

Mechanisms and Algorithms

Simple Machines III: Ratchets, Drives and Gearing

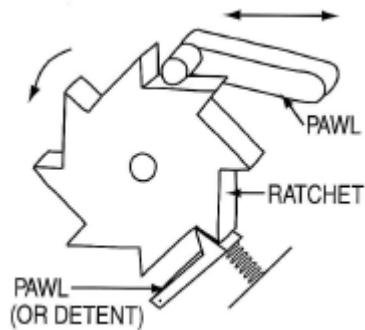


<http://www.youtube.com/watch?v=YeSkYwy3V9A>

View for some inspirational ideas for your Project

Ratchets

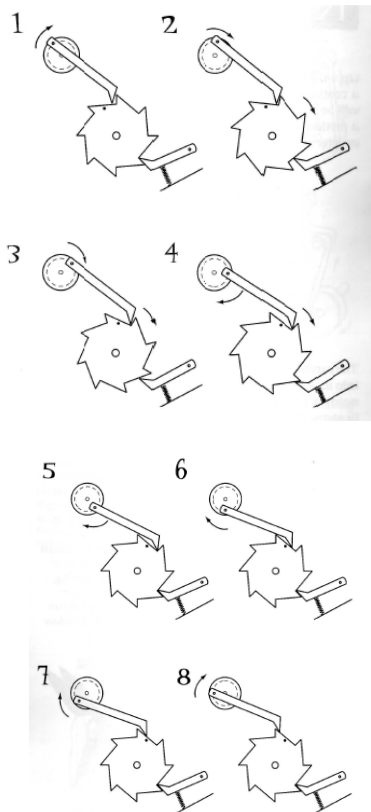
Unlike other mechanism which provide continuous motion, ratchets give stepped motion



- Ratchet is a wheel with notches in it
- The pawl pushes against the notches
- The pawl drives the wheel around in steps
- A second pawl (detent) stops the wheel from slipping back

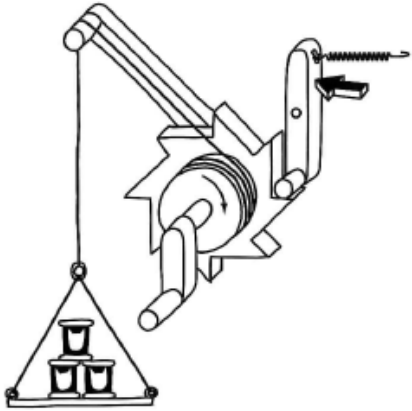
Any examples?

- Screwdrivers; switch enables CW or CCW
- Socket wrench set (e.g. sparkplug remover)



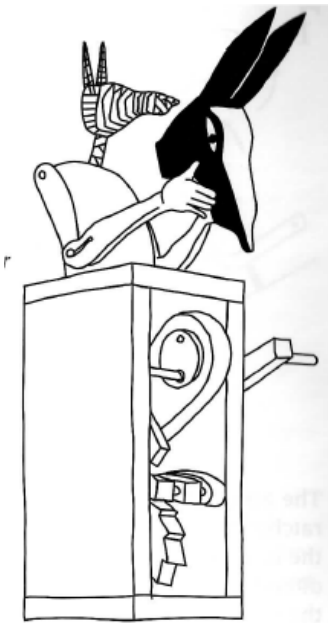
- Crank drives the ratchet
- One crank revolution moves ratchet one step
- There are 8 notches. So 1 ratchet revolution = 8 crank revolutions
- Observe dot on ratchet
- Observe pawl; ratchet must stop at correct point
- At correct point, ratchet will be in position for next push from crank pawl
- Detent pawl often has spring to ensure it contacts the ratchet

What does this do?



- Ratchets are also used as locking mechanisms
- The ratchet stops the wheel from turning the “wrong” way
- Heavy weights can be moved in short steps
- The pawl stops ratchet from turning very far in CCW direction
- Pawl’s release mechanism allows lift to be lowered

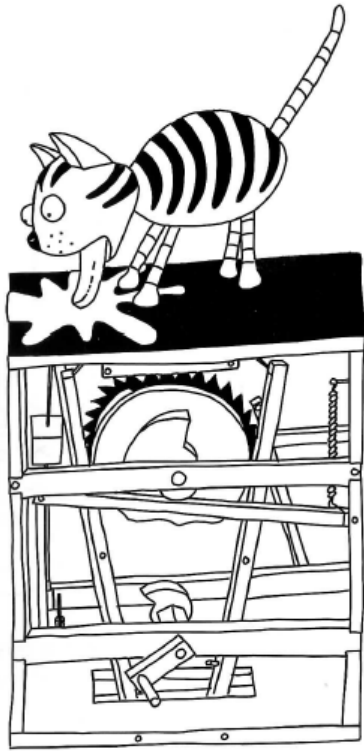
How does this work?



