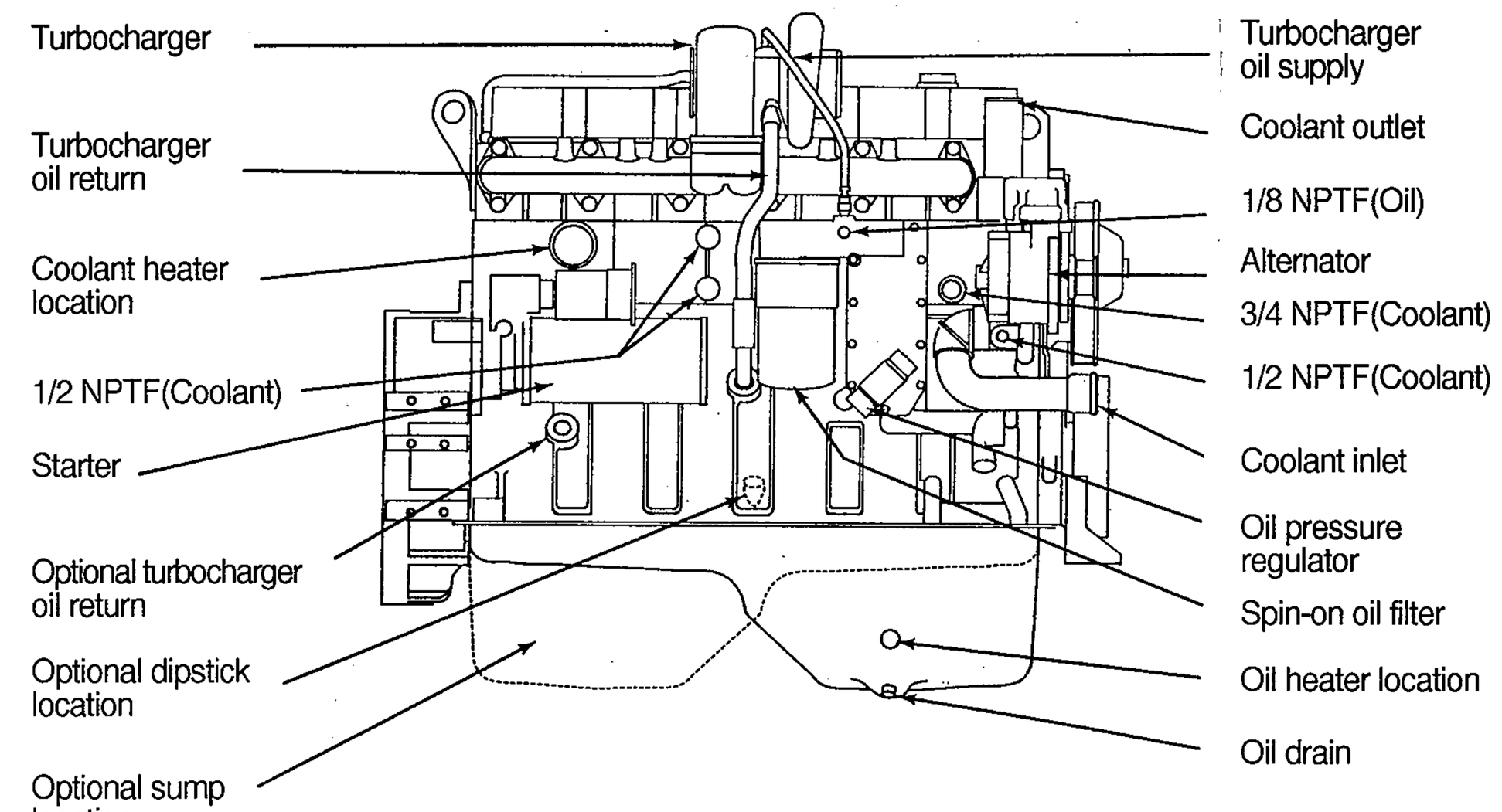
SECTION 2 ENGINE

GROUP 1 STRUCTURE AND FUNCTION

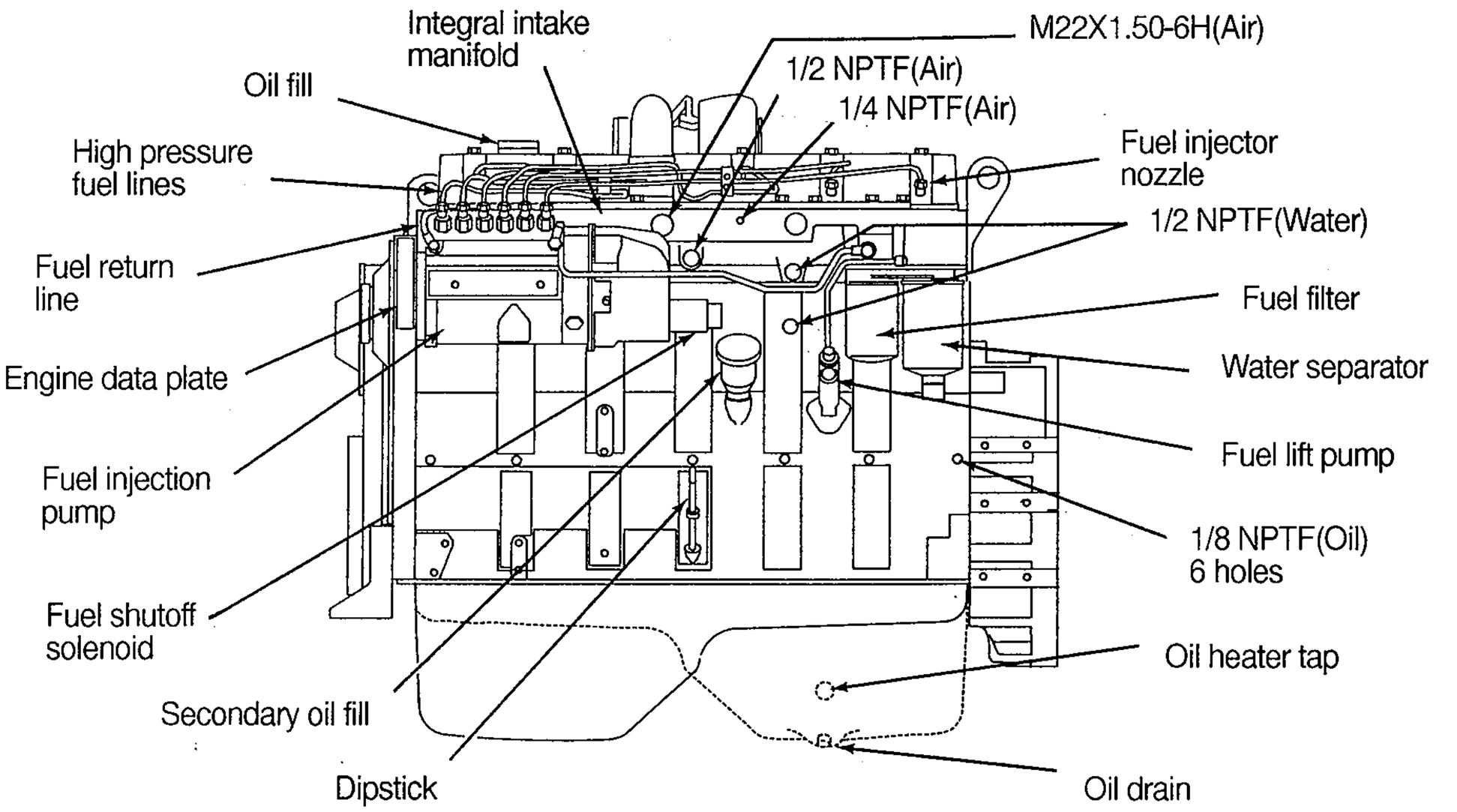
1. STRUCTURE

The pictures which follow show the locations of the major external engine components, the filters, and other service and maintenance points. Some external components will be at different location for different engine models.

※ The pictures are only a reference to show a typical engine.



Turbocharger side view



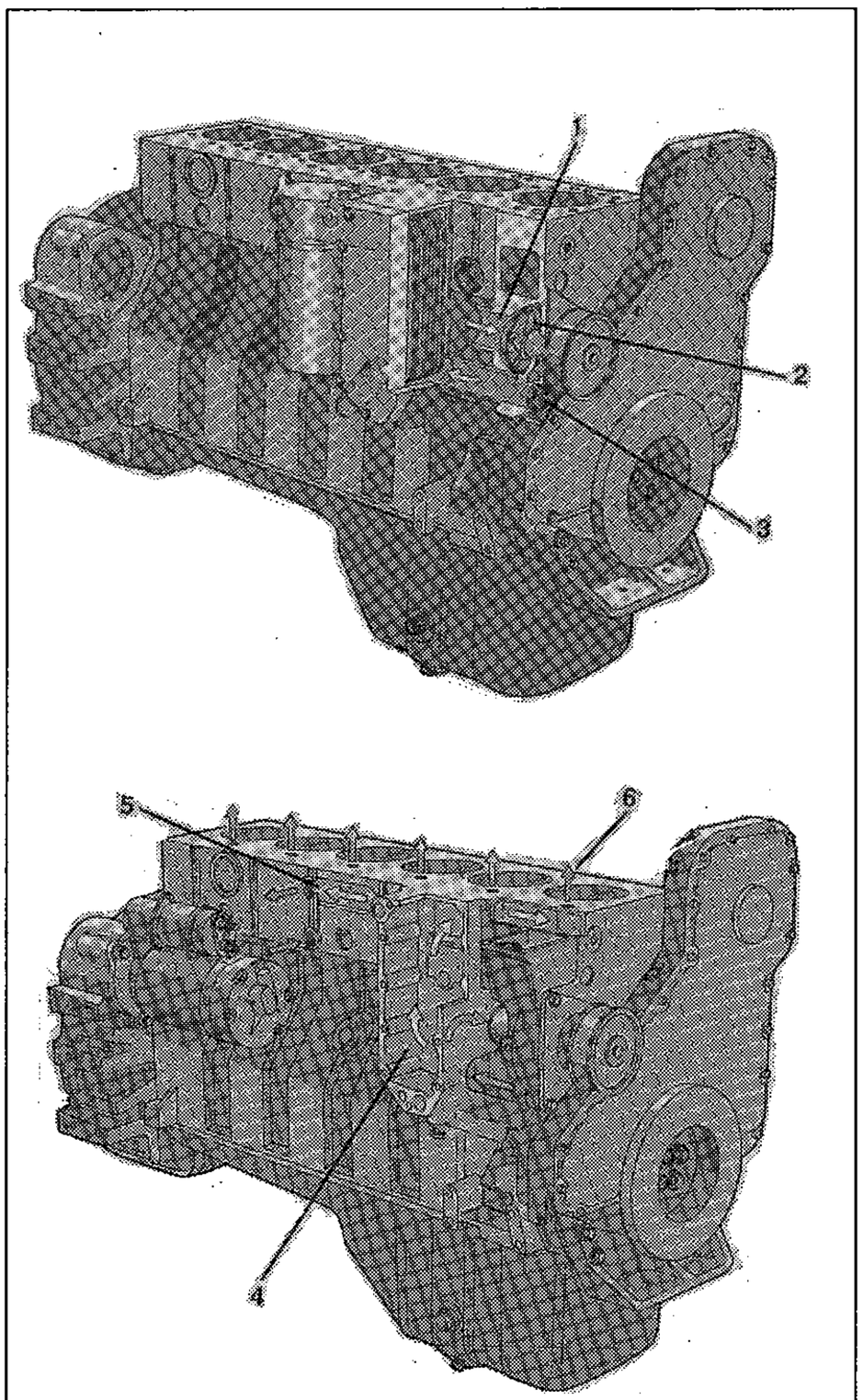
Fuel pump side view

2. COOLING SYSTEM

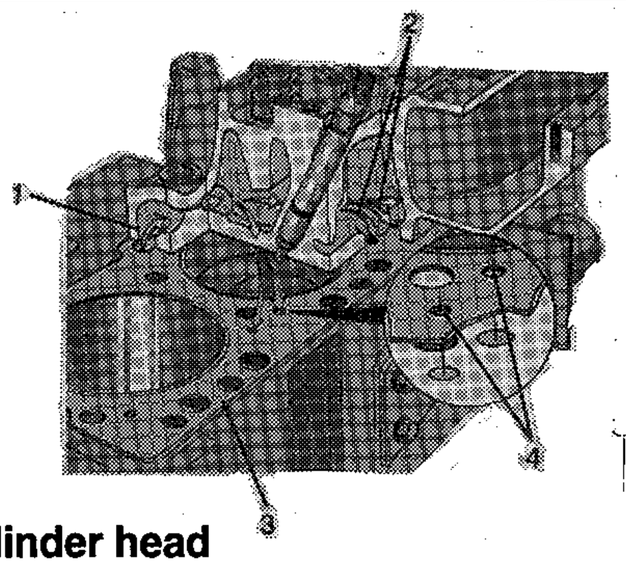
1) Coolant is drawn from the radiator by the integrally mounted water pump. The output from water pump empties into the bottom of the oil cooler cavity in the cylinder block.

2) From the cooler cavity, the coolant flows into the upper water manifold. A portion of coolant flows through the coolant filter and returns to the lower manifold. The remainder flows through 6 cast openings up to the cylinder head.

3) A portion of the coolant flowing into the cylinder head is directed to the liner cavity and, by means of a diffuser plate cast into the cavity, is circulated around the top portion of the liners. The remainder of the coolant flows across the valve bridges around the injector bores and down into the liner cavities through 2 orificed holes per cylinder. The orificed holes control the coolant flow around the liners.

