

SERVICE SCANIA

PRODUCTS

grupp/group	Work description	
	nummer/number	sida/page
1 a	2	1
datum/date	74-02-28	best. nr/order nr
75-03-15		E6201a

TURBOCHARGER

General

In all work on turbochargers the utmost cleanliness must be observed. The connections to the oil's intake and exhaust must not under any circumstances be left unprotected. Any dirt or other foreign matter that gets into the bearing housing will soon cause serious damage.

The opening pressure of the valve must be adapted to suit the flow of oil. Therefore, it is necessary to use only an original Scania oil filter. The oil cleaners of similar type, which are intended for some car engines are consequently unsuitable since they have exceedingly low opening pressures.

Oil Leakage

The underpressure in the intake line will be too great if the air cleaner becomes clogged up. There is then risk that the oil mist will be sucked out from the bearing housing (See 1a FU 2).

On the other hand it is more seldom that oil leakage is caused by the sealing ring on the turbine side being worn. In which case the exhaust gases will be blue when the engine is idling.

The sealing ring on the turbine side is usually worn into its correct position during the running-in period. Even the ring groove can be slightly worn. It is possible for the ring groove to be slightly worn without the sealing qualities deteriorating.

When repairing the turbocharger the turbine shaft should not be refitted if the width of the ring groove exceeds that indicated.

If the oil exhaust pipe from the turbocharger is deformed there is obviously a risk that the oil will be forced out through the sealings.

Lubrication

The turbocharger's speed of rotation is high, 60.000–100.000 rev/min. Thus it is vitally important that the lubrication of the system functions effectively. The special lubricating oil cleaner for the turbocharger shall be changed at prescribed intervals and even the engine's centrifugal cleaner shall be cleaned in accordance with our instructions. If this is not done the turbocharger cleaner will become clogged up too quickly and the resistance in the cleaner will only increase. If this happens a valve in the cleaner will let the oil pass the cleaner without it being cleaned, as a consequence of which the turbocharger receives impure oil and the bearings will thereby become severely worn.

Foreign Particles

The impellers of the wheel are quickly ruined if foreign particles get into the turbine. There will be less engine power and if operation is continued there is risk of damage being caused by overheating on account of the supply of air decreasing. This type of overheating is not noticeable on the coolant thermometer.

Never attempt to straighten up a damaged impeller, as it is quite possible for it to break off in operation and cause damage to the engine.

Air and Exhaust Leaks

Very slight leakages in the line between the air cleaner and turbocharger also lead to deposits of dirt in the compressor wheel. The charging pressure, and also the engine power will diminish accordingly. Furthermore, there is risk that the engine will become overheated.

Exhaust leaks between cylinder head and turbocharger also result in low charging pressure and consequent risk of overheating.

Periodical Maintenance

Every 60,000 km (900 hours)

Check in respect of air, exhaust and oil leaks.

Check the charging pressure.

Every 180,000 km (2,700 hours)

Fitting of replacement unit or reconditioning of turbocharger.

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grupp	sekt	nr	sida
1a	AR	2	2

Checks

Charging Pressure

The check on the charging pressure should take place in conjunction with the periodical maintenance or when the engine power appears to be at fault. However, it should be noted that insufficient charging pressure does not necessarily mean that the turbocharger is defective; as it may have been due to among other things a clogged air cleaner or leakage on the intake exhaust lines, faulty throttle control, defective injectors, defective injection pump or smoke limiter.

To check the charging pressure use is made of tools 98111 and 98113.

Connect the nipple 98113 to the existing socket for measuring on the intake pipe between the turbocharger and the cylinder head. The hose can be drawn into the cab and connected to the pressure gauge 98111 with measuring range 0–2,0 bar (kp/cm²).

Drive the truck up a hill. Select a suitable gear so that the engine will slowly increase to max. speed with the accelerator fully depressed. Check the pressure gauge and note the max. value at the same time as the tachometer is being read. Repeat the measurements several times by applying the brakes slightly while the accelerator is fully depressed the whole time.

If the engine cannot cope increase to max. speed whereby it is possible to make a reading at a slightly slower speed.

The charging pressure measured must be adjusted taking into consideration the air temperature, see 1a SP 2.

Afterwards check the value according to a suitable diagram in 1a SP 2.

N. B. The setting of the injection pump must not be changed in addition to those values permissible in order to adjust the charging pressure.

Cleaning the Compressor Wheel

Low charging pressure may among other things be due to dirty compressor wheels. Remove the compressor cover. Wash the compressor wheel with white spirit and a brush. Fit on the compressor cover and measure the charging pressure afresh.

Radial and Axial Clearance

Measurement of radial and axial clearance does not always give accurate information about the remaining service life of the turbocharger. When the turbocharger seems to function unsatisfactorily of misfires measurement of the charging pressure and/or measurement of the radial and axial clearance may on the other hand show that the unit is defective.

Measuring the Radial Clearance

When measuring the axial and radial clearance it is necessary to remove the turbocharger and secure it properly on a steel plate, to which the indicator gauge's magnetic stand can be fixed.

Apply the contact point of the dial indicator gauge to the turbine and compressor when respectively according to fig. 1 and 2. Pull one wheel upwards and push down the other one. Read the value measured. Push and pull in the other direction and read the value measured. The difference between the values constitutes the radial clearance. Repeat the measuring procedure three times.

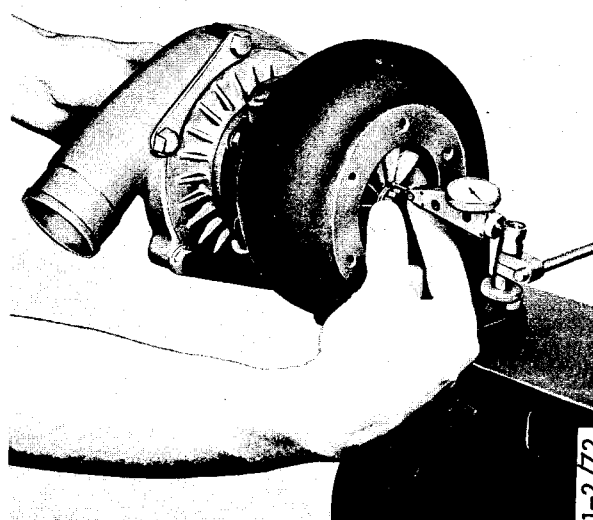


Fig. 1

Measuring the radial clearance of the turbine side.

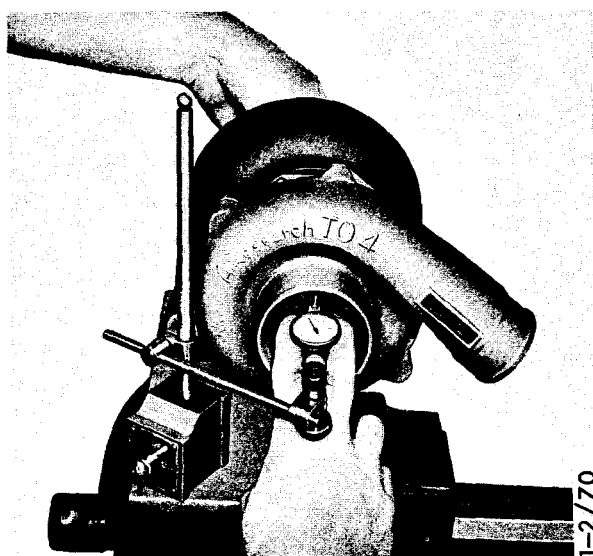


Fig. 2 Measuring the radial clearance of the compressor side

Measuring the axial clearance

Apply the contact point of the dial indicator gauge to the end of the shaft according to fig. 3. Push the shaft in longitudinally to and from and read the gauge in the end positions. The difference between the values read constitutes the axial clearance. Repeat the measuring procedure three times.

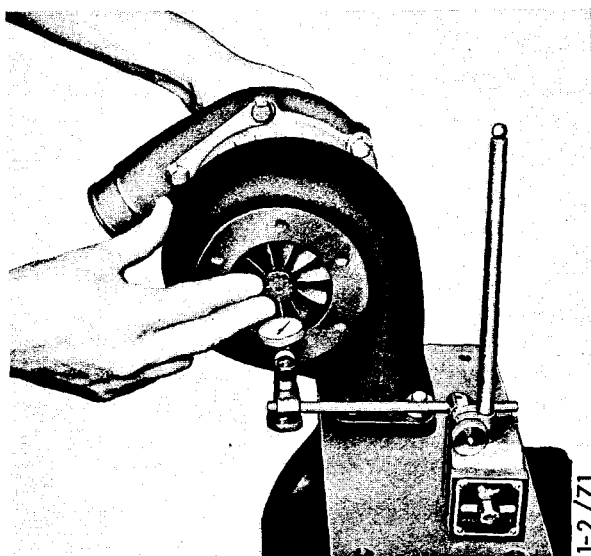


Fig. 3 Measuring the axial clearance

Reconditioning

It has been found extremely difficult to recondition the turbocharger with good result unless there is access to expensive special equipment, such as gauges, wet blasting plant and balancing machine. Therefore, we recommend the use of the "Scania Replacement System". If the replacement parts are not available it is possible to undertake reconditioning according to the instructions below (see "Reconditioning" under the respective turbocharger).

Balancing

The parts included are individually balanced. In practice, however, it has been experienced that after cleaning, balancing is very often unnecessary. Instructions for balancing in the balancing machine can be obtained from our Service Department.

Fitting the engine

When replacing the turbocharger the gaskets which are included in the outer repair set are to be changed and in addition the oil cleaner, too.

If the turbocharger breaks down the following is done:

Check that the air intake is clean and that no loose particles are to be found there.

Check the exhaust collector pipe and the intake pipe in respect of loose particles. Check that all the valves are whole.

Check the oil return line in respect of possible blockage and deformation

Check the oil pressure pipe in respect of possible blockage, deformation and leakage under pressure.

When changing the following is done:

Check the connection flange on the exhaust collector pipe so that no parts of the old gasket remain in place.

Fit a new gasket between the turbine housing and the exhaust collector pipe. Make certain that the gasket does not project forward in the exhaust opening.

Fit the turbocharger.

Connect the oil and air pipes. The bolts for the exhaust pipe are greased with a special high-temperature resistant yellow coloured lubricant, No. 561205.

Check to be certain that the expansion piece in the exhaust line is comparatively easy to turn by hand. If not, adjust the exhaust line.

Pull out the stop button and operate the engine with the starter motor for at least 30 seconds so that the lubricating oil will have sufficient time to reach the turbocharger.

Start the engine and check that there is no leakage.

datum	
75-03-15	74-02-28

SERVICE SCANIA

grupp	sekt	nr	sida
1a	AR	2	5

N.B. The two pins which hold the oil deflector and pressure plate are pressed into the bearing housing and cannot be removed.

11. Remove the sealing rings (3, 15) from the spacer sleeve and shaft.

Cleaning

1. Use suitable cleaning fluid, e.g. white spirit. Corrosive solvent, such as caustic soda, destroys certain parts and must not be used.
2. Wash the parts in the fluid until all impurities have been removed.
3. Use only a plastic scraper or bristle brush on the light alloy parts.
4. Blow clean all drilled ducts with compressed air.
5. Check that the surfaces nearest to the wheels (compressor-turbine) are clean and do not show any deposits.

3. Bearing housing (8).

Replace housing if bearing seats or sealing ring surface are obviously scratched or worn.

4. Spacer sleeve (5).

Replace housing if this or sealing ring groove is damaged.

5. Thrust washer (4).

Replace thrust washer.

Thrust disc (10).

Replace thrust disc.

6. Compressor wheel (6).

Check the compressor wheel carefully in respect of cracks, bent or excessively damaged blades. Never attempt to straighten a crooked blade.

7. O-ring (12).

Replace the O-ring.

AR

Check

1. Shaft with turbine wheel (2).
 - a) Check the bearing surfaces in respect of scratches and wear. Slight scratches can be tolerated.
 - b) Check the sides of sealing ring grooves in respect of wear. Slight scratches can be tolerated. If considerable wear is suspected, the width of ring groove can be checked with a gauge 98335. The groove must not be worn obliquely.
 - c) Check the turbine wheel carefully in respect of cracks and other faults such as bent or excessively worn blades. Never attempt to straighten a crooked blade. If it is suspected that the shaft is crooked or the wheel warped, the unit can be checked in a V-block. The shaft is measured at the compressor side nearest to thread for lock nut. The wheel is measured on the back side at the radius indicated.

2. Plain bearing (9).

Replace plain bearing.

Assembly

When the turbocharger unit has been cleaned and carefully inspected and all faulty parts replaced, assembly can commence.

Assembly of the unit takes place in reverse of that when dismantling, with attention being paid to the following points, so that a satisfactory result will be ensured.

- a) Lubricate bearings, axial unit, sealing ring, O-ring and turbine shaft with pure engine oil.
- b) Make certain that the correct sealing ring is put in the right place. The sealing ring (15) is somewhat larger than sealing ring (3), and it is impossible to slide it into the sealing plate. In addition sealing ring (15) is easier to press together (softer) than the sealing ring (3).

Warning: Do not extend the sealing rings too much when fitting, because this will result in a permanent elongation and the ring will break.

grupp	sekt	nr	sida
1a	AR	2	6

- c) Centre the sealing ring (3) in spacer sleeve (5) and slide unit into the sealing plate from the chamfered side (take great care). With the bearing housing compressor side turned so as to face upwards the following parts are fitted in the order quoted: Thrust disc (10) with oil grooves upwards. Thrust washer and oil deflector. After this the sealing plate together with spacer sleeve are tapped into position with a plastic mallet and locked with stop ring (14). The chamfered part of stop ring shall be facing upwards.
- d) Turn the bearing housing so that the turbine side is facing upwards and place it in a vice with open jaws so that the compressor wheel can pass through unimpeded.
- e) Centre the thrust washer (4) with aid of a pen or similar.
- f) Put the plain bearing (9) in bearing housing. When the turbine wheel, together with shaft (2), is inserted into the bearing housing, the sealing ring (15) shall be well centred. Do not force the ring into its seat, as a ring which is not centred properly can break, which in turn means that the shaft will get stuck. Fit the compressor wheel and tighten up the lock nut by hand.
- g) Turn the whole unit and fasten the turbine wheel shoulder in a vice, after which the compressor wheel lock nut is tightened up to the prescribed torque.
- h) Check after assembly that the rotor unit rotates freely.

TURBOCHARGER T04B

Reconditioning

May be performed when replacement units are not available.

Dismantling

Wash the outside with white spirit. Note the positions of the compressor housing and the turbine housing in relation to the bearing housing.

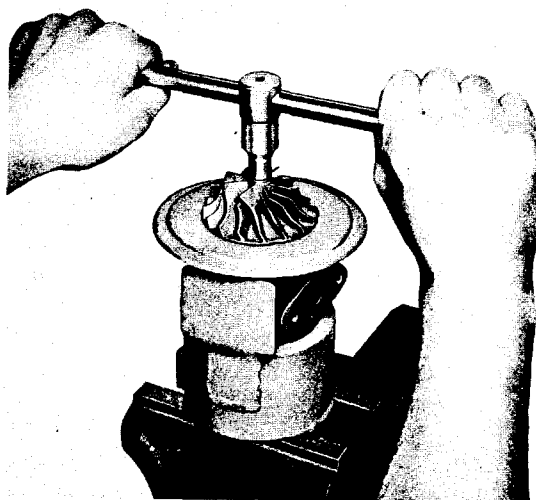
Open the securing plate, remove the bolts and undo the compressor cover and turbine housing.

Place the bearing housing with turbine shaft in tool 98338 and clamp the tool in a vice. Remove the nut retaining the compressor wheel, using a 3/8" socket wrench with T-handle. Do not use a ring spanner as this may result in the shaft being bent.

Tap the shaft end carefully and remove the compressor wheel (1). With draw the shaft with turbine wheel (10). The radiation shield (8) will then fall off.

Open the securing plate for the four bolts, which hold together the bearing housing and remove the bolts.

Take off the brace plate (12). Remove the thrust bearing (13) by lifting it straight up. Remove the rubber ring (4). Remove the snap rings (6) and take out the bearings (7).



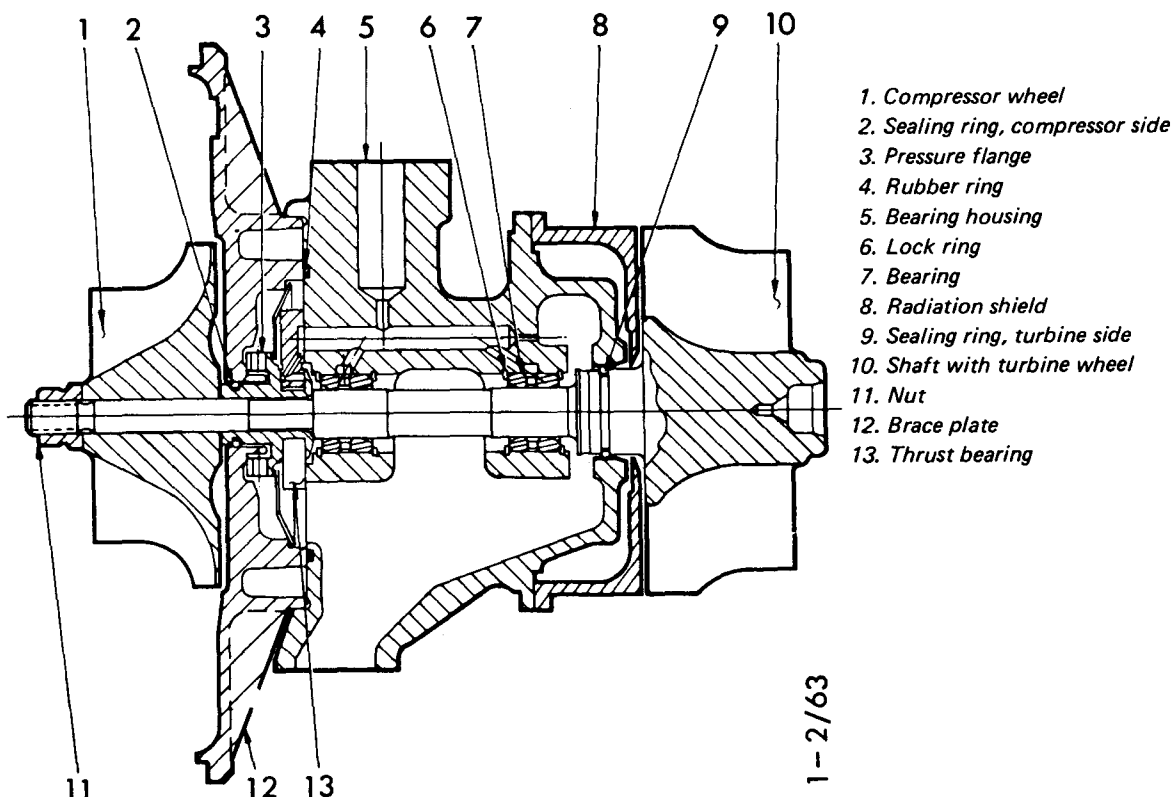
1-2/73

The nut on the compressor wheel is undone. The Turbocharger is fixed in tool 98338.

Cleaning

Use suitable cleaning agent, e.g. white spirit. Corrosive liquids, such as caustic soda, destroy certain parts and must not be used. First carefully scrape off all deposits, using a soft object (e.g. of plastic or aluminium).

Carefully blow out the oil passages in the bearing housing.



Check

Replace the parts included in the inside repair set.

Check the thrust bearing (13) in respect of wear and possible rough particles which have fastened in the bearing metal. Check the positions of the bearings in the bearing housing. Check to see that the end surface of nut (11) and corresponding surface on the compressor wheel (11) are undamaged. Change these parts, too, if they are damaged. Check the pressure flange and replace, if it shows signs of damage.

Assembly

The turbocharger is very sensitive to impurities. Therefore, be very careful when assembling and make sure that no dirty particles get into the bearing housing.

Fit the inside lock rings (6). The lock rings are fitted in with the rounded side against the bearing. Oil the bearing (7) with engine oil and put in the bearing. Fit the outer lock rings.

Fit the sealing ring (2) on pressure flange (3). Fit together pressure flange (3) and thrust bearing (13) and put them in position on the pins.

Put the rubber ring (4) in the groove.

Check to ensure that the spring disc is located in place in brace plate (12). Put brace plate (12) over the sealing ring (2). Turn brace plate (12) until the bolt holes come in the right position. Make certain that the plate does not come under the oil flanges. Fit the securing plate and bolts. Tighten the bolts to the prescribed torque and bend the plate. Check, that it is possible to turn the pressure flange.

Fit the sealing ring (9) on the turbine shaft. Hold the turbine shaft vertical and put it through the radiation shield (8) and bearing housing (5).

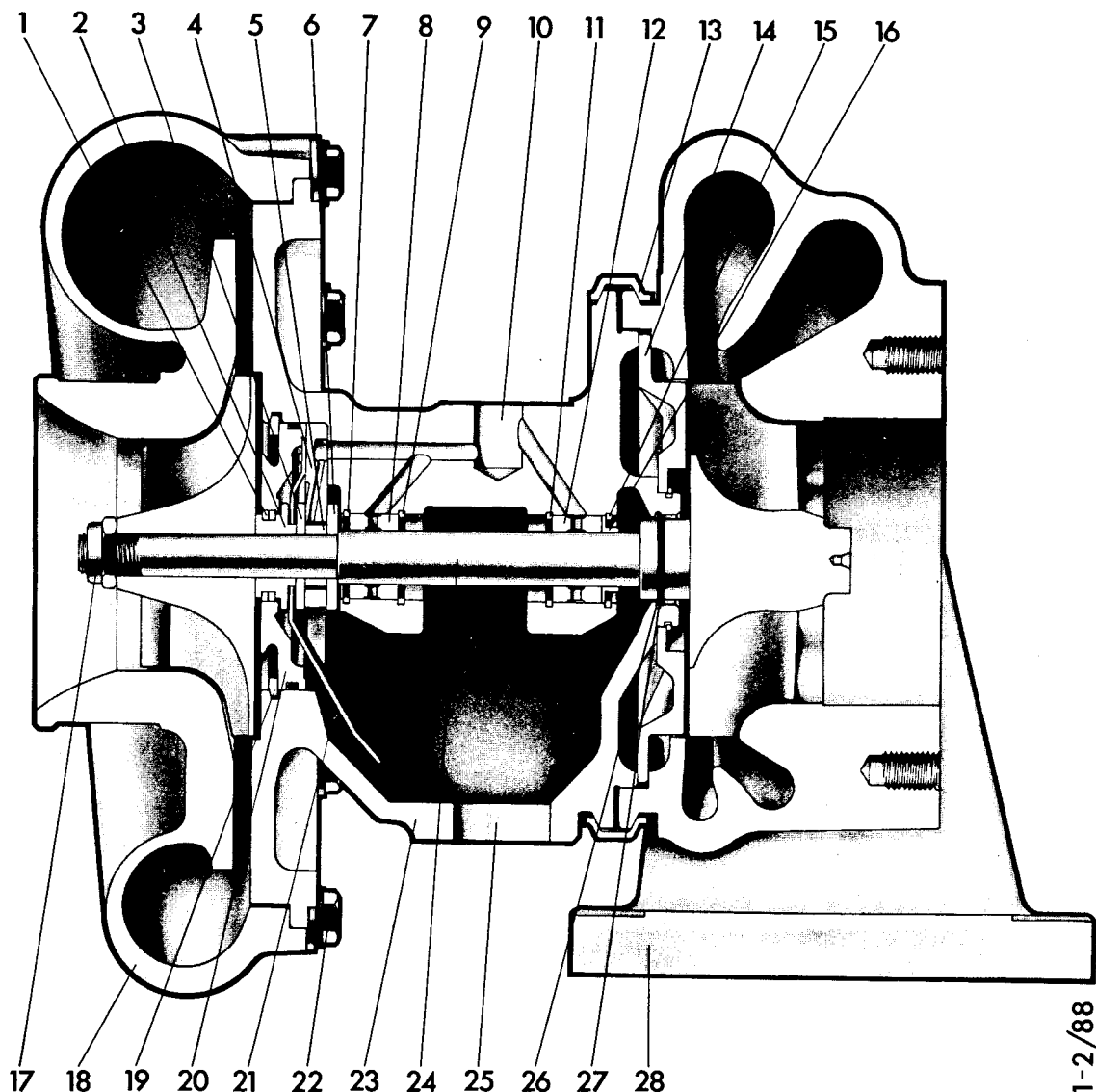
Fit the compressor wheel. Oil the threads and the end surface of nut (11) and put it in place. Tighten the nut by using a spanner with T-handle so that the shaft will not be bent.

Tighten the nut according to the instructions in 1a SP 2.

Check that there is clearance between the radiator shield and turbine wheel.

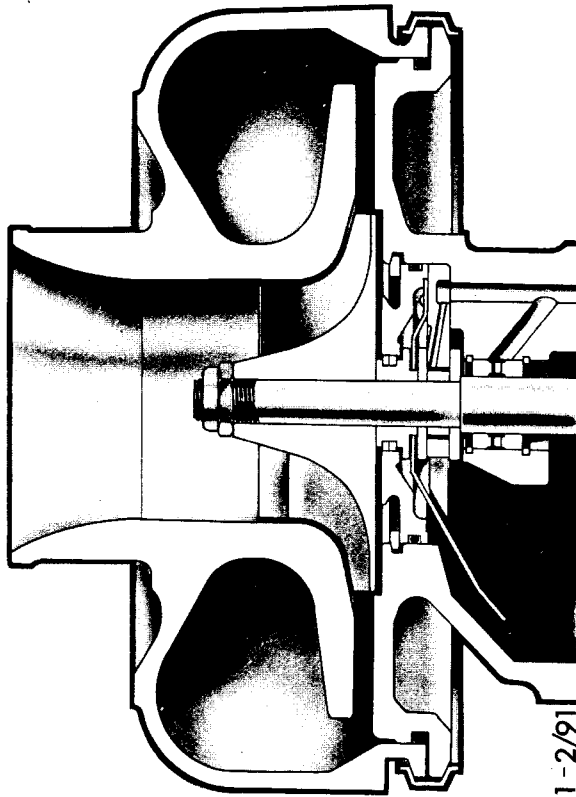
Put the turbine housing in its right position. Under the bolts fit clips and securing plate. First of all fit the two bolts by the inside of the oil inlet and outlet. Then fit the other bolts and tighten them to the prescribed torque. Fold up the securing plate. Put the compressor in the right position. Under the bolts fit clips and securing plate. Fit the bolts and tighten them to the prescribed torque. Fold up the securing plate.

TURBOCHARGER 4LE, 4LEK, 4LGK AND 4LGZ



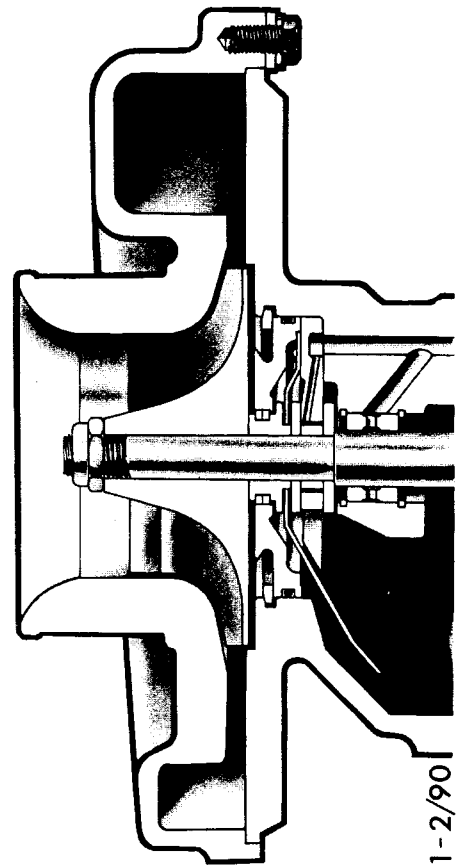
Turbocharger 4LGK

- | | |
|----------------------------------|---|
| 1. Sealing rings | 15. Lock ring |
| 2. Spacer sleeve | 16. Oil checking sleeve |
| 3. Thrust washer | 17. Nut |
| 4. Thrust washer (axial bearing) | 18. Compressor cover |
| 5. Sleeve | 19. Lock ring |
| 6. Thrust washer | 20. Sealing plate |
| 7. Lock ring | 21. Oil deflector |
| 8. Bearing | 22. Bolt for fastening compressor cover |
| 9. Lock ring | 23. Bearing housing |
| 10. Lubricating oil inlet | 24. Shaft with turbine wheel |
| 11. Lock ring | 25. Lubricating oil outlet |
| 12. Bearing | 26. Shoulder in bearing housing |
| 13. V-clamp | 27. Sealing ring |
| 14. Radiation shield | 28. Turbine housing |



Compressor end 4LE

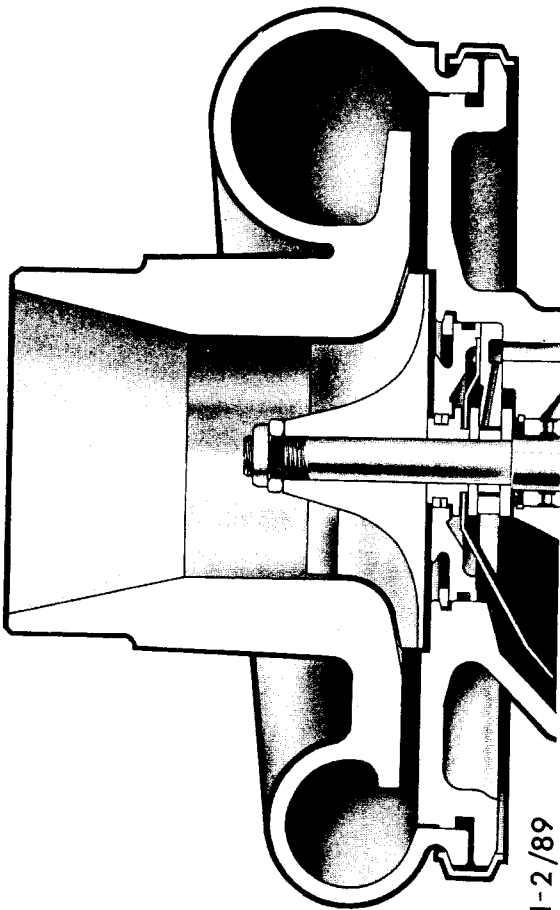
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Compressor end 4LEK

1-2/90

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Compressor end 4LGZ

1-2/89

75.1 7265/3200-10.340

grupp	sekt	nr	sida
1a	AR	2	10

Reconditioning

May be performed when replacement units are not available.

Dismantling

Wash the outside with white spirit. Note the positions of the compressor cover and turbine housing in relation to bearing housing.

Undo the compressor cover and the turbine housing.

Fix the knurled end of shaft in a vice.

Undo the nut (17) on compressor wheel. Be very careful to see that the shaft end is not bent. Remove the nut. Lift off the compressor wheel. If it is difficult to move tap very gently on the shaft end. Pull out the shaft with turbine wheel.

Remove the lock ring (19) and lift out with aid of two screw drivers the sealing plate (20). Remove the sealing plate O-ring.

Lift out the oil deflector (21) and parts (3, 4, 5 and 6) for thrust bearing.

Remove bearings (8 and 12) the oil checking sleeve and lock rings (7, 9, 11 and 15).

Remove the sealing ring (27) from the shaft.

Cleaning

Use suitable cleaning fluid, e.g. white spirit. Corrosive solvents, such as caustic soda, destroys certain parts and must not be used. Carefully scrape away all deposits with a soft object (e.g. of plastic or aluminium).

Blow clean all drilled ducts in the bearing housing.

Check

Replace the parts included in the inside repair set. Check the shaft and bearing housing bearing positions. Slight scratches

can be tolerated. Check the sealing ring groove in shaft with tool 98335. It must not be possible to press the tool into the groove. The groove may on the other hand be worn obliquely. Check the turbine and compressor wheel blades. Never attempt to straighten a crooked blade.

If it is suspected that the shaft is crooked or the wheel warped, the unit can be checked in a V-block. The shaft is measured at the end closest to the thread for nut. The turbine wheel is measured on the back side at the radius indicated.

Assembly

The turbocharger is very sensitive to impurities. Therefore, be very thorough when assembling and make sure that no particles of dirt force their way into the bearing housing.

Fit the inside lock rings (9 and 11). The lock rings are fitted with the rounded side against the bearing. Oil the bearings (8 and 12) with engine oil and put them in. Fit the oil checking sleeve (16) and the outer lock rings (7 and 15).

Fit the sealing ring (27) on the shaft. This ring is similar to the sealing rings (1), but is slightly larger and of softer material. Therefore, it is impossible to press it into the spacer sleeve (2). Be careful when assembling to see that the sealing ring does not become warped.

Very carefully put the shaft in the bearing housing. Make certain that the sealing ring is not damaged.

