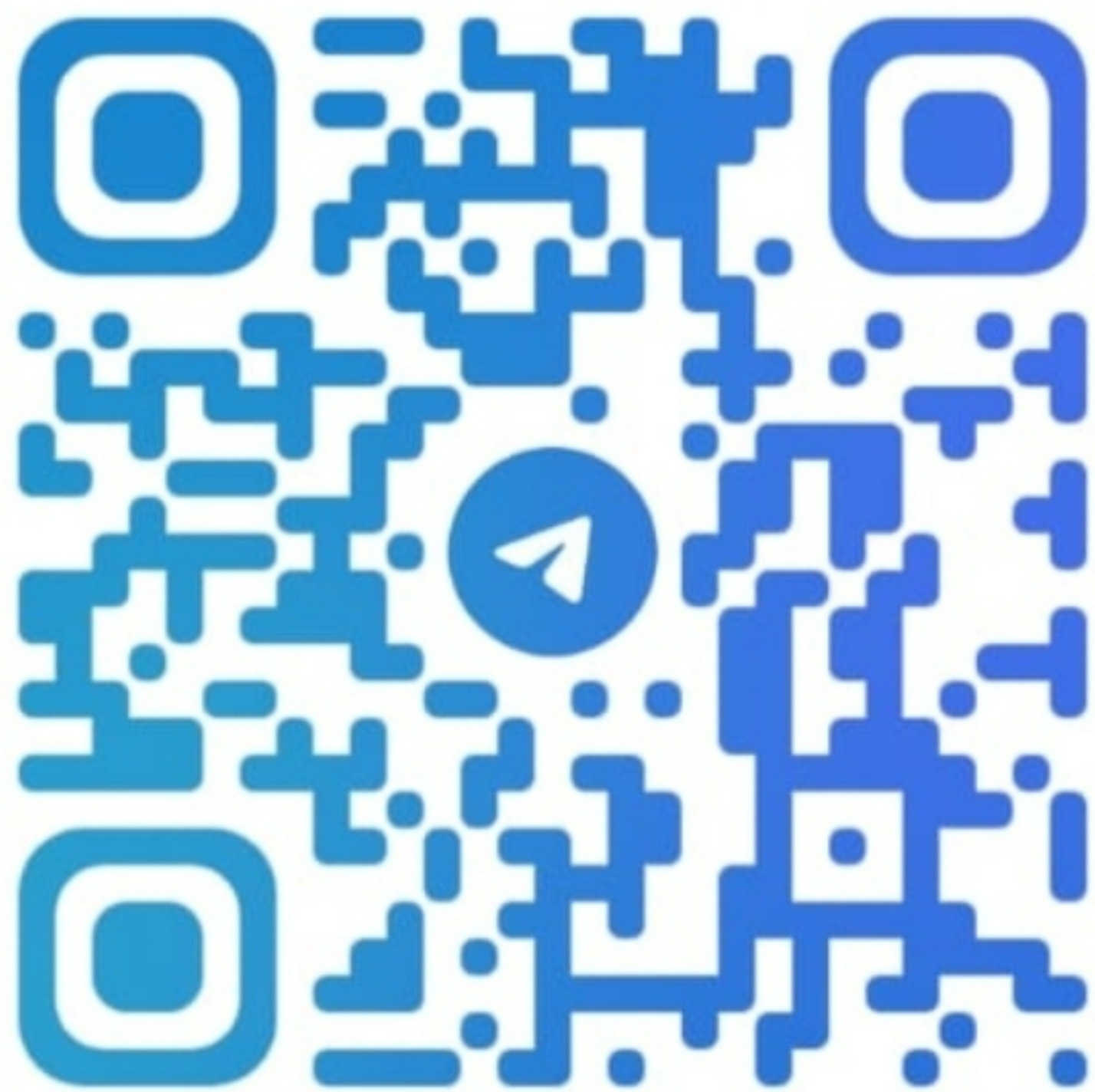


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Belt Drives

Introduction

- i. This is the power transmitting element which is used to transmit power from one m/c component to other m/c component
- ii. In this power is transmitted from driving pulley to driven pulley because of the friction between belt surface and pulley surface

Belt material used

The material used for flat belts are

Leather

Cotton

Fabric

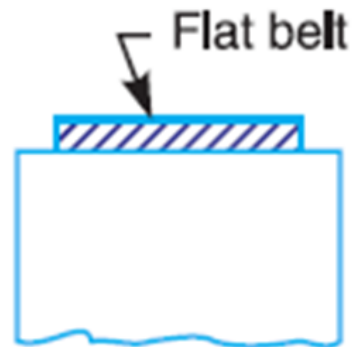
Rubber

The material used for V belts are

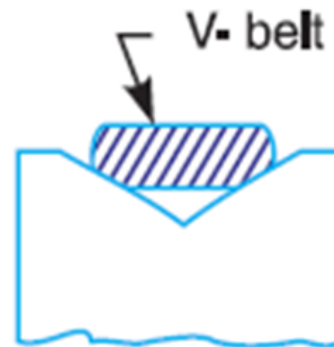
Fabric

Vulcanized rubber

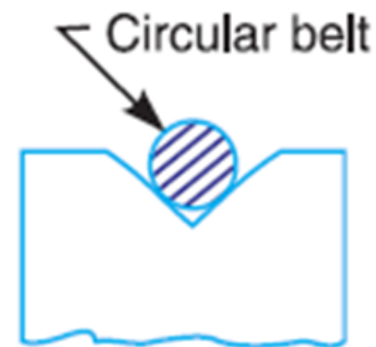
Types of belts



(a) Flat belt.



