GENERAL ARRANGEMENT - DIESEL LOCOMOTIVES

Lecturer (Diesel)/IRIMEE

Intro of Diesel locos in IR

- In the early 1960, IR began conversion of its mainline from steam to Diesel locomotives. For this conversion, GM and ALCO were asked to submit designs for new diesel locomotives.
- GM (WDM-4/2600)did not agree to the TOT agreement so the ALCO(WDM2) prototype was selected for production.
- However, even before the arrival of WDM2 another type of diesel loco was imported from ALCO beginning in 1957.This loco was classified as WDM1.
- WDM2 was first introduced in 1962 in IR.

Layout of Diesel Locos- Alco

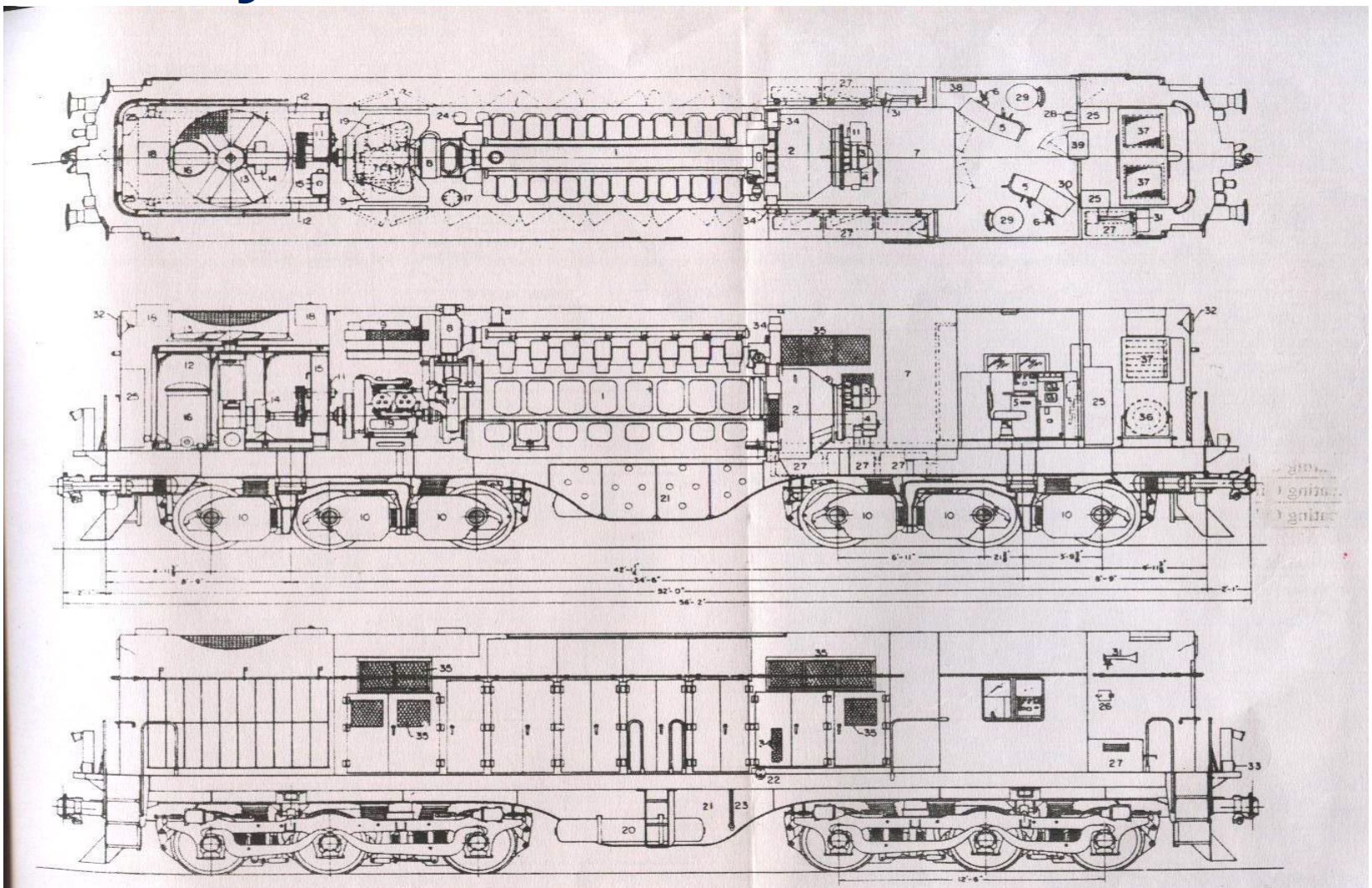


Fig 1.LOCATION OF APPARATUS

LOCO Terminologies

- Nose compt ,Driver's cabin,Control compt ,Radiator rm with Under truck is called as Locomotive.
  - Short hood end
  - Long hood end
  - Right side of locomotives
  - Left side of the locomotive
- Gen.room,Engine room and Expressor room is called as Diesel engine
  - Right side of the engine & Left side of the engine
  - Power take off end & Free end

Various compartments of locos

- A WDM2 is divided in main 8 parts as follows-
  - Nose compartment.
  - Driver’s cabin.
  - Control panel.
  - Tr. Generator compartment.
  - Engine room.
  - Expressor/Compressor compartment
  - Radiator Room .
  - Under truck

1.Nose compartment

- Some important components fitted in Nose compartment are as –
  - Dynamic braking grid resistance
  - Grid cooling Blower & Motor
  - A1 Differential pilot air valve
  - GD-80D type oil bath filter(atmosphere)
  - Control air reservoir
  - Sand Box etc

Dynamic Braking Grid

- 12 Nos braking grids are fitted.
- These grids get heated up when current passes in these grids during dynamic braking.
- Electrical energy dissipated to the atmosphere in form of heat energy.

Dynamic Braking Blower Motor

- It is DC motor with 02 blower.
- Its cool dynamic braking grids during dynamic braking.
- This machine draws current from traction motor armature while working as generator during dynamic braking.

2.Driver’s Cabin

- Control stand.
  - Air brake control stand .
  - Electrical control stand .
- Gauge panel
  - FOP gauge.
  - BP gauge.
  - LOP gauge
- Driver’s seat.
- Hand brake.

