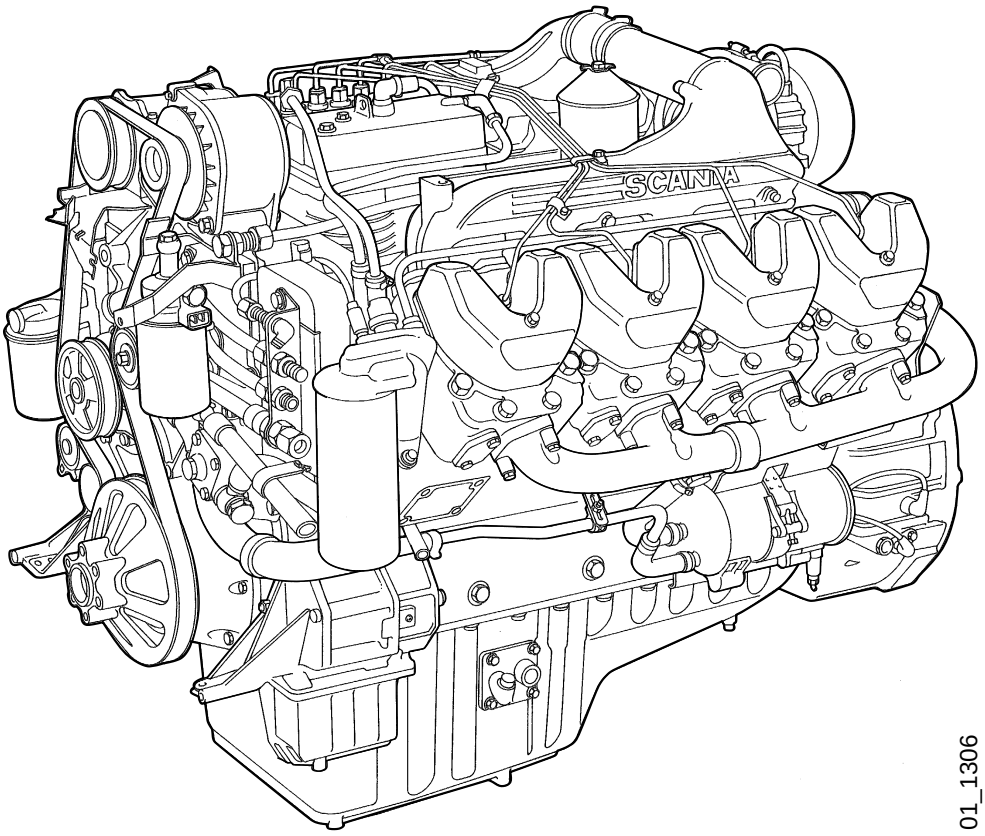
SCANIA

01:04-01

Issue 2 **en**

14 Litre Engine

Description of Operation



01_1306

1 585 669

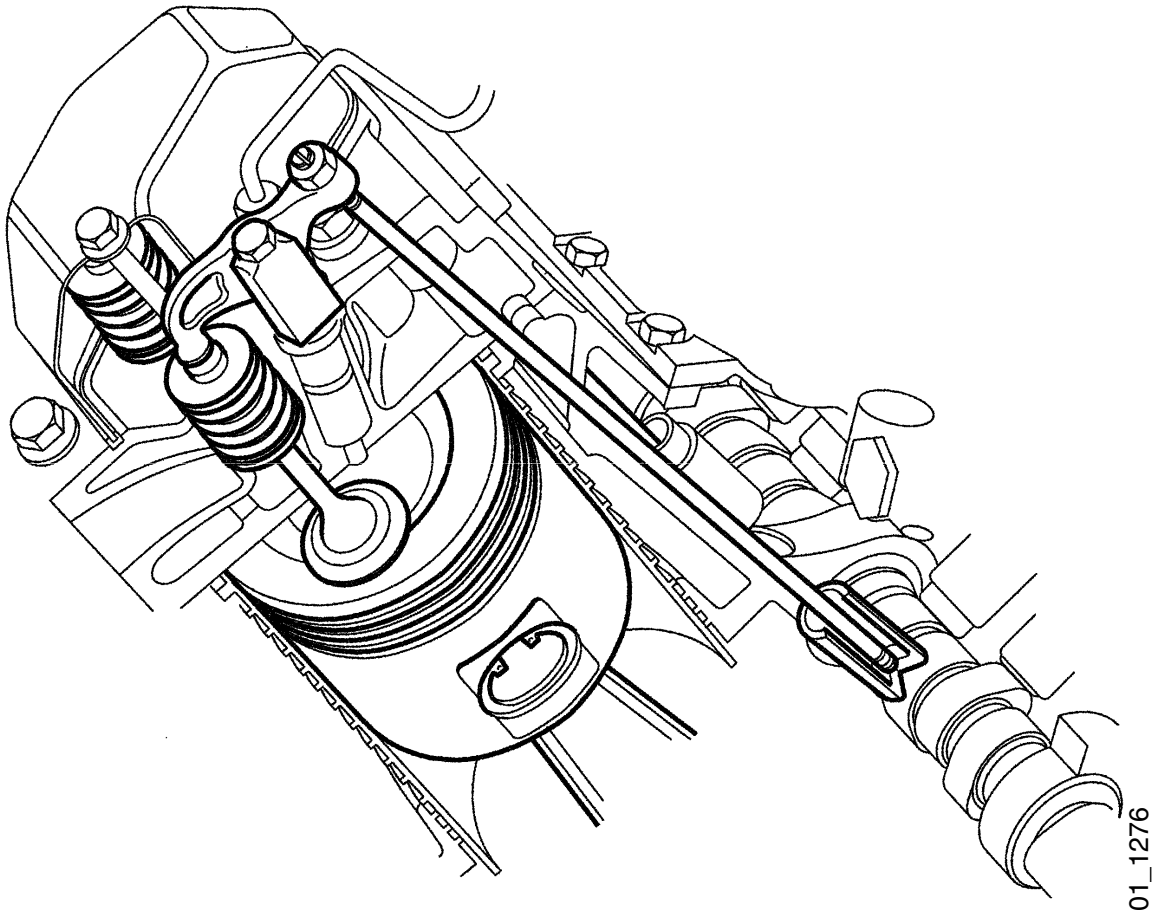
Contents

Description and Operation

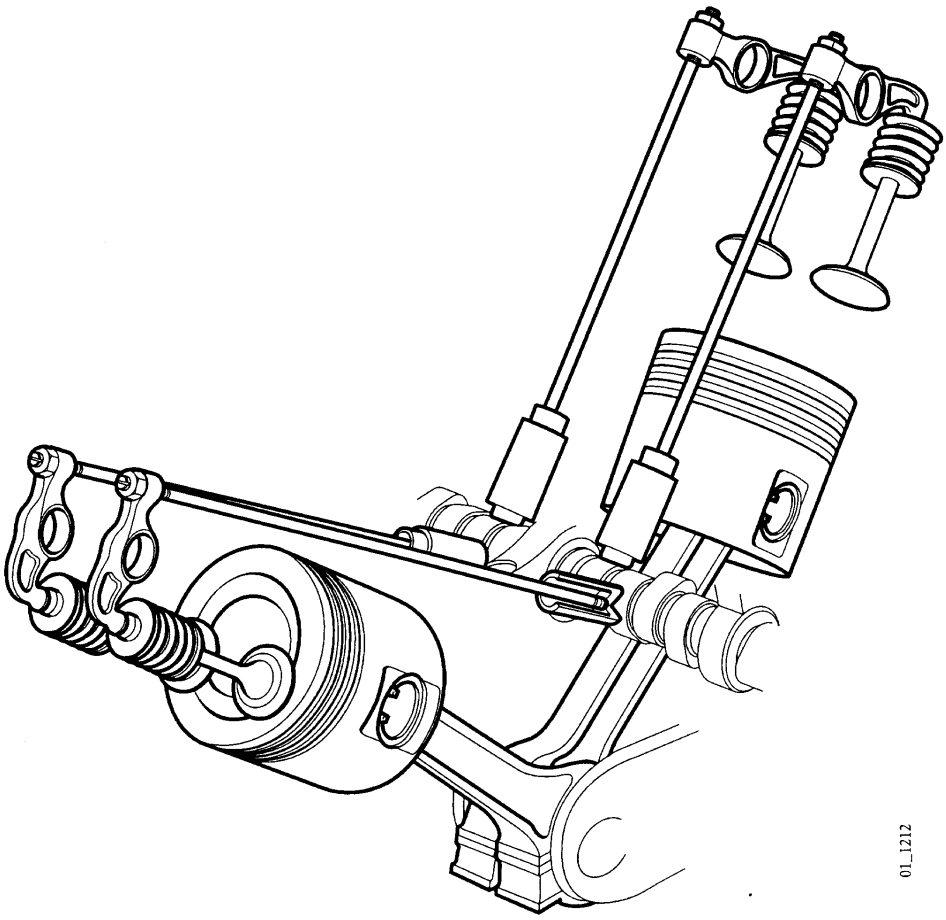
Valve mechanism

The valve mechanism acts on the valves to open and close them at the correct time in relation to the position of the crankshaft and the piston.

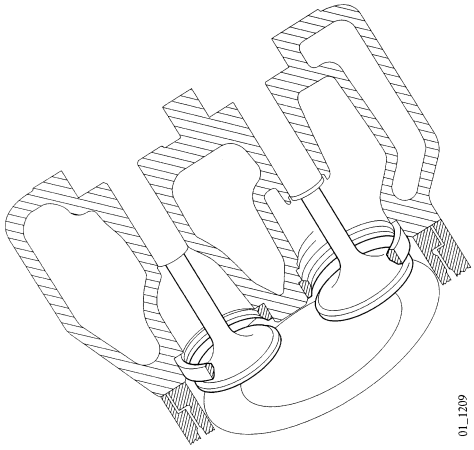
The camshaft is driven by the timing gears and rotates at half the speed of the crankshaft. The cams on the camshaft, two for each cylinder, act on the valve tappets.



One end of the push rod rests on the tappet, and the other end acts on the rocker arm. The rocker arm has an adjusting screw in one end. The spherical lower end of this adjusting screw rests in the push rod, so that the valve tappet always follows the camshaft.

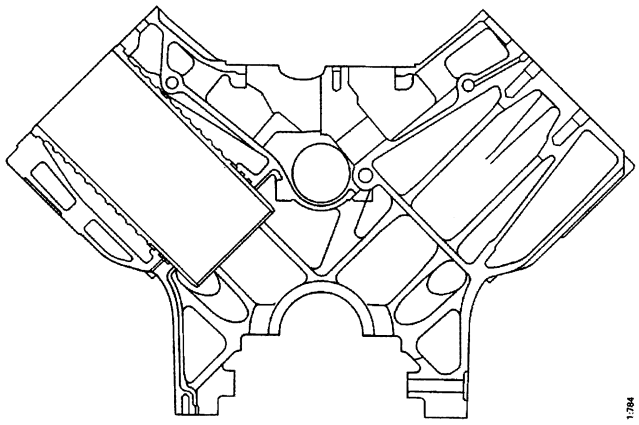


The valve seat rings are firmly pressed to a tight fit in the cylinder head. The valve seat rings are manufactured from a durable material, giving the valve seats a long service life. If necessary, the valve seat rings can be replaced.



