Power Transmission (การส่งกำลัง)

ME 310: Mechanical Design

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What is Power?

- Rate of energy (input or output) in [J/s] or [W]

Power Transmission in Mechanical Systems

- Mechanical power comes in rotational form: motors, engines, turbine

$$\begin{aligned} Power = Fv &= (Fr)\frac{v}{r} \\ &= T\omega \end{aligned}$$

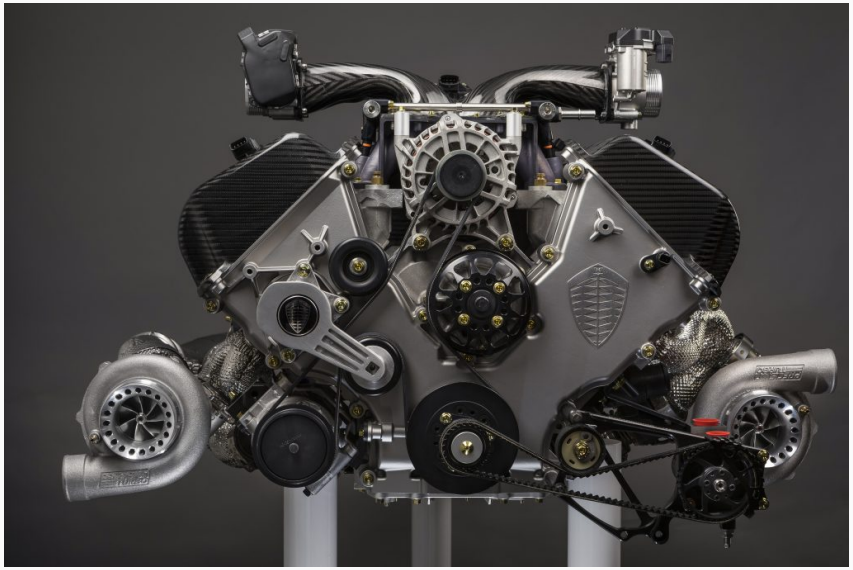
- Both T and ω will factor into the shaft design

