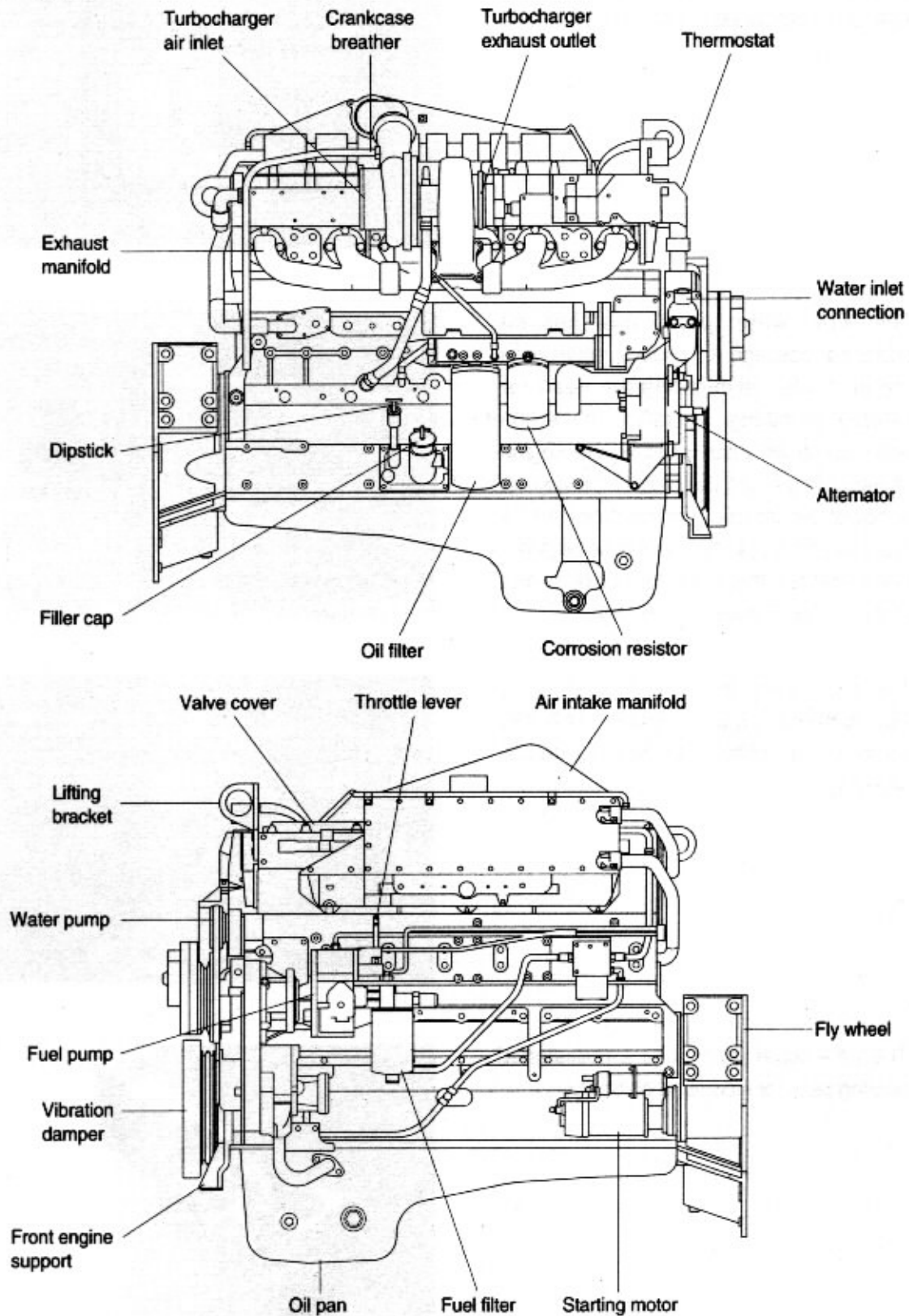


SECTION 2 ENGINE

GROUP 1 STRUCTURE AND FUNCTION

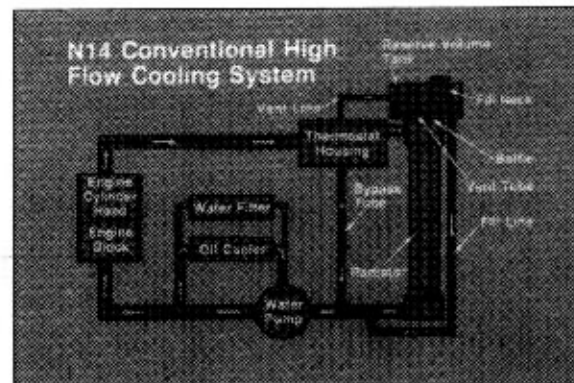
1. STRUCTURE



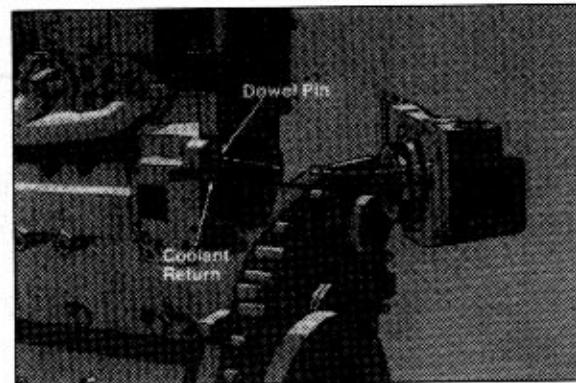
- Direct 4-stroke, 6-cylinders, water-cooling diesel engine in installed, cylinder block and cylinder head are made of case iron and turbocharger is attached.

2. COOLING SYSTEM

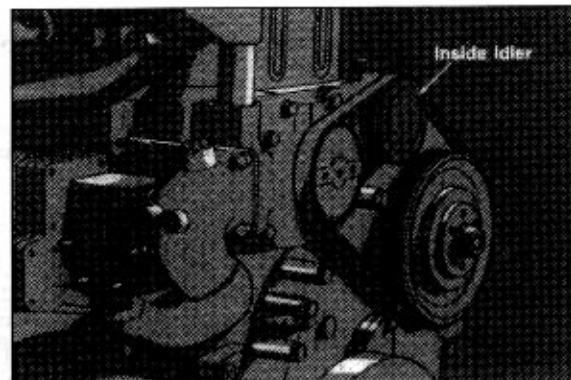
- 1) The N14 utilizes the conventional high flow cooling system. Lets take a look at the new features incorporated in this system.



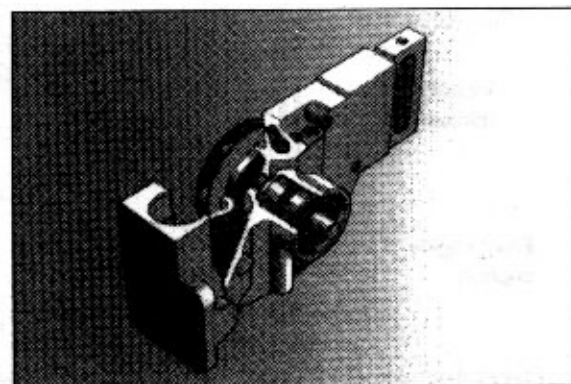
- 2) The N14 water pump now has an additional passage for coolant return from the oil cooler, eliminating the need for external plumbing. Installing the wrong water pump will result in excessive engine oil temperature and damage to the engine. A dowel pin installed in the block and a matching dowel pin hole in the water pump body ensures that only the correct water pump can be installed on the N14.



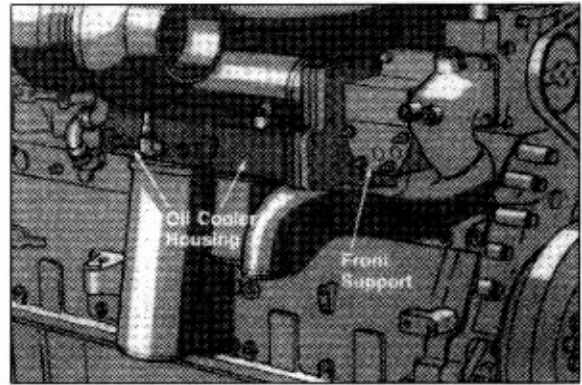
- 3) The water pump drive belt has an inside idler to maintain proper tension. This idler concept was utilized on the big cam III engines.



