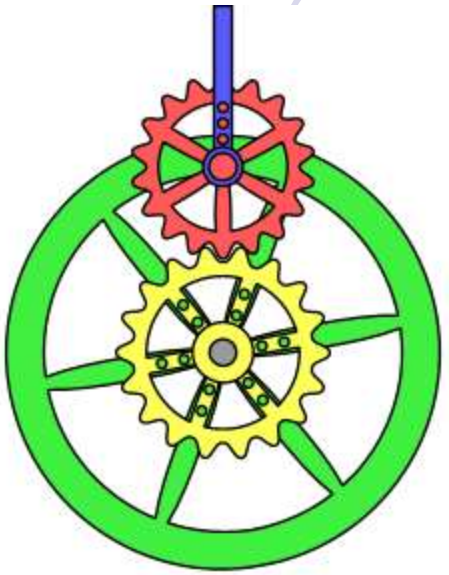
Mechanical Design II ME 352

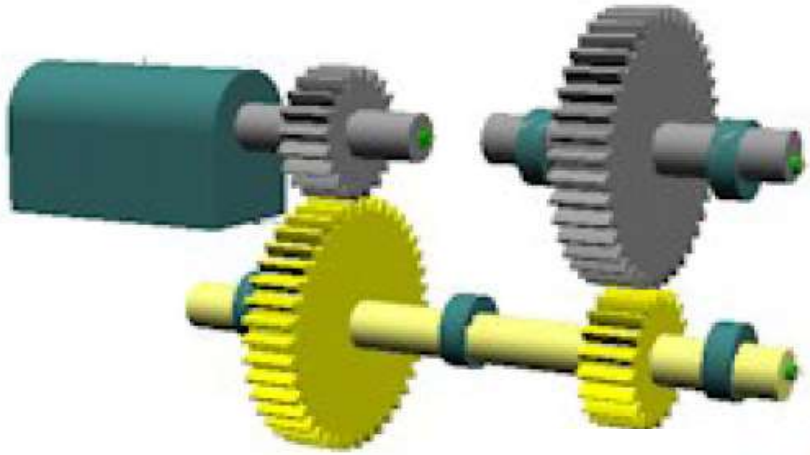
By S.G.Khan

- Types of gears

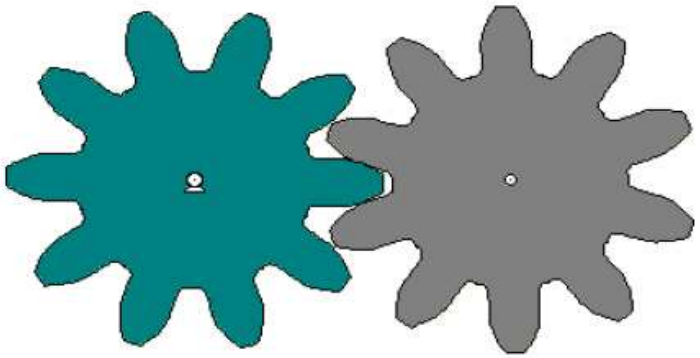


Chapter 13

Gears

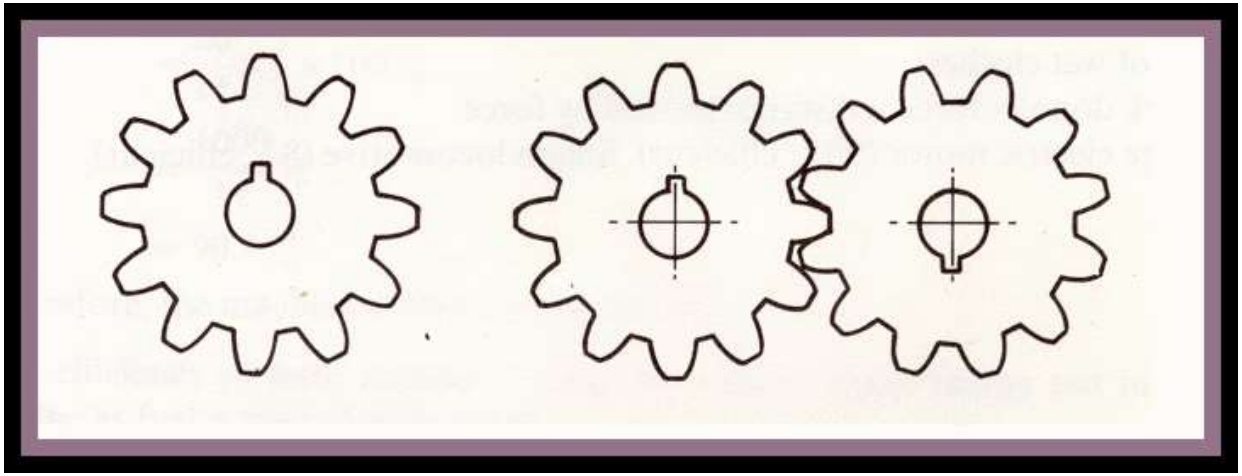


a toothed wheel that engages another toothed mechanism in order to change the speed or direction of transmitted motion



