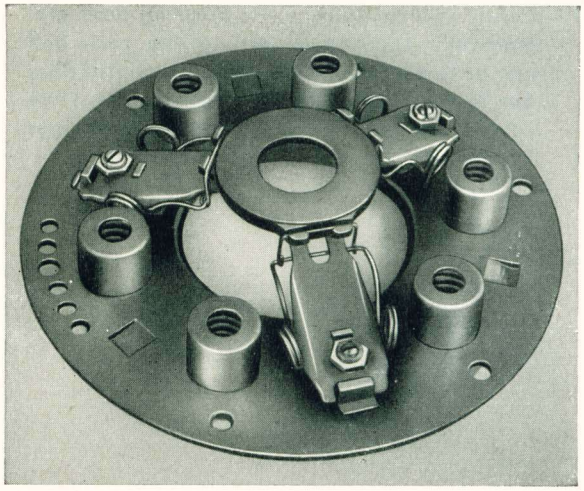
1 - Remove engine.

2 - Evenly release clutch cover securing bolts diametrically opposite in turn, giving each bolt one or two turns at a time to prevent distortion due to the reaction of the thrust springs.



3 - Take off clutch cover.

4 - Withdraw clutch driven plate.



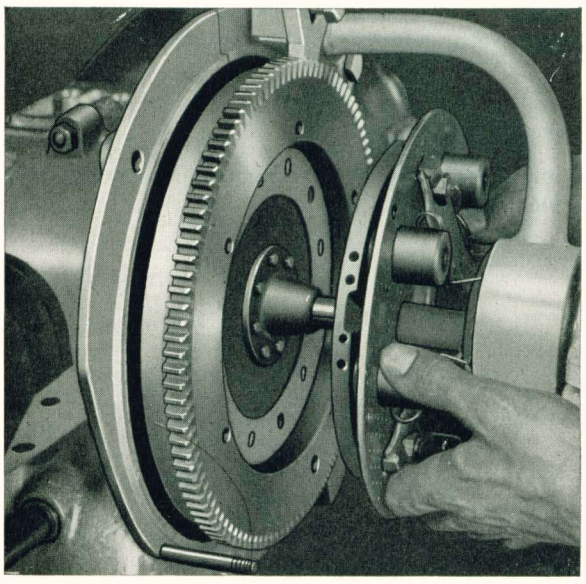
5 - Inspect release plate for wear and damage, renew if necessary. Check parallelism and distance between release plate and clutch cover bearing surface on flywheel. Readjust release plate as necessary. Renew damaged or coloured release plate caused by undue heat.

6 - Check carbon thrust ring for wear and cracks. Renew complete release bearing should it be found necessary. Note correct position of retaining clips.

7 - Inspect bearing points of clutch operating shaft in transmission case for wear.

8 - Fill pilot bush in flywheel gland nut with about 10 gr. Universal Grease VW—A 052.

9 - Reinstall clutch driven plate, using Pilot Mandrel VW 219 to ensure a correct centering.



Installation

Replacement is a reversal of the above, but it is essential to observe the following points:

1 - Clean clutch contact surface in flywheel and inspect it for wear. Regrind as necessary (max. 0.2 mm/0.008″) and polish, using fine emergy cloth. Replace flywheel if necessary.

2 - Inspect clutch driven plate for wear of linings (facings), run-out, and correct setting of cushion segments. Should it be necessary, renew linings or complete clutch driven plate.

3 - Inspect clutch pressure plate for wear and distortion. An uneven contact surface of the pressure plate causes the clutch to chatter an grab. Regrind contact surface or renew pressure plate as necessary.

4 - Examine release levers and springs and renew them if found necessary.

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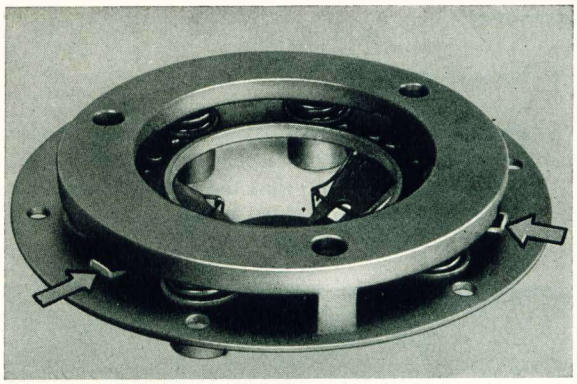
10 - Evenly tighten clutch cover securing bolts diametrically opposite in turn, giving each bolt one or two turns at a time to prevent distortion due to the reaction of the thrust springs. Note proper position of clutch cover locating lugs in flywheel.



Clutch

From Chassis No.:	(about) 1657072
Previously from Chassis No. 1	1378864—1383864
	and 1408860—1413860

As from the date specified above, a modified version of the clutch used up to now is being fitted in VW Passenger Cars.

The cross section of the clutch thrust spring has been reduced. The clutch linings are made of "Textar 50 S" or "Beral 1533/9 M".

The "Textar 50 S" lining is interspersed by a thin, continuous brass wire and is also marked by a square stamp. The brass wire of the "Beral 1533/9 M" lining is visibly arranged in a honeycomb pattern.

The thrust spring sleeves have a square hole for identification of these clutches.

The purpose of this modification is to reduce the foot pressure required at the clutch pedal.

Clutch plates of the former design may be exchanged for plates of the new type. In the opposite case, it will be absolutely necessary to replace the new clutch thrust springs and sleeves by those of the older type.

Attention

In the event of repairs, 6 springs of the new type or 6 springs of the old type have to be fitted. Never replace springs individually.