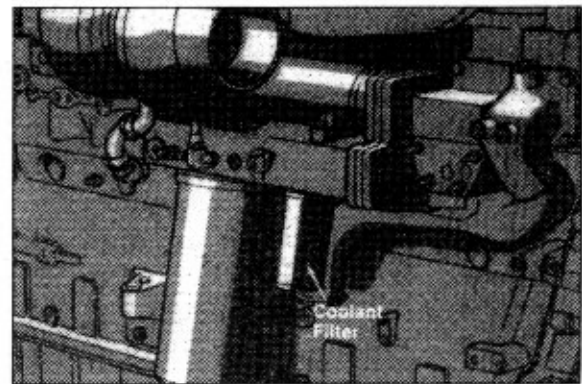
- 4) The new water pump has a redesigned bearing pack for increased durability.



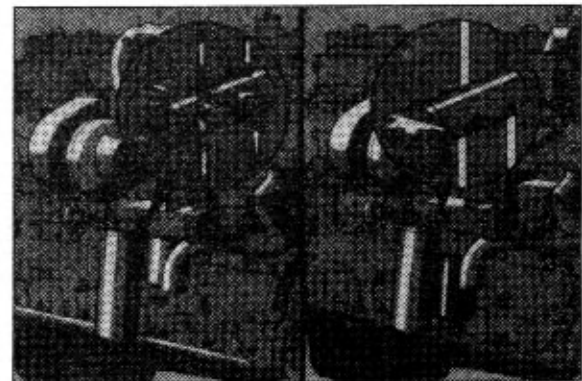
- 5) Both the oil cooler housing and front support are cast iron to increase strength and improve sealing.



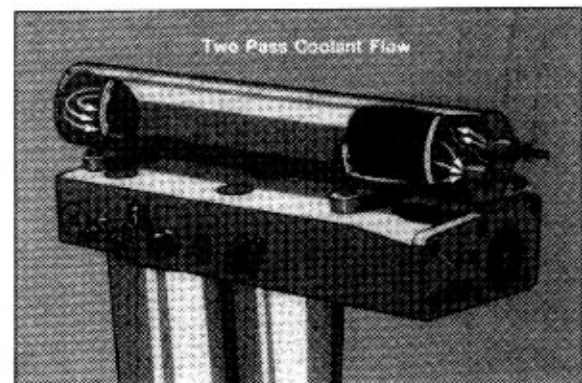
- 6) The N14 coolant filter is now located on the bottom of the oil cooler next to the oil filter.



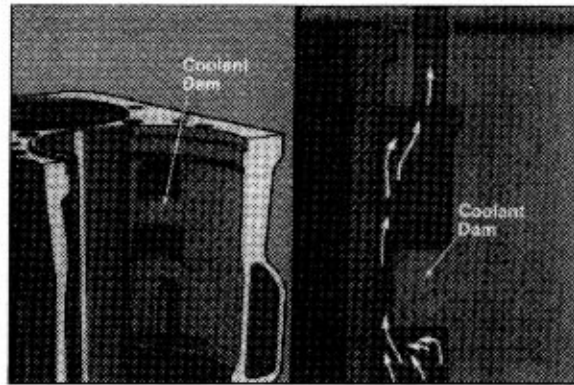
- 7) Above the coolant filter, there is a coolant filter shut-off valve. This valve is used to stop the flow of coolant to the filter, so that the filter can be replaced without coolant loss.



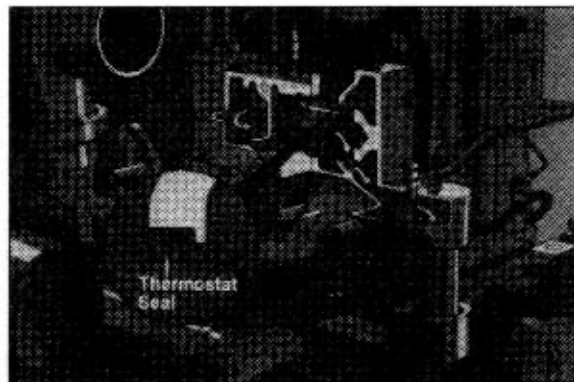
- 8) The coolant makes two passes through the oil cooler bundle to provide greater heat transfer from the oil to the coolant.



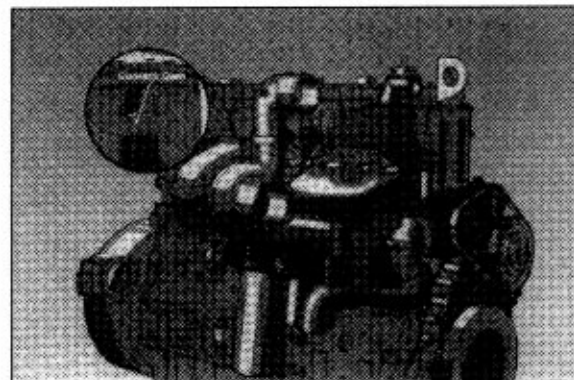
- 9) Coolant dams are cast into the block to promote a more uniform coolant flow around the cylinder liners, for improved liner cooling. This results in longer cylinder liner, piston and ring life.



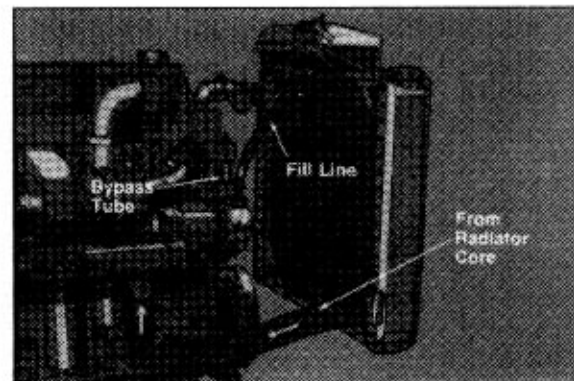
- 10) The thermostat housing contains a single thermostat and seal. This is the same type of thermostat used in previous conventional high flow cooling systems.



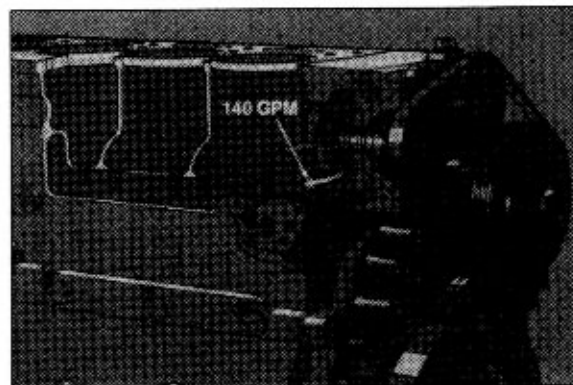
- 11) These new features improve the overall coolant flow on the N14 engine.



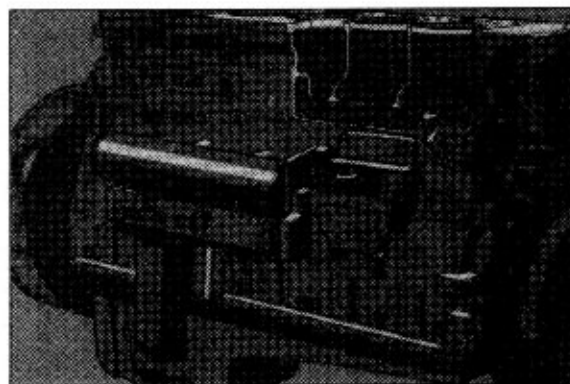
- 12) With these new features in mind, let's take a look at the coolant flow through the N14 engine. The coolant is drawn into the water pump from three sources : The bypass tube, the fill line, and the radiator core. The fill line ensures a positive at the water pump inlet.



