SECTION VIII

LUBRICATING OIL SYSTEM

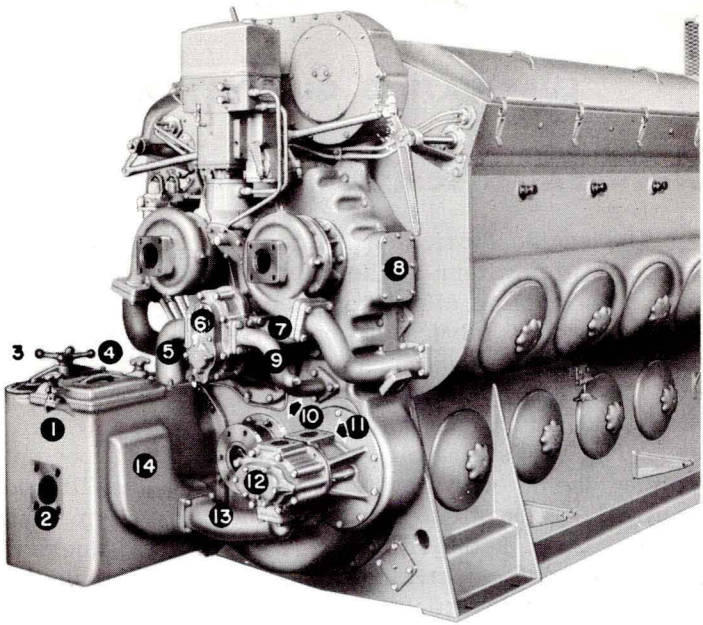
A. GENERAL DESCRIPTION

The engine lubricating system is a combination of three separate systems. The engine lubricating oil system, piston cooling oil system and scavenging oil system. The engine lubricating system supplies oil for lubrication of the various moving parts of the engine. The piston cooling system supplies oil for the cooling of the pistons and lubrication of the piston pin bearing surfaces. The scavenging oil system serves the purpose of supplying the other two systems with cooled and filtered oil, by taking the oil drained into the oil pan sump and forcing it through the filter and coolers from where it flows to the suction strainer housing supplying the lubricating and piston cooling oil pumps. Parts of the lubricating system mounted on the front of the engine are shown in Fig. 8-1.

B. UNIT DESCRIPTION

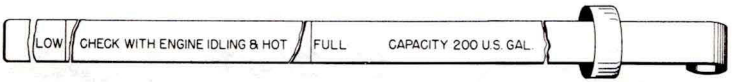
1. Oil Pan

The oil pan, Fig. 1-2, serves as the support for the crankcase and enclosure for the lower parts of the engine. It is rectangular in shape, having handholes on each side for inspection and servicing. It serves as a sump for the engine lubricating oil. When the engine is stopped, oil not trapped in filter, cooler or lines, drains into the sump. The scavenging oil pump suction line is built into the oil pan. It extends from the sump to the front of the engine, to line up with the scavenging oil inlet to the strainer housing, Fig. 1-2, Item 8.

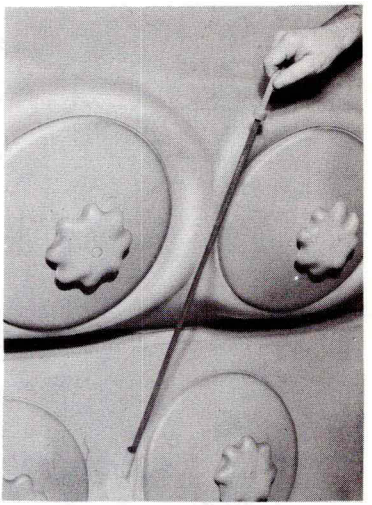


Lubricating System Components
Fig. 8-1

1. Strainer Housing.
2. Cooler Oil Inlet to Housing.
3. Lube Strainers Hold Down Crab.
4. Filler Opening Cover.
5. Lube Oil Suction to Lube and Piston Cooling Pumps.
6. Lube and Piston Cooling Pumps.
7. Lube Oil Discharge.
8. Oil Manifold Relief Valve Cover.
9. Piston Cooling Discharge.
10. Strainer Seal Oil Supply Line.
11. Scavenging Pump Outlet.
12. Scavenging Oil Pump.
13. Scavenging Oil Pump Suction Line From Strainer Housing.
14. Scavenging Suction Strainer Oil Outlet Channel.



A bayonet type oil level gauge at the side of the oil pan, Fig. 8-2, is marked to show oil capacity, low and full levels and has a part number identifying its use in a particular engine.

