GEAR

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GEAR…..

- Power transmission is the movement of energy from its place of generation to a location where it is applied to performing useful work

- A gear is a component within a transmission device that transmits rotational force to another gear or device

TYPES OF GEARS

1. According to the position of axes of the shafts.

a. Parallel

   1.Spur Gear

   2.Helical Gear

   3.Rack and Pinion

b. Intersecting

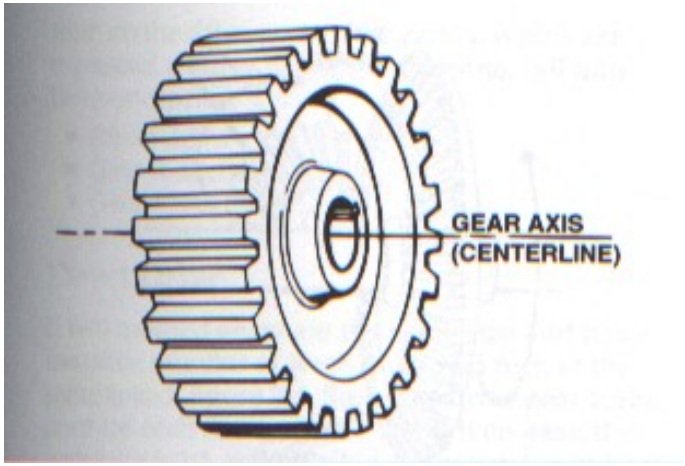
   Bevel Gear

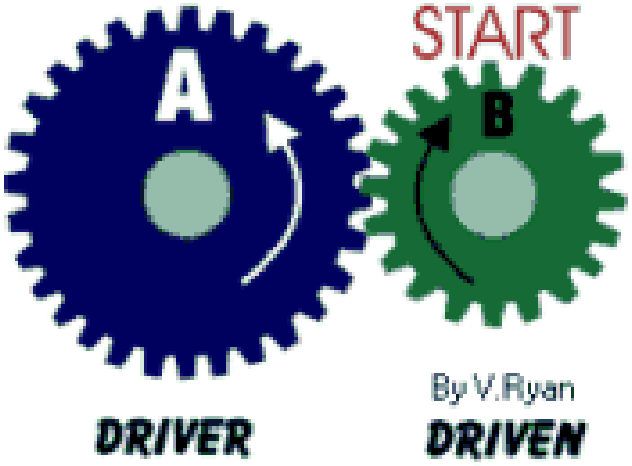
c. Non-intersecting and Non-parallel

   worm and worm gears

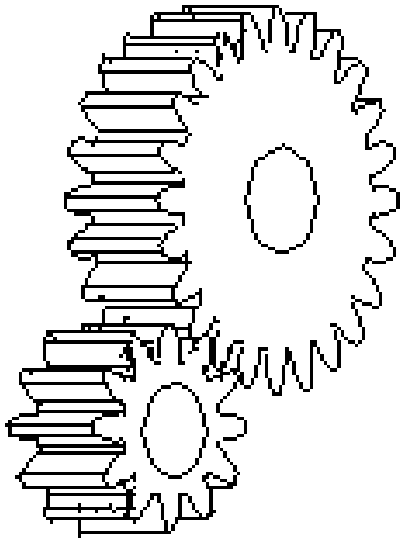
SPUR GEAR

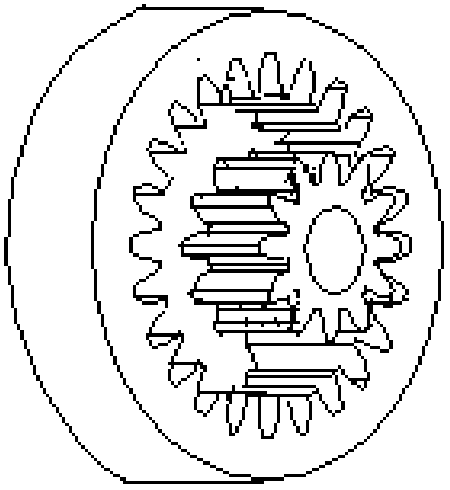
- Teeth is parallel to axis of rotation
- Transmit power from one shaft to another parallel shaft
- Used in Electric screwdriver, oscillating sprinkler, windup alarm clock, washing machine and clothes dryer





