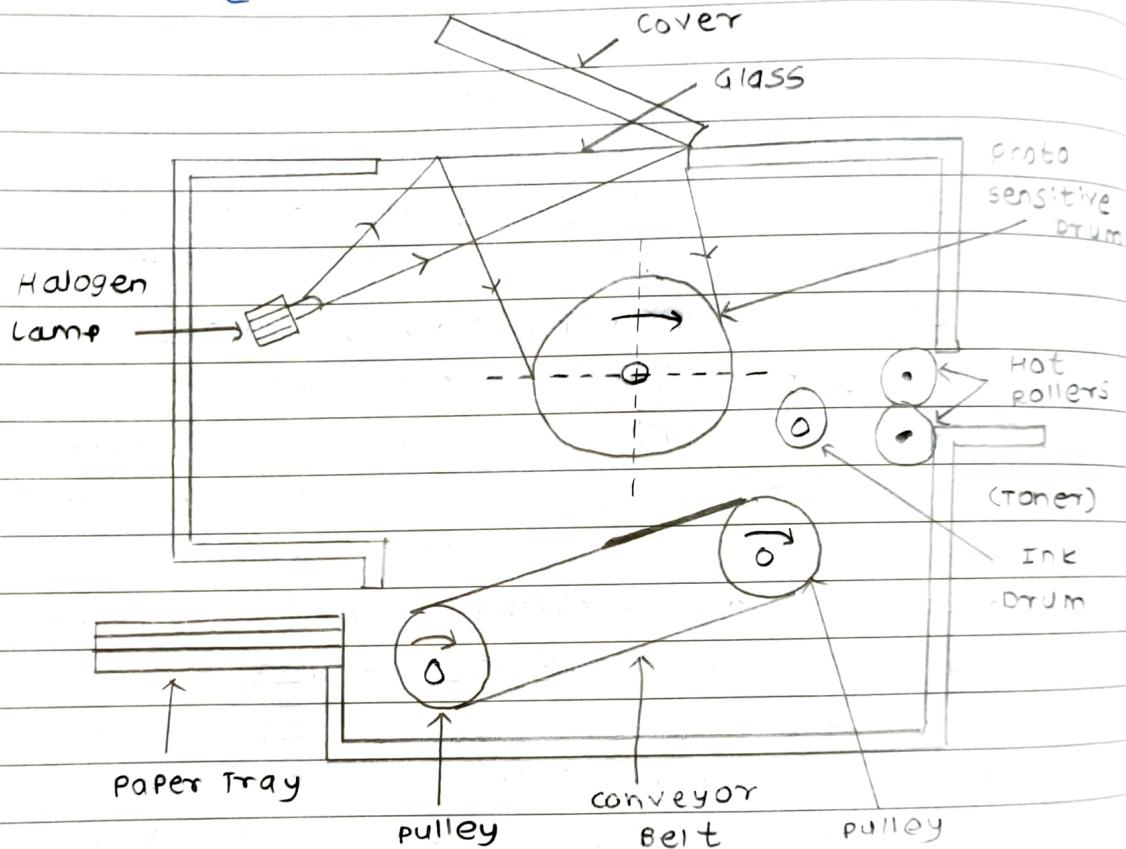


UNIT - 6

Engineering mechanism and their applications in Domestic appliances

* Printer (photocopier):



• Components:

- (1) Halogen Lamp
- (2) photo sensitive drum
- (3) Toner (ink drum)
- (4) conveyor belt and pulley
- (5) HOT ROLLERS.

• working:

- (1) In printer, conveyor belt is used for carrying the paper from paper tray to hot rollers.
- (2) when document is placed on glass, beam of



halogen light scans the document. The light gets reflected and electrical shadow of document is formed on photosensitive drum.

- (3) As photosensitive drum rotates, it carries electrical shadow of document towards toner.
- (4) Toner is positively charged. The positively charged toner ink sticks to negatively charged image on drum surface.
- (5) Thus inked image of document is formed on surface of drum.
- (6) When paper passes through two hot rollers, heat and pressure from rollers permanently fuses the toner particles on paper.

* Air compressors:

An air compressor is a device which compresses the atm. air to a higher pressure at expense of external work supplied either by electric motor or I.C. engine. Compressed air is delivered to 'receiver' for storage.

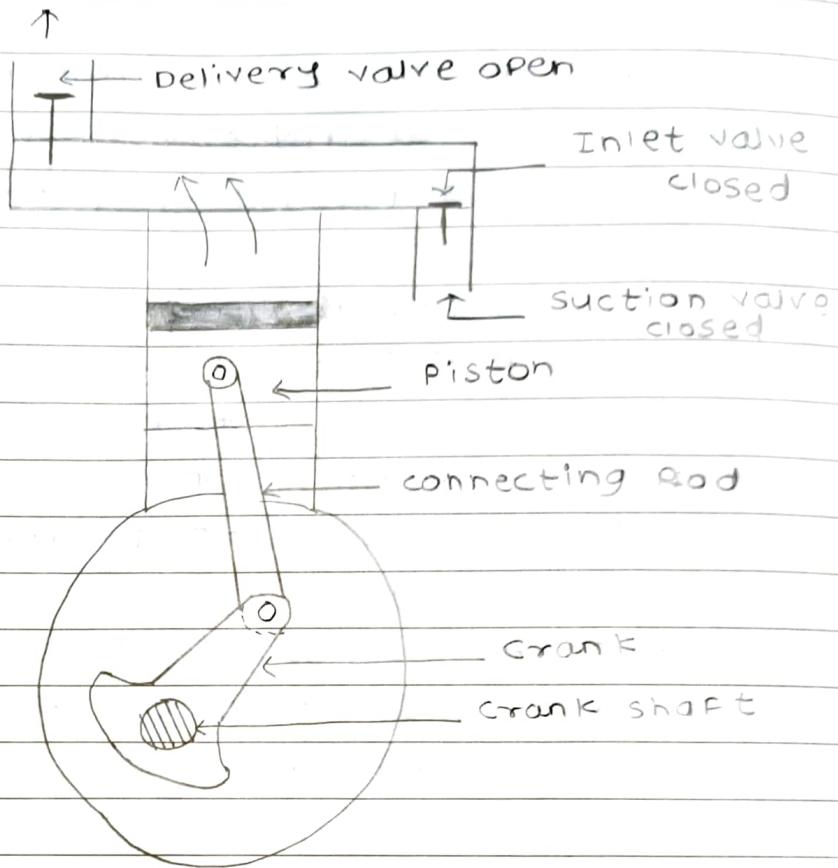
- Pressure ratio: Ratio of outlet pressure to inlet pressure:

