CATERPILLAR®

RENR5078-06

Systems Operation, Testing and Adjusting

3500B and 3500C Marine Engines

S/N S2D00001-UP (3508B engine)
S/N S2K00001-UP (3512B engine)

Use the bookmarks for navigation inside of the manual

CATERPILLAR®

Systems Operation
3500B and 3500C Marine Engines
Media Number -RENR5078-06 **Publication Date -01/10/2009** **Date Updated -06/10/2009**

i02217884

Cold Cylinder Cutout

SMCS - 1901

The engine uses a strategy for the cold cylinder cutout to reduce white exhaust smoke after start-up and during extended idling in cold weather.

During a cold start and/or extended periods at low idle, the engine's Electronic Control Module (ECM) turns off one unit injector at a time in order to determine if each cylinder is firing by monitoring the change in the fuel rack. If a cylinder is firing, the ECM turns on the injector. If a cylinder is not firing, the injector is turned off. This cold cylinder cutout provides the following benefits: reduction of white smoke, improved engine starting, reduction in the use of ether injection and reduction of warm-up time.

Note: During operation of the cold cylinder cutout, the engine may seem to misfire. This is normal. No corrective measures are necessary.

The cold cylinder cutout is activated after all of the following conditions are met:

- The cold cylinder cutout is programmed to ENABLE.
- The engine speed is equal to high idle or below high idle.
- The fuel rack is less than 13 mm (0.50 inch).
- The jacket water coolant temperature is below 63 °C (145 °F).

The cold cylinder cutout strategy is activated ten seconds after the engine starts and the engine reaches idle speed or three seconds after ether injection is completed.

The cold cylinder cutout is deactivated if any of the following conditions are met:

- The cold cylinder cutout is disabled with the Caterpillar Electronic Technician (Cat ET).
- The jacket water coolant temperature rises above 70 °C (158 °F).
- The cylinder cutout test is activated.
- The ether injection is used.
- The coolant temperature sensor has failed.

If the fuel rack is greater than 13 mm (0.50 inch), the cold cylinder cutout deactivates for three seconds.

The cold cylinder cutout will deactivate for three seconds when the engine speed varies by more than ± 50 rpm as the cold cylinder cutout begins. A new engine speed is established when the cold cylinder cutout reactivates.

The cold cylinder cutout deactivates for 30 seconds when the engine speed is at low idle for ten seconds and the engine speed falls by more than 50 rpm below low idle.

CATERPILLAR®

Systems Operation
3500B and 3500C Marine Engines
Media Number -RENR5078-06 **Publication Date -01/10/2009** **Date Updated -06/10/2009**