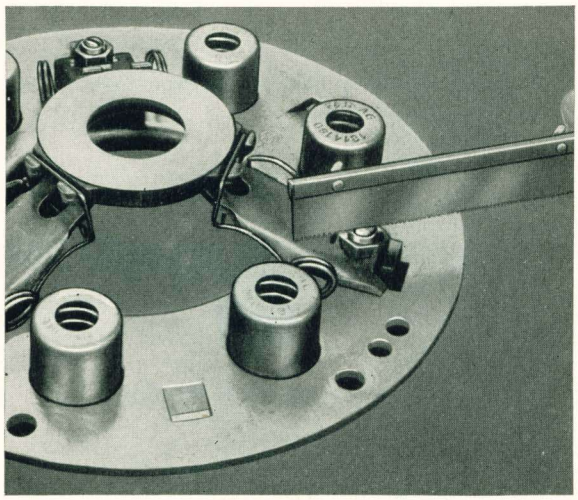
Clutch Disassembly

Disassembly

1 - Remove clutch.

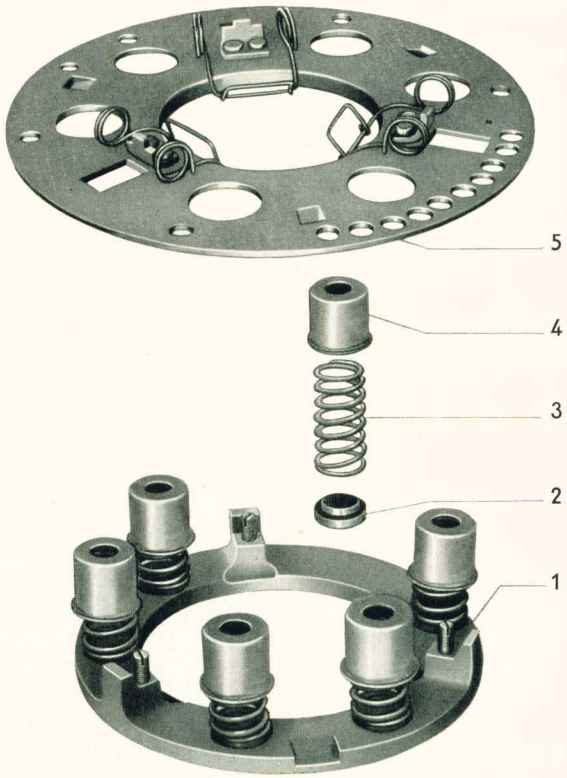
2 - Install clutch cover and pressure plate in Clutch Adjustment Gauge VW 254 (with gauge ring) or in flywheel (with clutch driven plate) and tighten by means of the six clutch cover securing bolts. Evenly tighten the bolts diametrically opposite in turn, giving each bolt one or two turns at a time to prevent distortion. Mark all parts in some way so that they may be reassembled in the same position, should new parts be unnecessary, as the clutch must otherwise be rebalanced.

3 - Undo the special nuts securing the release levers, using a saw to remove the metal peened over. Lift off release levers together with the springs and the release plate.



4 - Evenly release clutch cover securing bolts and take off clutch cover. Remove thrust springs, spring seats, and pressure plate.

Carefully inspect all clutch components before reassembly.



Arrangement of thrust springs

1 - Pressure plate
2 - Spring seat
3 - Thrust spring
4 - Spring cap
5 - Clutch cover

Clutch Cover and Pressure Plate

Inspection

1 - Check clutch cover for distortion and straighten it as necessary. Distortion of the cover is mostly a result of an uneven tightening or releasing of the bolts.

2 - Thoroughly clean pressure plate and inspect it for distortion, wear, and cracks. The contact surface of the pressure plate must bear evenly all the way round to avoid clutch chattering. Should the run-out be in excess of 0.1 mm (0.004″), the pressure plate may be reground and polished. The pressure plate must otherwise be replaced.

3 - Examine thrust springs.

Free Length:	51.7 mm/2.03″
Loaded Height:	29.4 mm/1.16″
Load:	57.5 ± 2.5 kg
Permissible Loss of Load down to:	49 kg

4 - Inspect release plate for wear and damage. Renew damaged or, due to undue heat development, coloured release plate.

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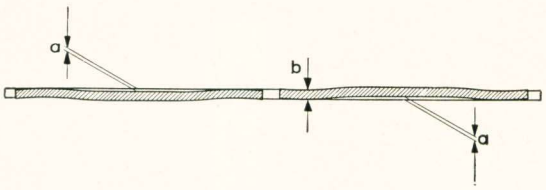
Clutch Driven Plate

Inspection

1 - The clutch driven plate has twelve cushion segments. The cushion segments are set alternatively concave and convex. It is essential to a perfect operation of the clutch that the segments are equally set.



a = 0.4—0.6 mm (0.016″—0.024″)
b = 1.2 mm (0.047″)

The hub of the plate must slide freely on the splined main drive shaft without undue radial clearance. Worn parts are to be renewed.

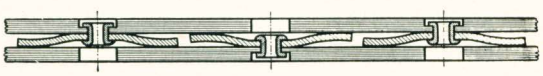
2 - Inspect clutch linings. Renew linings if they are oily, burnt, cracked, or nearly worn down to the rivets.

Important. — Only accredited clutch lining (facing) must be used. This is especially important for cars equipped with synchromesh type transmission.

