Felkopplade smörjoljerör för turbokompressorns oljefilter på vissa separatmotorer (DS11M01, DSI11M01, DS11A05 och DS11A06 med vattenkylt avgassamlarrör)

Bakgrund

Motorer med turbokompressor är försedda med ett speciellt oljefilter för denna. I vår produktion har detta oljefilter på de angivna motortyperna anslutits så att in- och utlopp kastats om.

Aktuell information

Oljerören ska vara kopplade så som anges i fig. 1. Om så inte är fallet ska rören kopplas om. Vid ändring av kopplingen kan de befintliga rören bockas om. Det är emellertid även möjligt att beställa nya oljerör från vår reservdelsavdelning. Samtidigt ska oljefiltret bytas.

Benämning	Art. nr.	Antal
Oljerör cylinderblock-filter	271523	1
Oljerör filter-turbokompressor	271524	1
Oljefilter	173171	1

Incorrectly fitted oil-pipes for the turbocharger oilfilter of certain separate engines (DS11M01, DSI11M01, DS11A05 and DS11A06 with water-cooled exhaust manifold)

Background

Engines equipped with turbocharger have a special oil-filter for this. The oil in- and outlet of this oilfilter have in our production for the stated engine types been fitted incorrectly.

Current information

The oil pipes should be connected as indicated in fig. 1. If this is not the case the connection must be altered. The existing pipes can be adjusted at this alteration. However, it is also possible to order new pipes from our Spare Parts Department. The oil filter must be replaced at the same time.

Denomination	Part No.	Quantity
Oil pipe, cylinder block-filter	271523	1
Oil pipe, filter-turbocharger	271524	1
Oil filter	173171	1

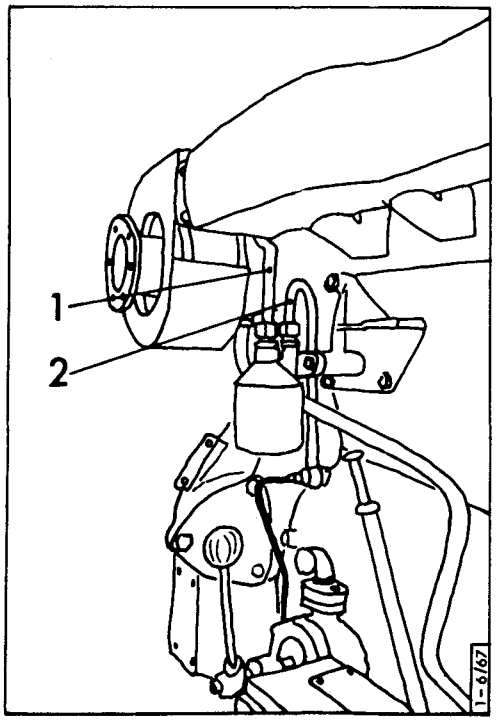

Fig. 1

1. *Smörjoljerör oljefilter-turbokompressor. Röret är kopplat till anslutningen i mitten ovanpå filterhållaren.*
2. *Smörjoljerör cylinderblock-oljefilter. Röret är kopplat till anslutningen vid sidan ovanpå filterhållaren.*

1. *Oilpipe oilfilter to turbocharger. The oilpipe is connected to the top center nipple of the filter bracket.*
2. *Oilpipe cylinder block to oilfilter. The oilpipe is connected to top side nipple of the filter bracket.*

3200-984

Falsch angeschlossene Schmierölleitung für Ölfilter des Turboladers bei gewissen Separatmotoren (DS11M01, DSI11M01, DS11A05 und DS11A06 mit wassergekühltem Abgassammelrohr)

Anlaß

Motoren mit Turbolader sind mit einem speziellen Ölfilter für diesen Turbolader versehen. Bei den obigen Motortypen wurde dieses Ölfilter in unserer Produktion so angeschlossen, daß Ein- und Auslaß umgewendet wurden.

Aktuelle Information

Die Ölleitungen müssen so angeschlossen sein, wie in Fig. 1 gezeigt. Ist dieses nicht der Fall, muß der Leitungsanschluß geändert werden. Bei Änderung des Leitungsanschlusses können die vorhandenen Leitungen umgebogen werden. Es können aber auch neue Ölleitungen von unserer Ersatzteilabteilung bestellt werden. Gleichzeitig muß das Ölfilter ausgewechselt werden.

Benennung	Teil Nr.	Anzahl
Ölleitung Zylinderblock-Filter	271523	1
Ölleitung Filter-Turbolader	271524	1
Ölfilter	173171	1

Conexión errónea de los tubos de aceite lubricante para filtro de aceite del turbocompresor de ciertos motores separados (DS11M01, DSI11M01, DS11A05 y DS11A06 con múltiple de escape refrigerado por agua)

Antecedentes

Los motores con turbocompresor están equipados con un filtro de aceite especial para el turbocompresor. En la producción de dichos tipos de motores, los tubos de entrada y de salida han sido invertidos.

Información actual

Los tubos de aceite tienen que estar conectados como en la fig. 1. En caso contrario, se conectarán de nuevo en la posición correcta. Los tubos existentes pueden acodarse en consecuencia. También se pueden encargar tubos nuevos a nuestro departamento de piezas de repuesto. Se cambiará al mismo tiempo el filtro de aceite.

Denominación	No. de art.	Cant.
Tubo de aceite, bloque del motor-filtro	271523	1
Tubo de aceite, filtro-turbocompresor	271524	1
Filtro de aceite	173171	1

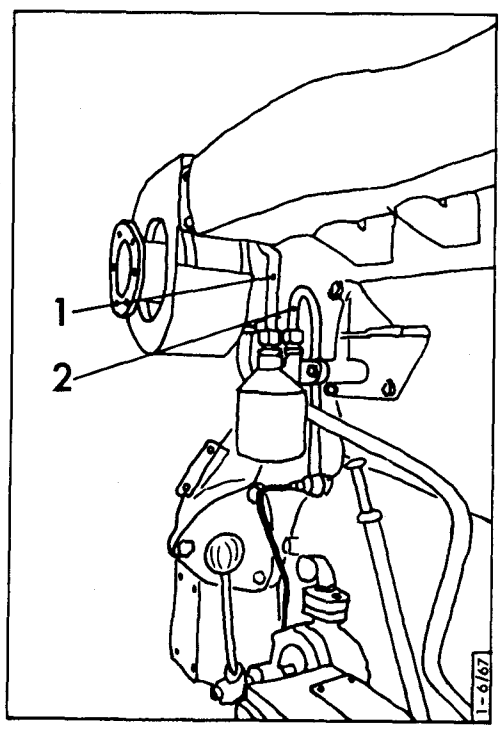

Fig. 1

1. *Schmierölleitung Ölfilter-Turbolader. Die Leitung ist an den Anschluß mitten auf dem Filterhalter angeschlossen.*
2. *Schmierölleitung Zylinderblock–Ölfilter, Die Leitung ist an den Anschluß seitlich vom Filterhalter angeschlossen.*

1. *Tubo de aceite lubricante, filtro de aceite-turbocompresor. El tubo llega a la conexión central encima de la caja de filtro.*
2. *Tubo de aceite lubricante, bloque de cilindros-filtro de aceite. El tubo llega a la conexión lateral encima de la caja de filtro.*

CAUTION

This section is applicable to only Waukesha models F476D and DS, which are designated by Scania as D and DS8A02, A04, A05, and A06. Engine serial numbers for these models are from 761785 (Sweden) and 133869 (Netherland).

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General

The engines described here of type D8 and DS8 have in general the same kind of build-up and, in the majority of cases, their corresponding assemblies are of the same design. Thus, as a rule it is possible to apply the same methods for maintenance work. On account of this the different engine types and variants are dealt with jointly in this section.

When it concerns identification or the procurement of spare parts reference is made to the Spare Parts List for the engine type in question.

Engine type designations

The engine type designation indicates the engine type, size and field of application etc. in code form.

Example:

DS8A05

Engine type

D = Diesel engine
DS = Diesel engine equipped with turbocharger
DSI = Diesel engine equipped with turbocharger and intercooler

Cylinder displacement

The number 8 indicates, the displacement of the engine in litres. Then the nearest integral number corresponding to the cylinder displacement in litres of the engine is given.

Field of application

A for general application and not requiring a marine cooling system, the basic design of which deviates from the engines intended for our trucks.

B for bus.

L for truck with conventional or semiforward control cab.

LB for truck with forward control cab.

M for general application which requires a marine cooling system.

Variant

A number in order of sequence is indicated for a variant. The characteristics which occasion new variant numbers are the differences in the designs of the engines for certain fields of application. For instance, differences in output, special designs for certain customers or sales market.

Classified marine engines

To ensure as far as possible that classified engines are fitted with classified spare parts, the engine type reference, carried on the engine name plate, is extended by two letters indicating the classification society in which the engine is classified. The classification societies are denoted as follows:

LR = Lloyd's Register of shipping
NV = Det Norske Veritas
BV = Bureau Veritas
GL = Germanischer Lloyd
SF = Statens Fartygsinspektion (The National Swedish Ship's Inspectorate), Stockholm

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Thus the reference DSI8M01-LR denotes a marine engine with a turbocharger certified by Lloyd's Register of Shipping.

Besides the engine number the complete engine type reference should always be stated, i.e. including the letters indicating the classification society, e.g. when ordering spare parts.

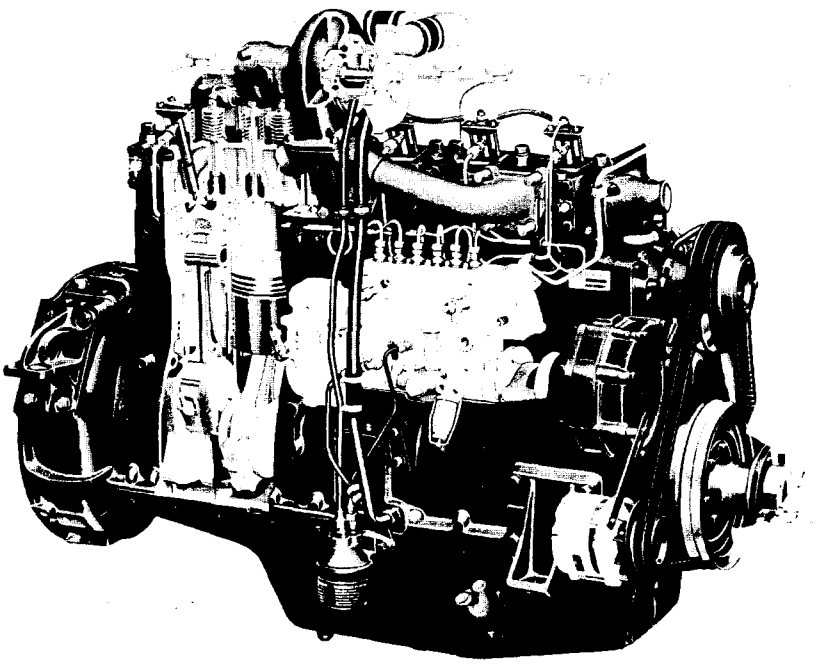

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Fig. 1 Diesel engine with turbocharger

TURBOCHARGER

Genral

The task of the turbocharger is to increase the air supply to the cylinders of the engine. This increase in the supply of air enables the engine to burn more fuel per piston stroke than a naturally aspirated engine, so that a greater power output becomes possible.

The turbocharger consists of the following main sub-assemblies. Exhaust turbine, bearing housing and compressor. The turbine and the compressor are mounted one on each side of the bearing housing, the turbine wheel and compressor wheel being united by a common shaft. The shaft runs in the bearing housing in "floating" sliding bearings.

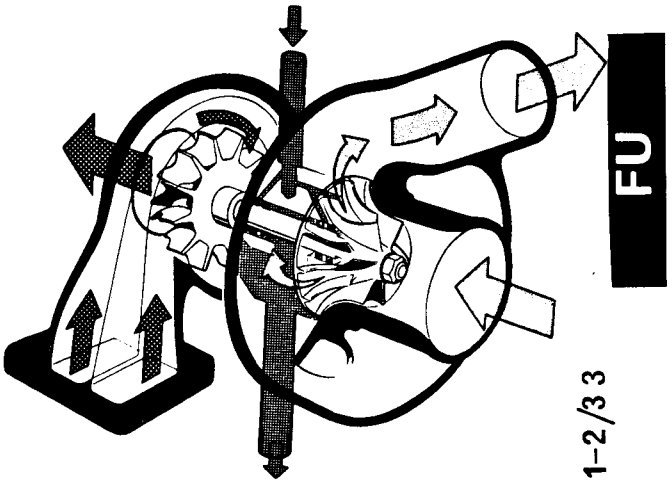
The turbine makes use of some of the energy contained in the hot exhaust gas. The exhaust gas goes straight from the exhaust manifold of the engine into the turbine housing. Inside the housing the gas first passes a nozzle ring to give it a greater velocity before it reaches the turbine wheel. The energy of the exhaust gas is converted by the turbine wheel into kinetic energy. The turbine wheel drives the compressor wheel, which is of the centrifugal type.

The air is drawn in at the centre of the compressor wheel and is forced out radially into the compressor housing through a diffuser. From the outlet of the compressor cover it is then forced into the engine intake manifold.

Since the turbine is driven by the engine exhaust gas, the speed of the turbocharger will automatically adjust itself to the load and speed of the engine.

The turbocharger is mounted directly on the exhaust manifold of the engine with a screwed fastening in the intake flange of the turbine. It is extremely important that this fastening alone should take the weight of the turbocharger and that no pipe connections or joints are too stiff, or they are liable to exert constraining forces on the unit and in such a condition could soon lead to trouble. For this reason, the exhaust pipe from the turbine is fitted with a special connection which takes up the movements that occur.

The lubrication of the bearings and the cooling of the bearing housing is effected by oil from the engine lubricating system. Before entering the bearing housing the oil first passes through a separate filter.



To seal between the shaft and the bearing housing use is made of sealing rings of piston ring type. This type of sealing ring does not seal properly as while in operation a certain amount of exhaust gas flows into the bearing housing, passes through the oil return pipe down to the oil sump and goes out through the crankcase ventilation. In some operating conditions, e.g. when braking with the engine or driving at high speed and with very little load there will be hardly any exhaust gas flow. Instead, it may happen that a small quantity of oil mist will force its way out. Oil is condensated from the oil mist, which will be seen on the inside of the intake and exhaust lines as a coating of grease. The oil mist does not disturb the function of the engine.

Start and stop

The engine should if possible be allowed to run at idling speed for a few minutes after start and stop. This saves both the turbocharger and the engine in general, as the various parts are then cooled off by the lubricating oil.

Types

Several turbochargers look very much alike in appearance. However, there may be considerable differences inside. Therefore, when carrying out repair work or changing the turbocharger the part number which is indicated on the unit must be checked so that the correct parts are ordered.

For classified engines turbochargers which have been specially checked must be used.

For certain turbochargers, which have been purchased as spare parts, it may be necessary to turn the compressor and turbine housings in relation to the bearing housing, in order that the turbocharger shall fit the engine.

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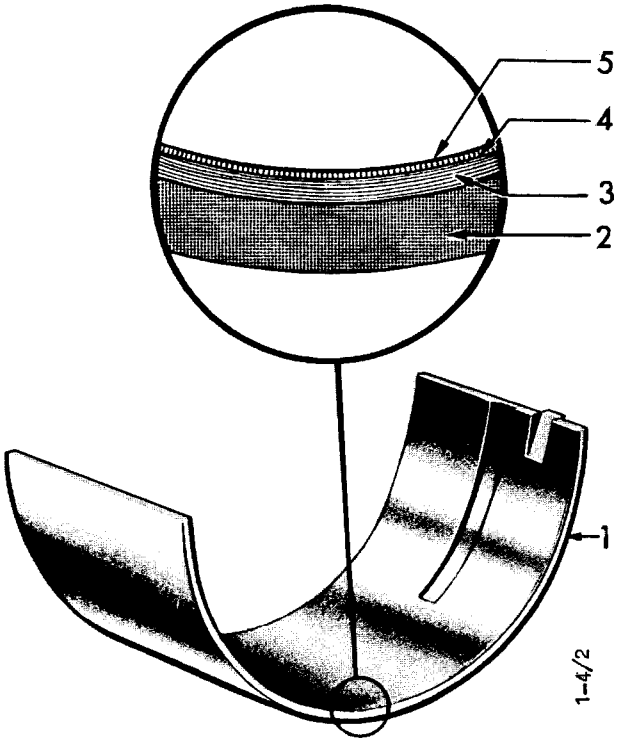
CRANKSHAFT AND RECIPROCATING COMPONENTS

The crankshaft is drop-forged of alloy steel and is statically and dynamically balanced. It is carried in force-lubricated main bearings with renewable bearing shells. The bearing shells are bullt up with lead-bronze on a steel body. On the friction surface there is a thin layer of lead and indium.



Cross-section of bearing shell

1. Bearing shell
2. Steel body
3. Lead-bronze
4. Lead
5. Indium

The lead-indium layer is softer than the actual bearing metal, and is therefore for the purpose of assisting running-in. No. risk is therefore entailed if, after a period in service, this layer is worn away. The bearing-surfaces of the crankshaft are hardened and fine-polished, giving long life. The axial thrust is taken up by washers at the rearmost main bearing.

The rear end of the crankshaft is in the form of a flange to which the flywheel is bolted. The ring gear for the starting motor is shrunk onto the flywheel.

The connecting rod bearings are of the same type as the main bearings, having renewable bearing shells of lead-bronze.

The pistons are made of an aluminium-silicon alloy. Each piston is provided with three compression rings and one or two oil rings. The top compression ring wear surface is hard chromium-plated, or molybdenum coated.

The piston pins are made of case-hardened chromium-steel. At normal working temperature they are fully floating, i.e. free to move in both piston and connecting rod.

The piston pin bushing made of lead-bronze on a steel body like the other bearings, but has no lead indium layer.

The vibration damper consists of a hermetically sealed housing. The housing encloses a steel damper ring of rectangular cross-section. The space between the damper ring and the housing forms a narrow gap which is filled with liquid. The liquid has a high viscosity (viscous liquid) and a high viscosity index, the latter indicating that the viscosity is relatively unaffected by temperature changes.

The housing, which is fixed to the crankshaft always accompanies the movements of the crankshaft. The damper ring, which is not directly secured to the housing, attempts, by its inertia, to go on rotating at the same speed. The occurrence of torsional vibration in the crankshaft will give rise to a difference in speed, of alternating direction, between the damper ring and the housing. The resistance offered by the liquid serves to equalize the speeds of the damper ring and the housing. Since the housing is fixed to the crankshaft, this speed equalization means that the vibration of the crankshaft will be damped down.

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

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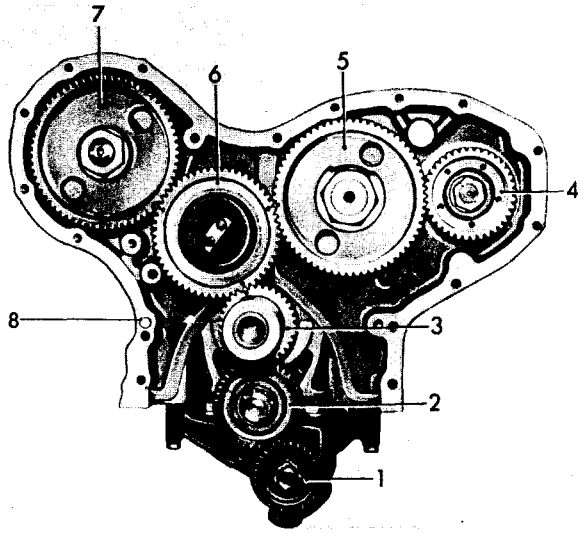
TIMING GEARS

The timing gears comprise cylindrical gearwheel with helical teeth.

The drive is taken from the crankshaft.



Timing gears

1. *Driving wheel of lubricating-oil pump*
2. *Idler gear for lubricating-oil pump*
3. *Crankshaft with gearwheel*
4. *Compressor gearwheel*
5. *Camshaft gearwheel*
6. *Idler gear*
7. *Driving wheel of injection pump*
8. *Dowel*

The injection pump and camshaft are driven through an idler gear.

The compressor is driven through the camshaft gearwheel.

The hydraulic pump is driven through a rubber coupling direct from the compressor gearwheel.

The lubricating-oil pump is driven by the crankshaft through an idler gear.

The timing gears are protected by a housing and a casing. The housing is bolted to the cylinder block, while the casing is bolted to the casing.

The lubricating-oil pump with its idler gear is sited partly down in the oil sump. The sump is bolted to the timing gear casing, cylinder block and flywheel housing.

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LUBRICATING SYSTEM

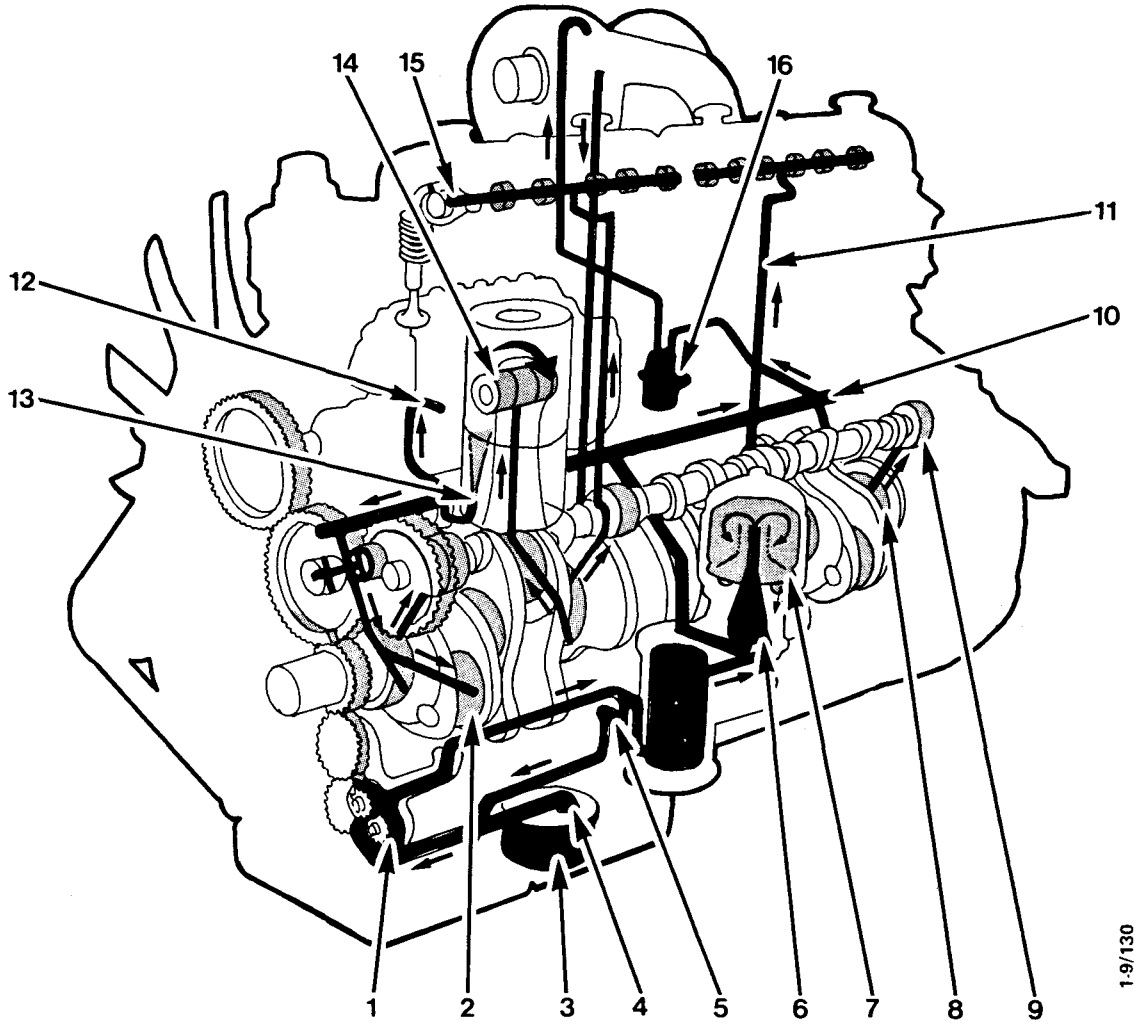

Fig. 1 Lubricating system

1. *Oil pump*
2. *Crankpin*
3. *Oil strainer*
4. *Suction pipe for oil from sump to pump*
5. *Reduction valve*
6. *Cyclone cleaner*
7. *Centrifugal cleaner*
8. *Main bearing journal*
9. *Camshaft bearing journal*
10. *Distribution oilway*
11. *Oilway for lubricating oil to rocker arm mechanism*
12. *Oil pipe to injection pump*
13. *Injection nozzle for piston cooling*
14. *Piston pin*
15. *Rocker arm mechanism*
16. *Oil filter turbocharger*

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The engine has a force-lubricating system, which means that the oil is forced round to the various lubricating points by an oil pump.

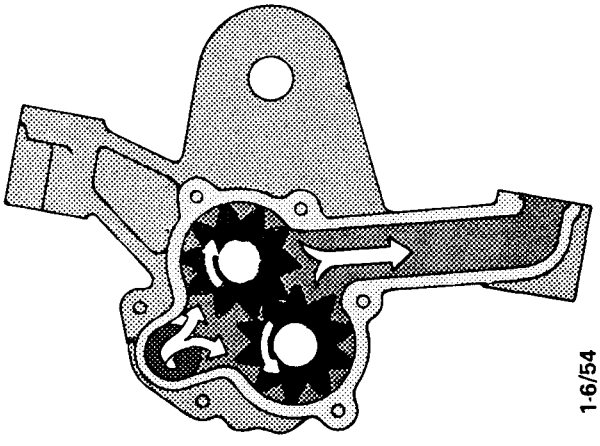
Oil pump

The oil pump, which is located at the front end of the oil pan, draws oil from the pan via an oil strainer. The oil strainer removes any coarse particles which may be present in the oil before it is drawn up out of the pan. The oil pump then feeds the oil under pressure into a lubricating-oil cleaner in which it is cleaned.

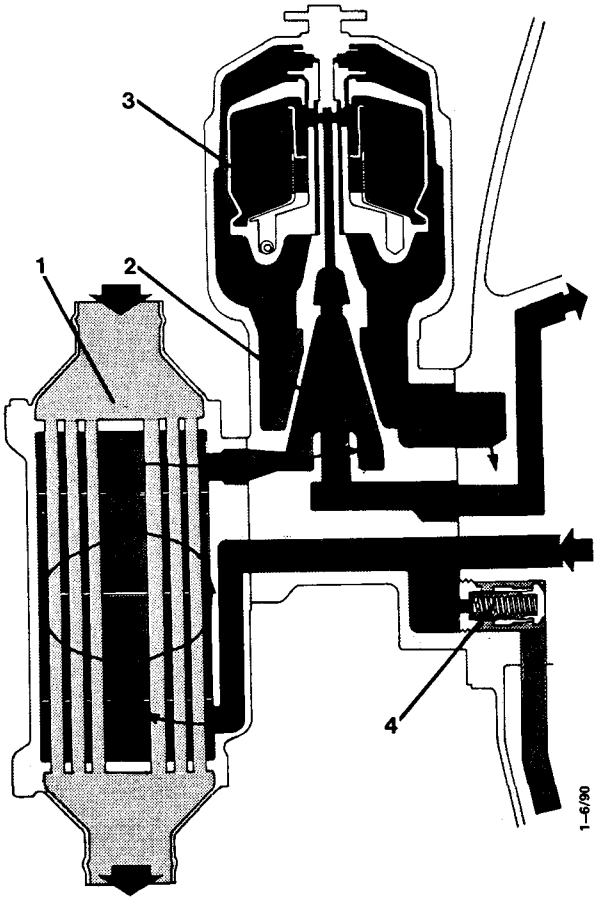
The pump consists of two pump gear wheels which are driven by the crankshaft gearwheel via an idler gear.

The pump gearwheels are mounted in the pump housing and the pump housing cover with replaceable bearing bushings.

