GOVERNMENT POLYTECHNIC COLLEGE
PERUMBAVOOR

INDUSTRIAL MAINTENANCE AND SERVICING LAB MANUAL

SEMESTER 5

DEPARTMENT OF MECHANICAL ENGINEERING

VISION AND MISSION OF THE INSTITUTION

VISION

Excel as a centre of skill education moulding professionals who sincerely strive for the betterment of society.

MISSION

1. To impart state of the art knowledge and skill to the graduate and moulding them to be competent, committed and responsible for the well being of society.
2. To apply technology in the traditional skills, thereby enhancing the living standard of the community.

DEPARTMENT OF MECHANICAL ENGINEERING

VISION

Excel as a centreof skill education in mechanical engineering moulding professionals who strive for the betterment of society

MISSION

1 Provide state of art knowledge ,skill and transform the students into responsible professionals for the sustainable development of society

2 To have good infrastructure facilities so that students will gain hands on experience by using various equipment and software .

COURSE TITLE : INDUSTRIAL MAINTENANCE & SERVICING LABORATORY COURSE CODE : 5028

COURSE CATEGORY : A

PERIODS/ WEEK : 4

PERIODS/ SEMESTER : 60

CREDIT : 2

CONTENT DETAILS

MODULE I

Use of tools and equipment in general purpose servicing

Perform the Maintenance of Bench Vice, Screw Jack.

Perform the Maintenance of Hydraulic jacks, Trolly jacks

Perform the Maintenance of Bucket grease guns, pressure control valves

Servicing and maintenance of water pumps

MODULE II

Dismantling, assembling and overhauling of different IC Engines parts

Dismantling, assembling and over hauling of automobile systems such as fuel feed pumps, Distributor &Carburettor

Dismantling, assembling and over hauling of oil pumps and fuel pumps

Dismantling, assembling and over hauling of fuel injectors Dismantling, assembling and over hauling of rocker shafts, cylinder heads, cylinder blocks, crank shafts

Dismantling, assembling and over hauling of clutch assembly,

Dismantling, assembling and over hauling of Gear box

Dismantling, assembling and over hauling of Differential assembly,

Dismantling, assembling and over hauling of slider joints,

Dismantling, assembling and over hauling of Master Cylinder,

Dismantling, assembling and over hauling of Brake & wheel cylinders.

MODULE III

Familiarization of air-conditioners maintenance tools Servicing and maintenance of air-conditioners.

Practice operations such as tube bending, cutting, flaring, jointing, leak testing, leak prevention.

Practice operations such as vacuum testing, charging.

MODULE IV

Familiarization of refrigeration maintenance tools Servicing and maintenance of refrigerators.

Practice operations such as tube bending, cutting, flaring, jointing, leak testing, leak prevention.

Practice operations such as vacuum testing, charging.

MODIFIED SYLLABUS

- **Hydrostatic testing on G.I pipe**
- **Overhauling ofgear box**
- **Overhauling of monoblock centrifugal pump**
- **Overhauling of differential unit**
- **Overhauling of open type compressor**
- **Overhauling of semi sealed compressor**
- **Overhauling of sealed compressor**
- **Overhauling of Four cylinder four stroke diesel engine**
- **Practice in copper tube fittings andleak testing**
- **Dehydration and gas charging practice on vapour compression refrigeration system**

CONTENTS

EXPERIMENTS

GENERAL INSTRUCTIONS

Rough record and Fair record are needed to record the experiments conducted in the laboratory. Rough records are needed to be certified immediately on completion of the experiment. Fair records are due at the beginning of the next lab period. Fair records must be submitted as neat, legible, and complete.

INSTRUCTIONS TD STUDENTS FOR WRITING THE FAIR RECORD

In the fair record, the index page should be filled properly by writing the corresponding experiment number, experiment name date on which it was done and the page number.

On the right side page of the record following has to be written:

1. Title: The title of the experiment should be written in the page in capital letters.
2. In the left top margin, experiment number and date should be written.
3. Aim: The purpose of the experiment should he written clearly.
4. Apparatus/Tools/Equipments/Components used: A list of the Apparatus/Tools/Equipments/Components used for doing the experiment should be entered.
5. Principle: Simple working of the circuit or line diagram should be drawn.
6. Procedure: Steps for doing the experiment and recording the readings should be briefly described.
7. Results: The results of the experiment must be summarized in writing and should be fulfilling the aim.
8. Inference: Inference from the results is to be mentioned.

On the Left side page of the record following has to be recorded:

Observations:

i) Data should he clearly recorded using Tabular Columns.

ii) Unit of the observed data should he clearly mentioned.

iii) Relevant calculations should be shown. If repetitive calculations are needed, only show a sample calculation and summarize the others in a table.

4. Graphs: Graphs have used to present data in a form that show the results obtained as one or more of the parameters are varied. A graph has the advantage of presenting large amounts of data in a concise visual form. Graph should be in a square format.

GENERAL RULES FOR PERSONAL SAFETY

1. Always wear light shirt/lab coat, pants and shoes inside workshops.

2. REMOVE ALL METAL JEWELLERY since rings, wrist watches or bands, necklaces, etc. make excellent electrodes in the event of accidental contact with electric power sources.

3. DO NOT MAKE CIRCUIT CHANGES without turning off the power.

4. Make sure that equipment working on electrical power are grounded properly.

5. Avoid standing on metal surfaces or wet concrete. Keep your shoes dry.

6. Never handle electrical equipment with wet skin.

7. Hot soldering irons should be rested in its holder. Never leave a hot iron unattended.

8. Avoid use of loose clothing and hair near machines and avoid running around inside lab.

INTRODUCTION

PLANT

A plant is a place where men, material, money, equipments, machinery etc are brought together for manufacturing products.

MAINTENANCE

Maintenance consist of all activities needed to keep the plant, machinery, tool and equipments service including building and fitting in standard working condition in other works, maintenance ensure that all production facilities are in serviceable condition at all-time causing no production bold up interruption or loss of their individual standard efficiency of operation. Maintenance is an important function in modern production management production facilities consist of machine plant and services.

BASIC FUNCTIONS

These include the following.

1. REPLACE

   To remove an unserviceable item installservicable counter parts in its place.

2. REPAIR

The application of maintenance service including fault location, trouble shooting, removal, installation and dis-assembly or assembly procedures and maintenance action to identify trouble and restore serviceable to an item by correcting specified damage fault, malfunction or failure in a part sub- assembly module (component or assembly) and item or system.

3. OVER HAUL

The maintenance efforts (service location) prescribed to a restored item to a completely serviceable/ operational conditions as required by maintenance standard in appropriate technical publication over haul is normally return an item to like new conditions.

4. REBUILT

It consists of these services or action necessary for the restoration of unserviceable equipment to use like new condition in accordance with original manufacturing standards. Rebuilt means the highest degree of material maintenance, applied to any equipment. The built operation includes the act of returning to zero those age measurement chore etc. considered in classifying equipment or components. Reconditioning reinvasion or other sub terms are also used for rebuilt.

5. SERVICE OR LUBRICATE

Operation required prod ally to keep an item in proper operating condition i.e, to clean (include decontaminate) to preserve to drain, to paint or to replenish gases, lubrication is the introduction of any of various substances between sledging surface to reduce infers and friction.

6. INSPECT

To determine the serviceability of an item by comparing it'sphysically, mechanical, and electrical characteristics with establish standards thorough examination.

7. TEST

To verify serviceability by measuring the mechanical or electrical characteristics of an item and compare those characteristics with prescribed standards.

8. ALIGN

To adjust specified variable elements of an item to bring about optimum or desired preference.

9. ADJUST

To maintain with in prescribed limits by bringing in to proper or exact position or by setting the operating characteristics to specified parameters.

10. CALIBRATE

To determine and cause correction to the made or to be an instrument or tests measuring and diagnostics equipment used in precision measurement. Consist of compression of two instruments one of which is a certified standard of know accuracy to defect and adjust any description in the accuracy of the instrument being compared.

11. INSTALL

The act of impacting, seating or fixing into position on item, part or model (component/ assembly) in a manner to allow the proper functioning of an equipment etc.

THE SCOPE OF PLANT MAINTENANCE

1. Plant and building
2. Machine and equipment
3. Supporting facilities and surrounding area
4. Factory premises and services
5. Housekeeping and safety
6. Wastage disposal and recycling
7. Environmental protection and pollution control

OBJECTIVES OF PLANT MAINTENANCE

Plant maintenance is needed and essential for the following reasons: -

1. In order to prefect the plant and building.
2. In order to keep the machine equipments and building fitting tools in good condition at all time and every time.
3. In order to prevent the breakdown of machine process and to reduce loss of production to minimum.
4. Ratting and defective machine tools and equipment may affect the quality of the work, so the need for maintenance arises.
5. Plant maintenance is necessary to improve the effectiveness of production system.
6. Plant maintenance is necessary to meet the schedule data of production.
7. Plant maintenance is necessary for the study of machines.
8. It helps to achieve all the objectives (i.e. profit maximization target achievement etc.)
9. It reduces the wastage and accidents.
10. It helps environmental production and pollution control activities.

TYPES OF MAINTENANCE

The following are the type of maintenance

1. Preventive maintenance
2. Preventive maintenance
3. Breakdownmaintenance
4. Scheduledmaintenance
5. Condition based maintenance

1. PRVENTIVE MAINTENANCE

This is also called as plannedmaintenance or systematic plant maintenance etc. In this system the steps are taken to prevent breakdown before it occurs and thus reduce consequent loss to the company preventive maintenance is a concept required to understand early in the design stage of equipment/ machinery. They after a planned inspection and conducted to carry out servicing including replacement of worn out parts. This will reduce every chance of break down and success of preventive maintenance depends upon the following

1. Periodicity of inspection and replacement.
2. Proper servicing of periodic intervals.

Frequency of periodic inspection and servicing vary with each machine/ equipment. Periodic inspection follows a calendar of servicing schedule such as daily, weekly, monthly, quarterly, six months and yearly etc. while servicing involves cleaning/ lubrications. Quarterly servicing involves minor repairing and replacement. Annual servicing involves major repair and replacement.

Annual servicing involves major over hand and reconditioning. A good scheme of preventive maintenance involves the following activities.

1. Periodic inspection at regular intervals.
2. Preparation of inspection sequences and lists the items to be inspected.
3. Prepare system to report changes of erecters in a structural manner.
4. Formulate a high power committee to systematic analysis of defective parts whose recommendation are followed and implemented.
5. A history record of all machines is opened where all inspection, repair, modification etc are recorded.
6. Preventive maintenance is not sub-contracted it is an in house activity.

OBJECTIVES OF PLANT MAINTENANCE

1. To minimize the possibility of breakdown of machineries and services.
2. To make plant and machinery always available for ready use without any possible delay.
3. To maintain optimum productivity.
4. To ensure the safety of workers.
5. To keep the required quality standard.
6. To return the value of machineries and tool.
7. To reduce the pollution control activities.
8. Increased machine/tool/equipment life.
9. Reduced material wastage and accident.

2. PREDICTIVE MAINTENANCE

This is modern concept having excellent future prospect. In this method we can predict the future failure beforehand and carry out prepare preventive measurement. It makes use ofsophisticated tests equipment such as electronic sensors, auto gadgets, vibration analysis amplitude meters, precision gauge,strain gauge and pollution test. Unusual sound emitting from a machine due to heat produced in mechanical and electronicparts. Excessive pollution from an engine may be indication of or symptom of danger. These can be consolidated by observations and detections at right time, necessary repairs are initiated and thus fault of parts are replaced by this process. It is now possible even to extend the life of machinery and plant and increase time intervals between successive servicing and over hand. It also avoids loss of production. The cost of this maintenance is less as compared to preventive under break down maintenance.

3. BRAK DOWN MAINTENANCE / CORRECTIVE MAINTENANCE

Break down maintenance is done by only when the machine becomes out of order and it cannot give its normal function any longer. The machine is repaired by the machinist or repairmentonly they are called on net maintenance is applied to machine which are not important i.e., breakdown of their machine will not affect the production. This type of maintenance is applied to small industries which cannot spend more money to prevent maintenance is given below: -

1. Production is delayed or stopped.
2. Leads to poor quality.
3. Plant life is reduced.
4. Increase cost of production due to delay and stoppage of production.
5. Increase pollution.
6. Reduce profit.

