EPF

Diplomawallah.in

Made by Raja Bhaiya

UPA

Chapter - 4.

1. classification of pumps
2. Explain the working principle of centrifugal pump and its application.
3. Explain the working principle of monoblock and its application.

Pumps :

The hydraulic machines which convert the mechanical energy into hydraulic energy are called pumps.

The hydraulic energy is in the form of pressure energy.

* classification of pumps :-

- + Displacement Pump
  - Rotary pump
    - Gear
    - rotor
    - → Vane pump
    - → Can & piston Pump
    - → Lobe pump
    - → Screw pump
    - → Gear pump — internal gr / External gr.
  - Reciprocating Pump
    - Piston
    - → Piston Pump
      - (I) Single acting pumps
      - (II) Double " "
    - → Plunger pump
    - → Diaphragram pump.
- Non + Displacement Pump or Dynamic pump
  - Impeller
  - Impeller rotor
  - Dynamic pump
    - → special effect P.
      - (I) Jet pump
      - (II) Electromagnetic Pump
    - → centrifugal pump
      - (I) Axial flow pump
      - (II) Submersible pump
      - (III) Radial flow pump
      - (IV) Mixed flow pump.

A pump is a mechanical device used to move liquids, gases, or slurries from one location to another. It typically works by applying mechanical energy to the fluid to increase its pressure or velocity. Pumps are essential in various applications. Such as in water supply systems, oil pipelines, HVAC systems, medical devices & more.

1. Based on operating principle :-

(i) Positive displacement pumps : These pumps operate by trapping a fixed amount of fluid and displacing it through the pumps mechanism.

Types :-

(i) Reciprocating pumps
- Piston pump
- Plunger pump
- Diaphragm pump

(ii) Rotary pumps
- gear pump
- vane pump
- Screw pump
- lobe pump.

(ii) Dynamic (Non-positive Displacement pump).
These pumps impart energy to the fluid using a rotating impeller or vane.

Types :-

(i) Centrifugal pumps
- Radial flow pump
- Axial flow pump
- Mixed flow pump

(ii) special pumps
- Jet
- Airlift pump.

2. Based on fluid motion :-
(i) Rotary pumps (eg. gear & screw pumps).
(ii) Reciprocating pumps (eg. piston & diaghragm P.)

3. Based on orientation
(i) Horizontal pumps
(ii) vertical pumps.

4. Based on fluid handled :-
   (i) water pumps (for clean or slightly contaminated water).
   (ii) Slurry pumps (for handling slurry or highly contaminated fluid).
   (iii) Oil pumps (e.g. for lubricating oils or crude oil)
   (iv) Chemical pumps (e.g- for corrosive liquids).

5. Based on driving Mechanism :-
   (i) Electric motor - Driven pumps.
   (ii) Engine driven pumps
   (iii) Manual pumps (e.g. hand - operated).
   (iv) Steam - driven pumps.

6. Based on Application :-
   (i) Domestic pumps (e.g- submersible pumps for sells)
   (ii) Industrial pumps (e.g- centrifugal pumps for factories).
   (iii) Agricultural pumps (e.g.- Irrigation pumps).
   (iv) Municipal pumps (e.g.- water supply & waste water treatment).

A) + Displacement pumps.
   → Move a fixed amount of fluid with each cycle - provide a high - pressure output.
   → Flow is constant, regardless of pressure.
   → Best for high - viscosity fluids and precise flow control.
   → Example :- Piston pumps, diaphragm pumps, gear pumps.

① Rotary pump : It is a type of + displacement pump that uses a rotating element to move fluid through the pump.

• operation :

- The pump consists of a rotor, stator, and pumping chamber.
- The rotor is eccentrically mounted and rotates inside the stator.
- As the rotor rotates, it creates a vaccum in the pumping chamber.
- Fluid entres the pumping chamber through the inlet.
- The rotor pushes the fluid through the outlet.

• Types

1) Grear pump : uses interlocking gears to move fluids.
2) Lobe pump : uses rotating lobes to move fluid.
3) Screeo pump
4) vane pump.

