Design Of Gears

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Introduction

- Slipping of belt and rope cause reduce in velocity ratio

e.g. Precision machines Watch

- Power transmitted by gear equivalent to friction wheels
- Tangential force (P) does not exceeds frictional resistance (F)
- To avoid slipping number of teeth are provided on periphery.
- Require small distance from driver to follower

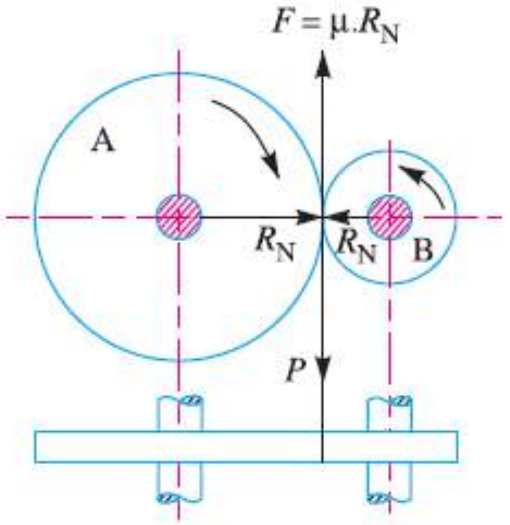

Fig.: Friction Wheels

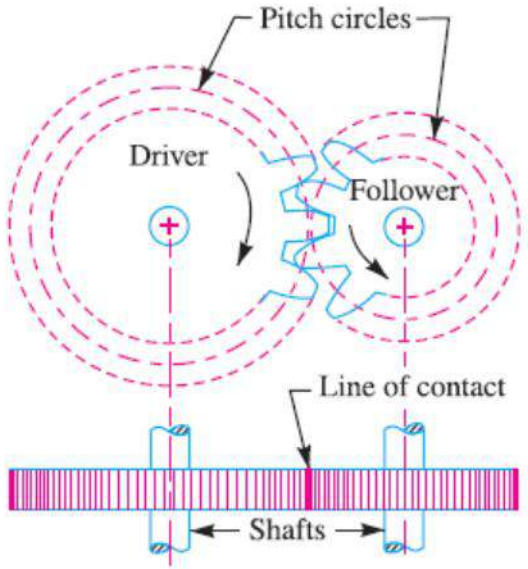

Fig.: Gears

Classification of Gears

1. According to position of axes of shafts.

The axes of the two shafts between which the motion is to be transmitted,

a) Parallel axes of shafts

- Parallel and co-planer shaft connected by gears.
- To reduce noise helical are used in which teeth are inclined to the axis.
- To balance end thrusts double helical gears are use and is also called as Herringbone gears.

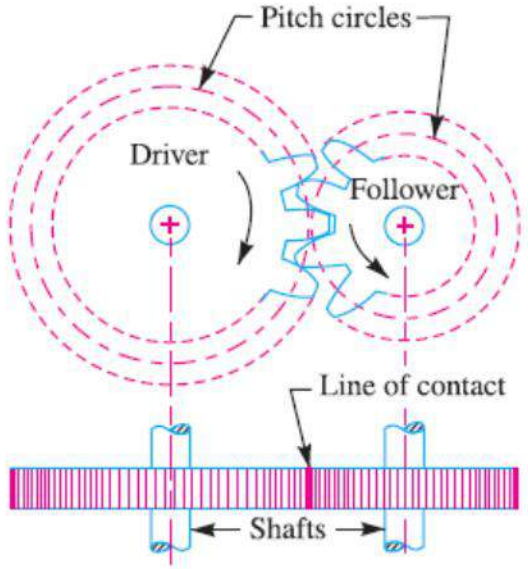

Fig.: Spur gears

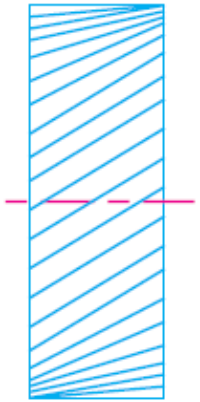

Fig. : Helical Gears

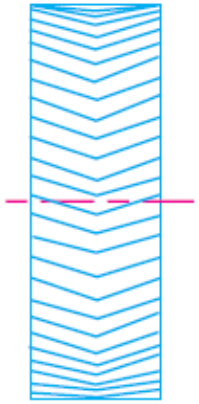

Fig. :Double helical gears

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b) Intersecting axes of shafts.

