

OPENCAST MACHINERIES

Q:- Describe basic Constructional features of -
Surface miner, Dragline, Shovel and backhoe,
Bucket Wheel excavator.

*Dragline :-

- 1) A dragline is an excavator which has a boom (length varies from 9 to 9.6m approx) one end which is attached with the revolving unit of the machine and the hanging end is the entire cycle carries a large sheave for the cable attached with the bucket.
- 2) It is made of the lattice construction by the structural steel which is lowered down or raised up the cable of boom hoist.
- 3) for dragging the bucket towards machine one end of a dragline cable is attached with the buck bucket and other end is connected to the drag hoist via fairlead which is at the foot of the boom.
- 4) The buck bucket is fitted up by dragging or pulling the bucket against the then it is hoisted up by the cable hoist cable.
- 5) Finally it dumps the material direct by over the spoil dumper over the trucks or railway wagons.
- 6) Since the dragline booms are longer in length it can dig well below and above the shovel where it stand and has higher flexibility in operating condition compare to a shovel.

Aji yadav

System of Working :-

- 1) The dragline may be either Crawler mounted, Wagon mounted, track mounted or Working type.
- 2) The bottom can move both vertically 25° to 60° and horizontally 0° to 108° with the help of swing mechanism to perform the job.
- 3) Rear end of the box shaped bucket whose one end is open is attached by means of two hoist chains are fitted with a dump sheave.
- 4) A dragline is operated by diesel engine or a motor which is external source through a trailing cable.
- 5) The drag chains are attached in the front side of the bucket at one end while the other end connected with a drag yoke. The drag chains are connected to the drag cable by dragline socket.
- 6) The material of the heavy bucket lip and teeth are made of manganese steel.
- 7) The material swinging, hoisting and acceleration after digging require maximum power demand.
- 8) Leveling and grading with the help of dozer is very essential.
- 9) Efficiency of a dragline is reduced machine form abuse is increased when it digs materials although its loading efficiency is less.
- 10) For OB removal a dragline is more mobile and versatile machine compare to a shovel although its loading efficiency is less.

Loading Capacity (Dragline) :-

A dragline is Capable of dragline with the following quantities of rock/earth (Solid in a year. 12 To 14 hours Work per day.

Bucket Size	Million M ³
4.5 to 7.5 m ³ (6 to 10 cycle)	0.25 to 0.75
11.5 to 15 m ³ (15 to 20 Cycle)	1.5 to 1.7
25 to 30 m ³ (30 to 40 cycle)	3 to 4.5

Applicability Condition (Dragline) :-

It is Suitable for digging alluvium, Sandy Soil, Unconsolidated rocks or blasted Coals. It is generally used for handling softer material so the ground must be soft or medium hard ground.

Advantages of Dragline :-

- 1) If the Soft mineral deposit the dragline can operate efficiently compared to the Shovel.
- 2) In the presence of hopper-reload or dragline can material into railway wagon belt conveyor and other transport facility.
- 3) Superior in Wet Pts.
- 4) Its maintenance cost is cheap.
- 5) It has more flexibility in operation.

Disadvantage of Dragline :-

- 1) It is used for softer rock formation.
- 2) It has lesser spotting ability.

- 3) It has lesser output than the Powered Shovel.
- 4) Production Cost is more as Compared to the Powered Shovel.

* SURFACE-Miner :-

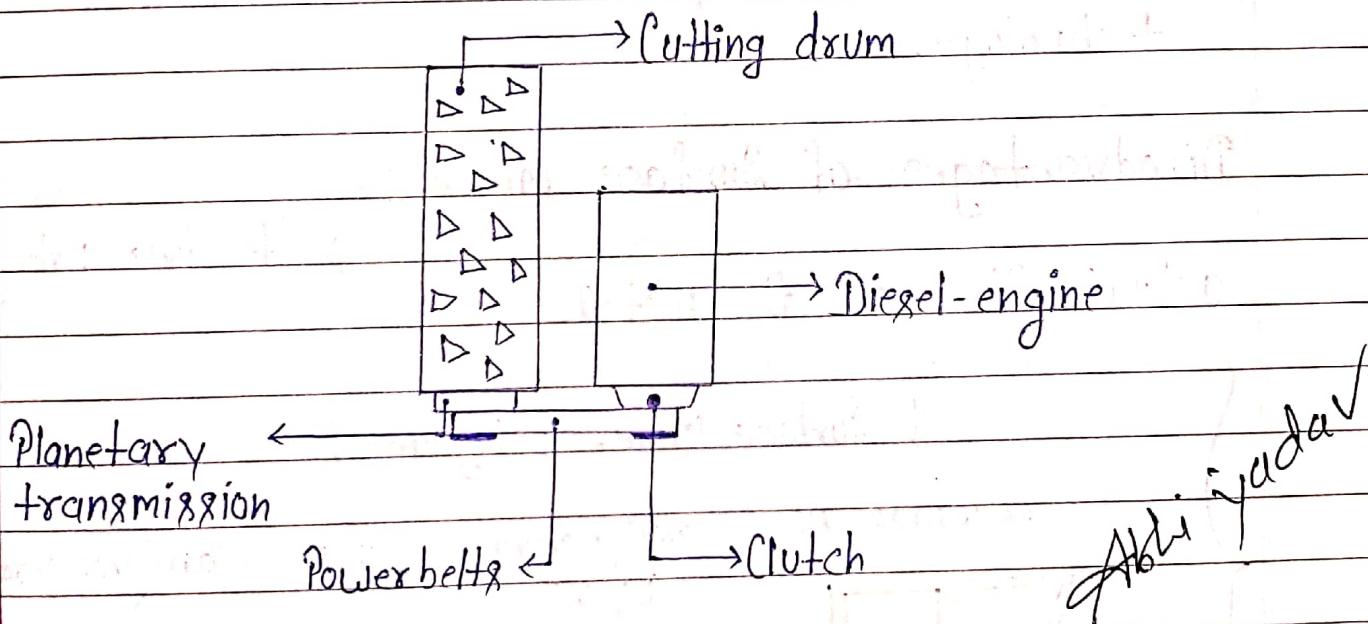
- 1) It is Circular mounted Machine.
- 2) The Cutting drum has helix Vanes over which tungsten carbide tipped cutting bits are mounted.
- 3) A shield Coal is fitted behind the drum.
- 4) Due to the rotation of the cutting drum the material is cut, crushed between the helix and coal.
- 5) The height of the discharge conveyor is also adjustable.
- 6) The cutting drum is operated by pole changing squirrel cage induction motor.
- 7) The machine runs of 3(300m) or 0.04(3800cm) crawler units.
- 8) The cutting drums of 3000/3800 width.

Application :-

- 1) Mining of thin seam deposited.
- 2) Creating Channel.
- 3) Digging exploratory trenches.
- 4) Remove the partings.
- 5) Road construction and maintenance.

* Working of Surface Miner :-

- The milling drum is mechanically driven by the direct drive system through transmission (V-belts) directly via a mechanical clutch on the flywheel side of the diesel engine.
- A gear box provided in between cutting drum and transmission will suitably reduce the RPM of the drum.
- There is also a power take off gear/split gears connected to other end of the engine through universal joint which transmits power for driving for hydraulic pumps one each for advance drive, rising and lowering of cylinders, conveyor operation, water pump.



* Benefits of Surface Miner :-

- Surface miner replaces equipment for drilling, blasting, loading and auxiliary works i.e. secondary blasting.
- Selective mining
- Low investment costs in comparison to the range of equipment necessary for conventional mining.
- Low operating costs due to equipment and less personal.
- Drilling and blasting is not necessary.

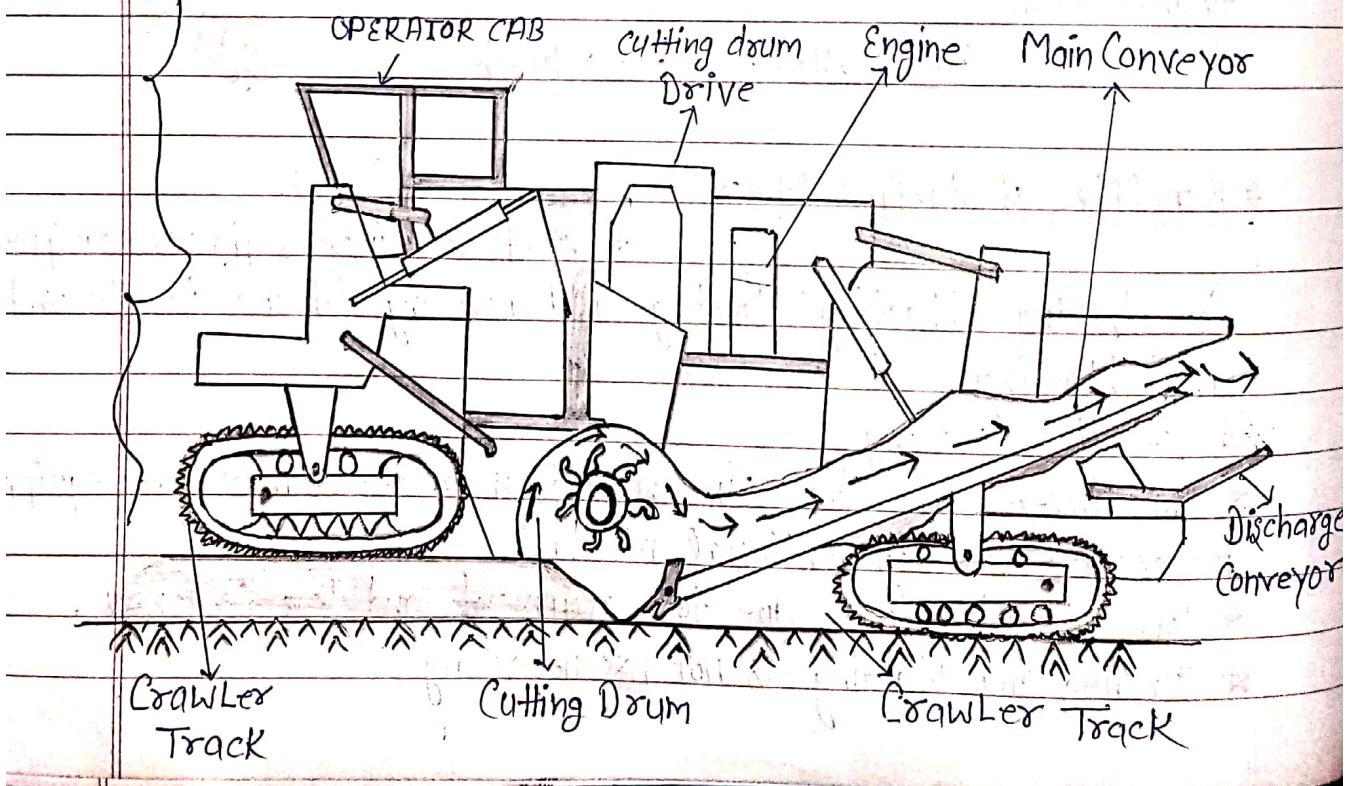
Advantages of Surface Miner :-

- 1) Presently being used in KOCP-I for Selective mining.
- 2) Can work safely on a gradient of 1 in 10 However, Presently being worked in KOCP-I in gradient of 1 in 12.
- 3) It eliminates drilling and blasting.
- 4) It is very good to environmental condition.
- 5) Primary crushing of material is not needed.
- 6) Installation cost is very low.
- 7) Manpower requirement & speed is low.
- 8) It has first training speed.
- 9) Does not need drilling and blasting.
- 10) At KOCP-I, Grade improved from F to E by this technology.

Disadvantages of Surface Miner :-

- 1) It does not give actual size of the metal.

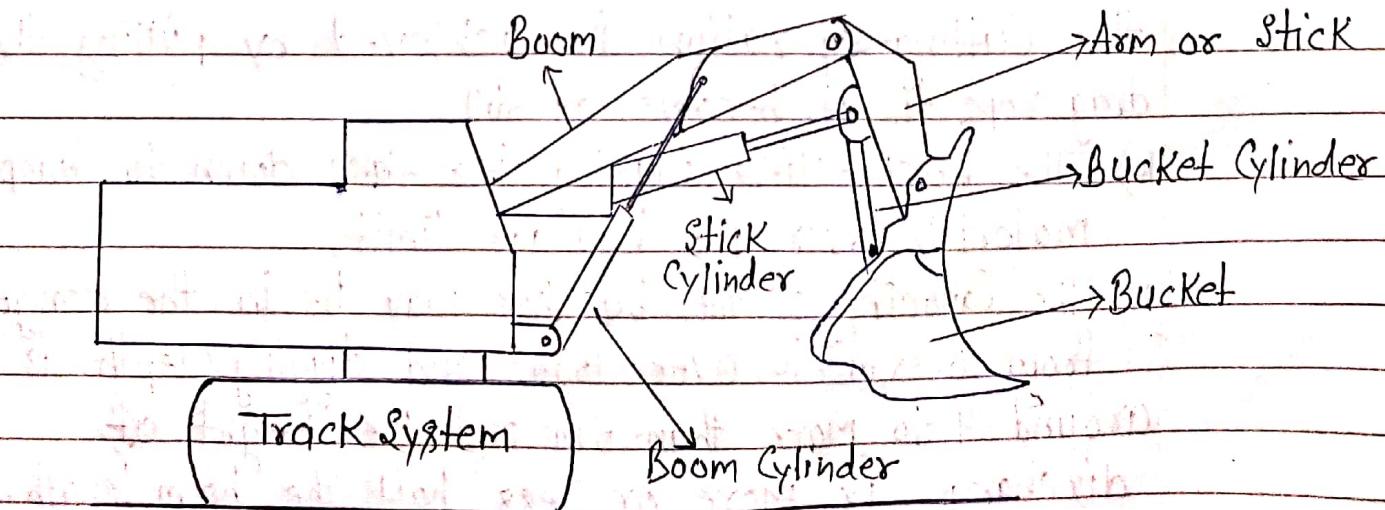
↓ Surface Miner Diagram ↓



* Shovel :-

- 1) A Shovel is a equipment Which excavates the rock or ore by digging from its operating box to Upwards and dump it either on a dumper or railway Wagon or over the Spoil dump.
- 2) It is a highly productive machine and Capable to handle all types of rocks ranging from fine to Very hard blocky dump, has lower operating Cost, higher production and Productivity etc.
- 3) It requires less man power to operate less Wire Coal and Less Surface preparation.
- 4) It Can also load in Various mining Conditions has longer life higher ability by and Can also do production by by staying in the inclined terrain.
- 5) A flat on mild gradient dry Competent floor is a Very good operating Condition for a dipper shovel (rocker shovel)
- 6) During operation assistance is some time required by either a bulldozer or a front end loader to gether and muck filling of Scattered rocks or ore.

Shovel Diagram

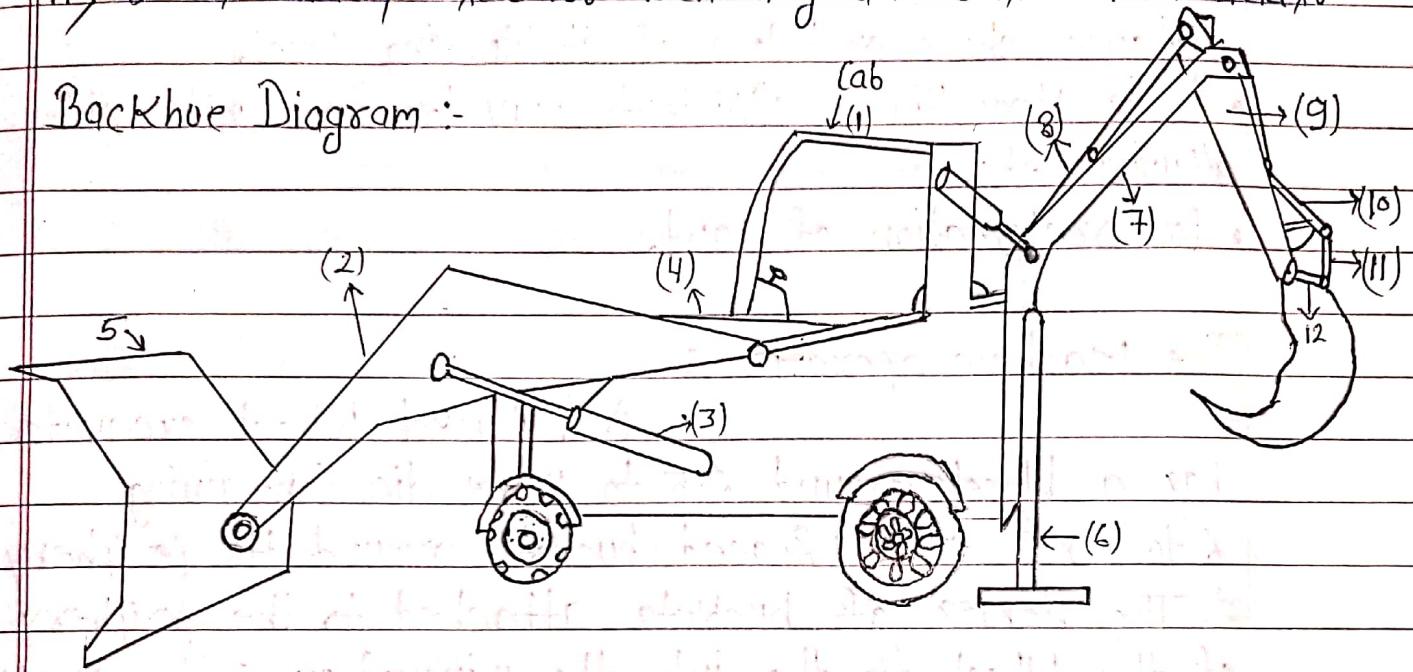


* Backhoe :-

- 1) It is also named as Pull Shovel, drag shovel etc.
- 2) It dig Soil, rock, or ore below the level of bench on which it stands and unload excavator materials over a truck or railway wagon.
- 3) It can be displayed efficiently where the mine is very much wetted by the prolonged rain or where seepage of water through the ground strata.
- 4) Generally the backhoe is very good for trenching shallow depth cutting and for basement excavator.
- 5) The hoe bucket is attached to a dipper sick at its lower end and facing towards the machine.
- 6) The middle of the deeper sick is hinged to a boom where as the top of the machine same is attached with a rope pulley.
- 7) The pulley is connected to a hoist rope to a jack boom attached to the top of the main machine body.
- 8) A drag rope is connected to a drag drum passing through the sheave attached to the side of the main boom.
- 9) The dipper is lowered down in to position by the hoist rope, so that bucket bites in to ground and the cutting operation is achieved by pulling the drag rope till it become of fall.
- 10) The bucket lifts making its face down to dump materials over the haulage limit.
- 11) The capacity of the backhoe may be in the range starting from 0.38 m^3 to over 18 m^3 and digging depth is around 4 to more than 8m and the height of discharge is more or less half the boom length.

- 12) As a safety measure the backhoe should be kept at a safe distance away from the crest of the bank to avoid danger arising due to caving.
- 13) Although it has large cycle times less efficiency in discharging material over the trucks but it can nicely be used for removing top soil and OB.
- 14) It is widely used for trenching and construction fields.

Backhoe Diagram :-



- (1) Cab Rops (11) Loader Bucket Cylinder (3) Loader Lift Cylinder
- (4) Loader lift arm (5) Bucket (6) Stabilizer Arm Cylinder
- (7) Backhoe boom (8) Dipper arm stick Crowd Cylinder
- (9) Dipper arm stick (10) Backhoe bucket Cylinder (11) Bucket side link
- (12) Pitman Arm.

* Bucket Wheel Excavator :-

- 1) It is suitable for long range striping of soft OB rock at a considerable lower cost although the machine is costly having lower flexibility.
- 2) The machine is nicely applicable in the following conditions.
 - Hard and tough wall fragmented blasted rock with no or less boulders having consistency of uniform ground and bank condition.