CAUSE OF BREAK DOWN OF MACHINE / EQUIPMENT

1. Careless towards minor repair.
2. Failure to replace worn out parts
3. Non-application of lubrication
4. Careless operation and mishandling of tools
5. Neglect cooling system

SCHEDULED MAINTENANCE

This type of maintenance is conducted by a predetermined and pre-plannedschedule;normally this is done according to the recommendation of the superior of the equipment. For example, the two wheeler supplier gives a time table or schedule to change oil, to check the lubrication system, ignition system and battery maintenance.

This case of maintenance is followed in the case of automobiles servicing replacement of mechanical parts like, belts, bearing spring etc cleaning of tank, chemical container pressure vessels, Boiler shells etc.

CONDITION BASED MAINTENANCE

It is a special type o maintenance carried out is sophisticated and highly precision machines/ equipment. The maintenance is done only it same condition is said to occurs. For example,the temperature or pressure of a system exceeds the limit an alarm may ring. So the system is

to be checked for some trouble and foible shoot. The equipment with some instrument mentioned for this purpose or by manually normally the manufactured will give the necessary instruments to treble shoot the machine/ equipment.

MAINTENANCE SCHEDULE

It is the detected time table for inspection and maintenance of the machineries and equipment. It consists of a master schedule and a detailed weekly or daily schedule. A master schedule contains the native and magnitude of cash repair and expected time span, it includes the man power required and man power needed for each repair detailed weekly or dally scheduled indicates the daily or weekly routine maintenance needed for each and every machines, equipments and tools maintenance schedule for it contain servicing, adjustments, lubrication details and particulars of replacement works.

Maintenance scheduling follies similar procedure to that out loaded for production. it is required to know that how long a job will take, when it schedule be done and if resources are available as explained earlier scheming means determining calenderer inspection data that will fall till the frequency requirement the most efficient use.

SCHEDULIING

1. System should be clean precise and easy to operate.
2. Should be based upon accuracy determined time standardize.
3. Should be finished in consultation with probation determent. So that the equipment for maintenance purpose can be stored.
4. Should aim at creating a blanked work, load on each track section in the department that is each section should be evenly loaded.

MAINTENANCE SCHEDULE

1. It should be such that the maintenance work can be carried out during lunch hours between shifts or at week end etc.
2. Take advantages of planed machine stoppage such as tool change loading and unloading of job etc.
3. Plan major pairs and over hands during holidays.
4. Make use of reserve plant if the needed axis's.

PROCEDURE

The scheduling of maintenance work involves essentially two steps.

1. Preparation of master maintenance schedule.
2. Preparation of detailed weekly or daily schedule

Master maintenance schedule indicates the nature and magnitude of each repair and construction. Test segment at maintenance for a specified time span.Considering total man hours needed for each test segment and man power available, the distribution of jobs (that will give reasonable man loading can be accomplished)is done. A master scheduleis flexible and equation always exist to accommodate anticipated test and jobs which are lagging behind scheduling. Detailed schedules are proposal by breaking over all time span located under master schedule detailed weakly works schedule provide information to each craft and shop regarding the test to be carried out. Each job frequent day in the coming week. Detailed scheduling requires of work, capacity of each section of the maintenance department and of the maintenance department as a whole like master schedule the detailed schedule should also be flexible and able to accommodate emergency jobs. Details schedule may be issue to concerted persons every day or near the work end.

Maintenance of each machine may be prepared and it will indicate the list of work which must be carried out (together with the frequency) and contain servicing, adjustment, lubrication details and contain replacement work.

SCHEDULING TOOLS (DIVICES)

They are classified as: -

1. Visual chart
2. Scheduling boards
3. Individual cards

STANDARD DATA FOR MAINTENANCE

No maintenance program can be accurately developed and maintenance without various standards such as

1. Time standard which indicates the time to complete maintenance.
2. Lubrication standards which mark an interval between lubrication.

PURPOSE

Maintenance standard are used for: -

1. Planning and scheduling maintenance work
2. Providing fair number of maintenance men
3. Measuring the output or effectiveness of performance of maintenance me
4. Providing incentive earning for maintenance men.

SETTING AND USING STANDARD DATA

Owning to the variable, non-reparative nature of maintenance work, a great deal to technical study is required before the standard data assembled represents sufficient coverage of the

wok to do effective planning standard data derived from time studies is probability the most widely used system for applying sophisticated labor control to maintenance department. For an individual concern to collect standard data, would require many engineering and thus make it probability because of initial cost. However, thereis management consulting firms who have assembledstandard data (for maintenance) and have established programs that are available to clients or installation, maintenance controls.

ADVANTAGES OF STANDARD DATA USING FOR MAINTENANCE CONTROL

1. Consistent estimation of maintenance jobs.
2. Elimination of delays through improved scheduling.
3. Improved supervision controls.
4. Determination of labour contents for each craft provides co-ordination of crafts.
5. Alternate method of maintenance can be properly weighted and compared.
6. Through application of maintenance standards and pre estimating the work, made longer can be adjusted as required.
7. Through controlled means, the fluctuation in maintenance requirement is handled properly.
8. Standard data forms a basic for accurately evaluating precutting and controlled maintenance expenditure.

RECENT DEVELOPMENTIN PLANT MAINTENANCE

In recent years there has been a tendency to use of management techniques for plant maintenance. These techniques have load to

1. An increase in maintenance efficiency
2. Reduced maintenance time
3. Improved service

USE OF WORK STUDY

In work study can improve maintenance scheduling and determine a great deal of frustration and anxiety on the parts of the production supervision.

USE OF NET WORK PLANNING TECHNIQUES

1. Critical path networking has enabled some firms to cut their down time by 20-30%.
2. Maintenance costs have been cut down.
3. Plant utilization has been raised.
4. CPN is very useful for planning and control of large maintenance projects.
5. Dramatic reduction in time (about 70%) where experienced with the over haul of generating plant by central electricity generation board in Great Britain by using network planning techniques.

6. When applied in the maintenance and overall of a rating PERT reduced its shut down time from 18 to 16 days and thus added 90000 barrels to its production volume.

USE OF OPERATION RESEARCH

Operation research handles maintenance problems such as the economic level of spare parts of which to replace an item.

USE OF COMPUTERS

1. Computers when using for managing maintenance problems provide more efficient operation and control.
2. Computers can prepare maintenance work orders desorption and job timing.
3. The following improvements are manual system of P.M have been claimed by using a computerized system of preventive maintenance.
4. Eliminate human error in preventive preparing work, order etc.
5. Reused cost of keeping records of equipments.
6. Reduced premature replacement of parts.

MAINTENANCE COST

The cost of plant maintenance depends on the following: -

1. The type of maintenance system selected.
2. Efficiency of maintenance management.
3. Exporters needed for maintenance.

It should be noted that the exact distribution machinery and equipments in the plant account for the major share of maintenance expenses. The next major expenditure is incurred in maintaining the infrastructure facilities and service needed or maintenance.

CO-ORDINATION OF MAINTENANCE DEPARTMENT WITH OTHER DEPARTMENT

Actually the maintenance department has to work in the production section, inspection section,and electric department and co-operation is necessary for efficient functioning of maintenance departmentand they planned frequency of visit to the production process. The maintenance people should prepare to maintain healthy relationship with other department. They have to attain the fault and other preventive programs by the proper information to the department. They have to consult with the metal evolves in order to find out the tool cause of failure. Never criticize the worker but give suggestions fact fault without insulting the operator even if the fault is due to the careless operation of the worker.

SERVICE TOOLS

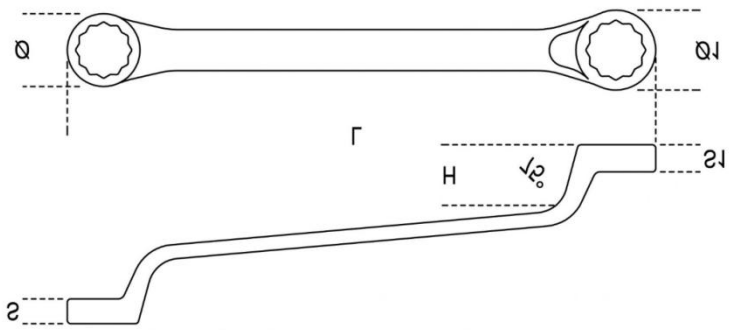
1.**SPANNER**

Spanner is used for tightening or loosening nuts and bolts with hexagonal or square heads. A variety of spanners are used in services and maintenance work. Commonly used spanners are made of drop forged steel.

a) Adjustable spanner (screw spanner)
b) Double end spanner
c) Box spanner(with ratchet)
d) Ring spanner
e) Tubular spanner

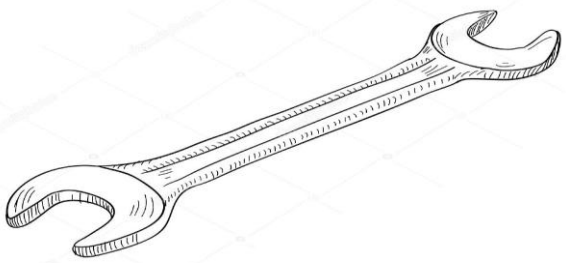
a) Ring spanner

The use of ring spanner is same as the double end spanner. They are strong and tighter than double end spanner and having usually double hexagon side.



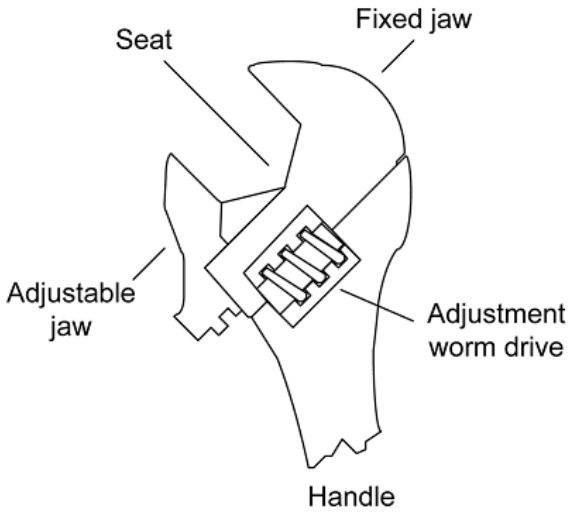
b) Double end spanner

These are also known as open spanner. It consists of two ends which are suitable for tightening or loosening nuts and bolts. They are made up of chromium vanadium steel. The sizes are: - 6-7, to 30-32 etc… in millimeters and $1/4^{th}$-$1/3^{rd}$ inches.



c) Adjustable spanner (screw spanner)

Adjustable spanner consists of an adjustable jaw and fixed jaw. The required distance between the jaws can be adjusted by turning the screw.



d) Box spanner set

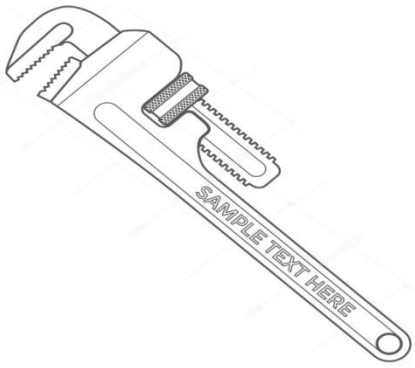
Where double end and ring spanner are not suitable for tightening or loosening the nut or bolt box spanner are used.It includes box spanner various denomination, extension rod small and large, universal joint, ratchet rod, and 'T'-rod

e) Tubular spanner (Pipe spanner)

Tubular spanner is used in the place where nut or bolt is placed in deep slots and grooves and where the double end or ring spanner cannot be used properly. Available in both sizes millimeters and inches.

2.PIPE WRENCH

It is used for holding and turning a wide range of pipes and fittings. It consists of fixed jaw and movable jaw.