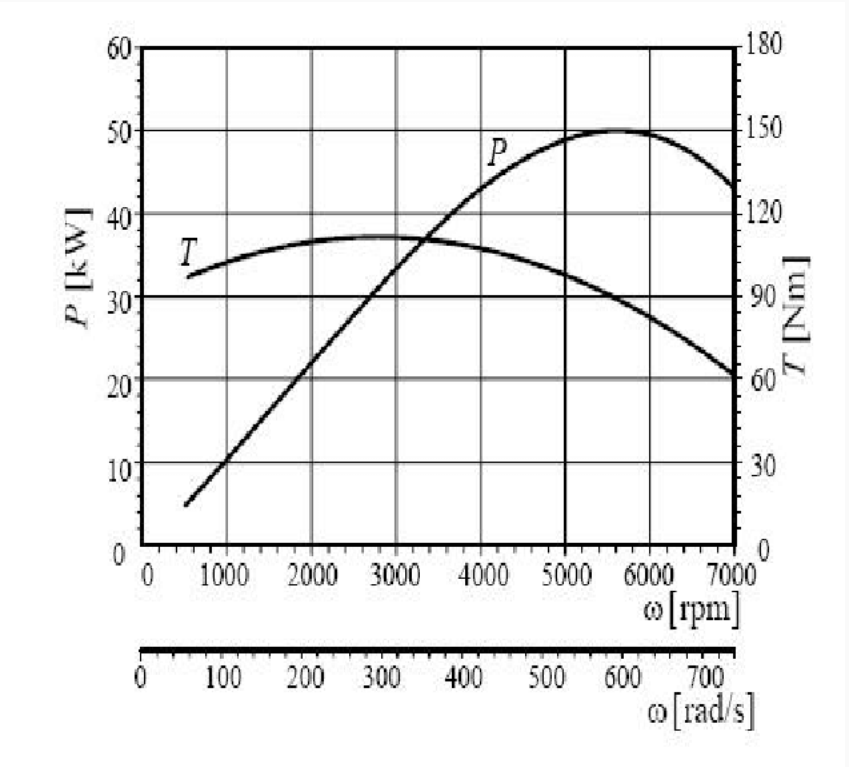
Mechanical Power Sources

Mechanical Power Sources

1. Motors
2. Engines
3. Turbines

Internal Combustion Engines





Diesel Fuel efficiency
High torque
Low rpm

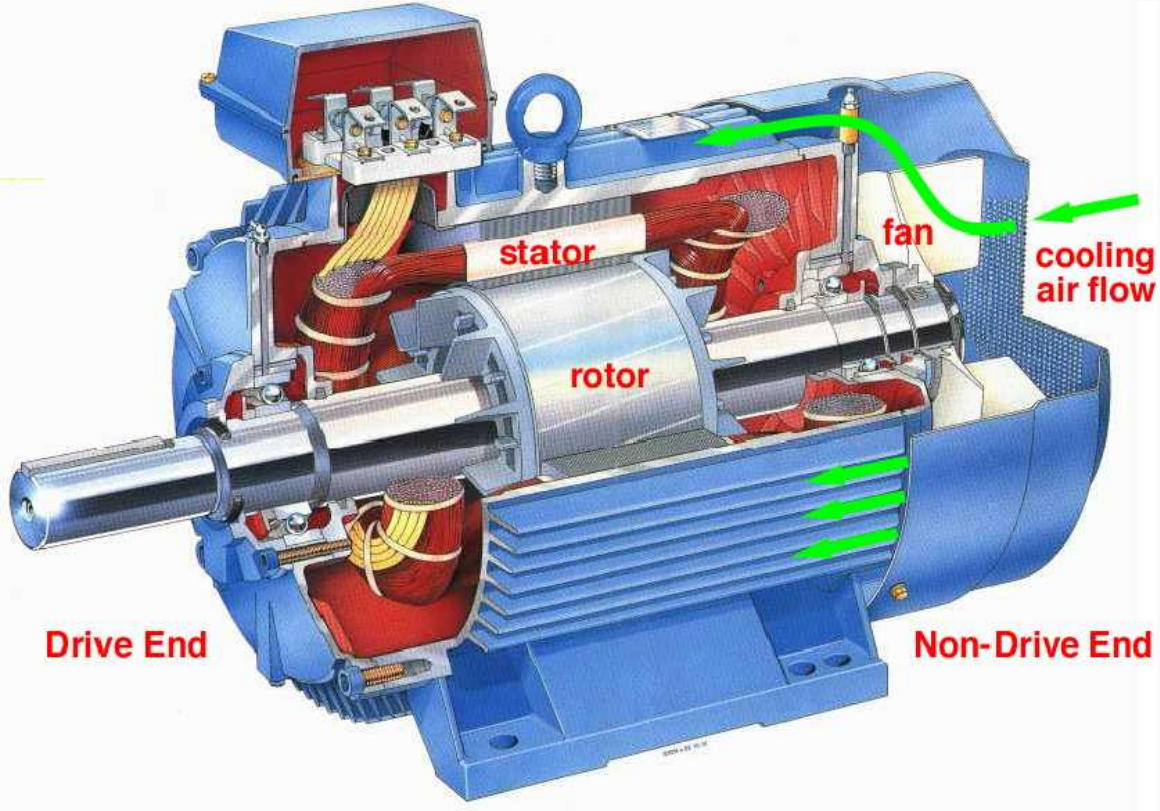
Gasoline High rpm
Less vibration
Less weight