Clutch Linings (Facings)

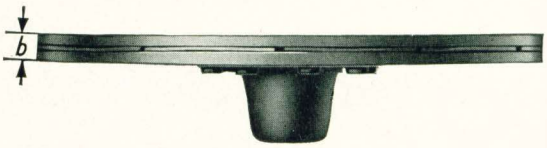
Outer Diameter	179.0—181.0 mm/7.04—7.12″
Inner Diameter	124.0—125.0 mm/4.88—4.92″
Thickness	3.4— 3.6 mm/0.13—0.14″

When riveting clutch linings to the cushion segments, it should be noted that every second hole is countersunk. The clutch linings on either side of the plate are individually riveted to the segments, that is, each of the two linings is attached to the plate with a separate set of rivets.



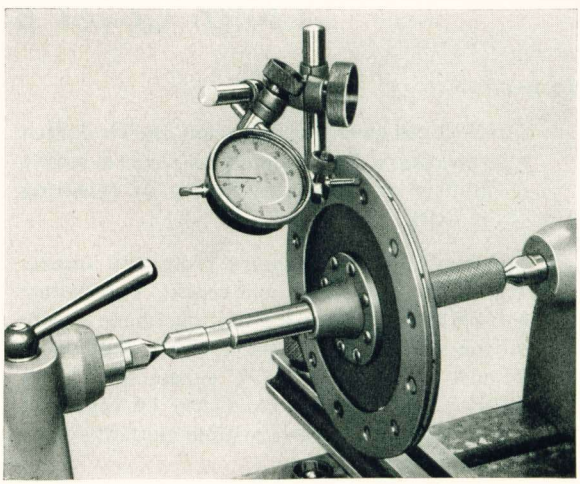
The linings are fastened to the convex side of the cushion segments.

3 - Check distance between friction faces of the clutch driven plate.



b = 8.6 to 9.2 mm (0.34″ to 0.36″)

4 - Check clutch driven plate for run-out with linings assembled. Permissible run-out: max. 0.5 mm (0.02″).

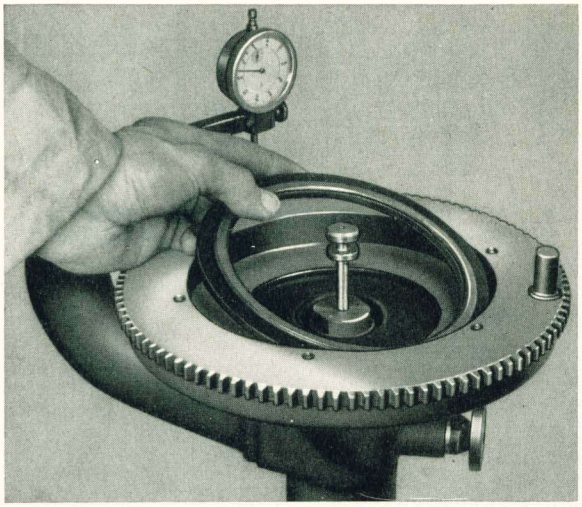


Assembling Clutch

Assembly

This is a reversal of the disassembly, but the following points should be noted.

1 - Place gauge ring in the Clutch Adjustment Gauge VW 254.

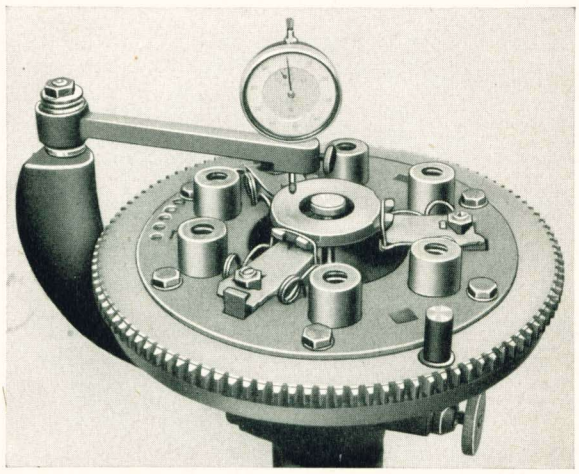


2 - Evenly tighten the clutch cover securing bolts diametrically opposite in turn, giving each bolt one or two turns at a time to prevent distortion

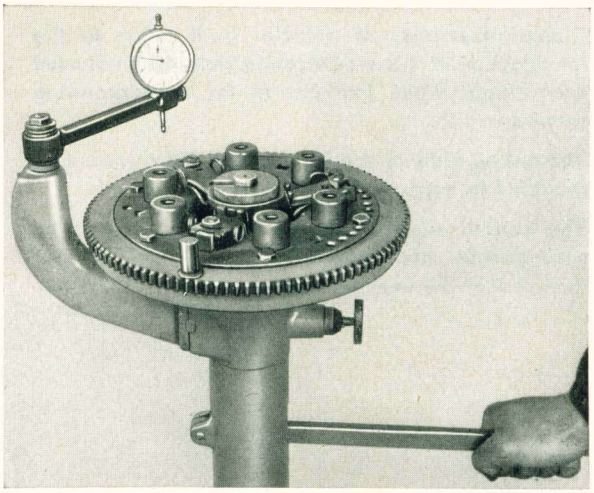
3 - Lightly grease the moving joints of the release levers, using Special Grease VW—A 051.

4 - Renew release lever special nuts and bolts if these have become unserviceable in disassembly.

5 - Adjust dial gauge to zero position on adjusting pin. Place tracer pin of dial gauge on release plate. Tighten special nuts at the release levers until the zero position on the gauge is restored.