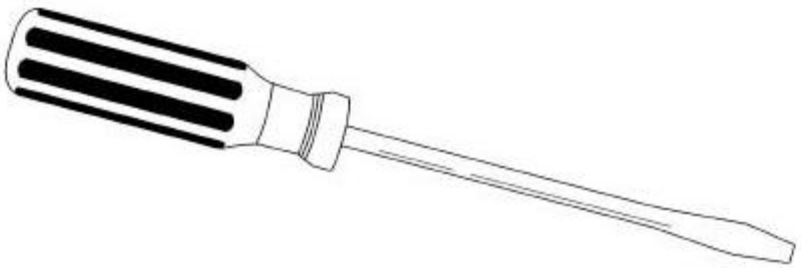


3. CHAIN WRENCH

This wrench mainly consists of a chain for holding,instead of jaws, for plumbing works.

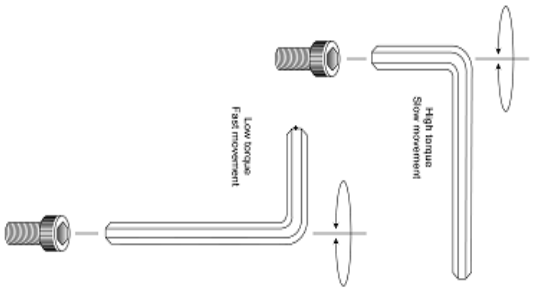
4. SCREW DRIVER

It is used to turn or drive screws with slotted heads. They are made in many sizes and several shapes. The size is made by the length of the blade which is made of the tool steel hardened end and tempered at the point.



5. **ALLEN KEY**

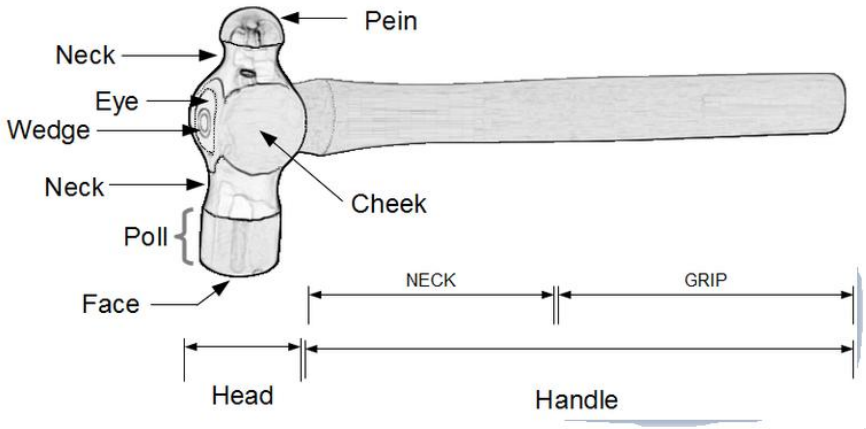
Allen key are used for tightening or loosening the Allen screws. It is made of hexagonal hard carbon steel and bends in the form of 'L'.



6. HAMMER

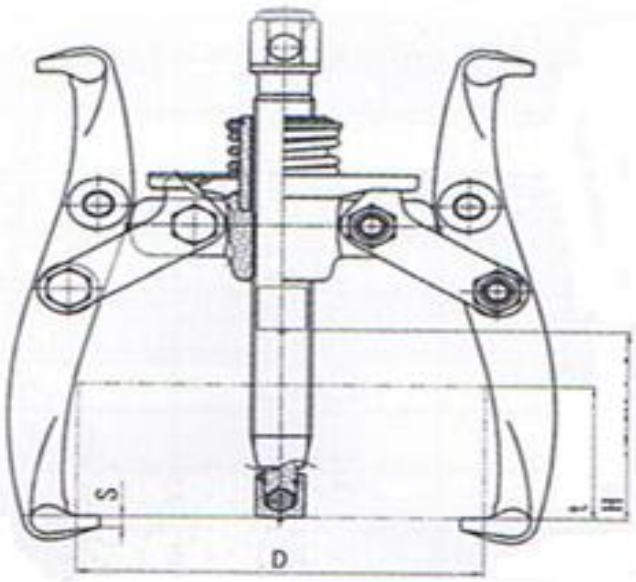
Hammers are used to strike on a tool, fastener of work piece. They are made of forged steel. They are classified according to the shape of peen and relative to handle.

a) Ball peen hand hammer
b) Cross peen hand hammer
c) Straight peen hand hammer
d) Sledge peen (double faced) hand hammer
e) Claw hammer
f) Chipping hammer



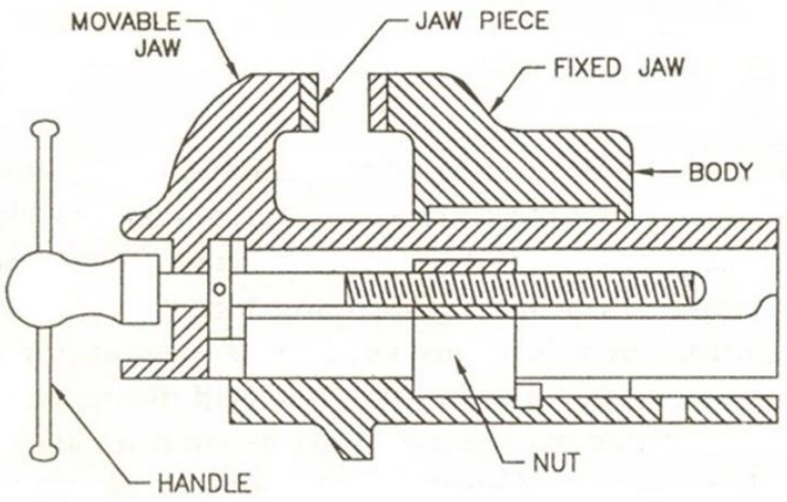
7. BEARING PULLER

Bearing puller is device used for pull of bearing from shaft, holes etc. it has their jaws and handle threaded screw.



8.BENCH VICE

Bench vice is used for holding the compotes tightly, while working. It is firmly fixed to a bench with nuts and bolt it consists of a cast iron or steel body, fixed jaw and a movable jaw.



9. STEEL RULE

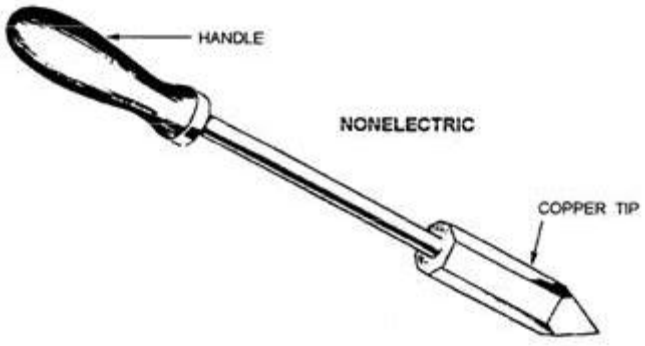
A steel rule is a strip of metal gradated in to units of measurement which can be used for measuring the actual dimension of an object with an accuracy of 1/64-inch British system and 0.5 mm in metric system.

10. CHUCK KEY

Chuck key is used to operate the jaw of chuck of lathe.

11. SOLDERING IRON

It is used for soldering joints with soldering wire or tin. Its size depends upon the wattage of the heating elements. A 65W soldering iron is very common for this purpose.



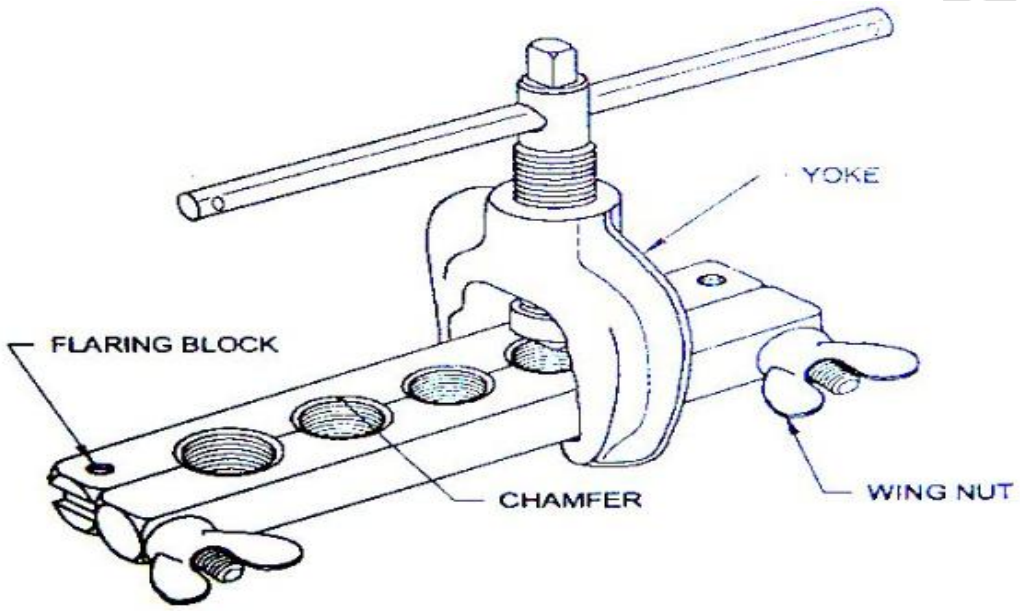
12. FLAIRING TOOL

a) YOKE

Yoke is used for marketing flair of different size of copper tubes. The yoke contains die or cone is rotated against the flair suet to produce flair.

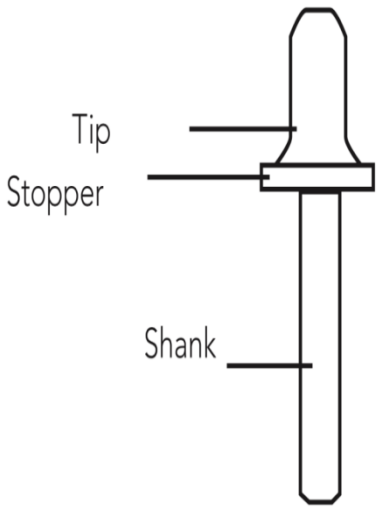
b) BLOCK

H – block is used to hold the tube with the flair and sawing purpose. H block consists of two bars forming holes of various sizes. They are clamped together with wing nuts and bolts.



13. SWAGING TOOL

It is used to expand the inner diameter of a tube in to the outer diameter of the same. Then the tubes are jointed on the swaged part by brazing. This is normally done in same diameter tubes for jointtogether.

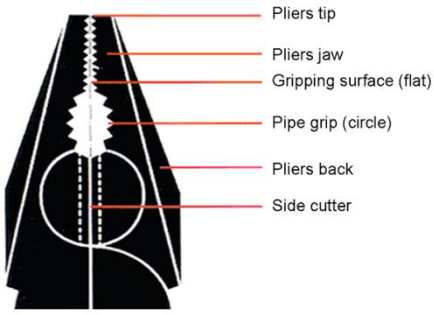


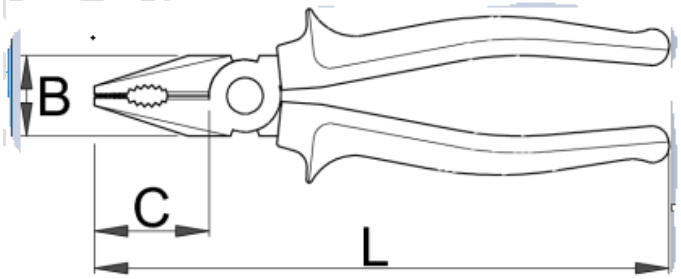
14. OIL CAN

It is a bottle containing oil to lubricating congested machine parts (bearing, bushes, pivot,etc…) by the long nozzle fitted on the device.