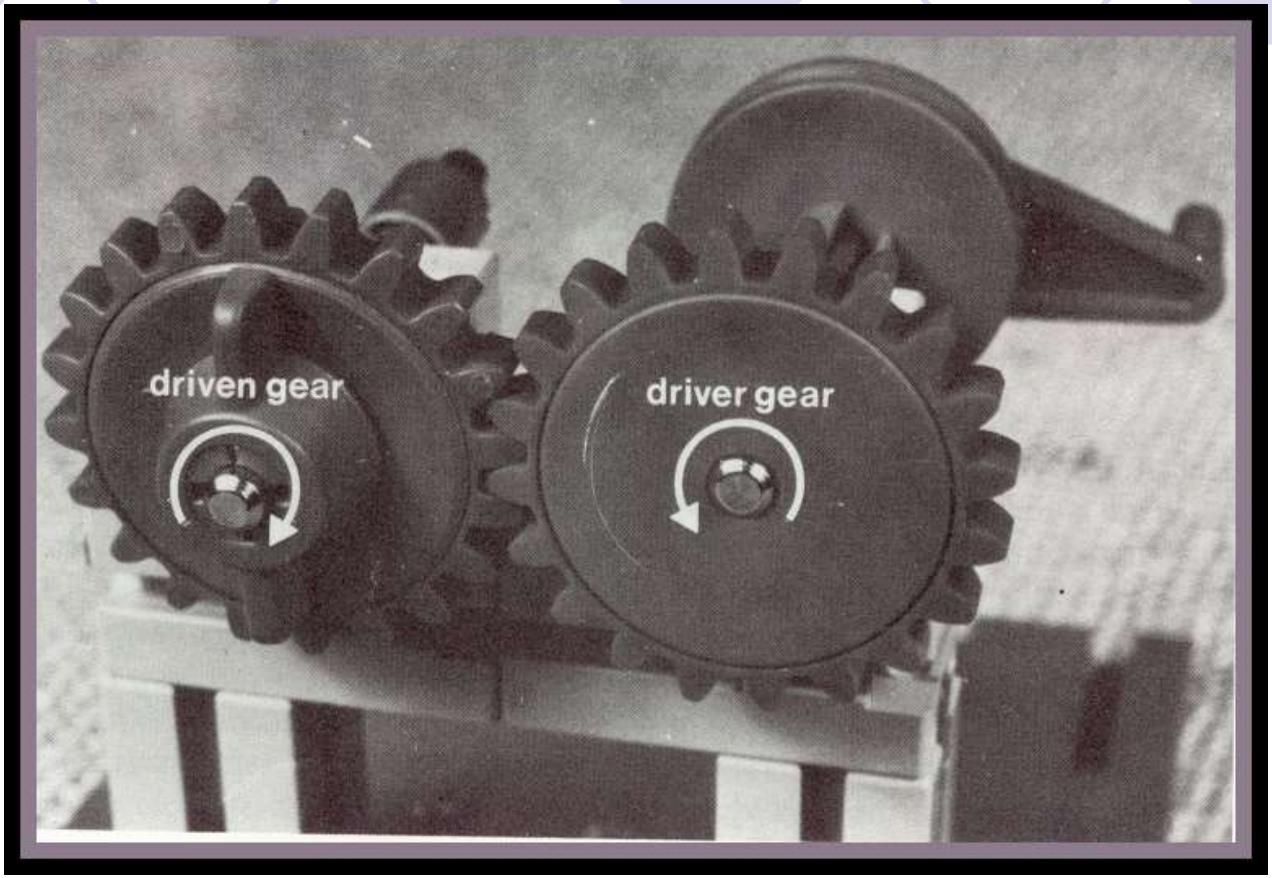
What is Gear?

- **The gear wheel is a basic mechanism. Its purpose is to transmit rotary motion and force. A gear is a wheel with accurately machined teeth round its edge. A shaft passes through its center and the gear may be geared to the shaft. Gears are used in groups of two or more. A group of gears is called a gear train. The gears in a train are arranged so that their teeth closely interlock or mesh. The teeth on meshing gears are the same size so that they are of equal strength. Also, the spacing of the teeth is the same on each gear. An example of a gear train is shown below.**



Single gear *gear train*

Drive and Driven Gears



Larger Gear can be called Wheel and Smaller Gear can be Called Pinion

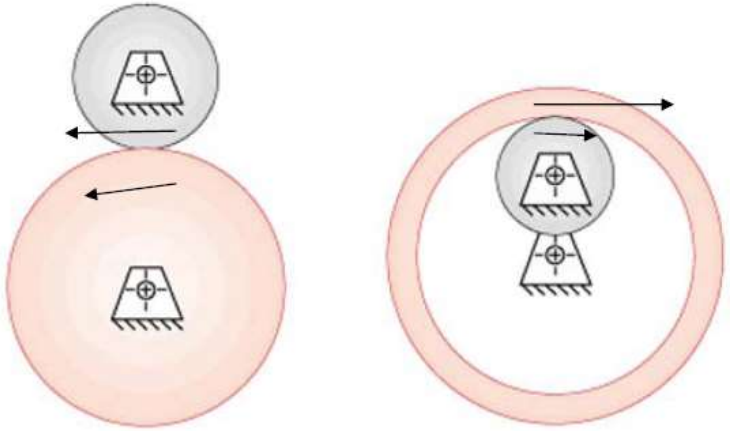
Why Gears?

- The designer is frequently confronted with the problem of transferring power from one shaft to another while maintaining a definite ratio between the velocities of rotation of the shafts.