External and Internal spur Gear…





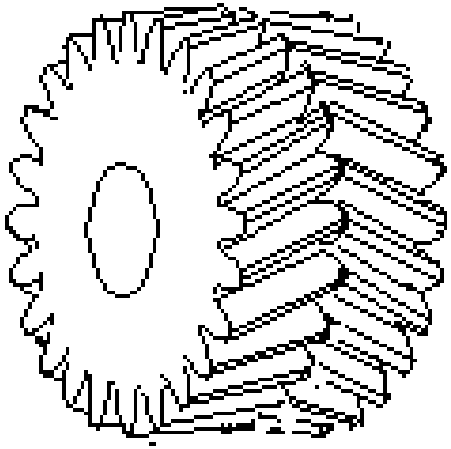
Helical Gear

- The teeth on helical gears are cut at an angle to the face of the gear
- This gradual engagement makes helical gears operate much more smoothly and quietly than spur gears
- One interesting thing about helical gears is that if the angles of the gear teeth are correct, they can be mounted on perpendicular shafts, adjusting the rotation angle by 90 degrees

Helical Gear…

Herringbone gears

- To avoid axial thrust, two helical gears of opposite hand can be mounted side by side, to cancel resulting thrust forces



- Herringbone gears are mostly used on heavy machinery.

Rack and pinion

- **Rack and pinion gears** are used to convert rotation (From the pinion) into linear motion (of the rack)

- A perfect example of this is the steering system on many cars

Bevel gears

- **Bevel gears** are useful when the direction of a shaft's rotation needs to be changed
- They are usually mounted on shafts that are 90 degrees apart, but can be designed to work at other angles as well
- The teeth on bevel gears can be **straight**, **spiral** or **hypoid**
- locomotives, marine applications, automobiles, printing presses, cooling towers, power plants, steel plants, railway track inspection machines, etc.