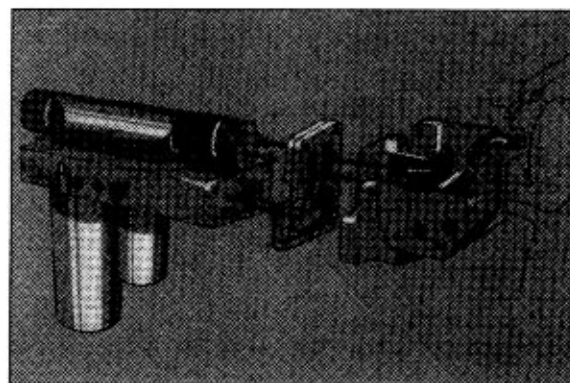
- 13) The water pump provides a coolant flow of approximately 140 gallons per minute, at 2100rpm.



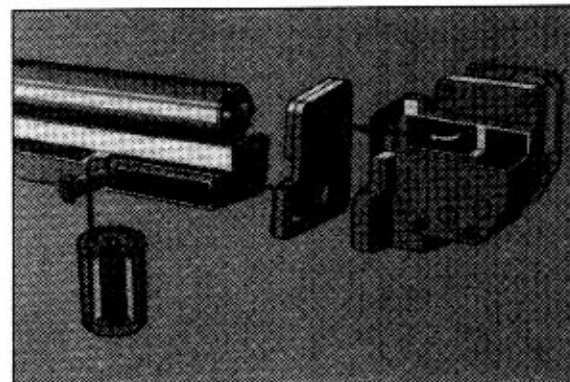
- 14) From the water pump, the coolant flow is directed to the main coolant header in the block and to the oil cooler support.



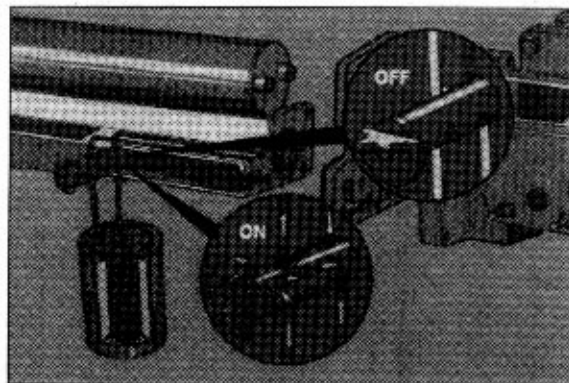
- 15) At the oil cooler support, a percentage of the coolant flows through the two-pass oil cooler bundle. From the oil cooler bundle, the return flow continues through the front support to the water pump via the new return passage in the block.



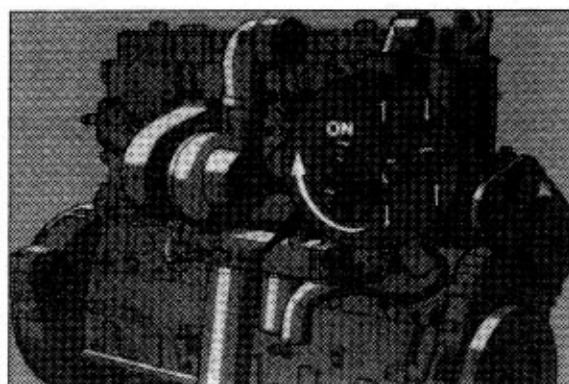
- 16) Notice that a portion of the coolant from the oil cooler support is directed to the coolant filter.



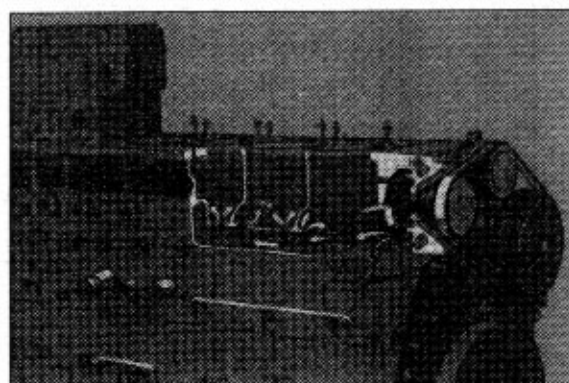
- 17) The oil cooler housing incorporates a manual shut-off valve. In the ON position, this valve directs coolant flow to the coolant filter. When rotated to the OFF position, the flow path to the coolant filter is closed. As we said earlier, this allows the filter to be replaced without coolant loss.



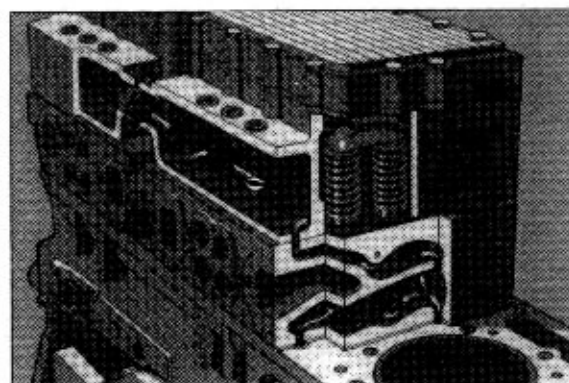
- ※ **Make certain that you rotate the coolant filter shut-off valve to the ON position, after you replace the filter.**



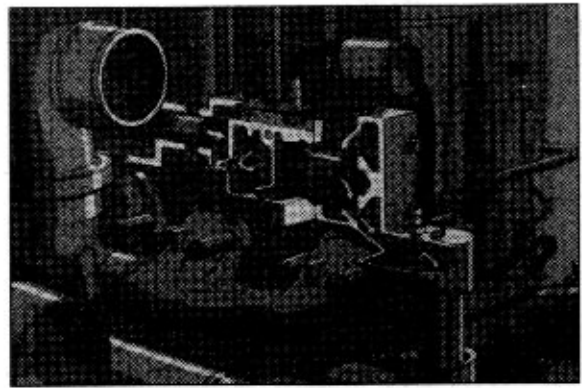
- 18) The remaining coolant in the block coolant header flows to the cylinder liner cavities, circulating around the liners and traveling upward and into the cylinder heads.



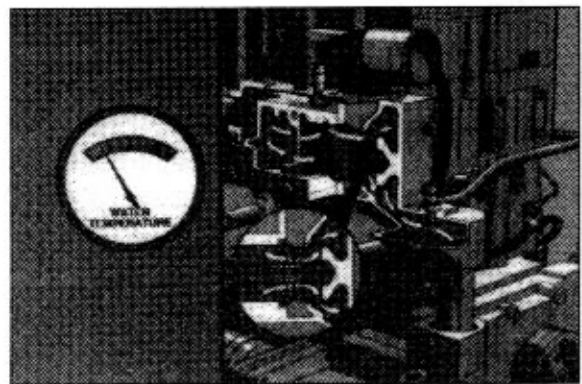
- 19) The coolant flows through the cylinder head and cools the valve seats, injector sleeves, fuel passages and the exhaust ports. The coolant then flows to the water manifold which is located on the side of the rocker housing.



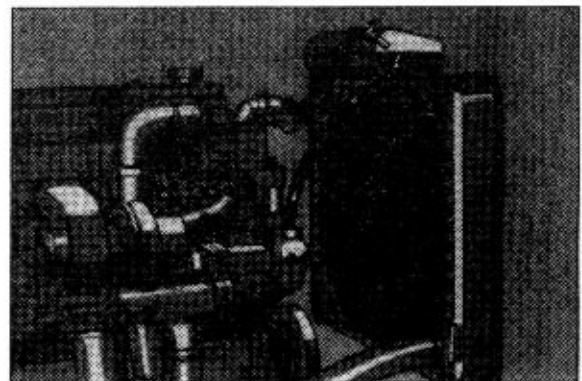
20) From the water manifold, the coolant then flows to the thermostat housing.