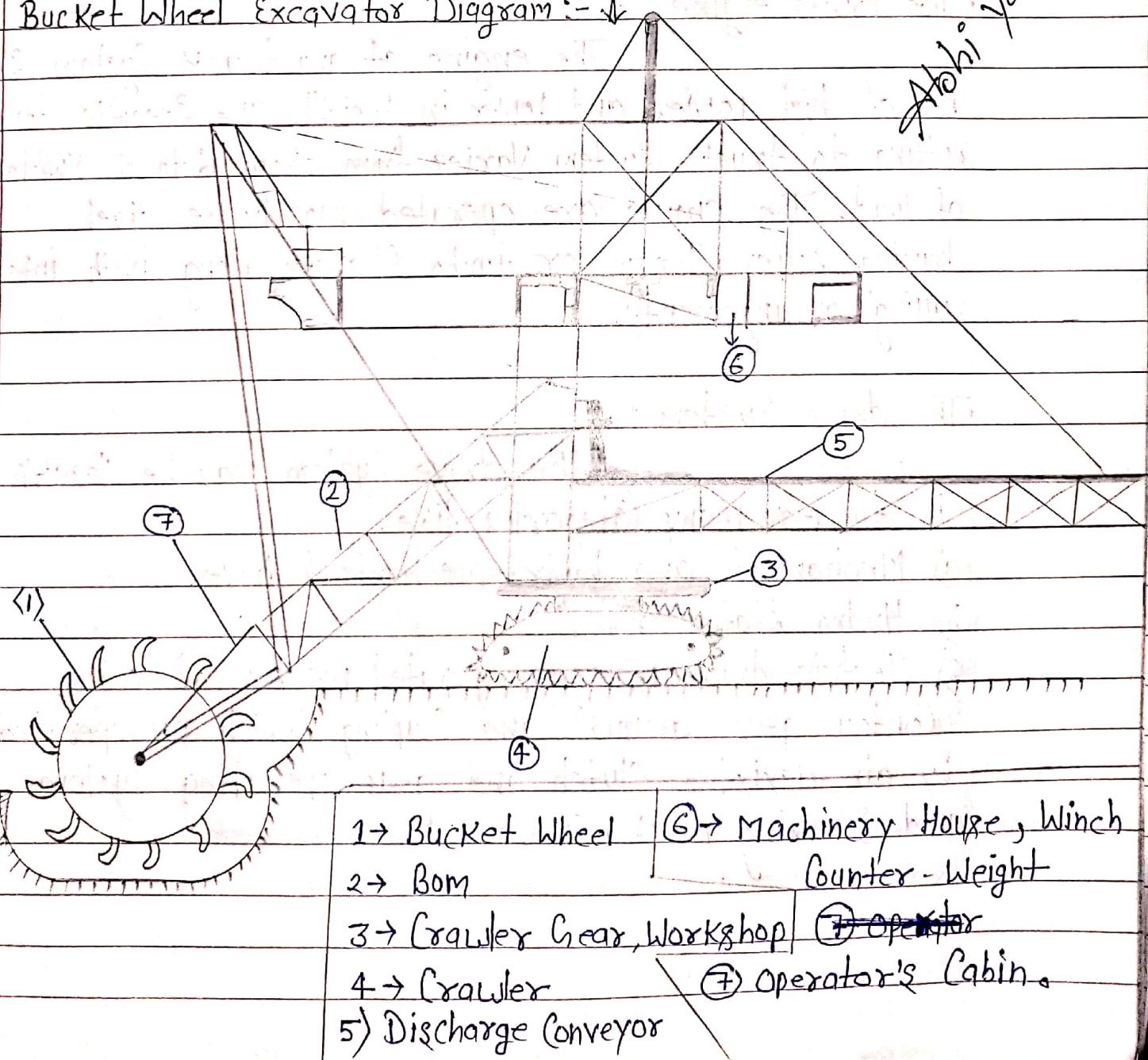
- Since it has a wide radius of excavator around 40 to 90m with high and deep cut the width of the boom or passes more reserve and create huge amount of space for the mobile equipment. The slope of the pit is also very stable.
- It can be used for selective and thick seam mining.
- For easy disposal of ore or OB to the considerable distance above or below of its working level.
- It is very highly efficient excavator for lignite, gift alluvium etc.
- For reclamation of land.

The Machine operation :-

- 1) A bucket wheel excavator has a wheel around 2.5 to 17m dia containing 6 to 8 nos evenly spaced buckets around its periphery.
- 2) The series of buckets attached to the periphery of the wheel dig the into the mineral or softer rock mass and cut the same when the wheel rotates from bottom to top the mineral or (clockwise)
- 3) The cut material is loaded by the bucket and discharged over the belt conveyor mounted.
- 4) The vertical movement of the cutting boom is done by a hoist rope connected with a structure in front of the excavator.
- 5) One end of the boom is attached to the swinging platform of the machine to swing the former horizontally.
- 6) Most of the bucket wheel excavators are either crawler track mounted or rail mounted. Rail mounted bucket wheel excavator are more common.

- 7) The excavators are operated by diesel or electrically.
- 8) Bucket Wheel excavator cuts softer mineral body or rock mass maintenance and above by rotating wheel which produces less stress and strain to the machine body.
- 9) Because of thin reason it also consumes less power requires less maintenance and above all the machine requires less body weight.
- 10) The rate Production by the bucket wheel excavator varies from 100 to more than 1000 m³/tonne. Machine weight varies from 35 to more than 7000 tonnes and Power 200 KW to more than KW.

Bucket Wheel Excavator Diagram:-



Ques :- Describe basic construction features of dumper Dozer, Scraper and road grader.

* Dumper :-

These are a heavy duty trucks with Container body of steel open at the top for receiving material located mechanically by tractor shovel, dipper Shovel, drag line etc. all dumper/tipper are provided With arrangements to lift the loaded body by Utilizing hydraulic pressure to force a ram out.

⇒ main units of truck/dumper are the following.

• The Power engine :-

The engine at any truck system should be of high power and lower in weight. The specific power relating to truck system varies from 6 to 8 Kw/tonne. of load. The engines are operated mostly be diesel having Super Charge or turbo Charger along with inter Cylcing arrangements.

• The drive System :-

The drive system may be classified in to many categories like.

- Mechanical and hydro mechanical drive.
- Hydro Static drive.
- Electric drive manually operated mechanical drive
(contain gear (around) and Coupling which are operated by air assisted Clutch and gear operating system and steering mechanism.)

Hydro Static drive :-

In this System Very large capacity pump is in the truck body which generate high pressure fluid (oil) and directed in the hydraulic prime mover in each of the drive wheel.

Suspension Unit :-

To save the frame and body Presently hydro Pneumatic Suspension system operated by nitrogen gas. Compressed by oil under pressure are widely used in heavy truck for their high shock absorbing efficiency.

Hydraulic System :-

Hoisting and lowering positional as well as operating of dumper by the hydraulic system operated by Vane pump. The hydraulic ram for hoisting and lowering operation are performed by two double acting rams, the rams is connected with frame as well as with body by belt and shock absorber arrangement.

Body :-

The body of the highway truck are generally of standard are V type or modified V type made of thick high strength alloy steel. The standard type body has vertical sides tipped from front rear and where has V shaped body has a consistent angle floor plate sloping towards the front from the rear end at truck having variable side. The body is also provided with reinforced lab guard at the front protection operator cabin. The body may also provided with soldier elector to clean the track fastened in between actual tyres.

Tyres :-

Both Phayrating and size of the tyres are selected based on the amount of load gradient at the haulage heavy thrust forced on the body with the Unloaded material by shovel flotation and traction requirement.

* Dozer :-

Dozer is a tractor with a pusher blades attached to the front portion. The tractor is the diesel operated Power Unit equipped with either Crawler Chain or rubber tyred wheels for lifting. The machine is also engaged for leveling or spreading earth for leveling of rock spoil in the dumping yard, grading and Compacting temporary roads, pushing mineral into Sub-ground level bunkers through grizzly, for towing dumpers, etc. It also serves the purpose of pushing boulders putting down trees. and is an essential equipment to push scrapers. A dozer equipped with a fork like attachment is known as ripper and operates like a plough to loosen moderately hard rock. The loosened rock may be loaded by a scraper. A dozer can dig 1.2m to 1.5m below ground in each earth or Weathered rock.

* Scraper :-

This machine is diesel-operated with pneumatic tyred wheels and has the centre a bowl fitted with a cutting blade at bottom. The blade is reversible and can be replaced when blunt. Its working may be compared to that of a lawn power. As a Scraper is pushed forward by a dozer, its blade cuts a thin slice of earth usually between 75mm and 225mm thick over a distance of nearly 30m.

The earth is automatically collected in a central bowl whose capacity ranges from $3m^3$ to $22m^3$ and it takes nearly one minute for loading. At the dumping yard as the Scraper moves, the bottom opening of the bowl is opened and the contents are unloaded in a layer 1500mm to 250mm thick, over a distance of 30 to 70m. The Coal excavated by it is however smaller in size in size. A Scraper may take 5 to 6 minutes for a complete cycle of loading and unloading if the total up and down distance of a trip is nearly 300m. One way traffic of loaded and empty scrapers is desirable for good results. One dozer is normally sufficient for every two scrapers used.

The scrapers manufactured by BEMI has the following main specification:-

Flywheel H.P of engine 332 at 2100 rpm.

Capacity : Payload 23000 Kg, Struck $11.5m^3$ heaped 16m

Maximum travel speed 44 Km/hr.

Overall dimension mm : length 12600 : width 3470

Height 3890 Net weight (no load) 26584 Kg.

Road Grader :-

- 1) This is a machine for leveling the road surface by smoothing out the ups and downs and for casting aside the boulders on the road.
- 2) It is always pneumatic tyre mounted with rear wheel drive and the front wheels are small.
- 3) The grading fastened blade is attached to a circle that is hung from the overhead frame and pulled by a drawbar fastened to the front of the frame.
- 4) The blade is usually connecting mechanical 3.5 to 4 long having replacement edges on the sides and bottom.

5) Steering is direct connecting mechanical by a hand wheel through a hydraulic booster.

6) The front position is mounted by the smaller pneumatic tyres wheel and connected with near main body by crossed braded frames.

- The motor grader of B.E.M.L has the following main specifications:

Engine flywheel HP 145 at 1800 RPM
Operating Weight 12650 Kg. Maximum drawbar pull 7280 Kg, Maximum speed forward 43.6 Km/Phr, Steering - full hydraulic, overall length - 8415 mm, width 2375 mm, height - 3200 mm, max minimum radius 10.4 m.

Able to work (Able to work)

Mine Pumps

Q:- Classify mine pumps:-

The different types of Pumps used in mines are :-

1) Reciprocating Pump or displacement type pump :-

Such as Single acting and duplex pumping either piston or ram different flange and pump and thru thrown ram pump.

2) Centrifugal or rotary pump :-

-a) Drill Pump basically a single stage Centrifugal pump.

-b) Bore hole pump : A multi stage centrifugal pump.

-c) Submersible pump : A vertical multi stage turbine pump.

-d) Sinking pump : Electrically driven vertical spindle centrifugal or turbine pump.

3) Mono Pump :- Differs entirely from either reciprocating or centrifugal pump in its construction and action.

4) Megator pump :- Works in a principle one what & similar that of a thru thrown ram pump.

5) Air lift pump :- An airlift pump is a pump that has low suction and moderate discharge of liquid and entrained solids.

* Centrifugal pumps :-

A pump Comprises basically a Casing and an impeller and shaft, together with stuffing boxes where the shaft enters stationary and moving parts.

for low and medium head duties Single stage pumps have Casings that are generally split on the horizontal centre line and are provided with double entry impellers.

No. There is however, a recent trend towards the provision of heavy shaft single entry single pumps for medium head duties.

for higher heads it is usual to group several impellers in series on the same shaft. Here the pump is split in a vertical plane, normal to the shaft, and comprises several stages, each complete with impeller, guide passages, and chamber. These stages are held together by end covers and through bolts.

Characteristics of Centrifugal Pumps :-

A Centrifugal pump is a dynamic machine, and therefore the quantity of liquid handled and the centrifugal head generated by the operating speed. Considering first the performance at a fixed speed in revolutions per minute, the pump will generate a certain head against a closed valve. When the valve is opened flow will occur only if the generated head exceeds the difference in pressure existing between the pump branches or since we are concerned with mine pumps, if the generated head exceeds the total static lift from suction sump to delivery level.

Considering now the characteristics of the pipe system, the static lift is constant but as the valve is opened additional head is required to overcome pipe, valve, and strainer friction and strainer friction and to provide velocity energy in the flowing water. These additional values are proportioned to the square of the quantity, and are determined from the pipe value and friction curves.

When a pump is ordered it is important to ensure that the head at closed valve materially head characteristics will exceeds the static lift. The flow will then be determined by the point of intersection of the pump-head characteristics with system characteristics, provided that the total suction is well within the suction lift curve.

Component of Centrifugal Pump :-

- 1) Casing :- Cast iron or bronze materials are used for Casing.
- 2) Impeller :- Impeller are made up of bronze. Monel metals are used for corrosive and salty water.
- 3) Wearing ring :- It is made up of bronze, cast iron, cast steel, stainless steel.
- 4) Pump shaft :- It is made of bronze. Stainless steel shaft & sleeve are used when liquid is abrasive.
- 5) Pump shaft :- It is made up of forged steel or phosphorous bronze.
- 6) Pump glands :- It is made up of bronze (cast iron or steel).

Constructional features of Centrifugal Pump :-

- 1) It consists of a close type of impeller mounted on a steel shaft which passes through the pump casing having water tight sealed stopping box at its end.
- 2) The bearing are carried on the extension of the end covers. The other end of casing is being supported by bearing in a water tight cap.
- 3) The impeller rotates within an expanding casing having a form like spiral.
- 4) The liquid is drawn from the centre of impeller and called as eye and the liquid passes round the casing and

being driven out tangentially by the veins blades of the impeller in to the main delivery.

Principle of operation of Centrifugal pump :-

- 1) A Centrifugal Pump Can't Create its own Vacuum therefore it needs Priming.
- 2) As the impeller rotates the liquid gains Kinetic energy due to Centrifugal force imparted to it.
- 3) When the liquid passes round the Volute Casing losses the Kinetic energy and Converted to Pressure energy.
- 4) As the one of reduced Pressure is created inside the impeller fresh liquid enter into it and this Process is Continued.
- 5) If 'V' is the Velocity of the liquid attained in a pump the head develop Will be $H = V^2 / 2g$.
- 6) This Unbalancing is Seet by right means of a thrust bearing usually of double ball type and placed on the shaft.
- 7) The Single intet impell impeller Causes axial inlet thrust towards the Suction because of Water leakage from the delivery side to behind the impeller eye, thus Causing a resultant back.

Starting of Centrifugal Pump :-

- 1) Close the main Valve.
- 2) Prime the pump.
- 3) Run the motor, gradually to a speed, Until the Pressure gauge Shows the required head.
- 4) Allow the motor to attain full Speed.
- 5) Open the main Valve slowly.
- 6) If the delivery Column is empty otherwise open the main Valve rapidly.

Stopping of Centrifugal Pump :-

- 1) Close the main Valve.
- 2) Switch off the motor.

* Centrifugal Pump Diagram :-

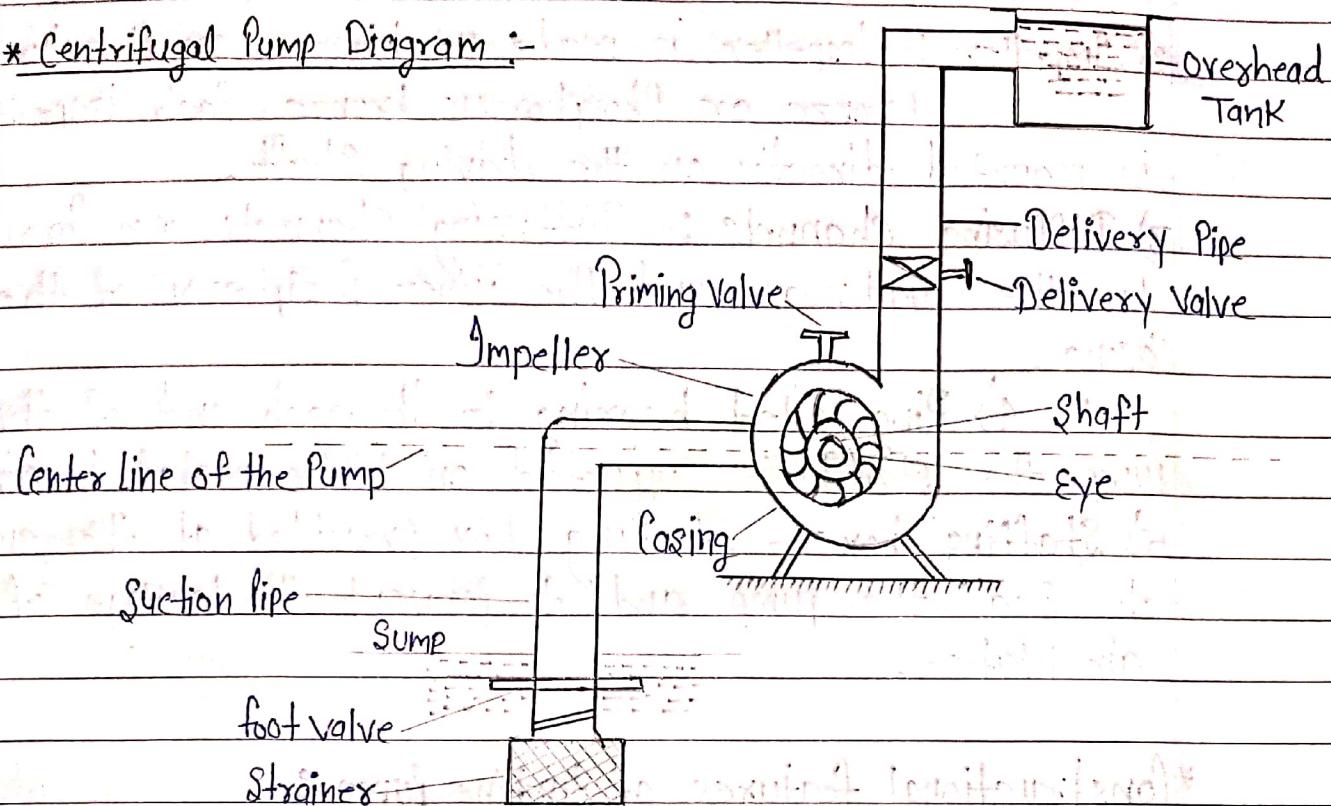
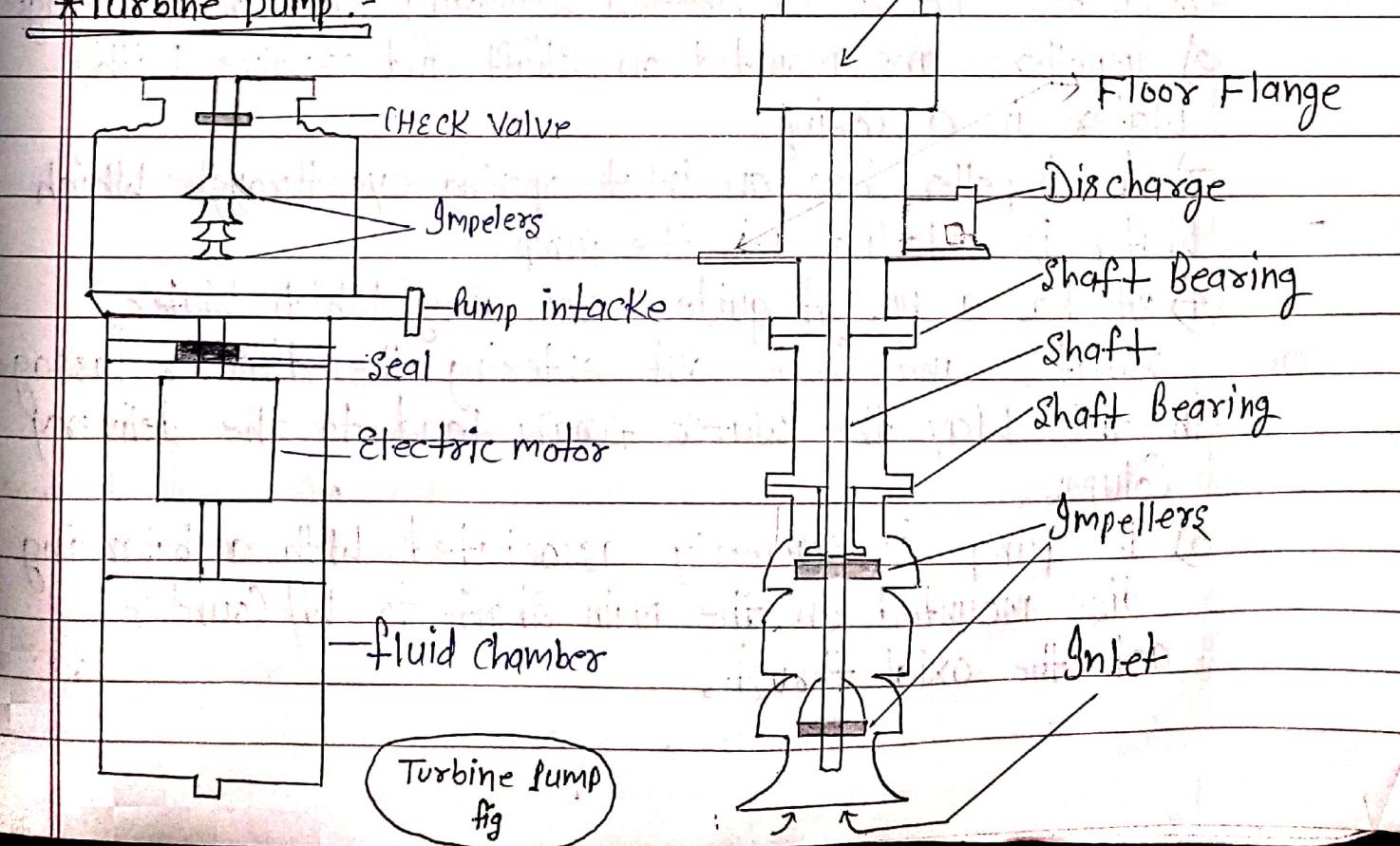


fig Centrifugal Pump Working

* Describe Constructional feature of Turbine Pump.

* Turbine pump :-



Main Part of turbine Pump :-

1) Pump Casing :- It is made up of Cast iron or Cast steel. It has got a suction inlet and a delivery outlet.

2) Impeller :- Impeller is made up bronze or phosphorous bronze or phosphorous bronze. Each impeller is mounted directly on the driving shaft.

3) Diffusing channels :- Diffusing Channels are formed by the diaphragm and the inner periphery of the Casing.

4) Ring oiled bearing :- At each end of the pump the shaft is supported on white metal bearing

5) Staffing box :- Staffing box provided at the end to seal the pump and to prevent the leakage of air water.

*Constructional features of turbine pump :-

1) The turbine Pump consists of one or more impeller diffused. Combination no. of combination signifying the no. of stage

2) Impellers are mounted on shaft and revolve with water in a Casing.

3) An impeller has an inlet opening eye through which water is entering into the pump.

4) It has a no. of guide vanes along which water rotates and comes out entering the diffuser passage. in this way the water finally lead to the delivery column.

5) The pump is commonly associated with a balancing disc mounted on the main shaft to w/ counter act the axial thrust.

