LUBE OIL SYSTEM OF HHP LOCO

OBJECTIVES

- Understand the requirement of LOS in GM loco.
- Understand the LOS of GM.
- Learn the function of Various components of LOS.
- Understand the difference between GM & Alco.

PURPOSE OF LOS

- To reduce friction and wear.
- Cooling of Bearing, Pistons etc.
- Protection of metal surfaces from corrosion, rust, surface damages and wear.
- Keep the components clean and free from carbon.

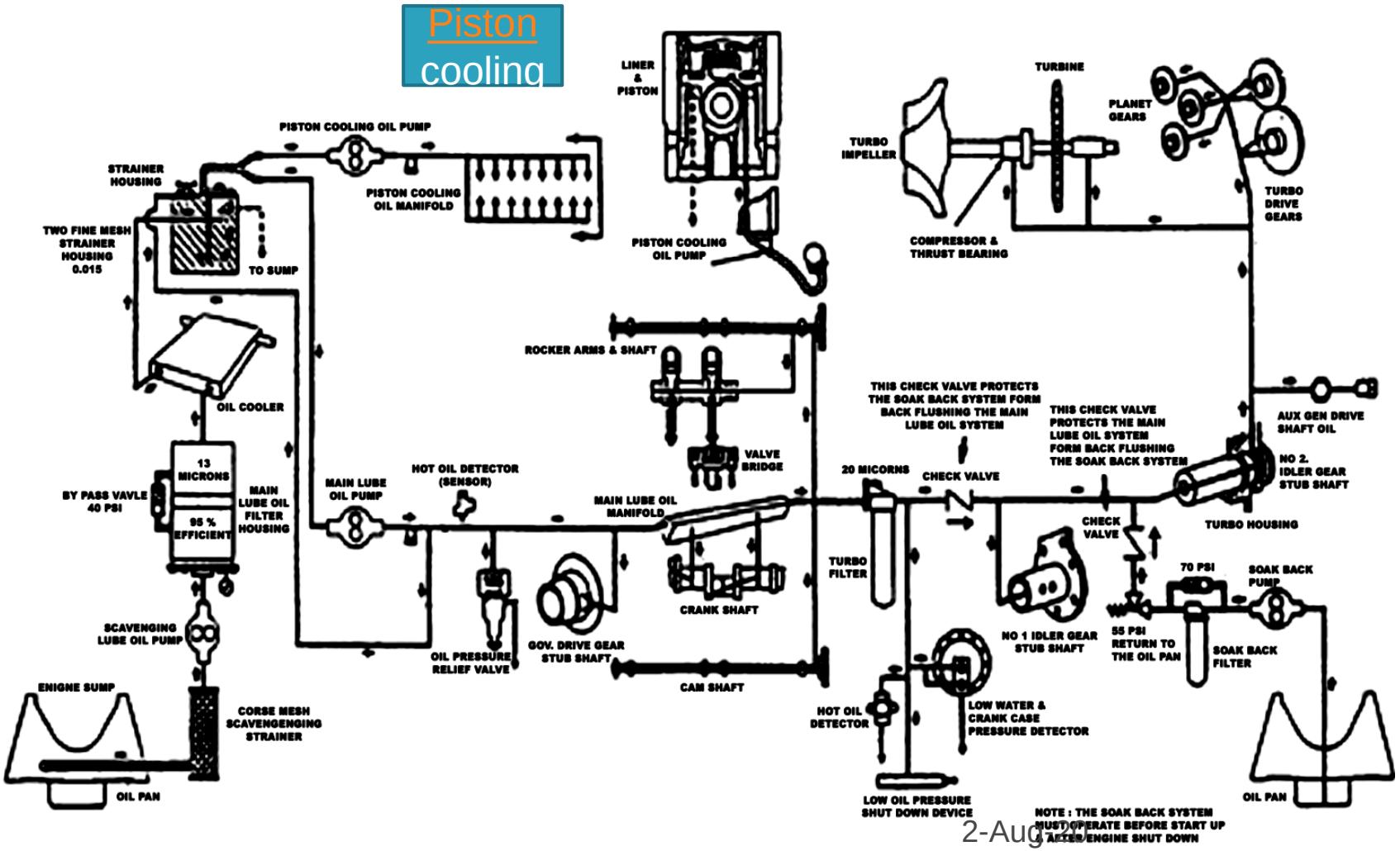
MAIN COMPONENTS IN LOS

- L.O.SUMP TANK
  - (PAC-950 Ltrs, MAC & all DLW Mfg-1457 Ltrs)
- STRAINER ASSEMBLY
- LUBE OIL PUMPS
- L/OIL FILTER
- L/OIL COOLER
- TURBOCHARGER OIL FILTER

FOUR SEPARATE L.O. SYSTEMS

- Engine L.O. System is a combination of four separate system.
  - Scavenging oil system
  - Main Lubricating system
  - Piston cooling system
  - Soak back oil system