• Advantages

- High efficiency due to their + displacement design.
- Loco pulsation :- provide smooth floco coith loco pulsation.
- can handle high pressure

Date
Page

- Applications :

1). Rotary pumps are used to in chemical Processing plants to handle corrosive and abrasive fluids.

2). " " " " " food processing plants to handle viscous and non-viscous fluids.

3). " " " " " used in pharmaceutical plants to handle high-purity fluids.

4). " " " " " used in oil and gas appn to handle crude oil and other petroleum product.

(2) Reciprocating pump: It is a type of + displacement pump that uses a piston or plunger to move fluid through the pump.

- operation

- The pump consists of a piston or plunger, cylinder, and valves.
- The piston or plunger moves back and forth in the cylinder, creating a suction & discharge stroke.
- During the suction stroke, the piston or plunger moves away from the valve, creating a vaccum that draws fluid into the cylinder.
- During the discharge stroke, the piston or plunger moves towards the valve, pushing the fluid out of the cylinder

- Types

1) Single-acting pump: fluid is pumped only during one stroke (either suction or discharges).
2) Double-" " : " " both suction and discharge strokes.
3) Diaphragm pump: uses a flexible diaghragm instead of a piston or plunger.

- Advantages:

- for industrial processes, such as manufacturing oil and gas and chemical processing.
- used in coater supply system to provide drinking coater and irrigation.
- used in power plants to provide cooling coater

and other fluids.
- are used in marine applic.

(B) non + Displacement pump or dynamic pump: also known as a non-positive displacement pump, is a type of pump that uses a rotating impeller to increase the velocity of a fluid, which in turn increases the pressure of the fluid.

① special effect pump
- Jet pump - It is a type of pump that use the principle of fluid dynamics to create a pressure diffⁿ, which drives the fluid flow. It consists of a nozzle, a venturis, and a diffuser.

- Electromagnetic pump: It is a type of pump that uses electromagnetic forces to move fluids.

It consists of a coil, a magnetic field, and a fluid channel.

(2) centrifugal pump : It is a type of pump that uses a rotating impeller to increase the pressure of a fluid. It is one of the most common types of pumps used in various industries.

or

The hydraulic machine which converts mechanical energy into pressure energy by means of centrifugal force acting on the fluid is called centrifugal pump.

1.t

- working principle : A centrifugal pump operates based on the principle of centrifugal force. It uses a rotating impeller to impart kinetic energy to the fluid, which is then converted into pressure energy as the fluid leaves the impeller.

1.t

- steps in operation :-

i) Priming : The pumps in filled with fluid to remove air and create a continuous flow.

ii) Fluid entry : The fluid entres the pump through the suction pipe and move to the centre of the impeller (the ~~edge~~ eye of the impeller).

iii) Impeller rotation : The rotating impeller blades ~~impart~~ impart kinetic energy to the fluid, causing it to move radially outward.

iv) Energy conversion : As the fluid moves outward, its velocity decreases and the kinetic energy is converted into pressure energy.

v) Fluid exit : The high-pressure fluid exits the pump through the discharge pi

jt. * Applications of centrifugal pumps :-

(i) water supply systems :- for domestic and industrial water supply.
(ii) Irrigation : In agriculture to transfer water
(iii) chemical industry : To handle chemicals, oils and slurries.
(iv) waste water management :- To pump sewage or wastewater.
(v) Power plants :- in cooling systems or boiler feedwater systems.
(vi) oil and gas industry : for transporting, petro leum and related products.

sunil • Components :

1) Impeller : The rotating component that increas the pressure
2) casing : The stationary component that houses the impeller and directs the fluid flow.
3) Shaft : The rod that connects the impeller to the motor or engine.
4) Bearing : The component that supports the shaft and allows it to rotate smoothly

- Types

1). Radial flow pump: The impeller is designed to produce a radial flow pattern.

2). Axial flow pump: The impeller is designed to produce an axial flow pattern

3). Mixed flow pump: The impeller is designed to produce a combination of radial and axial flow pattern.