- Two non-parallel and co-planer shaft connected by gears called as Bevel gears.
- It also have there teeth inclined to axis called as Helical bevel gears.

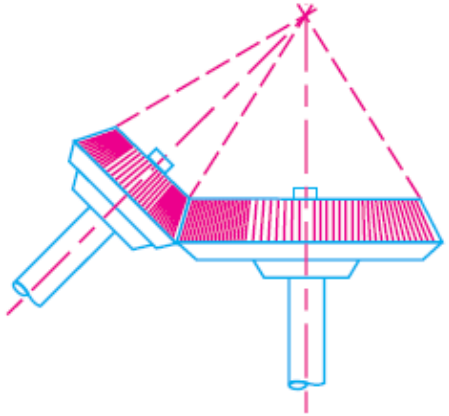

Fig. : Bevel gears

c) Non- Intersecting and Non- Coplanar axes of shafts.

- These gears are called spiral or skew bevel gear.
- It is having line contact.

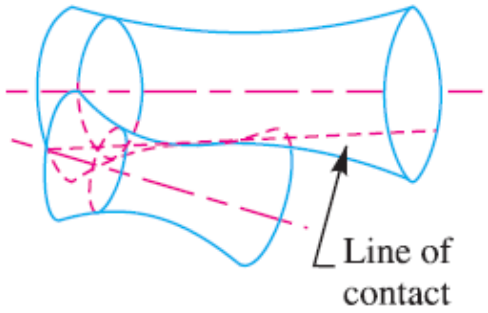

Fig. : Spiral Gears

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2. According to the type of gearing.

The gears, according to the type of gearing, may be classified as

a) External gearing

- Motion of the two wheels is always unlike.
- The larger of these two wheels is called ***spur wheel*** or ***gear*** and the smaller wheel is called ***pinion*.**

b) The gear of a shaft meshes externally (or internally) with the gears in a straight line called ***rack*** and ***pinion*.**

- The straight line gear is called ***rack*** and the circular wheel is called ***pinion.***

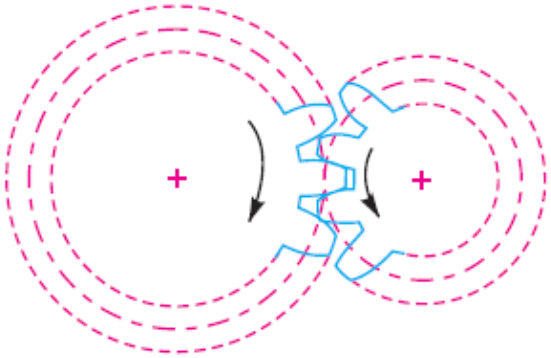

Fig. : External gearing

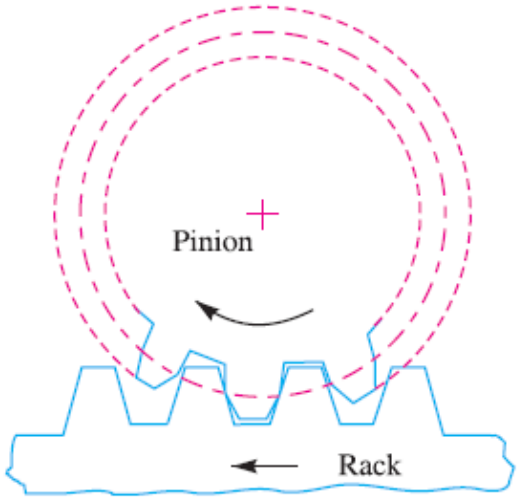

Fig. : Rack and Pinion

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c) internal gearing,

- Two shafts mesh internally with each other.
- Larger of these two wheels is called ***annular wheel*** and the smaller wheel is called ***pinion***.