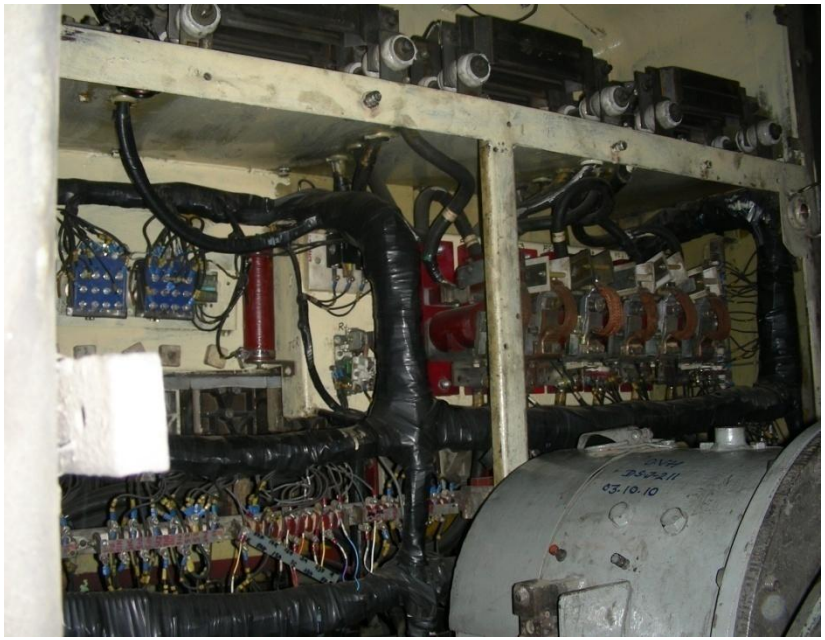
Control stand

- Selector handle.
- Throttle handle.
- Reverser handle.
- A9 V/V handle.
- SA9 V/V handle.
- Indication lamp for Hot engine,Ground relay,Wheel slip.
- Horns (SH&LH).

3.Control panel

- Front control panel
  - ECP ,VRP,
  - Engine control panel.
  - Field control panel
  - CK1&CK2 .
- Back control panel
  - Terminal boards.
  - Various resistance
  - Various contactors etc.

Back control panel

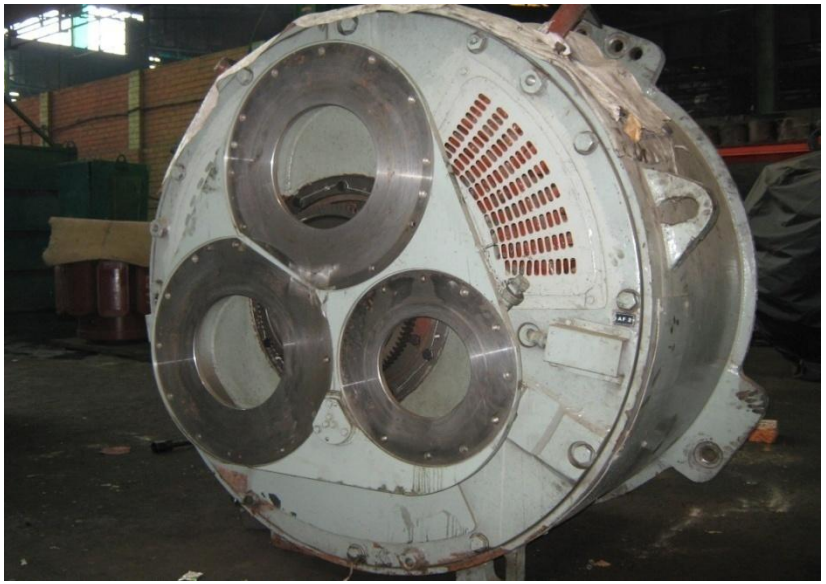


4.Traction Gen. compartment

- The following traction machineries are fitted-
  - Traction Gen/Traction Alternator
  - T.G.Gear box.
  - Excitor
  - Aux.Generator.
  - FTMB

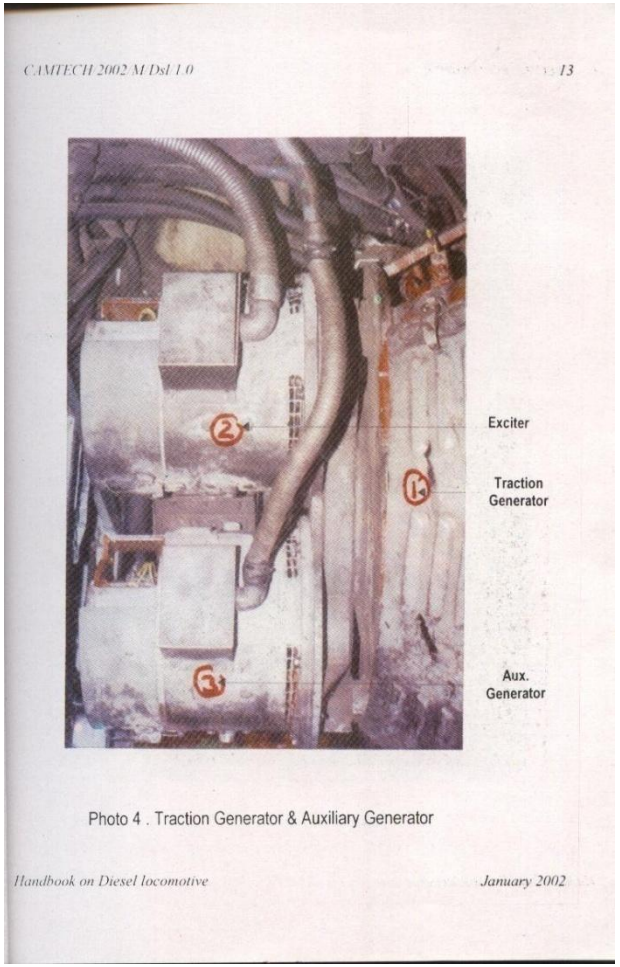
Traction Gen/Traction Alternator

- Traction Generator
  - It produces DC current for operation of all Tr. Motors, its field excitation.
- Traction Alternator
  - In AC/DC locos, TA is provided & it produces AC current.



Aux. Generator

- This is a DC generator.
- It supplies current for batteries charging on loco.
- It supplies current for operation of CC Ex.Motor, Fuel P/P motor, ECC coil assly, Relays and lighting etc.



FTMB

- It is gear driven from the main generator shaft.
- It supplies air to the Tr.motors No-1,2,3 fitted with wheel axle below the driver cabin.

