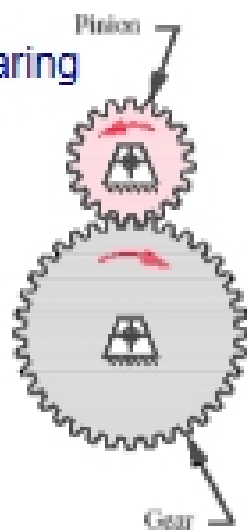


Outline

- ❖ Gear Theory
 - Fundamental Law of Gearing
 - Involute profile
- ❖ Nomenclature
- ❖ Gear Trains



Fundamental Law of Gearing

functionally, a gearsset is a device to exchange torque for velocity

$$P = T\omega$$

the angular velocity ratio of the gears of a gearsset must remain constant throughout the mesh

What gear tooth shape can do this?



$$m_v = \frac{\omega_{out}}{\omega_{in}} = \frac{r_{out}}{r_{in}}$$

pitch circle, pitch diameter d , pitch point

Towards the Involute Profile

A belt connecting the two cylinders



line of action, pressure angle ϕ

The Involute Profile

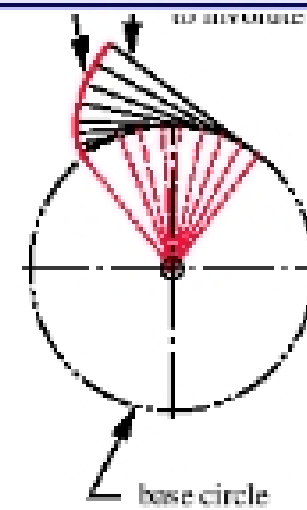
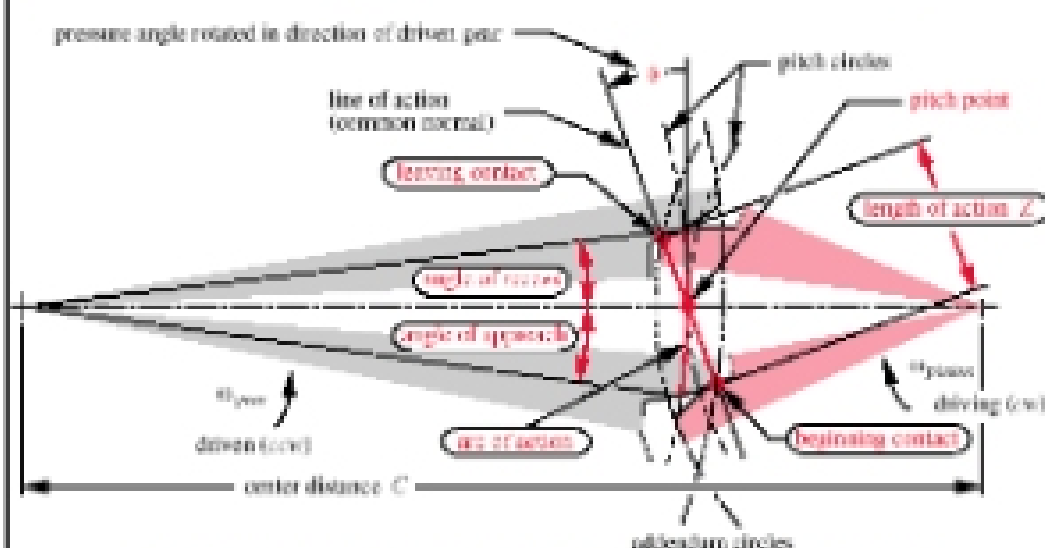


