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TRAINING REPORT

D.L.W.

(Diesel Locomotive works)

GBTU NEWS in

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♣ ACKNOWLEDGEMENT ♣

I would sincerely like to thank the employees and the officers of DLW, VARANASI for their help and support during the vocational training. Despite their busy schedules, they took time out for us and explained to us the various aspects of the working of the plant, from the production shops.

I would sincerely like to thank **Shri Ravi Shankar, Alok Singh** (CWI/TTC) and **Mr. Sunil Kumar**(JE/H.W.S.)**, Mr. Vinod Kumar**(JE/Rotor Shop) who was instrumental in arranging the vocational training at DLW Varanasi, and without whose help and guidance the training could not have materialized.

I express my deep sense of gratitude to **Mr. R. R. Jha** (Principal, TTC) for given me such a great opportunity.

PREFACE

The objectives of the practical training are to learn something about industries practically and to be familiar with the working style of a technical person to adjust simply according to the industrial environment.

It is rightly said practical life is far away from theoretical one. We learn in class room can give the practical exposure or real life experience no doubt they help in improving the personality of the student, but the practical exposure in the field will help the student in long run of life and will be able to implement the theoretical knowledge.

As, a part of academic syllabus of four year degree course in **Mechanical Engineering,** every student is required to undergo a practical training.

I am student of third year mechanical and this report is written on the basis of practical knowledge acquired by me during the period of practical training taken at **Diesel Locomotive Works, Varanasi .**

Introduction to D.L.W.

Background – Diesel Locomotive Works (DLW) is production unit under the ministry of railways. This was setup in collaboration with American locomotive company (ALCO) USA in 1961 and the first locomotive was rolled out in 1964. This unit produces diesel electronic locomotives and DG sets for Indian railways and other customers in India and Abroad.

Subsequently a contract for transfer of technology of 4000 HP Microprocessor Controlled AC/AC Freight (GT 46 MAC) / passenger (GT 46 PAC) locomotives and family of 710 engines has been signed with electro motive division of general motors of USA for manufacture in DLW. the production of these locomotives has now started and thus DLW is the only manufacturers of Diesel Electric Locomotives with both ALCO and General motors technologies in the world.

Brief History

- Set up in 1961 as a green-field project in technical collaboration with ALCO/USA to Manufacture Diesel Electric Locomotives.
- First locomotive rolled out and dedicated to nation in January,1964.
- Transfer-of-Technology agreement signed with General Motors/ USA in October,95 to manufacture state-of-the-art high traction AC-AC diesel locomotives.

- A flagship company of Indian Railways offering complete range of flanking products in its area of operation.
- State-of-the art Design and Manufacturing facility to manufacture more than 150 locomotives per annum with wide range of related products viz. components and sub-assemblies.
- Unbeatable trail-blazing track record in providing cost-effective, eco-friendly and reliable solutions to ever-increasing transportation needs for over three decades.
- Fully geared to meet specific transportation needs by putting Price-Value-Technology equation perfectly right.
- A large base of delighted customers among many countries viz. Sri Lanka, Malaysia, Vietnam, Bangladesh, Tanzania to name a few, bearing testimony to product leadership in its category.

SALIENT FEATURES:

Annual production capacity	125 Locomotives
Annual turn-over (Rs)	5000 million
Total number of staff	7223
Workshop land	89 Hectares
Township area	211 Hectares
Covered area in shops	86300 Sq.m
Covered area of other service buildings	73700 Sq.m
Electrical power requirement (Average maximum demand)	3468 KVA
Electrical energy consumption (units/year)	19.8 million
Stand by power generation capacity	3000 KW

PRODUCT OF DLW:

DLW is an integrated plant and its manufacturing facilities are flexible in nature. these can be utilized for manufacture of different design of locomotives of various gauges suiting costomer requirments and other products. the product range avilable is as under. :

- WDG4 4000 HP AC/AC Frieght traffic Locomotive
- WDP4 4000 HPAC/AC Broad Gauge High Speed Locomotive
- WDG3D 3400 HP AC/AC Broad Gauge Mixed Traffic Micro-Processor Controlled Locomotive.
- WDM3C 3300 HP AC/DC Broad Broad Gauge Mixed Traffic Locomotive.
- WDM3A 3100 HP AC/DC Broad Gauge Mixed Traffic Locomotive.
- WDP3A 3100 HP AC/DC Broad Gauge High Speed Passenger Locomotive.
- WDG3A 3100 HP AC/DC Broad Gauge Freight Locomotive.
- WDM2 2600 HP AC/DC Broad Gauge Mixed Traffic Locomotive.
- WDP1 2300 HP AC/DC Broad Gauge Intercity Express Locomotive.

- WDM7 2150 HP DC/DC Broad Gauge Mixed Traffic Locomotive.
- WDM6 1350 HP DC/DC Broad Gauge Mixed Traffic Locomotive.
- WDS6 1350 HP AC/DC & DC/DC Broad Gauge Shunting Locomotive.
- YDM4 1350 HP AC/DC & DC/DC Broad Gauge Mixed traffic Locomotive.
- EXPORT LOCO 2300 HP AC/DC Meter Gauge/Cape gauge Mixed Traffic Locomotive.
- Diesel Generating Sets 800 KW to 2500 KW
- Spare Parts fot engines, locomotives and generating sets

STRATEGIES

Our Vision: "To be a World class manufacturer of Diesel Electric locomotive

Our Mission :"We shall achieve our vision through Continuous Improvement in the areas of Product Quality, Research and Development, Supplier Partnership, Human Resource Development and Team Work with emphasis on Core Competence Leading to Customer Satisfaction And Business Excellence."

Our Quality Policy: "We are committed to Excellence in all Activities and Total

Customer Satisfaction through Continuous Improvement in Quality of Products

And Services."

Our Quality Philosophy:

- Quality is not controlled but produced;
- Emphasis is on quality in all organizational processes;
- Regular quality audit as per ISO procedures;
- Top Management totally committed to quality in all activities;
- Adoption of workers' participation and continuous improvement as a part
- of quality philosophy;
- Regular training schedules for all.

QUALITY ASSURANCE

Quality has been a crusade in DLW since its very inception. We actively inculcate the primary importance of manufacturing a quality product in all our workmen, supervisors and engineers from the day they join DLW. Each of our workmen is continually trained and re-trained in Quality aspects.

Modern instrumentation and machinery help the workmen in maintaining a high standard of quality. Under ISO 9002 certification scheme, all our jigs and fixtures, tools and gauges are calibrated regularly according to a carefully worked out plan.

DLW has a fully equipped Gauge Room for calibration of gauges, and a tool room for checking of jigs and fixtures. To supplement the rigorous standards of certification for DLW's vendors, almost all bought-out items are subjected to quality checks and certified by our incoming inspection. Now DLW's Quality thrust has been certified by an internationally accredited ISO certifying body, and DLW is proud owner of ISO 9002 certificate for the entire range of manufacturing activities.

HUMAN RESOURCES DEVELOPMENT

- *Battery of highly skilled, motivated and trained man-power treated as the most important organizational asset;*
- *People centric participative style of management with societal orientation.*
- *Training forms a continuous part of organizational culture;*

- *Regular training courses conducted in functional areas as well as in Quality Systems;*
- *Well equipped technical training center available for providing technical, computers and managerial training inputs to new recruits at staff and supervisors' level;*
- *Staff trained at General Motors, USA facilities as a part of new agreement reached with them;*
- *Management totally committed to healthy Industrial Relations, Staff welfare and Safety;*
- *Excellent industrial safety track record by adopting all round safety measures and conducting regular safety audits;*

EMPLOYEE BENEFITS

- DLW is committed to provide best possible staff welfare;
- Facilities and competent medical/ paramedical staff to meet any medical emergency;
- A well equipped and modern 90 bed hospital with latest fully self sufficient, and eco-friendly Township for employees sprawling over 211 hectares, in the vicinity of work-place;
- Excellent educational facilities for wards of employees within campus;
- It takes pride in making claim for having some of the best sports facilities in town viz. Olympic size sports grounds, stadium, swimming pools, lush green golf-course and other high-end sport facilities.

