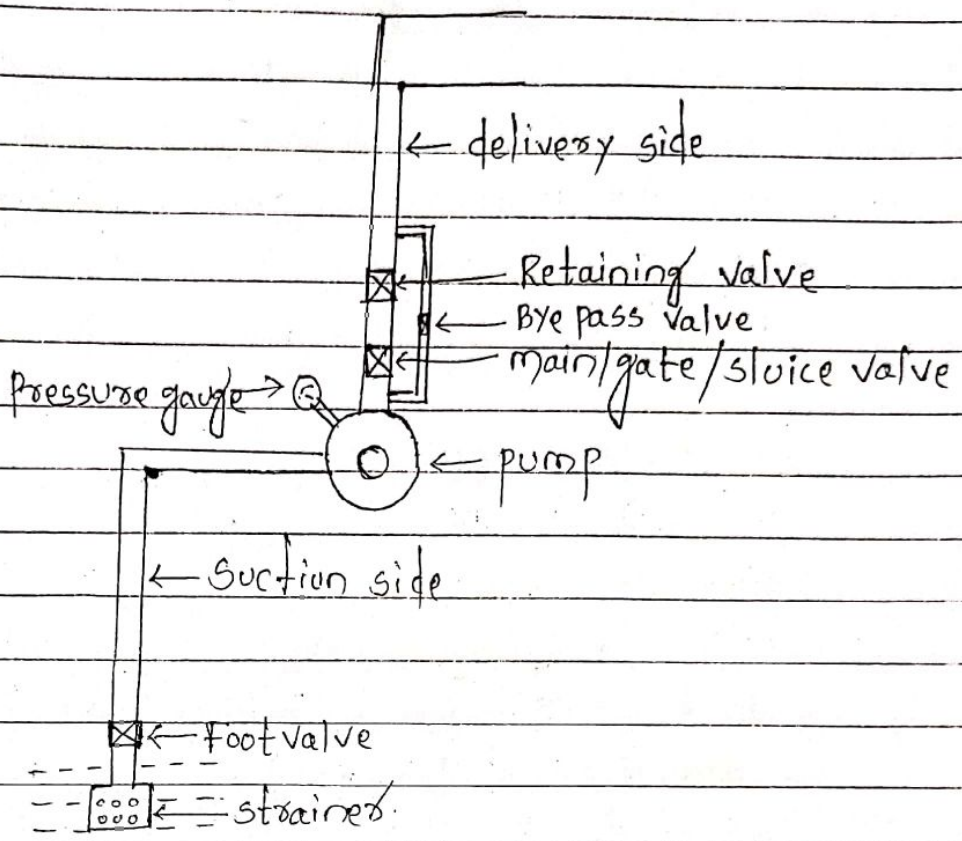
Sakti

MINE MACHINERY - 1

6th Sem.

Pump fittings and attachment :



Important defination :

1. Priming :

✓ If the pump barrel in suction side is filled with air the pump can't creates its own vaccum when it started and it fails to draw water, This difficulties are over come first filling the barrel by water, this process is called priming of a pump.

✓→ The priming may be carried out in delivery column the foot valve just above the strainer may be placed just hold the water suction pipe range.

✓ → so the process of pouring of water to suction pipe range before starting is termed as priming.

✓→ Centrifugal or turbine pump always needs priming // most reciprocating pump are self priming it means Funnel for manual pouring of water is provided for reciprocating.

All pumps are starts more easily when primed.

* Water hammer:

It is the violent shock caused by a moving column of water when being suddenly brought to rest. It generally it occurs in receproeating pump when the piston move faster or slower in casing.

Reason for water hammer:

1. when Suction pipe too small
2. when defective valve is their
3. Loose valve seat
4. when Cavitation occurs
5. due to fluctuation of power supplied to the pump.
6. In multistage turbine pump balanced fixed is properly mounted.

PreCaution:

1. Larger diameter Suction pipe range should be used.
2. Valve and valve seat should be checked Regularly.
3. Air vessel should be used to avoid Cavitation.
4. Ram speed should be syncronised with flow of water.

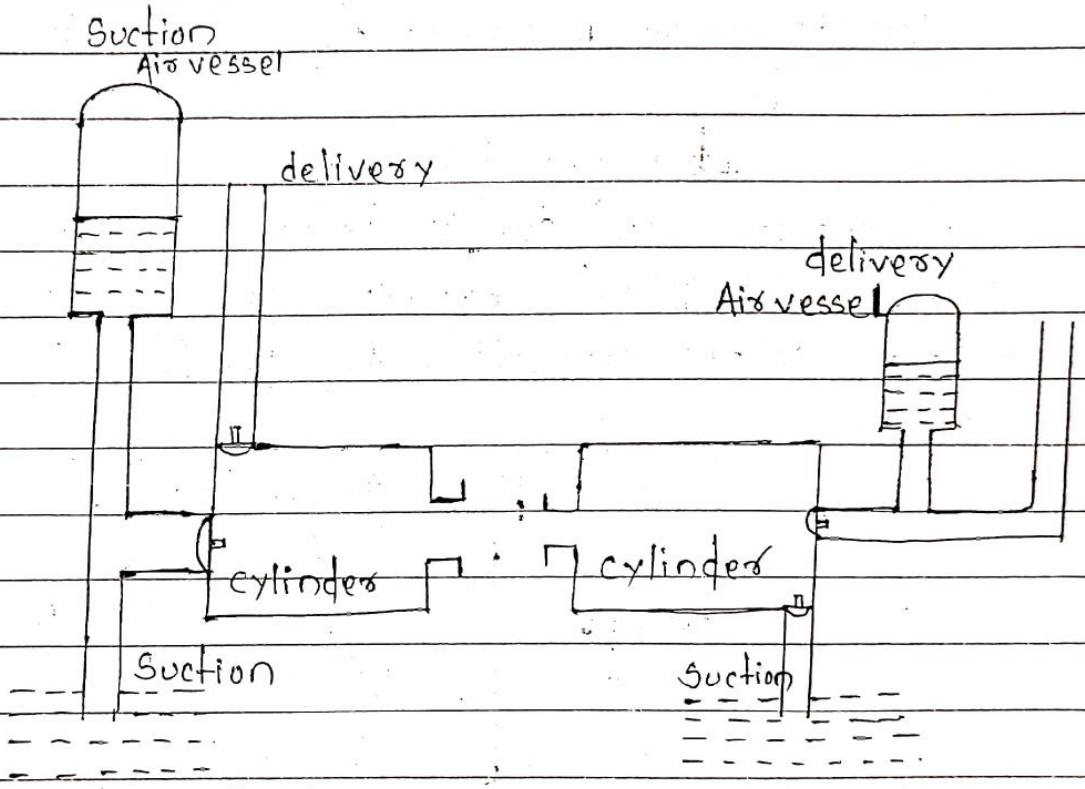
* Cavitation:

If a piston is too fast then water can't enter the cylinder to fill quickly enough to retreating piston. So a passial vaccum is created in a barrel So in the next stroke the water overtake the piston slowing down to the piston. A seviour knocked should be produced in the pump, This phenomenon formation of vaccum in with in pump is termed as Cavitation.

Preventive measures :

1. fitting of air vessel in Suction pipe line or delivery pipe line range to taking the Vaccum Created with in the pump.
2. Syncronised the speed of Ram
3. Running with a flooded Suction with Suction pipe below the water level in the Sump.

Air vessel :



→ Air vessel is a chamber filled with air and directly Communicated with delivery pipe or Suction pipe to reduce the shock, Jerk and noise in receprocating pump as well as in other pump for preventive measure against water hammer and Cavitation.

→ In reciprocating pump the forcing stroke accelerate the water column in delivery pipe but during the pulsation effect the accelerate water is brought to rest in returning stroke causing defective valves and fitting but if a air vessel is fitted the force to water released the pressure by drawing excess water in air vessel.

→ Air vessel have a valve which can only open when requireded pressure is maintained, this water can also be withdrawn in a chamber through different pipe through. Suction Sump.