Put on thrust washer (6), thrust bearing (4) and sleeve (5) and the other thrust washer (3) on shaft. Lubricate the parts with engine oil. Put in oil deflector (21). Fit the two sealing rings (1) on the spacer sleeve (2). Adjust the openings so that they are displaced half a turn. Fit the spacer sleeve (2) in the sealing plate (20). Fit a new O-ring on the sealing plate and fit it in the bearing housing with aid of a plastic mallet. Fit the lock ring (19). Fit the compressor wheel on the shaft. Tighten up the nut to the prescribed torque. Tighten up very carefully, ensuring that the shaft is not bent.

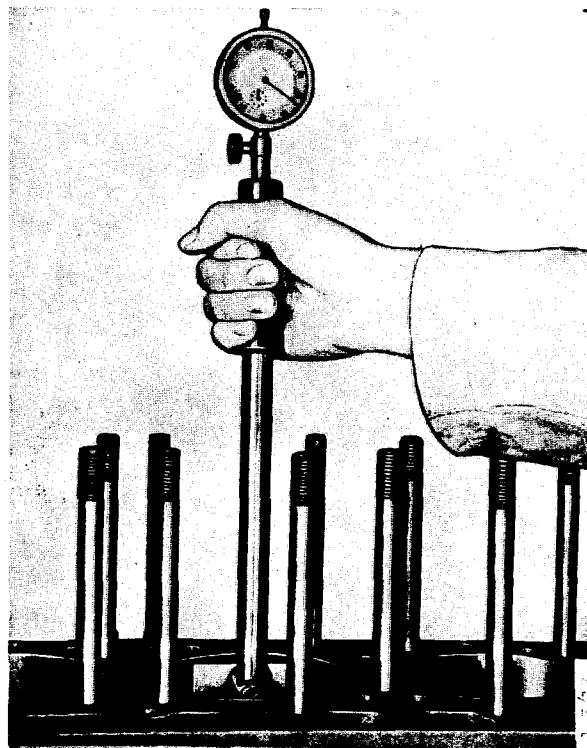
Check after assembly that the shaft rotates freely.

Fit together the bearing housing with compressor cover and turbine housing. The exact alignment of compressor cover and turbine housing is best facilitated on assembly of the engine.

CYLINDER BLOCK

The **cylinder block** and the upper half on the crankcase are a one-piece casting of alloy cast-iron. The main bearing caps are steel forgings. The cylinder block has renewable cylinder liners of the wet type, by which is meant that the liners are in direct contact with the circulating cooling water. The sealing between each liner and the cylinder block at the lower end of the liner is provided by three rubber rings seated in grooves in the cylinder block. The sealing at the upper end of the liner is effected by the cylinder-head gasket, which presses the collar on the liner down against a seating surface located in a recess in the block. Between the two lower O-ring grooves at each cylinder there is a drilled "weep hole" through the wall in the cylinder block. If coolant or lubricating oil penetrates through any of these holes on the outside of the block the affected cylinder seals should be renewed before more serious damage occurs.

When the engine is dismantled down for complete reconditioning the cylinder block must be cleaned. Wash off oil deposits in the crankcase with a suitable solvent. Then blow everything clean with compressed air and carefully remove all remnants of old gaskets.



Measuring cylinder liner wear

Measuring Cylinder Wear

Wipe out the cylinder bores thoroughly before taking any measurements. The work of measurement is done with a cylinder dial indicator, which can be zeroed using, for example, a new cylinder liner or a micrometer.

If oil consumption is high and wear exceeds the stated figure a change of piston ring should be considered, if a temporary repair is wanted. When complete engine reconditioning is being carried out we recommend changing the liner even if there is a lesser degree of wear.

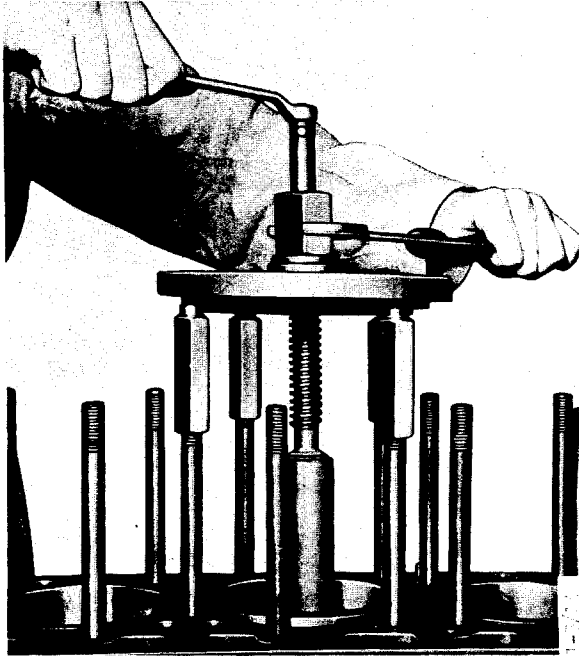
Changing a Cylinder Liner

Removing the Cylinder Liner

1. Remove pistons and connecting rods, see section entitled "Crankshaft and Reciprocating Components".
2. Remove the cylinder liner by using the puller. Put on the stud extensions. On engines where studs are missing support bolts part No. 98168 are used. Insert the puller through the cylinder liner and let the plate rest on the studs or support bolts. Turn the cross-piece so that the liner is positioned to bear against the liner shoulder

grupp	sekt	nr	sida
1a	AR	3	2

during removal. Then screw down the puller nut until the liner comes away. To prevent the rod from rotating with the nut, apply a suitable tool to the four-square flats at the upper end of the rod.



Removing the cylinder liner with the puller

sioned threads. Put on new sealing rings or where required sealing washers. Smear self-hardening plastic on the threads. Tighten the sealing plugs with the appropriate tool.

2. Check that the seating surface of the cylinder liner on the block is clean and free from defects. If the surface is damaged it may be necessary to use the facing tool. However, this method should be resorted to only when it is absolutely necessary. Great accuracy must be observed to ensure that the seating surface is not made inclined.

The least possible amount of metal should be removed; it is best if the surfaces are merely scraped clean with the reamer.

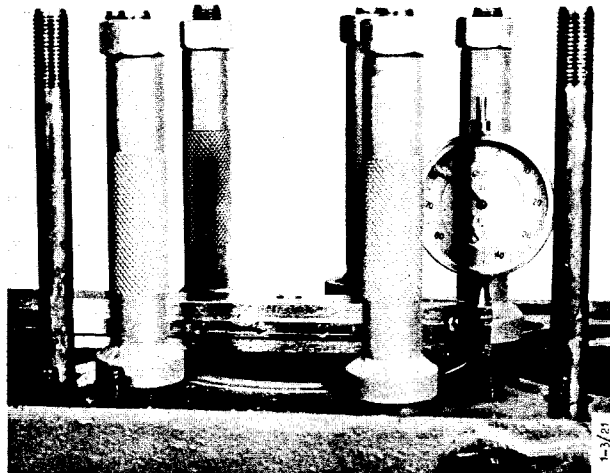
3. Give new cylinder liners a thorough inspection. Defects may arise during transport and through careless handling. Damaged edges, etc. are easy to spot but a crack is not so readily detected. The best way to detect cracks in the liner is by "ringing" it. If it is sound a clear bell-like tone will be heard, whereas a cracked liner will produce a "cracked" sound.

Clean the upper and lower locating surfaces and the seating surface, and the grooves for the sealing rings in the cylinder block.

Inspecting the cylinder block and cylinder liner

1. If there is an excessive amount of scale in the block it must be removed since cooling would otherwise be jeopardized. The coolant comes from the coolant pump through a passage at one long side on the block and flows out through holes in the passage wall partly up in the cylinder head, and also out against the liner. When these holes have been cleaned, it is possible to see if the distribution passage is blocked. If this is the case then the plugs on the outside of the block must be removed and the passage cleaned.

Examine the sealing plugs in the cylinder block as regards damage. Check that the threads on sealing plugs and in the cylinder block are clean. Replace if necessary the sealing plugs for new ones with overdimen-



Measuring the height of the cylinder liner above the cylinder block

Measuring and Adjusting the Height of the Cylinder Liner above the Cylinder Block deck

Before the liner is finally fitted into place its position in relation to the upper face of the cylinder block must be checked as follows:

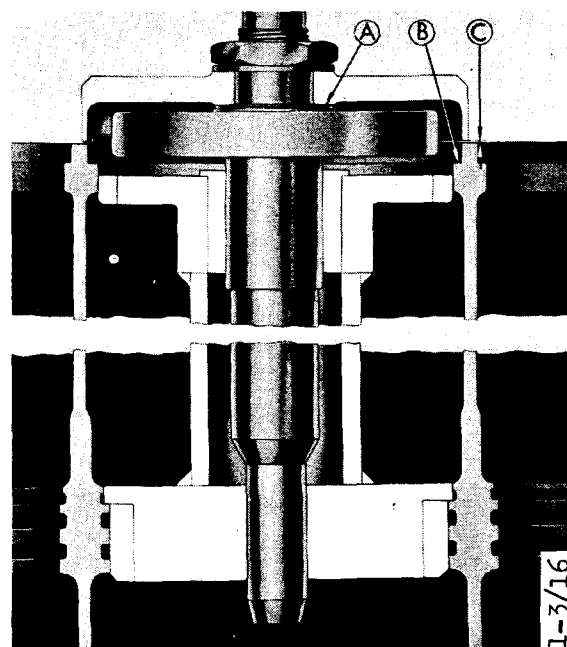
1. Use a micrometer to check flange on the cylinder liner in respect of parallelism between the sealing surfaces.
2. Put the liner in place without rubber rings.
3. Press down the liner with aid of sleeves on the studs and press them down to the specified tightening torque on the nuts. On D/DS5, D/DS8 five sleeves are used and on D/DS11 two.
4. Measure the height of the cylinder liner flange above the cylinder block. Each liner shall be measured on two diametrically opposed points in the transverse direction of the engine. Determine the difference between both the measurement results. The seating will not be satisfactory if there is greater difference in measurement than that recommended. It is also important to see that those cylinder liners, which belong to the same cylinder head are given as far as possible the same height above the cylinder block. The difference in height for liners belonging to the same cylinder head must not exceed the recommended limits. On engines with the cylinder heads, which cover three cylinders the middle liner under each cylinder head must not lie lower than the adjacent cylinder liners.

It is of the utmost importance that the surfaces against which the measurements are taken really are clean. The same applies to the surfaces against which the straight edge is applied. We should also like to point out that the reading can also be upset by local minor unevennesses and burrs. This means that if you get readings outside

the stated limits you should not scrap any component without undertaking the requisite check. If the liner is too low its vertical position can be adjusted in the first resort with shims. The shim should be placed on the seating surface between the liner and the block. Measure the liner height again.

If the stated measurement is not complied with, the liner seats should be reamed and shims fitted to the required extent as follows.

5. Choose a shim, which, in relation to the desired liner height, will require the least possible amount of reaming in the liner seat. When adjusting the liner height the upper half of the tolerance range should be striven after. Check the shims and polish off any burrs on their edges. Shims are available as spares in different thicknesses.



The position of the adjusting reamer in the cylinder liner seat.

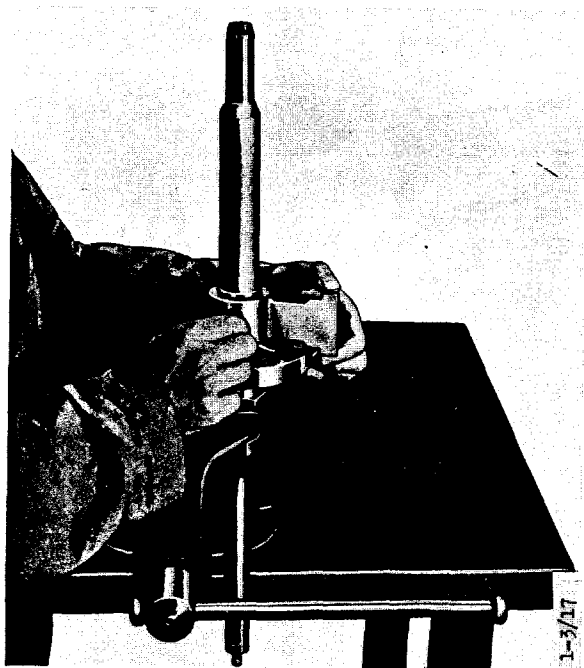
Always only use a shim, i.e. use **one** thick shim instead of several thin ones of the same thickness. Only use in exceptional cases more than one shim.

grupp	sekt	nr	sida
1a	AR	3	4

6. Measure the thickness of the shim with a micrometer.
7. Calculate the difference between the thickness of the shim and the amount by which it is desired to raise the cylinder height. The difference will be the thickness of the layer that will have to be removed with the facing tool.

Example for calculating the reaming depth required.

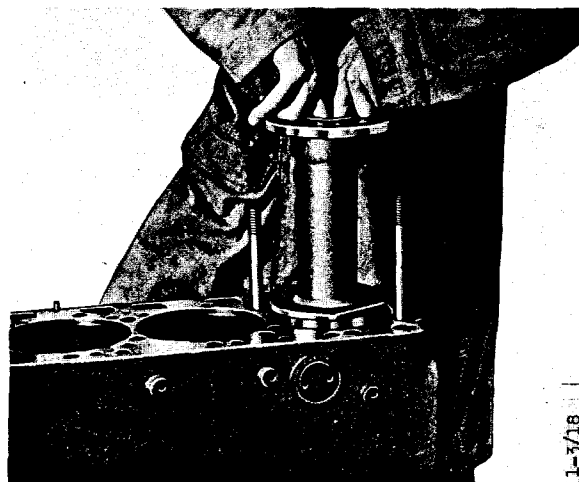
Measured liner stick up	0.03 mm
Cylinder liner stick up after measurement	0.09 mm
Raising the cylinder liner 0.09–0.03 mm	0.06 mm
Nearest thickness of shims	0.10 mm
Layer which must be machined away 0.10–0.06	0.04 mm



Adjust the cutting radius of the facing tool with aid of the setting gauge.

8. This point applies only to facing tools with an adjustable cutter.

Adjust the cutting radius of the tool for the type of engine you are working on using the setting gauge, which is pushed up onto the upper locating surface of the tool spindle. On the setting gauge are lugs, marked with the engine type reference, against which the cutter can be set. The cutter can be shifted by undoing the locking screw in the locking wedge which clamps the cutter in place. In some case it will be necessary to pry the wedge carefully loose, using a screwdriver for example, in order to be able to move the cutter.



Place the locating device in the cylinder-liner seat

Adjust the tool to the correct cutting radius by using the adjusting screw to shift the cutter towards a larger radius. Just before the correct cutting radius is reached, tighten the locking screw lightly so as to make it easier to control the movement of the cutter.

In changing the cutter, put the new one in right way round, so that its cutting direction agrees with the direction of rotation of the tools, as marked by an arrow on the stop disc. Check also that the flat surface of the cutter which is turned towards the bottom face of the cutting head bears firmly against it, and that there are no particles of dirt between any of the contact faces.

9. If the facing tool has a separate locating device, put the latter into the cylinder-liner seat.

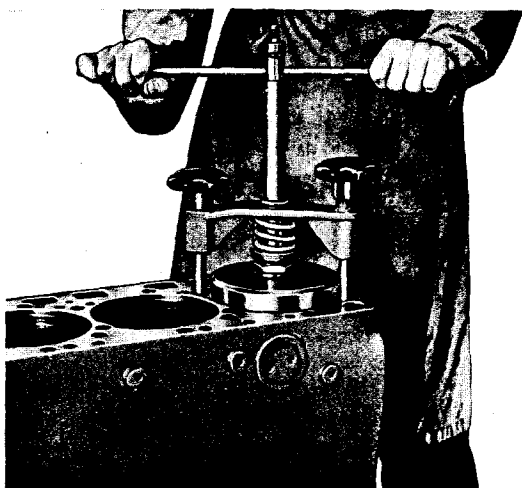
10. Smear the ground guide surfaces of the tool with engine oil to make it work easily.

Place the tool in the cylinder-liner seat. Check that the cutter of the tool bears against the seat (B).

11. The distance (C) between the stop disc of the facing tool and the plane of the cylinder block must be equal to the measurement obtained according to point 7. Measure the distance using feeler gauges and adjust as needed using shims (A) between the cutting head and the stop disc. Make sure there are no particles of dirt on any of the contact faces. Make the locknut really tight.

12. If you have a feed attachment for your facing tool, slip it down over the spindle of the tool and over two of the studs in the block, sited opposite each other. The two knobs belonging to the attachment should then be screwed onto these studs and tightened enough to produce a degree of resistance which feels just about right when the tool is turned.

13. Put a few drops of oil between the stop disc of the tool and the cylinder block so as to prevent damage to the contact faces.



Facing tool with feed attachment

14. Keep working on the liner seat with the tool until the stop disc bears against the cylinder block.

Never turn the tool backwards.

15. Clean the liner seat very thoroughly.

16. Fit the shim and the cylinder liner.

17. Press the cylinder liner down with the help of the studs and check the height of the liner according to the instructions given under point 4.

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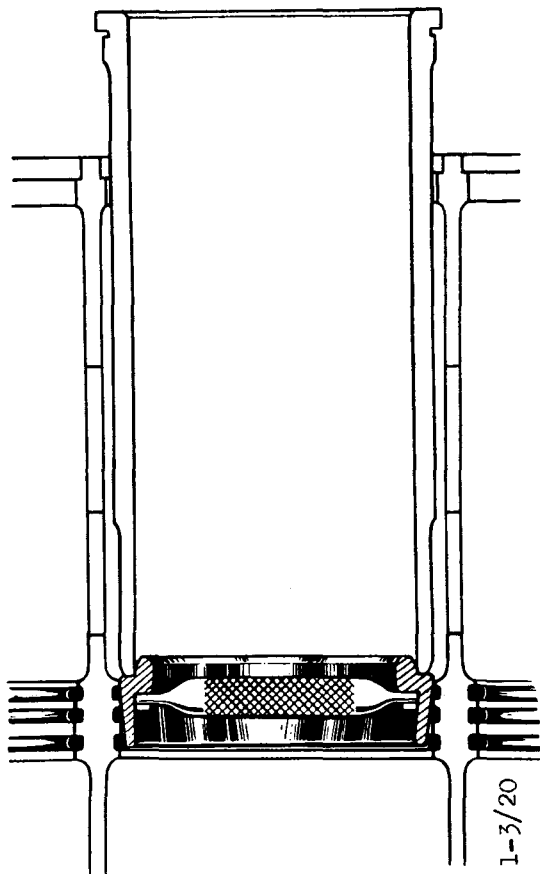
Fitting the Cylinder Liner

- When the vertical position of the liner has been settled, fit new rubber rings in the block before fitting the liner into place. To facilitate the fitting of the liner, the rubber rings and the lower locating surface of the liner should be smeared with ordinary engine oil.
- Always fit the liners, with the drill mark in their top edge turned to face the front of the engine.
- Press the liner down into position in the block. To prevent the sealing rings from dropping out of their grooves in the cylinder block as the liner is being pushed down, use the assembly tool, which should be smeared with engine oil. Place this tool on the site of the liner in the lower liner seat and then push it down with the cylinder liner. The tool keeps the rings in position while the liner is being pressed down.

grupp	sekt	nr	sida
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4. If the crankshaft has been taken out, the liner can be pushed down into place at one stroke. If the crankshaft is in place in the engine it must be turned so that the crankpin of the cylinder in question is halfway between T.D.C. and B.D.C. In this case the liner must be pushed down only sufficiently for the assembly tool to pass the lowermost sealing ring and come loose. Then raise the tool on edge and take it down past the crankshaft. The liner can then be pushed down into its position.
5. This step is carried out in special cases only: After the liner has been fitted its ovality can be checked as follows: Fit the cylinder head with its gasket and tighten the cylinder-head nuts. Measure the inside diameter of the liner. The ovality found should not be greater than the value stated. Measurement with the cylinder head removed does not give a reliable result.

If the liner cannot be pushed down by hand, it must on no account be knocked down. Pull it up instead and find out why it is binding.



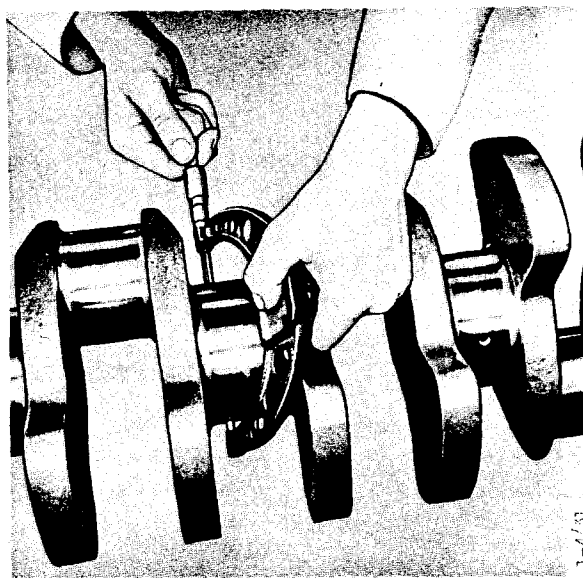
The assembly tool is pushed away by the liner when this is pressed down

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CRANKSHAFT AND RECIPROCATING COMPONENTS

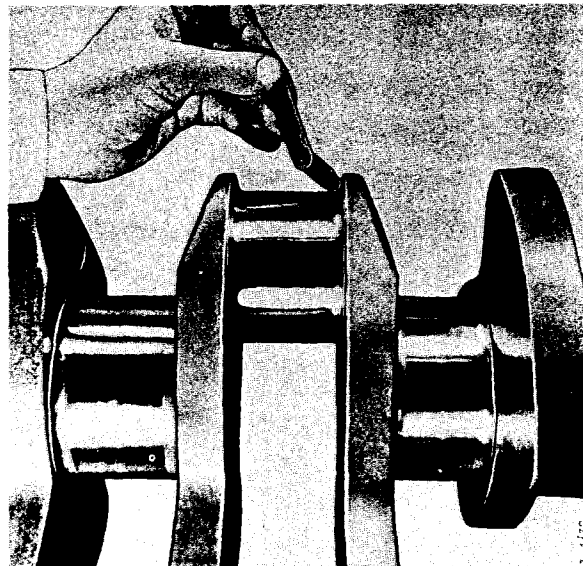
Removing the crankshaft

1. Drain off the engine oil.
2. Remove the engine.
3. Remove the oil sump, see section "Lubricating system."
4. Remove the oil pump with suction pipe for engine oil
5. Remove the timing-gear casing, see section "Transmission".
6. Remove the clutch.
7. Remove the flywheel.
8. Remove the flywheel casing.
9. Screw off the bearing caps on connecting rods.
10. Screw off the nuts holding the main-bearing caps and lift off the caps.
11. Lift up the crankshaft. The safest way to do this is with some form of hoist and a rope sling or suitably shaped yoke.



Measuring the wear

4. In grinding the crankshaft it is of vital importance to preserve the correct fillet radius on the journals and pins. It must have smooth transitions to the plane and the cylindrical surfaces. Polish all fillets carefully. Measure the radius with a radius gauge.



Measuring the fillet radius with a radius gauge

Overhauling the crankshaft

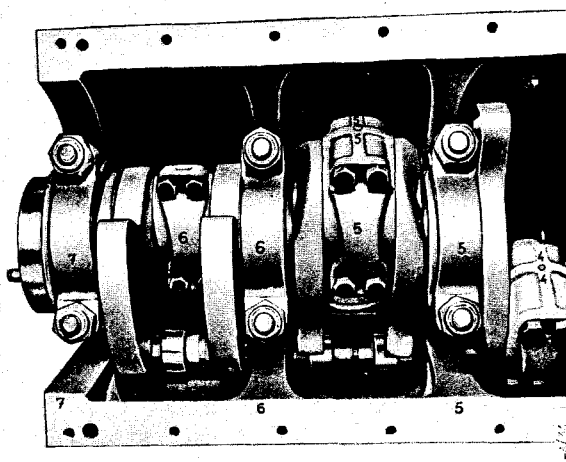
1. After removing the crankshaft, clean it thoroughly. Clean the oil passages carefully.
2. Investigate the wear. Measure the shaft journals with a micrometer on two perpendicular diameters. If any of these diameters is below the bottom limit indicated, regrinding of the crankshaft should be contemplated. The oil pressure should also be taken into account.
3. In regrinding the undersize given in the specification should be maintained. Finished bearing shells for these size are available.

Fitting the Crankshaft

1. Carefully clean all oil passages and contact surfaces for bearing shells, cylinder block, caps and crankshaft.
2. Position the bearing shells in their places in the block and in the bearing caps. See that the bearing shells are correctly positioned, and that neither bearing shells, bearings or caps have damaged edges or burrs.
3. Lubricate the journals and pins with clean engine oil and carefully put the crankshaft into place in the block.
4. Fit thrust washers on both sides of the rear main bearing. The oil grooves must face outwards towards the bearing surface of the thrust washers on the crankshaft.

On some later engine types the guide washers are shaped somewhat differently than that shown by the figure. Both the washers are there provided with pins which prevent the washers from rotating with the crankshaft. The pins are located in one end of the washers.

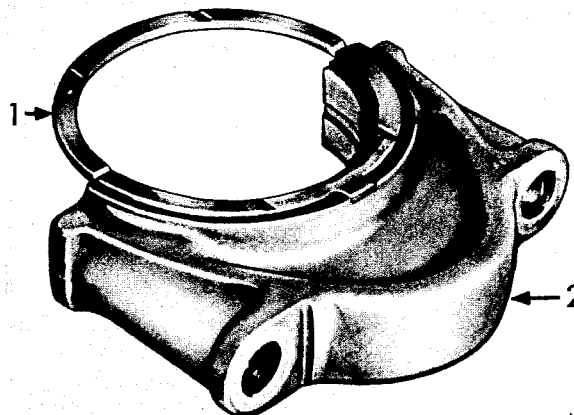
5. Fit the caps so that the stamped figure on each cap can be read from the same side as the corresponding figure on the block.



Marking of main- and big-end bearings

6. The nuts for the main bearing caps are of a self-locking type. Oil threads before screwing on the nuts. Then tighten them to the torque specified. On some later engine types hexagon screws are fitted instead of studs and nuts.

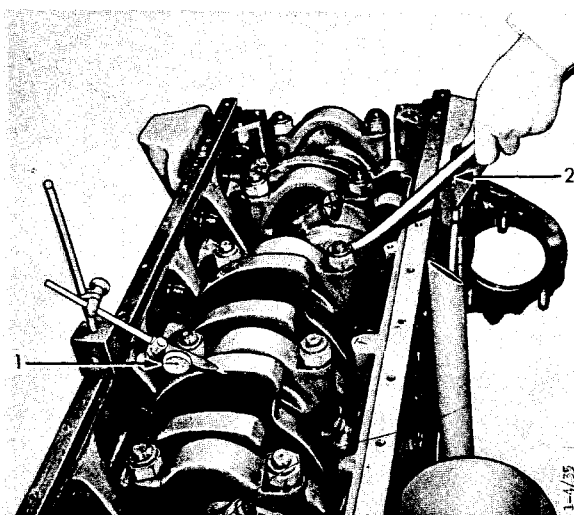
The bearing shells must on no account be scraped; nor may they be tightened by filing the bearing caps.



Main bearing caps with thrust washer

1. Thrust washer
2. Main bearing caps

7. Check the axial play of the crankshaft. The play can be adjusted by changing thrust washers, which are available in various thicknesses.



Checking the axial play of the crankshaft

1. Dial test indicator
2. Crowbar

Changing the Rear Oil Deflector

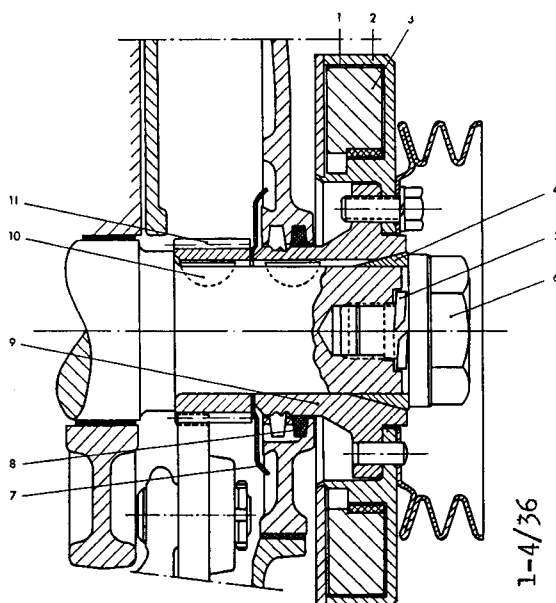
If the oil deflector has been removed (because it is damaged or to permit grinding of the crankshaft) a new oil deflector must always be fitted. Use the assembly tool. Check to make certain that the oil deflector is located properly on the shaft. On engines with rear crankshaft sealing of cuff type, the oil deflector is discontinued.

Vibration Damper

The damper requires no adjustment, oil replenishment or other maintenance.

Great care should be observed in handling the vibration damper. The slightest deformation of the housing can immobilise the damper ring and put the vibration damper out of action, which in its turn can lead to crankshaft cracks.

The vibration-damper housing is located by two locating pins on the vibration-damper hub.



Vibration damper

1. Gap between damper ring and housing. (The space is filled with liquid.)
2. Hermetically sealed housing
3. Damper ring
4. Expanding cone
5. Spring washer
6. Bolt securing hub to crankshaft
7. Oil deflector. (Discontinued if cuff sealing is fitted)
8. Felt ring. (Cuff sealing on later engines)
9. Hub
10. Key
11. Crankshaft gear

The spring washer (5) is not available on the later engine designs where the corresponding recess in the crankshaft is also removed. Nut 6 is henceforth fitted without spring washer 5 on crankshafts with recesses for the washer.

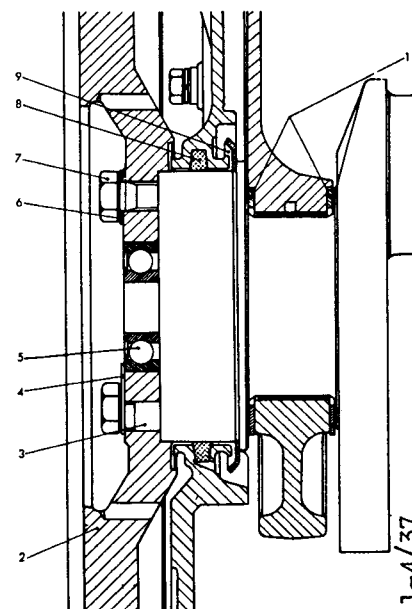
Note. Instead of the key joint shown above with hub 9 a polygon joint with a greater torque transmission is used in certain engine installations. Bolt 6 and the tightening torque for this are the same for both joints.

Removing and replacing the vibration damper

See section "Timing Gears".

Flywheel

The flywheel is attached to the rear end of the crankshaft by bolts locked with tab washers. The flywheel is located by three asymmetrically sited locating pins, so that the wheel can be fitted in more than one way only.



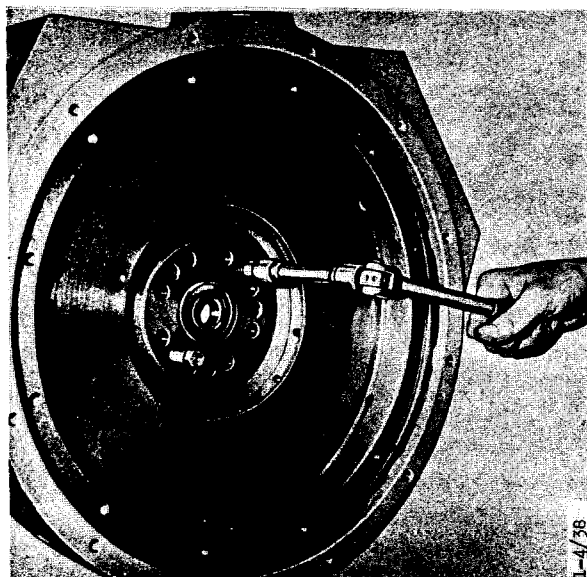
Flywheel

1. Thrust washer
2. Flywheel
3. Dowel
4. Lockwasher for bolt and ball-bearing
5. Ball bearing
6. Lock washer for bolt
7. Bolt securing flywheel to crankshaft
8. Felt ring. (Cuff sealing on later engines)
9. Oil deflector. (Discontinued if cuff sealing is fitted)

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Removing the flywheel

1. Turn down the tabs of the lock washers of the retaining bolts and screw out the bolts.
2. Pull the flywheel off the crankshaft using two puller screws.



Removing the flywheel with puller screws

4. Drive the heated ring gear onto the flywheel so that the bevelling on the teeth faces towards the starting motor. See that the ring gear beds down firmly onto the flywheel.
5. The ring gear must not be cooled with water, etc., but must be allowed to cool freely in air.