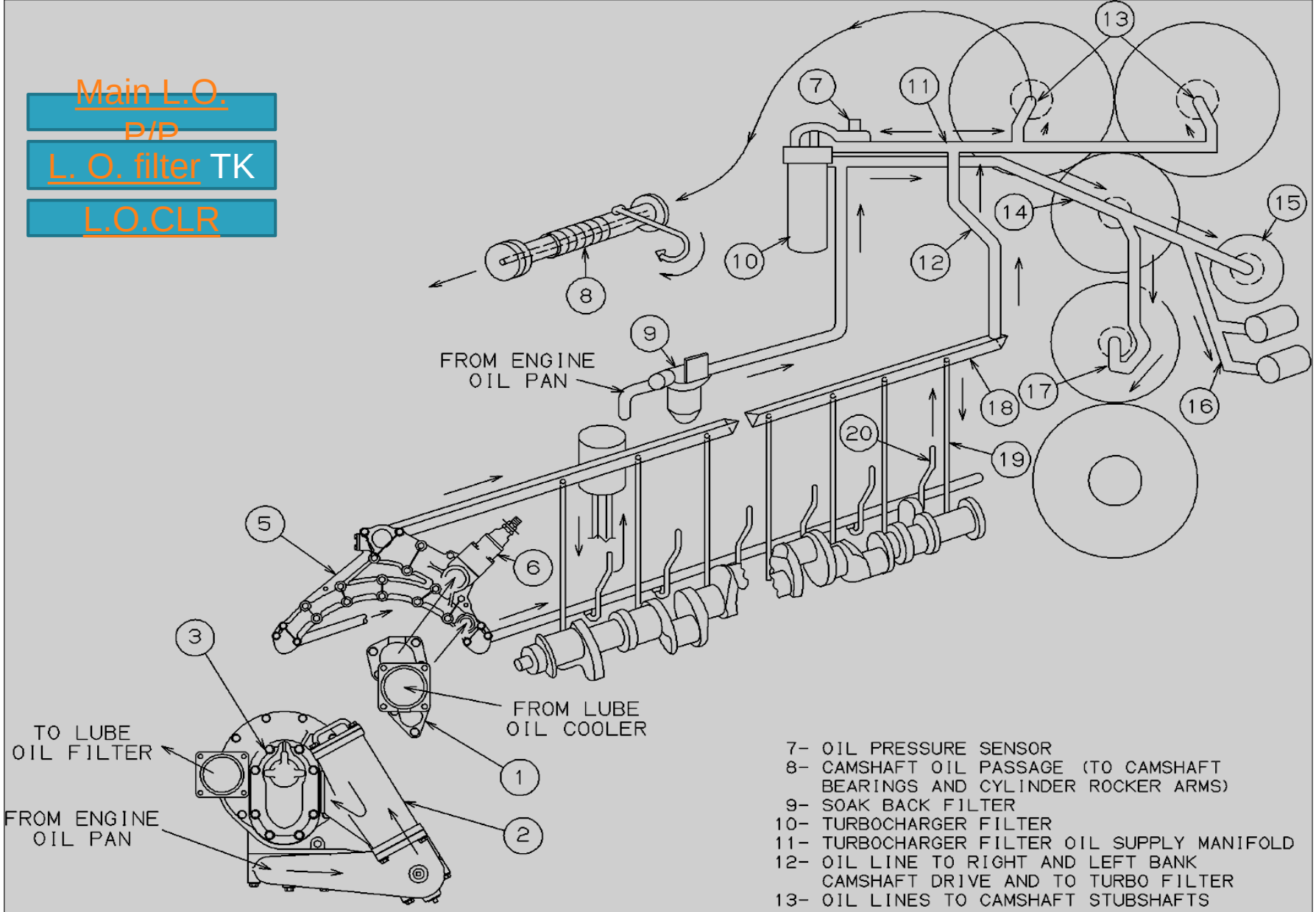
Line diagram of LOS



Main L.O. P/P

L. O. filter TK

L.O.CLR



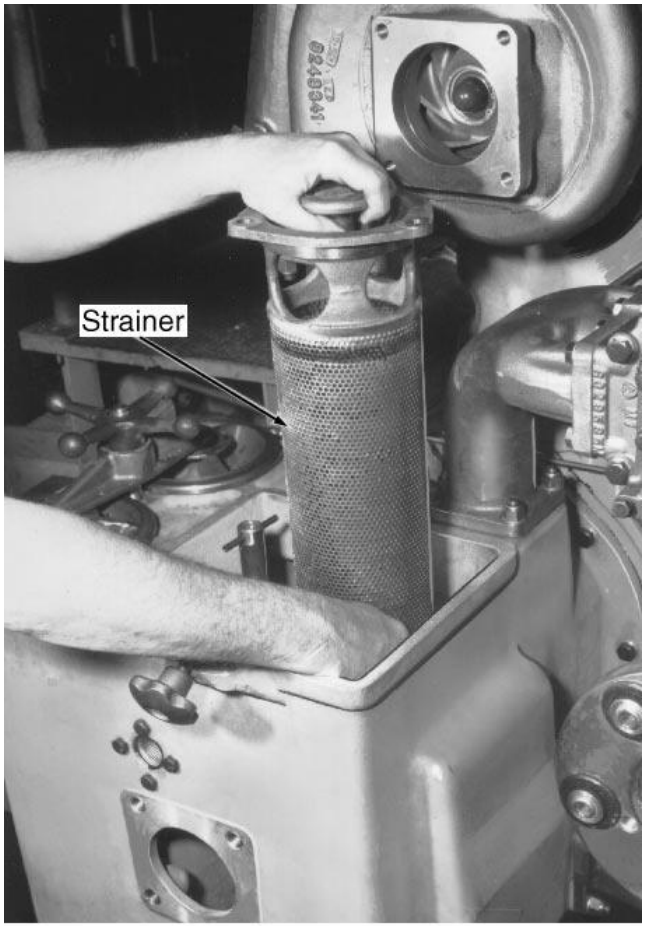
1- MAIN LUBE OIL AND PISTON COOLING OIL "Y"-BRANCH MANIFOLD
2- OIL STRAINER HOUSING & SUPPLY MANIFOLD
3- MAIN LUBE OIL AND PISTON COOLING OIL PUMP
4- OIL LINE TO GOVERNOR DRIVE GEAR STUBSHAFT
5- MAIN LUBE OIL AND PISTON COOLING OIL MANIFOLD
6- OIL PRESSURE RELIEF VALVE
7- OIL PRESSURE SENSOR
8- CAMSHAFT OIL PASSAGE (TO CAMSHAFT BEARINGS AND CYLINDER ROCKER ARMS)
9- SOAK BACK FILTER
10- TURBOCHARGER FILTER
11- TURBOCHARGER FILTER OIL SUPPLY MANIFOLD
12- OIL LINE TO RIGHT AND LEFT BANK CAMSHAFT DRIVE AND TO TURBO FILTER
13- OIL LINES TO CAMSHAFT STUBSHAFTS
14- OIL LINE TO NO. 2 IDLER GEAR STUBSHAFT
15- TURBOCHARGER GEAR TRAIN
16- TURBOCHARGER BEARING OIL SUPPLY LINES
17- OIL LINE TO NO. 1 IDLER GEAR STUBSHAFT
18- MAIN OIL MANIFOLD
19- OIL SUPPLY TO CRANKSHAFT AND BEARINGS
20- PISTON COOLING OIL LINE

EN39184

Crank case assembly

Strainer Assembly

- Cast Almunium housing.
- 02 strainers assemblies.
- 01 No Strainer(Coarse) for scavenging P/P at its suction side.
- 02 Nos Strainers (Fine)are for Main L.O.P/P at its suction side .
- It is important that strainer housing be filled before starting the

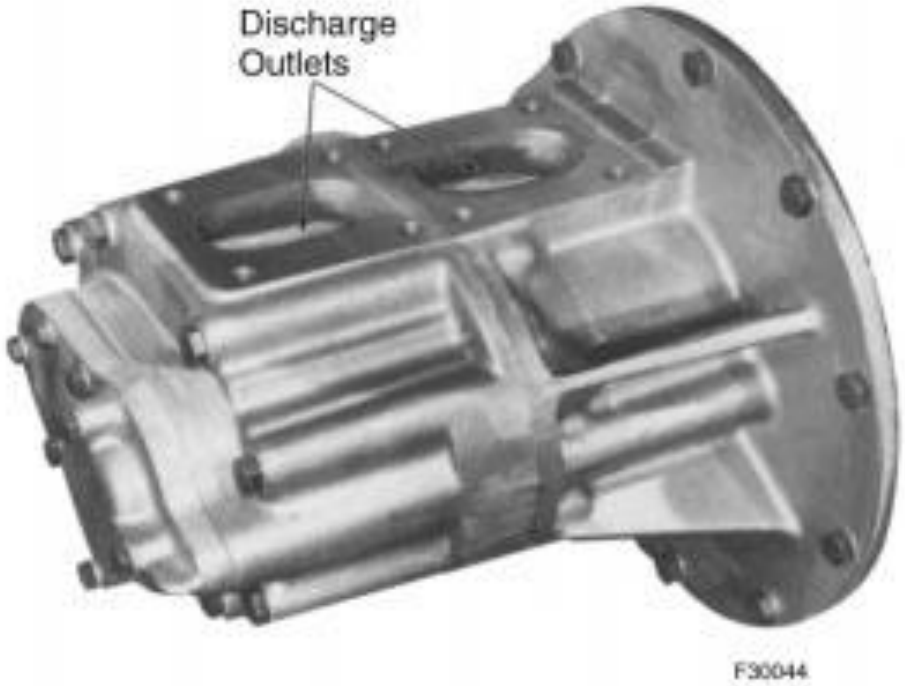


LUBE OIL PUMPS

- Scavenging Pump
- Main lube oil Pump
- Piston cooling oil pump.
- Soak back pump .

Scavenging L.O.Pump

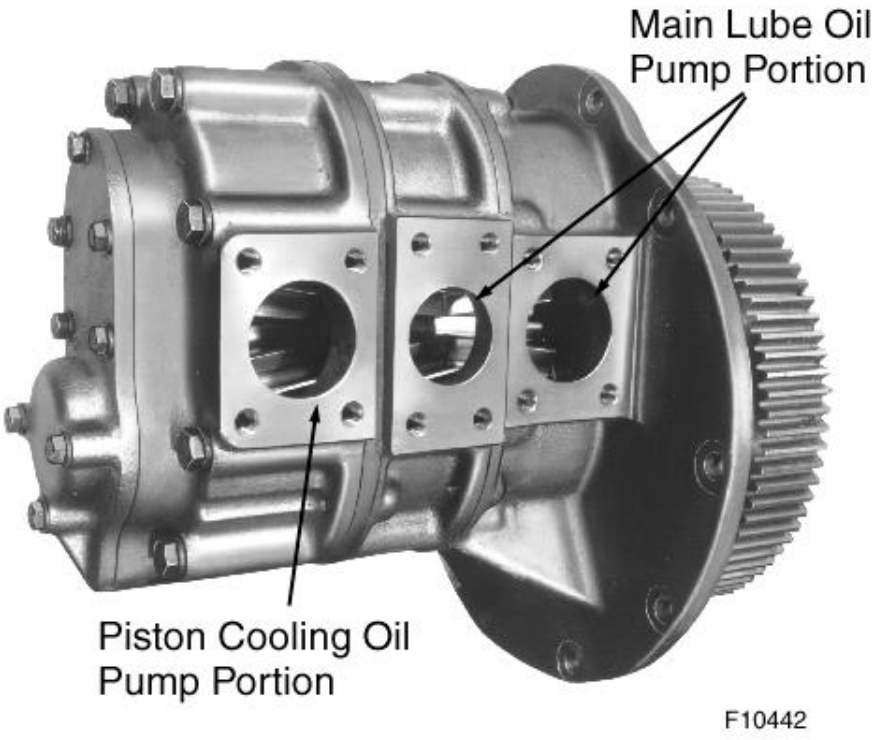
- Positive displacement helical gear type pump.
- Driven by the accessory drive gear.
- Pressure 20-35 Psi
- Discharge cap Scavenging P/P =405 GPM at 900RPM



Main L.oil & Piston Cooling Pump

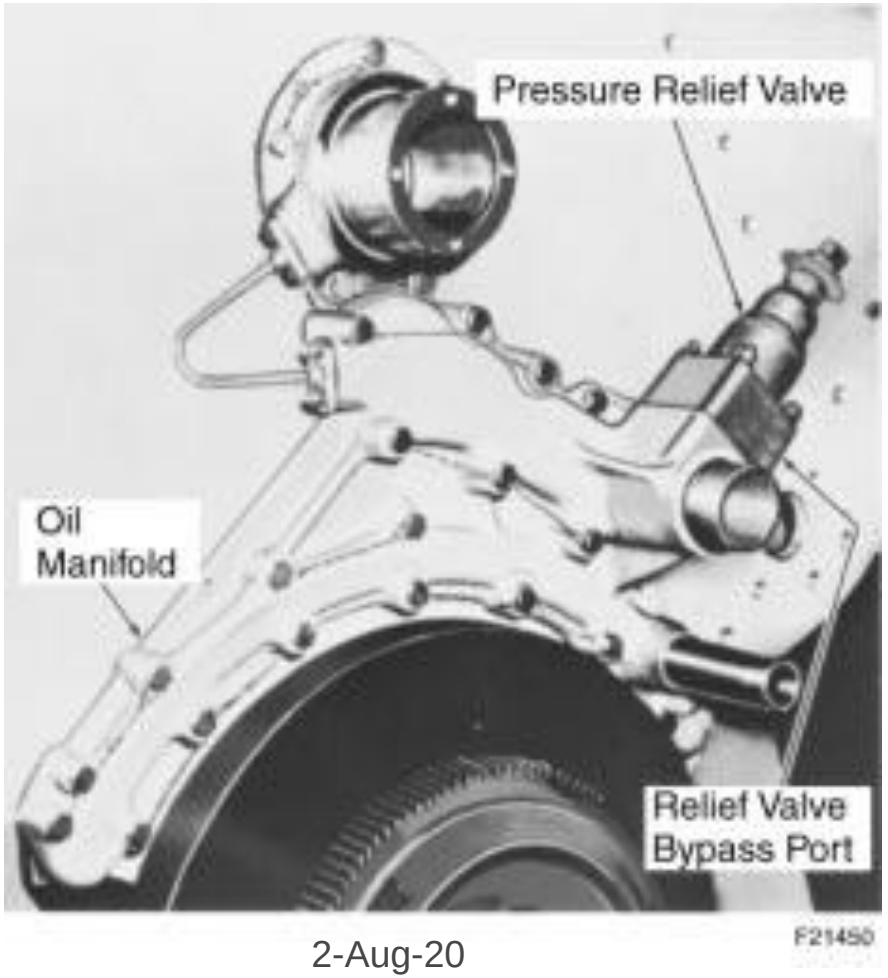
- Main lube oil P/P
  - Discharge cap= 867 LPM
  - Pressure = 100 -120 Psi
  - Max pressure is determined by Relief V/v setting (125 Psi)
- Piston cooling P/P
  - Discharge Cap= 413 LPM
  - Pressure=65-85 Psi