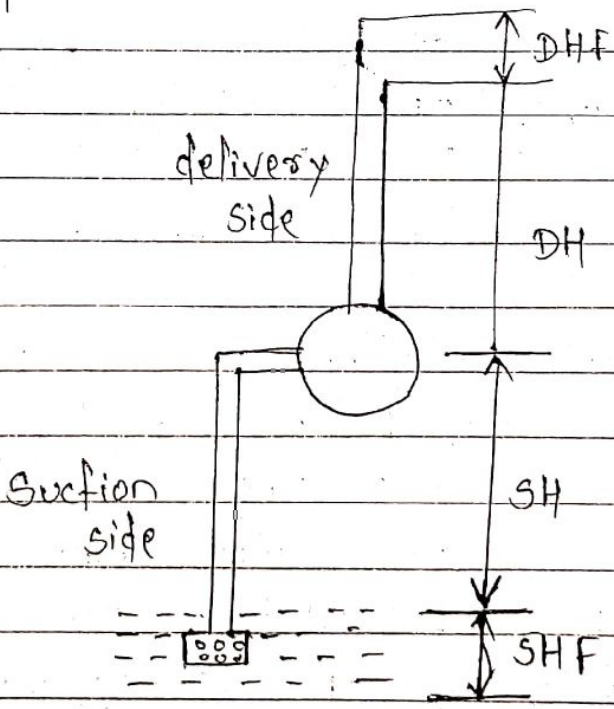
→ At the end of forcing stroke the pressure is normalised the excess water in the chamber can also be added to the main delivery range due to expansion of air in air vessel.

→ The air vessel which attach in delivery pipe range is termed as delivery Air vessel, when Communicated with Suction pipe range is termed as Suction air vessel.

Total head:

↑T is the Summation of Suction head, delivery head, Suction head due to friction, delivery head due to friction. ↑t is generally expressed as mtr.

→ ↑t is also representation the pressure Created by the Pump.



Centrifugal pump:

↑t consist of following parts.

These are : (1) Volute Casing
(2) ↑mpellers

(3) stoffing box
(4) shaft upon which impeller mounted
(5) A motor whose shaft is coupled to the shaft of pump and give external power to run the motor
(6) The other parts such as impeller seats suction side, delivery side and different valves and fitting needed for shifting of water to suction to delivery side.

description:

Centrifugal pump consist of impeller which passes through pump casing and having water sealed stopping box at its end.

→ The bearing which needs for the coupling of shaft are carried on the extension of cover where stoffing box is placed and remain water tight and air tight.

→ The impeller which resemble like a wheel like a 2 disc upon which number of vanes or blades can be mounted the blades are backwards curved to give effective work done in less effort.

→ An opening called the eye of the impeller is left at the center where the disc are mounted on the impeller seat which kied to the shaft of the pump.

→ The volute casing may made up of cast iron, copper for normal composes but to deal with acidic water the casing must up of monel metal.

→ The impeller and vanes are also available in different metal such as castiron, copper, stainless steel or monel metal.

Principle of operation:

→ A centrifugal pump can't create own vaccum. hence it needs priming. The centrifugal pump consist of 2 parts

one is starter & another one Rotter.

→ water enters the casing at the central position (eye) and comes in the contact which with the blades of impeller.

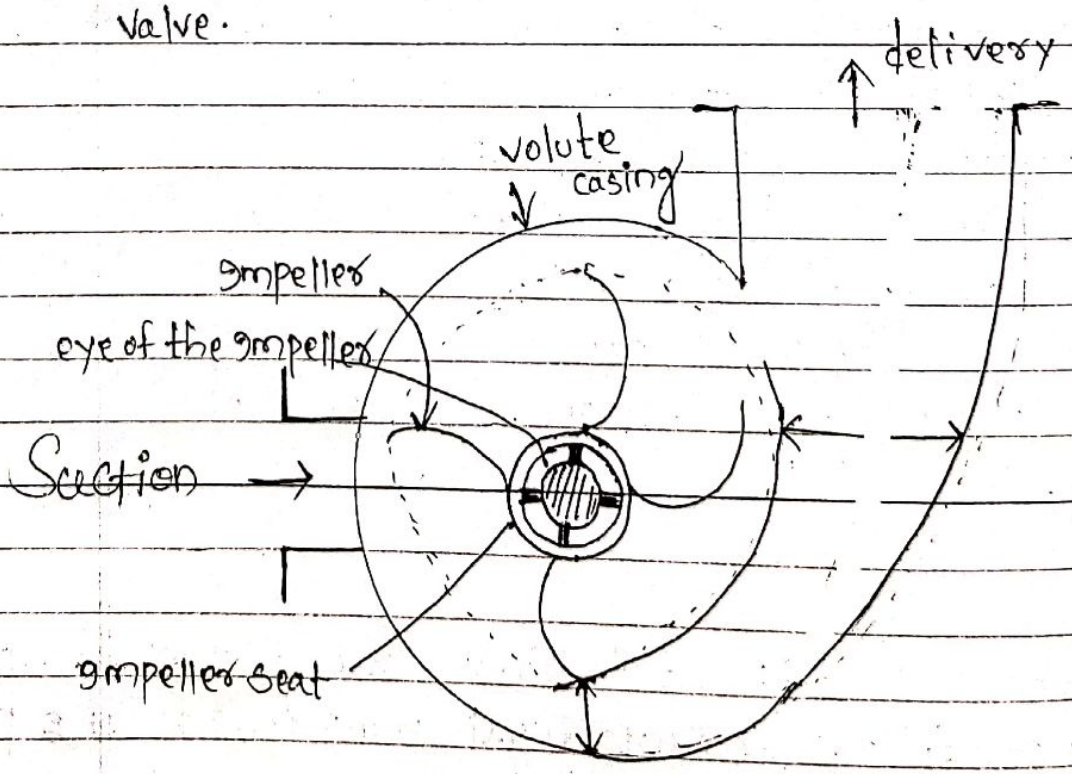
→ due to rotation of the impeller, the water is being thro by the vanes in tangentially dirⁿ.

→ The impeller are mounted in casing in such a way th the area the from impeller to volute casing is gradually increases to suction side to delivery side.

→ due to increase crosssectional area there is a pressur drop between the suction side and delivery side of the pump.

→ due to this bernouilli's theorm the water continuity to maintain suction side to delivery side.

→ when the fan throw the water in high speed the water strike in volute casing and loose the velocity as per conservation of energy, the kinetic energy developed in the water is reduced due to reduce velocity & converted into potential energy stored in the water, which develope head in delivery side and force to open sluice/main gate valve.



Advantage of Centrifugal Pump:

1. higher velocity in the suction range.
2. It does not Produce any pulsation during discharging of water/ Liquid.
3. It requires less space and Low Cost foundation Compare to the reciprocating pump.
4. Installation is easy.
5. It is applicable for high quantity and small head.
6. The pump is very Compact, simple, Produces less vibration, noise
7. It Produce high quantity of water in very Low time.

Disadvantage:

1. It has the Lower efficiency Compare to a reciprocating pump.
2. high Power Cost
3. It requires extra priming.
4. It Can't deal with viscous fluid.

Axial end thrust:

In multistage turbine pump due to heavy pressure in delivery side the end thrust accumulates in every stage of pump as the impeller are keyed on the same shaft in series. So the total thrust at towards the suction head upon the shaft which is known as axial end thrust.

→ The total thrust is equal to the area multiplied by the pressure per unit area in the clearance space multiplied by the number of impeller mounted on the shaft. axially

→ The end thrust makes the shaft shift towards the suction side resulting excessive friction bet^{n} rotating impeller and stationary guide vanes with in a turbine

pump. It is also lead to premature wearing of bearing and other fitting parts of the pump.

→ The Counter act the axial end thrust the following metho Can be adopted in different pump.

1. In single stage pumps symmetric double entry impeller are used.
2. In 2 stage pump the thrust is eliminated by placing the impeller back to back.
3. In multistage turbine pump hydraullic balancing disc Can be provided.
4. In vertical pump / submersible pump thrust bulb bearing are regularly pivoted & symmetric arrangement of impeller can be designed.

Turbine Pump:

The turbine pump consist of following parts.

1. Casing
2. Impeller mounted on the shaft in series
3. The stationary guide vane which forms diffusing channel & separate different stages of the pump
4. stuffing box
5. The vanes or blades mounted on the impeller th other anxeliary part are shaft coupling with motor, beari speed controller. suction & delivery fitting, balancing disc

description:

The turbine pump are necessarily needed for the developement of high hydraullic head with less qty. of water deliver.

