08/04/24

Cycle → Chain
2wheeler → Belt
Lift → Steel wires

GEARS (Gear Drives)

→ Gears are toothed wheels used to transmit power from one shaft to another when a constant velocity ratio is desired and the distance between the shafts is relatively small.

→ Gears are classified as below-

(i) Acc. to the position of shaft axes

- Parallel axes : Spur gear, Helical gear
- Intersecting axes : Bevel gears
- Non-parallel, non-intersecting : Worm gears

(ii) Acc. to peripheral velocity of the gears

- $v < 3\,m/s$: Low velocity gears
- $3 < v < 15\,m/s$: medium velocity gears
- $v > 15\,m/s$: High velocity gears

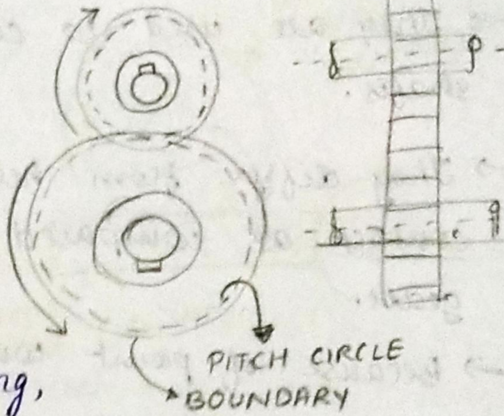
(iii) Acc. to type of gearing

- External Gearing (opp. dir^n)
- Internal gearing (same dir^n)

(iv) Acc. to pos^n of teeth on gear surface

- Straight Teeth : Spur gears
- Inclined Teeth : Helical gears
- Skewed (curved) Teeth : Spiral gears

Spur Gears



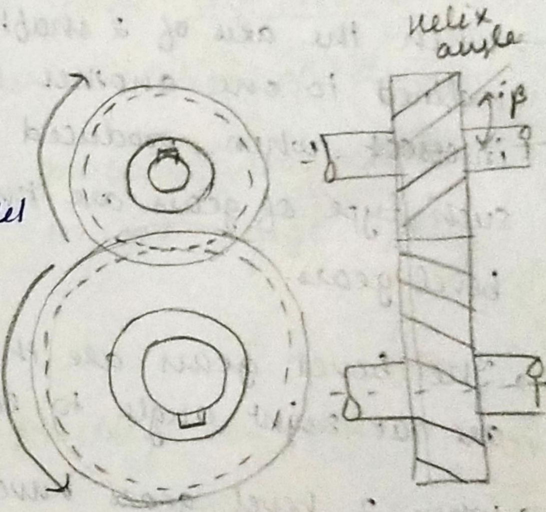
→ The power transmission takes place b/w 2 parallel shafts and co-planar.

→ The teeth are straight and parallel to the axis

→ Because of line contact (1M) during meshing, the drive will be noisy and can transmit high power.

→ Widely used in machine tools, automobile gear boxes, etc.

Helical Gears



→ Helical gears are used for transmitting power between 2 parallel and also b/w non-parallel, non-intersecting shafts.

→ Helical gears are preferred to the spur gears when smooth and quite running at higher speeds are necessary.

→ These gears produce the end thrust on the driving and driven shaft.

→ In these gears, the teeth are inclined to the axis of the shaft at an angle known as Helix angle (15°–45°). 1M

** → Double helical gears are aka herringbone gears.

Spiral Gears

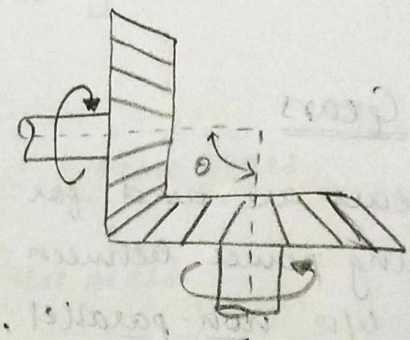
→ They are used to connect 2 non-parallel, non-intersecting shafts.

→ They differ from helical gears in that there's a point contact as compared to curvilinear contact in helical gears.

→ Because of point contact, spiral gears are more suitable for transmitting less power.

Bevel Gears

→ when the axis of 2 shafts are inclined to one another and intersect when produced such type of gears are known as bevel gears.