(b) V-belt.



(c) Circular belt.

Fig. 11.1. Types of belts.

where a moderate amount of power is to be transmitted

one pulley to another when the two pulleys are not more than 8 meters apart

where a moderate amount of power is to be transmitted

when the two pulleys are very near to each other

where a great amount of power is to be transmitted

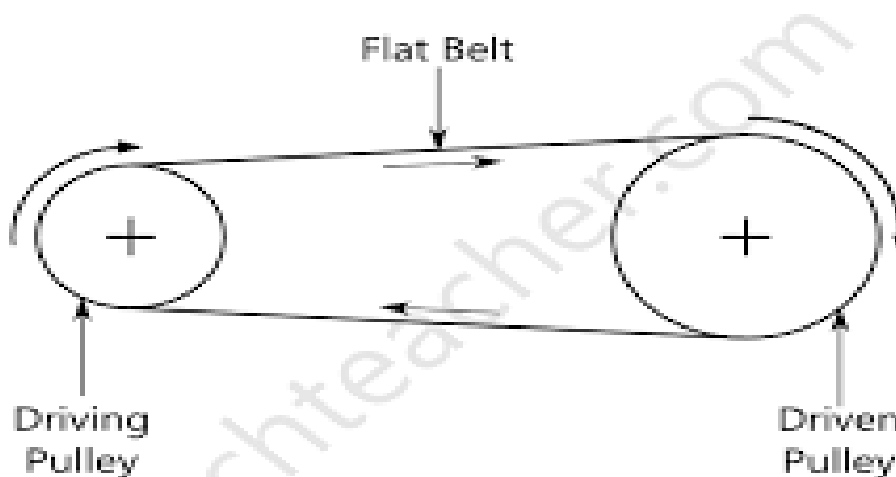
when the two pulleys are more than 8 meters apart

Elements of belts drive

1. Driving pulley
2. Driven pulley
3. Belt

The power is transmitted from driving pulley to driven pulley because of the friction between belt surface and pulley surface

Velocity Ratio / Speed Reduction Ratio



Let,

d = diameter of driving pulley

D = diameter of driven pulley

n = speed of driving pulley

N = speed of driven pulley

t = thickness of belt

i = Velocity Ratio / Speed Reduction Ratio

Velocity Ratio or Speed Reduction Ratio is the **ratio of diameter of driven pulley to the diameter of driving pulley**

OR

Velocity Ratio or Speed Reduction Ratio is the **ratio of speed of driving pulley to the speed of driven pulley**

•

$$i = \frac{\text{diameter of driven pulley}}{\text{diameter of driving pulley}} = \frac{\text{speed of driving pulley}}{\text{speed of driven pulley}}$$

$$i = \frac{D}{d} = \frac{n}{N}$$

if the belt thickness is considered

$$i = \frac{D+t}{d+t}$$

Sr no	parameters	Flat Belt	V Belt
1	Belt cross section	Rectangular	Trapezoidal
2	Material used	Leather, cotton, fabric, rubber	Fabric, vulcanized rubber
3	Type of pulley used	flat	grooved
		Advantages	Disadvantages
4	Construction	Simple	Complicated
5	Centre distance	Can be used for long centre distance	Can be used for small centre distance
6	Efficiency	High about 98%	Low about 80-96%