ENVIRONMENT & OUR SOCIETY

At DLW, we firmly believe that no organization can operate in vacuum and therefore, we owe a lot not only to the environment we breath in but also to the society we live in. Our environmental policy and other social goals enshrine this commitment and are reflected in all our activities.

Environmental Policy

"We, at Diesel Locomotive Works, Varanasi, while carrying out Chrome-plating and Wastewater Treatment will continually strive to minimize the impact of our activities on the environment.

We will minimize the resource consumption and waste generated from these shops to make our surroundings greener and cleaner.

We shall comply with all applicable environmental regulations.

We shall spread the message of environmental protection to the community by disseminating our Environmental Policy to employees and to the public."

Our Societal Orientation

- Our untiring efforts to make our micro-environment cleaner and better speak volumes about our commitment to society in general. This is evident from our constant endeavor in spearheading many such projects e.g. adult education, clean Ganga to name a few, through various social organizations.
- Value and Wealth creation not only for stakeholder but for whole society as a dominant shareholder.

Direct employment to more than 7000 people and indirect to more than 55000 people through wide cross-section of dedicated suppliers/ ancillary units, instilling a familial bondage among various stake

RESEARCH & DEVELOPMENT

- R & D - a Customer centric Activity Committed to Innovation and Continuous Improvement;

- Highly skilled Manpower capable of handling complete R&D activities;
- A sophisticated design center with modern CAD/ CAE workstations equipped with Unigraphics and Ansys;
- Back-up support from RDSO, a centralized R&D organization at corporate level;
- Several milestones in the past - an enviable pedigree viz.
  - original ALCO design made 7% more fuel efficient;
  - many design improvements leading to better performance, incorporated in the original ALCO design;
  - many new designs for locomotives such as WDP1, WDG2, WDP2 to name a few;

R&D strategy aims at absorption of new technology, up-gradation of existing processes, improvement in tool designs and machining facilities, development of new products and special processes for world-class quality - thus helping our customers to succeed.....

RECENT MILESTONES & FUTURE PLAN

MILESTONES ACHIEVED:

Transfer of technology (TOT) -- An added feather in the cap:-

- Agreement with General Motors of USA for technology transfer to manufacture high horse-power GT46MAC 4000HP AC/AC locomotive in India;
- Only country outside North-America to have this bleeding edge technology;

Many export/repeat orders complied successfully in recent past and many more in the pipeline;

Supplied more than 400 locomotives to various non railway customers;

Emerging as a leading manufacturer of ALCO/ GM locomotives for developing countries.

FUTURE PLANS :

- Assimilation of GM technology to manufacture their latest 710 series of diesel electric locomotives;
- To emerge as a globally competitive locomotive manufacturer;
- To develop as an export hub for ALCO/ GM locos for Asian market;
- To follow an export led growth strategy through continuous improvement;
- Cost effectiveness and technology/ product up-gradation as a key to retain global competitiveness by putting price-value-technology equation right.

ENGINE DIVISION

FABRICATION OF ENGINE BLOCK

Steel plates of sizes up to 80 mm thick are ultrasonically tested before being precision cut by numerically controlled flame cutting machines. Fabrication of engine block is completed by submerged arc welding using semi-automatic welding machines. Down-hand welding is ensured using specially designed petitioners. Special fixtures are used for making down-hand welding possible in inaccessible areas. Critical welds are subjected to radiographic examination. All welders are periodically tested and re-qualified for the assigned job

MACHINING OF ENGINE BLOCK

The fabricated engine block is then taken up for a variety of machining operations like planning, enveloping and end drilling. All these operations use heavy duty planers and CNC drilling machines. V-boring of cylinder liner bores is a process requiring a high degree of precision and is undertaken using a specially designed machine. Recent addition of a Plano-milling centre has provided further fillip to the quality and speed of enveloping operation. 12 Cylinder and 16 Cylinder Blocks have V angle of 45°, whereas the 6 Cylinder Block is inline type**.**

COMPONENT MANUFACTURING

Over 2000 components are manufactured in-house at DLW. These include ALCO turbo superchargers, lubricating oil pumps, cam shafts, cylinder heads, chrome plated cylinder liners, connecting rods and various gears. Our well-equipped Machine Shops have dedicated lines for operations like turning, milling, gear hobbing, drilling, grinding and planning etc. In addition, DLW is equipped with a variety of special purpose machines and a large number of state-of-the-art CNC machines to ensure quality and precision. All related processes like heat treatment and induction hardening are also carried out in-house. A completely new Chrome Plating Shop for Cylinder Liners has been set up with modern infrastructure like fume extraction system and Programmable Logic Controlled material movement system.

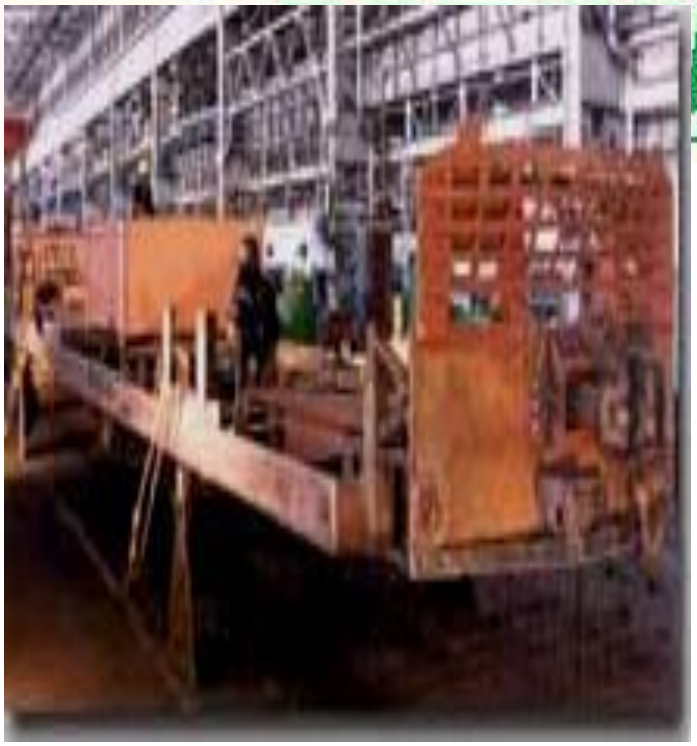
ENGINE ASSEMBLY & TESTING

The engine block, crankshaft, camshafts, cylinder liners, pistons, connecting rods, cylinder heads, exhaust manifold, turbo-supercharger and all related piping is assembled to make a complete engine. This is followed by mounting of electrical machines like traction alternator, auxiliary generator and exciter. This power pack is tested for horsepower output and other parameters of engine health on computerized Engine Test Beds. Only after the engine parameters are found perfect the power pack is allowed to be moved to the locomotive assembly area

VEHICLE DIVISION

NDERFRAMES & SUPERSTRUCTURES

Precision cutting and forming of sheet metal is utilized for manufacture of superstructures including drivers cab, engine hoods, and compartments for housing electrical equipment. All activities connected with pipes like pickling, bending, cutting, forming and threading of pipes of various sizes are undertaken in another well-equipped work area. In yet another work area, all electrical equipment is assembled in the fabricated control compartments and driver's control stands. Under frames are fabricated taking all due care to ensure designed weld strength. Care is taken to impart the requisite camber to the under frame during fabrication itself. Wherever required, welds are tested radio graphically. Welder training and their technical competence is periodically reviewed**.**



BOGIE MANUFACTURING

Large special purpose machines are utilized for machining cast and fabricated bogie frames. In the same work area, axle and wheel disc machining is undertaken on sophisticated CNC machines. Inner diameter of wheel discs are carefully matched with the outer diameter of axles before the wheel discs are pressed onto axles, at designated pressure, using a specially designed wheel press. The complete truck (bogie), including bogie frames, wheels and axles, brake rigging and traction motors is assembled before being sent onwards for locomotive assembly.