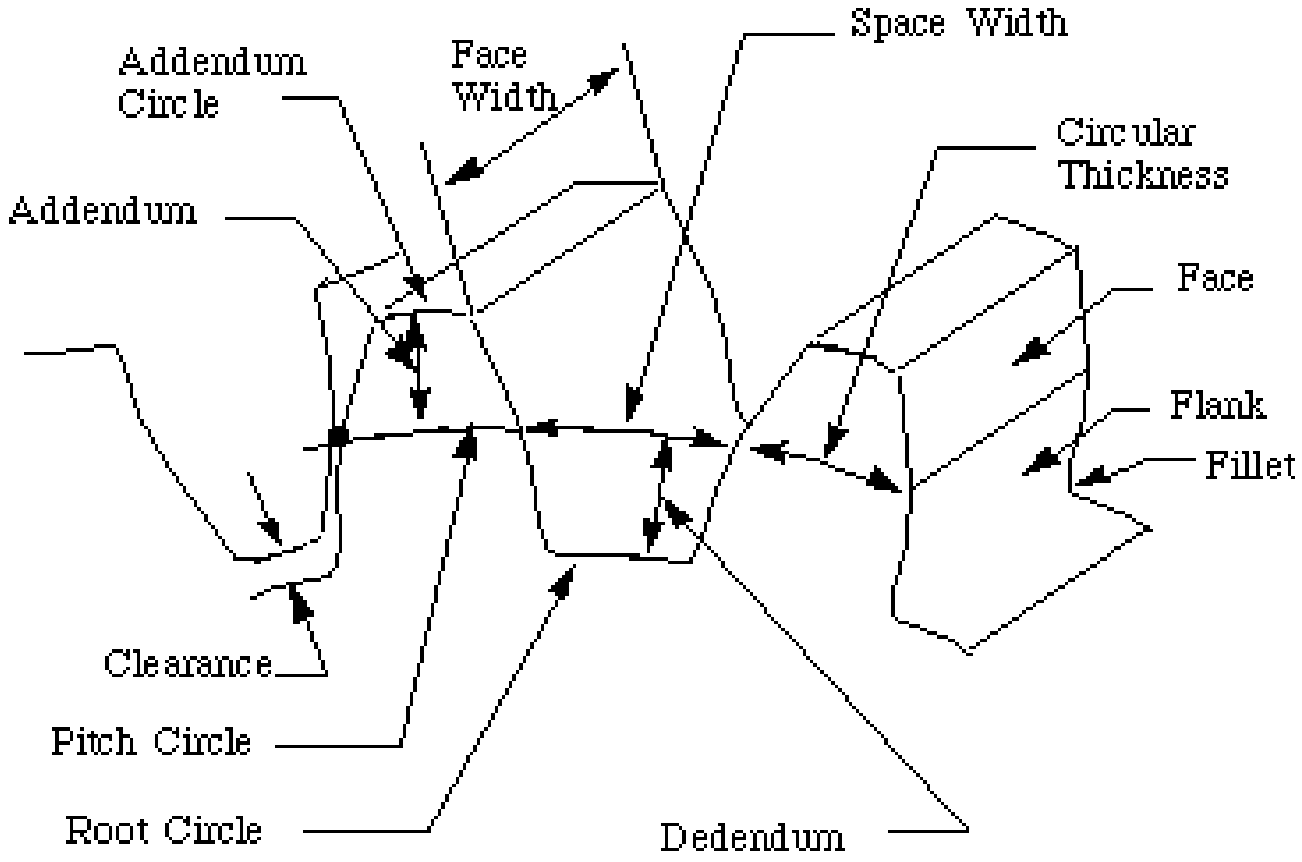
Straight and Spiral Bevel Gears

WORM AND WORM GEAR

- **Worm gears** are used when large gear reductions are needed. It is common for worm gears to have reductions of 20:1, and even up to 300:1 or greater
- Many worm gears have an interesting property that no other gear set has: the worm can easily turn the gear, but the gear cannot turn the worm
- Worm gears are used widely in material handling and transportation machinery, machine tools, automobiles etc

WORM AND WORM GEAR

NOMENCLATURE OF SPUR GEARS



NOMENCLATURE….

- **Pitch surface**: The surface of the imaginary rolling cylinder (cone, etc.) that the toothed gear may be considered to replace.
- **Pitch circle**: A right section of the pitch surface.
- **Addendum circle**: A circle bounding the ends of the teeth, in a right section of the gear.
- **Root (or dedendum) circle**: The circle bounding the spaces between the teeth, in a right section of the gear.
- **Addendum**: The radial distance between the pitch circle and the addendum circle.
- **Dedendum**: The radial distance between the pitch circle and the root circle.
- **Clearance**: The difference between the dedendum of one gear and the addendum of the mating gear.

NOMENCLATURE….

- **Face of a tooth**: That part of the tooth surface lying outside the pitch surface.
- **Flank of a tooth**: The part of the tooth surface lying inside the pitch surface.
- **Circular thickness** (also called the **tooth thickness**): The thickness of the tooth measured on the pitch circle. It is the length of an arc and not the length of a straight line.
- **Tooth space**: pitch diameter The distance between adjacent teeth measured on the pitch circle.
- **Backlash**: The difference between the circle thickness of one gear and the tooth space of the mating gear.
- **Circular pitch** (Pc) : The width of a tooth and a space, measured on the pitch circle. $P_c = \frac{\pi D}{N}$

NOMENCLATURE….