Connection



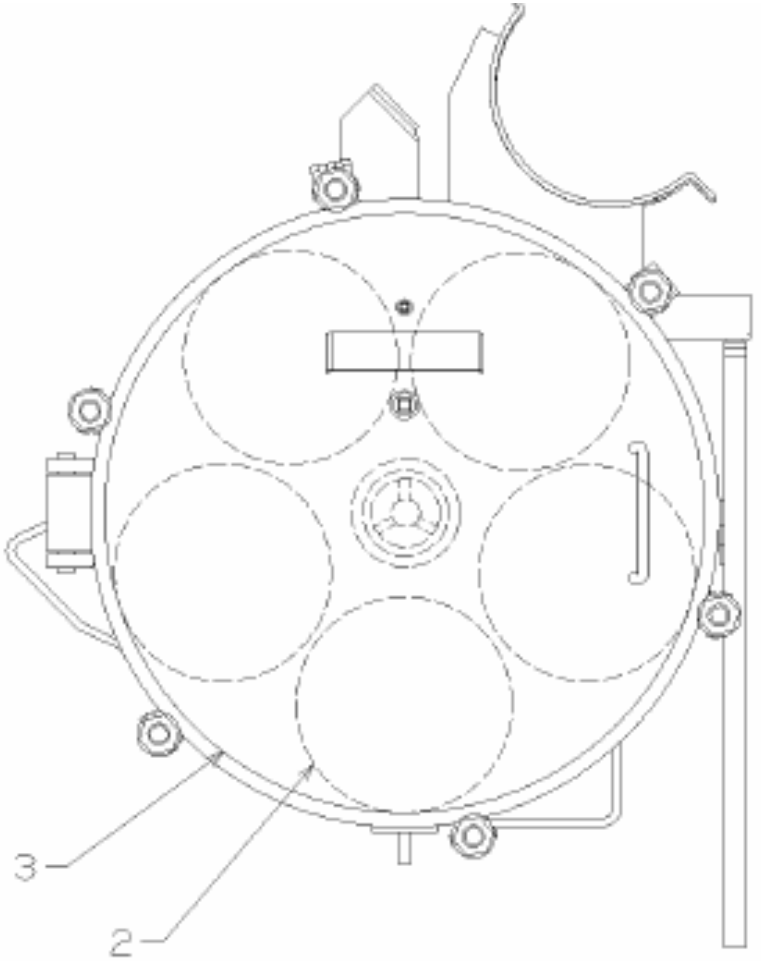
L.O.Pressure Relief V/v

- Installed on the lube oil manifold inside the accessory gear train housing on left side of the engine.
- Purpose is to limit max pressure of L.O entering to L.O.System.
- Max Oil pressure setting =125 Psi.



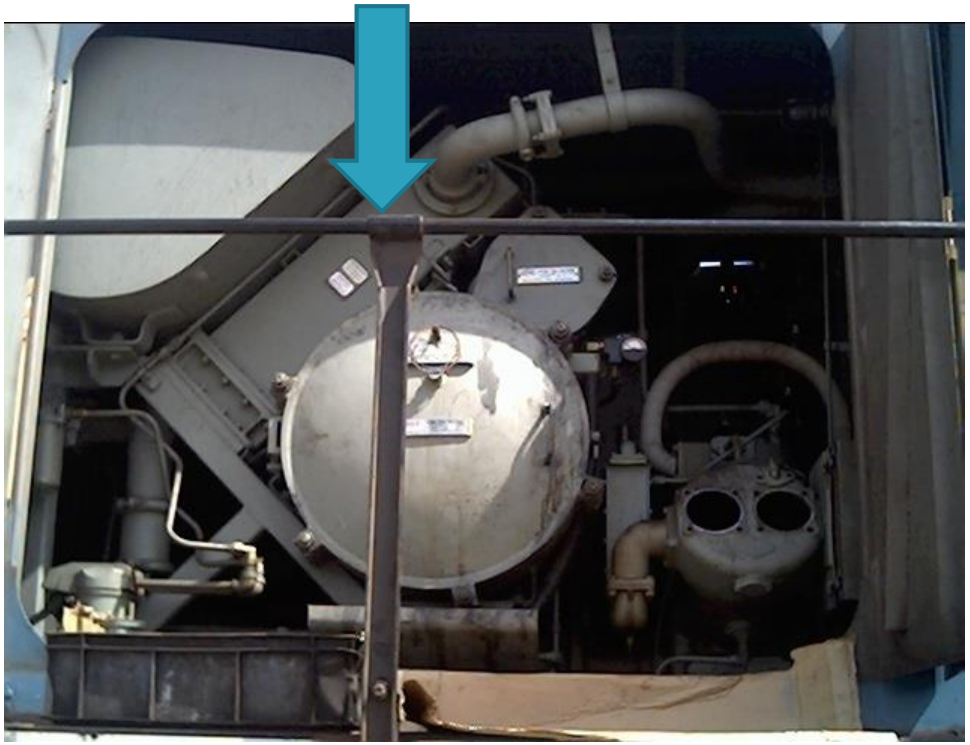
Lube Oil Filter Tank

- It consists 05 Nos paper type filter elements.
- By pass valve is provided.
- The By pass valve works at 40 Psi different pressure.
- A filter condition gauge is also provided across filter tank. if gauge needle shows Yellow and Red zone, the lube oil filter need change.



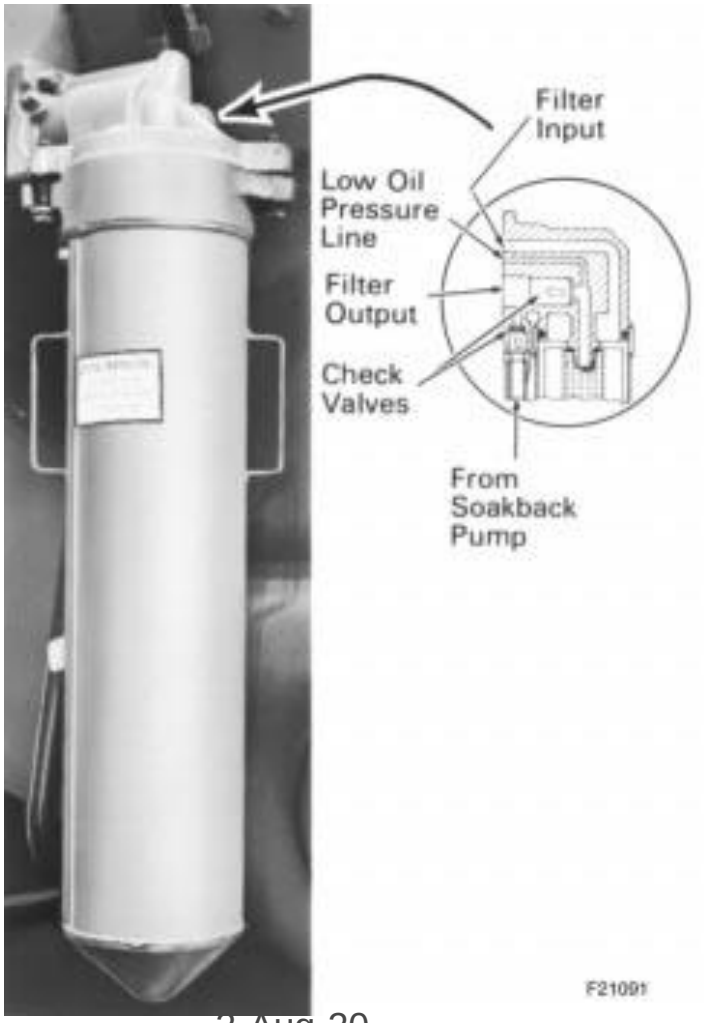
Lube Oil Cooler

- The cooling water returning from radiators enters the cooler through flange connection at top side, flows down through the cooler tubes and is discharged through flanged connection at the bottom of the cooler.
- The lube oil enters the shell and flows transversely around the tubes.
- The coolent and the oil flow through the cooler in opposite directions to produce the maximum cooling effect.