- Handle turns eccentric cam
- Eccentric cam pushes ratchet in steps
- Ratchet’s shaft has a snail cam on it
- Snail cam pulls arms forward
- Anubis takes mask off in steps
- But, mask snaps back on quickly



http://www.youtube.com/watch?v=zy5B_bzNID4



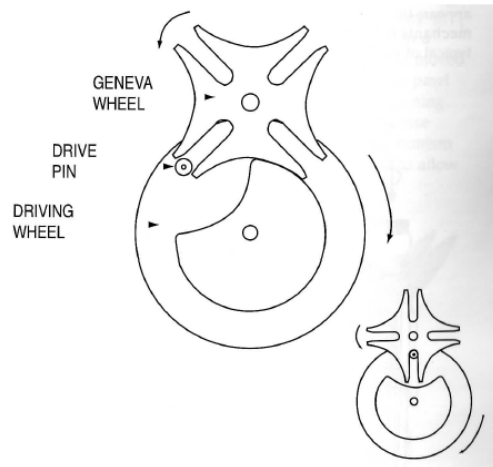
How does this work?

Poisoned Milk by Paul Spooner (Time at 2:19)

<http://www.youtube.com/watch?v=kv1CpJi60xQ>

- Milk is a single piece. It is pushed up rapidly from below
- Movement of this piece makes it look like cat is lapping
- Body is loosely jointed, held by string
- When string released, cat falls down

Geneva Wheel



- Produces intermittent motion
- Specialized form of a cam

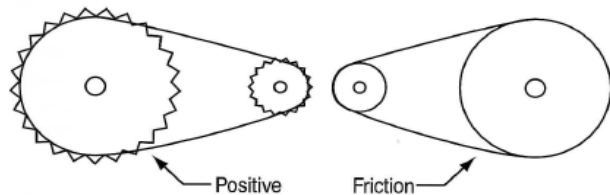
Applications?

Often found in cameras to step film one frame at a time

Drives and Gearing

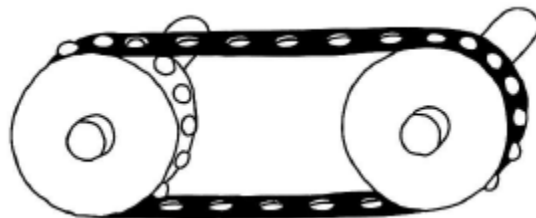
These drive connected mechanisms – specifically rotary-to-rotary connections

What are the 2 Types of Drives?



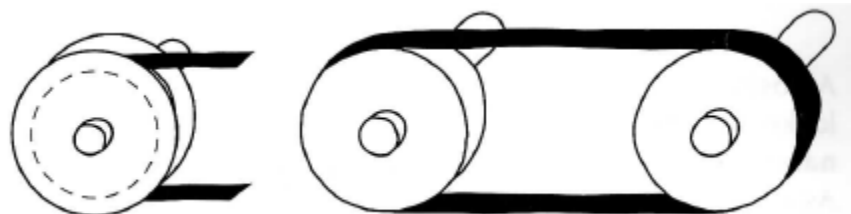
- Positive: input and output are locked and synchronous
- Friction: friction used to transfer movement

Teeth Locked Together



- Toothed wheels (aka sprockets)
- Teeth engage with holes in belt
- Driven wheel duplicates movement of driving wheel
- Wheels are locked together
- Application: photographic film in cameras

Frictional Connection

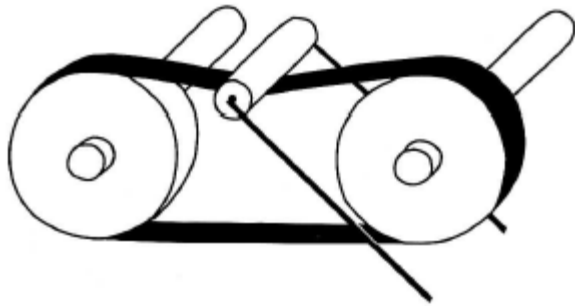


- Often employ flanges to prevent belt slip
- Friction between wheel and belt

Issues?

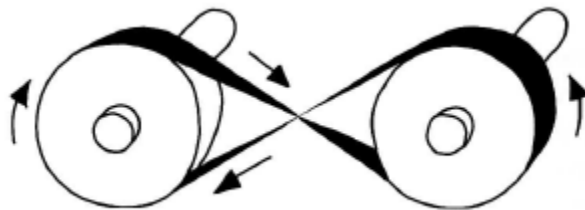
- Belt too tight = wheel turning is difficult
- Belt too loose = will slip around drive wheel

Ideas to Overcome Too Much or Too Little Friction?