- Transmission of specified angular motion from one shaft to another

Rolling Cylinders

- Gear analysis is based on rolling cylinders
- For external set gears rotate in opposite directions
- For internal set gears rotate in same direction

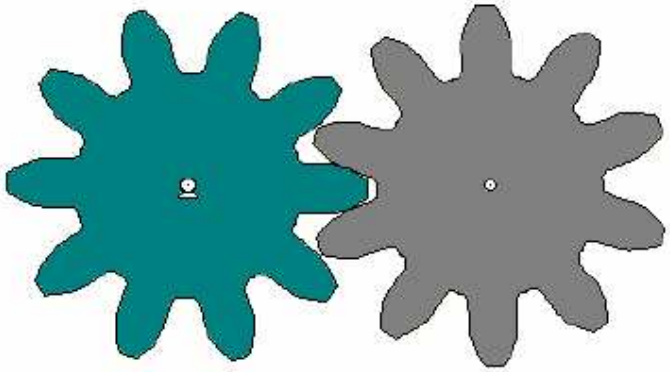


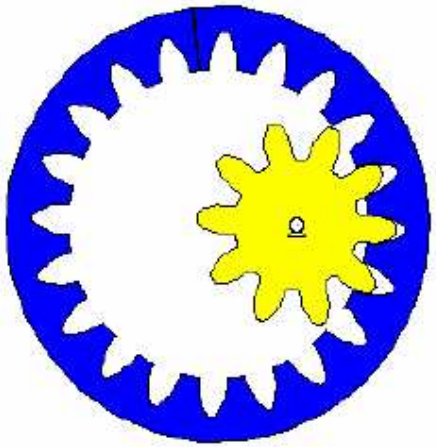
(*a*) External set (*b*) Internal set

Gear Types

Internal and External Gears

Two Gears together are called a gearset

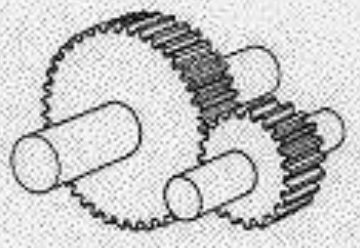




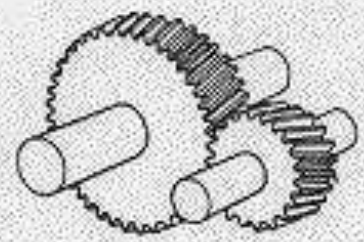
Gear Types

- Spur Gears
- Helical Gears (open or crossed)
- Herringbone Gears
- Worm Gears
- Rack and Pinion
- Bevel Gears