i02388972

Electronic Control System Operation

SMCS - 1901

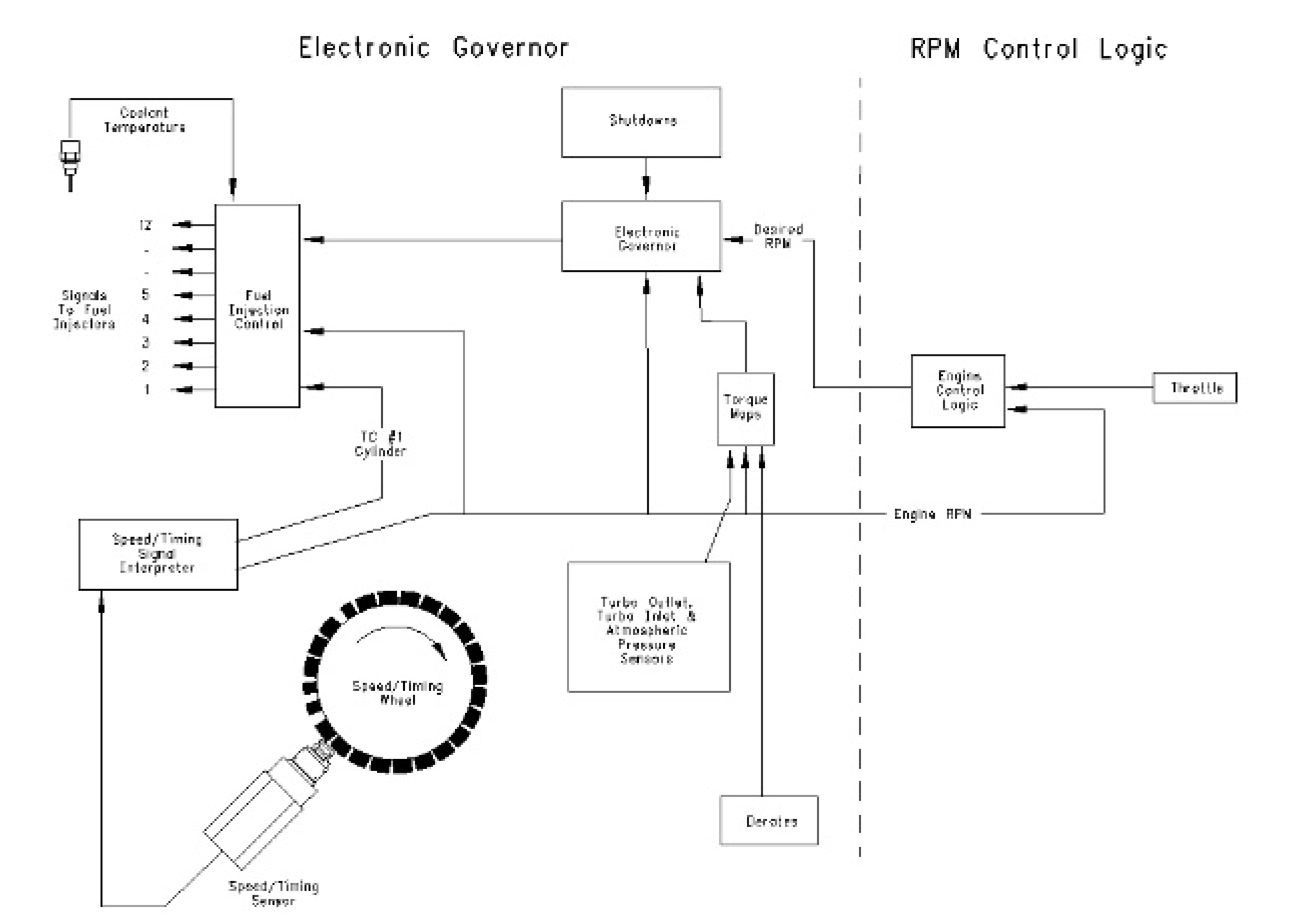

Illustration 1 g00669770

This engine was designed for electronic control. Each cylinder has an electronic unit injector. A solenoid on each injector controls the amount of fuel that is delivered by the injector. The Electronic Control Module (ECM) sends a signal to each injector solenoid in order to provide complete control over the operation of the fuel injection system.

Electronic Controls

The electronic system consists of the following components: the ECM, the mechanically actuated electronically controlled unit injectors (MEUI), the wiring harness, the switches and the sensors. The ECM is the computer. The flash file is the software for the computer. The flash file contains the operating maps. The operating maps define the following characteristics of the engine:

- Horsepower
- Torque curves

The ECM determines the timing and the amount of fuel that is delivered to the cylinders. These decisions are based on the actual conditions and/or the desired conditions at any given time.

The ECM compares the desired engine speed to the actual engine speed. The actual engine speed is determined through a signal from the engine speed/timing sensor. The desired engine speed is determined through the following items:

- Throttle position sensor
- Other input signals from sensors
- Certain diagnostic codes

If the desired engine speed is greater than the actual engine speed, the ECM injects more fuel in order to increase the actual engine speed.

Fuel Injection

The ECM controls the amount of fuel that is injected by varying the signals to the injectors. The injectors will pump fuel only if the injector solenoid is energized. The ECM sends a high voltage signal to the solenoid. This high voltage signal energizes the solenoid. By controlling the timing and the duration of the high voltage signal, the ECM can control injection timing and the ECM can control the amount of fuel that is injected.

Once the ECM determines the amount of fuel that is required, the ECM must determine the timing of the fuel injection. The ECM determines the top center position of each cylinder from the engine speed/timing sensor's signal. The ECM determines when fuel injection should occur relative to the top center position and the ECM provides the signal to the injector at the desired time. The ECM adjusts timing for optimum engine performance, for optimum fuel economy, and for optimum control of white smoke.

Programmable Parameters

Certain parameters that affect the engine operation may be changed with the Caterpillar Electronic Technician (ET). The parameters are stored in the ECM, and some parameters are protected from unauthorized changes by passwords.

Passwords

Several system configuration parameters and most logged events are protected by factory passwords. Factory passwords are available only to Caterpillar dealers. Refer to Troubleshooting, "Factory Passwords" for additional information.