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Principle of action of turbine pump :-

1) The pump is works on the principle of Bernoulli's theorem. According to which the sum of the kinetic energy and pressure energy of flow of water for each unit weight of water is constant at any point.

- 2) The rotating impeller gives an increased head and velocity while in the diffusing channels the velocity of water is reduced. in this stage kinetic energy is get converted in to potential energy.
- 3) This conversion of kinetic energy to potential energy is governed by the velocity of water thrown off by the impeller.
- 4) The net effect of head is a sum of heads developed at each stages.

Advantages of turbine pump :-

- 1) It requires a small floor space.
- 2) Less costly
- 3) Long Life
- 4) Simple in construction
- 5) Vibration and noise are negligible.
- 6) It is valueless
- 7) It gives informs load on the motor.

Disadvantages of turbine pump :-

- 1) It is lower efficient than reciprocating pump.
- 2) It cannot deal with directly water and a strainer must be required additional part.
- 3) It is not suitable for very high head as the pump is small in size.

Uses of turbine pump :-

- 1) In Linking of Shaft.
- 2) As boiler feed Pump.
- 3) for bore hole pumping.
- 4) for handling liquefied Petroleum.
- 5) In chemical factories for handling the acids and alcohols.
- 6) In hydraulic elevators.

*Water-hammer :-

When a moving Column of Water is Suddenly Come to rest then it begins to stroke of the Various parts of the pump. The pump is liable to break down by due to great impulsive force and violent Shocks. This phenomenon of Knocking is Called as Water hammer.

The main reason for a Water hammer. :-

1) When Suction pipe is too Small.

2) When the valve has become defective.

3) If the Suction Pump is too high.

4) If the Suction Pump is Partially Choked.

5) If the pump is Suddenly Starting or Stop.

6) If the Suction range is long.

How to minimize Water hammer. :-

1) If We Use a large dig. 2) Regular Choking of Water and the Valve set.

3) Checking of the Suction head regularly for any Choking.

4) Keeping short Suction range.

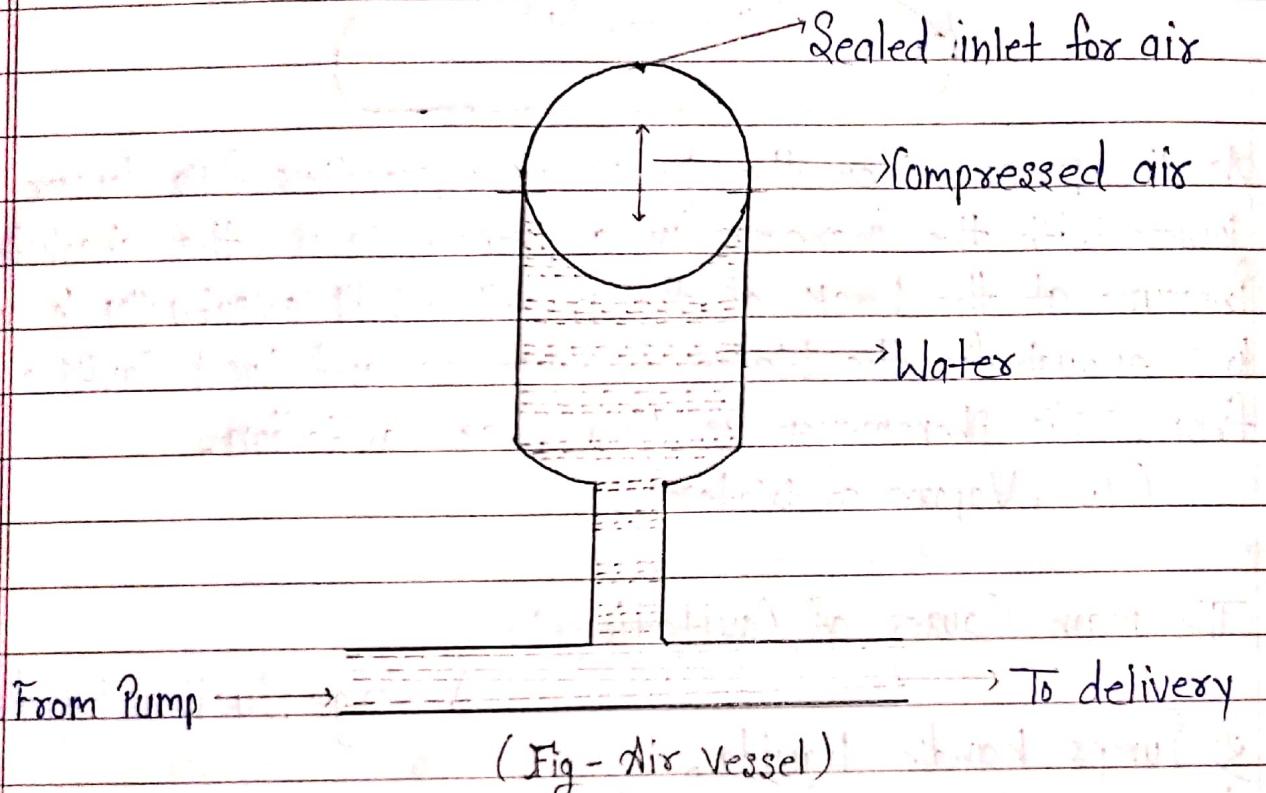
5) Use of air Vessel.

6) Close the gate Valve before Starting the pump and slowly open it.

7) Stop the pump gradually with help of fly wheel.

* Air Vessel :- or (Reciprocating)

- An air Vessel is cast iron closed chamber having an opening at its base through which the Water flows into the Vessel on from the Vessel.
- The purpose of using the air Vessel to obtain Uniform discharge from the reciprocating pump.
- It also helps in Saving the power lost in oscillating head.

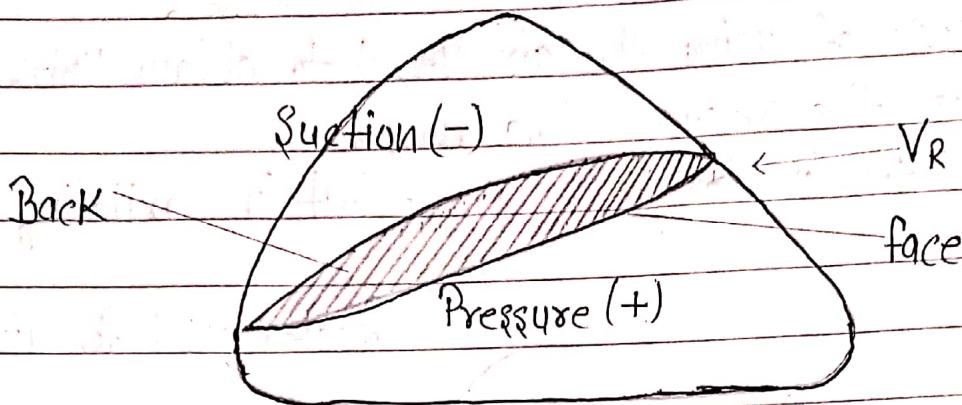


Advantages :-

- 1) Large Suction head.
- 2) Small Submergence of suction inlet.
- 3) 1) Possibility of Water hammer is minimize.
2) Life of the pump is increase.
3) Long range Suction Pipe can be employed With help of air Vessel.
- 4) Long Pump Can be run at higher Without any loss of power Cost.

* Cavitation :-

A typical Pressure distribution in a blade element is shown below,



As the pressure on the back of a propeller falls lower and lower with the increase in a propeller's n , the absolute pressure at the back of the propeller will eventually become low enough for the water to vaporize and local cavities form. This phenomenon is known as Cavitation.

(P_v , Vapour of Water)

The main causes of Cavitation:-

- 1) Large Suction head.
- 2) Pumps handle liquids.
- 3) Small Submersible of Suction inlet.
- 4) Excessive discharge Velocity.
- 5) Cavitation too is caused due to the formation of the Vapor Phase in the liquid.
- 6) Too many bending in discharge line.

The Symptoms of Cavitations:-

- 1) Noise.
- 2) Vibration.

* Friction head :-

Pipe, Valves and bends offers resistance to flow of liquid which has ultimately overcome by the pump. This is called friction pump.

$$h_f = f \frac{L}{D} \frac{V^2}{2g}$$

h_f = friction head loss

f = friction factor

L = Length

V = Velocity

D = Diameter

g = Gravity.

* Suction head :-

It is equal to static Suction head suction friction head and enhance looge in the Suction pipe and the pressure which may present in Suction times.

* Discharge Velocity head :-

It is the head exerted at the discharge of the liquid due to its discharge velocity. Mathematically.

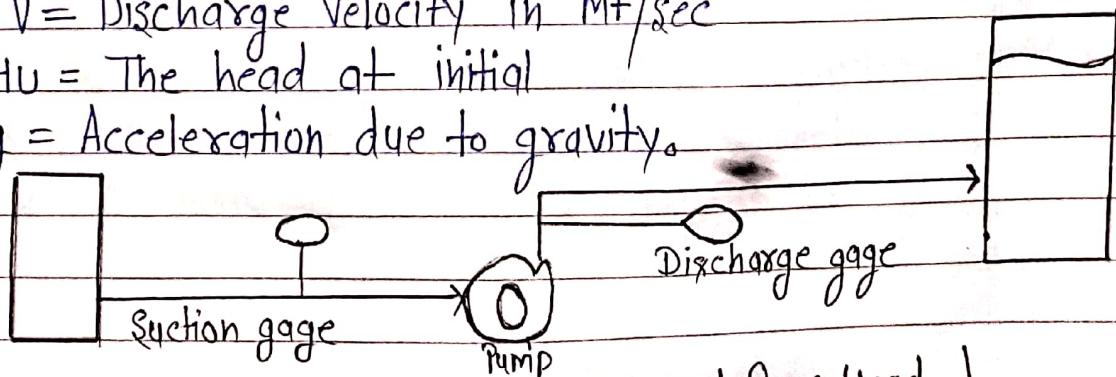
$$H_d = \frac{V^2}{2g}$$

Where

V = Discharge Velocity in mt/sec

H_d = The head at initial

g = Acceleration due to gravity.



(fig-Basic Suction Head, Discharge Head and Pump Head.)

Overall efficiency :-

It is expressed as ratio of the liquid in horse power input to the pump shaft. This may be obtained by the formula. $1000 HQ / 75$.

Where,

Q = Quantity of Water Pump in m^3/sec .

H = Total head in mt.

Specific-Speed :-

This Specific Speed of a pump is given by the formula.

$$Ns = \frac{\text{Speed} \sqrt{\text{Quantity}}}{(\text{head})^{3/4}}$$

Priming the Pump :-

In reciprocation pump, the Pump Cannot Creates its own Vacuum by Which the pump Cannot draw Water from the Sump. In Case of Centrifugal and turbine pump the pump are Self Primed. In reciprocating pumps When we start we have to Pour Water in the delivery side so that the pump can draw Water from the Sump.

* Centrifugal and turbine pumps. :-

A Centrifugal Pump Consists essentially of :-

- 1) An impeller keyed to a shaft.
- 2) A stationary spiral or volute casing within which the impeller rotates rapidly (usually 1450 or 3000 rpm)
- 3) Suction pipe connecting flange.
- 4) delivery pipe connecting flange.

The impeller looks some-

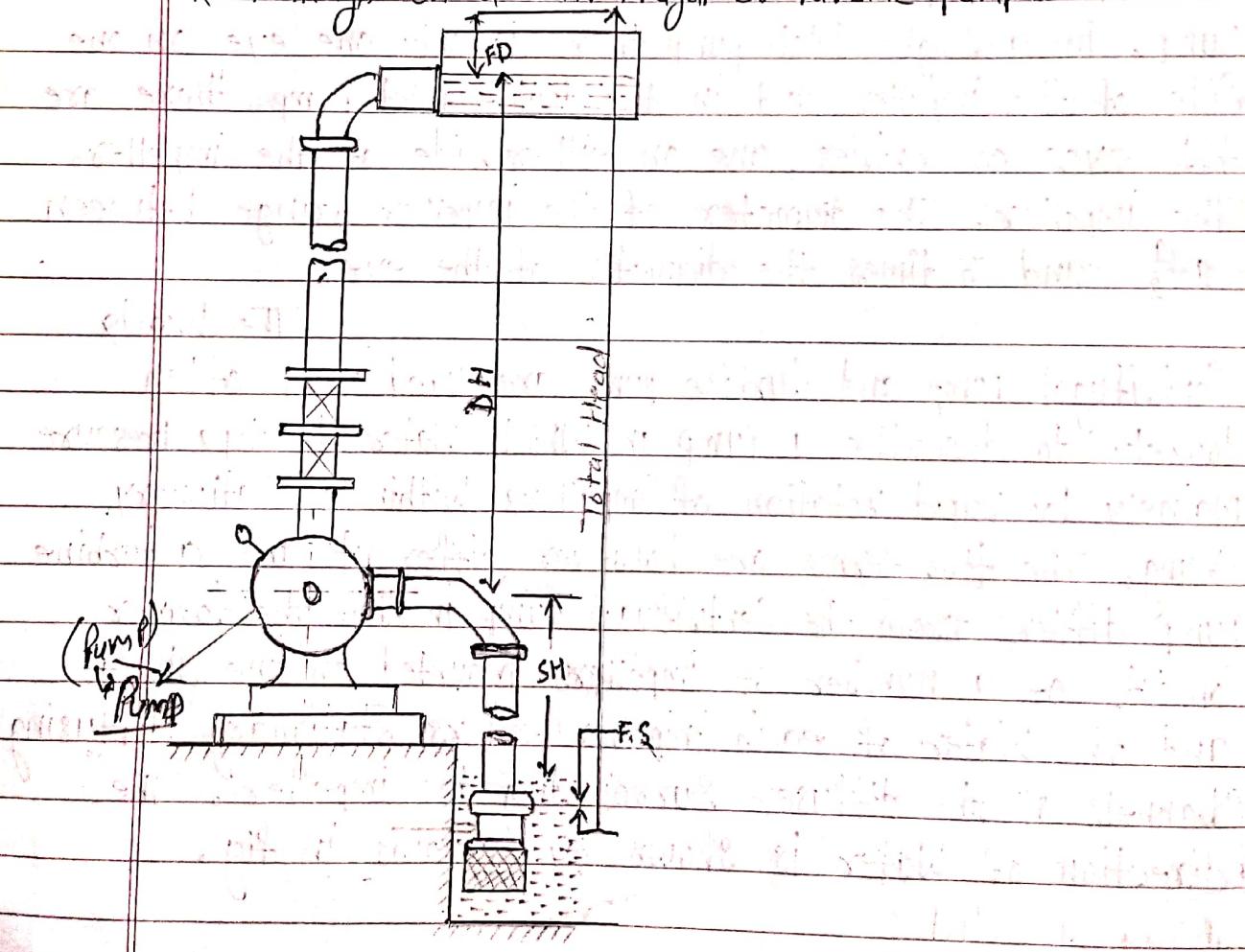
What like a wheel formed of two disc between which a number of curved blades or vanes are fixed. These blades are usually curved backwards, compared with direction of rotation. There is an opening at the center, called the eye of the impeller, for entry of water sucked into the pump. In a single inlet pump there is only one eye on one side of the impeller and in the double inlet pump, there are two eyes or entries, one on either side of the impeller. The diameter of the impeller range between $1\frac{1}{2}$ and 3 times the diameter of the eye.

The words

Centrifugal pump and turbine pump are used very often loosely to describe a pump in which water develops pressure mainly by rapid rotation of impellers within a stationary casing. The two terms are however different and a turbine pump differs from the centrifugal pump in that the former consists of a number of impellers mounted on one shaft and the water of each impeller enters stationary diffusing channels of the diffuser surrounding the impeller. The direction of water is shown by arrows in fig.

Fig :- Impeller and diffusing channels in a Centrifugal Pump (cross - Section)

* Fittings on a Centrifugal or turbine pump :-



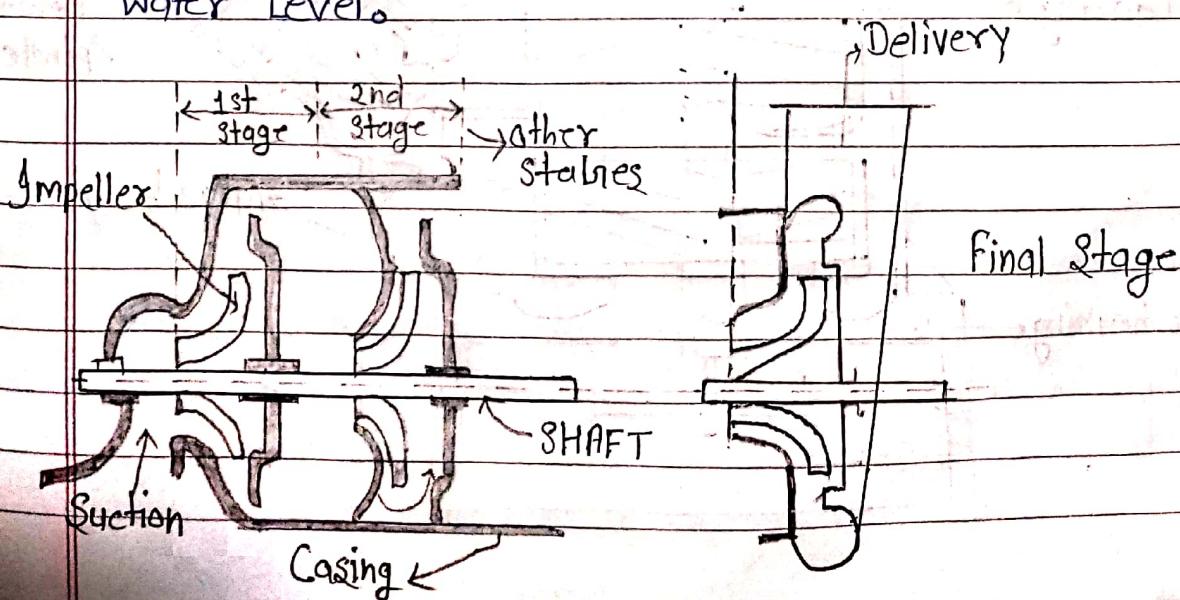
(fig)

Pump fittings :-

- 1) A foot-valve in the suction pipe to prevent water returning to the sump.
- 2) A main valve (also called Sluice Valve or gate valve) in the delivery column.
- 3) A retarding valve to hold the water in the delivery column if the pump stops while the main valve is open.
- 4) Bye-pass valve to enable the pump to be primed with water from the delivery column before starting up. On small pumps this is generally not provided.
- 5) Air cocks (one on each stage to release the air when priming the pump).

Arrangement of pipes and valves :-

- 1) The total suction lift, including vertical lift friction and the friction of the foot-valve and strainer, should not exceed 5m upto the centre line of the pump.
- 2) The suction pipe should be as short as possible, of large diameter and have minimum number of bends or elbows.
- 3) The pipe line should rise all the way to the pump so as to avoid air pockets.
- 4) An efficient strainer should be fitted well below the water level.



Ques. → Describe Constructional features and Working Principle of and use of Roto Pump (Screw pump)

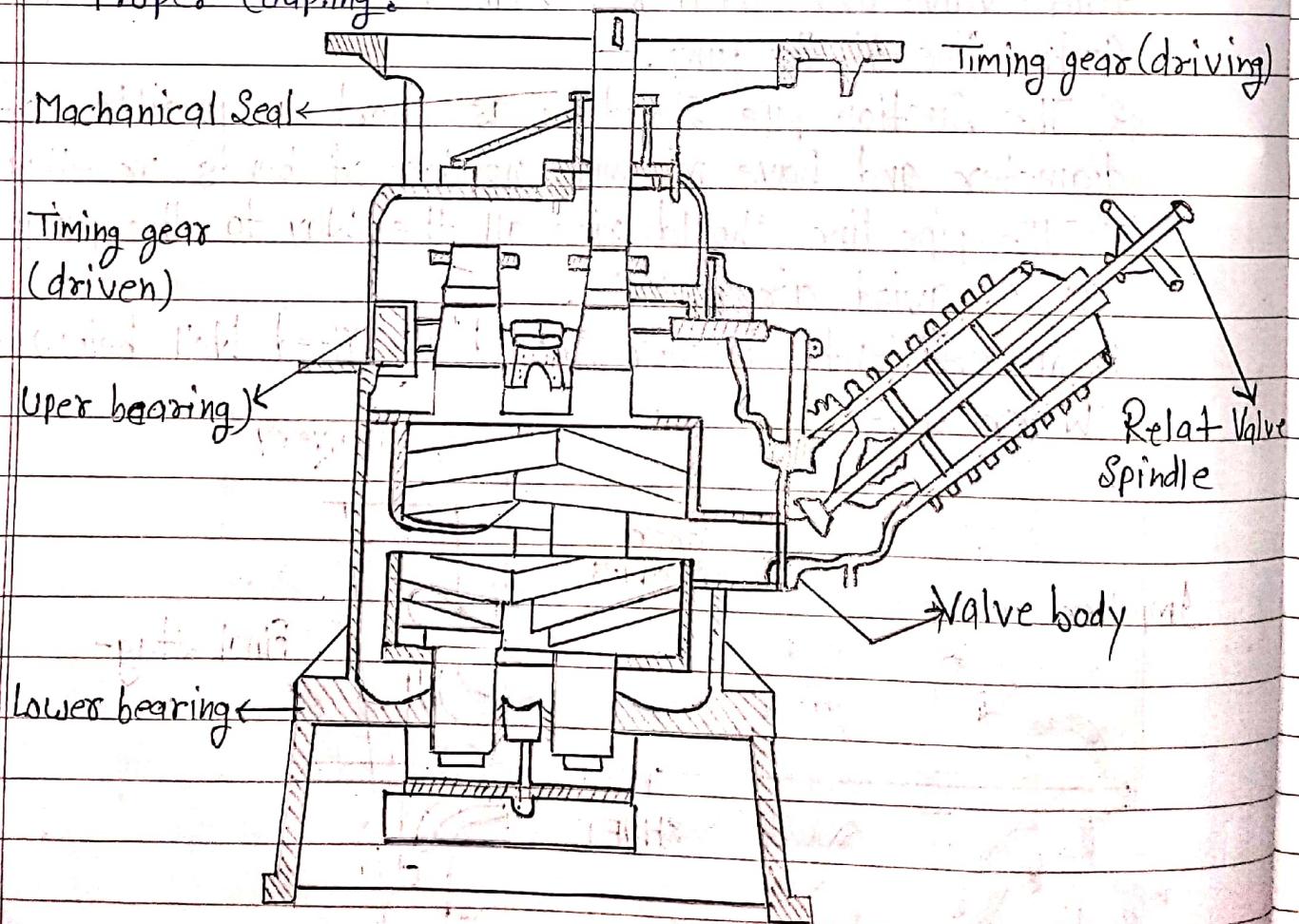
* Constructional features Roto Pump (Screw pump) :-

Ans -

Construction of screw pump is coherent and very straight forward in its making. See the diagram for construction details.