- Advantages:

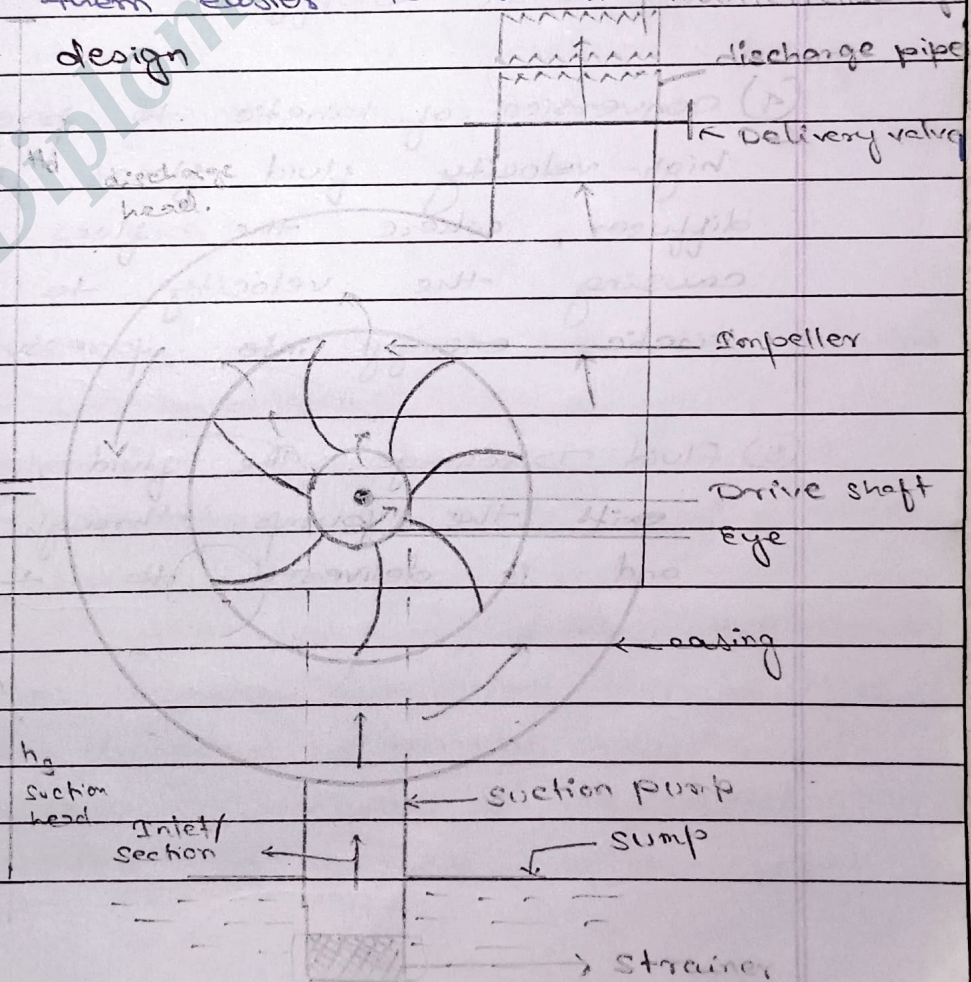
(1) High flow rates: can handle high flow rates.

(2) High efficiency

(3) low maintenance: have fewer moving parts, making them easier to maintain. outlet/discharge

(4) compact design

- Diagram:



How it works :

(1) Rotation of Impeller : The pump has a rotating impeller powered by an electric motor or engine. When the impeller rotates, it imparts kinetic energy to the fluid inside the pump casing.

(2) Fluid enters the pump : The fluid enters the pump through the suction side, typically through the eye of the impeller.

(3) Fluid Accel^{n} :- As the impeller blades rotate, they push the fluid outward (radially) from the centre (eye) of the impeller to the outer edges. This cause the fluid to gain velocity and kinetic energy.

(4) Conversion of kinetic to pressure energy : The high-velocity fluid flows into the volute or diffuser, where the flow area increases, causing the velocity to drop and converting kinetic energy into pressure energy.