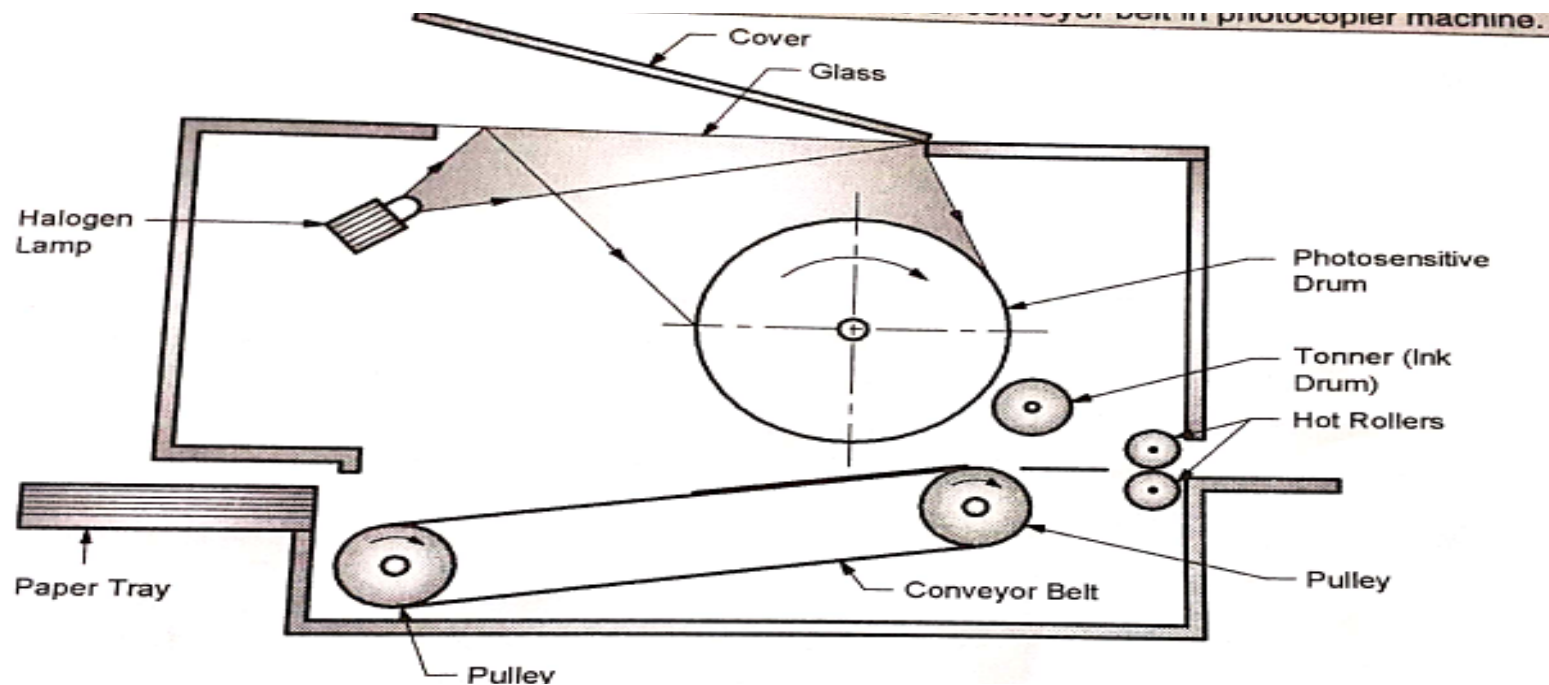
		Disadvantages	Advantages
8	Power transiting capacity	Can't used to transmit large power	Can used to transmit large power
9	Speed ratio	Can't used for high speed ratio limited to 3-4	Cant used for high speed ratio up to 8
10	Operating speed	Can't used for high speed application	Can used for high speed application
11	Slip	more	Less
12	Opern	noisy	Smooth and quit
13	Applications	Used to transmit power over long centre distance up to 15m	Used to transmit power over long centre distance up to 3m

Applications of belt drive

photocopier

Introduction

In this m/c conveyor belt is used for carrying the paper from paper tray to the rollers



Construction

A photocopier (also casually known as a 'xerox machine') consists of the following components:

1. A photoreceptor drum (or belt)
 - i. A photoreceptor drum which is covered by a layer of a semiconductor material, such as selenium, silicon or germanium.
 - ii. This is arguably the most critical part of the machine.
2. A toner
 - i. A toner which is basically just pigmented liquid.
 - ii. Sometimes referred to as 'dry ink', a toner is a dry mixture of fine, negatively-charged plastic particles and coloring agents that create the duplicate image on a piece of paper.

3. Toner cartridges

Color Laser Printer toner cartridges Corona wires, which when subjected to a high voltage, transfer a field of positive charge to the surface of the photoreceptor drum and the copy paper.

4. A light source

A light source which shine a bright beam of light on the original document and focus a copy of the image onto a specific place

Working

- i. To begin the photocopying process, the top lid of the photocopier is opened and the master copy is placed face-down on the glass surface, where a bright light beam will scan the entire document.
- ii. White areas on the paper reflect more light, while black areas reflect little or no light.
- iii. An electrical shadow (or image) of the master copy is formed on the photoconductor.
- iv. As the conveyor belt (with the photoconductor coating) moves, it takes the electrical shadow along with it too.
- v. The negatively-charged toner particles stick to the electrical shadow and an inked impression of the master copy is made on the conveyor belt.
- vi. A blank piece of paper is fed into the photocopier from the other side, which slowly moves towards the photoconductor belt.

- viii. As it moves on the conveyor belt, a strong positive charge is imparted to it.
- ix. The strong positive charge of the blank paper pulls the negatively-charged toner particles towards itself.
- x. Consequently, a duplicate image of the master copy is formed on the blank paper.
- xi. Finally, just before spitting the paper out, a fuser unit (a pair of hot rollers) supply heat and pressure so the toner particles are permanently attached/fused onto the paper.
- xii. This is why a freshly ejected duplicate copy is quite warm to the touch.

Advantages

- i. Very cheap if few copies are required
- ii. Quicker than duplicating or printing
- iii. Copies produced are of very high quality
- iv. Colored copies can be made
- v. The copies are exact copies of the original copy
- vi. Does not pollute the environment

Disadvantages

- i. Expensive for large number of copies
- ii. Copies may fade with time
- iii. Only selected colors may be copied
- iv. Cannot be used where there is no electricity.