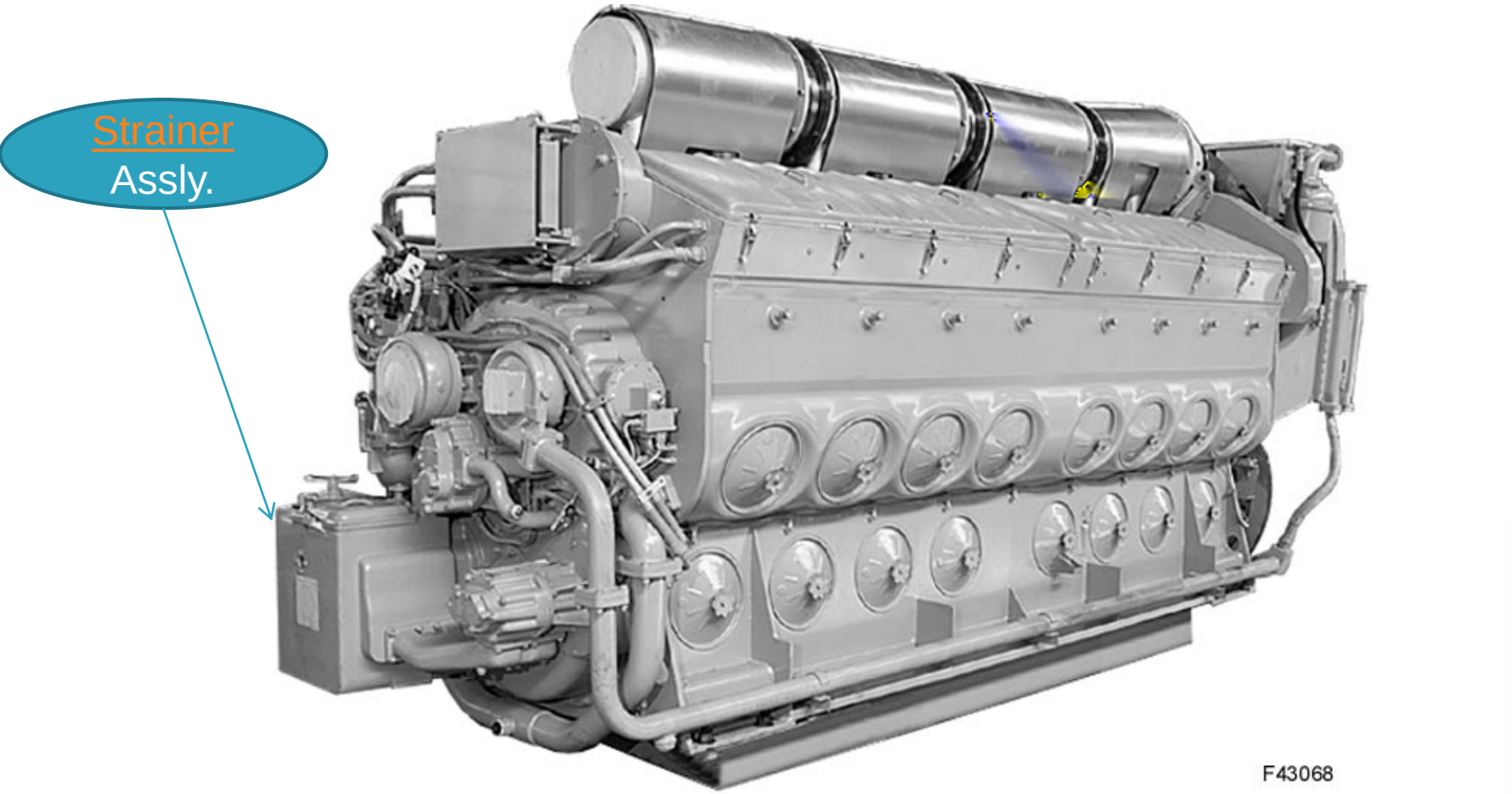


Turbocharger Oil Filter assembly

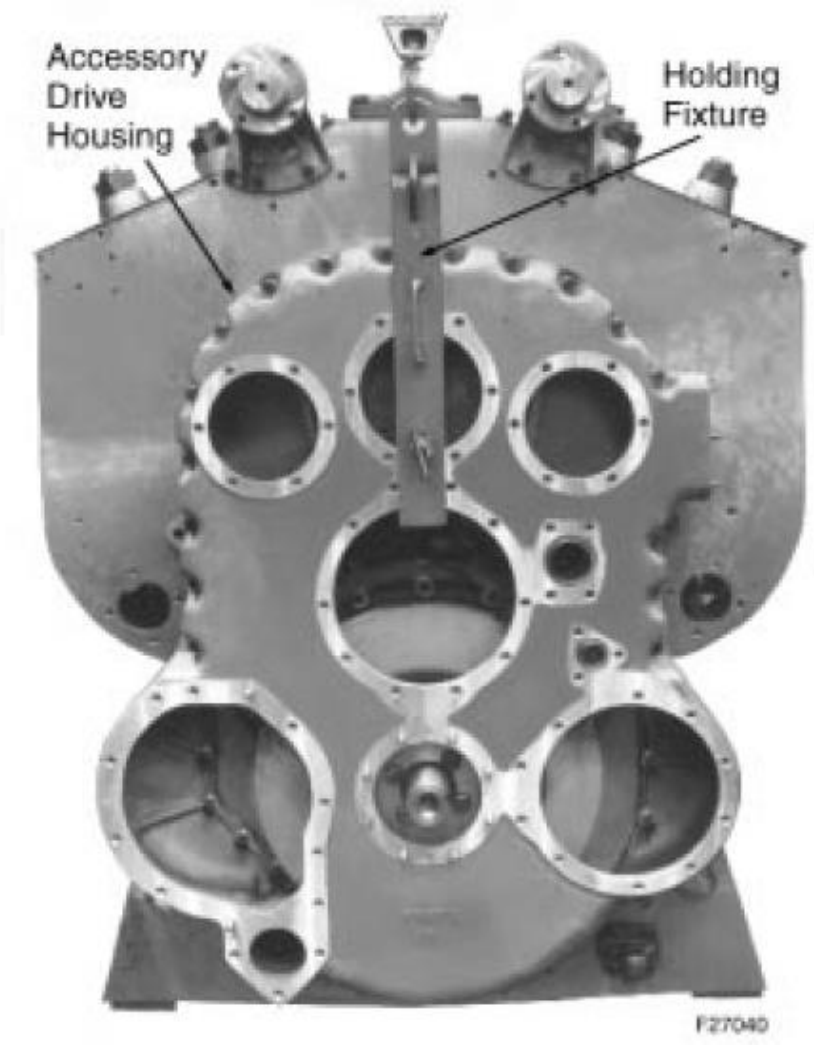
- It provide additional protection to high speed bearing of TSC.
- Mounted on the cam shaft drive housing at right bank of engine.
- Filter head contain 02 Check valve.



Engine Block



Accessory drive housing



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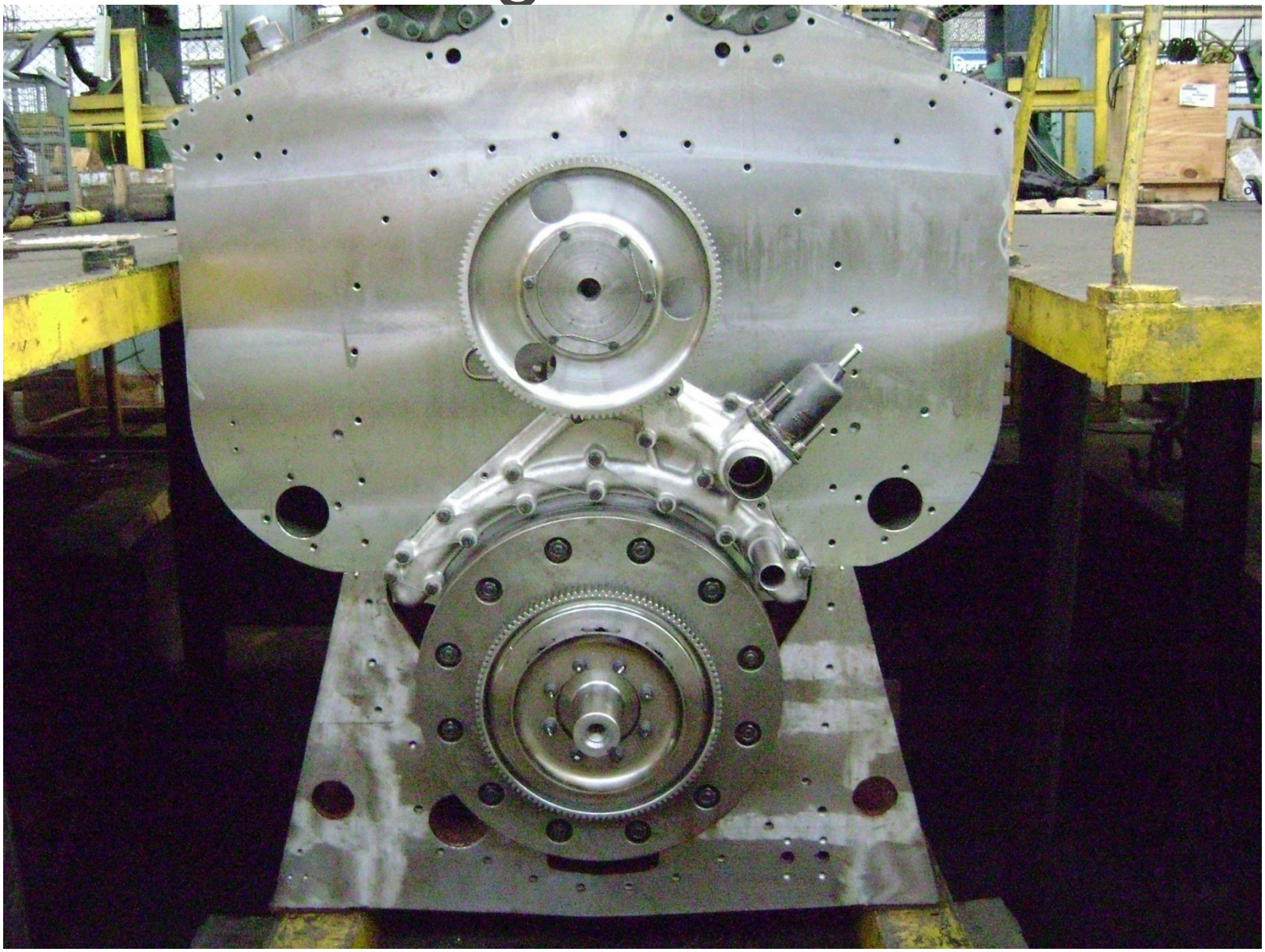
Engine Block -2