$$\text{pressure ratio} = \frac{\text{outlet (discharge) pressure}}{\text{inlet (suction) pressure}}$$

* Reciprocating Air compressor:

- Components:

- | | |
|--------------------|-------------------------------|
| (1) Piston | (4) crank |
| (2) cylinder | (5) Inlet and delivery valves |
| (3) connection Rod | (6) Receiver |



- (i) It consists of piston which is driven through connecting rod and crank.
 - (ii) The suction or inlet valve and delivery valve are mounted in cylinder head.
- working:
- (i) suction stroke:
 - when Piston is moving downwards , the delivery valve is closed.
 - when pressure inside cylinder falls below atm. pressure , the inlet valve opens.
 - The atm. air is sucked inside cylinder upto end of suction stroke.
 - (ii) compression and delivery stroke:
 - when piston is moving upwards , the air inside the cylinder is compressed.

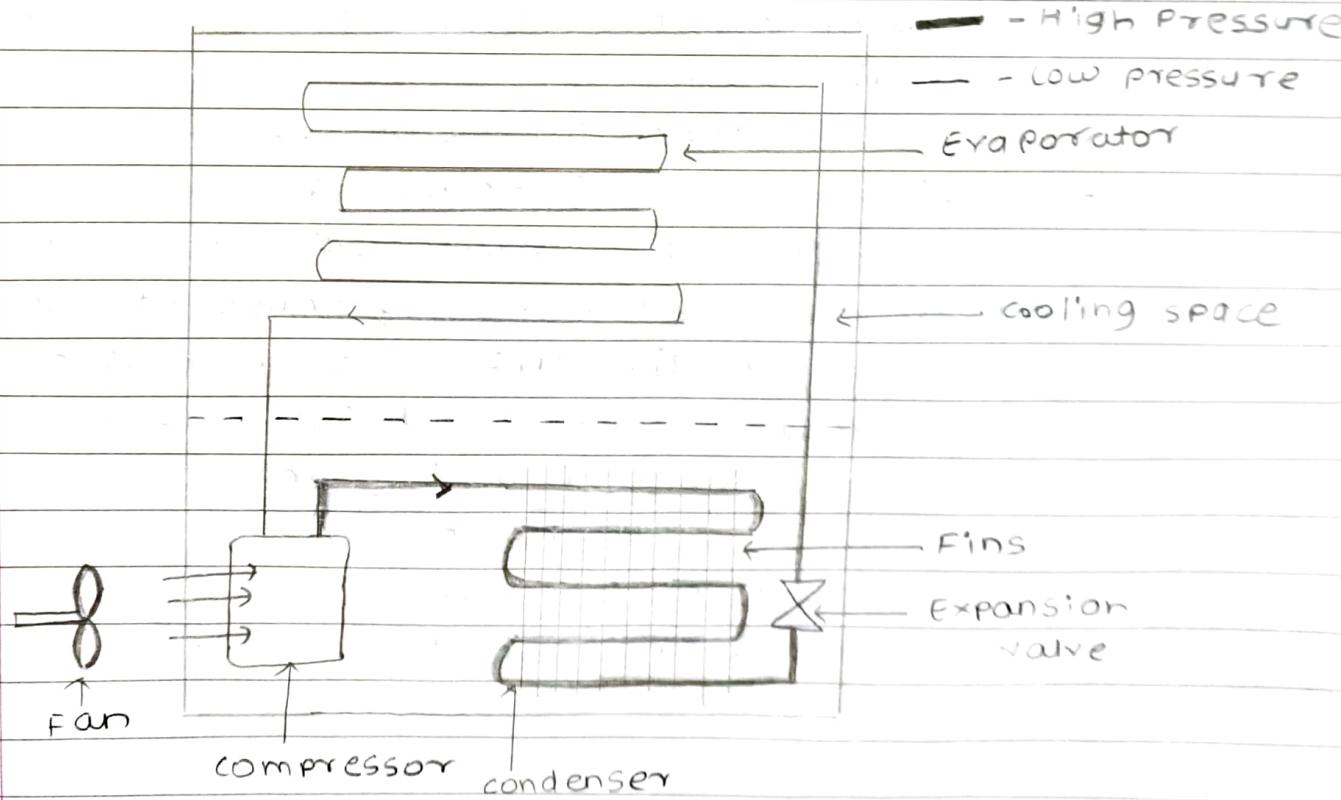
• When pressure inside cylinder reaches above pressure on delivery side, the delivery valve opens. The compressed air from cylinder is discharged to receiver.

• APPN:

- (1) For spray painting
- (2) In refrigeration and air conditioning industry.
- (3) Drill, hammers, machines.

* Refrigerator:

Refrigerator is an appliance having thermally insulated compartment from which heat is removed artificially and is maintained at lower temperature for storage of food.