- **Diametral pitch (**Pd): The number of teeth of a gear unit pitch diameter. The diametral pitch is, by definition, the number of teeth divided by the pitch diameter. That is,

$$P_d = \frac{N}{D}$$

Where

Pd = diametral pitch

N = number of teeth

D = pitch diameter

- **Module** (m): Pitch diameter divided by number of teeth. The pitch diameter is usually specified in inches or millimeters; in the former case the module is the inverse of diametral pitch.

$$m = D/N$$

VELOCITY RATIO OF GEAR DRIVE

d = Diameter of the wheel

N =Speed of the wheel

ω = Angular speed

velocity ratio (n) = $$\frac{\omega_2}{\omega_1} = \frac{N_2}{N_1} = \frac{d_1}{d_2}$$

GEAR TRAINS

- A gear train is two or more gear working together by meshing their teeth and turning each other in a system to generate power and speed
- It reduces speed and increases torque
- Electric motors are used with the gear systems to reduce the speed and increase the torque

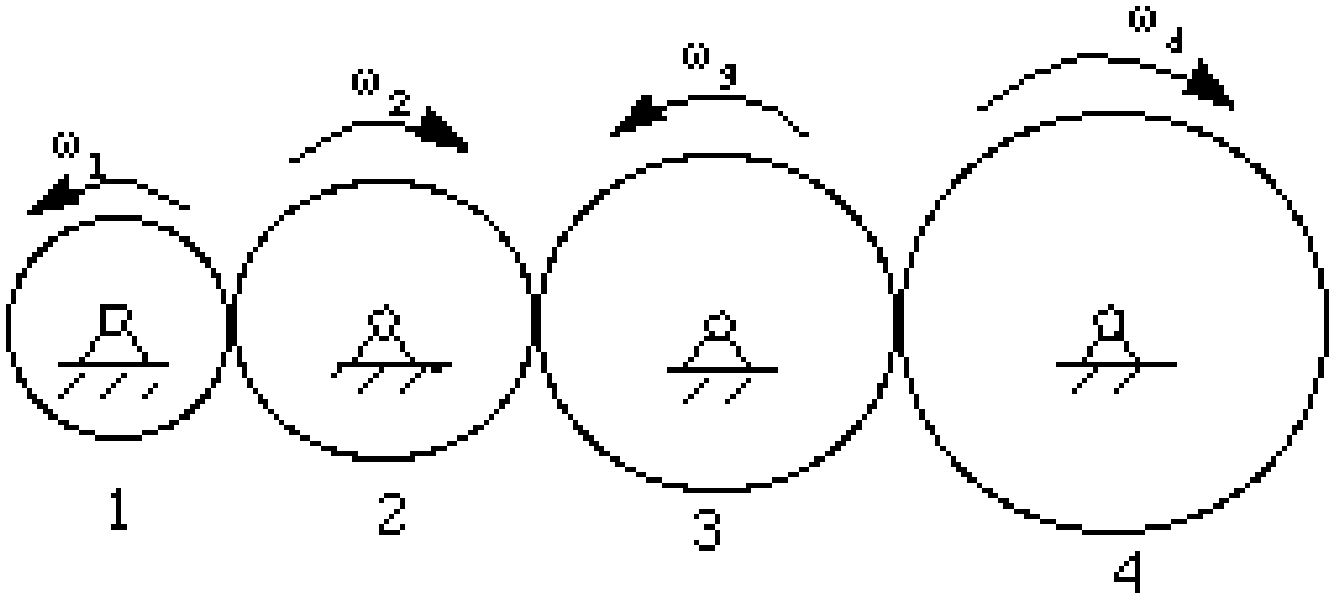
Types of Gear Trains

- Simple gear train
- Compound gear train
- Planetary gear train

Simple Gear Train

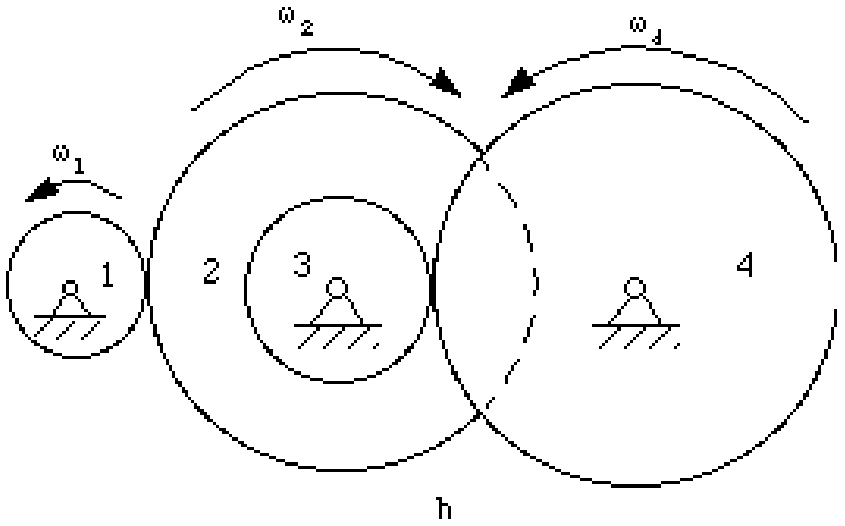
- The most common of the gear train is the gear pair connecting parallel shafts. The teeth of this type can be spur, helical or herringbone.
- Only one gear may rotate about a single axis