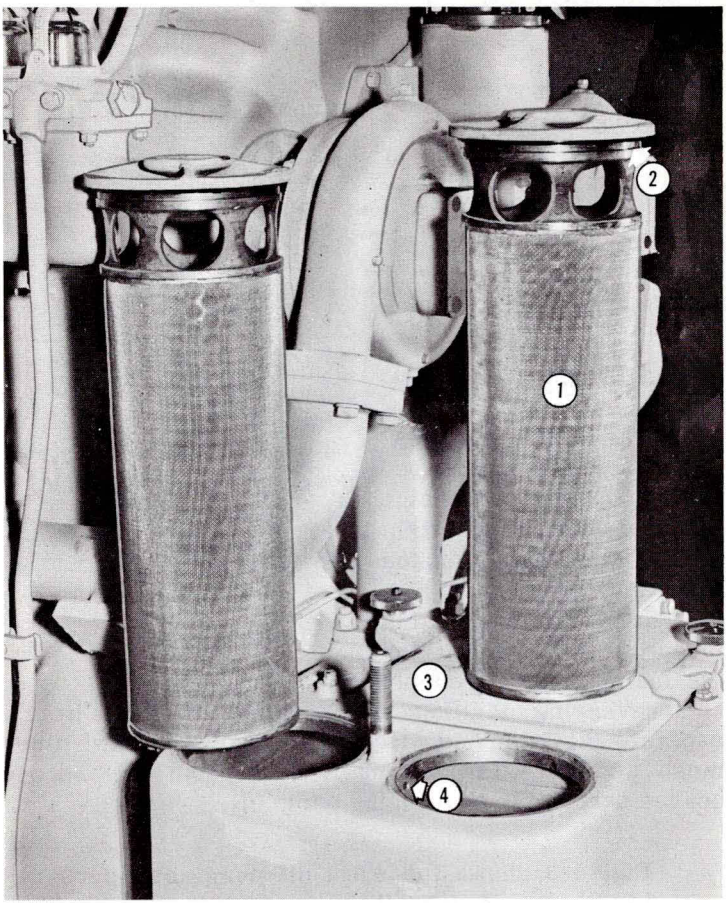


Lube Oil Level Gauge
Fig. 8-2

2. Oil Strainer Housing

The oil strainer housing is a large box-shaped cast aluminum housing mounted on the front right side of the engine on the accessory drive cover, Fig. 8-1, Item 1. It contains independent strainers for the main oil pump supply and scavenging oil pump. Each pump's strainers have a separate oil inlet and discharge. There are two fine-mesh strainers for the main lube pump oil and one coarse screen for scavenging pump oil.

Fig. 8-3 shows the main oil pump strainers removed from the housing. When in place they are held by a crab and hand-wheel on the stud between the holes. Each strainer is sealed at the top by a seal ring. Also, oil under pump pressure is admitted to a groove around each strainer, just below the seal, to prevent air entry in event of a leaky seal. A partition adjacent to the strainers, open at the bottom, separates them from the oil inlet area of the housing. Oil enters the strainers at the partition bottom and is taken up by the pump through a cast passage in the housing.

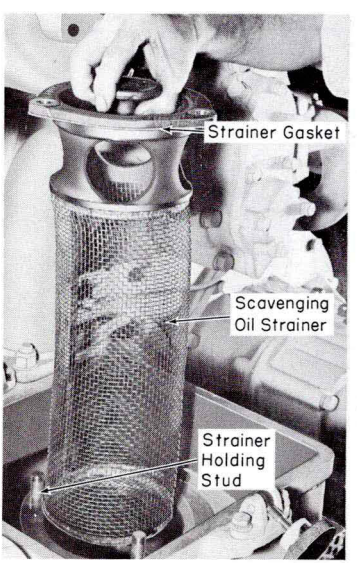


1. Strainer
2. Ring Seal
3. Filler Cover
4. Oil Passage

Pressure Pump Strainers
Fig. 8-3

The coarse scavenging oil pump suction screen is shown removed in Fig. 8-4. When the screen is in place its area is closed by a flange and gasket at the top of the screen and held by 3 studs and nuts, located under the large square oil filler opening cover. The inlet and outlet openings to the scavenging oil screen are shown in Fig. 8-5.

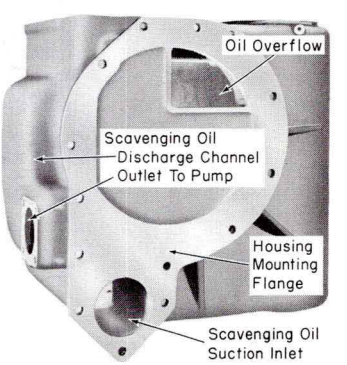
An oil level is maintained in the strainer housing up to the bottom of the overflow opening, Fig. 8-5. Excess oil returns to the oil pan sump. A spring loaded valve, Fig. 8-6, is provided to drain the oil from the strainer housing into the oil pan sump, at the time of an oil change. Some housings may have an additional valve which is used to drain the oil filter housing. Both valves are located under the filler cover and must be kept closed at all times except for the period of draining.



Scavenging Pump Strainer
Fig. 8-4

3. Scavenging Oil Pump

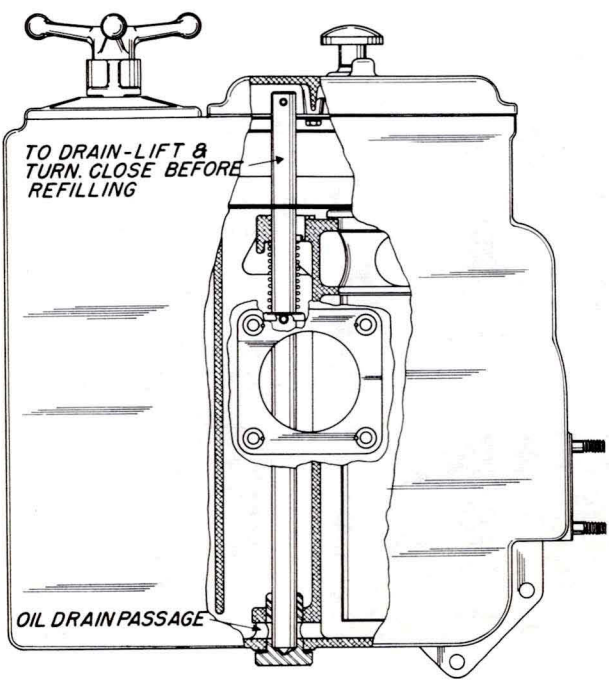
The scavenging oil pump, Fig. 8-1, Item 12, is mounted on the accessory



Back Of Strainer Housing
Fig. 8-5

gear cover in line with and to the left of the crankshaft and is driven by the accessory drive gear.

The scavenging oil pump, Figs. 8-7 and 8-8, is a positive displacement, helical gear type pump, and self priming. The pump housing, which is split transversely for ease of maintenance, houses a double set of mated pumping gears. The driving gears are retained on the pump drive gear shaft by Woodruff keys. The idler shaft is held stationary in the housing by a lock screw, and driven pump gears rotate on this shaft on bushings pressed into the gear shaft bore. The drive shaft turns in bushings pressed into the pump housing. These bushings are made with thrust collars which protrude slightly above the pump body and absorb the thrust of the drive gears.