Scavenging oil system

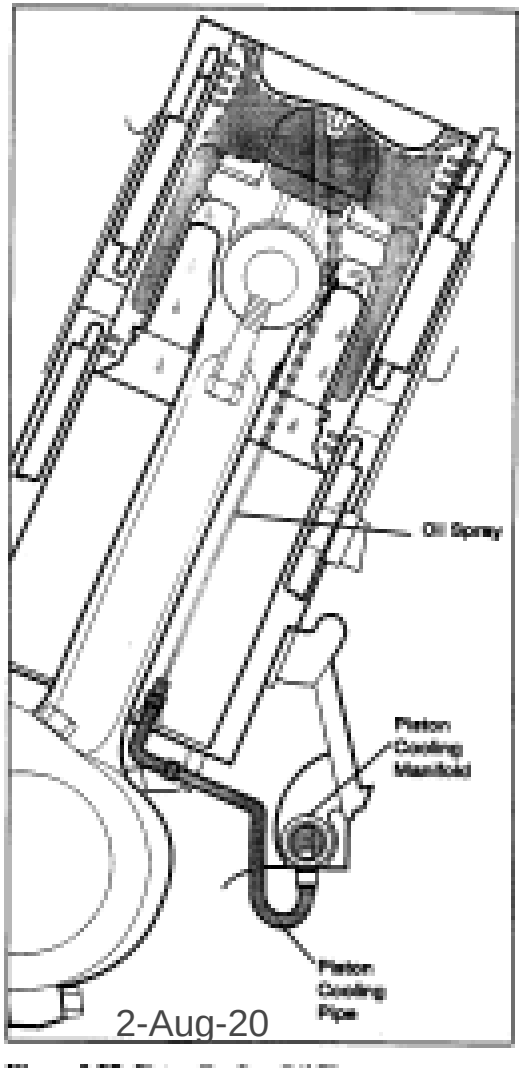
- Various steps involved in this are as below
  - Scavenging P/P sucks oil from sump.
  - Scavenging Pump feed L.O to L.O Filter tank.
  - Oil from filter tank goes to L.O. cooler.
  - Cooled Lube oil then passes to lube oil strainer (Fine) where it is filtered once again
  - Finally ,filtered oil sent to main header and other header for cooling of piston

Main lubricating oil system

- Various steps involved in this are as below-
  - Main lube oil P/P takes oil from the Lube oil strainer housing .
  - Oil from P/P goes to the main oil manifold extended to the length of engine .
  - From Main oil manifold ,Oil through drill passage goes to upper half of the Crank shaft main bearing.
  - From Main bearing, oil goes to Connecting rod bearing through drill passage made in Crank shaft.
  - Additionally ,Oil also goes to front end of the engine for lubrication of Vibration damper,Accessory drive etc.
  - Also oil enters the hollow bore camshaft from the cam shaft stub shaft.
  - An oil line from each cam shaft bearing at each cylinder head for lubrication of Rocker arm.leak of oil return to sump.

Piston cooling oil system

- Various steps involved in this are as below-
  - Piston cooling P/P takes oil from the L.Oil.strainer (Fine) housing .
  - Delivered to cooling oil manifold extending the full length of the engine one on each bank.
  - With the help of Piston oil cooling pipe, oil cool the underside of the piston crown.
  - Lubricate the ring belt.
  - Some of the oil enters through oil grooves in the piston pin bearing for lubrication.
  - Oil after cooling and lubrication drain back in to the oil sump.



Soak Back system (layout)

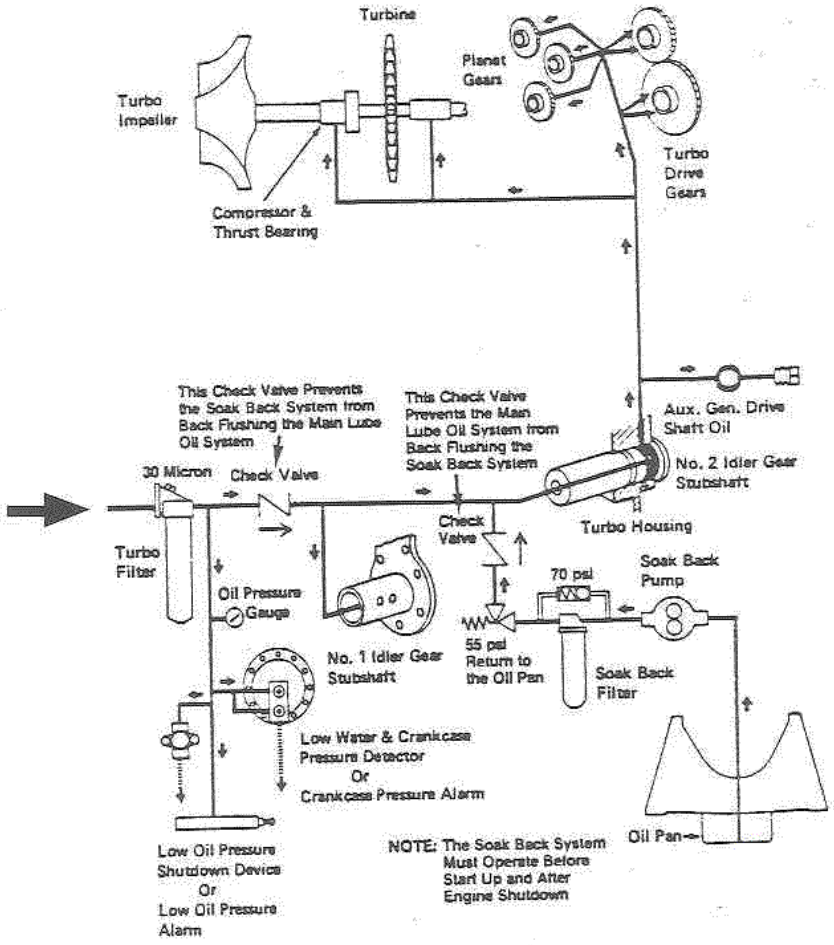


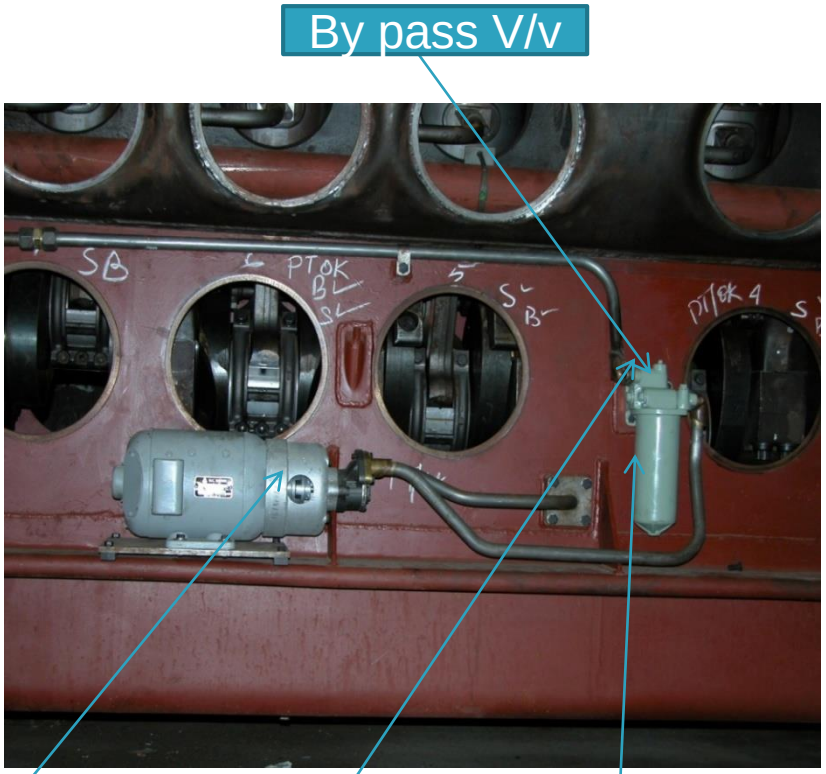
Figure 7-25 *Turbo Lube Oil System*

Soak Back Oil System-purpose

- It is a separate lube oil pressure source.
- Ensure lubrication of the Turbocharger bearings prior to engine start.
- Remove heat from the turbo after engine shutdown.
- This pressure system is controlled automatically by the locomotive control system.

SOAK BACK OIL SYSTEM

- Soak back oil system involves the following components-
  - Turbo Soak back P/P
    - Discharge cap=11 LPM.
    - Pressure= 42-50 Psi
  - Soak back filter.
  - By pass V/v.
  - Pressure relief V/v(set at 70 Psi)



Pre-Lubrication of Engine.

- Pre-lubrication of engine is done in following situation-
  - New Engine
  - Engine overhauled
  - Engine shut down for more than 48 hrs.
- Process of pre-lubrication:
  - Remove the Pipe plug from discharge elbow of Main lube oil P/p & Piston cooling p/p.
  - With the help of external source, lubricate the main L.O.S & Piston cooling sys. for at least 5 min at 10 Psi minimum pressure.

Cylinder wall varnishing

- Engines operated for extended periods of time under light or no load may experience varnishing of liner walls
- It may be necessary to load the engine either through temporary change of service or through use of a load box to remove the deposits and restore efficiency of ring set

Hot Oil Detector

- A thermostatic valve is located on the outlet elbow of the Main lub oil pump.
- When oil temperature rises to 124 degree C ,the thermostatic valve will open and the pressure oil is allowed to pass through the valve and drain into the governor drive housing. further, The Governor senses the resultant low oil pressure and initiates an engine shut down.

