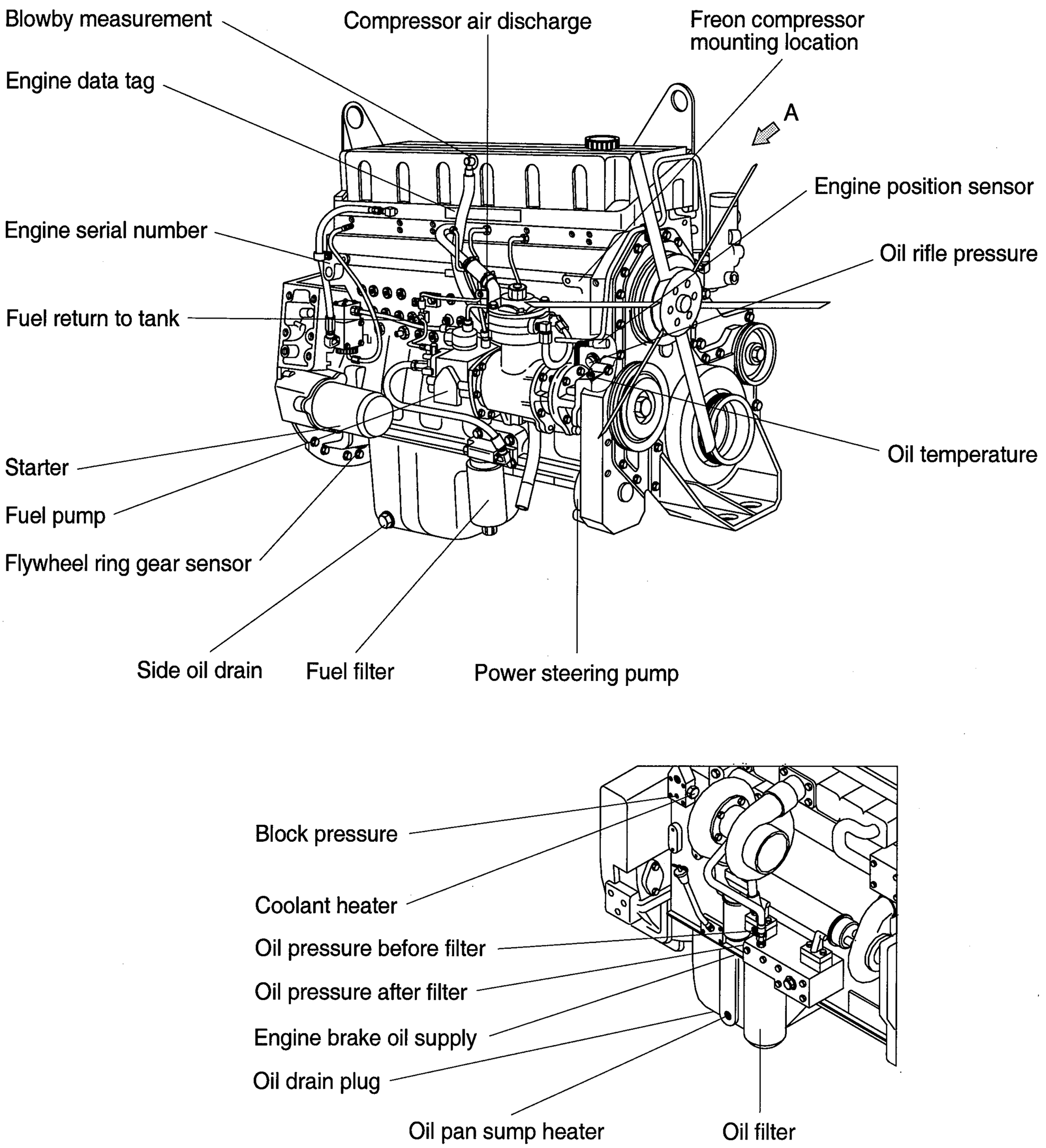
SECTION 2 ENGINE

GROUP 1 STRUCTURE AND FUNCTION

1. STRUCTURE

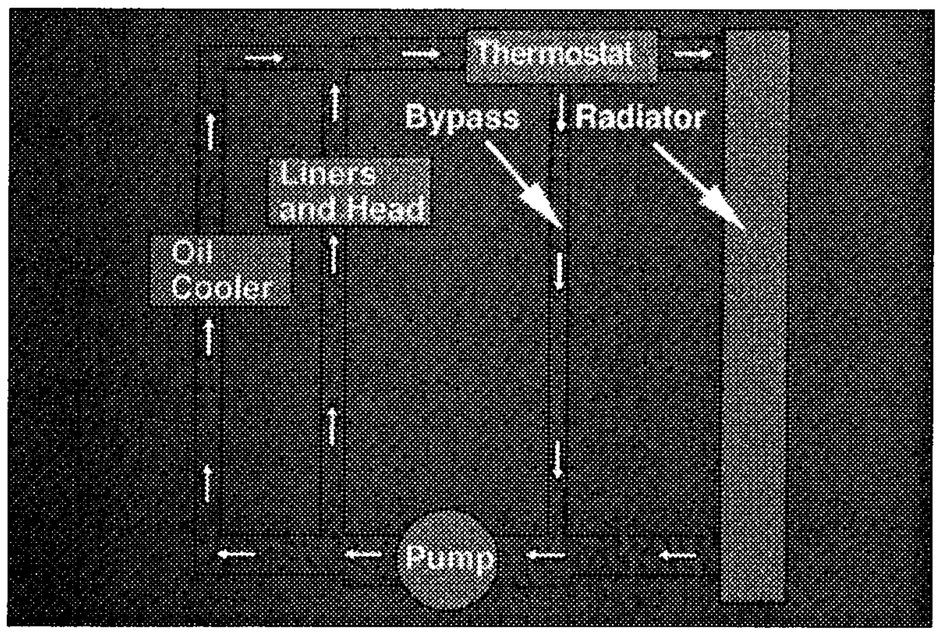


VIEW A

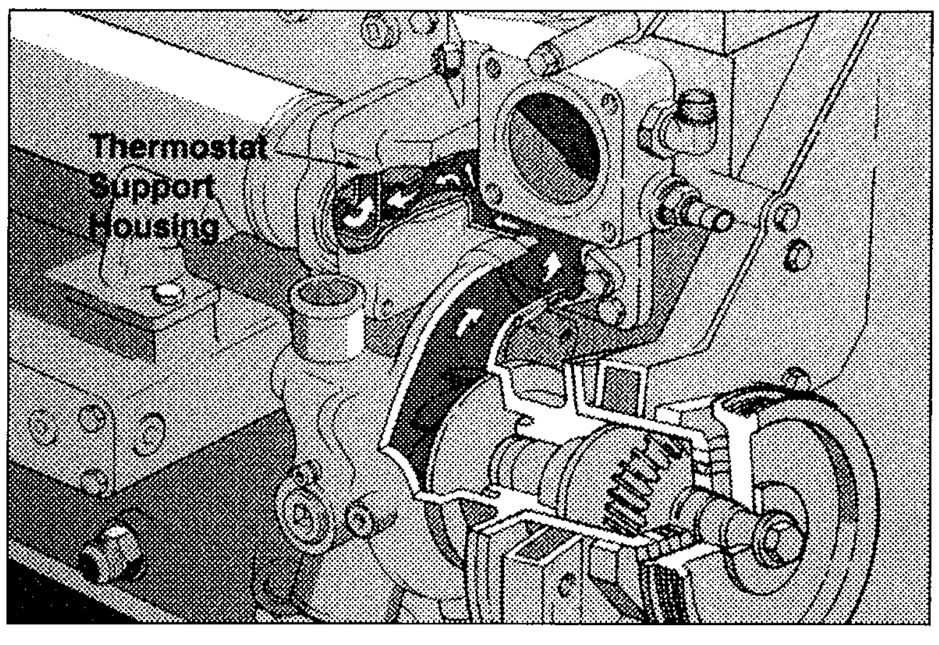
- Direct 4-stroke, 6-cylinders, water-cooling diesel engine in installed, cylinder block and cylinder head are made of case iron and turbocharger is attached.