++ operate in remote area

- - noise and vibration

- - maintenance issues

Motors



++ Smooth

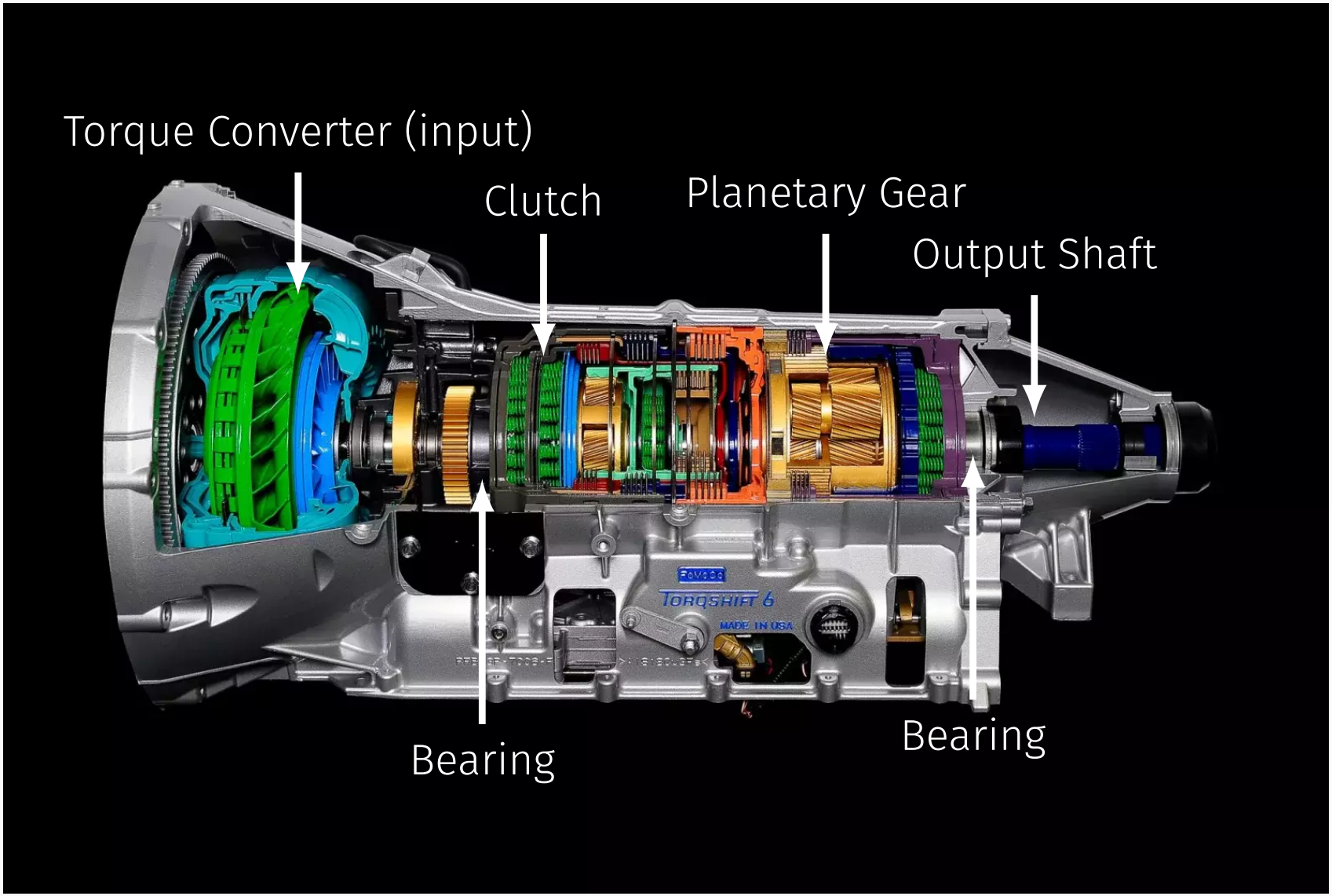
++ Less noise and vibration

++ Less energy cost

- - Need electricity

Overview of Power Transmission Components

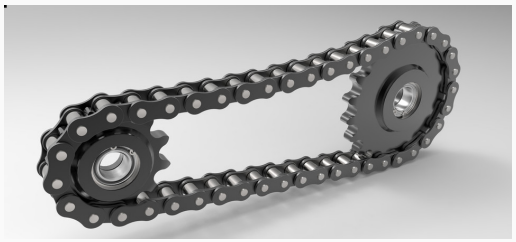
Machine Elements for Power Transmission



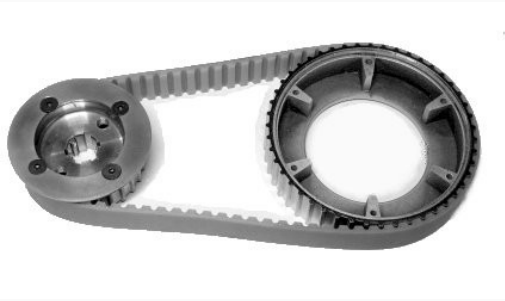
Power Transmission Drives

Gear

Chain