Cylinder block

The cylinder block is cast in one piece, and each cylinder has a separate cylinder head. The cylinder bores have wet liners.

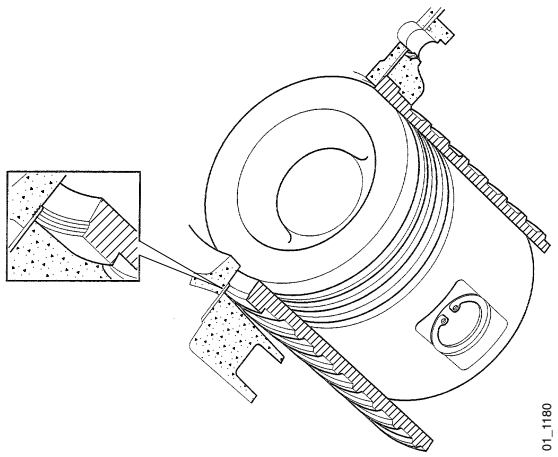


Cylinder liner

The cylinder liners can be replaced. A steel gasket with vulcanised rubber seals provides sealing between cylinder liner and cylinder head. (One gasket per cylinder.)

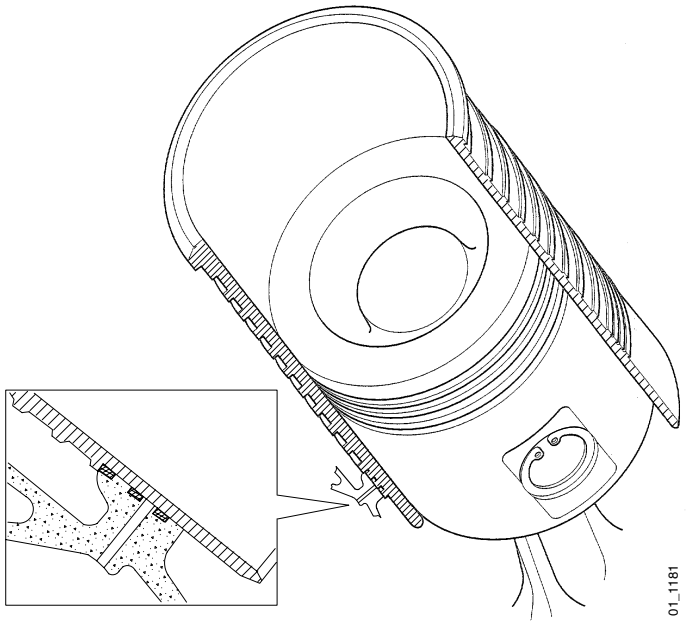
The cylinder liner protrudes slightly above the the cylinder block surface and presses the gasket against the cylinder head, thus making sure it seals.

The vulcanised rubber seals provide sealing against the coolant and lubrication oil channels.

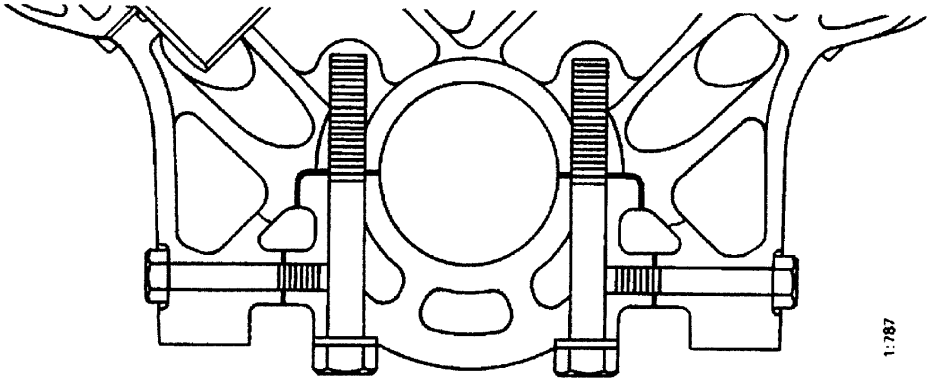


The lower part of the cylinder liners can move to some extent, to allow for thermal expansion. Sealing is achieved with three rubber rings around the lower part of the liner. Between the two lower rings there is an indicator hole which leads to the outside of the block.