The idler gear is mounted with two ball-bearings in the pump housing cover.



Lubricating-oil pump of gearwheel type



Lubricating oil cleaner with flange-mounted oil cooler

1. Oil cooler
2. Cyclone cleaner
3. Centrifugal cleaner
4. Reduction valve

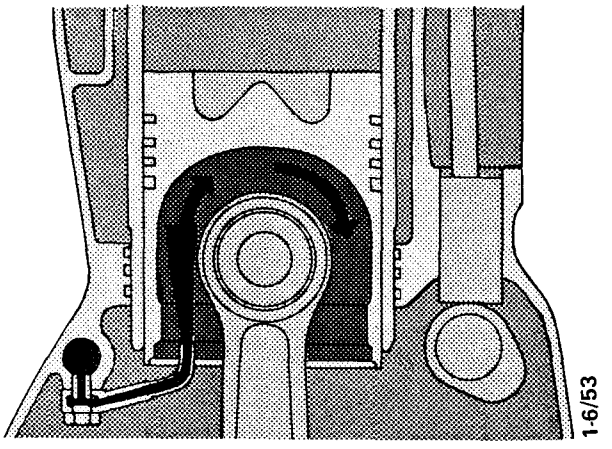
Lubricating oil cleaner

The lubricating cleaner consists of a cyclone and a centrifugal cleaner. The oil is first forced into the cyclone, where the impurities, by reason of their greater weight, are thrown out against the walls and are then forced up to the rotor section of the centrifugal cleaner by the current of following oil. This is made to rotate at high speed by the reaction of the oil squirting out of the two nozzles.

The centrifugal force throws foreign particles in the oil out towards the wall of the rotor, where they are deposited in the form of a black rubbery mass. The clean oil flows through a line back down into the oil sump.

The oil in the centre of the cyclone is free from impurities and is taken through the distribution oilway and other oilways in the block to the main bearings, the camshaft bearings and the timing gears. From the main bearings the oil goes through oilways in the crankshaft to the big-end bearings and from there by oilways in the connecting rods to the piston pins. Through oilways in the camshaft the oil is forced intermittently to the rocker arm mechanism. The oil running back from the rocker arm mechanism lubricates the valve tappets.

The injection nozzles for oil cooling of pistons are mounted in the longitudinal distribution oilway. Via the nozzles oil is injected up under the pistons.



Injection nozzles for oil cooling of pistons

The injection pump camshaft housing and governor are lubricated from the engine lubricating system. The feed oil is led to the pump housing via a pump element lifter, the radial clearance of which regulates the quantity of oil supplied to the pump housing. The level of the oil in the pump housing is determined by the outlet hole for return oil, which leads to the engine oil sump.

Pistons, cylinder bores and camshaft cams are lubricated by oil, which is splashed about by the crankshaft.

Oil cooler

The lubricating oil cooler is used for limiting the oil temperature. The inlet and outlet sides are connected to passages in the lubricating oil cleaner support.

Reduction valve

The oil pressure is controlled by a reduction valve of piston type that is accessible after the oil cleaner support has been removed.

Oil pressure gauge

The oil pressure gauge, which is sited on the instrument panel, is connected by a pipeline to the distribution oilway of the engine. The lubricating system is also provided with an electric unit connected to a warning lamp. The lamp, which is sited on the instrument panel, lights when the oil pressure gets too low.

Crankcase ventilation

To prevent the occurrence of overpressure in the crankcase, the engine is provided with a special breather pipe mounted on a side cover. Inside the side cover is a filter which extracts the oil from the crankcase gases before they leave the engine.

Oil pan

The oil pan is a silumin casting and is provided with a cylindrical oil strainer. The pan is so shaped that the return oil from the lubricating points of the engine runs down on the outside of the strainer. The drain plug for the engine oil is fitted with a magnetic plug. The magnetic plug collects oil particles of magnetic material out of the oil. Round it there is a sludge pocket.

The oil level in the engine is checked by using an oil dipstick put in the oil pan on the right-hand side of the engine. The oil level must be between the markings on the dipstick. It is only necessary to fill up with oil when the oil level has dropped to the bottom marking.

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CAUTION

This section is applicable to only Waukesha models F476D and DS, which are designated by Scania as D and DS8A02, A04, A05, and A06. Engine serial numbers for these models are from 761785 (Sweden) and 133869 (Netherland).

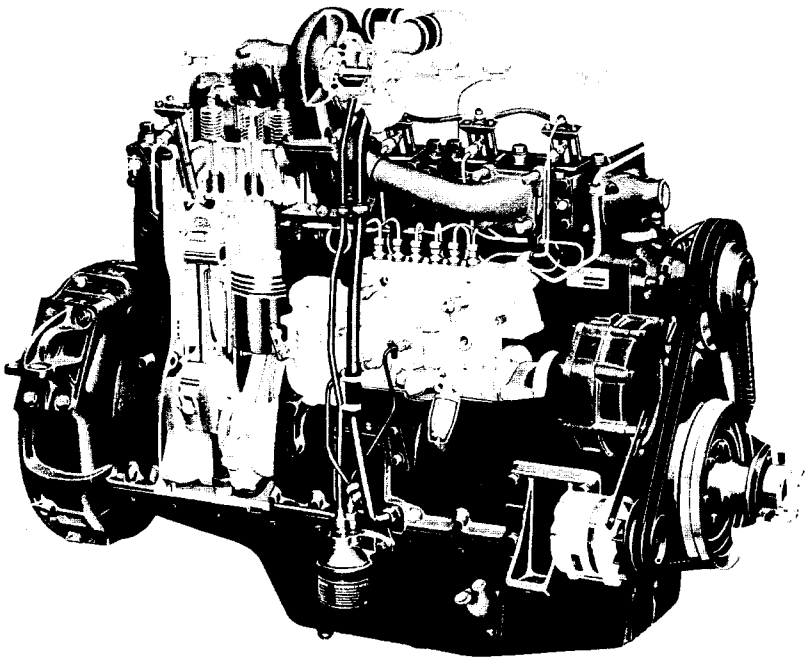

Fig. 1 Engine DS8

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.

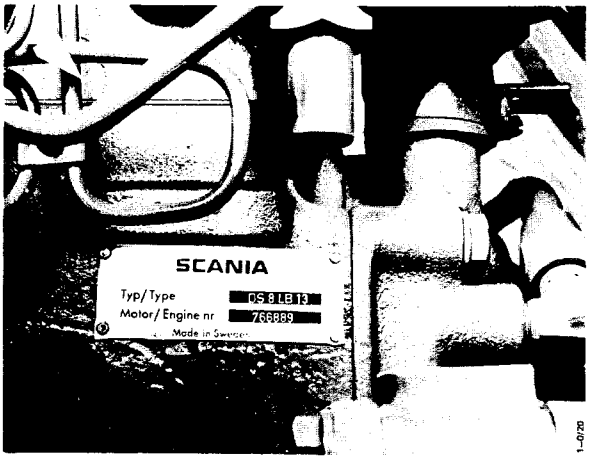

Fig. 2 Engine number and engine type designation

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 D8 and DS8 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.

AR

CYLINDER HEAD

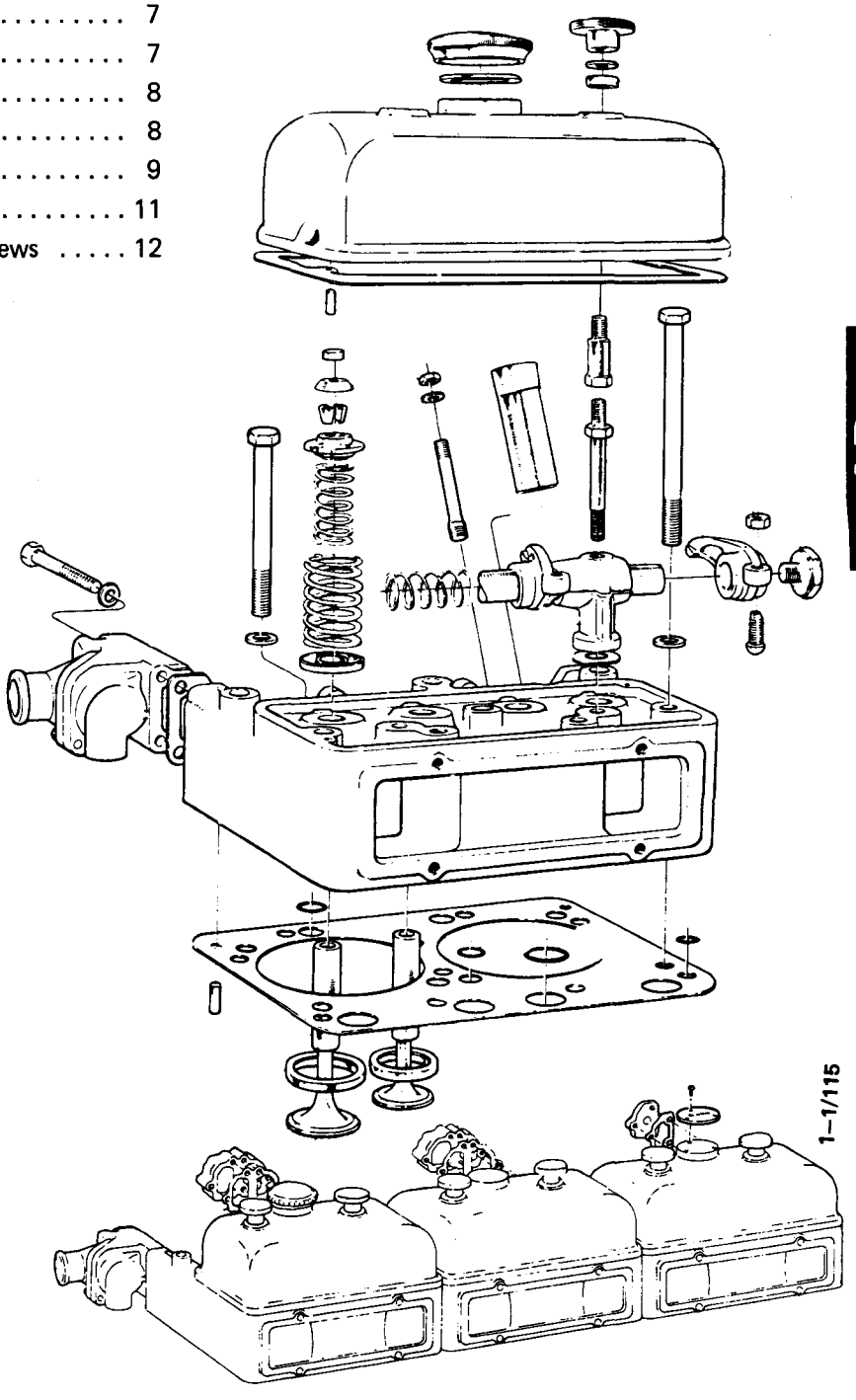

Fig. 1

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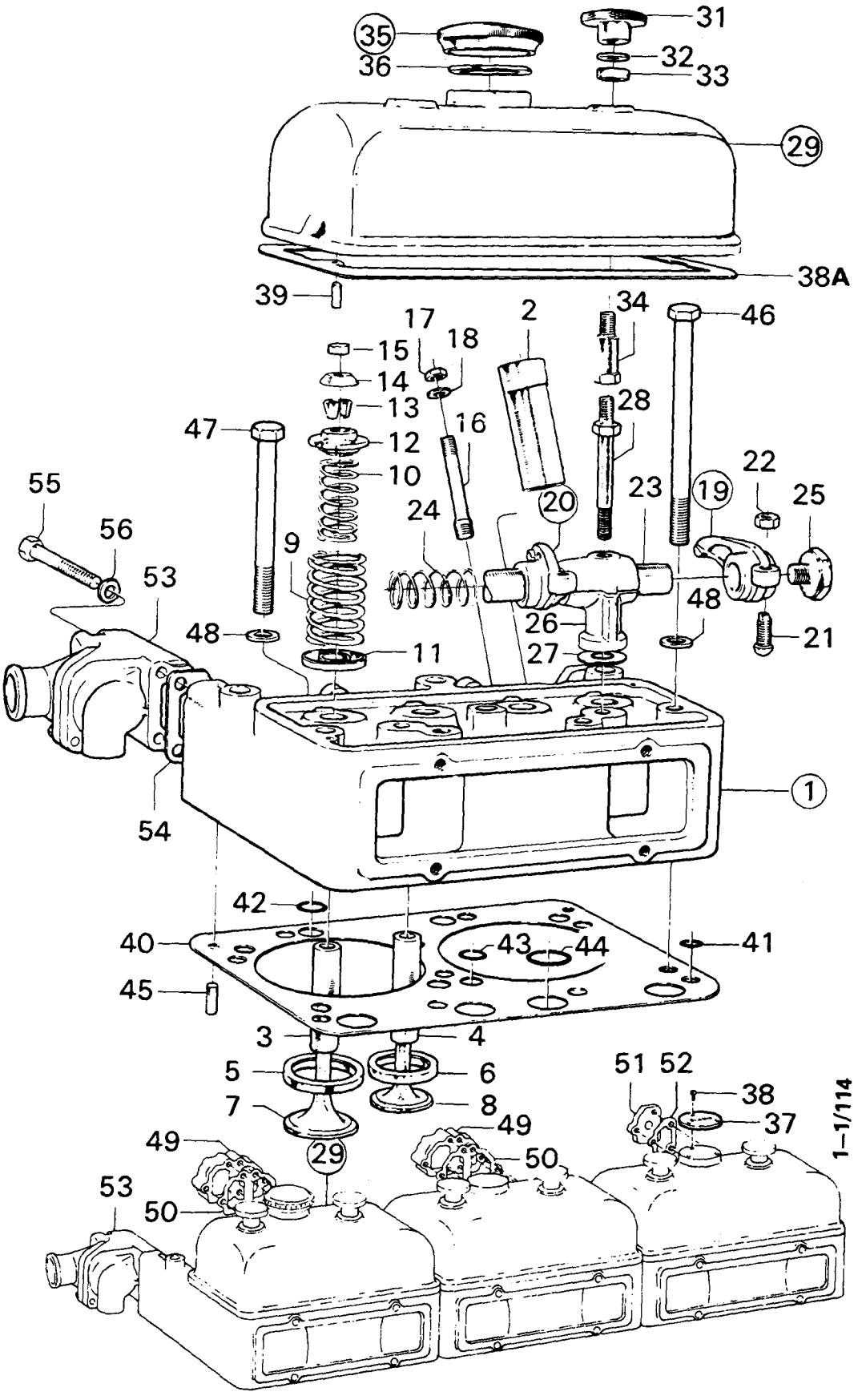
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Fig. 2

1. *Cylinder head*
2. *Sleeve for injector*
3. *Valve guide, intake*
4. *Valve guide, exhaust*
5. *Seat for intake valve*
6. *Seat for exhaust valve*
7. *Intake valve*
8. *Exhaust valve*
9. *Valve spring, outer*
10. *Valve spring, inner*
11. *Guide washer, lower*
12. *Guide washer, upper*
13. *Valve stem key*
14. *Protective ring (D8)*
15. *Valve cap*
16. *Stud for nozzle holder*
17. *Nut*
18. *Washer*
19. *Rocker arm with bushing, left*
20. *Rocker arm with bushing, right*
21. *Ball stud*
22. *Lock nut*
23. *Shaft for rocker arm*
24. *Spring*
25. *Plug*
26. *Bearing bracket*
27. *Gasket*
28. *Bolt*
29. *Valve cover*
31. *Knob nut*
32. *Washer*
33. *Rubber gasket*
34. *Pin*
35. *Cap*
36. *Gasket*
37. *Instruction sign plate*
38. *Screw*
38A. *Gasket*
39. *Hollow pin*
40. *Gasket for cylinderhead*
41. *Sealing ring*
42. *Sealing ring*
43. *Sealing ring*
44. *Sealing ring*
45. *Guide pin in cylinder block*
46. *Bolt*
47. *Bolt*
48. *Washer*
49. *Flange, water transfer*
50. *Gasket*
51. *Cover*
52. *Gasket*
53. *Thermostat housing*
54. *Gasket*
55. *Bolt*
56. *Washer*

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Removal

1. Remove the intake duct, exhaust manifold and, on DS8, 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.

Dismantling

1. Remove the valve caps and, on D8, the rubber protective rings which are fitted on the intake valves.

2. Remove the valves. Use valve spring compressor 87407 to take out the valve stem keys. If the valves are to be refitted, place them in a valve rack in consecutive order.

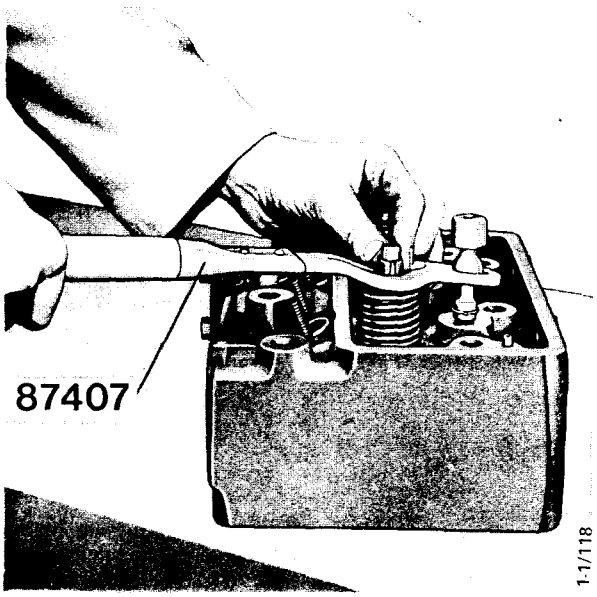

Fig. 3 Valve spring compressor

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.

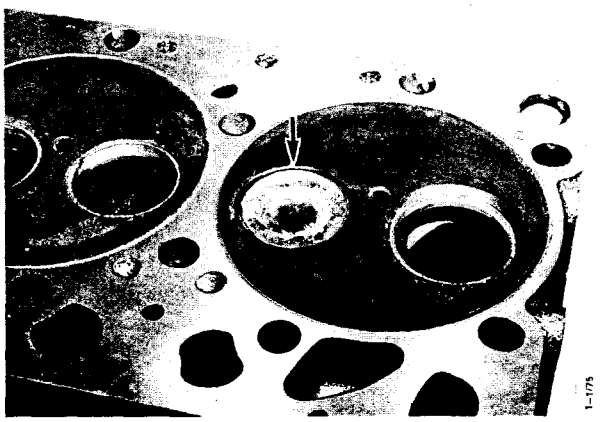

Fig. 4 The valve is welded on

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.

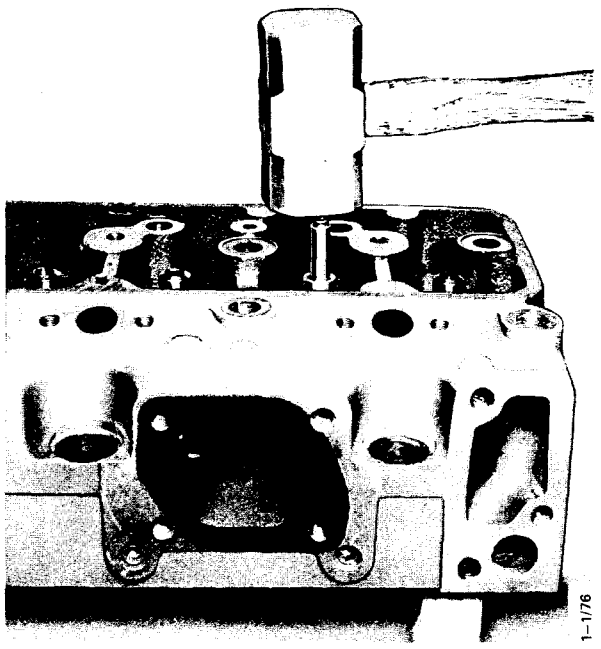

Fig. 5 Tap out the valve seat ring with welded-on valve

4. Press the guides out with drift 87961.

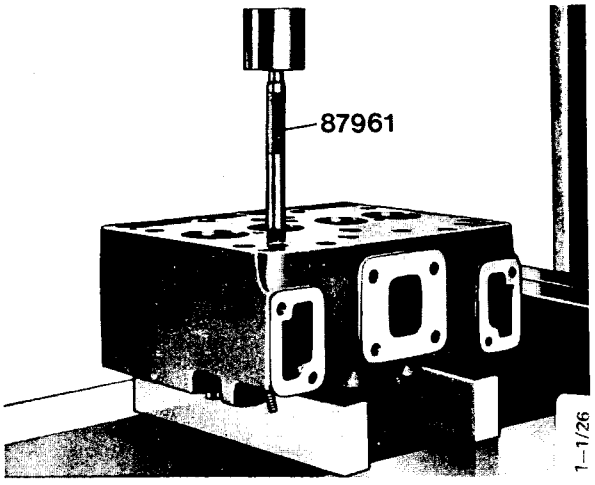

Fig. 6 Pressing out the valve guide

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

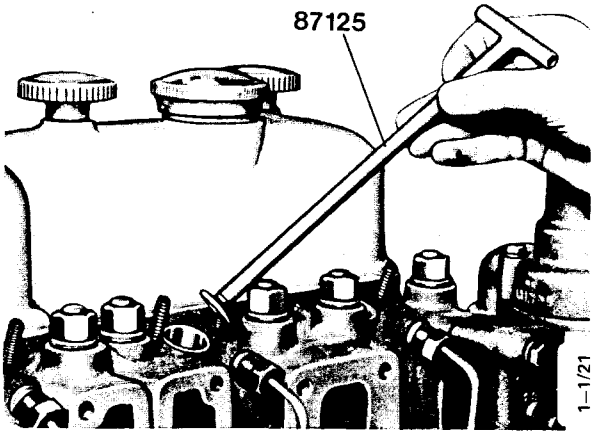

Fig. 7 Extractor for copper washer

Replacement of sleeves for injection

Removal

1. Thread the upper part of the injector sleeve with thread die 98520. (M22 x 1,5).

On a fitted cylinder head, the lower end of the injector sleeve is obstruted with a rag soaked in oil which prevents chips from falling down into the combustion chamber.

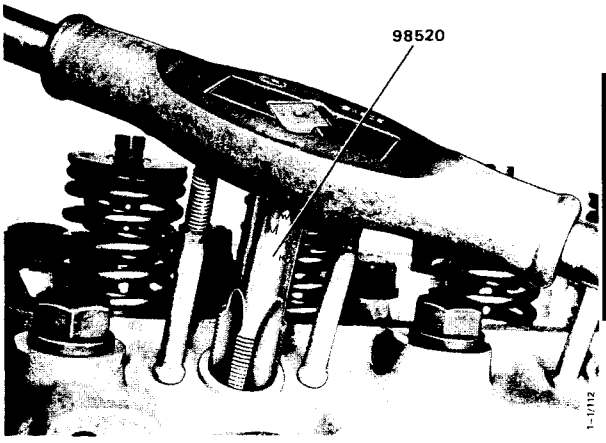

Fig. 8 The injector sleeve is threaded

2. Pull out the injector sleeve with puller 98519.

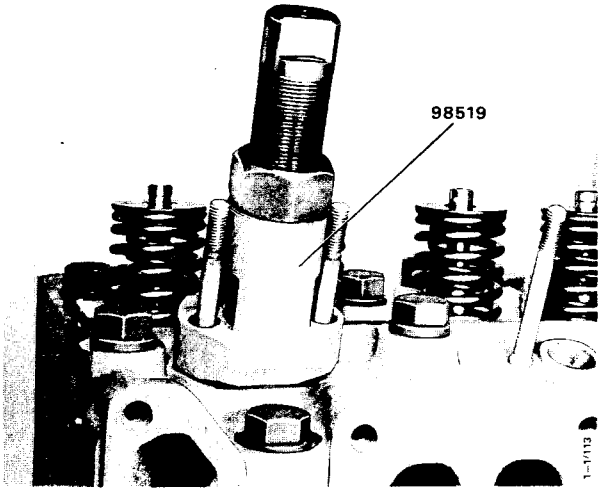

Fig. 9 Puller for injector sleeve

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Assembly

1. Degrease and check the contact surfaces of the injector sleeve in the cylinder head and grind off any possible burrs and unevennesses that can result in score marks on the sleeve.

2. Degrease the new injector sleeve and smear a thin film of sealing agent 561019 (thread sealing) on the sleeve and on the contact surfaces in the cylinder head.

3. Drive the injector sleeve home with drift 98522.

N.B. That the above-mentioned sealing agent takes a long time to harden 8—16 hours without activator. With activator the sealing agent hardens in 1/2—2 hours.

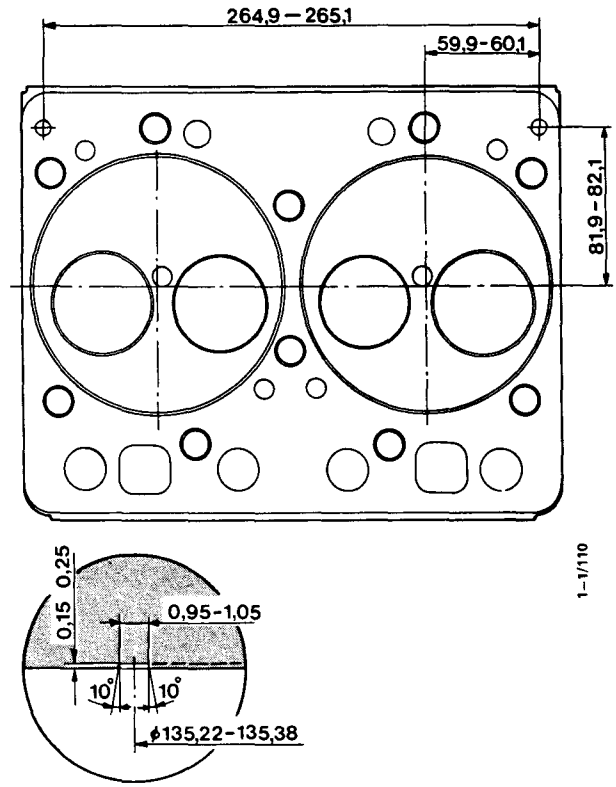

Fig. 11 Grooves for gasket in cylinder head

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 nor be less than 114.4 mm.

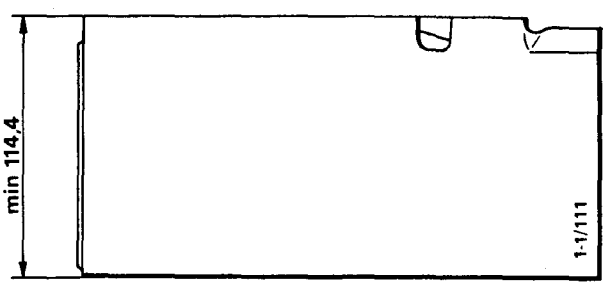

Fig. 10 Height of cylinder head after machining

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.

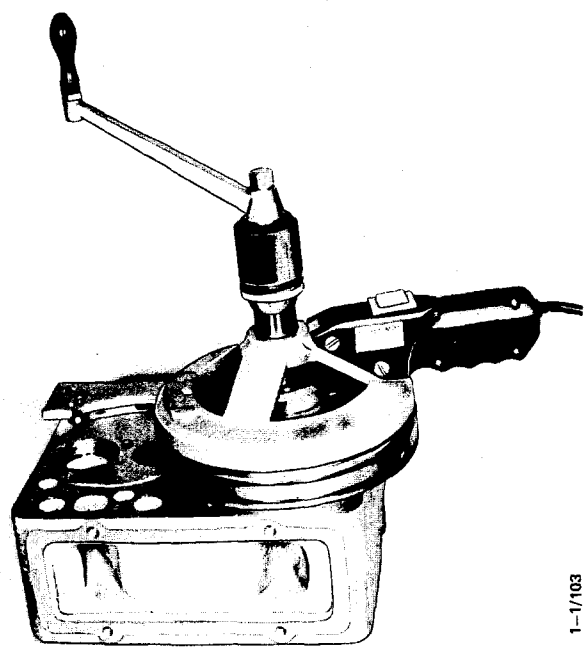

Fig. 12 Tool for milling of groove in cylinder head

Rocker arms

Drift 88091 should be used for pressing the rocker arm bushing in and out.