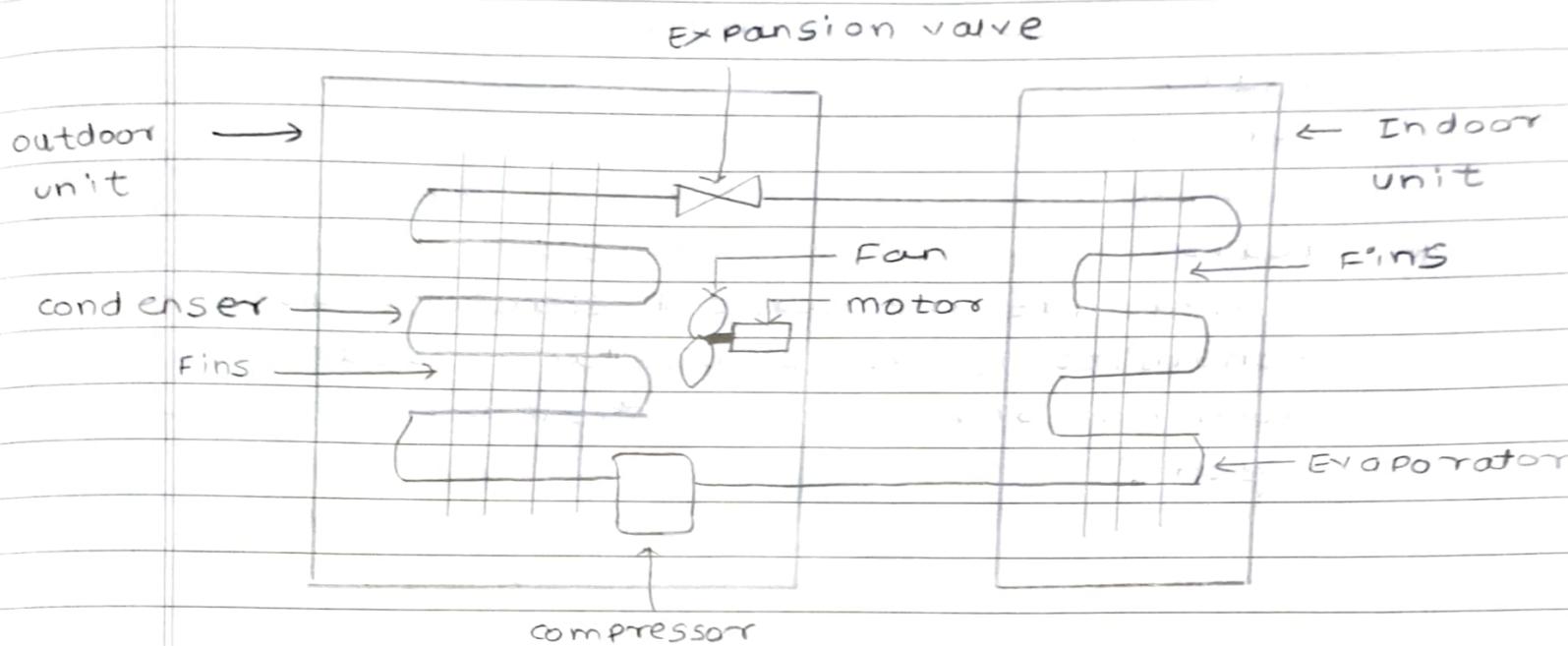
- Components:

- (1) Evaporator: Evaporator is a coil placed around the cooling space of refrigerator. The low temperature and low press. refrigerant in liquid state passes through evaporator coil. It absorbs the heat from space to be cooled and converts liquid refrigerant into vapour state. Heat absorption takes place at const. pressure and temp.
- (2) compressor: The low press. and temp. refrigerant in vapour state enters compressor. In compressor, low press. and low temp. refrigerant in vapour state is compressed to high pressure and temp.
- (3) condenser: The high press. and temp. refrigerant in vapour state enters condenser from compressor where it rejects heat to surrounding atm.
- (4) Expansion valve: In expression valve, the expansion of refrigerant takes place. The press. as well as temp. of refrigerant is reduced. The liquid refrigerant at low press. and temp. again enters evaporator.
Efficiency is expressed in C.O.P

$$C.O.P = \frac{\text{Desired cooling effect}}{\text{work Input}}$$

$$= \frac{\text{Heat removed}}{\text{work Input}} = \frac{Q}{W}$$

* Split Air conditioner:



(1) Air conditioner:

Air conditioner is a system that removes heat and moisture from enclosed space to improve the comfort of occupants.

(2) split AC :

- The split AC is an air conditioner with two separate units - indoor unit and outdoor unit.
- The indoor unit is installed inside the room to be air conditioned and outdoor unit is installed on exterior wall or outside the room to be air conditioned. working: of evaporator, compression
- constn: condenser ,expansion valve

(i) Indoor unit

- Expansion valve
- Evaporator

(ii) outdoor unit

- compressor
- condenser

water cooler: same as refrigerator

* Elements used in household appliances:

- 1. Belt drives (Belt and pulley)
- 2. Gears
- 3. springs.

* Gears: positives drive, toothed wheels

They are mechanical elements used for transmitting the power and rotary motion from one shaft to another by means of teeth

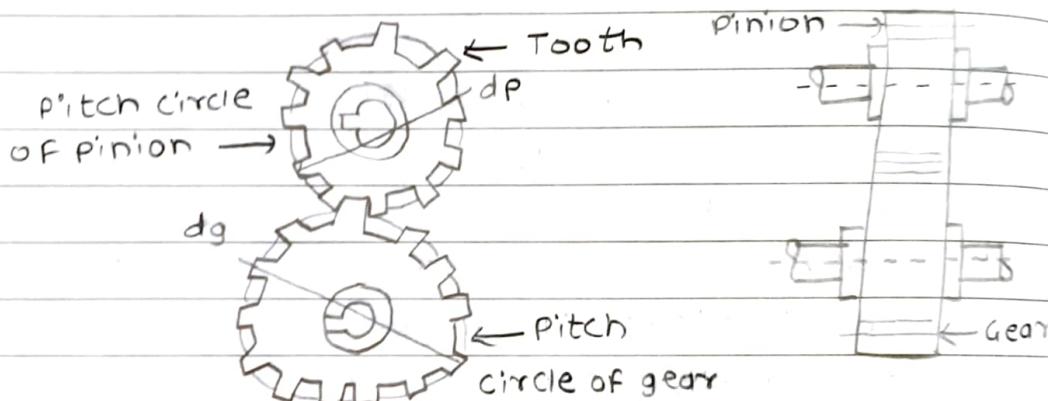


Fig: Gear drive

* Functn:

- (1) To increase torque and reduce the speed from input shaft to output shaft.
- (2) To increase speed and reduce torque from input shaft to output shaft.
- (3) Transmit power from one shaft to another shaft.
- (4) To change rotation direction from one shaft to another shaft.