2. COOLING SYSTEM

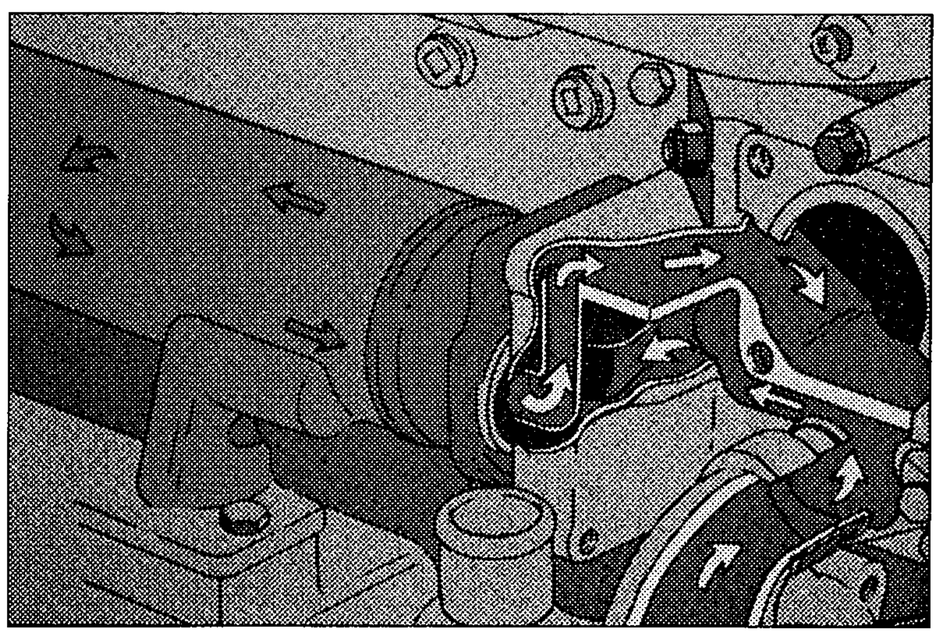
1) This illustration depicts the conventional high-flow cooling system in the M11 Plus. The coolant has two sets of coexisting pathways. The coolant path diverges once to direct coolant into either the oil cooler or the lower coolant manifold. Later in the coolant flow, the thermostat directs coolant to either return to the engine flow, or into the radiator for cooling.



2) After passing through the header plate, coolant is directed to one of two pathways. Most of the coolant passes through to the supply side of the lower coolant manifold cavity. The rest of the coolant passes through the thermostat support housing base into the oil cooler.

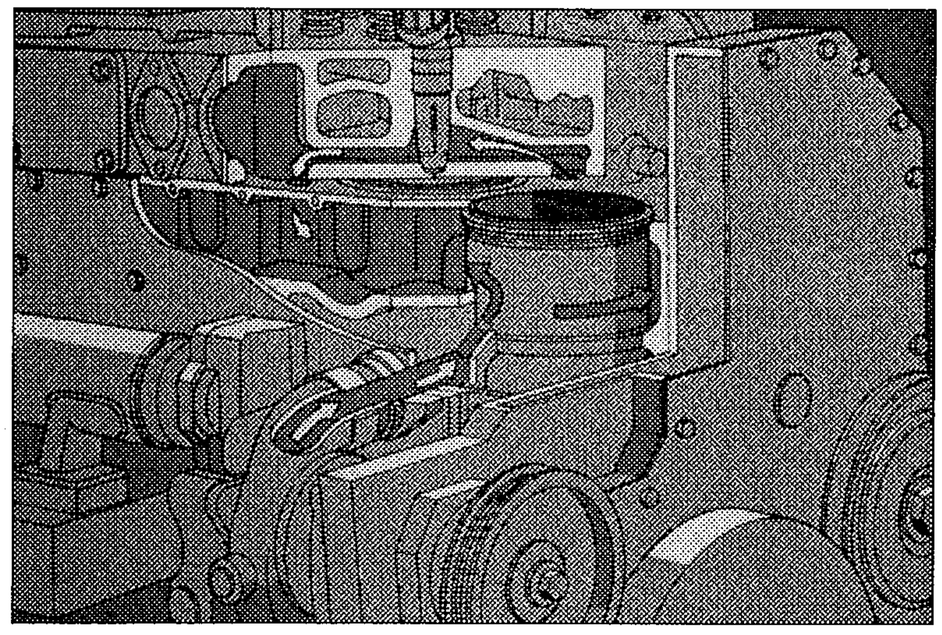


3) The oil cooler is a two-pass type. Coolant in the support housing flows through one side of the cooler and back through the other side of the cooler to return to the thermostat support housing base.



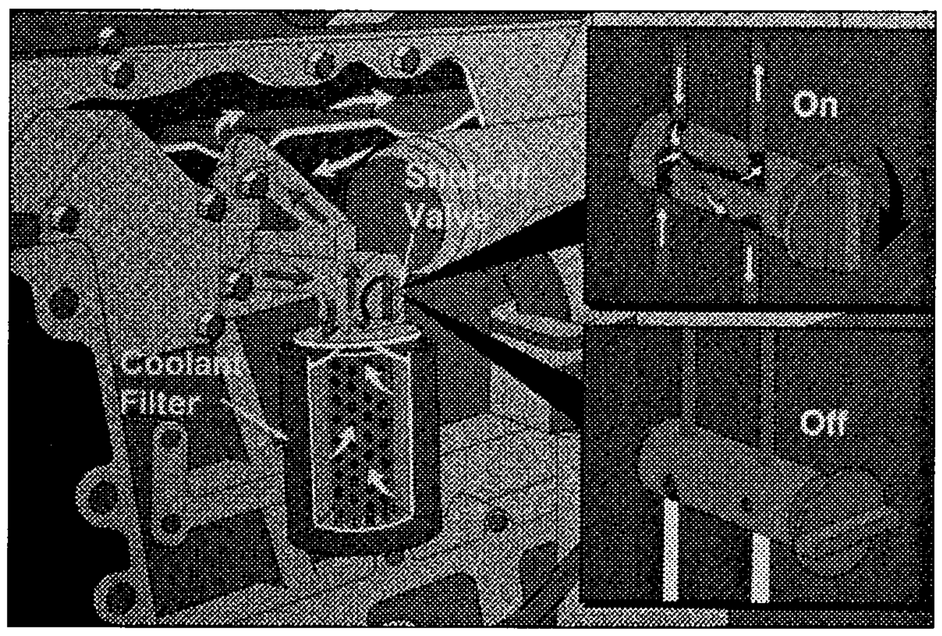
4) The coolant that is delivered to the lower coolant manifold flows to the cylinder liner cavities. It circulates around the liners and travels upward into the cylinder heads.

After flowing from the left side of the cylinder head to the right side, the coolant flows down into the return cavity of the upper coolant manifold.

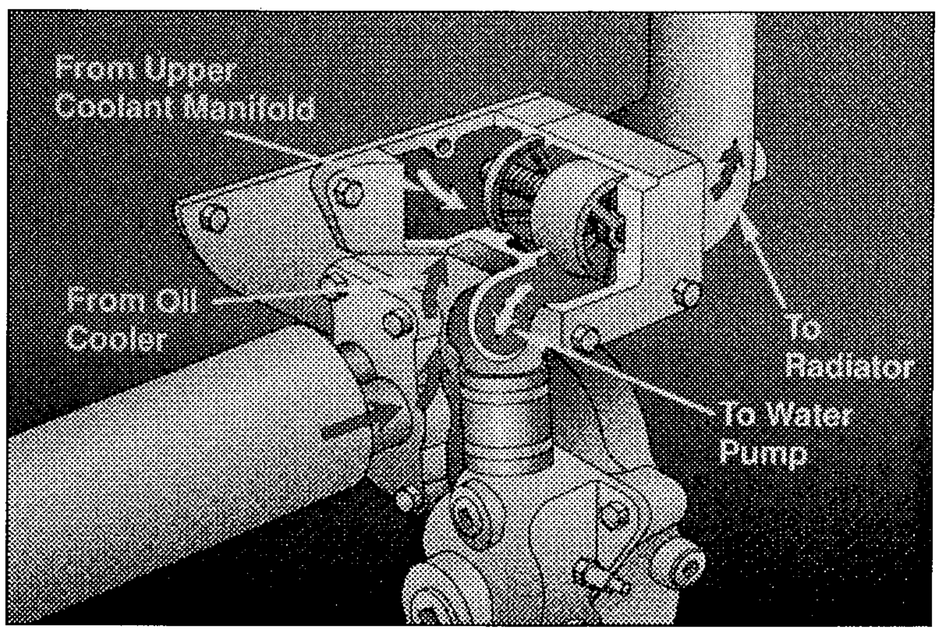


5) While the coolant is flowing through the lower coolant manifold, cylinder liner cavities, cylinder head, and upper coolant manifold, some is also being treated in the coolant treatment filter. The coolant filter is located near the oil cooler on the water header plate, and sends filtered coolant directly into the upper coolant manifold from the lower manifold.

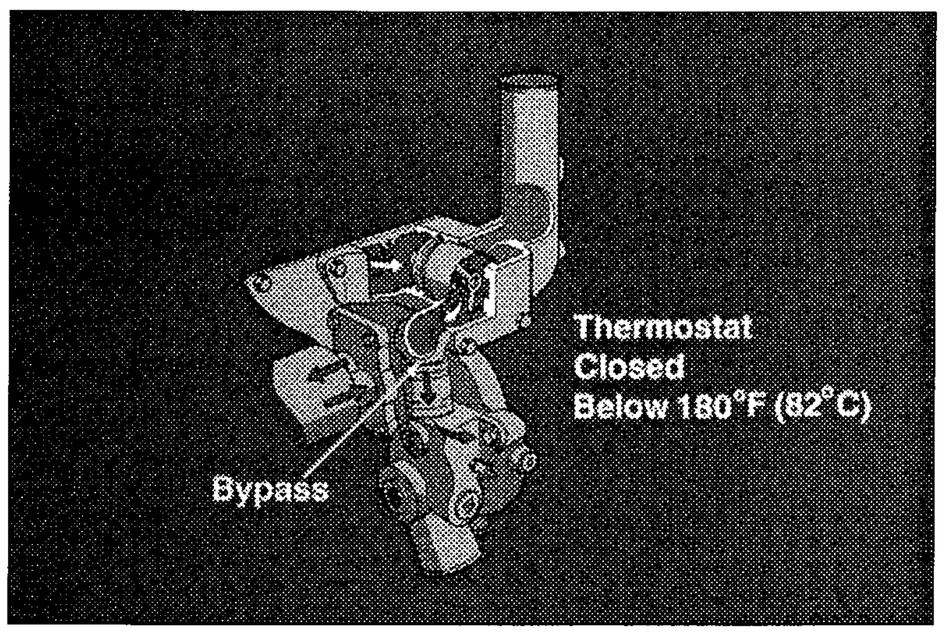
The coolant treatment filter incorporates a manual shut-off valve. In the ON position, this valve directs coolant flow to the coolant filter. When rotated to the OFF position, the flow path to the coolant filter is closed. This allows the filter to be replaced with minimal coolant loss.