Belt

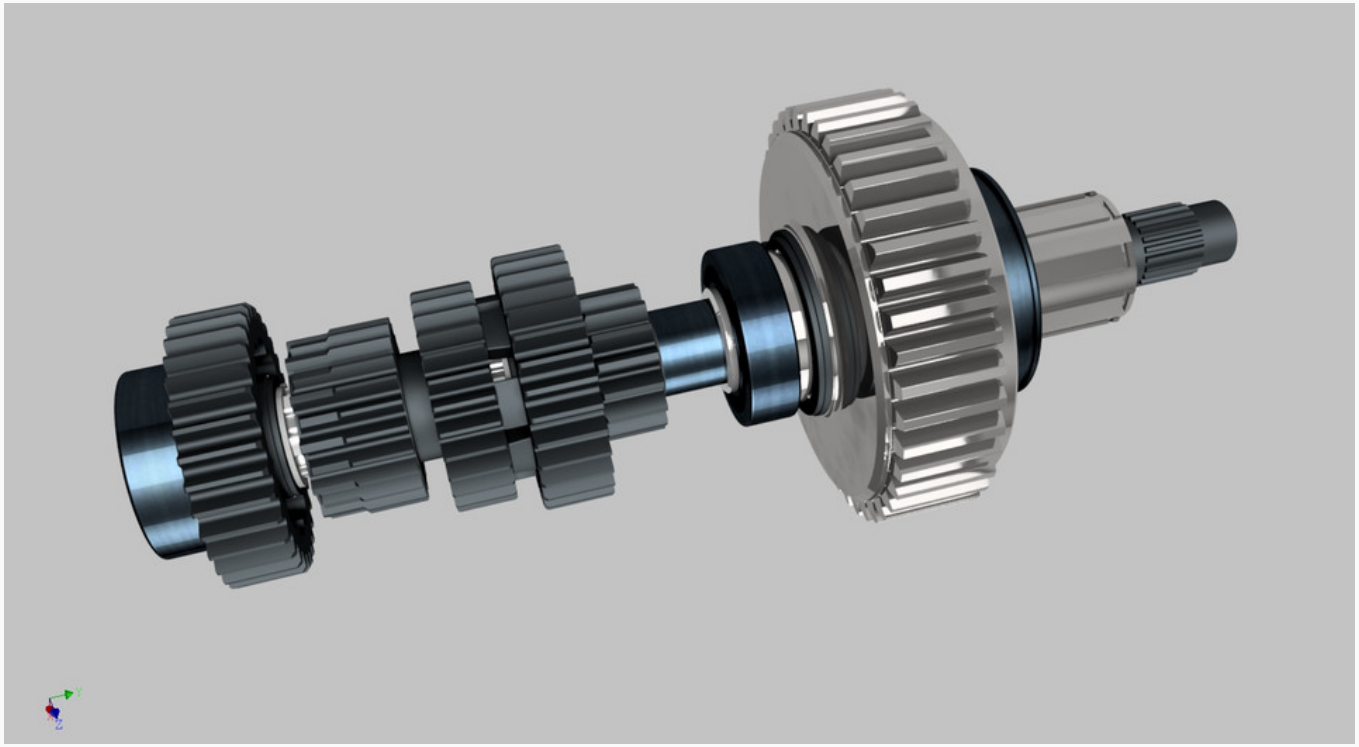


Typical Components

Shafts	transfer torque between aligned components over distance
Gears	transfer torque between components
Clutches	engages/disengages torque transfer
Bearings	support shaft rotation, axial, and bending loads
Pins and Keys	fix and transfer torque from components to shaft and from shaft to components
Couplings	connect two shafts with misalignment