⊗ Rotor. (Screw) Pump :-

If having three screw spindles, one of which is driven and other two are driven. There is a fine clearance between these screws and this fine clearance is responsible for the pumping action of the fluid. Drive to the main screw is given through the motor which is coupled to this by proper coupling.



Pumps have a Casing which has a proper inlet and outlet. Inlet is always preferred at the bottom and the outlet is preferred at the upper part of the pump. This is all we have in the construction of this Pump. One more thing which I forgot to tell is that this pump is having a relief valve fitted at the end of the outlet. Working of the Screw(Roto) Pump.

Advantage of Screw(rotor) Pump :- (Mono Pump)

- 1) Wide range of flows and Pressure.
- 2) Wide range of liquids and Viscosities.
- 3) Built-in variable capacity.
- 4) High Speed Capability allowing freedom of driver Selection.
- 5) Low internal Velocities.
- 6) Self-Priming with good Suction Characteristics.
- 7) High tolerance for entrained air and other gases.
- 8) Minimum Churning or foaming.
- 9) Low mechanical vibration, pulsation-free flow, and quiet operation.
- 10) Rugged, compact design - easy to install and maintain

Disadvantage of Screw Pump :-

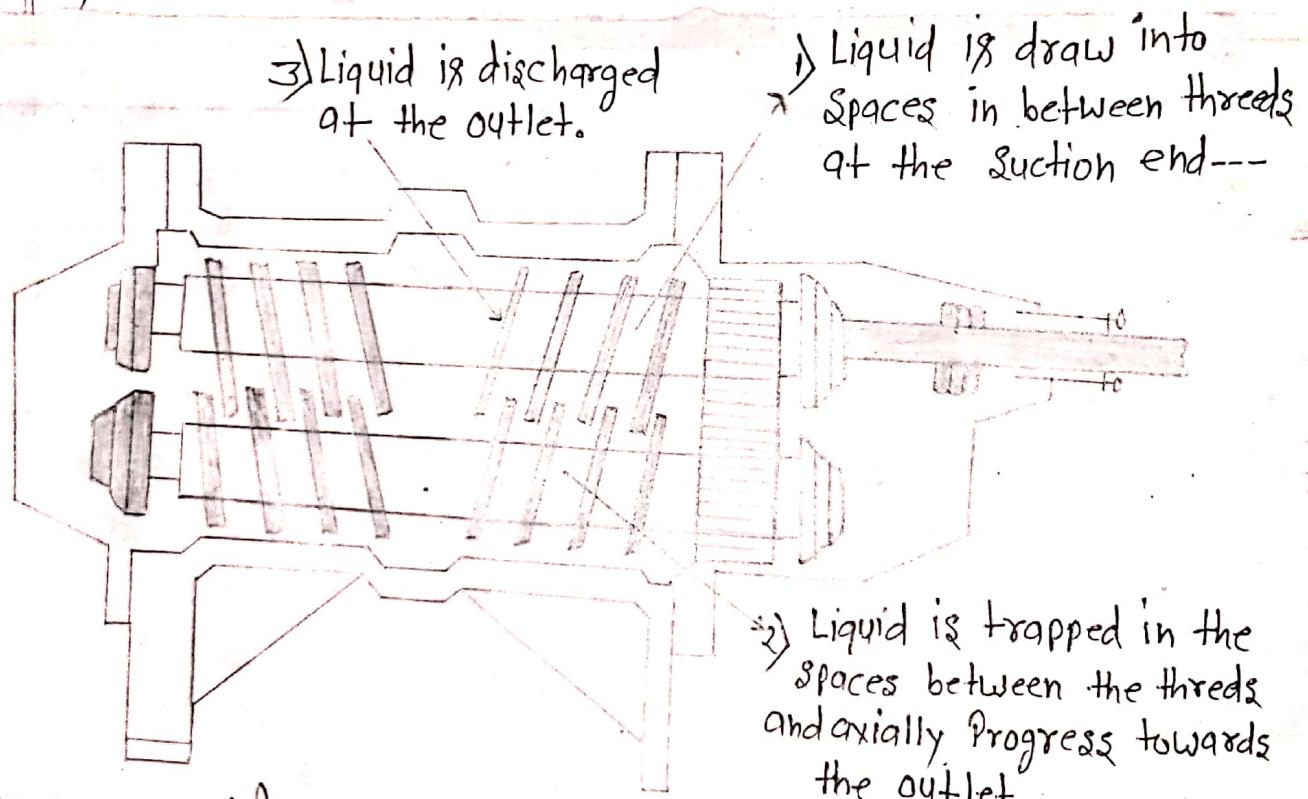
- 1) Relatively high Cost because of Close tolerances and running clearances.
- 2) Performance characteristics sensitive to viscosity change.
- 3) High Pressure Capability requires long Pumping elements.

* Working Principle of Screw(Rotor) Pump :-

• These Pumps are either of the Single type or Multiple Screw type works with a Single rotor moving with threads inside a Stator thus carrying the liquid along. Multiple Screw Pumps can be of the double or triple rotor Configuration.

The Screw pump Working animation Video

• A variation of the Screw pump is the two rotor Screw Pump is the shown in fig this pump shown has two rotors, each with opposing helical threads. The liquid is trapped between the screw threads and the pump casing and is conveyed axially by the meshing of the rotors, until it is discharged in the middle. The two rotor screw pump uses timing gears to keep the rotors synchronized.



(Double Screw Work)-Fig - Screw pump Working Principle
ing fig (Roto)

* Use of Screw (Roto) Pump :-

A screw pump is a positive-displacement pump that uses one or several screws to move fluids or solids along the screw axis. In this, it's simplest from a single screw rotates in a cylindrical

Cavity, thereby moving the material along the screw's Spindle. This ancient construction is still used in many low-tech applications, such as irrigation systems and in agricultural machinery for transporting grain and other solids.

Development of the screw pump has led to a variety of multiple axis technologies where carefully crafted screws rotate in opposite direction or remains stationary within a cavity. The cavity can be profiled, thereby creating cavities where the pumped material is "trapped" in offshore and marine installation a three-spindle screw pump is often used to pump high-pressure viscous fluids. Three screws drive the pumped liquid forth in a closed chamber. As the screws rotate in opposite direction, the pumped liquid moves along for transport the screws' spindles. The term's screw pump is often used generically. However, this generalization can be a pitfall as it fails to recognize the different product or screw configuration, as well as the uses, advantage and design considerations for each.

Each screw pump operates on the same basic principle of a screw turning to isolate a volume of fluid and convey it. However, the mechanical design of each is different. The primary difference is the number of screws: one two three or more.

* Describe Constructional features of Centrifugal and Turbine pumps.

* Centrifugal pump Construction :-

Centrifugal pump basically consists of a stationary pump a Casing and an impeller mounted on a rotating shaft. The Pump Casing provides a pressure boundary for the pump and contains channels to properly direct the suction and discharge flow.

The pump Casing has Suction and discharge penetrations for the main flow path of the pump and normally has small drain and vent fitting to remove gases trapped in the pump Casing to drain the pump Casing for maintenance.

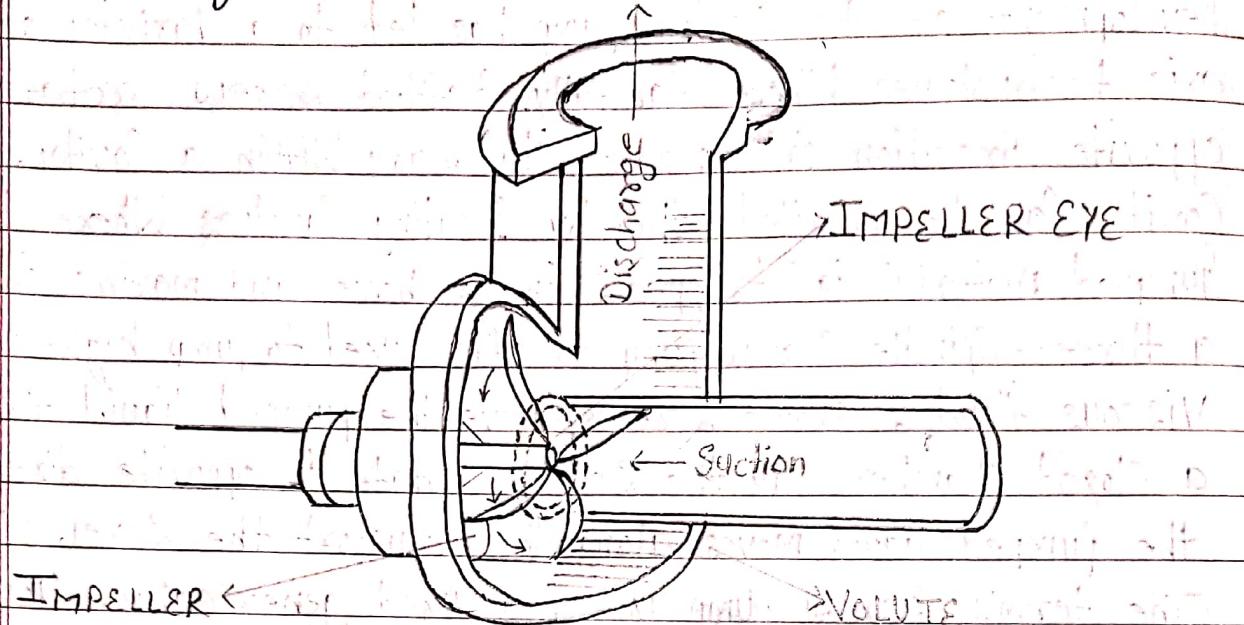
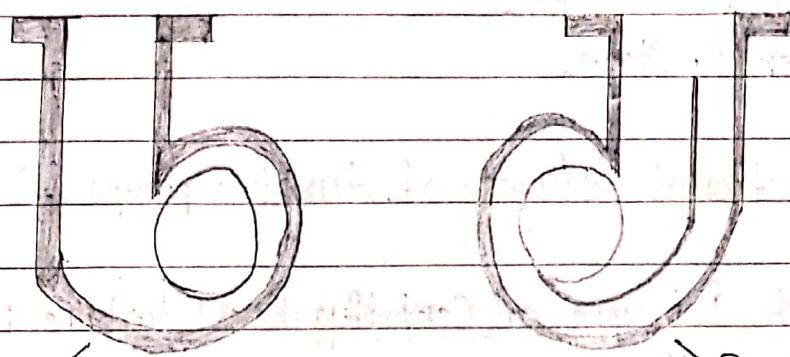


figure is simplified diagram of a typical Centrifugal Pump that show the relative locations of the pump suction, impeller, volute, and discharge. The pump Casing guides the liquid from the Suction connection to the center, or eye of the impeller. The vanes of the rotating impeller impart a radial and rotary motion to the liquid, forcing it to the outer periphery of the pump Casing where it is collected in the outer part of the pump Casing called the Volute.

The Volute is a region that expands in Cross-sectional area as it wraps around the pump Casing. The purpose of the Volute is to collect the liquid discharged from the periphery of the impeller at high Velocity and gradually cause a reduction in fluid Velocity by increasing the flow area. This converts the Velocity head to Static pressure. The fluid is then discharged from

The pump through the discharge Connection. Centrifugal pumps can also be constructed in a manner that results in two distinct volutes, each receiving the liquid that is discharged from a 180° region of the impeller at any given time. Pumps of this type are called double volute pump. In some applications that the double volute minimizes radial forces imparted to the shaft and bearings due to imbalances in pressure around the impeller.

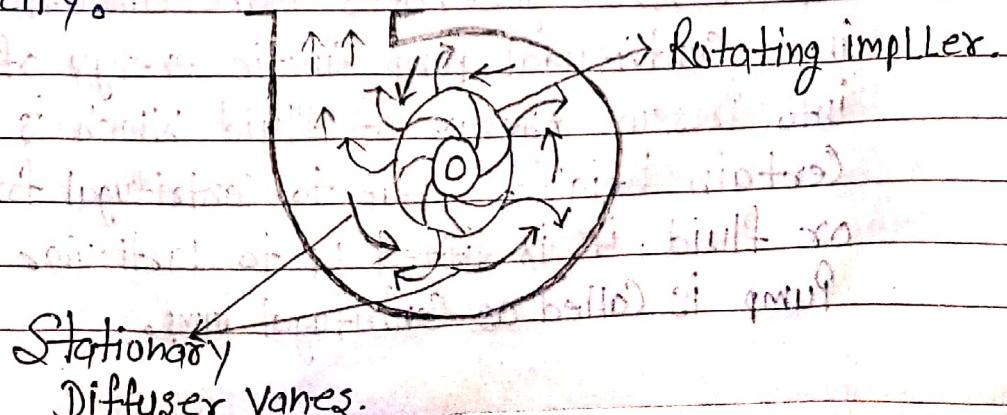


(fig = Single and Double Volute)

A Comparison of single and double volute centrifugal pumps is shown on figure.

Centrifugal Pump Diffuser Review :-

Some centrifugal pumps contain diffusers. A diffuser is a set of stationary vanes that surround the impeller. The purpose of the diffuser is to increase the efficiency of the centrifugal pump by allowing a more gradual expansion and less turbulent area for the liquid to reduce in velocity.



Classification of Centrifugal Pumps :-

Centrifugal Pumps may

be classified according to,

1) Working head.

2) Specific Speed.

3) Type of Casing

4) Direction of flow of Water

5) Number of entrances to the impeller

6) Disposition of Shaft.

7) Number of Stage.

* Constructional features of turbine pumps. :- Page No - 22 --

→ * State Principle of Centrifugal and turbine Pump and its applicability.

* Principle of Centrifugal Pump :-

This pump works on basic principle of Change in angular momentum. It state that the change in the angular momentum of a rotating particle is equal to the applied force. It the angular means when a certain amount of liquid is rotated with the help of external agency means turbines or electric motor or external force, in this Centrifugal force acts on it which further turns into pressure. In addition to this as liquid passes through revolving wheel or impeller which generates more amount of pressure. In short in a Centrifugal pump Kinetic energy of impeller is converted into Pressure energy of fluid which is used to raise up it to certain height. Due to Centrifugal force acting on water or fluid, it is lifted up to particular height. So these pump is called as Centrifugal Pump.

* Principles of Turbine pump :-

The primary difference between a centrifugal and a regenerative turbine pump is that fluid only travels through a centrifugal pump once, while in a turbine, it takes many trips through the vanes. Referring to the cross-section diagram, the impeller vanes move within the flow-through area of the water channel passageway. Once the liquid enters the pump, it is directed into the vanes, which push the fluid forward and impart a centrifugal force outward to the impeller periphery. An orderly circulatory flow is therefore imposed by the impeller vane, which creates fluid velocity. This velocity is then available for conversion to flow and pressure depending on the external system's flow resistance as diagrammed by a system curve.

In some competitive designs, you will find that only a single-sided impeller is used. That design suffers from a thrust load the direction of the motor that must be carried by the motor bearings. MTH turbines use a two-sided floating impeller design that pressure equally on both sides. This has the advantage of allowing the pump pressure to hydraulically self-center the impeller in the close clearances of the impeller cavity, while not burdening the motor bearing with excessive thrust loads.

Applications of turbine pump :-

Turbine pumps are used in clean liquid applications that demand high head, low flow, compact design, and flexible operation. They're used in a wide range of industrial applications such as cooling water circulators for lasers and other machines where high head is required. Turbine pumps are also found in small boiler feed service in bakeries, dry cleaners, small

Boiler feed Services in bakeries, dry Breweries, and other Commercial Plants. the Pump Applications page on GlobalSpec Provides a list of Pump types designed for Specific applications.

* Application of Centrifugal Pump :-

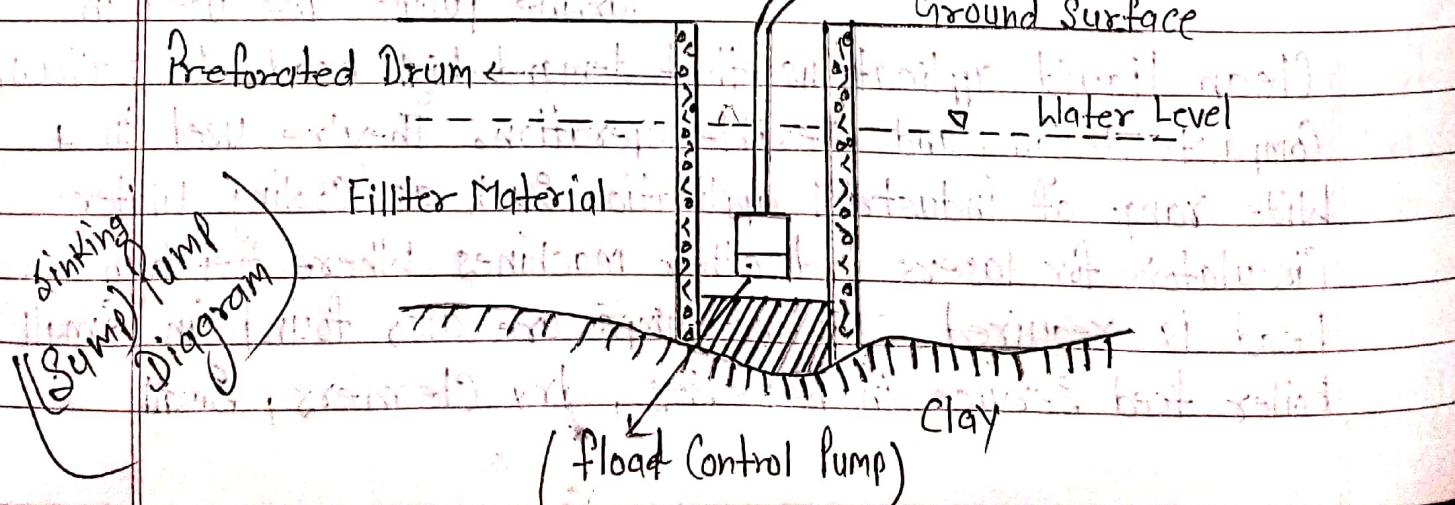
Centrifugal Pump are Used in many applications and across many industries. Some of the Commercial, municipal industrial and scientific fields that make use of such Pumps are listed below.

- 1) Oil and energy Companies, refineries Power plants.
- 2) Heating and ventilation, air conditioning, pressure boosting fire protection Sprinkler Systems.
- 3) Waste Water processing, boiler feed applications irrigation, drainage and flood protection.
- 4) Chemical and Process industries, Pharmaceuticals, Cellulose Sugar refining, food and beverage Production.

Ques :- * Describe Construction on Centrifugal and turbine Pumps.

Ques :- * Describe Construction features and Working Principle of Sinking Pump.

* Sinking (Sump) Pump :- Stand Trap → Discharge to Waste Water System



A long narrow pump designed for keeping a shaft dry during sinking operations. It is usually large enough to deal with 1,000 gal/min (3,780 L/min) from the greatest depth at which water will be encountered. A sinking pump must be slung from the surface and be fairly easy to raise and lower when shot firing takes place at the shaft bottom. Most are of the electrically driven centrifugal type and allow for additional stages to be fitted as the shaft depth increases. It may be suspended by a single-drum, worm-driven, capstan engine with a very slow speed.

Components :-

Modern sinking pump components in the United States are standardized. They consist of:

- A plastic, metal, or concrete container forming a sinking basin, approximately 2 feet (0.6m) across and 2 to 3 feet (0.6 to 1m) deep 15 to 25 U.S. gallons (60 to 100 litre) capacity.
- A (Sump) sinking pump, either 1/3 or 1/2 horsepower (200 or 400W) either battery or mains powered.

Advantages of Shaft Sinking :- (Mono Pump)

1) All operational processes are controlled and monitored from the surface. In addition to the separation plant, lowering units and recovery winches, the jobsite equipment includes a control container and power supply units.

2) All information available about the excavation is collected and visualized in the control container.

3) There, the operator has a full overview of the situation at hand and can respond accordingly at all times.