FIGURE 11-3

Meshing



pressure angle, line of action, length of action, addendum

Nomenclature

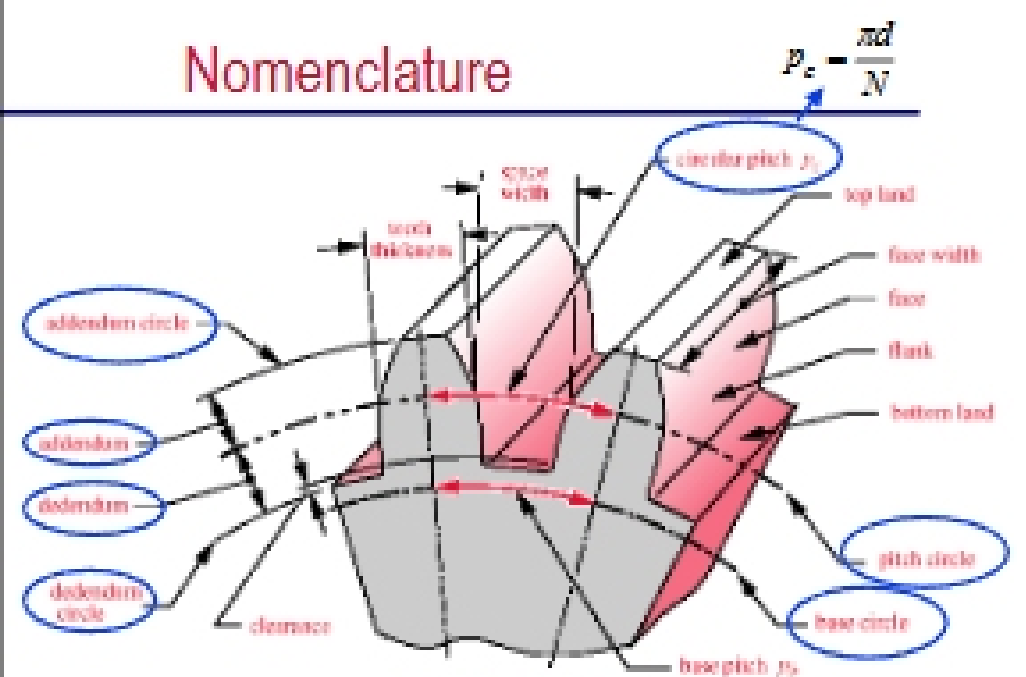


Figure 11-8

Pitches, Etc.

circular pitch (mm, in.) $p_c = \frac{\pi d}{N}$

base pitch (mm, in.) $p_b = p_c \cos \phi$

diametral pitch (teeth/in.) $p_d = \frac{N}{d}$

module (mm/teeth) $m = \frac{d}{N}$

Velocity Ratio

pitches must be equal for mating gears, therefore

$$m_V = \pm \frac{r_{out}}{r_{in}} = \pm \frac{N_{out}}{N_{in}}$$

Contact Ratio

average number of teeth in contact at any one time
= length of action divided by the base pitch, or,

$$m_p = \frac{p_d Z}{\pi \cos \phi}$$

$$Z = \sqrt{(r_p + a_p)^2 - (r_p \cos \phi)^2} + \sqrt{(r_g + a_g)^2 - (r_g \cos \phi)^2} - C \sin \phi$$

where C= center distance = $(N_1 + N_2)^{1/2} p_d^{1/2}$

Minimum # of Teeth

minimum # of teeth to avoid undercutting with gear and rack

$$N_{min} = \frac{2}{\sin^2 \phi}$$

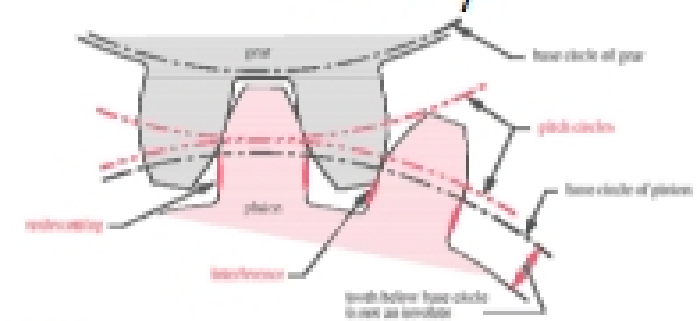
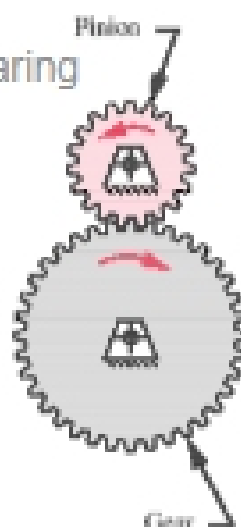