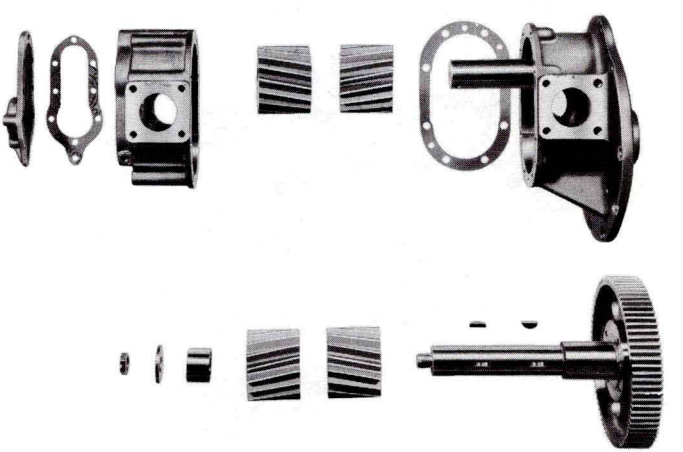
Strainer Housing - Internal Drain
Fig. 8-6

4. Lube Oil and Piston Cooling Pressure Pump

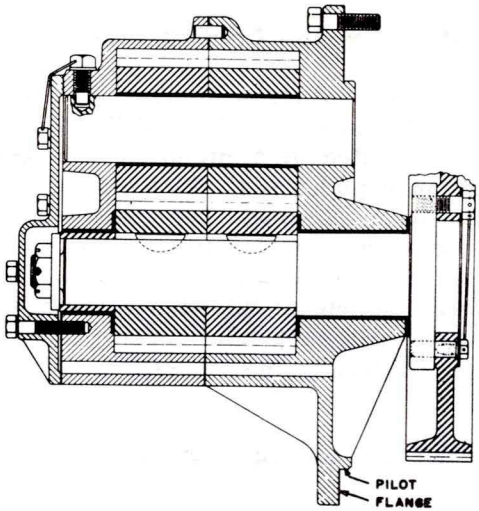
The lube oil and piston cooling oil pumps are contained in one housing, Fig. 8-9 and Fig. 8-10. The two pumps are separated by a division plate between the sections of the pump housing. Each has its individual oil inlet and discharge opening. The piston cooling pump at the outer end has narrower gears than the lube oil pump. Pump construction otherwise is similar to the scavenging oil pump. The lube oil and piston cooling oil pump is mounted at the accessory drive housing center, Fig. 8-1, Item 6, and is driven by the accessory drive gear.

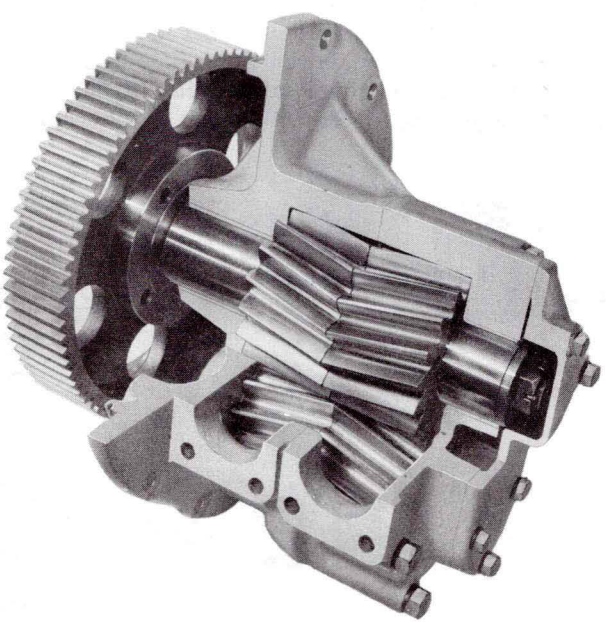
5. Lube Oil Pressure Relief Valve

The lube oil pressure relief valve, Fig. 8-11, is mounted on the lube oil cross-over manifold under the accessory gear train cover on the left side of the engine, Fig. 8-1, Item 8. A cover plate, easily removable, is provided for access to the valve for inspection and adjustment.