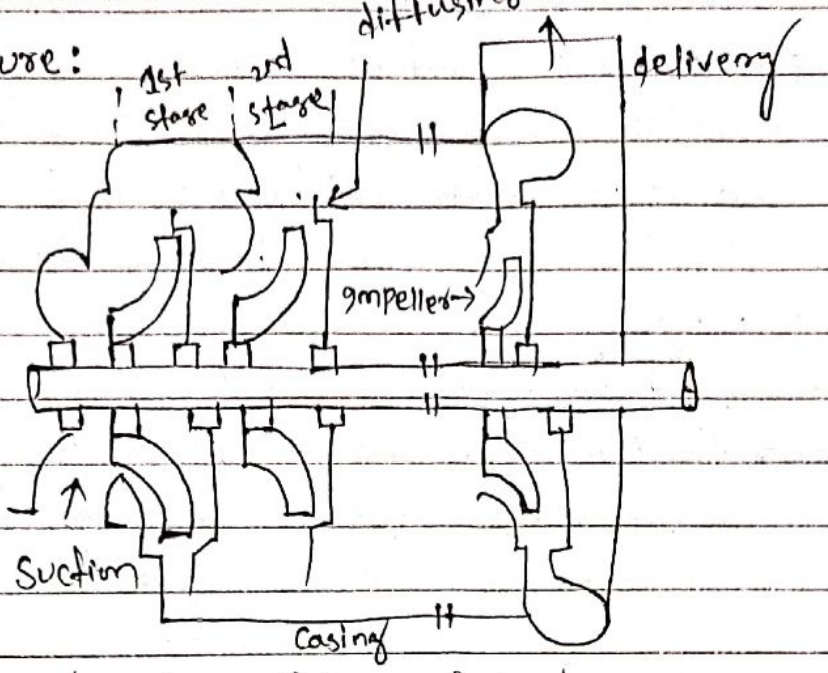
→ It differs from Centrifugal pump by replacing the volute Casing with a casing of stationary vanes, to form diffusing channel in the pump.

→ A multistage turbine pump is provided with a number of impeller in series on the same shaft with properly shaped diffusing channel with the periphery of the impeller.
→ Each impeller with its diffusing channel make a single stage Like that as per our head needed number of stages can be found in the multistage turbine pump.
→ The shaft of the pump which coupled to the shaft of motor by a water proof housing called stuffing box.

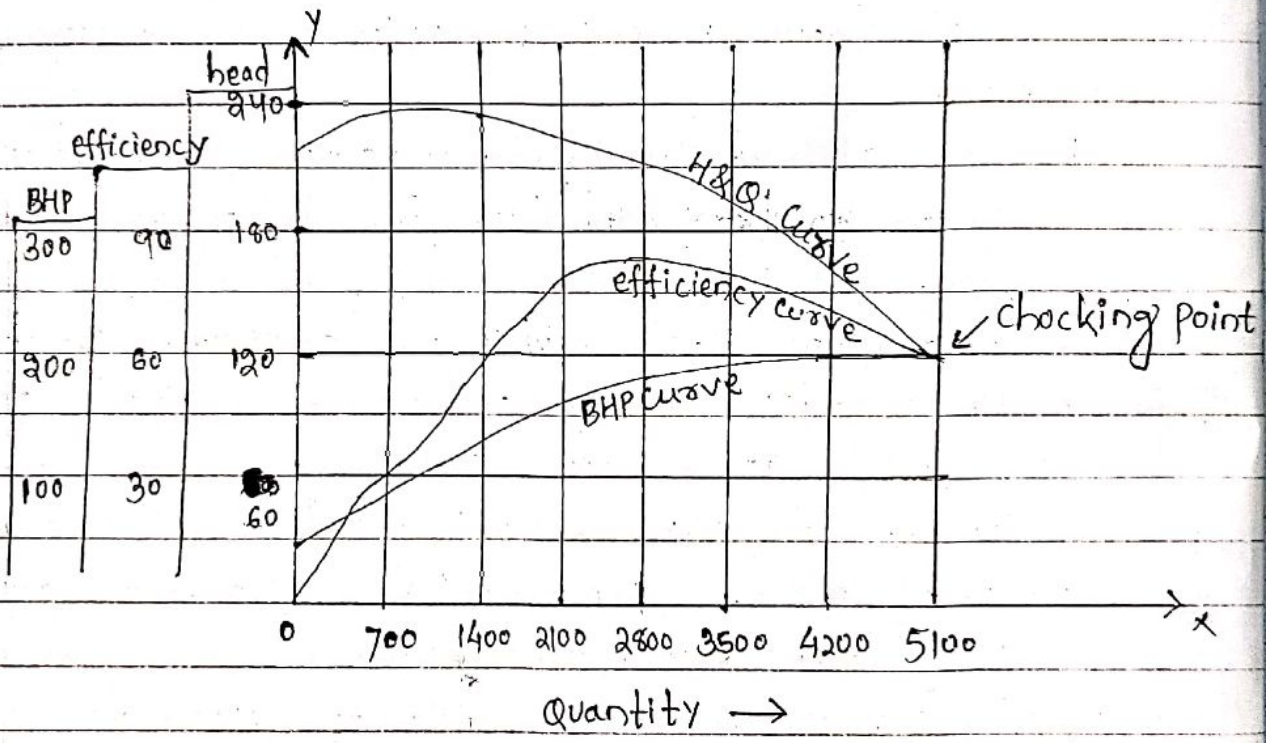
Principle:

→ When the impeller of turbine pump rotate it causes a suction effect in the pump.
→ water enters to the suction pipe as the atmospheric Pressure forces the water to the first impeller through the eye of the impeller.
→ In the impeller the water whirlled around the base and leaves its periphery with high pressure of K.E. in tangential direction.
→ The water thrown by the impeller passes through the diffusing channel with less velocity and pressure energy to the eye of the next impeller.
→ The function of the diffusing channel is same as volute casing in centrifugal pump, which convert K.E. or velocity to equivalent pressure energy.
→ By virtue of which the total head developed in last stage is the accumulation of head of each stage.
→ At the end of the delivery side a balancing disc is mounted on the shaft to counter act to the axial end thrust to a turbine pump.

Figure:



Characteristics Curve of turbine pump:



→ Generally the Curve of turbine pump applicable for testing of pump efficiency, power & head in the lab.

→ The Curve of turbine pump is the relationship between the quantity verses the head & efficiency & BHP.

→ A characteristics Curve is a Curve which shows how the magnitude of one quantity varies with the changes

in some other related quantity and it mean of a set of such curves that the performances of a turbine pump can be most readily demonostrated.

→ A Curve of turbine pump having different parameter, that is 1. efficiency Curve
2. Head & Quantity Curve
3. BHP Curve

→ The three Curve of turbine pump can meet a common point that is known as chocking point.

The Head- Quantity Curve :

The Curve shows the variation of head for varying quantities. The dotted line shows the static head in which the pump is working.

The head at zero delivery when the sluice valve remaining closed is greater than the static head thus ensuring that the pump is able to deliver water to desire lift when the sluice valve is opened. The pump has a humped back profile, the head is rising to a maximum and thereafter the head decreases with increasing quantity of water due to increased friction and shock losses within the pump, untill the pump ultimately chokes.

The maximum pressure is absolutely fixed by the impeller diameter and its speed.

The BHP Curve :

The Curve shows that the BHP increases more or less uniformly with increasing quantities up to and beyond full load and it is possible to overload the motor if the head against which the pump is working is reduced.

The efficiency Curve :

The Curve rises from zero with a closed sluice valve to a maximum at normal duty and

thereafter falls as the quantity increases. The max. value of the efficiency varies with the size of the pump, it may be ranges from 70-75%.

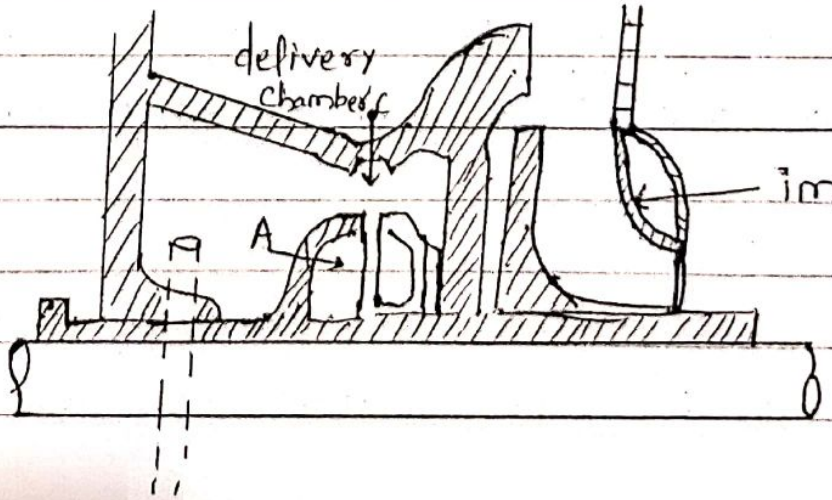
Hydraulic Balancing disc :

In this case the multistage turbine pumps, the water pressure progressively increases in each stage, with the result that the maximum pressure achieved in the last stage cause a back pressure on the bearings at the intake end.