Removing and replacing the flywheel casing

1. The flywheel casing is bolted to the engine block. Screw out the bolts. If necessary, knock off the casing with a fibre mallet.
2. A felt ring, located in the flywheel casing, bears against a sealing surface on the crankshaft. Change this felt ring. Soak the new felt ring in engine oil before fitting.
3. Put the assembly tool onto the dowels on the end of the crankshaft so that the periphery of the tool is flush with that of the shaft flange.
4. Fit a new gasket between the flywheel casing and the engine block after removing the remains of the old gasket.
5. Fit the flywheel casing.

Changing the ring gear on the flywheel

Change the ring gear of the flywheel if the teeth have become so badly worn that the starting-motor pinion has difficulty in engaging. Make the change as follows.

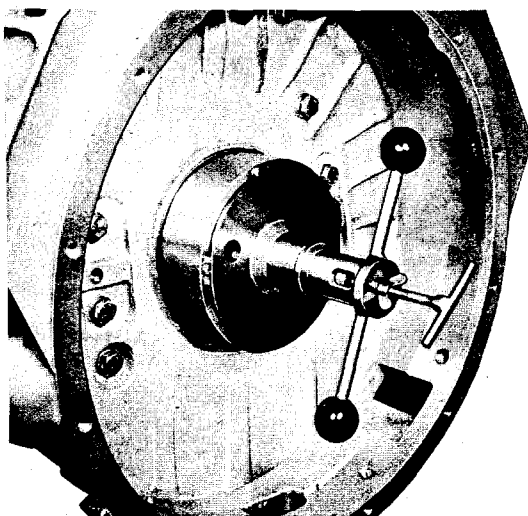
1. Grind as deep a groove as possible in the ring gear and split it with a cold chisel, after which the ring can be removed from the flywheel.
2. Clean the seating surface on the flywheel, a steel-wire brush being suitable for this purpose.
3. Heat the new ring gear so that it is evenly warmed all round to the temperature indicated. In order to be able to see when this temperature is reached, the ring should have two bright spots ground at different points. Heating should be discontinued at the latest when these surfaces begin to show blue coloration. If heating is continued beyond this point there is a risk that the ring gear will lose its temper.

Changing the Sealing Ring in the Flywheel Housing

On a number of engines of later design there are sealing rings instead of felt rings. Two sealing rings of different design have been fitted. One is white and slightly wider than the other, which is black. The different widths of the sealing rings must be paid attention to when changing in accordance with the instruction below. Use assembly tool 98321 when fitting sealing ring.

Changing the Sealing Ring with Flywheel Housing Fitted

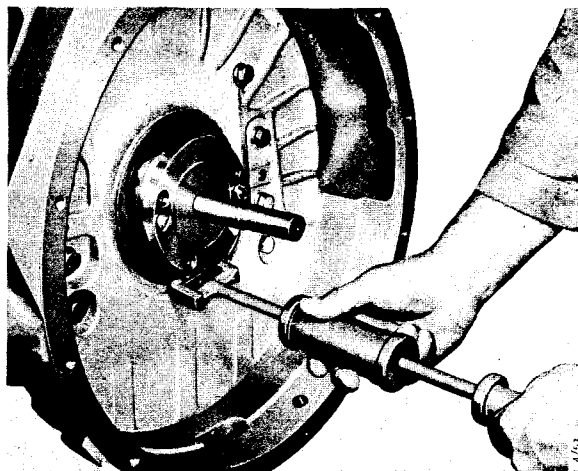
1. Firmly tighten the assembly tool spindle on the rear section of crankshaft. Then push the press sleeve over the spindle until it beds against the rear edge of the sealing ring. Then screw the handle on the spindle until contact is made against sleeve and, screw in the stop screw so that it bottoms against the top of the spindle. Lock the stop screw with the wing nut. Afterwards unscrew the handle and remove the press sleeve.



1-4/2

Assembly tool 98321 complete

2. Drill a hole approx. $\varnothing$ 2.5 mm in the bottom part of the old sealing ring.
3. Cut a piece of flat bar 34 x 15 x 5 mm and drill a hole $\varnothing$ 5 mm in the centre of bar. Fit the bar with a bolt (length min. 20 mm) in the hole in the sealing ring. Screw the bolt in a couple of turns until it "tightens". Then tap out the old sealing ring with striking tool 98169, which is fitted round the bar.



1-4/3

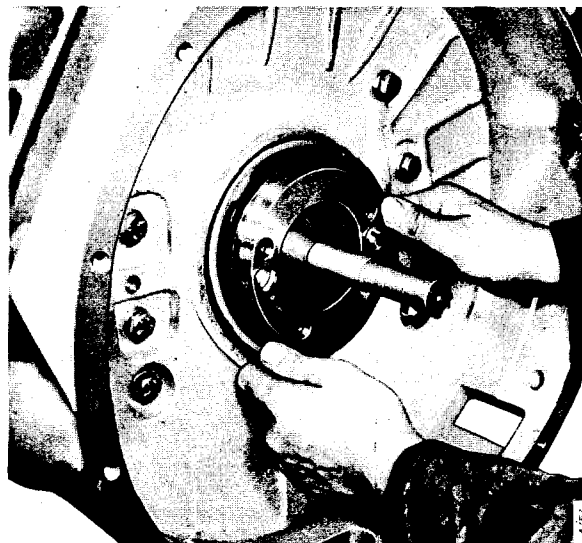
Tap out the old sealing ring with striking tool 98169

4. Check that the contact surface in the housing is faultless-examine the hole very thoroughly in the event of possible signs of oil leakage between housing and ring.
5. Check the sealing surface on the crankshaft. The new ring shall be displaced in the housing in the event of unusual wear on the end of crankshaft so that the ring will seal against an unworn surface of the shaft.

Remarks. In those cases where oil leakage occurs on the sealing despite the fact that both this and the crankshaft sealing surface are in good condition then a check should be made among other things to see that the clearance in the crankshaft main bearings is not greater than normal.

6. Examine the new sealing ring and make certain that its sealing lip is not damaged in any way.
7. Lubricate the crankshaft end, spindle flange and sealing ring liberally with engine lubricating oil.
8. Put the well oiled sealing ring on the spindle flange. The sealing ring shall be turned with the open side against the engine block. Tilt the ring slightly when it is put over the groove between the spindle flange and crankshaft end. Afterwards straighten up the ring and push it against the flywheel housing.

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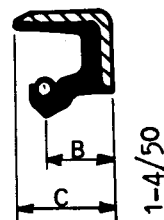


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Putting the sealing ring on the crankshaft end.

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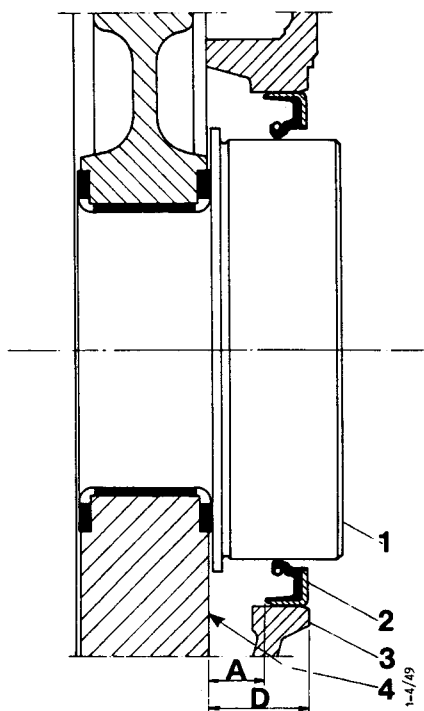
9. Push the press sleeve over the spindle until it beds against the sealing ring. Then screw the handle on the spindle until the stop screw bottoms against the top of the spindle. Check while pressing in that the sealing ring is guided up properly and does not turn over. The sealing ring is now in the same assembly position as the old. If the crankshaft end has unusual signs of wear the new ring shall be moved axially 1.5 mm so that the sealing lip seals against an unworn surface on the crankshaft. Undo the wing nut and screw out the stop screw 1 1/2 turns (pitch 1.0 mm/turn). Then firmly lock the stop screw with the wing nut. After which screw in the handle until the stop screw bottoms against the spindle bolt. The sealing ring has now been moved 1.5 mm.



Sketch of sealing ring

See "Specifications, Setting Values, Tools" concerning dimensions B and C.

Remarks. When changing the sealing ring for another type the width of the ring (see fig.) must be paid attention to during the axial movement. The ring can be moved until dimension A = 12 mm has been attained.



Sealing ring fitted in flywheel housing

1. Rear crankshaft end
2. Sealing ring in initial position
3. Flywheel housing
4. Engine block

Dimension A: Min. dimension between sealing ring and engine block

Dimension D: Dimension measured up between flywheel housing rear edge and engine block.

Example for Exchange of Sealing Ring

Sealing ring 178866 is fitted and shall be exchanged for 231938. The crankshaft length shows unusual signs of wear.

1. Sealing lip position (dimension B) on ring 231938 is 0.9 mm (12.3–11.4) further in than on ring 178866. The movement then required will amount to 0.6 mm (1.5–0.9).

Check to see that the min. dimension 12.0 mm is not lower by measuring up the distance between the flywheel housing rear edge and the engine block (dimension D). The old ring must be removed. Then add together the thickness of the new ring (C) with the removal which shall be undertaken plus possible earlier removal. Then deduct this amount from the first dimension (flywheel housing rear edge-engine block). This difference must not be below 12.0 mm.

Example:

$D = 32.0 \text{ mm}$

$\text{Dimension C} + \text{removal} + \text{previous removal} = 15.0 + 0.6 + 1.5 = 17.1 \text{ mm}$

$\text{Difference} = 32.0 - 17.1 = 14.9 \text{ mm}$

Thus in this case the min. dimension is not below 12.0 mm.

Fitting the flywheel

1. Oil the locating surfaces of the flywheel and position the flywheel on the shaft so that the dowels on the crankshaft fit into the appropriate holes in the flywheel.
2. Fit the retaining bolts together with new lock washers. N.B. On certain types of flywheel one of the lock washers for the bolts acts as locking for the ballbearing in the flywheel, too.
3. Tighten the retaining bolts to a torque of 19 kgm (138 lb.ft.) and lock them by turning up the tabs of the lock washers.

Connecting Rods

Removing a piston with connecting rod

1. Remove the cylinder head, see section "Cylinder Head".
2. Remove the oil sump, see section "Lubricating System".
3. Scrape away the edge of the carbon in the cylinder liner. Bevel off the "step" at the upper limit of piston travel with a scraper if it is sharply marked. Do not damage the wearing surface in the liner!
4. Remove the bearing caps and take out the bearing shells in both connecting rod and cap.
5. Press the piston and connecting rod out of the cylinder using a piece of wood.

On D/DS11 beginning from engine No. 880840 the injection nozzles for oil cooling of pistons are fitted. The injection nozzles must be removed **before** piston and connecting rod can be pressed out. Great care must be taken to see that the nozzles are not damaged in any way.

6. If the bearing shells are not to be renewed they should be laid out so that in reassembly they can be put back into their original places.
7. If the crankshaft is not to be removed, the bearing surfaces and oil passages must be protected by wrapping insulating tape or cellophane tape round the crankpins (with the sticky side out).
8. The piston and connecting rod can then be sent for washing as a unit.

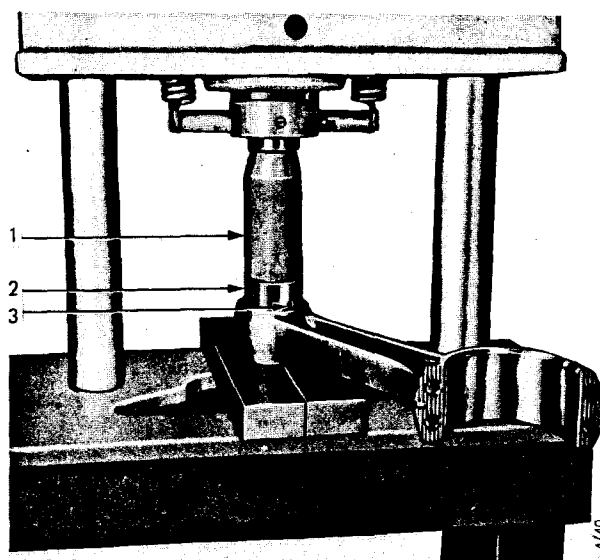
Removing the piston pin

1. Take away the retainers of the piston pin using a pair of retainer pliers.
2. Heat the piston on a hotplate to about 100° C. The piston pin can be pressed out by hand when the piston has reached this temperature. Use the appropriate drift. The piston pin must not be knocked or pressed out while the piston is cold. When cold the piston pin is usually a fairly tight fit in the piston, and the latter might be damaged.

Sometimes, however, a coincidence of tolerances may have the result that the piston pin is fairly loose in the piston even if it is cold.

Changing a piston-pin bushing

1. Press out the old bushing with the help of a press and the appropriate drift.



Pressing in a piston-pin bushing

1. Drift
2. Piston-pin bushing
3. Lubricating hole

grupp	sekt	nr	sida
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2. Check that the oil passage is clean and the bearing seat undamaged.
3. Press in the new bushing using the same drift. See that the oil hole in the bushing coincides with the corresponding hole in the connecting rod.
4. When it has been pressed in the bushing must be reamed or better still precision-drilled to the right size; see "Specification".
5. If the fit between the piston pin and the piston-pin bushing is correct, it should be possible to feel a slight play when the parts are dry. If the bearing surfaces are oiled the play should no longer be perceptible.

Checking and straightening a connecting rod

Connecting rods should be checked and if necessary straightened in a tool intended for this purpose. The method is as described below.

1. After checking and if necessary renewing the piston-pin bushing, fit the bearing cap according to the marking and tighten the nuts.
2. Set up the connecting rod in the tool using the expander, and put the piston pin belonging to it into the piston-pin bushing. Then set the gauge on the piston pin.

With the gauge tips horizontal, check whether the connecting rod is twisted.

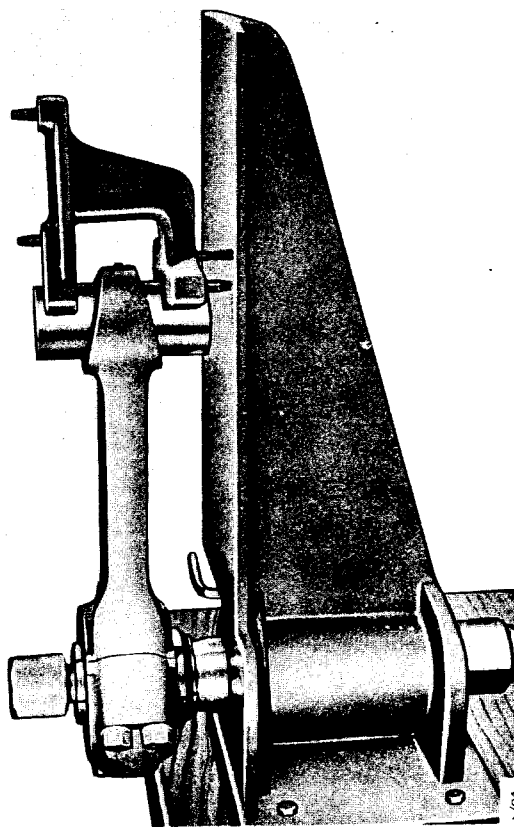
With the gauge tips vertical, check whether the connecting rod is bent.

3. Check also to see whether the connecting rod is bent in the form of an S. Do this by measuring the distance between the outer side of the piston-pin bushing and the plane surface of the tool.

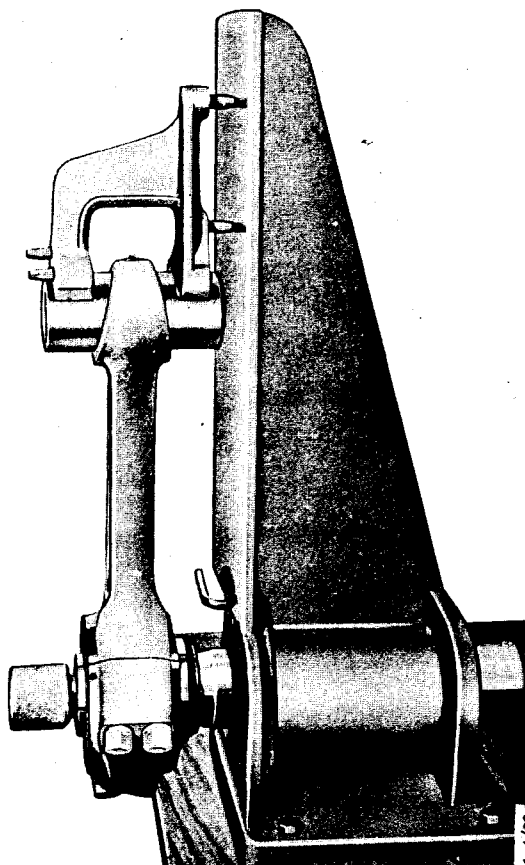
Reverse the connecting rod and take the corresponding measurement. The difference must not be more than 0.6 mm.

It is inadvisable to straighten connecting rods. Defective connecting rods should therefore be changed.

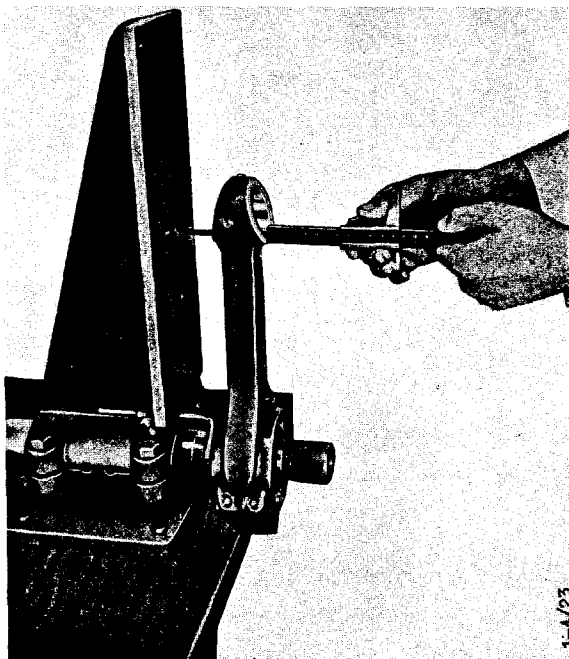
Important. Concerning the fitting of the piston pin and the fitting of the piston with connecting rod, see "Pistons and Piston Rings".



Checking whether the connecting rod is twisted, using the gauge



Checking whether the connecting rod is bent, using the gauge



Checking whether the connecting rod is bent in S-Shape

Piston and Piston Rings

Fitting a piston pin

The fit between the piston pin and the hole for the pin in the piston must be kept within quite narrow limits, for which reason every piston and piston pin is classified. Classification is carried out by division into tolerance groups.

A used piston pin must not be fitted in a new piston.

Pistons with differently shaped combustion chambers occur on certain basic engine designs. Therefore, when replacing the piston check to see that the piston recommended for the engine in question is fitted.

The piston-pin hole is offset to one side in the piston, and it is therefore important that the pistons are always fitted into the engine with the marking facing forwards. Since the connecting rods, too, may only be fitted one way round it is necessary to see that this marking faces the proper way right from the beginning when the piston is being fitted onto the connecting rod.

Changing Piston Rings

Normally speaking, re-ringing has not shown itself to be necessary as a maintenance measure. As a rule, the need does not arise until the engine as a whole is worn.

New piston rings, the top ring being chromium-plated, should be fitted only in the cases given below, provided that the running-in can be effected carefully according to our instructions.

It may therefore be advisable to use piston rings of un-chromed design for the top ring groove also on request for comparatively short running-in periods. For certain type engines in such cases the top piston ring of molybdenum design is recommended instead, which has more favourable running-in qualities.

More detailed directions are given as appropriate in separate instructions.

1. Remove the old piston rings. Use a pair of piston-ring tongs so as not to scratch the sides of the piston.
2. Clean the pistons and connecting rods. The piston-ring grooves can best be cleaned with a special scraper. Be careful of the sides of the grooves, so that the scraper does not remove stock from the piston but only the impurities. This is because it is important that the piston rings seal properly against the sides of the grooves. Clean out the oil holes inside and below the scraper rings using suitable drills, turning the drills by hand.

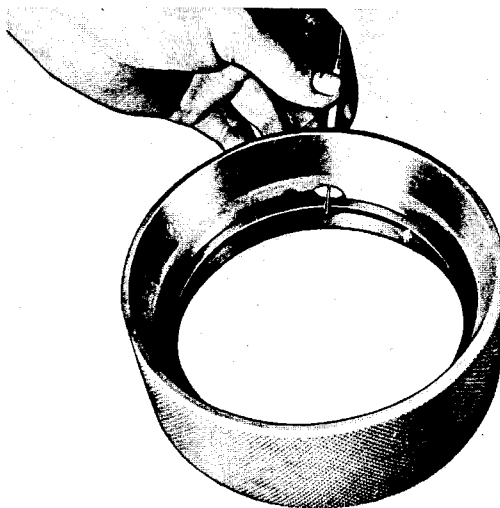
3. Check the axial play of the new rings with the aid of a feeler gauge.
4. Before putting new piston rings onto the piston the piston-ring gap must be checked. Use the piston-ring compressor. It has the same inside dimension as a new cylinder liner. Push the piston ring down using a piston until the piston-ring gap is opposite the hole in the side of the piston-ring compressor.

Check the piston-ring gap using the gauge. If the gap is too small, correct it with a piston-ring file.

5. The easiest way to fit piston rings is to use a pair of piston-ring tongs. With other methods it is easy to damage rings. The compression rings have different gaps, so be careful to put the right ring into the right groove.

Conical piston rings shall be fitted with the marking side facing upwards.

N.B. After re-ringing, the engine must be carefully run in. A good way is first to run the engine for an hour off load at a good speed, about 1200 r.p.m., and then to drive the vehicle quietly for the first 10 hours (500 km).

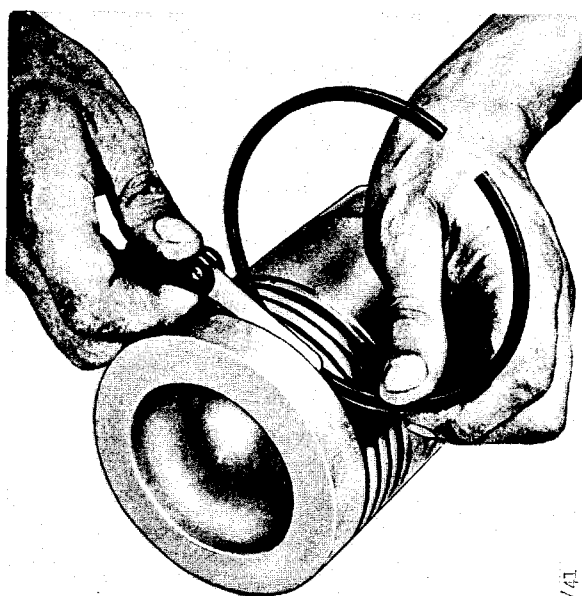


1-4/40

Checking the piston ring gap

Fitting a Piston Pin

When the piston pin is to be fitted the piston must be heated to the stated temperature. Note that the piston pin must not be knocked in; it must be possible to push it in by hand using moderate force.



1-4/41

Check the axial play of the piston rings

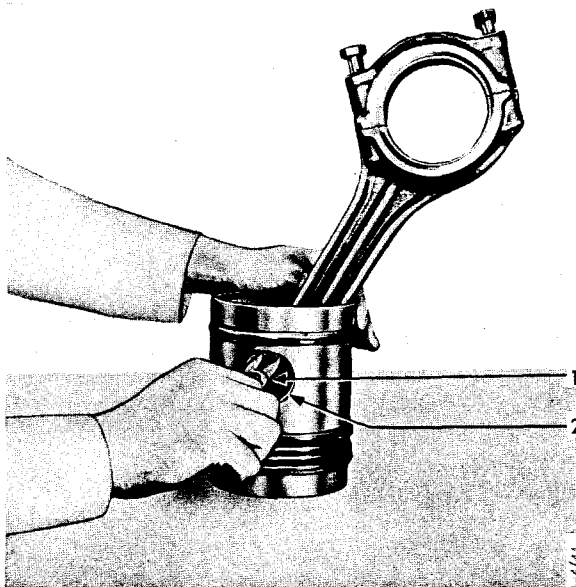


1-4/43

Fit the piston pin with the drift

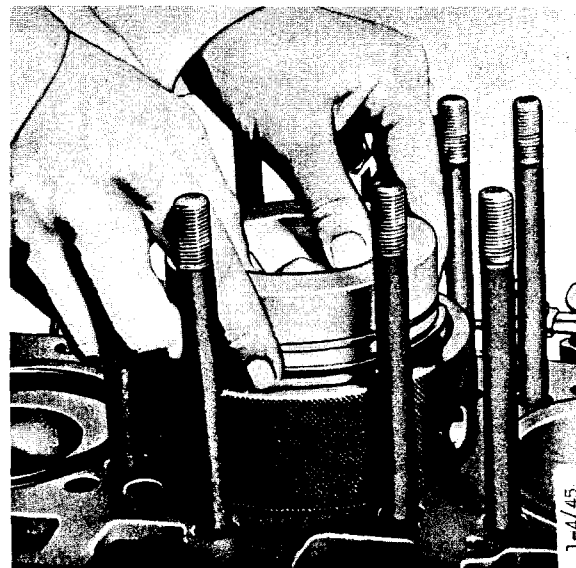
1. Drift
2. Piston pin

1. Heat the piston to the stated temperature.
2. Get the piston and connecting rod the right way round in relation to each other.
3. Fit the piston pin using the drift.
4. Fit the retaining rings of the piston pin.



Fit the retaining rings of the piston pin

1. Retaining-ring pliers
2. Retaining ring



Fit the piston with connecting rod into the cylinder

5. Put the bearing shells into place in the connecting rod and cap. See that they are the right way round, so that the lugs drop properly into their grooves. Lubricate the crankpin with engine oil.
6. Fit the cap and put new lock washers under the bolts, which must be well oiled. Take great care in tightening the bolts. Tighten them to the stated torque and lock them by turning up the tabs of the lock washers.
7. On D/DS11 beginning from engine No. 880840 with injection nozzles for oil cooling of pistons, refit the nozzles. The position of the nozzles is fixed by pins in the nozzles. The pins are guided into corresponding holes drilled in the block. The fixing bolts are then tightened to the prescribed torque. Check that the nozzles are correctly fixed before the fixing bolts are tightened up.

Fitting a Piston with Connecting Rod

1. Liberally oil the piston, piston rings, cylinder liner and piston-ring compressor with engine oil.
2. Spread the ring gaps round the piston so that they do not come directly one above the other.
3. Remove the protective coverings from the crank-pins.
4. Fit the piston with connecting rod into the cylinder, using the piston-ring compressor which will squeeze the piston rings together as the piston is being pushed down into the cylinder. Turn the connecting rod the right way round as shown in the figure under the heading "Fitting the Crankshaft".

TIMING GEARS

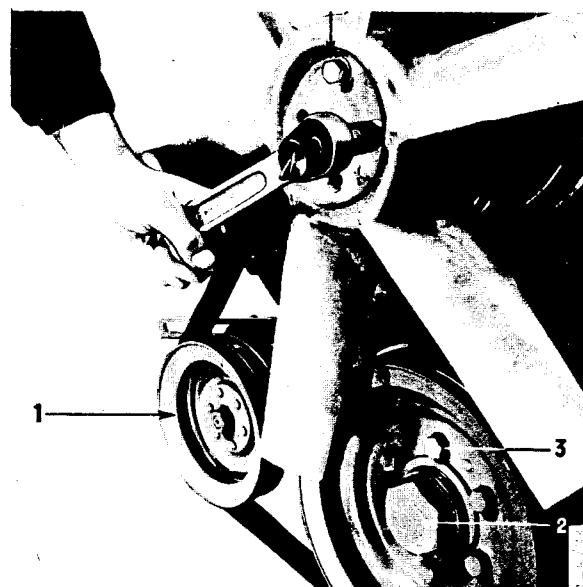
Dismantling the Timing Gears

Removing the Hydraulic Pump of the Power Steering

1. Drain off the hydraulic fluid.
 2. Undo the hose connections at the pump and the two nuts that secure the pump to the timing-gear casing.
- Fit protective plugs.
3. Pull out the pump. See that the five rubber bushings on the driver pins come out with it.

Removing the Vibration Damper

1. Reduce the belt tension by slackening the retaining screws of the generator and the screw in the generator support. On engines equipped with a tensioning pulley, undo the nut in the centre of the pulley.



Removing a Hydraulic Pump with a Broken Shaft

The pumpshaft is so designed that the coupling between the shaft and the driver breaks when the hydraulic pump is subjected to abnormal overloads, caused for instance by impurities in the hydraulic fluid. On some hydraulic pumps there is a spring with a ball, which is held in position by a metal washer in the centre of the driver and which thrusts the broken surfaces apart. The engine can still be run and the vehicle can also be steered, although the steering gear will now function as a purely mechanical unit.

A hydraulic pump whose shaft is thus broken must be removed with great care, since the spring and ball might otherwise drop into the engine. If this should occur, the lost parts must of course be recovered to prevent damage to the engine.

When the hydraulic pump is being removed and replaced the rubber bushings on the driver pins must be changed.

Remove the fan and the pulley

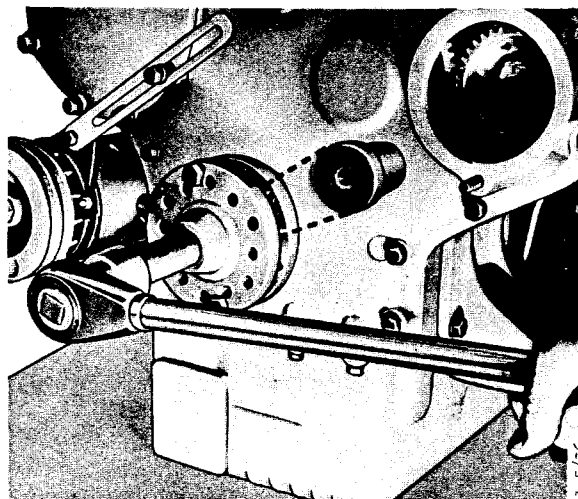
1. Belt pulley for generator
2. Bolt for hub of pulley and vibration damper
3. Bolts securing the pulley and vibration damper to the hub
4. Bolts securing fan and pulley to the flange on the coolant-pump shaft

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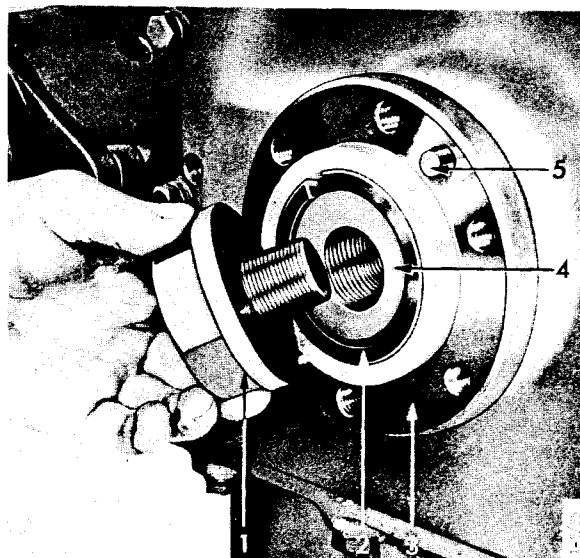
- Undo the bolts in the fan hub and lift off the fan, the belt pulley and the fan belts.
- Remove the coolant pipe and the drain pipe connected to the compressor.
- Undo the retaining screws of the large belt pulley, and take off the pulley and the vibration damper from the end of the crankshaft.

Lay the vibration damper where it cannot be subjected to any damage, since the slightest deformation of the damper housing may put the vibration damper out of action, which can result in crankshaft failure.

- Undo the screw on the crankshaft using the socket wrench.



Pull off the hub of the vibration damper



Attaching the hub

- Screw
- Split conical sleeve
- Hub
- End of crankshaft
- Dowel
- Take out the conical sleeve.
- Place the thrust plug in the end of the crankshaft.
- Pull the hub of the vibration damper off using the puller.

Removing the Timing-gear Casing

- Undo the screws round the timing-gear casing and the oil pan.
- Take off the oil deflector. In order to get at the lubricating-oil pump the oil pan must be completely detached and lifted down. On later engines with front crankcase sealing of cuff type the oil deflector is not fitted.