15. COMBINATION PLIERS

Combination of operations can be done by this type of pliers. That is why it is named so (cutting, gripping, pinching, holding etc…)

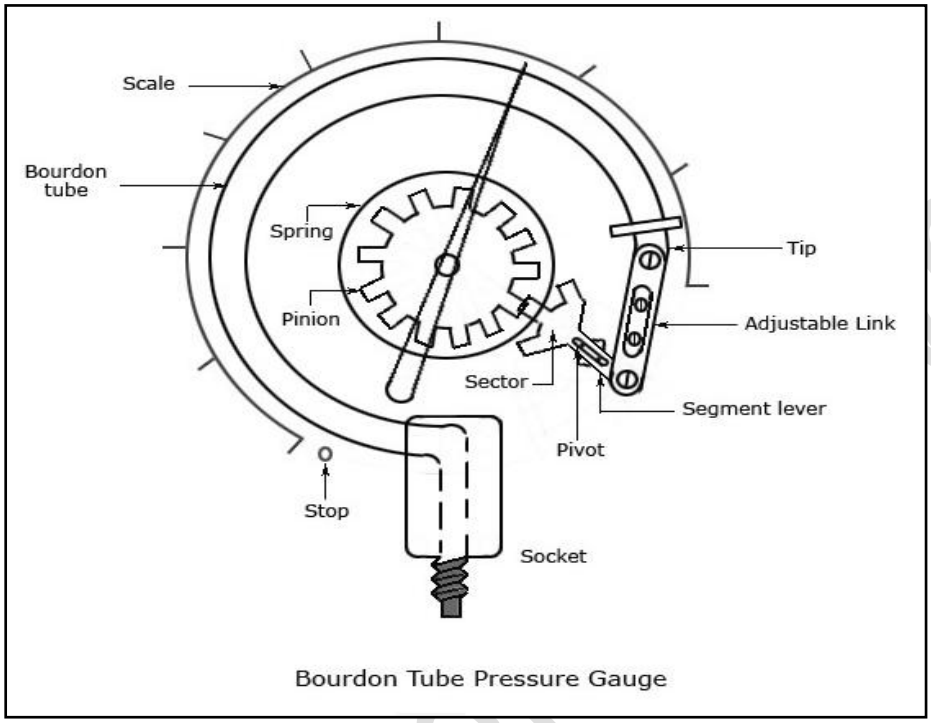




MEASURING INSTRUMENTS

1. PRESSURE GAUGE

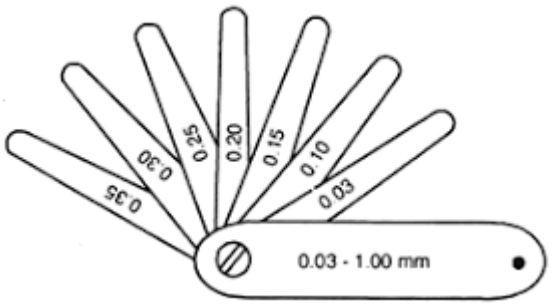
Pressure gauge is used to measure the pressure of refrigerant in a refrigeration machine it is graduated by a dial scale on lb / sq inch or kg /sq cm. The type of the gauges used in refrigeration trade onlytwo, that is high pressure gauge and a compound gauge.



Bourdon Tube Pressure Gauge

2. FEELER GAUGE

It is used to measure clearance between the two parts. It is the set of thin steel sheet strips (leaves) of various thicknesses looking like a knife. Each leaf is marked with its thickness which varies from 0.05mm to 1mm.



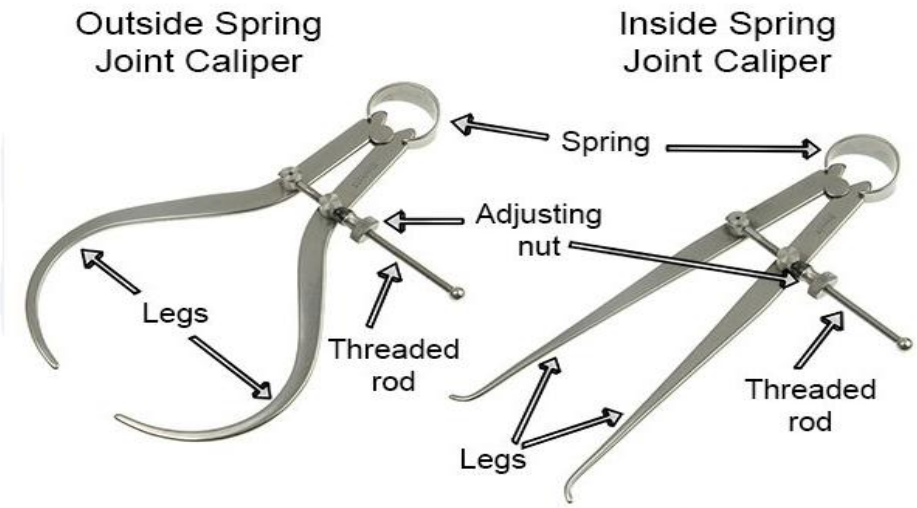
3. HAND VICE

The hand vice is used for gripping small items like screws, rivets, key etc.Which are too small to be held on a bench. The jaw width various from 40 to 44 mm and jaws are opened and closed by wing nuts.

4. CALIPERS

To measure the size of or to transfer a dimension to a component,calipers are used. A reasonable accuracy in dimension is obtained by using calipers.

a) Outside caliper
b) Inside caliper
c) Outside spring caliper
d) Inside spring caliper
e) Hermaphrodite (jenny or odd leg) caliper.



5. STEEL RULE

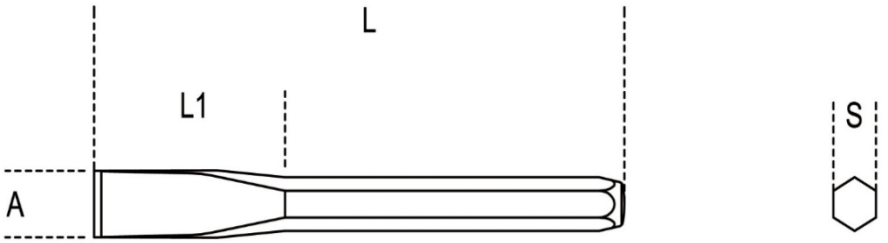
A steel rule is a strip of metal gradated in to units of measurement which can be used for measuring the actual dimension of an object with an accuracy of 1/64-inch British system and 0.5 mm in metric system.

CUTTING TOOLS

3. CHISEL

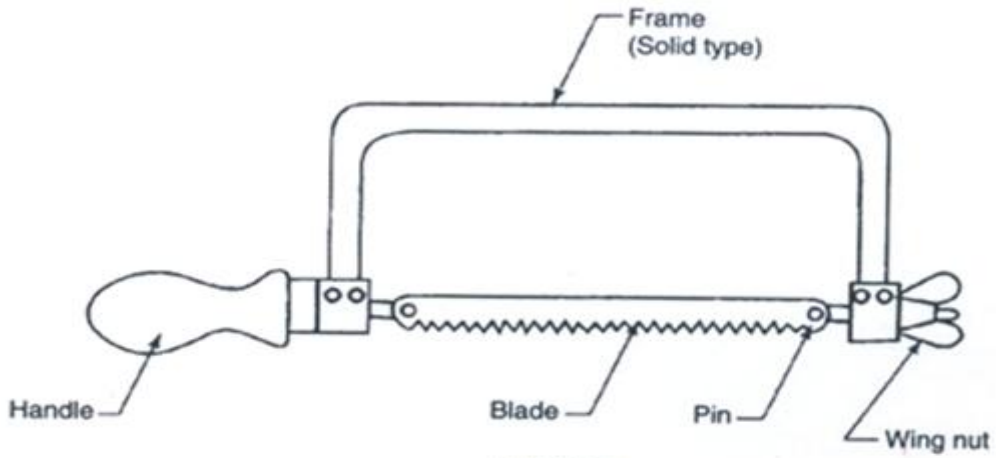
Chisel is used for cutting sheets, producing key way and for removing metal from surfaces. These chisels are forged from octagonal hard carbon steel.

a) Flat cold chisel
b) Crosscut cold chisel
c) Diamond –pointed cold chisel
d) Half-round cold chisel



4. HACK SAW

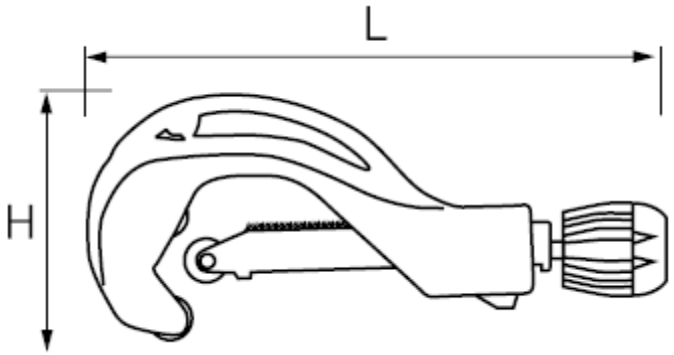
It is used for hand cutting of metals its frame is made from either a tube a solid flat. The blades are made up of high speed steel and are fixed in the frame to correct tension.



Hacksaw.

5. TUBE CUTTER

It is used to cut small diameter annealed copper or aluminum tubes. It consists of a v-block against which the tube rests and an adjustable round blade of carbon steel which cut the tube. After placing the tubes in the v-block blades is adjusted and tube cutter is revolved around the tube to cut it. The size of the tube cutter depends upon the maximum diameter of the tube which it can cut.



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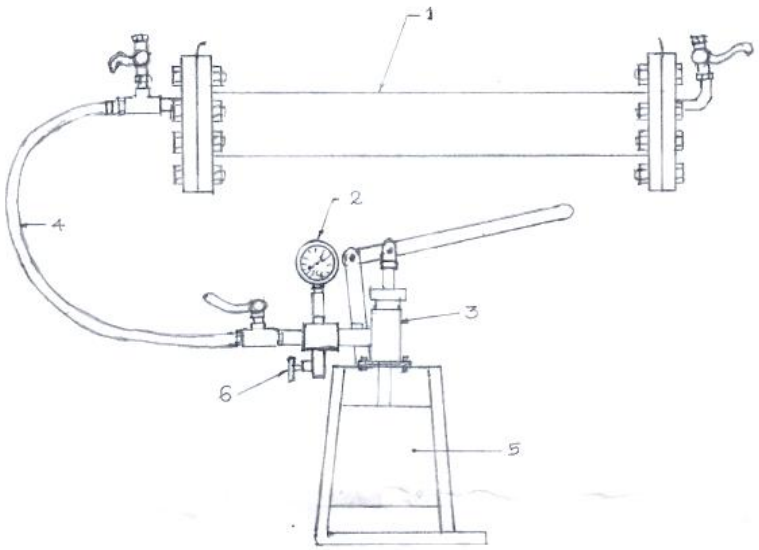
HYDROSTATIC TESTING ON G.I PIPE



1. G.I PIPE
2. PRESSURE GAUGE
3. HAND PUMP
4. HOSE
5. WATER TANK
6. RELEASE VALVE

AIM:

Pressure testing of G.I pipe

OBJECTIVE:

Dismantling, checking, assembling

TOOLS AND EQUIPMENTS USED:

Ring spanner 21-23, double end spanner 21-23, 24-27

DESCRIPTION:

A hydrostatic test is a way in which pressure vessels such as pipelines,plumbing gas cylinders, boilers and fuel tanks can be tested for strength and leaks. The test involves filling the vessel or pipe system with a liquid, usually water, which may be dyed to aid in visual leak detection, and pressurization of the vessel to the specified test pressure. Pressure tightness can be tested by shutting off the supply valve and observing whether there is a pressure loss. The location of a leak can be visually identified more easily if the water contains a colorant. Strength is usually tested by measuring permanent deformation of the container. Hydrostatic testing is the most common method employed for testing pipes and pressure vessels. Using this test helps maintain safety standards and durability of a vessel over time. Newly manufactured pieces are initially qualified using the hydrostatic test. They are then re-qualified at regular intervals using the proof pressure test which is also called the modified hydrostatic test Testing of pressure vessels for transport and storage of gases is very important because such containers can explode if they fail under pressure.

PROCEDURE:

1. Prepare a specimen of a 150 x 2000 mm G.I pipe.
2. Block the two ends of the G.I pipe with suitable blanks and bolts.
3. Pipe filled with water and removed the air through the air cock of the blank.
4. Connect the hydraulic hand pump to one end of the blank.
5. Pressurize the water in the pipe to 5 Kg/cm^2 and hold for the same for a period of ½ hour.
6. Release the pressure and disconnect the pump.

