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Positive displacement pumps:

Positive-displacement pumps operate by forcing a fixed volume of fluid from the inlet pressure section of the pump into the discharge zone of the pump. The inlet and outlet are in the same dir.

Applications:

Used in systems where the flow required is steady and the possibility of stopping the flow is low.

Liquids used:

PDPs require the usage of high density and high viscosity fluids to tolerate the clearance in the pumps body itself.

Pressure:

- Positive-displacement pumps frequently are used in hydraulic systems at pressures ranging up to 5000 psi within mechanical limitations and theoretically, infinite pressure to move fluids.
- Regardless of the pressure at the inlet, the fluid is moved at the same speed.

Flow rates:

Since hydraulic power equals the flow rate multiplied by the pressure, the flow rates of PDPs isn't that big compared to DHPs

Use of relieve valve:

Because of the high pressure, the delivery pipe must not be closed or serious damage will occur to the pump, that's why a pressure relieve valve must be placed in parallel to the pump itself so whenever the deliver is clogged and pressure rises in the pump, the valve opens

For controlling the flow:

Controlling the speed of the motor is the only way to control the flow. (Other than replacing the pump with bigger/smaller pumps)

Check valves at suction side:

- Since rotary DHPs have the ability to reverse the flow simply by reversing the direction of spinning and since the absence of back flow, the use of check valves is not necessary.
- Reciprocating pumps WILL backflow if check valves are absent.

Use of filter:

PDPs are durable and will pump fluids with residuals in it. Since there is a limit to the size of the clearance, only big residuals should be filtered out.

Reversing rotation:

- Rotary PDPs can reverse flow by reversing the direction of spinning.
- Reciprocating PDPs can reverse flow simply by flipping the check valves (or flipping the pump itself)

Types:

- rotary (ex: gear pump, screw pump)
- reciprocating (ex: piston pump)

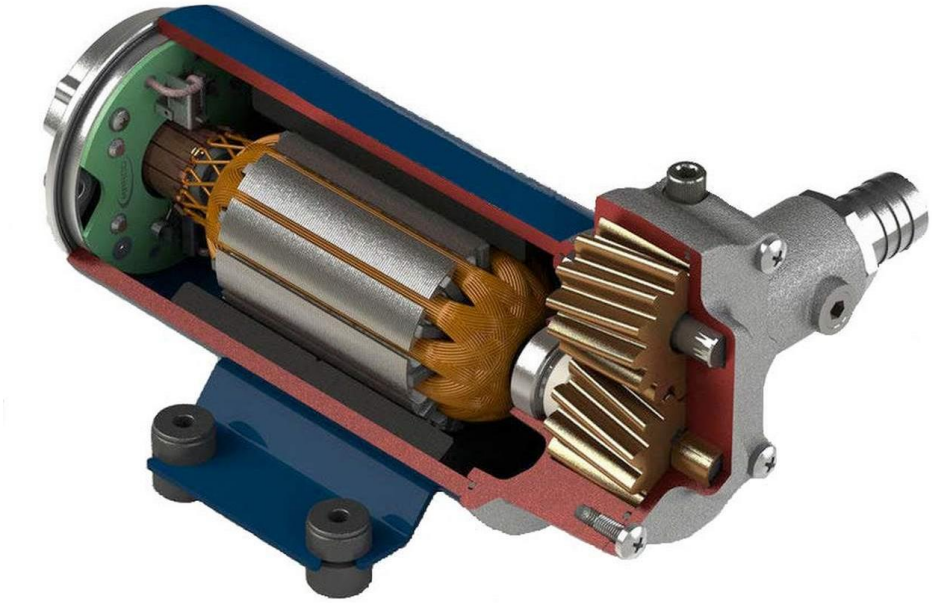

Figure 1 Gear Pump

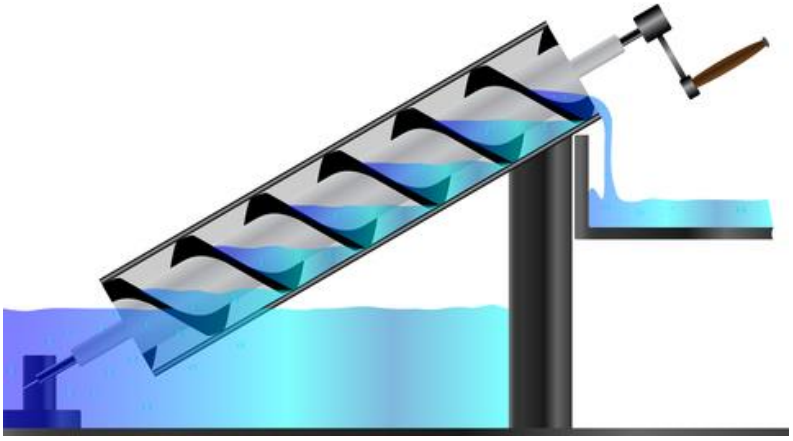

Figure 2 screw Pump

Figure 1 piston Pump

Rotodynamic pumps (dynamic head pumps):

A Rotodynamic pump is a device where mechanical energy is transferred from the rotor to the fluid by the principle of fluid motion through it.
These pumps are classified according to the main direction of fluid path through them like (i) radial flow or centrifugal, (ii) axial flow and (iii) mixed flow types

Applications:

The flow can be controlled so it is best used for variable demand systems.