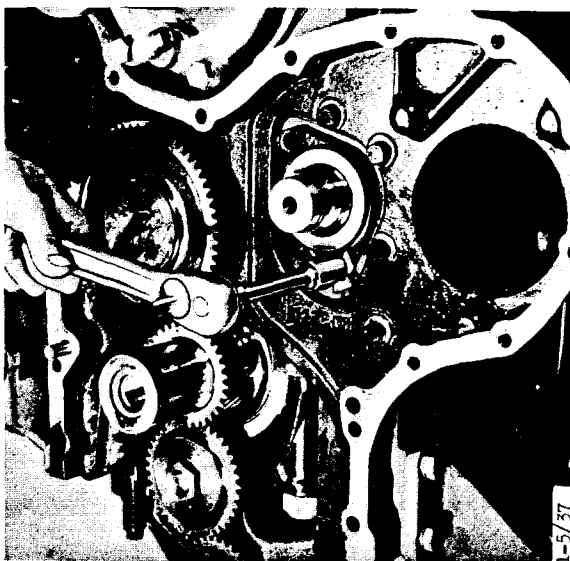
Removing the Compressor

- If the driving wheel of the compressor is to be detached from the compressor shaft, first remove the driver plate of the hydraulic pump and then the centre nut.
- Remove the water hose between the coolant pump and the lower part of the radiator.
- Detach: lubricating-oil pipe to compressor, hose clip on line for return coolant, pressure-regulator pipe, cooling coil for compressor air, connection for incoming coolant, hose from anti-freeze bottle, and nuts that secure compressor to timing-gear housing.
- Lift off the compressor and make sure of the rubber ring sited inside the attachment flange.

Removing the Camshaft with the Camshaft Gearwheel

It is not necessary to take the camshaft gearwheel off the camshaft in order to be able remove the camshaft from the engine. But the following steps must taken:

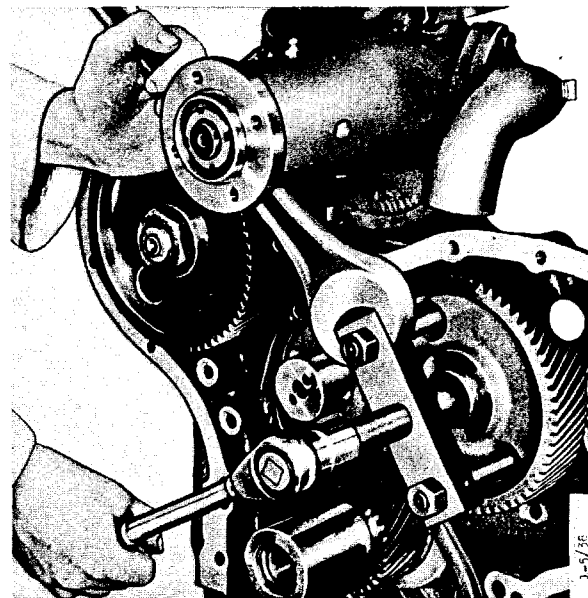
1. Take off the valve covers.
2. Detach the rocker-arm mechanism. Note that the lubricating-oil pipe, which is fitted to certain types of engine, must be detached first.
3. Lift out the pushrods.
4. Undo the screws holding the side covers and take the covers off.
5. Lift the valve lifters out and place them in order, e.g. in a drilled board.
6. Rotate the camshaft until one of the screws for the locating flange behind the camshaft gearwheel becomes visible. Undo and remove the screw and rotate the camshaft so that the other screw can be removed.
7. Pull the camshaft straight out so as not to damage the bearings.



Undo the screws of the camshaft locating flange. If the wheel is still on the camshaft, undo the screws through holes in the camshaft gearwheel

Removing the Camshaft Gearwheel

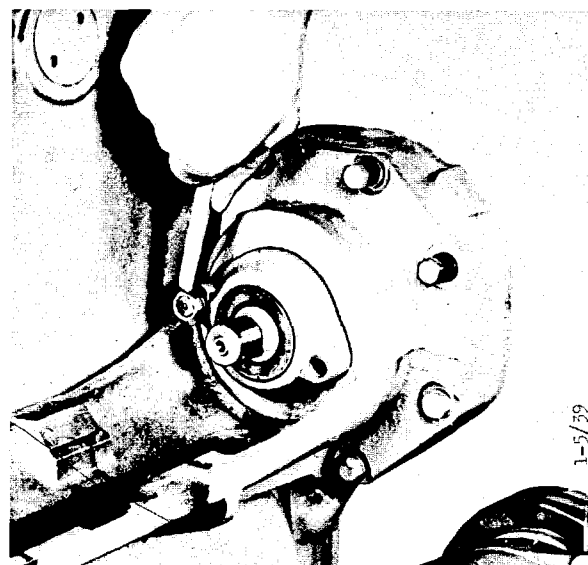
1. Knock down the lock washer and undo the nut.
2. Pull the wheel off using the puller.



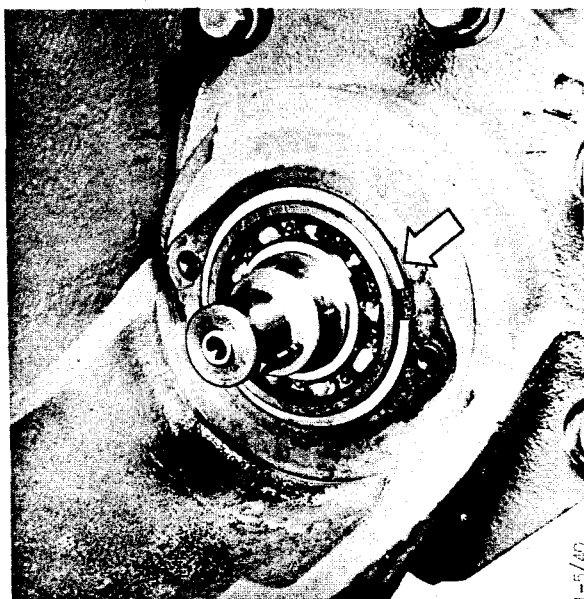
Remove the camshaft gearwheel

Removing the Driving Shaft of the Injection Pump

1. Remove the injection pump according to the instructions given in the section headed "Fuel System".
2. Undo the screws of the sealing-ring holder and pull it off the end of the shaft.

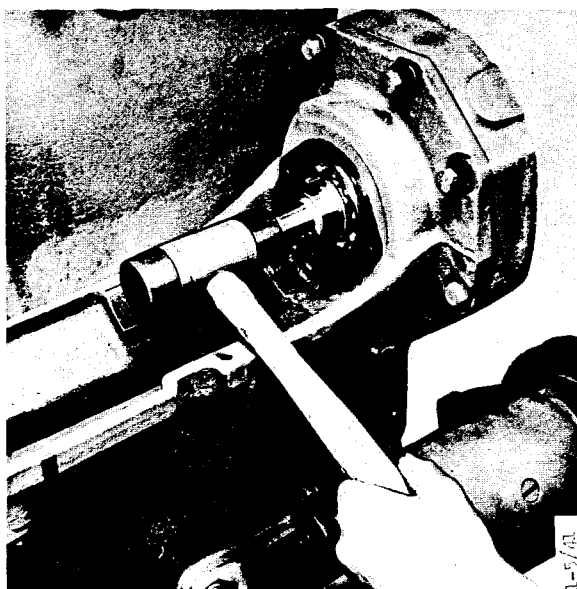


Undo the screws of the sealing-ring holder of the driving shaft of the injection pump



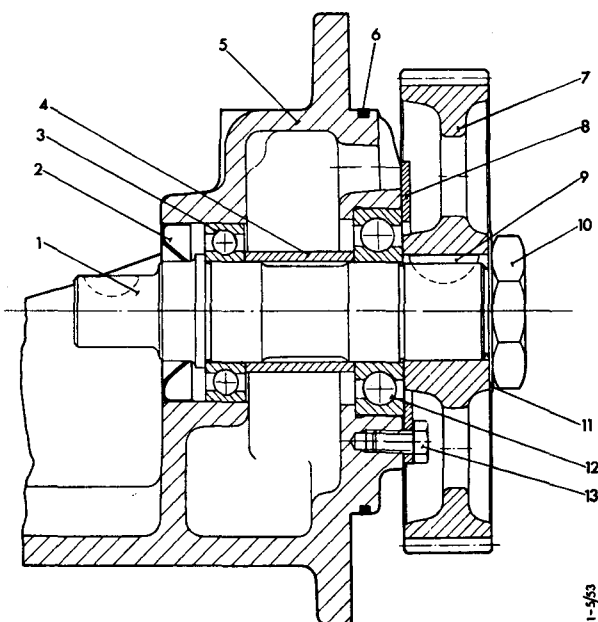
Remove the retaining ring in the rear bearing of the driving shaft

3. Remove the retaining ring in the outer ring of the rear ball bearing.
4. If the gearwheel or the front bearing is to be changed, undo the nut.
5. Knock the driving shaft out to the front using a fibre mallet.



Knock the driving shaft out to the front with a fibre mallet

On later engines there is a pump shelf fitted where the rear sealing ring holder and lock ring for the rear bearing are discontinued. Instead the front bearing is secured with a lock washer, see fig.



INJECTION PUMP DRIVE

- | | |
|-------------------------------------|------------------|
| 1. Driving shaft for injection pump | 8. Washer |
| 2. Sealing ring | 9. Wedge |
| 3. Ball bearing | 10. Nut |
| 4. Spacer sleeve | 11. Lock washer |
| 5. Pump shelf | 12. Ball bearing |
| 6. O-ring | 13. Screw |
| 7. Pump gearwheel | |

Once the lock washer screws have been removed the driving axle can be removed according to that described above.

Removing and Fitting the Pump-shaft Gearwheel

The nut of the wheel can best be undone while the driving shaft is still in place in the engine and the wheel is locked (see above).

Press off the gearwheel, the bearing and the spacer ring. Carry out reassembly in the reverse order.

Removing the Idler Gear and Stub Shaft

1. Undo the two-screws securing the washer to the shaft of the idler gear. Remove the washer.
2. Take off the front thrust washer, the idler gear and the rear thrust washer.

- To remove the stub shaft, undo the two screws in the shaft flange. Pull out the stub shaft.

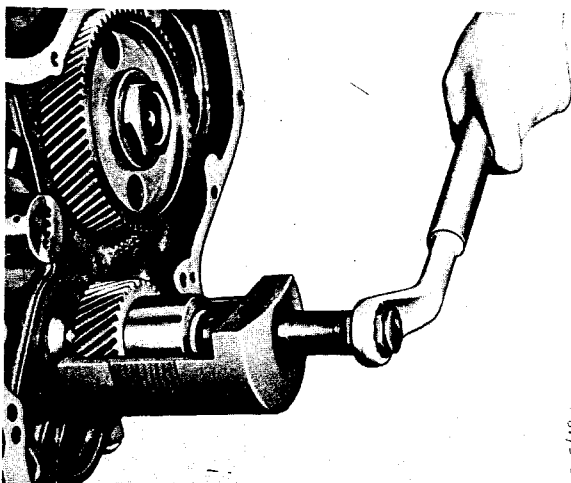
Removing the Crankshaft Gearwheel

The gearwheel need only be removed if it is damaged or worn.

Remove the oil pan; see the section headed "Lubricating System" (1).

Remove the key of the vibration-damper hub.

Put on the puller of the crankshaft gearwheel, and the thrust pad, and pull off the gearwheel.



Pull the crankshaft gearwheel off with the puller

Removing the Lubricating-oil Pump with Idler Gear

See the section headed "Lubricating System".

Changing Camshaft Bushings

The camshaft and the camshaft bushings suffer only negligible wear, and it is extremely rare for these items to require any attention. But in carrying out engine reconditioning, check that the bearing surfaces and the cams are not abnormally worn. If any bushing has been damaged, all bushings should be changed.

Press the new bushings in so that the oil holes come in line with the oil passages in the engine block.

After being pressed in the bushings must be machined to the stated dimensions. The use of a boring machine must be available if this work is to give fully adequate results.

Fitting the Injection Pump Shelf

In order to guarantee that the correct clearance is obtained between the pump and the intermediate gearwheels and that no strains are likely to occur between the pump shelf and the timing gear housing, the pump shelf shall be fitted according to the following:

- Securely bolt the pump shelf to the timing gear housing with two diametrically opposed bolts. The bolts shall not be tightened to max. torque, but sufficiently tight so that the pump shelf lies flush against the timing gear housing.
- Securely bolt the bracket under the pump shelf against the cylinder block. The bracket shall at the same time be pressed up against the pump shelf.
- Securely bolt the bracket to the pump shelf.
- Securely bolt the pump shelf to the timing gear housing.

Assembling the Timing Gears

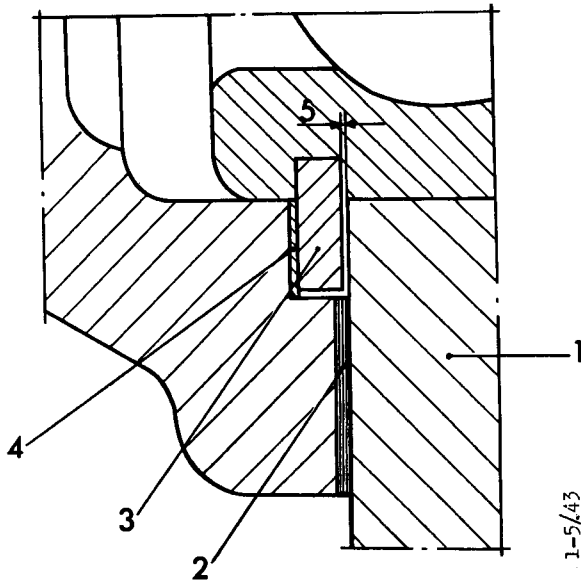
Fitting the Crankshaft Gearwheel

- Fit the key and check that it is not too high.
- Warm the wheel in a water bath. Turn the marking (0) to face forwards, and push the wheel into position on the stub shaft.

Fitting the Driving Shaft with the Pump-shaft Gearwheel.

- Drive the shaft in from the front with a fibre mallet, and match the two teeth so that a marked tooth fits into a marked tooth space on the idler gear.
- Put the retaining ring into its groove in the outer ring of the rear bearing. On later engines tighten up the lock washer in front of the front bearing.
- Check to make sure that the lip in the sealing ring is free from defect and is in its correct position. Then fit the sealing ring holder. Afterwards, check the axial clearance of the driving shaft, which shall be in accordance with the value indicated before the gasket between sealing ring holder and pump shelf has been pressed together (before the fixing screws of the sealing ring holder have been tightened up properly). Compare the figure below. The clearance is adjusted by using shims, which are available as spares in different thicknesses.

4. Tighten up the sealing ring holder.
5. Fit the injection pump, see the appropriate section "Fuel System".



1-5/43

Axial clearance of Driving Shaft .

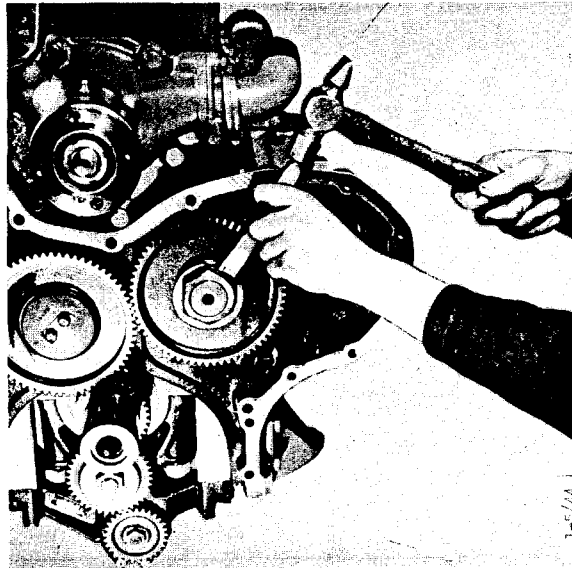
1. Pump shelf
2. Gasket
3. Retaining ring for ball bearing
4. Shim
5. Clearance between retainer ring and pump shelf shall be in accordance with the value indicated. Does not apply to engines of more recent design where the front bearing is secured with a lock washer.

Fitting the Camshaft and Camshaft Gearwheel

When the camshaft is being pushed into its bearings, take great care so as not to damage the bearing surfaces. If the oil pan has been taken out, it is a good plan to support the camshaft with one hand in the crank chamber.

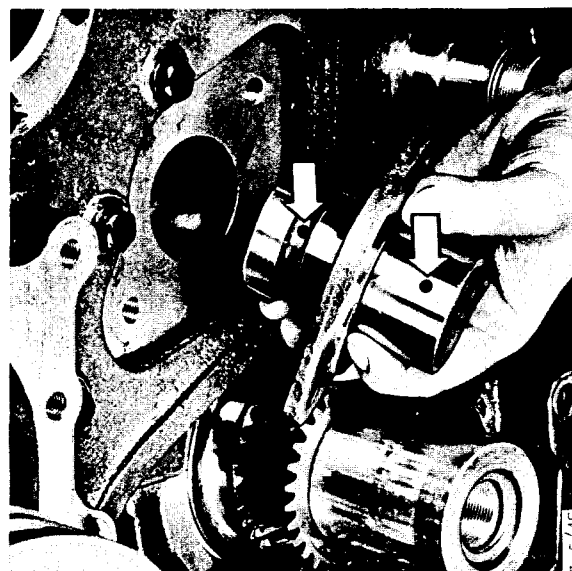
Put on the locating flange, make it tight with the two screws and lock it.

Warm the wheel in water and push it onto the end of the shaft so that a marked tooth fits into a marked tooth space on the idler gear (see the figure). Do not drive the cold wheel onto the shaft with a drift and a hammer, since this could leave the shaft crooked or otherwise damaged. Make the nut tight and lock it with a lock washer.



Lock the nut of the camshaft

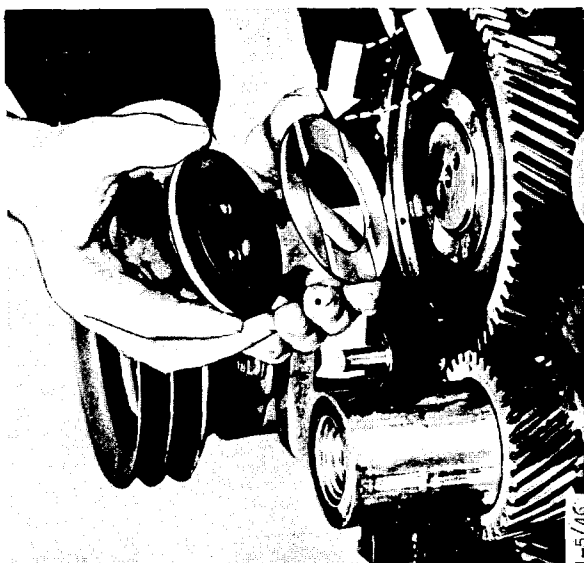
The wheel can also be fitted onto the camshaft while it is out of the engine. In this case, do not forget to begin by putting on the locating flange, and be careful not to damage the camshaft.



Recess and oil passages in shaft for idler gear

Fitting the Stub Shaft and Idler Gear

In the seat that takes the stub shaft in the cylinder block there is an oil passage. It is in communication with the recess and oil passage in the stub shaft. Oil is forced from the lubricating system of the engine through the stub shaft to the journal bearings and thrust washers of the idler gear. The oil that leaks through splashes out through the holes between the teeth and lubricates the whole timing-gear assembly. It is therefore very important to see that the idler gear and the thrust washers are fitted according to the directions given in points 2, 3 and 4.



Position the thrust washers with the oil grooves turned to face the idler gear

4. Fit the outer thrust washer with the oil grooves facing the wheel.
5. Fit the outermost washer. Do not lock the screws until the final check on the tooth play has been made.
6. Check that the outer thrust washer is not being pinched. It should be possible to move it slightly by hand.



The markings on the timing gears

1. Fit the stub shaft for the idler gear and check that there is nothing to prevent the oil from the oil passage in the cylinder block from passing through the stub shaft out to the bearing end on the shaft. There must be no gasket beneath the flange.
2. Fit the inner thrust washer so that the oil grooves face the wheel.
3. Turn the idler gear so that the radially drilled holes face forwards. This means that the stamped marks will also face forwards. Push the idler gear on so that the marked tooth spaces fit round a marked tooth on the crankshaft gearwheel, the camshaft gearwheel and the pumpshaft gearwheel respectively. At the same time check the tooth play in the timing gears: see under the heading "Checking the Tooth Play in the Timing Gears".

Checking the Tooth Play of the Timing Gears

Check the tooth play in the timing gears. The play is normal when it is possible, with all gearwheels fitted, to push the idler gear in on its stub shaft by hand using moderate force.

If the idler gear cannot be pushed in this way, it must not be driven in; the reason for the tight fit must be eliminated.

In the event of excessive play and noise in the timing gears, worn gearwheels should be changed.

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Check to see that the timing gears are correctly meshed and market

After the new timing gears have been fitted a check should be made to see that the gears are correctly meshed and market. By following the method of procedure below this check can even be done without it being necessary to dismantle the timing gear housing.

1. Check to make sure that the valve clearance for the intake valve on the first cylinder is that prescribed.
2. Turn the crankshaft in its direction of rotation until the piston for the 6th cylinder is travelling upwards in a state of compression. For D/DS5 this applies to the 4th cylinder. Both the valves for the 6th and 4th cylinders respectively are now in closed position.
3. Continue to turn the crankshaft until the intake valve for the 1st cylinder begins to open. The number of graduations indicated for respective engine when the intake valve begins to open. T.D.C. shall now correspond to that of the graduation on the flywheel. Wrong marking or faulty assembly of a tooth on the crankshaft or camshaft gearwheel will give approx. 11° faulty deflection of graduation on the flywheel.

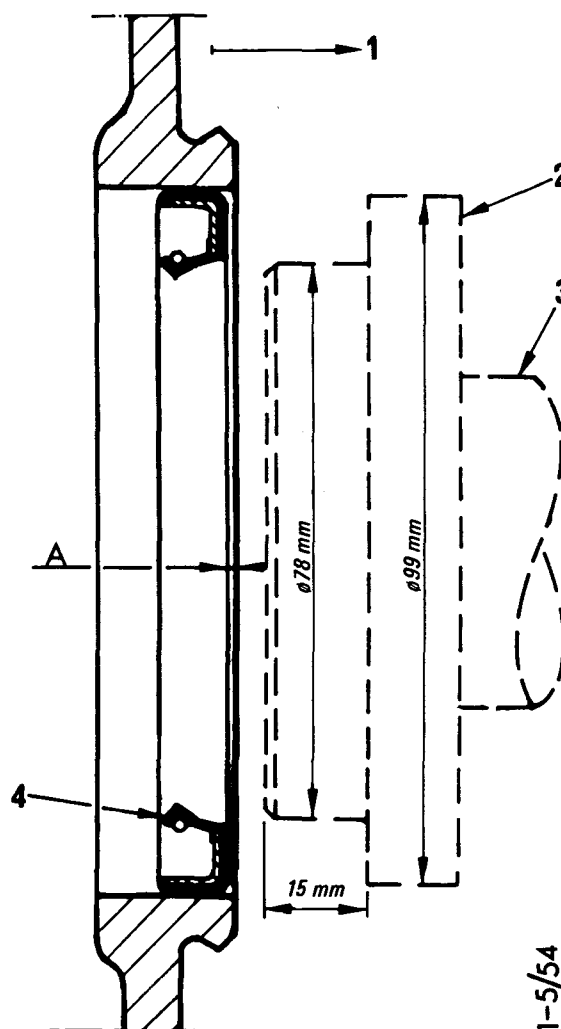
Fitting the Timing-gear Casing

Change the felt ring in the timing-gear casing. Thoroughly soak the new felt ring in engine oil before putting it into the groove.

Put the oil deflector in and fit the timing-gear casing.

Changing the cuff sealing in the timing gear housing

On later engines cuff sealing is fitted instead of felt ring. The oil deflector has in conjunction with this been removed. When changing the cuff sealing in the timing gear housing proceed as follows:



1. Front end of engine
2. Pressing plate
3. Pressing drift
4. Cuff sealing

When replacing the sealing proceed as follows:

1. It is already assumed that the timing gear housing is removed.
2. Tap out the old cuff sealing ring by using a hammer and drift. When doing so make quite certain that the sealing contact surface in the housing is not damaged by the drift.
3. Check to be sure that the contact surface in the housing is faultless — examine the hole very thoroughly in the event of signs of oil leaking between housing and the ring.

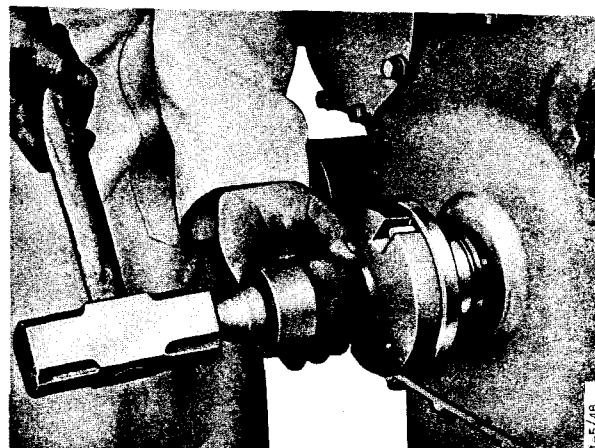
4. Check the sealing surface on the vibration damper hub. In the event of considerable abrasion marks being found once the sealing ring has been removed, the new ring when fitted in the housing must be displaced sufficiently so that it seals against a surface on the vibration damper hub which is not worn (see below).

Remarks: In cases of possible oil sealing leakage, despite the fact that this and the sealing surface of vibration damper hub are in good condition, a check ought to be made to see that the clearance in the crankshaft main bearings is not larger than usual.

5. Examine the new sealing ring, make certain among other things that the sealing lip is not damaged in any way.
6. Put the timing gear housing in a press with the bond of the housing against the engine block turned downwards.
7. Lubricate the sealing ring with engine lubricating oil and slip it on a press plate guide with the open side of the ring turned in the direction of pressing (= backwards, to engine block until the housings is fitted in, compare fig.).
8. Press down the press plate slightly and carefully at the same time closely observing that it is guided into the hole all the way round and does not turn over.

In the event of considerable abrasion marks on the vibration damper hub, the position of the ring shall be moved back by increasing dimension A by 2 mm for each time. Max. movement = 10 mm (dimension A = 10 mm).

After final check of the rings position and, once the timing gear housing has been fitted, lubricate the sealing ring and corresponding sealing surface on the vibration damper hub liberally with engine lubricating oil before the vibration damper hub is fitted.



Drive the hub on with the drift

Fitting the Compressor

Fit the compressor after first fitting a new rubber ring into its groove ahead of the attached flange. Make the compressor tight and connect up the pipes that were disconnected in removing it.

Fitting the Hydraulic Pump of the Power Steering

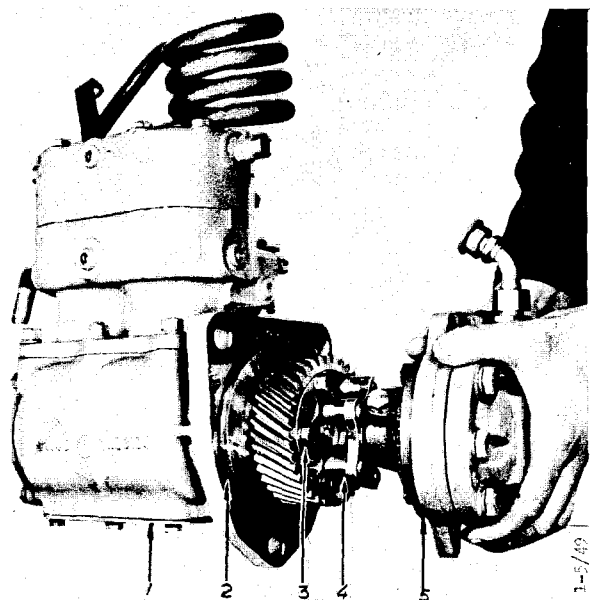
Fit the pump so that the rubber bushings on the driver pins fit into the corresponding holes in the driver plate in the driving wheel of the compressor. Make the nuts tight.

Remove the protective plugs and connect up the hose couplings. Fill up with hydraulic fluid.

Fitting the Vibration Damper

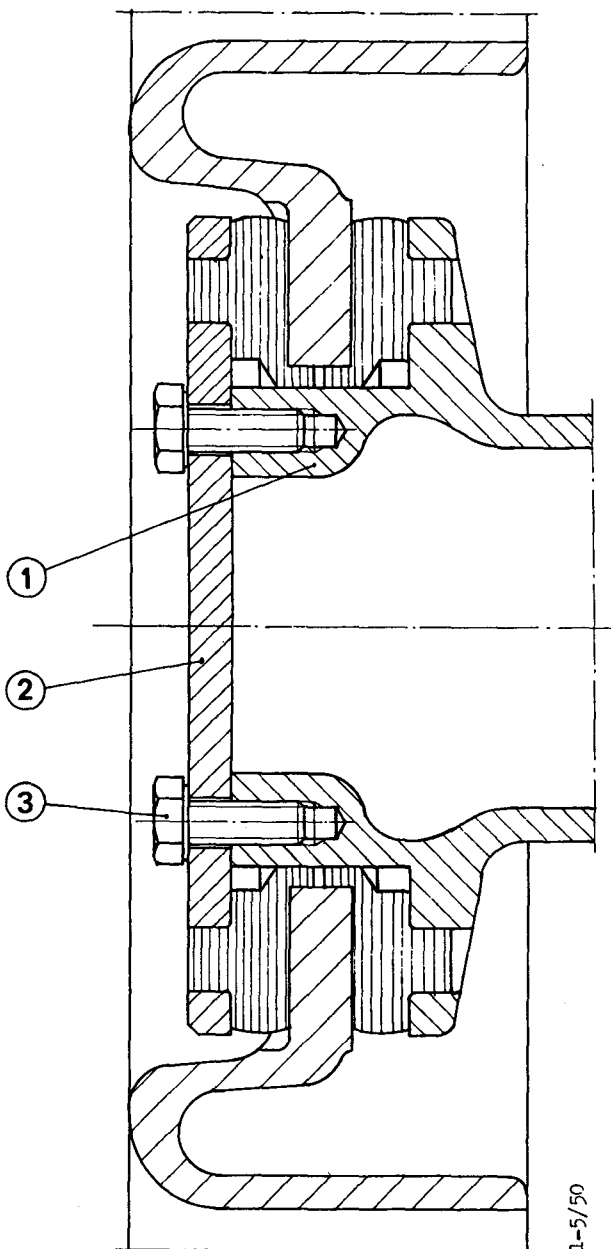
Drive the hub on with the drift.

Tighten the bolts of the vibration damper and the screw in the front end of the crankshaft to the stated torque.



Hydraulic pump and compressor

1. Compressor
2. Rubber ring
3. Driver plate
4. Driver with rubber bushings
5. Hydraulic pump



Attaching the cooling fan

1. Fan hub
2. Washer
3. Fixing screw

Fitting the Cooling Fan on the D8 Series Engines in the LB80 Series Chassis.

The fan is fitted on the crankshaft between the rubber elements. On being fitted these rubber elements are compressed when the screws are tightened, compare figure.

It is, therefore, very important that washer 2 when being fitted is tightened properly with all screws so that it lies flush against the fan hub. Otherwise, there is risk that the screws will gradually break on account of fatigue. Incidentally, the screws must be tightened up half a turn at a time so that the washer will not slant too much when the rubber elements are pressed together. Finally tighten the screws to the prescribed torque.

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LUBRICATING SYSTEM

Oil Pan

Removing the Oil Pan

1. Drain off the engine oil by screwing out the drain plug.
2. Screw out the screws of the oil pan.
3. Lift down the pan, take out the baffle plate and relief valve and clean the parts.

Fitting the Oil Pan

In fitting the oil pan a new gasket and a new O-ring at the sealing sleeve in the passage to the relief valve must be used.

To ensure adequate sealing it is important that the gasket and all sealing surfaces are absolutely dry and clean when the gasket joint is put together. If the gasket is smeared with any kind of sealing compound it may be spoiled by plastic deformation when the screws are being made tight.

1. Lift the oil pan into place. See that the gasket is correctly positioned.
2. The screws must be tightened evenly and to the correct torque. Excessive tightening may deform the seating surface of the oil pan against the gasket and render it uneven.
3. Put in fresh oil and check the oil level and oil pressure. Check also that the oil pan is free from leaks.

Lubricating Oil Pump

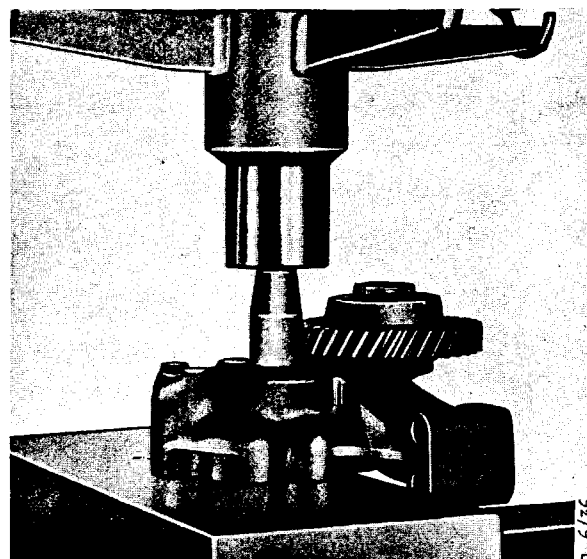
Removal

To remove the lubricating-oil pump and its idler gear only, it is merely necessary to drop the oil pan.

1. Remove the suction pipe.
2. Remove the screws that secure the pump and its bracket to the cylinder block on either side of the front main bearing.
3. Lift out the pump. Pay attention to the dowels and the gaskets.