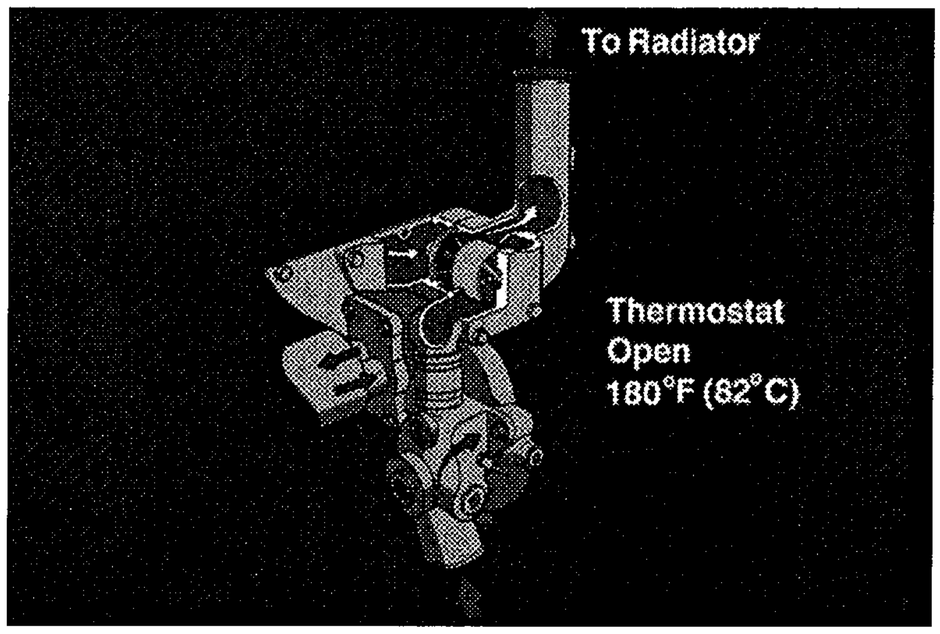
6) From the upper coolant manifold, coolant is directed back into the thermostat support housing base to mix with the coolant returning form the oil cooler. At this point in the the flow, the coolant thermostat senses the temperature of the coolant and directs it into one of two paths, depending on the coolant temperature.



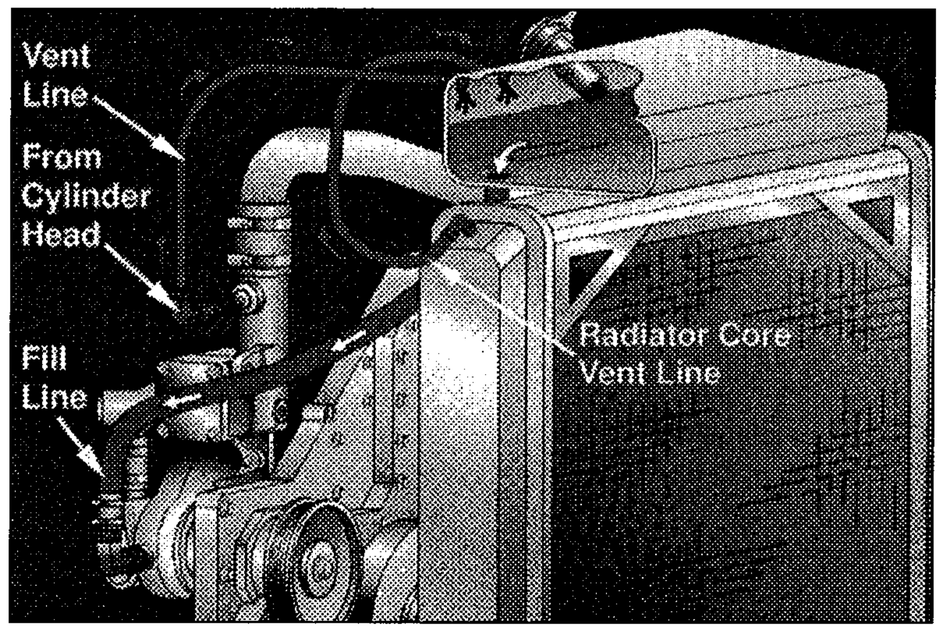
7) When the coolant temperature is below approximately 82°C(180°F), the thermostat is closed and all coolant flow is directed through the bypass tube to flow back into the water pump.



8) When the coolant temperature rises above approximately 82°C(180°F) in the thermostat support housing base, the thermostat begins to open and directs coolant flow to the radiator. As the engine temperature increases to approximately 94°C(202°F), the thermostat extends fully and shuts off the bypass flow to the water pump. All the coolant is then directed to the radiator before flowing back to the water pump inlet.

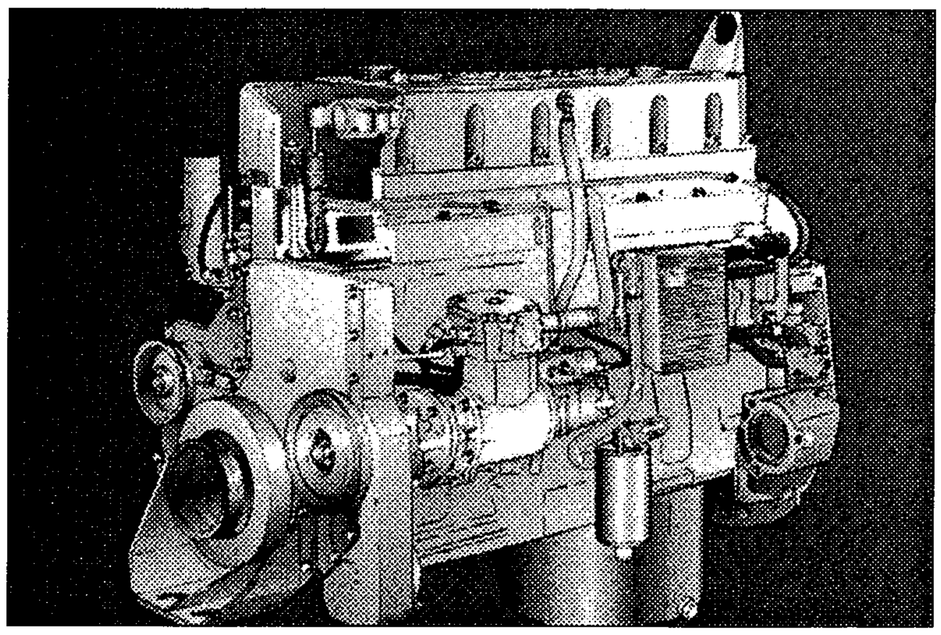


9) To purge air from the cooling system, there is a coolant vent line. The vent line allows a small amount of coolant to flow to the top tank of the radiator for deaeration. When the air has exited the coolant system, the coolant flows through the fill line and back to the water pump, as needed. The top tank provides expansive space and reserved volume area for the coolant.