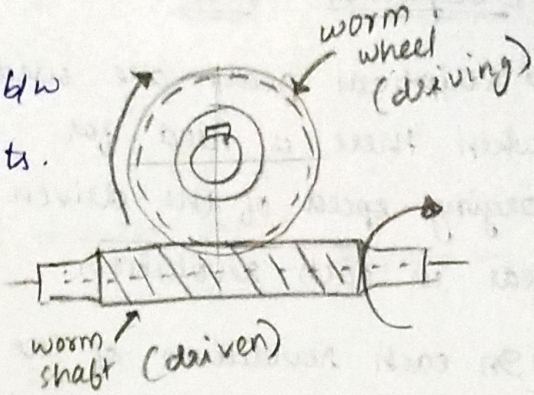


→ The bevel gears are those in which the axes of 2 shafts are at right angle to each other.

→ when 2 bevel gears have their axes at right angles and are of equal sizes they are called miter bevel gear.

** → These gears impose thrust as well as radial loads on the bearings supporting the shaft. (1m)

Worm Gears – closing & opening of metro doors



→ They are used to transmit power b/w 2 non-parallel, non-intersecting shafts.

→ A worm drive consists of a worm shaft with helical grooves which meshes with a gear called worm wheel.

→ Worm gear drives are used for high speed reduction as high as 60 : 1.

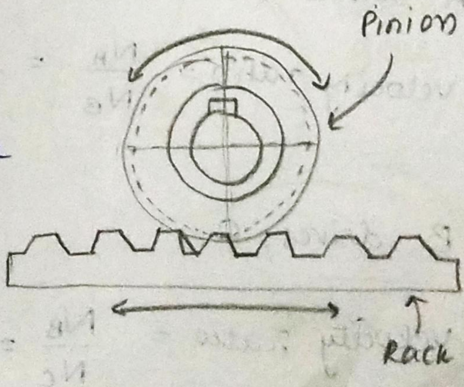
(Imp)

→ The worm gear drive may be made self-locking i.e- doesn't allow the reversal in the direction of drive.

→ They are generally employed in machine tools like lathe, minning, drilling machine to get large speed reduction.

** → These drives offer self-locking facility b/w driven and driving units.

Rack & Pinion



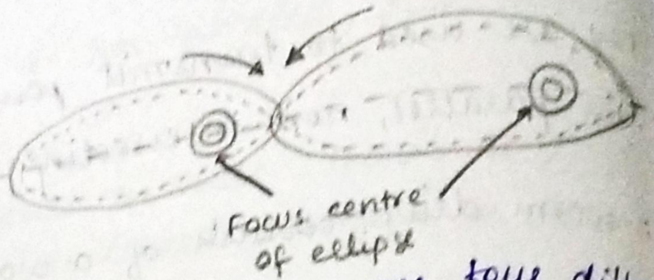
→ when a rotary motion is to be converted into linear motion, rack and pinion arrangement is used.

→ Theoretically, rack is considered to be a spur gear of infinite diameter.

→ This arrangement finds its application in machine tools such as lathe, drilling, etc.

Elliptical Gears

→ Elliptical gears are used when there is need for varying speed of the driven gear in each revolution.



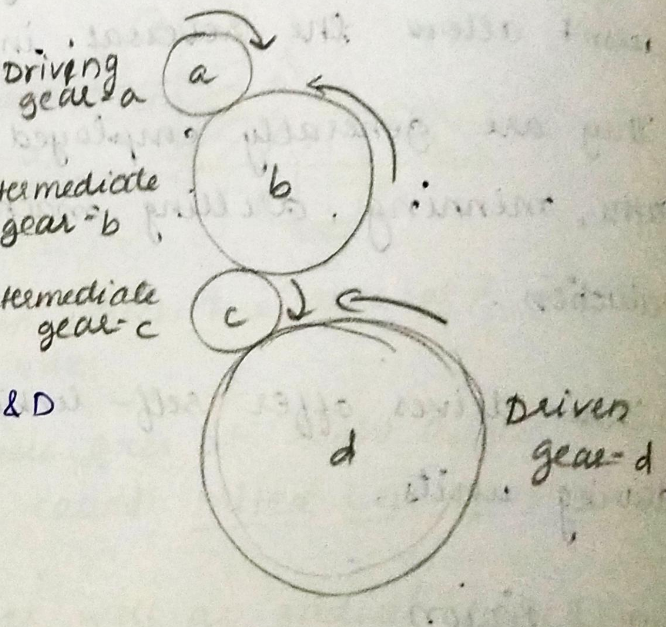
→ In each revolution of the driven shaft, there are four different speeds: two maximum and two minimum.

→ They are used in printing machines, packaging machines, quick return motion mechanism, etc.

#SIMPLE GEAR TRAIN

Let N_a, N_b, N_C & N_D be the rpm and

T_a, T_b, T_c & T_d be the no. of teeth of the gears A, B, C & D resp.