LOCOMOTIVE ASSEMBLY & TESTING

Assembled and tested engines are receive in this Shop from Engine Division. Also, under frames, assembled trucks, superstructures and contractor compartments are received from respective manufacturing and assembly shops of Vehicle Division. Important alignments like crank shaft deflection, compressor alignment and Eddy Current clutch/radiator fan alignment are done during assembly stage itself. Electrical control equipments are fitted and control cable harnessing is undertaken. The complete locomotive is thus assembled before being sent onwards for final testing and spray painting.

Rigorous testing of all locomotive systems is conducted as per laid down test procedures before the locomotive is taken up for final painting and dispatch.

OEM PARTS

We, at DLW, takes eminence and pride in building a long lasting relationship with our esteemed customers: both internal and external. At DLW, this relationship is seen as our life-long commitment to the customers. It offers wide range of locomotives, their spare parts and related transportation services. Though, organizational dynamism and vigorous pursuit of continuous improvement has always driven us to offer the latest in technology, yet we continue to support our older generation locomotives through a regular supply of spares. From complete maintenance support including comprehensive parts, assemblies and product upgrades, to training and customer service support, we believe in anticipating, responding and exceeding customers' expectations better and faster than competition, thus striving for customer delight.

Broadly our spares can be categorized as capital spares/ kits including

- Engines/ power packs;
- Transmission systems;
- Fueling systems;
- Brakes and draw gears;
- Under-frame;
- Suspensions;
- Locomotive bogie/ truck arrangements.

- Replacement/ emergency spares including items those are normally replaced in regular maintenance schedules

DLW manufactures more than 13000 items for all locos offered or being offered from its stable. Any requirement of kits/ sub-assemblies/ spares for ALCO design locomotives/ engines can be easily met at single destination. For the ease of identification and computerization, each item has been assigned a unique part number at DLW and needless to say that our part nos. have become trade standards with their global acceptability. Enquiries are welcome on line or through fax with details giving part nos. in case those are available.

HEAVY WELD SHOP

This shop mainly deals with the fabrication of the engine block and base (B.G. & M.G.) Turbo support. After cooler housing items. The engine block is the principal, structural member of the diesel engine. It is composite weldment with heavy plates thickness varying from 16 mm to 75 mm and steel forgives conforming to specification is 2062.

The spine being the most highly stressed item as we can say spine of the cylinder block is made out of one piece bitted 5"x 7" thickness

confirming to is 1895. The billet foundation plate and cylinder walls are built around the steel forging saddles to form the air chambers which ensure the maximum rigidity for successful fabrication of cylinder block special attention is paid to the following aspects cylinder block special attention is paid to the following aspects.

1. Inspection standard
2. Proper materials
3. Proper electrodes and flux
4. proper welding technique
5. welfare of staff

SEQUENE OF FABRICATION OF ENGINE BLOCK

1. Set up of saddles foundation plates and spine on special fixture and weld saddles spine founded on rails.
2. Set up welding of out side cylinder wall.
3. Set up of middle dock (Tack welded) with respect to target.
4. Remove can bearing shim from saddle face.
5. Intermediate machining operation remark in middle deck and chamber at top of spline.
6. Set up of inside wall and deck welded with spline.
7. Lay out of plane height.
8. Intermediate machining operation

   Machine height of out side wall and inside wall with respect to marking and camber.
9. Set up of top deck (Both side) and lifter block (G.E. side only) for filament of eye bolt and tack weld.

10. All in side (8x2 Beal welds) welding in done by sub are method.
11. Back gauging of saddle to foundation rail joint.
12. Lay out for bearing.
13. Set up for cam bearing with respect to pay out Si No.12.
14. Welding of the cam bearing and saddle with foundation rail bottom side (back gauge portion)
15. Set up of cam bearing rids and weld.
16. Say out for 8" machining.
17. Intermediate machining operation.
18. Flame cut counter of foundation plate to give relief clearance to free movement of counter with respect to crank shaft.
19. Set up of the side sheets and sub arc weld of side sheets and top deck.
20. Set up of full control compartment sheet and weld.
21. Intermediate machining operation mills both and to lay out for end plates considering total length and machining allowance.
22. Hydrostatic test of water compartment.
23. Set up of top end plates and weld.
24. Set up of top deck center and weld.
25. Stress relieving weldment.
26. Kerosene oil test for control shaft compartment.
27. Shot plast.
28. Final debarring.

Note: Saddle out side and inside walls foundation rail are x ray joints.

ELECTRODE

Saddle, spline and foundation plates are sledded on a rotary fixture E 6020 electrodes 6.3 mm and 5 mm of M/s A Par Pvt. Ltd. Bombay and celorex of M/s Advani or Liken capable of giving X-Ray quality joints are being used for the welding.

The coating is such that a stage containing iron oxide, manganese oxide and silicon is usually produced other constituents containing the oxides of aluminum manganese of sodium are prevent to modify the slag ferromanganese in the main de-oxygen and sodium silicate is used as the binder. In most cases core wire is of remounted steel.

CARE OF ELECTRODE

Saddle spline rotary fixture E-6020 electrodes 6.3 mm and 5 mm. Arc welding electrodes require special care in handling and storage to That the flux coating may retain its original strength of bonding over Long periods and give satisfactory welds on use so there electrodes are Kept in a store maintains its room temperature at least 10 to 20 c Higher then the out side temperature. When the storage atmosphere In humid the moister gets deposited in the minute pores of the flux Coating.

Stocking electrodes certain directly on the floor should be Avoided as also putting too many of them once above the other because the electrodes at the bottom may get crushed. Due to the weight above. It is good practice to stock. Electrodes shelves separately according to their sires types and batches.

FLUX: - In D.L.W. auto melt gr I flux of advance linken (P) LTD. Bombay

In used. The flux in a mixture of power of deter mined practical size and each particle in chemically basic in character these particles are

not fused. the flux in heated period to use in on over at 250 c for O2 hours as moisture flux generated the hydrogen in the arc and cause cold cracks in the weld deposit and in the heat effected zero.

WIRE:-Wire used in the sub are welding is the auto melt gr. A cold copper Coated size 5m.m. with low carbon content confirming to IS 2879 Manufactured by M/S Advani lincon P. ltd. Bombay. The chemical composition of the wire in carbon 0.08% m.m. 0.46% P.0.018% S0.022%.

STRESS RELIVE OF CYLINDER BLOCK.

After completion of welding the cylinder block in then stress relieved at the temp. Ranging from 115 F obtating total timing 28 Hrs ie.

(1) Pre heat time 14 Hours.

(2) Soaking time 04 Hrs and

(3) Cooling time 10 Hrs in stress relative's furnace capable to accommodate to B.G. block at a time. As the engine block in machined to very close tolerances. It is necessary that all stresses developed during the fabrication stages are completely relieved before machining. This would ensure a longer life in service without any distortion which would normally result on account of very alternating stresses that the engine block is subjected to during its service.

KEROSINE OIL TEST-

Check that there should not be any leakage at the bottom side of the fuel control compartment welding joint after powering kerosene oil. The

engine block is then shat blasted at pneumatic compressed air a pressure of 75ibs/sgu.inch.

DEBURING-

It is to be ensured that the completes (welding) weldment is free of any spatter welding defects and sharp corrosion of important welded joint have been ground then the cylinder block is marked and handed over for machining operation to H.M.S.