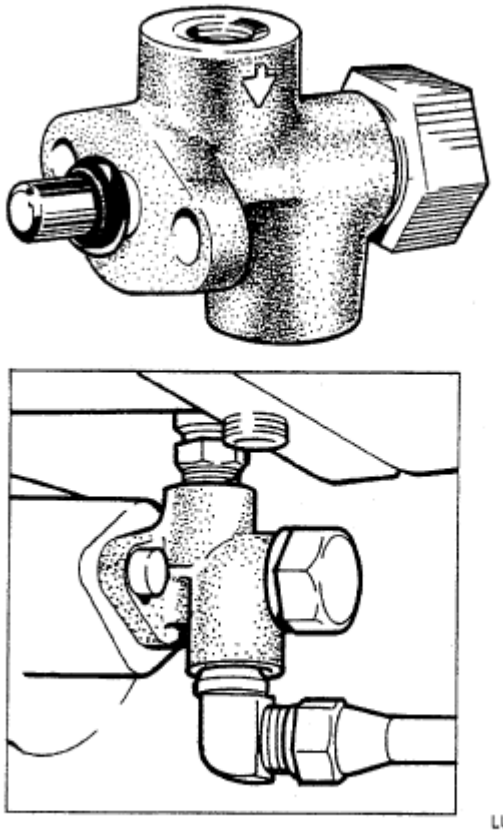


Figure 3-9 Hot Oil Detector Thermostatic Valve.

Lube oil consumption

- Areas to look for in case of excessive lube consumption:
  - External leakages
  - Poor health / improper assembly of engine
  - Worn power pack assemblies
  - Piston rings installed improperly
  - Oil separator screen missing
  - Turbocharger seal failure
  - Liner wall varnishing
  - Excessively worn head retainer surfaces
  - Worn or pounded head seat rings

Alco Loco Vs GM Loco (on LOS)

- The important comparisons between the two are given below-
- GM loco has 4 different lube oil P/P provided for different areas lubrication .In ALCO only one lube oil P/P.
- A separate system is used for piston cooling in GM loco but in ALCO loco, there is no separate system for Piston cooling .
- A separate system is used for turbo lubrication in GM loco but in ALCO loco, there is no separate system of TSC lubrication .
- In GM loco ,a Soak back system is provided for TSC cooling but in ALCO loco TSC is water cooled.

Water Cooling System

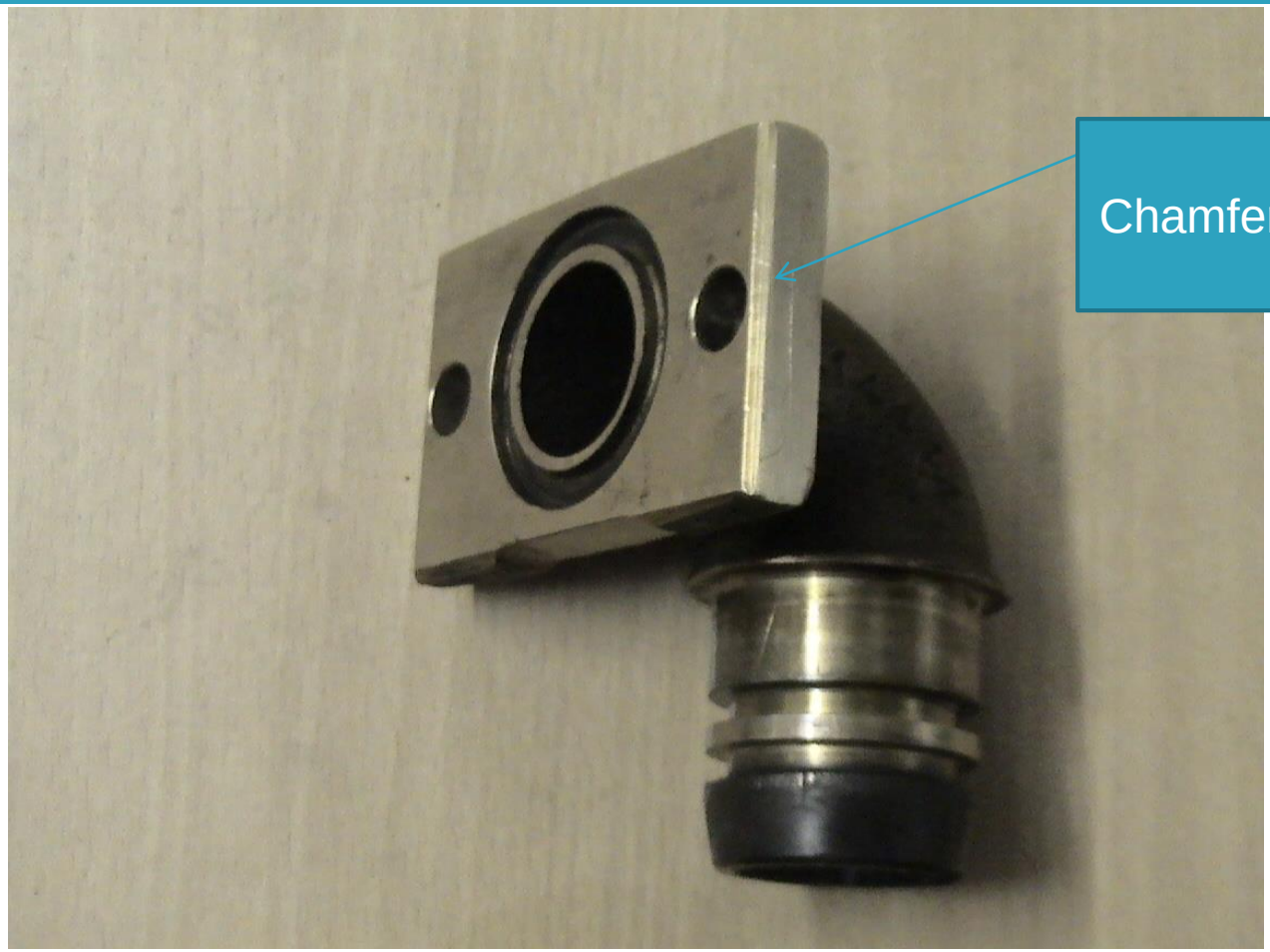
Purpose of Water Cooling

- It maintains a uniform level of temperature throughout the engine.
- Reduces thermal load by dissipating heat to atmosphere.
- It cools all engine Cylinder liners, Cylinder heads, After cooler, Lube oil cooler and Air compressors.
- Cooling system is a closed loop pressurized water system.

Components of CWS.

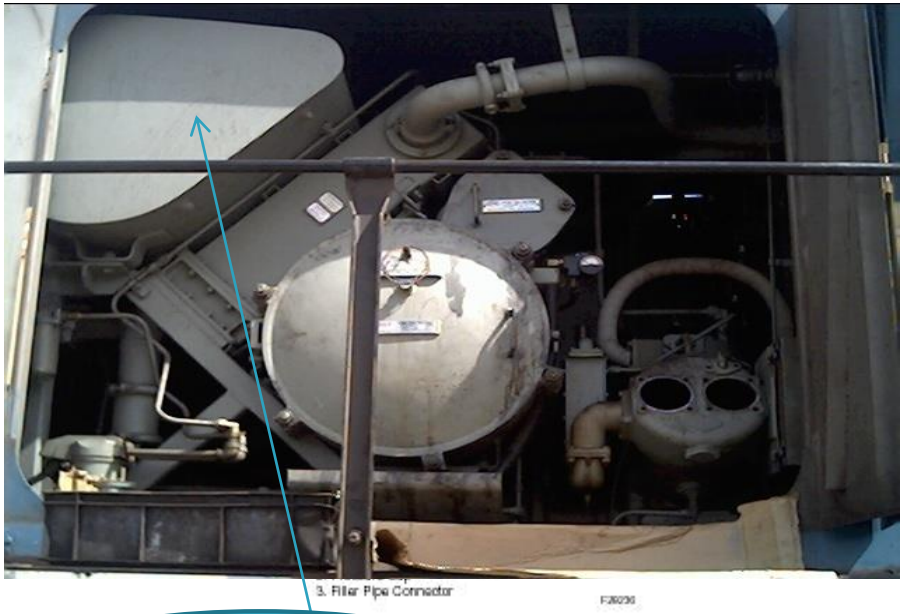
- Water pumps(Centrifugal)-2 Nos
- Water main header-02 Nos (left & Right bank)
- After cooler-2No
- Water outlet manifold or water return header-01 No
- Radiators cores(2 Nos or 4 Nos)
- Radiator Fan and motor assembly(2 Nos)
- Lube oil cooler-1 No(plate type)
- Expansion tank (1 no,Cap-371 lts),water cap of System-1045 lts