To counteract this back pressure, a hydraullic balancing disc is used.

The balancing disc consist of a cast iron or stainless steel disc keyed to the shaft near the delivery end and a bronze or cast iron seat fixed to the delivery chamber. The periphery of the disc moves in close contact with the seat leaving a clearance bet^{n} the delivery chamber.

As we know that one side of the impeller there is low pressure but on the other side of the impeller pressure is high. So an axial thrust will always be there towards the suction side. So to reduce or balance that thrust, we use different kinds of arrangement & to reduce pressure we use hydraullic balancing disc.



Advantage of Turbine Pump :

→ They take up much less space an important factor in u/g and in sinking shaft.
→ They are less costly, being simpler in Construction, Smaller in size, light and Compact.
→ Ideal pump for dealing with large quantities.
→ Lower initial Cost
→ installation & shifting is very easy.
→ high speed machine, they can be directed coupled to electric motors, so eliminating cost of gearing and looses therefrom
→ volume delivered can be regulated by adjusting the sluice valve.

disadvantage :

→ Lower efficiency 70-75% than ram pumps (80% or more).
→ Not Suitable for high ~~pressure~~ heads because the size of the pump becomes unmanageable.

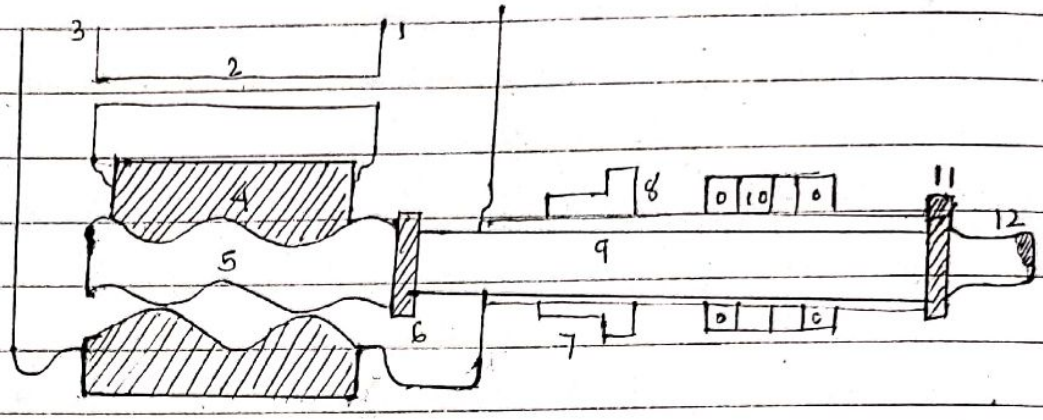
RotoPump

Mono pump / Screw pump :-

→ Mono pump is also known as screw pump or rotor pumps.
→ It is a electrical driven rotative pump having No valve.
→ The pumps requires No priming and can work in a suction lift as high as 7.5m.
→ This pump have following parts.

1. Suction
2. Snore bye pass
3. delivery
4. Rubber stator
5. steel Rotor
6. coupling
7. stuffing box

8. Coupling rod
9. bearing
10. motor shaft



description:

The monopump which Consist of a stator which is made up of natural of synthetic Rubber. Torsion free stator are generally used for this purpose.

→ The stator forms a double internal helix within the pump.

→ The Rotor is made up of mild steel or Cast iron and rotate inside the Strata.

→ The Suction & delivery branches have 19 mm to 75 mm diameter.

→ A snore bye pass pipe is connected to the delivery branch to Suction which recirculate little qty. of water to keep the stator lubricated.

→ A three phase Ac Squirrel Cage induction motor which produce 1450 rpm when rotate at full speed.

Principle of action:

here the pitch of the stator is twice than that of rotor as a result of which when the rotor rotates a posetive pressure is developed towards

the delivery side.

→ The water progress Constantly towards delivery side due to pitch difference.

→ The slot also Continously shield to maintain a posetive pressure.

→ The posetive displacement unit in the principle of mono pump.

Advantage of Mono pump :

→ The action is posetive and displacement is continuous without pulsations.

→ The pump Can work efficiently with suction lifts of up to 7.5m.

→ The pump can readily deal with grit without serious damage to the stator & rotor.

→ It is light and portable and maintainance is cheap.

→ It Can't requires priming.

→ The pump is skip mounted and can be easily shifted & installed. It requires no foundation.

disadvantage :

→ Attainable heads are limited being in region of 45m & 90m for single stage & two stage models.

→ If the pump runs dry the stator will immediately be damaged.

Submersible Pump / borehole Pump :

Borehole pump multistage turbine pump used for deliver water from Borehole well, shaft etc... It is up 2 types.

1. Submersible pump
2. shaft driven borehole pump

Submersible Pump:

→ In submersible pump the electric motor and the pump from one compact unit
→ The suction pipe is eliminated but a strainer can be placed betⁿ the motor and pump unit.
→ The pump itself consist of number of impeller mounted in a shaft, thenn supported by journal bearing.
→ The pump motor unit housed with in a cylinderical casing and is fixed at the buttom of delivery pipe line.
→ The pump may made up of aluminium, stainless steel or gun metal. the motor has PVC insulated winding. And the stator winding the water cooled. PVC insulated power cabel is held to the delivery pipe by clamps and connect to the motor through the flame proof coupling.
→ The submersible pump of kirloskar company is available with 3 to 15 number of stages & can be used 15mm to 150mm diameter on bore hole.
→ The delivery range varies 25 m to 5000 m per second with a lift of 20m to 200m depending upon the number of stage.

- Advantage:

→ does not require any priming
→ Saving of space & cost
→ easy to installed & withdrawn
→ No motor housing is Required
→ No change of fire or explosion
→ No valve
→ Need little supervision & maintainance.

Shaft driven borehole pump :

In the shaft driven borehole pump the pump unit & Motor unit placed in Separate Casing, the pump unit is Suspended through a hinge rod to the water Level, where as the motor unit is placed at ground level. The Pump is ~~given~~ driven by the shaft which is Suspended throughout the length of borehole and couple to motor shaft. The pump is a vertical multistage turbine pump without a balancing disc. Here the balancing disc is replaced by thrust bearing, which is mounted towards the upper part of the casing. The pump also have no Suction pipe & strainer. The driving shaft available in Section in 2 to 3m and jointed in muffel coupling, up to the water Level. The number of stages depends on the total head to be achieve generally 10-15 stages multistage turbine pump are used to delivered water upto 250 mtr. head. This types of pump is generally used in dip bore hole or wells for the purpose of dewatering and easy to maintain as pump unit and motor unit as Separately placed.

Various types of pipe joint are

1. Loose and flange joint
2. unicone Joint
3. Spigot and faucet Joint
4. Expansion Joint.

Loose and Flange Joint

The Loose flange joint is Suitable for mild steel pipe subjected to heavy pressure.

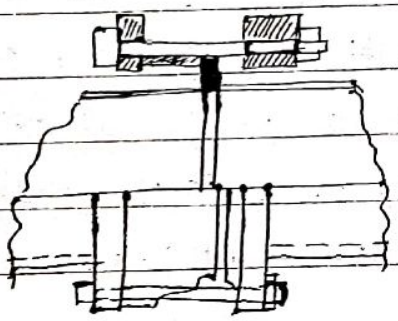
→ The Loose flange are Cast steel are placed on the pipe during Manufacture. during expansion of pipe the male end and female end are jointed, by these outer flange by bolting arrangement or by stout.

Rober cord or other fiberous material are placed betⁿ pipe to made them leak proof.

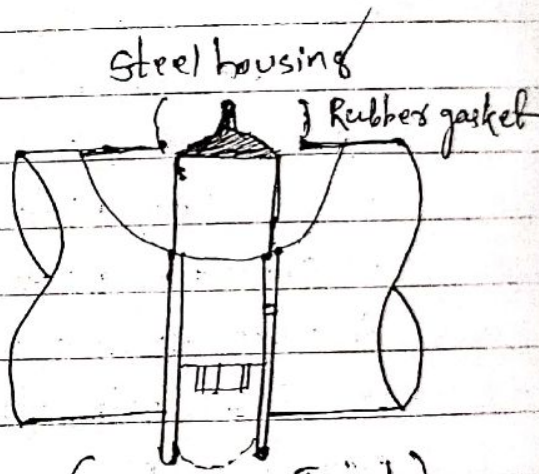
Unicone Joint :-

This is suitable for high head up to 300mtr & Compressed air up to 11 kg square cm pressure and has advantages to allow the angular moment of the pipe Ranging ±6° without causing leakge. The Joint Consist of special shaped Rubber rings and gasket placed betⁿ 2 pipes and the bole arrangement is placed with in a steel housing which are made in 2 halfs and bolted together to hold the Rubber gasket in the position.

