Four Bar Mechanism

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(thanks to Wikipedia and many others)

http://www.library.cmu.edu/ctms/ctms/examples/motor/motor.htm
Steam Engine

- Who invented the steam engine?
Aelopile

- Ball of Aeolus
- Hero Engine
- Described by Vitruvius, 1AD
- Probably Ctesibius, 200BC
Early Engines

- DaVinci, Architonnerre, 15th Century
  - Gives credit to Archimedes
  - Steam powered cannon

- Jerónimo de Ayanz y Beaumont
  - Patented first steam engine / pump 1606
Thomas Savery

- First engine applied to industry, 1698, 14-21 year vague patent, drain mines

- Operation
  - Condensed steam produced a partial vacuum in the pumping reservoir and using that to pull the water upward.
  - Rapidly cool the steam to produce the vacuum by running cold water over the reservoir.

- Problems
  - A lot of wasted heat
  - High pressure stressed engine
  - Needed lots of pumps for longer distances
  - Atmospheric pressure only worked so well (30 ft)
Newcomen: Atmospheric Engine, 1712
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Drain mines, 150 ft

Used steam and cold water to create a vacuum

Vacuum pulled piston (not the water)

Pivoted beam connected to pump and piston with chains

John Smeaton made improvements

Watt thought 80% Inefficient (heat loss)
Watt Engine

- Used steam pressure just above atmospheric pressure (Separate condenser)
- Rotary motion (piston-beam connection)
  - Get value on both sides of stroke
  - Useful for machines
- Mathew Boulton – business partner
Watt Engine

- Used steam pressure just above atmospheric pressure (Separate condenser)
- Rotary motion
  - Useful for machines
- Double acting
  - Get value on both sides of stroke
- Mathew Boulton – business partner
Watt’s Four Bar

Hand-drawn diagram by James Watt (1808) in a letter to his son, describing how he arrived at the design

“I am more proud of the parallel motion than of any other invention I have ever made,” letter to his son
Watt’s Parallel Motion

Pantograph, 1603
Christopher Scheiner
Automobile Suspension

Range Rover EV 1998
Four Bar Mechanism
If the sum of the shortest and longest link of a planar quadrilateral linkage is less than or equal to the sum of the remaining two links, then the shortest link can rotate fully with respect to a neighboring link.
Uses of Four-bars

- A – ground link
- B – input link
- C – coupler
- D – output link

- Function Generation (input/output relation)
- Line Path Generation (line on coupler)
- Point Path Generation (coupler point)
- Coupler configuration Generation
Cool Interactive Web Site

- https://courses.engr.illinois.edu/tam212/aml.xhtml
- Prof. Dullerud at UIUC
- Motion Gen
  http://www.stonybrook.edu/commcms/motiongen/