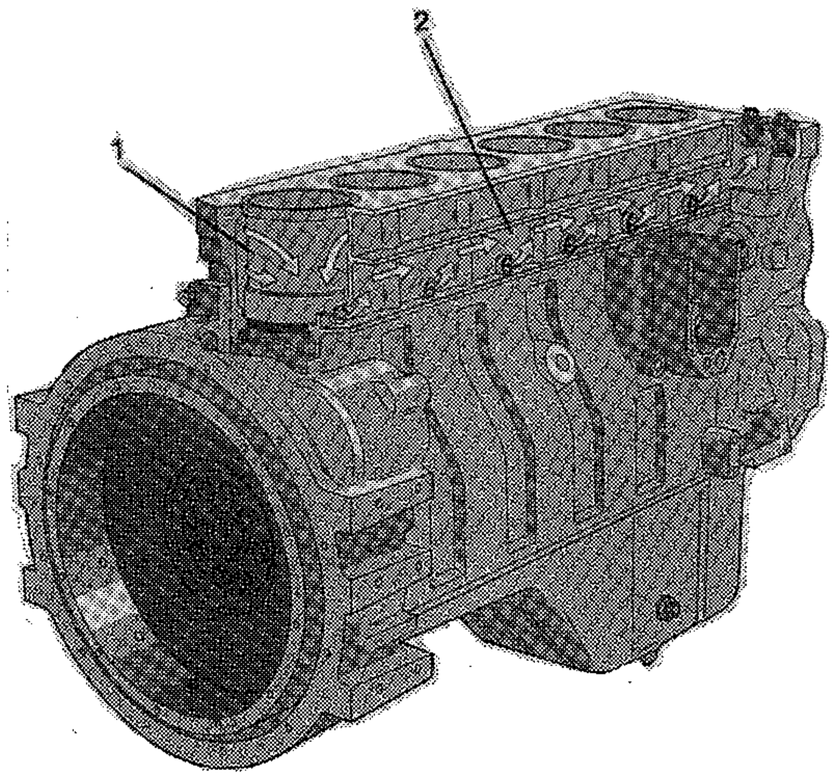


Cylinder block
1 Coolant inlet
2 Pump impeller
3 Coolant flow cooler
4 Coolant flow past oil cooler
5 Upper coolant manifold
6 Coolant to cylinder head



Cylinder head
1 Coolant flow from upper coolant manifold
2 Coolant to liner cavity
3 Cylinder head gasket
4 Coolant flow orifice

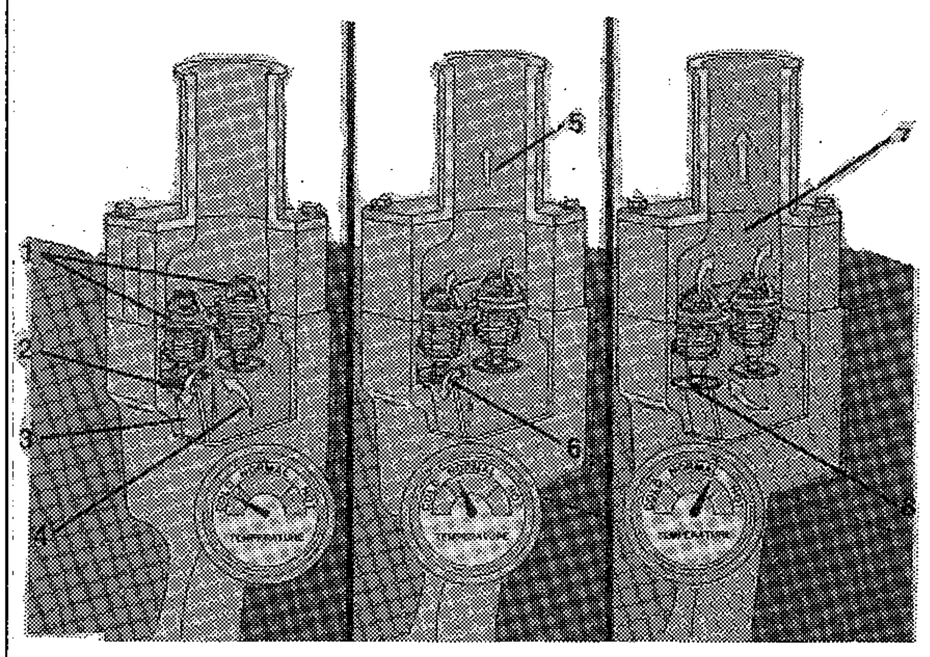
4) From the liner cavities the coolant flows through cast openings into the lower manifold and on to the thermostat cavity.



1 Coolant flow past cylinder liners
2 Lower coolant manifold

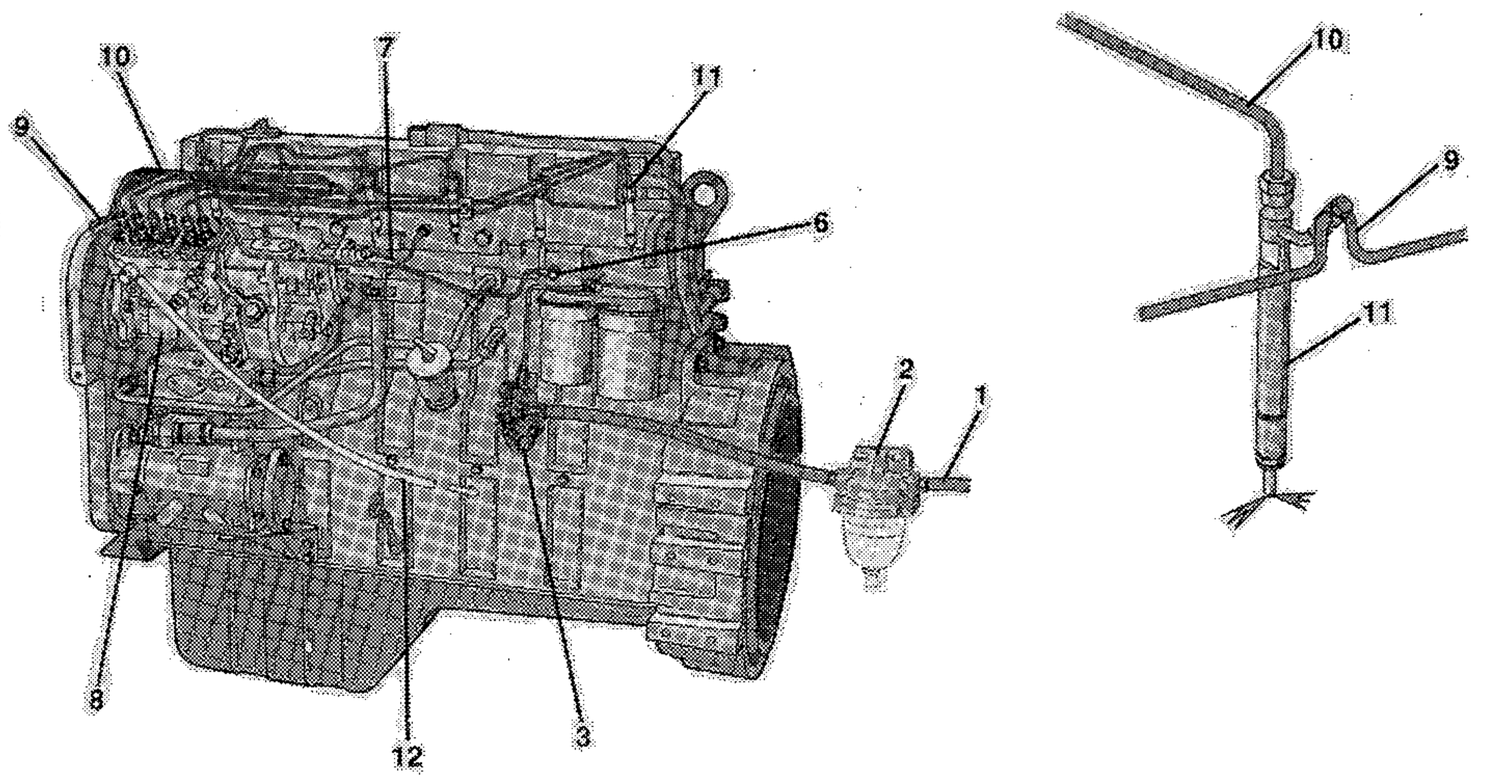
5) When engine is below operating temperature, the thermostats are closed. Coolant is bypassed to the water pump inlet. As the coolant temperature increases, both thermostats begin to open allowing some of the coolant to flow to the radiator.
At normal operating temperature, both thermostats are fully open and the bypass circuit is closed.