DESINING RECOMBINATION FOR CAMBEARING SUPPORT

Earlier design of cam bearing support welded with cylinder side waits then welded with the ribs (3/4"Th welded grc) due to heavy vibration and less welding area development of cracks wire observed in the com bearing supports. (Mainly upper portion)

To over come the problem of cracks and strengthen new design of cam bearing are welded all round with the ribs and then ribs are wide with the side cylinder wall.

Hydrostatic test

Water compartment are fully filled with water and after air light covering are pressure of 75 lbs/squ inch minimum is maintained for about half on hours. It there is any leakage in welds arranged welded and water listed.

Heavy weld shop

1. Heavy weld shop ha three important sections.
2. Flame cutting, grinding and straightening section.
3. Cylinder blocks fabrication section.
4. Main base, turbo support and miscellaneous section.

Flame cutting, grinding and straightening section

All the flame cutting items required for the B.G. & M.G. engine for block, base & turbo support are cut in the section by flame cutting machine. For all cutting of different types of items. The different types of plates are use as per their specification and thickness. Following important items are cut here.

Spline, top deck, middle deck side sheet, main base and plates top rail cross web, back, plate, centers block flanges levers etc.

In grinding section above items are deslaged and ground by pneumatic. Grinder.

In straighten section important items of cyl-block main base and turbo support are straightened.

Cylinder block fabrication section

The following components for B.G. Cylinder block assly are required.

1. End seal
2. Side plate L.S & R.S.
3. Angle L.S. & R.S.
4. Foundation plate L.S. & R.S.
5. Saddle machined inters main bearing I no.
6. Saddle machined gen end I no.
7. Saddle machined centre main bearing I no
8. Spline I no
9. Cyl side wall out side L.S. & R.S.
10. Cyl side wall in side G.S. & R.S.
11. Middle deck L.S. & R.S.
12. Cam bearing (inter, gen and & frill end) 18 nos
13. Cam ribs 18 nos

14. Top deck L.S. & R.S. and top deck centre
15. Weld strip (gen-end) R.S. & L.S.
16. Plate (water compt drive)
17. Frill end plate.
18. Self cont. compt L.S. & R.S.
19. End plate (gen end)
20. Cover (cont compartment)
21. Diaphragm
22. Lifter block (gen end)

Sequence of Fabrication Assembly:

Setting of saddles on the fixtures as per drawing with the foundation plat L.S. & R.S. and one spine on the top of the saddle. Tacked and welded all these with each other burn run of the saddle with spline, clean and grind the opening of the spline, then set and face the out side and inside walls L.S. & R.S. both sides of the saddle burn run off and clean grind of the wall opening

After that setting up the middle deck weld from bed bottom side of deck and lifter block weld 16 beets all welding as quality. Saddle to foundation plate, saddle to spline and saddle to out side wall welding is check as joints.

Arc wilding done machine on the cylinder block where the welding by machine is called submerged are welding. Copper coated mild steel class II were with flux is used.

After x-ray welding test, the assembly is sent for lay our of cam bearings in marking section. The cambering are set up tack and weld with the cam ribs and water compartment plates. After that again x-ray text of bottom plates is

done. Then burn opening and Skelton grinding operation is done. Then send this block assembly in the machine section for 8 machining of side sheet. Set and weld the side sheets on the 8 machining. Weld fuel self compartment on the positioned welding machine. Weld side sheet foundation rails. Side sheet to cam ribs. Out side wall of full self compartment. After that the block assembly is again sent to M/C section. For end milling to maintain the length of the block as per marking and size. Then hydraulic water test is done at 75 P.S.I.

At last set up the end plates (gen and free end) both side of the block assembly, tack and then setup the top deck centre in the centre of the block and weld it by sub are welding M/C

After complete fabrication the block is sent to H.T.S. sec. for stress reliving to 700 c then shot blasting the block and sent the machine section for final machining.

Main base fabrication

The following components are required for the assly of main base.

1. Side sheet L.S. and R.H.
2. Pipe assembly with plates
3. Engine mount free end and gen end CH/RH
4. Rib (engine mount free end & gen.end)
5. Top rail
6. Bottom. Plate (Gen end, free end & centre)
7. Plug L.O. drain.
8. Cross web G.A. 1,2,3,4,5,6,7,8, & 9
9. Cross web auxiliary assembly
10. End plate free end & gen end.

11. Oil drain compartment.
12. Pad
13. Brass engine mount free end.
14. Brass engine mount gen end.
15. L.O. suction pipe (sub. Assembly)

Sequence of Fabrication:-

Setting top rails on the fixture and mach the centre of the fixture. Set the side sheet R.S. & L.S. with the cross webs to maintaining the width of 31 ¾ of main base, tack and weld with cross webs. After that bottom plates gen end and free end are set up. Tacked and weld on its proper place. Then set and tack and weld the end plates gen end & free end with lo suction pipe. at post L.O. drain plug is set up and dip strike on it proper place. Engine mount free end and generator end CH/RH, T, welding is to be completed.

After fabrication, the main base is sent to H.T.S. for stress reliving at 700 c temperature and cooled in furnace. Then shot and de burn. Then sent to machine section for complete machining.

<u>TURBO SUPPORT FABRICATION:-</u>

It is the support for turbo which is mounted on cylinder block on free end side. Following components are required for it.

1- Flange bottom 2
2- Back plate 1
3- Side plate l.s 1
4- Side plate R.H 1
5- Flange oil catcher 1
6- Top plate air chamber 1
7- Front wall air chamber 1

8- Bottom Plate	1
9- Centre Plate	1
10- Back wall pt.	1
11- Side plate R.S	1
12- Partition plate	1
13- Patch plate	2
14- Gasket	4
15- Pipe segment	1
16-Cover	1
17-Ribs	1
18-Flange	1
19-Side pipes	2
20-Side plate air chamber	1

PROCEDURE OF FABRECATION

1. Dressing and setting of flange bottom and back plate on support. Welding of the flange from the centre of fixture.
2. Setting and tacking of back plate, buck wall and portion plate.
3. Tacking of right side plate on back plate.
4. Welding of 2" I.P.S extra heavy coupling on left side and its setting and tacking on back plate.
5. Grinding ,dressing , setting & tacking of centre on side plate R.S.&L.S
6. Setting & tacking of flange oil catcher.
7. Marking and gas cutting of 4 ¼ "dia hole in bottom plate and welding of ring on the hole of the plate.

8. Setting and tacking of above bottom P.t. on top plate on fixture.
9. Setting and tacking of side R.S
10. Dressing of back wall and its setting and tacking.
11. Setting and tacking of front and bottom plate & front wall.
12. Setting and tacking of pipe segment cover.
13. Inspection hole cutting in front wall.
14. Setting and welding of flange and side piece.

WELDING PROCESS

(1) Out side bottom plate, top plate, centre plate to side plate both sides an rest welding is down from bottom is top in sequence numbest for inside welding bottom pt, top plate and rest, from bantam is tip is done.

(2) In this operation the support is clamped on positioned with top plate and all the rest wadding is completed. After these gauging

Is done on flange oil catcher. Then later welding is done and base is welding.

HEAVY MACHINE SHOP

SHOP No. – 04

This shop carries out the machining of Cyl. BLOCK (M.G. & B.G.) main base, saddler Main bearing caps, Splines, Turbo Super Charger, Lube Oil, Fuel Oil & Water header) com bearing housing.

OPERATION:-

Planning, Milling, Drilling, Tapping, Boring Honing, Serration milling etc.

Types of Machine provided in the shop are :-

Double Housing planned machine (32", 24', & 16').

Radial drilling machine.

Radial drilling machine Traveling type.

Boring Machine

Angular Boring Machine (Excello)

Tracer Planner machine.

Hill Acme koing structural milling machine.

TOOLS USE :-

1. O.K. Tool (Rough & Finish)
2. C.C. Milling cutter (4", 9", & 10")
3. Boring Tipped Tool (Rough & Finish)
4. Honing Stone (For hand honing)
1. Drill, Reamer, Top (Various Seizer)
2. Serration Cutter.