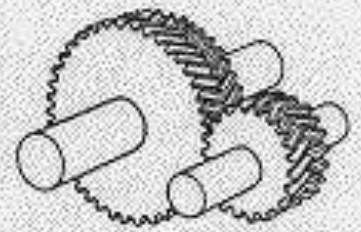
TYPES OF GEARS



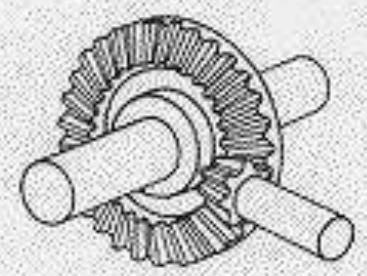
STRAIGHT SPUR



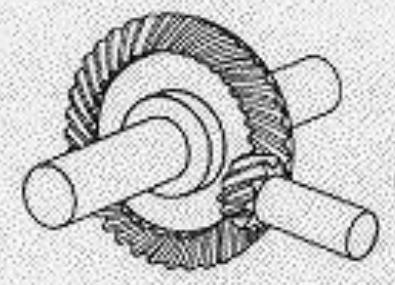
HELICAL SPUR



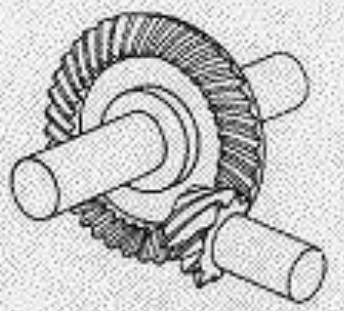
HERRINGBONE



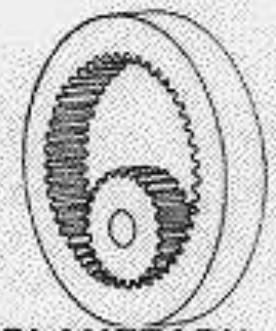
PLAIN BEVEL



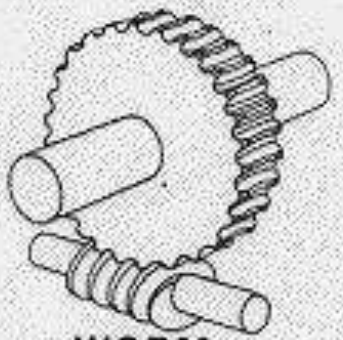
SPIRAL BEVEL



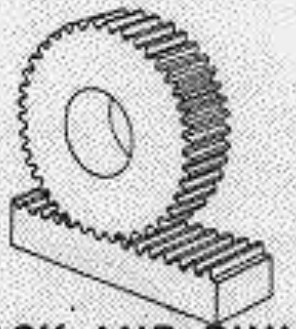
HYPOID



PLANETARY



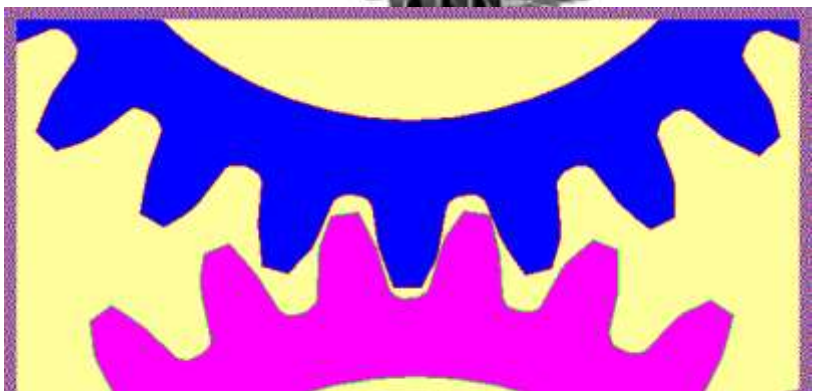
WORM



RACK AND PINION

Spur Gears

- Straight teeth
- Noisy since all of the tooth contacts at one time
- Low Cost
- High efficiency (98-99%)



Helical Gears

- Slanted teeth to smooth contact
- Axis can be parallel or crossed
- Efficiency of 96-98% for parallel and 50-90% for crossed

FIGURE 9-16

Parallel axis helical gears
Courtesy of Martin Sprocket and Gear Co., Arlington, TX

FIGURE 9-17

Crossed axis helical gears
Courtesy of the Boston Gear Division of IMO Industries, Quincy, MA

Crossed Helical Gears

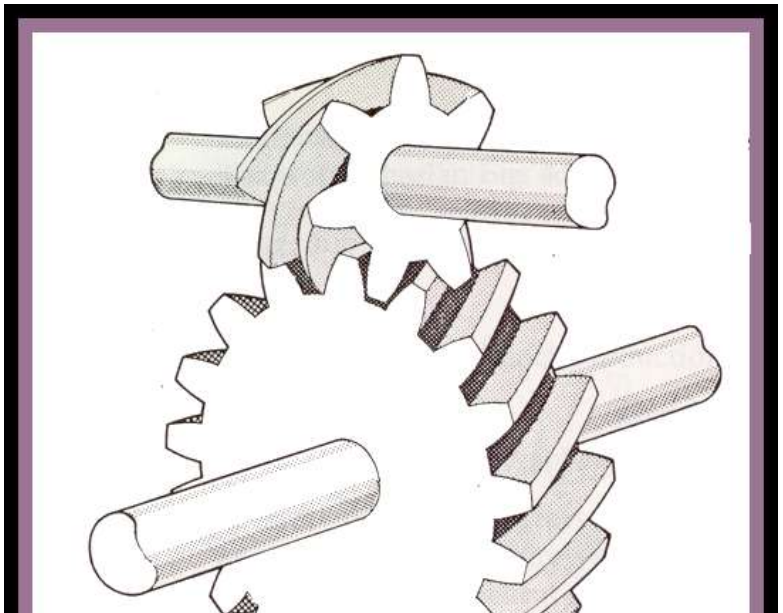


FIGURE 9-17

Crossed axis helical gears
Courtesy of the Boston Gear Division of IMO Industries, Quincy, MA

