

# THE NEWCOMEN MEMORIAL ENGINE

INTERNATIONAL HISTORIC  
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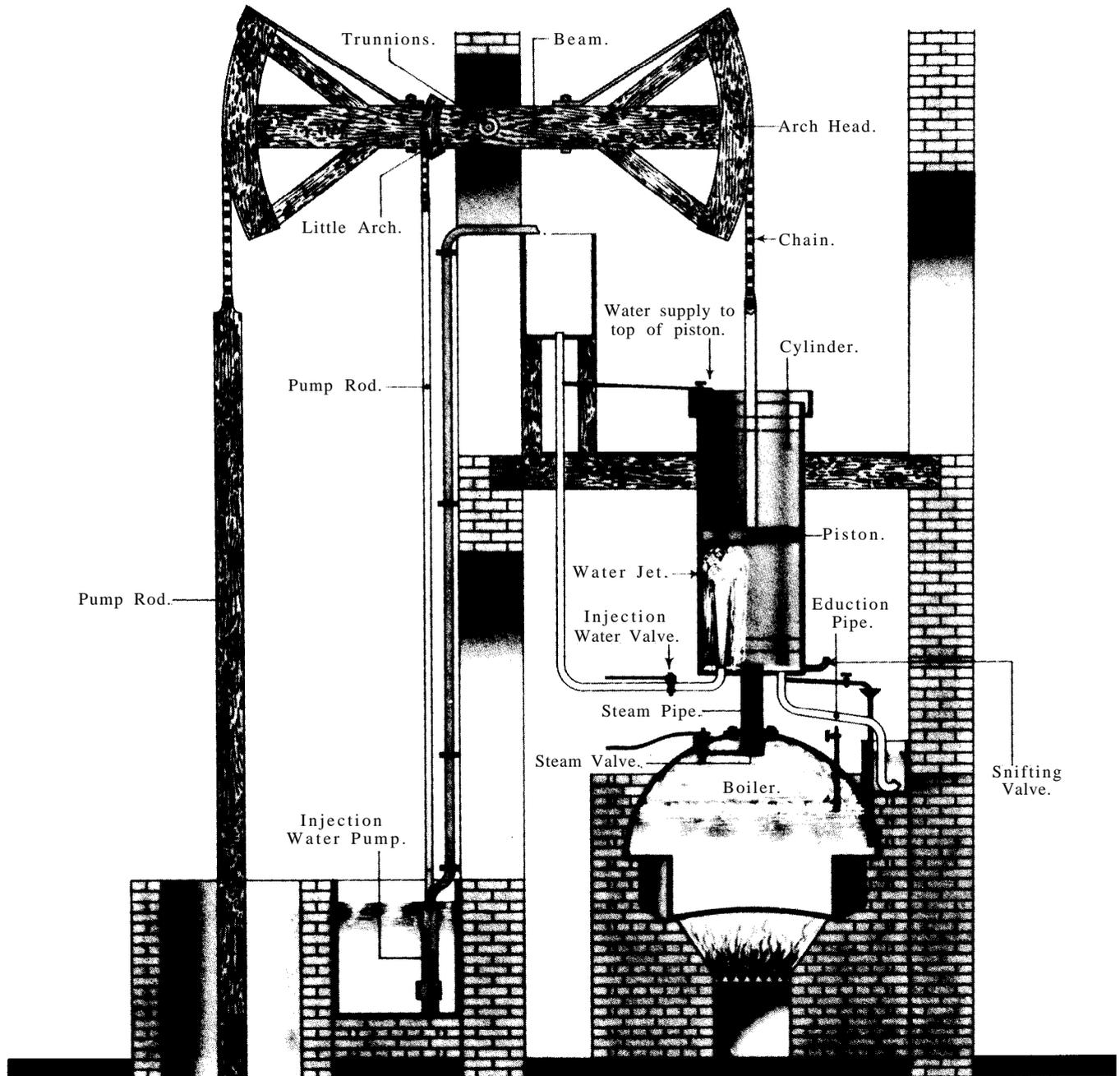
DARTMOUTH, DEVON, ENGLAND  
17/9/1981

Towards the end of the 17th century the need for better and cheaper means of removing water from coal and other mines in various areas of Great Britain became pressing. These mines, working earlier from the outcrops, had over the years been taken ever deeper and the principal coalmining areas of Staffordshire, Warwickshire and Tyneside were particularly troubled. Many of the mines had been drowned out and abandoned; existing pumps simply could not cope with the water.

Although steam and its effects had been much

experimented with in attempts to produce useful power, no practical pumping engine was devised until partial success was achieved by Thomas Savery's 'The Miner's Friend' (patented in 1698).

This machine had no heavy moving parts, using first a vacuum to 'suck' water into a container, and then steam pressure to force the water to a height, needing only simple valves to control the action. Suited to but modest lifts, the device was a most impractical arrangement for raising water from depths, and so failed its stated purpose.