Chain Drives

Introduction

- i. This is the power transmitting element which is used to transmit power from one m/c component to other m/c component
- ii. In this power is transmitted from driving pulley to driven pulley because of the friction between belt surface and pulley
- iii. In the belt and rope drive slipping may takes place.
- iv. To avoid slipping and to get a constant velocity ratio the belt and rope can be replaced by another type of drive called as chain drive

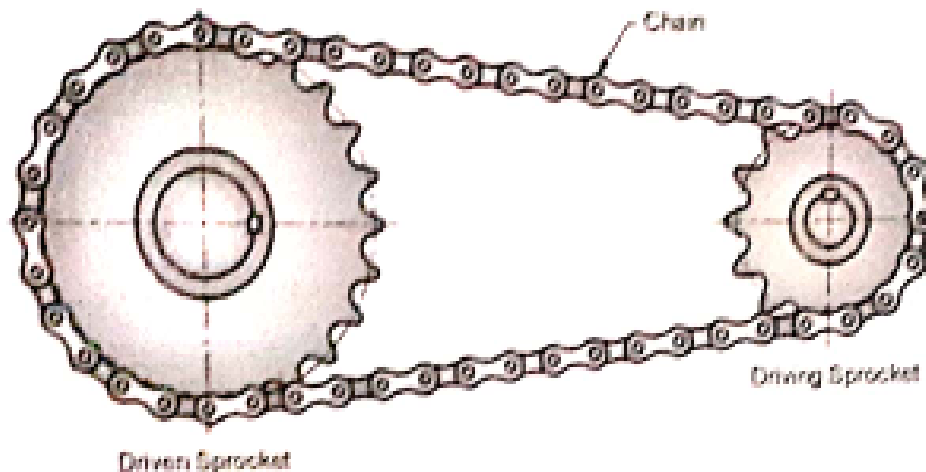
Elements of Chain drive

Driving sprocket

Driven sprocket

Chain

The power is transmitted from driving sprocket to driven sprocket because of the friction between chain surface and sprocket **surface**



Pumps

Introduction

- i. Pump increases the energy of flowing fluid
- ii. The main difference between turbine and pump is that, in case of turbine flow of fluid takes place from high pressure to low pressure
- iii. In case of pump the flow of fluid takes place from low pressure to high pressure

Types of pump

1. Positive displacement pump

Example : reciprocating pump

2. Rotodynamic pump

Example : centrifugal pump

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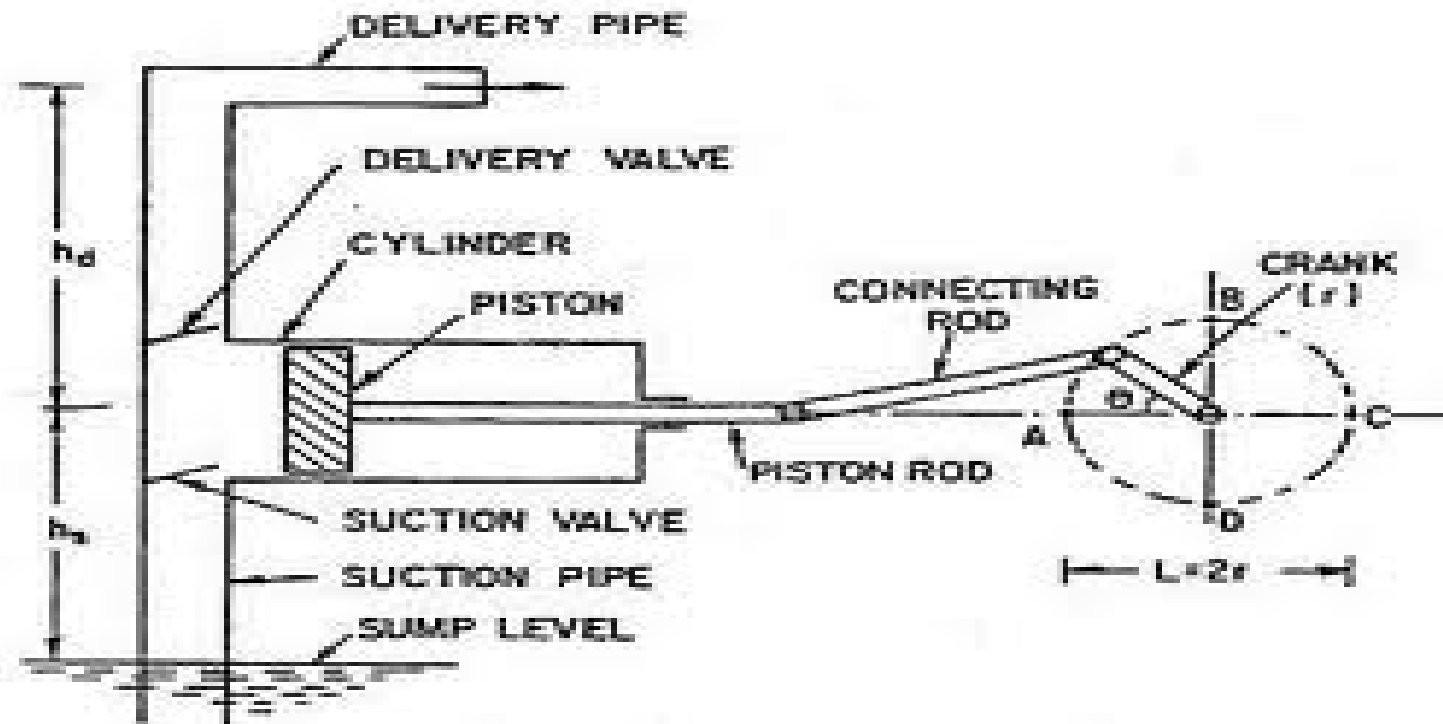
2. Rotodynamic pump