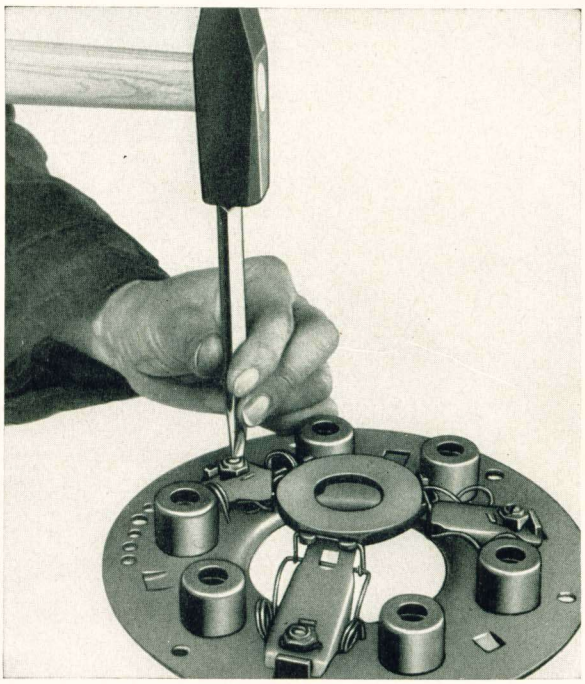
The distance between release plate and clutch cover bearing surface on flywheel amounts then to 26 mm (1.02″). Put the C-washer on release plate and load the clutch by pressing the lever several times downwards.



Recheck the distance of 26 mm (1.02″) from release plate to clutch cover bearing surface on flywheel. The parallelism of the release plate can then be checked by rotating the flywheel. Permissible run-out of release plate max. 0.3 mm (0.012″).

6 - The height and parallelism of clutch release plate may also be checked by means of a straight edge and a depth gauge.

7 - Secure special nuts using a peening tool.



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From Chassis No. 1 631 980 the distance between the clutch cover contact face at the flywheel and the clutch release plate is

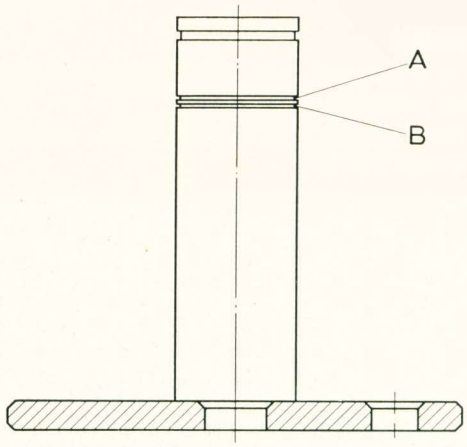
now: 27 mm
(formerly: 26 mm)

This modification provides increased safety against incomplete clutch release.

Clutch assemblies of vehicles built prior to the introduction of this modification should be adjusted accordingly when brought in for corresponding repairs.

The testing plate of special tool VW 254 a should be modified in accordance with the drawing.

The bottom edge of groove (B) which has to be subsequently provided, should be 1 mm deeper than that of the existing groove (A).



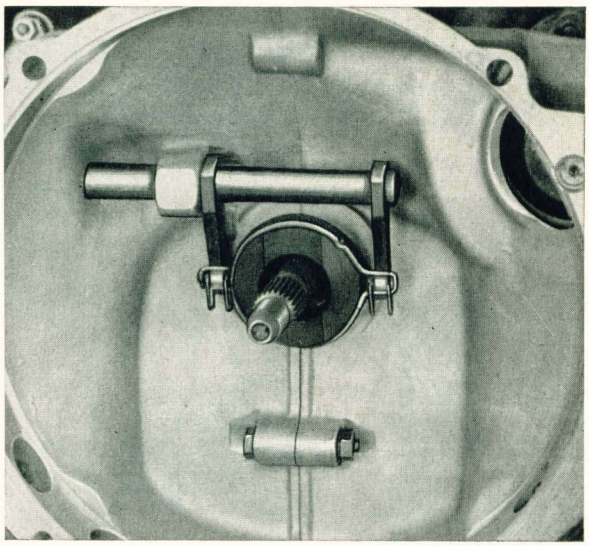
Removing and Installing Clutch Release Bearing

Removal

1 - Remove engine.

2 - Remove clutch release bearing retaining springs.

3 - Withdraw release bearing.



Installation

This is a reversal of the preceding operations, but attention should be paid to the following points:

1 - Inspect carbon thrust ring of release bearing for wear and cracks. Renew release bearing should the carbon thrust ring be damaged. The ring must not be replaced separately as it will definitely suffer damage when pressing it in position.

2 - Note correct position of retaining springs.

3 - Readjust clutch pedal free play after engine has been installed.