Fluids used:

Lower in viscosity than PDPs to allow the shape of the impeller to take effect

Pressure:

The pressures are relatively lower. They are referred as constant pressure pump as the discharge pressure through these pumps cannot be varied without changing the physical conditions of the pump while PDP are referred as constant discharge pumps because the volume/gap between the piston & cylinder in these pumps are constant.

Flow rate:

The flow rate is higher. . Also flow rate is affected by the pressure at the inlet.

Use of relieve valve:

There is no need because when the delivery side is closed, the fluid will just rotate inside the impeller (it will heat up eventually but no immediate danger)

For controlling the flow:

The same principle exists: controlling the speed of the impeller

Check valves at suction side:

There is no need for backflow doesn't exist

Use of filter:

There are multiple choices for the shape of impellers themselves each can tolerate a certain amount of impurities. However, the more resilient the impeller, the less efficient the pump.

Reversing rotation effect:

Because the rotodynamic pumps depend on how the fluid reacts upon moving on the impeller itself, reversing the direction of the flow will not allow the pump to work.

Examples:

Radial flow pipes, axial flow pipes and mixed flow pipes

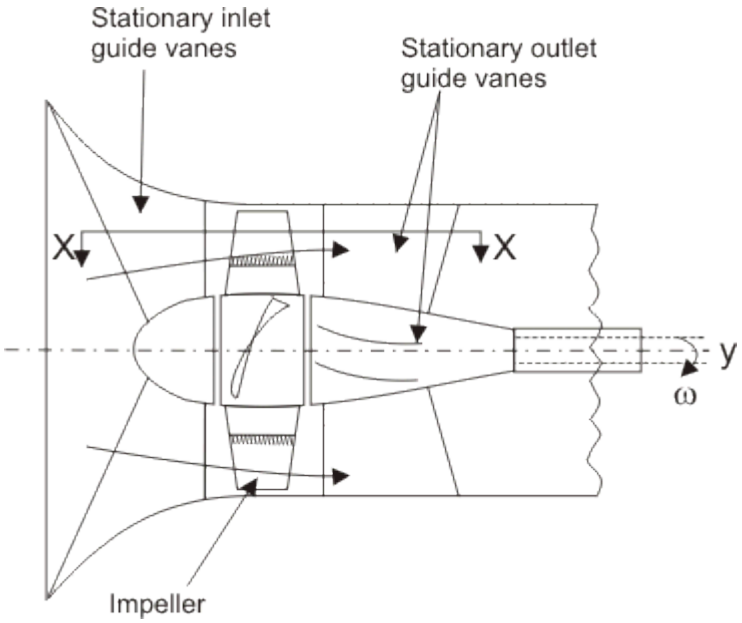

Fig4. Axial flow pump

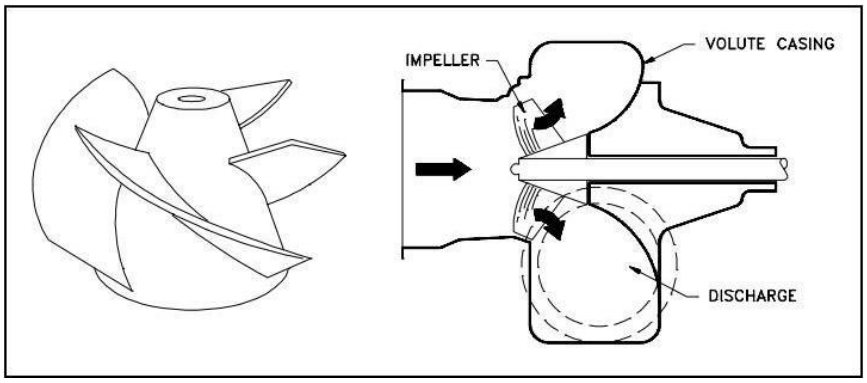

Fig5. Mixed flow pump

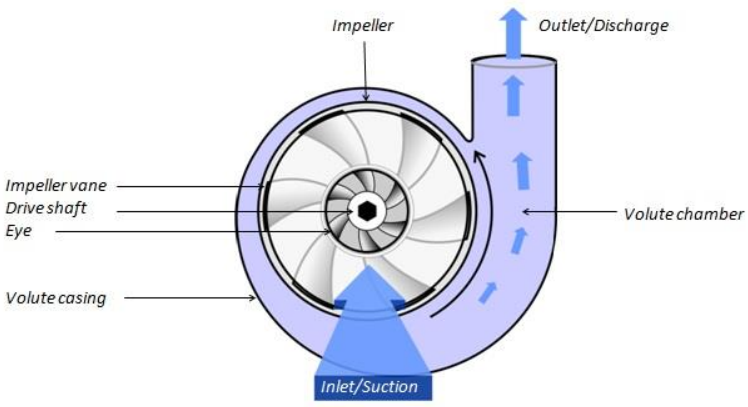

Figure 2. Volute case design

Fig6. Radial flow pump (centrifugal pump)

Table 1 Comparison summary

Point	PDP	Rotodynamic
Applications	Constant demand system	Variable demand system
Liquids used	High viscosity high density	Low viscosity low density
pressure	Higher pressures	Lower pressures
Flow rate	Lower flow rates	Higher flow rates
Use of relieve valves	mandatory	unnecessary
Controlling the flow	Controlling the speed of motor	Controlling the speed of motor
Check valves at suction side	Mandatory in reciprocating	unnecessary
Use of filter	Only to filter out large impurities	Only to filter out large impurities
Effect of reversing rotation	Flow reverses	Flow stops
Examples	Rotary: gear pump, screw pump Reciprocating: piston pump	Axial Mixed radial