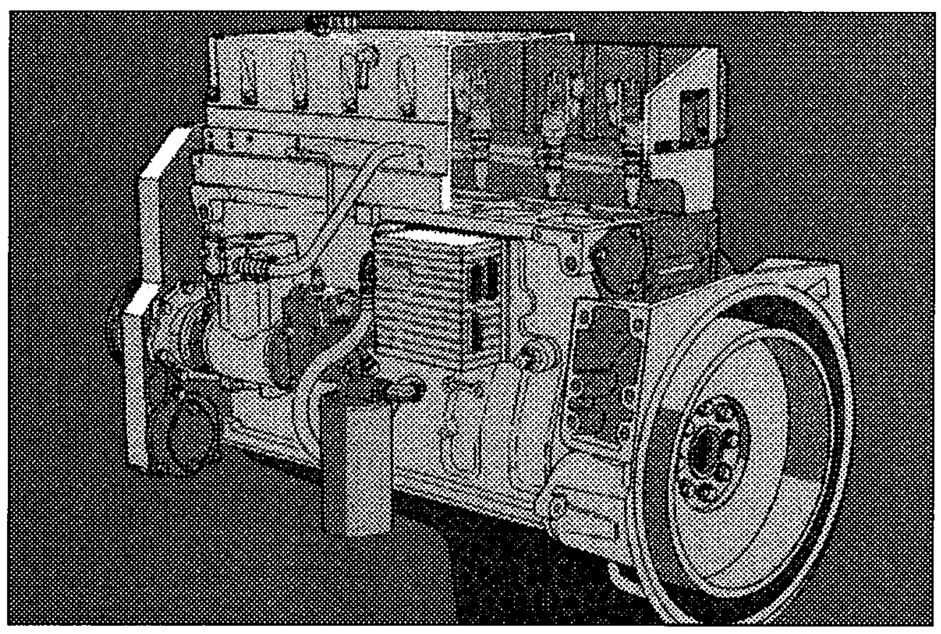


3. FUEL SYSTEM

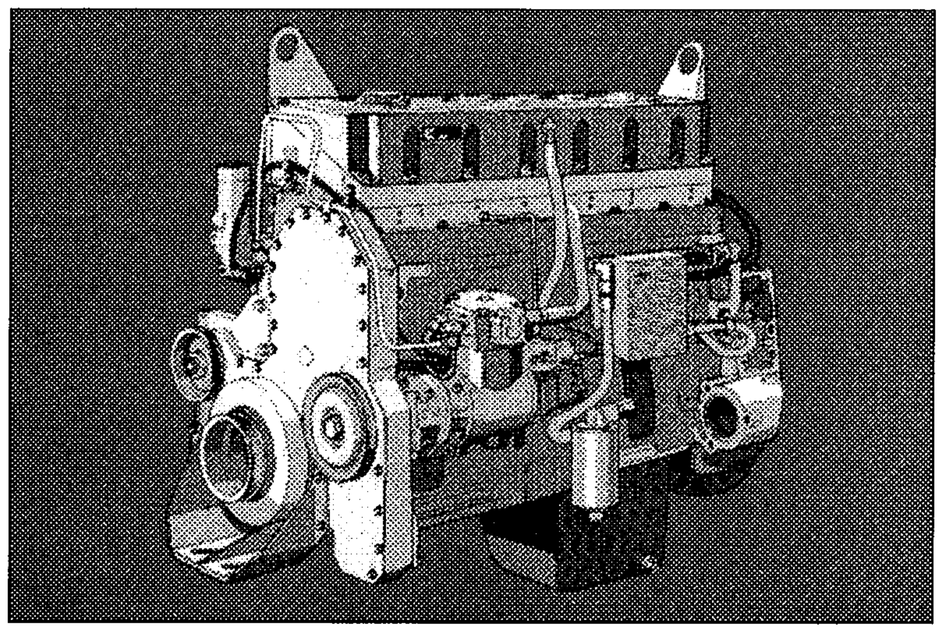
1) From the cooling plate, fuel travels to the fuel filter. The filter removes water and debris from the fuel before sending the fuel on to the fuel pump and then on to the injectors.



2) At the injector, fuel is precisely metered into the cylinders for combustion. A portion of the fuel, however, is used for timing, and is returned to the fuel tank through the fuel drain return.



3) The M11 Plus has evolved from an uncompromising research and development program with a dedication to performance, economy, and quality. This solid preparation brings you the top-end power, low-end torque, and excellent fuel economy.

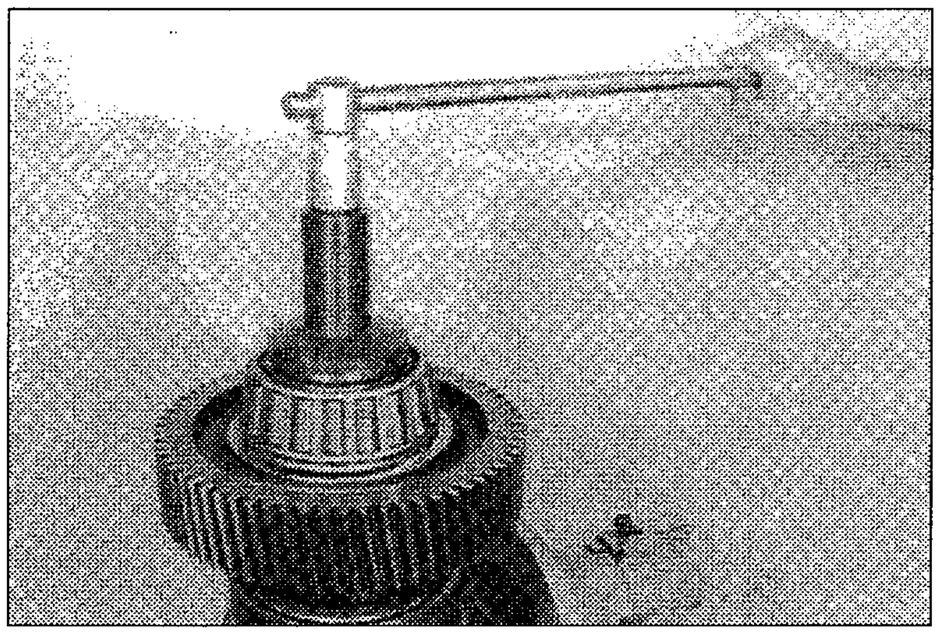


② Loosen slotted nut.

※ Slotted nut is secured with loctite.
To prevent the damage of the thread, heat slotted nut prior to loosen it(About 120℃).

※ Special tool

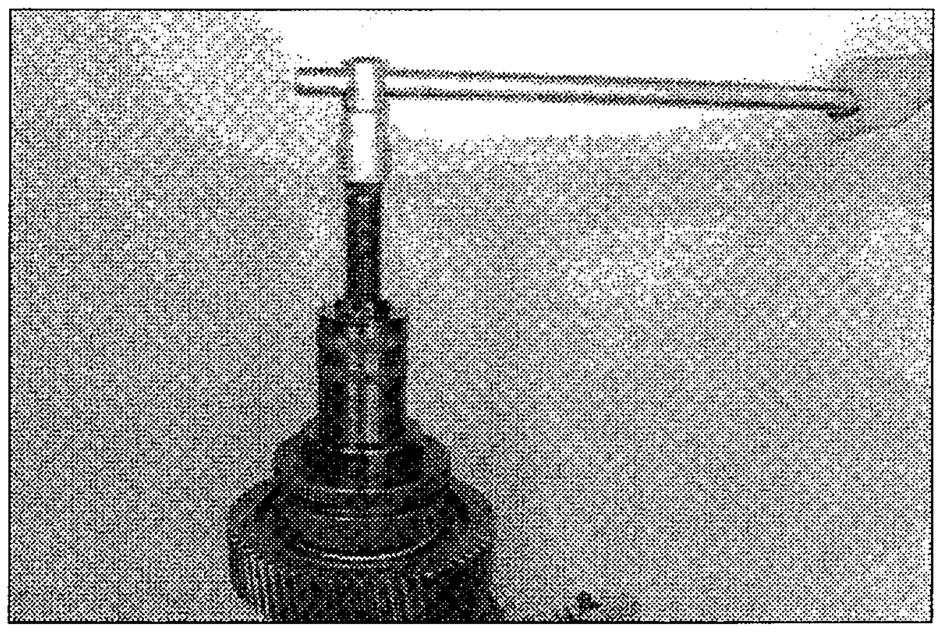
Hook spanner	5870 401 110
Hot-air blower 220V	5870 221 500
Hot-air blower 110V	5870 221 501



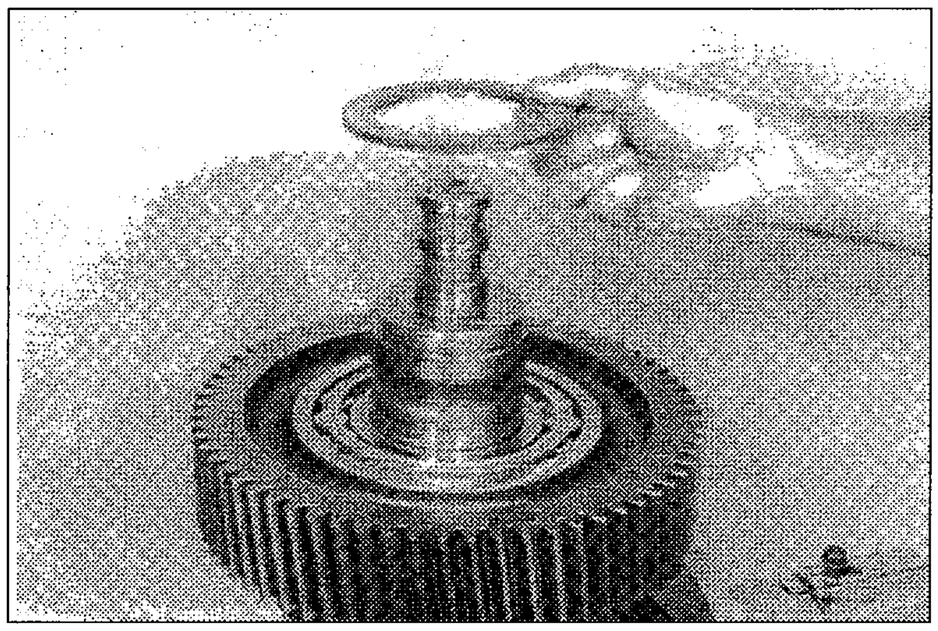
③ Pull off tapered roller bearing.