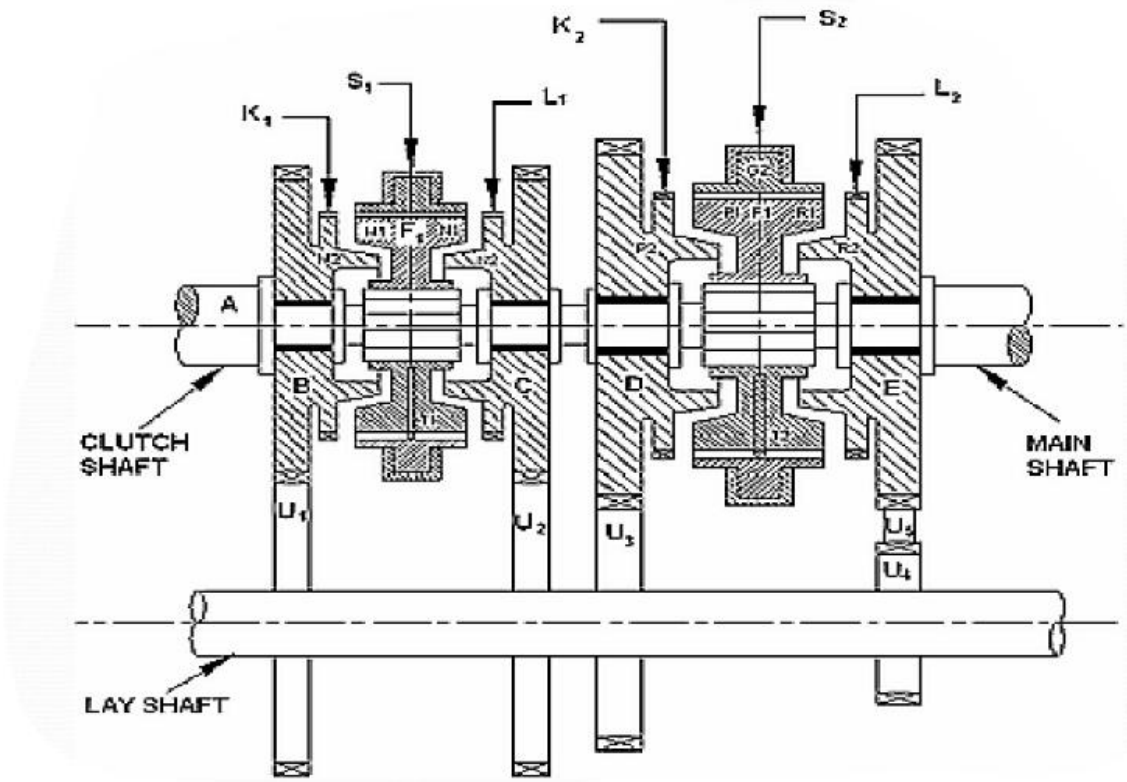
RESULT:

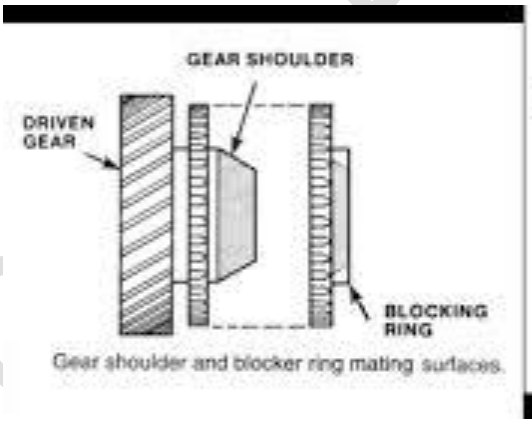
INFERENCE:

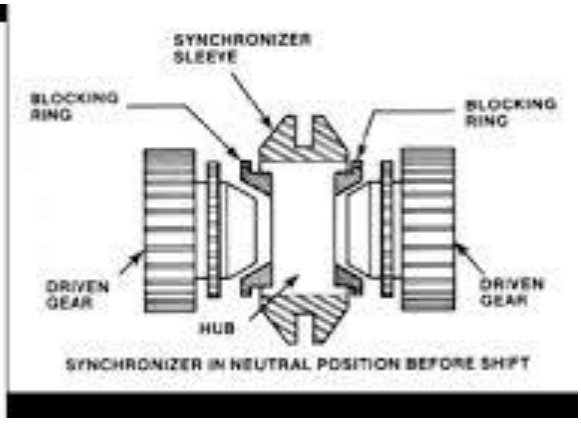
STATUS	DATE	MARK	SIGNATURE
ROUGH			
FAIR			

Exp no. Date:

OVERHAULING OF SYNCHRONMESH 5 SPEED GEAR BOX







AIM:

Dismantling and assembling of synchromesh gear box.

OBJECTIVE:

Dismantling, checking, assembling.

MATERIALS REQUIRED:

Gear oil, grease, cotton waste, emery paper etc.

TOOLS AND EQUIPMENTS USED:

Lock releaser (external bend), screw driver, double end spanner, punch, ring spanner set, combination plier, hammer, bearing puller, etc.

DISMANTLING PROCEDURE:

- Draining out the oil from the gear box.
- Remove the selector assembly, remove the top gear shaft.
- Remove the main gear shaft and bearing.
- Takeout the total assembly and dismantle gear and also reverse gear.
- Clean the all gears and parts.

ASSEMBLING PROCEDURE:

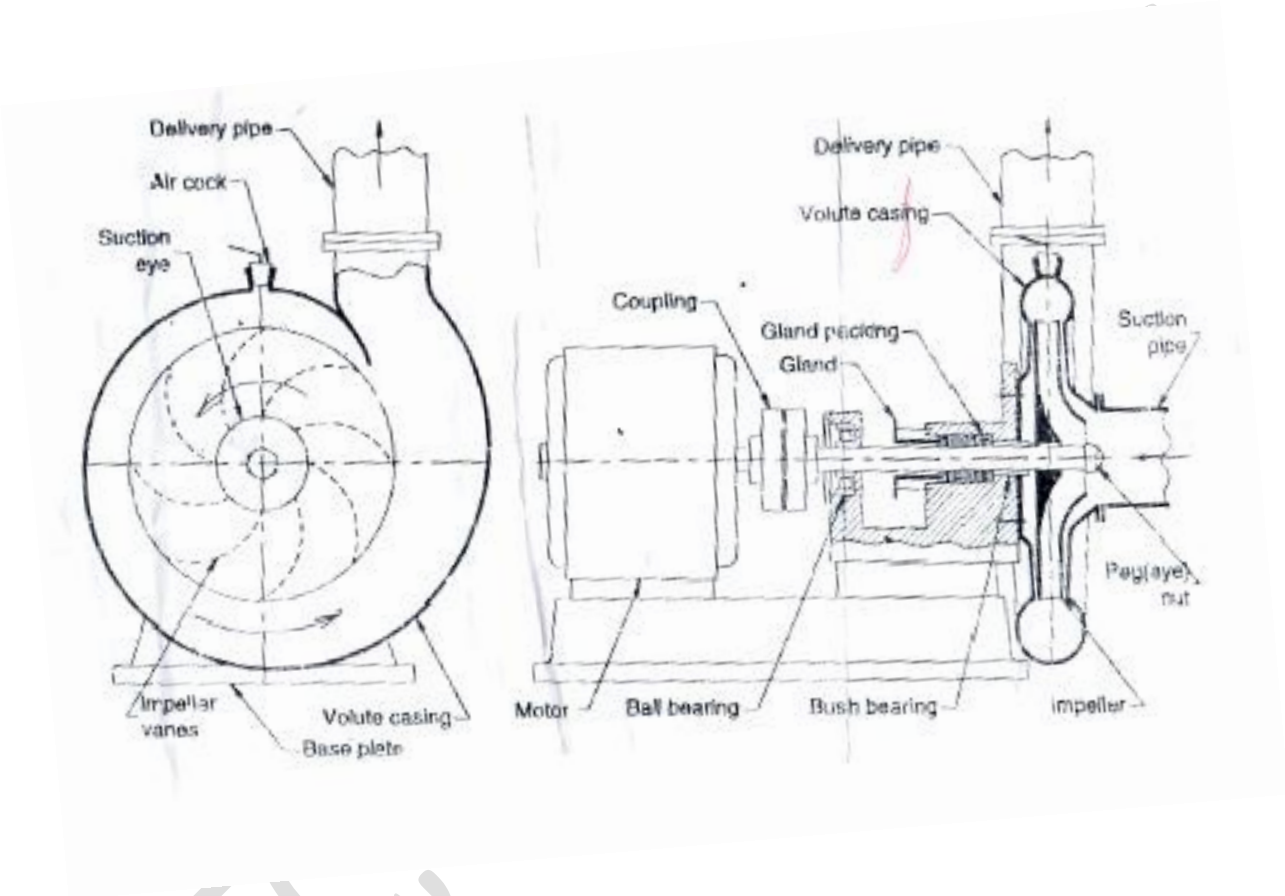
- Place the counter gear and set the reverse gear without providing the shaft.
- Set up the top gear and bearing.
- Assemble the other gears in the gear box.
- Insert the top gear shaft and tight the lock bolt.
- Complete the assembly and clean the box.

OBSERVATIONS:

MISSING PARTS	
PARTS TO BE REPLACED	
ANY MACHINING WORK	
REMARKS	

Expno: Date:

OVERHAULING OF MONOBLOCK CENTRIFUGAL PUMP



AIM:

Change the mechanical seal of a monoblock centrifugal pump.

OBJECTIVE:

Dismantling, Cleaning, checking, assembling and refitting.

MATERIALS REQUIRED:

Cotton waste, grease, kerosene oil, shellac, packing paper etc.

TOOLS AND EQUIPMENTS USED:

Ring spanner, double end spanner, screw driver, hammer, and flat chisel

DESCRIPTION:

The centrifugal pump is the most used pump type in the world. The principle is simple, well-described and thoroughly tested, and the pump is robust, effective and relatively inexpensive to produce. Principle of the centrifugal pump an increase in the fluid pressure from the pump inlet to its outlet is created when the pump is in operation. This pressure difference drives the fluid through the system. The centrifugal pump creates an increase in pressure by transferring mechanical energy from the motor to the fluid through the rotating impeller. The fluid flows from the inlet to the impeller center and out along its blades. The centrifugal force hereby increases the fluid velocity and consequently also the kinetic energy is transformed to pressure.

PROCEDURE:

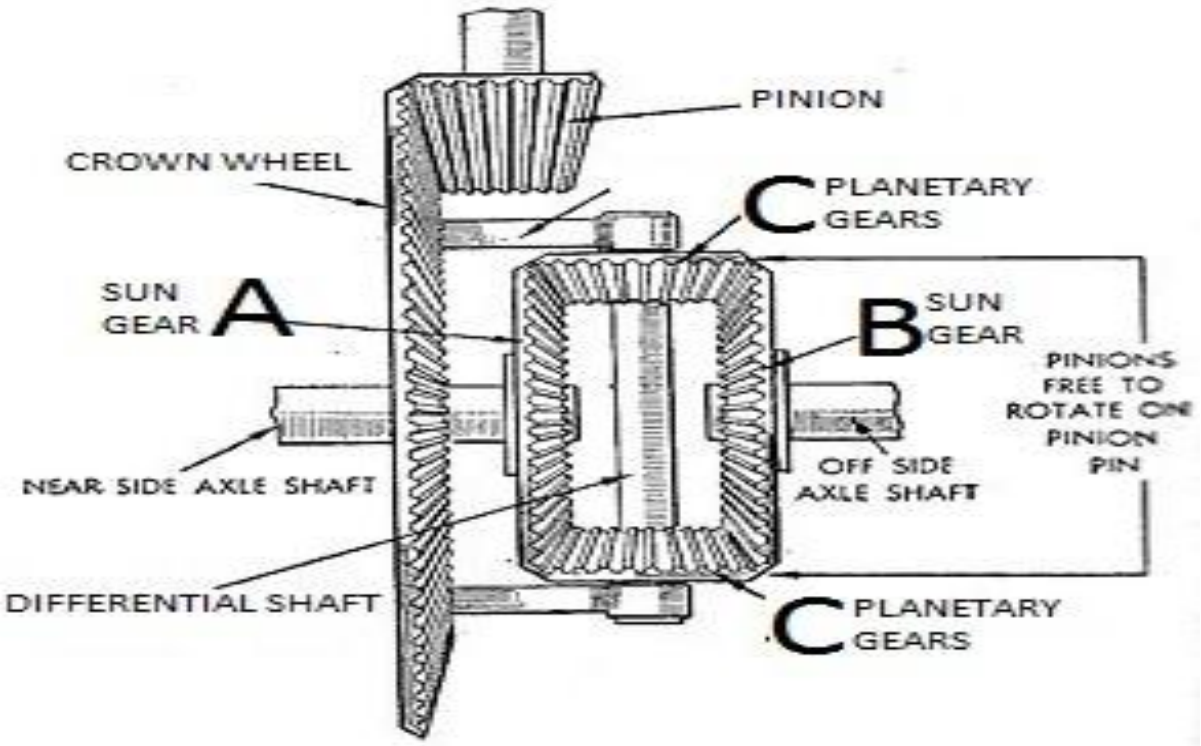
1. Disconnected the suction and delivery pipes from the pump
2. Dismantle the volute case of the centrifugal pump
3. Dismantle the impeller using vice grip pliers and impeller holder.
4. Remove the rotating element of the mechanical seal.
5. Remove the pump bracket from the motor casing.
6. Remove the stationary parts of the mechanical seal from the pump bracket.
7. Clean thoroughly impeller, casing, bracket and shaft.
8. Assemble the stationary part of the mechanical seal the bracket of the pump using shellac.
9. Fitted the bracket to the casing and fixed the rotating element of the seal to impeller shaft.
10. Tight the impeller to the shaft and assembled the volute casing with new packing.
11. Connect the suction and discharge pipes.Prime the pump with water and started the pump.