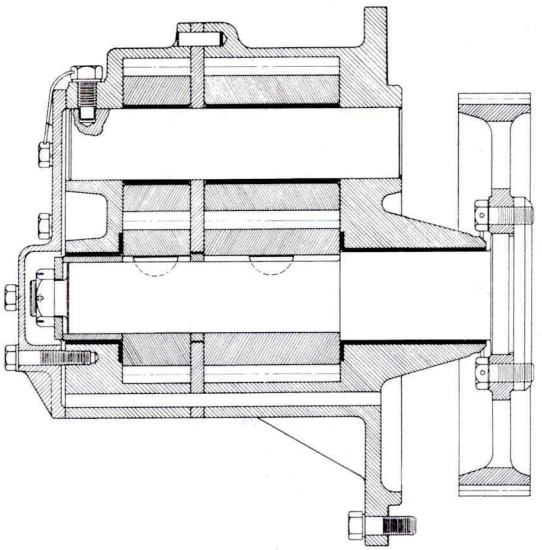


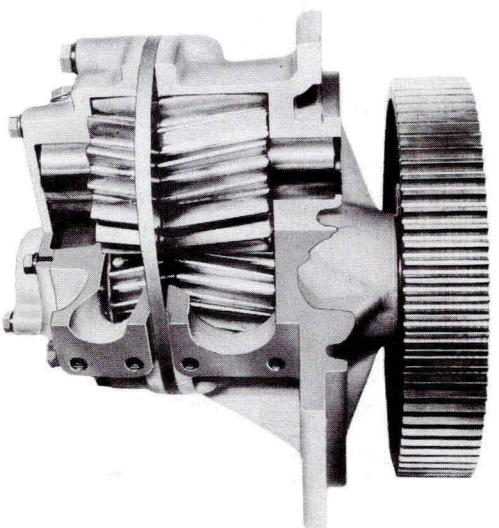
Scavenging Pump Exploded
Fig. 8-7





Scavenging Pump
Fig. 8-8





Lubricating And Piston Cooling Pump
Fig. 8-9

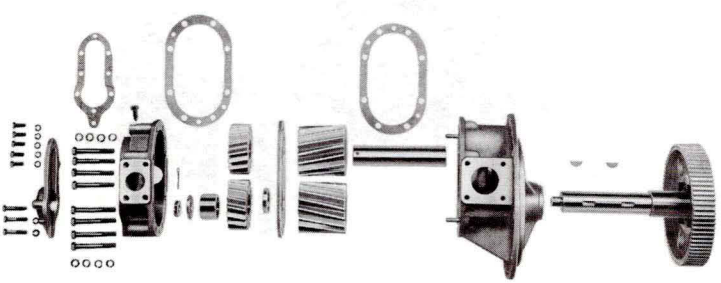
The purpose of the valve is to limit the maximum pressure of the lube oil entering the engine lube oil system. When the pump pressure exceeds the spring tension on the valve it will lift the valve off its seat and relieve the excess pressure. This oil drains into the accessory housing and to the oil pan sump.

6. Lube and Piston Cooling Oil Manifold

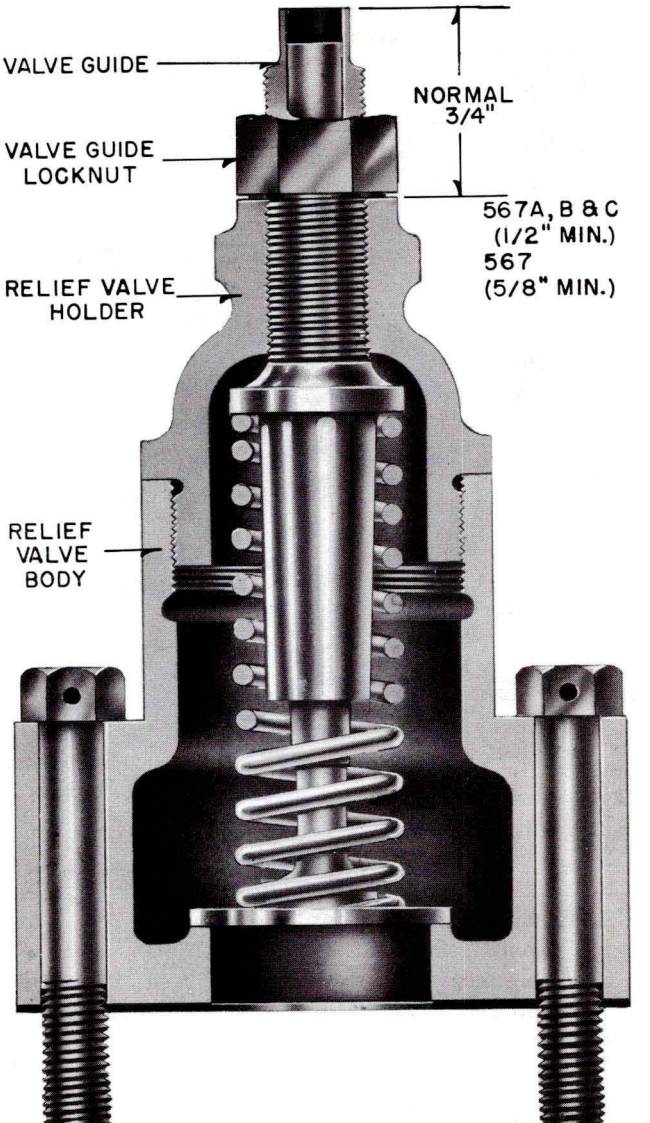
The lubricating and piston cooling oil manifold is a one piece casting with cored passages, Fig. 8-12. The manifold is mounted and doweled in the front end plate under the accessory drive cover. Connecting tubes passing through the accessory drive cover, protected against leakage by seal rings, connect the manifold to the discharge of the lube oil and piston cooling pressure pumps. The purpose of the manifold is to transfer the oil supplied by the lube oil and piston cooling pumps to the main bearing oil header in the center of the engine and to the piston cooling oil header pipes on each side of the crankcase just inside the oil pan mounting flange.

7. Lube Oil Separator

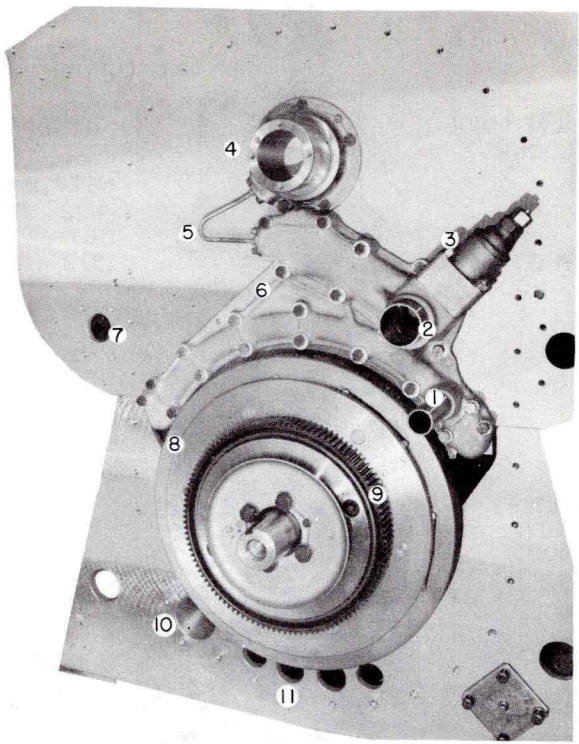
The oil separator, Fig. 8-13, is mounted on top the auxiliary generator drive housing. It is a cylindrical housing containing a securely held mesh screen ele-