※ Special tool

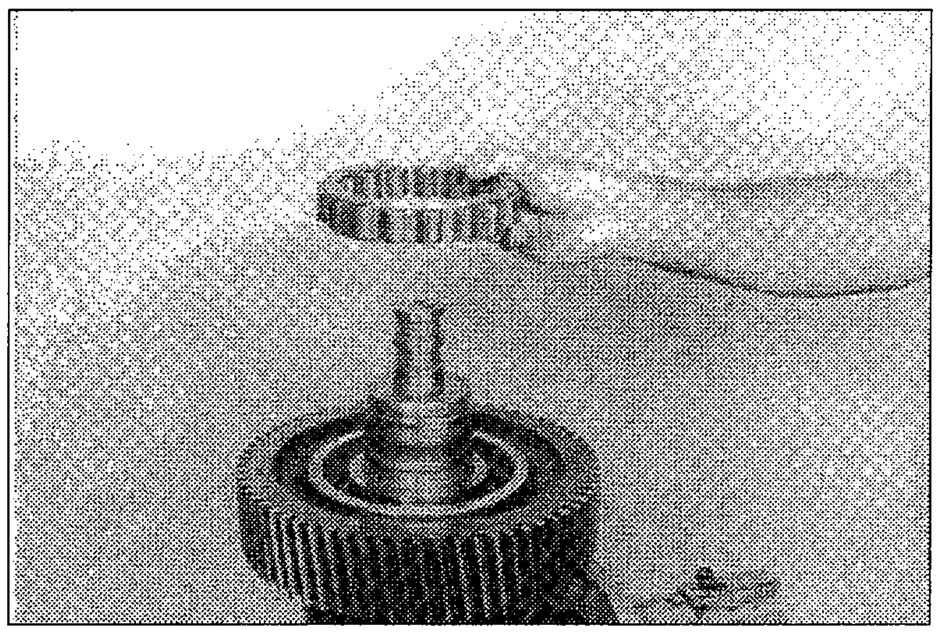
Grab sleeve	5870 003 030
Reducer	5870 003 011
Basic set	5870 002 001



④ Remove flanged disk.

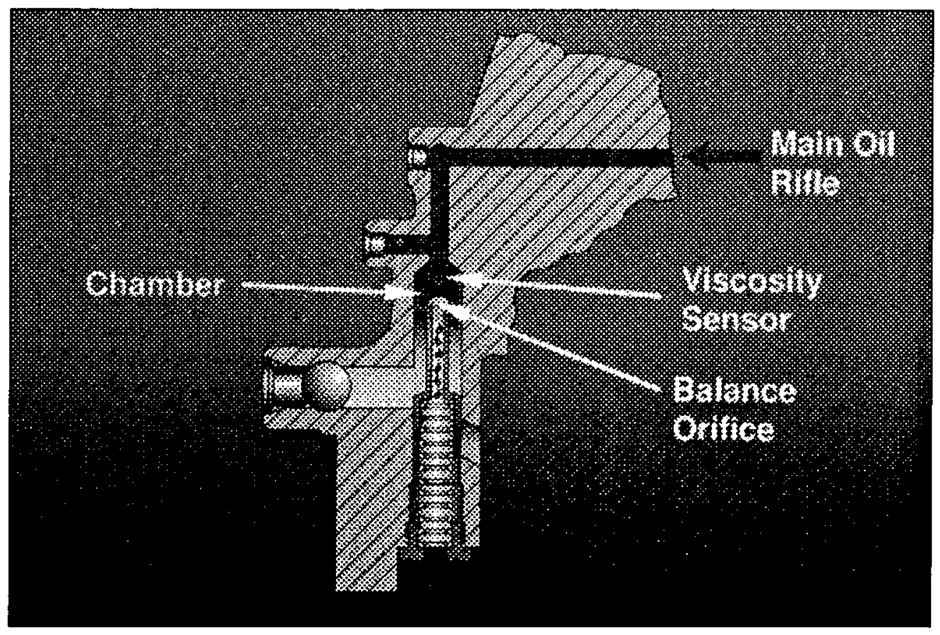


⑤ Remove upper roller bearing.

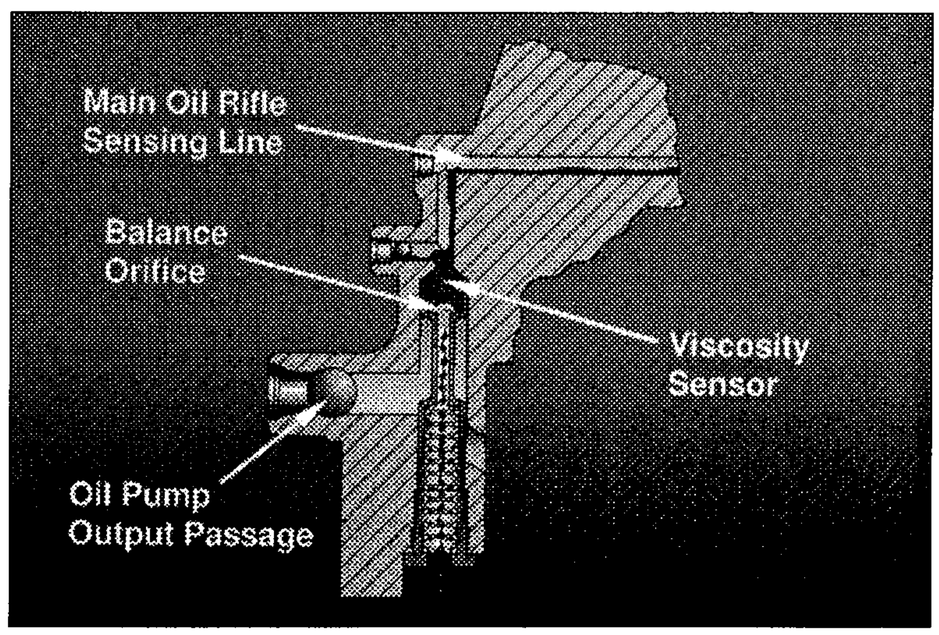


4) The regulator spool valve is held on its seat by spring pressure. Oil from the signal line flows through the viscosity sensor into the chamber above the spool valve and then exits through the balance orifice. Since the balance orifice is smaller than the orifice in the viscosity sensor, pressure will build in the chamber above the spool valve. The pressure in this chamber controls the position of the spool

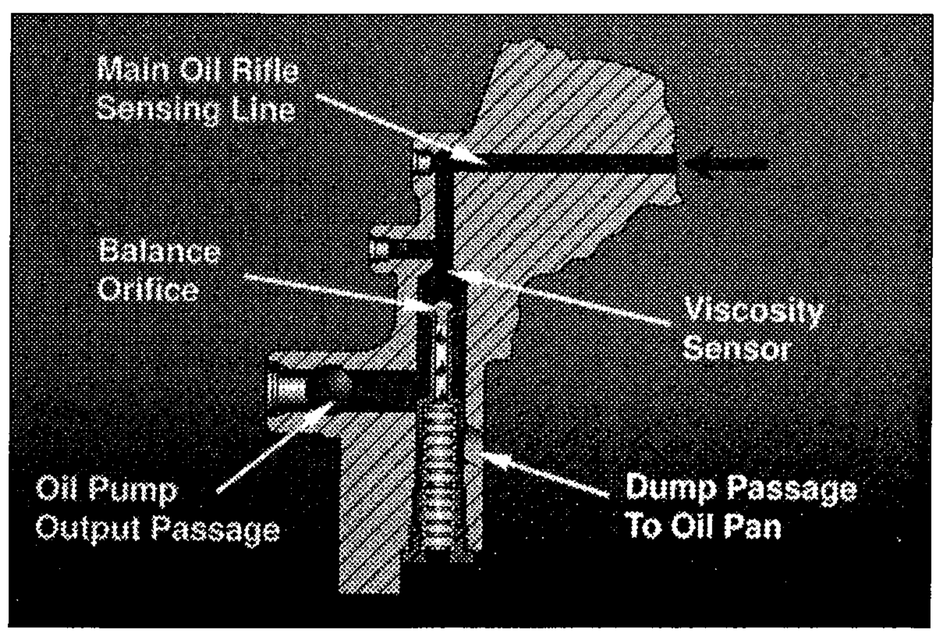
The viscosity sensor regulates the flow of oil delivered to the regulator valve to better control oil pressure when the oil is cold.
This sensor increases the oil flow to engine components during start-up and warm-up conditions.