MEASURING INSTRUMENT

1. Dial Baar gauge
2. Micron meter (out side and depth)
3. Vernier Height gauge.
4. Vernier calipers

5. Mandrill or optical shad rill machine

EX-CELLO ANGULAR BORING MACHINE :-

Motor R.P.M. in constant, Spindle, speed is control by clutch system.

H.M.T. ANGULAR BORING MACHINE :-

Spindle speed is directly controlled through motor. (Coated carbide is used in H.M.T. angular Boring machine)

Cyl. Block made of fabricated class II material except main bearing cop as it made class IV material.

The machining of cyl. Block is complicated and challenging job. It required great skill and knowledge. After duly fabricated, stress relieved and shot blasted the block is subjected to layout to ensure availability of adequate machining allowance, where necessary and to provide guide liner for subsequent machining the weight of the block is 6.02 Tons approx. (Fabricated Material)

After completion of all operations as per drawings the black subjected to inspection in addition to stage inspection dimension live radial distance between center of Crank bore and com bore, distance between center of com bore and liner seat etc. are checked at this stage the weight of the black is 05.02 tons apporx. 01 ton of material removed by the machining and than blank is block send for assly.

Main dimension of cyl. Block.

1. Did of com bore = 4.750” to 4.7515”
   (B.G. & M.G.)
2. Did of blank bore = 9.0355” to 9.0370”
   (M.G. & B.G.)
3. Did of liner bore = 10.750” to 10.752” (Upper)
   (B.G. of M.G.)
   = 10.621” to 10.623 (Lower)
4. Did of thirst Collar = 10ψ”
5. Thickness of thrust bearing = 4.247” to 4.249”
6. Thickness of the plate = free end = ∴”
   = gen. End = 1ω”
7. Radial distance between the centers of crank of
   Cam bore = 10.499” to 19.501”
8. Distance of liner seat from center of crank
   Bore = 32.480” to 32.485”
9. Total length of the M.G. black = 106.370”
   = 106.380”
10. Total length of main Bush B.G. = 172.380”
    B.G.= 172.370”
11. Total length of main Bush M.G. = 117.130”
    = 117.120”
12. Total length of B.G. Black = 161.625”
    = 161.630”

Main parts of the Cyl. Block (B.G.)

(I) Foundation Rail (R.S. AND L.S.)

(II) Saddle (9 Nos)

(III) Spline

(IV) Inner well (R.S. and L.S.)

(V) Other well (R.S. and L.S.)

(VI) Top deck (Middle)

(VII) Top deck (R.S. and L.S.)

(VIII) Side sheet (R.S. and L.S.)

(IX) Com bearing (16 Nos)

(X) Cop (9 Nos.)

(XI) Rib (16 Nos.)

(XII) Bottom Deck. Or Middle deck

(XIII) Fuel self comport.

Main parts of the Cyl. Block (M.G.)

1. Foundation Rail (R.S. and L.S.)
2. Saddle – 7 Nos. (One Center)
3. Top deck
4. Middle deck.
5. Side sheet (R.S. and L.S.)
6. Cam. Bearing 6 Nos.
7. Cap – 7 Nos.
8. Ribs – 10 Nos.
9. Fuel self comport.
10. Inner wall (R.S. and L.S.)

Horizontal Boring Machine :-

MW :- (no): 2155 & mw No. : - 2154

Cam and Crank.

Boring of cylinder block crank and cam.

Method:-

Load the block on fixture.

For checking weather there is any gap

Or not put the filler of size 0.001" to

0.0015" in side location pad. If there is

No gap then start work otherwise tight

The fixture and recheck till no gap situation.

Boring of Cam Bore: (LS & RS):-

This is done in three steps:

(a) **Rough Bore**: - Do this in one pass

R.P.M.: 35 Feed: 6 mm/min.

(b) **Semi Finish Boring**: - Do this in one pass

R.P.M.: 35 Feed: 6 mm/min.

(c) **Finish Boring** : Do this in one pass

Pass No.	Bore No.	R.P.M.	Feed
1.	1, 4, 7, 10		
2.	2, 5, 8,	224	25mm/min
3.	3.6.9.		

Boring of Crank Bore: This is also in three steep.

(a) **Rough Boring**: Do this in three pass.

Pass No.	**Bore No.**	**R.P.M.**	**Feed**

1.	1, 4, 7,	14	5 mm/min
2.	2, 5, 8,		
3.	3, 6, 9		

(b) **Semi Finish Boring**: Do in one pass

R. P. M.: 14 Feed: 5 mm/min

(c) **Finish Boring**: Do in one pass

R. P. M.: 140 Feed: 25 mm/min

Tool:-

Two tools are used for boring both tools are fixed in slot of boring bar. Due to spindle rotation boring is done. Tool movement and machine action is governed by G Code and M Code respectively. Absolute mode and incremental modes are used for tool movement. Single point cutting tool (two) is first fitted in devise block then in boring bar.

Cutting Oil:

Boring finishing operation cutting oil is used for smooth operation

Fixture: J/F No. : FB (E) 15/2

Different – Different tools are used in different step of Boring!

Crank:-

Rough Boring	:	8.880”
Semi Finish Boring	:	8-997”
Finish Boring	:	9.035”

Cam:

Rough Boring	:	4.700”

Semi Finish Boring : 4.720”

Finish Boring : 4.750”

Maximum removal of metal takes place in rough boring.

For making thrust (Cutting)

Tool Size : 10”

R.P.M. : 14

Feed : 22.86 mm/min
(.09”/min)

Tool material used in rough and semi finish boring is high speed steel and in finish boring amended carbide.

Angular Boring Machine:-

M.W. No. : 1263

Angular Boring

Boring of Top deck bore and middle deck bore:-

Method:-

Load the block on fixture.

For checking weather there is any gap or not put the filler of the size 0.001” to 0.0015” in side location pad. If there is no gap then start work otherwise tight the fixture and recheck till no gap situated.

Boring of Top deck Bore:

Tool:-

There are 18 tools are used. I tool in each side. Each are adjusted automatically for rough cut and finish cut. During rough cut, finish tool remains idle and during finish cut, rough tool remains idle. 7 tools are fixed in each side in boring bar and two are replaced according to demand of boring.

Different tools which are used are as follows:-

1. M.I.D. Counter Insert No – TPUN – 160308
2. Rough – snmm – 190612 (weight) 190616 (yellow)
3. Liner seat rough TNMG 220412
4. T/D Chamfer P.G. 002 (only for 1263 m/c)
5. Liner seat finish – TPUN – 110308
6. Micro boring tool OOC No. 10A2LB
7. Counter insert wide no. – PNUN – 160402
8. T.I.D. Counter No. (Rough) – 1263 (N.C.)TN – 28
   (TNUN 220 412)
9. 2187 M/c. – MIS Counter No. TNMM – 160408

LIGHT MACHINE SHOP

This shop deals with the matching of various small components required for the power pack unit such as, cam shaft, connecting rod, liners, gears levers, F.P. Support, Piston pin, nuts and bolts bushes, various shafts etc.

The light machine shop divided into the following section:-

1. Econometric section
2. Grinding section
3. Gear section
4. Cam shaft section
5. A.T.L. section
6. Belching section
7. Connecting rod section
8. Lathe section
9. Liners section
10. Drilling section
11. Milling section.

Connecting rod section:

In this section the connecting rod is made. All the machining operations of the connecting rod. Completed here with the help of various types of machine. The connecting rod has two parts, one is cap and other is rod. The material of the connecting rod is steep forging. In B.G. 16 per loco and in M.G. 6 per loco.