(5) Fluid Discharge : The fluid, now under high pressure exits the pump through the discharge pipe and is delivered to the required location.

3) # Explain the working principle of monoblock and its application.

A monoblock pump is a type of centrifugal pump where the motor and pump are integrated into a single unit (shaft). It eliminates the need for separate couplings, resulting in a compact design and reduce energy loss. It works on the principle of centrifugal force, which is generated by a rotating impeller.

- Working principle: A monoblock pump is based on the principle of centrifugal force. It uses a rotating impeller to impart kinetic energy to the fluid, which is then converted into pressure energy as the fluid leaves the impeller.

- Steps in operation :-

(i) Suction : Liquid is drawn into the pump's suction inlet.

(ii) Impeller rotation : The impeller, connected, connected to the motor shaft, rotates at high speed.

(iii) C.f : As the impeller spins, it imparts kinetic energy to the liquid. The liquid is thrown outward due to c.f.

(iv) Volute casing : The liquid is directed into the volute casing, a spiral-shaped chamber.

(iv) Pressure conversion : In volute casing, the K.E. of the liquid is gradually converted into Pressure energy.

(vi) Discharge : The pressurized liquid is then discharged through the pump's outlet.

Application :

(i) Agricultural irrigation : for watering crops in fa
(ii) Domestic water supply : to supply water to home and apartments.
(iii) Industrial use : cooling systems, liquid transfer & handling chemicals.
(iv) HVAC systems : Circulating water in heating, ventilation, and air conditionings systems.
(v) Dewatering : Removing water from construction sites or mines.

Advantages :

(1) Compact design : Saves space and reduce installation costs.
(2) High efficiency : Efficient energy conversion, leading to lower operating costs.
(3) Ease of Maintenance : Simple design and easy access to components.
(4) versatility : Available in various sizes and configurations to suit different needs.
(5) Reliability : Durable construction and robust components ensure long service life.

