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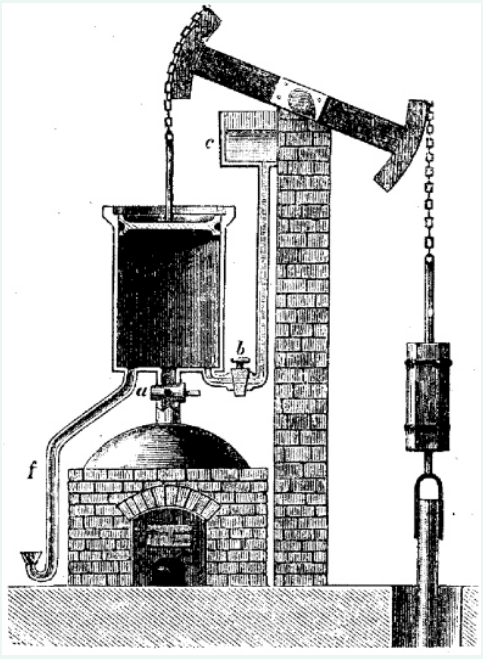
WATT'S SINGLE ACTION MINE PUMP H167

Up until the eighteenth century coal and tin miners often had to abandon their pits because of flooding. Trying to empty flooded mines with a bucket was impossible. Using a hand pump was little better. Some mine owners fitted pumps which were powered by horses, but the number of horses required was enormous and the costs correspondingly great.

In 1698, Thomas Savery (1650-1715) patented the first practical steam engine, a pump to drain water from mines. Savery's pump had no moving parts other than valves operated by hand. These were turned to let steam enter a sealed vessel. Cold water was poured on the vessel to chill it and condense the steam. Then a valve was opened so the vacuum in the vessel could suck water up a pipe.

In 1712, Thomas Newcomen (1663-1729), Savery's partner, invented another steam-engine pump for mines. Newcomen's engine had a large horizontal beam balanced in the middle like a seesaw. A piston which fitted into a cylinder hung from one end of the beam. When steam was let into the steam cylinder, it forced the piston up, lowering the other end of the beam. Cold water was then sprayed into the cylinder, the steam condensed, and the vacuum sucked the piston down again. This raised the other end of the beam, which was attached to the piston of a pump in a mine.



Plan of a Newcomen steam pump

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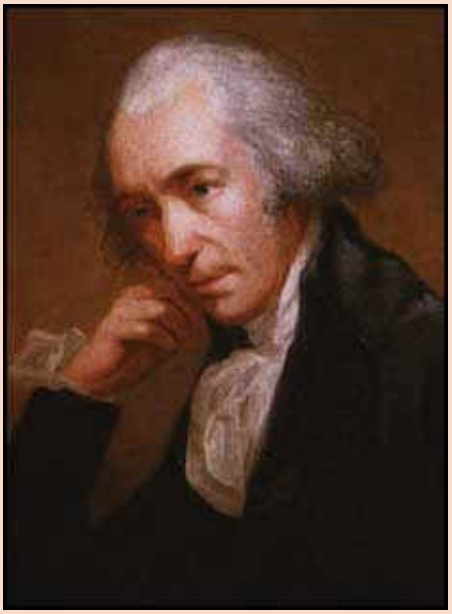
Newcomen's design was both powerful and useful. The first example was able to replace a team of 500 horses that had powered a wheel to pump out a mine! However it had a major problem in that the steam cylinder had to be repeatedly heated up and then cooled down. This took a huge amount of fuel and made the engine work very slowly.

James Watt (1736-1819), from Scotland, found a simple but very effective solution to this problem. In 1763 he realised that if the steam could be sucked out of the steam cylinder and cooled in a separate chamber this would mean that the steam cylinder would not need to be repeatedly heated and cooled. This separate chamber is called a condenser. By doing this the steam chamber could be kept at a constant temperature and the amount of fuel needed would be greatly reduced. It also meant that the engine could run much more quickly.