Inspection and Reconditioning

1. Dismantle the pump. Do not forget to remove the key of the pump wheel before the inner rotor is taken out of the pump housing.
2. Thoroughly clean all parts.
3. Inspect the pump. Change worn bearings and wheels. Ream the bushings for the rotor shaft after pressing them in. If necessary, grind the pump cover flat.



Press in the bushings for the rotor shaft

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4. Inspect the rotor set and replace it by a new one if it is worn.
5. Assemble the pump, using new O-rings.
6. Check that it runs easily.

Fitting

Fitting is carried out in the reverse order to removal. Always fit a new O-ring at the pressure passage.

After fitting the pump, always check that there is a clearance between the studs of the main bearing caps and the pump bracket.

Put in oil, give the engine a test run and set the oil pressure to the correct figure by means of the relief valve.

Reconditioning the Lubricating Oil Pump of Gear type

The wear on the oil pump is insignificant. On reconditioning an engine the pump should be thoroughly checked. This applies particularly where signs of excessively low oil pressure occurs. The checking values for the pump are indicated in the section "Specification, Setting Values and Tools".

DISMANTLING

Very carefully clamp up the pump gear 8 in a vice with copper jaws and undo the stop screw 7 (left thread) and the stop nut 5.

Undo the gear 3 with aid of puller. Put on one side the washer 6 and the key 4.

Put the pump in the press and press pin 11 out of the pinion 8. See to it that a suitable press plate is placed under housing on the opposite side through which pin 11 can be pressed down.

Knock out the bearing 12 from the bearing housing. Note that owing to retaining ring 9 the bearings must be removed from the opposite side. Put on one side the spacer washer 10.

Unscrew the pump housing fixing screws 17 and remove the pump housing cover and gear.

INSPECTION

If the pump housing is noticeably worn it does not pay generally speaking to repair the pump. However, should the bushings, pump gears, and roller bearings show signs of wear excellent results can be obtained by replacing these.

When replacing the bushings these should be pressed out in the pump housing and cover respectively by using a suitable drift, which distributes the pressing pressure so that it covers as large a surface on end of bushing as possible.

After pressing in the bushings these shall be machined (reamed) to the specified measurements and surface finish.

When machining the bushings, the pump housing cover shall be fitted on the pump housing and centred by its guide studs and the fixing screws 17 must be tightened to the prescribed torque.

After machining check to see that the shaft clearance of the gearwheels is that recommended. Then dismantle the pump housing again and clean it thoroughly. Note that among other things the lubricating hole to the idler gear bearing must be very carefully cleaned.

FITTING

Well lubricate all the surfaces on the pump gears with engine lubricating oil and put the gears in the pump housing. Check that the guide studs for the pump housing cover are fitted in the pump housing and that they are faultless.

Check that the sealing plane between the pump housing and pump housing cover is faultless and fit the cover on the housing with a new gasket in between. Tighten up the fixing screws to the prescribed tightening torque. On lubricating oil pumps of recent design the clearance between pump housing cover must be measured, so that a gasket of a suitable thickness is fitted. The new packing should have been fitted when the clearance was measured.

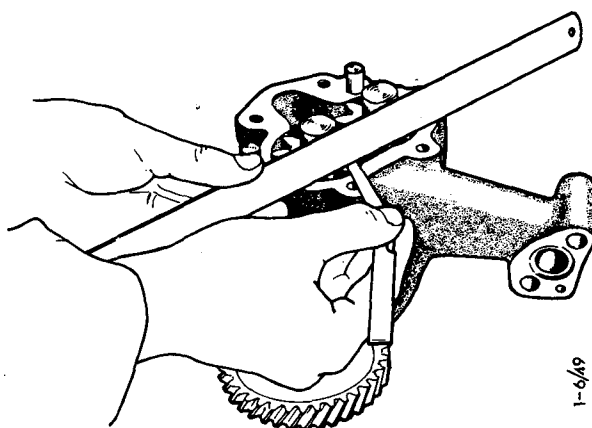
Press in new bearings 12 in the pump housing cover. First check to see that the lock ring opening 9 is turned facing the lubricating hole and that the spacer ring 10 is fitted between the bearings.

Press in the stud 11 and then press on the gearwheel 8 and thread in the lock screw 7 (note left thread).

Fit key 4, gearwheel 3, new lock washer 6 and screw on nut 5.

Put the pump housing in a vice with copper jaws and clamp up the gearwheel 8 very carefully. Then tighten the lock screw 7 and nut 5 to the prescribed torque and fold up the lock washer 6.

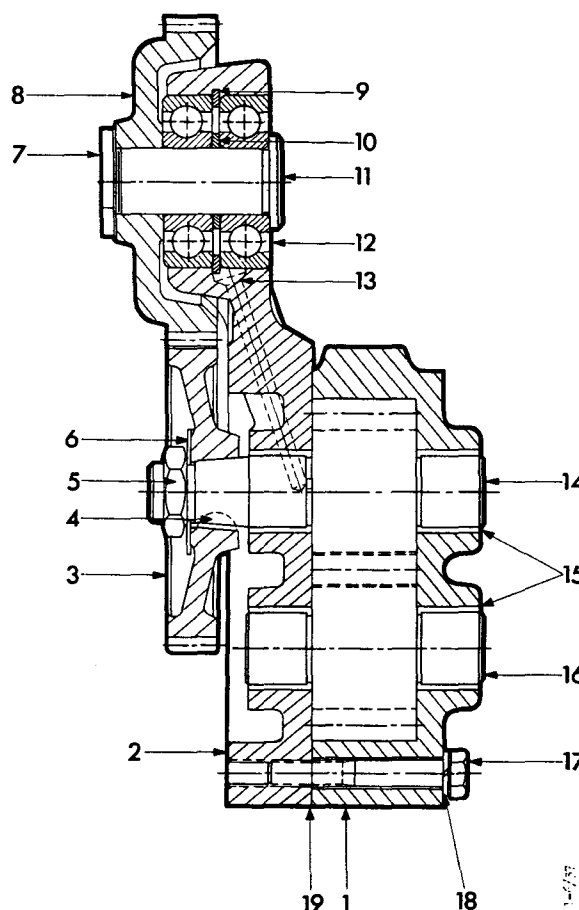
Well lubricate the gearwheels 12 with engine lubricating oil.



The clearance between pump gearwheel and pump housing cover is checked with a steel ruler and feeler gauge.

f) In order that the clearance shall lie within the limits indicated a gasket is selected with a thickness of 0.07 mm

g) The clearance will then be: 0.06 mm + 0.02 mm (increase of gasket thickness) = 0.08 mm



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The clearance measured shall be reduced by 0.02 mm which is the amount the gasket "settles to", when the fixing bolts are tightened up. Then all depending on the clearance measured, a suitable gasket is chosen for use. There are three thicknesses, see "Specifications, Setting Values, Tools".

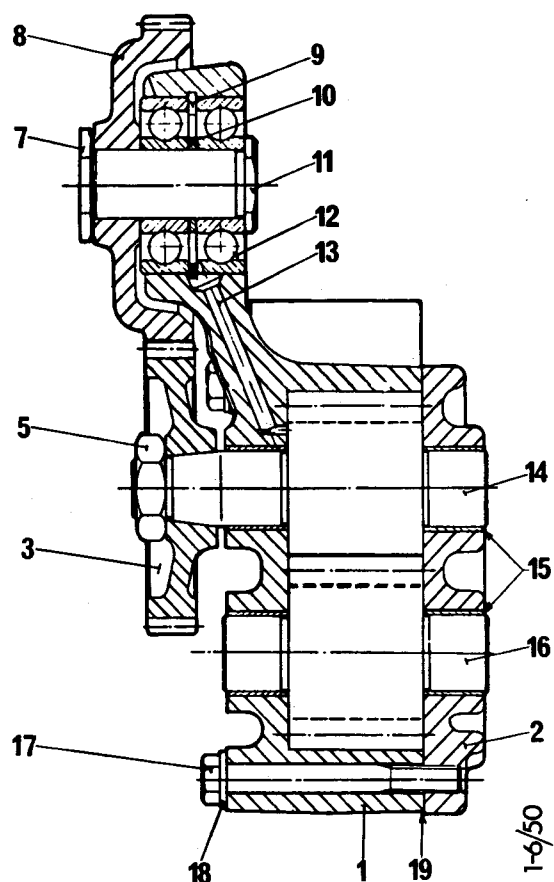
Example for determining gasket thickness

- Thickness of gasket to be used when measuring: 0.05 mm
- Clearance measured: 0.08 mm
- Clearance measured reduced by the amount the gasket "settles to" when fitting the pump housing cover: 0.06 mm (0.08-0.02)
- Clearance indicated: 0.07-0.10 mm
- In order that the clearance shall be that indicated the gasket must in consequence thereof be increased by 0.01 mm and max. 0.04 mm

Lubricating Oil Pump of previous design.

- | | |
|---|----------------------|
| 1. Pump housing | 10. Spacer ring |
| 2. Pump housing cover | 11. Bearing journal |
| 3. Pump gear | 12. Bearing |
| 4. Key | 13. Lubricating hole |
| 5. Lock nut | 14. Gear |
| 6. Lock washer | 15. Bushing |
| 7. Lock screw | 16. Gear |
| 8. Idler gear | 17. Screw |
| 9. Lock ring (its opening shall be turned upwards | 18. Spring washer |
| | 19. Gasket |

grupp	sekt	nr	sida
1a	AR	6	4

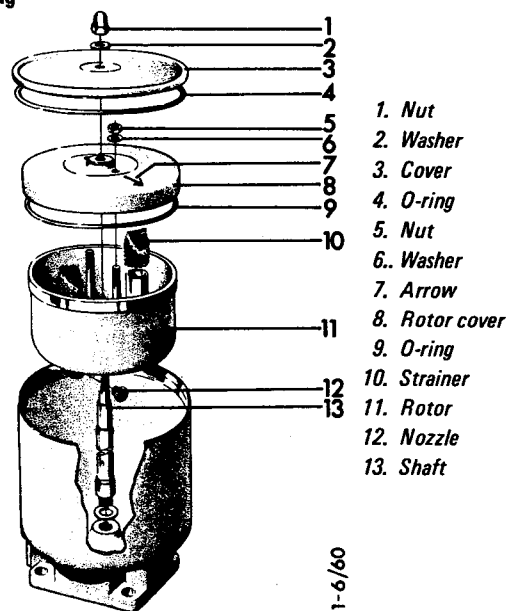


Lubricating Oil Pump of later design

Lubricating Oil Cleaner

When a purely routine clean out of the centrifugal cleaner is undertaken there ought to be a coating of dirt in the rotor. **If that is not the case this means in effect that the cleaner is not functioning properly.** The reason shall be investigated at once. However, should the coating of dirt, while cleaning in accordance with the recommended interval, exceed the maximum permissible thickness, the cleaner shall be cleaned out more often.

Cleaning

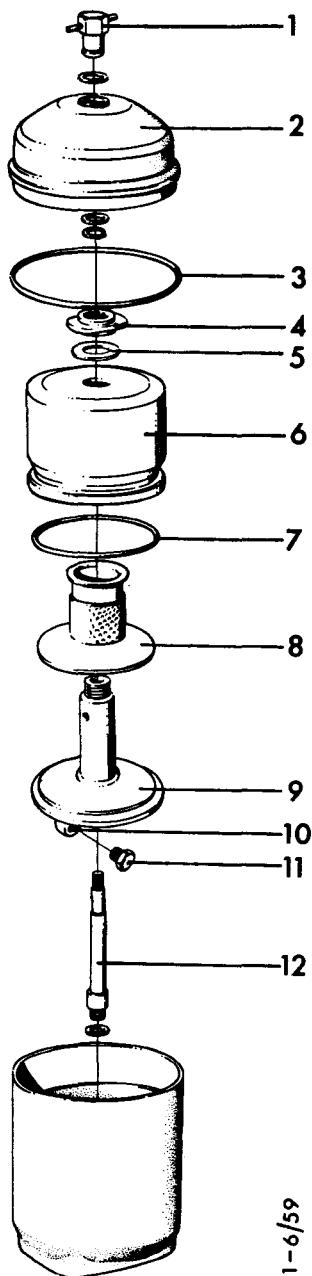


Lubricating oil cleaner GF 1

Type GF 1

1. Undo the nut on the cover. Lift off the cover very carefully with a screwdriver by prizing against the edge concerned.
2. Take out the rotor. Wipe the outside of it. Undo the two nuts a few turns and try to undo the rotor cover. If the cover fails to budge hold the rotor in the cover and tap cautiously with a plastic amallet alternately on the screws. Do not under any circumstances use a hammer as the screws and bearing can very easily be damaged. Take off the cover.
3. Scrape away the deposits on the inside of the rotor cover with a knife.
4. Wash the parts in white spirit.
5. Check the two nozzles (12) in the bottom. Make certain that they are not clogged up or damaged. Replace the damaged nozzles. Check the strainers (10) on the outlets.
6. Check the O-ring (9) and the rotor cover (8), replace damaged O-ring. Check that the bearings are not damaged.
7. Put the cover on the rotor. Make quite certain that it is even all round and that the arrow (7) on the rotor cover points in the same direction as that beneath the rotor itself. Put on the nuts and tighten both of them with the fingers. Then afterwards tighten them still further half a turn with a wrench.
8. Check to be sure that the shaft is not loose. If this should prove to be the case it must be locked with locking fluid 561056. In doing so the threads must first be degreased with trichlorethylene.

9. Put the rotor in position in the housing and make quite sure that it turns easily. Check that the bearing clearances are normal.
10. Check the gasket (4) in the cover and put in on. Tighten up the nut.



Lubricating oil cleaner GF 5

- | | |
|-----------------|-----------------|
| 1. Nut | 7. O-ring |
| 2. Cover | 8. Strainer |
| 3. O-ring | 9. Bottom plate |
| 4. Rotor nut | 10. Outlet hole |
| 5. Steel washer | 11. Nozzle |
| 6. Rotor cover | 12. Shaft |

Type GF 5

1. Screw off the nut (1) holding the cover in place (2) and take it off.
2. Lift out the rotor. Wipe the outside of it. Undo the rotor nut and screw it out approx. three turns (in order to protect the top bearing).

If the rotor nut is difficult to undo, turn the rotor upside down and fix the nut in a vice. Turn the rotor anti-clockwise by hand or, if this does not succeed, by putting a screwdriver between the outlet holes.

N.B. The rotor itself must under no circumstances be fixed in the vice.

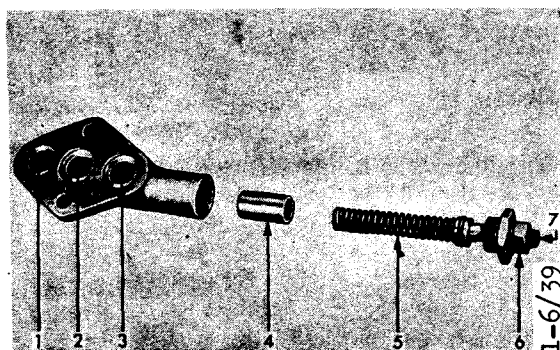
3. Hold firmly round the outer diameter of the rotor and give a slight blow with the hand or by using a plastic mallet on the rotor nut, so that the rotor cover will loosen from the bottom plate. Do not strike straight onto the shaft of the bottom plate, as by doing so it is easy to damage the bearings.
4. Take off the rotor nut with washer and part the cleaner.
5. Take away the strainer located on the bottom plate. If it has fastened prize it away very carefully with a knife at the bottom edge between the bottom plate and strainer.
6. Scrape away the deposits on the inside of the rotor cover with e.g. a knife.
7. Wash the parts in white spirit.
8. Check the two bottom nozzles. Make certain that they are not clogged up or damaged. Replace the nozzles.
9. Check to see that the bearings are undamaged.
10. Put the O-ring in position in the rotor cover. Change the ring on the slightest sign of damage.
11. Put the parts together and **tighten the rotor nut (4) by hand**. Pay attention to the washer (5) under the nut.
12. Check to be sure that the shaft is not loose. If this should prove to be the case it must be locked with locking fluid 561056. In doing so the threads must first be degreased with trichlorethylene.
13. Put the rotor back again and turn it by hand to see that it rotates easily. Check to see that the bearing clearances are normal.
14. Check the O-ring on the cover and put it in position. **Tighten the nut by hand.**

Check (Apply to both GF 1 och GF 5)

Run the engine until it is quite warm. Stop the engine. Check by listening with the ear close up against the cleaner that the rotor is spinning. An unmistakeable clear humming sound should then be heard. The rotor ought normally (with warm oil) to rotate for approximately one minute after the engine has stopped.

Reduction valve fitted in the oil sump

The relief valve controls the oil pressure. It is located on the left-hand side of the oil pan. It consists of a valve body, a valve plunger, a compression spring and an adjusting screw, against which the compression spring bears.

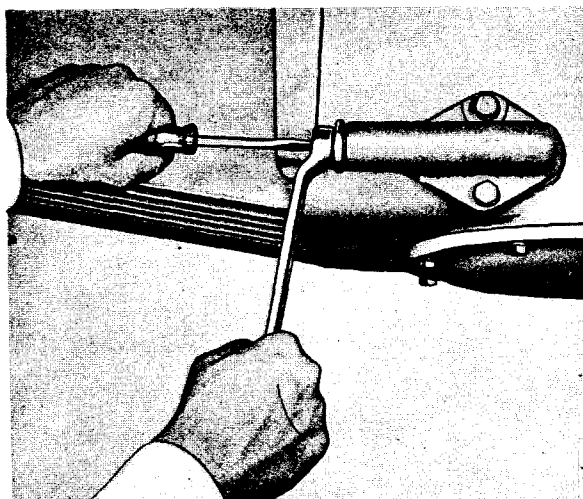


Relief valve

- | | |
|---|-----------------------|
| 1. Intake hole | 4. Plunger |
| 2. Outlet hole | 5. Compression spring |
| 3. Outlet hole for oil leaking past plunger | 6. Locknut |
| | 7. Adjusting screw |

The valve body has an intake hole and outlet hole. The outlet hole is closed by the valve plunger as long as the oil pressure is less than the maximum. When the oil pressure has reached this figure the spring is compressed and the outlet hole is uncovered, so that the pressure is prevented from rising further.

If the oil pressure in an engine has fallen too low, and normal pressure cannot be restored by adjusting the relief valve, the reason for the pressure drop may be that the valve is worn. Since it is often difficult to judge from the appearance of a relief valve whether it is worn or not, it should be removed and replaced by a new valve, after which the oil pressure in the engine should be checked afresh. This check should be made with the engine warm and running at the stated r.p.m. Adjust the spring loading in the relief valve with the adjusting screw to bring the oil pressure to the maximum permissible. The screw is screwed inwards to increase the oil pressure and outwards to reduce it.



Setting the maximum oil pressure

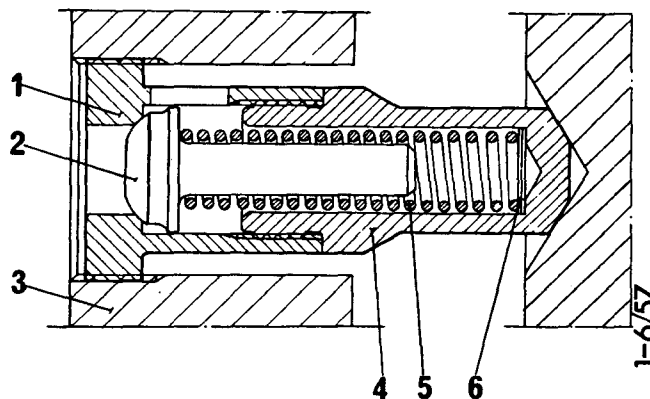
If the pressure is still too low even with the new valve, this points to some other fault. For example, the oil pump may be worn or there may be a leak in the piping. When the oil pump is being checked the suction pipe should also be examined for leaks.

If the engine is badly worn, the trouble is very likely due to excessive bearing slackness, which has a strong tendency to reduce the oil pressure.

N.B. Fit new O-rings beneath the assembly flange of the relief valve every time the valve has been taken out.

Reduction valve fitted in the cylinder block

On D/DS11 beginning from engine No. 880840, the reduction valve is fitted in the engine block behind the intermediate piece of the lubricating oil cleaner.



Reduction Valve

- | | |
|-------------------|---------------------|
| 1. Valve seat | 4. Sleeve |
| 2. Valve | 5. Pressure springs |
| 3. Cylinder block | 6. Washer |

The oil pressure is adjusted by increasing or reducing the number of washers. The pressure is raised by increasing the number of washers.

Oil Cooler

The oil cooler does not normally require any form of maintenance. If leakage is suspected the cooler should be pressure tested to the pressure values indicated. In case of possible water leakage past the O-ring sealing this must be exchanged for new.

Changing the O-ring Sealings

A special type tool is required for the removal and fitting of rings.

When fitting the cooling element in the oil cooler housing it is very easy to damage the O-rings with leakage as a result. Therefore, in order to prevent this happening assembly can be carried out in the following manner:

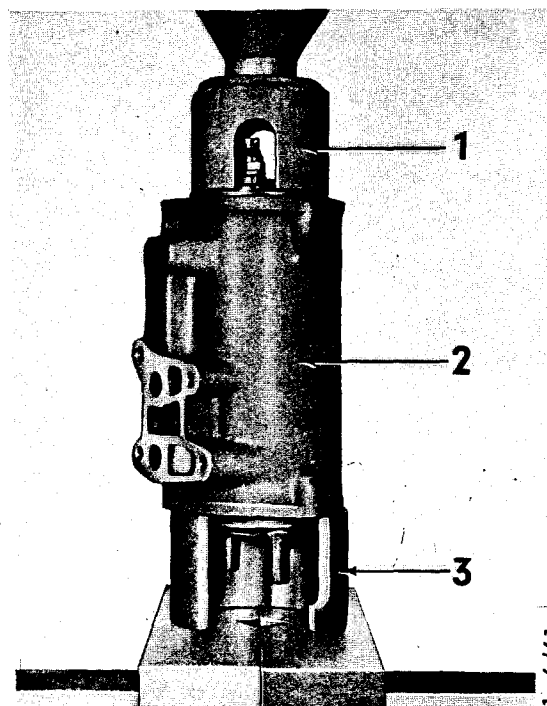
1. Put the new O-rings in oil for a few minutes.
2. Screw out the screws and remove the lock washers on the ends of the oil cooler. On earlier design oil coolers, screw out the lock screws on the longitudinal side of the oil cooler.
3. Then press in the element, according to figure, far enough so that the O-ring will be noticeable on the opposite side and can be exchanged.
4. Oil the O-ring groove and fit a new well-oiled O-ring.
5. Before the element is pushed back it is advisable on some cooler designs to position a protective foil (anti-rust material, thickness 0,1 mm width 15 mm, length 75 mm with well-rounded off edges) as protection for the O-ring when it passes the lock screw hole. Compare fig.

On the earlier design coolers it is advisable to put a protective foil (anti-rust material, thickness 0,1 mm, width 15 mm, length 75 mm, with wellrounded off edges), as protection for the O-ring when it passes the lock screw hole. Compare fig.

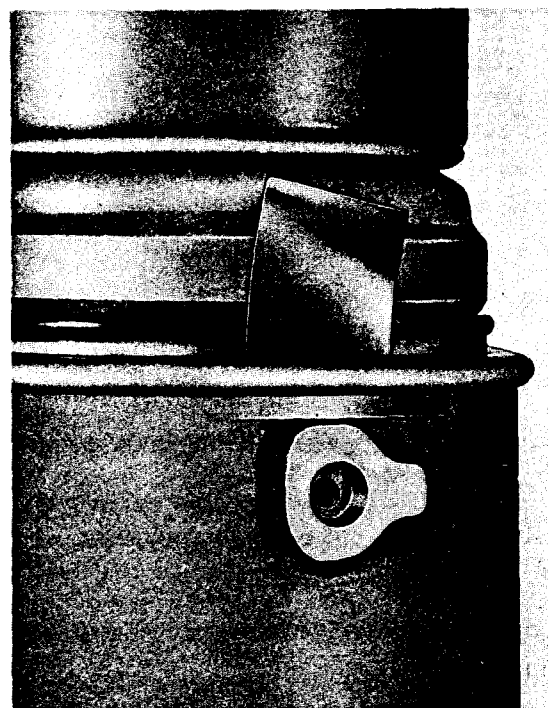
6. Afterwards press the element back in the housing and tighten up the lock washers. On earlier design oil coolers, refit the lock screw on the side where the last O-ring was replaced before the element is pressed back. Tighten up the lock screw, however not too hard. Do not use a longer wrench than 100 mm.

The cooling element is pressed back with a new O-ring fitted. The protective foil for the lock screw hole protects the O-ring while it is being pressed home (applies to earlier design).

After fitting the oil cooler shall be pressure tested.



The cooler element is pressed downwards in order to release one of the O-rings, but first of all both the lock screws must be removed.



The cooling element is pressed back with a new O-ring fitted. The protective foil for the lock screw hole protects the O-ring while it is being pressed home.

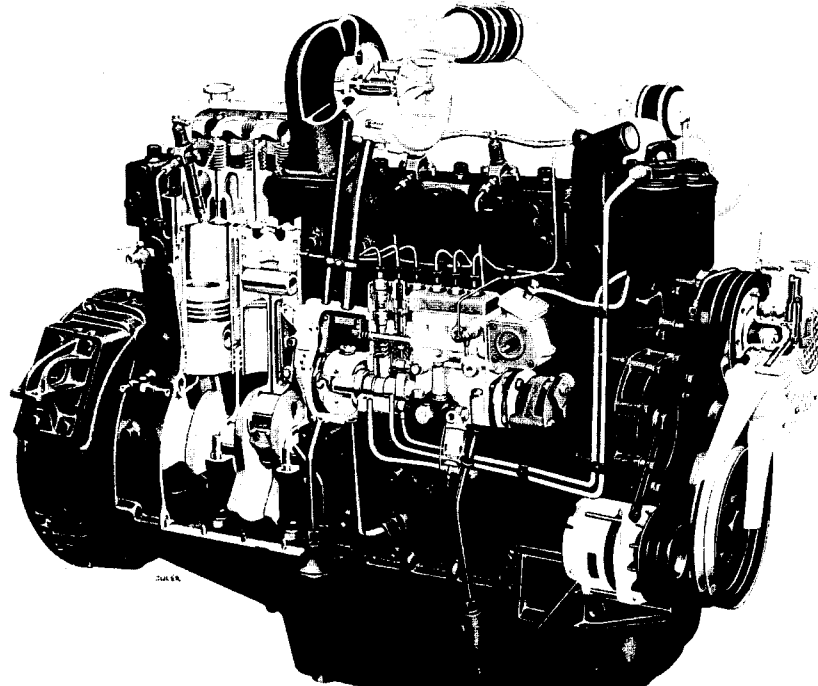
SERVICE SCANIA

PRODUCTS

grupp/group	Work description	
	number/number	sida/page
1 a	0	1
datum/date 77-02-28		best. nr/order nr E501a

CAUTION

This section is applicable to only Waukesha models F674D, DS, and DSI, which are designated by Scania as D, DS, and DSI11A04, A05, A06, and A07. Engine serial numbers for these models are from 888806 (Sweden) and 156300 (Netherlands).

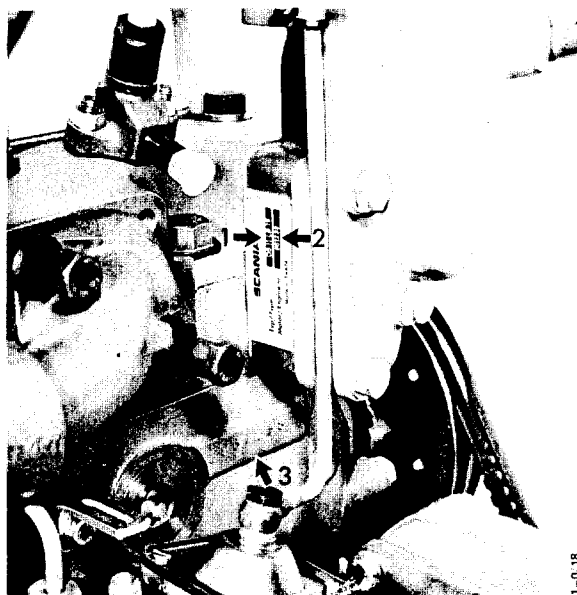


1-0/19

Fig. 1 Engine DS11

The engine type designation and engine number are stated on a sign plate which is attached to the thermostat housing. The engine number is also stamped into the cylinder block under the thermostat housing.

Certain separate engines have the engine sign plate on the injection pump shelf.



A manufacturing code is stamped into the cylinder block above the flywheel housing.

The work description in this chapter for engine types D11 and DS11 assumes a removed engine from which oil and water have been drained and from which the clutch has been removed.

Prior to assembly, all parts must be cleaned.

