Design Considerations

Week 4 Lecture

Puzzle Fits

- Useful for securing parts together
- Rely on strength of the material instead of the strength of the screws (Esp. useful for Battlebots)

Power Transmission: Source

- Motors, typically
- A motor is, simply, a device which converts electrical power into mechanical power

Motor Specifications, in two very different flavors:
Maxon Motors
Hobbyking Motor

Power Transmission

- Moving power from where it is (motor) to where it needs to be (wheel, weapon, etc.)
- Potentially change the torque or speed at the same time
- Methods:
  - Gears
  - Belts
  - Chains

Power Transmission: Gears

- Can increase RPM at the cost of lower torque
- Can increase torque at the cost of lower RPM
- Which it is depends on the ratio of pitch diameters
- Gear ratio:
    - $Diameter_2/Diameter_1$ = Number of $Teeth_2$/Number of $Teeth_1$
- Gear teeth must mesh
    - IE, the gear tooth profiles must be the same
    - This is expressed differently for different vendors

Power Transmission: a Few Gear Types

Spur Gears
- Parallel shaft transmission
- Typically low gear ratios (1:1 to 1:6)
- Simple and high efficiency (~96%)

Bevel Gears
- Perpendicular shaft transmission
- High efficiency

Worm Gear & Worm
- Perpendicular shaft transmission
- High gear ratios (worm has effectively 1 tooth)
- Cannot drive worm with worm gear
- Lower efficiency (~80%)

Belts

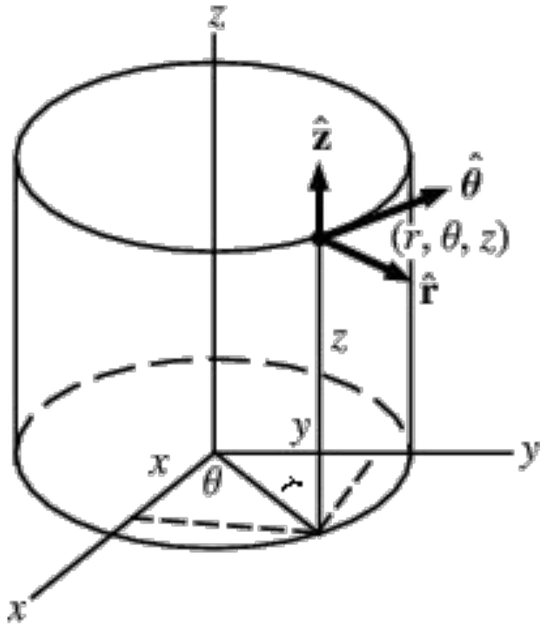
- Transmit power along parallel shafts
- Can also change torque/speed of shafts based on ratio of diameters of pulleys, same rules as gears

Chains

- Transmit power along parallel shafts
- Can also change torque/speed of shafts based on ratio of diameters of sprockets, same rules as gears and belts

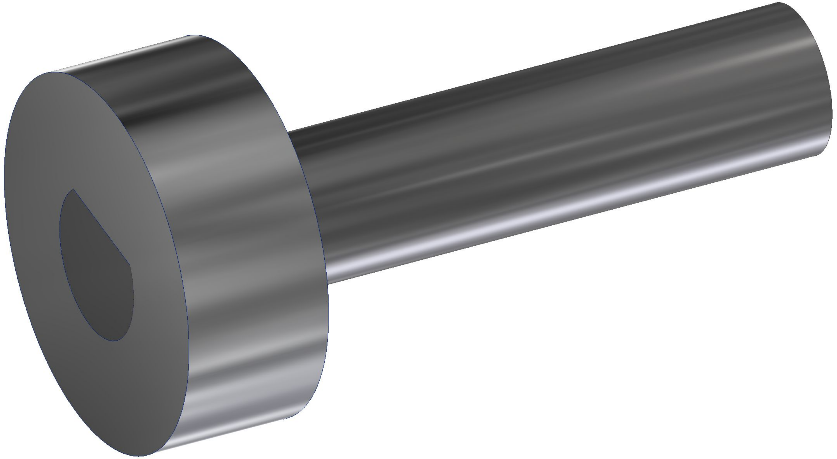
Shaft Retention

- Mating things to a shaft
  - Need to potentially constrain components in two directions
    - Axially
    - Tangentially
  - Components are retained radially by the shaft and bore of the components preventing motion
    - This leaves tangential and axial retention
    - Often, one accomplishes the other, because many methods utilize friction



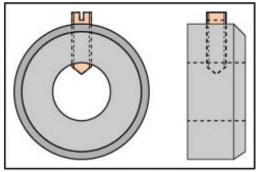
Interlocking Shafts

- E.G., interlocking D shaft and D slot
- Retention depends on exact method
- Rely on strengths of material
    - As a result, can be some of the strongest methods for retention
- Add complexity to manufacturing



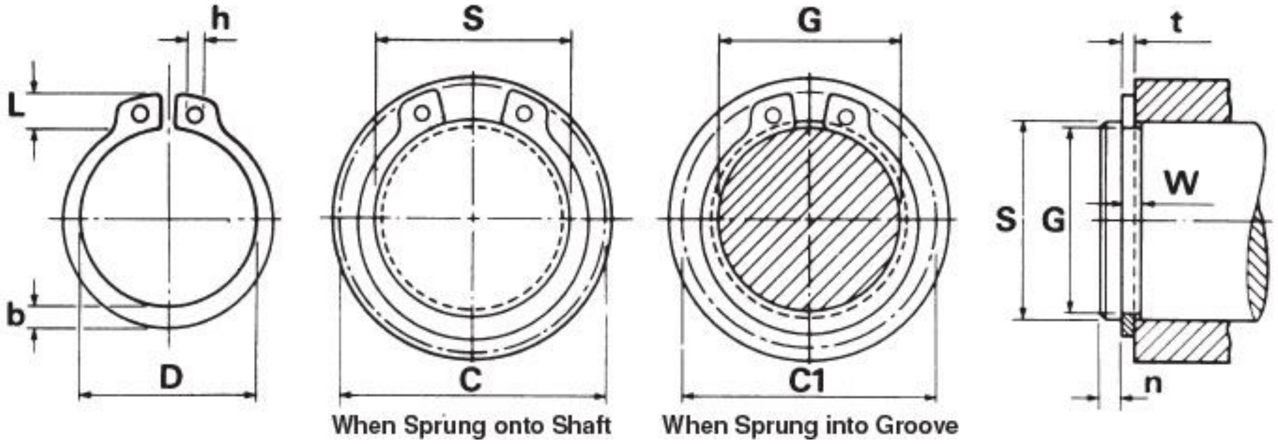
Set Screws

- Requires a flat on a shaft
- Retains components axially and tangentially, under low loads
  - Friction based



Snap Ring

- Requires a groove in shaft, concentrating stress
- Retains components axially



Shaft Collar

- Does not require shaft design modification
- Retains components axially

Keys

- Only retains components tangentially
  - Requires other components for axial retention
- Increases manufacturing complexity and acts as a stress concentrator in components