↑ It is not suitable for suction pipe Joint where Pre is negative.



Loose flange Joint



(unicone Joint)

Spigot and Faucet Joint :

The Spigot and faucet Joint is suitable for Cast iron pipes subjected to heavy pressure. The flanges are cost solid manufacturing with the pipes and are strengthen by external ribs.

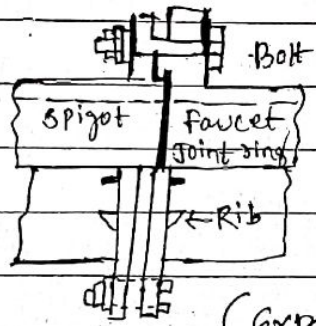
→ The one end of the pipe has a spigot or projection which fits in faucet of its neighbour.

→ A hollow rubber is placed betⁿ the pipes for gap betⁿ them & preventing any leakage.

→ The whole arrangement is tightened together no. of belts depending upon the pipe diameter.

Expansion Joint:

The expansion joint are also essential for pipe installation so that the various in length cause by expansion and contraction due to fluctuation of temperature can be accomodated without causing damage to the pipe lines. For this purpose the pipes are telescopically arranged by sleeve joint and tightened by graphatised asbestos for adjustment in various of temp.



(Expansion Joint)

Sump:

All the waters used for hydraullic stowing naturally inflow into the mines is collected at one common point from where it may be pumped to the surface.

→ Such places where water is collected is termed as water reservious or sump.

→ Depending upon the method of working position of sump it can be divided in to following categories:-

1. Main Sump
2. Intermediate Sump
3. District/face Sump

Description:

The main sump is placed at the bottom of the shaft is preferably near the shaft pillar it self.

→ The water from each district is collected in the face sump whose capacity is less. Then the water is stored in the face sump are delivered to the intermediate sump which are

placed in dip most points.

→ The intermediate Sump are into a main Sump which have more Capacity is less. Then the water is stored in the face Sump are delivered to the intermediate Sump which are placed in dip most points.

and placed at the dip of the mines and these main Sumps are providing water to the main sump placed at shaft bottom and dewater from Surface.

Main Sump :

The main Sump solves for following purposes :-

1. To Collect the clean water from different section.
2. To store the water during the period when the main pumps are not working.
3. To setteled the sediments of the mine water before pumping it to the surface.
4. Filteration and the purpose of tapping water with in the u/g mines.

Location :

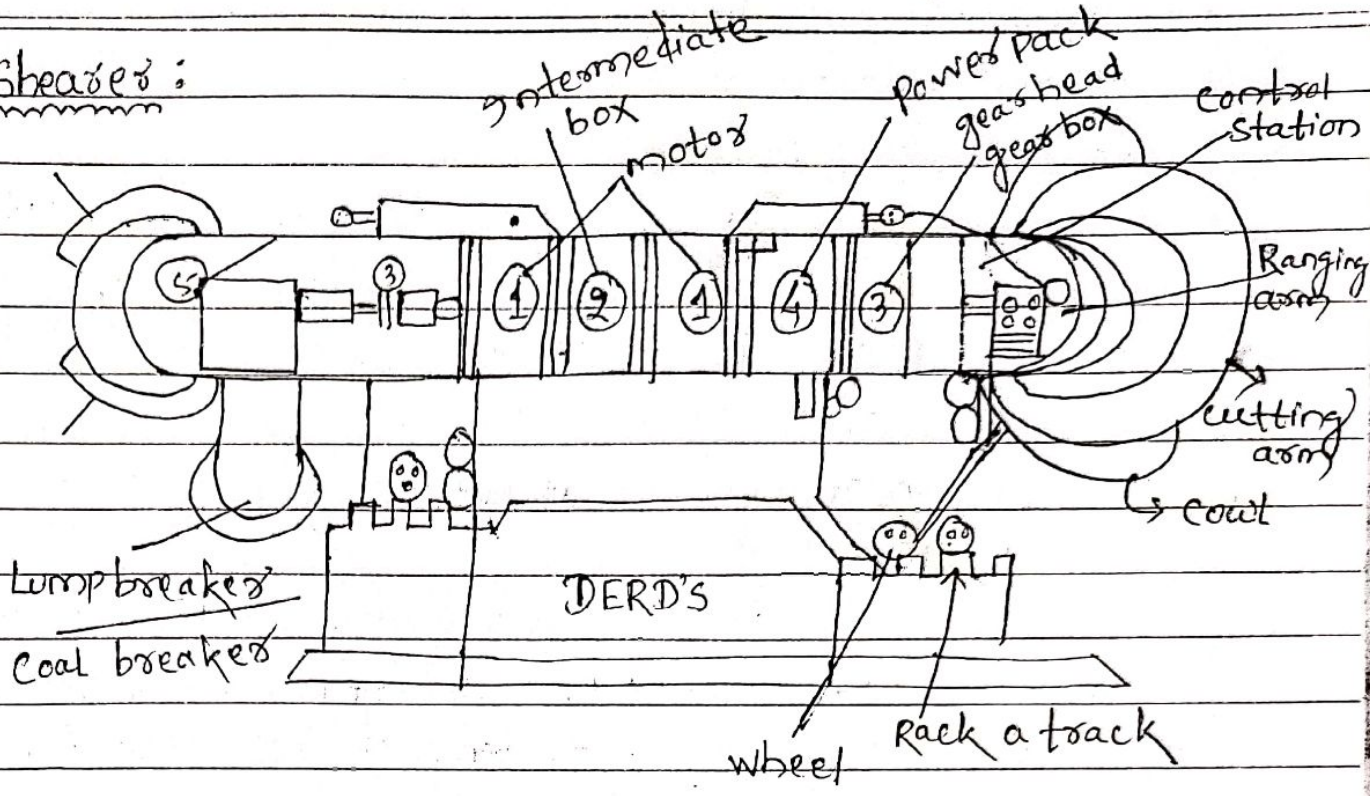
The Location of main Sump depends on the amount and direction of inclination of the seam. The relative posⁿ of shaft buttom excavations should be made where the conditi Permits.

→ The main Sump is also available at the dip most point where water can easily collected and the amount is delivered to the Sump of shaft pillar.

→ The Sump should be so Constructed and placed such at a level that it's whole volume can be utilised.

→ The capacity of the Sump should minimum 8 hours of maxⁿ water in flow.

Shearer :



The main Componet of shearer are :

1. electric motor
2. Gear head
3. haulage unit
4. Cutting drum

Electric motor :-

In modern shearer the electric motor of 150 kw to 1000 kw power are equipt in shearer. The motor gives power to the gear head for Cutting of coal and for Running of hydraulic pump in haulage unit.

→ The high Capacity shearer DERD's are generally equiped with 2 electric motor or multimotor for running of haulage unit, gearhead, Power pack and other anxeliary equipment.

Gearhead :

There are 2 gearhead in DERD shearer on both side of the DERD shearer for Controlling the drum attached with each Ranging arm.

The gear head is Responsible for Cutting and Ranging operation

of Cutting drum.

Cutting drum :-

The Cutting drum is leased with spiral veins on which the Cutting bits are mounted the average diameter of Cutting drum Ranges from 0.86 to 2.5 m with rotational speed of 30 to 45 rpm.

→ The function of the drum is Cutting as well as Loading of Coal to Afc.

→ The helix angel of the vein will be Right hand helix in Right hand drum & Left hand helix in Left hand drum.

→ The veins are mounted with tangestone Carbide bits which are replaceable.

Haulage unit :-

The haulage of shearer is 2 type.

1) chain type
2) Chain less type (Rack a track haulage)

Chain type :-

The Round link haulage chain along the hole face length is fixed on the both end on AFC. The chain passes through drive head, return head and the guide sprockets and a haulage unit of shearer.

Basing on the dirn moment of driving sproket of shearer move either towards drive end and return end.

Rack a track haulage :-

In this system a rack and a track is fitted in goaf side of Afc from drive head to tail end. The Shearer moves either towards drive end or towards tail end on the Afc by directly matching the driving sprocket with the rack a track depending on the dirn of rotation of driving sprocket.