Fig. 2 Engine number and engine type designation

77.21151/3200.1081

1-0 18

SERVICE SCANIA

PRODUCTS

grupp/group

Work description

1 a

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best. nr/order nr
E501a

CYLINDER HEAD

	Page
Removal	4
Dismantling	4
Cylinder head sealing surface against block .	5
Rocker arms	6
Rocker arm shaft	7
Valves	7
Valve springs	7
Assembly	7
Milling of valve seat rings	9
Fitting the cylinder head	10
Retightening the cylinder head screws	12

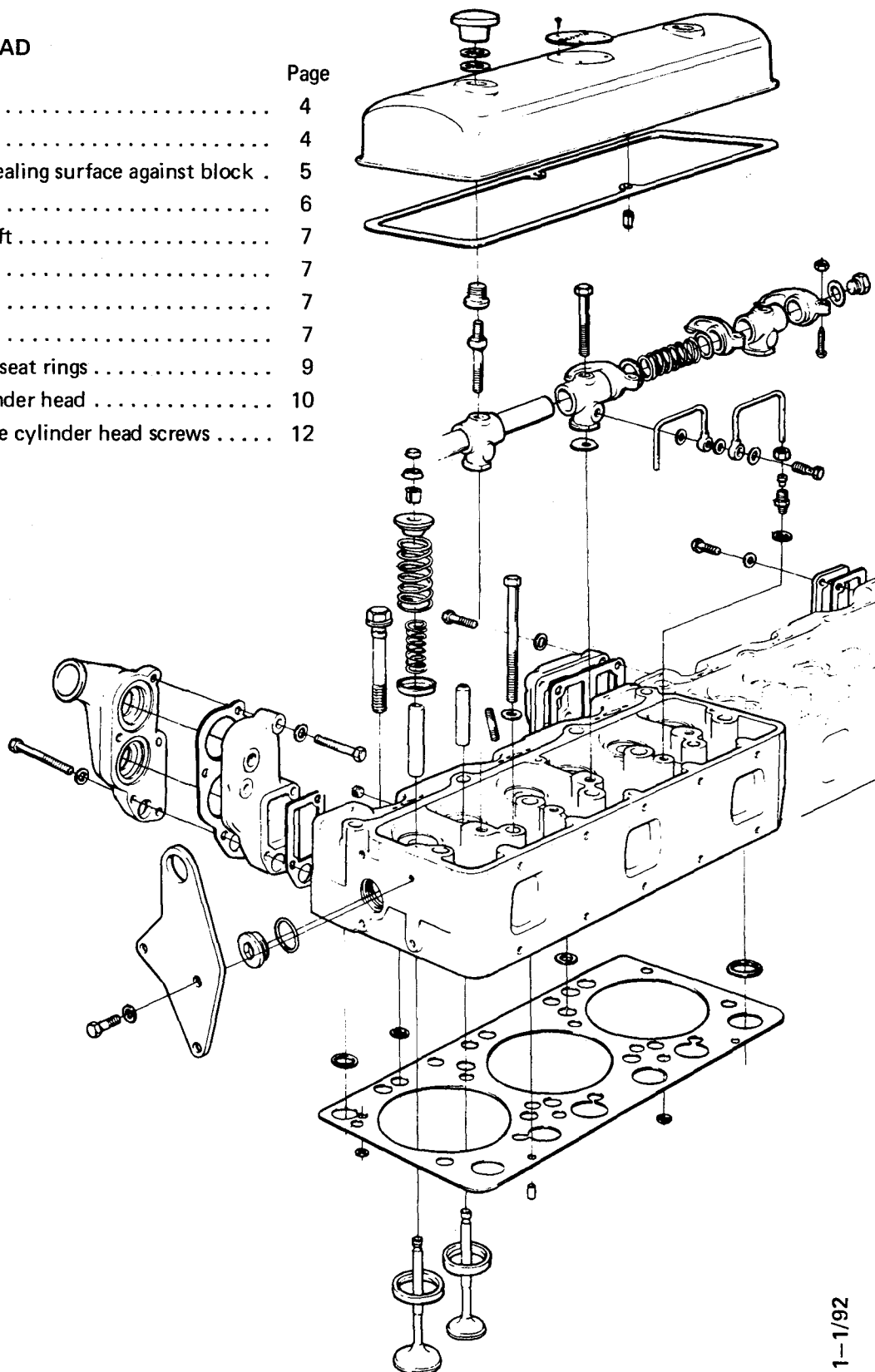
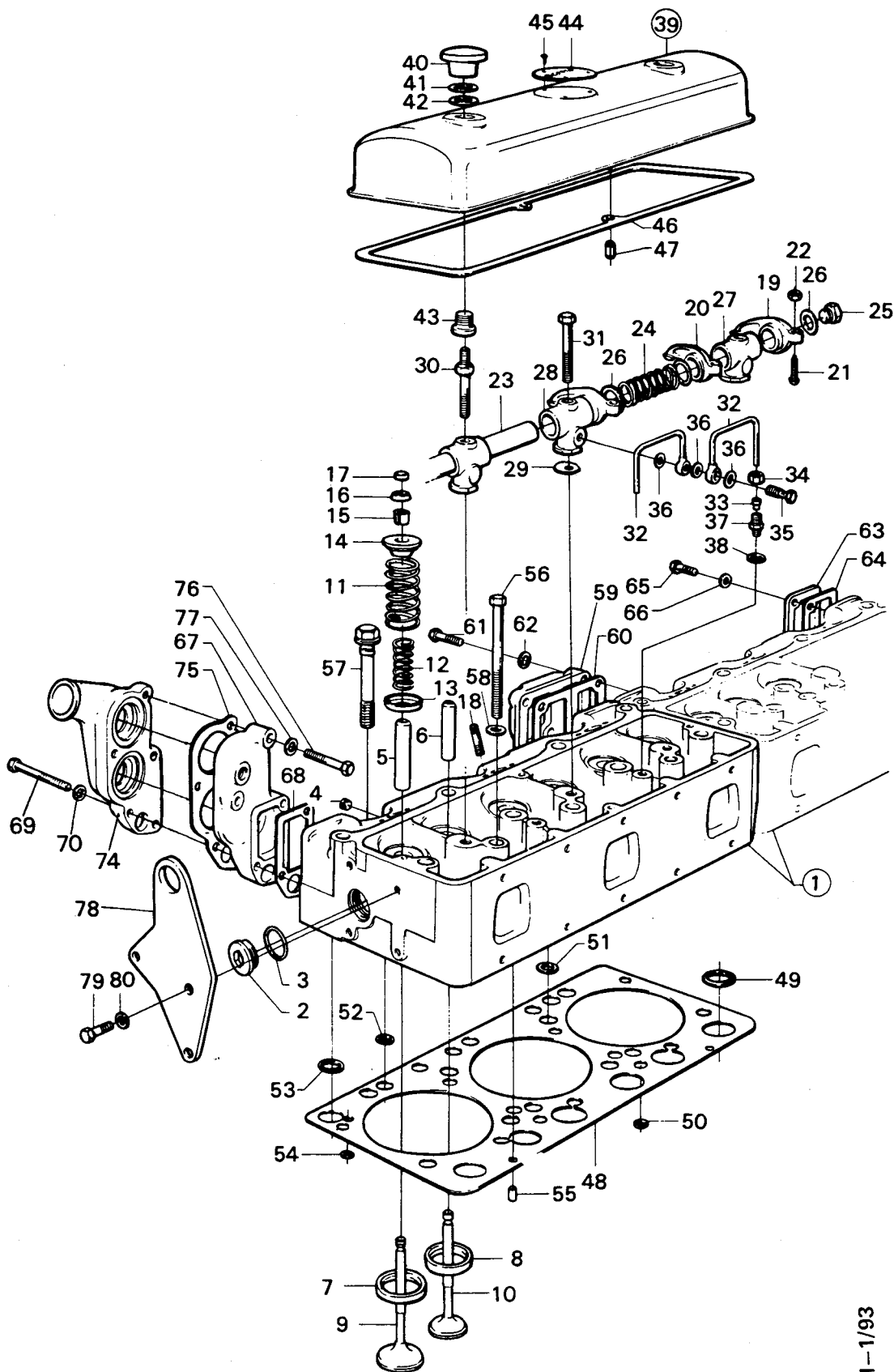


Fig. 1

77.21151/3200-1081

1-1/92



1-1/93

Fig. 2

- | | |
|------------------------------------|-------------------------------------|
| 1. Cylinder head | 40. Knob nut |
| 2. Plug | 41. Washer |
| 3. O-ring | 42. Rubber gasket |
| 4. Plug | 43. Pin |
| 5. Valve guide for intake valve | 44. Instruction sign plate |
| 6. Valve guide for exhaust valve | 45. Screw |
| 7. Seat for intake valve | 46. Gasket |
| 8. Seat for exhaust valve | 47. Hollow pin |
| 9. Intake valve | 48. Cylinder head gasket |
| 10. Exhaust valve | 49. Sealing ring |
| 11. Valve spring, outer | 50. Sealing ring |
| 12. Valve spring, inner | 51. Sealing ring |
| 13. Guide washer, lower | 52. Sealing ring |
| 14. Guide washer, upper | 53. Sealing ring |
| 15. Valve stem key | 54. Sealing ring |
| 16. Protective ring, D11 | 55. Locating pin for cylinder block |
| 17. Valve cap | 56. Screw |
| 18. Stud for nozzle holder | 57. Screw |
| 19. Rocker arm with bushing, left | 58. Washer |
| 20. Rocker arm with bushing, right | 59. Flange for water transfer |
| 21. Ball stud | 60. Gasket |
| 22. Lock nut | 61. Screw |
| 23. Shaft | 62. Washer |
| 24. Spring | 63. Blanking flange |
| 25. Plug | 64. Gasket |
| 26. Washer | 65. Screw |
| 27. Bearing bracket, outer | 66. Washer |
| 28. Bearing bracket, middle | 67. Thermostat housing, lower part |
| 29. Gasket | 68. Gasket |
| 30. Screw, outer | 69. Screw |
| 31. Screw, middle | 70. Washer |
| 32. Lubricating oil pipe | 74. Thermostat housing, upper part |
| 33. Cone | 75. Gasket |
| 34. Nut | 76. Screw |
| 35. Banjo screw | 77. Washer |
| 36. Gasket | 78. Bracket for lifting hook |
| 37. Nipple | 79. Screw |
| 38. Gasket | 80. Washer |
| 39. Valve cover | |

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Removal

1. Remove the intake duct, exhaust manifold and, on DS11, the turbocharger.
2. Remove the thermostat housing, the flange for water transfer and the blanking flange.
3. Remove the injectors and fit protective plugs in the ends of the pressure pipes and protective caps on the injectors and the injection pump.
4. Remove the valve cover, lubricating oil pipe and bearing brackets with shaft and rocker arms.
5. Lift up the pushrods and place them in consecutive order in a rack.
6. Remove the cylinder head screws, apply the lifting tool and lift the cylinder head off. Place it on a bench with a soft underlay in order to prevent damage to the sealing surface.

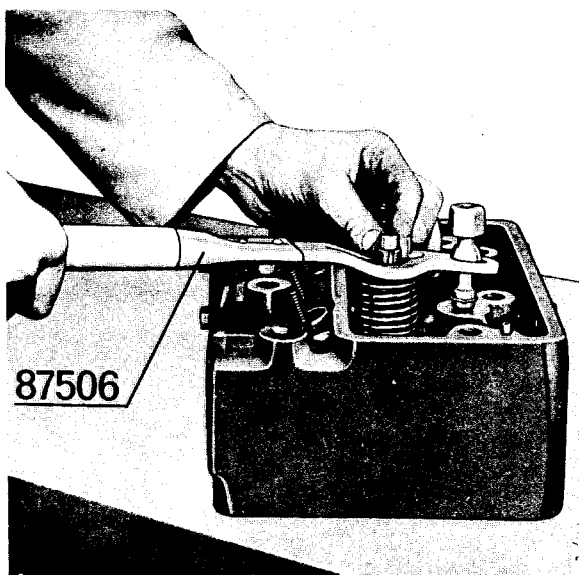


Fig. 4 Valve spring compressor

3. Remove the valve seats. Grind down the valve head of a rejected valve so that its diameter is slightly smaller than the inside diameter of the valve seat. Insert the valve and weld it to the seat (all the way round) by electric welding. Cool with water. Turn the cylinder head and tap the valve stem so that the valve and seat drop out.

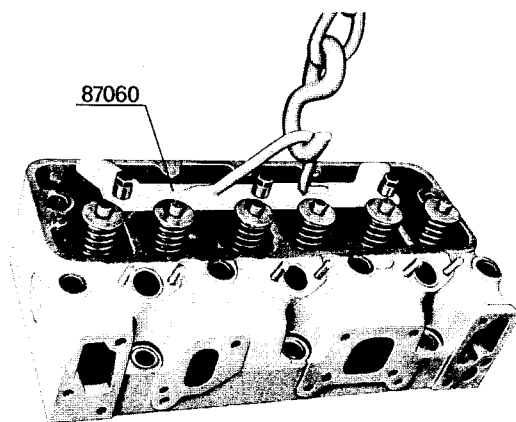


Fig. 3 Lifting tool

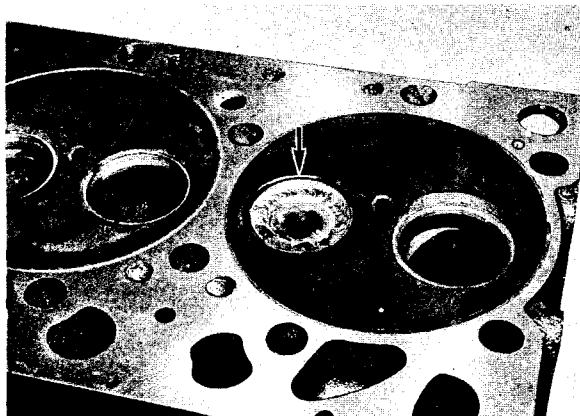


Fig. 5 The valve is welded on

Dismantling

1. Remove the valve caps and, on D11, the rubber protective rings which are fitted on the intake valves.
2. Remove the valves. Use valve spring compressor 87506 to take out the valve stem keys. If the valves are to be refitted, place them in a valve rack in consecutive order.

NOTE! Always turn the cylinder head so that the seats face downwards when the valve seat ring is tapped out. Otherwise, there is a risk of personal injury being caused by loose fragments.

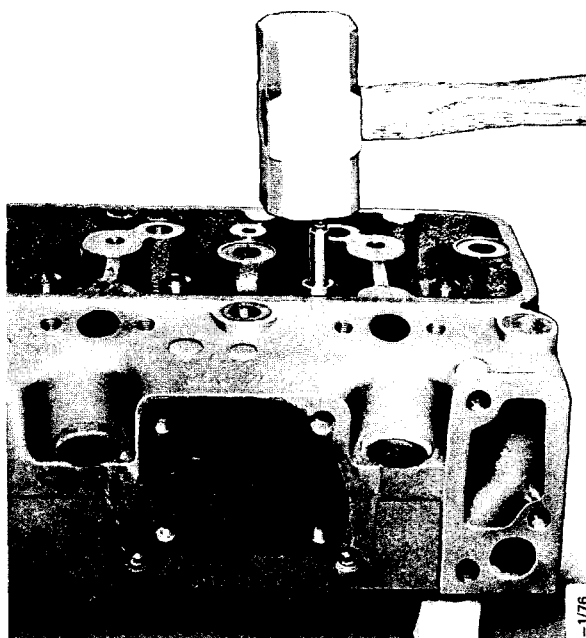


Fig. 6 Tap out the valve seat ring with welded-on valve

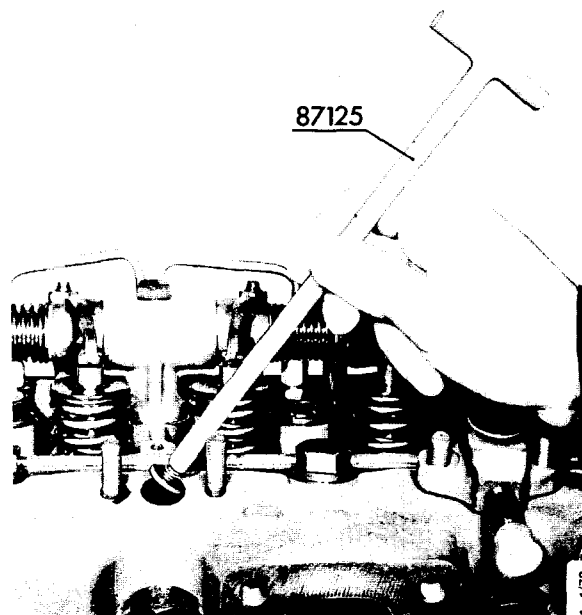


Fig. 8 Extractor for copper washer

4. Press the valve guides out with drift 87961.

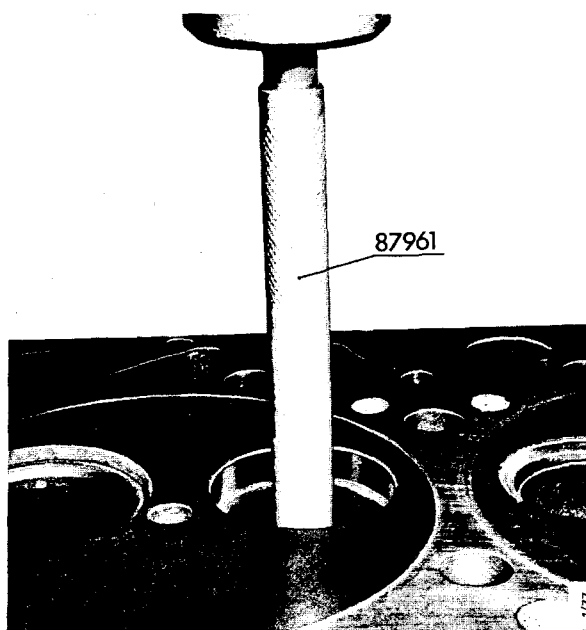


Fig. 7 Pressing out the valve guide

Cylinder head sealing surface against block

Examine the cylinder heads for cracks and other defects. Check the sealing surface against the cylinder block with a face plate. When the sealing surface is machined, if necessary, the height of the cylinder head must not be less than 124.4 mm.

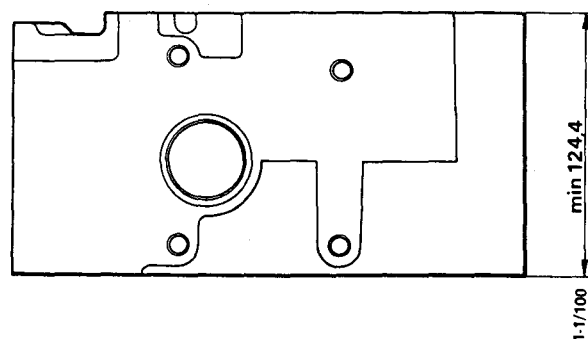


Fig. 9 Height of cylinder head after machining

5. Remove the cleaning plug.
6. Remove the remaining copper washers under the injectors with tool 87125.

After machining, a new groove will have to be milled for the gasket. The position and dimensions of the groove are indicated in the figure.

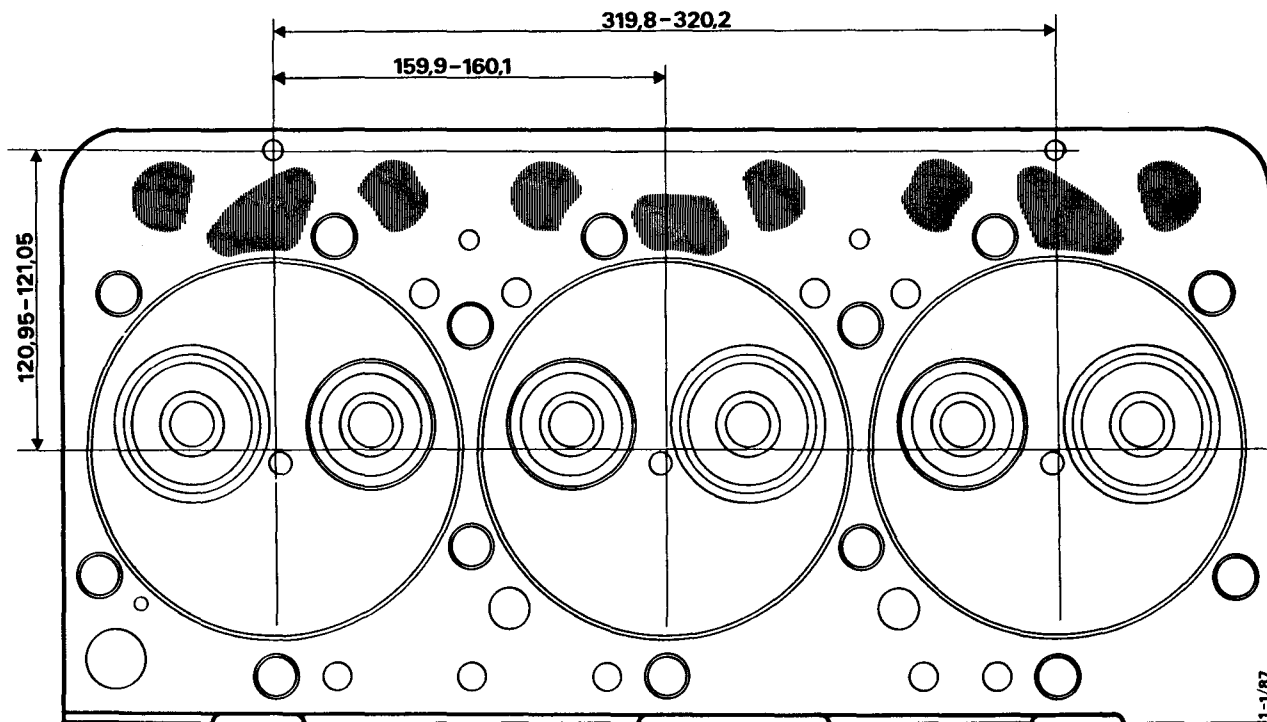
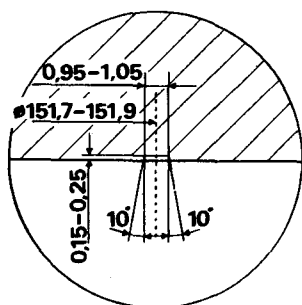


Fig. 10 Grooves for gasket in cylinder head



Rocker arms

Drift 87474 should be used for pressing the rocker arm bushing in and out.

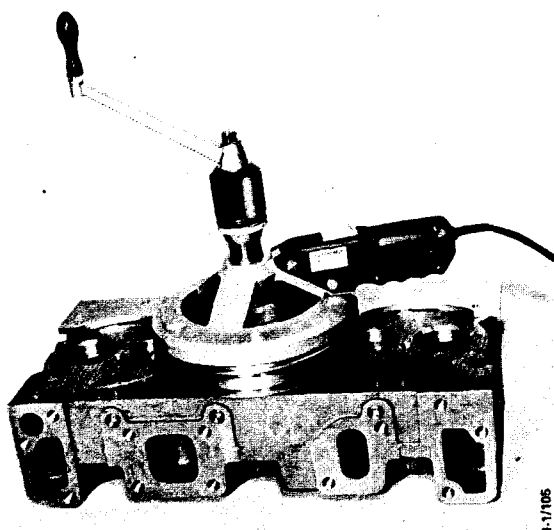


Fig. 11 Tool for milling of groove in cylinder head

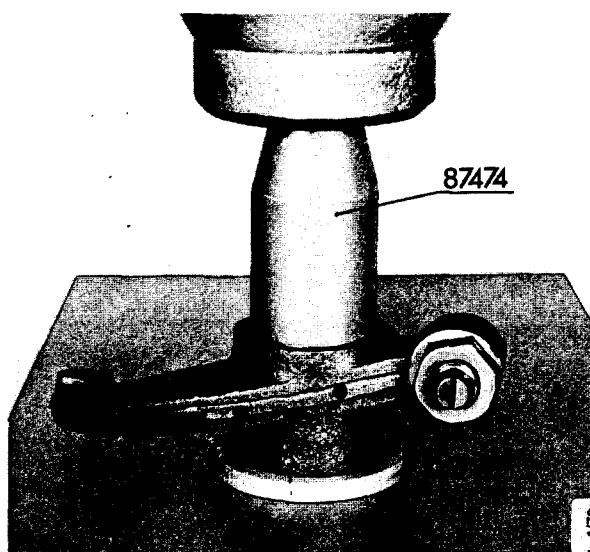


Fig. 12 Drift for rocker arm bushing

When a new bushing has been pressed in the two oil holes must be drilled to a diameter of 3 mm. The bushing must then be finely machined.

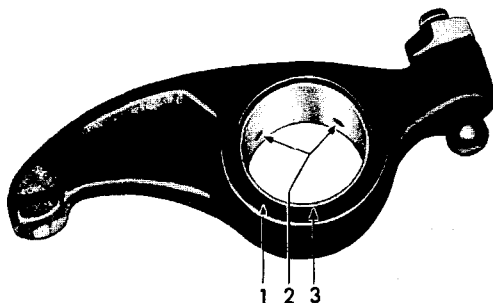


Fig. 13 Rocker arm with bushing
1. Rocker arm 2. Lubricating hole 3. Bushing

If wear is moderate, the pressure surface of the rocker arm against the valve cap can be adjusted in a grinding machine.

Rocker arm shaft

Examine the rocker arm shaft for wear. Also check that all oil passages are open. If wear is moderate, the rocker arm shaft can be turned so that the unworn surface comes downwards.

Valves

Valves which have been ground must be checked after machining in respect of dimensions and the angle of the valve head against the seat ring. This angle is checked with valve gauge 98429 which at one end is suitable for intake valves and at the other end for exhaust valves. The intake valve angle should be ground to 29.5° and the exhaust valve angle to 44.5° .

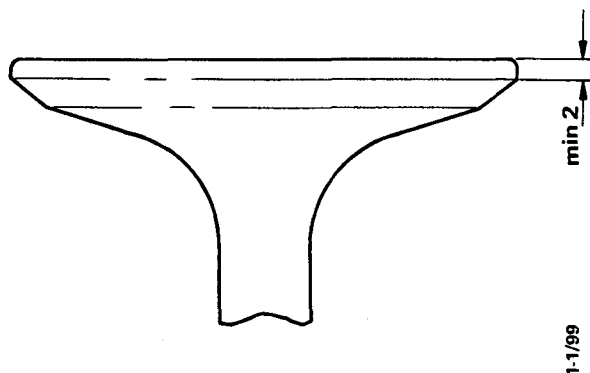


Fig. 14 Intake and exhaust valves can be ground as much as shown by the above figure

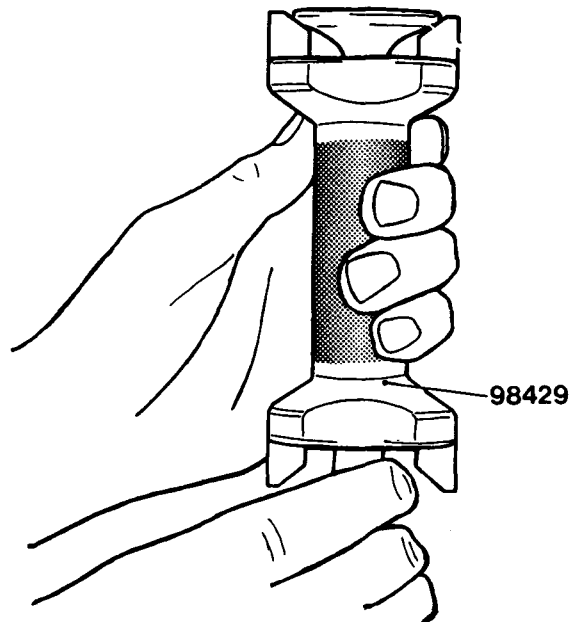


Fig. 15 Valve gauge

Valve springs

Prior to assembly, the valve springs should be checked in a spring testing device in respect of both free length and length at a given load.

Inner spring:	Free length	57.8 mm
	Length 34.1 mm at a load of 299 N (29.9 kp)	
Outer spring:	Free length	65 mm
	Length 37.1 mm at a load of 593 N (59.3 kp)	

Assembly

1. Lubricate a new O-ring and insert it in the hole for the cleaning plug before screwing the cleaning plug in. If necessary, use thread sealing compound 561019. Thorough cleaning of the threads is essential if this sealing compound is to be used.

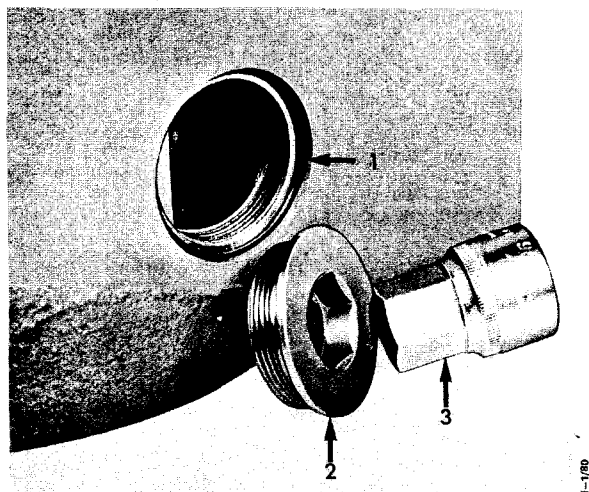


Fig. 16 Cleaning plug

2. Press new valve seat rings in, using drift 98501 and shank 98500. Before the valve seat rings are pressed in they must be chilled, as must the drifts, to approx. -80°C with carbon-dioxide snow or liquid air. Pressing in must be accomplished very quickly.

NOTE! Be very careful when handling the above-mentioned cooling agents and chilled parts, as frostbite is a very real hazard in this context.

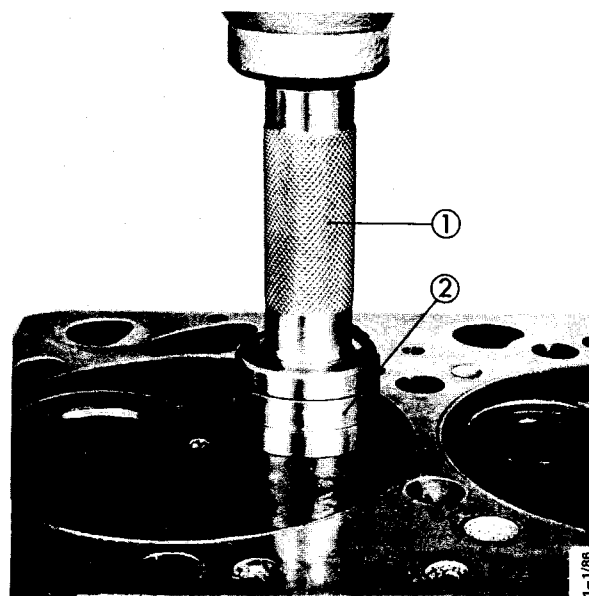


Fig. 17 Pressing in the valve seat ring
1. Shaft 98500
2. Drift 98501

Over-size valve seat rings can be fitted if the seat for the valve seat ring has been damaged. The seat must then be machined with a milling cutter and sophisticated measuring equipment

will also be needed. The following over-size valve seats are available:

Description	Part number
Valve seat, exhaust	242673
Valve seat, intake	247183

The seat for the valve seat ring in the cylinder head must be machined to the following dimensions:

For exhaust valve seat: $\varnothing 52 \begin{matrix} + 0.133 \\ + 0.114 \end{matrix}$

For intake valve seat: $\varnothing 56.2 \begin{matrix} - 0.047 \\ - 0.066 \end{matrix}$

3. Press new valve guides in, using drift 87423. Press the guide down as far as the drift permits, i.e. until contact is achieved against the spring seat in the cylinder head (24.0 ± 0.25 mm).

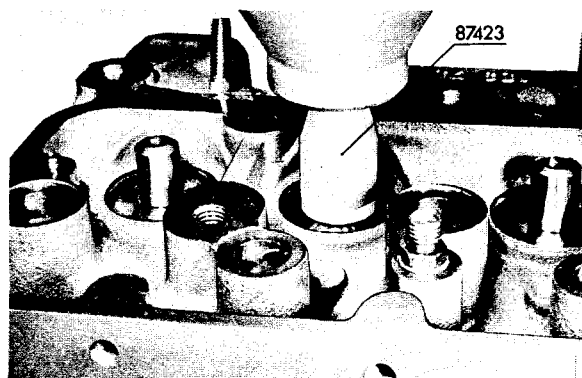


Fig. 18 Drift for pressing in the valve guides

NOTE that the valve guides for intake and exhaust valves have different part numbers. The intake valve guide is approx. 7 mm longer than the exhaust valve guide.

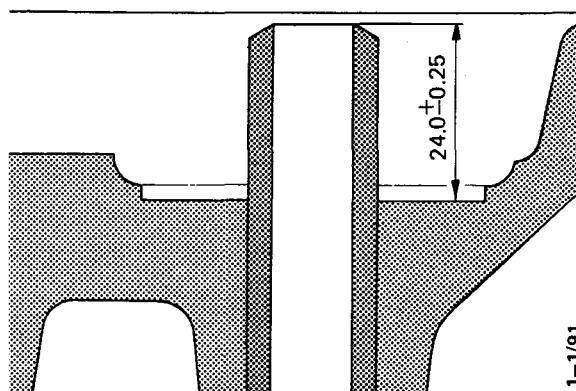


Fig. 19 Height of valve guide above spring seat

Milling of valve seat rings

When the valve seat rings have been pressed in they must be very accurately machined. For this purpose, use is made of a milling tool with a spindle which is guided by the valve guide.

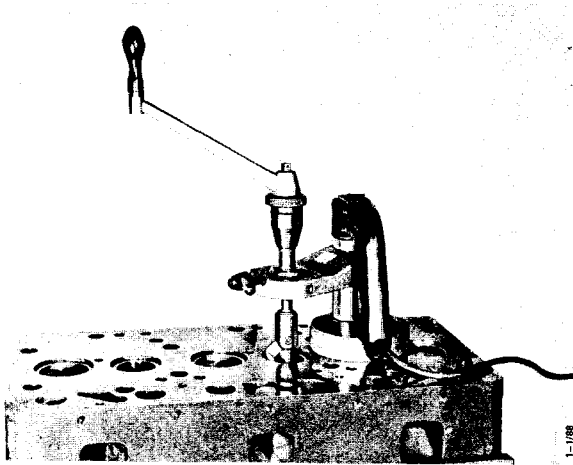


Fig. 20 Example of a tool for machining of valve seat rings

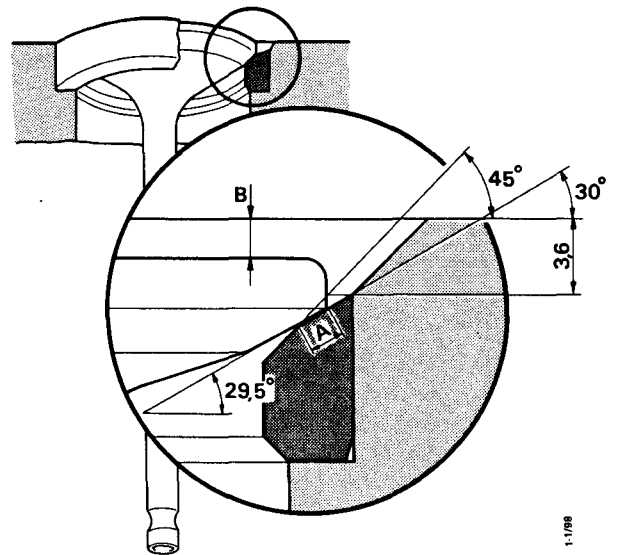


Fig. 22 New intake valve and a maximally machined valve seat ring

The exhaust valve seat must be milled to an angle of 45°.

The intake valve seat must be milled to an angle of 30°.

