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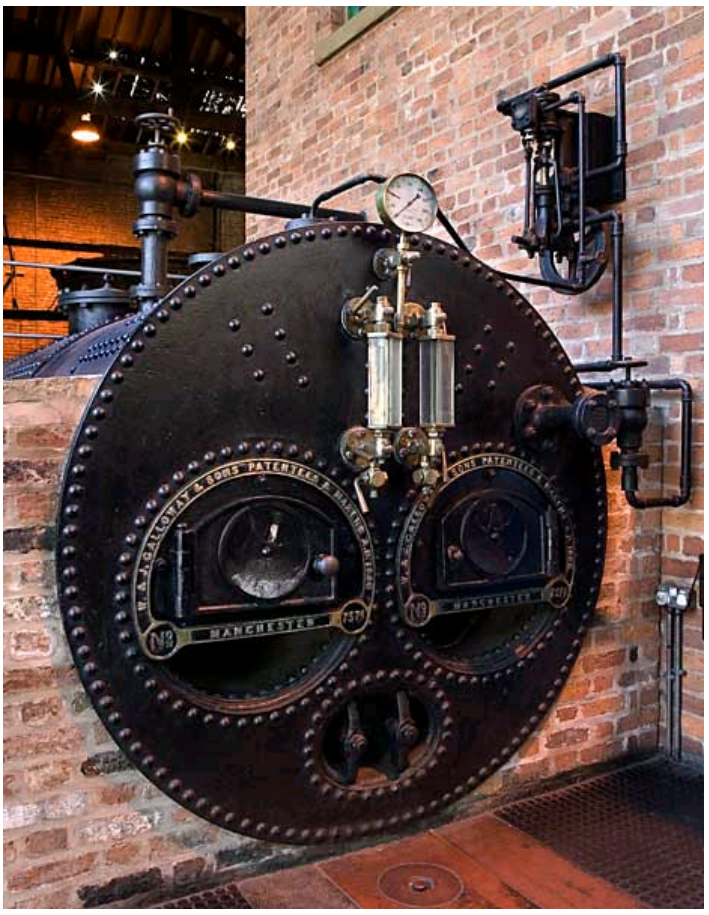
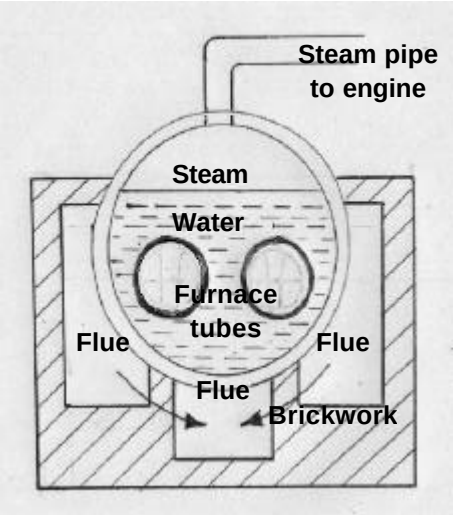
Lancashire Boiler

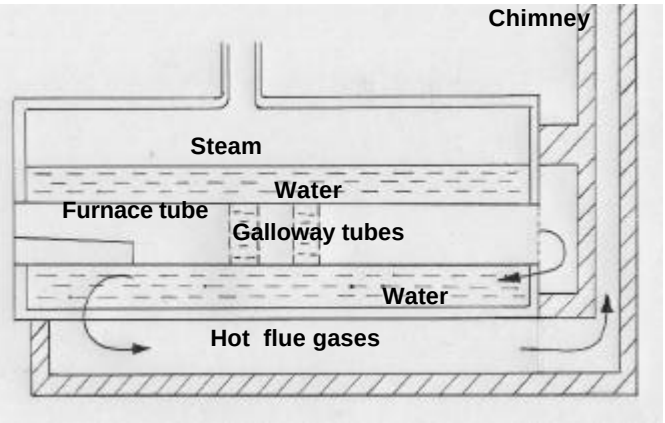
Every steam engine required a boiler in which the energy from burning fuel (usually coal) was used to heat water and produce steam under pressure. The boiler on display in the Power Hall is a modified Lancashire boiler. It was made by W. & J. Galloway & Sons of Knott Mill, Manchester. One side has been cut away to reveal the internal furnace tubes.

The high efficiency of the modified Lancashire boiler was the result of more than 100 years of continuous development. Thomas Newcomen's boiler of 1712 was circular with a domed top and built over a furnace in which coal was burnt. The boiler pressure was only 3 or 4 lbs per square inch (p.s.i.). A lot of heat was wasted because it escaped from the sides of the furnace, instead of heating the water in the boiler. In order to cope with higher steam pressures (up to 30 p.s.i.), James Watt designed the 'wagon boiler', so called because it was shaped like a horse-drawn cart. Around 1810, Richard Trevithick developed the cylindrical Cornish boiler. This boiler had a single fire tube running centrally along the length of the boiler, surrounded by water. Having the fire in a tube that was immersed in water greatly increased the amount of heat energy transferred to the water.



The Lancashire boiler was developed in 1844 by William Fairbairn. Born in Scotland, Fairbairn moved to Manchester after serving an apprenticeship in Newcastle-upon-Tyne. He became one of the leading mechanical engineers of his day. His Lancashire boiler had twin furnace tubes side-by-side, which gave it a much larger heating surface than that of the Cornish boiler. The addition of 'Galloway tubes', patented in 1848, brought a further improvement in heat transfer and fuel efficiency. These were metal tubes that crossed the hottest part of the furnace. They improved water circulation and increased the area of the heating surface. Galloway tubes also acted as stiffeners and greatly strengthened the main flues against collapse.





To produce steam, coal was shovelled through the firedoors at the end to maintain a fire in each of the furnace tubes. A typical Lancashire boiler would consume around six tons of coal per day. The level of the water in the cylinder which surrounded the internal fire tubes, could be monitored by checking the glass gauges on the front of the boiler. The water level would be maintained by opening the water feed valve, as required, to replace the water that had been converted to steam. The steam pressure in the boiler was indicated by the steam pressure gauge, which is positioned just above the water level gauges.

Checking water level regularly was vital to safe operation. Even the best designed boiler cannot withstand the tremendous pressures created if the water level is allowed to drop too low. Allowing the water level to drop below the tops of the internal flues would be likely to cause an explosion. To avoid this kind of accident, boilers were fitted with safety valves. These valves made a loud noise, as they released excess steam, to draw the attention of the engineer.

Lancashire boilers were surrounded by brickwork flues. This meant that the hot flue gases produced by burning coal could circulate under and along the sides of the boiler before reaching the chimney. Thus, instead of escaping straight up the chimney and being wasted, the flue gases helped to heat the water in the boiler.

For more information:
Read McEwen, A. *Chronicles of a Lancashire Boilermaker*. Sledgehammer Press, 1996.
Visit Queen Street Mill, Burnley