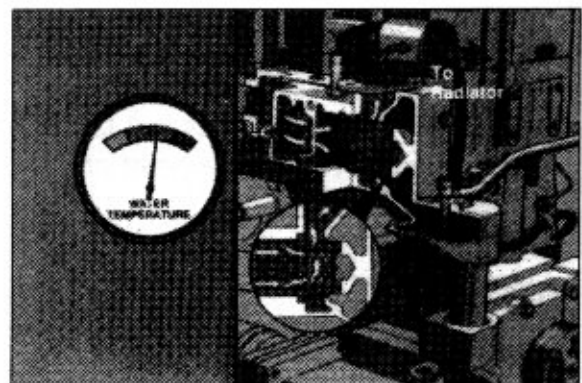
21) In the thermostat housing, the thermostat senses the coolant temperature. If the coolant is below operating temperature, the thermostat remains closed and the coolant is directed back to the water pump through the bypass tube.



22) The engine coolant vent line allows a small amount of coolant to flow to the top tank of the radiator for deaeration purposes. The coolant then flows through the fill line and back to the water pump, as needed.

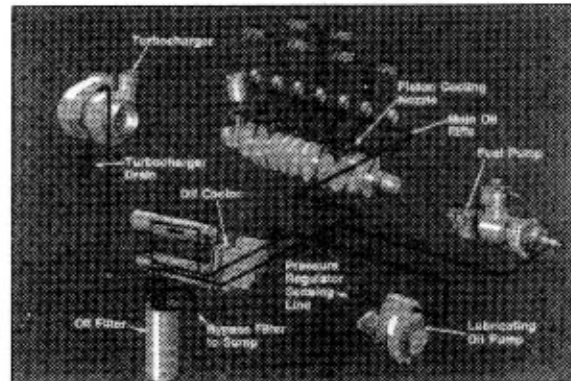


23) As the coolant reaches operating temperature, the thermostat opens, allowing the coolant to flow to the radiator core and back to the water pump.

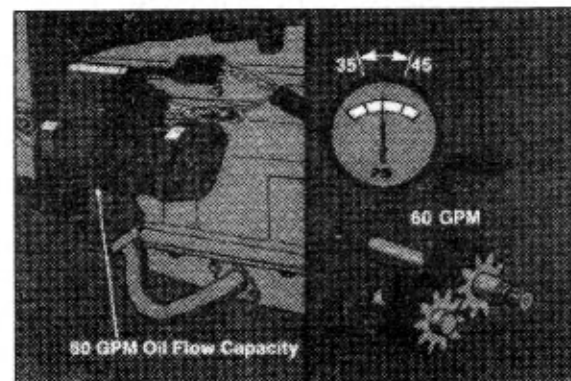


3. LUBRICATION SYSTEM

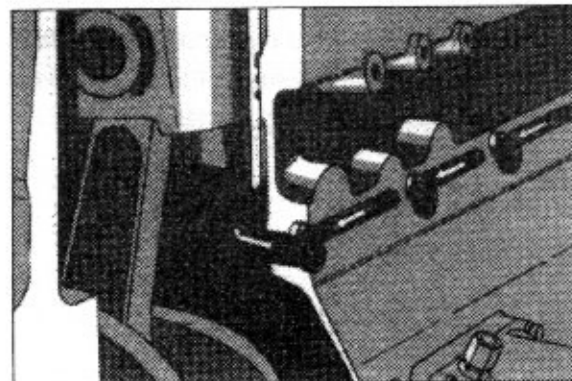
- 1) Now, let's examine the new features of the N14's lubrication system.



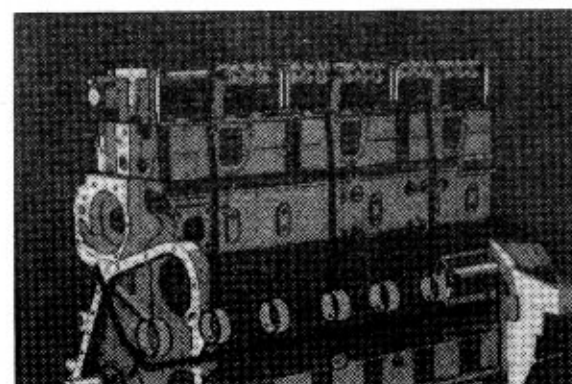
- 2) The flow capacity of the oil pump has been increased from forty to sixty gallons per minute. This increase provides the required flow for the new piston cooling nozzles, while handling the increased overhead and C-Brake oil flow demands. Note that, even though oil flow has increased, oil pressure remains at 35~45psi.



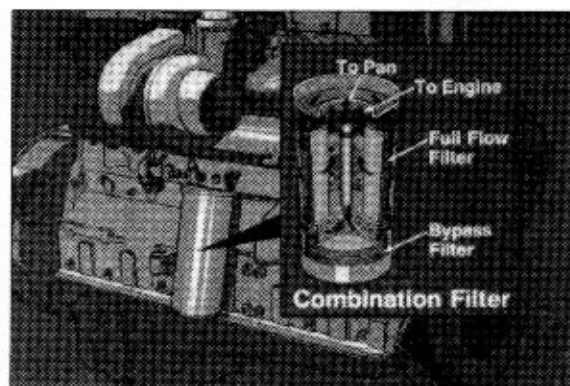
- 3) The oil flow through the piston-cooling nozzle has been increased by 1 1/2 gallons per minute. To accommodate this additional flow, the rifle size has been increased.



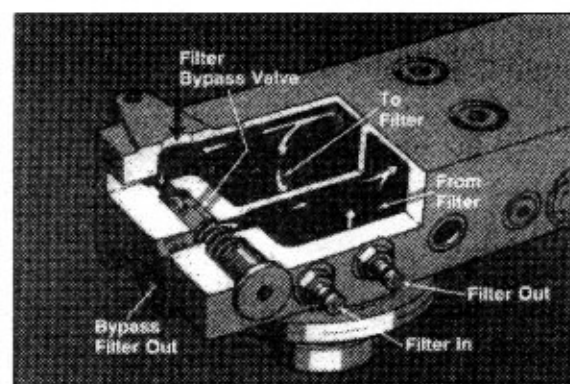
- 4) The oil passage in each cylinder head has also been enlarged to supply a greater volume of oil to the overhead and to enhance C-Brake operation.



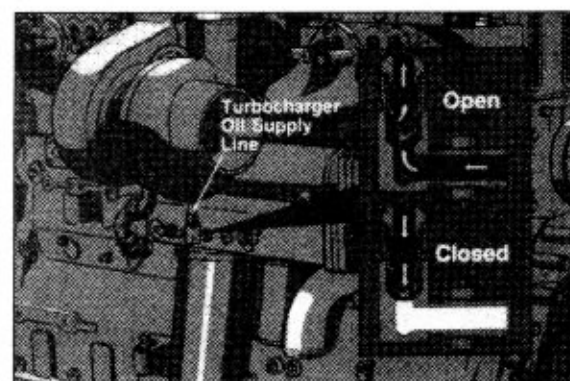
- 5) The oil filter is a high-performance combination filter. The first filter element is a full-flow 30-micron filter, providing filtered oil to the engine. The second element is a 10-micron bypass filter. This filtered oil is returned to the pan. The combination filter provides for both filtering operations in one canister, thereby improving serviceability.



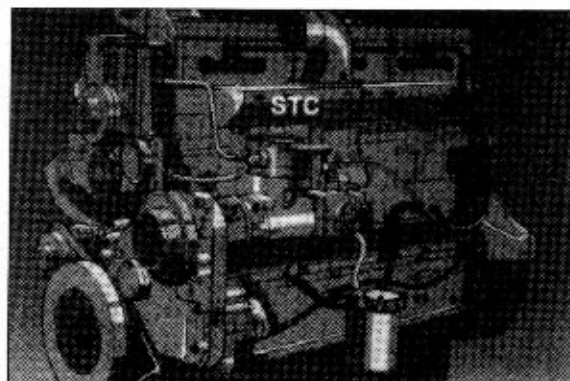
- 6) The oil cooler housing is equipped with a filter bypass valve. This valve protects the oil filter in the event of high oil pressure spikes. If the pressure difference between the filter-in passage and the filter-out passage exceeds 100psi, the bypass valve is actuated. The bypass valve also provides oil to the engine if the oil filter becomes plugged.