The other anxeliary equipment are

(1) Powered Cowl :- To protect the machinery for broken piece of coal.

(2) Water spraying device for dust control for colling of electric motor, Control hydraulic circuit.

(3) for lump breaker for reducing the size of Lumpy coal tensiong arrangement in chain type haulage etc..

Specification :-

Motor - 1000 kw
operating volt - 3.3kV
haulage speed - 24 mtr/m
Cutting speed - 18 mtr/minute
Ranging arm Length - 2.77m Length
drum diameter - 2.5mtr
Rpm of drum - 30 to 45 rpm
Number of vein - 6 vein per drum
Cutting depth - 1m
Type of cutting picks - chisel type
Conical with Polycrystalline sintered diamond.

Electric Coal drill :

The drill is used for drilling hole in Coal and other Similar, Soft rock formatn and operated electrically : All the spair parts of the drill machine are enclosed in a Casing which is flame proof.

→ The Casing is of steel body weight is 21.5 kg where as aluminium body drill weight 17.5 kg.

→ It Contain Squirrel cage induction motor which is placed in the flame proof casing and have 2 hand grips to hold the machine and operate smoothly.

→ The handgrip are Symmetrically placed on both side of machine

For balancing the weight of the machine by drillers.

→ The switching device which control the speed of the drill is placed at the buttom of right hand grip of the motor casing

→ while the cable which supplied current enters the casing on the left hand grip, thraugh plugs and socket arrangement.

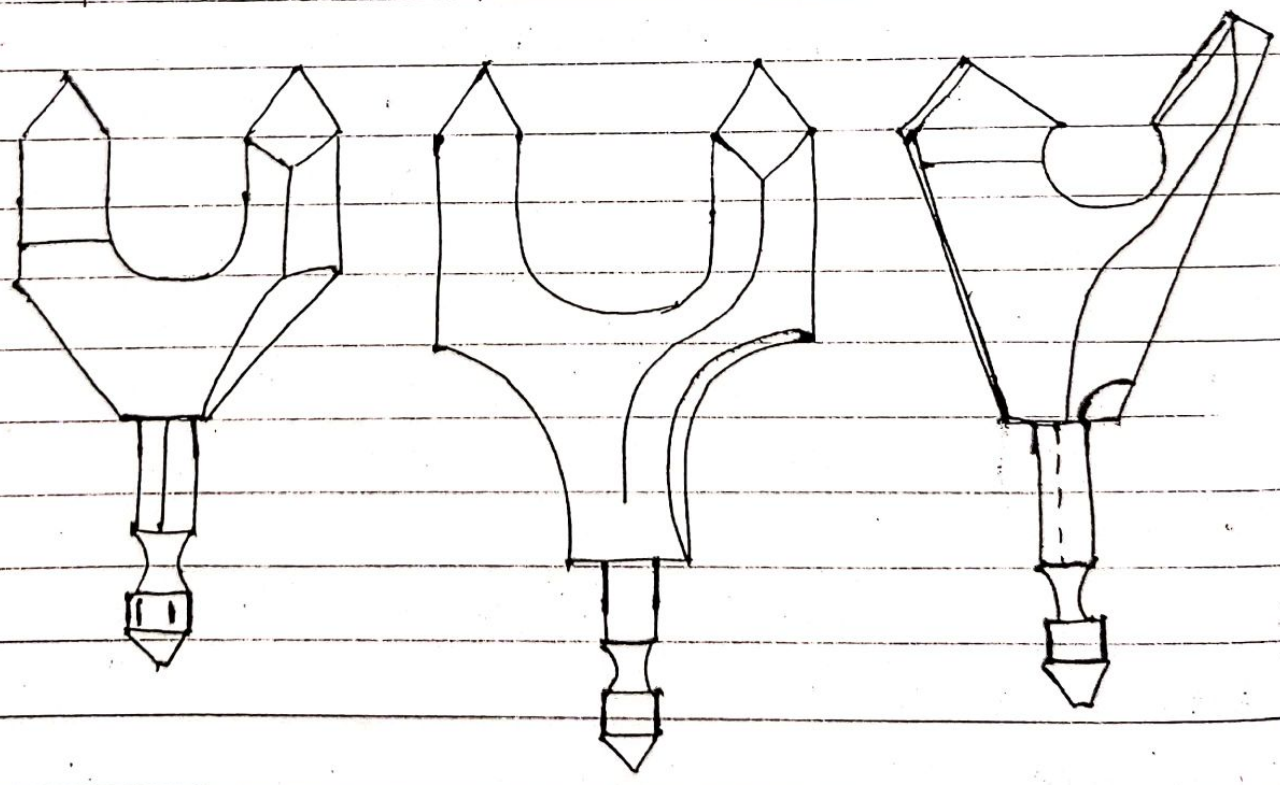
→ Coal drill requires 125 volt of 3Phase Ac supply to produce who 1 kW o/p for the rotation of the drill rod.

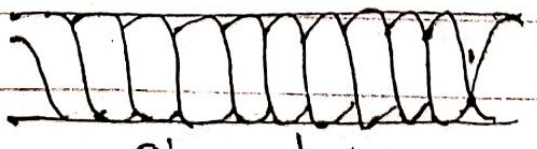
→ The rpm of motor 430-600 depending upon the gearbox by using this drill machine a driller can drill 80 hole in 8 hour shift with rate of penetration 1.5 mtr per minute.

→ The drill bit which are used for coal drill is tonguestone carbide tipped.

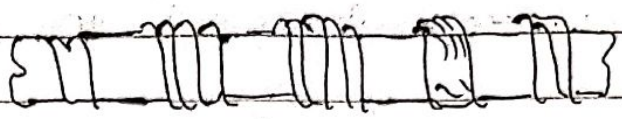
→ Now a days Romote Sensor are used for operating the coal drilling desire angel and with desire speed.

→ The cables are gerserally are 6.5 mm Square crosssectional area with 5 core type for supplying the current to a hand held electric coal drill.

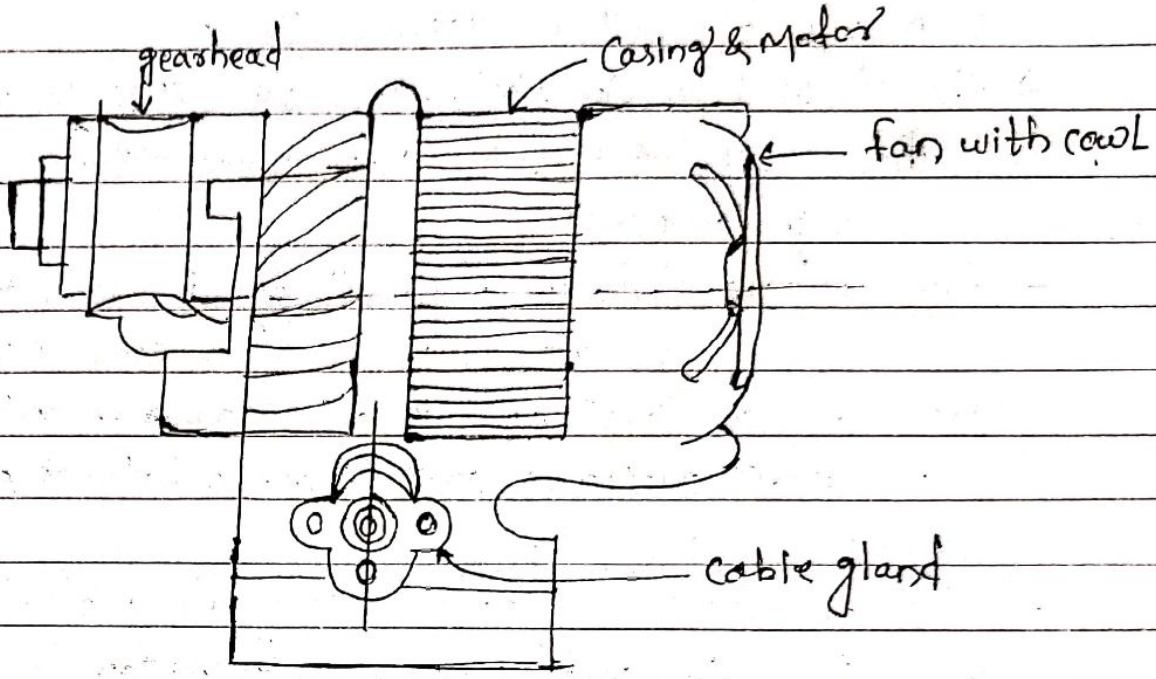




Diamond



Turbine



Gathering arm loader :

The gathering arm loader Consist of

1. gathering head
2. A Central Cowl mounted chesis
3. A real boom with Conveyour system

description :

The gathering head have twing crank disk upon a ramp plate, a Separate motor is used in function of each arm.