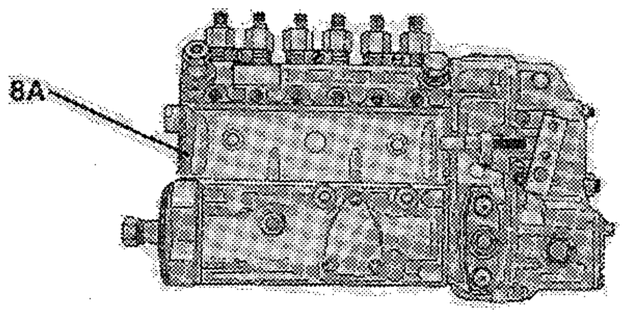
Thermostat

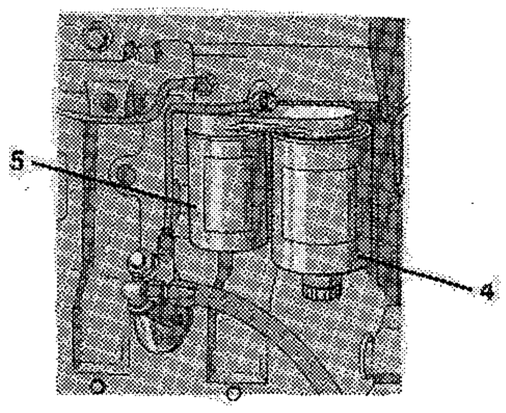


Closed	Intermediate	Open
1 Thermostats	5 Partial coolant flow to radiator	7 Coolant to radiator
2 Coolant to pump inlet	6 Restricted coolant flow to bypass	8 Bypass closed
3 Bypass passage		
4 Coolant from lower coolant manifold		

3. FUEL SYSTEM







1	Fuel from supply tank	6	Low pressure supply line	9	Fuel drain manifold
2	Pre-filter or screen	7	Turbo boost control line	10	High pressure fuel lines
3	Lift pump	8	Robert bosch PES6MW injection pump	11	Robert Bosch, 17mm closed nozzle, hole type injectors
4	Fuel/water separator				
5	Fuel filter	8A	Robert bosch PES6A injection pump	12	Fuel return to supply tank

A cam-actuated lift pump provides positive fuel pressure to the injection pump. Fuel flow begins as the pump pulls fuel from the supply tank. The system should have a pre-filter or screen to remove larger contaminants from the fuel before reaching the lift pump. The pump supplies low pressure fuel through the fuel filter head and filter to the injection pump at 140 kPa (20 psi).

The Robert Bosch PES6A injection pump is used on all engine models. The model PES6MW pump is used on the higher rated 6CTA8.3 engines. The injection pump builds the high injection pressures required for combustion and routes the fuel through high pressure fuel lines to each injector.

All C series engines use Robert Bosch 17mm closed-nozzle, hold-type injectors. When the high-pressure fuel reaches the injector, the pressure lifts the needle valve against the spring tension to allow fuel to enter the combustion chamber.

Any leakage past the needle valve enters the fuel drain manifold. The manifold routes leakage from the injectors to the injection pump vent fitting. Fuel from the fitting is returned to the supply tank.

4. AIR INTAKE AND EXHAUST SYSTEM

The engine was designed as a turbocharged engine, but a naturally aspirated engine is available for industrial applications.

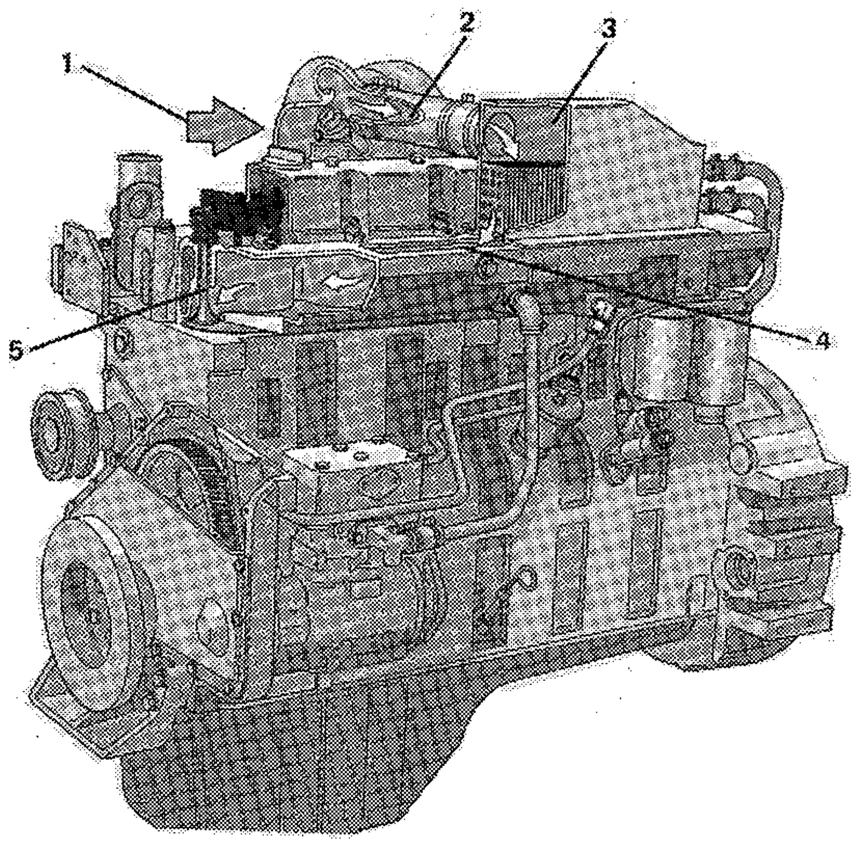
Air is pulled into the engine from an air filter. Clean air is very important to the life of the engine. Ingested dust and dirt can very quickly damage the cylinders.