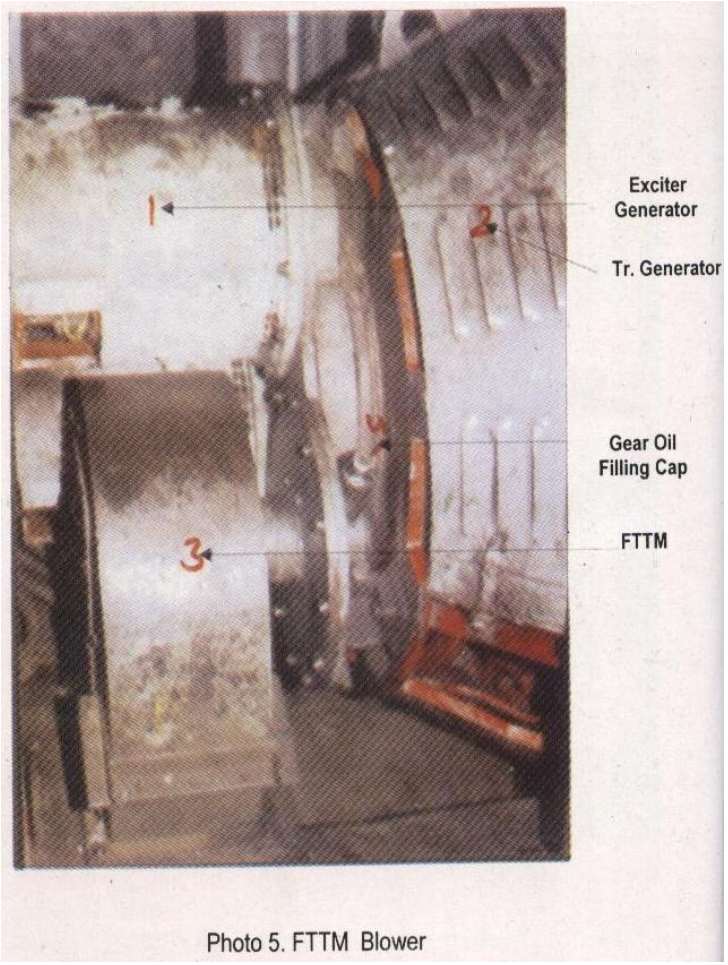


Photo 5. FTTM Blower

5.Engine Room/compartment

- Free end: TSC end of the engine.
- Generator end: Power take off end of engine.
- Engine cylinder are numbered from the free end. Right(1R)and left (1L).
- The following components are fitted -
  - Engine base,Engine block,
  - After cooler,TSC,Exhaust manifold
  - Governor,FIP & support,Cylinder head,
  - C/C Exh.Motor,Lub oil P/P, Water P/P.

ENGINE BLOCK(Cylinder Block)

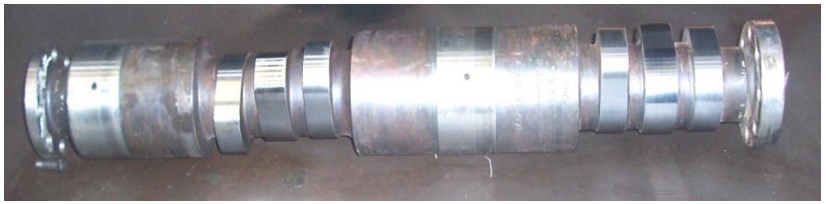
- Engine block houses 8 cylinders in each side in V arrangement.
- In this way ,total 16 cylinders can be fitted in a Engine block.
- In engine block,There is cavity for cooling water circulation.
- Engine block is of steel plate,welded together and mounted on Engine base (Crank case)with the help of nuts and bolts.
- One V type gallery is provided as Air inlet manifold.

CRANK SHAFT

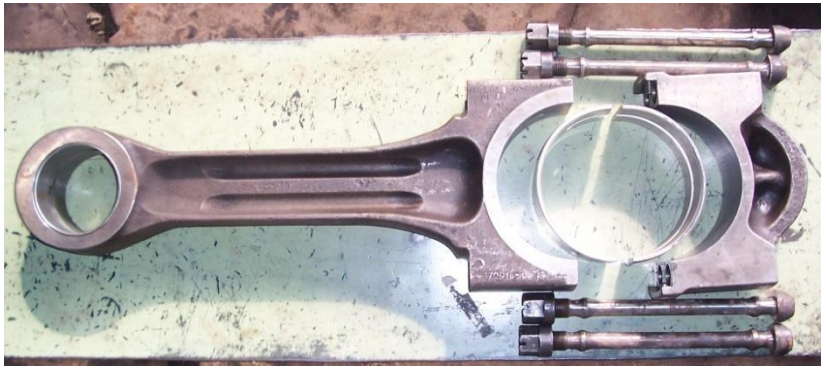
- 16 Cylinder Engine Crankshaft
  - No of Main Bearings- 9
  - Location of Centre Journal- 5
  - No. of Crankpins- 8
    - For Lifting - 2 & 7
    - For Support- 3 and 7

Cam Shaft

- 3 Cams are provided for each Cylinder
- Opening and closing Inlet and Exhaust valves.
- Timely injection of fuel in Cylinder.

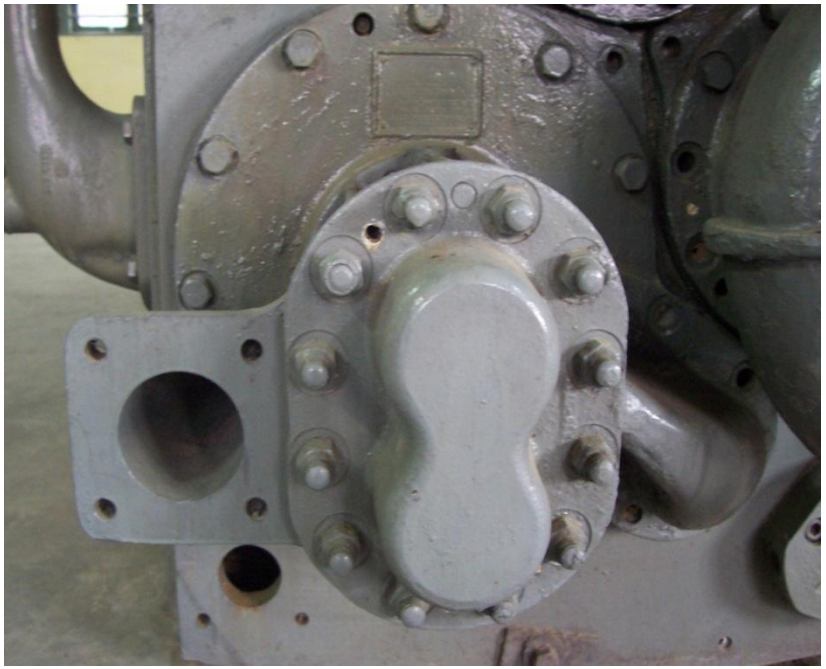


Piston & connecting rod



Lube oil pump

- Gear type pump
- Mounted on the free end
- Driven by the diesel engine



Turbo Super Charger

- Air charge of higher density during suction stroke of piston.
- Fitted above After cooler housing at free end .
- Pressure upper limit -1.80- 2.20 kg/cm2.