If coolant leaks out through an indicator hole, this indicates that the sealing rings are leaking. Thus, the sealing rings can be replaced before coolant leaks into the crankcase.



Due to the V-shaped cylinder arrangement, the main bearings are subjected to stress, including lateral stress. The main bearing caps are therefore mounted with vertical as well as horisontal bolts.



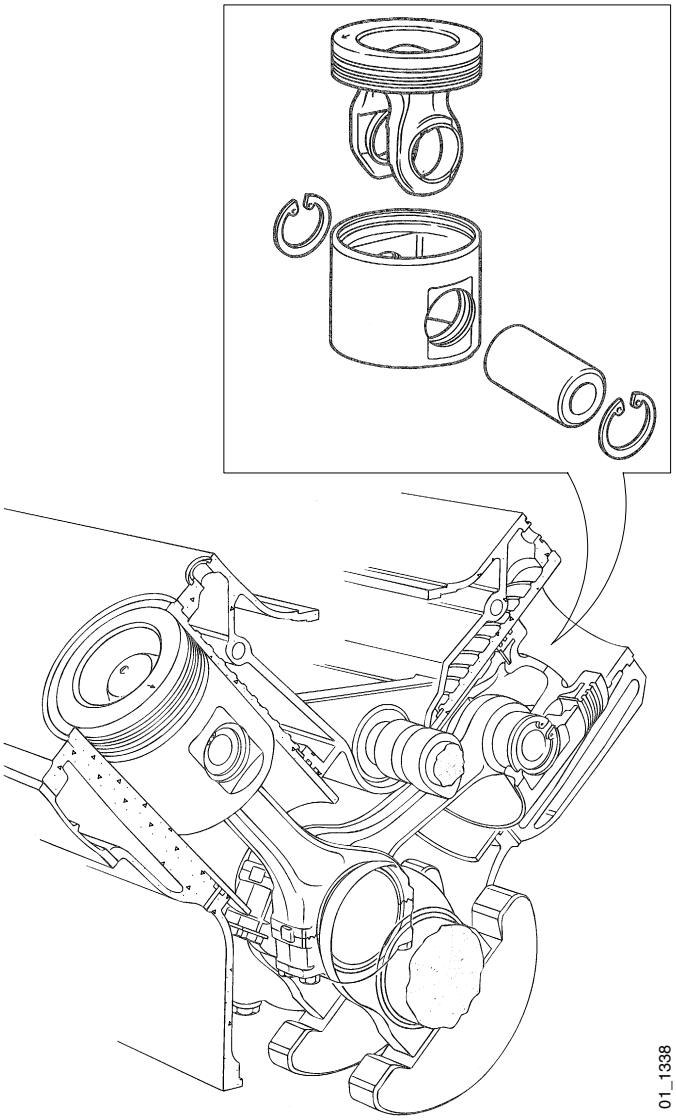
Crank mechanism

Pistons

In this engine articulated pistons are used. They are split and have an aluminium skirt and a steel crown.

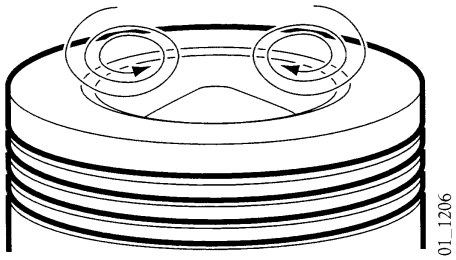
One of the advantages of articulated pistons is that they withstand more stress than conventional pistons. This allows for a higher engine output.

In some engine types the pistons are one-piece castings.

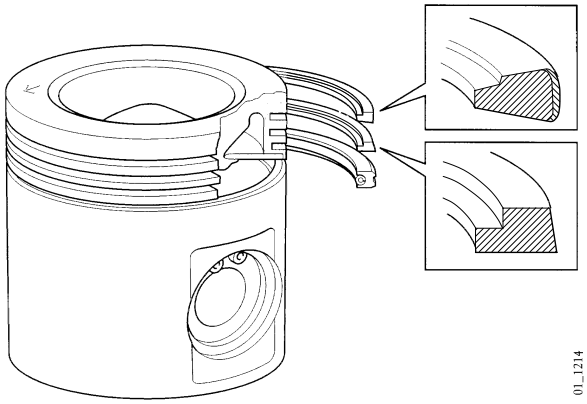


The combustion chamber is a recess in the piston crown. It is bowl-shaped with a raised section in the centre.

In order for the piston to run smoothly there must be a gap between the piston and the cylinder wall. The piston rings seal this gap and abduct heat from the piston.



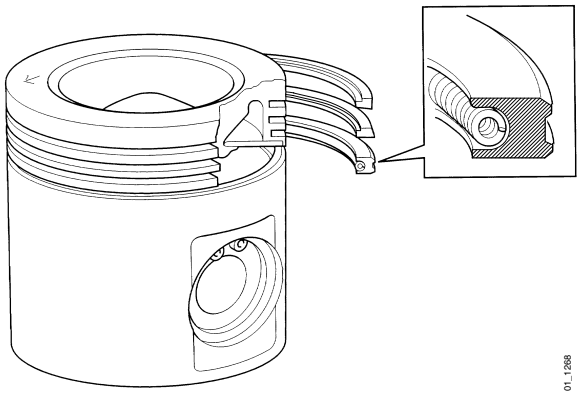
The piston has two compression rings. The top compression ring is subjected to higher temperature and higher pressure than the other piston rings. Therefore the stress is particularly high in the upper piston ring groove.



The piston has one oil scraper ring. It stops lubrication oil from entering the combustion chamber and being combusted.

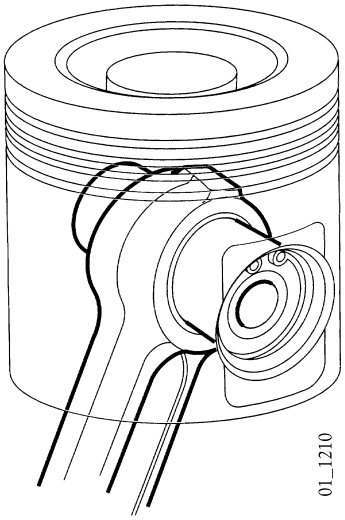
Inside the oil scraper ring there is an expander which presses the ring against the cylinder wall. The expander is a coil spring.

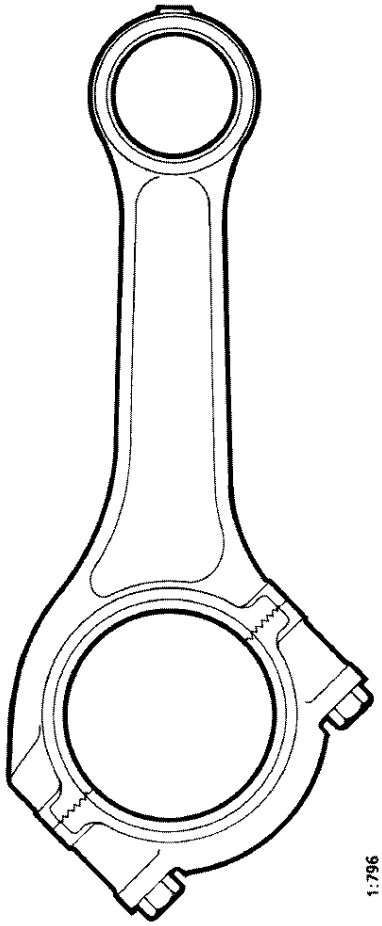
The design of the piston and the piston rings is vital for the reliability, lubrication, oil consumption and fuel consumption of the engine.