Make sure that an excellent quality air cleaner is used and that it is periodically replaced according to the manufacturer's recommendations.

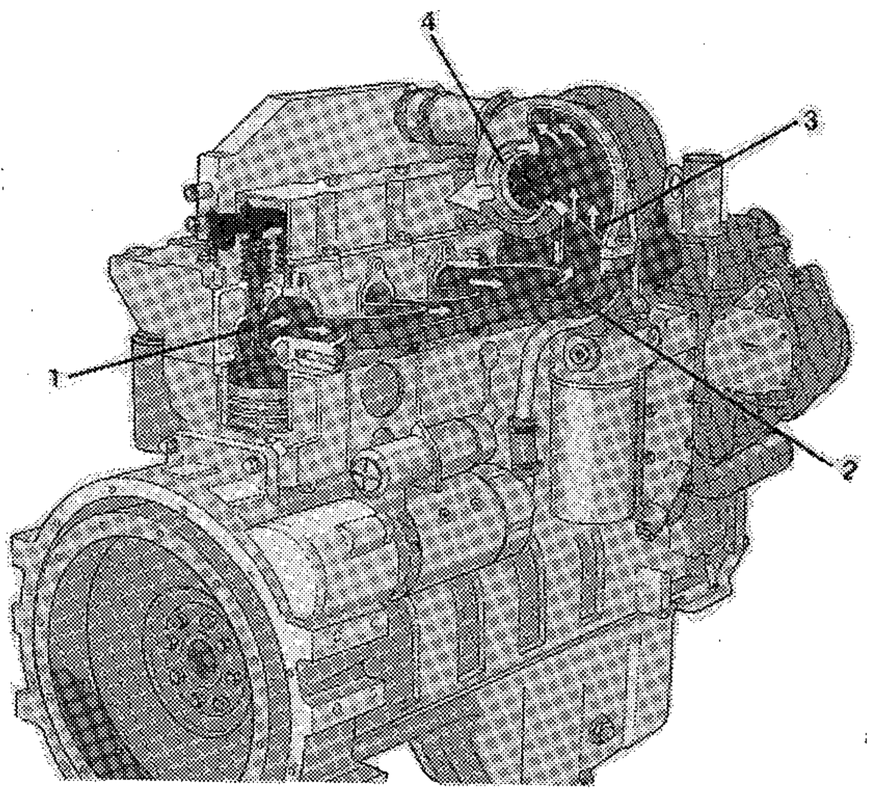
Intake air for the naturally aspirated engine flows from the air cleaner to the intake manifold. From the intake manifold, the air is pulled into the cylinders and used for combustion. After combustion it is forced out of the cylinders and through the exhaust manifold.

On the turbocharged engines the intake air is drawn through the air cleaner into the compressor side of the turbocharger and then through the crossover tube and into the intake manifold. From the intake manifold the air is forced into the cylinders and used for combustion. Energy from the exhaust gases is utilized by flowing the exhaust through the exhaust side of the turbocharger to drive the turbine wheel. The turbine wheel and shaft drives the compressor wheel which forces more air into the cylinders for combustion. The additional air provided by the turbocharger allows more fuel to be injected to increase the power output from the engine.

On turbocharged-aftercooled engines, intake air from the turbocharger flows through the cooling fins of the aftercooler before entering the intake manifold. The cooled air becomes more dense and contains more oxygen which allows more fuel to be injected further increasing the power output from the engine.



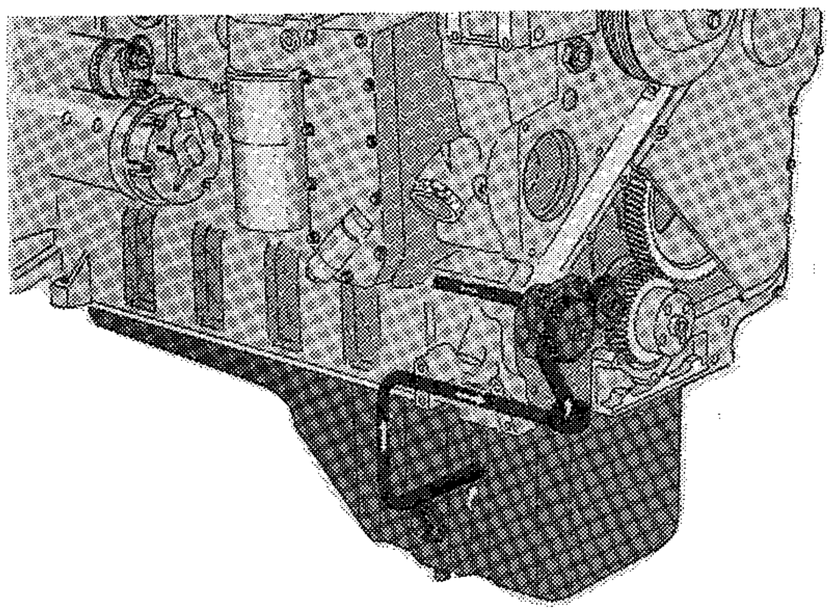
Intake system
1 Intake air inlet to turbocharger
2 Turbocharger air to aftercooler
3 Aftercooler
4 Intake manifold
(integral part of cylinder head)
5 Intake valve

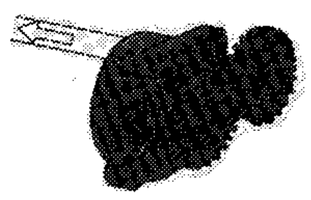


Exhaust system
1 Exhaust valve
2 Exhaust manifold(pulse type)
3 Dual entry turbocharger
4 Turbocharger exhaust outlet