Main dimensions

1. crank bore (big bore) =6-411” to 6.421”

2. piston pin bore (small bore)=3.998” to 3.999”
3. Distance Between Two = 20.995” to 21.000” bare centre
4. Rod Thickness = 3.020” to 3.022”
5. Weight = 32 Kg 950 gram to 32 Kg gram.
6. Pressure Torque = 150 P.S.I.

01. Econometric section :-

This section manufacturing various sizes etc.

Machine provided: - econometric machine, do-all machine, belt grinding machine (for control shaft feed)

02. Gear- Section: -

This section deals to making various gears impeller such as : cam shaft gear, crank shaft gear, extension shaft gear, impeller gear (follower & drive) and broaching Machine Provided :-

(a) gear hobbling machine
(b) gear shaving machine
(c) V.T.L. machine
(d) Radial drilling machine
(e) Broaching machine & (F) centre mill M/C

03. Grinding Section: -

In this section the various small components are grinding as per required finishing after machining operation and each components having grinding allowance (G.A.) main piston pin, impeller and fuller and follower gear, pin valve guide, various studs. Cam roller, seat (V/C Q ‘X’ head) spider various bushes etc.

Machine provided

(a) cylindrical grinding machine

(b) internal grinding machine

(c) centre less grinding machine

(d) thread rolling machine

(e) universal grinding machine

(f) external grinding machine

04. Camshaft section –

This section making cam shaft (both B.G. & M.G.) with completed machining operation by various special type of machine. In B.G. 08 nos per loco and in M.G. 03 per loco.

Machine Provided

1. Centre mill machine
2. Auto lathe machine
3. Gun drill machine
4. External grinding machine
5. Lathe machine
6. Cam grinding machine
7. Radial drilling machine
8. Cam angle checking machine
9. Magna flux machine

Cam shaft length size (B.G.)

Cam	shaft no.	Do all size	milling size?
16 B731	73	39 29/32”	39.656”
	74	37 1/8”	36.875”

75	39 3/8”	39.125”
76	47 11/32”	47.093”
77	43 3/32”	42.843”
78	37 1/8”	36.875”
79	47”	46.750”
80	38 17/32”	36.281”

Cam shaft length size (M.G.)

Cam	shaft no.	Do all size	Milling Size?
16B	95	33 3/8”	33.125”
	96	32 7/8”	32.625”
	97	41 13/32”	41.156”

Cam angle

Air cam	7	angle	315.769”	315-46
Fuel cam	7	angle	327	
Ex. Cam	7	angle	238.936	238-56
Air cam	8	angle	45.769	45-46
Fuel cam	8	angle	57	
Ex. cam	8	angle	328.936	328-56

05. Automatic Turret Lathe (A.T.L) Section:-

This section manufacturing various types of small components for Power pack engine such as:

Lock spring seat (V/L & X-Hd) spewing seat. Ball end, cup end ad. Screw (X-HD & V/L) cop screws L.A.S. retainer, spring lever, F.P. inlet, Porg Bkt. piston pin liner sleeve, body outer ring spicier etc. machine provided.

1. M.T.L. (Bar type , chuck type)

2. U.T.L.

The A.T.L. section is the vital section of this shop. Maximum small components are manufacturing in the section

06. Benching Section:

In this section the benching operation of the entire component which are manufacturing in the shop are done here. In the benching section. There hawing hand cutter maching and belt grinding machine, with the half of these machine bar removing from all the components.

07. Cyl. Liner Section:

In this section .cycle liner machine operation have done here by the various type of m/cs. the material of the cyl. Liner is spe. Cast iron and the set the per loco is in B.G. 16 and in M.G. 6 cylinder.

Main Dimension:-

1. Length 21 15/16 + 1/64
2. Inside dia rough honing -9.010”
3. Inside dia finish honing – 9.015”
4. Out side dia – 10.00”
5. Dia of groove – 10.749 to 10.750”

Machine provided:-

1. Shot blast machine.
2. Vertical boring machine
3. Auto lathe machine.
4. Honing machine.
5. Cylindrical grinding machine.

08. Lathe section:

This section deals various types tropical small components are manufacturing. Centre lath machines oar provided in this section.

The components are: brass sleeve, wear plate, valve guide, long stud, shaft etc.

In drum type turret lathe M/C manufacturing pin cam roller, cup end, bush washer etc.

09. DRILLING SECTION :-

In this section dials with various Types of drilling, reaming, counter bore spot tracing and counter sinking operation done of various small components.

The components are, F.P. support, P.R. Lighter, X head, Valve Lever, Spring Lever, Brg, Bracket, Pin, Ecc Lever, Upper housing etc.

MACHINE PROVIDED:-

1. Radial drilling Machine,
2. Gang drilling machine of multy spindle drilling machine
3. Drilling Machine
4. Electronic drilling machine.

10. MILLING MACHINE:-

This section manufacturing various types of milling operation of the components in types of milling machine.

MACHINE PROVIDED:-

1. Vertical milling machine

2. Horizontal milling machine
3. Universal milling machine.

CAM -SHAFT

OBJECTIVE: - The Cam shaft is made replaceable section of heat treated precision machined alloy steel with chromium. The Cams are formed internal with shaft and bearing and Cam Surfaces and hardened by high frequency induction .

shaft is driven from the crank shaft through a forged steel heat treated span type gear train of adjusted adequate diameter and face width.

The push rod lifter having contact with its cams through their rollers over the valves air inlet and exhaust gases. The middle cross head lifted operates the injection to inject the fuel.

In the generator end of cam shaft a gear is coupled with which gives the motion to turbo generator which generate the electricity for the governor of the engine.

In the other end of the cam shaft a carrier weight is linked after the cam shaft vibration dumper which is housed in O.S. Trip assly and operates tripping of system. Through its plunger that is opened by the centrifugal force of cam shaft rotation.

PROCEDURE: - Four shafts having no 77, 78 79 +80for right side ware leaned thoroughly. Passed the dowel pins in holes of 0.499". Kept these shafts on leveled co- boars with the pilots.

The sequence of number male and female flanges must be like 77, 78, 79&80respectivesly .applied 18 no studs of y2 N.F. and fastened items with elastic stop nuts 36 no. applied y2" plug on generator end.

Similarly other four shaft having SL. no. 73, 74, 75, &76 for left side were assly.

Material specification: - M.S., CR steel D.81602HR application of cam shafts for the different engines is as fallows:-

M.G. 95, 96, + 97

B.G. 73 74 75 &76 , 77, 78, 79, & 80

L.S. R.S.

WDML: - 107, 108, &109/L.S. ,

104,105,&106/R.S.VIBRATION DAMPER ASSEMBLY.-

CRANK SHAFT (TYPE 251 B)OBJECTIVE:- The Vibration damper is fitted with crank shaft to prevent the vibration of crank shaft when the engine starts the Crank shaft gets a sudden shock the Vibration Trademark diminishes these shocks. In the same way when the engine Stops unexpectedly the crank shaft gets a heavy shock. So the get heavy shock. so we gets reduced of these shocks we use the vibration damper as a safety device and to increase the life of crank shaft .

Material:--

Outer ring steel 54190

Intermediate ring steel 54190

Spider cast iron 8054

PROCEDURE: -- Debarred the holes of outer ring and screw hole of 1 by 2". Applied lye bolt in the threaded holds cleaned.

Placed the outer ring plate on a round wooden piece of 6" height from centre bore side of it to downward. Place the intermediate ring on the outer plate dropped a little oil on the top of the intermediate ring.

ROTOR SHOP

This shop is deals with the manufacturing of Turbocharger. Turbocharger is known as the Heart of Diesel Locomotive. Basically in this section manufacturing of assembly & sub assembly of Turbocharger is made. But the outer casing of Turbocharger is made up in Heavy Machine Shop.

Turbocharger is use for the providing fresh air to the engine. Due to this the efficiency & power generated by engine is increased. For the running of Turbocharger we are not using any extra energy source like generator, motor etc. For starting of Turbocharger generally we use exhaust gasses.