CATERPILLAR®

Systems Operation
3500B and 3500C Marine Engines
Media Number -RENR5078-06 **Publication Date -01/10/2009** **Date Updated -06/10/2009**

i02388169

Turbocharger

SMCS - 1052

Rear Mounted

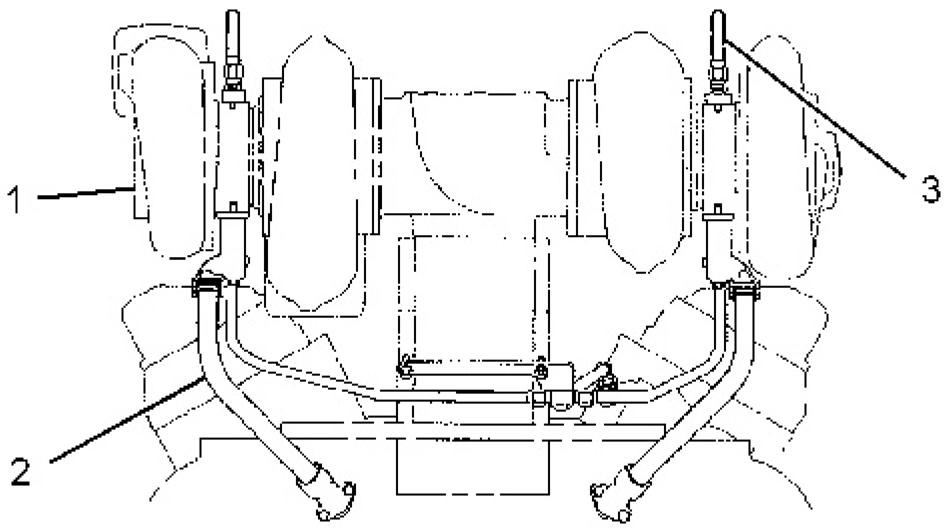

Illustration 1 g01192255

Turbocharger (typical example)

(1) Turbocharger

(2) Oil drain line

(3) Oil supply line

Two turbochargers (1) are used on the rear of the engine. The turbine side of each turbocharger is connected to the turbocharger's respective exhaust manifold. The compressor side of each turbocharger is connected by pipes to the aftercooler housing.

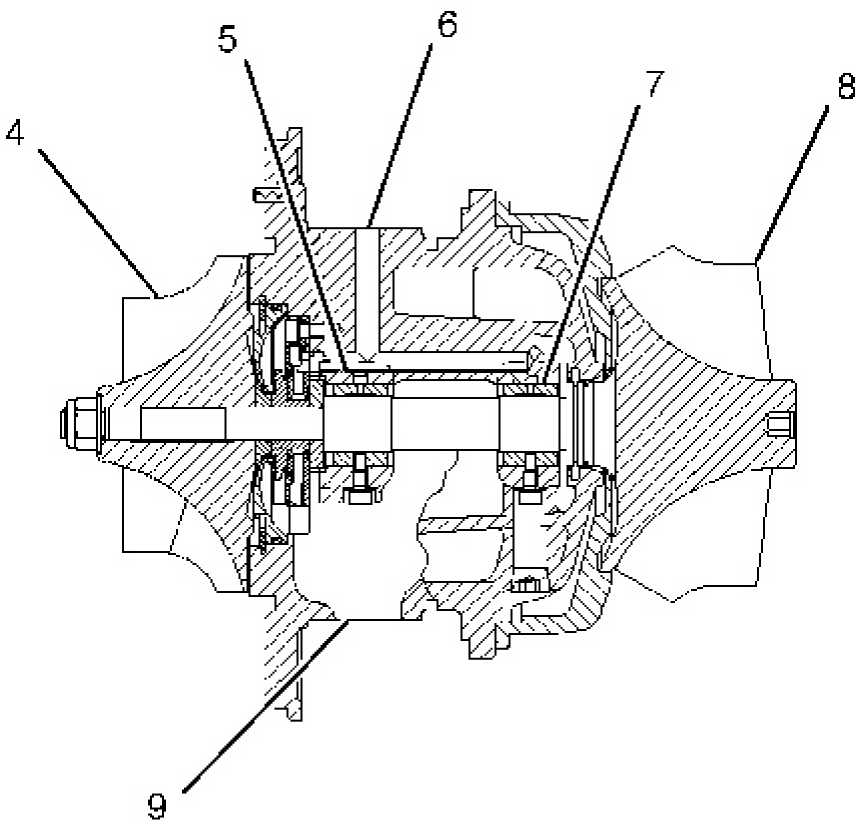

Illustration 2 g01192286

Turbocharger (typical example)

(4) Compressor wheel

(5) Bearing

(6) Oil inlet port

(7) Bearing

(8) Turbine wheel

(9) Oil outlet port

The exhaust gases go into the exhaust inlet of the turbine housing. The exhaust gases push the blades of turbine wheel (8).