Example : centrifugal pump

Reciprocating Pump

Introduction

- i. Reciprocating pump is positive displacement type pump.
- ii. In this liquid is displaced using piston cylinder arrangement which is driven using crank and connecting rod.



Construction

1. Suction pipe

- i. Suction pipe is connected to the sump and through this pipe liquid is sucked into the pump
- ii. Delivery pipe is connected to the discharge end of the suction pipe

2. Piston and cylinder

The piston reciprocates inside the cylinder

3. Crank and connecting rod

- i. The crank is mounted on the crankshaft
- ii. It is driven either by IC engine or electric motor

4. Sump

It is the reservoir through which the liquid is pumped into the system

Working

1. Suction stroke

- i. The crank is connected to the piston by connecting rod hence the rotary motion of crank is connected into reciprocating motion of the piston
- ii. Initially the crank is at IDC
- iii. When the crank rotates in CW direction, piston moves towards right side
- iv. Hence at the left side of the piston, vacuum or space is created
- v. This vacuum opens the suction valve and the water from sump will be forced to the left side of the piston
- vi. At the end of the suction stroke the cylinder is full of water

2. Delivery stroke

- i. When the crank rotates from ODC to IDC the volume inside the cylinder will be reduced and water will be compressed
- ii. because of this high pressure will be developed inside the cylinder
- iii. because of high pressure, delivery valve opens and water is delivered through the delivery pipe

Centrifugal Pump

Introduction

Centrifugal pump is the hydraulic m/c in which mechanical energy is converted into pressure

Construction

1. Impeller

- i. It is the rotating part of centrifugal pump
- ii. It consist of curved vanes

2. Casing

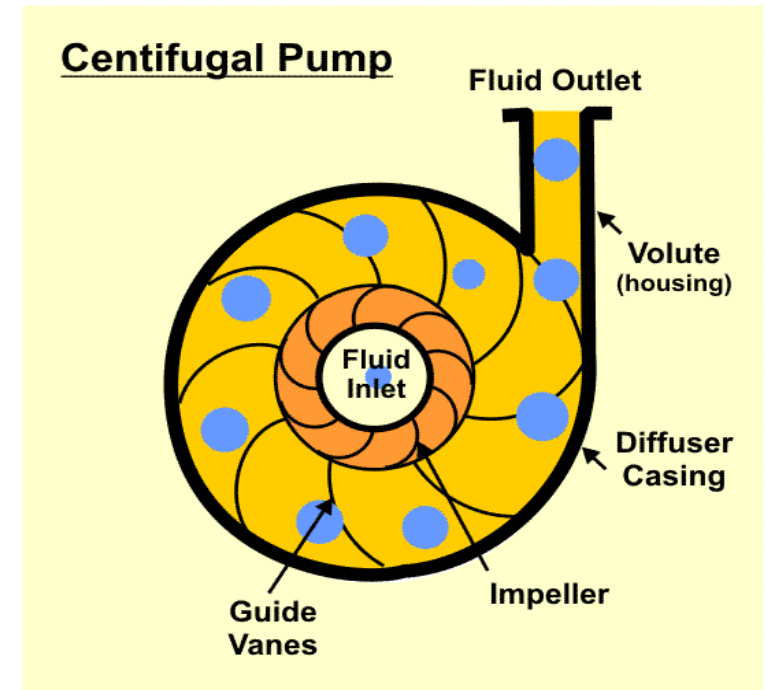
- i. It is an air tight passage surrounding the impeller
- ii. The casing is of spiral type in which the area of flow increases gradually
- iii. This increases the area and increase the pressure of the water flowing through the casing

3. Suction pipe

- i. Its one end is connected to the inlet of the pump and other end dips into the water sump
- ii. At the lower end of the suction pipe, strainer is fitted to remove dust and dirt

4. Delivery pipe

- i. Its one end is connected to the outlet of the pump and other end delivers the water at desired height
- ii. To control the flow of water delivery valve is connected to this pipe



Working

- i. The water from the sump is forced on the shaft
- ii. Water falls on the impeller which consist of curved vanes
- iii. Because of rotating curved vanes water is discharged with high pressure
- iv. guide vanes are used to guide water to delivery pipe