Simple Gear Train

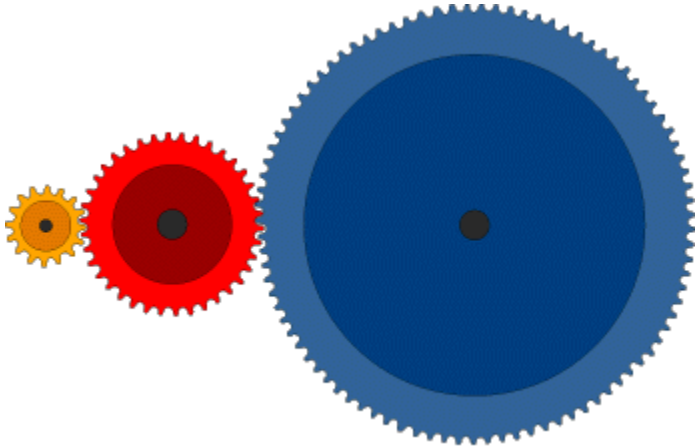


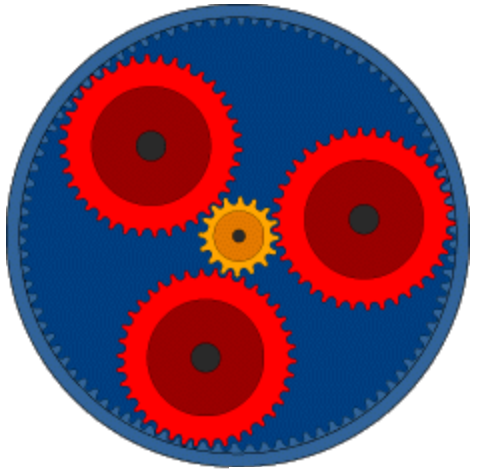
Compound Gear Train

- For large velocities, compound arrangement is preferred
- Two or more gears may rotate about a single axis



Planetary Gear Train (Epicyclic Gear Train)





Planetary Gear Train…

- In this train, the blue gear has six times the diameter of the yellow gear
- The size of the red gear is not important because it is just there to reverse the direction of rotation
- In this gear system, the yellow gear (the sun) engages all three red gears (the planets) simultaneously
- All three are attached to a plate (the planet carrier), and they engage the inside of the blue gear (the ring) instead of the outside.

Planetary Gear Train…

- Because there are three red gears instead of one, this gear train is extremely rugged.
- planetary gear sets is that they can produce different gear ratios depending on which gear you use as the input, which gear you use as the output, and which one you hold still.

Planetary Gear Train…

- They have higher gear ratios.
- They are popular for automatic transmissions in automobiles.
- They are also used in bicycles for controlling power of pedaling automatically or manually.
- They are also used for power train between internal combustion engine and an electric motor