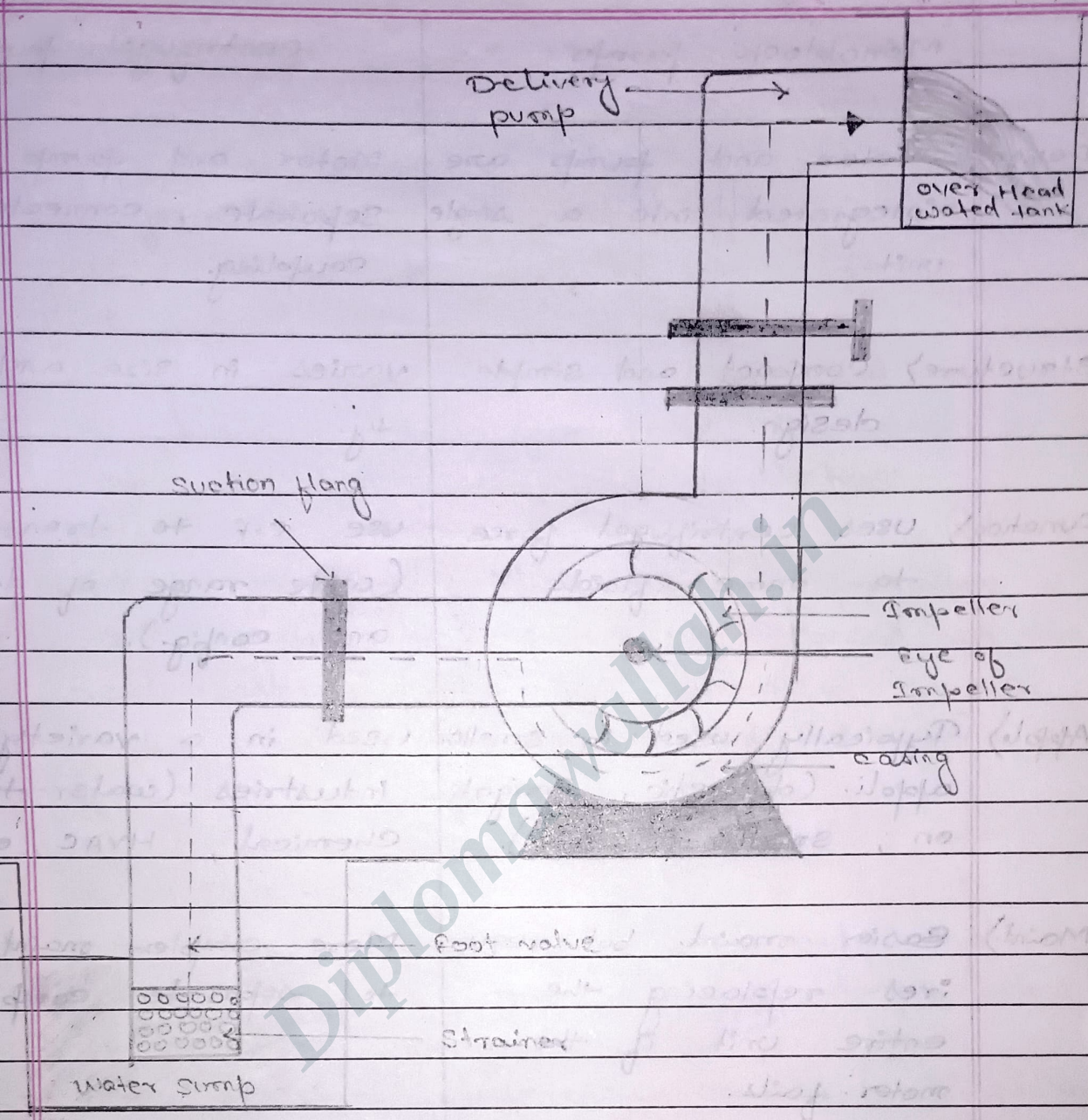


Fig :- Monoblock pump

	Monoblock pumps	centrifugal pumps
Design)	Motor and pump are integrated into a single unit.	Motor and pump can be separate, connected by a coupling.
Structure)	compact and simple design.	varies in size and complexity.
Function)	uses centrifugal force to move fluids.	use c.f to transfer fluids (wide range of designs and config.).
Appl.)	Typically used in smaller appli. (domestic, irrigation, small industries).	used in a variety of industries (water treatment, chemical, HVAC, etc).
Maint.)	Easier maint. but requires replacing the entire unit if the motor fails.	More complex maint. due to separate comp.
cost).	cost-effective for smaller systems.	generally more expensive, especially for larger or industrial system.

Reciprocating pump: A reciprocating pump is a type of positive displacement pump that operates using a piston or plunger moving back and forth (reciprocating motion) within a cylinder to transfer fluid.

- It is designed to handle a fixed volume of liquid per cycle and is ideal for high-pressure, low-flow applications.

* Working principle: The working principle of reciprocating pump is based on the reciprocating motion of piston or plunger which creates a suction and discharge effect in a cylinder.

(i) Suction stroke.

- As the piston moves backward, the pressure in the cylinder drops below atmospheric pressure.
- This pressure difference causes the suction valve to allowing the fluid to flow into the cylinder.

(ii) Discharge stroke:

- As the person moves forward, it compresses the fluid in the cylinder, increasing its pressure.
- The increased pressure causes the discharge valve to open, forcing the fluid out through the delivery pipe.

This cycles repeats, delivering fluid at high pressure and in a pulsating flow.

* components of a Reciprocating pump :-

(i) cylinder :- houses the piston / plunger

(ii) Piston or plunger :- reciprocates to move the fluid.

(iii) Discharge valve : opens during the discharge stroke to eject fluids.

(iv) suction valve : opens during the suction stroke to allow fluid entry.

(v) Crankshaft and connecting rod : convert rotary motion of the motor into reciprocating motions of the piston.

(vi) Air vessel : reduces flow pulsations and maintain steady pressure.

* Applications of Reciprocating pumps.

(i) Oil and gas industry :- injection of chemicals or oils at high pressures.

(ii) water supply : for wells and municipal water systems.

(iii) Industrial application : for pumping viscous liquids in hydraulic systems.