Sr no	particulars	Centrifugal pump	Reciprocating pump
		advantages	disadvantages
1	Initial cost	Low	High
2	Maintenance cost	Low	High
3	Space requirement	Less	More
4	Flow rate	Continuous and smooth	Fluctuating
5	Quantity of liquid supplied	Large	Small
6	Speed	Run at high speed	Run at low speed
7	Torque	Uniform	Non uniform
8	noise	Produce less noise	Produce more noise
		disadvantages	advantages
	pressure	not suitable for high pressure	suitable for high pressure
	Applications	domestic water supply power plant fire protection sprinkler Air conditioners Chemical industries Irrigation	Boilers Hand operated pumps Agriculture field Pressure washing

Air compressors

Introduction

- i. A device or machine providing air at high pressure is called air compressor
- ii. An air compressor atm air is compressed and delivers high pressure air to storage vessel known as receiver

Applications of compressed air

- i. Machine tools
- ii. Cleaning of workshops and automobiles
- iii. Super charging of IC engines
- iv. Spray painting
- v. Refrigeration
- vi. Air-conditioning
- vii. Diesel engine
- viii. Air braking

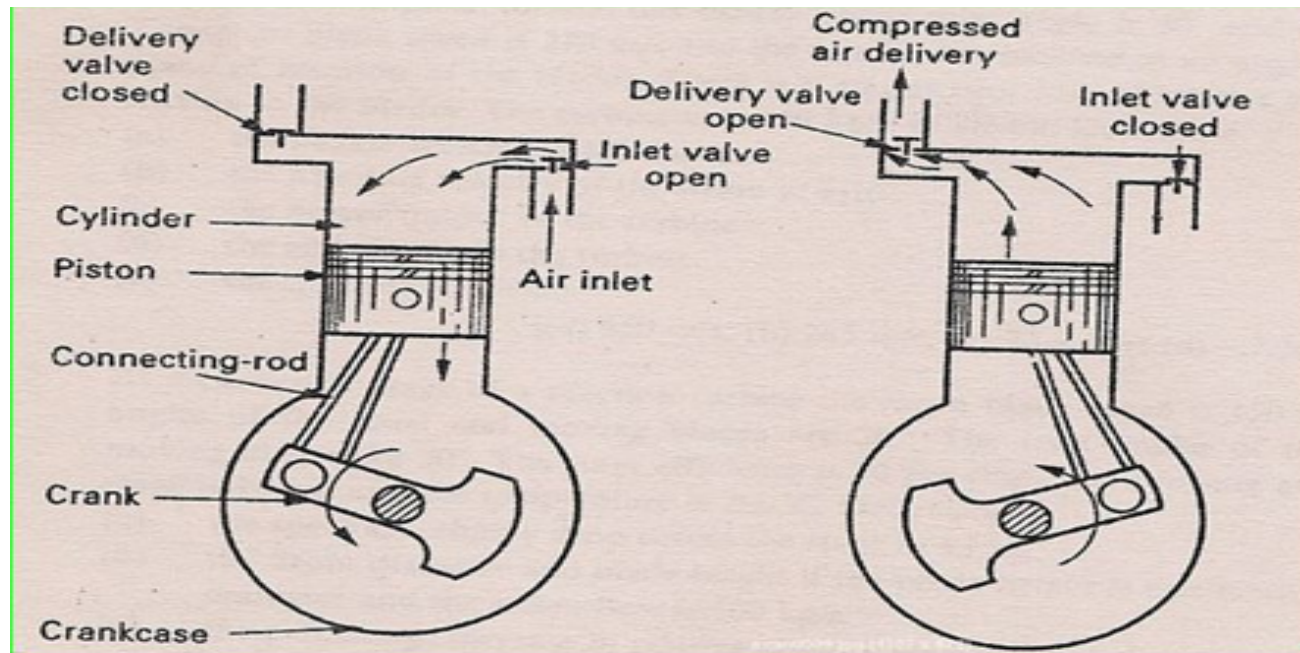
Construction

1. Crank and connecting rod

- i. The crank is mounted on the crankshaft
- ii. It is driven either by IC engine or electric motor

2. Inlet and exhaust valve

Inlet and exhaust valves are closed by the pressure difference on both side of valves



Working

The working of reciprocating compressor is divided into two stroke

1. Suction stroke

- i. During suction stroke, piston moves downward.
- ii. because of this the pressure inside the cylinder falls below atm pressure
- iii. Hence the inlet valve is open and air is sucked inside the cylinder
- iv. At the end of inlet valve is closed

2. delivery stroke

- i. In this stroke piston moves from bottom side to top
- ii. because of this movement volume inside the cylinder reduces and air is compressed
- iii. As the air is compressed its pressure increases
- iv. When the pressure increases above the receiver pressure delivery valve opens and air is discharged to the receiver

Applications of Compressor

1. Vapour Compression Refrigeration System
2. Water Cooler

Vapour Compression Refrigeration System

Introduction

- i. Vapour compression refrigeration system is most commonly used method of refrigeration for refrigerators, air conditioners
- ii. In this system the commonly used refrigerants are R11, R12, R22

Construction

This system consists of following basic components

1. Receiver

- i. The refrigerant from receiver pass to the expansion valve through pipe
- ii. This pipes are usually made of copper