Herringbone Gears

- Eliminate the thrust force
- 95% efficient
- Very expensive

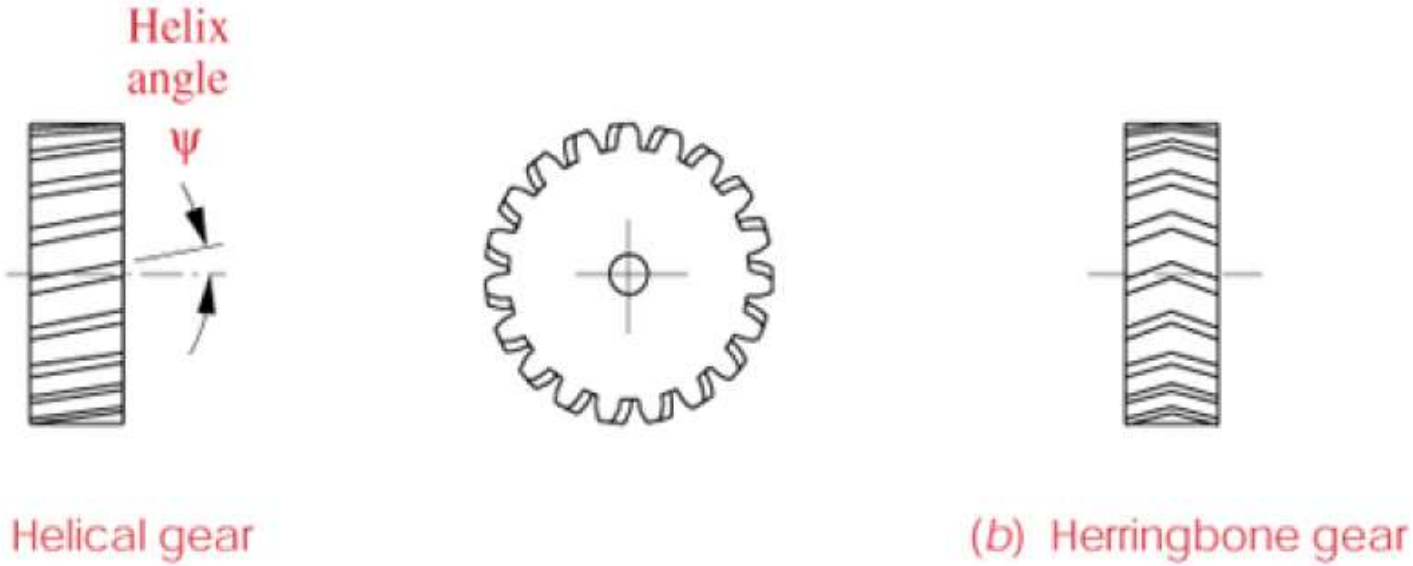
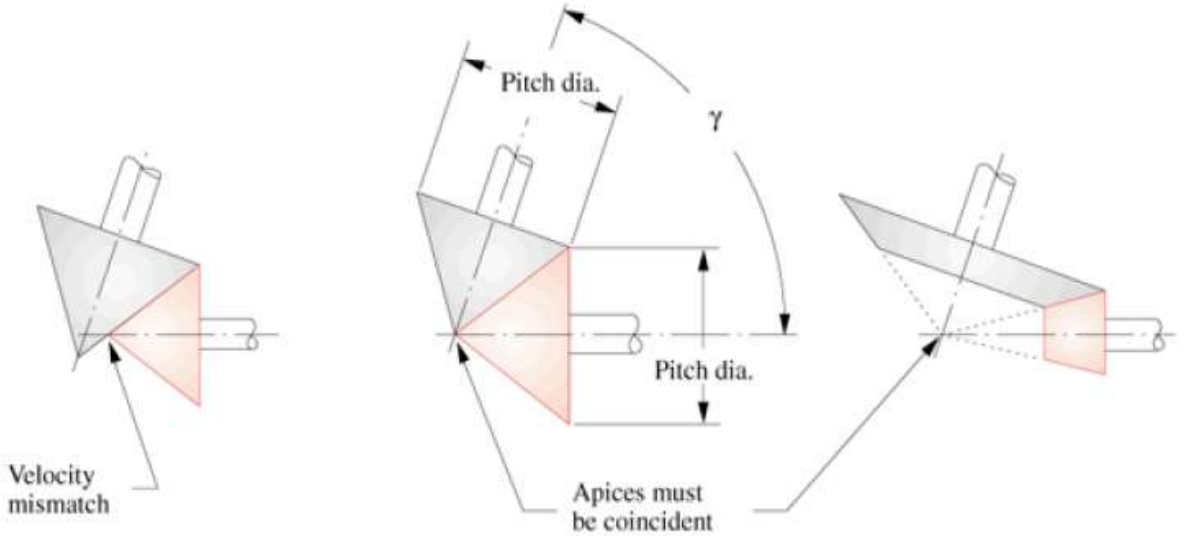