OBSERVATIONS:

MISSING PARTS	
PARTS TO BE REPLACED	
ANY MACHINING WORK	
REMARKS	

Expno: Date:

OVERHAULING OF DIFFERENTIAL UNIT



AIM:

Dismantling and assembling of differential unit.

OBJECTIVE:

Dismantling, cleaning, checking, assembling and refitting the unit.

MATERIALS REQUIRED:

Cotton waste, grease, kerosene oil, shellac, and packing papers etc.

TOOLS AND EQUIPMENTS USED:

Ring spanner, double end spanner, box spanner, screw driver, hammer, and flat chisel.

DESCRIPTION:

In automobiles and other wheeled vehicles, the differential allows the outer drive wheel to rotate faster than the inner drive wheel during a turn. This is necessary when the vehicle turns, making the wheel that is traveling around the outside of the turning curve roll farther and faster than the other. The average of the rotational speed of the two driving wheels equals the input rotational speed of the drive shaft. An increase in the speed of one wheel is balanced by a decrease in the speed of the other.

When used in this way, a differential couples the input shaft (or prop shaft) to the pinion, which in turn runs on the crown wheel of the differential. This also works as reduction gearing to give the ratio. On rear wheel drive vehicles, the differential may connect to half-shafts inside an axle casing or drive shafts that connect to the rear driving wheels. Front wheel drive vehicles tend to have the pinion on the end of the main-shaft of the gearbox and the differential is enclosed in the same casing as the gearbox.

A differential consists of one input, the drive shaft, and two outputs which are the two drive wheels, however the rotation of the drive wheels are coupled by their connection to the roadway. Under normal conditions, with small tyre slip, the ratio of the speeds of the two driving wheels is defined by the ratio of the radii of the paths around which the two wheels are rolling, which in turn is determined by the track-width of the vehicle (the distance between the driving wheels) and the radius of the turn.

DISMANTLING PROCEDURE:

- Dismantle rear wheels of both sides, removed the wheel drum and axle
- Takeout the differential unit
- Detach the crown unit and the pinion unit
- Dismantle the crown gear, takeout the star gear and sun gear
- Clean the gears and other parts

ASSEMBLING PROCEDURE:

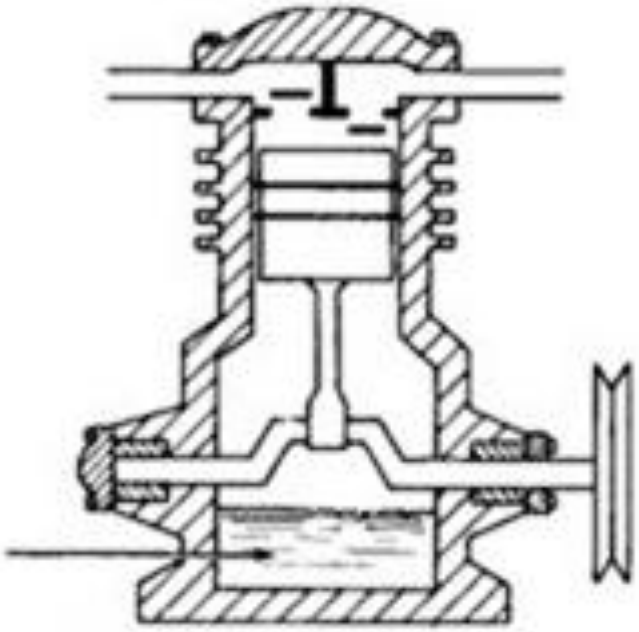
- Install the star gear and sun gear in the cage.
- Fix the crown and pinion unit
- Fix the axle and wheel drum
- Fix the wheels on both sides

OBSERVATIONS:

MISSING PARTS	
PARTS TO BE REPLACED	
ANY MACHINING WORK	
REMARKS	

Exp no. Date:

OVERHAULING OF OPEN TYPE COMPRESSOR



A. Discharge line L. Oil passage

B. Cylinder head M. Wrist pin

C. Gasket N. Oil grooves

D. Valve plate O. Connecting rod

E. CylinderP. Crank case

F. Piston Q. Oil

G. Discharge valveR. Pulley

H. Discharge chamber S. Shaft seal

I. Suction chamberT. Bush bearing

J. Suction lineU. Crankshaft

K. Suction valve

AIM:

Overhauling of an open type compressor.

OPERATION TO BE CARRIED OUT:

Dismantling, cleaning, checking, assembling and refitting.

MATERIALS REQUIRED:

Cotton waste, grease, kerosene oil, shellac, packing paper etc.

TOOLS AND EQUIPMENTS USED:

Ring spanner, double end spanner, box spanner, screwdriver, hammer, flat chisel.

DESCRIPTION:

A gas compressor is a mechanical device that increases the pressure of a gas by reducing its volume. An air compressor is a specific type of gas compressor.Compressors are similar to pumps both increase the pressure on a liquid and both can transport the fluid through a pipe. As gases are compressible, the compressor also reduces the volume of a gas. Liquids are relatively incompressible; while some can be compressed, the main action of a pump is to pressurize and transport liquids.

PARTS:

Cylinder

It is made of cast iron in small compressor.

DISMANTLING PROCEDURE:

1. Pump down the gas in the receiver.
2. Switch of the machine and draw out power pump.
3. Disconnect suction and discharge line from the compressor.
4. Remove V-belt of the compressor.
5. Open the base bolt of a compressor and draw out of the machine.
6. Place the compressor on the table in such a way there should be no weight on the fly wheel.
7. Loose the fly wheel nut and remove the flywheel from the shaft with the help of puller.
8. Draw out oil from the compressor and measure it.
9. Open all the bolts of the head with a ring spanner.
10. Remove the head and valve plate, if it sticks, strike with mallet.
11. Unscrew the discharge valve and remove suction valve also.
12. Remove discharge and suction service valve.

13. Mark a straight line on crank case and bottom which a triangular file.
14. Open the bolts of the bottom with ring spanner.
15. Mark a line on the seal cover plate and crank case.

ASSEMBLING PROCEDURE:

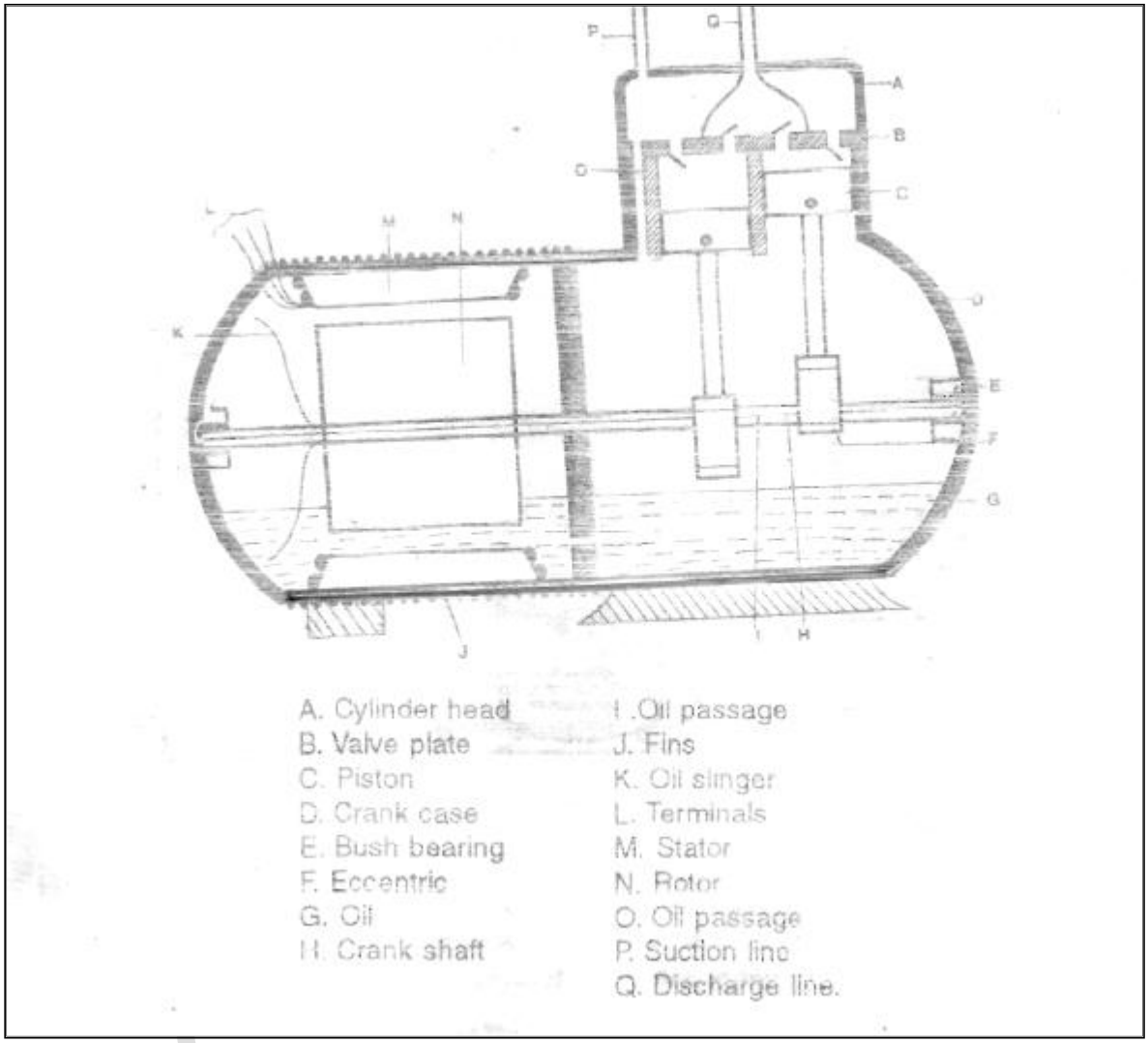
1. Connect the connecting rod to the piston with the piston pin.
2. Put pistons in the cylinders and fit shaft in the bearing of connecting rod and of compressor main bearing
3. Tight the eccentric hook bolt if any
4. Put thrust ball in the thrust ball plug assembly.
5. Fit the seal ring against the shaft shoulder and set upon it
6. Match the mark of seal cover plate and housing
7. Put bolts into the seal cover and tight them cross with ring spanner
8. Match the mark of the bottom with crank case bolt
9. Fit valves on valve seat and place valve plate block
10. Connect the suction and discharge service valve
11. Fit the wheel on the shaft
12. While assembling put new gasket where ever it is dry
13. Put new oil in exact quantity through the suction gage port
14. Fill gas pressure of 30 -35 lbs /square in to the compressor and test leakage with soap solution
15. Fit compressor on the condensing unit.