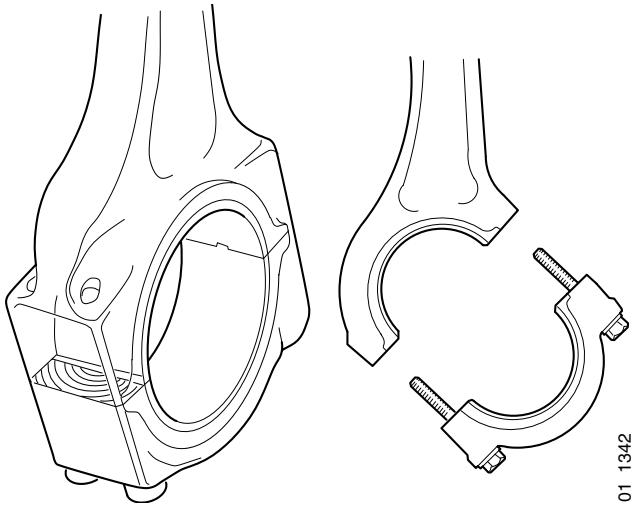
Connecting rods

The small end of the connecting rod is wedge-shaped. This allows for larger contact surfaces in piston and connecting rod.





The big end of the connecting rod is split diagonally, so that the piston and the connecting rod can be pulled up through the cylinder. To ensure that the connecting rod bearing cap does not move in relation to the connecting rod, the mating faces have circular grooves.



Crankshaft

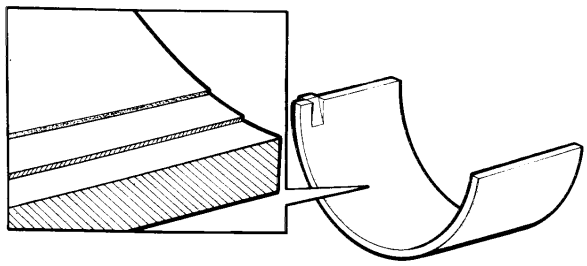
Each compression stroke acts to "slow down" the crankshaft and each combustion stroke acts to increase its rotational speed.

The pistons and connecting rods change direction twice every engine cycle.

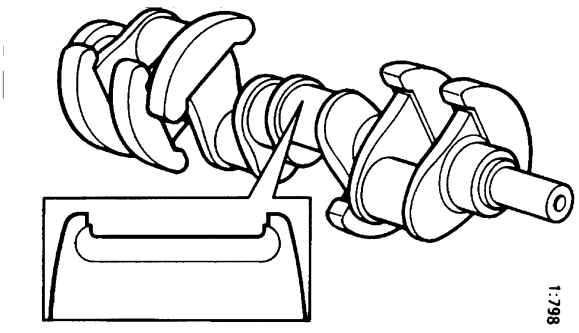
The crankshaft is thus subjected to several power impulses per cycle.

The quality of the material is vital for the durability of the crankshaft. Strict requirements also apply to design and surface treatment. For example, the surface finish of the shaft journals is vital in preventing fatigue failure.

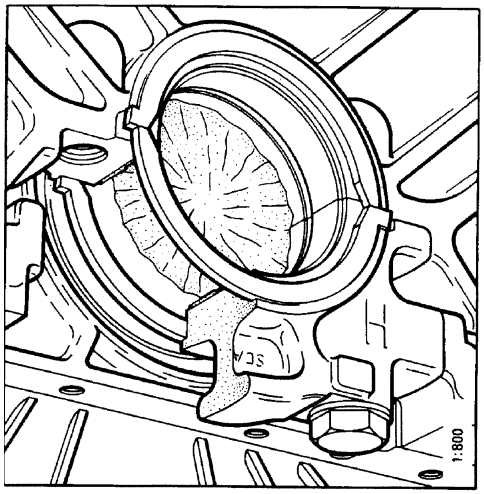
The bearing shells of the main bearings and the con rod bearings consist of three layers. The outer layer is steel, the mid layer lead bronze, and the inner layer is lead and indium or lead, tin and copper. The inner layer will normally wear off.



The bearing surfaces on the crankshaft are hardened to such a depth that they can be re-ground in several stages.



At the rear main bearing there are thrust washers for the axial mounting of the crankshaft. These thrust washers are available in different dimensions, to allow for adjustment of the axial clearance of the crankshaft.



Crankcase ventilation

The crankcase is ventilated to the crankcase ventilation unit via the timing gear cover.

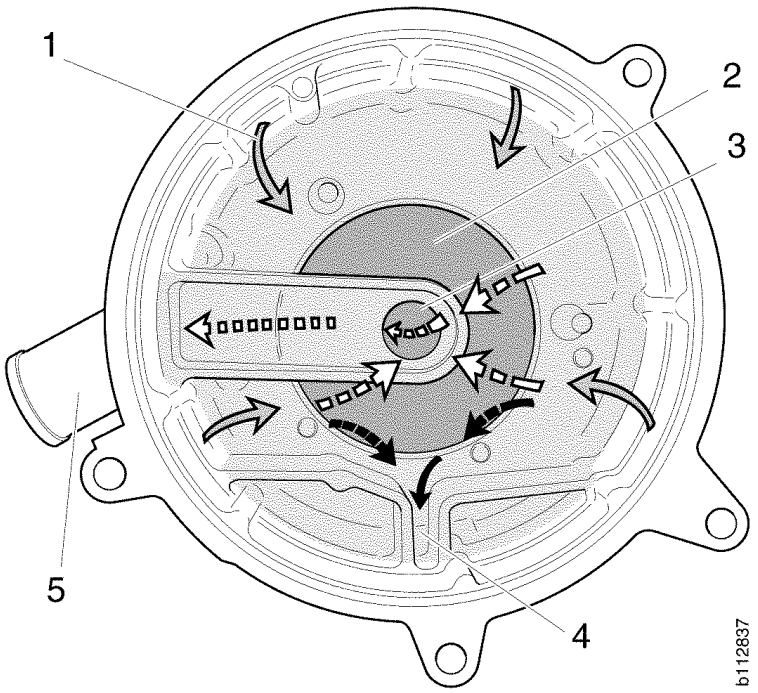
The fumes in the crankcase contain oil. The lubrication oil is deposited in a separator in the the crankcase ventilation unit, and it runs from there to the bottom of the unit and back to the crankcase via a cover plate.

To ensure that fumes and oil can flow through the crankcase ventilation, the ventilation unit and the inlet and outlet ports must not be blocked. Otherwise the lubrication oil in the crankcase may be drained off via the turbo charger.

There is a slight vacuum in the crankcase. The vacuum results from the connection between the crankcase ventilation outlet and the intake side of the turbo charger.

To regulate the vacuum in the crankcase there is a diaphragm which closes the crankcase ventilation outlet to the turbo charger when there is too much vacuum at the intake side. This may occur when the throttle is at or near WOT.

In spite of the separator, it is normal for the crankcase fumes to still contain small amounts of oil when they enter the engine intake system. Oil that is carried in the crankcase fumes will form a thin oil film in the charge air system.