JAMES WATT

Many Newcomen engines were adapted to take Watt's design. Watt teamed up with Matthew Boulton, a forceful and energetic Birmingham-based tycoon. Boulton & Watt became the most important engineering firm in the country, meeting considerable demand. Initially this came from Cornish mine-owners, but the engines were soon being used for purposes other than pumping water and could be found in paper, flour, cotton and iron mills, as well as distilleries, canals and waterworks. By 1790 Watt was a wealthy man, having received £76,000 in royalties on his patents in eleven years. In 1785 he and Boulton were elected fellows of the Royal Society.

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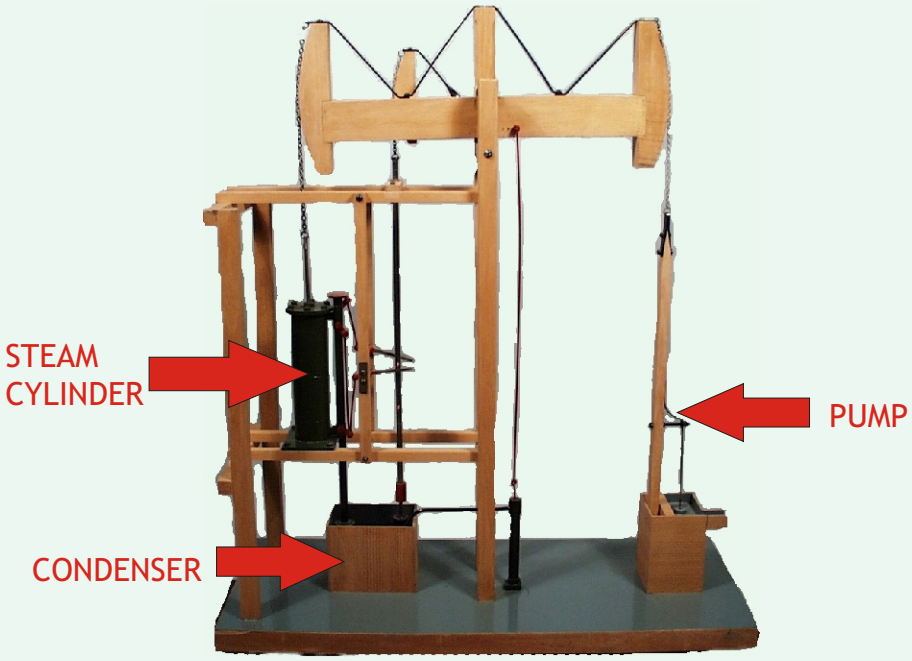
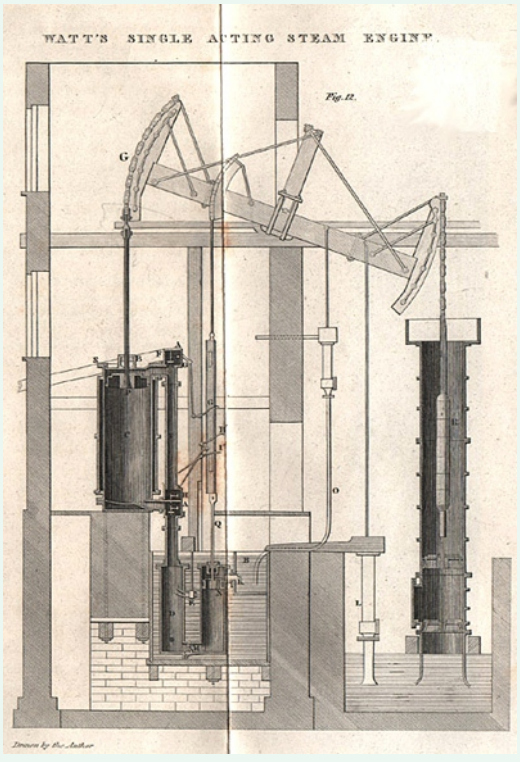


The model shows the basic Watt design.

The steam cylinder is the raised green cylinder. The model does not include the boiler, which would have been necessary to heat the water! This would have been found either to the side or below the steam cylinder.

The condenser, where the steam was sucked and cooled, is in the tank below the steam cylinder. This tank would have been filled with water to keep the condenser cool.

The pump is at the other end of the beam.

The illustration to the right shows a contemporary plan of the Watt engine.