Removing and Installing Clutch Operating Shaft

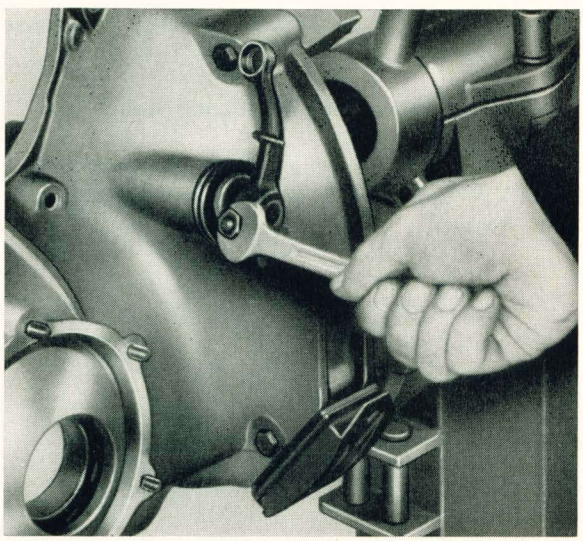
Removal

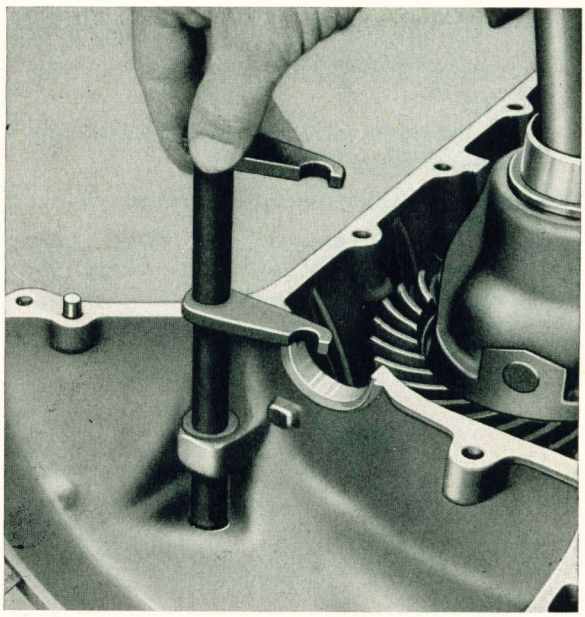
1 - Remove engine and transmission.

2 - Disassemble transmission case.

3 - Unscrew nut at clutch operating lever and withdraw lever together with return spring and spring seat.

4 - Pull out operating shaft.





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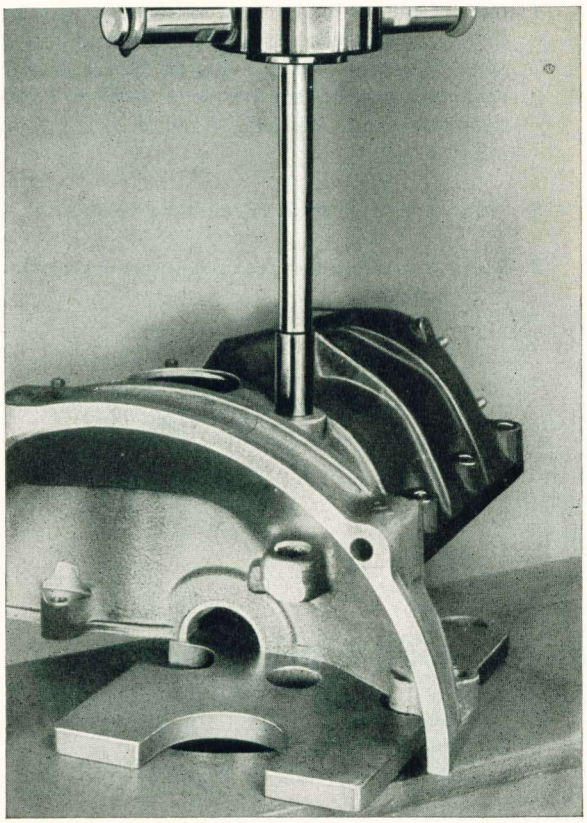
Installation

Installing clutch operating shaft is a reversal of the removal procedure, but the following hints should be noted:

1 - Inspect operating shaft and bushes in transmission case for wear. Renew if necessary.



2 - Apply Special Grease VW A—051 when installing operating shaft.

3 - Check return spring and renew it when found to be weak.

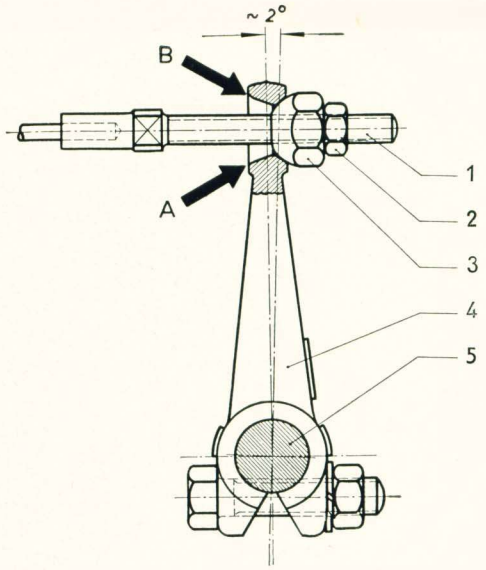
4 - With the clutch correctly adjusted, check position of operating lever.

The position of the operating lever is correct, if:

a - **with clutch engaged,** the clutch cable threaded end piece only lightly touches the lower edge (A) of the bevelled hole in the lever;

b - **with carbon thrust ring just touching release plate,** the inclination of the lever towards the front is not in excess of 2°;

c - **with clutch fully released,** the upper edge (B) of the bevelled hole is not forced against the threaded end piece.



1 - Clutch cable threaded end piece
2 - Lock nut
3 - Adjusting nut
4 - Operating lever
5 - Operating shaft

A wrong position of the lever due to the clutch being mal-adjusted, an excessively worn carbon thrust ring, or a restricted movement of the adjusting nut in its concave seating are liable to cause a buckling at the threated end piece and may eventually lead to breakage of the cable.

The following hints should be noted to prevent breakage:

a - Renew release bearing if badly worn.

b - Grease the adjusting nut with Universal Grease VW A—052 when carrying out inspections or repairs.