* Types of Gears:

- 1. Parallel Axes Gears - Spur gears, Helical gears, Herringbone gears - Internal gear pair,

External gear pair, Rack and Pinion.

- 2. Intersecting Axes Gears - Bevel Gears
- 3. Non-Intersecting and far axes gears - worm gears
- 4. Non-Intersecting and Non-Parallel axes Gears - crossed Helical Gears.

* Parallel axes gears:

(1) Spur gears:

Spur gears are used for transmitting power/motion b/w two parallel axes shafts.

In spur gears, teeth are parallel to axis of gear. Diagram

• APPLN:

Used in automobile gear boxes, machine tool gear boxes, industrial gear boxes, clocks, watches, etc.

(2) Helical Gears:

In helical gears, the teeth are at an angle known as helix angle, with axis of gear.

The helix angles of gear and pinion are same in magnitude but of opp. hands. A right-hand gear meshes with left-hand pinion or vice-versa.

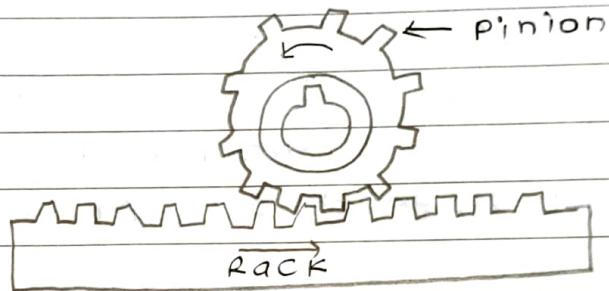
• APPLN:

Used for transmitting power/motion b/w two parallel axes shafts.

(3) RACK and PINION:

Rack is a straight line gear. In rack and pinion, the straight sided rack meshes with pinion.

Rack and pinion is used to convert rotary motion of pinion into linear motion of rack or vice-versa.



• APPLICATION:

Rack and pinion are used in lathe, drilling, milling machine, etc.

• Advantages:

- (1) Gear drive is positive drive.
- (2) G.D can be used at high speed.
- axes (3) Transmitting power b/w two shafts.

• Limitations:

- (1) cannot be used for long centre distances.
- (2) cannot absorb shock
- (3) costly
- (4) Affected by dirt or dust, requires casing.

* APPN OF GEARS:

(1) WALL CLOCK:

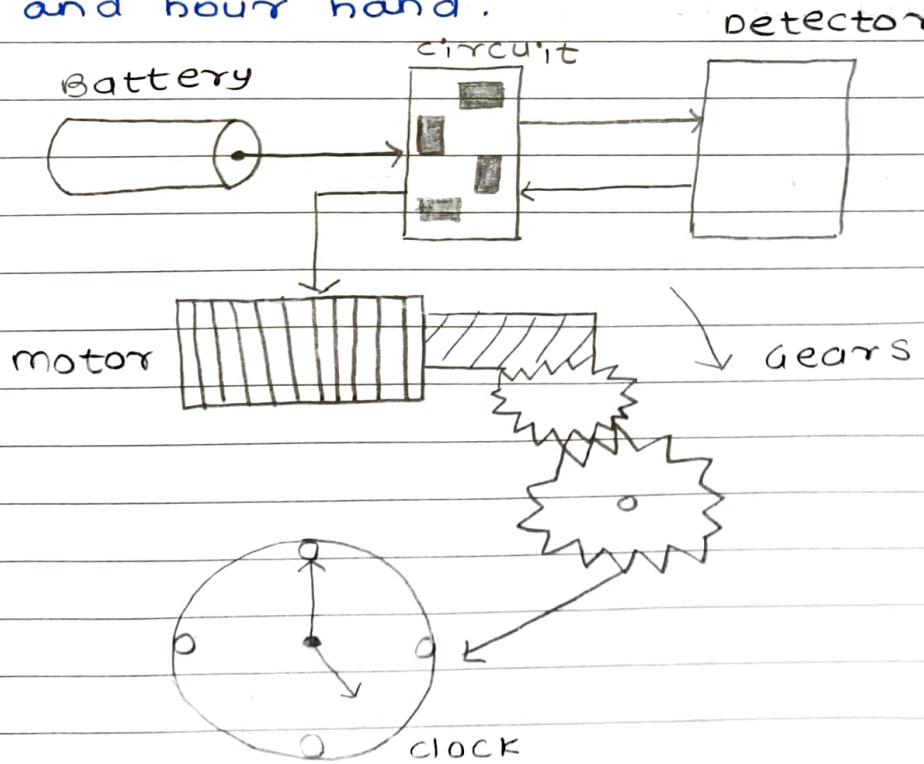
- Principle: It is a device that performs regular movements in equal intervals of time.
- Working:

(1) In wall clocks, particular arrangement of gears are used to move hour, minute and second hand in various ratios by using battery source.

(2) Battery sends an electrical signal to quartz crystal when oscillates at precise frequency.