FIGURE 9-15

A helical gear and a herringbone gear



(*a*) Incorrect arrangement (*b*) Correct arrangements

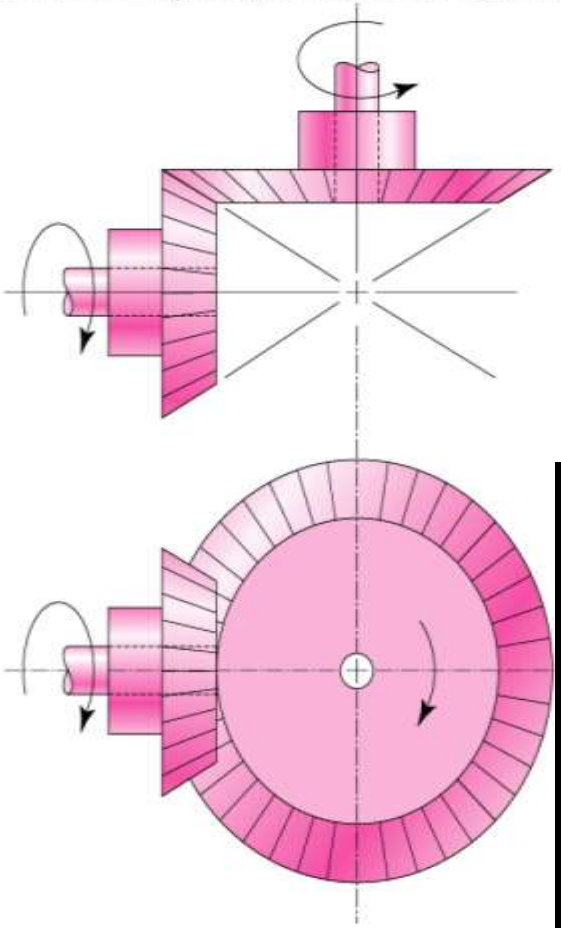
E 9-20

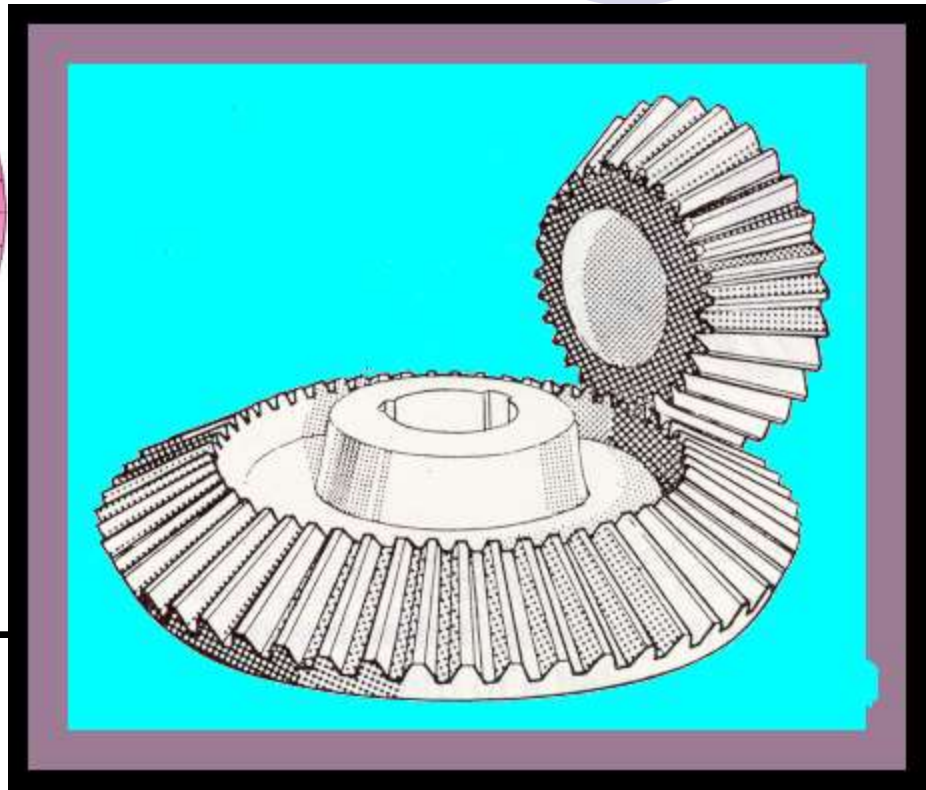
jears are based on rolling cones

FIGURE 9-21

Fig. 13.3

Bevel Gear



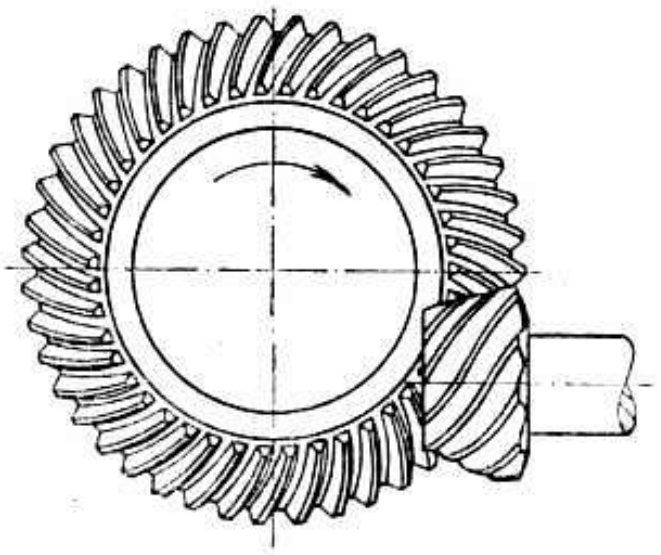


- A **spiral bevel gear** is a bevel gear with helical teeth. The main application of this is in a vehicle differential, where the direction of drive from the drive shaft must be turned 90 degrees to drive the wheels.

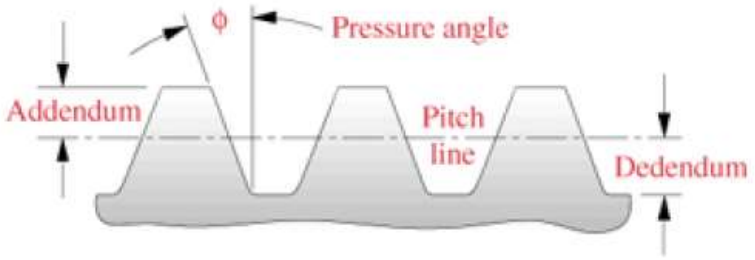
- The helical design produces less vibration and noise than conventional straight-cut or spur-cut gear with straight teeth.

- A spiral bevel gear set should always be replaced in pairs i.e. both the left hand and right hand gears should be replaced together since the gears are manufactured and lapped in pairs.

- A **hypoid** is a type of spiral bevel gear whose axis does not intersect with the axis of the meshing gear.
- The shape of a hypoid gear is a revolved hyperboloid (that is, the pitch surface of the hypoid gear is a hyperbolic surface), whereas the shape of a spiral bevel gear is normally conical.
- The hypoid gear places the pinion off-axis to the crown wheel (ring gear) which allows the pinion to be larger in diameter and have more contact area. In hypoid gear design, the pinion and gear are practically always of opposite hand, and the spiral angle of the pinion is usually larger than that of the gear. The hypoid pinion is then larger in diameter than an equivalent bevel pinion.