2. Expansion valve

- i. It is also known as throttle valve
- ii. When the liquid refrigerant is passed through the expansion valve, its pressure reduces
- iii. As the pressure drops, temp is also drops

3. Evaporator

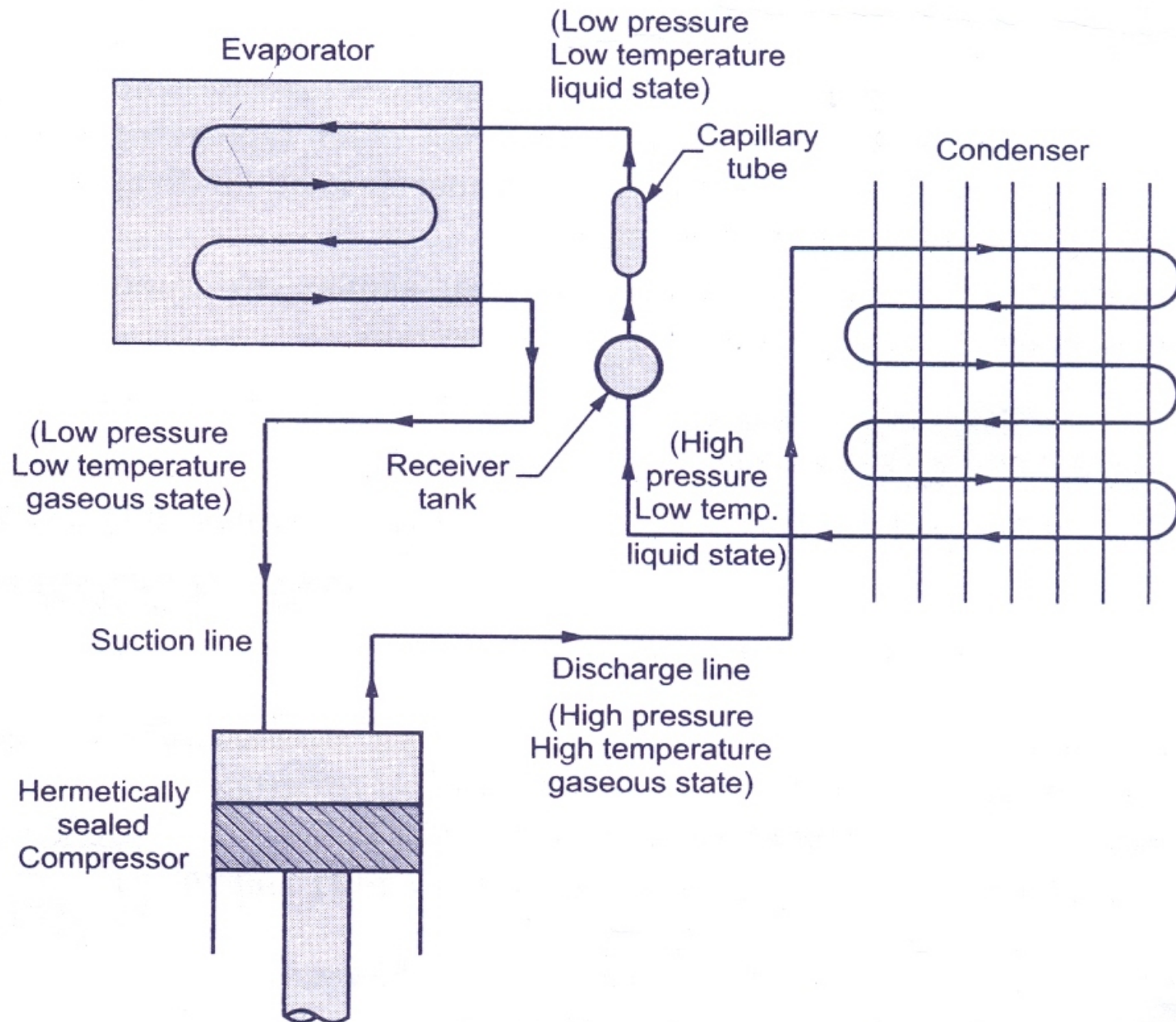
- i. Refrigerators are commonly equipped with two evaporators
- ii. it locates in the freezer

4. Compressor

- i. In refrigerators generally hermitically sealed type of compressor is used
- ii. It is mounted on the bottom side of the refrigerator
- iii. It is driven by electric motor

4. Condenser

- i. In refrigerators it is placed on the rear side
- ii. It is in contact with air



Working / Process

1. Evaporation

- i. The low pressure and low temp liquid refrigerant from expansion valve enters into the evaporator
- ii. The low temp liquid absorbs the heat from the evaporator and cools the substance in the evaporator
- iii. It is the coldest region in the refrigerator and acts as freezing unit.
- iv. By absorbing the heat from the evaporator, the liquid refrigerant becomes vapour and leaves the evaporator

2. Compression

- i. The low pressure and low temp vapour from the evaporator enters into the compressor
- ii. The compressor compresses the vapour refrigerant
- iii. As a result of this pressure and temp of vapour refrigerant increases