Clean air from the air cleaners is pulled through the compressor housing air inlet by the rotation of compressor wheel (4). The compressor wheel blades compress the inlet air. This compression gives the engine more power because the compression allows the engine to burn additional fuel with greater efficiency.

The maximum speed of the turbocharger is controlled by the engine's electronic control of fuel delivery. When the engine is operating, the height above sea level also controls the maximum speed of the turbocharger.

Bearing (5) and bearing (7) in the turbocharger use engine oil under pressure for lubrication. The oil is sent through the oil inlet line to oil inlet port (6) at the top. The oil then goes through passages in the center section for lubrication of the bearings. The oil goes out of oil outlet port (9) at the bottom. The oil then goes back to the flywheel housing through oil drain line (2) .

Center Mounted

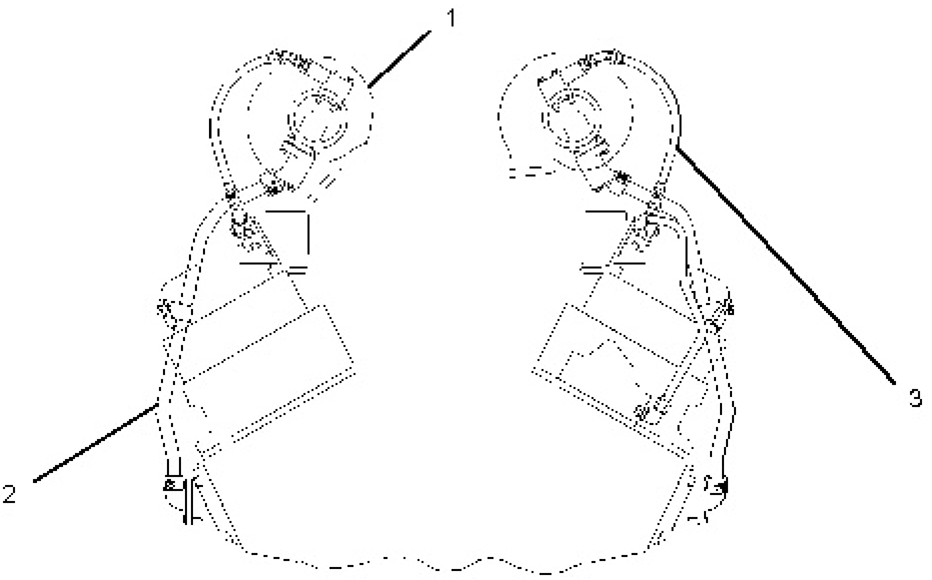

Illustration 3 g01192313

Turbocharger (typical example)

(1) Turbocharger

(2) Oil drain line

(3) Oil supply line

Four turbochargers (1) are used on the top of the engine. The turbochargers are located on each side of the vee. The turbine side of each turbocharger is mounted to the respective exhaust manifold. The compressor side of each turbocharger is connected by pipes to the top of the aftercooler housing.