→ In the face the ramp is set under the blasted material and the arms collect those material by swinging action.

→ The rate of loading depends on the size of motor used for both the arms. The Loading Capacity may range from 1 tonne per minute per 4 tonne per minute, the speed of the gathering arm Can be varied by using speed Controller.

→ The collected material in these arm is supplied to the chain Conveyour. The chain Conveyour is placed in the

Opposite part of the Central Control unit and Supported by a boom.

→ The boom Can be raised or Lower in a Vertical range of 0.1m to 0.9m with the help of hydraullic jack.

→ The Jip or boom Can also swing at an angle of 45° horizontally to the axis of the machine which make gathering arm Loader versatile in Coal mines.

→ The Central unit is the main Controlling unit of the machine which have breaking arrangement, hydraullic control, electric pannel, power Cabel and signallic arrangement, Lightening which makes gathering arm loader in balance equipment in Coal face.

→ The gathering arm Loader Supply the material may transporting unit like gate conveyour, minecar, tub and Locomotive.

Jack hammer:

A Jack hammer is a Compressed air drill machine which is normally used in metal mines. It is a hand held drill machine which Can drill hole vertically downwards and with a force of 15 to 25 kgf and drill up to a depth of 3m holes. The diameter of the hole varies 25 to 30 mm rarely goes upto 50mm.

Jack hammer also be used for drilling upward in horizontal direction in a drifter.

→ For vertical holes to absorb the shock air leg is provided which give the motive power to the drill as well.

Air Leg:

An airleg is essentially along cylinder in which a piston is actuated by Compressed air Control valves to extend or Compressed the piston by Controlling the air Supply. An air leg relifs the operators fatigue which involves long holding keeping the pressure on the

drill machine.

→ But air leg doesnot increase the rate of penetration in u/g metal mines for high speed drivage large size jackhammer are used so termed as Jumbo or rigs.

Applicability Condition of Excavator:-

The Selection of excavator depends on the following factor:

1. Surface topography
2. Stripping ratio
3. Hardness of the material
4. Grade of ore
5. Tonnage required for the handle per unit time
6. Cost of machine
7. Climatic Condition
8. operation and maintainance
9. Availability of spare parts
10. Continous or discreate operation

* Dumping height:

At a particular boom angle it is the distance betⁿ the level where a excavator rest and the buttom most point of the bucket under tipping / dumping condition.

* Cutting height:

At a particular boom angle it is the vertical distance betⁿ the level and the top most point of the bucket when the boom and its accessories at full extended condtⁿ.

* Dumping radius:

At a particular boom angle it is the horizontal distance betⁿ vertical swing axis of the excavation and the vertical centerline of the bucket when boom is at fully extended condition.

Cycle time:

It is the summation of crowding time, (digging + loading + hoisting) + swinging time towards dumper + dumping time of the truck + swinging back to its origin position.

Swinging factor:

The standard cycle time of a shovel based on 90° swing for loading. Generally the swing factor is 1 at 90° and it increases and decreases depending on the increasing or decreasing the swing angle respectively.

Utilisation factor:

It is the ratio of actual working hour of a shift to the total hours of a shift in percentage.

So utilisation factor is equal to $\frac{\text{Actual working hours}}{\text{Total hours}} \times 100$

Swell factor:

It is the ratio of weight per unit volume of solid rock mass in the bench to weight per unit volume of loose rock mass after blasting.

Mathematically

$$\text{Swell factor} = \frac{\text{weight per unit volume of solid rock mass}}{\text{weight per unit volume of Loose rock-mass after blasting.}}$$

Bucket fill factor:

It is the ratio of volume of material inside the bucket to the volume of bucket in percentage.

Mathematically

$$\text{Bucket fill factor} = \frac{\text{Volume of material inside the bucket}}{\text{volume of the bucket}} \times 100$$

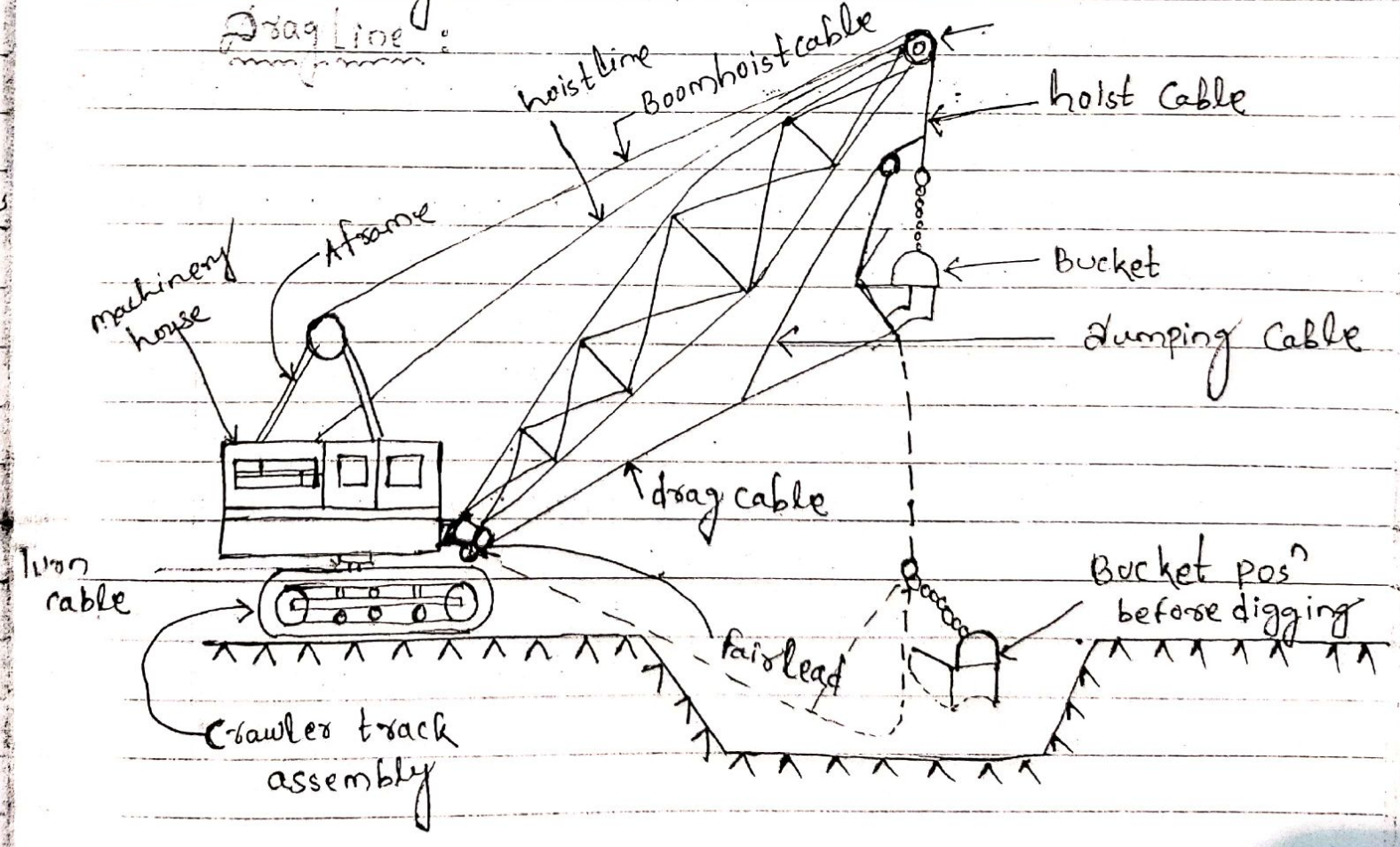
Excavator:

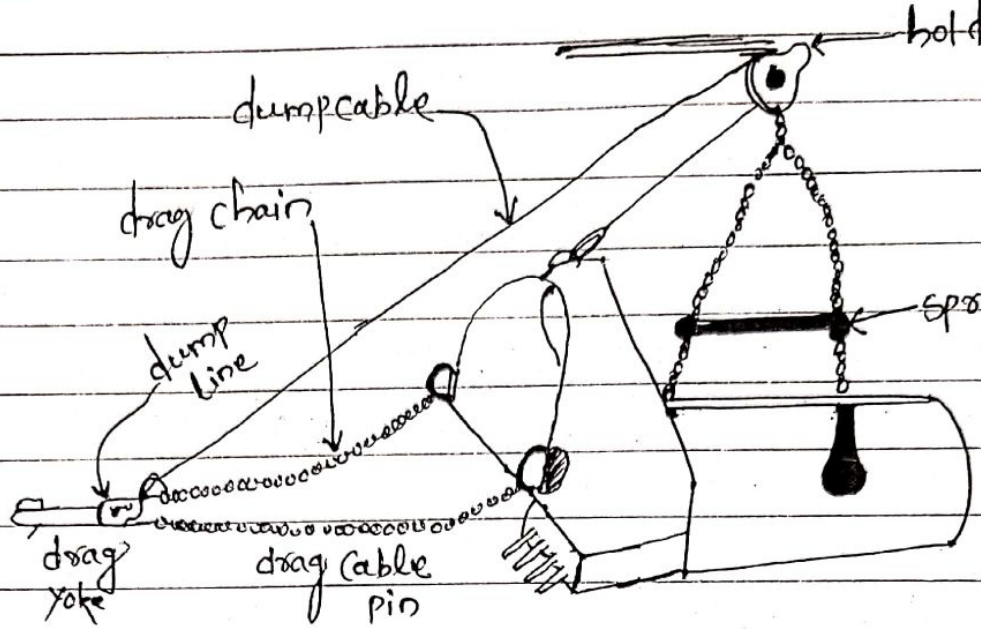
1. Shovel :-

Selection of Shovel :

→ Requirement of daily production
→ Type & quantity of material to be excavated
→ Bucket fill factor.
→ working cycle time
→ Height of the bench
→ Number of face to be worked
→ Capacity of the bucket
→ Availability of electric power
→ Capital Cost of the equipment
→ operative and maintainance cost
→ Availability of spare parts
→ Availability of skilled operator

Drag Line :





(Dragline bucket)

Selection of dragline :

It is general used for handling softer unconsolerated material. It can excavate deep box cut.

→ It has a greater digging reach and dumping radius.

→ It may or maynot required other equipment for disposal of overburden.

→ It is less efficient than shovel, in production and flexibility of operation.

→ In the soft mineral deposit the dragline can operate efficiently as compared to shovel.

→ dragline is an excavator which has a boom whose length varies from 9m to 96m approximately one end of the boom is attached with the revolving unit or swinging of the machine where as the hanging end carries a large sheave for cable attach with the bucket.

→ The boom is made of lattice construction by the structural steel which is lower down raised up with the help of boom hoist cable.

→ for dragging the bucket towards the machine a drag ~~line~~ cable is attach with the bucket where as other end of the bucket is connected to dragboist cable.
→ The bucket is filled by pulling the bucket against the loose material by drag cabel & then bucket is hoisted of hoist cable.
→ During dumping of the material the dragcable is loosen to dump the material directly is spoilled on ~~the~~ or over the truck or railways wagon.
→ It is cheapest means of over burden removal so used for overcasting.

* distinguish betⁿ Ropeshovel & Hydraullic shovel

Rope shovel	Hydraullic shovel
→ Higher initial Cost, Longer life Lower depreciation cost.	→ Lower initial cost, shorter life.
→ It Can't be used as back hoe.	→ It can be used as back hoe.
→ operation is jerky & cycle time is more.	→ operation is smooth and cycle time is less.
→ Level floor clean up to limited	→ Level crowd permits better floors clean up.
→ Steering and movement is difficult.	→ Steering and movement is less difficult.
→ Boom remains at Constant angle during digging.	→ Boom angle Can change during digging.
→ Efficiency of power utilization is Lower under the identical Condtⁿ.	→ Efficiency of power utilization is higher.

* distinguish betⁿ electric shovel and disel shovel

Electric shovel	disel shovel
→ Applicable for doing a particular work for a shorter duration	→ Applicable for doing any work form shorter to Longer duration.
→ It is used where electric power is not available that is in remote Location.	→ It is used where electric power is available.
→ It has high operating & maintainance cost and shorter life.	→ It has Low operating and maintainance Cost and Longer life.
→ Cycletime is more	→ Cycle time is Loss.
→ vibration & Noise level is more.	→ vibration & Noise Level is less.
→ utilization of power is poor.	→ utilization of power is moderate.

Constructional features of shovel :-

A shovel is an equipment which excavates the rock or ore digging from its operating body to upwards and dump it either on a dumper for back filling after swing itself with in its limit.

→ It is a highly productive machine and capable to handle all types of ores, rocks ranging from fine to very hard blocky Lumps, has Lower operating cost, higher production and productivity etc...

→ It requires Lower power and has less wire rope Cost.

→ It also requires Less man power to operate and requires less Surface preparation.

→ It can also Load in variation mining conditions has Longer life, higher availability and also do Production by staying in the inclined terrain.

→ Shovel can used in strip mining method, in tandem operation Shovel pull back operation while is a Combination of shovel and dragline for handling the overburden.

→ The design of the shovel is such that only its minimum mechanical parts like the dipper stick, bucket etc... play important role in digging operation.

→ The bucket which is mounted with a sharp teeth Cut the rock or mineral body and break them with the help of pressure provided by the hoist and crowd action.

Advantage :-

→ It Can give high production.

→ It has Lower operating Cost

→ It requires less power & Less wire rope Cost

→ It is mainly used for overcasting.

→ It can handle all types of materials, including large block material.

disadvantages :-

→ It has low flexibility
→ It's utilisation factor is less.
→ Electric power cost is more.
→ Availability of spair parts are too difficult to gain.

Sinking pump :-

During the shaft sinking processes, specially designed sinking pumps are employeed. Air lift and Reciprocating pump or turbine pumps may be employeed for the purpose.

→ The pump is arranged in vertical pos^{n} with ~~with~~ water Colled michell thrust bearing as its top to counteract the end thrust.
→ A 4 pole squirrel cage induction motor, running at 1450 RPM and water cooled, drive the pump through flexible coupling. The motor is started from surface by directing switching or by an auto transformer. A special cable drum is provided at the surface to enable current to be supplied to the motor.
→ The variation in the head is dealt with by inserting dummy stages when the head is low and replacing them by ordinary impeller as the sinking becomes deeper variation in the quantity, at any given head, would be dealt with by adjusting the main sluice valve.

Advantage :-

→ Smaller space required
→ Absence of sound & vibration
→ Ability to deal with varying heads & quantities.

disadvantages :-

→ speed control can't be readily arranged
→ Require skilled personnel for maintainance & Repair.

Scrapers :-

The disel powered wheel mounted o/c equipment works some what like a 'Lawn mower'. The machine has a cutting bucket at its centre, front end of which can be raised or lowered with help of hydraullic pushers by movement of Levers in operater's cab. when lowered, it pushes into the ground. with scraper in this pos^n, a dozer pushes the scraper from behind.

→ A thin layer of 10 - 200mm is cut by the time scraper moves 30-40m, the bucket gets filled with the earth. front end of the bucket is lifted and its open end comes in front of a closing door.
→ After taking the load, scraper moves with help of its engine and reaches the place where the material is to be dumped. Here, as the front portion of the bucket is lowered, bucket empties as scraper moves forming a layer 150-250 mm thick.
→ Cycle time of scraper Loading, transport of OB to dump, unloading & returning to OB face may be 5-6 minutes depending upon hardness of strata, lead and skill of operator.

LHD :-

Load haul dumper is a tyre mounted loading machine which takes blasted Coal from the face in its bucket, transports it over a distance and dumps it on the district chain & belt Conveyour.

→ Being tyre mounted, it run faster than SDL. (a speed upto 4 km/hr)

→ Bucket, which is fitted in front of the machine, may be of 4 types :- 1) Tilting front discharge
2) pusher plate front discharge
3) Tilting side discharge
4) chain side discharge

→ Recently in one mine of Singareni diesel powered LHD has been introduced.

→ LHD has a power off switch which operates in case of excessive tension in trailing cable.

Applicability Condtⁿ :-

→ NO LHD is available for seam height less than 1.8m. LHD can work in seams upto 2.4m thick.

→ for smooth working, galleries have to be maintained clear of scattered Coal.

SDL :-

↑ This a popular Coal loading machine of u/g mines which can unload coal to the right or left of machine. SDL takes blasted Coal from the face with bucket at front of the machine, transports and dumps coal onto chain Conveyors installed neared the faces.

→ SDL of bucket Capacity 1m³ for coal are the most common.

→ SDL are used both for developement & depillaring and are increasingly replacing manual loading.
→ Width of the machine is 1.8m, making it suitable to take a right angle turn in a 3m wide gallery easily.