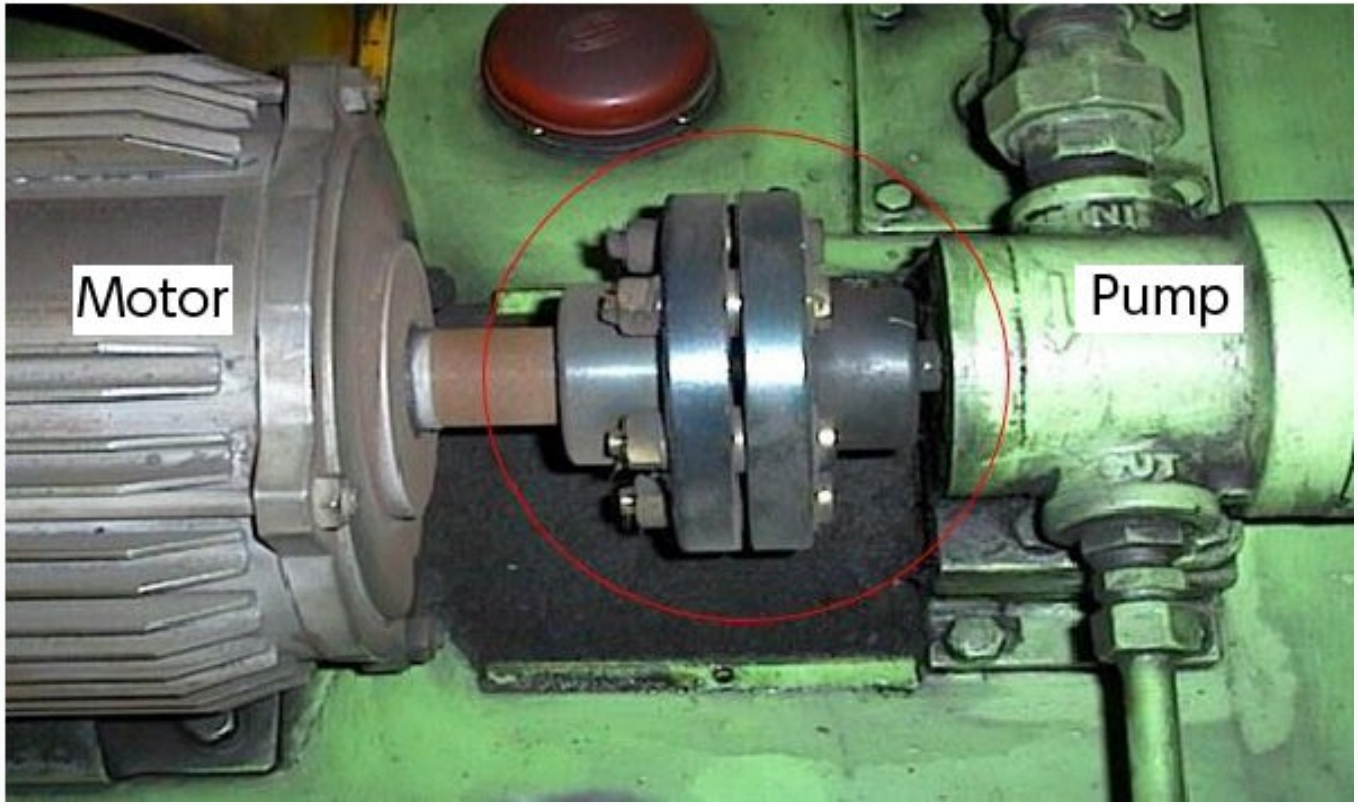
Shafts

- Most important element in power transmission system
- Transfer torques among all adjacent components