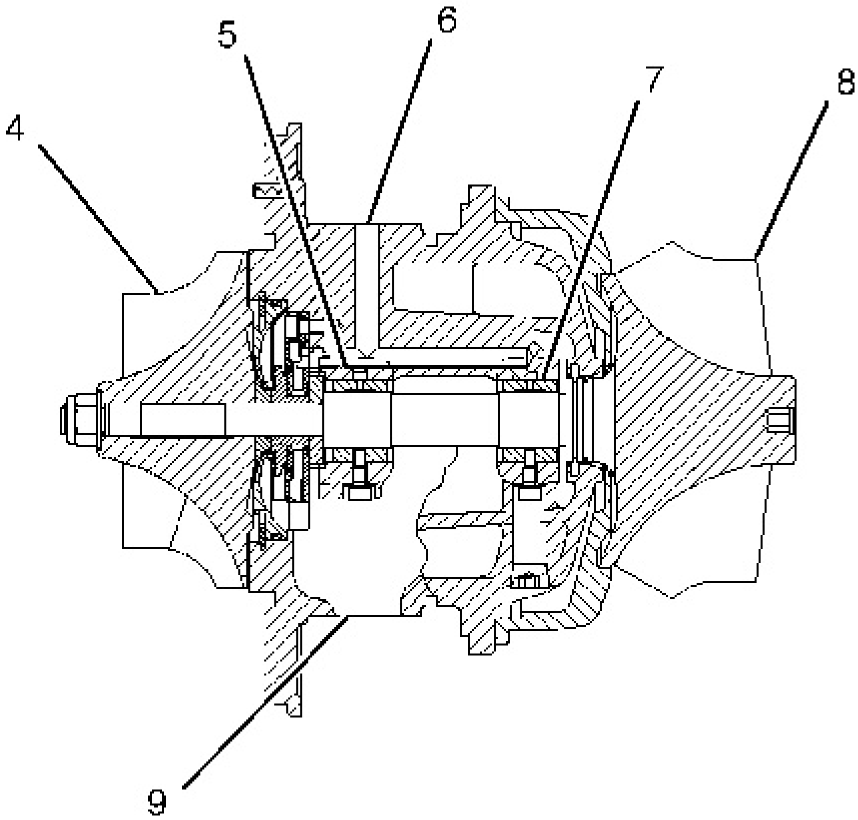

Illustration 4 g01192286

Turbocharger (typical example)

(4) Compressor wheel

(5) Bearing

(6) Oil inlet port

(7) Turbine wheel

(8) Bearing

(9) Oil outlet port

The exhaust gases go into the exhaust inlet of the turbine housing. The exhaust gases push the blades of turbine wheel (8).

Clean air from the air cleaners is pulled through the compressor housing air inlet by the rotation of compressor wheel (4). The compressor wheel blades compress the inlet air. This compression gives the engine more power because the compression allows the engine to burn additional fuel with greater efficiency.

The maximum speed of the turbocharger is controlled by the engine's electronic control of fuel delivery. When the engine is operating, the height above sea level also controls the maximum speed of the turbocharger.

Bearing (5) and bearing (7) in the turbocharger use engine oil under pressure for lubrication. The oil is sent through the oil inlet line to oil inlet port (6) at the top. The oil then goes through passages in the center section for lubrication of the bearings. The oil goes out of oil outlet port (9) at the bottom. The oil then goes back to the engine block through oil drain line (2) .

CATERPILLAR®

Systems Operation
3500B and 3500C Marine Engines
Media Number -RENR5078-06 **Publication Date -01/10/2009** **Date Updated -06/10/2009**