AFTER COOLER

- Cool the inlet air.
- The cooler consists of-
  - a tube bundle mounted
  - in the air intake passage

FIP & FUEL PUMP SUPPORT

- FIP injects the fuel oil in the cylinder through HP tube & Fuel injector.
- It is mounted on FI Support.

GOVERNOR

- Controls the speed of the diesel engine by regulating the rate of fuel injection.
  - Mech–Hydraulic Governor (WW Gov.)
  - Microprocessors Controller Based Governor(MCBG)

6.Compressor compartment

- Driven by diesel engine through a flexible coupling.
- This furnishes air for purposes of loco control, air brake system and vacuum in vacuum braked trains.

7.Radiator compartment

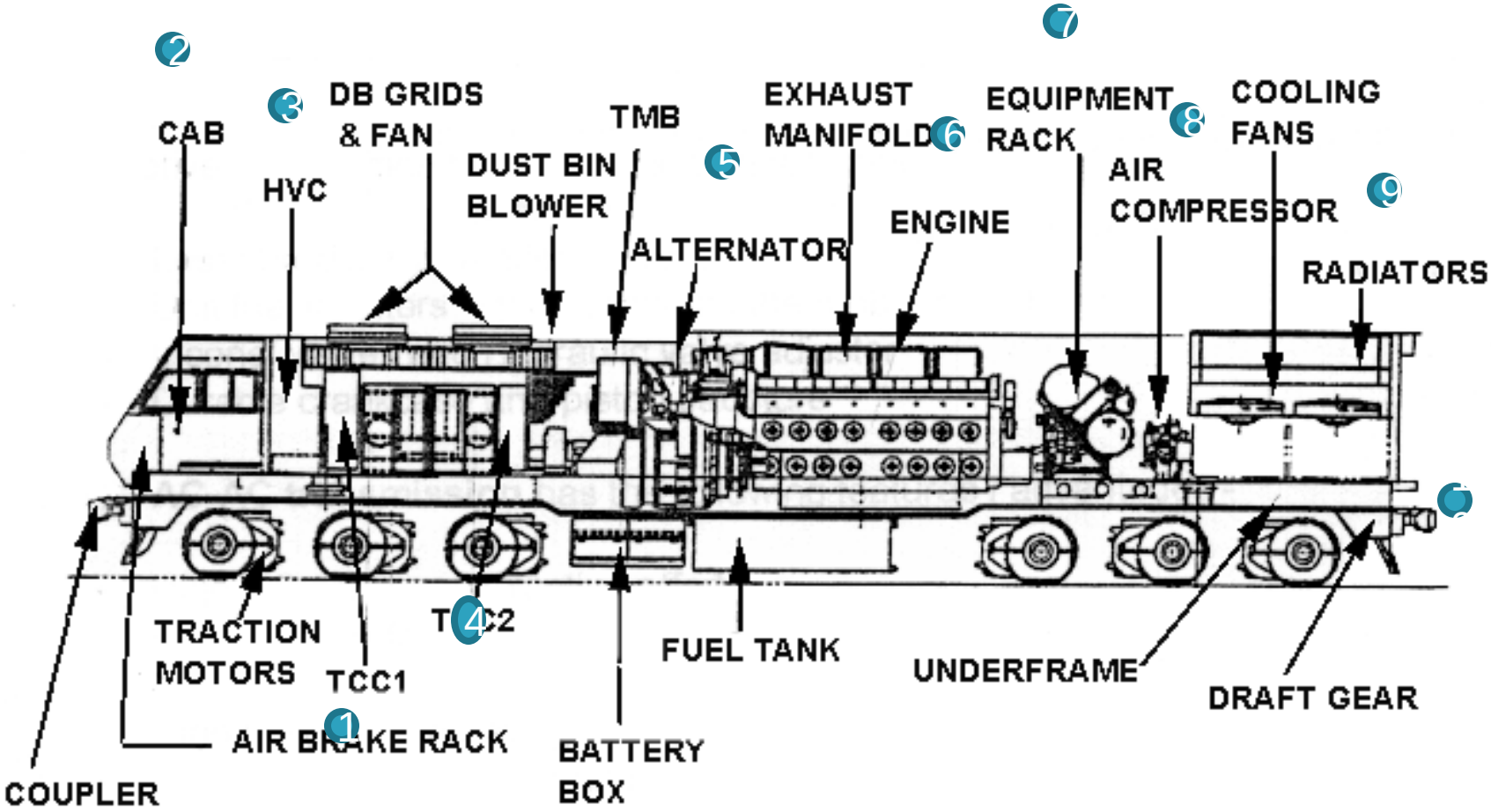
- Horizontal Shaft.
- RTMB & Pulley.
- Lube oil CLR.
- Radiators core.
- ECC
- Right angle gear box.
- Universal Shaft.
- Radiator fan.
- Lube oil filter tank.
- Exp.tank (155 ltrs)

8.Under truck

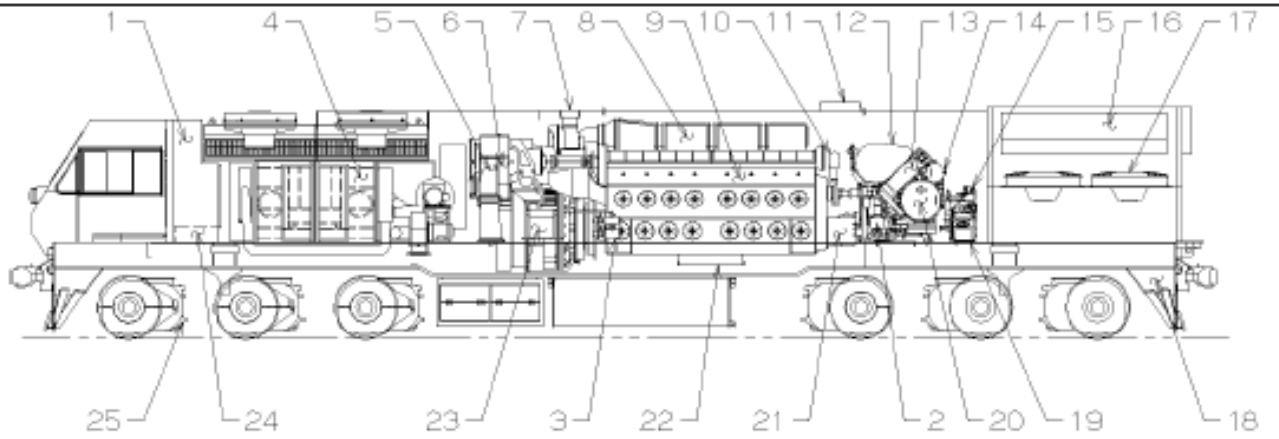
- 3 axle, Independent Driven Bogie
- CO-CO type,
- Three point loading
  - Pivot Pin -60%
  - Side L/Bearer-40%
- Single piece cast steel
- Adhesion-27%.
- Suspended traction motor arrangement.