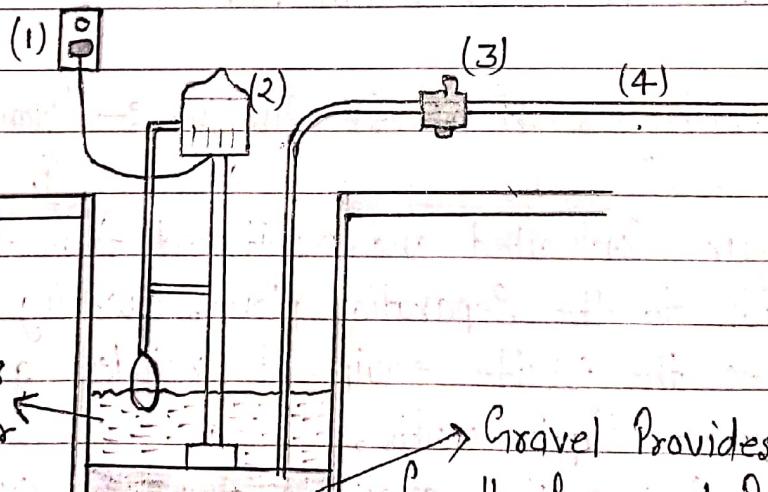
4) After completing exa excavation or when changing excavation tools the shaft boring machine is retrieved using recovery winches.

5) The advantage of the modular design of the overall system become particularly apparent in inner-city projects.

6) The equipment can be arranged as needed. for example, the separation plant can be installed in a street next to the jobsite if there is not enough space for it next to the shaft.

* Working Principle of Sinking Pump :-

You've got lots of stuff in your basement; but do you have a sinking (sump) pump? A sump (sinking) pump is a device used to get water and dampness in basements. One of the most common types is known as a pedestal pump. They tend to be less expensive and longer lasting than other options. Here's what one looks like and how it works.



Sump Pit Collects
Unwanted Water
in a basement

Gravel Provides a solid base
for the pump and Prevents debris
from clogging it.

(1) Power Supply :-

A normal 15-amp three prong grounded.

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Outlet is best. outlet should have a ground fault interrupter (GFI).

2) Motor :- Usually $\frac{1}{3}$ to $\frac{1}{4}$ horsepower. Operated with a float switch or bail that floats along a metal rod indicating rising or sinking water levels.

3) Check Valve :- To prevent water from flowing back into sump pit when the pump is not operating.

4) Drain Hose :- Should take water at least 20 feet away from the home's foundation.

* Suspension

* Mine Cage Suspension gear :-

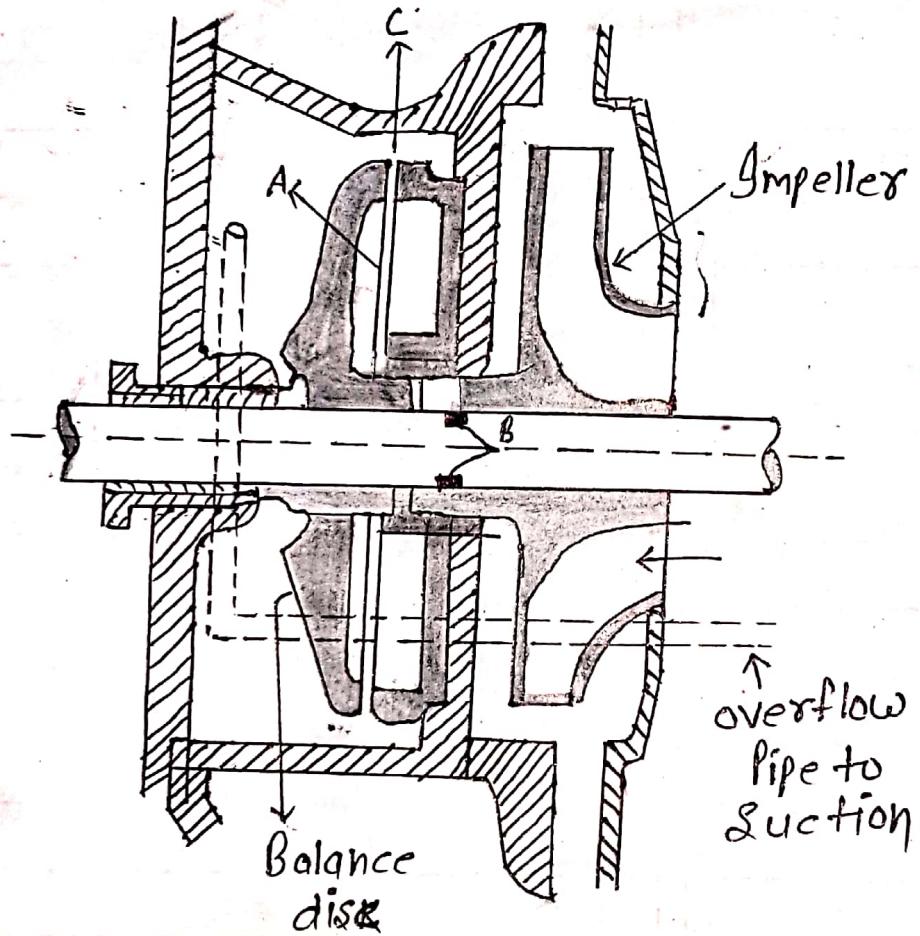
Mine Cage Suspension gear is an assembly of mine hoisting system between cage/skip and winding rope which is used to raise and lower conveyance. Safety within the mine shaft CSC₁ is used for suspension of cage/skip for winding in underground mines it comprise various component including rope cap, safety hook, distribution plate, bridle chains and/or chase block and link.

~~There are two types of assembly of cage suspension gear (CSC₁) : (i) Sing Point and (ii) Bridle chain types.~~

In types
bridle chain types CSC₁ different types of shackles parts where cage shackle is used to connect cage/skip with distribution plate through chain.

* Explain balancing the axial thrust of the turbine pumps.

* Balancing Axial thrust :-



⇒ In all Centrifugal and multi-stage turbine pumps having single inlet impellers, a considerable pump end thrust is developed which acts towards the suction end of the pump and this must be counteracted in some way in order to ensure that the impellers revolve freely in their designed positions within each cell or stage.

The axial end thrust occurs because water under pressure leaks into the clearance space on both sides of each impeller, b/w the impeller and its enclosing diaphragms.

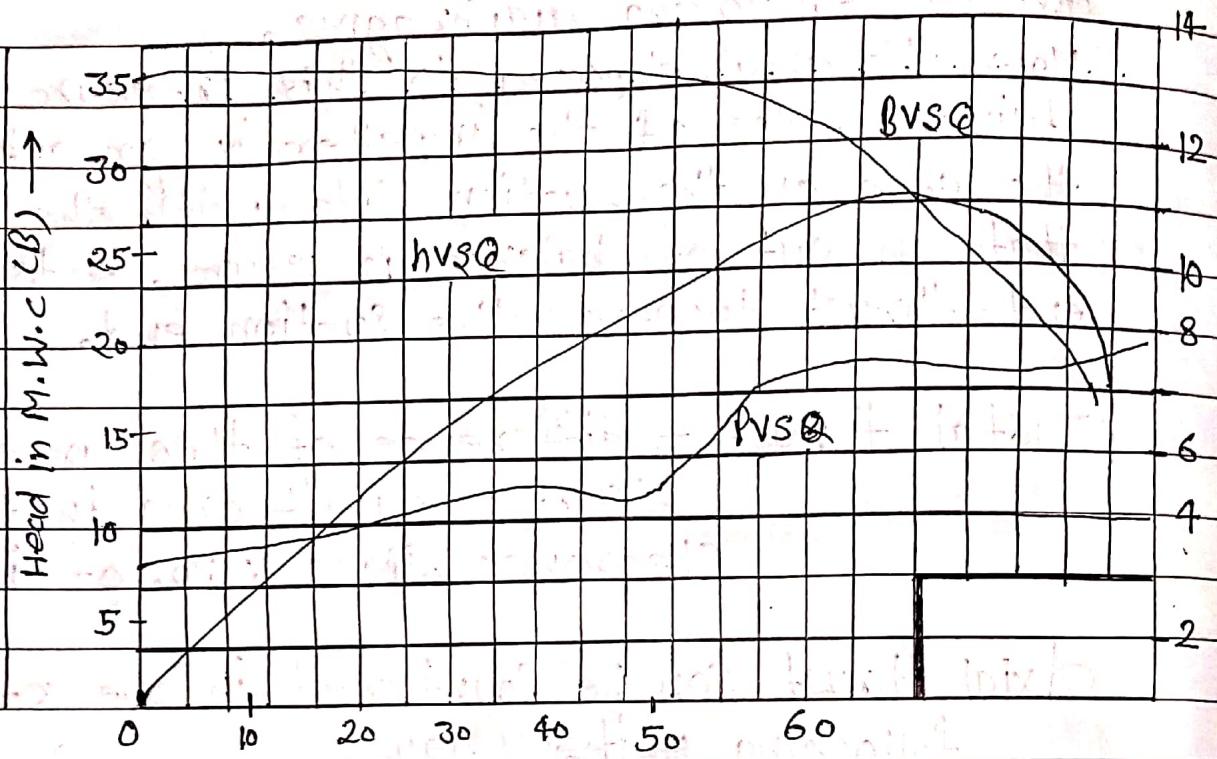
Now the area exposed to this pressure on delivery sides of the impeller is greater than the area on the suction side with the result that an out of balance pressure sets up an end-thrust towards the suction end.

Total thrust = difference of two areas \times Pressure per unit area in the clearance space \times no. of impellers.

Axial thrust can be countered in one of the following ways.

- In the case of single stage centrifugal pump this can be eliminated by using a double entry impeller or by drilling the eye of the single impeller which must then have false neck rings behind it.
- In case of 2-stage centrifugal pump the thrust can be eliminated by placing the impellers back to back eg. Kirlosker DSM Pumps.
- By use of a thrust bearing.
- By use of a balance disc.

* Draw Characteristics Curves for turbine Pumps.



→ Characteristics Curve is a curve which shows how the magnitude of one quantity varies with the change in some other related quantity.

→ At a constant speed a pump can deliver any capacity from zero to maximum.

Depending in the head design Suction Conditions.

→ The total head the power required and resulting efficiency varies with the capacity of the discharge.

→ The inter relationship b/w these variable at constant speed can be plotted graphically with quantity on the X-axis and other on Y-axis is called the characteristic curves.

→ At Constant Speed the following relation hold good.

1) Quantity (Q) \propto dia of impeller.

2) Head (H) \propto (dia) 2

3) HP \propto (dia) 3

At Variable Speed.

1) Quantity and Speed: (N)

2) Head and N^2

3) HP and N^3

We will study the following curve in this characteristics Curve (H_Q) of turbine pump.

1) Head Quality Curve (H_Q Curve)

2) BHP Curve.

3) Efficiency Curve.

4) Suction head curve.

* Head Quality Curve.

→ The curve showing the relationship between discharge and the head of constant speed is called head quality curve.

→ With increasing of pressure/head the quantity goes gradually decreases to a ~~minimum~~ ultimate load and then it becomes steady.

B.H.P Curve :-

- 1) At a Constant Speed the Power required by the Pump is function of discharge head and the Power absorbed is called as B.H.P Curve.
- 2) The Power Curve is a straight line because Power and head are directly proportional to each other.
- 3) B.H.P Curve does not start from zero as after giving the power to the pump can able to draw water.

* EFFICIENCY CURVE :-

- 1) The efficiency Curve rises from zero value to peak value and this gradually decreases in case of a low Specific Speed Pump and sharply decreases in case of a high Specific Speed Pump.
- 2) At a Constant Speed the efficiency is a function of discharge rate. the Curve between two Variable is K/q the efficiency of discharge Curve.
- 3) As the Starting of the Pump delivery Value is closed therefore discharge is zero, it means the efficiency is zero.

4) The mechanical efficiency is the ratio of Water H.P to B.H.P.

$$\times \text{ME of Pump} = \frac{\text{H.P. in water}}{\text{H.P. input to pump shaft}} = \frac{\text{Water H.P.}}{\text{Brake H.P. of driver motor}}$$

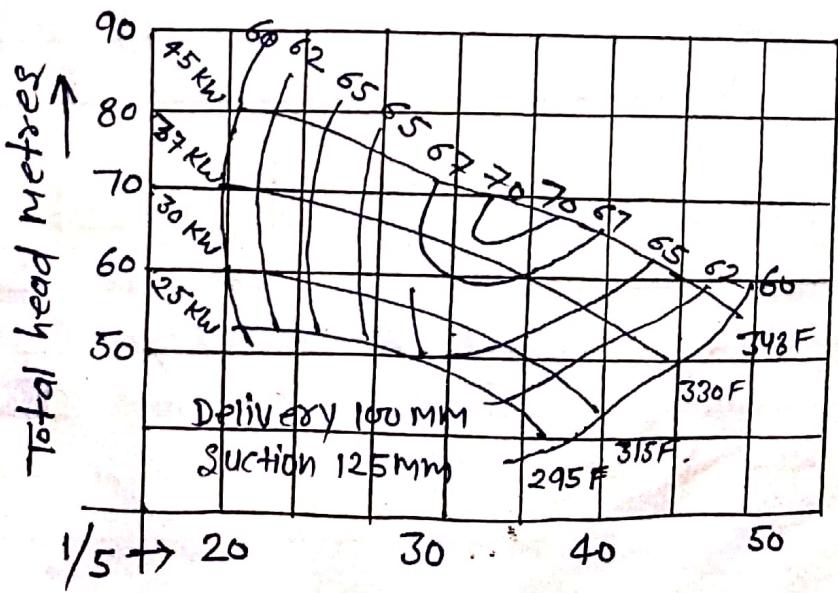
SUCTION HEAD CURVE :-

1). The Suction lift decreases as the temperature of the liquid increases.

2) There are several factors which effect the suction differences.

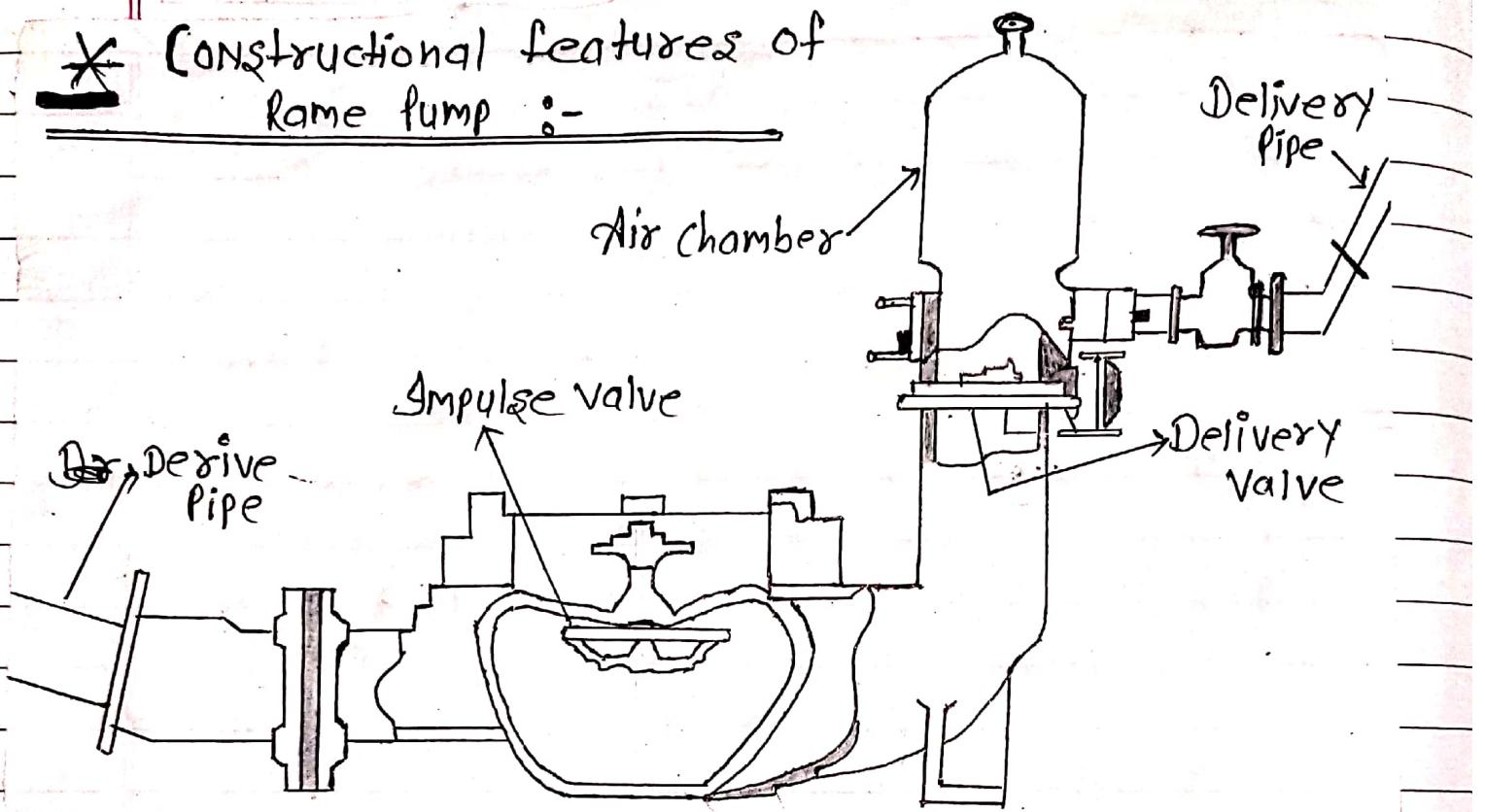
EX - Temp. of the liquid, Viscosity, density and attitude at which is carried out.

3) The Suction lift varies inversely, to the density of the liquid. Heavier is the liquid, Suction lift is radical.



* Ques - Describe Constructional features, Working and use of ram pumps.

* Constructional features of Ram pump :-



(Ram Pump) Diagram

Construction features of ram pump :-

- 1 → The main principle in ram pump is that Water during the down stroke is forced into the delivery pipe.
- 2 → It is a structurally simple unit consisting of two moving parts. These are the impulse Valve (waste) and the delivery (check) Valve.
- 3 → The unit also consists of air chamber and an air valve.

- 4 → The closure of the impulse valve creates a high pressure rise in the derive pipe.
- 5 → The same case usually made of Cast iron but may be line with brass or gun metal.
- 6 → If the water is usually corrosive the whole pump resist corrosion.

* Working principle of Ram Pump

- 1 → During the upstroke of the plunger are induce pressure with the barrel exactly as in a bucket pump.
- 2 → The Suction Valve "v" influen of the atmospheric pressure.
- 3 → During the downward stroke Valve "v" close the delivery Valve "n" open & and Water is force out of barrel into the delivery pipe.
- 4 → The pump delivers water during one stroke only and only the half of pump speed is therefore effective.
- 5 → They are used where pumping condn is more odorous because of dirty water are high lift or both combined.
- 5 → The maximum suction lift is same as with bucket pump plunger pump can force water to much greater height the delivery head may be much greater.

USE OF RAM PUMP :-

- 1 → They are used where pumping cond is more odorous because of dirty water or high lift or both combined.
- 2 → They are also used for raising water from dip or for keeping dry the advancing face of an incline.

* Advantage of ram pump.

- 1 → It can be driven by electric motor is that the stroke is limited by the length of engine.
- 2 → Piston or pump ram running up against the cylinder and power cost are lower.
- 3 → High mechanical efficiency.

* Disadvantage of ram pump

- 1 → They take up great deal of room.
- 2 → It requires large and costly foundation when to install.
- 3 → For delivery to large quantities of water they have a relatively high first cost.

* Types of ram pump

- 1) Horizontal ram pump.
- 2) Vertical ram pump.

CHAPTER - 05 (PIPES AND Valves)

Question \Rightarrow Discuss the Pipe line layout.

(OR)

- \Rightarrow State the Procedure of Supporting the Pipe in Shaft.
- \Rightarrow Laying pipe lines in shaft is very labour consuming as the work is enclosed for preparation delivery of pipe.
- \Rightarrow Installation of pipes and fitting and pipe line testing in shaft for a raising steel pipes may be inlet.
- \Rightarrow It is lighter in weight therefore much more convenient to handle and easier to support in the shaft.
- \Rightarrow The steel pipe is cheaper but they are affected by acidic water.
- \Rightarrow To prevent the section of mine water the inside of such pipes are handle but they are good for rough and are not affected by acidic water.
- \Rightarrow Therefore cast iron pipes are most common for installation in shaft ranges.

UNDERGROUND FACE MACHINERIES

* Electric Coal drill :-

This drill used for drilling holes in coal and similar soft rock is electrically operated and is of rotary types. Such drills are manufactured by a few companies like MAMC, Voltas Chanda and Co and others.

Coal drills manufactured of two types.

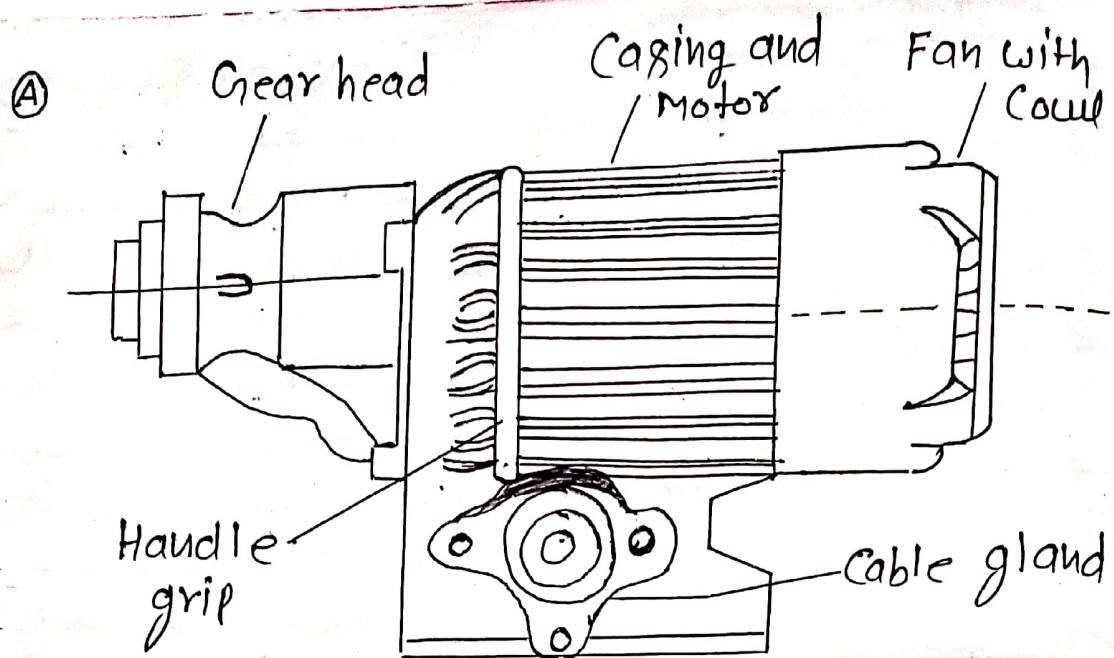
- 1) Type CD-1 (With Steel body)
- 2) Type CD-2 (With aluminum body)

The steel body drill (type CD-1) weight 21.5 Kgf and the aluminum body drill weight 17.5 Kgf. The coal drill is used not only for coal but other rocks in coal mines except very hard grade of stone.