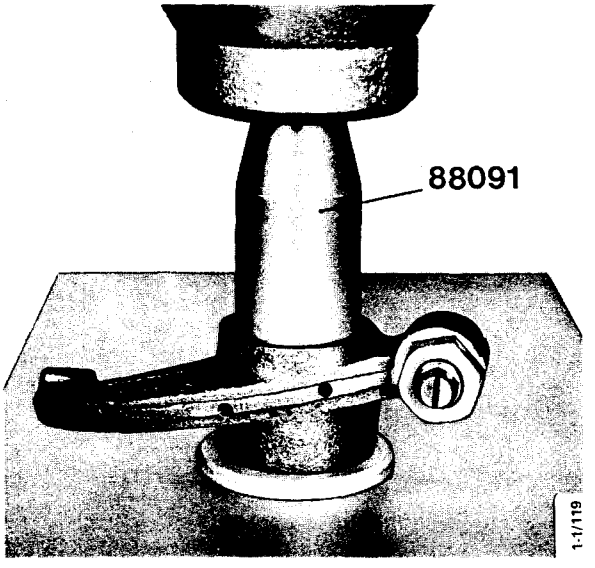

Fig. 13 Drift for rocker arm bushing

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.

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

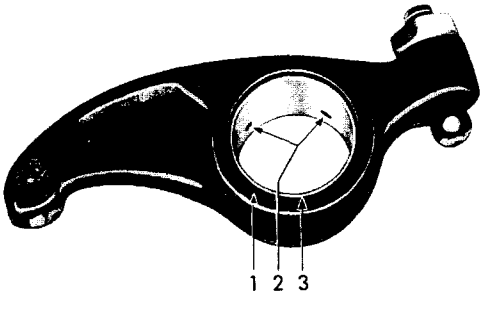

Fig 14. Rocker arm with bushing
1. Rocker arm 2. Lubricating hole 3. Bushing

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°.

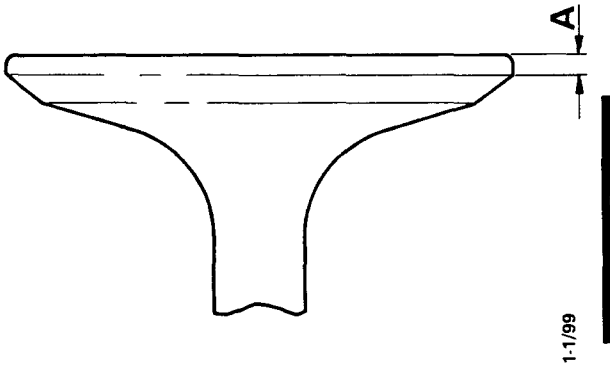

Fig. 15
A. Minimum dimensions for ground valve
Intake 2 mm
Exhaust 1.7 mm

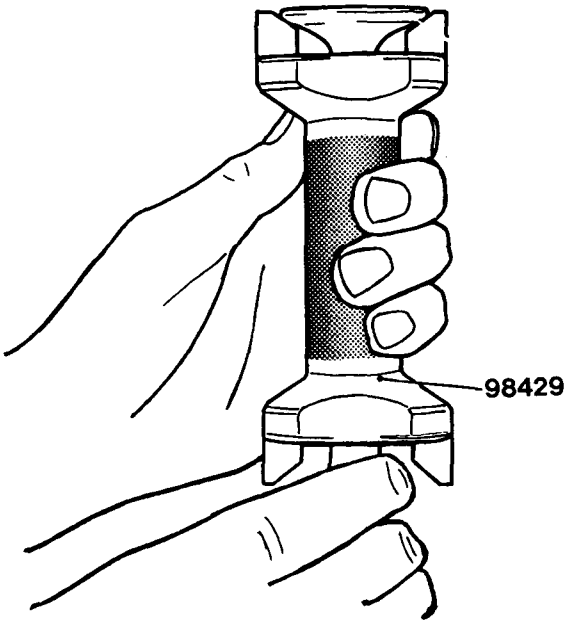

Fig. 16 Valve gauge

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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	60.5 mm
	Length at a load of 340 N (34 kp)	34 mm
Outer spring:	Free length	67.5 mm
	Length at a load of 660 N (66 kp)	37 mm

Assembly

1. Press new valve seat rings in, using drift 98502 and shank 98500. Before the valve seat rings are pressed in they must be chilled, as must the drifts, to approx. $-80^{\circ}C$ 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.

Oversize 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 oversize valve seats are available:

Description	Part number
Valve seat, exhaust	245845
Valve seat, intake	152670

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

For exhaust valve seat: Ø 47.08–47.10 mm

For intake valve seat: Ø 55.08–55.10 mm

2. 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 ± 0.25 mm).

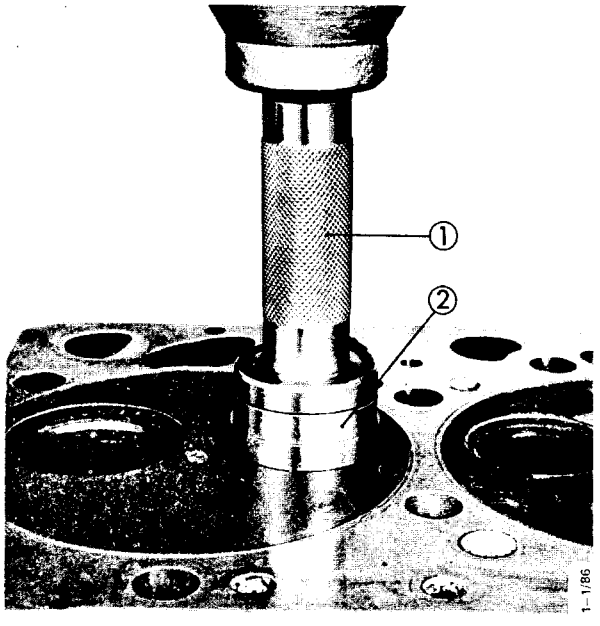

Fig. 17 Pressing in the valve seat ring
1. Shaft 98500
2. Drift 98502

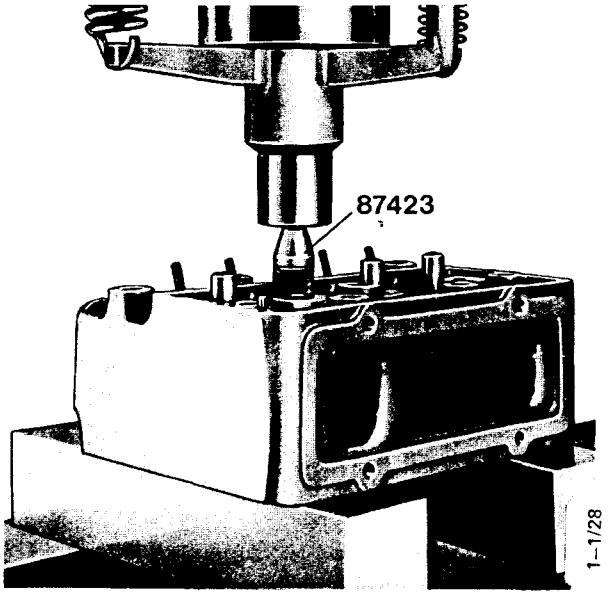

Fig. 18 Drift for pressing in the valve guides

NOTE that the valve guides for intake and exhaust valves have different part numbers. The intake valve guide is approx. 13 mm longer than the exhaust valve guide.

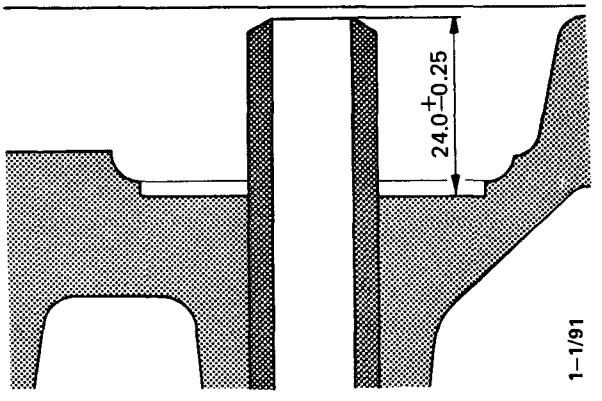

Fig. 19 Height of valve guide above spring seat

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

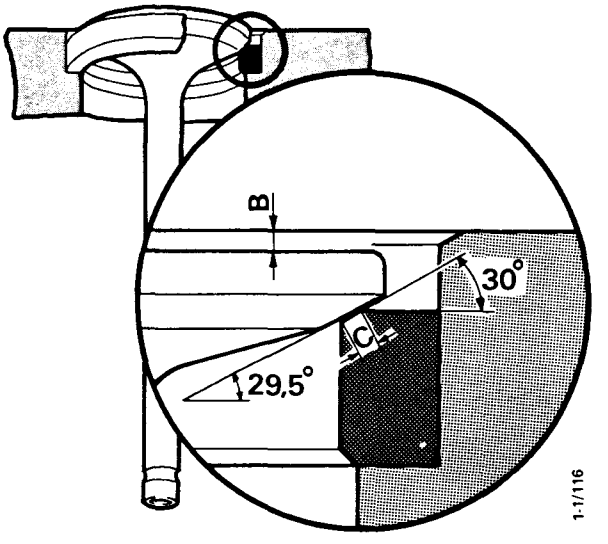

Fig. 21 New intake valve and new valve seat ring

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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.

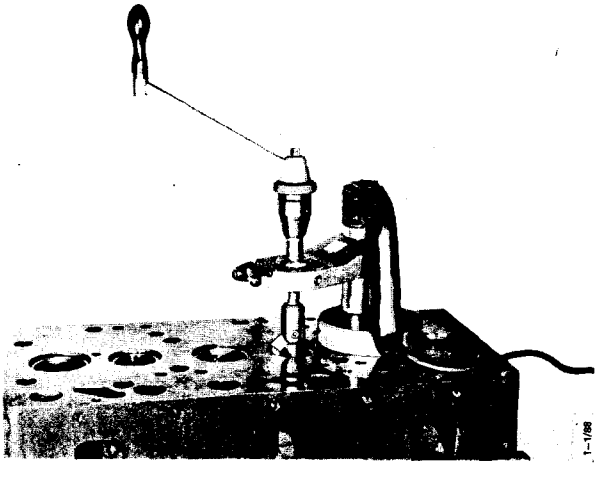


Fig. 20 Example of a tool for machining of valve seat rings

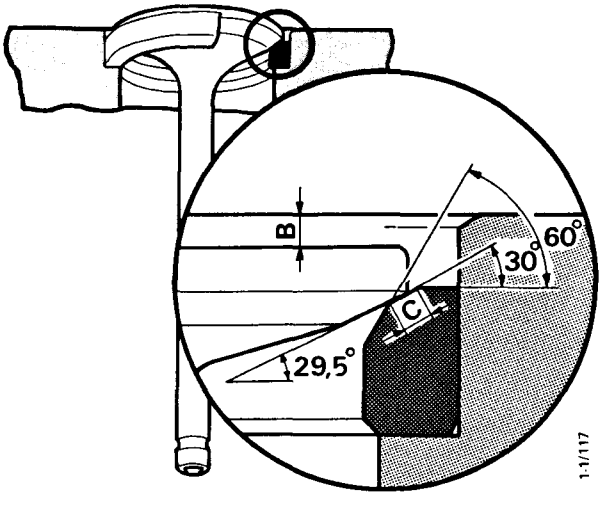


Fig. 22 New intake valve and a maximally machined valve seat ring

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

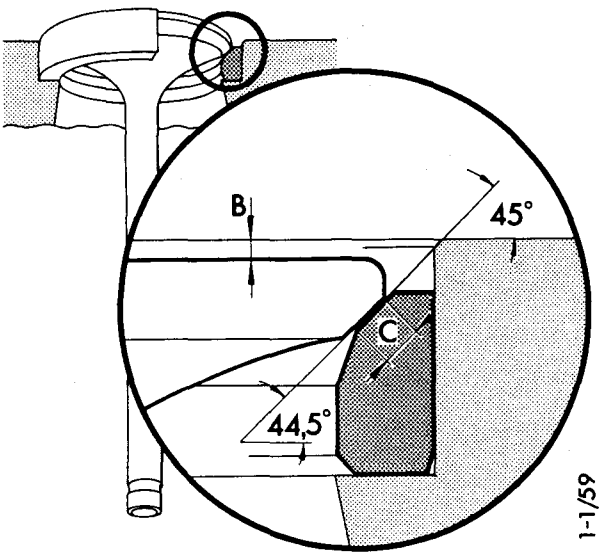


Fig. 23 New exhaust valve and new valve seat ring

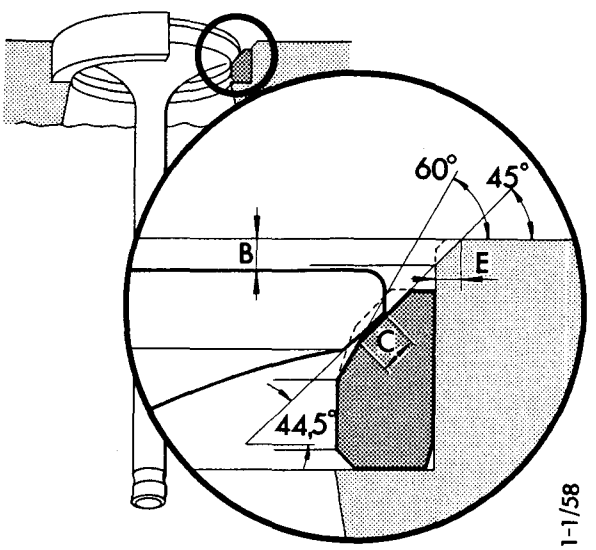


Fig. 24 New exhaust valve and a maximally machined valve seat ring

3. 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 87407 and insert the valve stem keys. Fit the rubber protective ring on the intake valves on the D8 engine. Fit the valve caps.

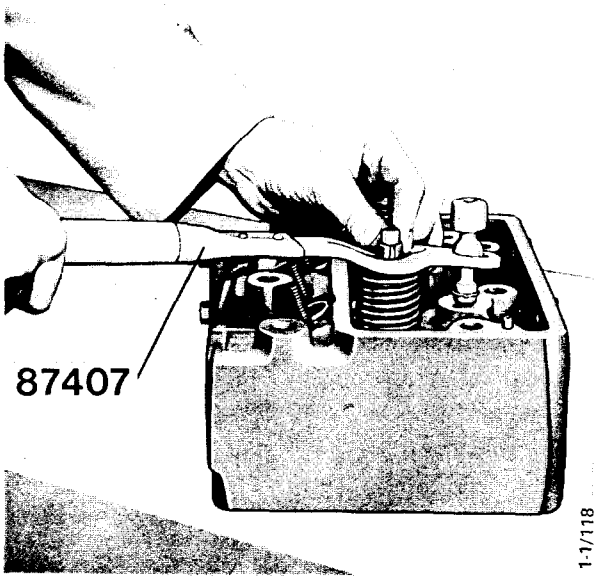


Fig. 25 Valve spring compressor

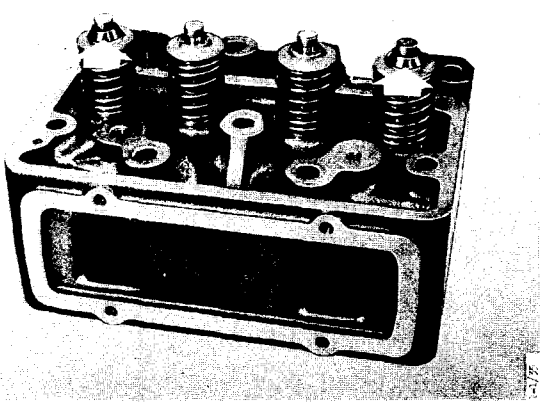


Fig. 26 Protective rings on D8 engine intake valves

Fitting of cylinder head

1. Check the liner height according to 1d 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.

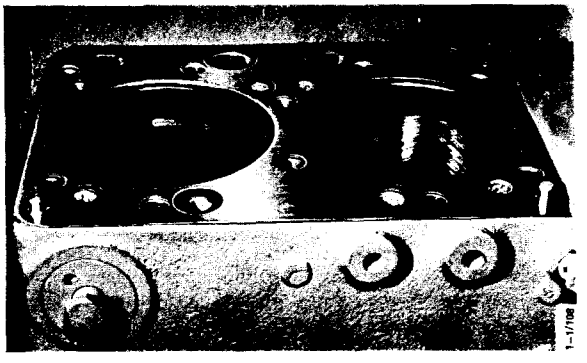


Fig. 27 New gasket and new rubber seals fitted

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.

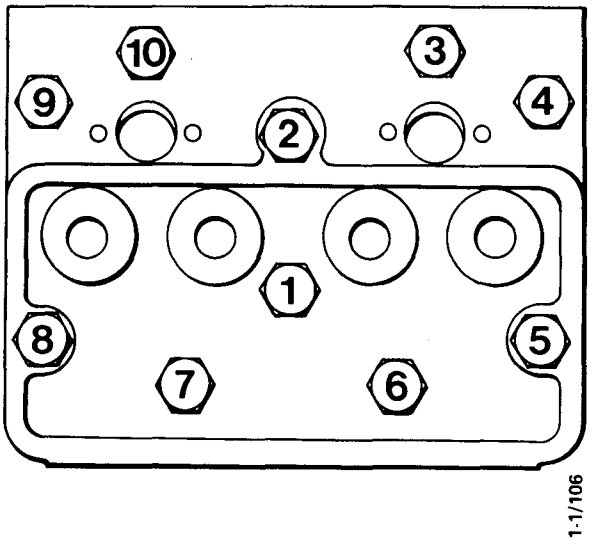


Fig. 28 Sequence for tightening of cylinder head screws

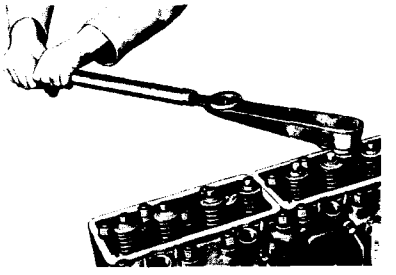


Fig. 29 Always use a torque wrench

Torque values	50%	75%	100%
M14 x 1.5 screws	90 Nm (9 kpm)	130 Nm (13 kpm)	190 Nm (19 kpm)

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

One of the gasket serves to seal against the oil and the other one 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.

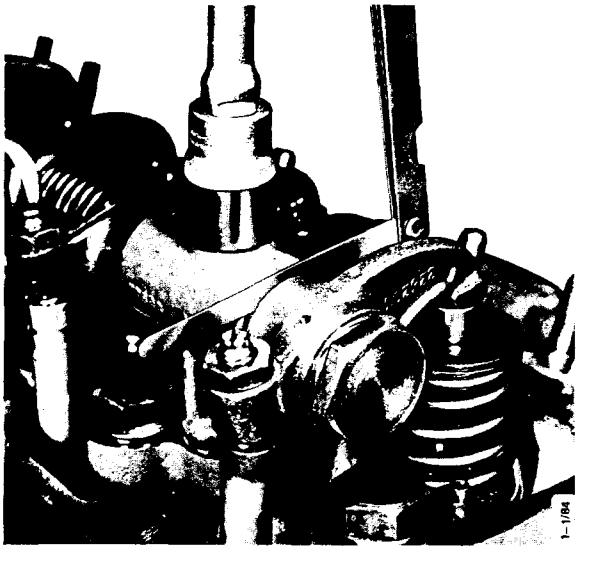


Fig. 30 Insert an 0.15-mm feeler gauge between the outer rocker arm and bearing bracket before finally tightening the rocker arm shaft

AR

6. Adjust the valve clearance: intake valves to 0.35 mm and exhaust valves to 0.70 mm.

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

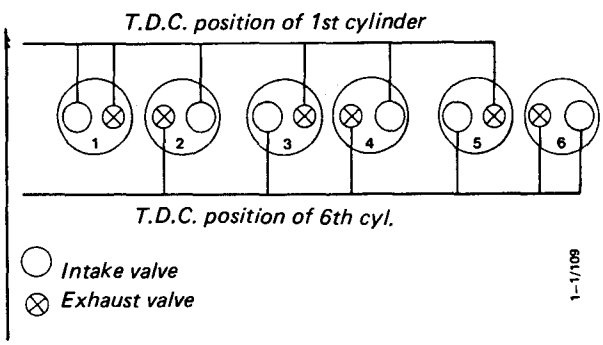
A. Adjust both valves for each cylinder, starting on the TDC position of the first cylinder after compression. Turn the crankshaft a third of a revolution at a time and adjust the valves in injection sequence, i.e. 1 - 5 - 3 - 6 - 2 - 4.

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) 6 (exhaust) 8 (intake) 10 (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) 5 (intake) 7 (exhaust) 9 (intake) 11 (exhaust) 12 (intake)



7. Fit the injectors.

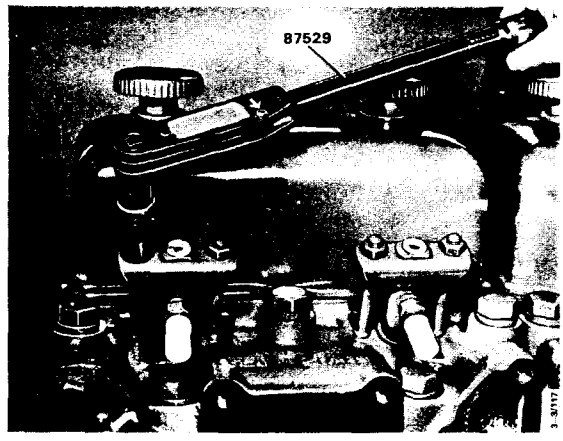


Fig. 33 Torque wrench for injectors

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. According to 2 above.

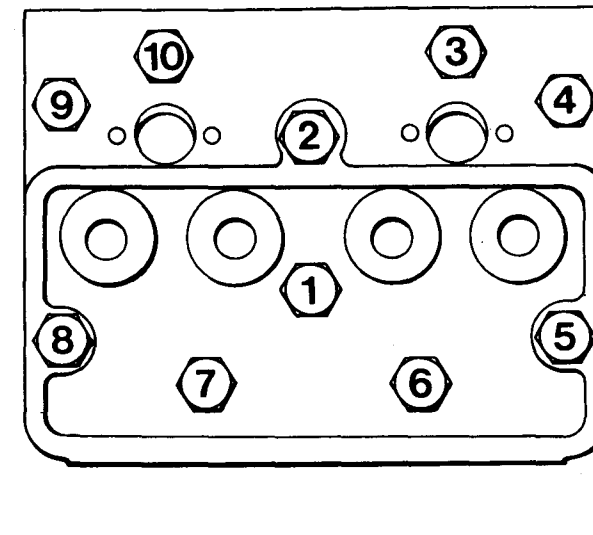


Fig. 34 Tightening sequence for cylinder head screws

TURBOCHARGER

AR

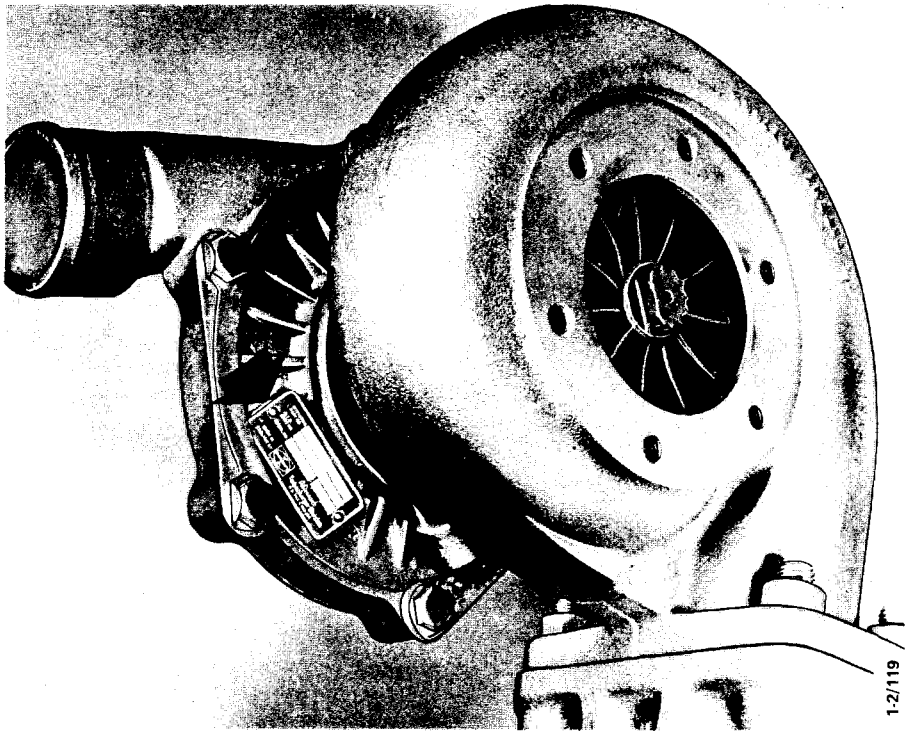


Fig. 1 Turbocharger
Scania part number is punched in by arrow

77.21150/3200-1121

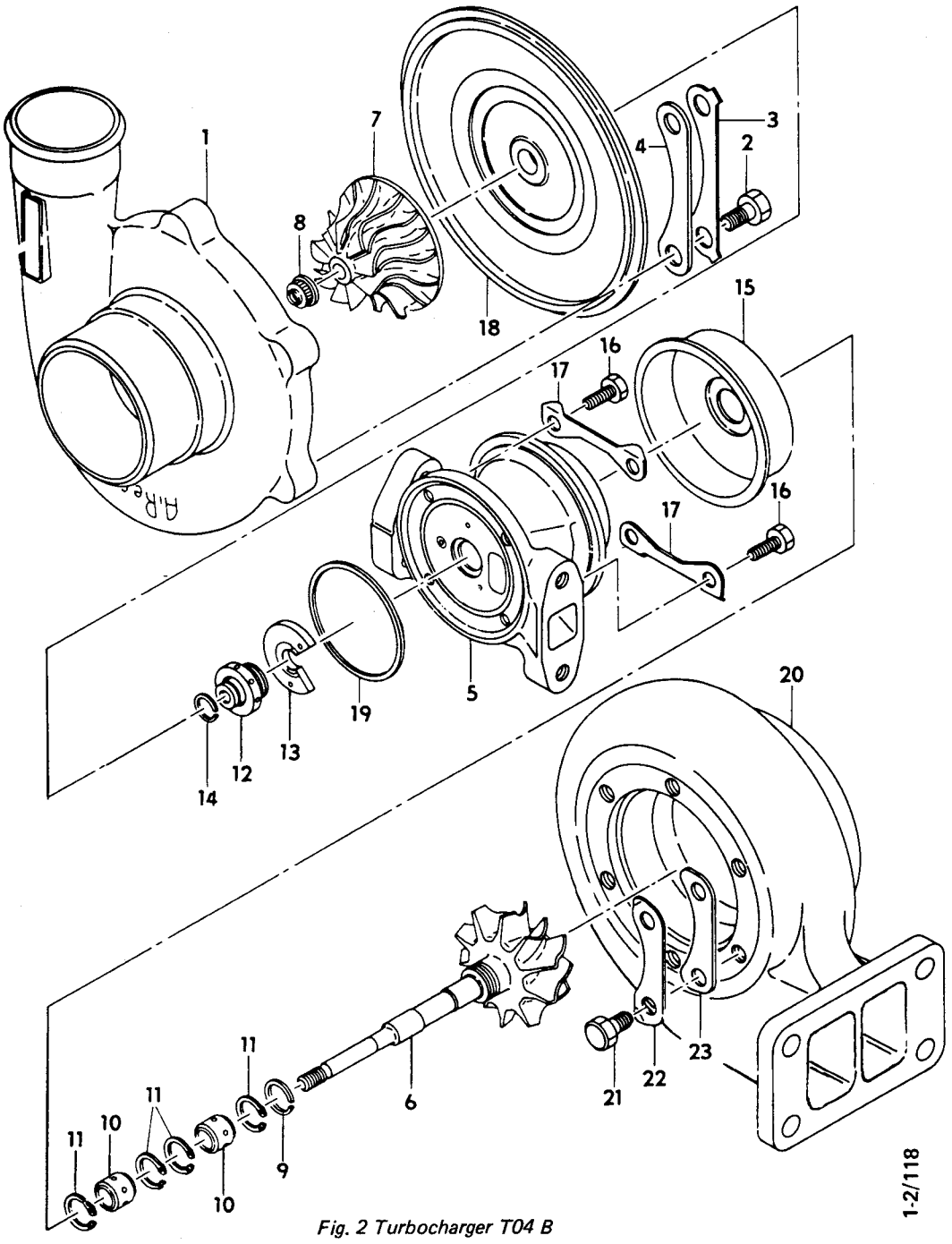


Fig. 2 Turbocharger T04 B

1. Compressor easing
2. Bolt
3. Lock washer
4. Clamp
5. Bearing housing
6. Shaft with turbine wheel
7. Compressor wheel
8. Lock nut
9. Sealing ring, turbine side
10. Bearing
11. Lock ring
12. Pressure flange
13. Thrust bearing
14. Sealing ring, compressor side
15. Radiator protector
16. Bolt
17. Lock washer
18. Support plate
19. Sealing ring
20. Turbine housing
21. Bolt
22. Lock washer
23. Clamp

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.