i02389290

Lubrication System Operation

SMCS - 1300

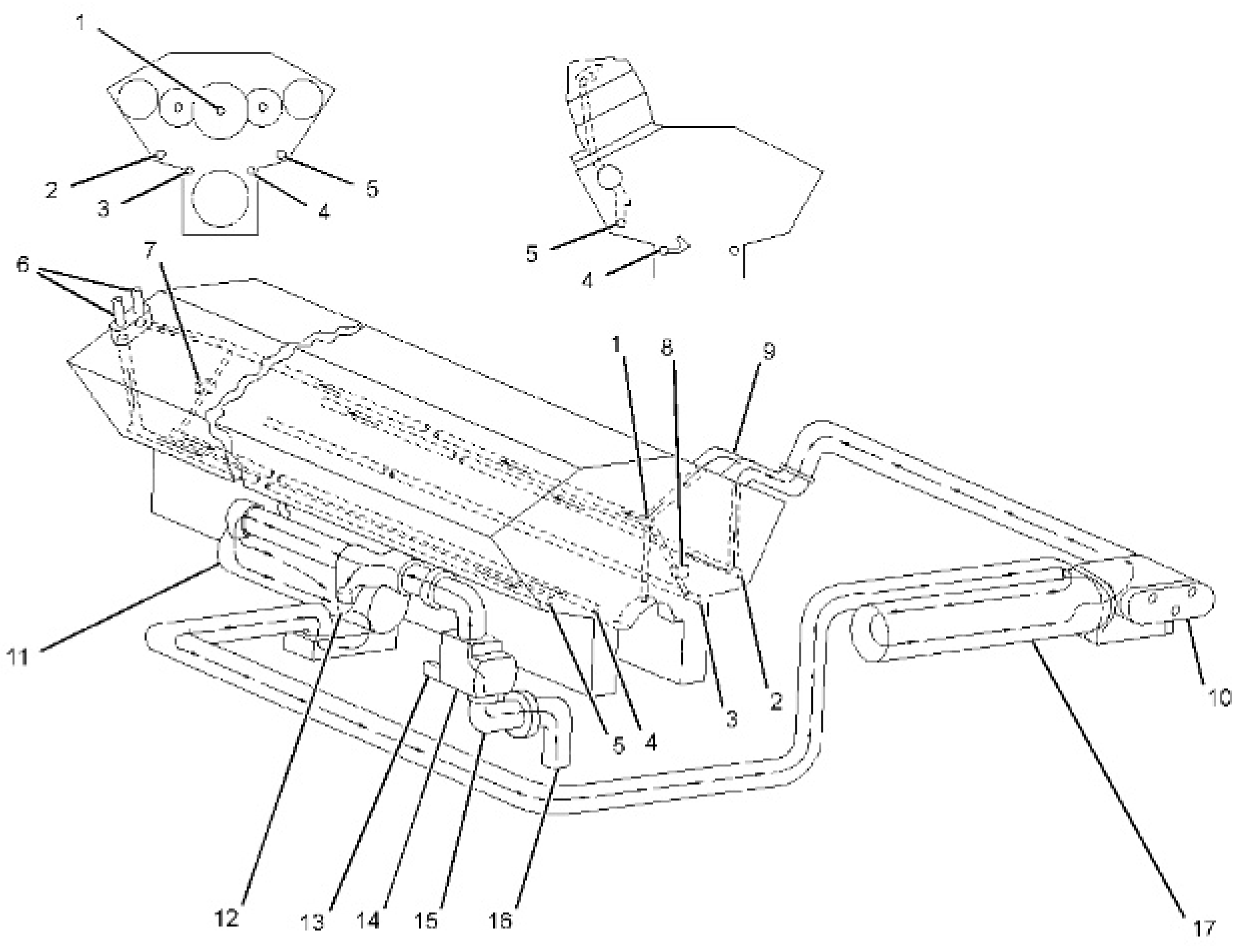

Illustration 1 g01192996

Main oil pump and lubrication system schematic (typical example)

(1) Main oil gallery

(2) Camshaft oil gallery

(3) Piston cooling jet gallery

(4) Piston cooling jet gallery

(5) Camshaft oil gallery

(6) Turbocharger oil supply

(7) Sequence valve

(8) Sequence valve

(9) Elbow

(10) Engine oil filter bypass valve

(11) Engine oil cooler

(12) Engine oil cooler bypass valve

(13) Engine oil relief valve

(14) Engine oil pump

(15) Elbow

(16) Suction bell

(17) Engine oil filter housing

This system uses an engine oil pump (14) with three pump gears. The pump gears are driven by the front gear train. Oil is pulled from the pan through suction bell (16) and through elbow (15) by the engine oil pump. The suction bell has a screen in order to clean the engine oil.

There is an engine oil relief valve (13) in the engine oil pump. The engine oil relief valve controls the pressure of the engine oil from the engine oil pump. The engine oil pump can put too much engine oil into the system. When there is too much engine oil, the engine oil pressure goes up and the relief valve opens. This allows the engine oil that is not needed to go back to the inlet oil passage of the engine oil pump.

The engine oil pump pushes engine oil through engine oil cooler (11) and through the engine oil filters to main oil gallery (1) and through camshaft oil gallery (2). Engine oil cooler (11) lowers the temperature of the engine oil before the engine oil is sent to the filters.

Engine oil cooler bypass valve (12) allows engine oil to flow directly to the filters if the engine oil cooler becomes plugged. The engine oil cooler bypass valve also allows engine oil to flow directly to the filters if the engine oil becomes thick. The engine oil cooler bypass valve will bypass the engine oil to the filters above 180 ± 20 kPa (26 ± 3 psi) of oil pressure differential.

Cartridge type filters are used. The filters are located in an engine oil filter housing. Cartridge type filters use a single bypass valve that is located in the engine oil filter housing.

Clean engine oil from the filters flows through the engine oil line and into the block through elbow (9). Part of the engine oil flows to left camshaft oil gallery (2). The remainder of the engine oil flows to main oil gallery (1) .

Camshaft oil gallery (2) and camshaft oil gallery (5) are connected to each camshaft bearing by a drilled hole. The engine oil flows around each camshaft journal. The engine oil then travels through the cylinder head and through the rocker arm housing to the rocker arm shaft. A drilled hole connects the bores for the valve lifters to the oil hole for the rocker arm shaft. The valve lifters are lubricated at the top of each stroke.

Main oil gallery (1) is connected to the main bearings by drilled holes. Drilled holes in the crankshaft connect the main bearing oil supply to the rod bearings. Engine oil from the rear of the main oil gallery goes to the rear of right camshaft oil gallery (5) .