OBSERVATIONS:

MISSING PARTS	
PARTS TO BE REPLACED	
ANY MACHINING WORK	
REMARKS	

Exp no. Date:

OVERHAULING OF SEMI SEALED COMPRESSOR



AIM:

Overhauling of semi sealed compressor.

OPERATION TO BE CARRIED OUT:

Dismantling, cleaning, checking, assembling and refitting.

MATERIALS REQUIRED:

Cotton waste, grease, kerosene oil, shellac, packing paper etc.

TOOLS AND EQUIPMENTS USED:

Ring spanner, double end spanner, box spanner, screwdriver, hammer, flat chisel

PROCEDURE

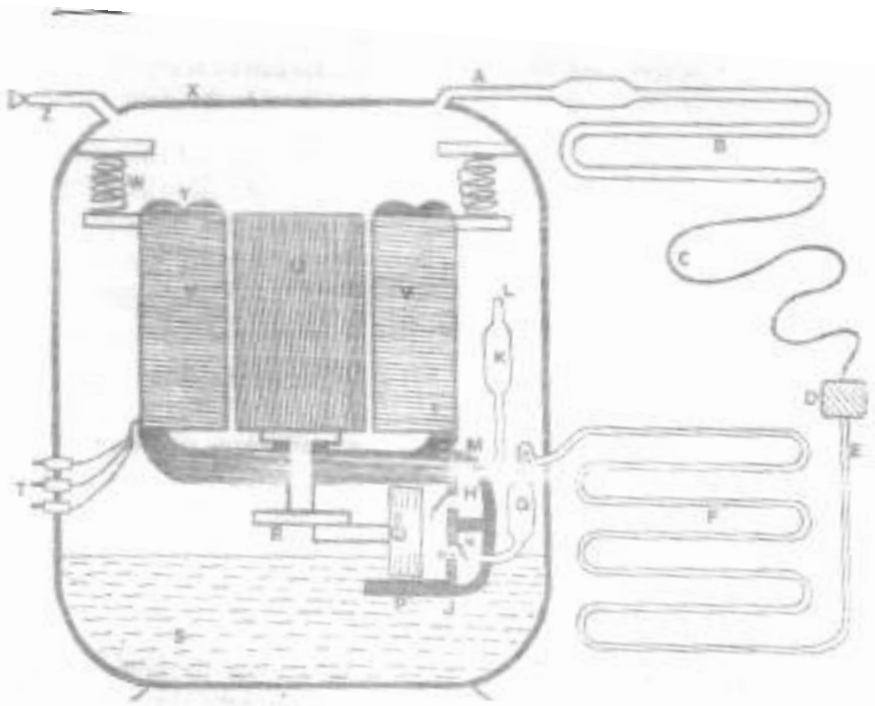
1. A semi sealed compressor is an assembly of compressor and motor mounted in same housing rather than sealed unit. A semi sealed unit have bolt joints so this can be easily serviced.
2. Remove the gas from the system and disconnect the electric accessories
3. Remove the suction and discharge line from the service valve and take the unit away from the system
4. Drain out the oil from the system and measure it.
5. Mark a straight line over the unit, unscrew the bolt and remove the cover
6. Dismantling, check of all parts and repair if it is necessary
7. Clean all parts with petrol and apply clean refrigeration oil to all moving parts
8. Reassemble the unit in correct order with new gasket and charge new oil.

OBSERVATIONS:

MISSING PARTS	
PARTS TO BE REPLACED	
ANY MACHINING WORK	
REMARKS	

Expno: Date:

OVERHAULING OF SEALED COMPRESSOR



A. Suction line
B. Evaporator
C. Capillary
D. Drier filter
E. liquid line
F. Condenser
G. Discharge muffler
H. Suction chamber
I. Suction valve
J. Valve plate
K. Suction muffler
L. Internal suction line
M. Cylinder head
N. discharge chamber
O. Discharge valve
P. Cylinder
Q. Piston
R. Eccentric
S. Oil
T. Terminals
U. Rotor
V. Stator
W. Internal suspension spring
X. Dome
Y. Windings
Z. Charging line.

AIM:

Overhauling of semi sealed compressor

OPERATION TO BE CARRIED OUT:

Dismantling, cleaning, checking, assembling and refitting.

MATERIALS REQUIRED

Cotton waste, grease, kerosene oil, shellac, packing paper etc.

TOOLS AND EQUIPMENTS USED:

Ring spanner, double end spanner, box spanner, screwdriver, hammer, flat chisel.

PROCEDURE:

1. Remove the gas from the system.
2. Disconnect electric accessories from the sealed unit.
3. Remove the suction and discharge line.
4. Loose base bolts and remove the sealed unit.
5. Remove oil from sealed unit.
6. Make line somewhere at the weld of the unit with a file.
7. If the sealed unit is round cut its weld on lathe.
8. If the sealed unit is elliptical cut its weld with hacksaw or grinder as convenient.
9. Remove the lid of the sealed unit disconnect the discharge line connection inside it.
10. Disconnect starting, running and common terminal leads.
11. Draw out the compressor motor assembly with a puller if the if the assembly is fitted in the sealed unit.
12. Check and repair the compressor motor assembly as necessary.
13. Clean all parts with petrol and apply clean refrigeration oil to all moving parts.
14. Fit the compressor motor assembly in the in the sealed unit and connect the discharge line with the discharge connection on the dome.
15. Operate and test the compressor motor assembling correct functioning.
16. Place the lid and set the line marked as the sealed unit.
17. Weld the unit with electric welding.
18. Test the leakage of sealed unit.
19. Operate the sealed unit and charge oil in it.
20. Fit the sealed unit in machine and tighten the bolt.
21. Connect suction and discharge line.
22. Fit electrical accessories with sealed unit and complete electrical connections.
23. Evacuate the complete refrigeration system.
24. Charge gas in the system and test it

OBSERVATIONS:

MISSING PARTS	
PARTS TO BE REPLACED	
ANY MACHINING WORK	
REMARKS	

Exp no: Date:

OVERHAULING OF FOUR CYLINDER FOUR STROKE DIESEL ENGINE

AIM:

A detailed study of a four-cylinder diesel engine by dismantling and assembling.

OBJECTIVE:

Dismantling, Checking, Assembling.

TOOLS AND EQUIPMENTS USED:

Double end spanner, Ring spanner, Tubular spanner, Box spanner Screwdriver, Ball peen hammer, Torque wrench.

PROCEDURE:

The cylinder head of engine is removed by removing the bolt at the four corners of the cylinder head.Then remove the oil pan at the bottom side. After remove the stud of big end of the connecting rod by using suitable spanner. Then remove the piston from crank shaft. Remove the bushes from crank shaft and detach the crank from crank case. Finally remove the valve from the cylinder head. After dismantling all parts clean and apply lubricating oil. The cleaned parts are assembled carefully with proper tools.

PARTS

CYLINDER BLOCK

The cylinder block is the main body of the engine, the structure that supports all the other components of the engine. In the case of the single cylinder engine the cylinder block houses the cylinder, while in the case of multi-cylinder engine the numbers of cylinders cast together to form the cylinder block. The cylinder head is mounted on the top of the cylinder

CYLINDER HEAD

The top end of the cylinder is covered by cylinder head overwhich inlet and exhaust valve, spark plug or injectors are mounted. A copper or asbestos gasket is provided between cylinder and cylinder head to make an air tight joint.

PISTON

Transmit the force exerted by the burning of charge to the connecting rod. Usually made of Aluminium alloy which has good heat conducting property and greater strength at higher temperature.

PISTON RINGS

These are housed in the circumferential grooves provided on the outer surface of the piston and made of steel alloys which retain elastic properties even at high temperature. 2 types of rings- compression and oil rings. Compression ring is upper ring of the piston which provides air tight seal to prevent leakage of the burnt gases into the lower portion. Oil ring is lower ring which provides effective seal to prevent leakage of the oil into the engine cylinder.

CONECTING ROD

It converts reciprocating motion of the piston into circular motion of the crank shaft, in the working stroke. The smaller end of the connecting rod is connected with the piston by gudgeon pin and bigger end of the connecting rod is connected with the crank

CRANKSHAFT

It converts the reciprocating motion of the piston into the rotary motion with the help of connecting rod. The special steel alloys are used for the manufacturing of the crankshaft. It consists of eccentric portion called crank.

CRANK CASE

It houses cylinder and crankshaft of the IC engine and also serves as sump for the lubricating oil.

FLYWHEEL

It is big wheel mounted on the crankshaft, whose function is to maintain its speed constant. It is done by storing excess energy during the power stroke, which is returned during other stroke.

PISTON PIN

A hollow hardened steel pin which is used to connect piston and small end of connecting rod.

INLET MANIFOLD

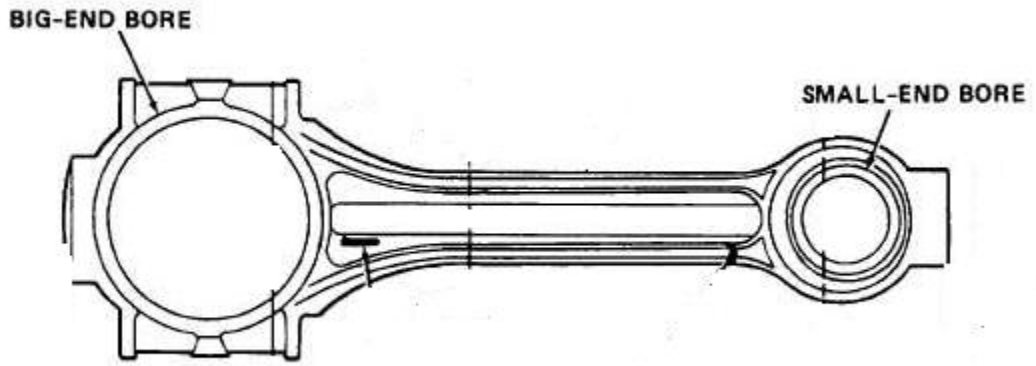
The air or air fuel mixture is drawn in to the cylinder.

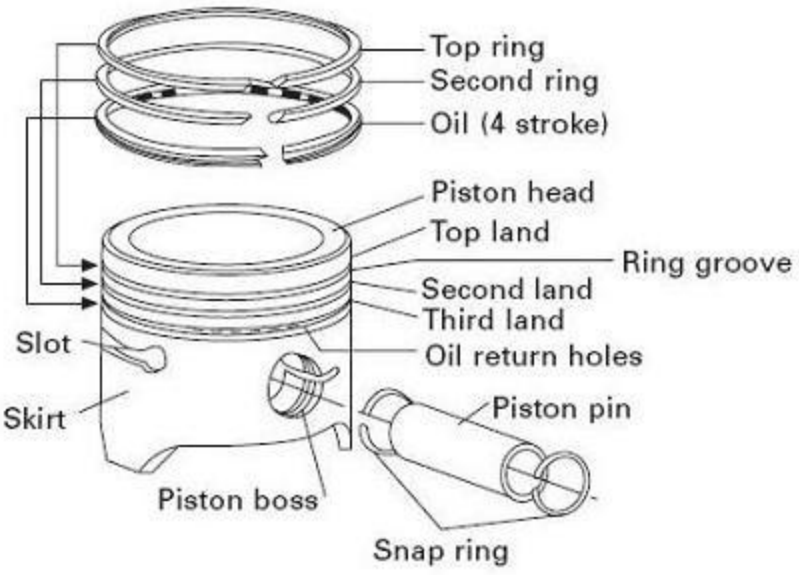
EXHAUST MANIFOLD

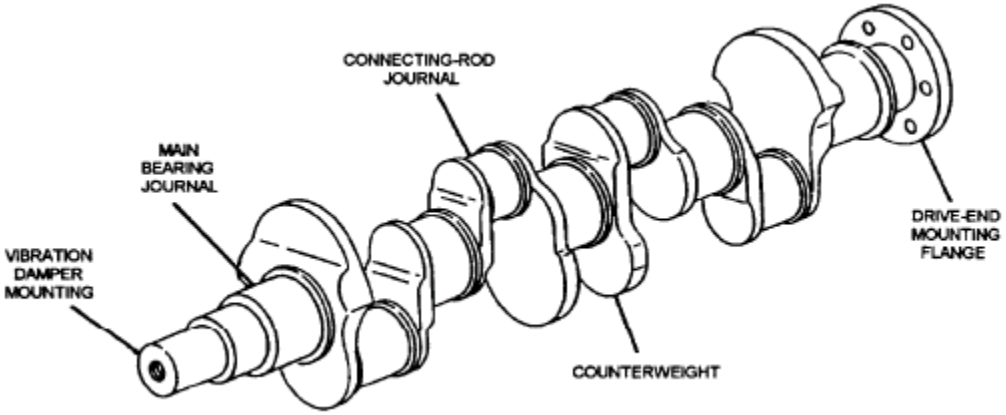
All the exhaust gases generated inside the cylinder after burning of fuel are discharge d through the exhaust manifold into the atmosphere.