1-6/78

Fig. 3 Lubricating oil filter for turbocharger

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 axhaust 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 revolution 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 our 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.

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. In 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.

AR

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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/cm^2).

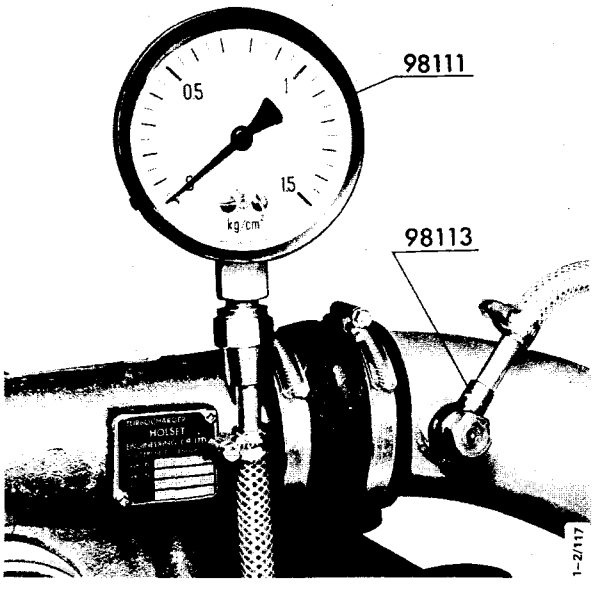

Fig. 4 Tools for measurement of charging pressure

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 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 in 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 1d SP 2.

Next, check the value in accordance with the appropriate diagram in 1d 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 the 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.

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.

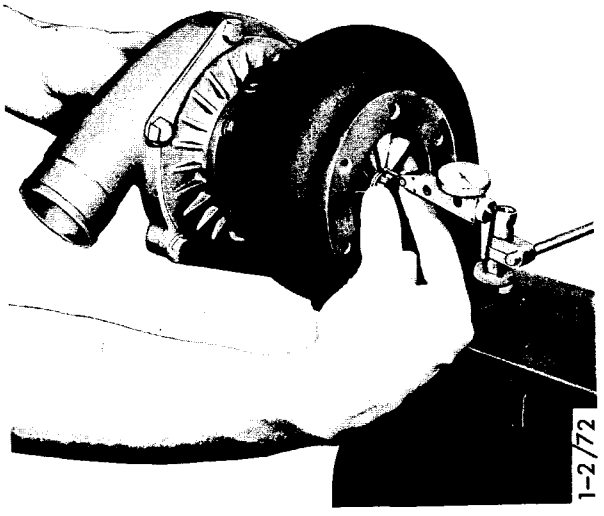

Fig. 5 Measurement of radial clearance at the turbine end

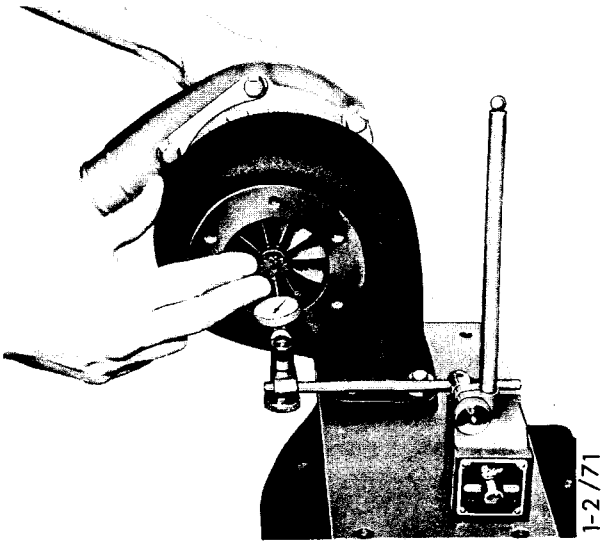

Fig. 7 Measurement of axial clearance

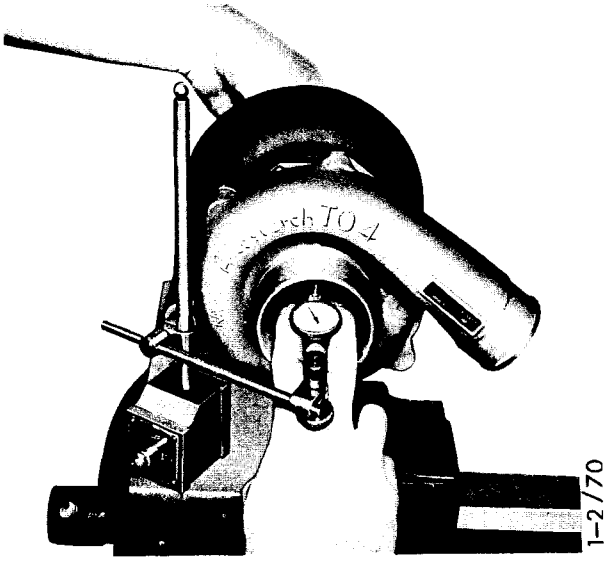

Fig. 6 Measurement of radial clearance at the compressor end

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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.

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.

Dismantling

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

Open the securing plates, remove the bolts and undo the compressor casing and turbine housing.

Fit the bearing housing with turbine shaft in tool 98338, which is firmly secured in a vice. Undo the nut in the compressor wheel (11) with aid of a 3/8" sleeve with T-shaft. Do not use ring spanner as the shaft can then be easily bent.

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Tap carefully on the end of the shaft and take off the compressor wheel (1). Pull out the shaft with turbine wheel (10). The radiation protector (8) will then drop out.

Open the securing plates for the four bolts, holding together the bearing housing and remove the bolts.

Remove the support plate (12) Take out the thrust bearing (13) by lifting it straight out. Remove the rubber ring (4). Undo the retaining rings and take out the bearings (7).

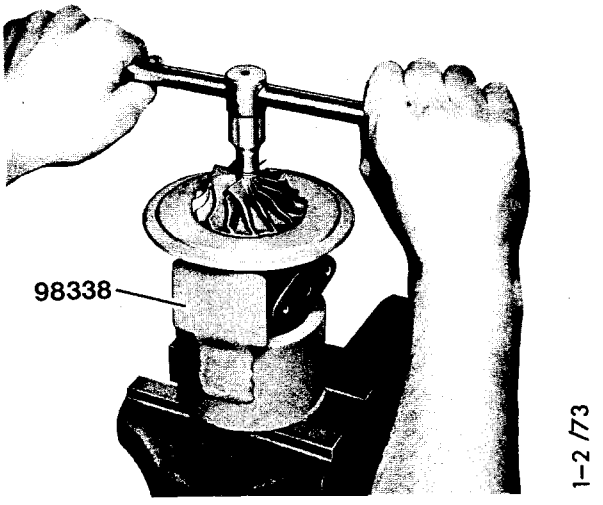

Fig. 8 The nut in the compressor wheel is undone. The turbo-compressor is put in tool 98338

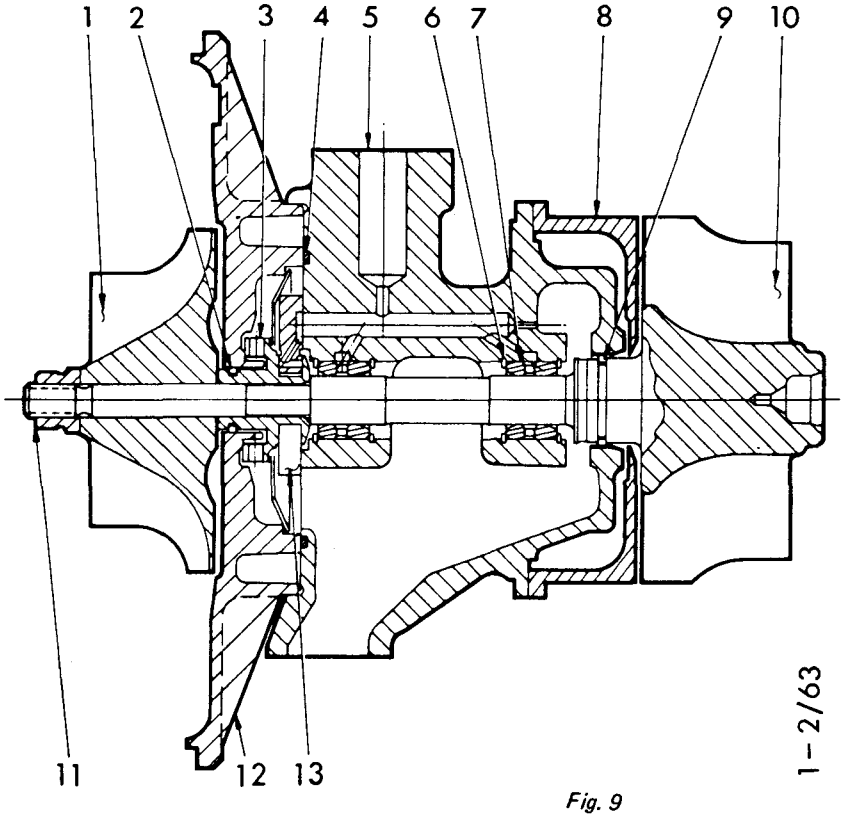

Fig. 9

1. *Compressor wheel*
2. *Sealing ring, compressor side*
3. *Pressure flange*
4. *Rubber ring*
5. *Bearing housing*
6. *Retaining ring*
7. *Bearing*
8. *Radiation protector*
9. *Sealing ring, turbine side*
10. *Shaft with turbine wheel*
11. *Nut*
12. *Support plate*
13. *Thrust bearing*

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 throughly clean with compressed air.

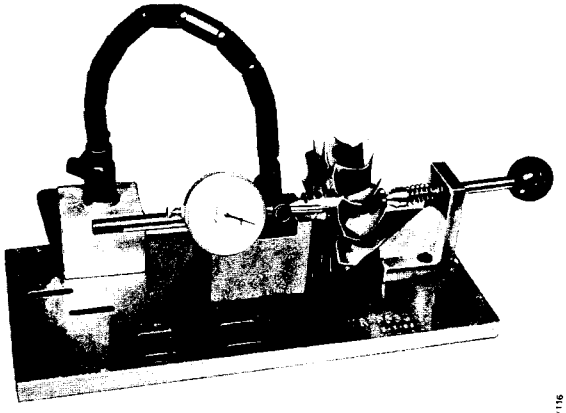

Fig. 11 Measurement of throw on turbine wheel

Checking

Change all parts included in the repair kit.

Examine the thrust bearing (13) in respect of wear and possible hard particles which have fastened in the bearing metal. Check the bearing positions in the bearing housing. Check that the end surface of nut (11) and corresponding surface on the compressor wheel (1) are undamaged. Change these parts, too, if they are damaged in any way. Check the pressure flange (3) and replace it if damaged.

Check the turbine and compressor wheel blades. Never attempt to straighten a distorted blade.

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.

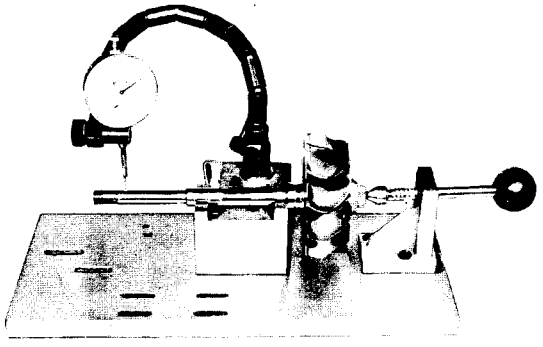

Fig. 10 Measurement of throw on shaft

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.

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 (6), locating them with their rounded side towards the bearing. Lubricate the bearings (7) with engine oil and insert them. Fit the outer lock rings.

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

Insert the rubber ring (4) in the groove.

Check that the spring disc is located in its place in the support plate (12). Put the support plate (12) over the sealing ring (2). Turn the support plate (12) until the bolt holes are correctly aligned. Make sure that the plate does not come under the oil flanges. Fit the securing plate and the bolts. Tighten up the bolts to the prescribed torque and bend the securing plate. Check that it is possible to turn the pressure flange.

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

Fit the compressor wheel. Oil the threads and the end plane of nut and put nut (11) in place. Tighten the nut with a sleeve with T-handle so as to avoid bending the shaft.

Tighten the nut to a torque of 2 Nm (0.2 kpm) and thereafter a further quarter of a turn.

Check that there is clearance between the radiation protector and the turbine wheel.

Put the turbine housing in the right position. The clamps and securing plate under the bolts. Fit the two bolts by the side of the oil inlet and outlet first. Fit the remaining bolts and tighten them to the prescribed torque. Fold up the securing plate.

Put the compressor casing in correct position. Fit clamps and securing plate under the bolts. Tighten the bolts to the prescribed torque. Hold up the securing plate.

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 and 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

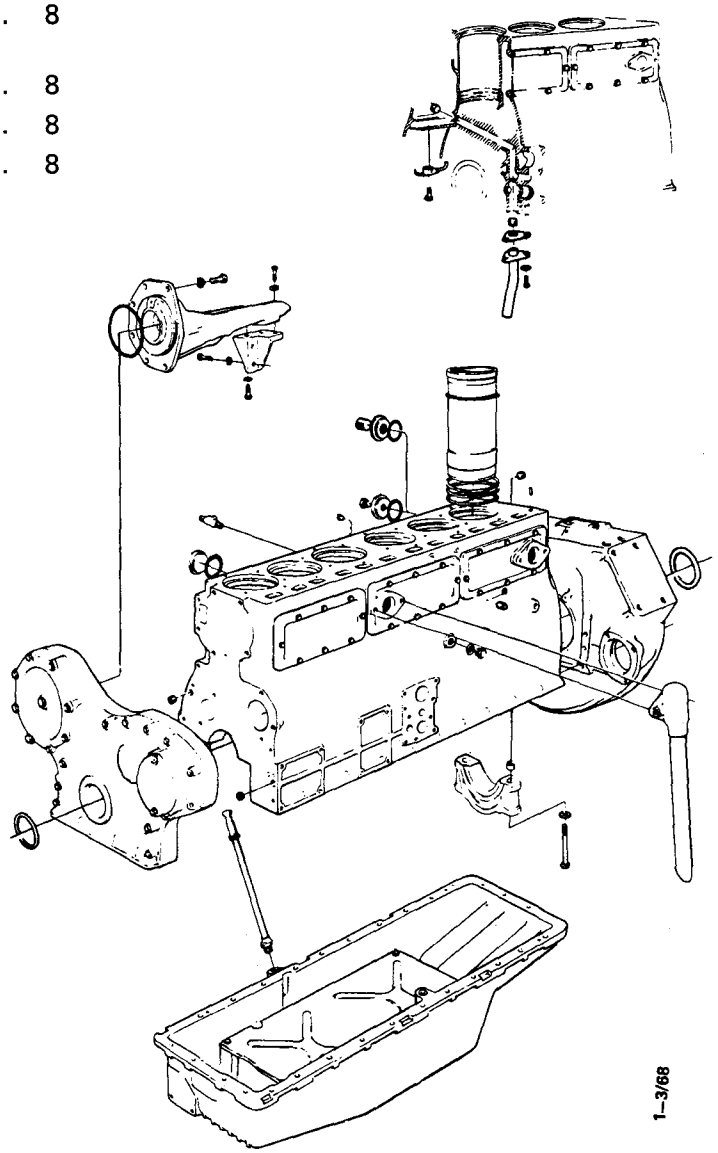

Fig. 1

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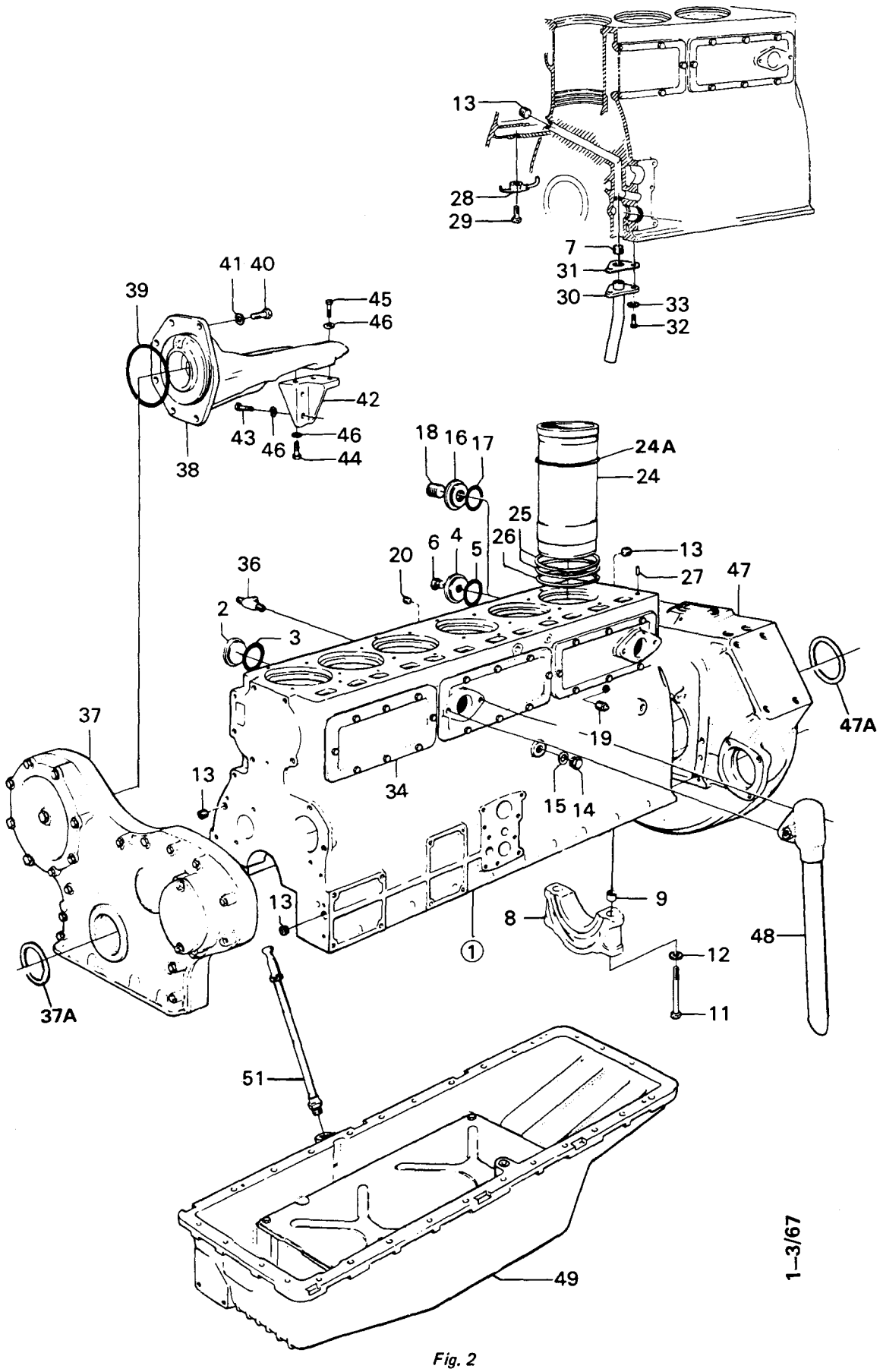
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Fig. 2

1. *Cylinder block, complete*
2. *Sealing plug*
3. *O-ring*
4. *Sealing plug*
5. *O-ring*
6. *Plug*
7. *Plug, tapered*
8. *Bearing cap*
9. *Guide*
11. *Screw for bearing cap*
12. *Washer*
13. *Plug*
14. *Plug*
15. *Gasket*
16. *Sealing plug*
17. *O-ring*
18. *Plug*
19. *Plug*
20. *Plug*
24. *Cylinder liner*
24A. *Shim*
25. *O-ring, upper and middle*
26. *O-ring, lower*
27. *Locating pin*
28. *Nozzle for piston cooling*
29. *Banjo screw*
30. *Pipe*
31. *Gasket*
32. *Screw*
33. *Washer*
34. *Side cover*
36. *Threaded fitting*
37. *Timing gear housing and casing*
37A. *Sealing ring*
38. *Injection pump shelf*
39. *O-ring*
40. *Screw*
41. *Washer*
42. *Bracket*
43. *Screw*
44. *Screw*
45. *Screw*
46. *Washer*
47. *Flywheel casing*
47A. *Sealing ring*
48. *Ventilation pipe*
49. *Oil pan*
51. *Oil dipstick*

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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 oilway in the crankshaft against impurities with a strip of tape with the tacky side outwards.

5. Pull the cylinder liner out with puller 87627 and support screws 98518.

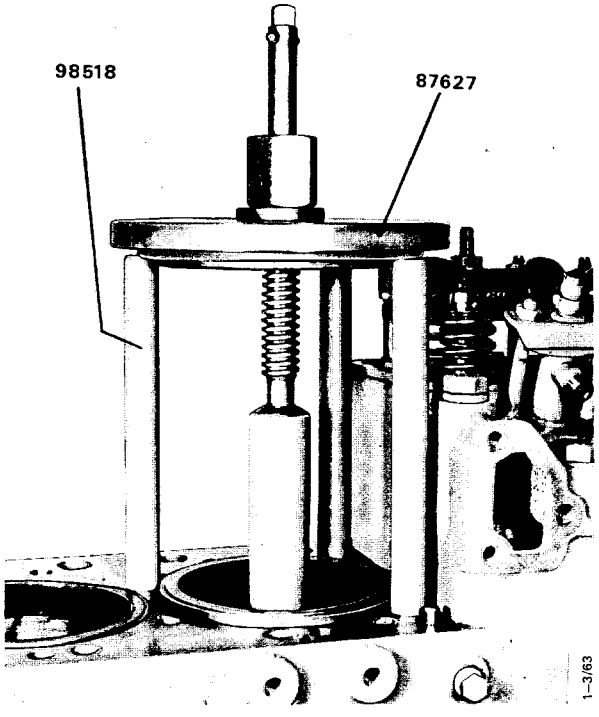

Fig. 3 Puller for cylinder liner

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.

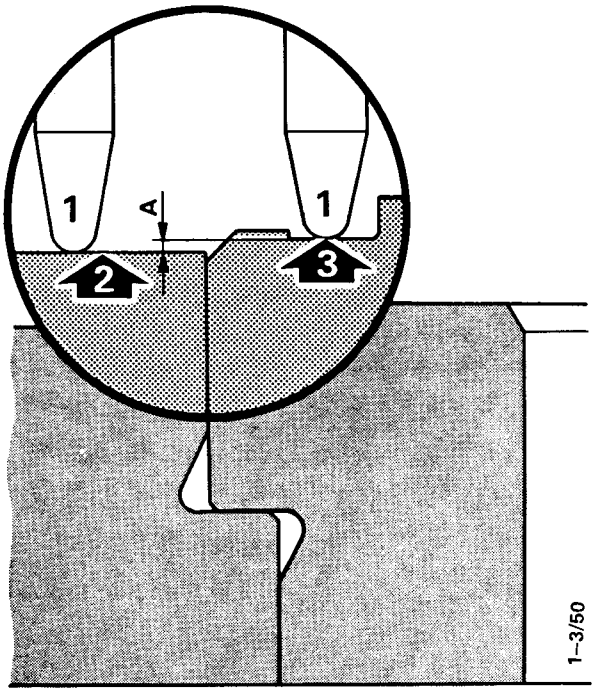

Fig. 4

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 clamps 98515.

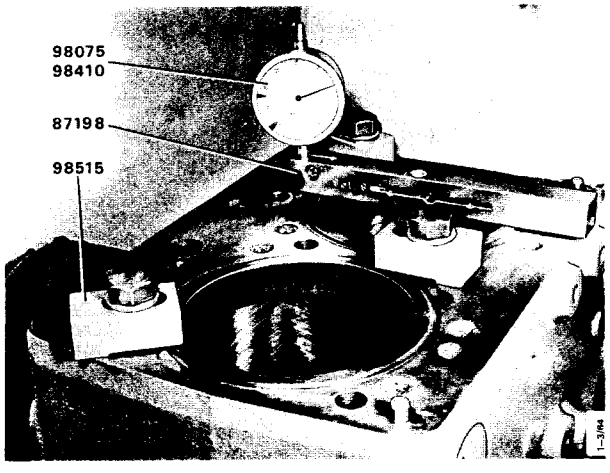

Fig. 5 Clamps for pressing down the cylinder liner, measuring straight edge and dial indicator with measuring point

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 height of the cylinder liner above the block should be 0.03–0.08 mm.

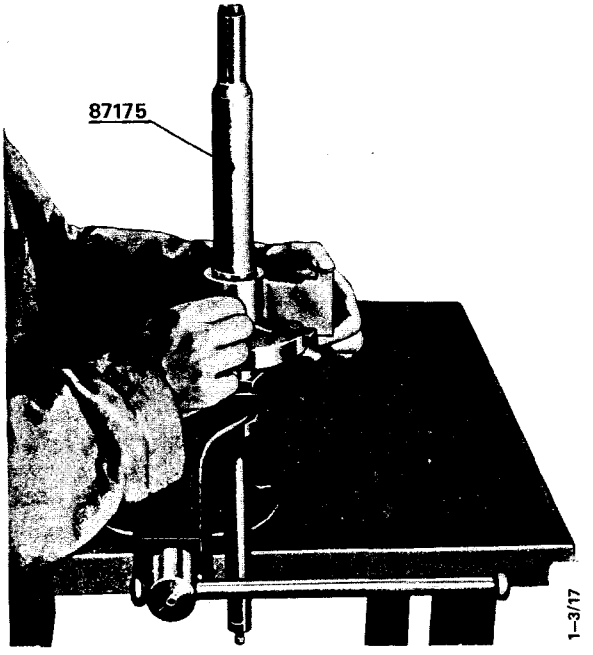

Fig. 6 Adjust the cutting radius of the reamer with the aid of the setting tool

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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 87044 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.

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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.

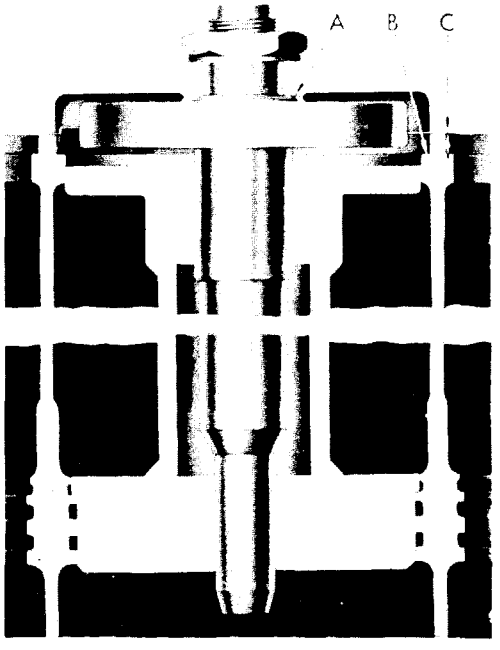

Fig. 7 Placing of adjusting reamer in cylinder liner seat

Push the feeder for the reamer 98517 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.