Note: *Cross-section of the crankcase ventilation in 14 litre engines.*

1 *Inlet from front timing gear cover*

2 *Diaphragm*

3 *Hole which is closed by diaphragm when there is too much vacuum at the intake side of the turbo charger*

4 *Drain hole for deposited lubrication oil*

5 *Outlet to intake side of the turbo charger*

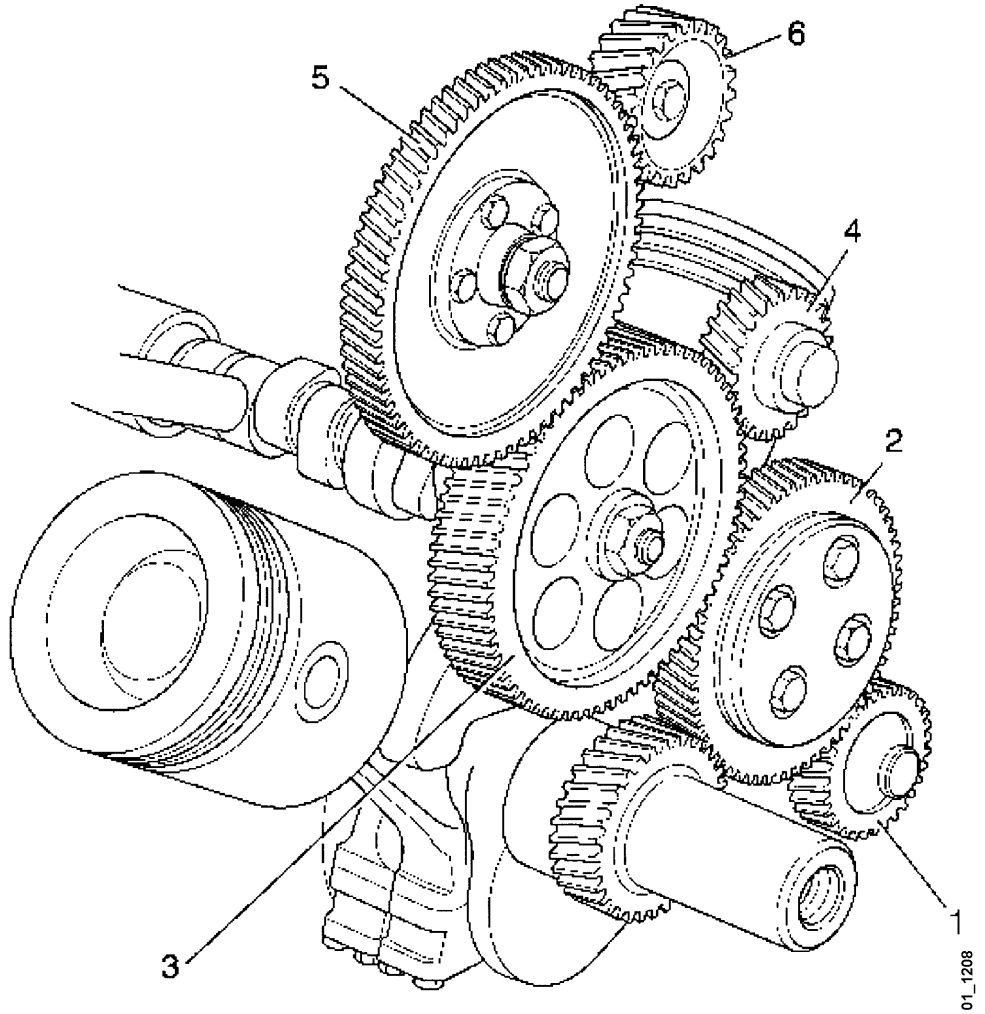
Engine timing

Timing gear train

The crankshaft gear drives an intermediate gear. The intermediate gear drives the oil pump and the camshaft. The camshaft gear in turn drives the power steering pump and the injection pump. The injection pump gear drives the compressor gear.

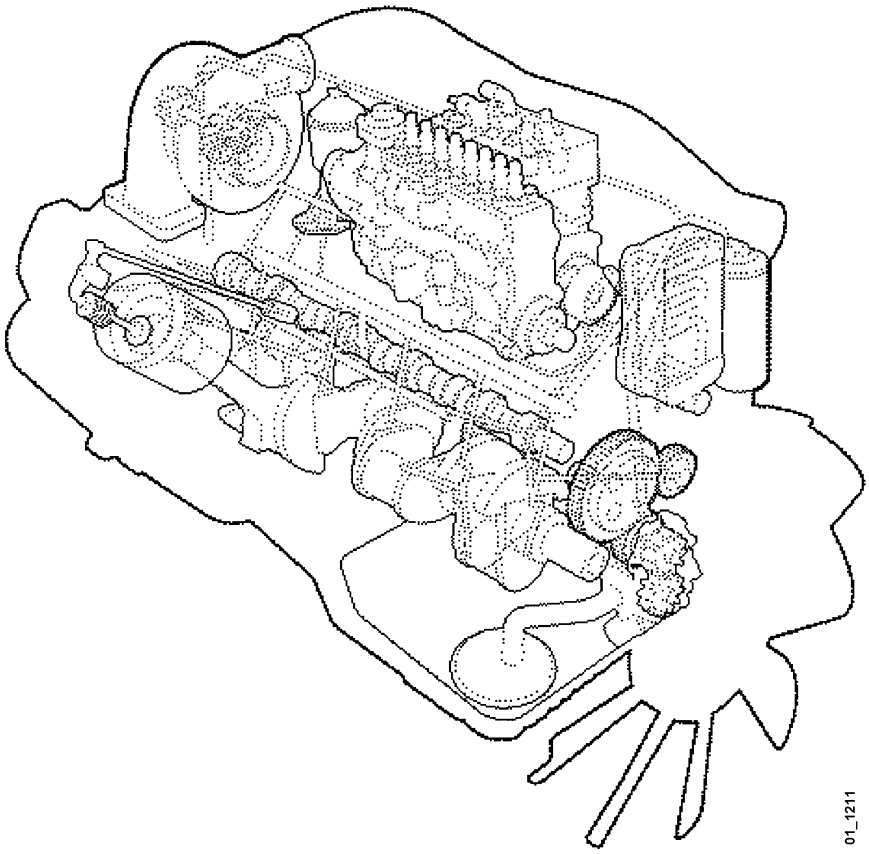
The camshaft and the injection pump rotate at half the speed of the crankshaft.

To facilitate assembly the gears have markings, either on a tooth or in a tooth gap. The injection pump gear has an oval hole for adjusting the injection timing (a).



1 Oil pump gear
2 Intermediate gear
3 Camshaft gear
4 Power steering pump gear
5 Injection pump gear
6 Compressor gear

Lubrication system

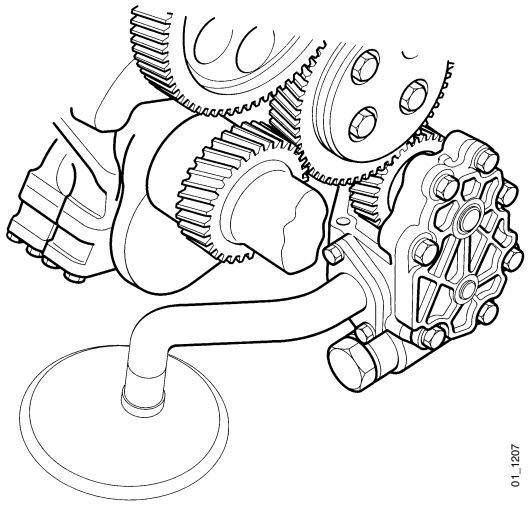


Oil pump

The oil pump, which is driven by the intermediate gear, provides the circulation neccessary for the lubrication oil to reach all lubrication points and flow through the oil filter and the oil cooler.

The oil filler and the oil dipstick are located on the left hand side of the engine.

