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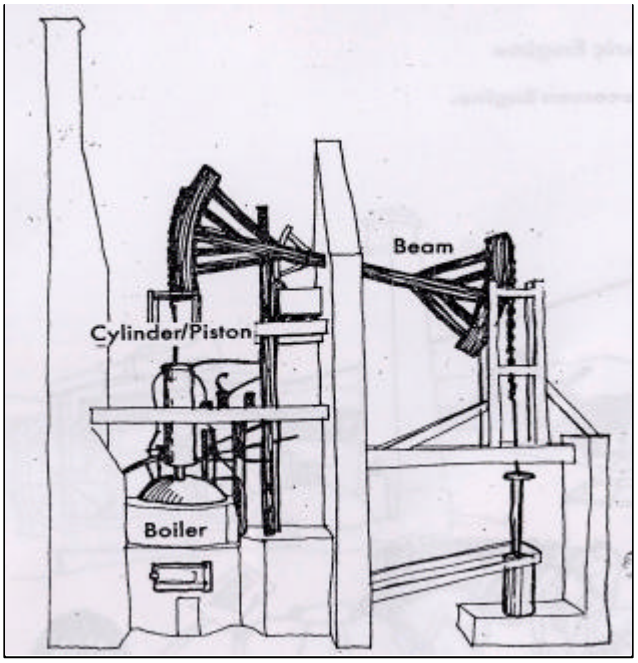
Replica Newcomen Atmospheric Engine

The engine on display in the Power Hall is a one-third scale working model of Thomas Newcomen's original atmospheric beam engine of 1712. It was built by the Mechanical Engineering Department at the University of Manchester Institute of Science and Technology in 1971 and presented to the Museum in the same year. Newcomen's atmospheric engine was the forerunner of the high-pressure steam engines that were vital to the machanisation of the cotton industry in Manchester.

It was the need to find an effective way of pumping floodwater from coal mines that resulted in the first serious efforts to harness steam power. In 1698, Thomas Savery built the first practical steam pump. This worked by using the partial vacuum created when steam is condensed inside a container to suck water up a pipe. However, owing to the low working pressure and primitive engineering skills of the time, the pump was unable to raise water from deep within the mine. As a result, the Savery engine was little used and eventually abandoned.

In 1712, Thomas Newcomen invented a beam engine, which was a great improvement on Savery's steam pump. This type of engine was originally used to pump water from mines, but was soon adapted for other purposes. It was called a beam engine because of the large wooden beam, which was pivoted in the centre and rocked up and down in a see-saw action. One end of the beam was connected to a piston inside a cylinder whilst the opposite end was connected via rods to a pump in the mine.



The working cycle of this type of early beam engine is quite simple. Steam produced in the boiler is admitted into the bottom of the cylinder. This causes the piston inside to rise and the opposite end of the beam to descend, assisted by the weight of the pump rods. Once the piston has reached the top of the cylinder, cold water, stored in a tank, is sprayed into the cylinder. This cools the steam, causing it to condense back into water. The absence of steam pressure creates a partial vacuum beneath the piston and the pressure of the atmosphere above forces the piston downwards. The opposite end of the beam, which is connected to the pump, rises upwards in a see-saw action, raising water from the mine.

Although the Newcomen engine was a technological advance, it was very slow and wasteful. Each injection of cold water cooled the cylinder and some of the steam was used to reheat the cylinder on the following stroke. In about 1763, the Scottish engineer, James Watt had an idea for improving the efficiency of the Newcomen engine. Watt was working on a model Newcomen engine at Glasgow University. His idea was to add a separate condensing cylinder, instead of using the main cylinder for condensing the steam back into water. This would enable the main cylinder to remain hot after each stroke. This increased efficiency, because none of the heat energy of the steam was being used to reheat the main cylinder. After patenting his idea in 1769, Watt went into partnership with Matthew Boulton, a Birmingham entrepreneur, to produce the improved Boulton & Watt engine. He went to devise further improvements to the steam engine that made it suitable for powering a variety of machinery.

For more information:

Read Allen, J. S. *The Steam Engine of Thomas Newcomen*. Ashbourne, UK; Landmark Publications, 1996.

Visit Elsecar Heritage Centre, Barnsley
The Science Museum, London
Black Country Living Museum, Dudley
How Steam Engines Work: www.mgsteam.btinternet.co.uk