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

Never turn the reamer backwards.

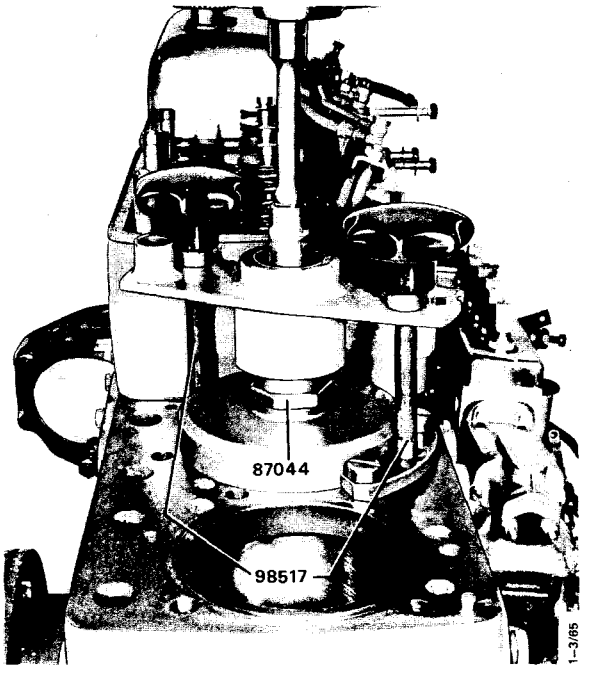

Fig. 8 Reamer with feeder

Clean the cylinder liner seat very throughly.

Fit the shim and the cylinder liner.

Press the cylinder liner down with the aid of the clamps 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.

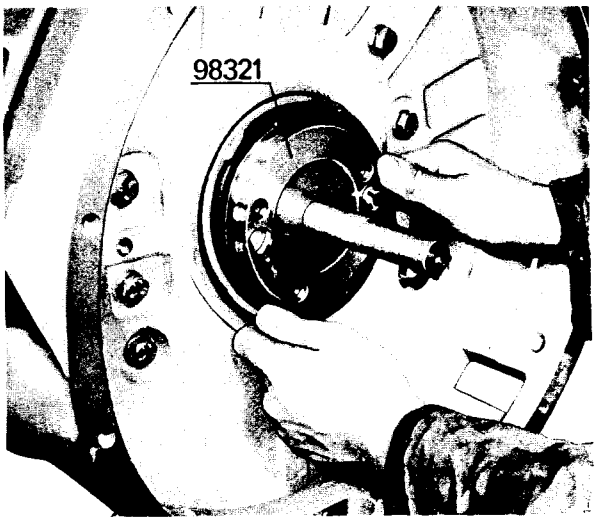

Fig. 10 Easing the sealing ring onto the crankshaft

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.

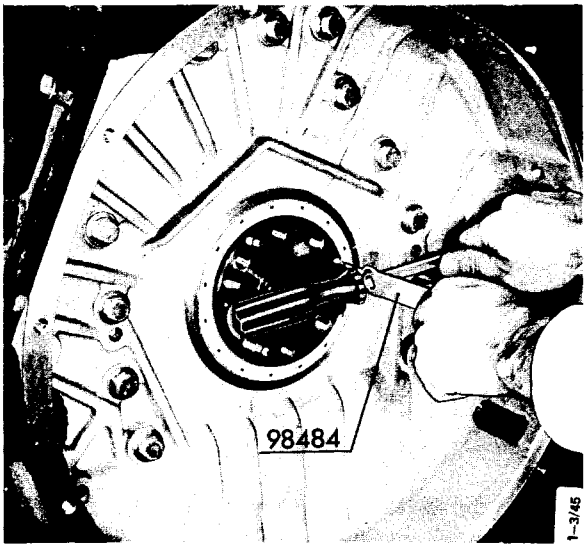

Fig. 9 Extractor for sealing ring

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.

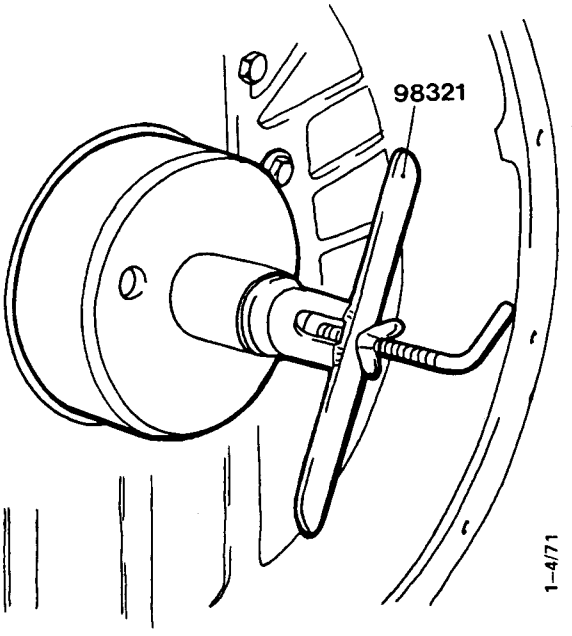

Fig. 11 Tool for pressing in sealing ring

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 the flywheel casing

1. Fit a new gasket and place the casing on the locating pin.

2. Tighten the screws in the order indicated on the figure below to a torque of 55 Nm (5.5 kpm).

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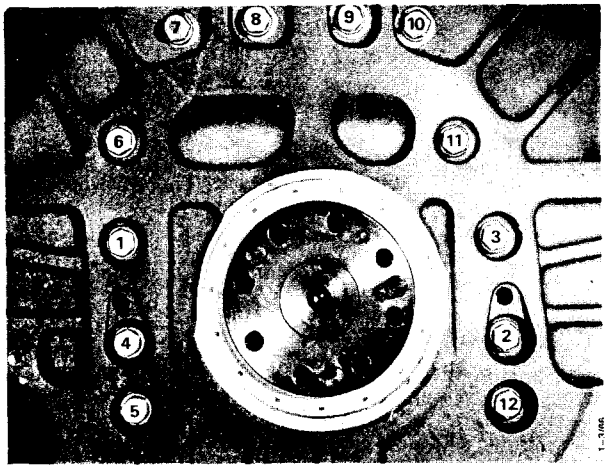

Fig. 12 Tighten the screws for the flywheel casing in numerical order

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

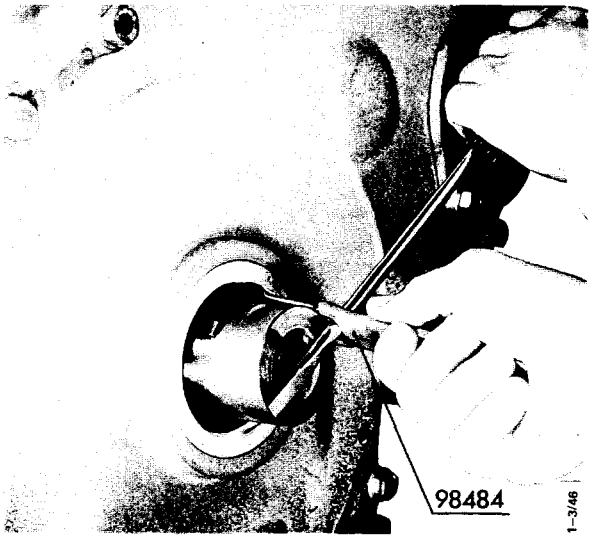

Fig. 13 Extractor for sealing ring

1. Remove fan belts, crankshaft belt pulley and vibration damper hub (see 1d 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.

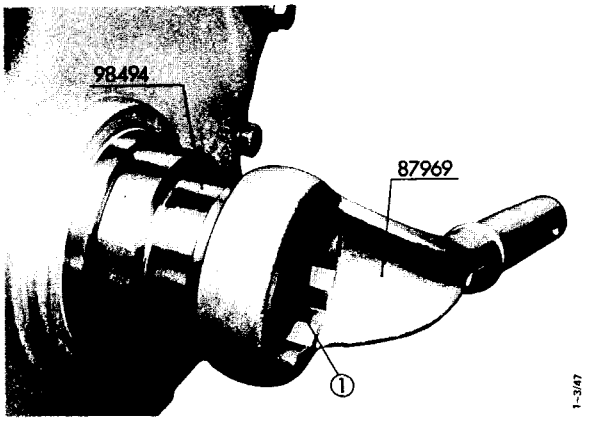

Fig. 14 Assembly drift for sealing ring

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.

CRANKSHAFT AND RECIPROCATING COMPONENTS

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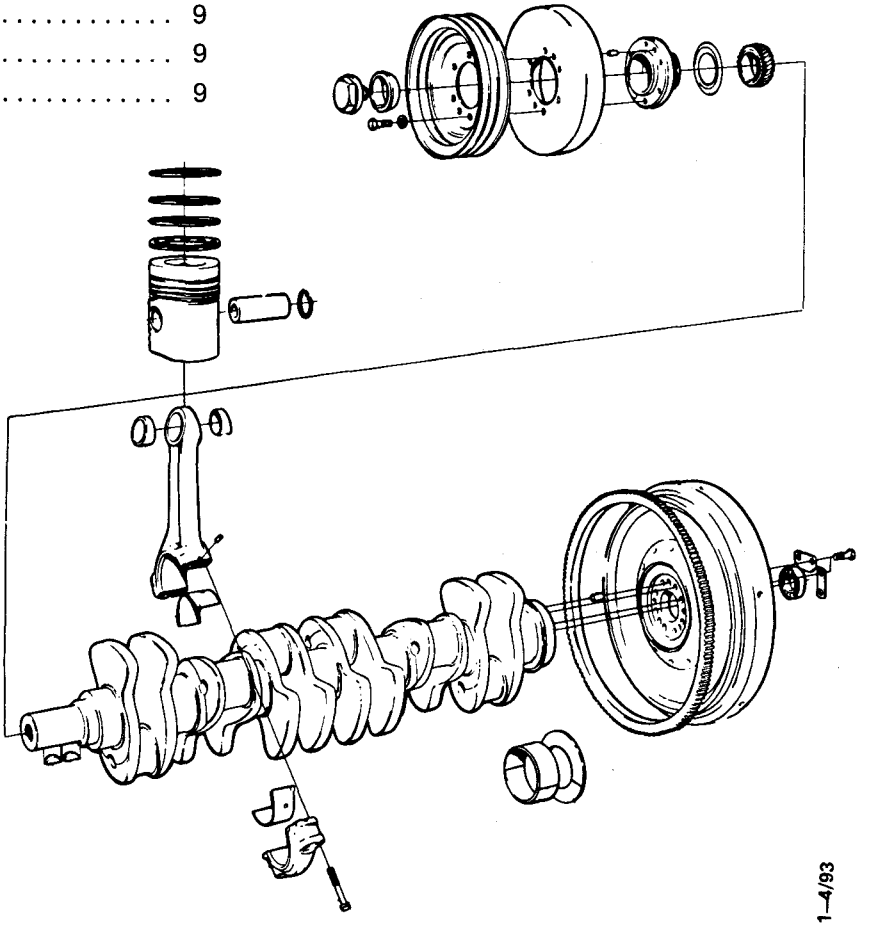

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Fig. 1

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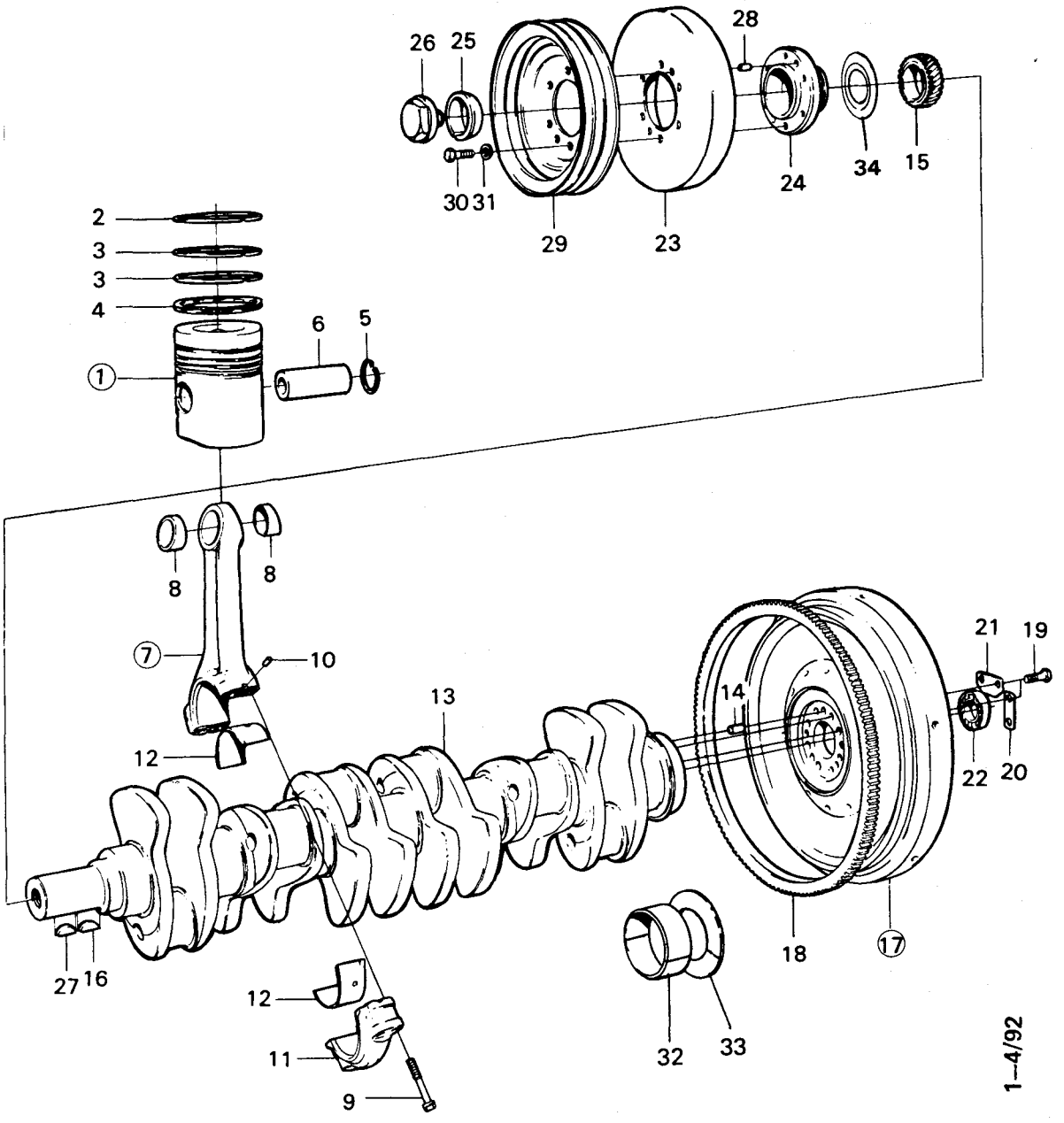

Fig. 2

1. *Piston*
2. *Compression ring, top*
3. *Compression ring, bottom*
4. *Oil ring*
5. *Lock ring*
6. *Piston ring*
7. *Connecting rod*
8. *Bushing*
9. *Screw*
10. *Locating pin*
11. *Bearing cap*
12. *Bearing half for connecting rod*
13. *Crankshaft*
14. *Locating pin*
15. *Crankshaft gearwheel*
16. *Key*
17. *Flywheel*
18. *Gearwheel*
19. *Screw*
20. *Lock washer*
21. *Lock washer*
22. *Ball bearing*
23. *Vibration damper*
24. *Hub for vibration damper*
25. *Tensioning cone*
26. *Screw*
27. *Key*
28. *Locating pin*
29. *Pulley*
30. *Screw*
31. *Washer*
32. *Bearing half for crankshaft*
33. *Guide washer for crankshaft*
34. *Oil thrower*

Connecting rod and piston

Removal and dismantling of piston and connecting rod

1. Scrape off the soot from the cylinder liner.

2. Remove the oil nozzle for piston cooling.

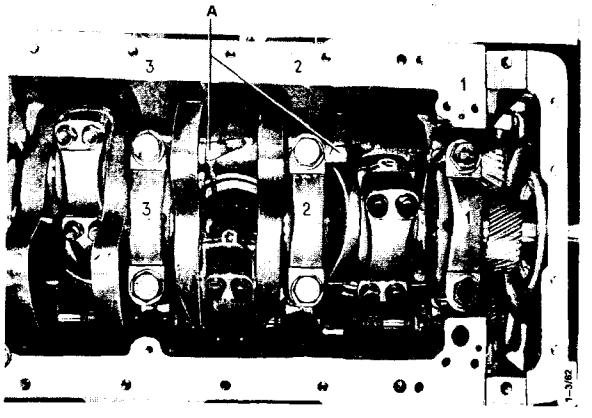

Fig. 3 Marking of main and big-end bearing caps
1. Oil nozzle for piston cooling

3. Remove the bearing cap and bearing shells. Protect the oilway in the crankshaft with, for example, a piece of tape, applying it with the tacky side outwards.

4. Press the piston and connecting rod out.

5. Remove the piston pin retaining rings, heat the piston to approx. 100°C and press the piston pin out.

Remove the piston rings and oil rings, taking care not to scratch the sides of the piston.

When graphited (black) pistons are cleaned in a washing machine the graphiting occasionally disappears. This is of no importance for pistons which have been in use for some time. New pistons should, however, be cleaned with a certain degree of caution, for instance with white spirit.

Checking of connecting rod

Check the connecting rods in a tool intended for this purpose. The procedure is as follows:

1. When the piston pin bushing has been checked and replaced if necessary, fit the bearing cap according to the marking and tighten the screws to the prescribed torque.

2. Set up the connecting rod in the tool with the aid of the expander and fit the appropriate piston pin in the piston bushing. Then place the indicator on the piston pin.

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

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

3. Check also to see whether the connecting rod is bent into the shape of an S. Do this by measuring the distance between the outer side of the piston pin bushing and the flat face of the tool. Turn the connecting rod over and take the corresponding measurement. The difference must not be more than 0.6 mm.

It is not advisable to straighten connecting rods. Defective connecting rods should therefore be discharged and replaced by new ones.

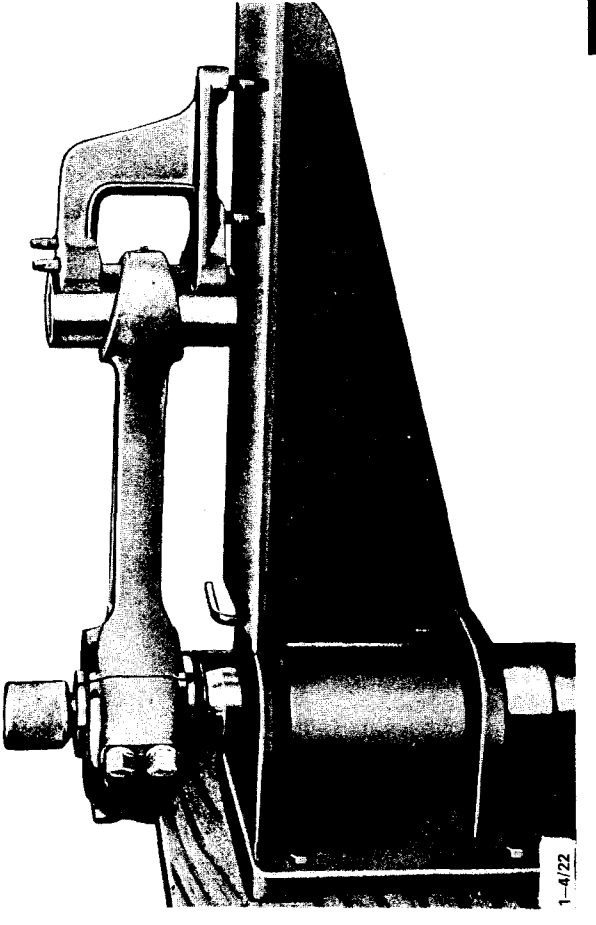

Fig. 4 Check the connecting rod for bentness with the aid of the indicator

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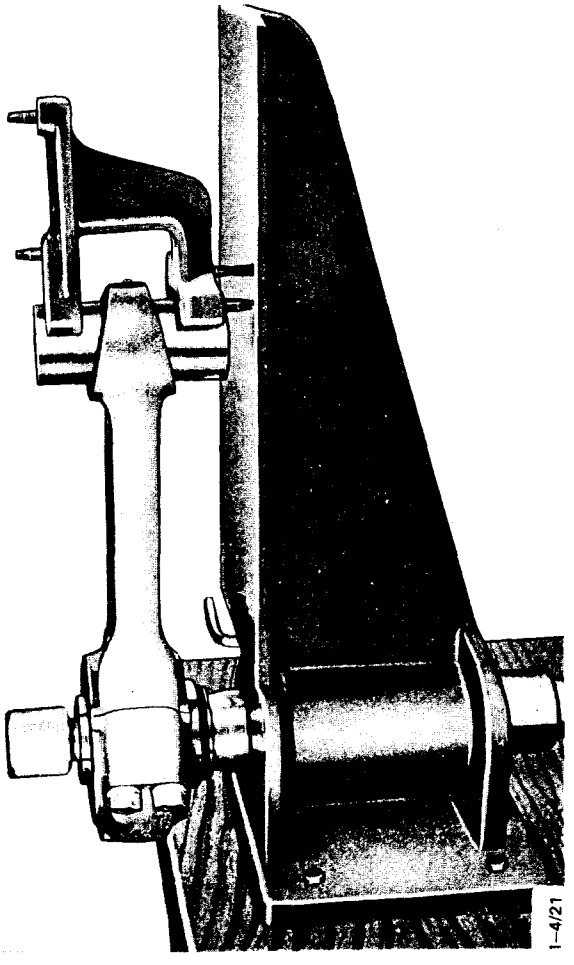

Fig. 5 Check the connecting rod for twist with the aid of the indicator

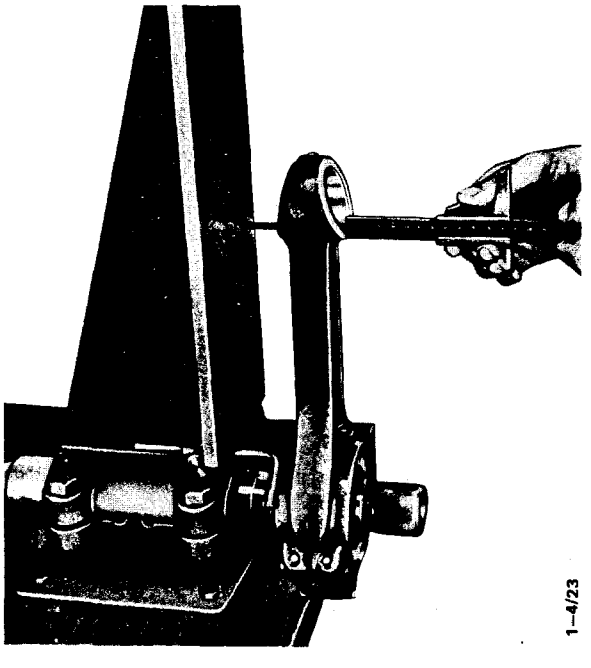

Fig. 6 Check whether the connecting rod is bent into the shape of an S

Assembly and fitting of piston and connecting rod

Assembly

Clean the pistons and their ring grooves thoroughly without scratching the sides of the grooves. Clean out the oil holes in the piston with a suitable drill bit.

Before fitting, check that the piston and piston-ring gaps are correct and that the axial play does not exceed the permissible value (0.25 mm).

Fig. 7 Measuring axial play for piston ring

The upper compression ring is cylindrical and the two following ones are conical and must be fitted with the side marked TOP facing upwards.

The oil ring is fitted with an expander.

When a new piston with fitted piston rings is to be installed, check the ring gap in piston ring compressor 87718 and gauge 87147. The ring gap is measured through the hole in the tool. The same tools can also be used to check the ring gap on unfitted piston rings.

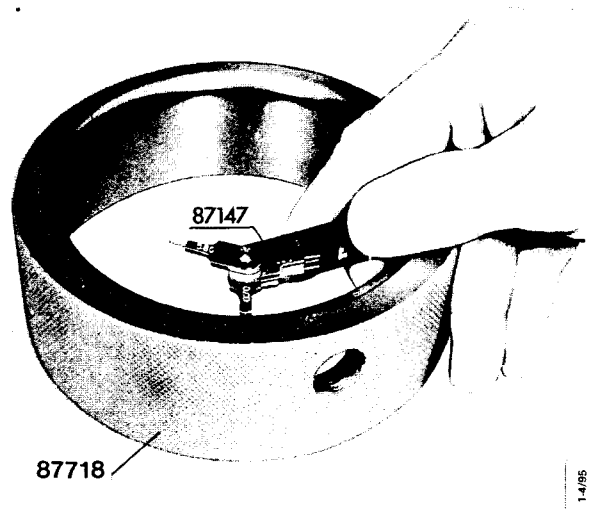

Fig. 8 Checking the gap of an unfitted piston ring

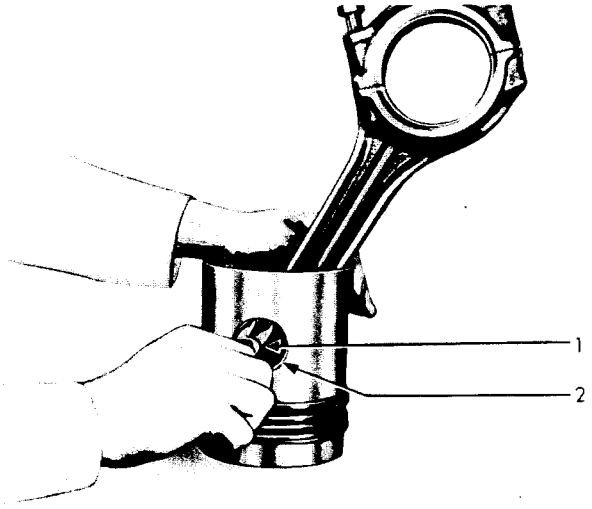

Fig. 10 Fitting the lock ring for the piston pin

Fit one of the lock rings for the piston pin. Heat the piston to approx. 100°C and mount the piston on the connecting rod. The piston is marked with an arrow which must point forwards. The connecting rod (= cylinder) number is punched into the right side at the dividing face for the cap.

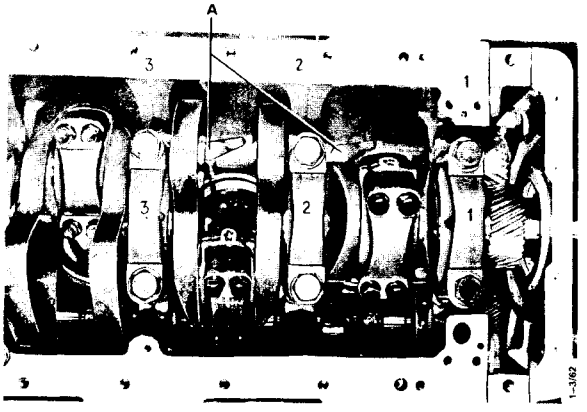

Fig. 11 Marking of connecting rods, cylinder block and bearing caps

A. Oil nozzle for piston cooling

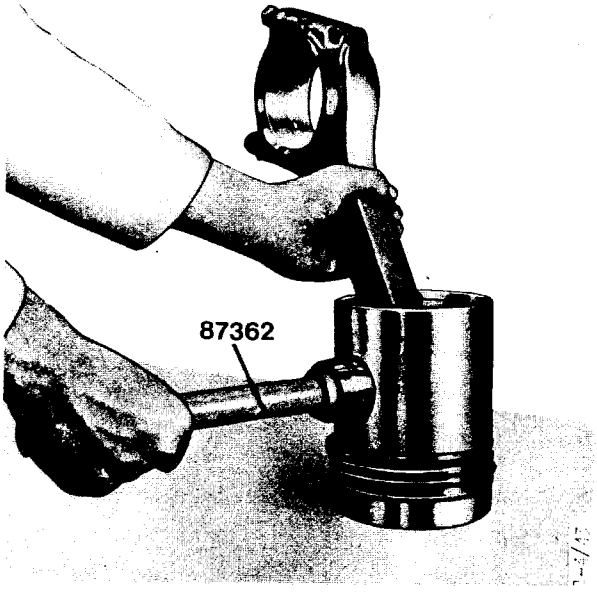

Fig. 9 Fitting the piston to the connecting rod

Remember to fit the second lock ring for the piston pin!