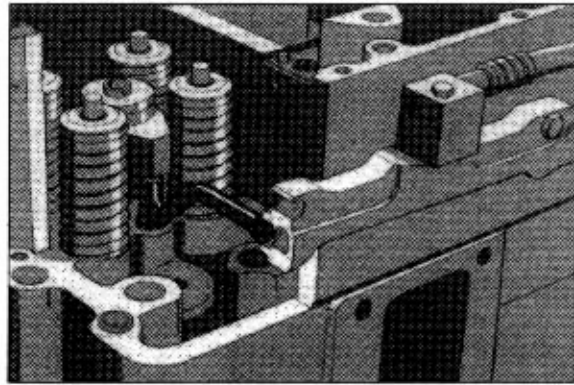
- 7) The turbocharger supply line now incorporates a check valve. This valve prevents oil from draining out of the supply line after engine shutdown, and provides improved turbocharger lubrication at startup.



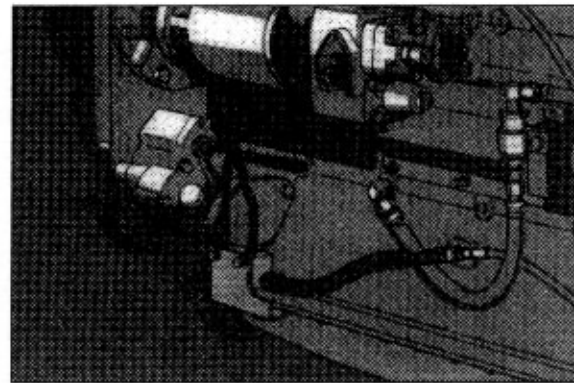
- 8) An N14 engine that is equipped with step timing control has several new lube oil plumbing improvements. These improvements provide better durability and serviceability for the STC system oil flow.



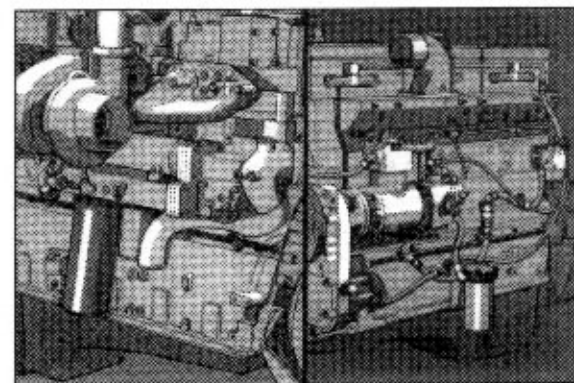
- 9) Located on the intake side of the rocker housing is an oil manifold, which distributes oil to three external connector housings. The connector housings in turn provide oil to each STC injector through an internal metal jumper tube.



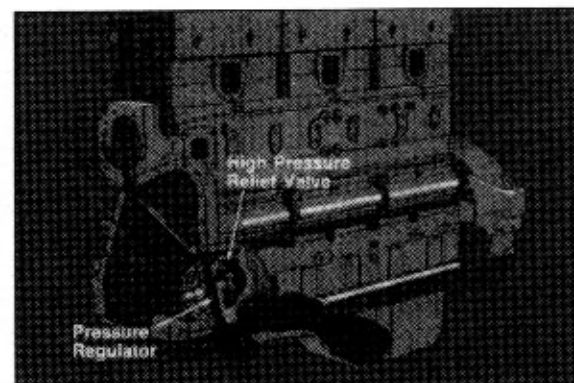
- 10) To provide the proper oil pressure to the STC injector tappets during cold oil conditions, an oil viscosity sensor has been installed on all STC model engines.



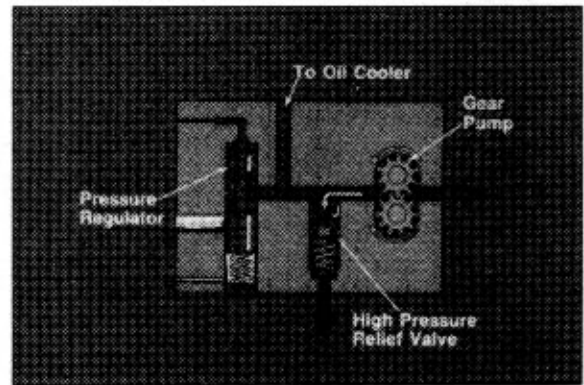
- 11) These new features improve the lubrication system operation. To thoroughly understand this system, let's look at how the oil is delivered to the various components of the N14 engine.



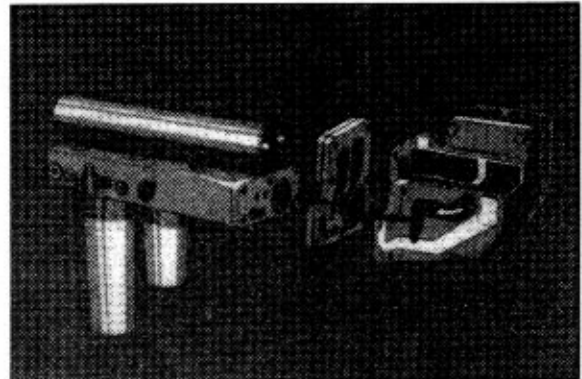
- 12) The lube pump initiates oil flow at the oil sump, through the internal oil suction tube. The pump contains a high-pressure relief valve and main oil rifle pressure regulator.



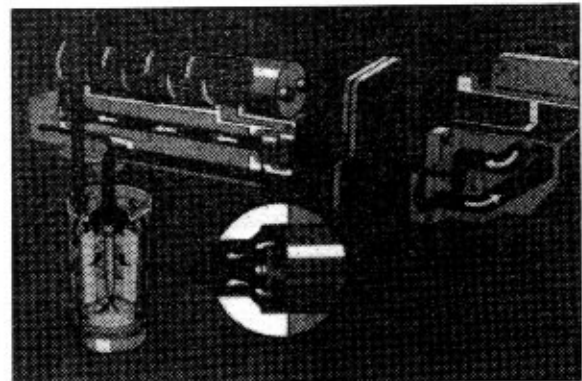
13) If oil pressure should exceed the maximum setting, during a cold start-up, the disc type high-pressure relief valve opens, and excess oil is bypassed into the oil pan. After start-up, the oil pressure is regulated in the main oil rifle, by way of a signal line, to the lube pump pressure regulator.



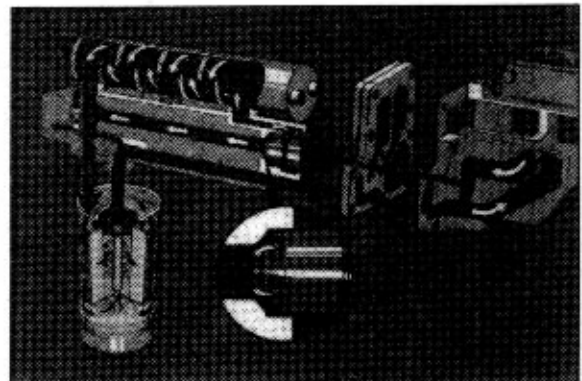
14) Oil then flows to the lubricating oil cooler assembly, which contains a thermostat to direct the flow of oil.