IMPORTED WATER OUTLET ELBOW



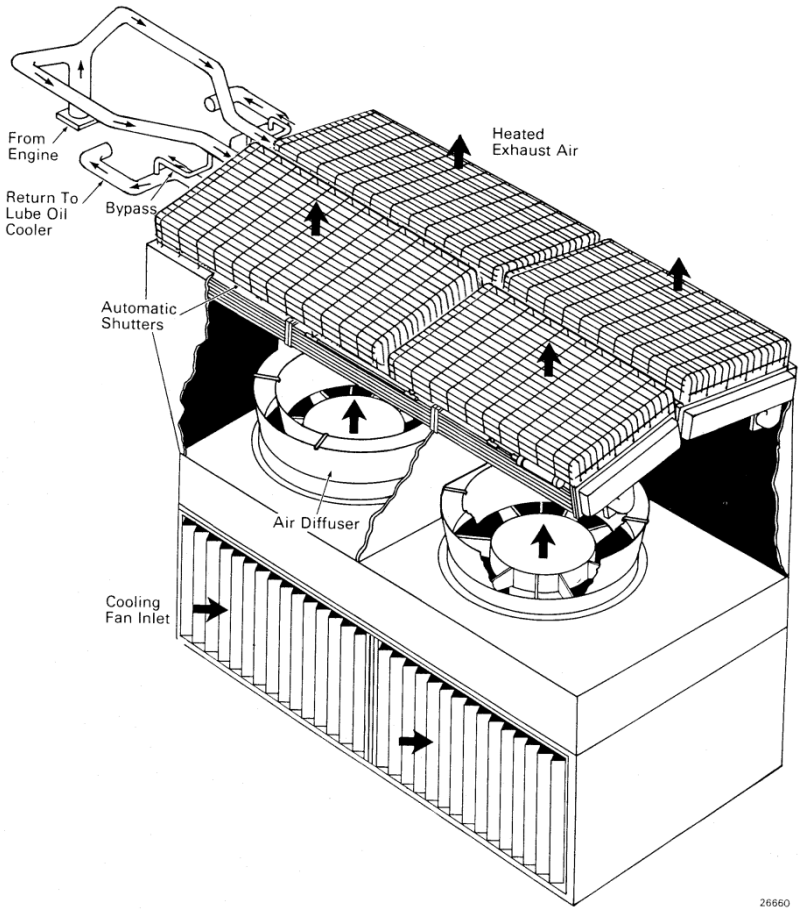
Water Expansion Tank

- Capacity/Tank-371 Ltr
- Pressure caps regulate the pressure.
- It opens at 20 PSI & also equipped with Vac. Breaker.
- The handle of pressure cap is interlocked with



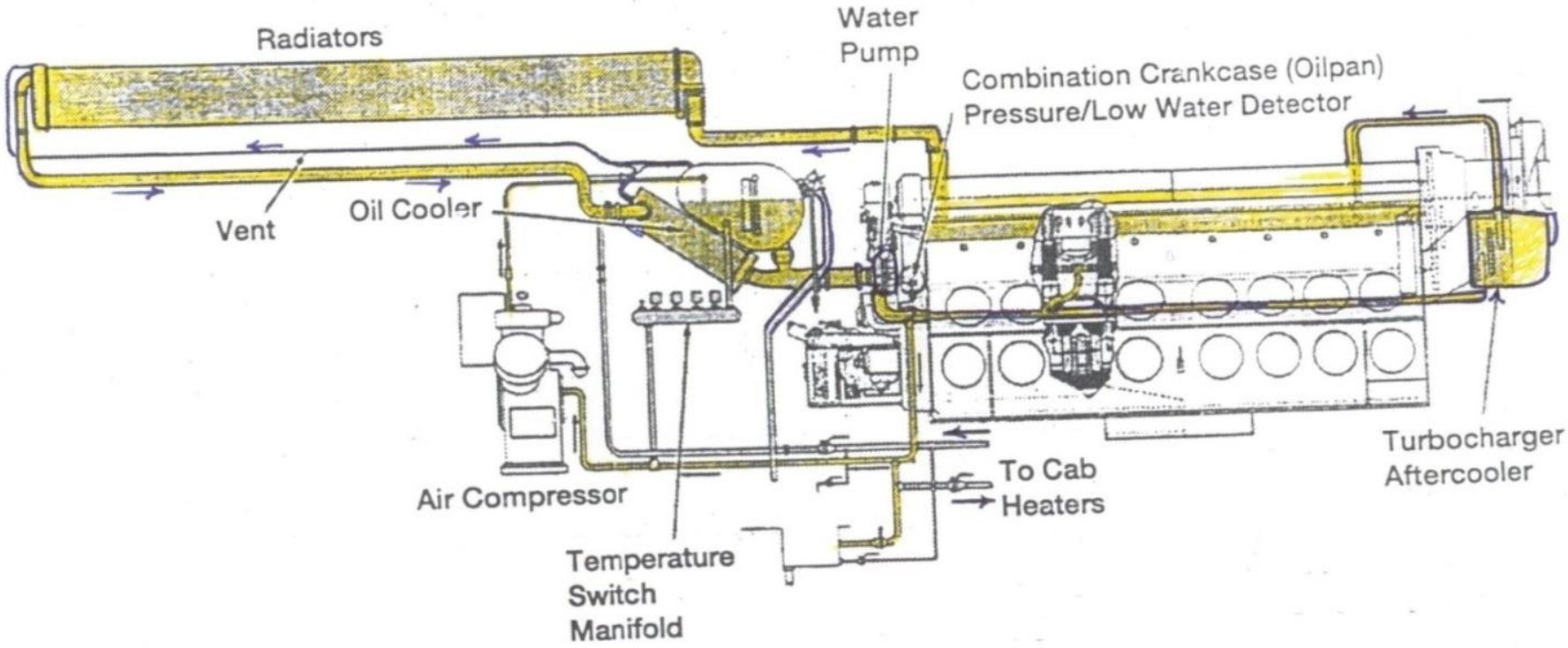
Radiator Core and Fan

- The hot water in the Radiator core is cooled through 02 Nos AC motor driven Radiator Fans (8 Blades 52” dia) powered from Companion Alternator.
- Radiator fans are controlled by EM 2000 with two feed backs from Temperature Sensors (ETP1&ETP2).
- Coolent temperature maintained between 79’c & 85’c.