General arrangement of GM/HHP loco

EMD LOCO LAYOUT



Front view of locomotive



1. #1 Electrical Control Cabinet
2. Fuel Pump
3. Engine Starting Motors (Qty. 2)
4. Traction Control Cabinet
5. Traction Motor Cooling Blower
6. Main Gen. Assembly Blower
7. Engine Exhaust Stack
8. Engine Exhaust Manifold
9. Diesel Engine
10. Governor
11. Engineroom Vent
12. Engine Water Tank
13. Lube Oil Cooler
14. Primary Fuel Filter
15. Air Compressor
16. Radiators
17. AC Radiator Cool. Fans (Qty. 2)
18. Draft Gear
19. Compressor Filter
20. Lube Oil Filter Tank
21. Lube Oil Strainer
22. Lube Oil Sump
23. Main Generator Assembly
24. No.1 Elect. Cntrl. Cab't Air Filt.
25. Traction Motors (Qty. 6)

Various compartments

- Nose compartment
- Driver's cabin
- Electrical control cabinet(ECC-1 & 2)
- Traction control converters compartment(TCC)
- Traction generator compartment
- Engine compartment
- Engine accessories compartment
- Compressor compartment
- Radiator compartment
- Superstructure of locomotive.

1.Nose compartment

- All valves related to Brake system (CCB) are fitted.
  - Display unit ,
  - PSU,
  - Dead engine cock etc.
- Sanding magnet valve and Magnet valve for short hood horn is also provide inside this compartment and this may be seen after opening of side cover near by the driver cabin on right side.

2.Driver cabin

- 02 Nos -Control stand.Each control stand mainly consists –
  - Various gauges
  - Reverser handle,Throttle with dynamic brake,Auto brake V/V handle
  - VCD reset button
  - Sanding switch
  - Horn switch (for L.H side & S.H side)
  - Wiper knob.

3.Electrical Control Cabinet

- ECC-1 situated on the back wall of the loco cab. It controls and powers the loco & it consists-
  - (Engine Control Panel).
  - EM2000 (Display screen).
  - Circuit Breaker Panel
  - Circuit breaker & test Panel.

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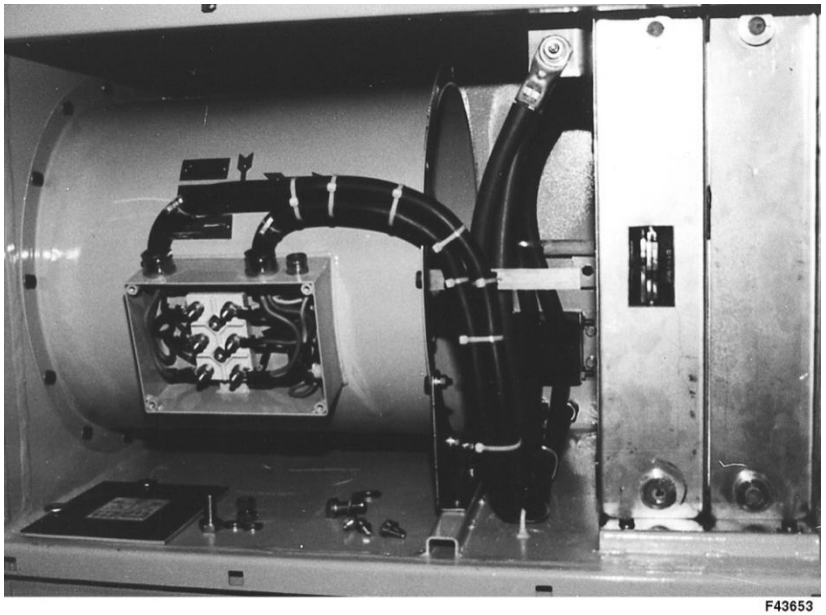
ECC-2

- ECC-2 is mounted on the left side of the locomotive, under the loco under frame, between the Fuel tank and the No.2 bogie.
  - AUX GEN circuit breaker mounts in this cabinet.

4.TCC compartment

- It consists of –
  - TCC1 (for each parallel set of 3 Nos Tr.Motors)
  - TCC2 (,,)
  - TCC electronic blowers (2 Nos) for TCC1&TCC2.
  - Dynamic braking grids(8 Nos grids ,4 Nos on each side)
  - Dynamic grid cooling fans (2Nos).
  - Blower for inertial filters(Dust bins blowers).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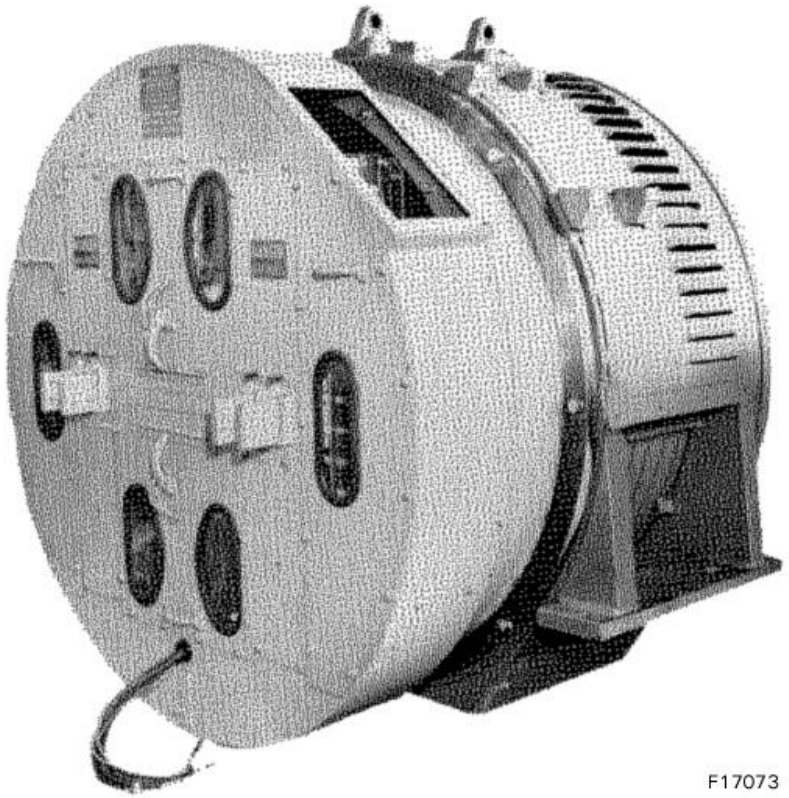
5.Generator compartment

- it consists of following components –
  - Two Alternator(01No-Main Alternator & 01No-Companion Alternator).
  - Traction motor blower.
  - TSC with after cooler.
  - Auxiliary Generator.
  - Engine Starting motor-2 Nos
  - Inertial air inlet filters for engine left /right air intake and for TM blower.