Fitting

1. Place the piston ring compressor on the cylinder liner.

2. Lubricate the piston, piston rings, cylinder liner and piston ring compressor copiously with engine oil. Turn the piston ring so that their gaps are spread around the piston instead of being opposite each other.

3. Press the piston down into the cylinder. Remove the protection from the crank pins.

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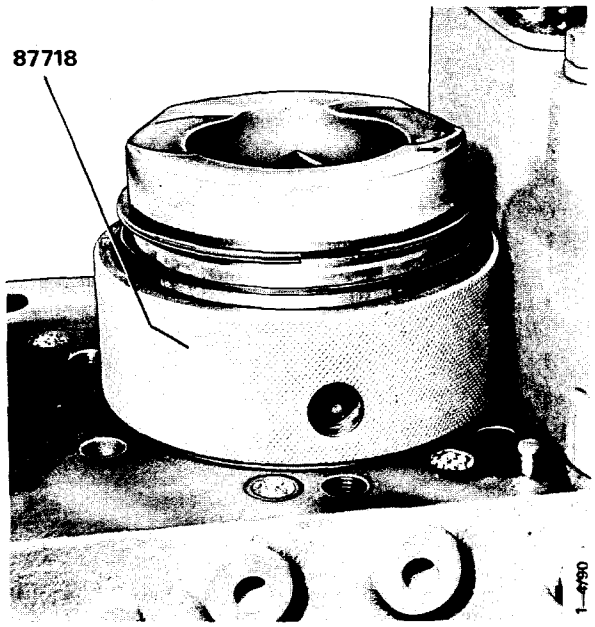

Fig. 12 Fit the piston with the aid of the piston ring compressor

4. Fit the big-end bearing halves, lubricate the crank pin and screw the cap on using well oiled screws. Tighten the screws with a torque of 110 Nm (11 kpm).

5. Fit the oil nozzle for piston cooling. The position of the nozzle is fixed by an arm with a pin which fits into a hole in the block.

NOTE! A damaged nozzle must always be discarded and replaced by a new one so that the oil jet comes in the right direction. Tighten the banjo screw for the nozzle with a torque of 16 Nm (1.6 kpm).

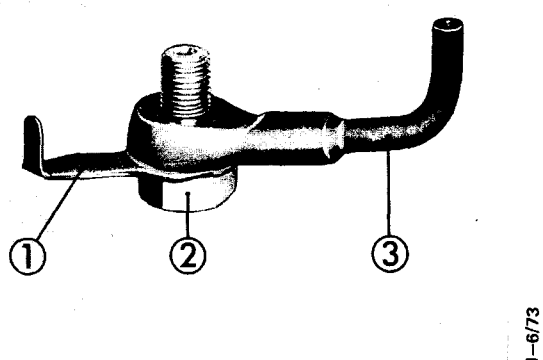

Fig. 13
1. Arm 2. Banjo screw 3. Oil nozzle

Flywheel

Removal

1. Fold the tabs of the lock washers down and remove the screws.

2. Pull the flywheel off the crankshaft with the puller screws.

3. Tap out the ball bearing.

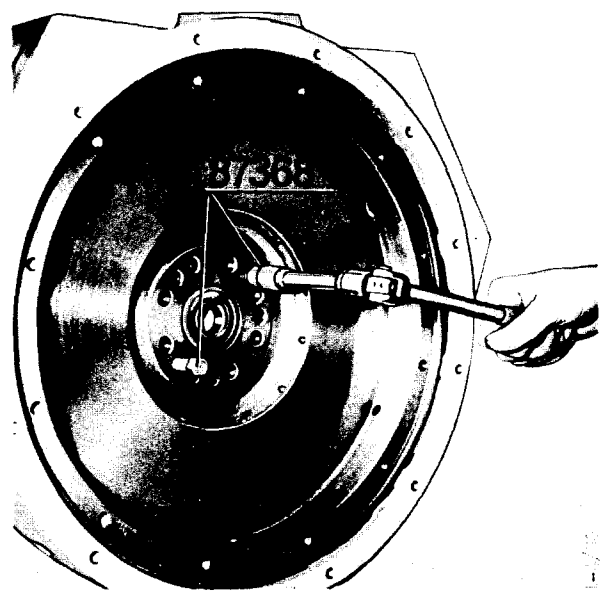

Fig. 14 Remove the flywheel with the aid of the puller screws

Changing the ring gear

Change the flywheel ring gear if the teeth have become so severely worn that the pinion of the starter motor has difficulty in engaging. The changing is performed as follows:

1. Grind as deep a groove as possible in the ring gear and split gear and split it with a cold chisel. Remove the ring gear from the flywheel.

2. Clean the contact surface on the flywheel with a steel brush.

3. Heat the new ring gear so that it is uniformly heated all round to approx. 250°C. In order to be able to check when this temperature has been reached, start off by grinding a couple of bright spots at different places on the ring gear. Heating should be discontinued at the latest when these spots start becoming blued. If heating is prolonged beyond this point there is a risk that the ring gear will lose its temper.

4. Drive the heated ring gear onto the flywheel so that the bevelling on the teeth faces towards the starter motor. Make sure that the ring gear bears up firmly against the flywheel.

5. The ring gear must not be cooled rapidly but should be allowed to cool freely in air.

Fitting

Press a new ball bearing into the flywheel and mount the flywheel on the crankshaft.

Insert new tabbed lock washers. On certain types of flywheels, one of these washers also serves to lock the ball bearing.

Tighten the screws with a torque of 190 Nm (19 kpm).

Vibration damper, hub and crankshaft gearwheel

Removal

1. Remove the fan hub if fitted, pulley and vibration damper. Handle the vibration damper cautiously so that it does not get distorted and put out of action, which could result in crankshaft rupture.

2. Back off the screw for the vibration damper hub, using socket wrench 87519.

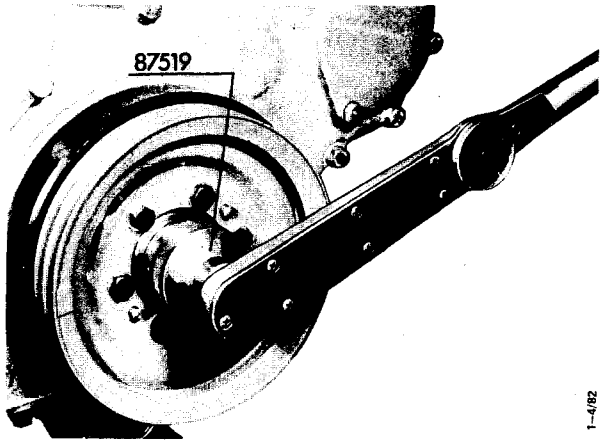

Fig. 15 Backing off the screw for the vibration damper hub

3. Withdraw the vibration damper hub, using puller 87665 and thrust pad 87663, inserting the latter in the crankshaft end. Pull the hub off 2–5 mm. Detach the puller and remove the cone. Refit the puller and pull the hub off completely.

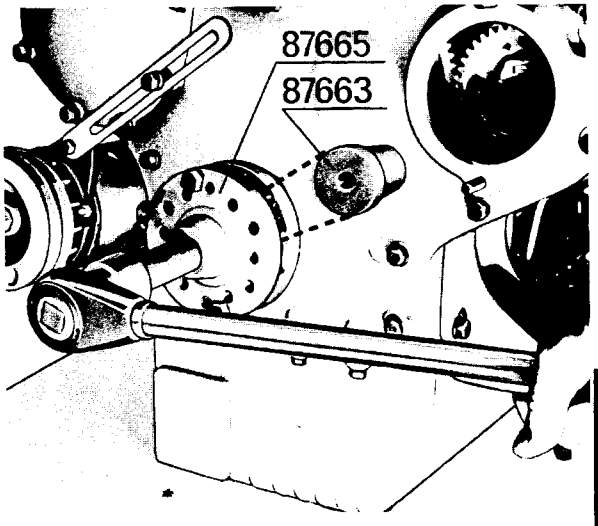

Fig. 16 Pulling off the vibration damper hub

4. Remove the woodruff key.

Engines with a polygon joint in the crankshaft: The vibration damper hub is pulled off with the same tools as are used for engines with a woodruff key in the crankshaft. The cone between the vibration damper hub and crankshaft is not included in the case of polygon joints.

5. Remove the oil pan, the oil pump and the timing-gear housing.

6. Rotate the crankshaft so that an O-marked tooth on the crankshaft gearwheel and O-marked teeth on the camshaft and pump shaft gearwheels point towards the centre of the idler gear. (Independent of O-marking on idler gear).

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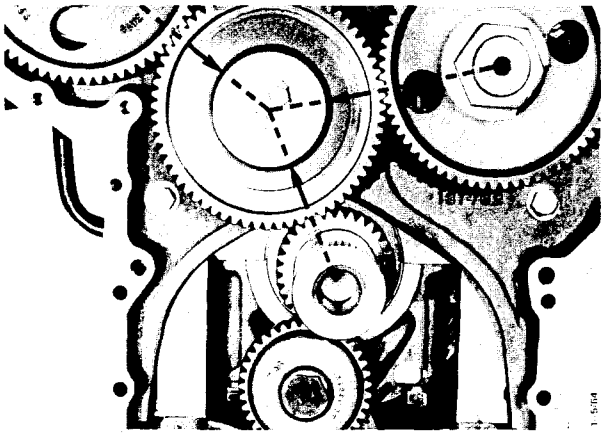

Fig. 17 Setting of timing-gears before idler gear is removed

7. Remove the idler gear and pull the crankshaft gearwheel off with puller 87358 and thrust pad 87663.

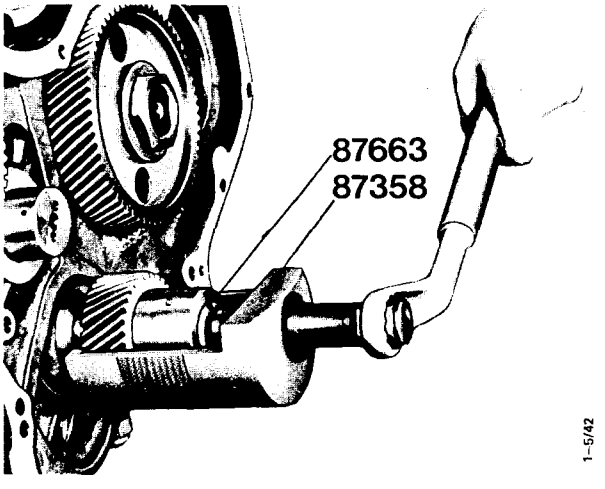

Fig. 18 Pull the crankshaft gearwheel off

NOTE! Never rotate the crankshaft or camshaft after having removed any of the gears, as there would then be a risk of the valve heads striking against the pistons.

Fitting

1. Insert the key for the crankshaft gearwheel in the crankshaft. Make sure that the key is tapped right down to the bottom of the groove.

2. Heat the crankshaft gearwheel in boiling water. Turn the "O" marking forwards and push the gearwheel in onto the crankshaft. If necessary, use drift 87932. Fit the idler gear so that an O-marked tooth fits into a marked tooth space. See 1d AR 5.

3. Insert the key for the vibration damper hub in the crankshaft. Make sure that the key is tapped right down to the bottom of the groove.

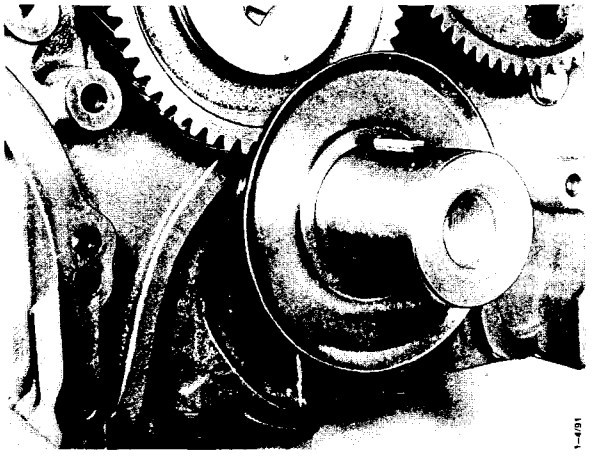

Fig. 19 Fit the oil deflector

4. Fit the oil pump, timing-gear housing and oil pan. (With regard to the sealing ring in the timing-gear housing see 1d AR 3).

5. Drive the vibration damper hub on with drift 87509.

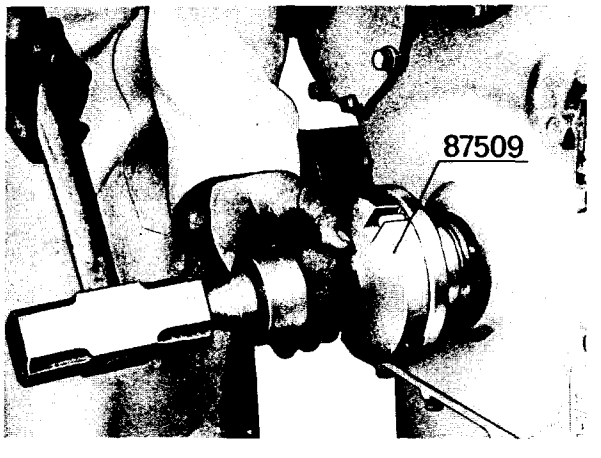

Fig. 20 Driving on the vibration damper hub

6. Fit the cone and tighten the screw with a torque of 735 Nm (75 kpm).

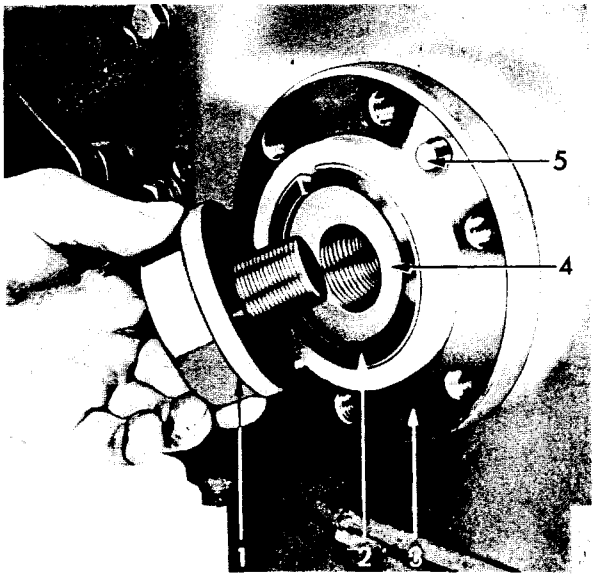

Fig. 21 Attachment of hub

7. Put on the vibration damper and pulley and tighten the screws with a torque of 110 Nm (11 kpm).

Crankshaft

Removal

1. Remove all pushrods and valve lifters. If pistons or liners are to be changed at the same time as the crankshaft also remove the cylinder heads.

2. Remove the flywheel and flywheel casing.

3. Remove the vibration damper, hub, oil pan, timing-gear housing and idler gear.

4. Remove the oil pump, all oil nozzles for piston cooling and all connecting rod caps. Push all pistons to the TDC position or, if the cylinder heads have been taken off, remove them.

5. Remove all main bearing caps and lift the crankshaft out carefully, for instance with a lifting strap which will not damage the shaft journals.

6. Remove main bearing halves and thrust washers at the 7th main bearing.

Checking and grinding

1. Measure the crankshaft pins. Measure the shaft journals with a micrometer at two diameters rectangularly opposite each other. If any of these diameters falls short of the stipulated lower limit regrinding of the crankshaft should be considered. Due allowance should also be made to the oil pressure, which in turn is influenced by factors such as wear in main and big end bearing shells.

2. In regrinding, the stipulated undersizes must be adhered to. Suitable bearing shells for these sizes are available.

3. In grinding the crankshaft, it is of vital importance for the correct fillet radius on journals and pins to be preserved.

Fitting

1. Take particular pains to clean all oilways in the crankshaft, bearing pins and contact surfaces for bearing shells and caps thoroughly.

2. Check that the sizes of the bearing shells and thrust washers are correct. Position the bearing shells in the block and bearing caps. Lubricate bearings and bearing pins copiously.

3. Lift the crankshaft carefully into position. Put on the caps and tighten the screws with a torque of 290 Nm (29 kpm). Check that the shaft rotates easily.

4. Fit the idler gear in the timing-gear housing, so than an O-marked tooth meshes with an O-marked tooth space. See 1d AR 5. Insert the key for the vibration damper hub.

5. Put the timing-gear housing on.

6. Refit all other removed parts.

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TIMING GEARS

AR

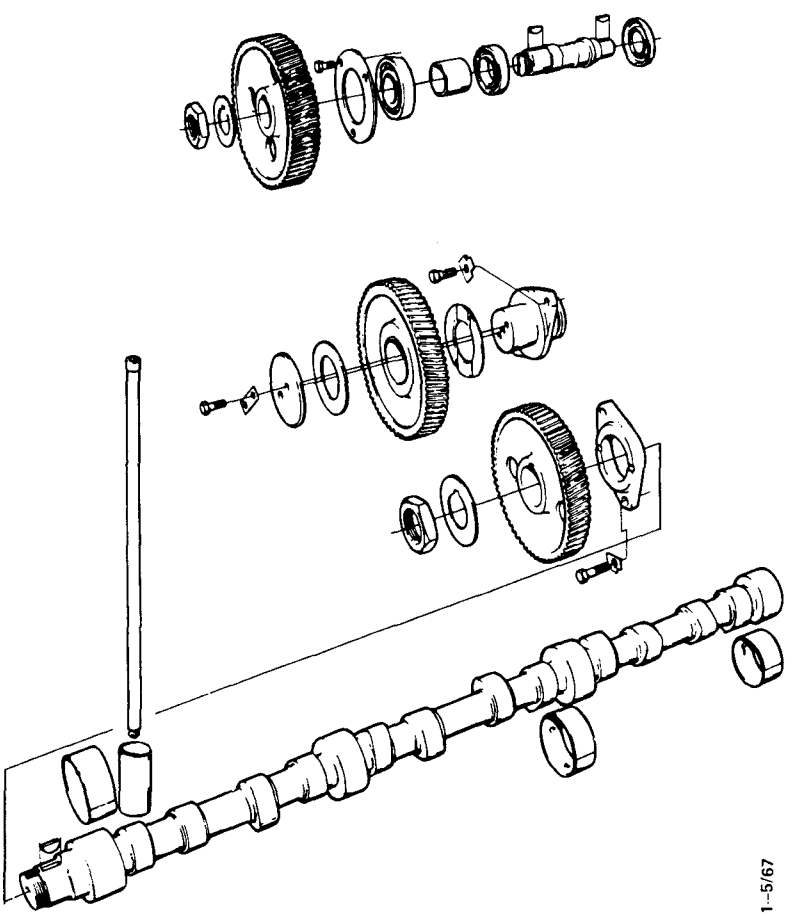

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Fig. 1

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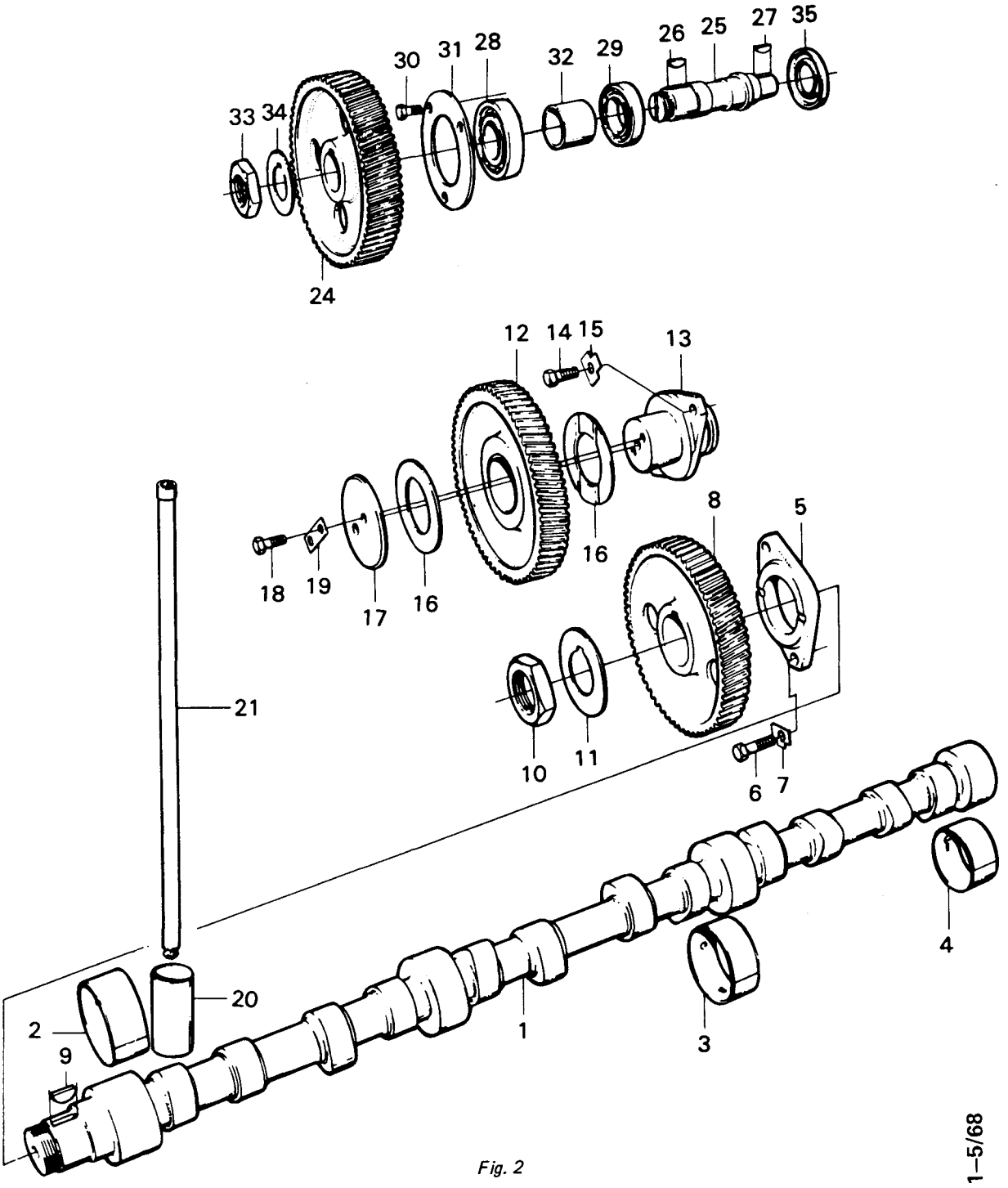


Fig. 2

1. *Camshaft*
2. *Camshaft bearing, 1st*
3. *Camshaft bearings, 2nd and 3rd*
4. *Camshaft bearing, 4th*
5. *Flange*
6. *Screw*
7. *Lock washer*
8. *Camshaft gearwheel*
9. *Key*
10. *Nut*
11. *Lock washer*
12. *Idler gearwheel with bushing*
13. *Axle stub*
14. *Screw*
15. *Lock washer*
16. *Guide washer*
17. *Washer*
18. *Screw*
19. *Lock washer*
20. *Valve lifter*
21. *Pushrod*
24. *Pump shaft gearwheel*
25. *Drive shaft for injection pump*
26. *Key for pump shaft gearwheel*
27. *Key for connection to injection pump*
28. *Ball bearing*
29. *Ball bearing*
30. *Screw*
31. *Washer*
32. *Spacer sleeve*
33. *Nut*
34. *Lock washer*
35. *Sealing ring*

Gearwheels

Removal

1. Remove the crankshaft belt pulley, vibration damper and hub as well as the woodruff key.

2. Remove the timing-gear housing. See 1d AR 3.

3. Fold up the tabs of the lock washers for the pump and camshaft gearwheels and back off the nuts.

4. Rotate the crankshaft so that an O-marked tooth on the crankshaft gearwheel and O-marked teeth on the camshaft and pump shaft gearwheels point towards the centre of the idler gearwheel. (Regardless of the O-marking in the idler gearwheel).

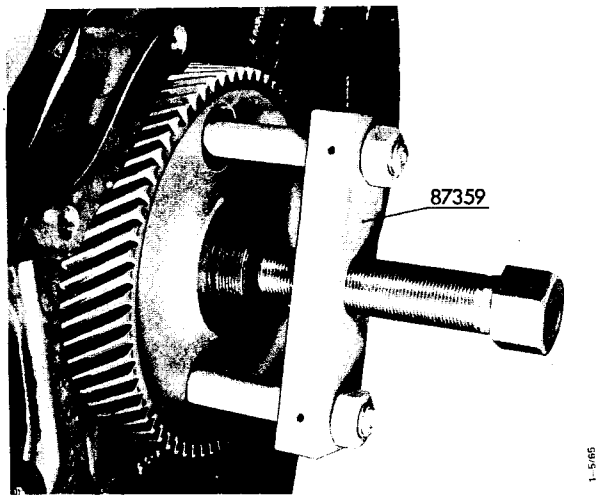


Fig. 4 Puller for pump gearwheel and camshaft gearwheel

7. Remove the idler gear bearings.

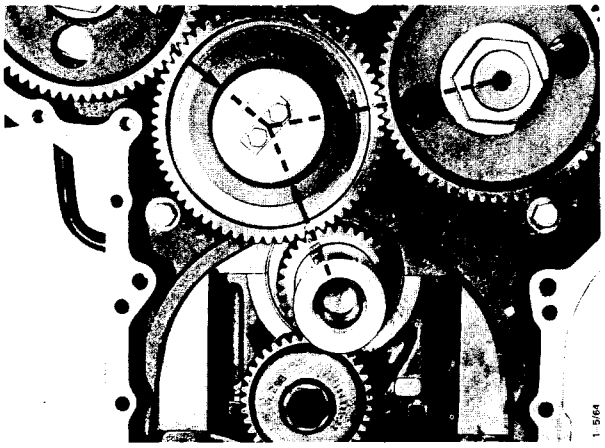


Fig. 3 Adjustment of timing-gear wheels before idler gear is taken out

5. Take out the idler gear.

6. Remove the pump shaft gearwheel and camshaft gear-wheel with puller 87359.

NOTE! Remove the pushrods if the crankshaft or camshaft has to be turned round a little when any of the timing-gears has been removed. Otherwise there is a risk of the valve heads striking against the pistons.

Fitting

The timing-gear wheels are marked with an "O" on a tooth or tooth space and must be adjusted when fitting so that an O-marked tooth meshes with an O-marked tooth space.

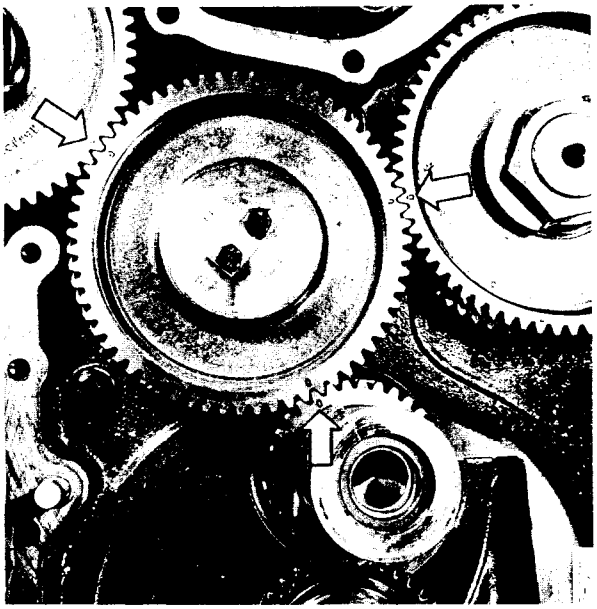


Fig. 5 Marking of timing-gears

AR

Fit the timing gearwheels for the injection pump and camshaft. Heat the gears to 100°C before fitting. Then insert the idler gear and adjust so that the O-markings on the gearwheels come opposite each other. It should be possible to push the idler gear in by hand.