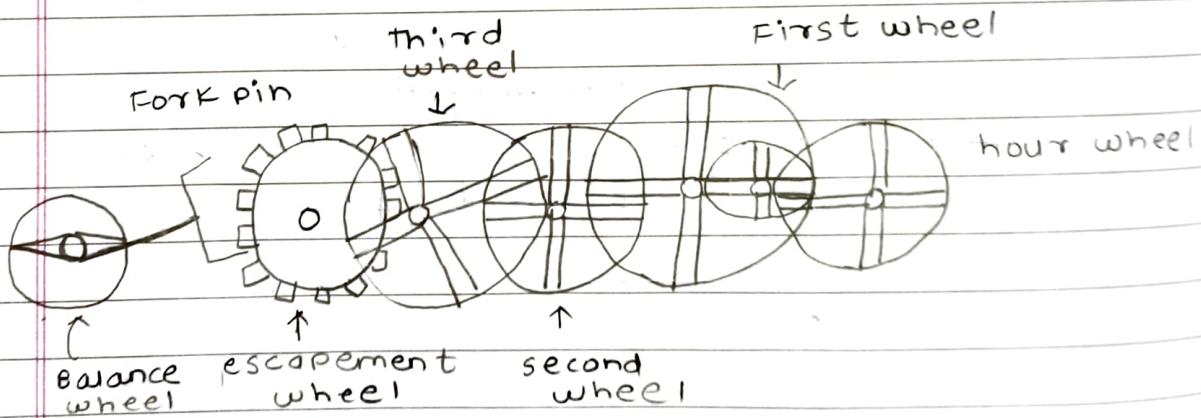
(3) The circuit generates electric pulses

(4) Pulses are given to motor which drives gear wheel that spins clock's second, minute and hour hand.



(2) watches:

- A mechanical watch is a watch that uses a clockwork mechanism to measure the passage of time. quartz watches - battery
- A mechanical watch is driven by a mainspring which must be hand wound periodically.
- Its force is transmitted through a series of gears to power the balance wheel.
- The escapement is what that makes the 'ticking' sound which is heard in an mechanical watch.
- mechanical watches are typically not as accurate as modern electronic quartz watches.
- The internal mechanism of watch, excluding face and hands , is called movement.



(3) Printer (photocopier)

* Belt Drives (Belt and pulley)

Belt Drives are used to transmit the power from one shaft to another shaft.

- Elements:

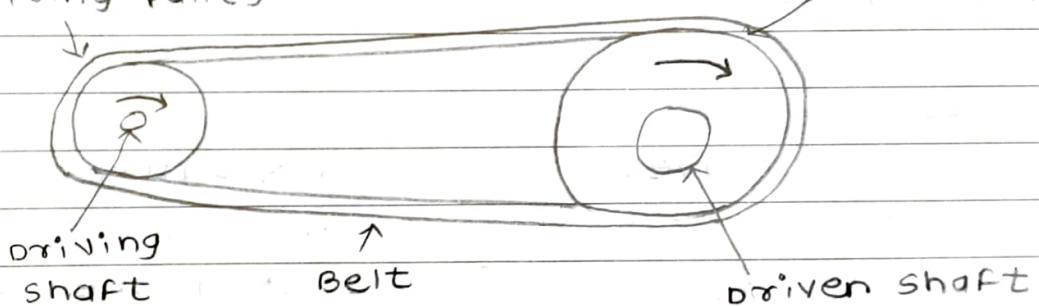
- (1) Driving (Head) Pulley
- (2) Driven (tail) pulley
- (3) Belt

The belt envelops the driving and driven pulleys. The power is transmitted from driving pulley to driven pulley through belt bcoz of friction b/w belt and pulley surface.

In belt drive, as power is transmitted bcoz of friction b/w belt and pulley surface, it is not a positive drive and there can be a small % of slip.

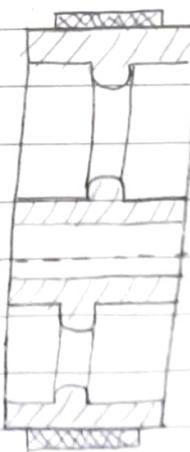
driving pulley

driven pulley



- * Flat Belts:

- The flat belts are rectangular and are rectangular in cross-section. The width of belt is higher than thickness of belt.
- The flat belt can be used to transmit a moderate amt of power from one pulley to another, when two pulleys are not more than 15m apart.



- Advantages:

- (1) They are cheap
- (2) Easy to maintain
- (3) High efficiency (98 %)

- Limitations:

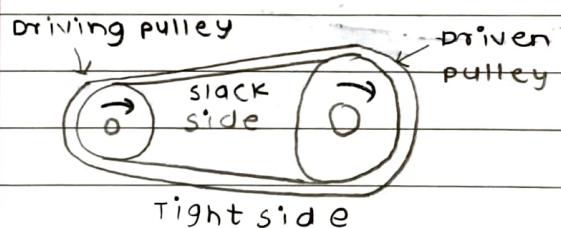
- (1) Slip is more
- (2) Larger in size
- (3) occupy more space
- (4) cannot transmit very high power.

- APPN:

- (1) Used in electric motors.
- (2) I.C. engines to drive pumps, stone crushers
- (3) Drive machines from line shaft in the industrial applications.

- * TYPES:

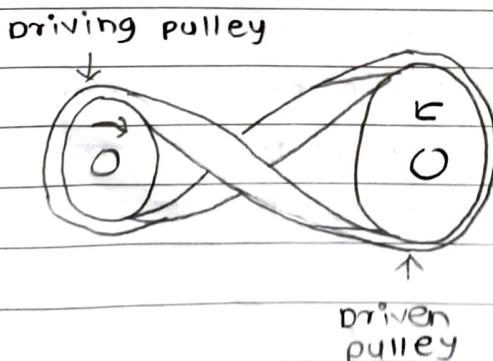
- (1) Open Belt Drive:



Both pulleys rotate in same directn.

use: used when shafts are lvel.