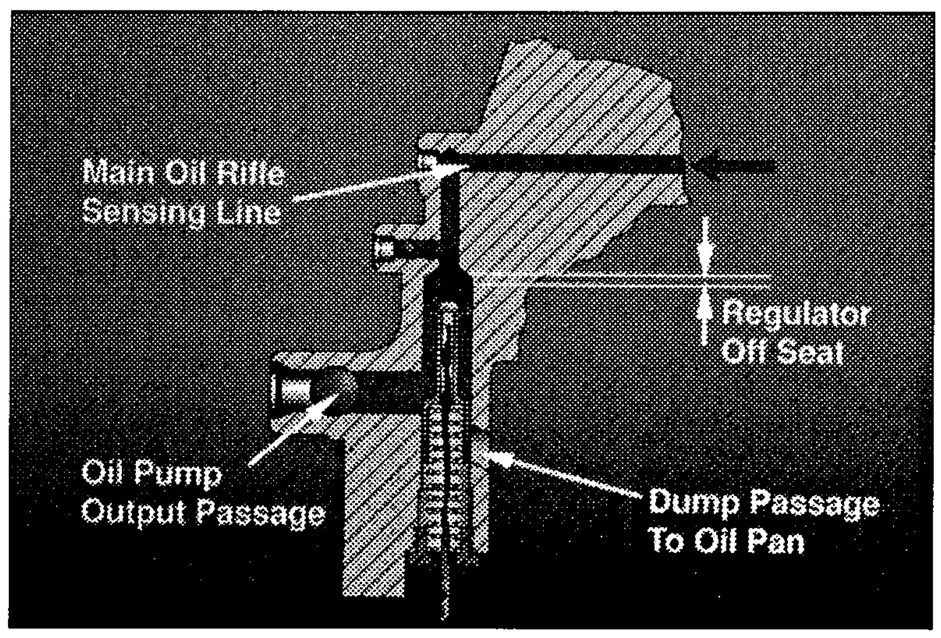
5) Let's take a closer look at how the viscosity sensor works. Once the engine has been shut down, oil drains from the upper cavity of the pressure regulator valve, through the balance orifice.



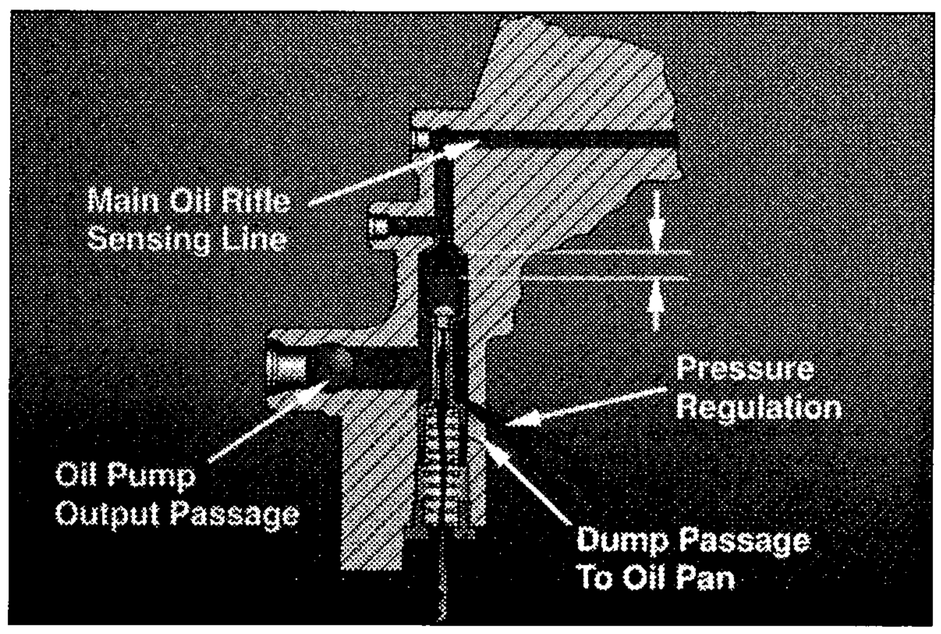
6) At start-up, when the engine is cold, the oil will be viscous and will not flow through the viscosity sensor freely. Oil entering the valve chamber will escape through the balance orifice at a quick enough rate to prevent significant pressure from building in the valve chamber. With an absence of pressure in the chamber, the valve will remain on its seat and not relieve oil pressure.



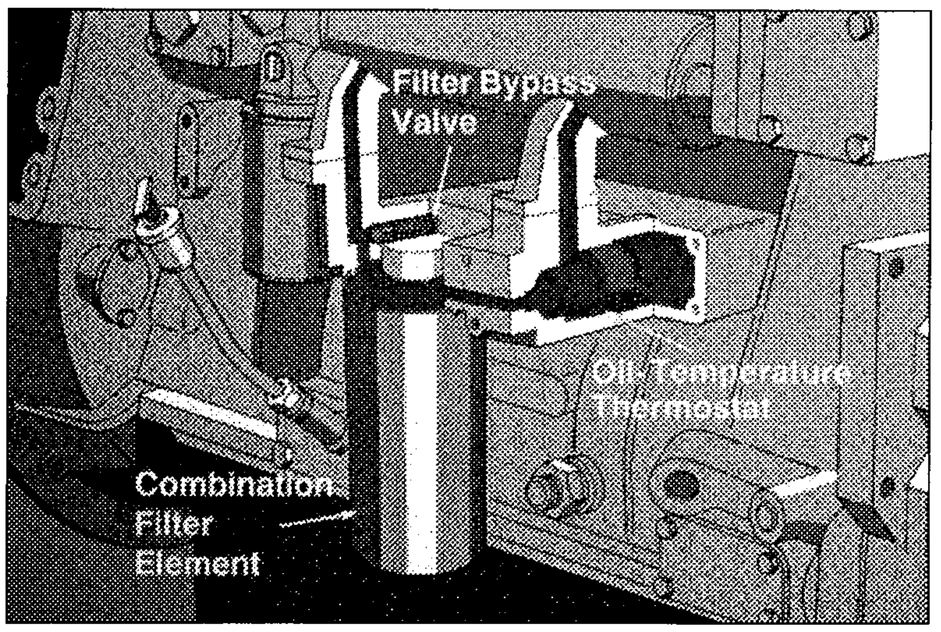
7) As the oil pressure and temperature increase, more oil will flow through the viscosity sensor into the valve chamber. At a certain point, the flow entering the chamber will be greater than can escape through the balance orifice and pressure will start to build in the chamber. This pressure in the chamber will force the spool valve off its seat and start the system pressure regulation.



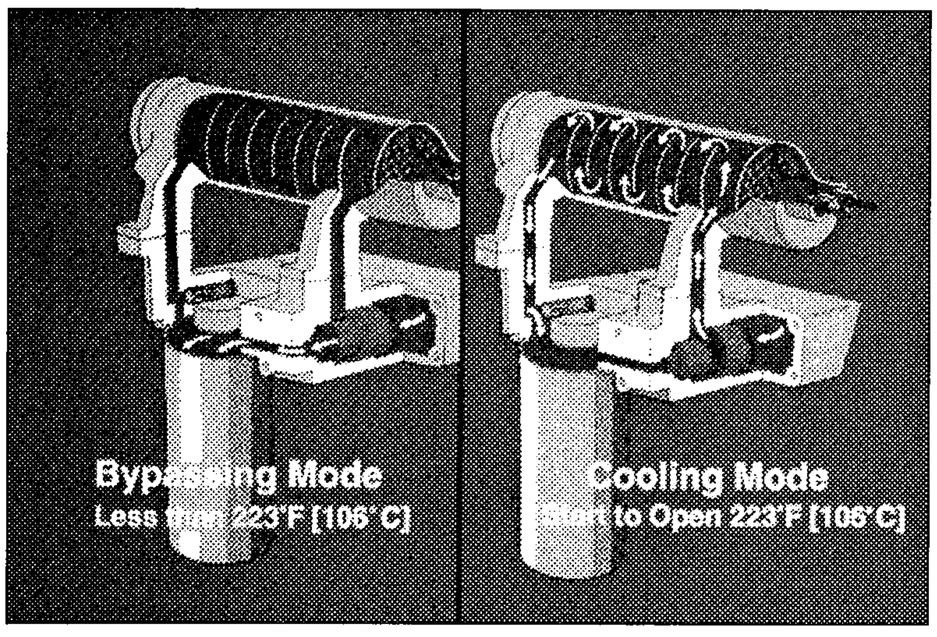
8) At normal engine operating temperature, the sensor does not restrict the oil flow. The balance orifice allows a continuous flow through the regulator, but provides sufficient restriction to assure high pressure in the valve chamber. When the oil pressure reaches operating levels, the spool valve relieves sufficient flow to control and maintain operating oil pressure.