Check after fitting that an O-marked tooth meshes with an O-marked tooth space.

The axial washers for the idler gear must be turned so that the oilways in the washers face towards the gearwheel.

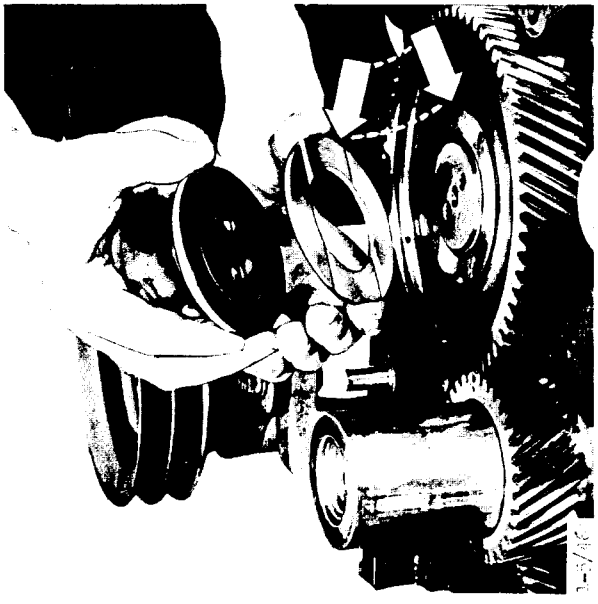


Fig. 6 Washers for idler gear

After having fitted the idler gear, tighten the nuts for the pump gearwheel with a torque of 200 Nm (20 kpm) and those for the camshaft gearwheel with a torque of 400 Nm (40 kpm). Lubricate the nuts with oil on the side which rests against the locking plate. Fold up the tabs on the locking plate (lock washer).

Camshaft

Removal and fitting

1. Remove the timing-gear housing.

2. Remove the rocker arm mechanism.

3. Lift the pushrods out and mark them so that they can be refitted in the same place as before.

4. Take away the side doors, take out the valve lifters and mark them also.

5. Remove the screws for the locating flange. (These screws can be removed even when the camshaft gearwheel is mounted on the camshaft, through the holes in the gearwheel).

6. Pull the camshaft out cautiously so as not to damage the cams and bearings.

7. Fitting is carried out in the reverse order.

Replacement of camshaft bearings

The camshaft and camshaft bearings are subjected to only negligible wear and it is seldom that anything needs to be done about these parts. In connection with engine overhauls, however, check that the cams and bearing surfaces are not obnormally worn.

New bearings must be fitted so that their lubrication holes come opposite the oil passages in the block.

After fitting, the bearings must be machined to the specified dimensions. See section SP. A boring mill will be needed for machining of the bearings.

Checking the camshaft setting

1. Turn the crankshaft to the T.D.C. position after the compression stroke of the first cylinder. (Valve clearance on both valves).

2. Secure two dial indicators to the guide washers for the valve springs.

3. Adjust the rocker arms so that the clearance no longer exists and an additional 0.1 mm (both valves are thus open 0.1 mm).

Zero-set both dial indicators.

4. Turn the crankshaft one revolution in its direction of rotation until the TDC position is reached once again.

5. Take readings on both dial indicators and compare with the values stated below.

DS8, camshaft art. No. 251311

Intake valve lifting height	1.9–3.2 mm
Exhaust valve lifting height	2.1–3.3 mm

D8, camshaft art. No. 251310

Intake valve lifting height	0.5–0.9 mm
Exhaust valve lifting height	0.8–1.1 mm

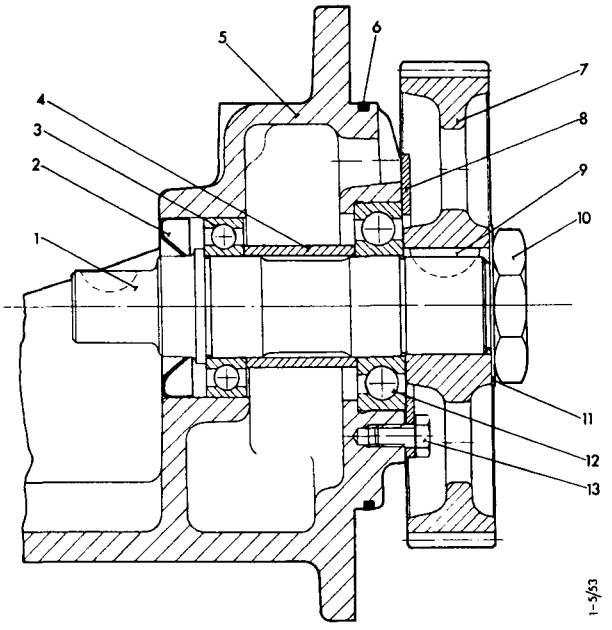


Fig. 6 Drive for injection pump

1. *Drive shaft*
2. *Sealing ring*
3. *Ball bearing*
4. *Spacer sleeve*
5. *Pump shaft*
6. *O-ring*
7. *Pump shaft gearwheel*
8. *Washer*
9. *Key*
10. *Nut*
11. *Lock washer*
12. *Ball bearing*
13. *Screw*

Rocker arm mechanism

Valve lifters and pushrods

Removal

1. Remove the rocker arm mechanism.

2. Lift the pushrods out and mark them so that they can be refitted in the same place as before.

3. Take away the side doors, lift the valve lifters out and mark them also.

Check that the valve-lifter contact surface against the camshaft is undamaged. Check that the pushrods are straight by rolling them on a faceplate. Minor deviations from true can be corrected by straightening with a rubber mallet. Check also that ball sockets and ball studs are seated in the pushrods.

Drive shaft for injection pump

Removal and fitting

The drive shaft can be removed with or without the pump shaft gearwheel. Back off the three screws for the washer (accessible through holes in the gearwheel) and tap the drive shaft out forwards.

Remove the gearwheel, washer, front ball bearing, spacer sleeve and rear ball bearing. Tap the sealing ring out.

Fitting is carried out in the reverse order. Se also Fitting of gearwheels.

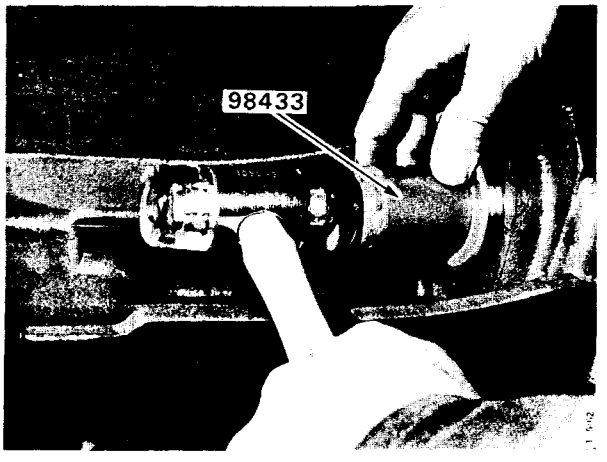
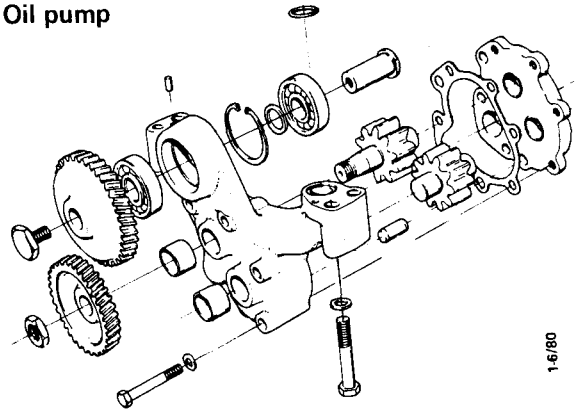


Fig. 7 Drift 98433 for sealing ring

LUBRICATING SYSTEM

Oil pump



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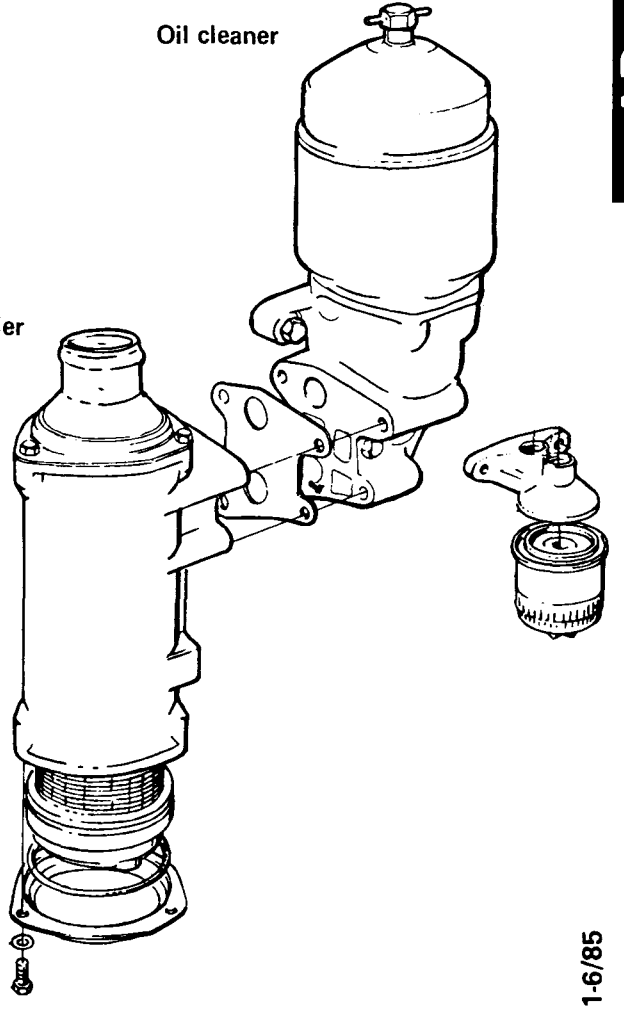
Oil cleaner

Oil cooler



Oil pressure valve

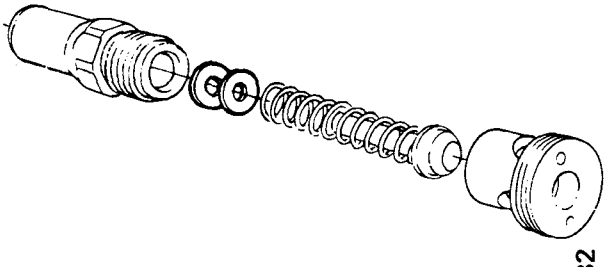


Fig. 1

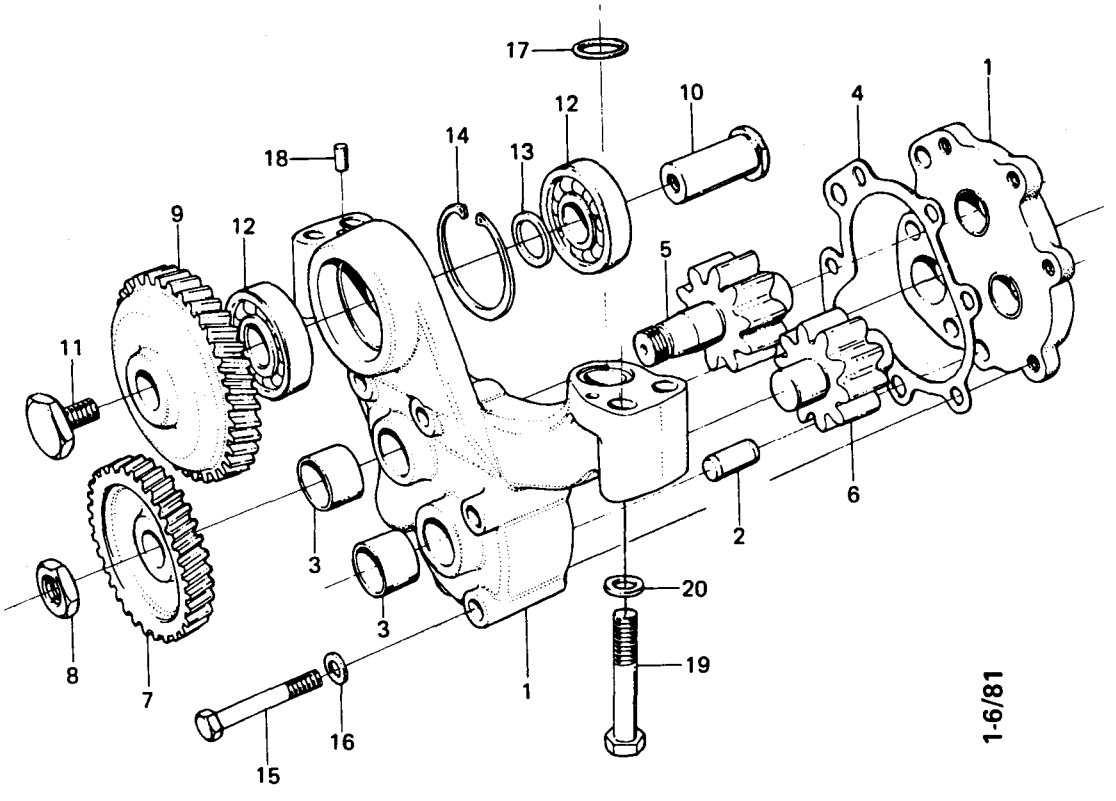


Fig. 2

1. *Housing with cover*
2. *Pin*
3. *Plain bearing*
4. *Gasket*
5. *Pump gearwheel*
6. *Pump gearwheel*
7. *Pump pinion*
8. *Nut*
9. *Gearwheel*
10. *Pump shaft*
11. *Screw*
12. *Ball bearing*
13. *Spacer*
14. *Lock ring*
15. *Screw*
16. *Washer*
17. *O-ring*
18. *Locating pin*
19. *Screw*
20. *Washer*

Dismantling

1. Remove the lock screw for the idler gear.

NOTE! The lock screw has a left-hand thread.

2. Back off the nut for the pump pinion and pull the pinion off with a universal puller.

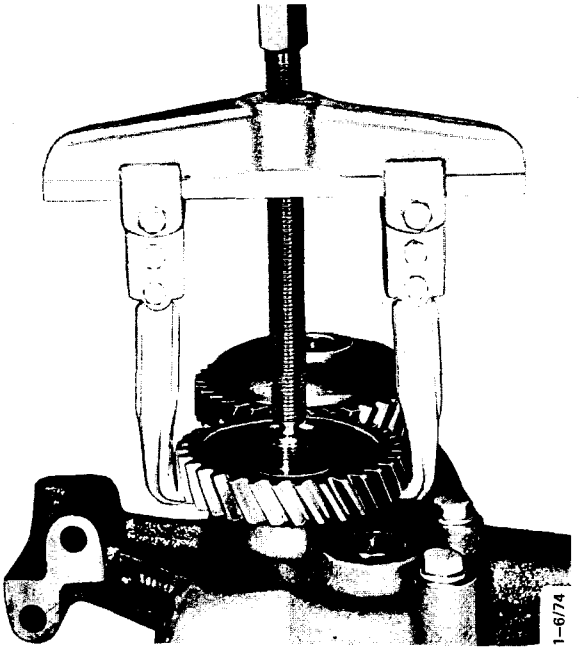


Fig. 3 Pulling off the oil pump pinion

3. Press the idler gear pin out. Use, for instance, thrust pad 87663.

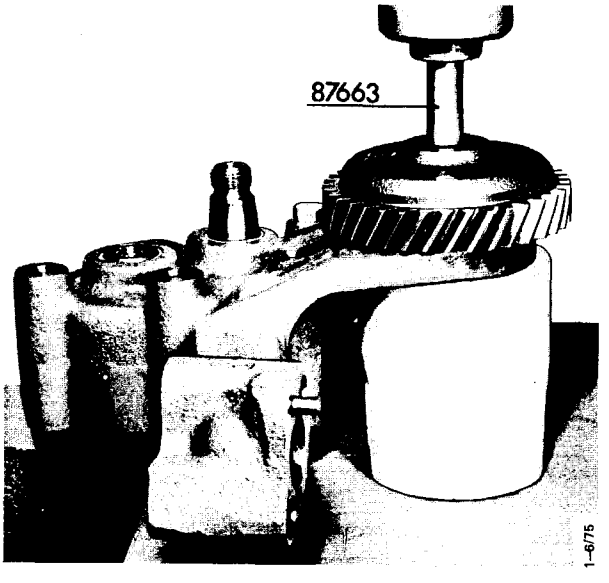


Fig. 4 Pressing out the idler gear pin

4. Press the pin out of the rear ball bearing.

5. Remove the lock ring and tap the remaining ball bearing out.

6. Remove the screws and separate the cover from the housing. Remove the oil pump gearwheels.

7. Press the bearing bushings out.

The pump housing cover is drilled with the pump housing a matched item and must not be changed separately. New bushings are available as spare parts. After new bushings have been pressed in they must be accurately machined, which requires special tools.

Assembly

1. Press new bearing bushings in. Screw the cover and housing together and tighten the screws with a torque of 20 Nm (2.0 kpm). Machine the bushings to the prescribed dimensions according to 1d SP 6 and check that the distance between the gearwheel shafts is correct.

2. Insert both oil pump gearwheels and measure the distance between the gearwheel and the surface of the pump housing.

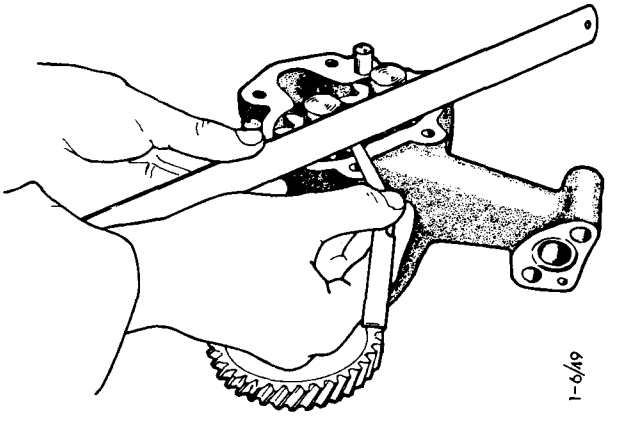


Fig. 5 Measuring clearance in the oil pump

Gaskets for fitting between pump housing and cover are available in the following thicknesses: 0.05, 0.07 and 0.10 mm. NOTE! The gaskets "give" 0.02 mm when the screws are tightened, and consequently the gasket thickness must be reduced by this amount (0.02 mm) when calculating the clearance.

The correct clearance is 0.07—0.10 mm and is obtained as follows:

Measured clearance plus gasket thickness less 0.02 mm.

AR

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3. Screw the cover and pump housing together. Tighten the screws with a torque of 20 Nm (2.0 kpm).

4. Press the rear ball bearing onto the idler gear pin. Fit the lock ring in the housing. Tap the bearing (with the pin) into the housing. Insert the spacer and press the front bearing on.

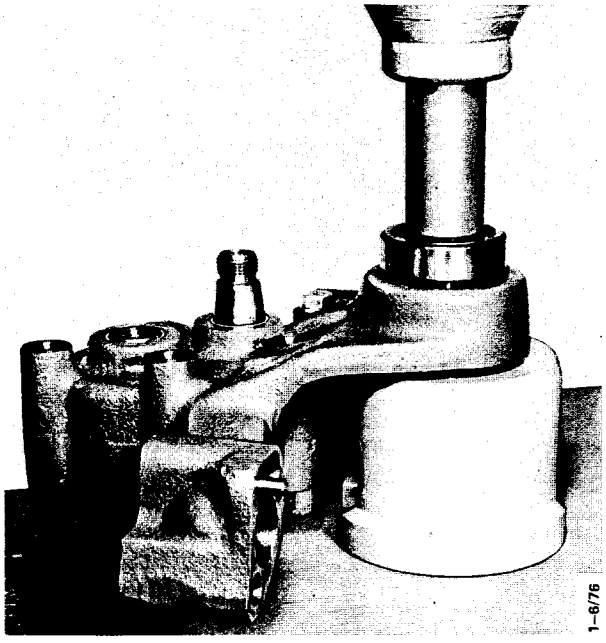

Fig. 6 Pressing on the front bearing

5. Press the idler gear onto the pin.

6. Screw the lock screw in and tighten it with a torque of 40 Nm (4.0 kpm). Note that the screw has a left-hand thread.

7. Put the gearwheel on and tighten the nut with a torque of 140 Nm (14 kpm).

8. Lubricate the oil pump copiously with oil before mounting it on the engine block.

Oil pressure valve

The oil pressure valve is screwed to the engine block under the bracket for the oil cleaner and oil cooler.

Adjustment of oil pressure

1. Remove the bracket for the oil cleaner and oil cooler from the engine block. The cooler and cleaner can remain on the bracket.

2. Remove the oil pressure valve, using stud wrench 98386.

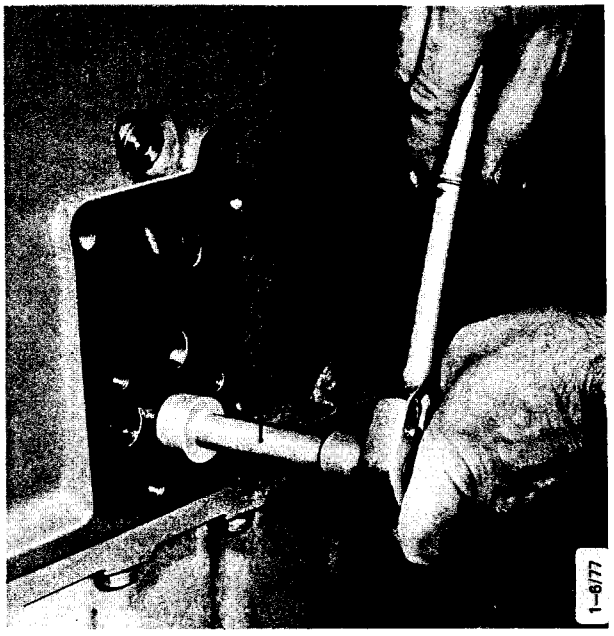

Fig. 7 Stud wrench for oil pressure valve

3. Dismantle the oil pressure valve. The pressure is raised by increasing the number of shims. One shim increases the pressure by approx. 0.12 bar. Adjust the oil pressure to 4.5–6.0 bar with the engine warm and running at 2 200 r/min.

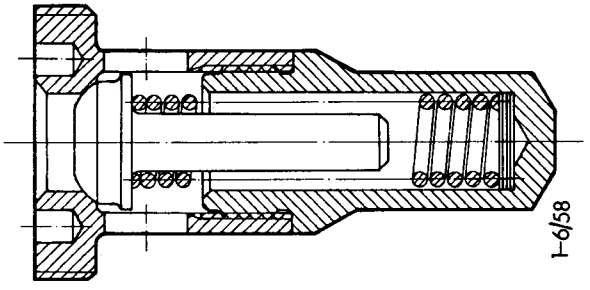

Fig. 8 Oil pressure valve, earlier version

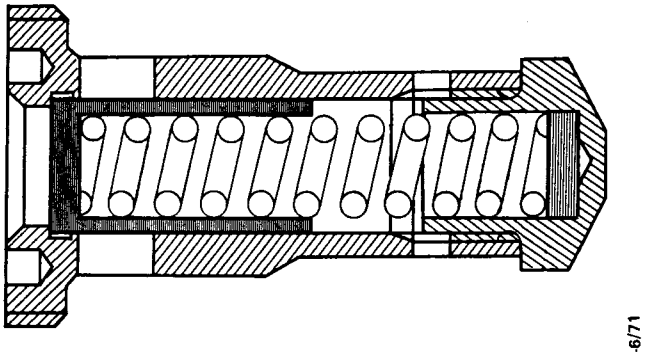

Fig. 9 Oil pressure valve, new version as from engine number 765974

Oil cleaner

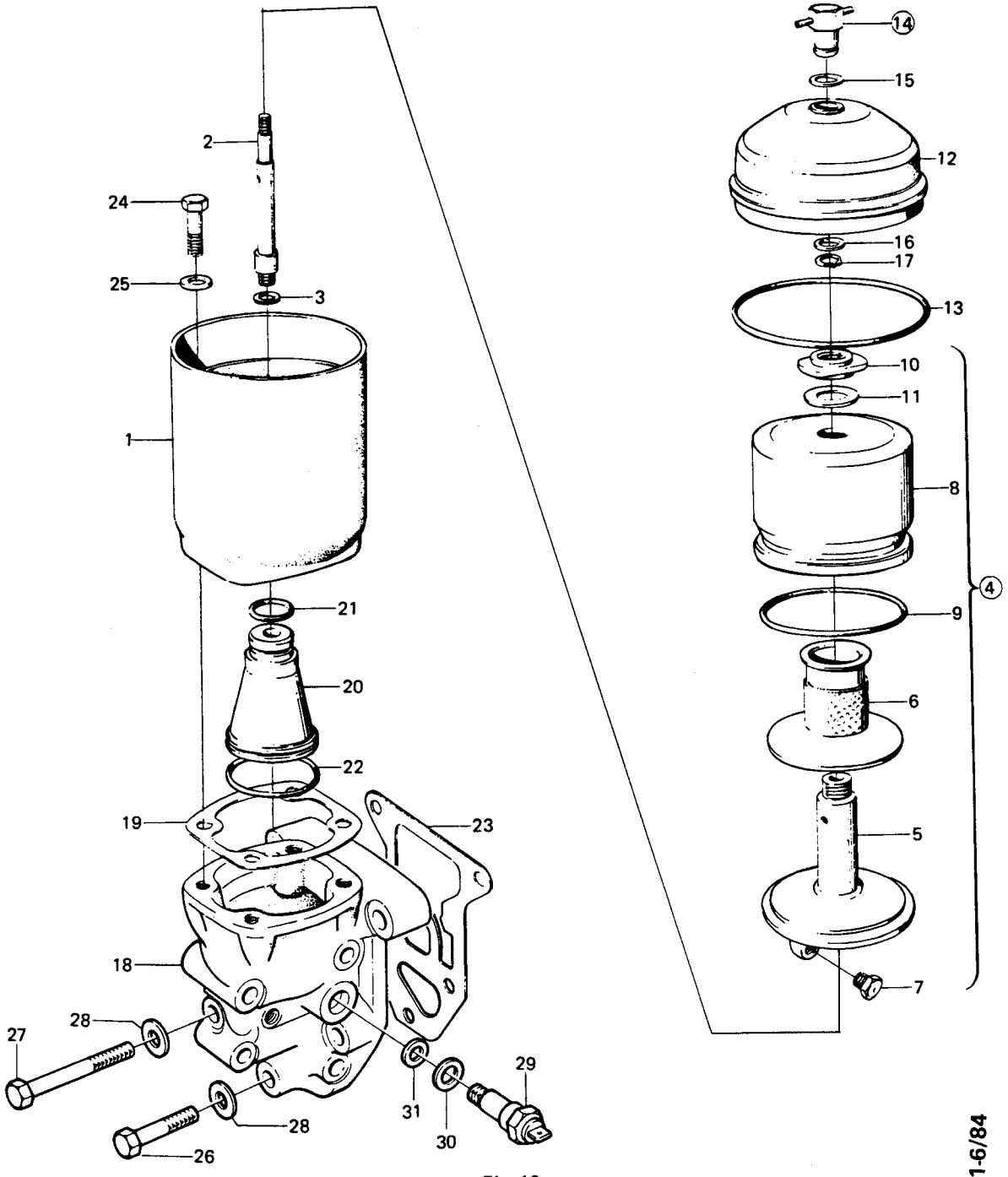

Fig. 10

1. *Housing*
2. *Shaft*
3. *Washer*
4. *Rotor assembly*
5. *Rotor*
6. *Strainer*
7. *Nozzle*
8. *Cover*
9. *O-ring*
10. *Nut*
11. *Washer*
12. *Cover*
13. *O-ring*
14. *Lock nut*
15. *Gasket*
16. *Washer*
17. *Lock ring*
18. *Bracket, complete*
19. *Gasket*
20. *Cyclone*
21. *O-ring*
22. *O-ring*
23. *Gasket*
24. *Screw*
25. *Washer*
26. *Screw*
27. *Screw*
28. *Washer*

AR

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Centrifugal oil cleaner

When routine cleaning of the oil cleaner is to be carried out there should be a coating of dirt in the rotor cover. If not, it is probable that the rotor does not rotate. The cause of this must be determined immediately.