Rack and Pinion

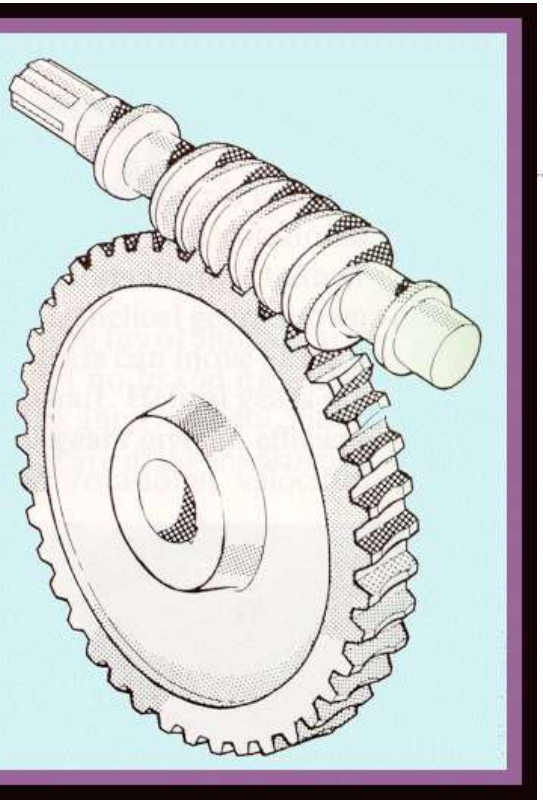


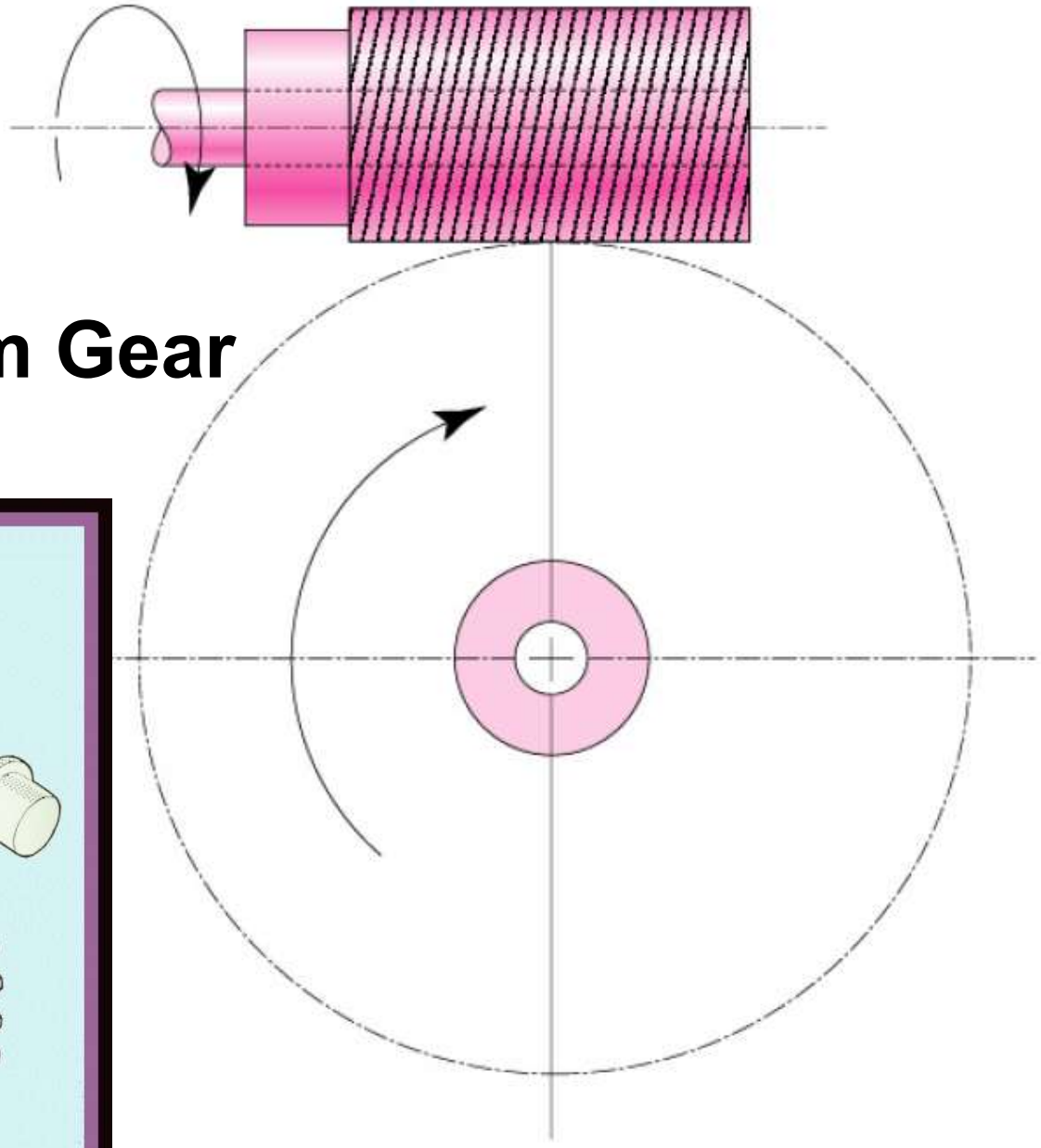
Standard full-depth involute rack

FIGURE 9-19

A rack and pinion *Photo courtesy of Martin Sprocket and Gear Co., Austin, TX*

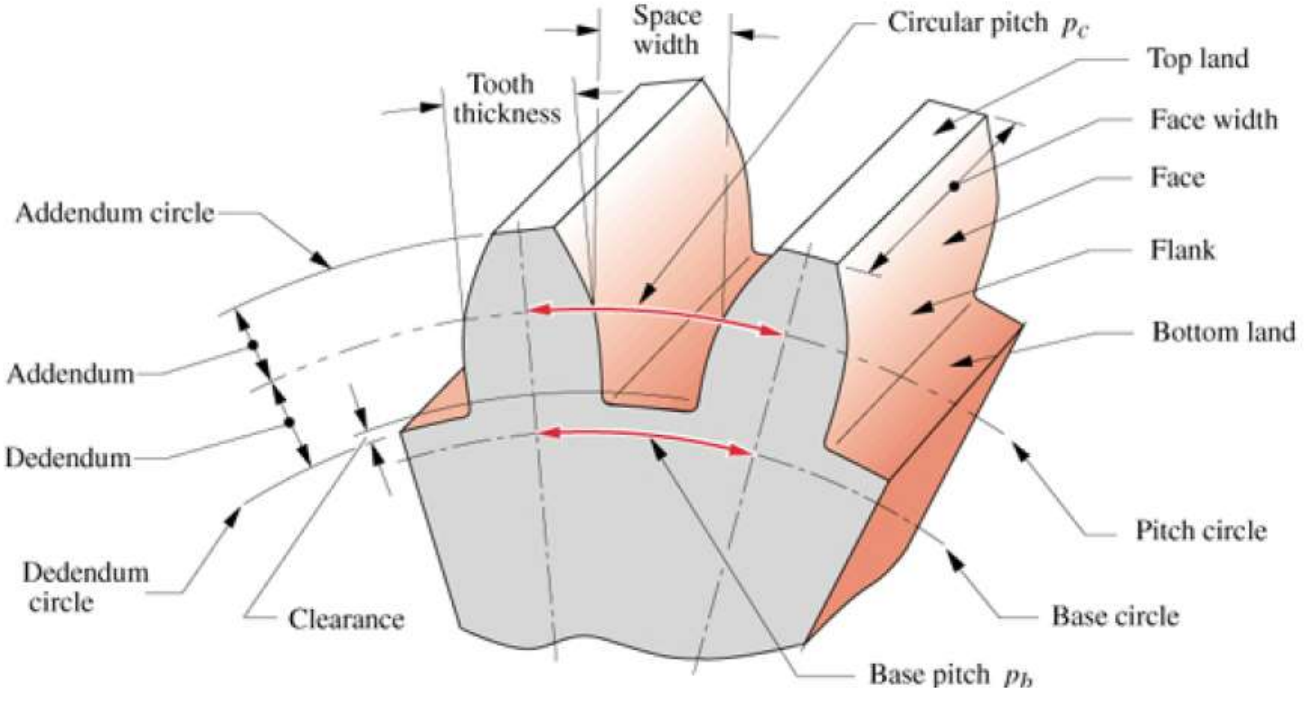
Worm Gear





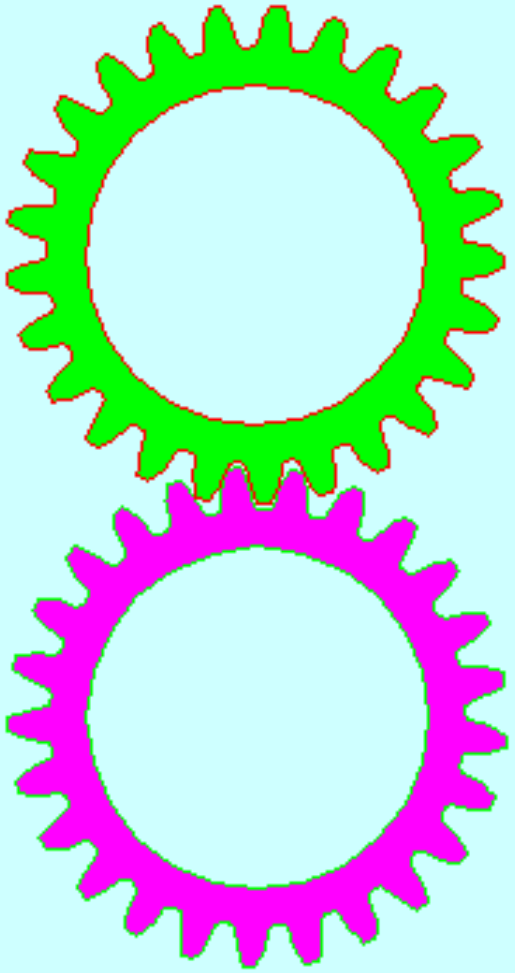
Gear Tooth Nomenclature

- Diametral Pitch (in 1/inch), $P=N/d$
- Circular Pitch, $p= \pi d/N$ *(inch system)* $= \pi.m$ (SI System)
- Module (in mm), m=d/N
- $p.P = \pi$



Clearance is the distance from the tip of a tooth to the circle passing through the bottom of the tooth space with the gears in mesh and measuring radially.

The correct clearance is vital to the motion of gears



spur gears in mesh.

Thanks