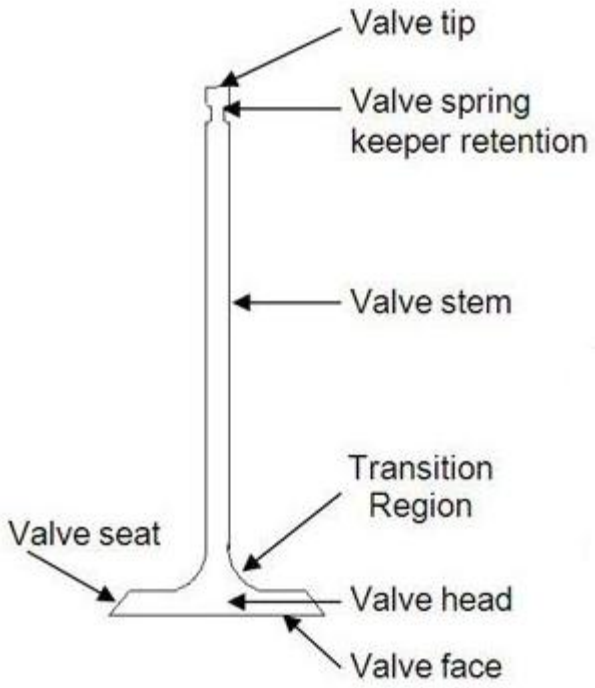
OBSERVATIONS:

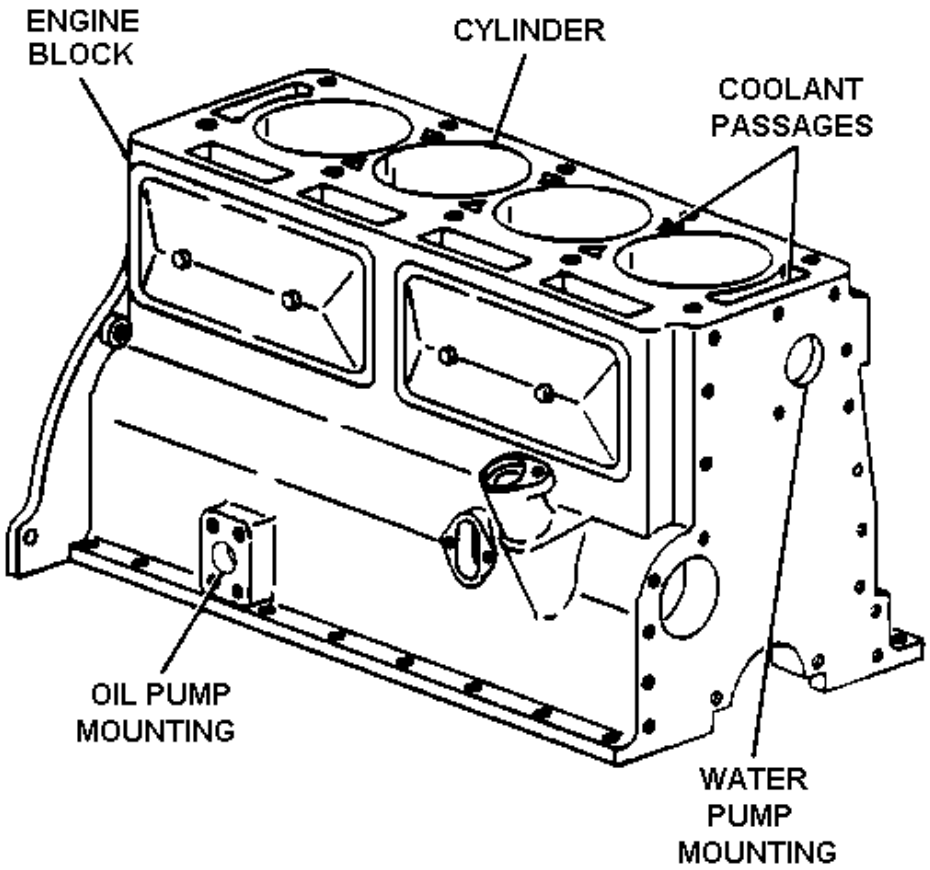
MISSING PARTS	
PARTS TO BE REPLACED	
ANY MACHINING WORK	
REMARKS	





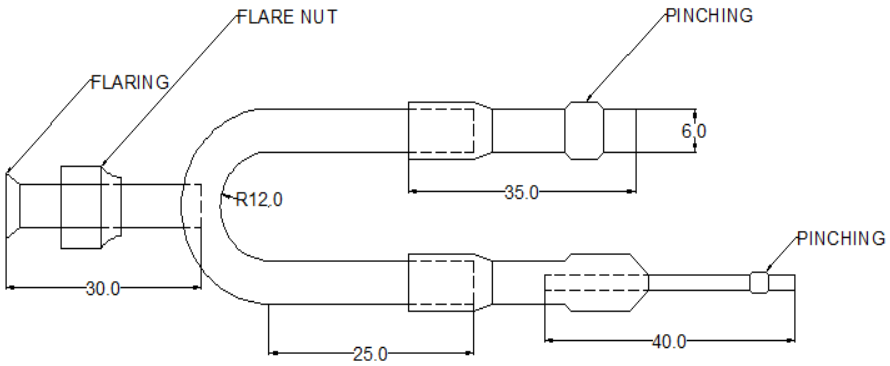



Valve tip
Valve spring keeper retention
Valve stem
Transition Region
Valve seat
Valve head
Valve face


ENGINE BLOCK
CYLINDER
COOLANT PASSAGES
OIL PUMP MOUNTING
WATER PUMP MOUNTING

Exp no: Date:

PRACTICE ON COPPER TUBE FITTINGS AND LEAK TESTING



AIM:Prepare the copper tube joints by brazing and leak test as in fig.

OBJECTIVES:

1 Get practice in copper tube fittings of refrigeration and air conditioning equipments.
2 Get practice in brazing.
3 Get practice in leak testing, handling of refrigerantcylinders.

TOOLS REQUIRED

Steel rule,Scriber,Tubecutter,Reamer,Flaringtool,Swagingtool,Tubebender,Ballpeenhammer,Combinationpliers,Flat smooth file,Triangular file, blow lamb, Flat tongs,Pinching tool

MATERIALS REQUIRED

Annealed copper tube,Capillarytube,Brazingrod,Butane gas, CTC (Carbon Tetra Chloride), Waterpaper, Flux,Cotton waste, Soap solution.

PROCEDURE

1. Made the copper tube pieces for work from the tube coil, using steel rule, scriber,tube cutter, and triangular file.
2. Made the open end of tube preparation using smooth file and reamer.
3. Made the flaring by flaring tool as in fig.
4. Made the swaging by swaging tool as in fig.
5. Made the U bent with lever type bender by using the following the equation. Length of the bend = (angle of bend/360) x πd, where d is diameter of bend as given in drawing.
6. Made a hole of 6mm diameter on outer middle of bend using triangular file/drill.
7. Made the capillary tube attached to the copper tube as in fig. Using flaring block, pinching tool, combination pliers.
8. Made the joint of tubes as in fig. Using brazing torch/ blow lamp,flux, brazing rod and flat tongs.
9. Cleaned and leak test has done by nitrogen using soap solution.

PRECAUSIONS

1. Tubes should be straightened before cut in to required dimensions.
2. End preparation should be done thoroughly before and after brazing using water paper and metallic brush.
3. Leak testing should be done by maintaining proper gas pressure and with apparatus classified.

RESULT

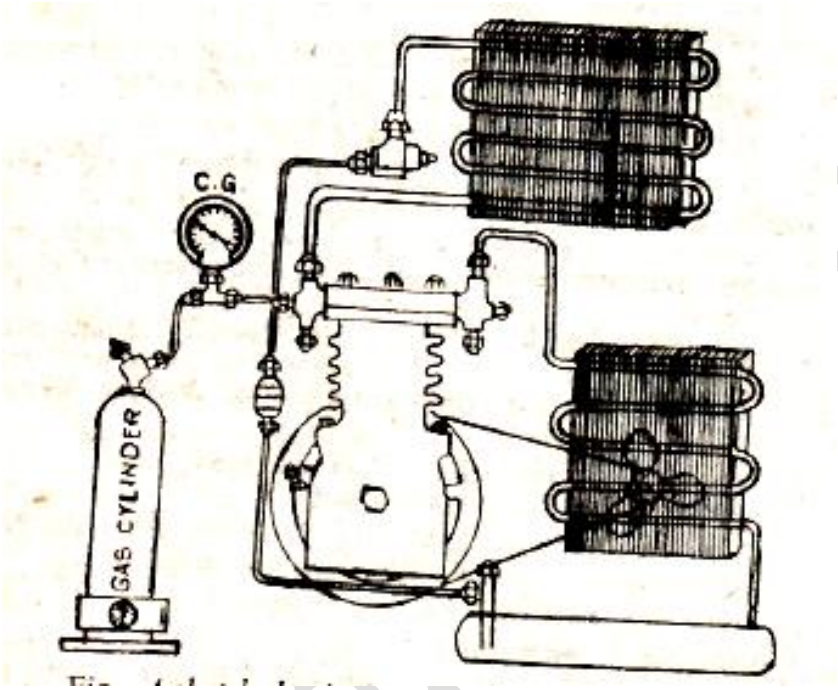
Specified leak proof joint has been obtained

INFERENCE

STATUS	DATE	MARK	SIGNATURE
ROUGH			
FAIR			

Exp no: Date:

DEHYDRATION AND GAS CHARGING PRACTICE ON VAPOUR COMPRESSION REFRIGERATION SYSTEM



AIM:

Dehydration and gas charging practice in vapor compressing refrigeration system.

OBJECTIVES :

(1) Get practice of knowledge in refrigeration system
(2) Get knowledge and study on components of the system
(3) Get practice in vacuolization and dehydration process
(4) Get practice in gas charging, leak testing, safe handling of refrigerant cylinders

TOOLS :

Steel rule, Screw driver, Combination pliers, Nose pliers, Double end spanner (14-15,16-17,), Ring spanner (8-9, 10-11,12-13), Cylinder key, Blow lamp, Tube working kit, Gas charging kit.

EQUIPMENTS:

Vacuum pump, weighing balance, gauge manifold

PRECAUTIONS:

(1) Thorough leak testing on each brazed joints have to be done

(2) The charging lines should be purged promptly

(3) Care should be taken to avoid over charging

(4) Top up the system after being installed.

PROCEDURE:

(1) All the components in refrigeration system was connected as per cycle, by using brazed cupper tube fittings.
(2) Make the pressure test/ leak test of the system using Nitrogen 20 Kg/cm^2 pressure.
(3) Maintained the pressure for minimum 1 hour and confirmed the leaks by inflation.
    i. Checks(pressure gauge) / Soap bubble test.
(4) Drained out the testing gas.
(5) Heated the coils nearly 60-70℃ and vacuumised the system through vacuum pump and gauge manifold, for one hour.
(6) While the vacuum reached up to 30" of Mercury and the pump.
(7) Weighed the gas cylinder and connected to the manifold through flexible charging line.
(8) Purged the tube for a while and charged the system in liquid cross charging method.
(9) Started the machine and observed the performance based on temperature and pressure in the system.
(10) Suction pressure has been corrected and sealed the charging lines by brazing.

Result:

Neatly charged system has obtained.

STATUS	DATE	MARK	SIGNATURE
ROUGH			
FAIR			