Components of Turbocharger:--

For assembly of Turbojet following parts are manufactures in rotor shop----

1. Impeller
2. Inducer
3. Nose piece
4. Stud Rotor
5. Nut
6. Washer
7. Thrust Washer

8. Key
9. Oil Slinger
10. Turbine Disc
11. Turbo Shaft
12. Lock plate

Assembly of Turbocharger:--

The assembly of turbocharger is done by dividing whole turbocharger in three parts. These are as follows----

1. Rotor
2. Compressor
3. Casing

1. Rotor:--

Rotor is the inlet part of turbocharger which is comprises with following parts. Turbo Disc, Rotor stud, Turbo shaft, thrust collar, Nose disc, Washer & Nut.

Rotor is rotating at speed of 18000 rpm & working at high temperature due to that the rotor is made of steel.

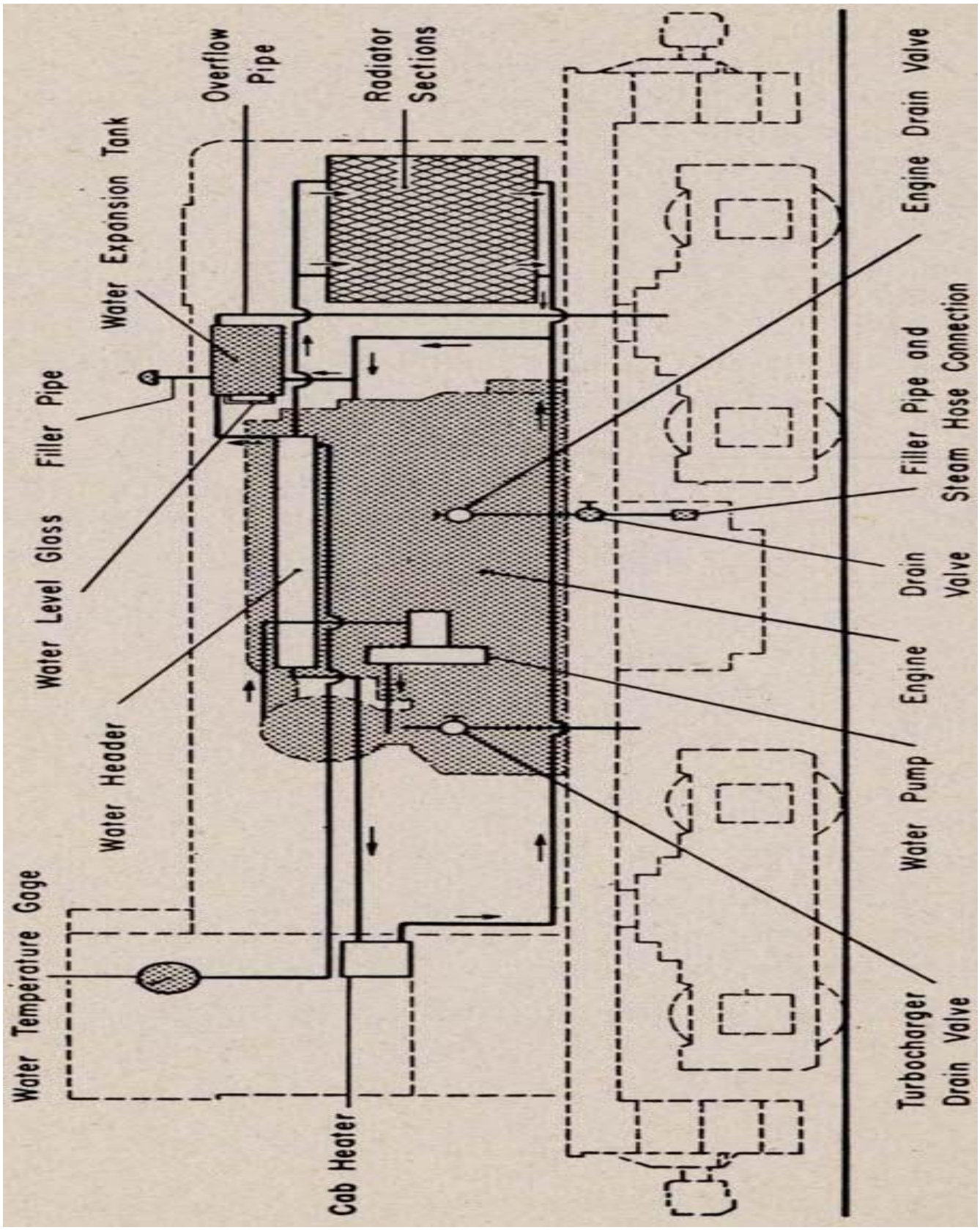
2. Compressor:--

Compressor is the combination of impeller & inducer. Impeller is made up of Al-alloy. Impeller & inducer is use for sucking of fresh air from environment.

3. Casing:--

Casing is made of M.S. & also a special type of coating is done. Due to that coating it can easily resist the heat.

For the proper working & life of Turbocharger balancing of impeller, inducer & turbine disc is done by help of Dynamics Balancing Machine.



Working of Turbocharger:--

Exhaust gasses are entering form inlet strikes onto the nozzle disc. Then after it will strike onto the turbine blade. Due to this the turbine starts rotating at a speed from 0-18000rpm. It will be transfer the motion to compressor which is comprises with impeller & inducer. From that rotation sucking of fresh air from environment is occurring. That air is now entered in intermediate casing and blow from blower casing.

That air is contains some dust particles and also temperature of that coming air is high. For removing heat and dust particles a special arrangement will be done in between the blower casing and cylinder. That special arrangement comprises with continuous flow of water.

For ALCO, simple turbocharger is use. In ALCO the power required is less up to level of 2600-1350 HP i.e. there is not any arrangement of starting of turbine. So initially when the engine is at starting position the rich mixture enters into the cylinder. When exhaust gasses are generate then the turbocharger is in working conditions.

For GM Loco, we are using self starting turbocharger. In this a special arrangement will be done for starting of turbocharger. Main shaft is connected to the crank shaft of main engine i.e. by this arrangement initial starting problem is removed. And after that all the working of turbocharger is same as ALCO. Here the sun & planet gear combination is present which is come in slip position after achieving proper speed of turbine blade.

In turbocharger, lubrication system is also provided for increasing life of turbocharger's subassembly.

SALIENT FEATURE OF G.M. MOTOR TURBOCHARGER

1. No. per engine—1

2. Stages—Single stage

3. Drive—Mechanical drive as well as exhaust gas driven with over running clutch.

4. Air Flow—6.35kg/s
(Rated O/P)

5. Efficiency (At match pt.)--

- Turbine—87.2%
- compressor—81.5%
- Mechanical—87.8%

6. Temperature for which critical components are designed—

- Compressor Stage—
  --Air temperature up to 190.6°C
- Turbine stage--
  --Gas temperature up to 593.3°C
  --Gas temperature up to 482.2°C on outlet side.

7. Pressure Ratio of Compressor –2.8

8. Temp. (Charge air after compressor)-- 171°C

9. Speed of Turbo (At rated O/P)—18,950rpm

HEAT TREATMENT SHOP

In this shop hardening, stress leaving, tempering, normalizing, carburizing, quenching, is done by help of conventional & unconventional process. Here we are doing hardening of cam-shaft, connecting rod, piston pin, different small components of cylinder head.

This shop is divided in two parts which are as follows—

1. Induction Section—Use for Induction hardening

2. Furnace Section—Use for Overall process

Induction Section:-

In induction section, stress leaving & hardening of cam shaft, its bearing & cam lobes is done at different temperatures. In induction type hardening we are using copper coil for hardening.

Stress leaving is done below critical temperature. Cam shat is made up of alloy steel i.e. we are doing stress leaving process at a temp 723°C. After that hardening is done by induction coil. The major drawback of this process is to decide what the exact temp is for stress leaving or hardening.