5. LUBRICATING SYSTEM

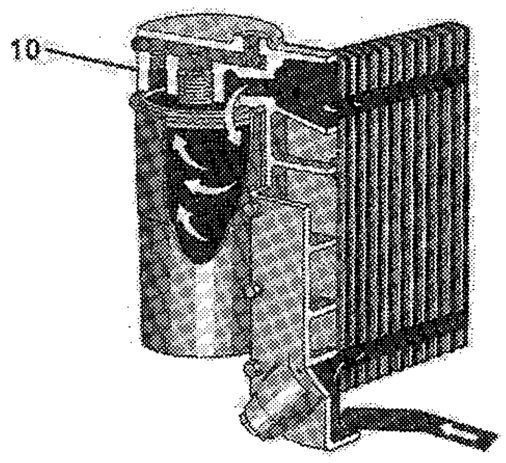
1) LUBRICATING OIL SYSTEM

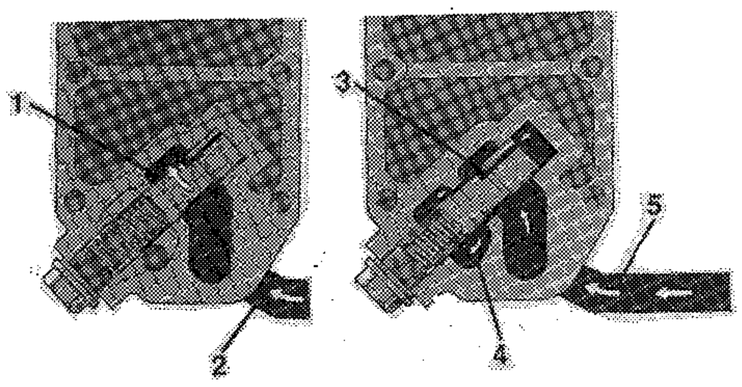




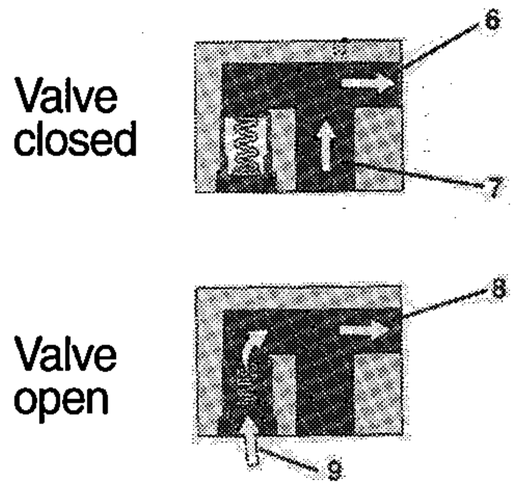
Gerotor lubricating oil pump

Lubricating oil cooler; full flow filter





Pressure regulating valve



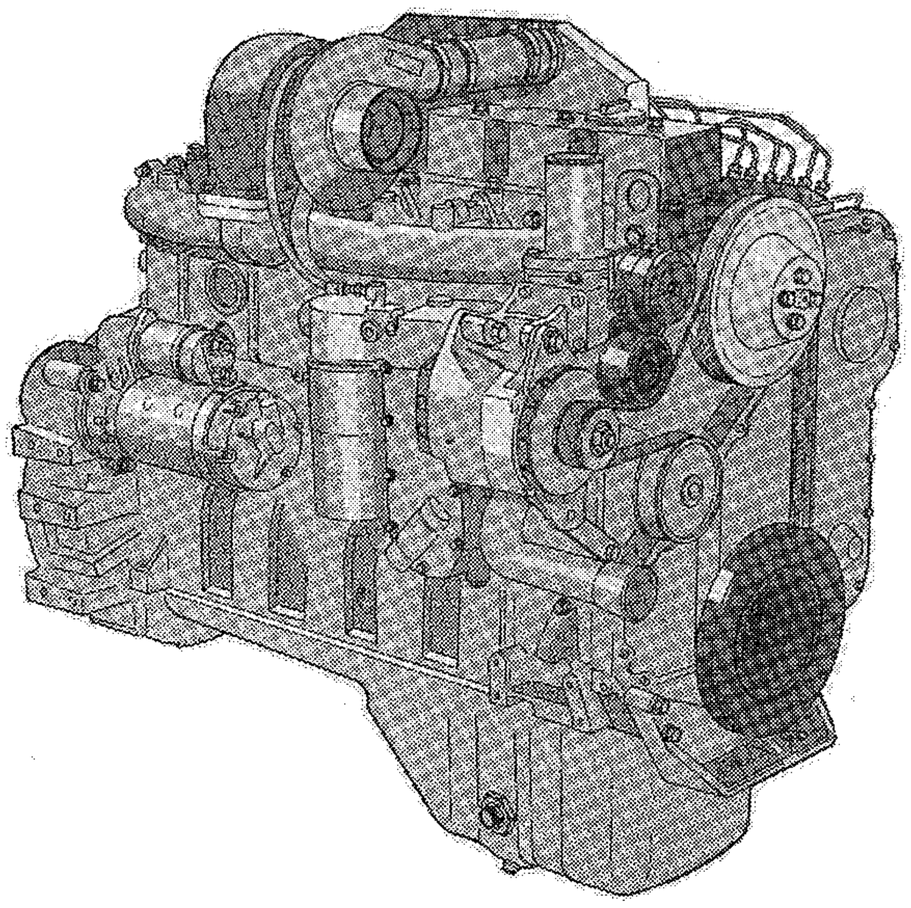
Filter bypass valve

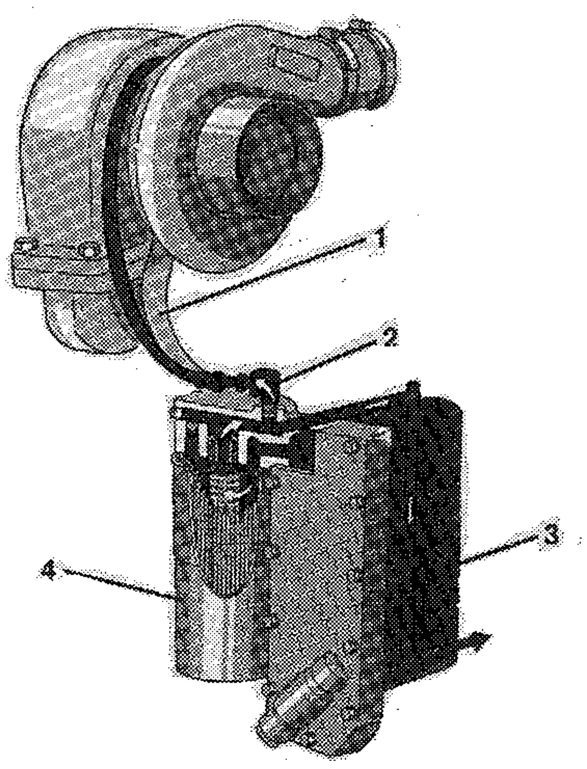
1	To oil cooler	5	From pump	9	From oil cooler
2	From pump	6	To main oil rifle	10	Filter bypass valve
3	To oil cooler	7	From filter		
4	To pan	8	To main oil rifle		

The oil flow begins as the gerotor type oil pump pulls oil from the oil pan through the rigid, internally mounted suction tube. The oil pump then delivers the oil through an internal drilling in the cylinder block to the oil pressure regulator, which is located in the oil cooler cover. The valve relieves oil pressure during cold starting and regulates oil pressure after the oil is warm. The regulator valve remains closed until the oil pressure is approximately 315kPa (45psi). When the oil pressure is greater than 315kPa(45psi), the valve begins to open and pressure is relieved by allowing some of the oil to return to the pan. The valve plunger has a tapered shoulder which creates a variable opening to regulate the pressure.