* → Describe Constructional feature, operation principle and use of electric coal drill.

* Constructional feature of electric Coal drill :-

- The electric Coal drill essentially a squirrel cage induction motor is a flame proof with two hand grips symmetrically placed on two sides of the machine.
- It is an electric motor-driven drill designed for drilling holes in coal for placing blasting charges.
- The switching device is placed under the right hand grip of the motor Casing while the cable entry is at the left hand grip through the plug and socket arrangement.



A fig Electric Coal drill

A Couled for mounted on the drill together with fins on the Caves helps to bring down the temperature of the drill.

- OPERATION and Principle E-Coal drill:-

- The Switching device is placed under the right hand grip of the motor casing while the Cable entry is but the left hand grip through the plug and socket arrangement.
- The output power of the motor which has two Poles is FKW half hourly rotated and is around for 125 Volts , 3 Phages , 50 cycles Supply.
- A double Stage reduction gear box helps to utilize the machine to drill in Coal or Stone of various hardness.
- With Changeable gear point the drill can be used to give speeds of RPM of 600, 500

or 430 depending upon the gear box used.

- The power supplied through the 6.5 mm^2 .

5 core trailing cable of 100m long from a drill panel which receiver powers at 550 volt by armoured cable and steps it down to 770v.

- This closure of circuit operates electromagnetically the main switch at 110v in the drill panel.

- The drill machine comprises of

(i) drill machine (ii) drill rod (iii) drill bit

* Uses of Electric Coal Drill :-

The Coal drill is used not only for Coal but other rocks in Coal mines except very hard grades of stones.

→ * State types of drill rods and drill bits used in electric coal drills.

* Drill Rods ⇒

- The drill rod is of diamond section for drilling in Coal and it fits in the drill check by a beyond joint but the bit is attached to the rod by wire nail.

- Tungsten Carbide typed drill bits are used and of these eccentric type bit is employed in Coal.

- The rate of penetration of bit in Coal is generally 1.5 mt/min.

- The drill is capable of drilling holes 1.5 mt deep in a shaft of 8 hours.

* Drill bit :-

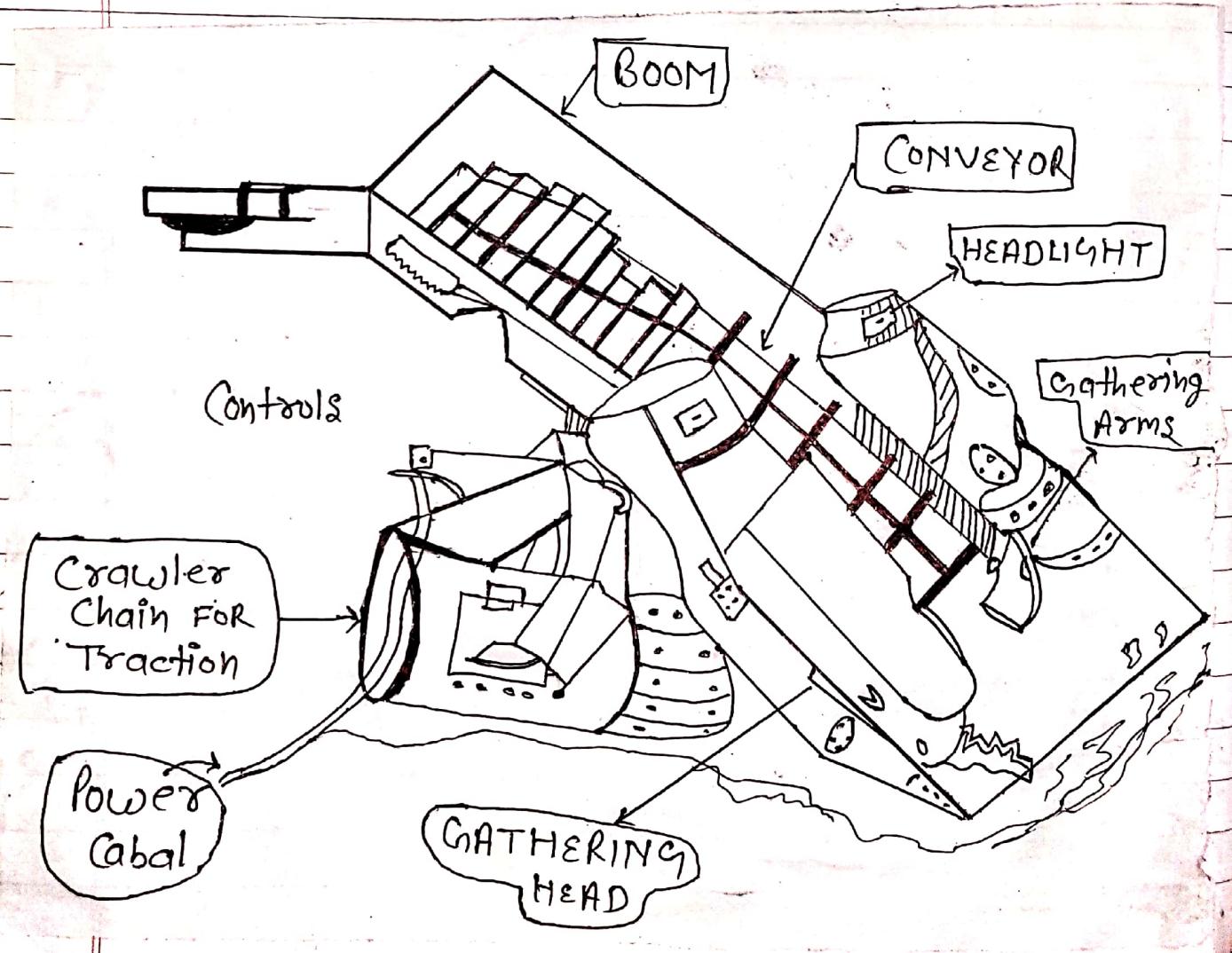
The different types of drill bits used in the element Coal drill are.

- (i) Eccentric type
- (ii) Concentric type
- (iii) VEE Type.

In Coal mine of Western Coalfield Ltd. the drill was used in galleries 4.5M in wide 42.6M high the coal yield per blasting was nearly 25te.

* Describe basic construction features of gathering arm loader, Scraper loader, Side discharge loader and load haul loader.

* Gathering arm loader :-



It consists of three principle units

i) A gathering head

ii) a central crawler mounted chassis

iii) A rear boom or jib.

i) The gathering arms are operated by twin crank drives. These drives are, flush with the working surface of the head

ii) There is a separate driving motor for each of the arms.

iii) A chain conveyor extending from the gathering head up to the boom end is transportation medium, conveying coal gathering from the face to the receiving mine car, tub, conveyor or shuttle car.

iv) The ramp of gathering head can be raised or lowered usually through 0.5 m

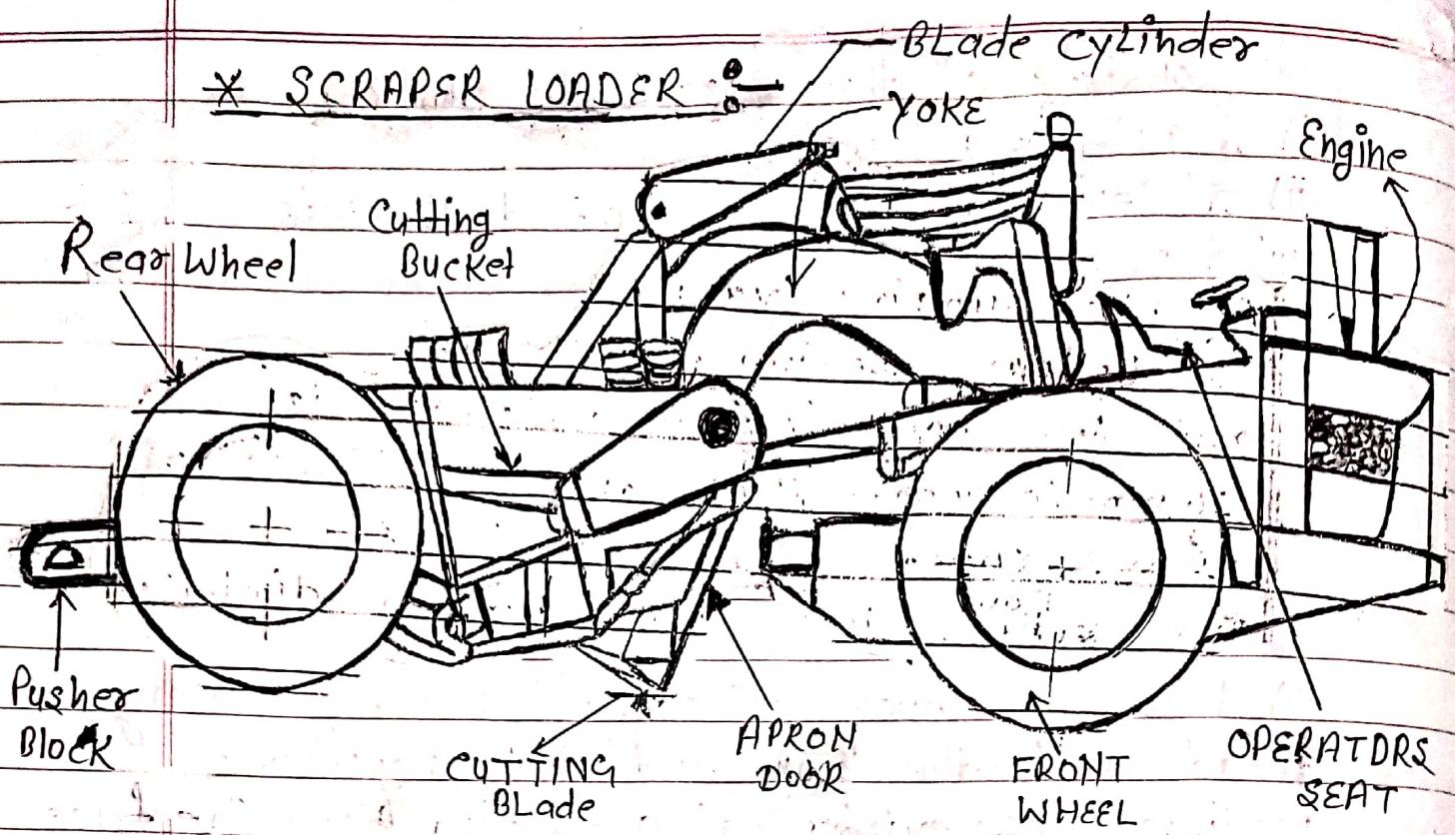
v) Hydraulic jacks are used for elevation of the gathering head and they are controlled by the operator from this position at the controls.

vi) There variable speed are available on the loader for gathering speed of the arms.

vii) The rate of loading depends upon the no. of the strokes/men and conveyor speed is also related to the rate of loading of the gathering arms

viii) The conveyor chain is supported by the delivery jib or boom.

ix) The loader has sometimes to load the coal by double handling and this reduces its output considerably.



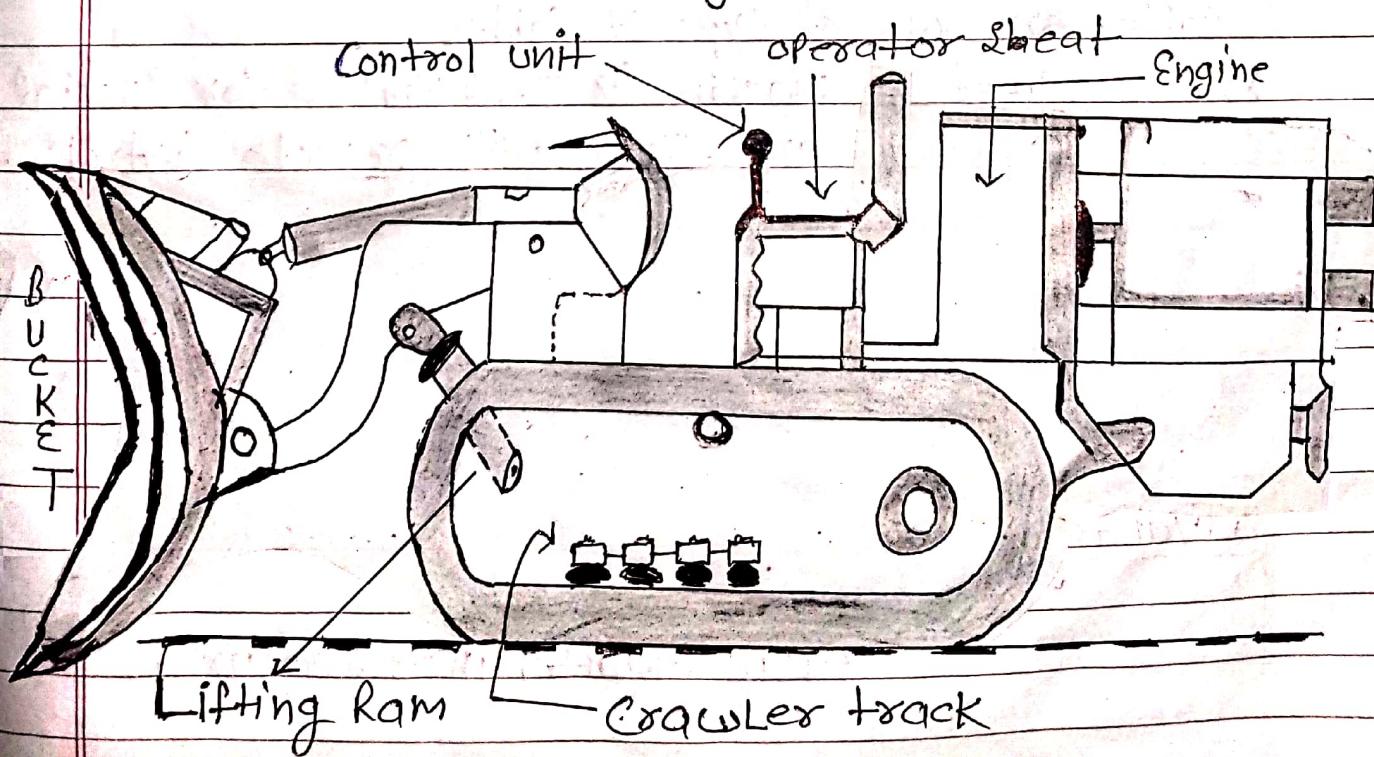
- 1) The Machine is diesel operated with Pneumatic wheel and has at the centre a bowl fitted with a cutting blade at bottom.
- 2) The earth automatically collected in the bowl located at the centre of the machine.
- 3) A Scraper is pushed forward by a dozer.
- 4) Its blade cuts a thin slice of a earth usually between 100mm to 250mm thick over a distance of nearly 30m.
- 5) The bowl Capacity ranges from 3 m^3 usually between 100mm + 22 m^3 and it takes nearly half to one minutes for loading.
- 6) When the Scraper is fully loaded its bottom opening is closed through a table operated by the operator.
- 7) At the dumping yard as the Scraper moves the bottom opening of the bowl is opened and the contents are unloaded in a layer 150mm to 200mm thick over a distance of 30m to 50.

- 8) The bowl is always bottom discharging.
- 9) Scraper are used in Coal mines for cutting and transport Weather Sand Stone as well as Coal.
- 10) The Coal excavated by it is however small size. A Scraper may take 5 to 6 minutes for a complete cycle of loading and unloading, if the total up and down distance of a trip is nearly ~~300m~~ 300M.

→ Excavation Cum transport.

- Suitable for soft material.
- Generally used for top soil removed.
- Flywheel H.P of engine 332 at 2100 rpm.
- Capacity Payload 23000 Kg, Struck 11.5 m³, heaped 6 M³
- Maximum travel Speed (forward) 44 Km/hr
- Overall dimension mm :- length 12600 : width 3470 height 3890
- Scraper are used in Coal mine for cutting and transporting Weathered Sandstone as well as Coal.

→ * S.D.L (Side discharge Loader) :-



- (i) It is a popular Coal loading Machine of U/g mines which can unload Coal to the right or left of Machine.
- ii) SDL takes blasted Coal from the face With bucket at front of the machine , transports and dump Coal into chain Conveyor , belt Conveyor , tube or mine car .
- iii) It is crawler mounted machine and it can work in gradient upto 1 in 8.
- iv) It can operate on much softer floor than rubber tyred machine.
- v) Height of Machine over canopy is 2.1m.
- vi) They are capable of turning in its own length but no designed for continuous travel .
- vii) SDL is not considered as a transport system as it travels with materials for a short distance.
- viii) SDL are made with flameproof motors are for use in underground Coal Mines .
- ix) It operates with 40 H.P motor on either 550 or 1100 Volts and accomodate 45m of type II cable or 30m of type I cable .
- x) The speed of machine is 3.86 Km/hr for special application they are fitted with remote control arrangement .
- xi) One SDL on average load about 100 tonnes / day
→ But adequate blasted Coal and evacuation capacity , and efficient maintenance .

Advantage :-

- High output
- Less operating
- Low maintenance required .

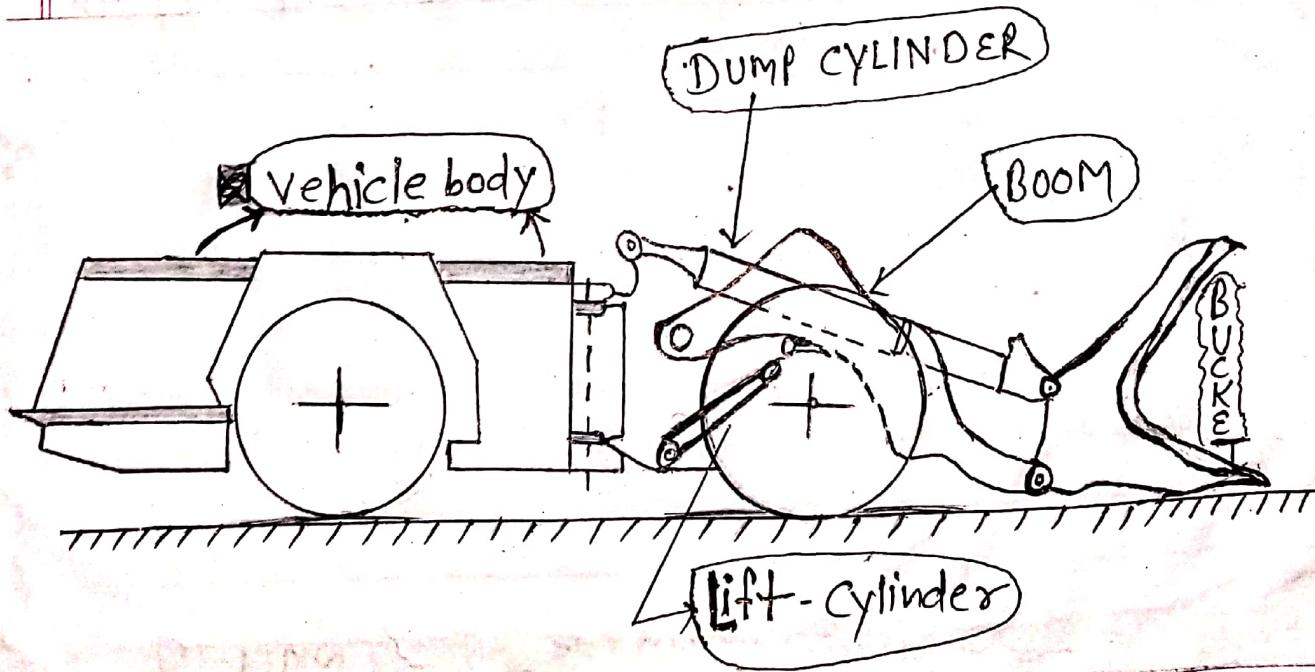
Disadvantages :-

- Additional ventilation required due to heat.
- Initial investment is high
- Trailing cable create problem.

- Safety features of SDL

- Parking brake, Service brake
- Dead man switch (foot operated)
- Emergency stop.
- Audio visual alarm
- Low oil level and high temperature power unit off switches.
- Front and ~~and~~ rear light.
- Canopy over operator seat.