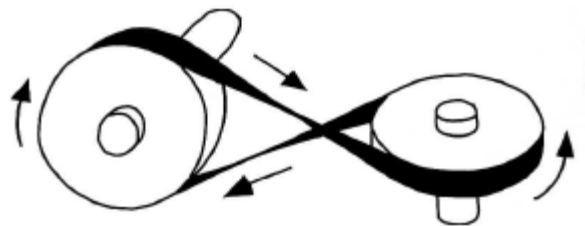
- Employ tensioner mechanism
- Also called an “idler” or “jockey wheel”
- Tensioner can move to take up any slack in belt
- Also increases the amount of belt that is contact with wheel
- Results in increased friction and hence efficiency

Counter-Rotation



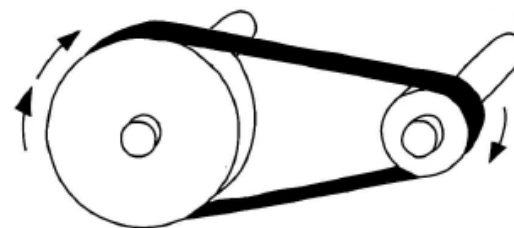
- Twist adds more belt surface in contact with wheel
- Also lets the wheel to rotate in opposite directions

Change Plane of Rotation



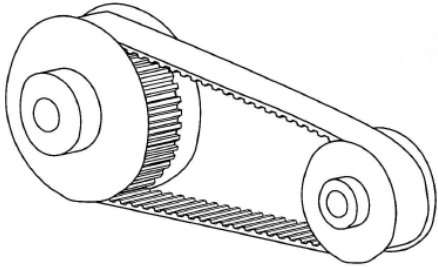
First shaft turns 90-degrees to the second one

Gearing Principle



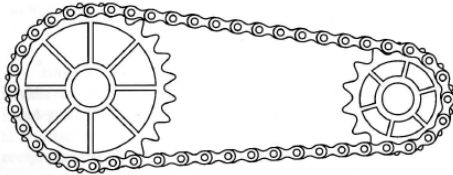
Big wheel rotates slower than small one

Positive Drives



Toothed Belts (or Timing Belts)

- Belt has teeth
- Teeth engage with notches on the pulley wheels
- Flanges on wheels to prevent belt from slipping off



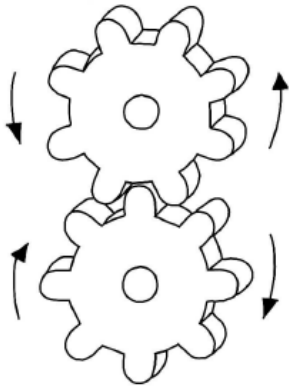
Chain and Sprocket

- Teeth are on the sprocket wheel (notches on the belt)
- Add or remove links to make chain the correct size

Gears

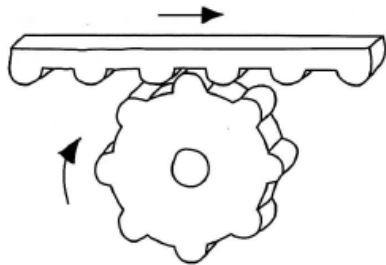
- When wish to have some parts move faster than others, use gearing
- NB: Change in speed also changes power delivered
- Power delivery: Teeth on the gear wheels act like a series of levers

Spur Gears



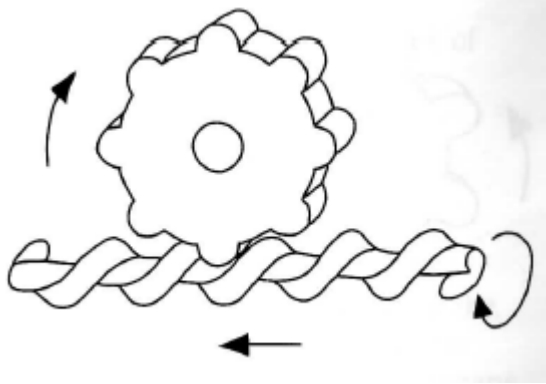
- Regulated motion is when spur gears have the same number of teeth and hence force and speed same for both gears
- NB: rotational directions of these gears are opposite

Rack and Pinion



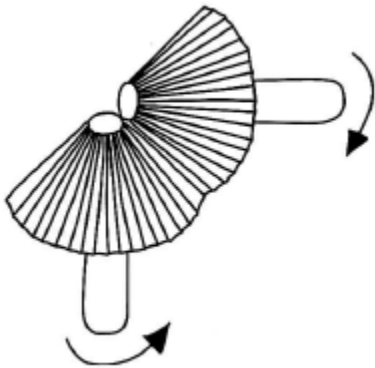
- Gear wheel meshes with the toothed rack
- Rack slides horizontally
- Yet another way to convert rotary motion to a reciprocating one

What is this called? Any advantages?

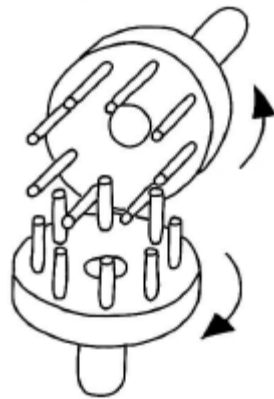


- Worm gear: shaft has a screw thread
- Screw thread meshes with the toothed wheel
- Gives a very slow but powerful force to the toothed wheel

Bevel Gears



- The 2 wheels mesh at 45-degrees
- Plane of rotation changes from horizontal to vertical (and vice-versa)



- Pin Wheel: easier to make, but less accurate
- Positive drive; does not rely on friction