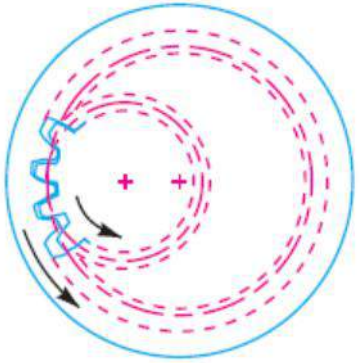


Fig. : Internal gearing

3. According to the peripheral velocity of the gears.

The gears, according to the peripheral velocity of the gears, may be classified as :

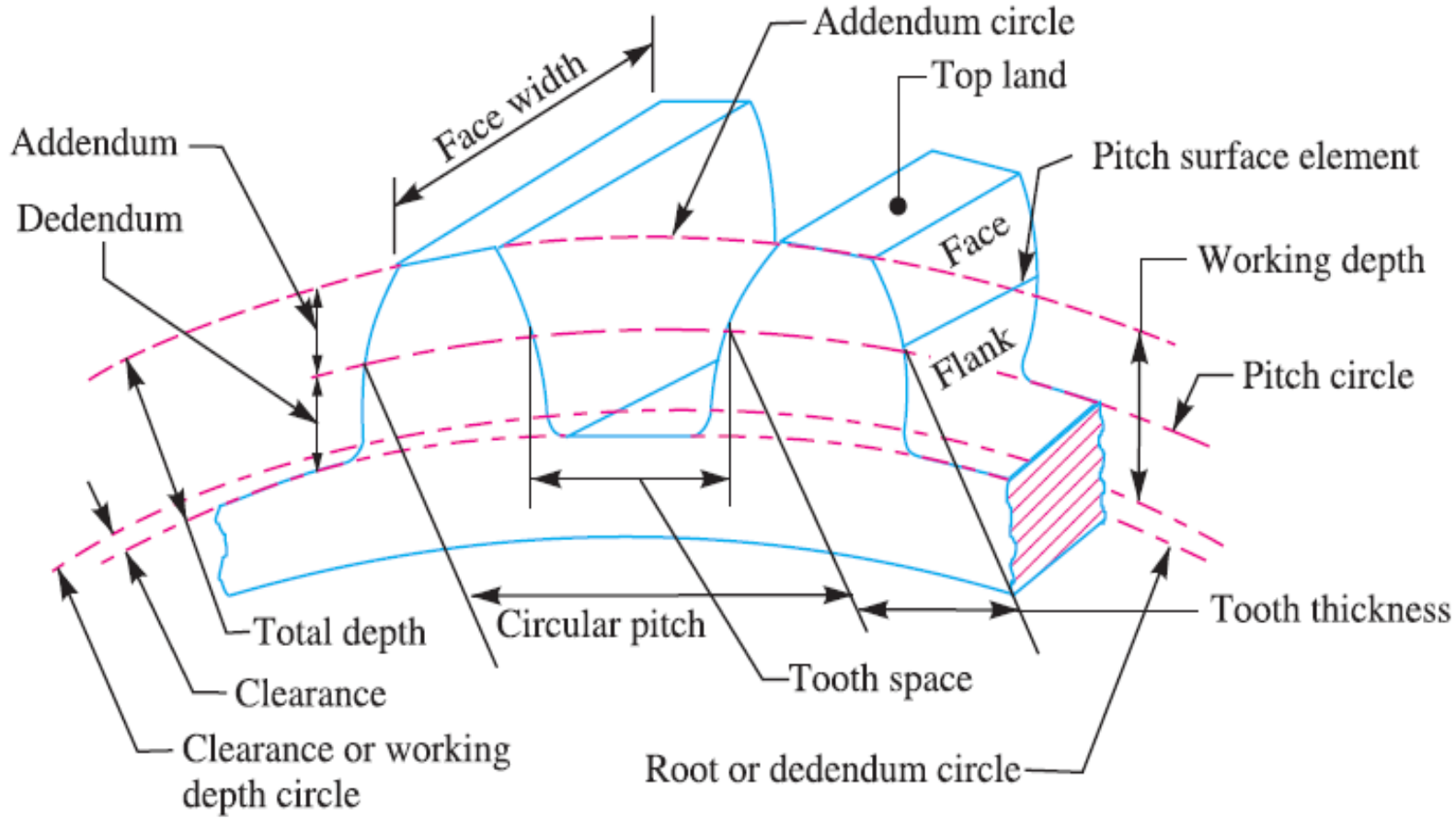
(*a*) Low velocity : Velocity less than 3 m/s.