3. Condensation

- i. The high pressure and high temp vapour refrigerant from the compressor enters into the condenser
- ii. the outer surface of condenser tube is in contact with atm air
- iii. This air receives the heat from the high temp vapour inside the condenser
- iv. As a result of this, vapour gets cooled and converted into liquid

4. Expansion

- i. The liquid refrigerant from the condenser from the condenser stored in the receiver
- ii. This liquid refrigerant from the receiver passed to the evaporator through throttle valve
- iii. This valve reduces the pressure of liquid refrigerant by keeping the enthalpy constant
- iv. Hence cycle is completed

Applications of refrigeration

- i. Formation of ice
- ii. Preservation of food, vegetables
- iii. Preservation of photographic films
- iv. preservation of medicine
- v. Preservation of fruits
- vi. Cooling of liquid in chemical plants
- vii. Processing of farm crops
- viii. Preparation of butter

Levers

Introduction

- i. Levers are the most basic machines which are used to do some work with minimal effort.
- ii. A lever amplifies an input force to provide a greater output force, which is said to provide leverage.
- iii. We are aware there are various types of lever depending upon the position of the fulcrum, the force and the weight.
- iv. Every tool which is used to perform work comes under any one of this category.

types

According to where the load and effort are located with respect to the fulcrum, there are three types or classes of lever:

First Class Lever

This is a type of lever which has the fulcrum in between the weight and the force applied. Its order is represented as force-fulcrum-weight.

This is the most basic type of lever.

Example:

Our hand pushing an object or seesaws, crowbars.

Using a scissor represents the use of two first-class levers.

A wheel and axle is also an example.

Pulling a nail out of a wooden plank also represents first class lever.

Second Class Lever

In this, the fulcrum is at one end and the force applied is on the other end. The weight is situated in the middle of these two. The order of this would be fulcrum-weight-force. Application of force at one end will result in some work done on the other end.

Example:

Wheelbarrow

Staplers

Doors or gates

Bottle openers

Nutcracker

Nail clippers

Valves

Introduction

Various types of valves are required in any piping system in order to regulate the fluid flow within that system.

Valves can be manually operated or they can have an actuator to change and control the valve opening.

The actuator may be pneumatically, hydraulically, or electrically operated.

The valves represent a considerable percentage of the overall expenditure of the chemical process industry and, therefore, must be carefully selected.

Spring

Introduction

- i. Spring is an elastic machine element that can deflect under the application of load.
- ii. When the load is removed, it regains its original position. In other words, spring is a mechanical object made up of material having very high yield strength to restore elastic.
- iii. It is used in various machines to absorb shocks or it also resist to transfer shocks and vibrations on various critical machine members.

Spring materials

Oil Tempered Steel

Stainless Steel

Inconel

Titanium

Types of Springs

1. Helical Spring
2. Compression spring
3. Torsion spring
4. Spiral Springs
5. Leaf springs
6. Volute and conical spring

Applications of Springs

- i. To absorb shock load
- ii. To store energy
- iii. To measure force
- iv. To motive power
- v. To Return motion
- vi. To control of vibrations

Applications of Springs

Door closure

Introduction

- i. In this mechanism, when the person pushes the door, the door gets opened but the energy applied by the person stored in the helical compression spring.
- ii. When the door is released then the stored energy is released and door regain original position

Construction

1. Door Frame

- i. Lever 1 is connected to door frame
- ii. Hence as we push the door there is change in position of lever 1.

2. Levers

- i. The mechanism consists of two levers 1 and 2.
- ii. Lever 1 is connected to door frame and lever 2 is connected to pinion.

3. Rack and Pinion

- i. This is the special type of gear.
- ii. This is used to convert rotary motion of the pinion into reciprocating motion of rack.

4. Helical Compression Spring

- i. The spring has property that it can be stretched when the force is applied and again regain its original position when the force is released.
- ii. As per the force applied it can be stretched and compressed.

Working

- i. When the person applies the force on lever to open the door the angle between lever 1 and lever 2 increases.
- ii. because of this lever 2 rotates in anticlockwise direction.

Now as the lever 2 is connected with pinion, pinion also rotates in anticlockwise direction.

The pinion is in mesh with rack hence rack moves towards right side.

Blower

Introduction

- i. Blower is equipment or a device which increases the velocity of air or gas when it is passed through equipped impellers.
- ii. Blower is also commonly known as Centrifugal Fans in industry

Working Principal

- i. In a blower, the inlet pressure is low and is higher at the outlet.
- ii. The kinetic energy of the blades increases the pressure of the air at the outlet.

Applications

- i. Blowers are mainly used in industries for moderate pressure requirements where the pressure is more than the fan and less than the compressor.
- ii. They are mainly used for flow of air/gas required for exhausting, aspirating, cooling, ventilating, conveying etc.

types of Blowers

Blowers can also be classified as

- i. Centrifugal blowers
- ii. Positive displacement blowers

Helical Spring

Compression spring

Torsion spring

Spiral Springs

Leaf springs

Volute and conical spring

Helical Spring

Compression spring

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