From the regulator cavity, the oil flows through the cooler cover and cooler element. Coolant flowing past the plates of the element cools the oil.

2) LUBRICATION FOR THE TURBOCHARGER



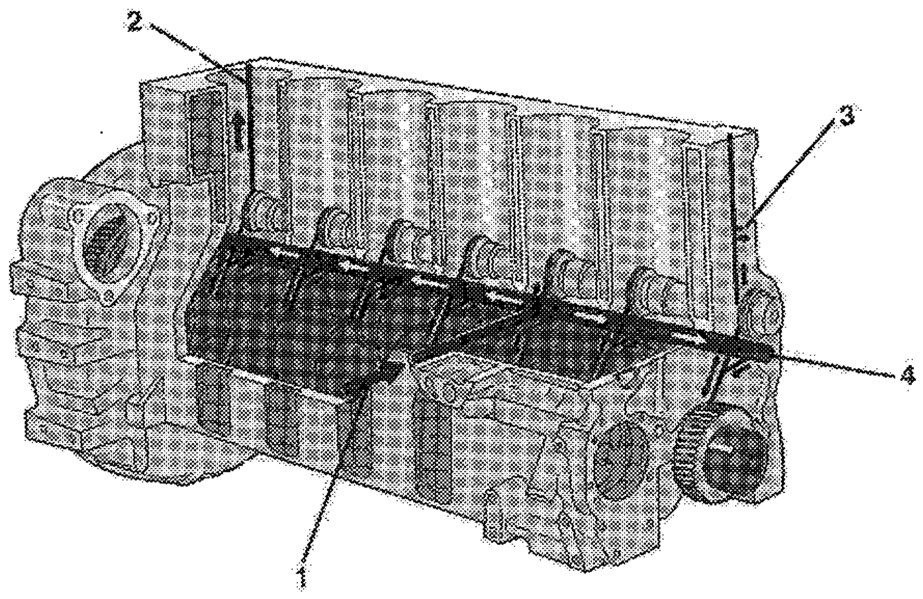


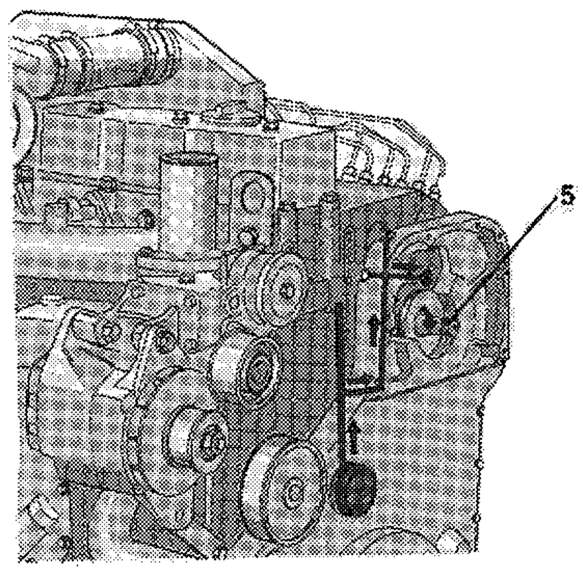
1 Oil drain
2 Turbocharger supply
3 To main oil rifle
4 Filter

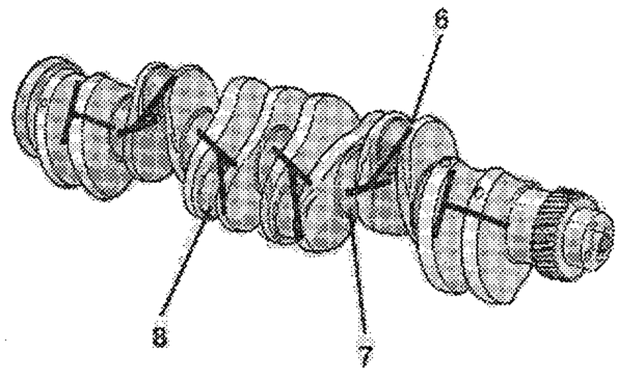
From the cooler, the oil flows through a passage in the cooler cover to the oil filter. The filtered oil flows up the center of the filter to the filter head. At the filter head, the oil flow is divided: A portion flows to the turbocharger; the rest flows down a passage in the cylinder block that connects to a cross drilling over the number 3 main bearing.

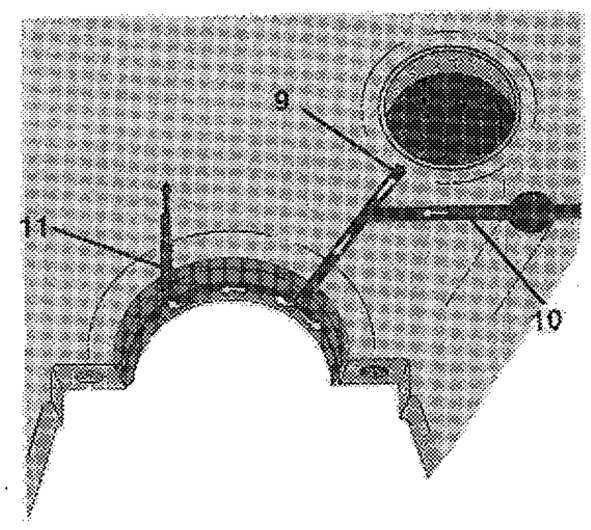
The oil cooler cover contains a bypass valve that will let the oil flow bypass a plugged oil filter. If the pressure drop across the oil filter exceeds 138kPa(20psi), the bypass valve will open, allowing the oil to continue through the engine.