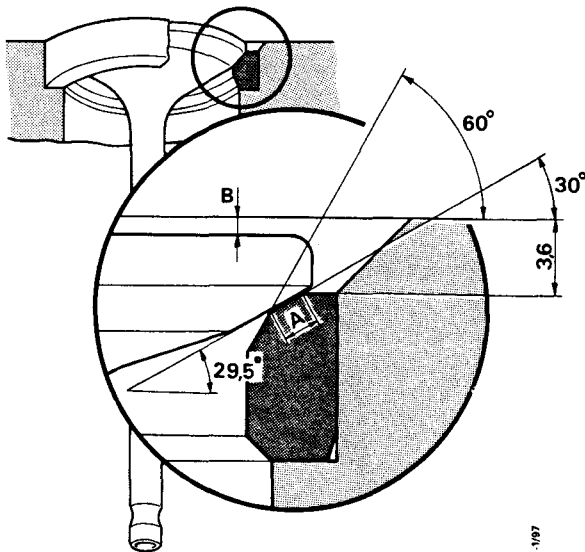


Fig. 21 New intake valve and new valve seat ring

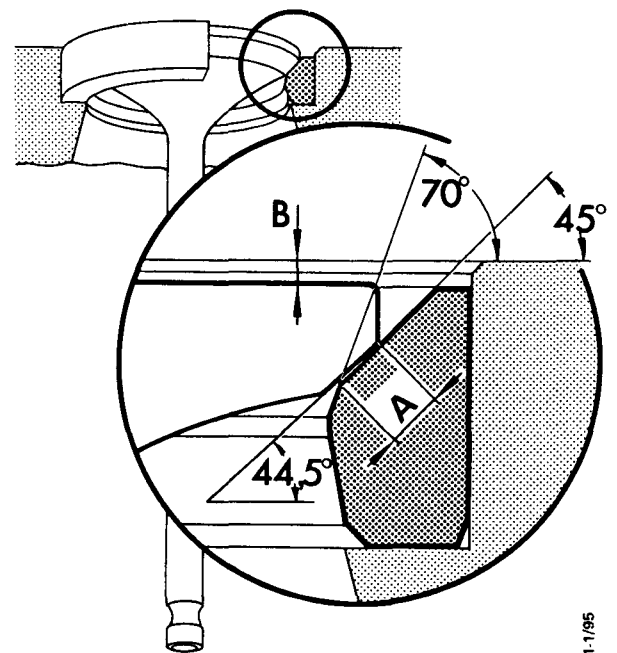


Fig. 23 New exhaust valve and new valve seat ring

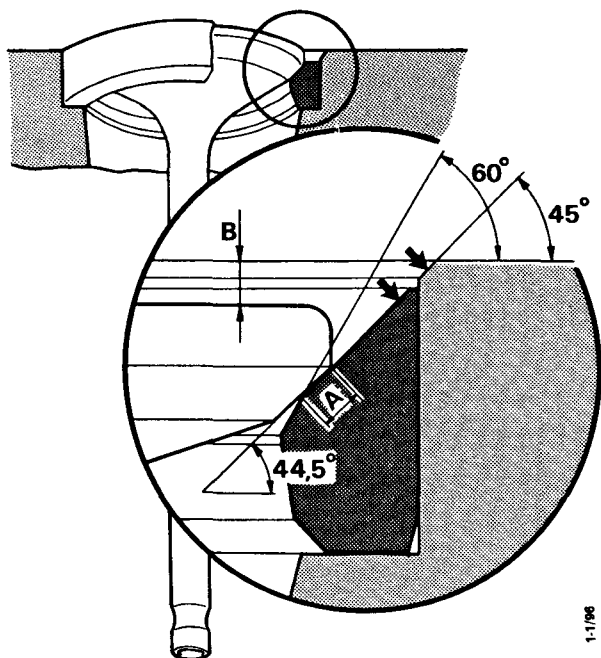


Fig. 24 New exhaust valve and a maximally machined valve seat ring. Surfaces at the arrows in the same line

4. Lubricate the valve stem with engine oil before inserting it in the guide. Put on the lower guide washer, the two valve springs and the upper guide washer. Compress the springs with the aid of valve spring compressor 87506 and insert the valve stem keys. Fit the rubber protective ring on the intake valves on the D11 engine. Fit the valve caps.

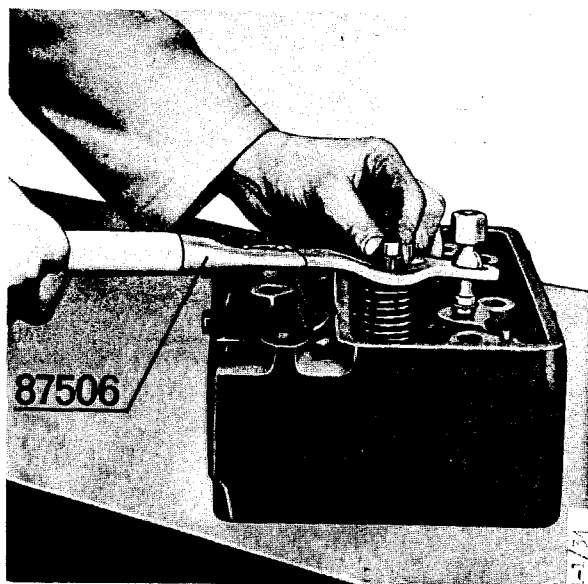


Fig. 25 Valve spring compressor

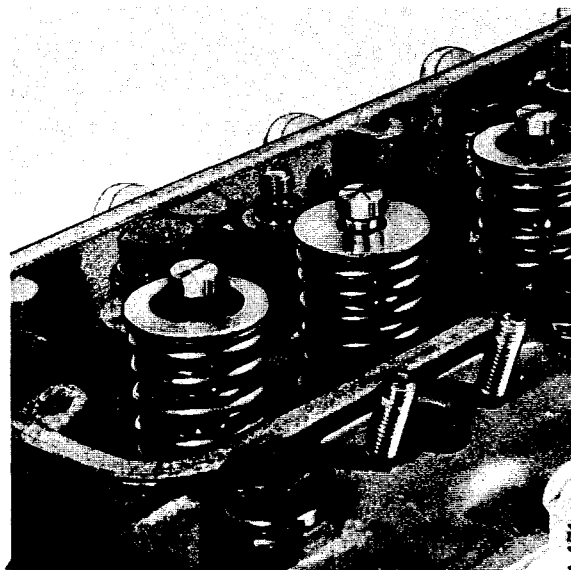


Fig. 26 Protective rings on D11 engine intake valves

Fitting of cylinder head

1. Check the liner height according to AR 3, page 4.
2. Fit a new gasket and rubber seals for oil and washer. Rubber seals must be fitted in all the holes in the gasket except those for the cylinder head screws.

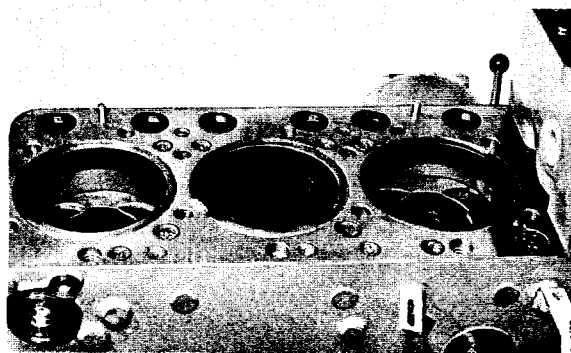


Fig. 27 New gasket and new rubber seals fitted

3. Put the cylinder head into place and check that the locating pins fit into their holes.

4. Lubricate the threads of the cylinder head screws and their faces under the screw heads. Tighten the screws in the sequence indicated in the figure and in three stages as follows:

Tighten all the screws to 50% of the prescribed torque, then tighten them once again to 75% and, finally, once again to the prescribed torque.

NOTE! The three screws (11–12–13) under the injectors must be tightened to a higher torque than the other screws.

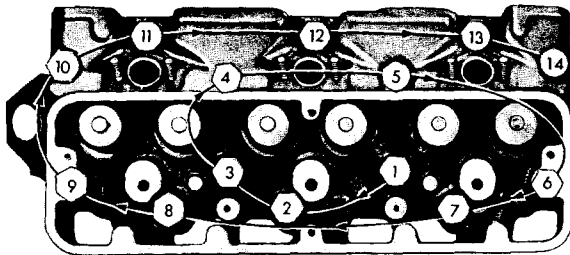


Fig. 28 Sequence for tightening of cylinder head screws

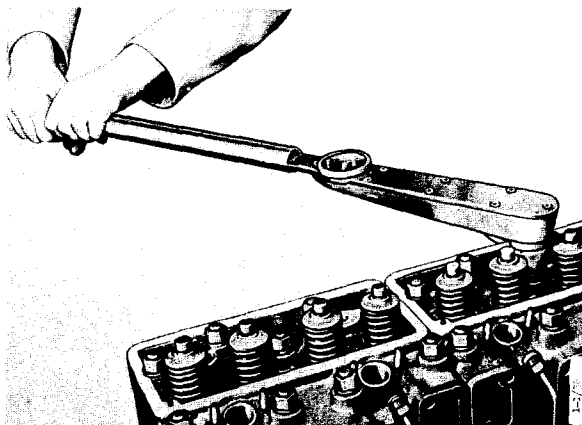


Fig. 29 Always use a torque wrench

5. Place a gasket under each bearing bracket for the rocker arm shaft.

The middle gasket serves to seal against the oil and the other two as spacers to ensure the same height on all bearing brackets.

Tighten the three screws alternately and, before finally tightening them, insert an 0.15-mm feeler gauge between the outer rocker arm and bearing bracket to give a clearance of at least 0.1 mm.

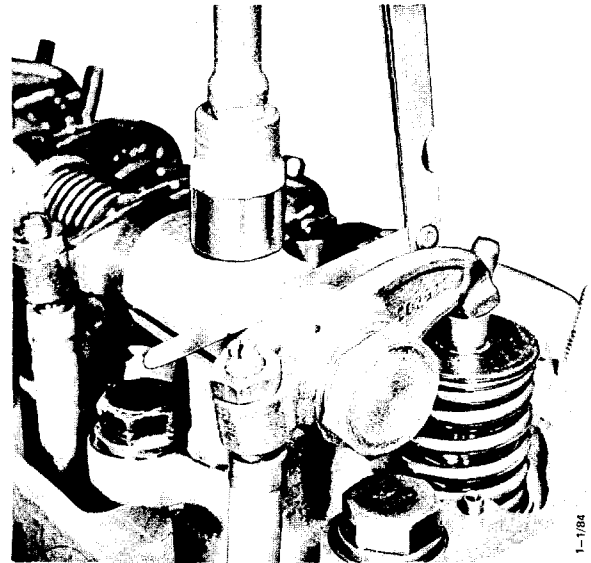


Fig. 30 Insert an 0.15-mm feeler gauge between the outer rocker arm and bearing bracket before finally tightening the rocker arm shaft

6. Adjust the valve clearance: intake valves to 0.35 mm and exhaust valves to 0.80 mm.

Adjustment can be carried out according to either of the following alternatives:

A. Adjust both valves for each cylinder, starting on the TDC position of the first cylinder after compression. Turn the crankshaft a third of a revolution at a time and adjust the valves in injection sequence, i.e. 1 - 5 - 3 - 6 - 2 - 4.

B. Set the first cylinder in its exact TDC position after compression. The following valves can now be adjusted:

1 (intake) 2 (exhaust) 4 (intake) 5 (exhaust) 7 (intake) 9 (exhaust)

Turn the crankshaft exactly one revolution so that the TDC position of the 6th cylinder is set. The remaining valves can now be adjusted.

3 (exhaust) 6 (intake) 8 (exhaust) 10 (intake) 11 (exhaust) 12 (intake)

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Torque values	50%	75%	100%
M16x2 screws	120 Nm	180 Nm	240 Nm
M18x2 screws	150 Nm	230 Nm	300 Nm

grupp	sekt	nr	sida
1a	AR	1	12

T.d.c. position of 1st cyl

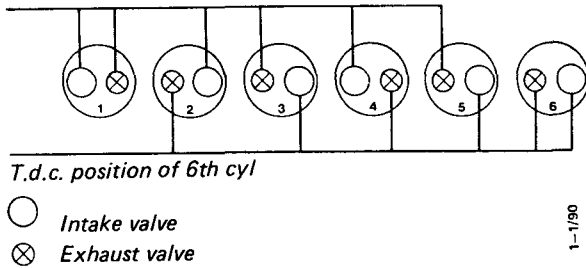


Fig. 31 Valve adjustment schedule

7. Fit the injectors.

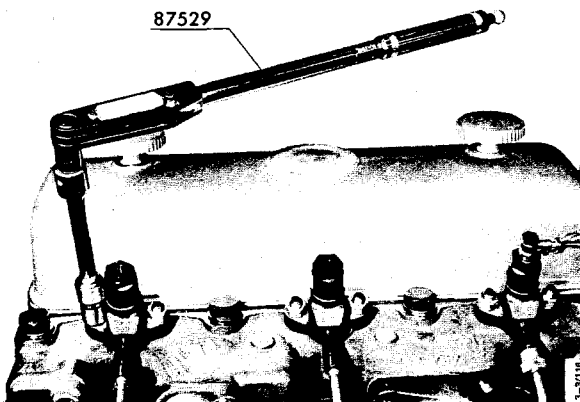


Fig. 32 Torque wrench for injectors

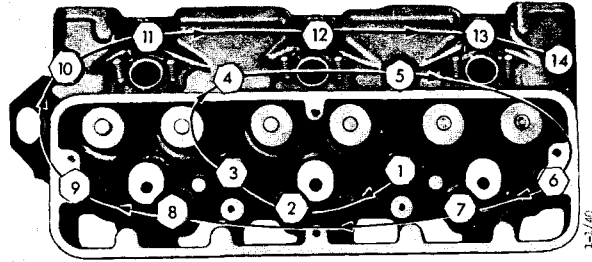


Fig. 33 Tightening sequence for cylinder head screws

Retightening the cylinder head screws

Whenever new cylinder head gaskets have been fitted the cylinder head screws must be retightened twice as follows:

1. After a test run under load (approx. 30 minutes). Slacken the screws one at a time about a quarter of a turn and tighten to the prescribed torque. Tighten all the screws in this way in the sequence shown in the figure. Recheck the tightening torque on all screws.

2. When the engine has been driven about 2.500 km (1 500 miles) or 50 hours. Remove the screws, one at a time, lubricate the thread and washer with oil and tighten the screws to the prescribed torque. Tighten all the screws in this way in the sequence shown in the figure. Recheck the tightening torque on all screws.

The rocker arm shaft and the injectors must be removed before retightening is carried out.

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PRODUCTS

grupp/group	Work description	
1 a	nummer/number 2	sida/page 1
datum/date 77-02-28	best. nr/order nr E501a	

TURBOCOMPRESSOR

	Page
General	3
Oil leakage	3
Lubrication	3
Foreign objects	3
Air and exhaust leaks	3
Checks	4
Measurement of charging pressure	4
Cleaning the compressor wheel	4
Measurement of radial and axial clearance	4
Overhauling	5
Dismantling	6
Cleaning	6
Checking	6
Assembly	7
Fitting on the engine	7

AR

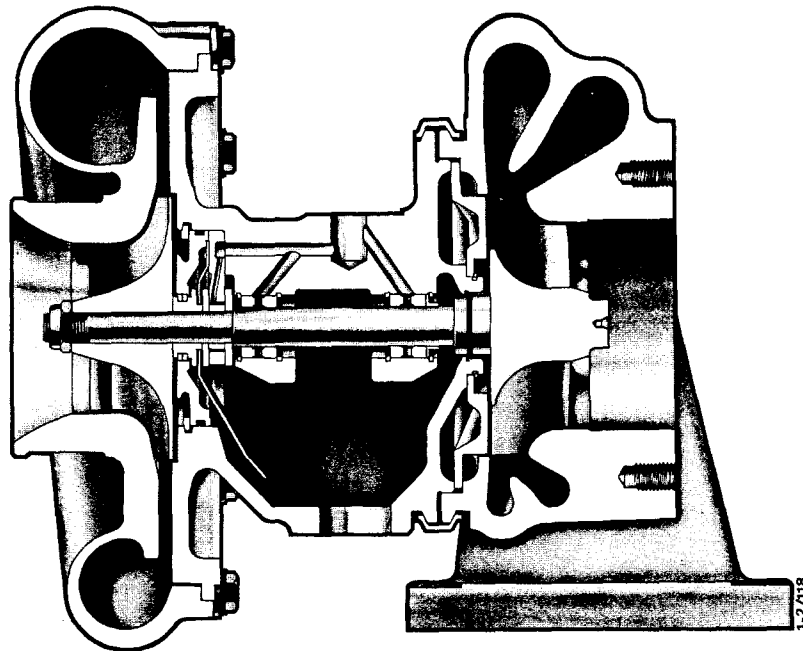
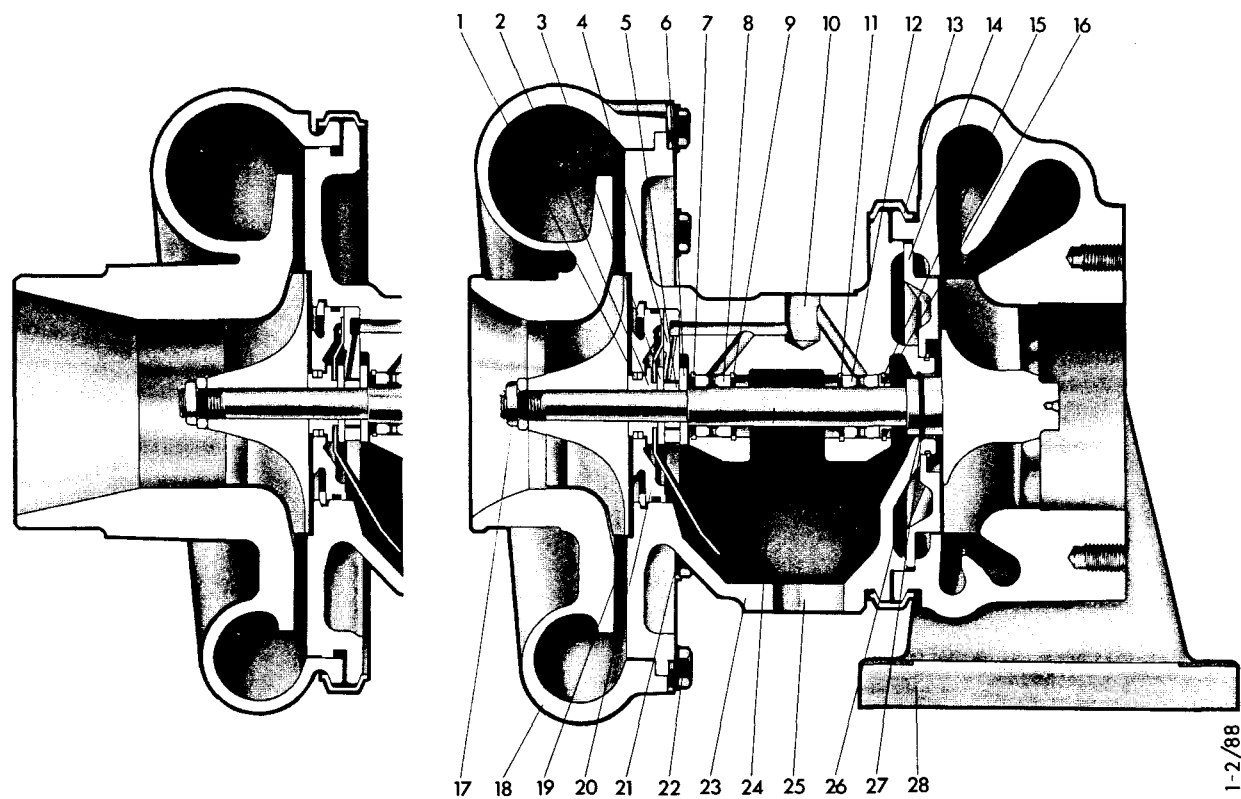


Fig. 1

grupp	sekt	nr	sida
1a	AR	2	2



Compressor side 4LGZ

Turbocharger 4LGK

Fig. 2

1. Sealing rings
2. Spacer sleeve
3. Thrust washer
4. Thrust bearing (axial bearing)
5. Sleeve
6. Thrust washer
7. Lock ring
8. Bearing
9. Lock ring
10. Lub. oil inlet
11. Lock ring
12. Bearing
13. V-clamp
14. Radiation shield

15. Lock ring
16. Oil control sleeve
17. Nut
18. Compressor casing
19. Lock ring
20. Sealing plate
21. Oil deflector
22. Screw for attachment of compressor casing
23. Bearing housing
24. Shaft with turbine wheel
25. Lub. oil outlet
26. Shoulder in bearing housing
27. Sealing ring
28. Turbine housing

General

In all work on the turbocharger conditions of scrupulous cleanliness must be observed. The connections for the oil inlet and outlet must never be left uncovered. A foreign particle entering the bearing housing can rapidly lead to a total breakdown.

Oil leakage

A clogged air cleaner causes the vacuum in the intake line to be excessive. If this occurs, there is a risk that oil must will be drawn out from the bearing housing.

It is more seldom, on the other hand, that oil leakage is caused by wear on the sealing ring on the turbine side. If this occurs, the exhaust gases will be blue when running at idling speed.

The sealing ring on the turbine side is normally worn into its right position during the running-in period. The ring groove can also become slightly worn. The ring groove can be skew-worn without this having any adverse effect on the effectiveness of the seal.

In repairing a turbocharger, the turbine shaft should not be refitted if the width of the ring groove exceeds the stipulated value.

If the oil outlet pipe from the turbocharger is distorted there is obviously a risk that oil can penetrate out through the seals.

Lubrication

The turbocharger rotates at a very high speed – 60 000 – 100 000 revolutions per minute. It is therefore important for the lubrication to function satisfactorily. The special lubricating oil filter for the turbocharger must be changed at the specified intervals and the centrifugal cleaner in the engine must also be cleaned in accordance with out instructions. If this is not done, the turbocharger's filter will become clogged all too rapidly and the resistance in the filter will increase. A valve in the filter then opens and allows oil to pass through the filter without being cleaned. The turbocharger receives uncleaned oil and the bearings are subjected to heavy wear.

The opening pressure of the valve is adapted to the oil flow. For this reason, only Scania original oil filters should be used. The oil filters of similar type intended for certain car engines are not suitable because the valve has far too low an opening pressure.



Fig. 3 Lubricating oil filter for turbocharger

1-1/78

AR

Foreign objects

Foreign objects in the turbine or compressor very rapidly ruin the wheel vanes. The engine output deteriorates and if running is continued there is a risk of overheating damage in consequence of inadequate air supply. This type of overheating is not noticeable on the coolant thermometer.

Never attempt to straighten a damaged vane: it will usually break during operation and can cause engine damage.

Air and exhaust leaks

Even very tiny leaks in the line between the air cleaner and turbocharger give rise to deposits of dirt on the compressor wheel. The charging pressure, and thus also the engine output, decreases. Moreover, there is also a risk of the engine becoming overheated.

Exhaust leaks between the cylinder head and turbocharger also result in low charging pressure and risk of overheating.

grupp	sekt	nr	sida
1a	AR	2	4

Checks

Measurement of charging pressure

The charging pressure should be measured in conjunction with periodical maintenance or when there seems to be something wrong with the engine output. It should be observed, however, that too low a charging pressure does not necessarily imply that the turbocharger is defective but can be due to such factors as a clogged air filter, leaky intake and/or exhaust lines, incorrectly set throttle control, faulty injectors, a faulty injection pump or a faulty smoke limiter.

The charging pressure is measured with the aid of tools 98111 and 98113.

Connect the nipple 98113 to the measuring take-off on the intake manifold between the turbocharger and the cylinder head. Connect the hose to pressure gauge 98111, which has a measuring range of 0–1.5 bar (kp/cm²).

the highest value while reading off the tachometer. Repeat this procedure a few times by braking slightly while keeping the accelerator pressed right down all the time.

Separate engines:

On separate engines the driven unit must be loaded on the corresponding manner.

If the engine is unable to come up to the maximum speed the reading can be taken at a slightly lower speed.

The measured charging pressure has to be adjusted in view of the air temperature: see 1a SP 2.

Next, check the value in accordance with the appropriate diagram in 1a SP 2.

NOTE! The setting of the injection pump must not be altered in any circumstances beyond the permissible values in order to adjust the charging pressure.

Cleaning the compressor wheel

A low charging pressure can be consequence of a dirty compressor wheel. Remove the compressor casing. Clean the compressor wheel with white spirit and a brush. Refit the compressor casing and measure the charging pressure again.

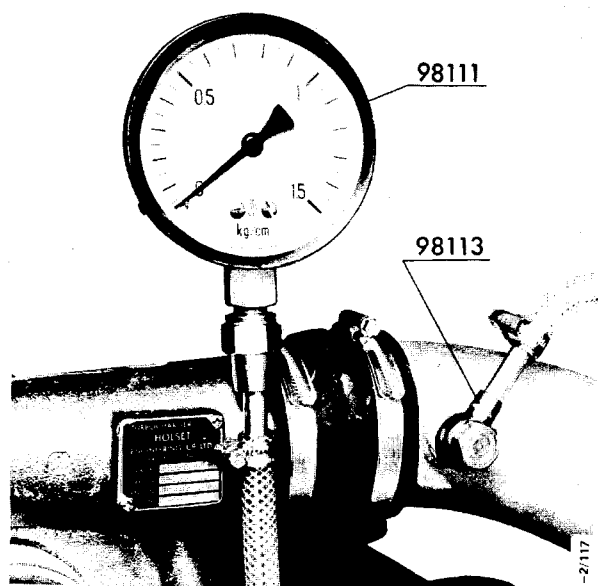


Fig. 4 Tools for measurement of charging pressure

Measurement of radial and axial clearance

As a rule, measurement of radial and axial clearance does not give much information about the remaining service life of the turbocharger. However, if the turbocharger appears to be performing unsatisfactorily or produces unwanted noise, measurement of charging pressure and/or of radial and axial clearance can show that the turbocharger is defective.

When measuring axial and radial clearance it is appropriate to remove the turbocharger and to screw it to a steel plate, to which the magnetic stand of the dial indicator can also be attached.

Radial clearance

Apply the measuring point of the dial indicator to the turbine wheel or compressor wheel, as applicable, as indicated in the figures below. Pull one wheel upwards and push the other one downwards. Take a reading. Push and pull in the opposite direction and take a reading. The difference between the values thus obtained gives the radial clearance. Repeat the measuring procedure three times.

Vehicle engines:

Drive the vehicle up a slope. Select a gear so that the engine slowly speeds up to max r/m with the accelerator pedal pressed right down. Take a pressure-gauge reading and note

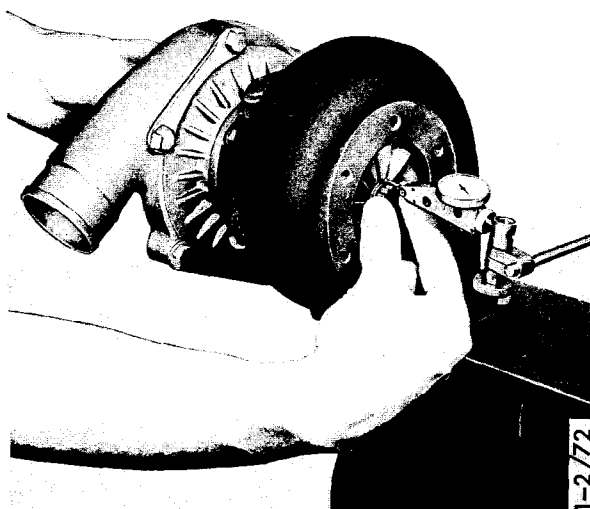


Fig. 5 Measurement of radial clearance at the turbine end

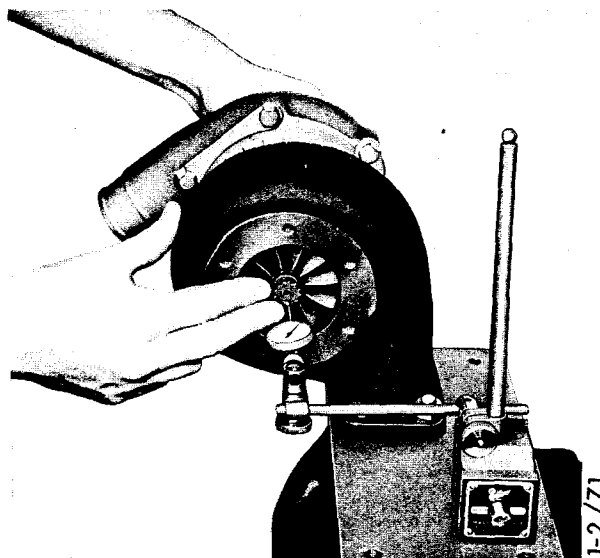


Fig. 7 Measurement of axial clearance

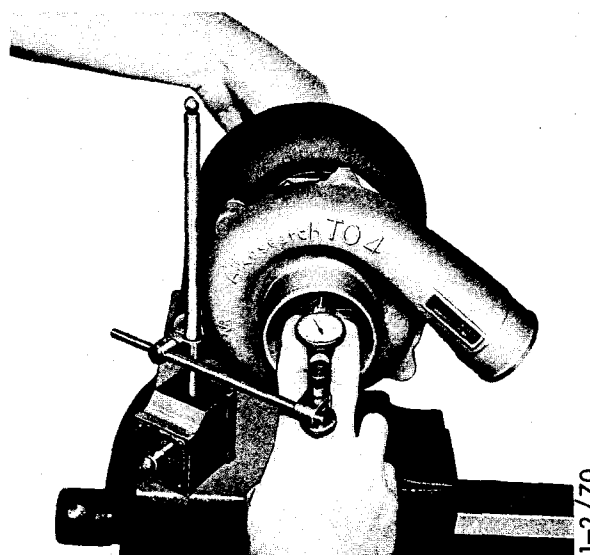


Fig. 6 Measurement of radial clearance at the compressor end

Axial clearance

Apply the measuring point of the dial indicator to the shaft end as shown in the figure. Push the shaft in the longitudinal direction to and fro and take readings in the end positions. The difference between the values obtained gives the axial clearance. Repeat the measuring procedure three times.

Overhauling

In practice, it has proved difficult to overhaul the turbo-charger satisfactorily without access to expensive special equipment such as measuring tools, wet-blasting equipment and a balancing machine.

If replacement parts are not available, overhauling can be carried out in accordance with the following instructions.

Dismantling

Wash the outside with white spirit.

Remove the compressor casing and turbine housing.

Secure the knurled end of the shaft in a vice.

Slacken the nut (17) (Fig. 2 on page 2) at the compressor wheel. Take care not to bend the shaft end. Remove the nut. Lift off the compressor wheel. If it is jammed, tap the shaft end gently so that it loosens. Pull out the shaft with the turbine wheel.

Remove the lock ring (19) and lift out the sealing plate (20), using two screwdrivers. Remove the O-ring from the sealing plate.

Lift out the oil deflector (21) and parts (3, 4, 5 and 6) of the thrust bearing.

Remove the bearings (8 and 12), the oil control sleeve (16) and the lock rings (7, 9, 11 and 15).

Remove the sealing ring (27) from the shaft.

grupp	sekt	nr	sida
1a	AR	2	6

Cleaning

Use a suitable cleaning fluid such as white spirit. Alkaline liquids, such as caustic soda, ruin certain parts and consequently must not be used. Carefully scrape off all deposits with a soft implement (e.g. of plastic or aluminium).

Blow all oil passages in the bearing housing thoroughly clean with compressed air.

Checking

Change all parts included in the repair kit. Examine the condition of the bearing seats for the shaft and bearing housing. Slight scratches can be tolerated. Check the sealing ring groove on the shaft with tool 98335. It should not be possible to press the tool into the groove. On the other hand, skew wear on the groove is permissible. Check the vanes of the turbine and compressor wheels. Never attempt to straighten a distorted vane.

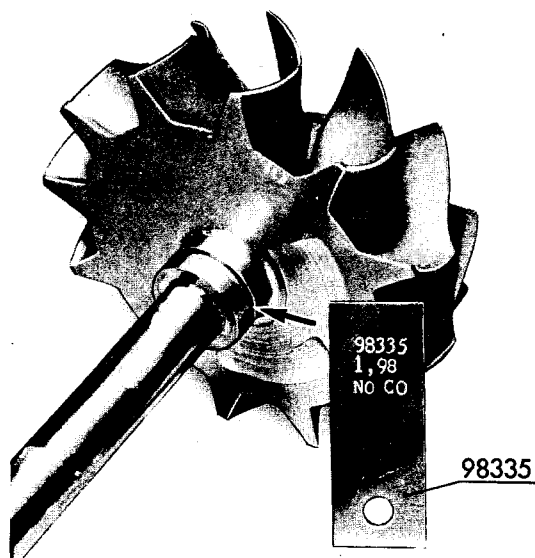


Fig. 8 Gauge for checking of ring groove

If it is suspected that the shaft is crooked or the turbine wheel warped the shaft can be checked in a V-block. The shaft is measured at the end nearest the thread for the nut. The turbine wheel is measured on the back at the radius indicated.

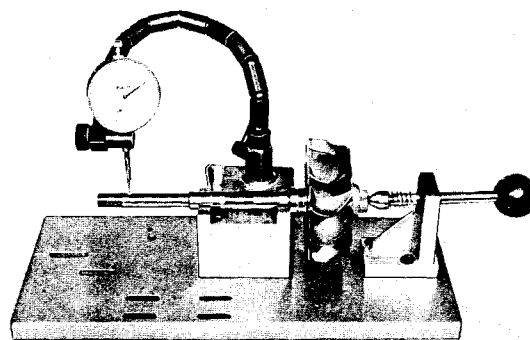


Fig. 9 Measurement of throw on shaft

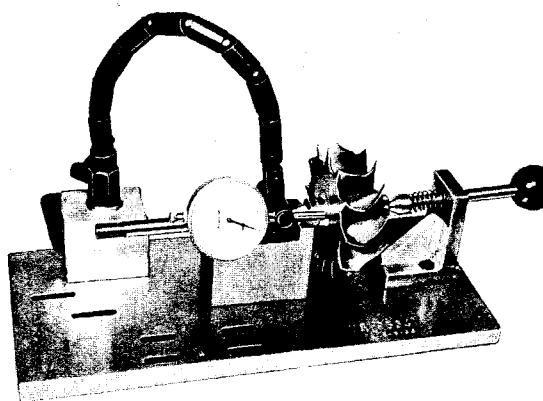


Fig. 10 Measurement of throw on turbine wheel

If the turbocharger has broken down, the following checks must be performed on the engine:

Check that the air intake is clean and that there are no loose particles present there.