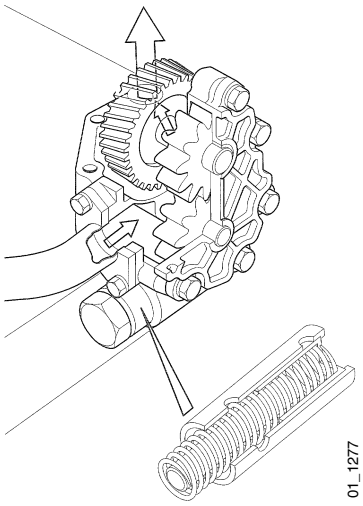
The lubrication oil is passed through a strainer on its way from the oil sump to the oil pump.



After the oil pump the lubrication oil flows through a safety valve which opens at 9 bar.

If the oil pressure is too high, the oil pump and other lubrication system components max be exposed to severe stress.

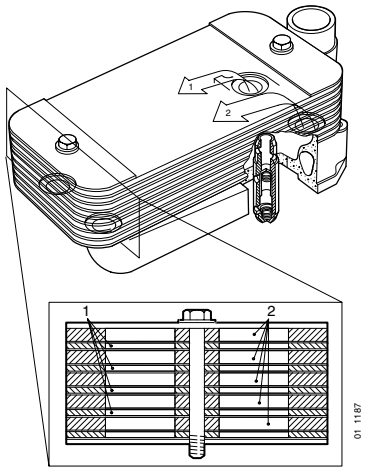
The oil pressure must be high enough for sufficient oil for lubrication and cooling to reach each lubrication point.



Oil cooler

From the oil pump the lubrication oil flows to the oil cooler, via channels in the block and an intermediate piece. All of the oil flows through the oil cooler, where it is cooled down by the coolant in the cooling system.

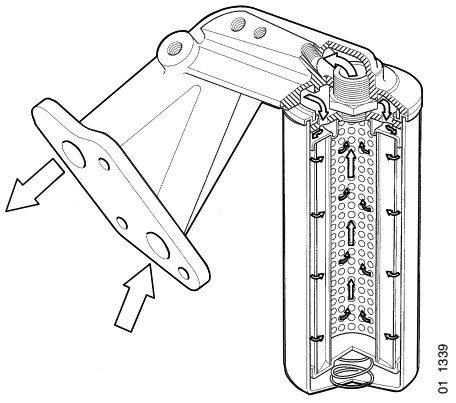
Superfluous oil is drained off to the oil sump via a flow control valve in the intermediate piece. The flow control valve acts as a pressure regulating valve when the oil pressure is too high, and opens at 6 bar.



1 Oil
2 Coolant

Oil filter

After the oil cooler the lubrication oil is filtered in a full flow oil filter. This filter is a paper filter through which all of the oil flow passes.



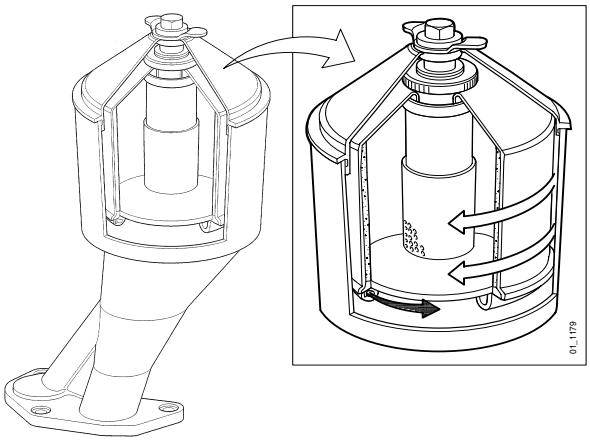
Centrifugal cleaner

After the full flow oil filter the oil flows to the main oil channel. From the oil channel some of the oil is diverted to the centrifugal cleaner, and when it has been filtered there it flows to the oil sump.

The centrifugal cleaner has a rotor which is made to rotate by the force of the jet of lubrication oil spraying through two nozzles in the bottom of the rotor.

Foreign particles are thrown against the rotor wall where they stick and form a solid coating.

The rotor should be disassembled and cleaned according to the intervals stated in the Scania Maintenance Program.

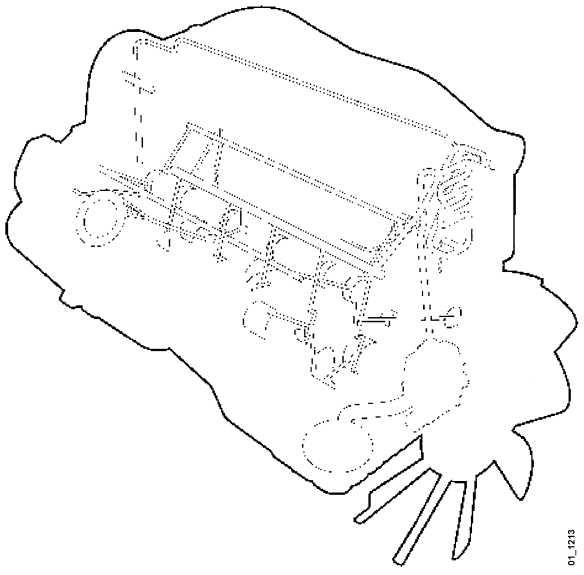


Lubrication oil channels

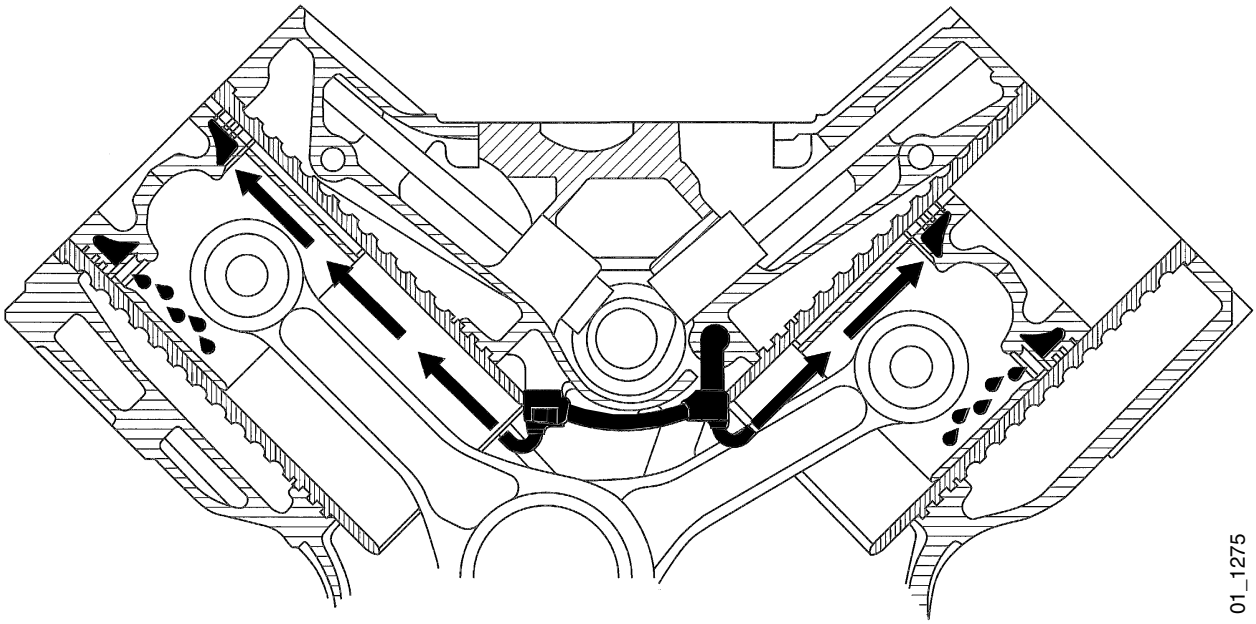
Lubrication oil is led to the camshaft bearings and the crankshaft main bearings through channels in the cylinder block.