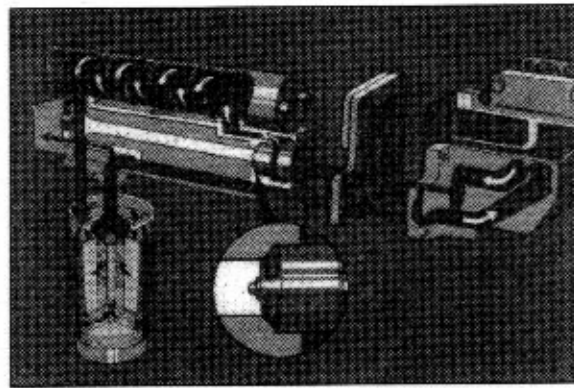
15) When the oil is cold it is routed through the bypass loop and directly to the oil filter. No oil circulates through the oil cooler bundle during cold engine operation.



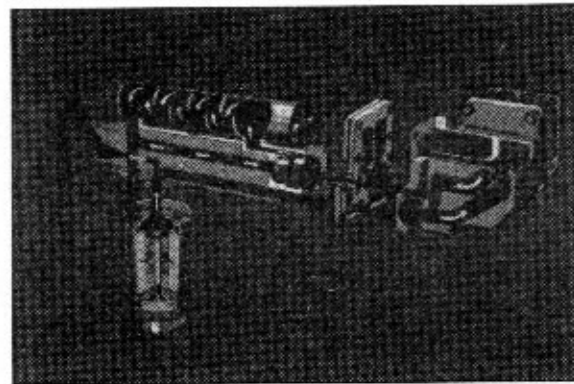
16) As the oil temperature increases the oil flow will be divided between the bypass loop and the oil cooler bundle.



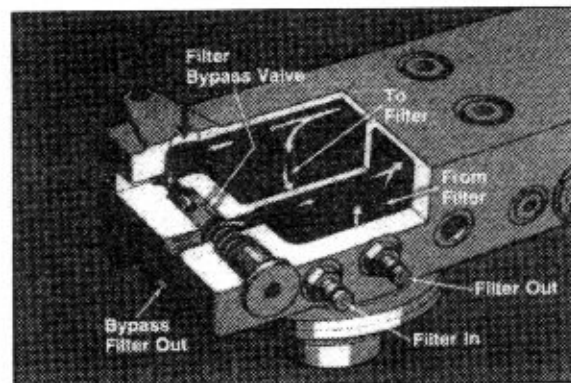
- 17) When the oil temperature reaches approximately 110°C(230°F) the thermostat completely shuts off the bypass loop. This routes all the oil through the cooler bundle to provide maximum oil cooling.



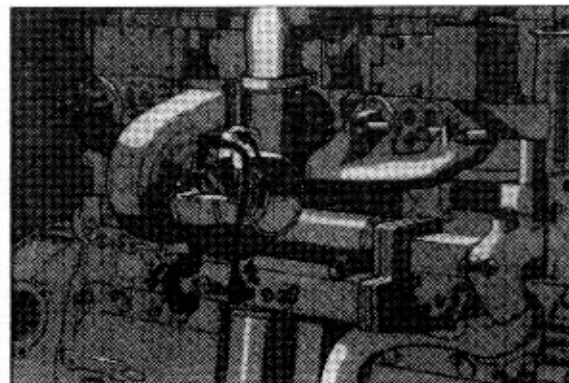
- 18) From either the oil cooler bundle, or the bypass loop, the oil flows into the combination filter. The full-flow portion of the filter provides oil to the engine. The oil that flows through the bypass filter element returns to the oil pan.



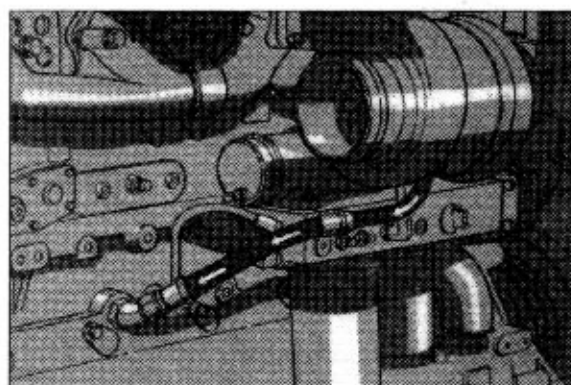
- 19) As we discussed earlier, the oil cooler housing contains the filter bypass valve. When the pressure difference between the oil filter **in** passage and the full-flow filter **out** passage exceeds 100 psi, the valve opens. This action creates a flow path to reduce the pressure differential.



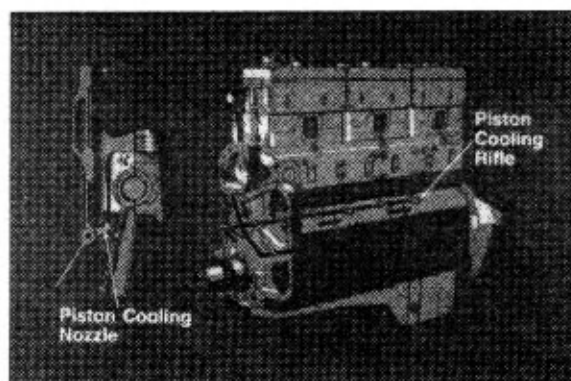
- 20) Filtered oil from the oil cooler is supplied through a one way check valve to the turbocharger oil supply line.



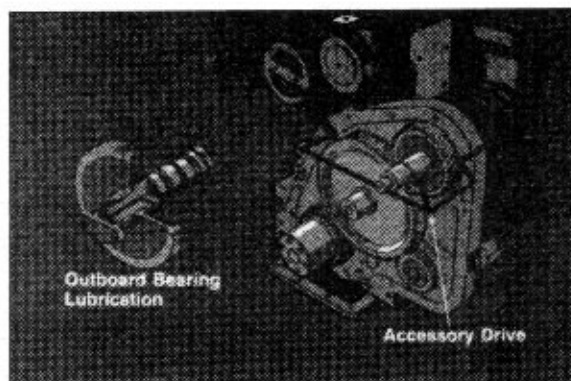
21) The oil passes through the turbocharger and is returned to the sump via the turbocharger drain line.



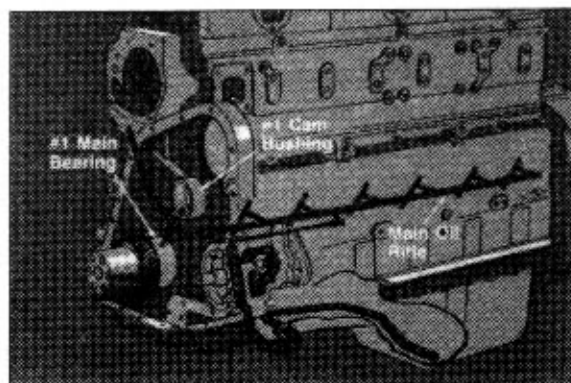
22) Filtered oil flows from the cooler housing to the cross drilling at the front of the block. A portion of the oil is routed to the piston-cooling rifle. The piston-cooling rifle supplies oil to the piston-cooling nozzles, which deliver a constant oil spray to cool the pistons.



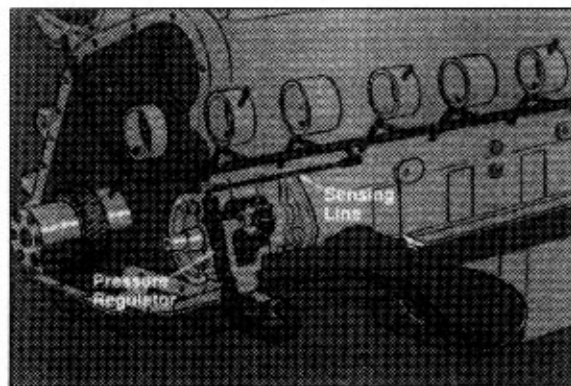
23) A passage in the gear case cover supplies oil to the accessory drive, air compressor and fuel pump. The camshaft outboard bearing support, located in the front cover, is lubricated through a drilling in the cam nose.