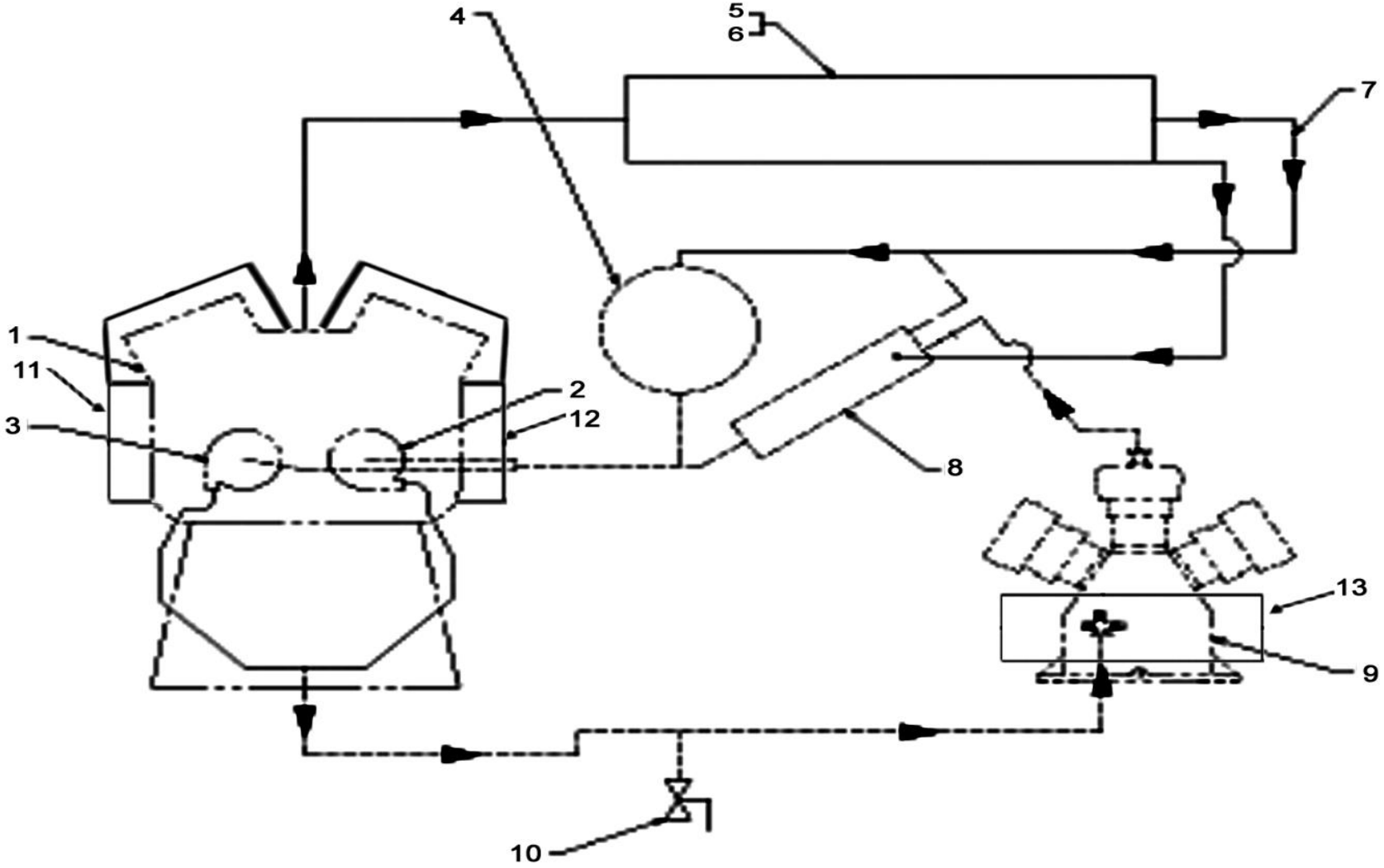


WCS Diagram-I

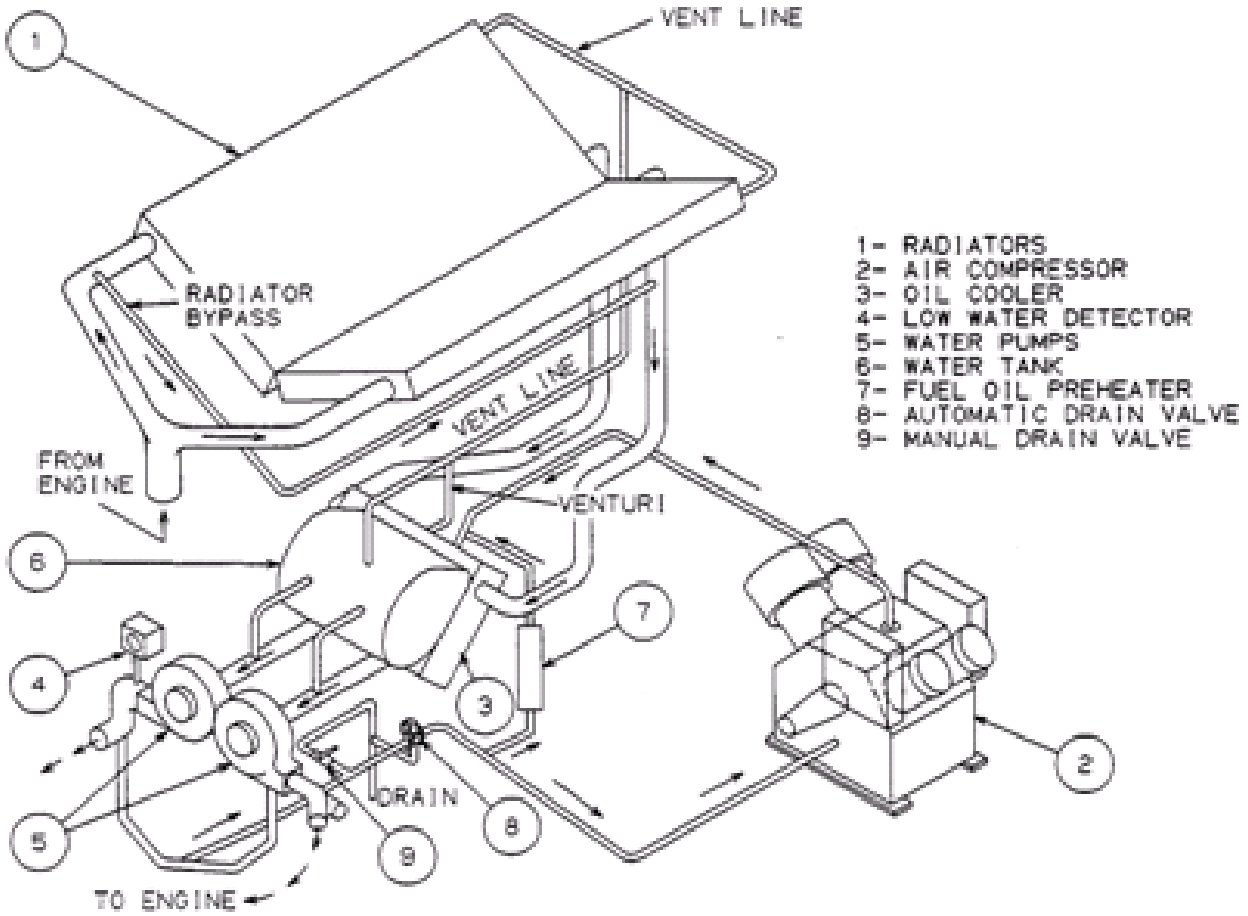
Radiator connection



Lay out of WCS



WCS Diagram-II



Schematic diagram of cooling system of EMD Engine

Functioning process of CWS

- Water from the Water expansion tank as well as Lube oil cooler is drawn by centrifugal Water pumps(one on each bank).
- Expansion tank connected at inlet of the water pump make up water in the water system.
- water from water P/P sent to 02 Water inlet manifold or water main header (left & Right).
- From water main header water enter to all Cylinder liner jackets through water Jamper.
- After cooling the cylinder liner , water enter into the cylinder head through 12 holes and cool combustion chamber of the cyl .head.

Functioning process(cont.…)

- Outlet water from each Cyl.head goes to the Return header (Out let manifold) which carry water to the Radiators.
- Each Water inlet manifold or water main header is connected at the rear end from where a water pipe line carry water to cool the After cooler.
- Water from the After cooler goes to water return header and through water return header to Radiator core.
- One branch line from discharge side of Water pump goes to compressor to cool the compressor liners, Cylinder heads,V/vs and compressed air inside the intercooler. Air compressor cooling is done whenever engine is running .

Advantage of Pressurized CWS

- Raise the boiling point of the cooling water. This in turn permits higher engine operating temperatures.
- No loss of coolant.
- Uniform water flow.
- Minimizes the possibility of water pump cavitations.

Cold Engine Speed Up

- If the engine water temperature is below 46’c ,the engine speed will be raised to throttle 2 automatically by the computer.
- Once the engine water temperature reaches above 52’c ,the engine speed will be reduced to idle.

Hot Engine

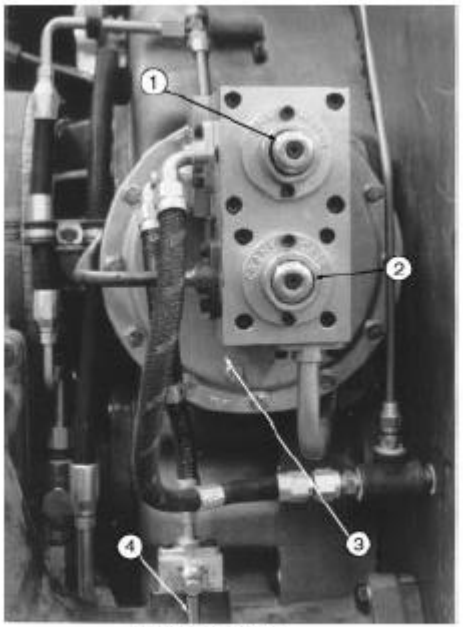
- When the engine temperature become excessively high (above 97’c),the EM2000 will display “HOT ENGINE-and throttle 6 limit” message and the computer will initiate the reduction in engine speed upto 6th notch even if the throttle is on 7th or 8th notch. this condition will remain in effect until the temperature return to safe limit (79’c to 85’c).
- In case engine temp. is not reduced (emergency), Lube oil temp will increase, the thermostatic valve in the "hot oil detector" will dump oil pressure in the line to the governor low oil pressure detector-engine will shut down.

Temperature control in the cooling system

- Mainly 02 Nos Electronic temperature sensing probes(ETP-1&2),EM2000 computer and Radiator fans take part in controlling the water temperature .
- Electronic temperature sensing probes(ETP-1&2) are located in the water pipe line between the lube oil cooler to the inlet of water pump on the engine left side.

Low Water Pressure Detector

- This safety device is spring loaded. It has two diaphragm in the stack ,one sensing Water pressure into the engine and the other sensing Engine air box pressure.
- When water pressure falls, the device dumps oil from the Governor supply line, causing an engine shut down.
- The following condition will cause LWPD to trip-
  - Loss of water level.
  - Low water pressure(water pressure is within 0.5 Psi of air box pressure).
  - Excessive air box pressure due to turbo surging.



1. Low Water Portion
2. Crankcase Pressure Portion
3. Vent And Test Fitting
4. Test Cock

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Radiator core(Maintenance care)

- **Leakage test**: Each radiator shall be tested with air pressure of 75psi applied for atleast 10 minutes and there shall be no leakage of air during static testing.
- The air pressure drop through the radiators shall not exceed 2” water column at maximum airflow rate specified as above and the water pressure drop across the radiator should not exceed 10 psi.
- During warranty service period, maximum of 4 tubes per core will be allowed for blocking.

GM Vs ALCO(on base of CWS)

- Water system capacity in GM loco is 1045Ltrs while in Alco is 1210 ltrs.
- In GM loco 2 water P/P is provided.in ALCO ,only one water P/P is provided.
- In GM loco,Radiator fan is operated by electrical motors and in ALCO loco,Fan is driven by mechanical power.
- In GM,the water system cools the Compressors also .But in Alco, the Expressor /compressor is air cooled.
- GM loco has low water temperature control system . In Alco ,no such system provided.
- In GM,The TSC cooling is done by lubricating oil but in Alco loco the TSC cooled by water system.
- The Expansion tank is located in the equipment rack in GM loco. In Alco loco, the expansion tank is located in Radiator compartment at the top of the long hood end.
- In GM, Radiator core are located in a hatch at the top of the long hood end .In Alco, Radiator core are placed in vertical position in Radiator compartment.

Schedule Maintenance

- Daily
  - Level of coolant.
- 90 day inspection
  - Test, strength of corrosion inhibitor.
  - Self test of rad. Fan.
  - Fan contactors & Fuses.
- 6 Month Inspection
  - Radiator external cleaning by low pr . compressed air (top to bottom)
  - Pressure water

Schedule Maintenance

- 1Yrly Inspection:-
  - Magnet valve controlling the radiator shutter to be overhauled.
  - Pressure testing of the cap & system.
- 2Yly Inspection:-
  - Replace pressure cap & inspect filter neck.
  - 3 Yly Inspection:- - O.H. Water Pump, shutter control magnet valve & replace flexible piping.
  - Cooling fan & motor O.H.
- Cleaning -
  - Blow compressed air & reverse operation of cooling fan by Interchanging the position of two AC leads.

Failures on account of CWS.

- (These failures were occurred in Siligure Diesel shed in 2009-10 in account of CWS.)

- L/side outer side radiator core flange bolt loose.
- Both side Radiator core vent pipe were twisted.
- Water leakage from Radiator core vent pipe joint.
- R/Side Radiator Core, 4" steel pipe found crack.
- Water leakage from After cooler core.
- Right side after cooler core inside tube leakage (old material).
- compressor Inter cooler header gasket worn out.
- Water pump seal burst.
- Water leakage from water tank gauge glass 'O' ring.
- Right side Radiator core vent hose got punctured.
- Water tank pressure cap lock defective.

THANKING YOU