

STEAM AND COAL

The independent energy of the forces of nature



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Mineral coal is a fossil fuel of high calorific power which began to be used on a large scale in England at the start of the Industrial Revolution. There are various types of coal: anthracite, soft coal, lignite

and peat.

Coal was the main fuel used by the steam engine. The successful use of energy from water vapour depends on the capacity of compressing it and making it flow in a controlled way. Nature offers us various examples of this phenomenon.

Catalonia has always been a country poor in coal resources. Soft coal from Sant Joan de les Abadesses, and lignite from Elk Berguedà, l'Anoia and Baix Ebre were not enough in quantity or quality to satisfy the needs of the country, and coal had to be obtained from England and, from the late-19th century onwards, from Asturias.



EVOLUTION OF THE STEAM ENGINE

The steam engine was one of the first technological innovations resulting from scientific advances. Developed by technicians and mechanics, it was improved over a period of some 200 years.

Experiments were carried out on the force of steam and the vacuum as long ago as

Greek times, but no practical application emerged.

Hero of Alexandria made steam move artifacts, whilst in 1654, O. von Guericke demonstrated the force of atmospheric pressure by creating a vacuum in a container. This principle was used in the first steam engines.

D. Papin was the first to consider the use of steam to produce effective work, and built an atmospheric machine in which a vacuum was created by condensing steam in a cylinder, making the piston descend.

T. Newcomen designed a machine based on Papin's principles, using it to pump water from mines

Modifying and perfecting Newcomen's model, J. Watt created a much more efficient machine which saved coal and could move the gears of factory machinery.

Principal innovations: Incorporation of a separate condenser (1769), transformation of vertical action into rotary movement (1781), double effect (1782), speed changer (1787), parallelogram.

In 1800, when Watt and Boulton's patent expired, many improved models appeared on the market.

The changes made to machines and boilers were aimed at obtaining high pressure with better use of steam expansion with double, triple and quadruple expansion, and more effective steam distribution mechanisms (sliding valves).

APPLICATIONS OF THE STEAM ENGINE



INDUSTRY

Industrial use of the steam engine: in Catalonia, this began at the Bonaplata factory

The steam engine caused a veritable revolution in the

manufacturing industry, mechanising processes and increasing productivity.

In 1833, the Bonaplata, Rull, Vilaregut i Cia factory, located in the Raval district of Barcelona, became the first to use steam power in Catalonia for a wholly industrial purpose, becoming an emblem of industrialisation in Catalonia, which was based on the cotton textile industry.



INDUSTRY

The boiler, an essential element in the functioning of the steam machine.

The boiler generated steam from the combustion of coal, which heated the water. Boilers evolved to optimise heat transfer and avoid the explosions which affected early factories.



INDUSTRY

The "Vapor Vell", Sants

The Güell, Ramis i Cia textile factory, founded by Joan

Güell in Sants in 1844, was popularly known as the "Vapor Vell". When built, it was the largest in the Principality.

The gearings and a system of belts and pulleys transmitted the movement generated by the steam engine.

The vapors and the birth of the working class

The vapors were large factories in cities, using steam engines for power and in which the relationship between bosses and workers was restricted to labour questions.

Hard working conditions, with low wages and working days of up to 15 hours, were a constant source of conflict, leading the workers to organise and create the first movements to defend their interests.



TRANSPORT

The railway connected peoples and markets

The railways heralded the beginning of the revolution in land transport which was to affect both goods transportation and passenger travel. The railways soon spread throughout England and Europe. In 1848, the first railway line in Spain was opened between Barcelona and Mataró.



TRANSPORT

The steamship brought the continents closer together

The first steamship sailed to the USA in 1807, but it was not until 1889 that the great expansion of maritime steam traffic began. The first steamships consumed large amounts of coal and could not risk making long voyages, as fuel took up the greater part of the space used for cargo. In Catalonia, the first steamship was the schooner "El Balear" 1834.



PUBLIC WORKS

With the steam roller, the steam engine was introduced into public works.

The steam roller was a kind of locomotive used in public works. It had one or two rollers to gravel or flatten roads.



AGRICULTURE

The difficult mechanisation of the field

The introduction of the steam engine into agriculture occurred later due to the difficulty of transporting the engine and the investment and maintenance costs involved. It was first used to thresh grain (1841) and later for ploughing for other agricultural work. In Catalonia, the first steam threshing machine operated in Manresa (Bages) in 1882.

THE MANUFACTURE OF STEAM MACHINES IN CATALONIA,



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Nuevo Vulcano Workshops

The company has its origins in the maritime company of Societat Catalana de Vapors, later Sociedad de Navegación e Industria, which in 1833 installed a boiler works at the Moll Nou in the Port of Barcelona with the name of Nuevo Vulcano in honour of the god of fire. This was the first Catalan firm specialising in the construction of ships and machinery.



THE MANUFACTURE OF STEAM MACHINES IN CATALONIA,

Alexander Bros.

The Alexander brothers from Scotland established a foundry in the Barceloneta district of Barcelona in 1849, specialising in the construction of steam engines for shipping, as well as medium and small machines for industry and agriculture.



FOREIGN STEAM MACHINES

The R. Wolf de Magdeburg steam engine

The firm of R. Wolf de Magdeburg was one of many in central Germany engaged in the 19th century in machinery manufacture. It began activity in 1862 with the construction of locomotives. In 1928 it merged with Buckau and went on to become one of the most important machinery manufacturers of the period. The firm had a delegation in Barcelona and installed steam engines at many Catalan factories.

MACHINES WHICH DID NOT PROSPER



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The high-speed machine

The evolution of the steam engine was designed to increase its performance and to diversify its applications.

The high-speed machine, applied to power generation and shipping, was quickly replaced by the explosion engine and steam turbines.



MACHINES WHICH DID NOT PROSPER

The hot air engine, a frustrated invention

It was known as the "fire engine" and its main characteristic was that it did not require water vapour, heating and cooling the air directly. It was easy to operate, but had low power and needed constant monitoring. It was used to perform small industrial tasks and in laboratories, but was quickly sidelined after the introduction of the explosion engine.