3) LUBRICATION FOR THE POWER COMPONENTS







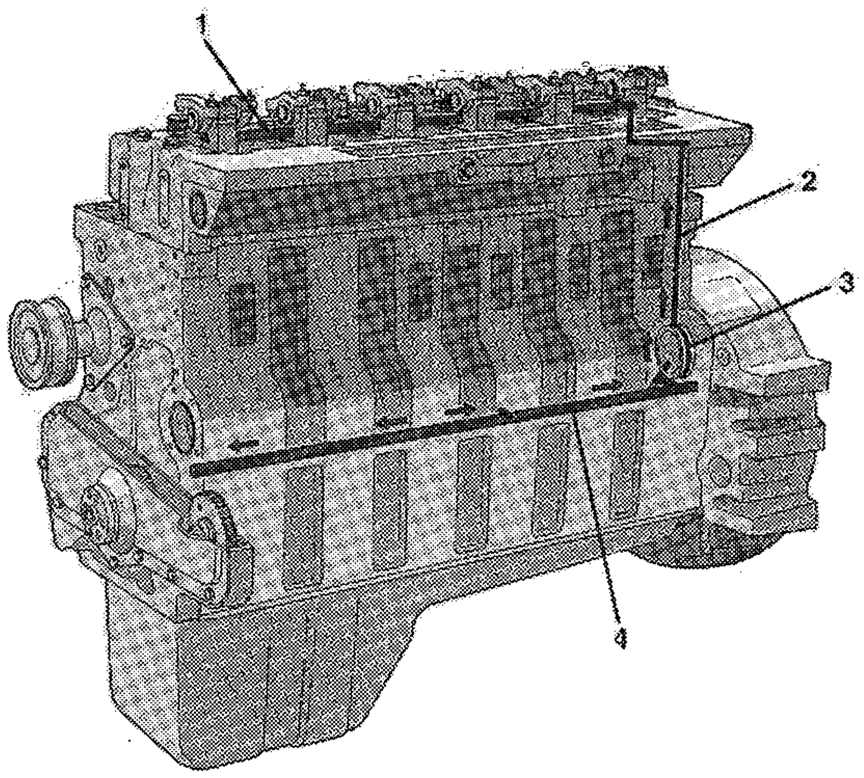


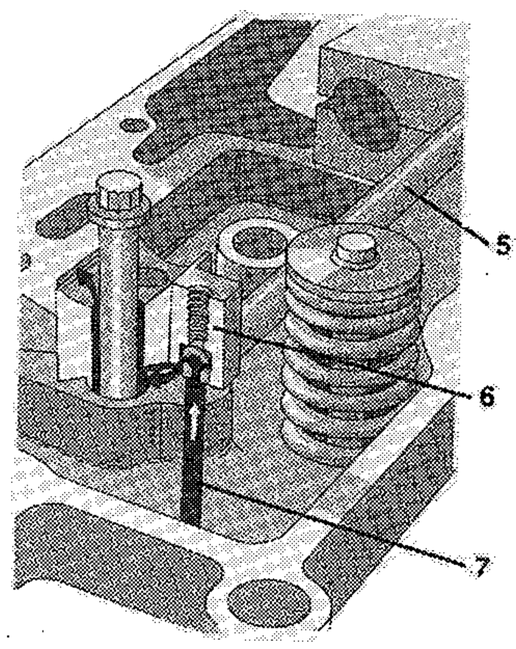
1 From oil cooler
2 To overhead
3 To injection pump
4 Main oil rifle
5 Fuel pump
6 To rod bearing
7 Crank shaft main journal
8 Rod journal
9 To cam bore
10 From main oil rifle
11 Piston cooling nozzle

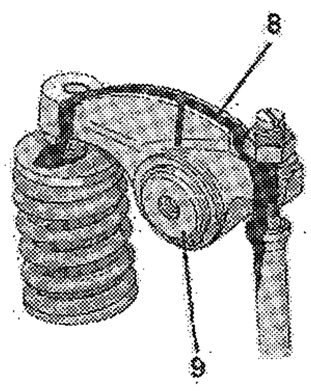
After the oil has been cooled and filtered, it flows through the cross drilling over the number 3 main bearing to the main oil rifle. The main oil rifle is drilled through the length of the cylinder block and carries oil through individual drillings to the overhead and lower end of the block. A transfer drilling from the main oil rifle intersects with a drilling between the main bearing bore and the camshaft bushing bore. These drillings supply oil to the cam bushing and main bearing. The groove in the upper main bearing shell supplys oil to the piston cooling nozzle located in the main bearing saddle. The spray from the nozzle splash lubricates the piston pin. From the main bearings, the oil enters the crankshaft and lubricates the connecting rod bearings through internal cross drillings.

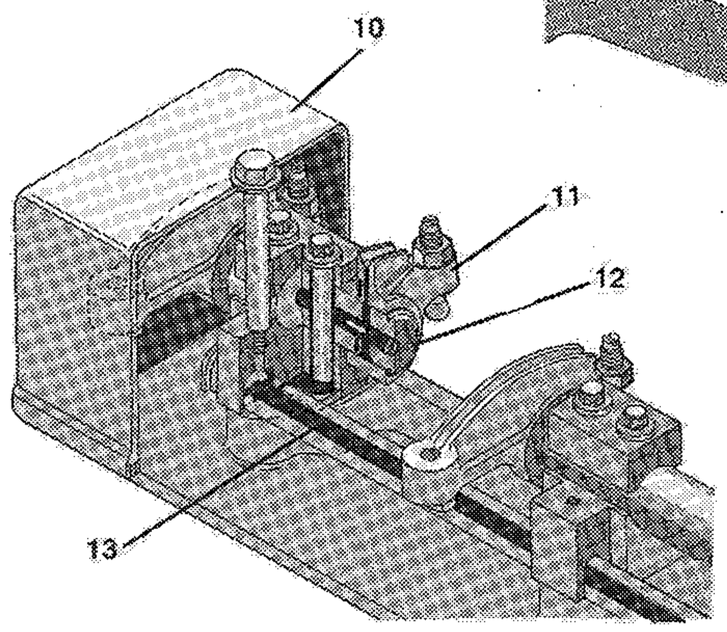
Drillings in the cylinder block and gear housing connect to the external groove on the number 1 camshaft bushing to supply oil to the injection pump. An overflow hole located above the injection pump shaft allows oil to return to the oil pan.

4) LUBRICATION FOR THE OVERHEAD









1	Oil transfer tube	6	Rocker lever support	11	Rocker lever
2	To overhead	7	From No. 7 cam bore	12	Rocker lever shaft
3	No 7. cam bushing	8	Oil trough	13	Oil transfer tube
4	Main oil rifle	9	Rocker lever shaft		
5	Oil transfer tube	10	Valve cover		

Oil for the overhead components is supplied by a vertical drilling through the cylinder head and block that intersects the external groove on the number 7 camshaft bushing. The main oil rifle supplies oil to the camshaft bushing. Oil flows from the vertical drilling to an angle drilling in the cylinder head. From the angle drilling the oil flows through the transfer tube. The rocker lever supports are installed over the transfer tube. From a hole in the transfer tube the oil is transferred to the rocker lever support capscrews by the relieved area in the base of the support.

Oil flows around the capscrews up to the rocker lever shaft. Oil flows into the inside diameter of the shaft and along its length. The ends of the shaft are sealed by cup plugs. Drillings in the shaft allow the oil to flow from the inside diameter to the bores of the rocker levers. The rocker lever has a drilling that transfers oil from the bore to a trough on the top of the lever. Oil flows along the trough to lubricate the push rod socket and the valve stem.

The front gear train assembly is lubricated from oil splash and carry-over. The oil pump idler gear is force lubricated.

From the gear train assembly the oil drains back to the oil pan for recirculation.