Sequence valve (7) and sequence valve (8) allow engine oil from main oil gallery (1) to flow to piston cooling jet gallery (3) and to piston cooling jet gallery (4). The sequence valves begin to open at approximately 130 kPa (19 psi). The sequence valves will not allow engine oil into the piston cooling jet galleries until there is pressure in the main oil gallery. This decreases the amount of time that is necessary for pressure buildup when the engine is started. This also helps hold pressure at idle speed.

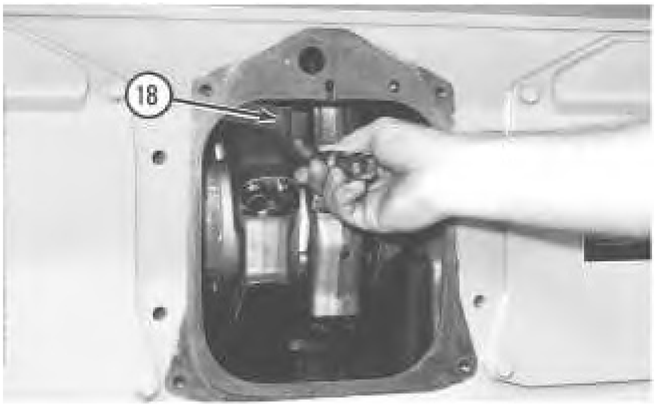

Illustration 2 g00281794

Piston cooling and lubrication (typical example)

(18) Piston cooling jet

There is a piston cooling jet (18) below each piston. Each piston cooling jet has two openings. One opening is in the direction of a passage in the bottom of the piston. This passage takes engine oil to a manifold behind the ring band of the piston. A slot (groove) is in the side of both piston pin bores in order to connect with the manifold behind the ring band. The other opening is in the direction of the center of the piston. This helps cool the piston and this lubricates the piston pin.

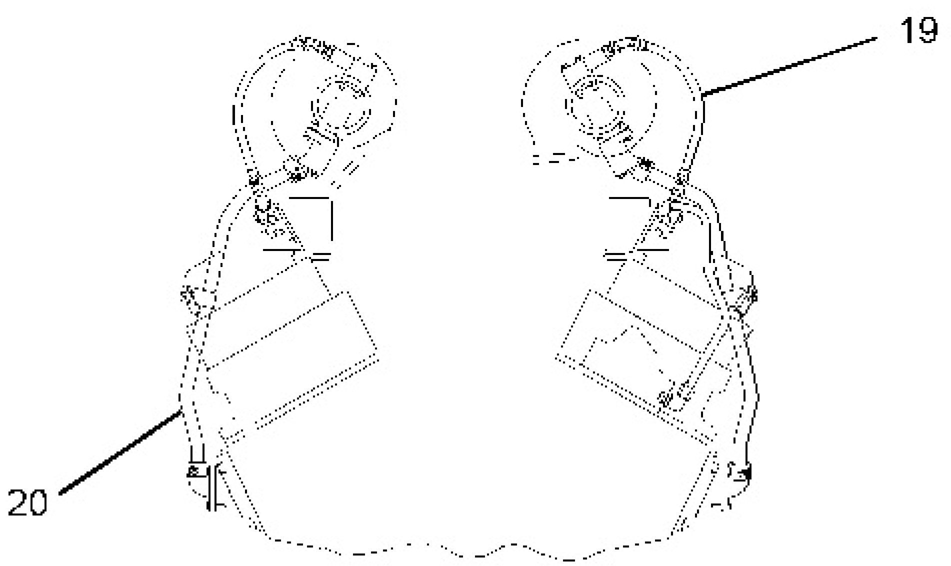

Illustration 3 g01193001

Center mounted turbochargers (typical example)

(19) Oil supply line

(20) Oil drain line

On center mounted turbochargers, oil supply lines (19) send engine oil from the front and the rear adapters to the turbochargers. Oil drain lines (20) are connected to a camshaft inspection cover.