If the coating of dirt exceeds the maximum permissible thickness (20 mm) when cleaning is performed at the prescribed intervals the rotor cover should be cleaned more frequently.

Dismantling and assembly

1. Unscrew the lock nut holding the cover and take the cover off.

2. Lift the rotor out. Wipe the outside clean. Slacken the rotor nut and back it off about three turns (in order to protect the bearing).

If it proves difficult to loosen the rotor nut, turn the rotor upside down and clamp the rotor nut in a vice. Turn the rotor counterclockwise by hand or, if this proves impossible, by inserting a screwdriver between the outlet holes.

NOTE! Never clamp the rotor itself in a vice.

3. Hold the rotor cover by its outside diameter and strike gently with a blow of the hand or with a plastic mallet on the rotor nut so that the rotor cover lets go of the rotor. Never strike directly on the rotor, as such action could cause damage to its bearings.

4. Remove the rotor nut, the washer and the cover from the rotor.

5. Remove the strainer from the rotor. If it has stuck, pry it carefully off by inserting a knife in the lower edge between the rotor and the strainer.

6. Scrape off the deposits on the inside of the cover with a knife or other suitable implement.

7. Wash the parts.

8. Check the two nozzles on the rotor. Make sure that they are not clogged up or damaged. Defective nozzles should be discarded and replaced by new ones.

9. Check that the bearings are undamaged.

10. Put the O-ring in position in the cover. A new O-ring should be fitted if the old one shows the slightest sign of damage.

11. Fit the parts together and tighten the rotor nut by hand. Remember the washer under the nut.

12. Check that the shaft is not loose. If it is, lock it with locking fluid 561056.

13. Refit the rotor and turn it round by hand to make sure that it rotates easily.

14. Check the O-ring on the cover of the cleaner housing and fit it into place. Tighten the nut by hand.

Bracket and cyclone

The cyclone is attached to the bracket for the centrifugal cleaner. The cyclone is sealed with two O-rings between the bracket and the housing for the centrifugal cleaner. When this housing has been removed the cyclone can be taken out. In the bracket there is a threaded hole where the oil pressure monitor is screwed in.

Oil filter for turbocompressor

The turbocompressor rotates at a very high speed, i.e. 60.000–100.000 r/min. It is therefore important for the lubrication to function satisfactorily. The special oil filter for the turbocompressor must be changed at the prescribed intervals and the centrifugal cleaner for the engine oil must also be cleaned in accordance with our instructions. Otherwise, the filter for the turbocompressor will become clogged up far too quickly and the resistance in the filter will increase as a result. A valve in the filter then opens and allows the oil to pass the filter without being cleaned. Uncleaned oil is supplied to the turbocompressor and the bearings are subjected to heavy wear.

The opening pressure of the valve is adapted to the oil flow rate. For this reason, always use genuine Scania oil filters. The oil filters of similar type intended for certain car engines are not suitable since the valve will then have too low an opening pressure.

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Fig. 11 Lubricating oil filter for turbocompressor

Oil cooler

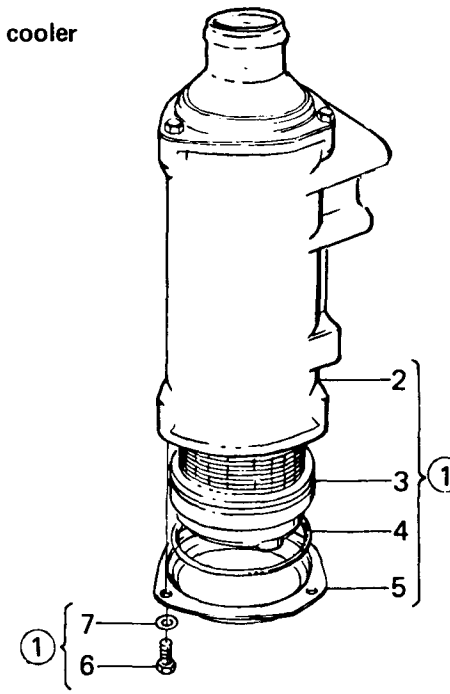

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Fig. 12

1. Oil cooler
2. Housing
3. Element
4. O-ring
5. Cover
6. Screw
7. Washer

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Normally the oil cooler requires no maintenance. If leakage is suspected, it should be pressure tested to the prescribed values.

Changing the filter

Release the filter with the aid of, for instance, a screwdriver with a square blade which fits into the keyway in the bottom of the filter. Fit a new filter as follows:

Smear the rubber gasket for the filter with oil.
Tighten the filter by hand until the gasket homes.
Tighten an additional half turn by hand.
Start the engine and check that no leakage occurs.

Changing the O-rings

1. Remove the screws and take away the covers on the ends of the oil cooler.

2. Press the element out only far enough for the O-ring to become visible on the opposite side so that it can be re-place. Use drift 98512.

3. Oil the O-ring and its groove copiously and fit the O-ring.

4. Press the element back so that the other O-ring becomes visible and can be replaced.

5. Press the element back into position so that the covers can be screwed on.

6. Pressure test the oil cooler.

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GENERAL

CAUTION

This section is applicable to only Waukesha models F476D and DS, which are designated by Scania as D and DS8A02, A04, A05, and A06. Engine serial numbers for these models are from 761785 (Sweden) and 133869 (Netherland).

Specifications

Cylinder arrangement		In-line engine
Number of cylinders		6
Cylinder bore	mm	115
Stroke	mm	125
Displacement	dm^3	7.79
Number of main bearings		7
Firing sequence		1-5-3-6-2-4
Compression ratio		D8: 16.5; DS8: 15.5
Injection		Direct
Mode of function		4-stroke
Cooling		liquid
Weight [1]	kg, approx.	D8: 695 DS8: 760
Output		
Speed	See Instruction Manual or Service Card	
Torque	for the engine concerned.	

1) Vehicle version without compressor, hydraulic pump, coolant and oil

Tools

	Art. No.	Class
Hoisting tools for removal and fitting of engine in truck		
Lever hoisting block 1.500 kg	98317	2
Hoisting strap 98	98094	2
Equipment for removal and fitting of engine in B, BF buses	98014	3
Wrench for oil plug and sealing plug	87202	1

Lubricating oil:

Engines without a turbocompressor (D8 engines) are to be lubricated with an oil satisfying the requirements of the American specification MIL-L-2104B (API CC).

Engines with a turbocompressor (DS8 engines) are to be lubricated with an oil satisfying the requirements of the American specification MIL-L-2104C (API CD).

SAE 10W	at outdoor temperatures below $-10^{o}C$
SAE 20 (SAE 20W)	at outdoor temperatures between $-10^{o}C$ and $+10^{o}C$
SAE 30	at outside temperatures above $+10^{o}C$

Never use flushing oil in the engine.

Capacity: approx. 16.5 dm^3 (litres)

SP

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CYLINDER HEAD

Specifications

Min. height of cylinder head after facing	114.4 mm
Distance "B" between plane of cylinder head and valve head (intake and exhaust valve)	min. 0.75 mm
Locking fluid for injector sleeve	561019

Intake valve

Clearance (cold engine)		0.35 mm
Head angle		29.4°–29.6°
Overall length		169 mm
Head diameter		50 mm
Stem diameter		10.937–10.950 mm
Valve timing, D8	opens	11° B.T.D.C.
	closes	41° A.B.D.C.
DS8	opens	26° B.T.D.C.
	closes	24° A.B.D.C.
Lifting height without valve clearance D8 and DS8		12.6 mm

Exhaust valve

Clearance (cold engine)		0.70 mm
Head angle		44.4°–44.5°
Overall length		169 mm
Head diameter		42 mm
Stem diameter		10.927–10.940 mm
Valve timing, D8	opens	43° B.B.D.C.
	closes	7° A.T.D.C.
DS8	opens	56° B.B.D.C.
	closes	26° A.T.D.C.
Lifting height without valve clearance D8		12.8 mm
DS8		13.0 mm

Intake valve seat

Exchangeable

Seat angle	30.0°–30.5°
Width of contact surface "C"	1.0–1.7 mm
Height	7.6 mm
Outside diameter	54.973–54.990 mm
Valve seat position, diameter	54.880–54.900 mm
Valve seat position, depth	11.45–11.55 mm
Valve seat, oversize:	
Outside diameter	55.173–55.190 mm
Valve seat position, diameter	55.080–55.100 mm

Exhaust valve seat

Exchangeable

Seat angle	45°–45.5°
Width of contact surface "C"	1.9–2.3 mm
Height	8.8 mm
Outside diameter	46.964–46.975 mm
Valve seat position, diameter	46.880–46.900 mm
Valve seat position, depth	11.45–11.55 mm
Valve seat, oversize:	
Outside diameter	47.164–47.175 mm
Valve seat position, diameter	47.080–47.100 mm

SD

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Valve bushings

Length intake	86 mm
exhaust	73 mm
Inside diameter (fitted)	10.98–11.00 mm
Max. clearance for valve stem	0.17 mm
Height above plane for valve spring	24.0 ± 0.25 mm

Valve springs

Outer spring

Free length	67.5 mm
Compressed to 660 N (67 kp)	37.0 mm

Inner spring

Free length	60.5 mm
Compressed to 340 N (34 kp)	34.0 mm

Rocker arm mechanism

Rocker arm shaft, outside diameter	21.98–21.99 mm
Rocker arm bushing, inside diameter (pressed in)	22.00–22.02 mm
Profile depth	1.25 Ra
Diameter of lub. holes (2 holes)	Ø 3 mm
Springs on rocker arm shaft:	
Free length	79 mm
Clearance: outer rocker arm – bearing bracket, min.	0.10 mm
Lubrication via passage in camshaft:	Intermittent

Tightening torques

	50%	75%	100%
Cylinder head screws M14 x 1.5	90 Nm (9 kpm)	130 Nm (13 kpm)	190 Nm (19 kpm)
Screws for bearing bracket for rocker arm shaft			47 Nm (4.7 kpm)
Plugs in ends of rocker arm shaft			50 Nm (5.0 kpm)
Nuts for adjusting screw on rocker arm			40 Nm (4.0 kpm)
Nuts for injectors			10 Nm (1.0 kpm)

Tools

	Art. No.	Class
Polygon wrench for cylinder head screws	79090	2
Extractor for washer under injectors	87125	2
Torque wrench for nuts for injectors	87529	2
Puller for injector sleeve	98519	1
Thread clic M22 x 1.5 (incl. in 98519)	98520	1
Valve spring compressor	87407	2
Drift for pressing out valve bushing	87961	3
Drift for fitting of valve bushing	87423	1
Valve gauge	98429	1
Drift for fitting of valve seat	98502	1
Shank for valve seat drift	98500	1
Drift for bushing in rocker arm	88091	3
Drift for fitting injector sleeve	98522	1

Tools for machining of valve seat rings and tools for milling of grooves in cylinder head: Mira DSK and Mira BB-M20. (These tools can be bought from Scania or directly from Baumgartner AG, Zürich, Schweiz.)

TURBOCHARGER

A sign plate on the turbocharger states the make, type and Scania article number.

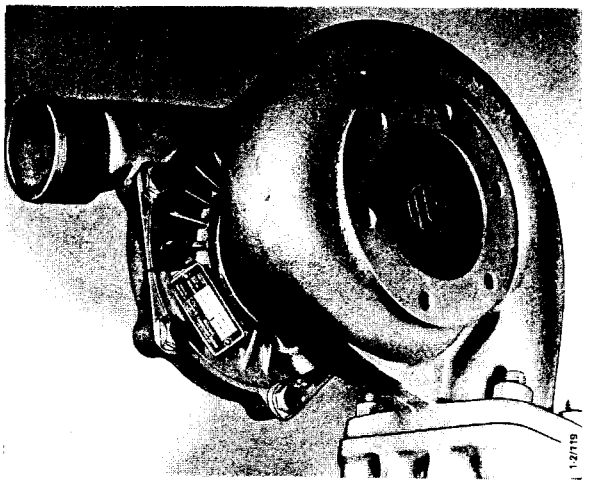
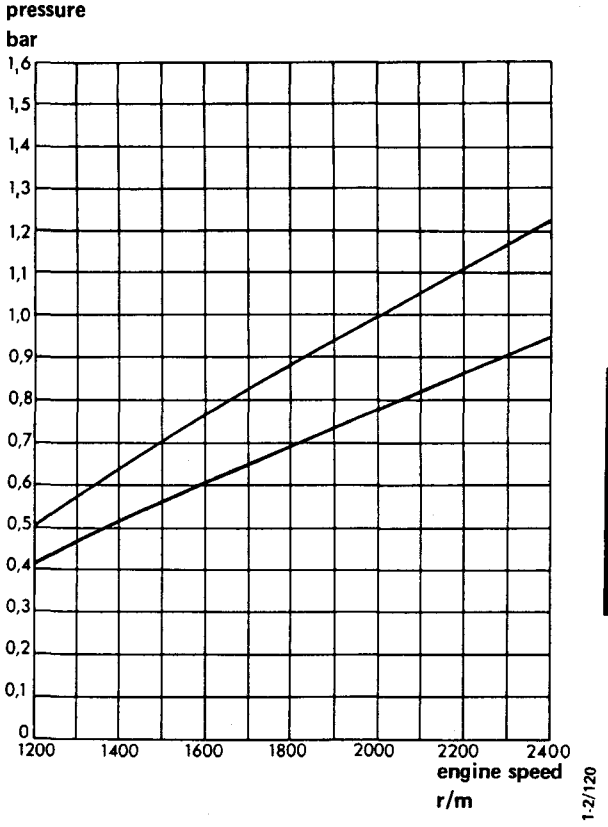


Fig. 1 The sign plate on the turbocharger with the Scania article number stamped in where the arrow points

Charging pressure at different engine speeds

NOTE that the engine must be run up to full output at the speed concerned. See 1d AR 2 page 4.



The pressure value given in the diagram are applicable when measuring is carried out at an intake air temperature of +25°C. If measuring is carried out at other temperatures, the measured value must be corrected in accordance with the table below.

SP

Measured charging pressure		Temperature of intake air in °C (temperature of outdoor air)											
		−20	−15	−10	−5	0	+5	+10	+15	+20	+25	+30	+35
bar	(kp/cm^2)	Corrected values											
0.20	(0.20)	0.16	0.16	0.17	0.17	0.18	0.18	0.19	0.19	0.20	0.20	0.21	0.22
0.30	(0.31)	0.23	0.24	0.25	0.26	0.27	0.27	0.28	0.29	0.30	0.30	0.31	0.32
0.40	(0.41)	0.31	0.32	0.33	0.34	0.35	0.36	0.37	0.38	0.39	0.40	0.41	0.42
0.50	(0.51)	0.39	0.40	0.41	0.42	0.44	0.45	0.46	0.47	0.49	0.50	0.51	0.52
0.60	(0.61)	0.46	0.48	0.50	0.51	0.52	0.54	0.55	0.57	0.58	0.60	0.62	0.63
0.70	(0.71)	0.54	0.56	0.58	0.59	0.61	0.63	0.65	0.66	0.68	0.70	0.72	0.73
0.80	(0.82)	0.62	0.64	0.66	0.68	0.70	0.72	0.74	0.76	0.78	0.80	0.82	0.84
0.90	(0.92)	0.70	0.72	0.74	0.76	0.79	0.81	0.83	0.85	0.88	0.90	0.92	0.94
1.00	(1.02)	0.77	0.80	0.82	0.85	0.87	0.90	0.92	0.95	0.97	1.00	1.02	1.05
1.10	(1.12)	0.85	0.88	0.91	0.94	0.96	0.99	1.02	1.05	1.07	1.10	1.13	1.16
1.20	(1.22)	0.93	0.96	0.99	1.02	1.05	1.08	1.11	1.14	1.17	1.20	1.23	1.26

Example: If a charging pressure of 1.0 bar is measured at −15°C it is found from the table that this corresponds to 0.80 bar. In this case, then, 0.80 bar must be compared with the appropriate diagram. If measuring was carried out at +35°C and gave a pressure of 0.5 bar, this corresponds to 0.52 bar which must be compared with the appropriate diagram.

Wear limitis

Radial clearance of shaft	max. 0.90 mm
Axial clearance of shaft (after running in)	max. 0.10 mm
Shaft run-out in V-block	max. 0.01 mm
Width of shaft piston ring grooves	max. 1.87 mm
Diameter of bearing housing at bearing positions	max. 15.82 mm
Shaft diameter at bearing positions	min. 10.14 mm

Tightening torques

Compressor wheel lock nut, first tighten to a torque of 2 Nm (0.2 kp) and a further quarter of a turn	
Screws for compressor casing and turbine casing	13 Nm (1.3 kpm)
Nuts for turbine casing - exhaust manifold	39 Nm (3.9 kpm)
Screws for intake manifold	40 Nm (4.0 kpm)
Screws for exhaust manifold	70 Nm (7.0 kpm)

Tools

	Art. No.	Class
Fixture for dismantling	98338	3
Pressure gauge for charging pressure	98111	3
Nipple for connection of pressure gauge	98113	3
Lubricant for exhaust manifold screw threads	561205	
Gasket set (incl. oil filter)	550107	
Repair kit	550103	

CYLINDERBLOCK

Specifications

Permissible grinding of upper plane of cylinder block	max. 0.10 mm
Cylinder liners Type	wet, exchangeable
Cylinder bore	115.000–115.020 mm
Shims thickness	0.20, 0.25, 0.30, 0.50 and 0.75 mm
Max. ovality (cylinder head fitted)	0.05 mm
Heigh above cylinder block	0.03–0.08 mm
Max. permissible height difference under same cylinder head	0.03 mm
Max. permissible height difference on one and the same liner between dimensions measured at two diametrically opposite points in the transverse direction of the engine	0.02 mm
Max. wear	0.35 mm
Drilling mark on top of liner flange to face forwards	

Sealing rings for cylinder liners:
Upper: black
Middle: black
Lower: black with violet colour marking or green
A black ring with violet colour marking or a green ring can also be fitted in the top and middle ring grooves. A black unmarked ring may not, however, be fitted in the lower ring groove.

Tightening torques

Screws for pressing down cylinder liner	50 Nm (5.0 kpm)
Screws, timing-gear housing - cylinder block	55 Nm (5.5 kpm)
Screws, flywheel casing	55 Nm (5.5 kpm)
Screws, injection pump self	55 Nm (5.5 kpm)
Screws, oil pan	50 Nm (5.0 kpm)
Drain plug	80 Nm (8.0 kpm)
Banjo screw for oil nozzle	16 Nm (1.6 kpm)
Screws for main bearing caps	210 Nm (21 kpm)

Tools

	Art. No	Class
Puller for cylinder liners	87627	1
Support screw for 87627 (set of 3)	98168	1
Clamp for pressing down cylinder liner (set of 3)	98515	1
Adjusting reamer for cylinder liner seat	87044	1
Feeder for adjusting reamer (incl. in 87044)	87051	1
Brackets for feed tool (set)	98517	1
Spare cutter for adjusting reamer	87179	1
Shims for adjusting reamer, set of 20 washers 0.03, 0.05, 0.10 and 0.20 mm (one set included in 87175)	87207	1
Straight edge for dial indicator	87198	2
Dial indicator	98075	2
Measuring point for dial indicator	98410	1
Sealing ring extractor	98484	1
Assembly tool for sealing ring in flywheel casing	98321	1
Assembly tool for sealing ring in timing-gear housing	98494	1

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CRANKSHAFT AND RECIPROCATING COMPONENTS

Specifications

Pistons

Type	With combustion chamber in piston top
Material	Light alloy with ring carrier of cast iron for first compression ring. Fitted with the arrow on the piston pointing forwards.
Diameter measured at an angle of 90°C to and under piston pin	114.75 ± 0.012 mm
Piston pin hole	45.997–46.003 mm
Ring groove width: compression ring alt. 1 and 2	2.465–2.485 mm
Compression ring 2	2.445–2.465 mm
Compression ring 3	2.425–2.445 mm
Oil ring	4.777–4.797 mm

Piston pin

Type	Floating
Diameter	49.995–46.000 mm
To be removed or fitted in a piston which has been heated to +100°C	

Piston rings

No. of compression rings	3
Gap: 1st ring	0.5–0.7 mm
2nd and 3rd rings	0.3–0.6 mm
Max. clearance in groove	0.25 mm
Height	2.37 mm
Rings marked "TOP" must be fitted top side up	
No. of oil rings	1
Gap	0.4–0.8 mm
Max. clearance in groove	0.25 mm
Height	4.73 mm

Connecting rods

Connecting rods and caps marked 1–6	
To be fitted with marking facing towards the right-hand side	
Axial clearance	0.20–0.35 mm
Bearing clearance	0.044–0.100 mm
Connecting rod bushing:	
Diameter	46.030–46.043 mm
Finish	0.6 Ra

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Crankshaft

Main bearing journals	Diameter	
	Standard	85.000–84.978 mm
	Undersize 1	84.750–84.728 mm
	Undersize 2	84.500–84.478 mm
	Undersize 3	84.250–84.228 mm
	Undersize 4	84.000–83.978 mm
	Undersize 5	83.750–83.728 mm
	Undersize 6	83.500–83.478 mm
	Fillet radius	4.9–5.1 mm
	Profile depth of bearing surface	0.25 Ra
	Width	
	Journal No. 2, 3, 4, 5, 6	42.00–42.28 mm
	Journal No. 7	42.20–42.28 mm
	Journal No. 1 incl. chamfer	38.7–39.5 mm
Crankpins	Diameter	
	Standard	75.000–74.981 mm
	Undersize 1	74.750–74.731 mm
	Undersize 2	74.500–74.481 mm
	Undersize 3	74.250–74.231 mm
	Undersize 4	74.000–73.981 mm
	Undersize 5	73.750–73.731 mm
	Undersize 6	73.500–73.481 mm
	Undersize 7	73.250–73.231 mm
	Undersize 8	73.000–72.981 mm
	Fillet radius	4.9–5.1 mm
	Profile depth of bearing surface	0.25 Ra
	Width	52.0–52.1 mm
Thrust washers	Thickness	
	Standard	3.429–3.378 mm
	Oversize 1	3.505–3.454 mm
	Oversize 2	3.556–3.505 mm
	Oversize 3	3.683–3.632 mm
	Oversize 4	3.937–3.886 mm
	Axial clearance	0.09–0.29 mm

Flywheel	Max. machining of pressure surface for disc: See group 4 Clutch
Ring gear	Heat to approx. +250°C before fitting
Crankshaft gearwheel	Heat to approx. 100°C before fitting. Tooth play against idler gear 0.03–0.15 mm

Tightening torque

Big-end bolts (oiled threads)	110 Nm (11 kpm)
Main bearing screws	210 Nm (21 kpm)
Flywheel screws	190 Nm (19 kpm)
Crankshaft screw	735 Nm (75 kpm)
Vibration damper hub, screws	110 Nm (11 kpm)

Tools

	Art. No.	Class
Piston ring compressor	87718	1
Alt.: Piston ring compressor	98323	3
Gauge for measurement of piston ring gap	87147	2
Drift for fitting of piston pins (changed from Ø 23.5 to Ø 22.5 mm)	87362	3
Puller screws for flywheel	87368	2
Wrench for crankshaft screw	87519	2
Puller for vibration damper hub	87665	1
Thrust pad (included in 87665)	87663	1
Drift for vibration damper hub	87509	1
Puller for crankshaft gearwheel	87358	1
Drift for crankshaft gearwheel	87932	1

Tools for sealing rings for crankshaft: see 1d SP No. 3.

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TIMING GEARS

Specifications

Camshaft

Axial play	0.10–0.25 mm
Bearing play, bearing 1	0.045–0.083 mm
Bearing play, bearings 2–4	0.030–0.079 mm

Checking the camshaft setting, see section AR.

Camshaft bearings (to be finely drilled in a machine when changed)

Inside diameter bearing 1	68.200–68.230 mm
2	68.100–68.130 mm
3	68.000–68.030 mm
4	60.000–60.030 mm
Profile depth of bearing surface	0.6 Ra
Thickness of thrust bearing (guide flange)	18.20–18.25 mm

Camshaft gearwheel

Heat before fitting to	+100°C
Tooth play against idler gear	0.03–0.15 mm

Pump shaft gearwheel

Heat before fitting to	+100°C
Tooth play against idler gear	0.03–0.15 mm

Idler gear

Axial play, max.	0.238 mm

Valve lifters

Diameter	34.940–34.955 mm
Diameter in cylinder block	34.988–35.012 mm

Tightening torques

Nut for pump shaft gearwheel	200 Nm (20 kpm)
Nut for camshaft gearwheel	400 Nm (40 kpm)

Tools

	Art. No.	Class
Puller for pump shaft gearwheel and camshaft gearwheel	87359	1
Drift for sealing ring for pump drive shaft	98433	1

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LUBRICATING SYSTEM

Specifications

Oil pump

Capacity	114 dm^3/min at 2.400 r/min
Tooth play: crankshaft gearwheel - idler gear on oil pump	0.05–0.23 mm
Tooth play: idler gear - pump gearwheel	0.01–0.11 mm
Tooth play: oil pump gearwheels in pump	0.13–0.43 mm
Radial play: pump gearwheels - pump housing	0.13–0.18 mm
Axial play: pump gearwheels - pump housing cover	0.07–0.10 mm
C/c distance between pump gearwheels	47.68–47.72 mm
Diameter of pump gearwheel journals	22.222–22.235 mm
Inside diameter of pump housing bushings, machined	22.265–22.286 mm
Finish, pump housing bushings	0.6 Ra

Oil pressure valve

Oil pressure:	
With warm engine and speed of 2.400 r/min	4.5–6.0 bar (kp/cm^2)
With warm engine and speed of 800 r/min	min. 1.5 bar (kp/cm^2)
Free spring length: Earlier version	66.4 mm
New version as from engine No.765974	61.4 mm
Shims thickness	0.5 mm
One shim changes the oil pressure approx.	0.12 bar (kp/cm^2)

Oil cleaner

Permissible deposit thickness on wall of cover	20 mm
Shaft diameter	
at upper bearing	9.497–9.512 mm
at lower bearing	12.667–12.685 mm
Diameter of bearings	
upper	9.576–9.591 mm
lower	12.751–12.769 mm

Oil filter for turbocompressor

Use only SCANIA original filter, part No.	173171

Oil cooler

Pressure test at:	water side	4 bar (kp/cm^2)
	oil side	10 bar (kp/cm^2)

Tightening torques

Oil pump

Screws for oil pump cover	20 Nm (2 kpm)
Lock screw (l.h. thread) for idler gear	40 Nm (4 kpm)
Nut for pump drive wheel	140 Nm (14 kpm)

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Oil cleaner

Screw for rotor cover and screw for oil cleaner housing cover	Tighten with fingers

Oil cooler

Drain cock (if provided)	23 Nm (2.3 kpm)

Oil nozzles for piston cooling

Banjo screw	23 Nm (2.3 kpm)

Tools

	Art. No.	Class
Drift for idler gear journal	87663	1
Stud wrench for oil pressure valve	98386	1
Drift for oil cooler, full-flow type	98512	1
Locking fluid for rotor shaft article number	561056	
Activator T for quicker hardening of locking fluid article number	561045	