Traction Alternator

- Type-TA-17 ,Weight-8709 kgs.
- No. of Brushes-06,No. of Poles- 10
- It rotates at engine speed generating AC power.
- Its excitation source- Companion Alternator
- TA Rectified Output: 600V (at 1 notch) to 2600 V(at 8 notch) DC
- Max. Continuous Current : 1250 A.



Companion Alternator

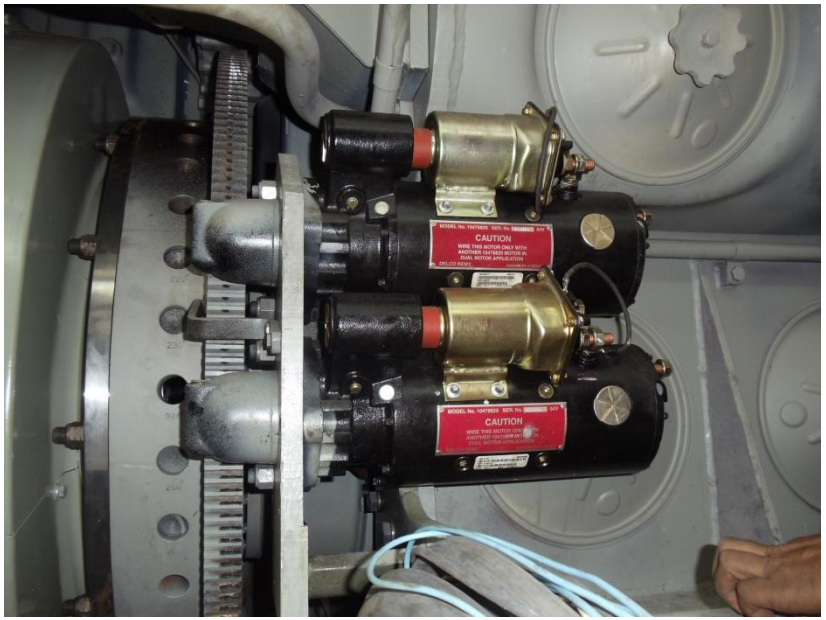
- Output Voltage : 55 to 230 VAC
- Max.Power : 250 KVA
- Max Current: 600 A
- CA rotor field is excited by AG supply of 74 V DC.
- It supplies current to excite the TA field & power to radiator cooling fan, TCC electronic blower, traction inverter blowers etc.

Auxiliary Generator

- Rectified output ratings:18 KW (24 HP)
- Driven by cam shaft at 3 times engine speed.
- It supply AC power to rectifier in the battery charging system. Then it is converted into 74V DC for companion alternator excitation control system & locomotive battery charging.
- It also supplies DC power to Fuel p/p motor, TSC lube oil P/P motor, Battery charging ,locomotive lighting etc.

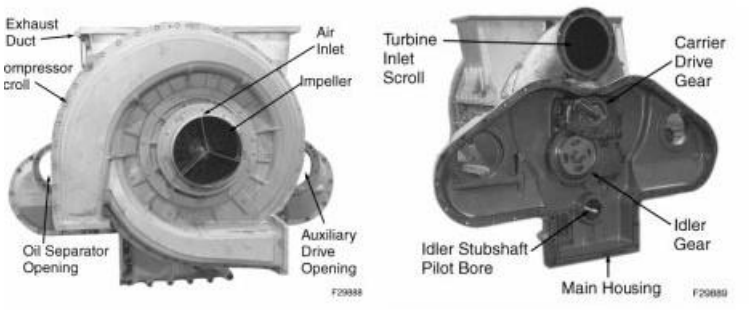
Engine starting motor

- The diesel engine is equipped with two 64V DC motors (connected in parallel) for cranking.
- Power circuits to the motors are interlocked so that the pinions of both starting motors must be engaged with the engine ring gear before cranking.



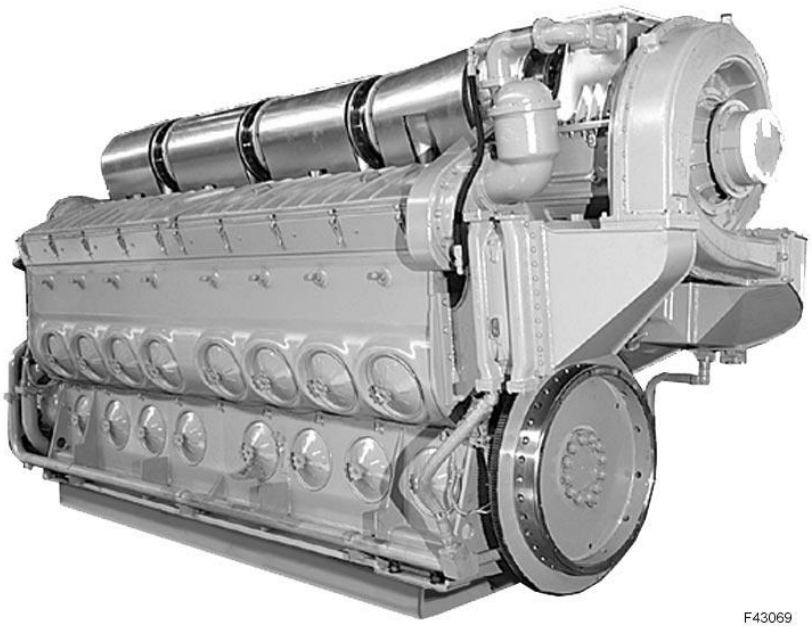
Turbo supercharger

- Engine driven till 5th notch.
- Gear ratio 1: 16.7
- Engine driven necessary for engine starting, light load operation, and rapid acceleration.
- Switch over to exhaust gas drive from 6th notch onwards.
- Turbo screen provided.
- Soak back lubrication system for pre and post lubrication.