To the rocker arms lubrication oil is led through a channel in one of the camshaft bearing journals.

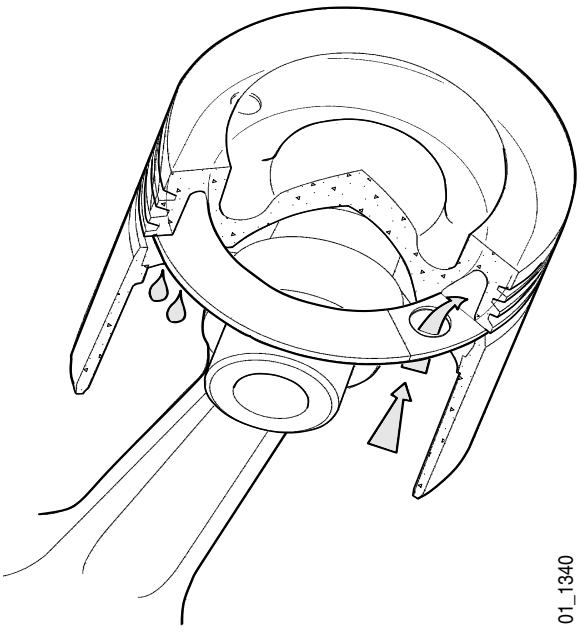
The channel is constantly pressurised. The oil flows up into the rocker arms through a groove in the camshaft bearing.



The pistons are cooled by the lubrication oil. Oil is sprayed up under the piston crown through special nozzles, one for each cylinder.



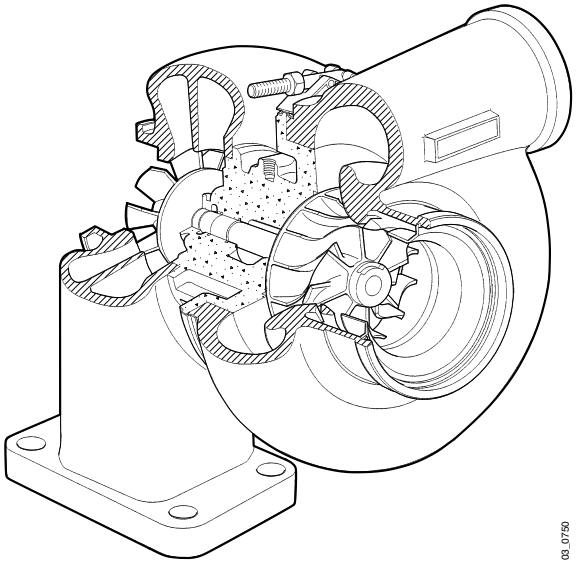
Lubrication oil is led through a hole into a cooling jacket in the piston crown and then out through a different hole.



Turbocharger

The turbo charger increases the air mass in the engine cylinders. The extra air means that the engine can burn more fuel. An engine with a turbo charger thus produces a higher power output than the same engine without a turbo charger.

The turbo charger consists of a turbine and a compressor. The turbine is driven by the engine exhaust. The compressor compresses the engine intake air.



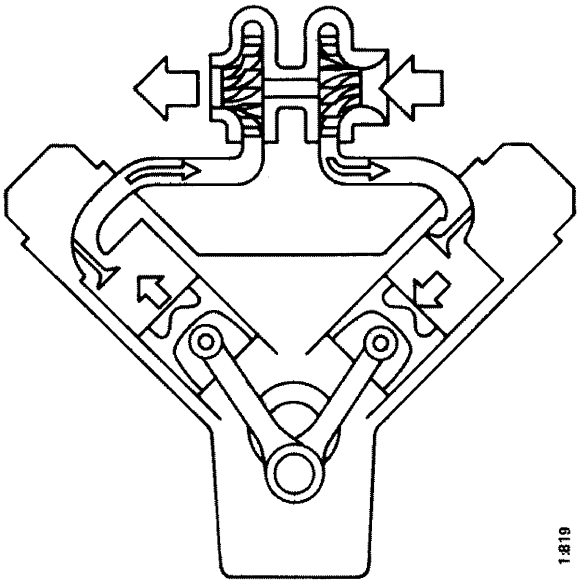
The compressor wheel is fitted to the same shaft as the turbine wheel. The bearing housing is located between the compressor and the turbine.

When the engine output increases, the engine produces more exhaust. This increases the speed of the turbine wheel, and thus of the compressor. The air mass is thus automatically adjusted to the requirements of the engine, and no separate regulating system is required.

The compressor wheel rotates at very high speeds. At full power output the wheel speed is ca. 110 000 rpm. The turbine wheel reaches a temperature above 600°C.

Requirements are therefore strict for rotating parts, balancing, cooling and lubrication.

The axle is mounted in two bushings rotating freely in the bearing housing. The bearing housing is sealed off from the turbine and the compressor with sealing rings resembling piston rings.



A blocked air filter will cause excessive vacuum in the intake pipe. If this happens, the excessive vacuum may draw oil mist from the bearing housing via the compressor into the engine.

If the sealing ring on the turbine side is worn, the exhaust will be blue when the engine is idling.

If the oil drain tube from the turbo charger is damaged, the pressure of the lubrication oil pressure may cause oil to leak out through the seals.

It is vital that the lubrication functions properly.

If the centrifugal cleaner is not cleaned, the oil filter will quickly block up and the flow resistance in the filter increase. If this happens, a valve in the filter retainer opens and lets the oil pass the filter without being filtered. Unfiltered oil is then passed to the turbo compressor, resulting in excessive wear of the bearings.

The valve is designed to fit original Scania filters, and only these filters should be used.

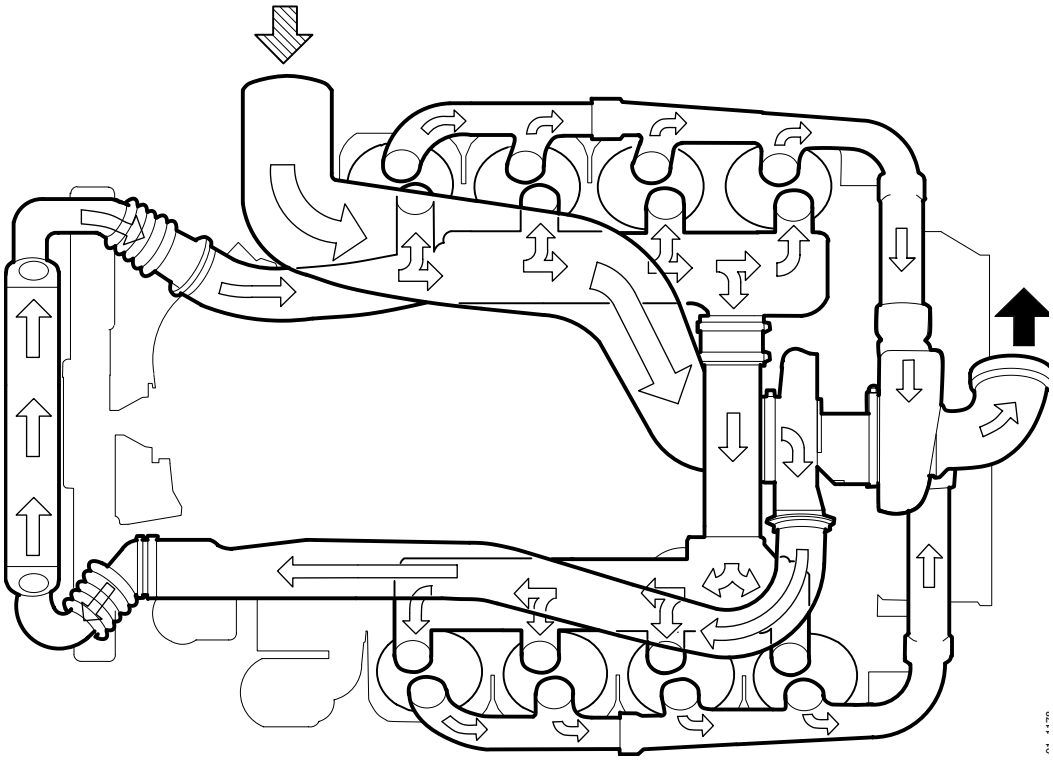
Foreign particles, e.g. grains of sand or metal particles in the turbine or the compressor, will destroy the vanes of the wheels. This will lead to imbalance and bearing wear. The power output of the engine decreases, and if the engine is still run the reduced air supply may cause the engine to overheat, resulting in engine damage. This type of overheating does not show on the coolant temperature gauge.