- (2) Crossed Belt Drive:

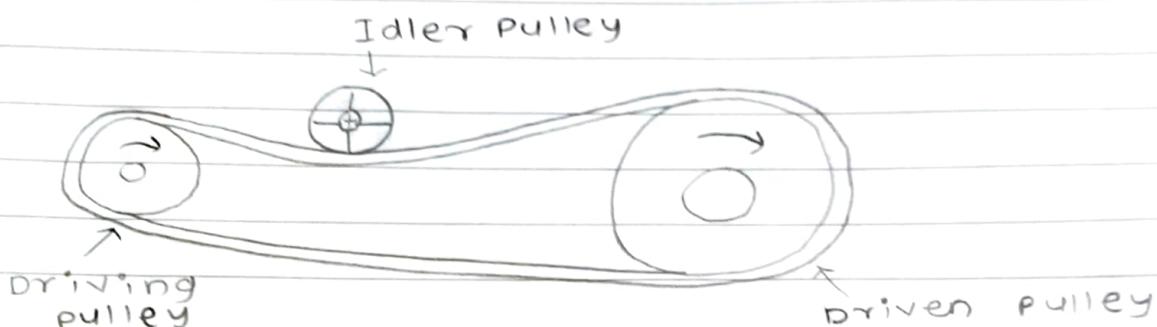


Both pulleys rotate in opp. directn

Gives stronger frictn grip beth belt and pulleys compared to open belt.

use: used when shafts are lvel and centre distance is shorter

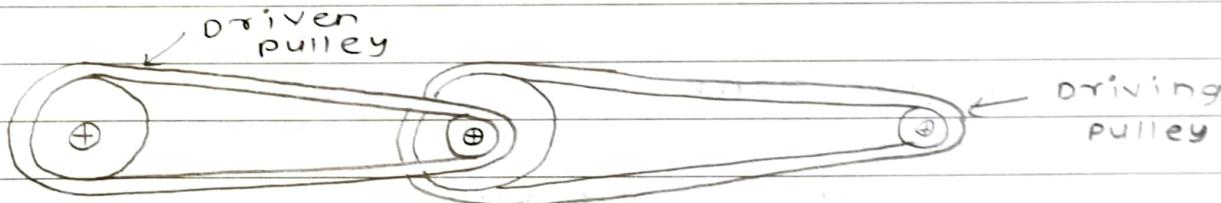
(3) Open Belt drive with Idler pulley :



The open belt drive with idler pulley is used to obtain high velocity ratio and desired belt tension.

use: used when shafts are tall and when an open belt drive cannot be used.

(4) Compound Belt drive:



A compound belt drive relatively high reduction ratio .

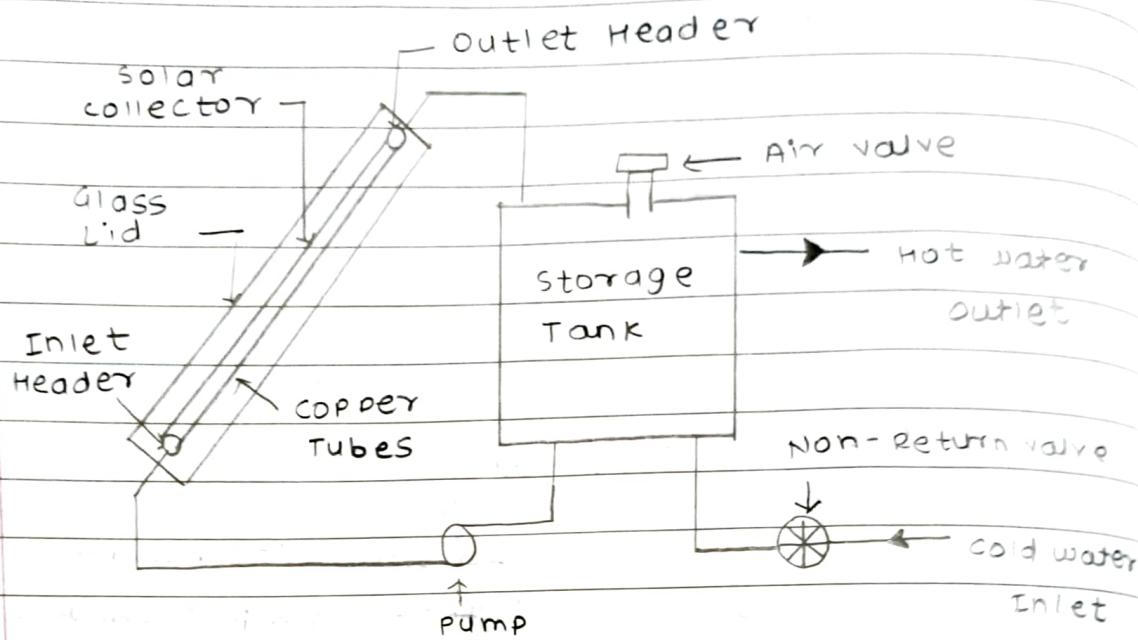
use: used when power is to be transmitted from one shaft to another through pulleys .

* Solar water Heater:

Solar water Heater is used to heat water by using solar energy which is renewable , non-polluting and available free of cost in abundance.

• components:

storage Tank , pump , Solar collector .



(1) storage Tank:

The cold water is supplied to storage tank from inlet pipe. The non-return valve fitted on inlet pipe prevents reverse flow of water from storage tank to inlet pipe.

(2) pump:

The supply tank supplying water to storage tank should be at sufficient height. The pump is used to supply the water to solar collector from storage tank.

(3) solar collector:

The solar collector consists of an insulated box covered with glass lid. The insulated box contains no. of copper tubes, connected betn inlet header and outlet header. Cu tubes are painted by black color from outside.