The principal features of the Newcomen engine in section. Steam is generated at atmospheric pressure in the boiler and fills the cylinder during the upward stroke of the piston. The steam valve is then closed and the steam is condensed by a jet of cold water causing a vacuum under the piston. The atmospheric pressure acting on the top of the piston forces it down, hence the description 'atmospheric' engine, and this constitutes the working stroke. The piston is raised again by the over balancing weight of the pump rods.

In the very early years of the 18th century Thomas Newcomen (1663–1729) and his assistant John Calley developed an engine of quite different form which employed a vacuum created by condensing steam from a pressure only just above atmospheric. He employed a vertical open-topped cylinder in which a piston moved. This piston was connected by chains to one end of a massive rocking beam, to the other end of which were chained the pump rods that went down into the mine. Steam was admitted into the cylinder from the boiler placed below, and the weight of the pump rods activated the beam so that the piston moved towards the top of the cylinder and drew in steam. At this moment water was sprayed inside the cylinder and a vacuum created into which the piston was forced by atmospheric pressure, rocking the beam and thus creating a stroke of the engine.

Very soon the engine was made self-acting by the addition of a plug rod hung from the rocking beam and having pegs which, during the stroke, actuated levers connected to the valves. The power of Newcomen's engine was limited by the level of contemporary technology; the ability to cast large cylinders and supply them with adequate steam. This invention was of prime importance and became an immediate and outstanding success.

Newcomen's first successful engine is recognised as that built in 1712 near Dudley Castle in Tipton, West Midlands, England. This engine was followed rapidly by others in the coalmines of Warwickshire and in the area of Newcastle-upon-Tyne and then spread throughout the country giving a very rapid take up of the invention.

Thomas Newcomen, a Baptist of Dartmouth in Devon, found it best to operate within the Savery Patent which had been granted in very broad terms and which had been further extended to 1733. However, Savery died in 1715 and an organisation was then set up known as the 'Proprietors of the Invention for Raising Water by the Impellent Force of Fire' to exploit the invention. Newcomen was granted a significant number of shares in this Company. Thus the spread of the invention was controlled and exploited until the lapse of the Patent.

By this date there had been at least 95 engines built in the country and the stage had been set for the rapid rise in industrial activity which was to accelerate the so-called 'Industrial Revolution.'

Only a few years after the adoption of the engine

in Britain its use spread to the Continent, first in 1720-21 in Belgium and the following year in Hungary. Other engines soon followed in France, Germany and Austria and by 1727-8 in Sweden. The introduction of the Newcomen engine into Continental Europe was a most important technology transfer and one which had a significant effect upon mining operations.

The first engine to be built in the New World was constructed by Josiah Hornblower of Cornwall, a son of one of Newcomen's associates. The majority of the parts left England in 1753 and, after a long journey, arrived in New York in early September.

It was set up at the Schuyler Copper Mine in what is now North Arlington, New Jersey. A section of the cylinder of the engine remains in the Smithsonian Institution, Washington DC.

Although there were a number of detailed improvements to the Newcomen 'Atmospheric', or 'Fire Engine', as it was known, there was no essential change of principle until James Watt developed the separate condenser and closed in the top of the cylinder – matters not realised in successful full-scale practice until 1776. This was some 64 years after Newcomen's first success and by which time some 600 engines had already been built in Britain.

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## THE DARTMOUTH ENGINE

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Throughout the years the size of engines increased to meet increasing service demand. The largest known had a cylinder of 80 inches diameter. Nevertheless, small engines continued to be built to suit less onerous pumping requirements and, long after the Watt improvements, engines of the Newcomen or atmospheric type continued to be constructed. Some engines had later modifications and amongst these was a device to circumvent the Watt Patent. Known as a pickle-pot condenser, it was fitted beneath the cylinder and although less efficient than a separate condenser nevertheless improved the efficiency of the engine.