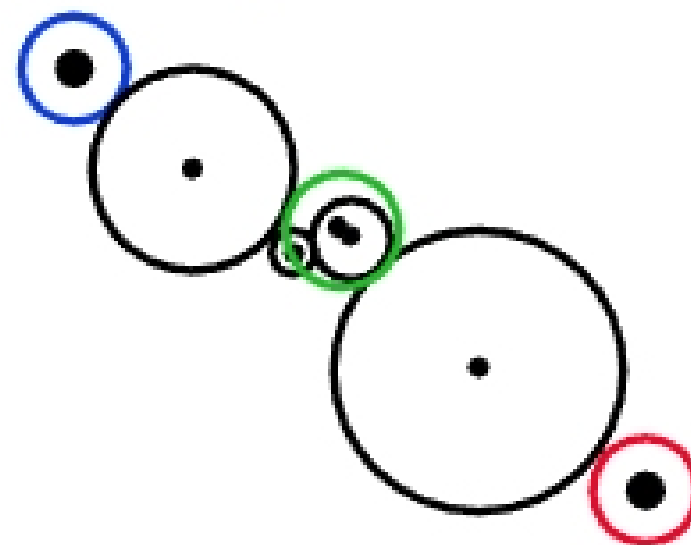
FIGURE 11-11

Outline

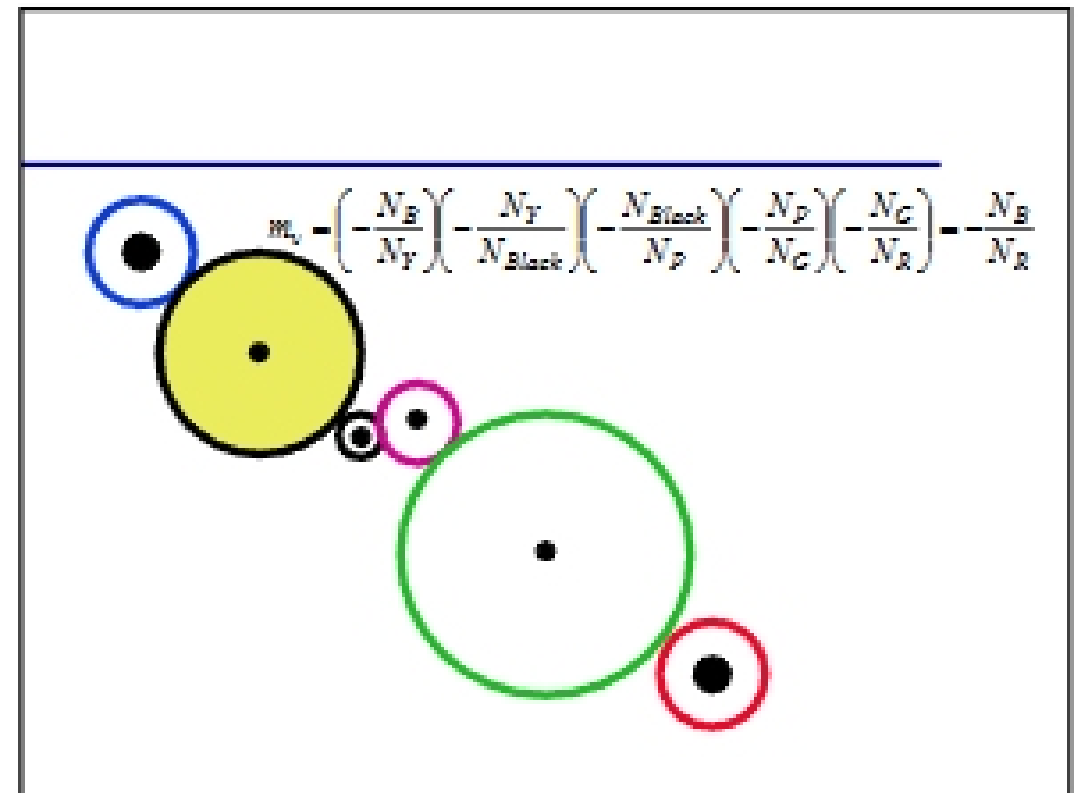
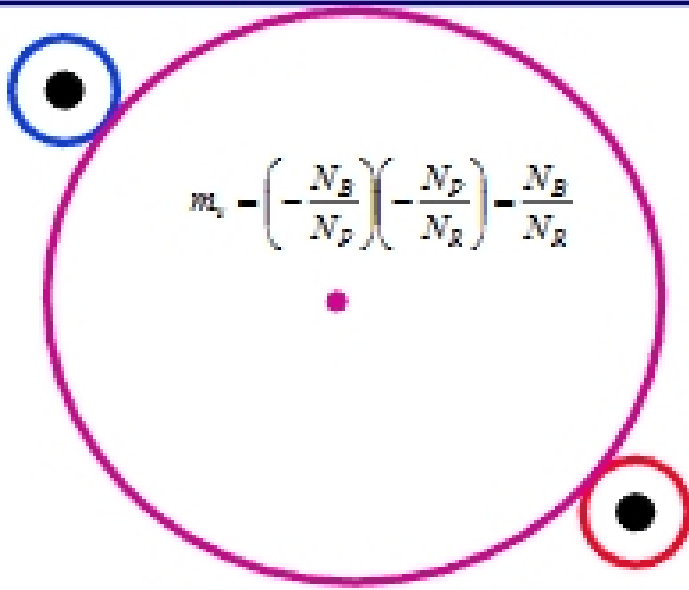
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Simple Gear Trains