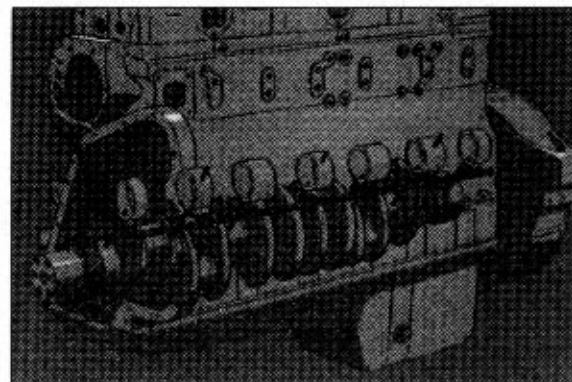
24) The remaining oil flows across the front of the block to the main oil rifle. This cross-drilling provides oil flow to the number one main bearing and cam bushing.



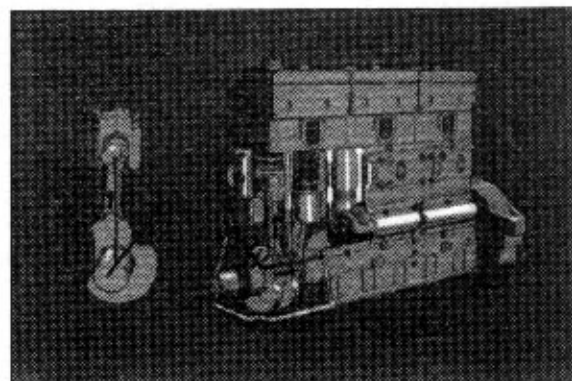
- 25) From the main oil rifle, the pressure is sensed by the pressure regulator located in the lube oil pump, and regulated at approximately 40psi.



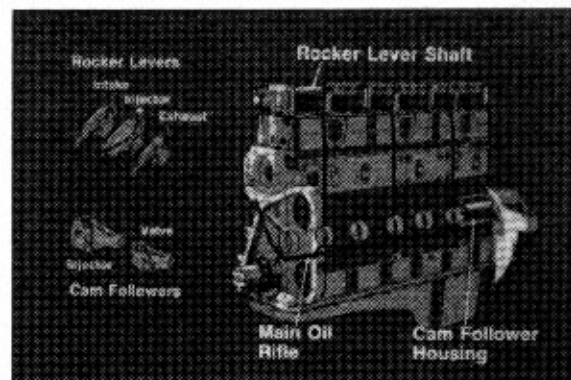
- 26) The oil then branches off the main oil rifle in cross-drillings, lubricating the main bearings and cam bushings.



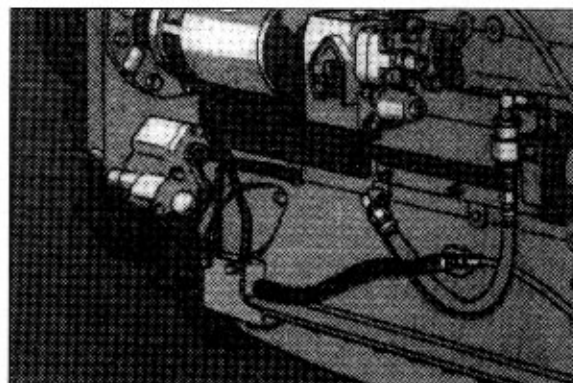
- 27) From the main journal in the crankshaft, oil is fed through a cross-drilling to the connecting rod journal. The oil then flows through an internal drilling in the connecting rod to lubricate the piston pins and bushings.



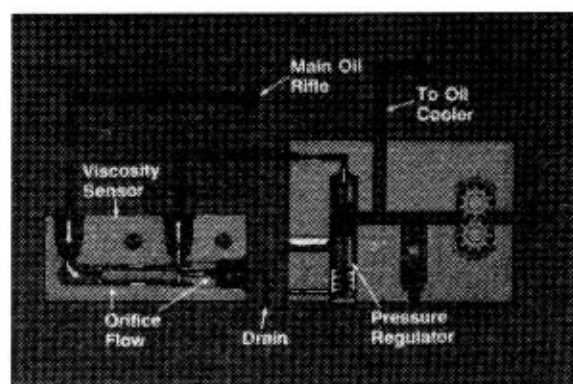
- 28) The oil that flows to the camshaft bushings also lubricates the camfollower and overhead assemblies through intersecting drillings at numbers 2, 4, and 6 camshaft bushings.



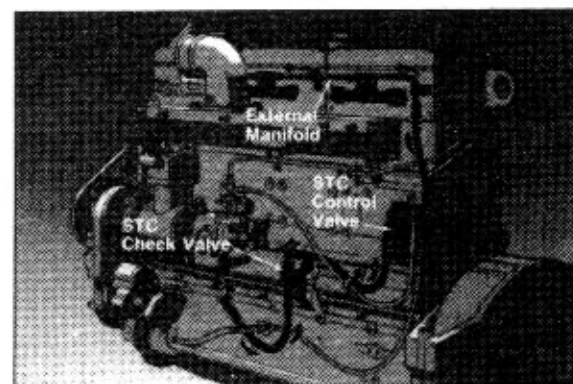
29) On N14 engines equipped with STC, the lubrication system supplies the STC system with the proper oil flow and pressure. This is accomplished through the help of a viscosity sensor, connected between the main oil rifle and the pressure-regulating valve in the oil pump.



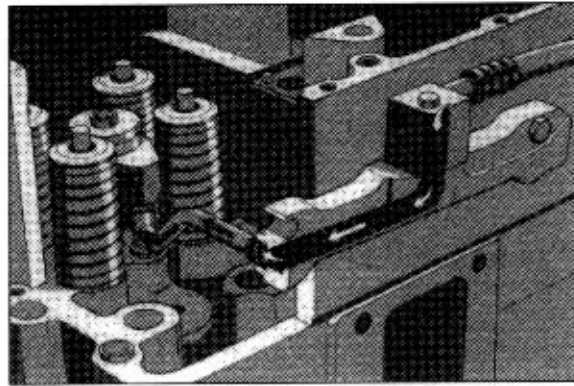
30) From the main oil rifle, the oil flows through the sensing line to the viscosity sensor. In the viscosity sensor, an orifice restricts the flow of oil, resulting in a pressure drop to the pressure regulator when the oil is cold. This action causes the main rifle oil pressure to increase, thereby supplying the STC tappets with the correct oil pressure. In addition, an orifice drain releases any pressure on the regulator when the engine is shut down. During normal engine oil operating temperature, the viscosity sensor affects neither the oil flow, nor the pressure, to the pressure regulator.



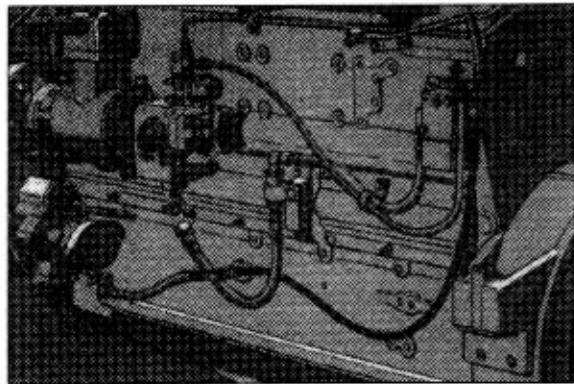
31) From the main oil rifle, oil flows through the STC check valve, to the STC valve, and on to the external manifold.



32) From the external manifold, oil flows through the connector to the internal jumper tubes and to the injectors.

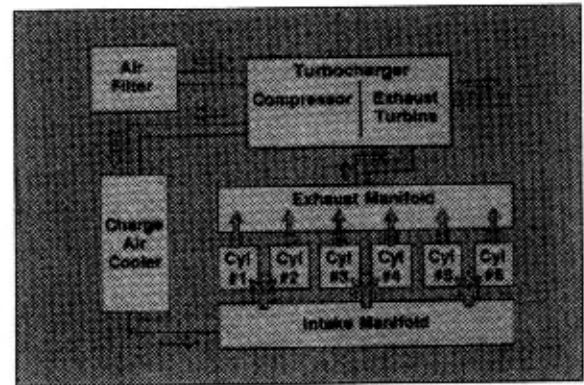


33) Finally, a limited amount of oil is returned from the STC valve to the sump by way of a drain-back bleed line.