(iv) Irrigation : for small-scale irrigation systems

(v) Power plants :- as boiler feed water pumps.

(vi) chemical industry : for accurate fluid metering and high pressure delivery

Advantages :-

- can handle high pressure
- can provide high flow rates.
- are efficient, especially for low-flow, high-pressure applications.
- have a compact design.

• Types :

(1) Single-Acting Pump : Fluid is pumped only during one stroke (either suction or discharge).

(2) Double-" " : " " " " both suction and discharge stroke

(3) Diaphragm pump : uses a flexible diaphragm instead of a piston or plunger.

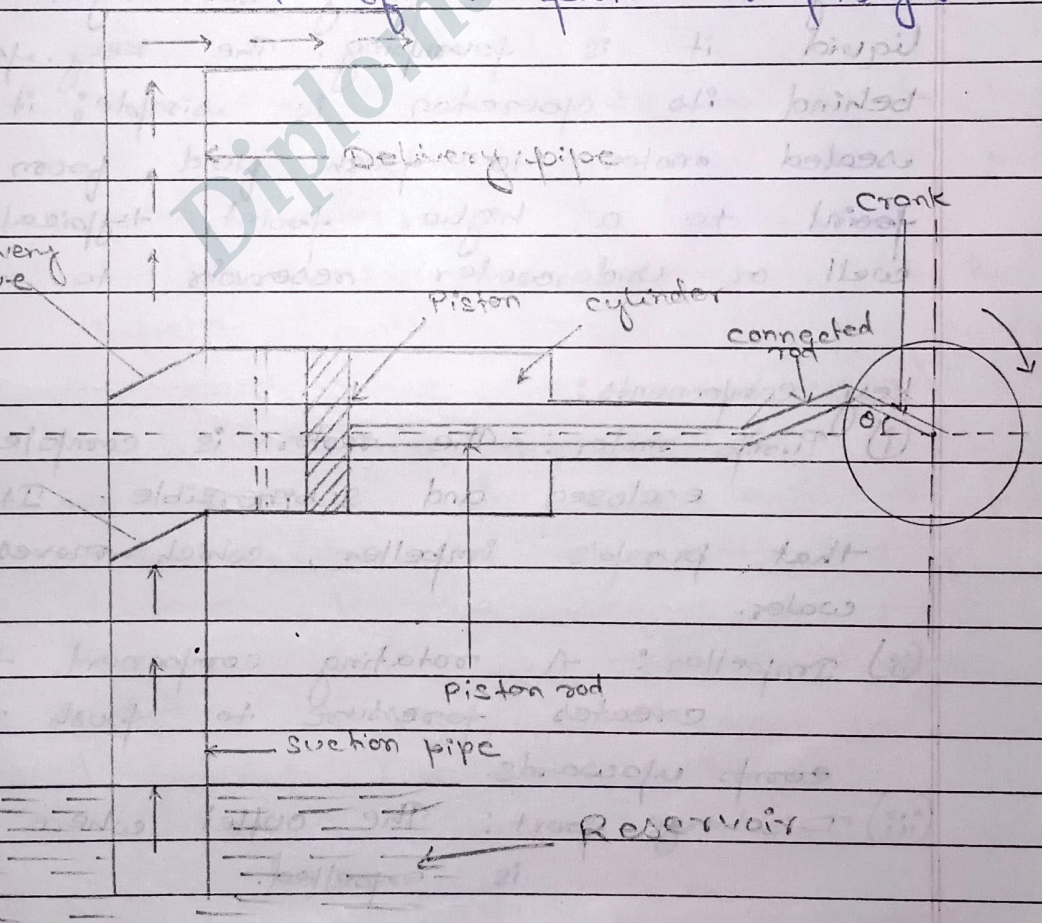


fig: reciprocating pump.

hermetically → air tight
ingress → entrance

Chapter - 5

(1) Explain the working principle of submersible pump and its application.
(2) Explain the working principle of reciprocating pump and its application.
(3) Select a suitable pump for a given application.

Submersible pump: A submersible pump is a device designed to operate while fully submerged in the fluid and it is pumping. It uses a hermetically sealed motor to prevent water or fluid ingress.