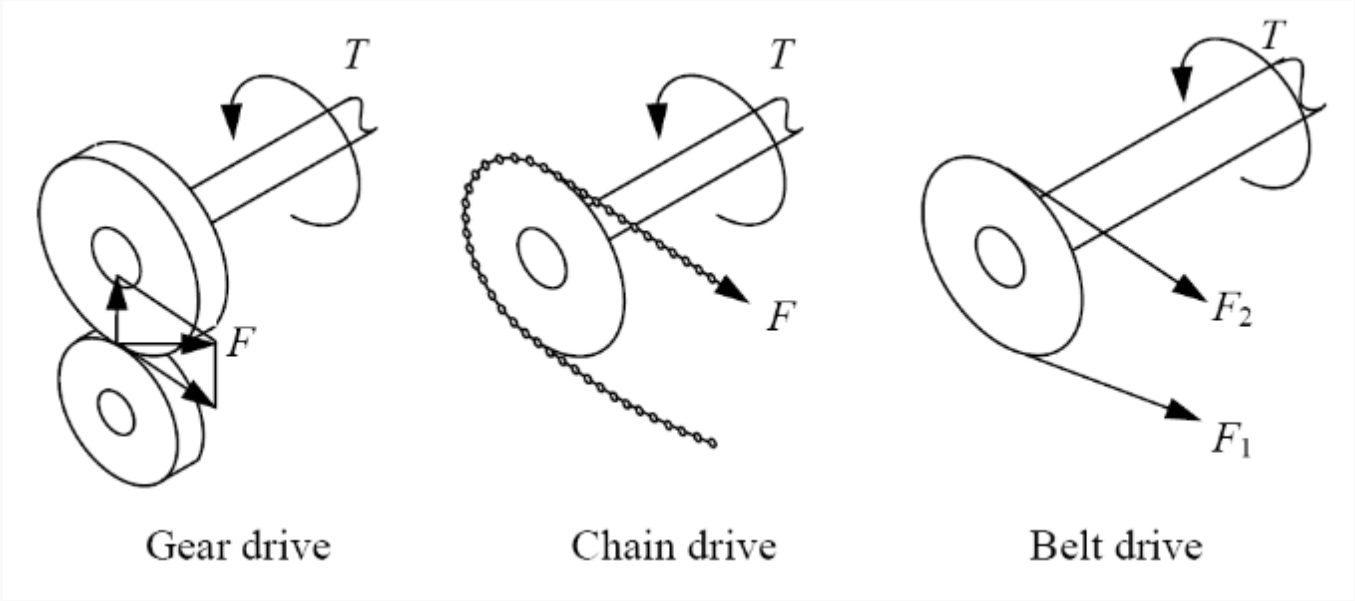
Welds and Bolts

- Shafts don't float $\rightarrow$ must be fixed somewhere
- Glues aren't always the answer $\rightarrow$ welds and bolts



Shaft Loading Conditions

- Torque
- Bending $\implies$ radial load from torque transmission



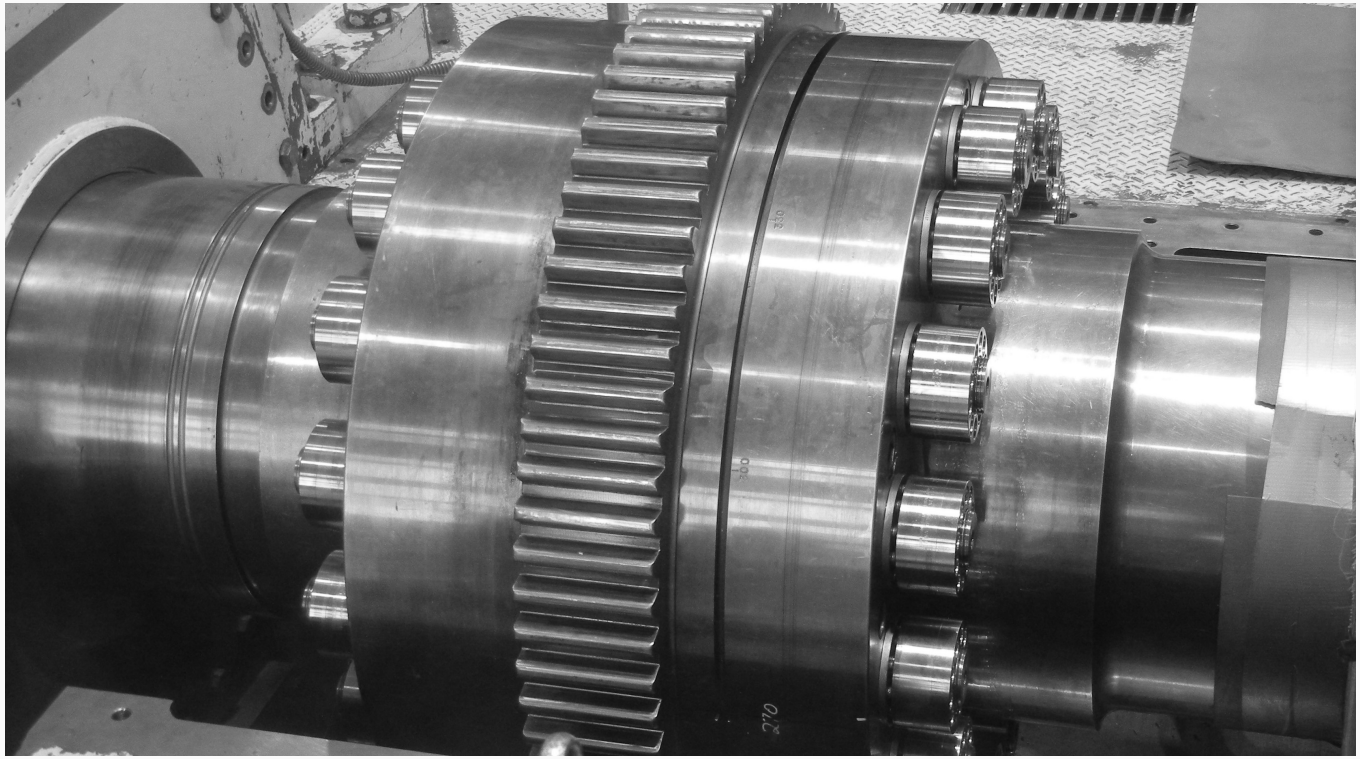
$$F = \frac{T}{r\cos\theta} \qquad F = \frac{T}{r} \qquad F_1 - F_2 = \frac{T}{r}$$