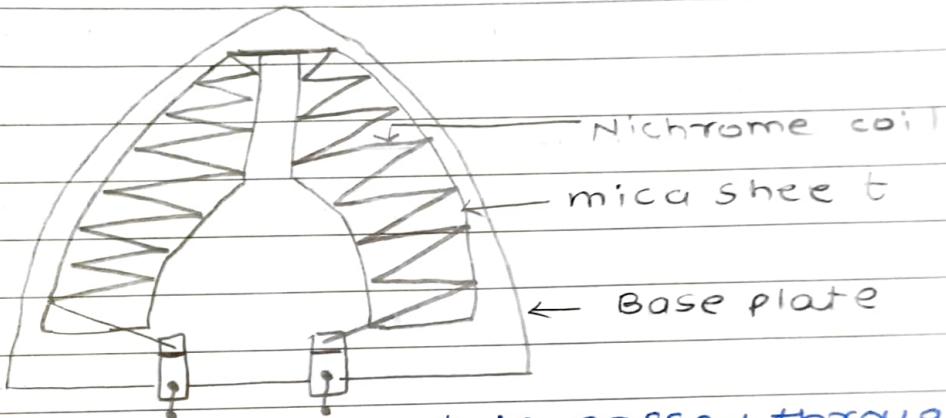
The cold water enters inlet header and flows through copper tubes. The solar radiation heats water flowing through copper tubes (Cu



is good conductor of heat). The black colour is good absorber of heat.

The glass lid prevents loss of heat due to radiation. The hot water from outlet header flows to storage tank.

* Electric Iron:



when electric current is passed through coil, it gets heated

$$\text{Heat generated by coil, } H = I^2 R t$$

Based on heat and pressure.

- components:

(1) **Nichrome coil:** In electric iron, Nichrome coil is used as heating element. It has high resistance. Thus, when current is passed through nichrome coil, it produces high heat.

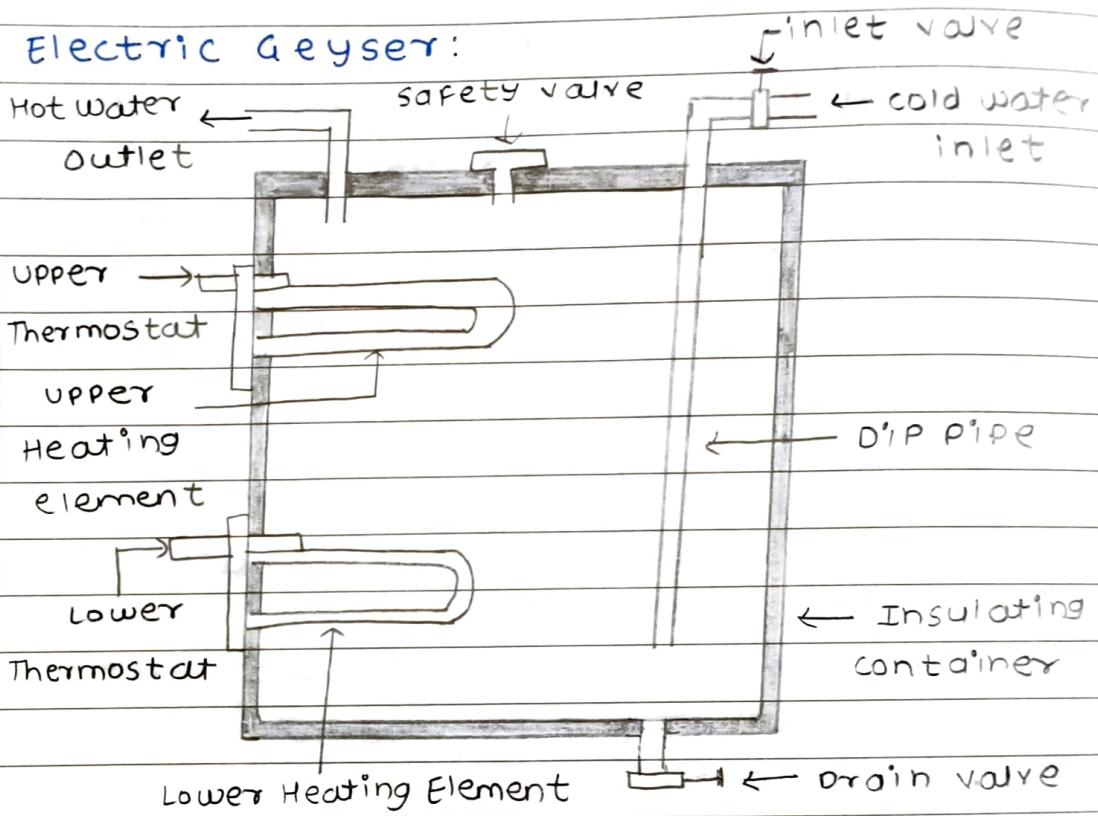
(2) **mica sheets:**

The Nichrome coil is placed between two mica sheets. The mica is an electric insulator but a good conductor of heat.

(3) **steel Base plate and Body:** when an electric current is passed through heating coil i.e.

Nichrome coil, the coil gets heated. Heat is transferred to base plate due to conduction. The heat of base plates and manual pressure applied on iron, helps to iron the clothes.

* Electric Geyser:



• Components:

- (1) **Insulating container:** The container is provided with insulating layer to avoid dissipation of heat to surrounding atm.
- (2) **Cold water Inlet and dip Pipe:** The cold water is supplied to geyser through cold water inlet pipe. The cold water inlet pipe is provided with inlet valve so as to control supply of cold water. The cold water to geyser is supplied in lower part of tank through dip pipe.
- (3) **Hot water outlet:** The hot water is taken out from geyser through hot water outlet.