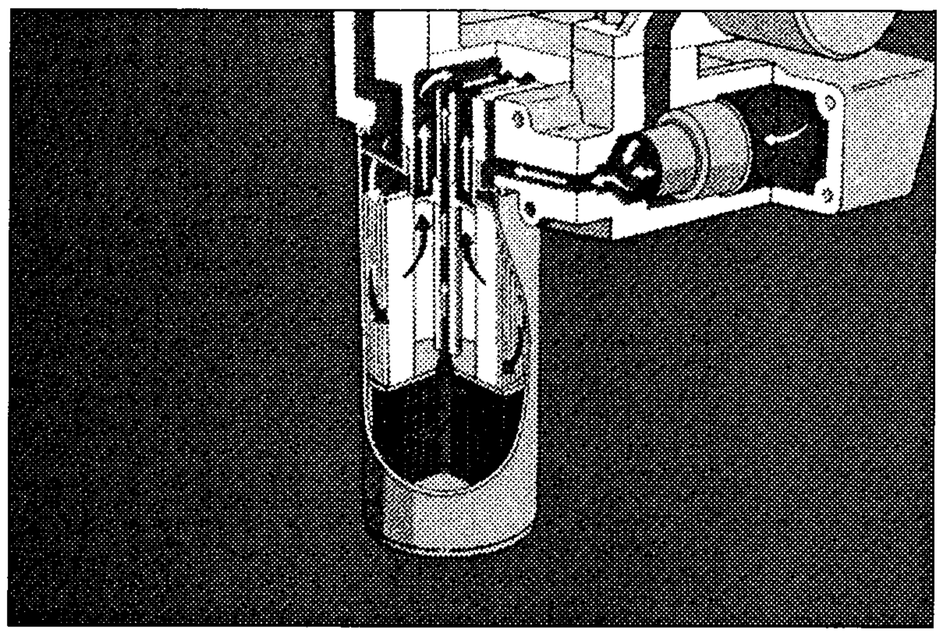
9) The filter head includes the following components:
   - Oil-temperature thermostat
   - Combination filter element
   - Filter bypass valve



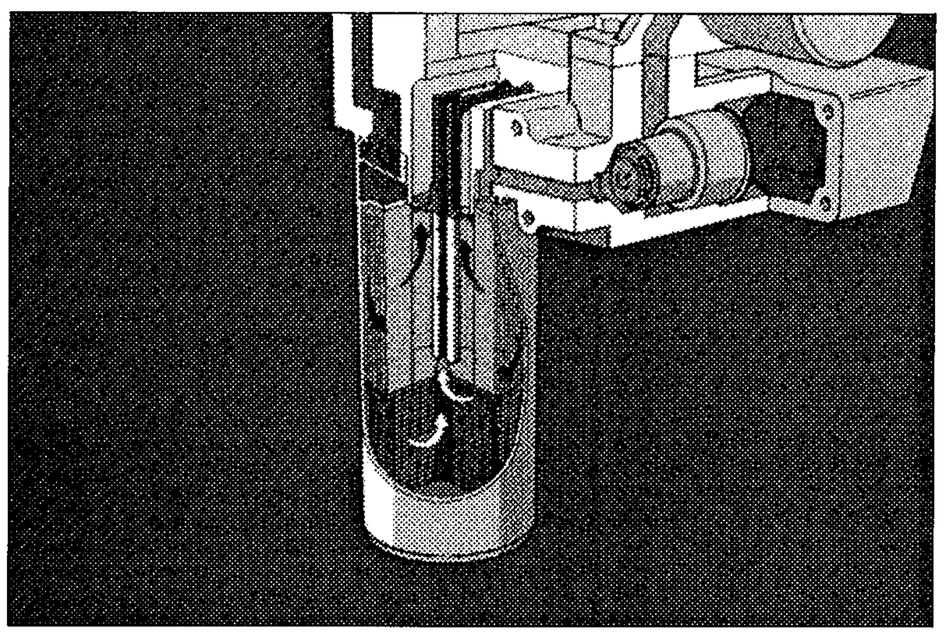
10) The thermostat in the filter head allows oil to bypass the oil cooler when the oil is cold. The thermostat is calibrated to begin to open and allow oil cooling when the oil temperature reaches 106°C(223°F). This feature increases operating efficiency when the engine is cold. The oil that bypasses the oil cooler flows to the oil filter element.



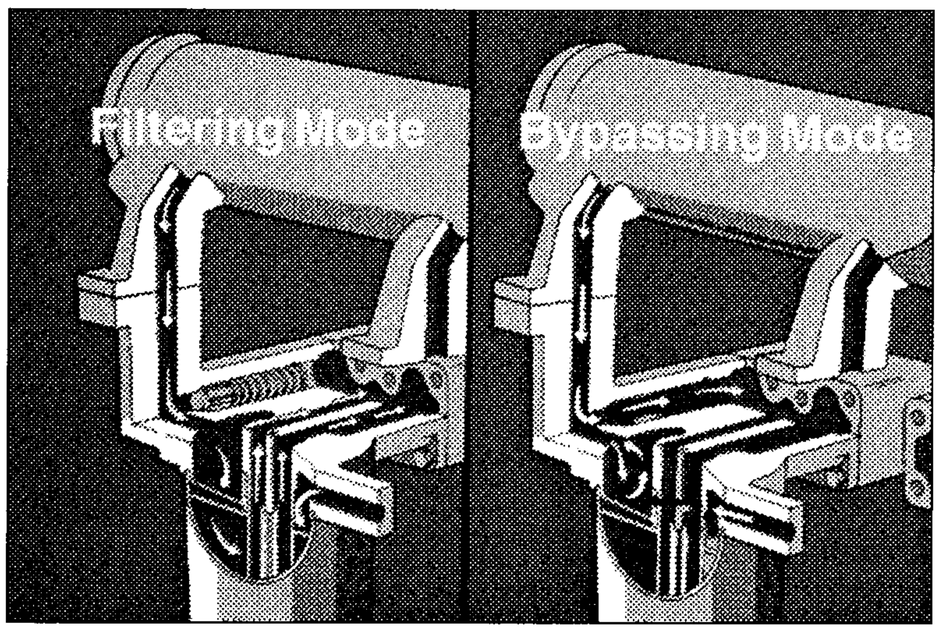
11) The Fleetguard LF3000 Combo oil filter element provides both full-flow filtration at 30 microns and bypass filtration at 10 microns in the same filter canister.



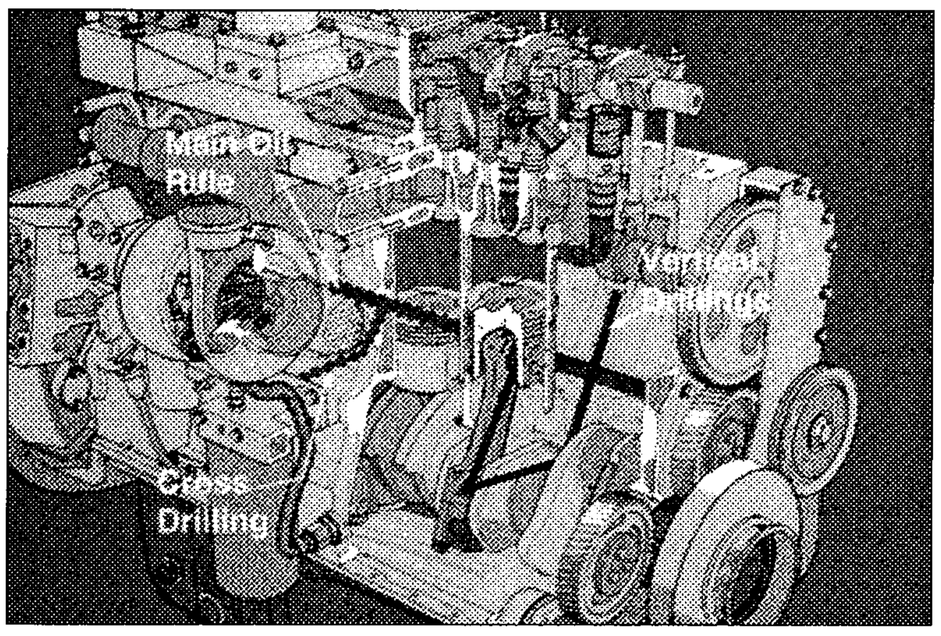
12) The bypass filtration flow ratio is controlled by an orifice in the filter head. This is then directed to the oil pan through a passage in the oil cooler support housing.



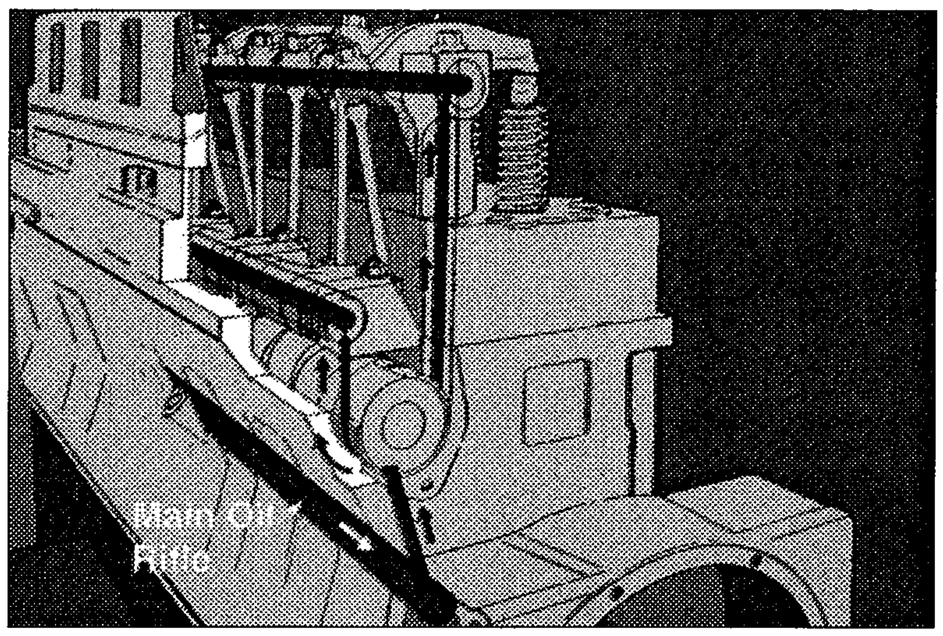
13) The oil filter bypass valve is designed to provide precise control of bypass oil flow. It opens when the pressure differential across the oil filter element is greater than 655kPa (95psi).