Exploded View Of Lube And Piston Cooling Pump
Fig. 8-10

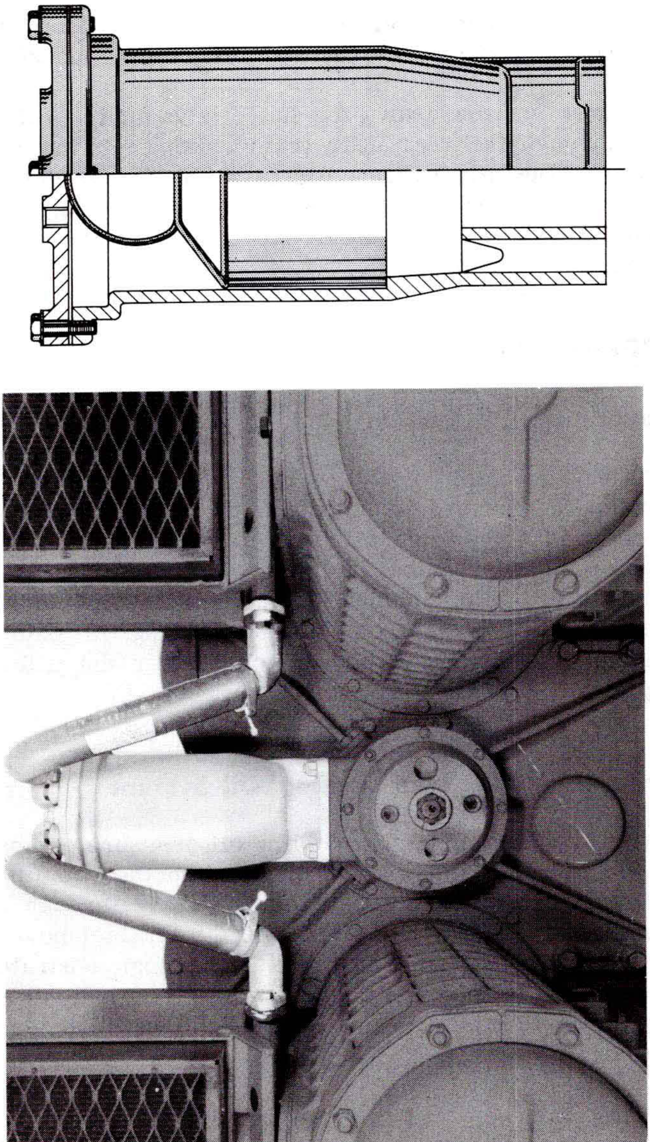


Engine Oil Pressure Relief Valve
Fig. 8-11



1. Piston Cooling Oil Inlet
2. Lubricating Oil Inlet
3. Lubricating Oil Relief Valve
4. Governor Drive Gear Stubshaft
5. Stubshaft Oil Line
6. Lubricating and Piston Cooling Oil Manifold
7. Right Bank Water Inlet
8. Harmonic Balancer
9. Accessory Drive Gear
10. Scavenging Oil Suction Line Outlet
11. Oil Pan Return Oil Opening

Lubricating And Piston Cooling Oil Manifold
Fig. 8-12



Oil Separator
Fig. 8-13

ment. The housing cover has two openings on top to connect hoses leading to the suction side of each blower.

Blower suction draws the hot oily vapor from the oil pan through the rear gear train housing into the oil separator. The oily vapor collects as oil on the mesh screen of the separator element, drains to a trough at the separator bottom and flows into the gear train returning to the oil pan.

C. OPERATION

1. Scavenging Oil System

The scavenging oil pump draws oil from the oil pan sump or reservoir, through the scavenging oil strainer, and forces the oil through the oil filter and oil cooler to supply the lube oil and piston cooling oil pump. Provision is made to assure an oil supply to these pumps if oil from the scavenging oil pump is restricted by unusual conditions in either the filter or cooler.

2. Lube Oil and Piston Cooling Oil System

The lube oil and piston cooling oil pressure pumps draw the cleaned and cooled oil through the two fine mesh strainers in the oil strainer housing through a common suction elbow from the top of the strainer housing and discharges it under pressure through separate piston cooling oil pump and lube oil pressure pump discharge elbows to the manifold connections on the accessory gear cover.

The piston cooling oil manifold delivers oil to the two piston cooling header pipes. The oil is forced out of the headers through the piston cooling oil "pee" pipes which direct a stream of oil into a hole in each piston pin carrier. This oil cools the piston pin crown, the

compression ring section of the piston skirt and lubricates the piston pin and bearing, then drains out of the piston through holes in the carrier.

The lube oil manifold delivers the oil from the lube oil pressure pump to the main "V" shaped oil header running throughout the length of the crankcase. An oil line taken off the pressure oil manifold extends to the governor drive gear stubshaft. Pressure oil in the "V" shaped header flows down the main bearing "A" frame oil tubes to lubricate the main bearings and then through drilled passages in the crankshaft to the connecting rod bearings. Leak-off oil from the adjacent main bearing will lubricate the thrust bearings. The harmonic balancer and accessory drive gear are lubricated by oil flowing forward under pressure from the #1 main bearing journal through radial drillings in the crankshaft which align with similar drilling in the harmonic balancer hub and accessory drive gear allowing pressure lubrication of spring packs and rim to hub bearing surface.

The oil flowing from the rear end of the "V" shaped main bearing oil header lubricates the gear bearings in the camshaft and blower drive and passes into the camshafts. The camshaft bearings are lubricated by radial holes in each segment bearing. From one bearing cap of each camshaft segment oil flows through a line to the rocker arm shaft bushings and through drilled passages in the rocker arm to the cam follower roller bushings and hydraulic lash adjusters. Leak-off from the camshaft and rocker arms flows across the tops of the cylinder heads into a drain channel extending the length of the engine. Vertical drain pipes from this channel allow the oil to drain to the oil pan.