(*b*) Medium velocity : Velocity in between 3 m/s to 15 m/s.

(*c*) High velocity : Velocity more than 15 m/s.

Terms used in Gears

1. Pitch circle.
2. Pitch surface element.
3. Addendum.
4. Dedendum.
5. Addendum circle.
6. Dedendum circle.
7. Circular pitch($pc = \pi D/T$).
8. Clearance.
9. Total depth.
10. Working depth.



Law of Gearing-Condition for Constant Velocity Ratio of Gears

- Portions shown by thick line curves of the two teeth
- *T T* be the common tangent and *MN* be the common normal to the curves at point of contact *Q*.

$$\therefore \quad v_1 \cos \alpha = v_2 \cos \beta$$

or $$(\omega_1 \times O_1Q) \cos \alpha = (\omega_2 \times O_2Q) \cos \beta$$

$$(\omega_1 \times O_1Q) \frac{O_1M}{O_1Q} = (\omega_2 \times O_2Q) \frac{O_2N}{O_2Q}$$

$$\therefore \quad \omega_1 . O_1M = \omega_2 . O_2N$$

or $$\frac{\omega_1}{\omega_2} = \frac{O_2N}{O_1M} \qquad ...(i)$$

Also from similar triangles O_1MP and O_2NP,

$$\frac{O_2N}{O_1M} = \frac{O_2P}{O_1P} \qquad ...(ii)$$

Combining equations (*i*) and (*ii*), we have

$$\frac{\omega_1}{\omega_2} = \frac{O_2N}{O_1M} = \frac{O_2P}{O_1P} \qquad ...(iii)$$

We see that the angular velocity ratio is inversely proportional to the ratio of the distance of *P* from the centres

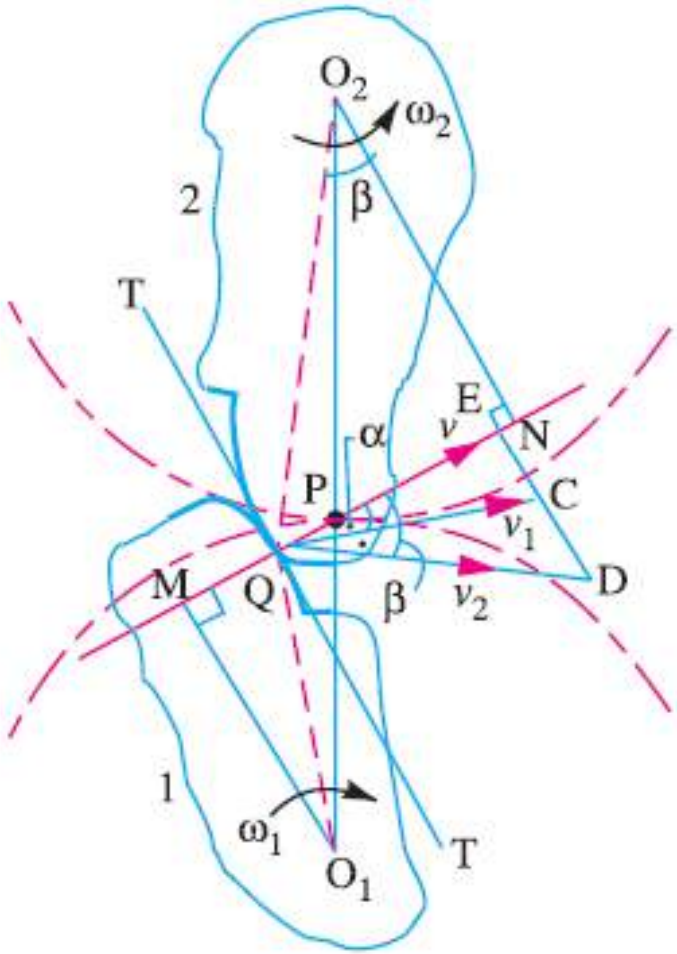


Fig. : Law of Gearing