



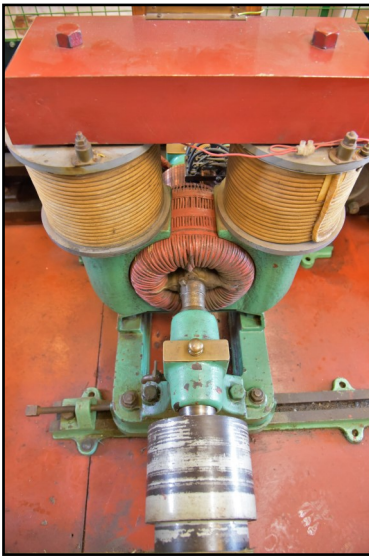
Waterworks Museum - Hereford

Wilson Hartnell 110v Dynamo

May 2023

Researched by: Richard Curtis (Trustee)

One of three items on long term loan from Wales



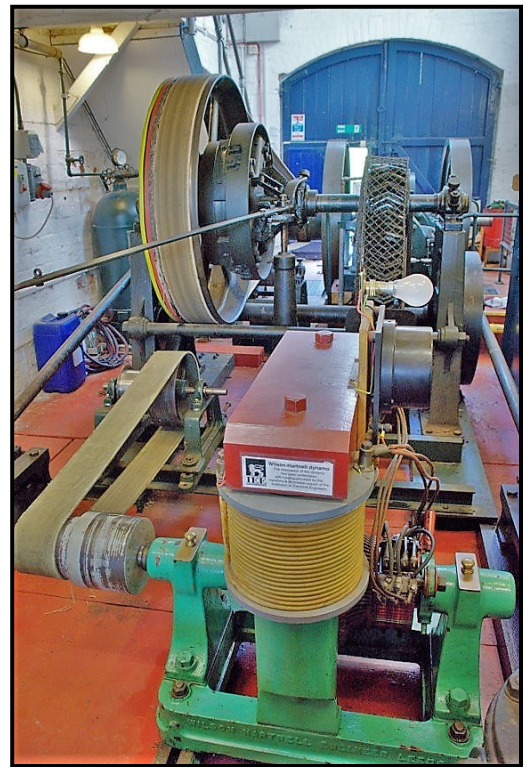
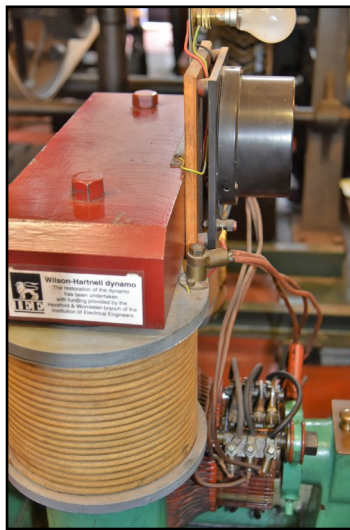
The Wilson Hartnell 100v Dynamo is one of three artefacts that have been on long term loan to the Waterworks Museum from Amgueddfa Cymru - Museum Wales since 1999.

It was originally installed in Barry Urban District Council's refuse destructor plant when it opened in March 1901.

In July 1972 it was donated to the Welsh Industrial and Maritime Museum, where it was displayed in Cardiff Bay between 1977 and 1998. When the museum was closed, the dynamo was moved to the museum's store in Nantgarw.

Shortly after this, Trustees were delighted when the dynamo was offered to the Waterworks Museum on long term loan by the National Museum of Wales (the successor to the Welsh Industrial and Maritime Museum's collection), Restored to full working order by our Volunteers, it can now be seen in operation powered by our 1912 National Gas Engine.

In 1900 it would not have been unusual in an electric lighting plant to see a dynamo driven by a gas engine, for example as one was at Ledbury and Tewkesbury. Our display of the Wilson Hartnell dynamo is, therefore, redolent of a typical system of the period.



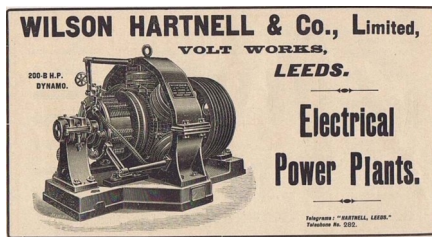
Wilson Hartnell & Co, Limited



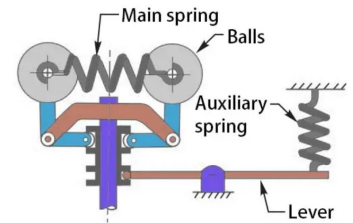
The engineering business was founded by Wilson Hartnell (1839-1920) on Kirkstall Road in Leeds in 1871. It became a limited company in 1901, the same year the facility in Barry opened.