Check the exhaust and intake manifolds for loose particles. Check that all valves are intact.

Check the oil return line for clogging and distortion.

Check the oil pressure pipe in respect of clogging, distortion and possible leakage under pressure.

datum	
77-02-28	

grupp	sekt	nr	sida
1a	AR	2	7

Assembly

The turbocharger is very sensitive to impurities. Bearing this in mind, take great pains when assembling and make sure that no particles of dirt enter the bearing housing.

Fit the inner lock rings (9 and 11), locating them with their rounded side towards the bearing. Lubricate the bearings (8 and 12) with engine oil and insert them. Fit the oil control sleeve (16) and the outer lock rings (7 and 15).

Fit the sealing ring (27) on the shaft. This ring is similar to sealing rings (1) but is slightly bigger and softer. Consequently, it cannot be slid into the spacer sleeve (20). Take care to avoid warping of the sealing ring when fitting it.

Pass the shaft carefully into the bearing housing. Make sure that the sealing ring does not get damaged.

Slide the thrust washer (6), the thrust bearing (4) and the sleeve (5), followed by the second thrust washer (3), onto the shaft. Lubricate these parts with engine oil. Fit the oil deflector (21). Mount the two sealing rings (1) on the spacer sleeve (2), locating the openings displaced half a revolution. Fit the spacer sleeve (2) in the sealing plate (20). Fit a new O-ring to the sealing plate and tap the plate into the bearing housing with the aid of a plastic mallet. Fit the lock ring (19). Mount the compressor wheel on the shaft. Tighten the nut to the prescribed torque, proceeding carefully so as to avoid bending the shaft.

Check that the shaft rotates easily.

Assemble the bearing housing together with the compressor casing and turbine housing. The positions of the compressor casing and turbine housing are exactly adjusted most easily in conjunction with fitting on the engine.

Fitting on the engine

When the turbocharger is changed, the gaskets and oil filter provided in the gasket set must also be changed.

Check the connection flange on the exhaust manifold to make sure that no fragments of the old gasket remain there.

Screw on the turbocharger.

Connect the oil air pipes. Lubricate the screws for the exhaust manifold with special high-temperature-resistant copper-coloured lubricant, article No. 561205.

Check that the expansion piece in the exhaust manifold can easily be turned by hand. If not, adjust the exhaust manifold.

Pull out the start button and run the engine with the starter motor for at least 30 seconds so that the lubricating oil reaches the turbocharger.

Start the engine and check that no leakage occurs.

CYLINDER BLOCK

	Page
Cylinder liners	4
Removal of cylinder liners	4
Measurement of liner height.	4
Adjustment of liner height.	5
Fitting of cylinder liners.	6
Flywheel casing	7
Changing the sealing ring with the flywheel casing fitted	7
Fitting of flywheel casing.	7
Timing-gear housing	8
Removal.	8
Changing the sealing ring with the timing-gear housing fitted	8
Injection pump shelf	8
Fitting	8

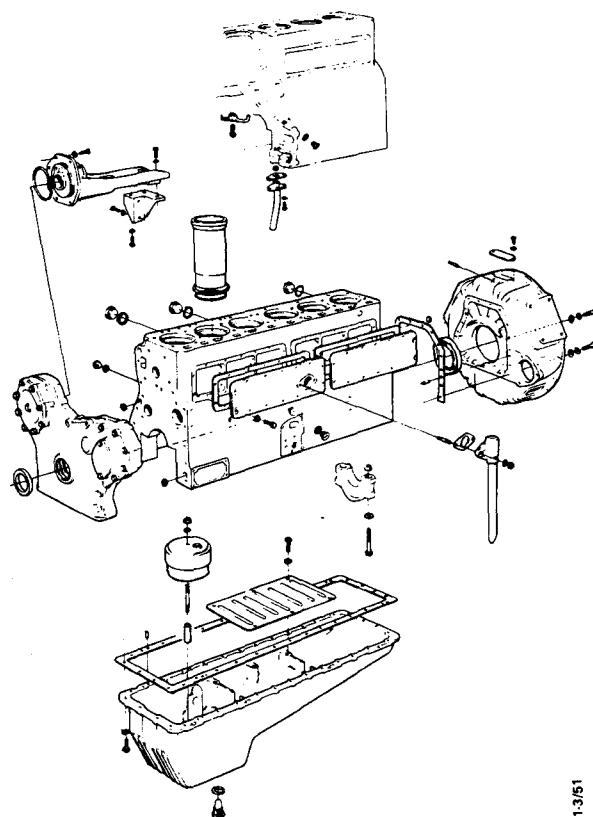


Fig. 1

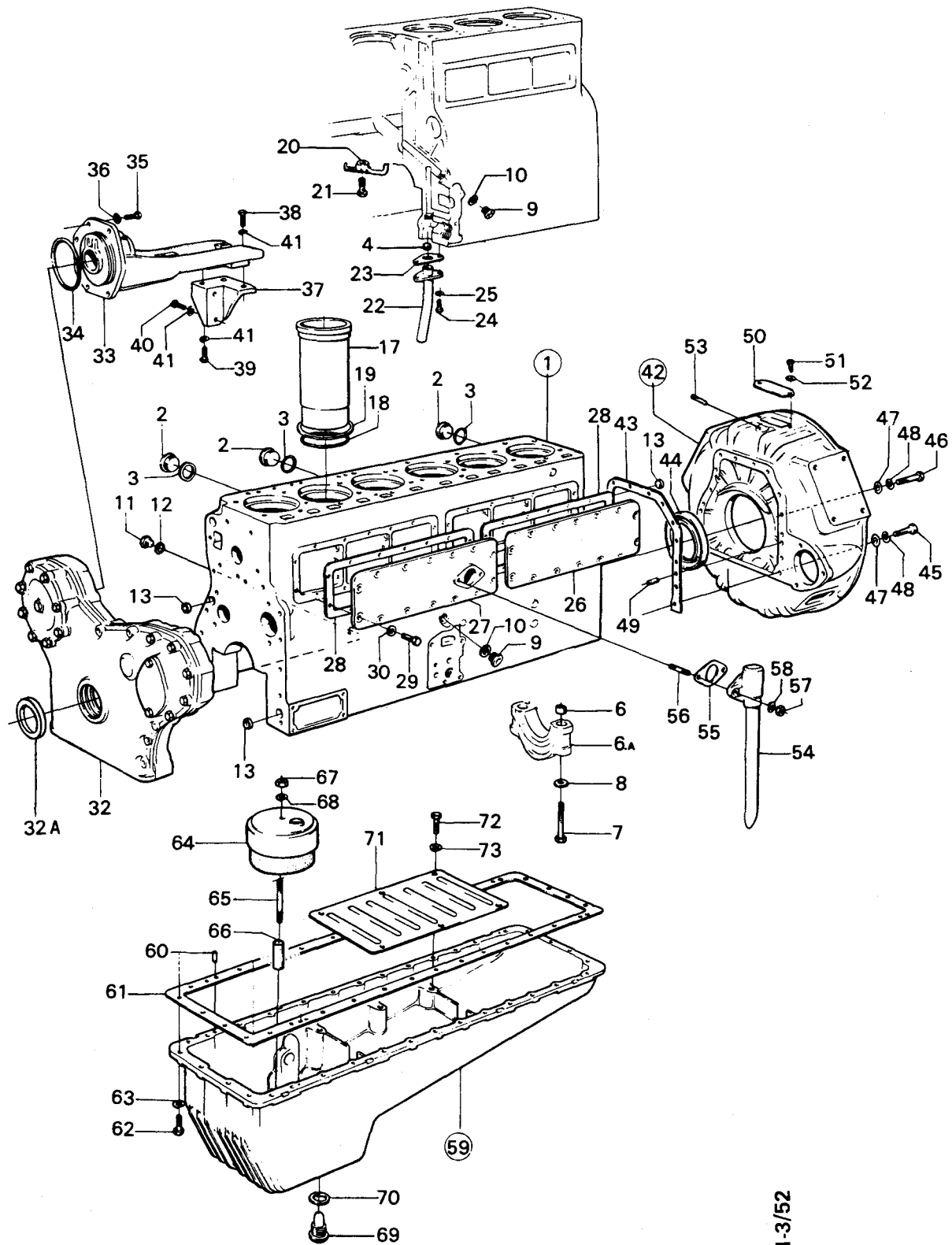


Fig. 2

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SERVICE SCANIA

grupp	sekt	nr	sida
1a	AR	3	3

- | | |
|------------------------------------|------------------------------|
| 1. Cylinder block, complete | 39. Screw |
| 2. Sealing plug | 40. Screw |
| 3. O-ring | 41. Washer |
| 4. Plug, tapered | 42. Flywheel casing |
| 6. Guide | 43. Gasket |
| 6A. Bearing cap | 44. Sealing ring |
| 7. Screw for bearing cap | 45. Screw |
| 8. Washer | 46. Screw |
| 9. Plug | 47. Washer |
| 10. Gasket | 48. Spring washer |
| 11. Plug, D11 | 49. Locating pin |
| 12. Gasket, D11 | 50. Door |
| 13. Sealing washer | 51. Screw |
| 17. Cylinder liner | 52. Washer |
| 18. Sealing ring, upper and middle | 53. Pin, flywheel graduation |
| 18. Sealing ring, lower | 54. Ventilation pipe |
| 19. Shim | 55. Gasket |
| 20. Nozzle for piston cooling | 56. Stud screw |
| 21. Banjo screw | 57. Nut |
| 22. Pipe | 58. Washer |
| 23. Gasket | 59. Oil pan |
| 24. Screw | 60. Locating pin |
| 25. Washer | 61. Gasket |
| 26. Side door without filter | 62. Screw |
| 27. Side door with filter | 63. Washer |
| 28. Gasket | 64. Oil strainer |
| 29. Screw | 65. Stud screw |
| 30. Washer | 66. Spacer sleeve |
| 32. Timing-gear casing | 67. Nut |
| 32A. Sealing ring | 68. Washer |
| 33. Injection pump shelf | 69. Drain plug |
| 34. O-ring | 70. Gasket |
| 35. Screw | 71. Baffle plate |
| 36. Washer | 72. Screw |
| 37. Bracket | 73. Washer |
| 38. Screw | |

grupp	sekt	nr	sida
1a	AR	3	4

Cylinder liners

Removal of cylinder liners

1. Remove the cylinder head.
2. Remove the oil pan.
3. Remove the oil nozzle for the piston which is to be removed.
4. Take out the piston with connecting rod. Protect the oil-way in the crankshaft against impurities with a strip of tape with the tacky side outwards.
5. Pull the cylinder liner out with puller 87627.

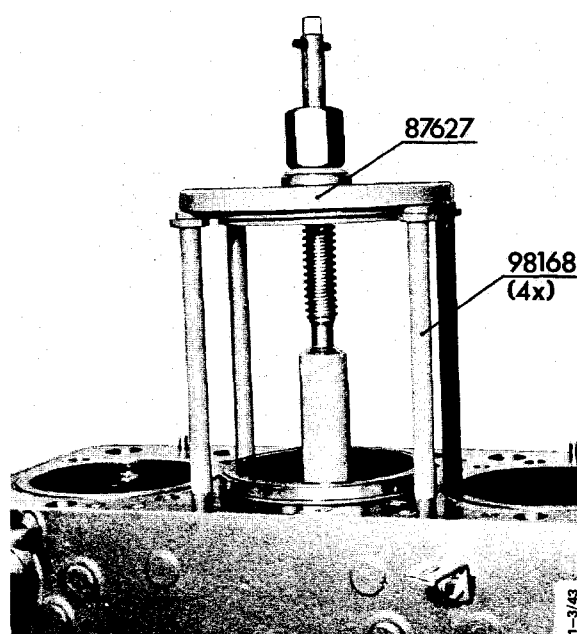


Fig. 3 Puller for cylinder liner

Measurement of liner height

The cylinder liner must be located slightly above the face of the cylinder block in order for satisfactory sealing to be obtained. Measuring is done against the surfaces shown by the figure below.

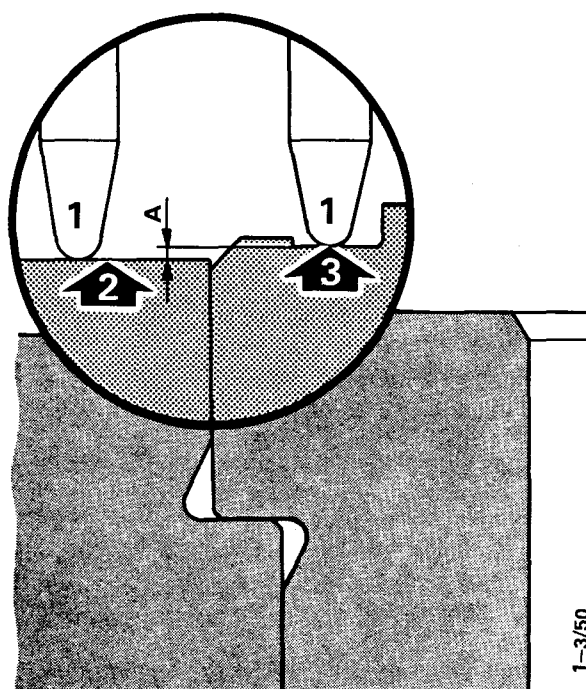


Fig. 4

1. Measuring point on dial indicator
2. Surface of cylinder block
3. Groove in cylinder liner where measurement is taken
- A. Cylinder liner height

Insert the liner without sealing rings and press it down with the aid of two sleeves 87626, pressing the latter down with the cylinder head screws.

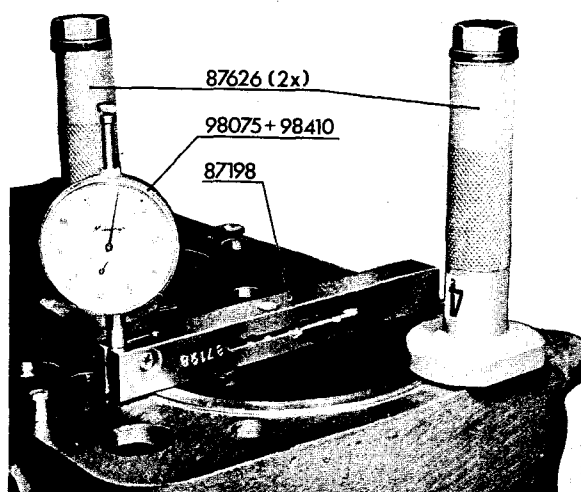


Fig. 5 Sleeves for pressing down the cylinder liner, measuring straight edge and dial indicator with measuring point

Place the measuring straight edge 87198 and dial indicator 98075 fitted with measuring point 98410 on the liner and zero-set the dial indicator against the block. Slide over the straight edge and measure in the groove in the liner as indicated in the figure. Make sure that the measuring point on the dial indicator is pointed enough to be able to reach right down to the bottom of the groove in the liner. Measure each liner at two diametrically opposite points in the transverse direction of the engine. The difference between the two values measured on the same liner must be exceed 0.02 mm.

The middle liner under each cylinder head must not be lower than the adjacent cylinder liners.

The height of the cylinder liner above the block should be 0.03–0.09 mm.

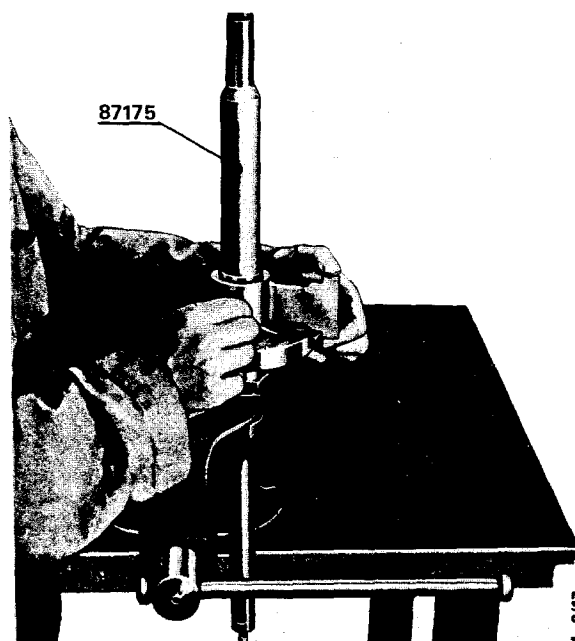


Fig. 6 Adjust the cutting radius of the reamer with the aid of the setting tool

Adjustment of liner height

The liner contact surface in the block must be clean and flawless. If the surface is damaged it will be necessary to use a facing reamer 87175 and feeder 87051. When the contact face of the liner in the block has been reamed a shim will have to be fitted in order for the liner height to be correct.

The least possible amount of reaming should be resorted to, so that the thinnest possible shim can be fitted. Shims are available in the following thicknesses: 0.20, 0.25, 0.30, 0.50 and 0.75 mm.

Polish off any burrs and measure the thickness of the shims with a micrometer. Try to use only one shim, i.e. one thick shim instead of several thin ones.

When adjusting the liner height, try to get within the upper half of the tolerance range.

Calculate the difference between the thickness of the shim and the amount by which it is desired to raise the cylinder liner. This difference gives the thickness of the layer that will have to be removed with the reamer.

Example for calculation of requisite reaming depth.

Measured cylinder liner height	0.02 mm
Wanted height	0.08 mm
Raising of cylinder liner 0.08–0.02 mm	0.06 mm
Nearest shim thickness	0.20 mm
Layer to be removed 0.20–0.06 mm	0.14 mm

Adjust the cutting radius of the reamer for the engine type concerned with the aid of the setting tool, pushing this up onto the upper locating surface of the reamer spindle. The setting tool is provided with lugs marked with motor type designations against which the cutter can be set. The cutter can be moved by slackening the locking screw in the wedge-shaped locking plate which holds the cutter in place. In some cases it may be necessary to pry the locking plate carefully loose, for instance using a screwdriver, in order to be able to move the cutter. Set the right cutting radius by moving the cutter towards a bigger radius with the adjusting screw. Just before the right cutting radius is reached, tighten the locking screw slightly, thereby making it easier to control the movement of the cutter. When fitting a new cutter, be sure to insert it the right way round so that its cutting direction will coincide with the direction of rotation of the reamer, which is indicated by means of an arrow on the stop plate. Check also that the flat face of the cutter which is turned towards the bottom face of the cutter head bears firmly against this and that there are no particles of dirt between any of the contact surfaces.

Insert the guide for the reamer in the block.

Smear the ground guide surfaces on the reamer with engine oil to ensure that the reamer will run easily.

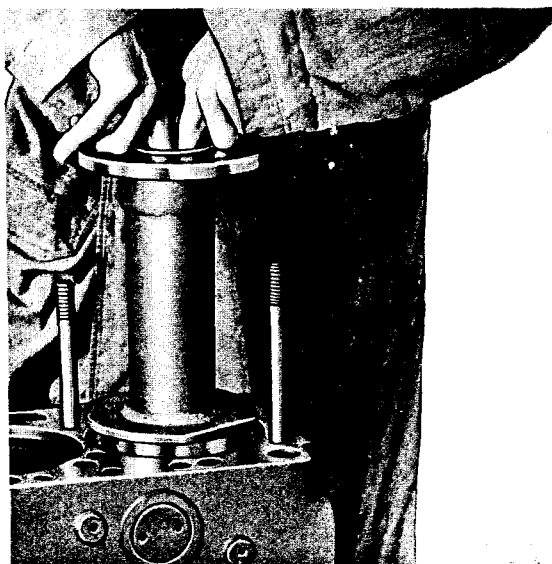


Fig. 7 Place the guide in the cylinder liner seat

1-3/18

Put the reamer in the guide. Check that the reamer cutter bears against the cylinder liner seat (B).

The distance (C) between the stop plate of the reamer and the face of the cylinder block must be exactly the same as the measurement obtained according to the example presented above, i.e. 0.14 mm. Measure the distance with a feeler gauge and adjust as necessary with shims (A) between the cutter head and stop plate. Tighten the lock nut firmly. Shims for the reamer are available in the following thicknesses: 0.03, 0.05, 0.10 and 0.20 mm.

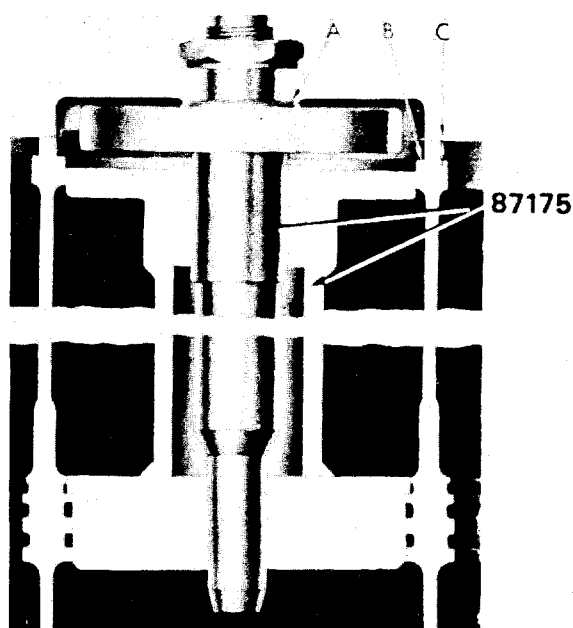


Fig. 8 Placing of adjusting reamer in cylinder liner seat

1-3/16

Push the feeder for the reamer down over the reamer spindle and two of the stud screws in the block sited opposite each other. Then screw the two knobs belonging to the feeder onto the stud screws and tighten them enough to give a resistance which feels just about right when the reamer is turned.

Pour a few drops of oil between the reamer's stop plate and the cylinder block in order to prevent damage to the contact surfaces.

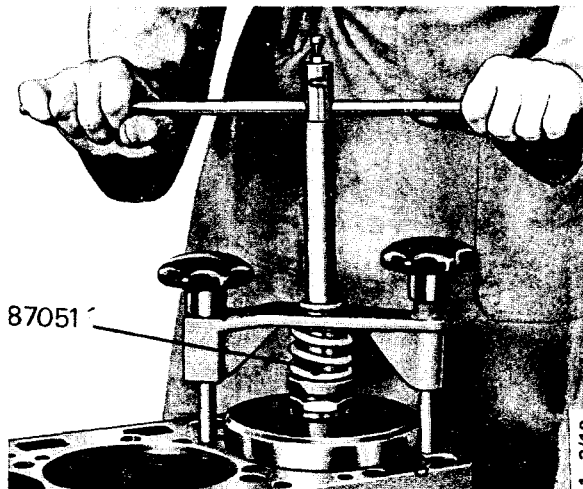


Fig. 9 Reamer with feeder

1-3/19

Ream the cylinder liner seat until the stop plate bears against the cylinder block.

Never turn the reamer backwards.

Clean the cylinder liner seat very thoroughly.

Fit the shim and the cylinder liner.

Press the cylinder liner down with the aid of the sleeves and check the cylinder liner height in accordance with the instructions given earlier.

Fitting of cylinder liners

Before inserting cylinder liners, check that there is not an excessive amount of scale in the block, since the presence of scale impairs cooling of the liners. The coolant is conducted through a passage in the right side of the block and flows out through holes in the passage wall, partly up to the cylinder head and partly out towards the liners. When these holes have been cleaned it is possible to see whether or not the passage is clogged up. If the passage needs cleaning, the plugs on the outside of the block must be removed first.

When the height position has been determined fit new rubber rings in the block. Flex the rubber rings out before inserting them so that they fit firmly all round in the groove in the block. Note that the rubber ring for the lowermost ring groove is of different material than those for the two upper grooves and can be identified through a violet colour mark or by the ring being green. This ring can also be fitted in the upper ring grooves. A black unmarked ring, on the other hand, must not be fitted in the bottom groove. To facilitate fitting of the liner, the rubber rings and the lower locating surface on the liner should be smeared with the engine oil.

If a used liner is to be fitted the envelope surface must be cleaned thoroughly. Otherwise there is risk of rest flakes falling down on the contact surface of the cylinder block resulting in permeability.

Always fit the liner with the drill mark in its upper edge facing the front end of the engine.

Press the liner down into position in the block.

Flywheel casing

Changing the sealing ring with the flywheel casing fitted

1. Measure the distance from the edge of the flywheel casing to the sealing ring (= 0 on new engines).
2. Remove the sealing ring with the aid of extractor 98484.

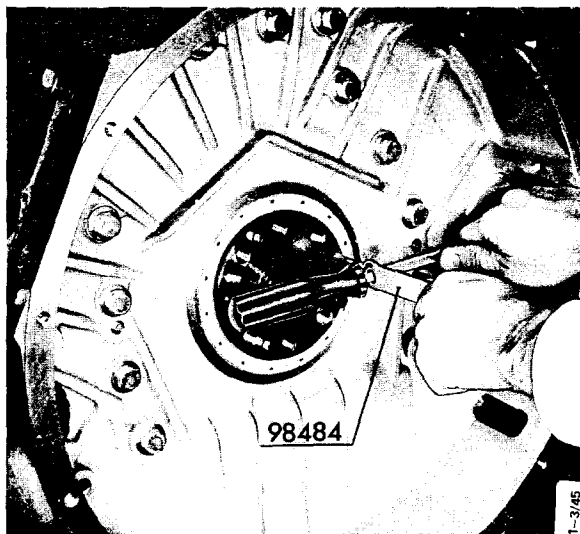


Fig. 10 Extractor for sealing ring

3. Check the sealing surface of the crankshaft. If the sealing surface is marred by abrasion grooves the new sealing ring must be displaced 1.5 mm forwards.
4. Fit the sealing ring with tool 98321. Fill the space between the sealing butts with grease.

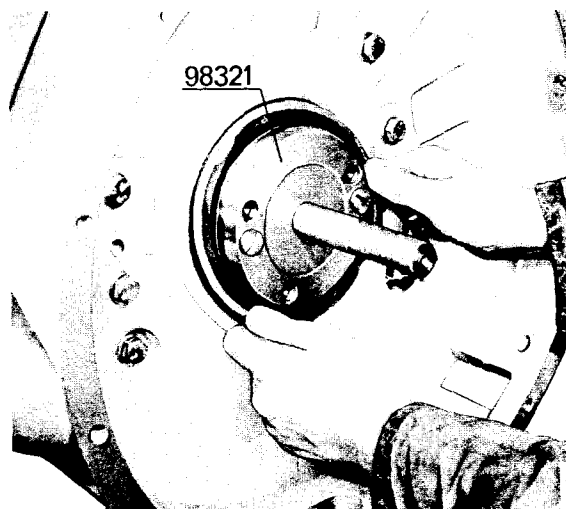


Fig. 11 Easing the sealing ring onto the crankshaft

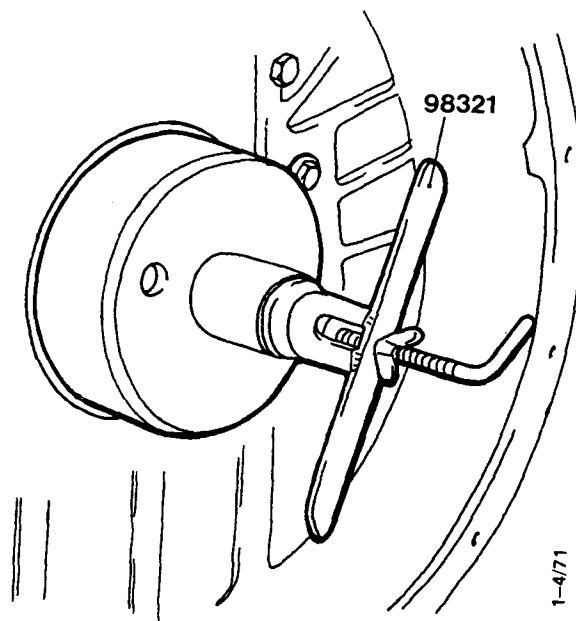


Fig. 12 Tool for pressing in sealing ring

5. After fitting, check that the distance between the sealing ring and the edge of the flywheel casing is the same all the way round.

The sealing ring can be displaced forwards max. 5 mm.

Fitting

1. Fit a new gasket and place the casing on the locating pins.
2. Tighten the screws in the order indicated on the figure below to a torque of 85 Nm (8.5 kpm).

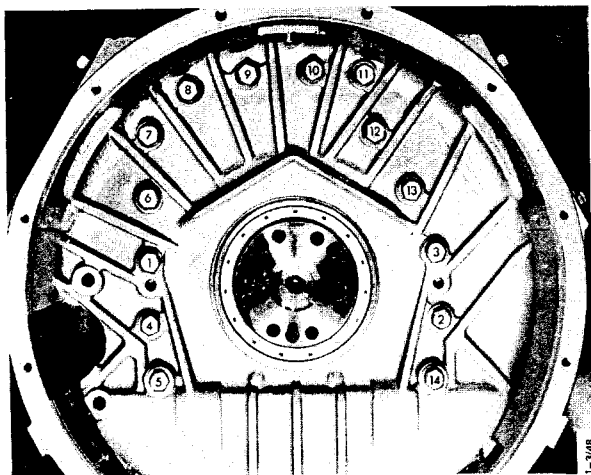


Fig. 13 Tighten the screws for the flywheel casing in numerical order

Timing-gear housing

Removal

In order to remove the timing-gear housing the following parts will have to be removed:

1. Belt fans.
2. Hydraulic pump for steering.
3. Crankshaft belt pulleys and vibration dampers.
4. Vibration damper hubs.
5. Since the lower edge of the timing-gear housing is screwed to the oil pan with a gasket in between, the oil pan will have to be lowered a bit to allow removal and fitting of the housing. The oil pan gasket often bursts when the oil pan is removed and for this reason removal of the pan is recommended.

Changing the sealing ring with the timing-gear housing fitted

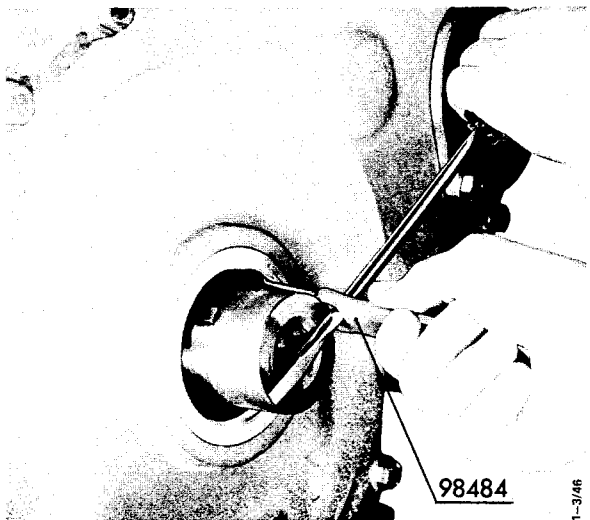


Fig. 14 Extractor for sealing ring

1. Remove fan belts, crankshaft belt pulley and vibration damper hub (see 1a AR 4, crankshaft and reciprocating components).
2. Remove the sealing ring with the aid of extractor 98484.
3. Wipe the sealing ring seat in the casing clean and tap a new sealing ring in so far that assembly drift 98494 and the crankshaft screw belonging to the engine can be applied.

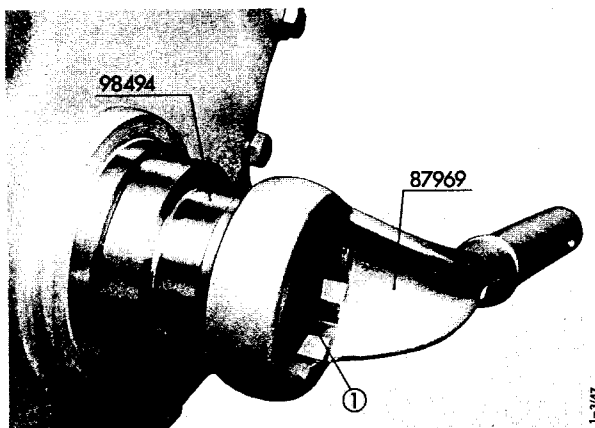


Fig. 15 Assembly drift for sealing ring

4. If the vibration damper hub shows wear from the old sealing ring, the new ring must be moved in 2 mm in the casing. The assembly drift is graduated for five different sealing ring positions. The innermost position for the sealing ring is obtained when the crankshaft screw is screwed all the way in.
5. Lubricate the hub contact surface against the sealing ring copiously with oil. Pack the space between the lips of the sealing ring with grease. Fit the hub, vibration damper, pulley and fan belts.

Injection pump shelf

Fitting

1. Insert a new sealing ring and a new O-ring and screw the shelf to the timing-gear housing.
2. Screw on the pump shelf bracket. Press the bracket firmly against the block and shelf while tightening the screw alternately.