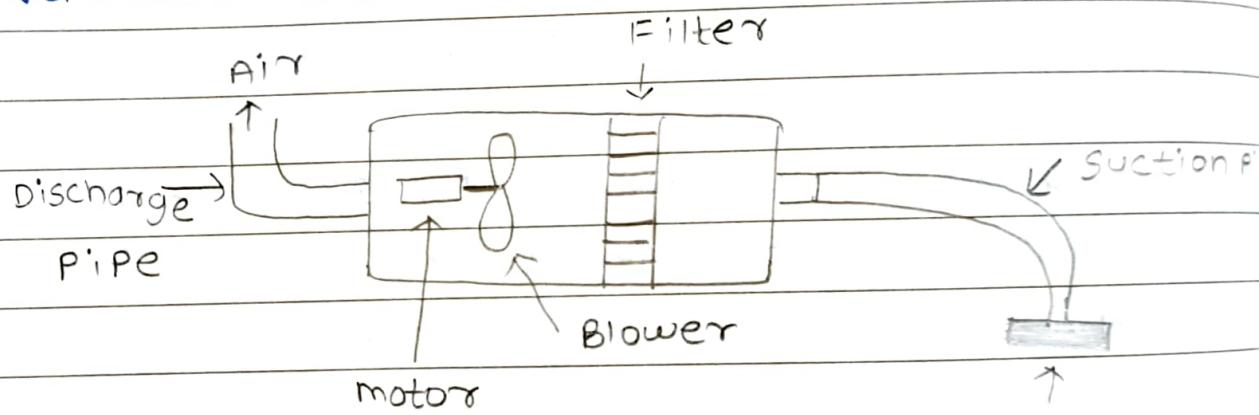
The hot water is light and hence it is in upper part of tank.

- (4) **Mica Upper Heating Element and Thermostat:**
The U.H.E has a heating coil. The U.H.E has its own thermostat. Once upper tank is hot thermostat cuts-OFF electric supply to U.H.E.
- (5) **Lower Heating Element and Thermostat:**
Once the U.H.E is cut-OFF, the L.H.E starts functioning. It has its own thermostat. Both heating elements do not functn simult.
- (6) **safety valve:** If pressure inside geyser shoots up bcoz of some reason, the safety valve opens and releases high pressure fluid to ensure safety.

* Blower:

- (1) The machine which is used to produce low volume of gas with a moderate increase in pressure.
- (2) It consists of wheel with small blades on circumference and casing to direct the flow of air outwards.
- (3) They are mechanical devices used for circulation of air.

* vacuum cleaner:



• Principle : vacuum cleaner is an apparatus which collects dust and small particles from floors ,other surfaces by means of suction.

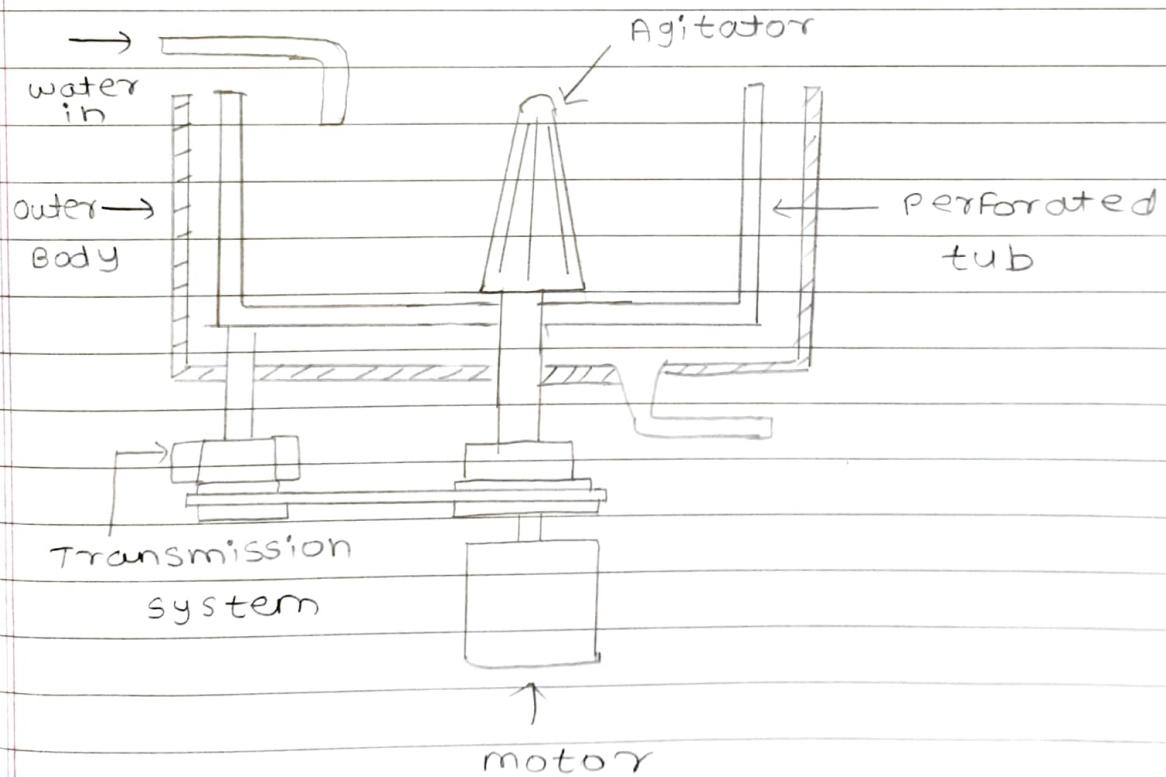
• const'n and working:

- (1) motor and centrifugal Blower: when pressur

diff. is created b/w two locations, particles or materials flows from location of high pressure to location of low pressure. The centrifugal blower creates vacuum.

- (2) Filter : Because of vacuum, dust and small material particles are sucked in through suction pipe. The filter removes dust and small material particles and clean air is discharged to atmosphere.
- (3) Suction pipe : The dust and other small particles
- (4) Discharge : Discharges clean air to atm.

* Washing machine:



- principle: It works on principle of configuration which is fictitious force that pulls out from centre of body while moving in circular path.