Even a minute leakage in the pipe between the air filter and the turbo compressor will cause deposits of dirt on the compressor wheel. The charging pressure will decrease, resulting in increased exhaust temperature and smoke. In addition, it will lead to excessive wear of the engine.

Low charging pressure may also be caused by exhaust leaks between the cylinder head and the turbo charger.

Charge air cooler

The air coming out of the turbo compressor flows through tubes to the charge air cooler, which is located in front of the radiator. The charge air is cooled by the air stream, which then flows past the radiator. When it has been cooled, the intake air flows to the intake mainfold, which distributes the air to the cylinders.



Fan

Fan drive

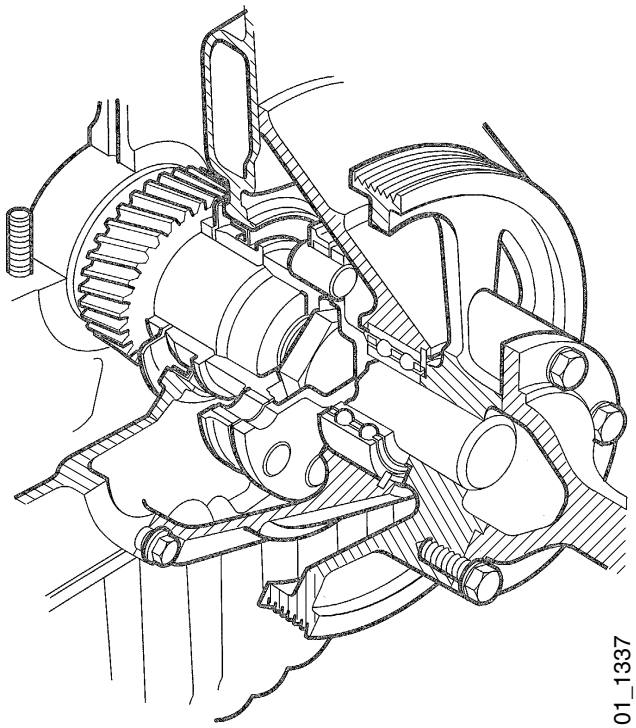
The fan is driven by the crankshaft by way of a clutch with rubber segments.

The intermittent con rod forces cause torsional vibrations in the crankshaft.

Torsional vibrations have the folllowing effect:

- Imagine that the rear end of the crankshaft and the flywheel rotate at a constant speed. In relation to the constant speed of the flywheel, the rotational speed of the front end of the crankshaft will increase and decrease several times during each rotation.
- The vibrations may cause noise from the timing gears.

To prevent this the fan clutch also acts as a crankshaft damper.



01_1337

Belt transmission

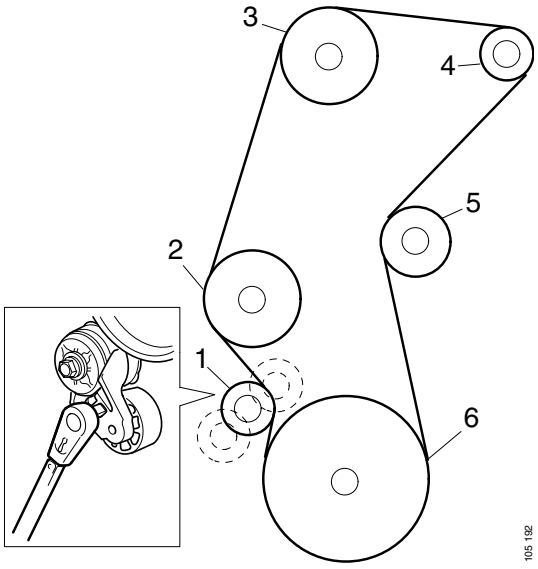
The belt transmission drives the coolant pump, the AC compressor and the alternator.

The belt is a poly-V belt; a flat belt with small V-shaped grooves on the inside.

This type of belt allows for tensioning pulleys on the outside, which increases the gripping angle on the pulleys.

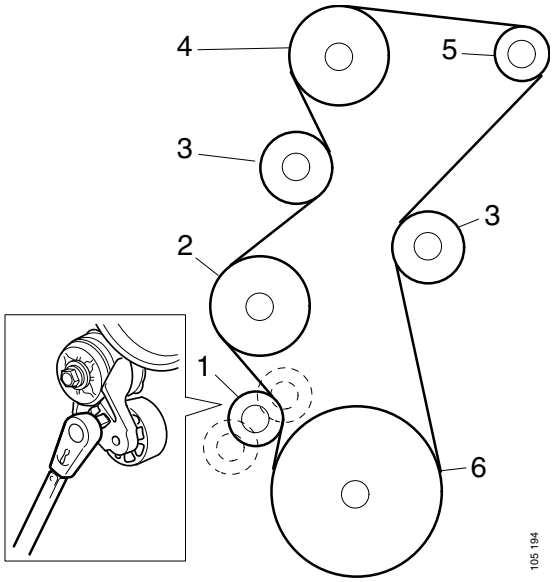
Correct belt tension is ensured by an automatic belt tensioner.

14 litre engine with AC and one idler pulley



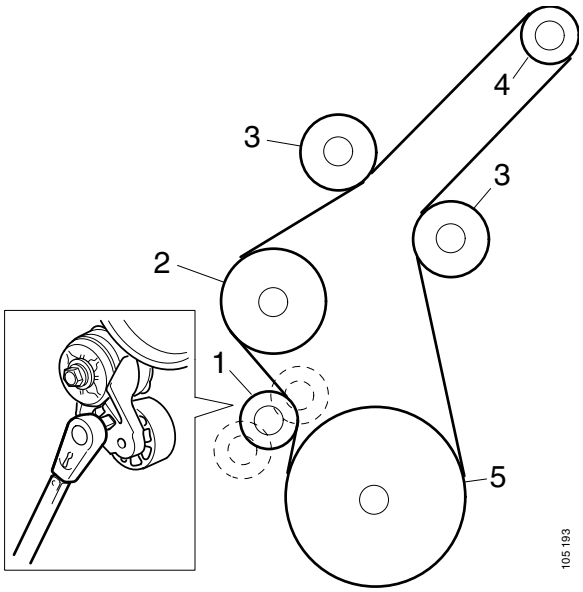
1 Automatic belt tensioner
2 Coolant pump
3 AC compressor
4 Alternator
5 Idler pulley
6 Crankshaft

14 litre engine with AC and two idler pulleys



1 Automatic belt tensioner
2 Coolant pump
3 Idler pulley
4 AC compressor
5 Alternator
6 Crankshaft

14 litre engine without AC, with two idler pulleys



1 Automatic belt tensioner
2 Coolant pump
3 Idler pulley
4 Alternator
5 Crankshaft