Working Principle: or

A submersible pump is a type of pump designed to be fully submerged in the liquid it is pumping. The key principle behind its operation is simple: it uses a sealed motor to push fluid from a lower point to a higher point, typically from a well or underwater reservoir to the surface.

Key components:

(i) Pump motor: The motor is completely enclosed and submersible. It drives that pump's impeller, which moves the water.

(ii) Impeller: A rotating component that creates pressure to push the liquid upwards.

(iii) Discharge port: The outlet where the water is expelled.

(iv) casing: The casting surrounds the motor and impeller to protect them and prevent leakage.

(v) Suction: water enters the pump through the intake port, where the impeller draccons it in.

(vi) Power cable: Provides electrical ~~for~~ protection against damage while submerged.

working process:-

(1) submersion: The pump is placed below the water surface, typically at the bottom of a well or reservoir

(2). Motor Activation: when powered on, the motors begins to ~~rem~~ turn the impeller inside the pump.

(3) water intake: The impeller spins, creating low pressure at the intake and drawing water into the pump.

(4). water compresion and ~~movement~~: As the impeller continues to spin, it increases the pressure of the water and pushes it up the discharge pipe.

(5). water Discharge: The water exits the pump through the discharge port and is delivered to the surface or to a higher point (eg. a tank or irrigation system).

Applications:

(i) Domestic applications:-

- water supply for homes from wells or tanks.
- Sewage pumping in basements.

(ii) Agricultural :-
- Irrigation from bore wells or rivers.
- Dewatering agricultural fields.

(iii) Industrial use :-
- pumping slurry in mining and construction.
- Oil and gas industries for transporting fluids

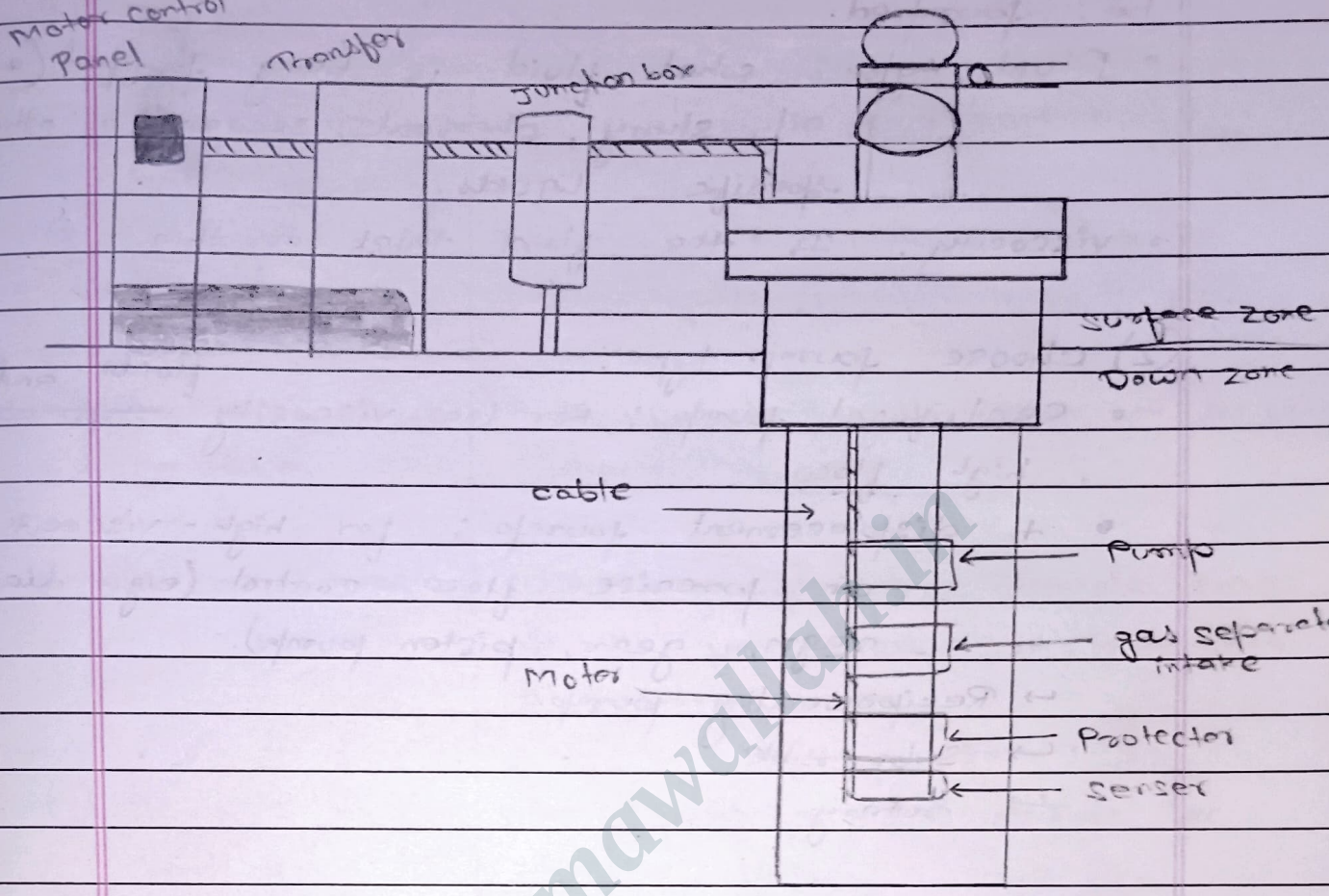
(iv) Municipal use : • waste water treatment plants.
• Drainage systems for flood control.