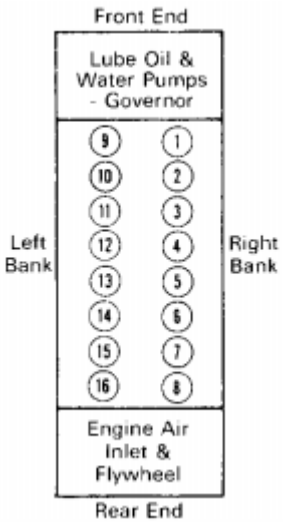
6.Engine compartment

- Engine model : 710 G3B
- Crank Shaft Rotation : Anti-clockwise (facing fly wheel end)
- Max. Engine RPM(Full Speed) : 904-954 (8th notch)
- Idle RPM(Speed) : 200
- No of Cylinder : 16
- Compression Ratio: 16:1
- Engine Governor: WW Governor



Engine arrangement

- Governor, water p/p, and the lube oil p/p are on the “front” of the engine.
- The turbocharger and the flywheel are located at the coupling end or “rear” of the engine.

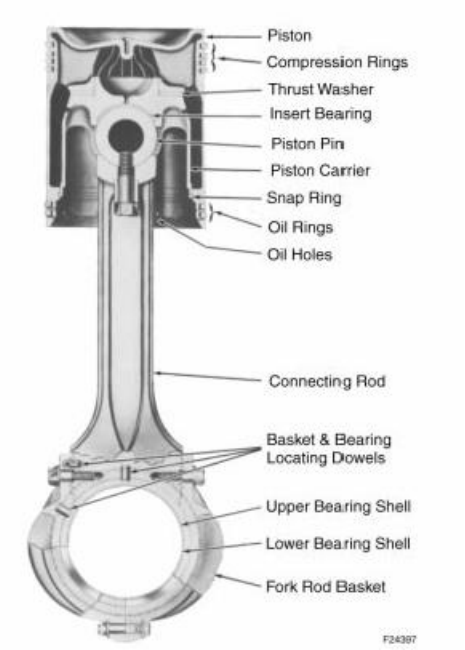


Power assembly

- Power assembly (consisting of con.rod, piston, liner and cylinder head in assembled form as single unit).
- Unit replacement facility.
- Easy to replace.
- Valve seat insert not used in Cylinder head.
- Reduces failure due to droppage of valve seat insert.

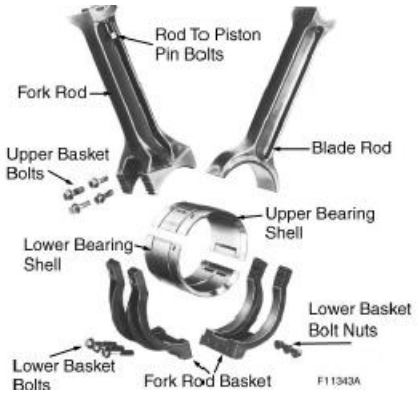
Liner and piston

- Cast Iron Liner with Laser hardened bore
- Fully floating cast iron alloy Piston with tin plating.
  - Piston carrier.
  - Maintain uniform clearance.
  - Cooling of the piston crown with a pressurized oil.
  - Half set of bearing used on the top side of piston pin.



Connecting Rod

- Interlocking Con. Rod. Design.
  - consisting of blade rod and fork rod.
  - No Offsetting of left and right bank cylinders.
  - Reduced length of crankcase and crankshaft
- Same set of bearing is used for both the rods.
  - Load on bearing

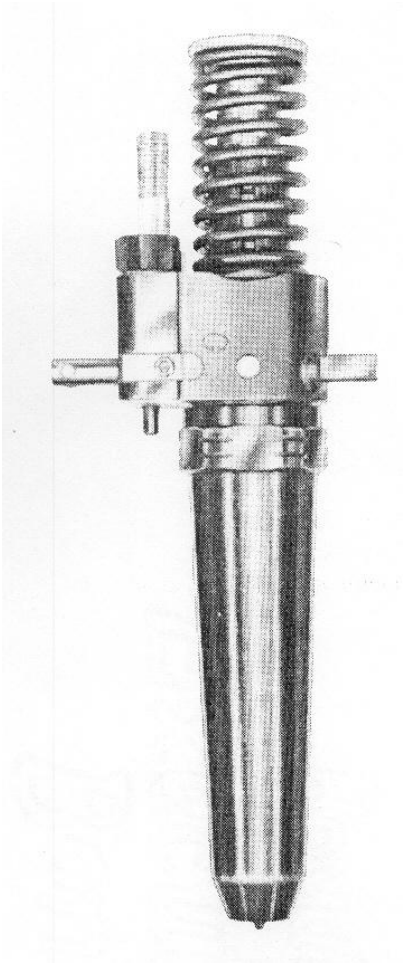


Rocker assembly & Valve bridge

- Overhead camshaft operates the valves directly through Rocker assembly.
  - No push rod is required.
- Two Valve Bridge with automatic lash adjuster (hydraulic) operate 4 nos. of exhaust valves.
  - No clearance is required to be maintained between valve stem and valve bridge.

