MOTION TRANSMISSION SYSTEMS
AND MOTION TRANSFORMATION
SYSTEMS
MOTION TRANSMISSION SYSTEMS

Transfers the same type of motion from one part of an object to another (rotational to rotational, translational to translational)

3 parts to a system:

1. Driver component \( \rightarrow \) receives the force
2. Driven component \( \rightarrow \) receives the motion
3. Intermediate component \( \rightarrow \) link between the two
Example:
Bicycle chain and gears are a motion transmission system
1) Gear trains
- contains at least two gears that mesh together
- direction of parts: alternates from one to another
- It is reversible
- Found in watches, manual eggbeaters

Things to consider when building a gear train:
1. Gear teeth (evenly spaced, same size)
2. Gear types (straight vs. bevel)
3. Gear size (bigger or more teeth = slower)
2) Chain and sprocket systems:

- A chain connects gear component that are far apart
- Direction of parts: sprockets inside the chain turn in same direction
- Reversibility: yes
- Example: Bike chains

Things to consider when building a chain and sprocket system:

1. Teeth on sprocket must be identical
2. System needs lubrication
3. Smaller sprocket = faster
4. Parts must mesh easily together
3) Worm and worm gear systems

- consists of a screw and at least one gear
- Direction: varies with the threads on the screw
- NOT reversible
- Examples: string musical instruments, car gear boxes

To consider:

1. Gear teeth must match worm's grooves
2. The driver component MUST be the worm
4) **Friction gear systems:**
- similar to gear trains: reversible and motion alternates from one to another
- less efficient (friction gears can slip)
- larger gear = slower rotation

5) **Belt and pulley systems**
- Similar to chain and sprocket: reversible and the pulleys inside the belt rotate in the same direction
- pulleys have a groove where belt fits
- belt must adhere to pulleys
- smaller pulleys = faster rotation
SPEED CHANGE

• the speed of the driven component depends on the size ratio with the driver component
• to calculate the speed we use the following formula:

\[
\text{speed ratio} = \frac{\text{diameter (or # of teeth) of driver component}}{\text{diameter (or # of teeth) of driven component}}
\]
Example: Look at the gears below and determine the speed change if:

A) A is the driver component
B) A is the driven component
A) 

\[ \text{speed ratio} = \frac{\text{diameter (or # of teeth) of driver component}}{\text{diameter (or # of teeth) of driven component}} \]

\[ \text{speed ratio} = \frac{24}{40} = \frac{3}{5} = 0.6 \]

If the speed ratio is LESS THAN 1, the speed decreases

B) 

\[ \text{speed ratio} = \frac{\text{diameter (or # of teeth) of driver component}}{\text{diameter (or # of teeth) of driven component}} \]

\[ \text{speed ratio} = \frac{40}{24} = \frac{5}{3} = 1.7 \]

If the speed ratio is GREATER THAN 1, the speed increases
MOTION TRANSFORMATION SYSTEMS

when motion of one part is transferred to another and the type of motion is changed (ex. rotational to translational)

four common types exist:

1. rack and pinion
2. screw gear
3. cam and follower
4. slider crank
1. Rack and pinion systems
   • contains a rack (straight bar with teeth) and a pinion (gear)
   • Possible Motions:
     ▪ rotational $\rightarrow$ translational or
     ▪ translational $\rightarrow$ rotational
   • It is reversible
   • Examples: Steering systems, microscope mechanisms
   • To consider
     ▪ The teeth on rack and pinion must be identical
     ▪ The system needs lubrication
     ▪ the greater the # of teeth on the pinion the slower the rotation
RACK AND PINION
2. Screw gear systems contains a screw and a nut
Neither is reversible

2 types:

1. Type 1 →
   - screw is the driver (rotational motion)
   - Motion: rotational into translational motion
   - Ex. jack to raise a car

2. Type 2 →
   - nut is the driver
   - transforms rotational into translational motion
Ex. Wrench
SCREW GEAR

**TYPE 1**

Rotation of the screw

**TYPE 2**
3. Cam and follower systems
Motion: rotational to translational motion only
Not Reversible
Example: mechanical toys, sewing machine
To consider:
- follower must be guided in its motion
- shape of the cam determines how the follower will move
- spring keeps the follower in contact with the cam
CAM AND FOLLOWER
4. Slider-crank mechanisms
translational to rotational motion (to turn the wheels of your car) or rotational to translational
Reversible
Example: pumps, gas engines
To consider
- rod connects the piston to the crank
- The cylinder guides the translational motion of the piston
- requires lubrication
SLIDER CRANK