Gears vs Chain vs Belt

Properties	Belt	Chain	Gear
Main elements	pulleys, belt	sprockets, chain	gears
Slip	some	none	none
Distance	large	medium	small
Space	large	medium	small
Complexity	low	medium	high
Damage to system under Failure	none	small - medium	serious
Life	short	medium	long
Lubrication	not required	required	required
Installation	easy	medium	hard
Speed	low	medium	high

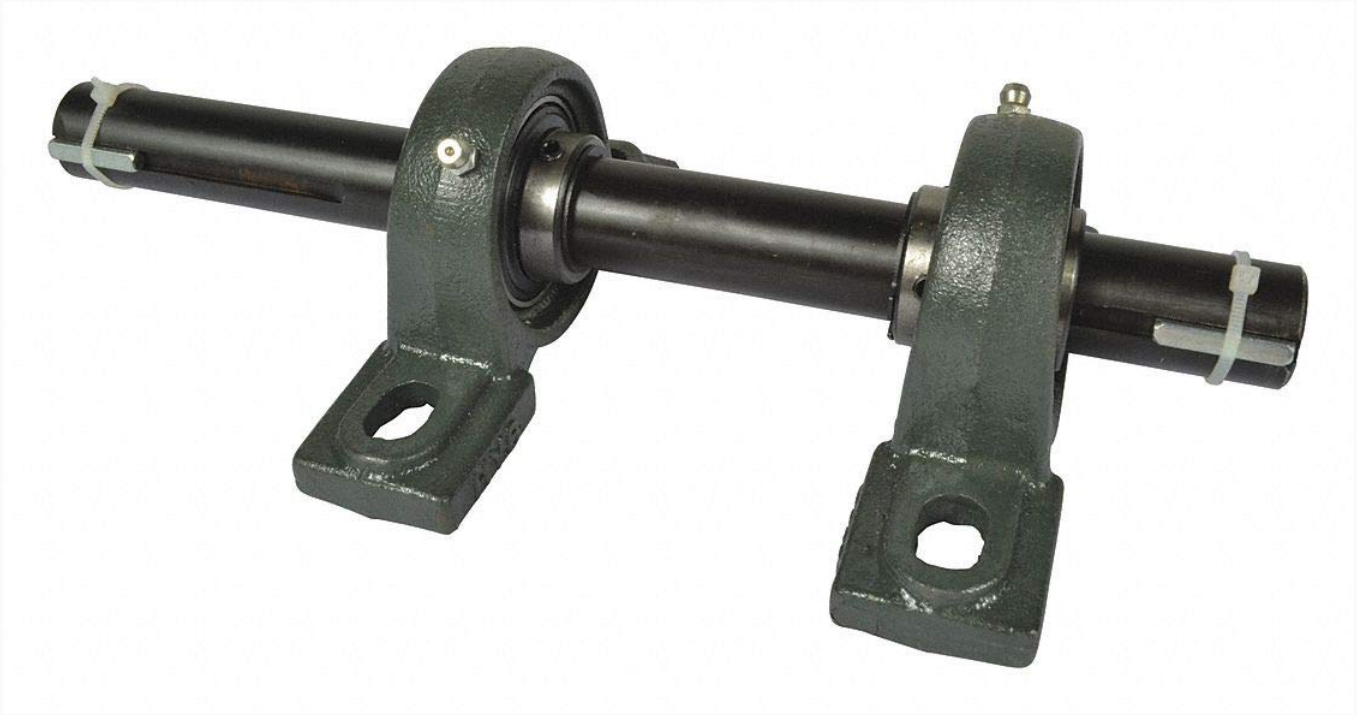
Pin, Keys, Couplings

- Fix components to shaft
- Transfer torques to and from shaft



Bearings

- Support bending and axial loads from shaft
- Facilitate rotation



Clutches and Brakes

- Provide way to engage/disengage from drive
- Rely on friction or positive contact