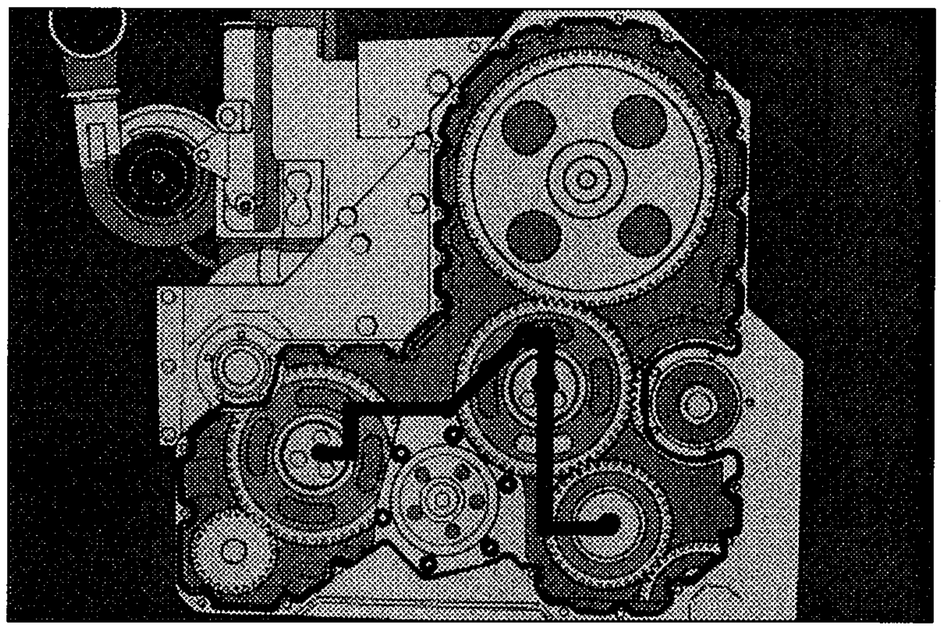
14) Seven vertical drillings intersect the main oil rifle to provide oil flow to the main bearings. Drillings in the crankshaft route oil flow from the main bearing to the rod bearing and from the connecting rod to the piston pin.



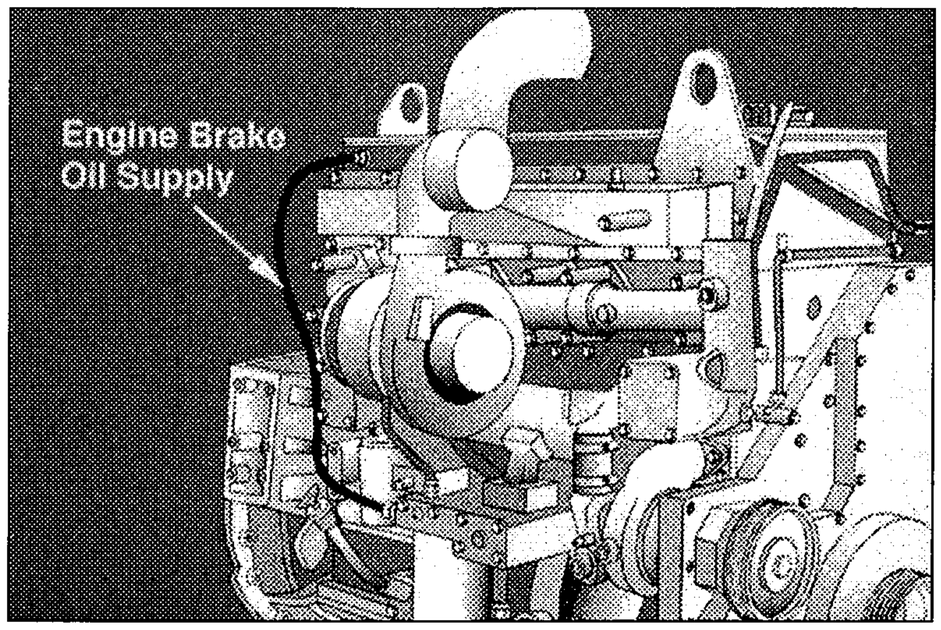
15) These seven vertical drillings also provide flow to the cam bushings. Each cam bushing has a groove around the outer diameter that routes oil to drillings supplying the cam follower shafts and the rocker lever shafts. However, oil to the rocker shafts are fed by the rear pedestal of the front and rear rocker lever sets. The rocker levers and cam followers receive oil flow from the drillings in the shafts.



16) In the front gear train, the three idler gear shafts receive oil flow from drillings in the block that intersect with the vertical drilling supplying the number one main bearing.

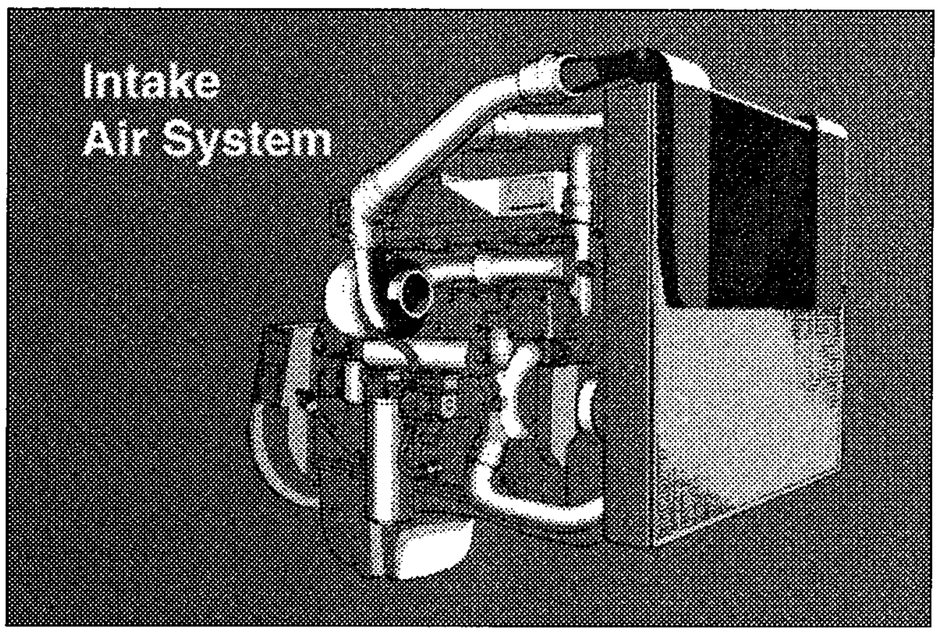


17) The engine brake is supplied oil from the filter side of the filter head through an external line. It then is directed to the oil control solenoid and on the the master and slave pistons.

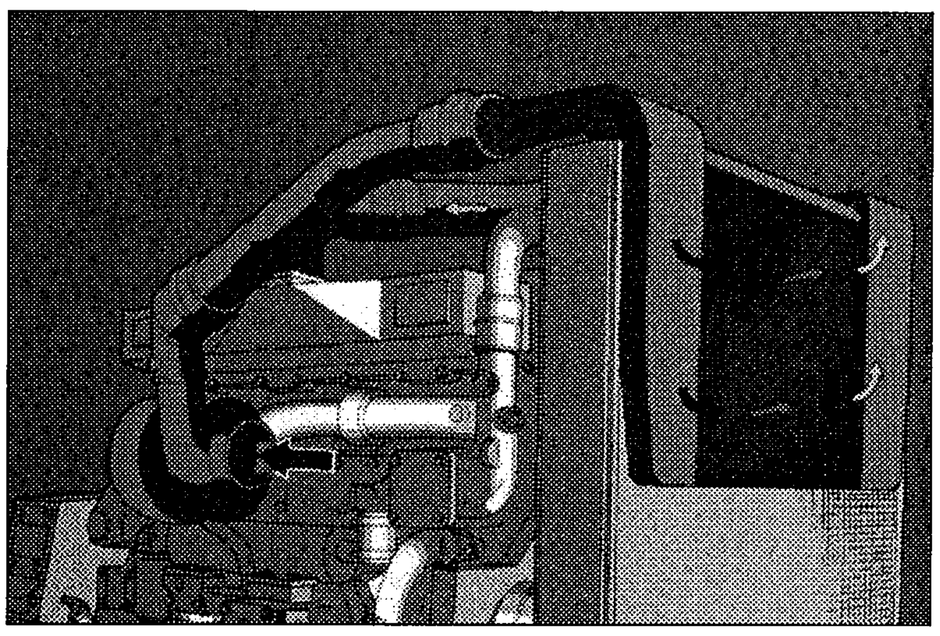


5. INTAKE AND EXHAUST SYSTEM

1) The M11 Plus air intake system uses the Holset HX55 turbocharger and a charge-air cooler.



2) Pressurized air form the turbocharger is directed to a Charge-Air cooler located in front of the vehicle radiator. After passing through the Charge-Air cooler, the cooled air is directed to the intake manifold. This system provides lower intake air temperatures and reduces engine emissions.



3) The exhaust manifold is new on the M11 Plus. The manifold features a monarch type flange design. The manifold has increased wall thickness for improved durability. The end sections connect the center section with a slip joint.