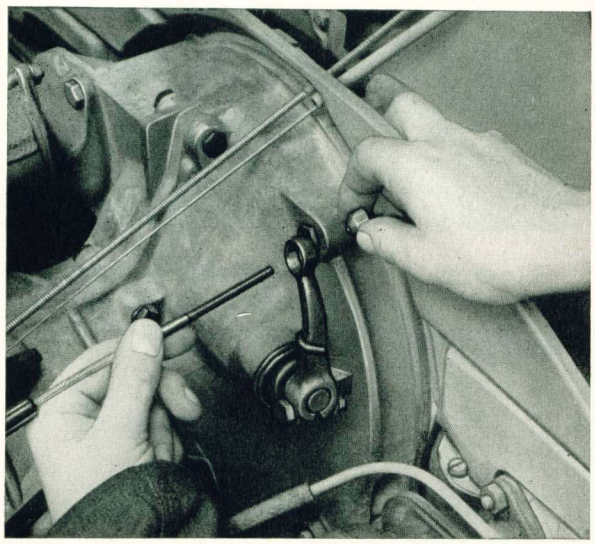
Clutch Cable Removal and Installation

M

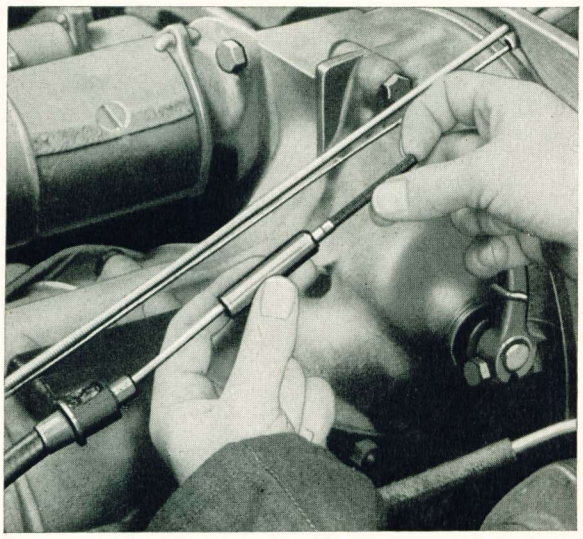
Removal

1 - Raise rear end of car and remove left-hand rear wheel.

2 - Disconnect clutch cable from clutch operating lever on transmission case.



3 - Withdraw rubber boot from conduit tube and pull out clutch cable from rubber boot.



4 - With the mechanical brake, withdraw the brake push bar 5—10 cm (2″—4″) towards the front.

5 - With the hydraulic brake, disconnect the piston push rod of the brake master cylinder.

6 - Disconnect accelerator cable.

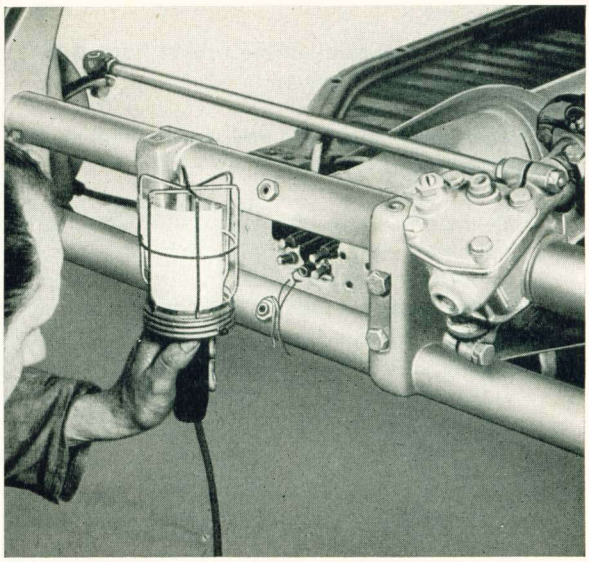
7 - Remove pedal linkage.

8 - Pull out clutch cable through the hole for the pedal linkage in the frame tunnel.

Installation

Installing the clutch cable is a reversal of the removal procedure, but the following points should be heeded:

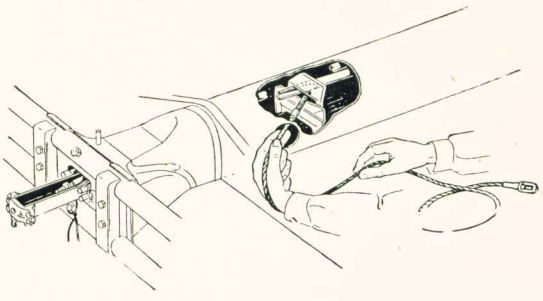
1 - Inserting the cable into the conduit tube can best be carried out with another mechanic guiding the operation from the frame head or through the front inspection holes with the body



in situ, using an inspection lamp. A pushed-in cable which missed the opening of the conduit tube is liable to become jammed in the tunnel, making a removal extremely difficult.

2 - Grease clutch cable with Universal Grease VW A—052.

3 - Insert clutch cable through the hole in the frame tunnel and see that the end of the cable goes into the slit of the conduit tube as shown below.



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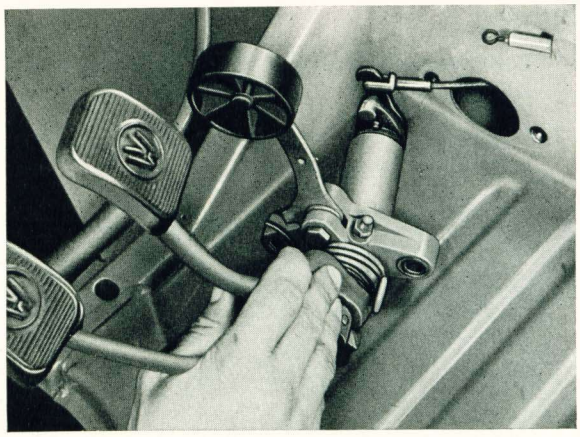
Lead the cable with the left hand, while pushing is forward with the right hand until the threaded cable end has fully entered the conduit tube. Then push the cable completely through the tunnel.