As well as a maker of dynamos and electrical plant, the company carried on business as engineers, iron, steel and brass founders, boiler makers, iron and steel cable makers, and wire drawers,

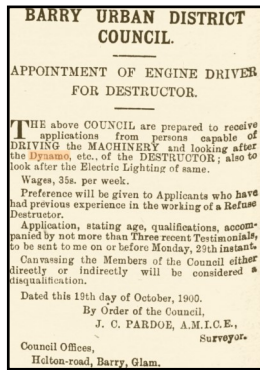
Hartnell's obituary stated how he gave particular attention to the design and manufacture of two-pole direct current dynamos, which he initially used to provide lighting to the mills and grand houses of Yorkshire that established his reputation.



Wilson Hartnell is better known for his paper "Controlling the Power of Steam Machines" and his patent in 1871 of the design of a governor that was radically different from that designed by James Watt and the many other designs that had evolved from it. See page 4.



Wilson-Hartnell Governor



Barry UDC waste destructor

Approval to investigate the setting up of a facility to dispose of the town's waste was given in summer 1897. Then, there were relatively few such units in England - mainly in London, or in bigger towns and cities on the south coast or industrial north, and none in Wales.

When it opened in 1901 the refuse destructor was the first of its kind in south Wales. There were two in

north Wales, but these had been set up as part of an electric lighting company and not solely for disposal of town waste.

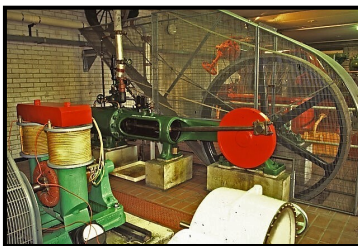
Contracts for building the destructor were let in May 1899, but it was only in November 1900 that approval was given for it to provide electric lighting to an adjacent abattoir and council school.

The total cost of the scheme was £8,118: building £3000, chimney stack £1805, two cells (incinerators) £2763, and electric lighting £550.

More information about the destructor is provided on page 3, as set out in an item in the local newspaper, the Barry Dock News, on 1 March 1901 (the day after the opening of the new works).

The first engine driver earned 35s per week to drive the machinery and look after the dynamo and electric lighting

Welsh Industrial and Maritime Museum

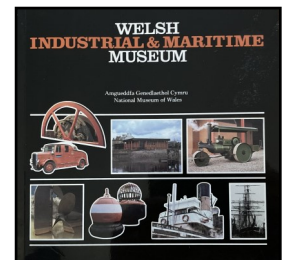


The dynamo was donated to the Welsh Industrial and Maritime Museum in July 1972, five years before the museum opened to the public in 1977.

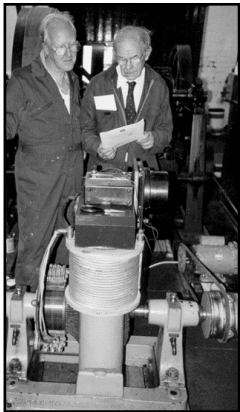
Here, it was displayed driven by the Tangye steam engine that had also been donated from the Barry refuse destructor, until the museum closed in 1998 to

prepare for the creation of the Cardiff Bay Barrage.

Many items were put into storage until the opening of the National Waterfront Museum in Swansea in 2005. However some items were distributed to other museums and the Wilson Hartnell dynamo was one of three items loaned to the Waterworks Museum.



Displaying the dynamo at the Waterworks Museum

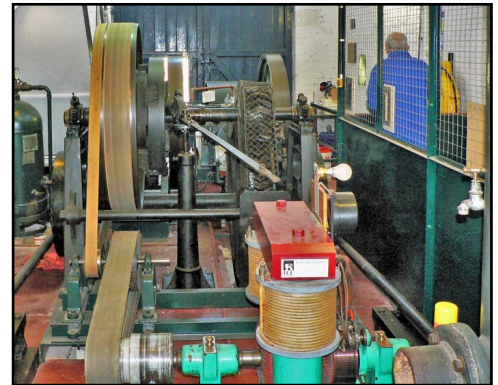


Summer 2001: volunteer engineers Alan Shaw & John Liddle running tests on the dynamo

The dynamo was in good condition when it was received so volunteer effort was mainly focused on how best to display it. .

With the installation of lay shafting and a belt drive from the National Gas engine we have been able to demonstrate the principle of the dynamo and illustrate how electric power was generated 120 years ago. The working display in Bay 1 of the Museum shows an electric output indicated by a voltmeter and an incandescent lamp.

The installation of the dynamo was supported by a grant from the local branch of the Institution of Electrical Engineers after its members enjoyed a group visit to the Museum in 2001.



Barry Dock News: 1 March 1901

DESCRIPTION OF THE NEW ESTBALISHMENT

The site off Hannah Street, Cadoxton, is more than an acre in extent and has a frontage if 318ft on to the main road. Between the main entrance and the buildings is an inclined roadway to a tipping platform 119ft long with guide rails.

The cells (incinerators) are capable of burning 30 tons of all kinds of town and market refuse per day to a hard innocuous clinker.

The boiler, one of Messrs Babcock & Wilcox's, is one of the water tube type ... suitable for a daily working pressure of 115lbs to the square inch.