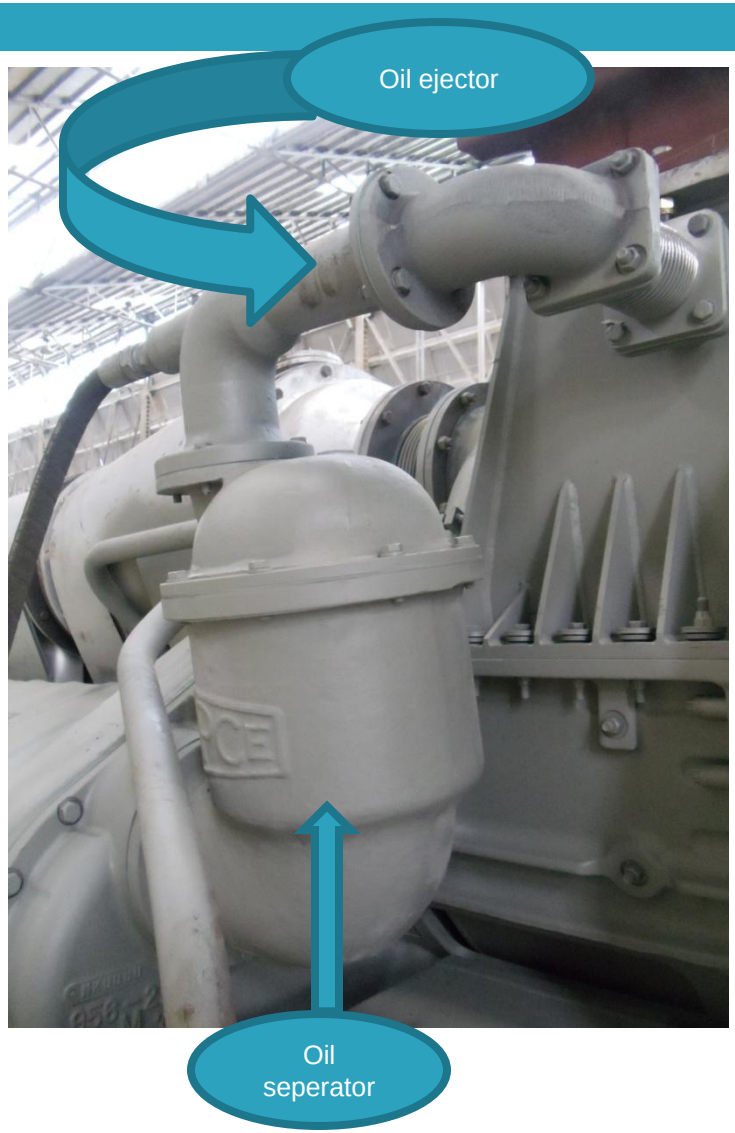
Unit Injector

- Unit Injector (combined Pump and Nozzle assembly).
  - H.P. line not required
- Injection pressure can be increased upto 20000 to 30000 psi, helps in better atomisation, mixing and combustion
  - More accurate timing.
  - Improves SFC.



Ejector Tube

- Crank case vacuum is maintained through Ejector tube extended to turbo chimney (Vacuum created by ventury effect).
  - Crank case exhauster motor is not required.
  - Simple, trouble free and economic.



7.Engine Accessories Compt.

- It consists of –
  - wood ward governor
  - Lube oil pumps
  - Water pump (2 Nos)(gear driven)
  - Lube oil strainer.
  - Lube oil cooler
  - Pressurized water tank
  - Fuel primary filter
  - Fuel pump with motor
  - Engine mounted fuel oil secondary filter(2 Nos) with sight glasses.
  - EPD

Water Expansion Tank

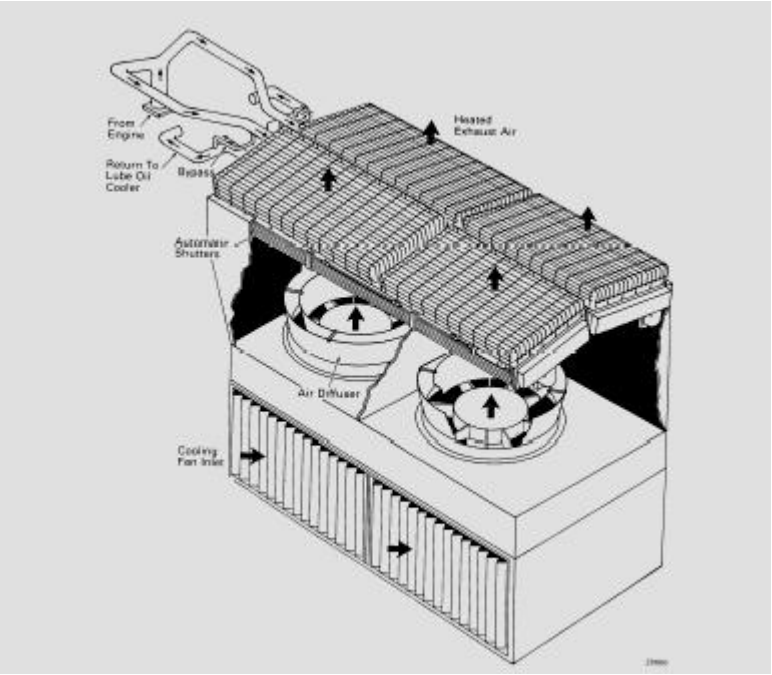
- Raise the boiling point of the cooling water. This in turn permits higher engine operating temperatures, with a minimal loss of coolant due to boiling.
- Pressurization also ensures a uniform water flow.
- It minimizes the possibility of water pump cavitations.
- No losses of water during vaporization.

8.Compressor Compartment

- This compartment consists of –
  - 01 No-2 stage ,3 cylinder, water cooled Air compressor.
    - Working pressure- 9.84 Kg/cm2
    - Rotates at engine speed.
  - Computer controlled pneumatically operated compressor clutch .

9.Radiator compartment

- it consists of-
  - 02 Nos Radiator core located above the cooling fans.
  - Two Radiator cooling fans (AC motor driven)
    - Get power from Companion Alternator.
  - Main reservoir air cooling coils.

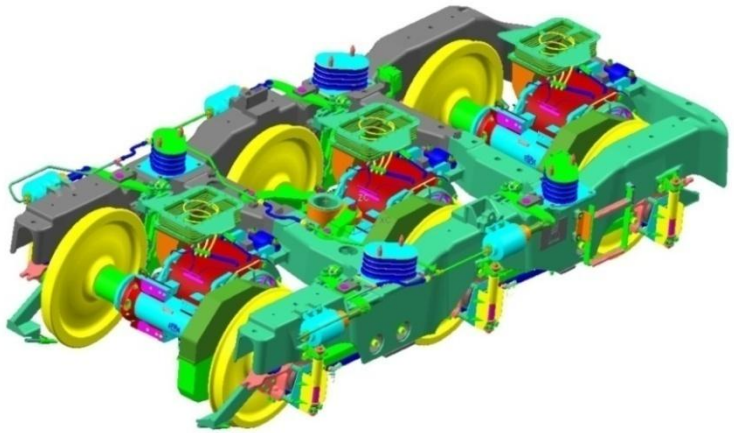


10.Superstructure of Loco

- Fuel tank,Cap-6000 ltrs (WDG4,WDP4)
- 02Nos Main reservoir on left side of loco.
- Air dryer Rt side of the loco.
- 8 nos sand boxes on wheel pairs 1,3,4,&6,.
- BP&FP angular cut off cocks are provided at both ends of the loco.

Bogie

- HTSC(High tensile steel cast).
- Two-stage suspension.
- Centre pivot does not take any vertical load and is used only for transfer of traction and braking forces.
- All Traction motor nose positions are oriented to the same side of each axle within the bogie frame.
- Axle boxes are fitted with tapered roller bearings.
- Six vertical hydraulic dampers.
- Two hydraulic yaw dampers .
    - The yaw dampers are oriented in such a way that they provide damping both in lateral and yaw modes.



Thanking you