(v) Marine use : • emptying bilge water in ships.
- water wells
- Sewage & wastewater systems.
- Dewatering • Flood control • Aquariums & fountains
- Oil & gas industry.

* Advantages :
- operates silently since it's underwater.
- No need for priming as it remains submerged.
- Energy - efficient due to minimal fluid lifting requirements.
- Durable in harsh conditions like underwater.

↳ High efficiency.
↳ durable
↳ Space - saving

Disadvantages :
↳ complex maintenance
↳ power consumption
↳ risk of overheating.



Submersible pump.

Selection of a suitable pump :

Selecting a suitable pump for a given application involves evaluating several factors based on the operating requirements and fluid characteristics.

(1) Identify requirements

- Flow rate : required volume of fluid to be moved (measured in litres per second, gallons per minute etc.).
- Head / Pressure requirements : How high or at what pressure does the liquid need to

be pumped.

- Fluid type: what fluid is being pumped (water, oil, slurry, chemical, sewage, or other specific liquids.
- viscocity: Is the fluid thick or thin.

(2) Choose pump type:

- centrifugal pump: For low-viscosity fluids and ~~or precise~~ high flow
- + displacement pump: for high-viscocity or precise flow control (e.g.- diaphragm, gear, piston pumps).
  - ↳ Reciprocating pump.
  - ↳ Submersible
  - ↳ rotary

(3) Consider other factors:

- Efficiency and maintenance: Choose based on energy use and service needs.
- Power source: Electric, pneumatic, or other options.
- Environment: whether the pump operates in a submerged condition, open air or hazardous environment.

(4) For example:- For example clean water at high ~~pressure~~ flow, a centrifugal pump is a good choice.

* Pumps used for different applications.

	APPLICATIONS	SUITABLE PUMP
(i)	Domestic water supply	centrifugal P., Monoblock Pump or submersible pump.
(ii)	Agricultural irrigation	S.P for bore wells, C.P for surface water or M.P.
(iii)	chemical handling	Diaphragm pump or magnetic drive pump for corrosive or hazardous chemicals.
(iv)	Slurry & mud handling	slurry pump or C.P designed for abrasive fluids.
(v)	wastewater and seewage	Submersible seewage pump or RCP for heavy duty sludge
(vi)	oil and gas industry	gear pumps for lubrication oil, RC.P for metering and injection
(vii)	Boiler feedwater systems	High pressure C.P, or multistage P.
(viii)	High pressure systems	Rc P for low-flows high-pressure appl.