The clutch cable guide tube at the end of the frame tunnel should bend down 20 or 30 mm (.8'' or .12''). This tension of the guide tube is obtained by inserting washers between the bracket at the transmission and the end piece of the guide tube.

4 - Note correct position of the rubber boot at the end of the conduit tubes.

5 - Grease clutch cable eye and clutch pedal shaft with Universal Grease VW A — 052.

6 - With the cable eye attached to the hook, the clutch pedal must be held in a vertical position to prevent the cable becoming disconnected. It is also recommended in this connection that an assistant pulls a tension at the other end of the cable.



7 - See to it that the pedal stops are in correct position. With the hydraulic brake, the piston push rod must have a clearance of 1 mm (0.04'') in the piston.

8 - Grease clutch cable adjusting nut with Universal Grease VW A — 052.

9 - Adjust clutch pedal free play.

Adjustment of Clutch Pedal Free Play

M

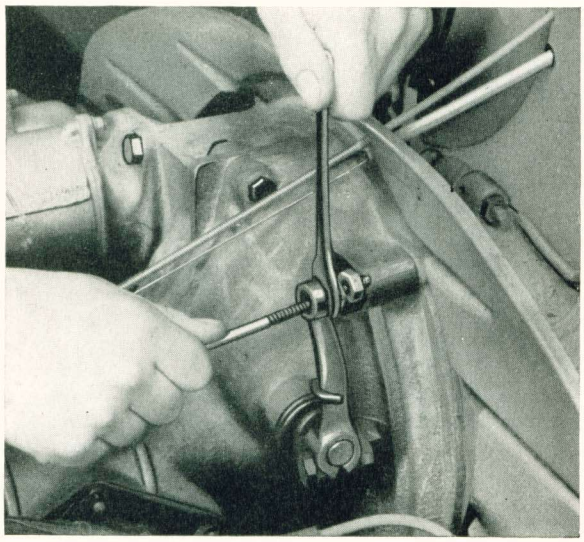
General

The clutch is to be adjusted so that there is a clearance of 1—2 mm (0.04″—0.08″) between the carbon thrust ring of the release bearing and the clutch release plate with the clutch engaged. Measured at the clutch pedal, this clearance amounts to a pedal free play of 10—20 mm (0.4″—0.8″). The clearance may be adjusted at the adjusting nut on the cable end.

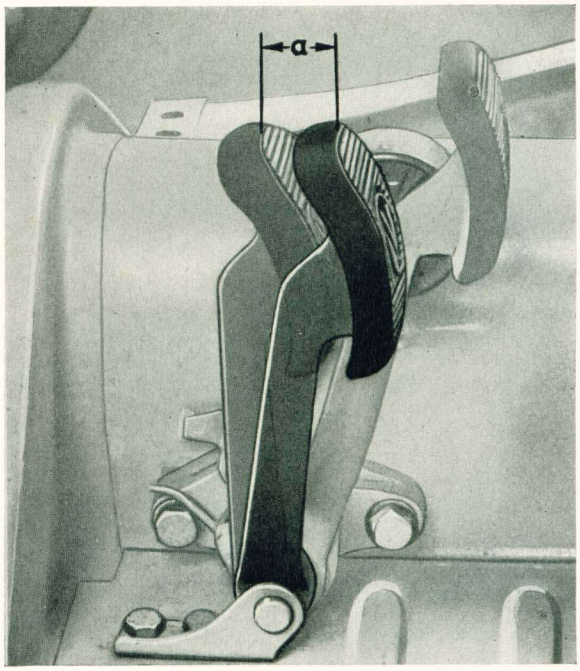
As the wear on the clutch lining increases, the clearance between the carbon thrust ring and the release plate is reduced until these two parts contact each other. This condition leads to excessive wear or damage. At the same time it reduces the clutch pressure which is liable to result in a slippage and burning of the lining.

Adjustment

1 - Release lock nut on the threaded cable end.



2 - Adjust clutch clearance by turning the adjusting nut on cable end until the clutch pedal free play amounts to 10—20 mm (0.4″—0.8″). Depress clutch pedal several times and recheck pedal free play.



a = 10—20 mm (0.4″—0.8″)

3 - When the correct adjustment has been reached, hold adjusting nut and tighten lock nut against it.

4 - Grease clutch cable adjusting nut with Universal Grease VW A—052.

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Clutch Trouble Checking

Symptom	Cause	Remedy
1. Noise	a - Pilot bush in flywheel gland nut worn	a - Renew bush and fill it with 10 gr. Universal Grease VW — A 052
	b - Carbon thrust ring excessively worn	b - Renew carbon thrust ring. See to it that release plate and clutch clearance are correctly adjusted. Tell driver not to use clutch pedal as a foot rest
	c - Driven plate fouling pressure plate	c - Renew or straighten driven plate
	d - Weak release lever springs or unequal tension	d - Renew springs
2. Chatter or Grabbing	a - Transmission case not tightly mounted	a - Tighten mounting bolts and nuts
	b - Bend of cable guide tube not correct	b - Correct the bend to 10 or 20 mm (.4'' or .8'')
	c - Grease or oil on driven plate, flywheel or pressure plate	c - Renew oil seal. Clean all parts and reline driven plate
	d - Uneven contact of pressure plate	d - Renew or regrind pressure plate
	e - Release plate not running true	e - Eliminate run-out. Max. permissible run-out: 0.3 mm (0.012'')
	f - Unequal tension of thrust springs	f - Renew thrust springs
3. Dragging or Incomplete Release	a - Excessive pedal free play	a - Adjust clutch clearance: 10—20 mm (0.4''—0.8'') at clutch pedal
	b - Distorted driven plate or bent main drive shaft	b - Straighten or renew driven plate or main drive shaft
	c - Cushion segments excessively set or plate linings broken	c - Reline or replace driven plate
4. Slippage	a - Lack of pedal free play due to wear of linings	a - Adjust clutch clearance: 10—20 mm (0.4''—0.8'') at clutch pedal
	b - Grease or oil on clutch linings	b - Replace clutch linings. Replace engine or transmission oil seal if necessary