⇒ * LOAD HAUL DUMPER (L.H.D)



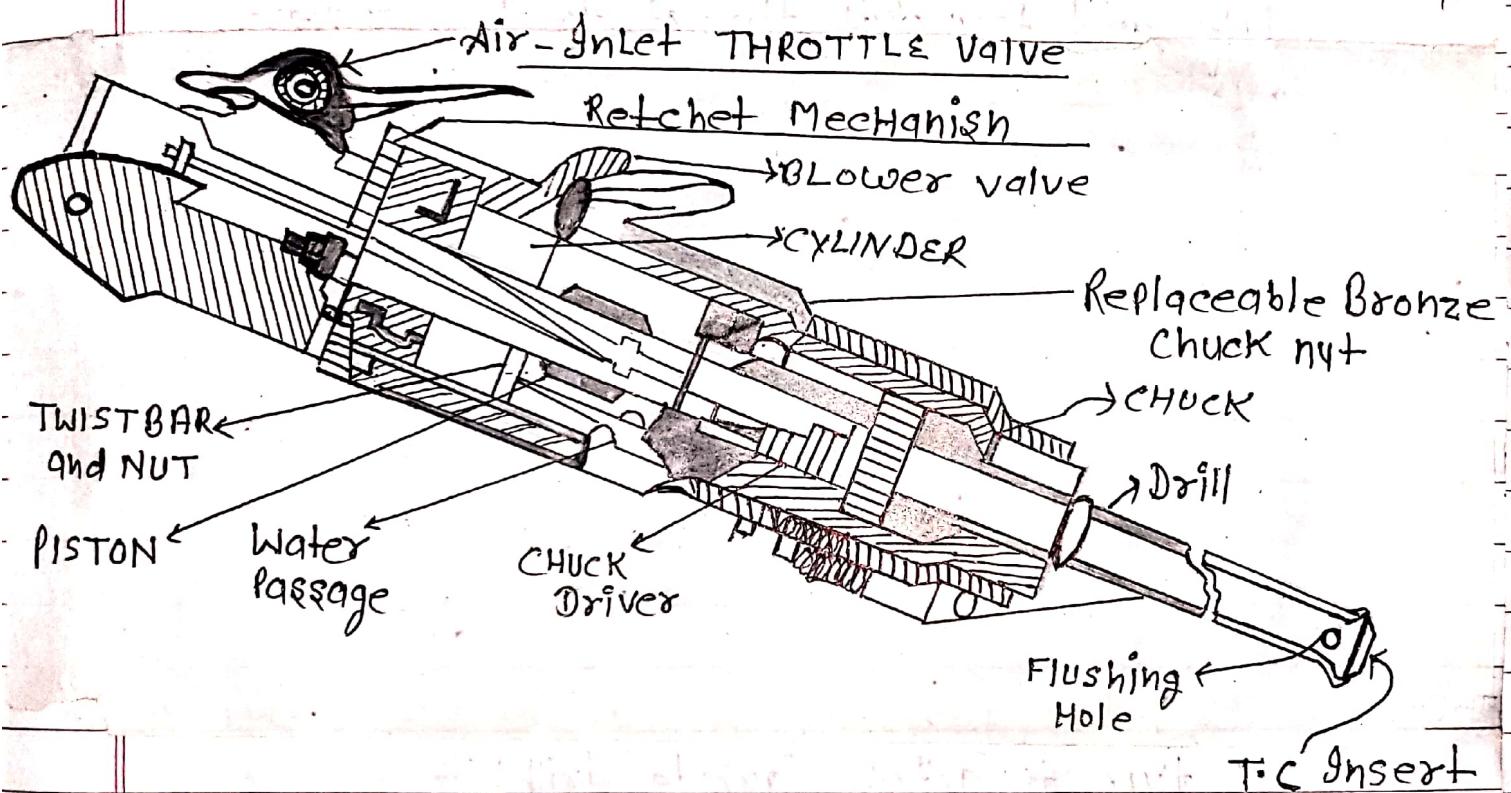
- i) Load haul dumper is a mining equipment that performs loading, hauling, and discharging of bulk material.
- ii) LHD is a type mounted loading machine which takes blasted coal from the face in its bucket, transport is over a distances and dumpers it on the district chain or belt conveyor.
- iii) Being tyre mounted it runs faster than SDL (at speed upto 4 km/hour) and the Chain/belt conveyor could be kept as far away as 90 m from the face.
- iv) LHD are normally used on gradient up to 1 in 6.
- v) The maximum speed is 8-10 km/hr when empty and 3-5 km/hr when loaded.
- vi) The LHD are rubber tyred mounted machine driven by flameproof electric motor or by a flame proof diesel engine.
- vii) LHD are typically track less and the term is usually restricted to vehicle used u/g.
- viii) No LHD is available for seam height less than 1.8m LHD can work in seams upto 2.4m thick.
- ix) Bucket, which is fitted in front of the machine, may be of 4 types : Tilting front discharge, pusher plate front discharge, Tilting side discharge and chain side discharge.
- x) All movement of bucket are by hydraulic pushers.
- xi) Recently in one mine of Singareni diesel powered LHD has been introduced.
- xii) For smooth working, galleries have to be maintained clear of scattered coal.
- xiii) Maximum speed for loader 3-5 km/hr.
 - Floor Condition : required strong and good floor.
 - Roof Condition : required good roof.

- Describe basic Construction features and operation principle of jack hammer drill.

* JACK HAMMER DRILL :-

A JACK hammer is a pneumatic or electro mechanical tool that combines a hammer directly with a chisel.

Hand-held jackhammers are generally powered by compressed air, but some are also powered by electric motors.



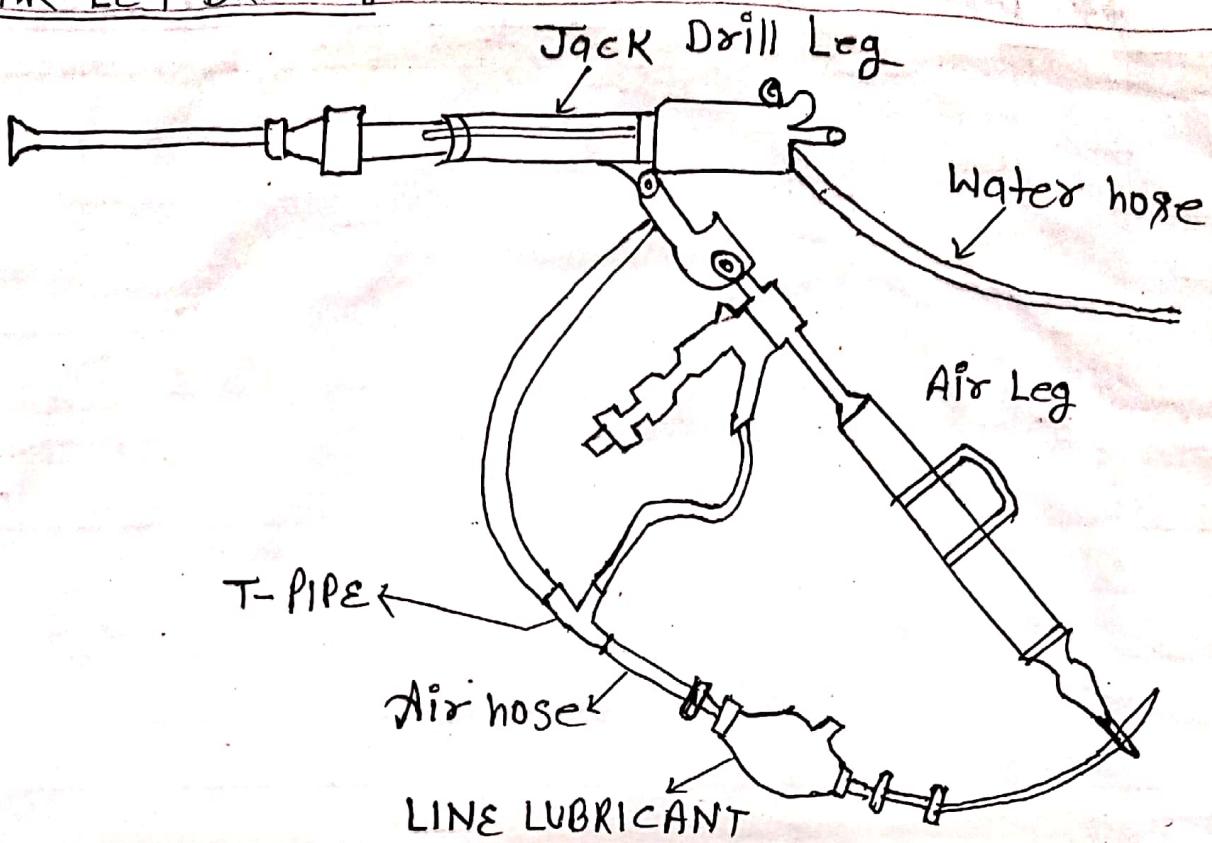
CONSTRUCTIONAL FEATURES :-

- The drill rod is hexagonal in Cross-Section.
- Compressed air enters the drill through a hose pipe (19mm bore) and a curved metal tube with Swivel Connection.
- The drill weight is 15 to 25 Kgf and drill hole of dia 30mm to 38mm up to 3m depth.

Working Principle :-

- 1) The Pneumatic jack-hammer works with a centrifugal piston driven by compressed air with strokes ranging between 18000 and 35000 min⁻¹ in reciprocating motion and is controlled by a flutter valve.
- 2) The rotation device with a pawl and ratchet mechanism allows rotation only in one direction.
- 3) Drilling stand guide the percussion bit into the hole and transmit thrust to the hammer.
- 4) It is a hand held drill used for vertically downward drilling.
- 5) A drifter and stopper work on the same principle as a jack hammer.
- 6) In a few cases a jack hammer may be mounted on an air leg it may be used for drilling inclined holes.
- 7) An oil bottle placed between the drill and the air receiver and connected by hose pipes to both, provides lubrication to the drill when working.
- 8) Drill rod may also be equipped with detachable X-type tungsten carbide drill bit.
- 9) The air consumption is generally 2-2.5 m³ of free air/min.
- 10) For dust suppression on a jackhammer can be adopted to wet drilling by some modification so that the drill cuttings mixed with water come out the hole in the form of sludge.
- 11) Suitability shaped at one end of the to form the shank and other choice shaped as to form a non-detachable single chisel bit with a tungsten carbide insert.

* AIR LEG DRILL :-



- i) An air leg essentially a long cylinder in which a piston is actuated by compressed-air controlled valve which is also used to release the air pressure to lower the piston.
- ii) The valve control the feeding pressure on the drill.
- iii) The air leg does not increase the rate of penetration or feed and it is used for drilling upto upto 2 M in height.
- iv) Where compressed air is the motive power for drill, air legs may be advantageously used to mount the compressed air drill.
- v) An air leg relieves the operator of the fatigue involved in holding the drill and keeping it pressed forward as the leg exerts an upward lift and a forward unfeeling pressure on the drill.

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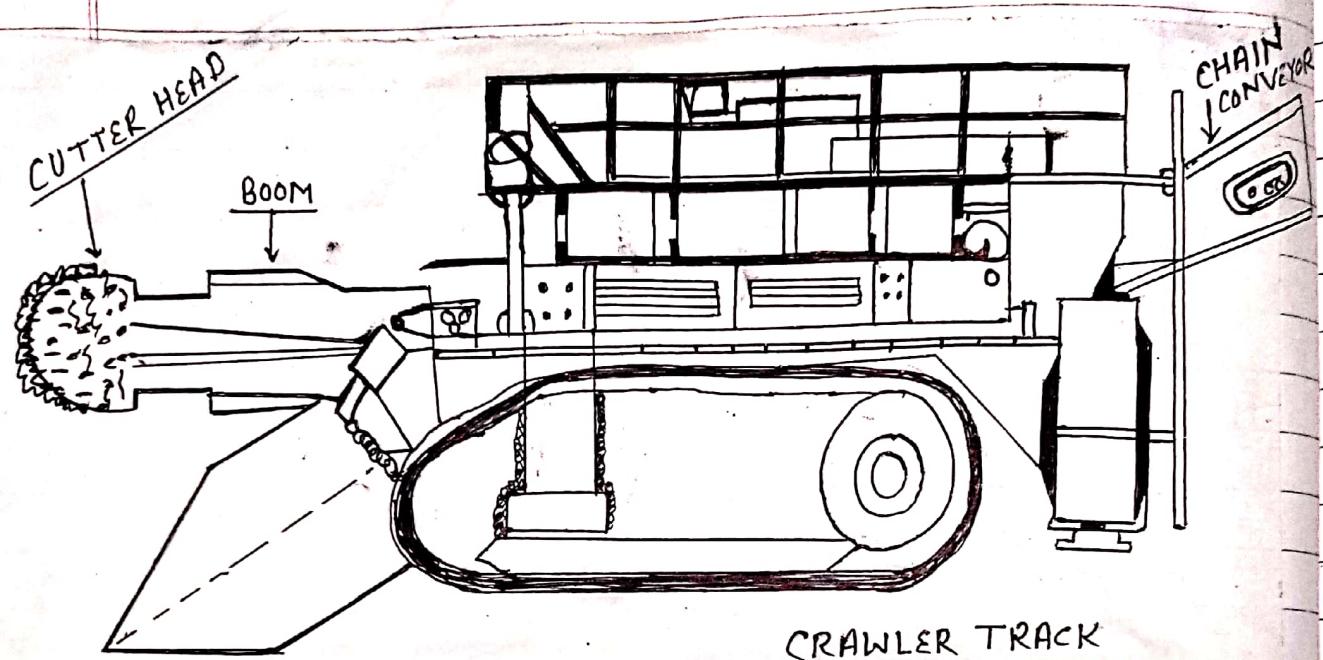
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- * Describe basic construction features and operation principle of road header.

* ROAD HEADER :-



- i) Road header is used for cutting Coal and driving roadways in sedimentary rocks in which Coal seam are found.
- ii) This Crawler mounted machine has a boom with a large Cutter head fitted with cutting picks.
- iii) As Cutter head rotates, the picks cut stone or coal which is gathered by its gathering arms into a chain conveyor situated in centre of the machine.
- iv) Chain conveyor moves the material to the rear of machine for loading into a belt conveyor through bridge conveyor.
- v) Boom can be moved up or down or sideways as required to cover the entire face.
- vi) Boom design of road header have two booms, some have batters fitted on them.

viii) Road header produces a lot of dust.

An automatic methane sensor fitted on road header cut off power to the methane machine automatically when CH_4 reaches 1.25% / or other valve or set.

ix) It has several FLP motor with a total power of 155 KW.

x) Road header is 7.5 - 10m long heavy machine

xi) Road header is stopped in case of interruption in working of auxiliary fan.

xii) It weight only 16 tonne and exert a ground pressure 924 N/m^2 .

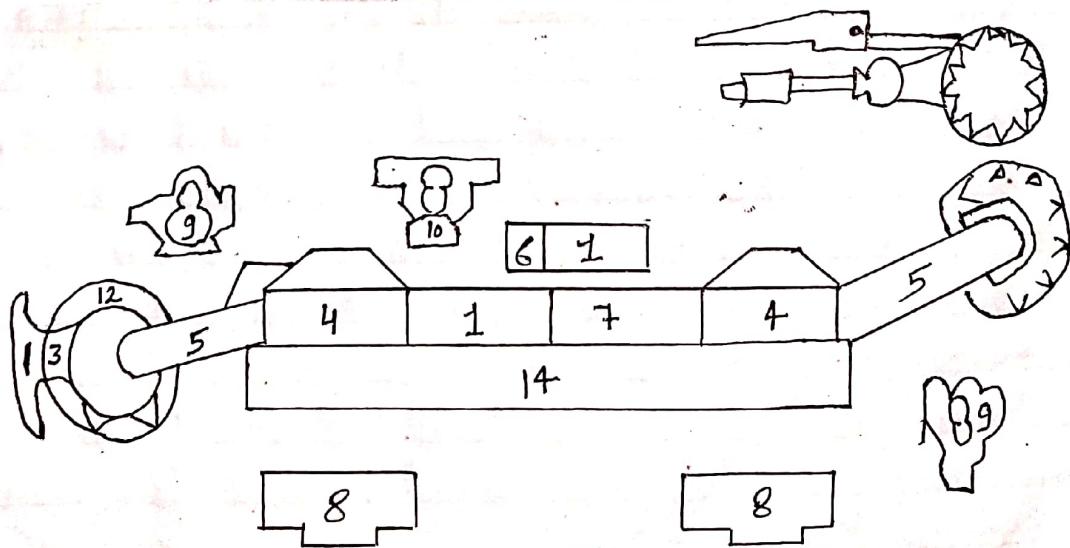
xiii) The truck are hydraulically operated even a working speed of 0.03 m/sec .

xiv) It has a cutting of 1.72m width.

xv) Road header have not been found cost effective in coal mines.

xvi) They are now used selectively where drivage in stone may be required.

* SHEARER-LOADER :-



- 1) Electric Motor
- 2) Hydraulic haulage pump box
- 3) Haulage gearbox
- 4) Gearhead gearbox
- 5) Ranging arm
- 6) Adopter box or radio control box
- 7) Power pack (chain less haulage machine only)
- 8) Underframe mounted chainless haulage fraction unit.
- 9) End mounted chainless haulage fraction unit
- 10) Intermediate box for chainless haulage fraction unit
- 11) Lumpbreaker on chain haulage or chain chainless machine.
- 12) Cutting drums
- 13) Powered Cowl
- 14) Roll steering.

- Longwall Shearer is a cutter loader for cutting coal on an longwall faces.
- It is mounted on armoured face conveyor (AFC) and runs on it with rack and pinion - rack on the AFC and pinion on the Shearer.
- A machine with two cutting drum (one in front and one in the rear end) is known as double end ranging drum shearer (DERD).
- The front drum cuts about 70% height from the floor and the rear drum balances 30%.
- It is popularly called shear in short is basically a normal Coal Water with the chain and jib replaced by a horizontally drum lifted with picks. The machine of 3 units.

1) Cutting units :-

- (i) It consists of a special gear box which drives a horizontal shaft towards the face.
- (ii) Shearing drums are shearing discs fitted in tension of the shaft.
- (iii) The shearing drum can be raised/lowered in a vertical plane with the help of a jacking for cutting various heights.

2) Haulage unit :-

- (i) The travel of Shearer Loader is effected with the shaft of chain haulage mechanical mechanical controls with hydraulic system.
- (ii) In the haulage system which is mechanically controlled only multi-fixed haulage speed are possible.
- (iii) In the hydraulic system operation by hydraulic control provides indefinitely variable speed & travel which varies from 0-0.12 m/sec

3) Motor unit :-

It provides power from 225 KW with the help of a single electric motor/two motors of a maximum voltage of 4.2 KW of 50 cycle 3 (Phase), AC Supply.

(THE END)

Bore Hole Pump

* Bore Hole Pump :-

A pump which is used in a borehole of a couple of cm diameter is called a borehole pump. Bore hole Pumps are multi stage turbine type pump used to deliver water from bore holes wells or shaft from depths ranging up to as much as 200m or more. Such pumps may be of two types.

1) Shaft driven bore hole pump.

2) Submersible Pump.

1) Shaft driven bore hole pump :-

The Water pump is driven by this gear and coupling. Make sure the bearing is good and that the seal surface is not grooved before reusing it.

2) Submersible Pump :- (ESP)

A Submersible pump is a device which has a hermetically sealed motor close-coupled to the pump body. The whole assembly is submerged in the fluid to be pumped. The main advantage of this type of pump is that it prevents pump cavitation a problem associated with a high elevation difference between pump and the fluid surface. Submersible pumps push fluid to the surface as opposed to jet pumps having to pull fluids. Submersibles are more efficient than jet pumps.

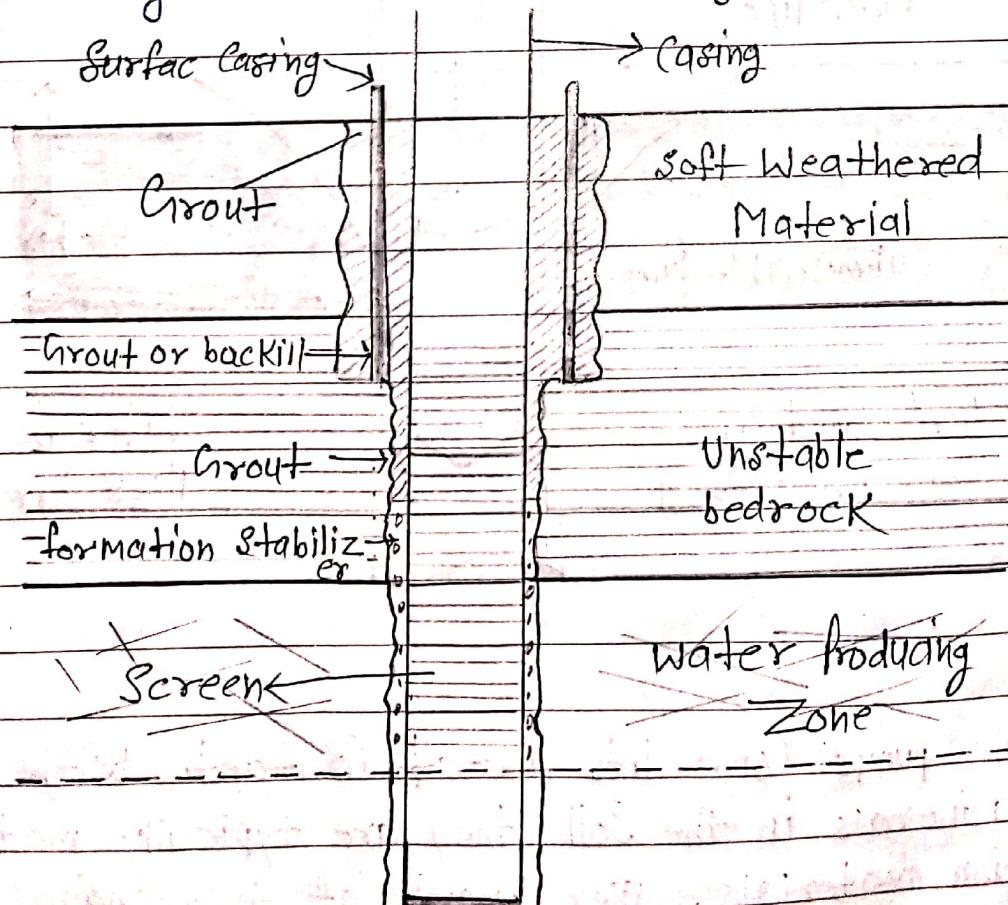
Bore Hole Pump Applicability Condition :-

- 1) In deep wells With the 200 mt. borehole pump is Suitable.
- 2) It is Suitable for driving and shaft.
- 3) In Washers borehole pump is Used.
- 4) Borehole pump is Used, Where Several longs of HP is required.
- 5) In shortage of electrical energy borehole pump is Suitable option.