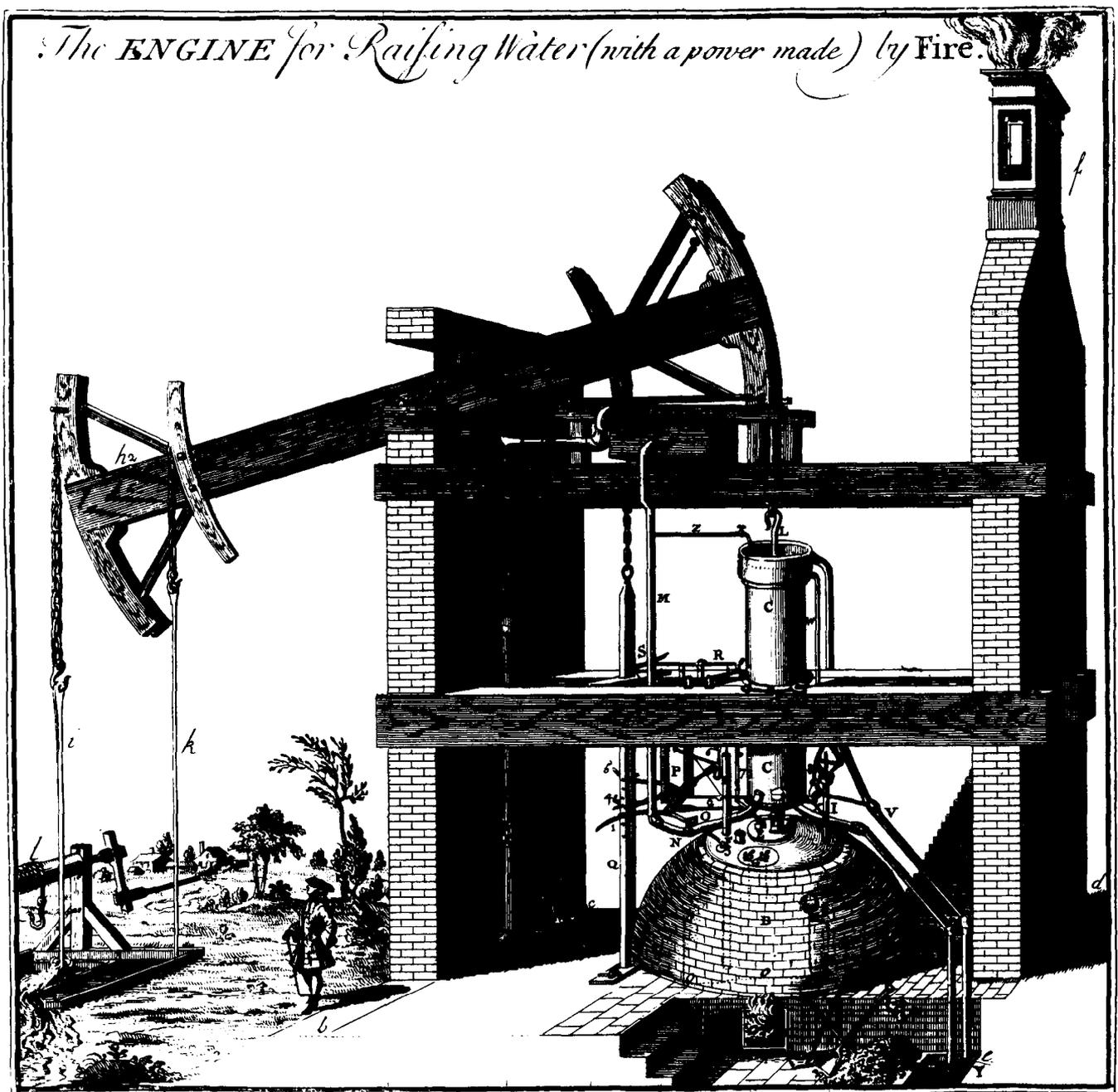
The Newcomen Society for the Study of the History of Engineering and Technology sought to create a suitable memorial to Thomas Newcomen on the occasion of the tercentenary of his birth. A small engine of 22 inch diameter cylinder, very similar to that of the 1712 Dudley Castle engine but made of iron and not brass, had been purchased secondhand

in 1821 by the Coventry Canal Co to power water from a well into a canal at Hawkesbury Junction, Warwickshire.

The earlier history of the engine is unknown and it is only certain that it had been acquired from Jonathan Woodhouse. It is unlikely that it dates from much before the end of the 18th century but it nevertheless displays many of the features of the early engine. It has a simple untrussed wooden beam with arch heads, chain connections and wooden spring-beams. A pickle-pot condenser is

fitted beneath the cylinder and a hydraulic device is now incorporated to allow the engine to be set in motion and the visitor to observe the movement of the engine. The operating valves are activated by a plug rod as in the early engines.

The engine was donated by the British Transport Commission to the Newcomen Society in 1963. Having stood idle for some 50 years it was then dismantled, removed and re-erected at Dartmouth to form a fitting memorial to its inventor. The engine is a direct descendant of Newcomen's first machine.



A drawing by Henry Beighton 1717, probably of his engine at Oxclose. Note the difference in the valve gear from the Griff engine.



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## ACKNOWLEDGMENTS

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The Newcomen Engine is the third International Historic Mechanical Engineering Landmark to be designated outside of the United States. It is the 67th designated since the historical recognition programme began in 1973. For a complete list, write to ASME, Public Information Dept., 345 E. 47th Street, New York 19917, USA.

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Reference: *The Steam Engine of Thomas Newcomen*, L. T. C. Rolt and J. S. Allen, Moorland Publishing Company, Hartington, 1977.