Collections Department
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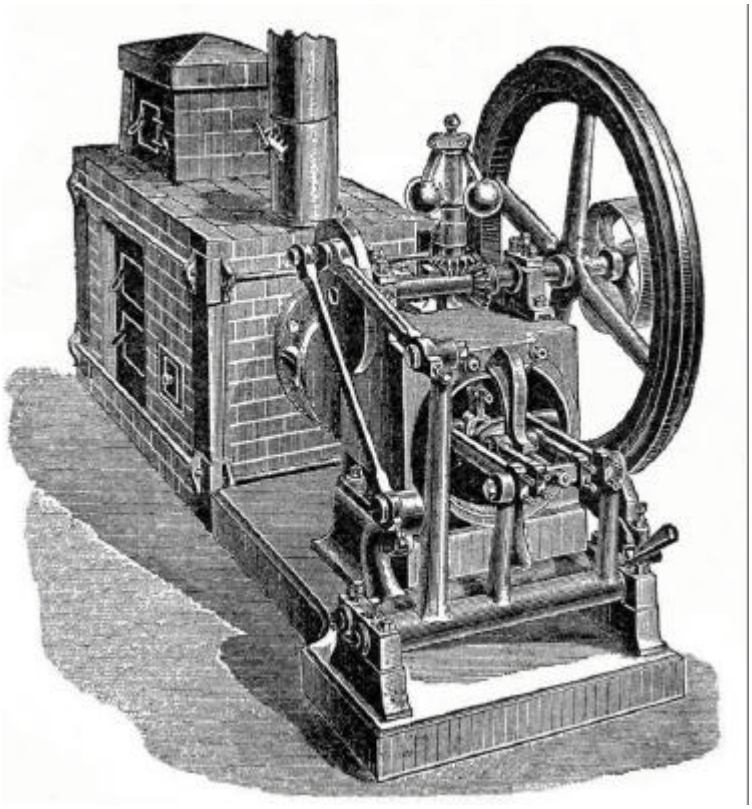
Bailey Hot-Air Engine

This engine was made by W. H. Bailey & Co of Salford in the 1880s. It could use wood, coke, coal or any waste material as fuel. Engines of this type were popular for use in sawmills and on farms for driving light machinery. This engine was presented to the Museum by W. H. Bailey & Co. in 1969.

Engineers had long been intrigued by the possibility of an engine that worked using only hot air. Sir George Cayley developed the principles of hot-air engines in 1806. Ten year later, Robert Stirling, a Scottish clergyman, and his brother James, an engineer, patented a practical hot-air engine and later built one.

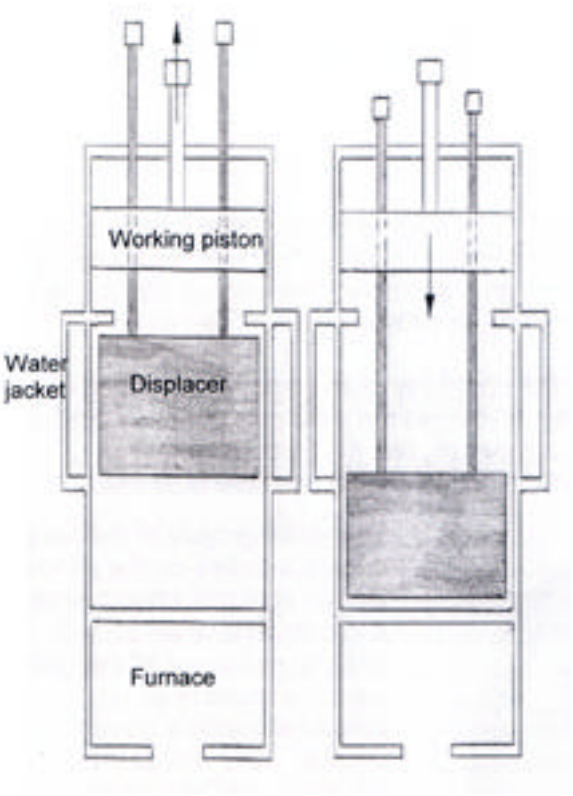


The working cycle of the hot-air engine is based on the principle that air expands when heated and contracts when cooled. In order to make use of this effect, a fixed amount of air is contained inside a closed cylinder. One end of the cylinder is kept hot by an external heat source, while the opposite end is kept cool. A displacer piston moves the air between the hot end and the cold end, causing it to expand and contract. The expanding and contracting air drives the working piston back and forth in a reciprocating action. This back-and-forth motion of the piston is converted to the rotational motion of the flywheel via a crank.

Hot-air engines were very popular because they were simple to make, ran silently and used very little energy. Since they used hot air at low pressure, they were also safer than steam engines. If the cast-iron boiler of a steam engine burst, it expelled dangerously hot, high-pressure steam, causing serious injuries to anyone nearby.

There are a number of different configurations of hot-air engines. The main types were a single-cylinder design, as in the Bailey engine, where the working piston and a displacer piston shared the same cylinder. The two-cylinder design, as in the Robinson engine, placed the working piston and displacer piston in separate but interconnected cylinders.

Fig 1a Fig 1b



The Bailey engine has just one horizontal cylinder containing two pistons, a loose-fitting displacer piston and a working piston. One end of the cylinder is built into a furnace, which is kept permanently hot. The opposite end is cooled by a water jacket. With the displacer at the cold end of the cylinder (Fig 1a), heat from the fire causes the air in the cylinder to expand, thus driving out the working piston. The displacer then moves to the hot end of the cylinder (Fig 1b) displacing the hot air to the cold end of the cylinder, where it is cooled by a water jacket. As the air cools, it contracts, drawing the working piston back. The cooled air is then displaced to the hot end of the cylinder by the action of the displacer. It is then reheated and the cycle begins again.

Technical Data

Engine type	Horizontal hot-air engine
Manufacturer	W. H. Bailey & Co. Ltd, Salford
Date of manufacture	1880
Fuel	Coal, coke or wood
Rating	3 horsepower
Speed	180 rpm

For more information:

Read Sier, R. *Hot Air Caloric and Stirling Engines: A History*. Chelmsford, UK; L. A. Mair Publishing, 2000.

Visit The Science Museum, London.

Stirling Engines website: www.stirlingengines.org.uk