(i) A drives B

$$\text{velocity ratio} = \frac{N_A}{N_B} = \frac{T_B}{T_A}$$

(ii) B drives C

$$\text{velocity ratio} = \frac{N_B}{N_C} = \frac{T_C}{T_B}$$

(iii) C drives D

$$\text{velocity ratio} = \frac{N_C}{N_D} = \frac{T_D}{T_C}$$

velocity ratio between driving & driven gears given by

$$V.R. = \frac{N_A}{N_D} = \frac{N_A}{N_B} \times \frac{N_B}{N_C} \times \frac{N_C}{N_D}$$

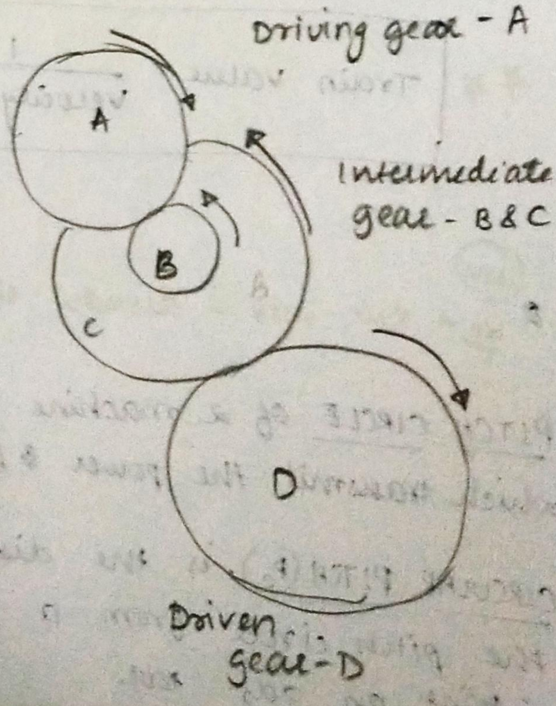
$$= \frac{T_B}{T_A} \times \frac{T_C}{T_B} \times \frac{T_D}{T_C}$$

$$\boxed{\frac{N_A}{N_D} = \frac{T_D}{T_A}} = \text{velocity ratio}$$

$$\boxed{\text{Train value} = \frac{1}{\text{velocity ratio}} = \frac{N_D}{N_A} = \frac{T_A}{T_D}}$$

Velocity Ratio of a Compound Gear Train

Let N_A, N_B, N_C, N_D be the RPM & T_A, T_B, T_C & T_D be the no. of teeth of the gears A, B, C, D respectively.



(i) A drives B

$$\text{velocity ratio} = \frac{N_A}{N_B} = \frac{T_B}{T_A}$$

(ii) Since the gears B and C are keyed (mounted) to the same shaft and hence

$$N_B = N_C \quad \text{But,} \quad T_B \neq T_C$$

(iii) C drives D

$$\text{Velocity ratio} = \frac{N_C}{N_D} = \frac{T_D}{T_C}$$

velocity ratio b/w driving & driven wheels:

$$V.R = \frac{N_A}{N_D} = \frac{N_A}{N_B} \times \frac{N_C}{N_D} = \boxed{\frac{T_B}{T_A} \times \frac{T_D}{T_C}}$$

** $\boxed{\text{Velocity ratio} = \frac{N_A}{N_D} = \frac{T_B}{T_A} \times \frac{T_D}{T_C}}$

** $\boxed{\text{Train value} = \frac{1}{\text{Velocity ratio}} = \frac{N_D}{N_A} = \frac{T_A}{T_B} \times \frac{T_C}{T_D}}$

(4m)

Qn → List adv & disadv. of gear drives

PITCH CIRCLE of a machine gears represent a imaginary cylinders which transmit the power by rolling friction.

CIRCULAR PITCH (P_c) is the dist. measured on the circumference of the pitch circle from a point on one tool to corresponding point on adj. tool.

Gear Tooth Profile

If T = no. of teeth on gear

d = diameter of pitch circle

$$T_c = \frac{\text{Pitch circum.}}{\text{no. of teeth}} = \frac{\pi d}{T} \Rightarrow \boxed{T_c = \frac{\pi d}{T}}$$

Diametral Pitch (P_D)

$$P_D = \frac{\text{no. of teeth}}{\text{pitch diam.}} = \frac{T}{d} \Rightarrow \boxed{P_D = \frac{T}{d}}$$

Module (m)

$$\boxed{m = \frac{d}{T}}$$