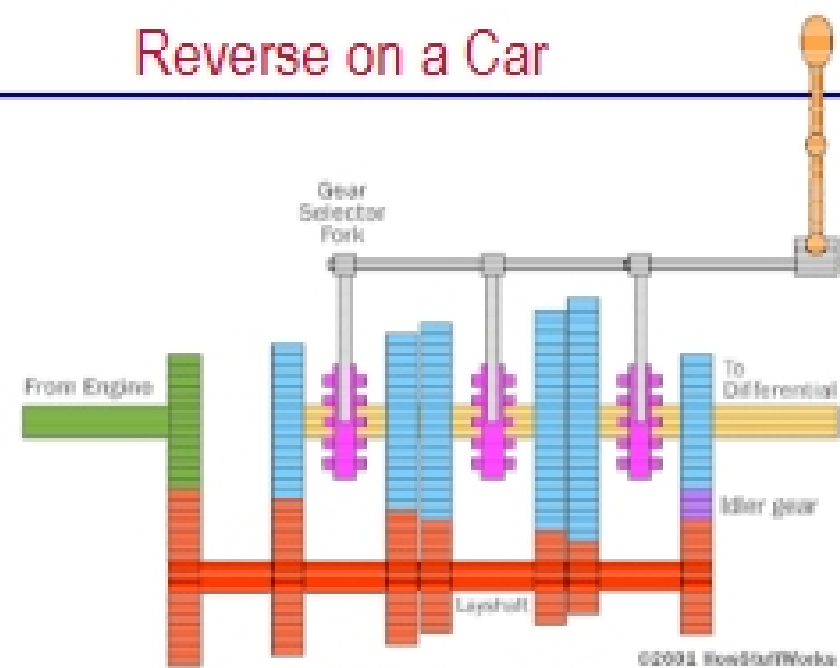
Simple Gear Train



Simple Gear Train

- ❖ Fine for transmitting torque between
 - shafts in close proximity
 - when m_v does not need to be too large
- ❖ Use third gear ("idler") only for directional reasons (not for gear reduction)

Reverse on a Car



Actual Manual Transmission