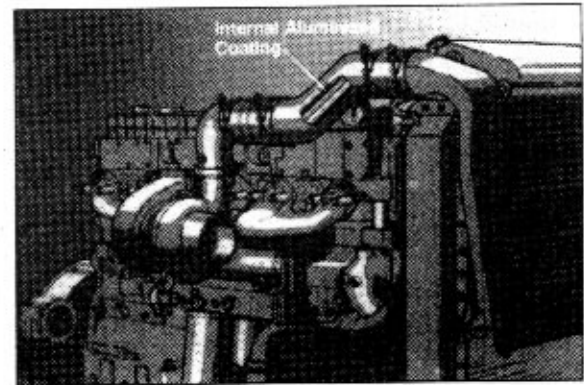


4. AIR SYSTEM

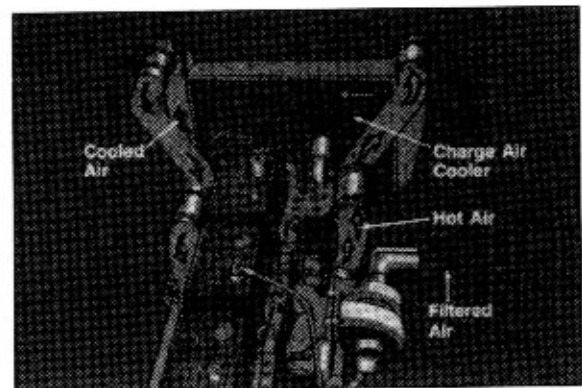
- 1) The N14 incorporates a charge-air cooling system for better control of intake temperatures, and reduced emissions.



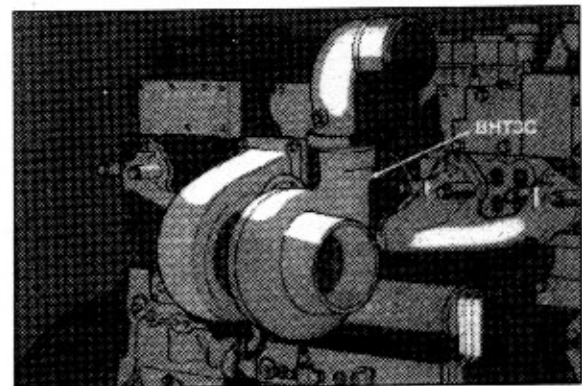
- 2) The charge-air cooler steel connecting piping has been internally aluminized to prevent corrosion. Hoses and clamps are also a special design to handle the high boost temperatures and pressures.



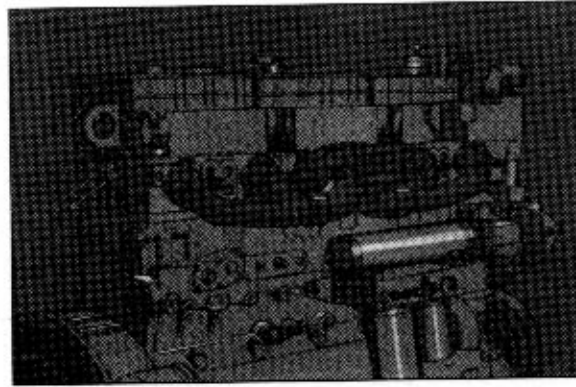
- 3) The charge-air cooler is mounted in front of the radiator. It is designed to significantly lower intake air temperatures.



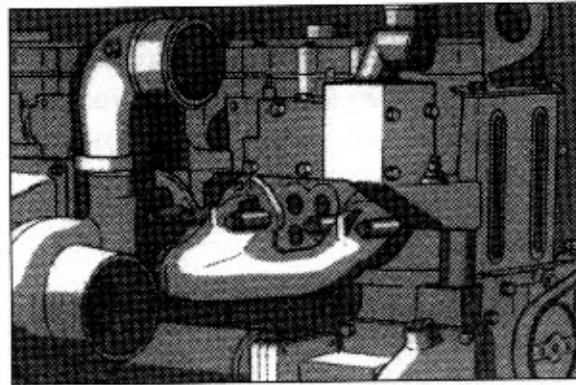
- 4) The N14 is fitted with the enhanced BHT3C turbocharger, which optimizes engine response, and reduces emission levels.



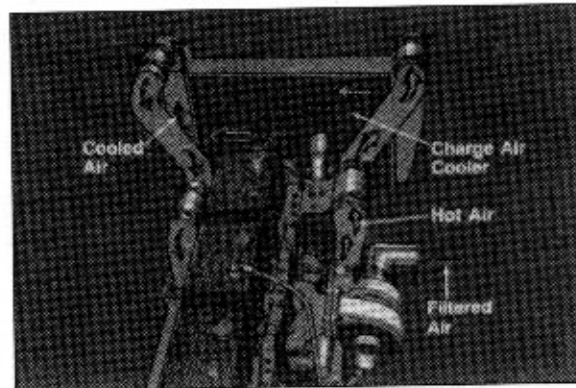
- 5) The exhaust manifold has also been changed to a new drop-center design. This design gives additional space around the water manifold, and provides more OEM accessory space.



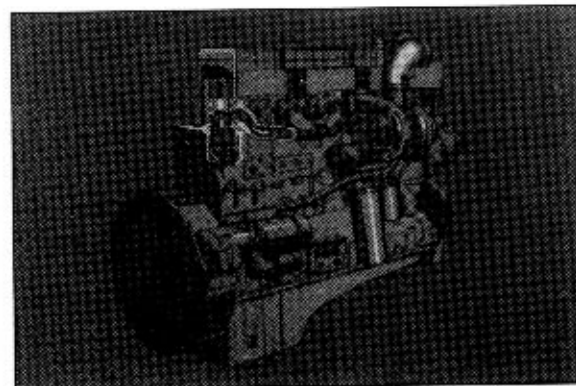
- 6) Spacers are now used on the exhaust manifold capscrews to ensure a more constant clamping force. The spacer reduces the amount of heat transferred to the capscrew, thus reducing capscrew growth.



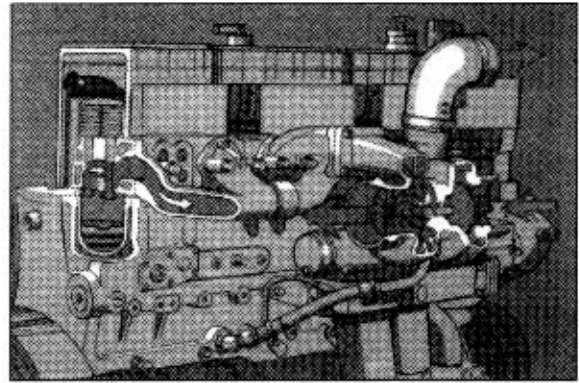
- 7) Let's follow the air flow through the N14. Air is drawn through the air cleaner by the turbocharger. The turbocharger compresses the air, causing the air to heat up. The air flows through the charge-air cooler, where it is cooled before going through the intake manifold and to the cylinders.



- 8) From the cylinders, the exhaust gases are directed into the turbocharger by the exhaust manifold.



- 9) The expanding exhaust gases turn the exhaust turbine wheel, which is on a common shaft with the intake compressor wheel. The spent exhaust gases then exit through the exhaust system.



5. FUEL SYSTEM

- 1) The fuel systems for the N14 PT-STC engine has not been changed from the fuel systems on previous engines. The fuel pump pulls fuel from the tank through the fuel filter. While in the pump, the fuel is regulated and governed. This fuel is then delivered to the injectors. Finally, any excess fuel flows through the injector fuel return line, back to the fuel tank.