Oil from the upper idler gear stubshaft lubricates the auxiliary generator drive bushings and then flows through the blower oil lines to the bearings and blower rotor gears.

3. Lubricating Oil Pressure

Adequate lubricating oil pressure must be maintained at all times when the engine is running. Upon starting and idling an engine it will be noted that the oil pressure builds up almost immediately. In the event of cold oil the pressure may rise to the relief valve setting which will be approximately 50 pounds.

Lubricating oil pressure is not adjustable. The operating pressure range is determined by such things as manufacturing tolerances, oil temperature, oil dilution and of course, engine speed. Thus no specific operating pressures can be given. Generally however, the lubricating oil pressure will be between 16 to 25 pounds at idle speed of 275 RPM and 30 to 50 pounds at full speed of 800 to 835 RPM.

The minimum pressure at idle is 6 pounds and at full speed is 20 pounds. Operation at pressures above these minimums is entirely satisfactory. In the event of insufficient oil pressure, a shutdown feature built into the governor will automatically protect the engine by causing it to stop.

4. Piston Cooling Oil Pressure

No gauge for piston cooling oil pressure is provided. Piston cooling oil pressure can be determined by connecting a gauge at the 3/4" plugged opening at the pump discharge elbow. Pressure of the piston cooling oil will be governed by oil viscosity, speed of engine, temperature of oil and wear of pump parts. The minimum piston cooling oil pressure at idle engine speed (275 RPM) is 3 p.s.i. and at full speed 15 p.s.i.

5. Low Oil Pressure and High Lube Oil Suction Shutdown

Engines are equipped with electro-hydraulic or pneumatic-hydraulic speed control governors which have

the low oil pressure and high lube oil suction shutdown as a part of the governor. Under either condition of low oil pressure or high suction the governor will act to shut down the engine. It allows a short time delay of about forty seconds at idle engine speed to allow engine starting and time to determine cause of trouble. However, repeated re-starting of the engine after shutdown to locate trouble should not be attempted. The time delay is voided at 425 RPM engine speed and over, at which speed shutdown will occur in about two seconds. Details of the shutdown arrangement are outlined in the governor section. Oil pressure is measured at the rear of the engine with a connection being made at this point to the governor.

6. Possible Lubrication Troubles

a. Absence of Oil in Strainer Chamber
This may be caused by inoperative scavenging system or open drain valve. Failure of scavenging system may be due to a broken or loose oil line connection causing an air leak, a faulty scavenging pump or clogged suction screen, or low oil level.

b. Low Lubricating Oil Pressure
This may be due to stuck oil relief valve or foreign material on valve seat holding valve open, broken oil lines, clogged suction strainers, excessive bearing wear, low oil viscosity, faulty pump or diluted oil, or insufficient oil in strainer housing.

c. Failure of Oil Pump
This may be due to sheared pump gear keys, broken housing or damaged gears.

d. Dilution
It is possible for fuel oil to get into the lubricating oil if a fuel line connecting the injector to the fuel manifold is loose or broken or an injector is defective. If such a condition has

existed the lube oil viscosity should be checked. The lube oil may also be contaminated by water. This can be checked visually on top cylinder heads or oil pan, also by taking test sample of oil.

e. Excessive Oil Consumption
This may be caused by oil leaks, broken or stuck piston rings, worn cylinder liners, damaged blower oil seals, clogged oil separator screen, improper grade of oil or clogged oil drain holes under oil control rings of piston.

f. Little or No Lube Oil Consumption
This may be due to water or fuel leaking into the oil.

D. MAINTENANCE

1. Oil Change

Engine lube oil should be drained, filters replaced, suction strainers and screens cleaned at intervals outlined in Maintenance Instruction 1704, Scheduled Maintenance Program. Before the oil is drained, its viscosity should be checked for indications of fuel dilution, indicating leaks, or contamination to allow their correction before adding new oil.

a. General Procedure

(1) Provide container or run-off line for draining oil. Shut down engine. Open valve in strainer housing, allowing oil to drain into oil pan sump. Remove plug at end of drain line and open drain valve. Allow all oil to drain out of oil pan.

(2) Remove pump suction strainers, screens, filter containers and cartridges. Clean

strainers, screens and filter containers, as recommended in cleaning bulletin, Maintenance Instruction 1706.

(3) Wash down top deck, oil pan and filter housings using fuel oil or kerosene. Drain off all cleaning fluid and wipe areas free of excess cleaning liquid using bound edge absorbent towels.

(4) Replace pipe plugs in drain lines, where required, and close valves. Where necessary renew gaskets.

(5) Install clean strainers, screens and filter containers with new elements. Prepare system to receive new oil.

(6) Recharge engine with lube oil within specifications given in Maintenance Instruction 1752 (latest revision). Add oil through square filler opening at strainer housing. (Note: Be sure strainer housing internal drain valve is closed.) Sufficient oil will be retained in the housing to supply lube and piston cooling oil pumps on starting. Engine oil capacity may be found on the oil gauge and is given in the specifications at end of this section. Pour a liberal quantity of oil over cylinder mechanism before starting.

(7) Inspect engine prior to starting, then start engine. Check oil level with engine at idle speed. If oil level is not to "full" mark on gauge, add oil to bring level to "full" mark, with engine at idle.

2. Checking Oil Viscosity

Oil viscosity should be checked at intervals as specified in the Scheduled Maintenance Program. By

comparing the oil viscosity at different intervals taken at the same temperature or compensated to the oil viscosity when the oil was new, a close check can be kept on the oil to assure its replacement before its condition is rendered unusable and dangerous, within the recommended oil drain period.

Oil having viscosity changed to a great extent will, if not renewed, result in oil cooler clogging, strainer clogging, insufficient oil supply, carbon build-up on vulnerable places such as rings, grooves and small clearances with resulting damage. Therefore, to provide protection to the engine, the oil and system components should be carefully observed for proper functioning.

3. Oil Pressure Relief Valve

Disassemble the relief valve and inspect its parts at intervals given in Maintenance Instruction 1704.