The steam engine (manufactured by Messrs Tangye of Birmingham) is a horizontal high pressure non-condensing one, with a 10" diameter cylinder.

The chimney stack is 150ft high.

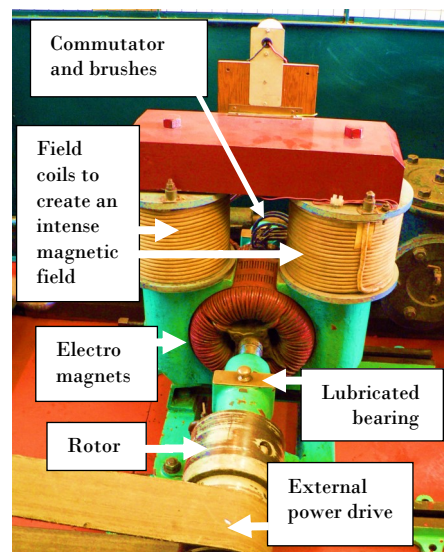
In addition to the dynamo, a loan of £541 has been sanctioned by the Local Government Board to cover the cost of supplying electric lighting appliances to supply the destructor and public abattoir.

The following year, a further loan was approved to provide electric lighting to a new council school built on adjacent land. In 1904 electric lighting was supplied to the council's Manual Instruction Centre. The cables for this were laid underground, in the Chairman of the Council's words, 'to set a good example to the National Telephone Company'.

SO HOW DOES A DYNAMO WORK?

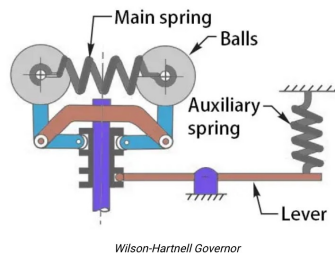
A dynamo converts mechanical energy supplied by a driving engine into direct current electrical energy.

It consists of a coil of wire rotating in a magnetic field to create energy. A split ring commutator changes the coil connection every half turn. As the induced energy is about to change direction the connections are reversed so that the electric current to the external circuit flows in the same direction (as direct current).



The first dynamo was built in laboratory experiments in the early 1830's by Michael Faraday, but it took another 40 years before the technology had developed to provide a reliable source of power for growing Victorian industry.

Hartnell's patent governor



Wilson Hartnell patented his governor in 1871. At that time, the most reliable and efficient device to regulate the speed of steam engines was that invented by James Watt. Both devices work on the principle of centrifugal force to regulate the flow of fuel to an engine to keep it running at a near constant speed.

A Watt governor consists of two rotating balls connected to arms, which are connected to a spindle. As the speed of the engine increases the force on the balls increases causing the arms to move outward. This reduces the throttle, and flow of fuel, thereby decreasing the speed of the engine.

There had been several improvements on the Watt design, but the Hartnell governor, which controlled the movement of the flyballs or weights by means of a spring, was very different. Smaller in size (later making it suitable for internal combustion engines), it was noted for improved sensitiveness and the power and ease of its regulation, which gave much better results than the previously used throttle valve and slower running heavy weight governors.



Two of the main exhibits at the Waterworks Museum, the 1895 Worth Mackenzie Triple Expansion Steam Engine and the 1906 twin cylinder engine of the same make, do not have governors of any sort.

This is why it is essential to have a competent engineer in Bays 6 & 7 at all times when the steam engines are running.

Hereford's waste destructor

The waste destructor in Barry at which the Wilson Hartnell dynamo operated was set up specifically to deal with the town's domestic and commercial waste. Relatively few were set up for this purpose. More common was for one to be part of an early system of electric lighting or, as in Hereford, as part of a system of sewage treatment. In these systems town waste was used as fuel for the boilers that generated the power for an electric lighting dynamo, and as a cheap and efficient boiler fuel.



FIG. 22.—MELDRUM'S "SIMPLEX" DESTRUCTOR AT HEREFORD, SHOWING SECTION OF GRATE BEING FIRED.

The most significant cost of operating a sewage works in 1899 was coal and the whole of this cost was saved when Hereford's City Engineer converted the boilers from coal-fired to incinerate town waste. However, this was not the only benefit.

One third of the city's waste was now disposed of in a far more sanitary manner, i.e. it was not sent to waste tips outside the City. In addition, the incineration residue from the destructor (clinker) could be crushed and screened to size for use in the filter beds that wastewater and sewage passed through before being returned to the river Wye.

Built between 1885-1890, the Sewage Treatment Works comprised of five precipitating tanks, night flow storage tanks, 6.5 acres of filter beds, sludge from which was compacted in filter presses and tipped for reuse.

A new interceptor sewer to gathered waste from nine existing sewers (each with its own discharge straight to the River Wye) and brought this to Eign where it was treated before being discharged to the river.

In 1899, City Engineer John Parker added the refuse burner, which delivered the benefits that are described above.