In induction method copper coils are heated due to this induction current will generate. This induction current produces an electromagnetic force. Which attracts the carbon particles to the surfaces due to this the bond breaking energy is developed & that energy is causes heating of material. At that we can't does any arrangement for measuring the temp of work piece.

- Hardening—At temp 800°C
- Quenching—Water+8 to 10 %polymer quench

- Tempering—below critical temp

Furnace Section:-

In this section we are using different type of furnaces for all the heat treatment process will be done. For hardening carbon must be present up to 0.5%.Hardening is done in furnace at 920°C here thermocouple are attach for measure exact temp of hardened material.

Quenching:-

Quenching is done after hardening of material. In this air cooling is done. When our job is come at 100°C then other heat treatment process is done.

Carburizing:-

Carburizing is process for those materials which has low percentage of carbon. Carburizing is done in a special machine. Carburizing is done by two methods first one is Wet & second is Gas. For wet, liquid calcium carbonate is use.

Tempering:-

Tempering is done below critical temp to release stress between hardened & unhardened zone to increase the life of job.

After that we are checking the hardness of job on **Brinell Hardness Machine.** This is done on gauge room.

SUB ASSEMBLY SHOP

This shop deals with following section:--

- Turbo machining section
- Cylinder head & shot blast section
- Fuel pump, Support, Cam shaft ate section
- Cylinder head
- Turbo
- Governor, Water Pump, Fan drive, Lube oil Pump, After cooler assembly section.

Point 3-6 is sub assembly section.

Cylinder Head Section:-

The lay out of this section is product type. There are different machines had do set up per sequence of operation of cylinder head.

A milling machine provides profile cutting and taper profile according of the template. The tracer runs and cutter forms shaper radial drilling machine. This machine provides for drilling tapping. Core boring operation as per drawing

HEARALD BOROING MACHINE

This machine having four spindles for boring of guide hole, air & exhaust it dimensions are—

Valve inner sheet dia 4 hole-3.1805”-3.1815”

Guide hole dia-1.0625”-1.0635”

Valve sheet depth (E1, E2, A1)-0.740” to 0.745” & A2-0.950”

Depth of sheet (A1 E1, E2)—0.205”-0.215”

Spring sheet depth (E1, E2, E1)-1.865”-1.885

Control Shaft Assembly:-

It is a link between Governor & Fuel injector pumps by which the mechanical power from the governor transmitted to the fuel injection pump Racks. It means to control the amount of fuel according to the requirement of load & speed.

Explosion Door Cover Assembly:-

It is special type of main base door cover which when the crank case exhauster failed to work.

Cam Shaft Vibration Damper Assembly:-

When vibration developed on the cam shaft will be damped by this assembly.

O.S.T. Housing Assembly:-

This assembly controls the R.P.M. of crank shaft and keeps it a specified limit (1000 to 11500 r.p.m.). When OST is operated in the case 16 cylinder engine the engine RPM will come in ideal but in case of 16 cylinder engines will be stopped.

Fuel Pump Support Assembly:-

It is a support of the fuel pump on which the fuel injection pump is mounted and the power of cam shaft is transmitted to operate fuel injection pump through the cross head lighter & to operate push rod by PRD. Lifter by which the inlet & exhaust valve open & closed through the valve lever & yokes.

Crank Shaft Vibration Damper:-

Damped the vibration of the crank shaft which is developed during the power stroke of Engines as act of fly wheel of the crank shaft.

Cylinder Head Assembly:-

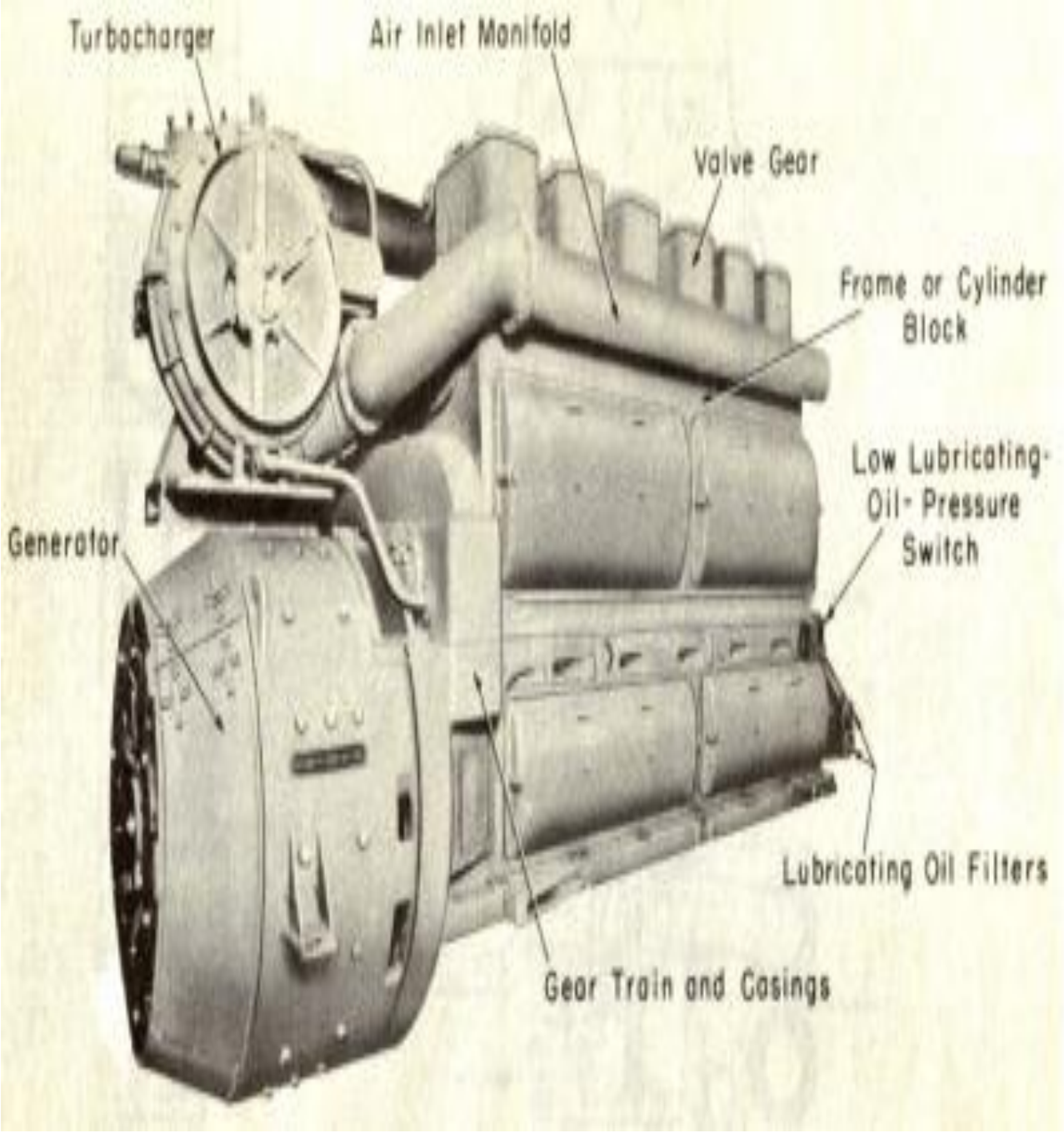
By this assembly cylinder of the engine covered and for the fitment of the inlet valve, exhaust valve and atomizer assembly and connection of air inlet & exhaust outlet.

It is a hollow casting in which the water jacket of made for the circulation of the cooling water to control the temperature of heat.

Acceleration Control Device:-

By this device by monopoly of the driver is controlled the air & fuel supply is controlled by according to the fuel ratio.

"It is controlled the proper fuel and air ratio"



Schematic diagram of ALCO Engine