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1 - VW Special Service Tools

VW 109	Box Wrench 10 mm
VW 112	Special Wrench 36 mm with Guide Plate
VW 122 b	Circlip Pliers
VW 123	Piston Ring Compressing Tool 75 mm dia.
VW 123 a	Piston Ring Compressing Tool 77 mm dia.
VW 124	Chisel (Peening)
VW 161 a	Circlip Pliers
VW 163 a	36 mm Socket
VW 165	Socket Wrench for Cylinder Head Nut
VW 201	Oil Pump Extractor
VW 202	Extractor
VW 202 a	Extractor Hooks
VW 202 f	Thrust Pad
VW 203 b	Fan Pulley Extractor
VW 204	Crankshaft Oil Seal Installing Tool
VW 205 a	Electric Piston Heating Tool (75—78 mm dia.)
VW 207	Piston Pin Pilot Drift
VW 207 a	Piston Pin Removing and Installing Tool
VW 212 a	Piston Pin Bearing (little end) Removing and Installing Tool
VW 214	Device for Checking, Straightening, and Reaming Connecting Rods
VW 218	Gland Nut Bush Pilot Drift
VW 219	Clutch Pilot
VW 231 a	Crankshaft Drill Jig
VW 231 b	Flywheel Drill Jig
VW 246	Not-Go Plug Gage
VW 252 d, e, f	Master Ring Gages
VW 253	Valve Guide Plug Gage
VW 254 a	Clutch Adjustment Dial Gage
VW 292	Crankshaft End Play Gage
VW 310	Fixture
VW 311	Valve Extractor
VW 311 b	Valve Grinding Kit
VW 311 c	Chuck
VW 400	Repair Press 15 t
VW 401	Thrust Plate
VW 427	Guide Tube
VW 428	Guide Tube (tapered)

2 - VW Workshop Equipment for Local Manufacture

(The earlier VW Numbers are given in brackets)

VW 600	(VW 304) Engine Trolley
VW 603/1	(VW 603 or VW 355/4) Vehicle Trolley
VW 604	(VW 351/1) Ramp
VW 605	(VW 301) Gantry
VW 633	(VW 672 a) Trestle
VW 650	(VW 358 a) Cylinder Retainer
VW 659	(VW 384) Dial Indicator Bracket
VW 660	(VW 385) Straightener for Sealing Sleeve
VW 661/1	(VW 661 and VW 353) Oil Cooler Test Applicance
VW 661/2	(VW 661 and VW 353) Oil Cooler Test Applicance
VW 666	Adjusting Lever for Air Intake Throttle Ring

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3 - Normal Hand Tools

Screwdriver, 6 mm
Combination pliers
Pipe wrench
Prick punch (center punch)
Pin punch, 2 mm
Mechanic's hammer, 300 grams
Mechanic's hammer, 500 grams
Rubber mallet, 85 x 50 mm
Aluminium mallet
VW Spark plug wrench
Triangular scraper
Flat scraper
Flat file, 180 mm in length
Socket wrench, 14 mm
Socket wrench, 17 mm
Socket wrench, 19 mm
Open-end wrench, 7 mm
Open-end wrench, 9 mm
Open-end wrench, 10 mm
Open-end wrench, 14 mm
Open-end wrench, 17 mm
Open-end wrench, 19 mm
Open-end wrench, 22 mm
Box wrench, 10 mm
Box wrench, 14 mm
Box wrench, 17 mm
Box wrench, 19 mm
Box wrench, 27 mm
Box wrench, 30 mm
Wire brush
Oil-can
Can for derusting fluid
Grease container
Scratch awl
Test lamp, 6 volts
Dial indicator
Set of feeler gages, 0.1—0.5 mm
Micrometer caliper, 0—25 mm
Micrometer caliper, 25—50 mm
Micrometer caliper, 50—75 mm
Caliper square, 300 mm in length, measuring 1/50 mm
Depth gage, 300 mm in length, measuring 1/50 mm
Straight edge, 1000 mm in length
Dial gage for checking 18—100 mm inside diameters measuring 1/1000 mm
Tap M 6
Tap M 8
Tap M 10
Tap M 10 x 1.0
Tap M 12 x 1.5
Tap M 14 x 1.25
Tap M 18 x 1.5
Die M 6
Die M 8
Die M 10
Die M 10 x 1.0
Die M 12 x 1.5
Die M 14 x 1.25

Die M 18 x 1.5
Die stock, size 1
Die stock, size 2
Tap wrench, size 1, adjustable
Tap wrench, size 2, adjustable
Drill 5.0 mm
Drill 6.7 mm
Drill 7.0 mm
Drill 8.0 mm
Drill 8.5 mm
Drill 9.0 mm
Drill 10.0 mm
Drill 10.5 mm
Drill 12.0 mm
Broach 7 H 7
Broach 7.008 H 7
Broach 7.023 H 7
Torque wrench
Inspection lamp with cable and plug
Electric drill
Oil funnel

4 - Supplementary Workshop Equipment

Crankcase refacing tool
Valve spring tester
Engine test stand
Valve grinding machine

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