Steam Power during the Industrial Revolution

The development of the stationary steam engine was an

important element of the Industrial Revolution; however, for

most of the period of the Industrial Revolution, the majority of

industrial power was supplied by water and wind. In Britain by

1800 an estimated 10,000 horsepower was being supplied by

steam. By 1815 steam power had grown to 210,000 hp. Small

power requirements continued to be provided by animal and

human muscle until the late 19th century.

2 The first real attempt at industrial use of steam power was

due to Thomas Savery in 1698. He constructed and patented in

London a low-lift combined vacuum and pressure water pump,

which generated about one horsepower (hp) and was used in

numerous water works and tried in a few mines (hence its "brand

name", The Miner's Friend). Savery's pump was economical in

small horsepower ranges, but was prone to boiler explosions in

larger sizes. Savery pumps continued to be produced until the late

18th century.

3 The first safe and successful steam power plant was

introduced by Thomas Newcomen before 1712. A number of

Newcomen engines were successfully put to use in Britain for

draining hitherto unworkable deep mines, with the engine on the

surface; these were large machines, requiring a lot of capital to

build, and produced about 5 hp (3.7 kw). They were extremely

inefficient by modern standards, but when located where coal was

cheap at pit heads, opened up a great expansion in coal mining

by allowing mines to go deeper. Despite· their disadvantages,

Newcomen engines were reliable and easy to maintain and

continued to be used in the coalfields until the early decades of the 19th century. By 1729, when Newcomen died, his engines had

spread (first) to Hungary in 1722, Germany, Austria, and Sweden.

A total of 110 are known to have been built by 1733 when the

joint patenl expired, of which 14 were abroad. In the 1770s, the

engineer John Smeaton built some very large examples and

introduced a number of improvements. A total of 1,454 engines

had been built by 1800.

4 A fundamental change in working principles was brought

about by James Watt. In close collaboration with Matthew

Boulton, he had succeeded by 1778 in perfecting his steam

engine, which incorporated a series of radical improvements,

notably the closing off of the upper part of the cylinder, thereby

making the low pressure steam drive the top of the piston

instead of relying on the atmosphere, use of a steam jacket and

the celebrated separate steam condenser chamber. The separate

condenser did away with the cooling water that had been injected

direclly into the cylinder, which cooled the cylinder and wasted

steam. Likewise, the steam jacket kept steam from condensing

in the cylinder, also improving efficiency. These improvements

increased engine efficiency so that Boulton & Watt's engines used

only 20-25% as much coal per horsepower-hour as Newcomen's.

Boulton and Watt opened the Soho Foundry, for the manufacture

of such engines, in 1795.

5 By 1783 the Watt steam engine had been fully developed into

a double-acling rolative type, which meant that it could be used

to directly drive the rotary machinery of a factory or mill. Both of

Watt's basic engine types were commercially very successful, and by 1800, the firm Boulton & Watt had constructed 496 engines,

with 164 driving reciprocating pumps, 24 serving blast furnaces,

and 308 powering mill machinery; most of the engines generated

from 5 to 10 hp (7.5 kW).

6 The development of machine tools, such as the lathe, planing

and shaping machines powered by these engines, enabled all the

metal parts of the engines to be easily and accurately cut and in

turn made it possible to build larger and more powerful engines.

7 Until about 1800, the most common pattern of steam engine

was the bearr. engine, built as an integral part of a stone or brick

engine-house, but soon various patterns of self-contained portative

engines (readily removable, but not on wheels) were developed,

such as the table engine. Around the start of the 19th century, the

Cornish engineer Richard Trevithick, and the American, Oliver

Evans began to construct higher pressure non-condensing steam

engines, sending exhaust into the atmosphere. This allowed an

engine and boiler to be combined into a single unit compact enough

to be used on mobile road and rail locomotives and steam boats.

8 In the early 19th century after the expiration of Watt's patent,

the steam engine underwent many improvements by a host of

inventors and engineers.