When relief valve is disassembled, examine valve stem and guide for any roughness or galling. If valve stem appears good, check its diameter. Minimum valve stem diameter is .4925". Check squareness of valve face to stem; should not exceed .002" total indicator reading. Using a telescoping gauge, check valve guide inside diameter. Maximum inside diameter should not exceed .5025". Load test valve spring; to compress spring to 3-3/8" should require at least 200 pounds. Replace parts as required.

The setting of the oil relief valve connected to the lube oil manifold determines the maximum pressure at the lube oil pump. It is not set by pressure gauges, but by specific dimension from the top of the valve guide to the top of the valve holder.

To set the relief valve, Fig. 8-11, shut down the engine and remove relief valve cover, Fig. 8-1. Loosen locknut. Applying a wrench to the flats on the valve

guide, position the top of the valve guide 3/4" above top of valve holder and tighten locknut.

With the relief valve set to 3/4" dimension it will allow a maximum lube oil pressure at the pump of about 60 p.s.i. and provide sufficient valve lift under cold oil conditions.

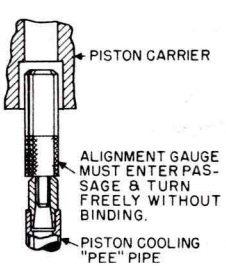
Under some conditions such as weakening of the spring, it may be necessary to increase the spring tension. However, under no condition should the top of the valve guide be less than 1/2" from the top of the valve holder.

Lube oil manifold pressure or pressure at the valve may be determined by applying a pressure gauge at the pump discharge elbow.

4. Piston Cooling "Pee" Pipe Alignment

The alignment of the piston cooling oil "pee" pipe to the inlet hole of the piston carrier is checked with alignment gauge, 8071720, shown in Fig. 8-14.

The small end of the gauge fits into the nozzle of the "pee" pipe and by bringing the piston to bottom center it should enter the inlet hole in the piston carrier and turn freely in this position. This gauge is not to be used for bending the "pee" pipe in case of misalignment. If the gauge will not freely enter the carrier hole, the "pee" pipe should be removed and replaced with a new one of correct alignment.



"Pee" Pipe Alignment
Fig. 8-14

The piston cooling "pee" pipe is a very important part of the engine and should be inspected carefully not only for misalignment, but also the condition of the nozzle should be examined for ragged edges that might cause the oil to spray out instead of shoot out in a stream.

A cleaning tool for the "pee" pipe may be obtained under part #8087086.

5. Oil Pumps

a. Removal and Disassembly

(1) Disconnect oil line from discharge elbow and remove discharge and suction elbows. Remove pump mounting bolts, allowing pump to be removed. Clean outer area of pump before disassembly.

(2) Remove capscrews securing outermost small cover, to allow access to the main driveshaft holding nut. Remove cotter pin, shaft nut and washer. Remove capscrew which holds pump idler shaft stationary.

(3) Removal of other pump housing bolts permits entire housing disassembly for removal of pump gears and pump drive gear. Do not press driveshaft from pump housing as Woodruff keys may damage inner driveshaft bearing. (Drive gear is on pump side of driveshaft flange on lube oil pump, outside on scavenging oil pump.)

b. Inspection and Repair
Clean all parts and examine for signs of failure on gear teeth, key ways and inside pump surfaces. Check clearances as given in specifications. Replace parts as inspection or clearances indicate.

c. Pump Assembly
To assemble pump reverse general procedure outlined in Item "a" above. On replacement of internal pump gears, they must be replaced in mated pairs.

6. Lube Oil Strainers

Lube oil strainers should be removed at each oil change and cleaned as outlined in Maintenance Instruction 1706.

As described under "Unit Description", engine lube oil strainers have an oil seal in addition to the seal rings. The oil under pressure will leak out under the strainer flanges if the seal rings are not seated properly or are damaged. When strainers are replaced, care should be taken to see that the sealing surfaces are free from nicks and scratches and seal rings are in good condition. Also, that the oil passages to the seals are open and clear.

The oil seal may be checked, with the engine at idle speed, by loosening slightly the large wing nut holding the strainers in place. Carefully raise the strainer furthest from the engine. Oil should leak out around the strainer flange. If no oil appears, the engine should be shut down and the oil supply passages inspected and cleaned.

Any air which might enter system at this location will be discharged with the lubricating oil and may cause damage, even though normal oil pressure is indicated.

7. Lube Oil Separator

The oil separator screen should be cleaned at intervals given in Maintenance Instruction 1704.

Oil separator screens are removed after first shutting the engine down, then removing suction hose at the cover. After cover is taken off, the screen is removed. The element is cleaned as recommended in Maintenance Instruction 1706.

8. Prelubrication of Engines

The prelubrication of newly installed overhauled engines or engines having been in storage a considerable length of time, before their initial running is a necessary and important practice. This procedure alleviates engine loading of unlubricated parts during the interval until normal lube oil pump operation starts. Also, it offers protection in seeing that oil distribution in the engine is satisfactory. The oil supply from an external pump should be warm. Oil pressure need not exceed 35 p.s.i. A piping diagram for pressure pretest of the lube oil, fuel oil and cooling system may be obtained by requesting blue print, File 294.

At the time of pumping the oil through the engine, inspection should be made at the rocker arms, camshaft bearings and main bearings to see that oil is reaching these parts. The crankshaft should be rotated at least one revolution so as to distribute oil over various moving parts. Sufficient oil should be pumped to assure oil reaching all parts of the engine.

Before starting the engine, pour a liberal quantity of oil over the cylinder mechanism of each bank. This applies also on new engines.

Inasmuch as new engines have been filled and run with oil before leaving the factory, prelubrication of such engines is considered unnecessary.

NOTE: When an engine is replaced due to mechanical breakdown, it is important that the entire oil system, such as oil coolers, filters and so forth, be thoroughly cleaned before a replacement engine or the reconditioned engine is put in service. A recurrence of trouble may be evident in the clean engine, if other system components are neglected.