* Construction (Bore hole Pump) :-

Essentially it Consist of 2 parts, one at the surface and the other inside the borehole.

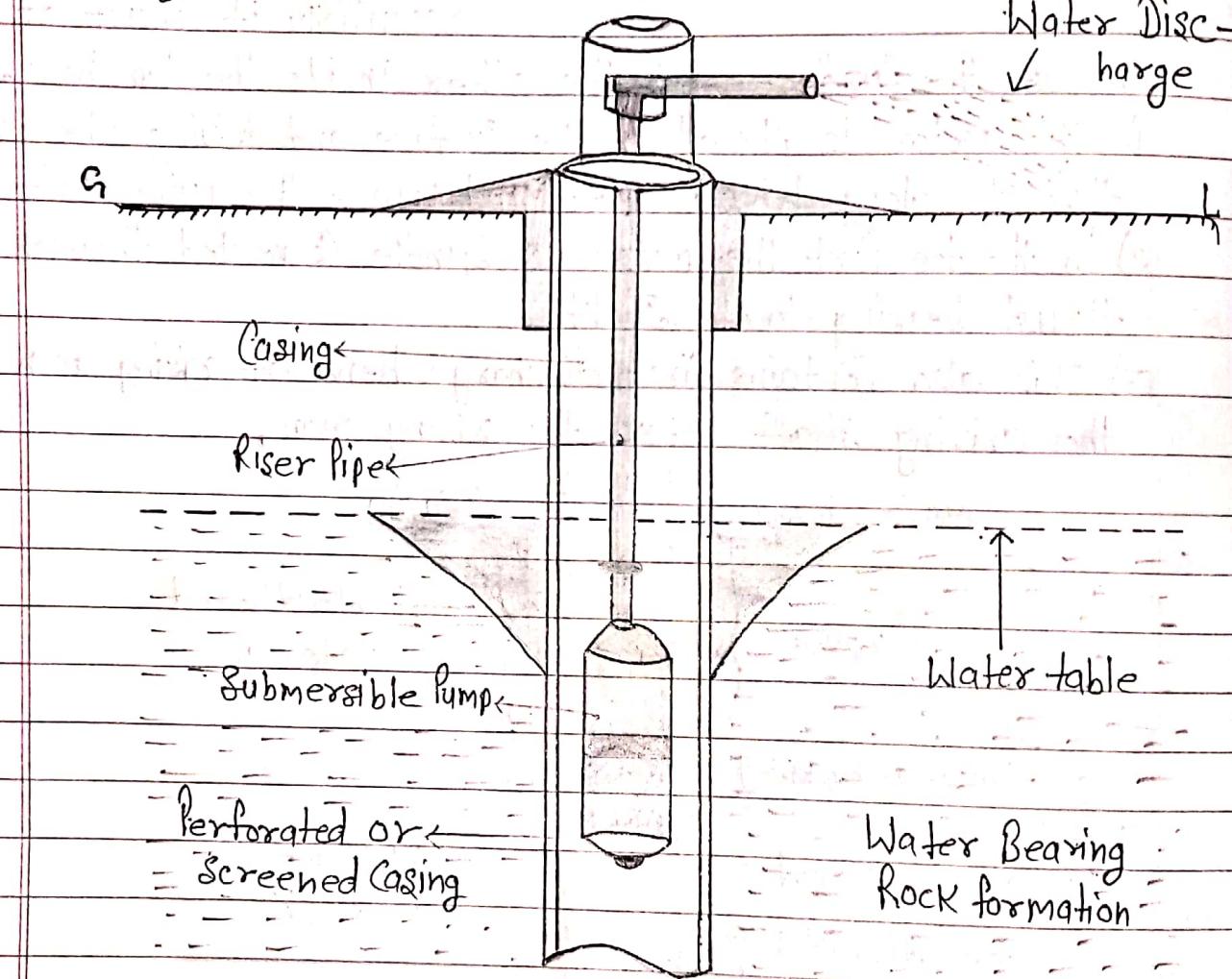
- 1) The motor is placed in the Surface and driving the pump through along driving shaft and lower the pump unit is placed.
- 2) In the top part the motor is spindle connected through a thrust bearing to the shaft.
- 3) This also contains first discharge bend of rising men where the driving shaft enters the rising man.



The lower part along with Suction pipe with strainer is suspended for the rising men the rising column.

- The rising column is supported by intermediate guide bearing.
- Impellers diffusers of pump are usually bronze.
- In this pump a strainer is attached at the end there is no foot valve.

*Working of bore hole pump.



Borehole pumps come into direct contact with minerals with minerals in the soil, they are typically made of corrosion materials. They consist of two main components a foot part that houses the pumping mechanism and makes

Contact with the fluid to be pumped, and the head part, which serves as the weight-bearing portion and the outlet for the fluid. Because boreholes are rounded and usually very narrow, there aren't many types of pumps that can fit inside. The best options are line shaft turbine pumps or submersible turbine pumps.

* Used :-

Borehole pumps are used in a variety of fields including irrigation, municipal water supply, construction, mining, and industry.

* Installation of bore hole pump :-

Before starting any work on the pump/motor, make sure that the electricity supply has been switched off and that it cannot be accidentally switched on.

- 1) Assembly of Motor Pump
- 2) Riser pipe
- 3) Cable Fitting
- 4) Lowering the pump
- 5) Installation Depth

1) Assembly of Motor Pump :-

Couple the pump and the motor properly along the same axis and insert the motor shaft in the pump shaft joint. The coupling must not be forced.

- 2) Riser pipe :- A tool, e.g. a chain pipe wrench, is used when the riser pipe is fitted to the pump,

The pump must only be gripped by the pump discharge Chamber.

3) Cable Fitting :- Cable ties must be fitted every 3 metres to fix the Submersible drop Cable and the Straining Wire, if fitted, to the riser pipe of the pump.

4) On Lowering the Pump :- It is recommended to check the well by means of an inside Calliper before lowering the pump to ensure unobstructed passage.

Installation Depth :-

The dynamic water level should always be above the suction motor adaptor of the pump. The minimum safety margin should be 1 metre head at the bore's lowest water level. When the pump has been installed to the required depth the installation should be finished by means of a Depth seal. Slacken the starting wire so that it becomes unloaded and lock it to the depth seal by means of wire locks.

Abhishek

CHAPTER - 05 (PIPES AND VALVES)

Question \Rightarrow Discuss the Pipe line layout.

(OR)

\Rightarrow State the Procedure of Supporting the Pipe in Shaft.

\Rightarrow Laying Pipe lines in Shaft is very labour consuming as the work is enclosed for preparation delivery of pipe.

\Rightarrow Installation of Pipes and fitting and Pipe line testing in Shaft for a raising Steel pipes may be inlet.

\Rightarrow It is lighter in weight therefore much more convenient to handle and easier to support in the shaft.

\Rightarrow The Steel Pipe is cheaper but they are affected by acidic water.

\Rightarrow To prevent the action of mine water the inside of such pipes are handle but they are good for rough and are not affected by acidic water.

\Rightarrow Therefore Cast iron pipes are most common for installation in shaft ranges.

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CHAPTER-02 OPEN CAST Machineries (only one Ques)

* Difference between electric Shovel and diesel Shovel.

S.N	ELECTRIC Shovel	DIESEL Shovel
(i)	It is used where electric power is available	It is used where electric power is not available i.e. in remote location.
(ii)	It has moderate digging characteristics.	It has a good digging characteristics.
(iii)	Applicable for doing any work from shorter to longer duration.	Applicable for doing a particular work for a shorter duration.
(iv)	Cycle time is less as compared to a diesel Shovel.	Cycle time is more.
(v)	Machine available time is very provided there is no interruption of power	Machine available time is moderate.
(vi)	It has low operation and maintenance cost longer life	It has high operation and maintenance cost and shorter as compared on electric Shovel.

SHORT TYPE QUESTIONS ON TWO NUMBER

Ques :- Define Water Hammer.

Ans :- When a moving Column of Water is suddenly come to rest then it begins to stroke of the various parts of the pump. The pump is liable to break down by due to great impulsive force and violent shocks. The phenomenon of knocking is called as Water hammer.

• Main reason for a Water hammer.

- i) If the Suction pump is too high.
- ii) If the Suction range is long.
- iii) When the Valve has been become defective.

Ques - Write use of Electric Coal drill.

Ans - The Coal drill is used not only for coal but other rocks in Coal mines except very hard grades of stones.

Ques - Define air Vessel.

Ans - An air Vessel is cast iron closed chamber having an opening at its base through which the Water flows into the vessel on from Vessel.

- It also helps in saving the power lost in orilating head.
- The Purpose of using the air Vessel to obtain Uniform discharge from the reciprocating pump.

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Ques- What is three throw Ram pump.

Ans- This type of pump consists essentially of three single acting ram pumps side, either vertical or horizontal, and driven from a triple crank-shaft with cranks set at angles of +20 degrees. The three-throw pump can deal with heads up to 1,000 yd (900m) in a single lift.

Ques- Name the various type of pipe joint in mines.

Ans- Pipe Joint :- Pipes are lengthened by the use of joint and coupling the different types of joint in a pipe range are.

- a) Loose - Flange joint.
- b) Spigot and faucet joint.
- c) The Union joint.
- d) Expansion joint.

Ques- Define Reciprocating Pump.

Ans- • Reciprocating pump are used increase the energy level of water by virtue of which it can be raised to a higher level.
• The use of reciprocating pumps is being limited these days and being replaced by Centrifugal pumps.
• Reciprocating pumps are positive displacement pump, i.e. - Initially, a small quantity is taken into a chamber forced out with pressure by a moving mechanical elements.

Ques- Define - Priming

- Ans- • Priming of a pump is very essential step in start up of a Centrifugal pump. Fact is that Centrifugal pump are not capable of pumping air or Vapours.
- Priming is the process in which the impeller of a centrifugal pump will get fully submerged in liquid without any air trap inside. This is especially required when there is a first start up.

Ques- Define Cycle time.

Ans- It is the total time taken by the shovel to complete one full cycle of operation starting from the crowding operation in the face. swing dumping and again come back to the face for crowding operation.

⇒ Digging + loading + hoisting + dumping + swing back time.

Ques- Explain axial end thrust.

Ans- It is the force generated due to the pressure inside the expansion joint. Pressure thrust is calculated by multiplying the area of mean bellow's diameter by the pressure.

Ques- Define dumping radius.

Ans- At a particular boom angle it is the horizontal distance between the vertical swing axis of the main body if the short and the vertical centre line of the backed When the boom are at their full extended position.

Ques- Define maximum cutting height of excavator.

Ans- It a particular boom angle. It is vertical distance between Where the shovel rest and the top most point of the bucket Where the boom are at their full extended position.

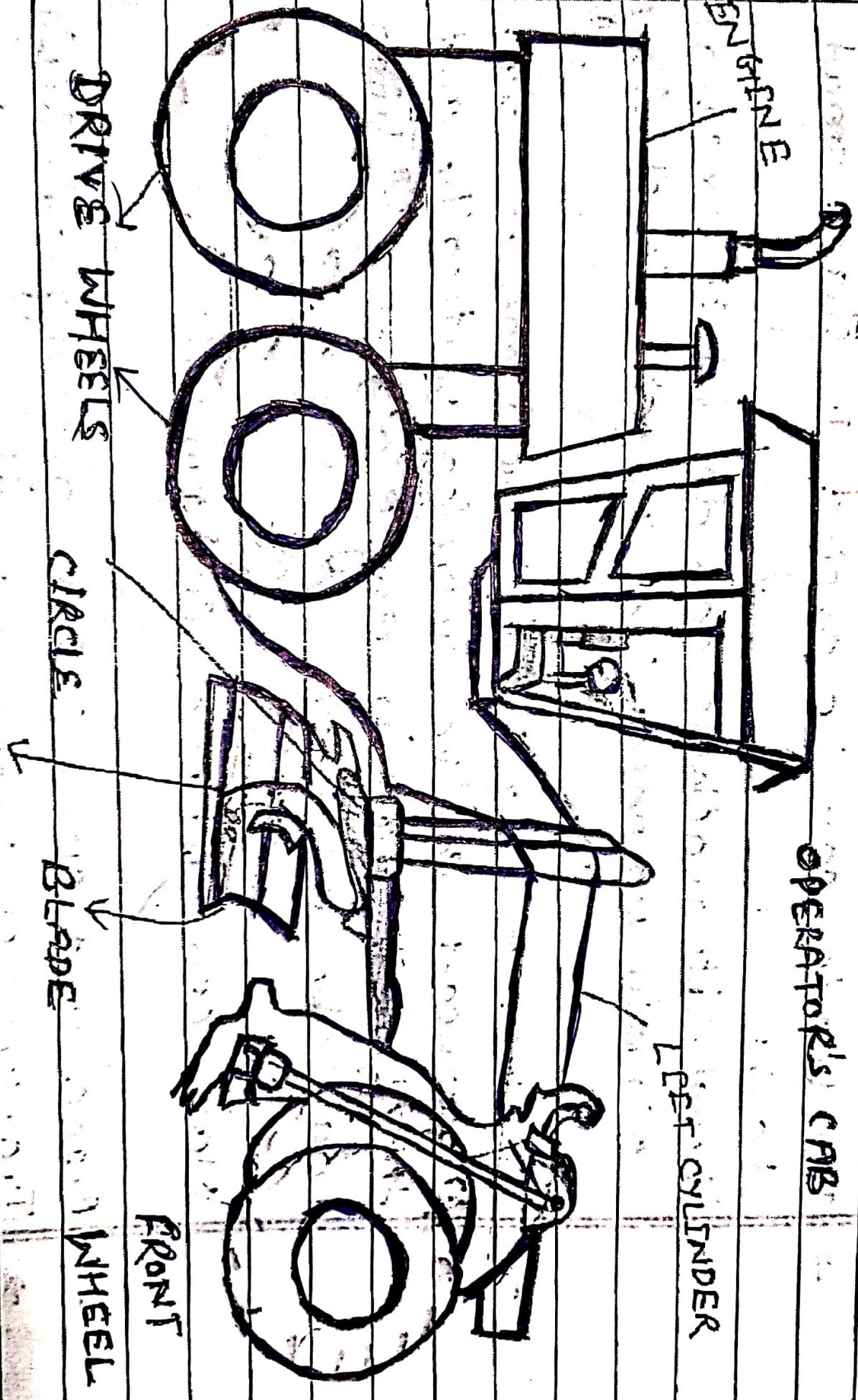
Ques- Define Bucket fill factor.

Ans- It is the ratio between the actual volume of the material inside the bucket in the Volume of the bucket Whole multiplied by 100. Mathematically,

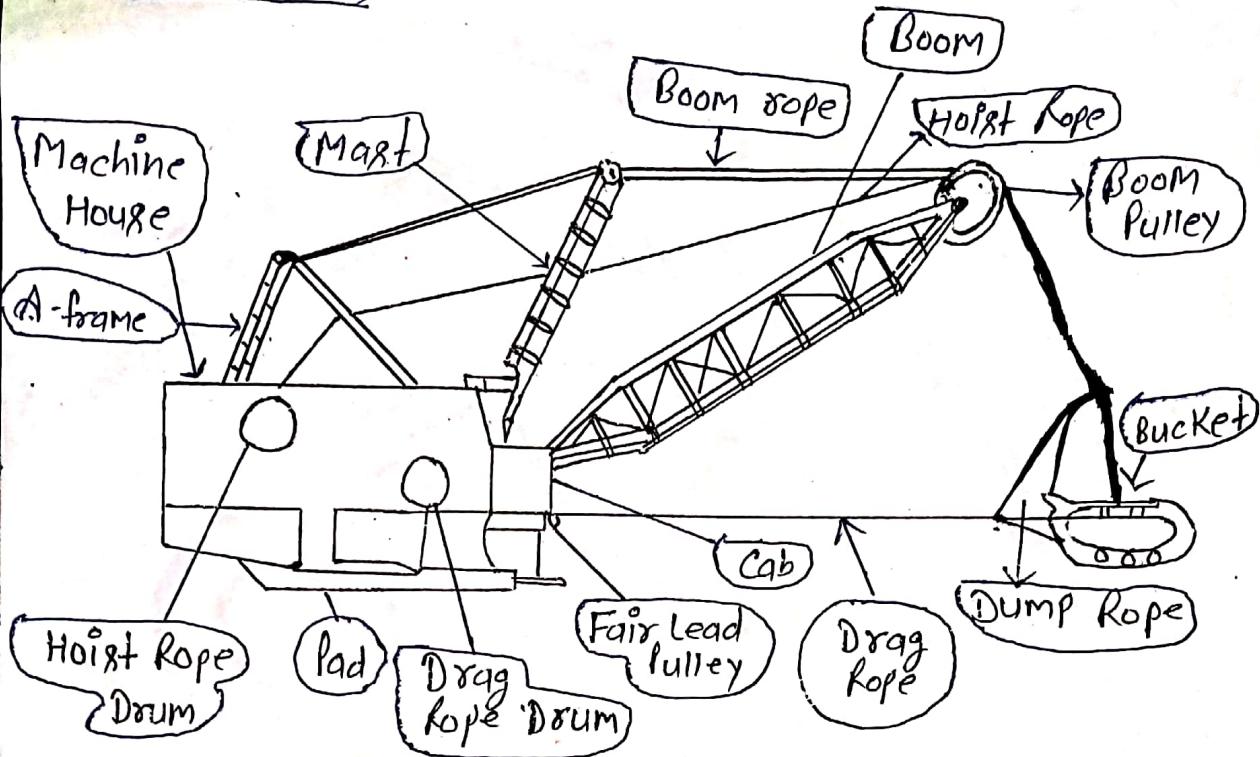
$$\text{Bucket fill factor} = \frac{\text{Actual volume of material inside the bucket}}{\text{Volume of bucket}} \times 100$$

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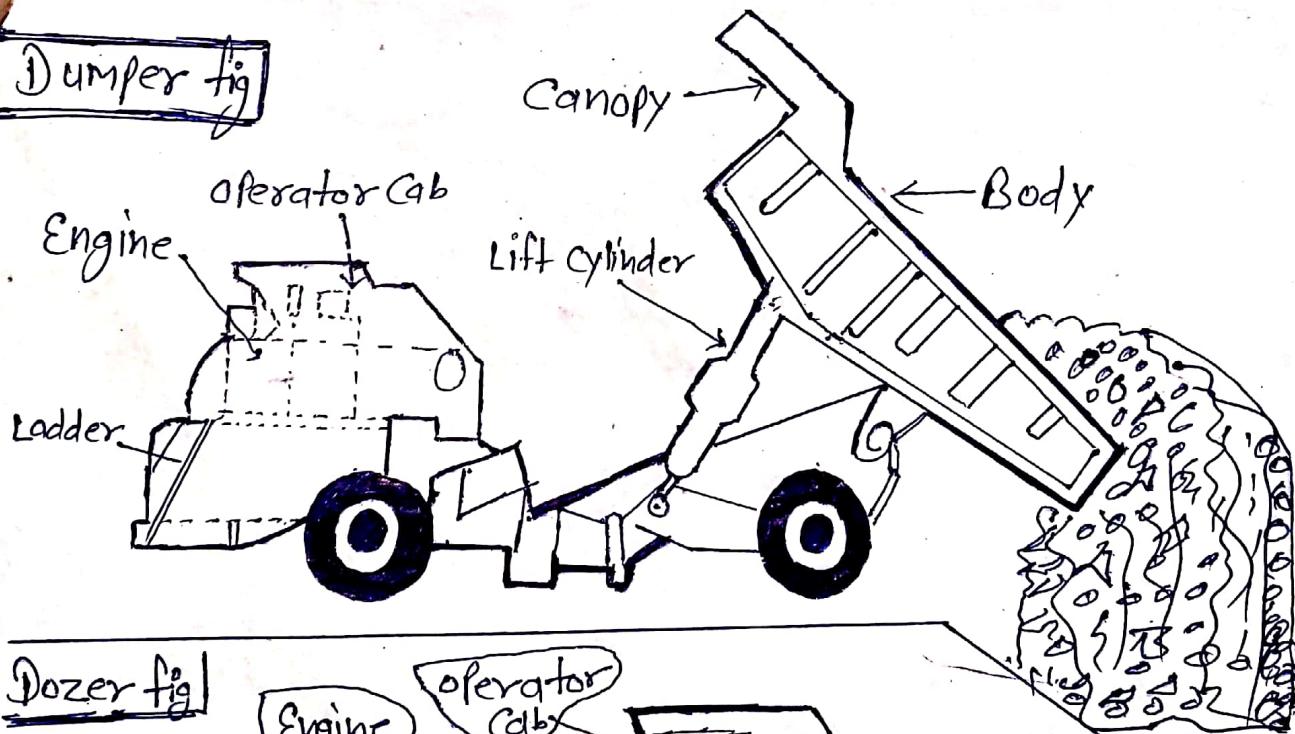
ROAD GRADER



Dragline fig



Dumper fig



Dozer fig

