11. Flank of tooth. It is the surface of the gear tooth below the pitch surface.

12. Top land. It is the surface of the top of the tooth.

13. Face width. It is the width of the gear tooth measured parallel to its axis.

14. Profile. It is the curve formed by the face and flank of the tooth.

15. Fillet radius. It is the radius that connects the root circle to the profile of the tooth.

16. Path of contact. It is the path traced by the point of contact of two teeth from the beginning to the end of engagement.

Gear Materials

The material used for the manufacture of gears depends upon the strength and service conditions like wear, noise etc. The gears may be manufactured from metallic or non-metallic materials.

The metallic gears with cut teeth are commercially obtainable in cast iron, steel and bronze. The nonmetallic materials like wood, raw hide, compressed paper and synthetic resins like nylon are used for gears, especially for reducing noise.

The cast iron is widely used for the manufacture of gears due to its good wearing properties, excellent machinability and ease of producing complicated shapes by casting method. The cast iron gears with cut teeth may be employed, where smooth action is not important.

The steel is used for high strength gears and steel may be plain carbon steel or alloy steel. The steel gears are usually heat treated in order to combine properly the toughness and tooth hardnes

Condition for Constant Velocity Ratio of Toothed Wheels–Law of Gearing

wheel 2, as shown by thick line curves in Fig. 12.6. Let the two teeth come in contact at point Q, and the wheels rotate in the directions as shown in the figure.

Let $T\ T$ be the common tangent and MN be the common normal to the curves at the point of contact Q. From the centres O_1 and O_2, draw O_1M and O_2N perpendicular to MN. A little consideration will show that the point Q moves in the direction QC, when considered as a point on wheel 1, and in the direction QD when considered as a point on wheel 2.

Let v_1 and v_2 be the velocities of the point Q on the wheels 1 and 2 respectively. If the teeth are to remain in contact, then the components of these velocities along the common normal MN must be equal.

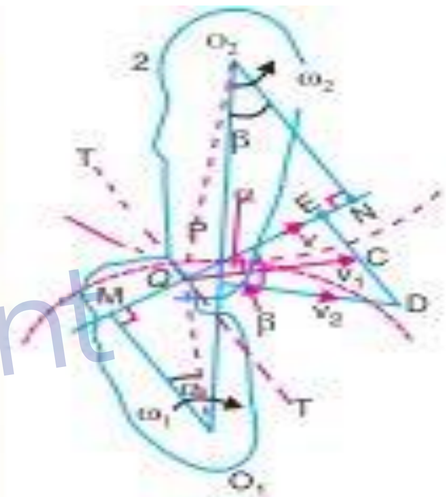


Fig. 12.6. Law of gearing.

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

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

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

$$\therefore \quad \frac{\omega_1}{\omega_2} = \frac{O_2N}{O_1M} \qquad \ldots(i)$$

Also from similar triangles O_1MP and O_2NP,

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

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

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

12.8. Velocity of Sliding of Teeth

The sliding between a pair of teeth in contact at Q occurs along the common tangent $T\ T$ to the tooth curves as shown in Fig. 12.6. ***The velocity of sliding is the velocity of one tooth relative to its mating tooth along the common tangent at the point of contact.***

The velocity of point Q, considered as a point on wheel 1, along the common tangent $T\ T$ is represented by EC. From similar triangles QEC and O_1MQ,

$$\frac{EC}{MQ} = \frac{v}{O_1Q} = \omega_1 \quad \text{or} \quad EC = \omega_1 . MQ$$

Similarly, the velocity of point Q, considered as a point on wheel 2, along the common tangent $T\ T$ is represented by ED. From similar triangles QCD and $O_2\ NQ$,

$$\frac{ED}{QN} = \frac{v_2}{O_2Q} = \omega_2 \quad \text{or} \quad ED = \omega_2 . QN$$

Let v_S = Velocity of sliding at Q.

$$\therefore \quad v_S = ED - EC = \omega_2 . QN - \omega_1 . MQ$$

$$= \omega_2 (QP + PN) - \omega_1 (MP - QP)$$

$$= (\omega_1 + \omega_2)\ QP + \omega_2 .\ PN - \omega_1 . MP \quad \text{...}(i)$$

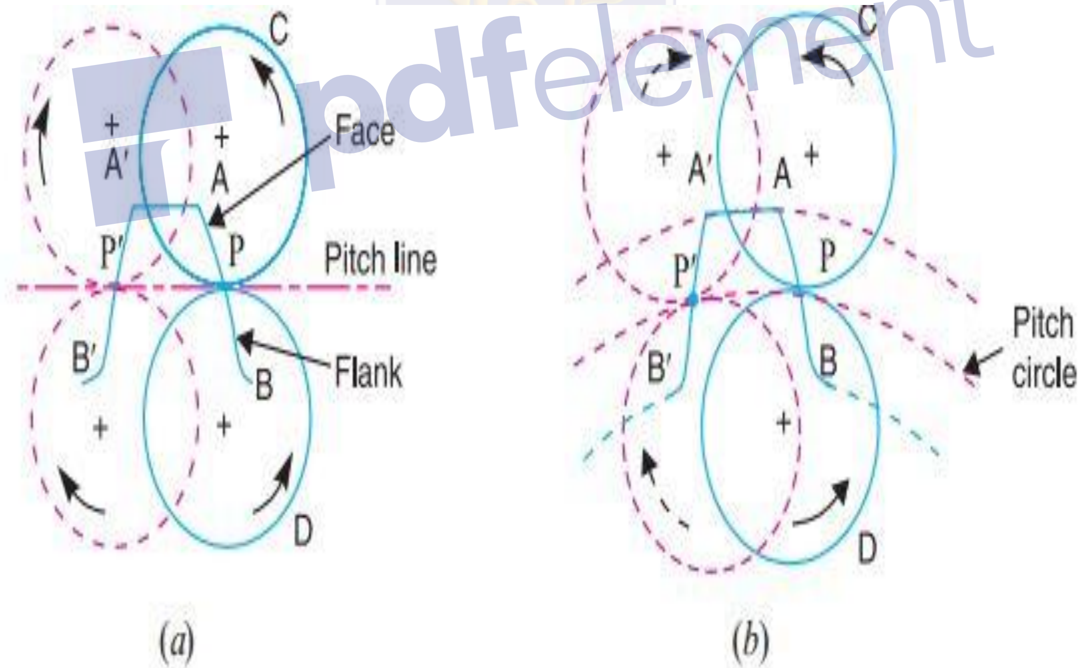
Since $\dfrac{\omega_1}{\omega_2} = \dfrac{O_2P}{O_1P} = \dfrac{PN}{MP}$ or $\omega_1 .\ MP = \omega_2 . PN$, therefore equation (*i*) becomes

$$v_S = (\omega_1 + \omega_2) QP \quad \text{...}(ii)$$

Forms of Teeth:

1. Cycloidalteeth ; and 2. Involute teeth.

A cycloid is the curve traced by a point on the circumference of a circle which rolls without slipping on a fixed straight line. When a circle rolls without slipping on the outside of a fixed circle, the curve traced by a point on the circumference of a circle is known as epi cycloid. On the other hand, if a circle rolls without slipping on the inside of a fixed circle, then the curve traced by a point on the circumference of a circle is called hypo-cycloid.



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