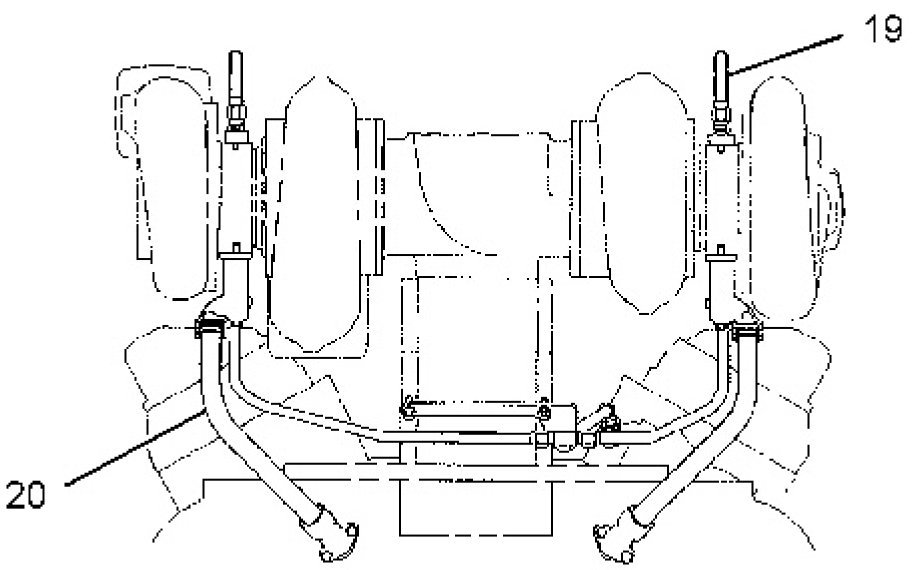

Illustration 4 g01193018

Rear mounted turbochargers (typical example)

(19) Oil supply line

(20) Oil drain line

On rear mounted turbochargers, oil supply lines (19) send engine oil from the rear adapter to the turbochargers. Oil drain lines (20) are connected to the flywheel housing on each side of the engine.

Engine oil is sent to the front gear group and the rear gear group through drilled passages. The drilled passages are in the front housing, the rear housing and cylinder block faces. These passages are connected to camshaft oil galleries (2) and (5) .

After the engine oil has finished lubricating, the engine oil goes back to the engine oil pan.

Diesel Engines		Machinery	
ABS	Agco-Sisu	Drott	Dynapack
Akasaka	Baudouin	Extec	Faun
BMW	Bukh	Fendt	Fiat
Caterpillar	CHN 25/34	Fiatallis	Flexicoil
Cummins	Daihatsu	Furukawa	Gehl
Detroit	Deutz	Genie	Grove-gmk
Doosan-Daewoo	Fiat	Halla	Hamm
Ford	GE	Hangcha	Hanix
Grenaa	Guascor	Hanomag	Hartl
Hanshin	Hatz	Haulpack	Hiab
Hino	Honda	Hidromek	Hino truck
Hyundai	Isotta	Hitachi	Hyster
Isuzu	Iveco	Hyundai	IHI
John-Deere	Kelvin	Ingersoll-rand	JCB
Kioti	Komatsu	JLG	John-Deere
Kubota	Liebherr	Jungheinrich	Kalmar
Lister	Lombardini	Kato	Kioti
MAK	MAN B&W	Kleeman	Kobelco
Mercedes	Mercruiser	Komatsu	Kramer
Mirrlees BS	Mitsubishi	Kubota	Lamborghini
MTU	MWM	Landini	Liebherr
Niigata	Paxman	Linde	Link-belt
Perkins	Pielstick	Manitou	Massey-Ferg.
Rolls / Bergen	Ruggerini	Mccormick	MDI-Yutani
Ruston	Scania	Mitsubishi	Moxy
Shibaura	Sisu-Valmet	Mustang	Neusson
SKL	Smit-Bolnes	New-Holland	Nichiyu
Sole	Stork	Nissan	OK
VM-Motori	Volvo	OM-Pimespo	others-tech
Volvo Penta	Westerbeke	Pel-Job	PH-mining
Wichmann	Yanmar	Poclain	Powerscreen
Machinery		Same	Samsung
ABG	Airman	Sandvik	Scania
Akerman	Ammann	Schaefer	Schramm
Astra	Atlas Copco	Sennebogen	Shangli
Atlas Weyha.	Atlet	Shibaura	Steiger
Bell	Bendi	Steinbock	Steyr
Bigjoe	Bobcat	Still	Sumitomo
Bomag	BT	Super-pac	Tadano
Carelift	Case	Takeuchi	TCM
Caterpillar	Cesab	Terex	Toyota
Challenger	Champion	Valpadana	Venieri
Claas	Clark	Versatile	Vogele
Combilift	Crown	Volvo	Weidemann
Daewoo-Doosan	Demag	Wirtgen	Yale
Deutz-Fahr	Dressta	YAM	Yanmar