In some cases engines have been removed from service and stored in the "as is" condition by draining the oil and applying antirust compound. When these engines are returned to service, care must be taken to see that any loose carbon deposits are flushed out before adding a new oil charge. The entire engine should be sprayed with fuel, to break up any carbon deposits, and then drained, being careful that the drains are not plugged. Fuel should not be sprayed directly on the valve mechanism or bearings, as lubrication will be removed or dirt forced into these areas. The surfaces should then be wiped dry before the new oil is added to the engine.

9. Oil System Information

Additional information on the oil system and components is given in the latest revisions of Maintenance Instruction bulletins. These instructions cover important items such as the Scheduled Maintenance Program which outlines maintenance intervals, flushing instructions, cleaning information and lubrication specifications.

E. SPECIFICATIONS

Lube Oil

Lubricating oil to be used in the engine should be an S.A.E. #40 oil corresponding to specifications given in the latest revision of Maintenance Instruction 1752.

	New	Limit
Lubricating Oil Pumps		
Clearance - Drive shaft to bushing	.0015" - .0045"	.007"
Clearance - Idler gear shaft to gear bushing	.0015" - .0051"	.007"

	New	Limit
*Clearance - Gears to separator plate	.002" - .018")	Should
Clearance - Gear to housing - endwise	.018" - .022")	not Wear
*Clearance - Gear to thrust bearing	.005" - .016"	.022"
**Clearance - Gear to thrust bearing	.008" - .016"	.022"
Protrusion - Thrust bearing from housing	.001" - .007"	Flush
Backlash - Pump gears	.012" - .016"	.030"
Backlash - Drive gears	.008" - .016"	.030"
Clearance - Pump gears to housing (radial)		.010"
Bushing diameter		
Outer pump body		2.379"
Inner pump body		2.504"
Driven gear		2.004"
Face runout - drive gear - total indicator reading		.003"
Pump flange face runout total indicator reading		.005"
Concentricity - pump flange pilot - total indicator reading		.002"

Pump Capacity (Approx. GPM)

	6 cyl.	8 cyl.	12 cyl.	16 cyl.
800 RPM				
Scavenging	124	124	182	248
Piston Cooling	31	31	43	59
Lube Oil	59	71	103	140
835 RPM				
Scavenging	130	130	190	260
Piston Cooling	33	33	45	61
Lube Oil	62	74	108	146

Oil Capacity

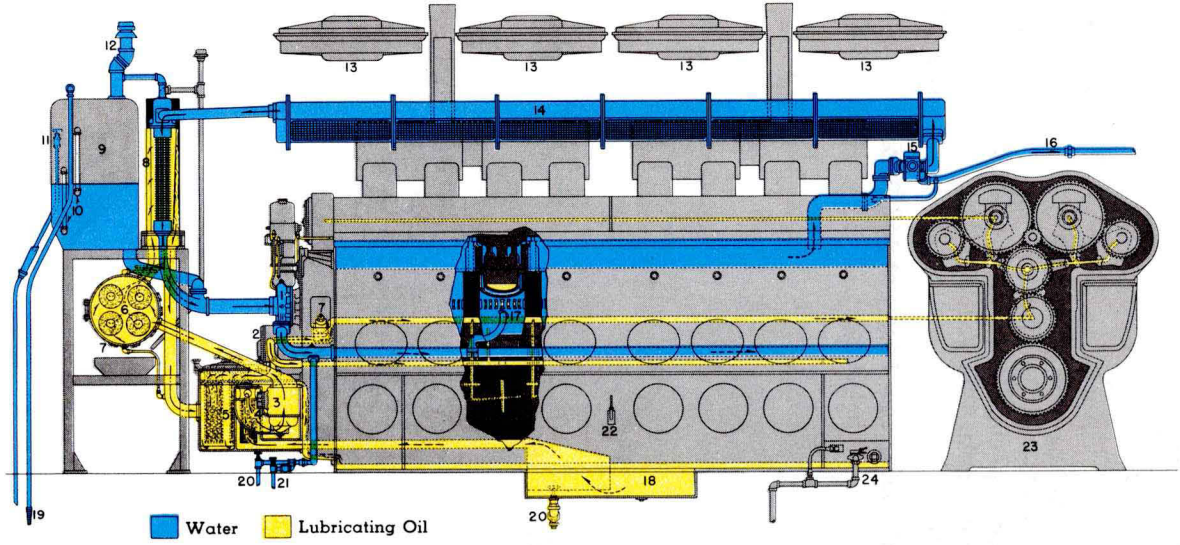
6 cyl. - 120 gal. (U.S.) 12 cyl. - 165 gal. (U.S.)
8 cyl. - 130 gal. (U.S.) 16 cyl. - 200 gal. (U.S.)

*Lubricating oil pump only. **Scavenging oil pump only.

F. EQUIPMENT LIST

Name	Part No.
Spray gun	8193041
Gauge - piston cooling pipe alignment	8071720
Testing device - lube oil suction	File 110
Lube oil system - pretest diagram (includes diagram for fuel and water system)	File 294

For additional tools, see Tool Catalog 91B.



1. Water Pump
2. Lubricating Oil Pump
3. Scavenging Oil Pump
4. Sump Oil Strainer
5. Lube Oil Strainers
6. Lube Oil Filter
7. Lube Oil Relief Valves
8. Lube Oil Cooler
9. Cooling Water Tank
10. Water Level Gauges
11. "G" Valve
12. Roof Filler
13. Cooling Fans
14. Radiator
15. Thermostat Switch
16. To Cab Heater
17. Cylinder Liner
18. Engine Sump
19. Side Filler
20. Drains
21. Steam Admission Line
22. Bayonet Gauge
23. Camshaft Drive Gear Train
24. Air Box Drain

Fig. 8-15 - Schematic Of Cooling And Lube Oil System