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Wind generated electricity – We have been here before

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A B S T R A C T

The long history of the attempts to harness the power of the wind to generate electricity from the late 19th Century to the present day is outlined. The article discusses the way that the filing of patents has reflected the waxing and waning of enthusiasm for this free, but challenging, resource and the commercial realities of trying to convert an unpredictable and sometimes violent energy source into an economically viable contributor to the world's energy needs. The author opines that the key to unravelling this dichotomy may lie in the successful development of alternative, improved methods of storing electricity.

1. Introduction

Wind powered sailing ships go back at least 5000 years while windmills for raising water, grinding grain etc. go back over a 1000. The development of the post mill was one of the major technical breakthroughs of the Middle Ages so, by the time the First Industrial Revolution began in the 1750's, wind power was a major energy source. Thereafter, industry increasingly used coal powered engines and, by the 1850's, engines had begun to replace wind in ship propulsion, but in 1880 wind power was still widely used.

2. Electricity

It is unclear who first thought of generating electricity by wind. In 1860 Moses Farmer allegedly patented a device to convert wind into electricity and a Belgian Professor, Francois Nollet may have done this in 1841 [1]. However, the independent development of effective incandescent light bulbs by Swan and Edison in 1881 led to a surge in demand for electric power generation machinery. In 1881 the famous physicist William Thompson (Lord Kelvin) pointed out that the supply of coal was finite and that wind powered electricity generation was a possible solution [2]. The development of reliable electrical batteries made storage of the generated electricity a feasible option. It was extensively discussed e.g. in *The Scientific American* in 1883 [3] which also considered various storage schemes some feasible, e.g. raising water to a reservoir, others which some might find bizarre, e.g. lifting weights, coiled springs etc!

3. James Blyth (1839–1906)

James Blyth was an electrical engineering Professor in Glasgow, Scotland, UK, who apparently built the first operative machine in 1887. He had three different turbines, one of which powered his holiday home in Marykirk for 25 years. It was said he offered the surplus electricity for lighting the village street but the villagers turned it down as they thought electricity was the" work of the devil!". He did file a patent in 1891 and licensed a firm of Glasgow engineers to exploit it [4]. They built only one, for use at a local asylum, which was abandoned after many years when the main vertical driving shaft broke. George Cadbury (founder of the famous chocolate firm) erected a similar one in England in the 1890's but discovered that the wind speed variability wore out the storage batteries very quickly.

4. Charles Brush (1849–1929)

Charles Brush was a successful electrical industry pioneer and, in 1887–88, he adapted a multiblade 60 ft high farm windmill to generate battery stored power for his estate in Cleveland, USA. Unlike Blyth's machine, it was automatic and had a braking control to prevent damage with strong winds. However he made no attempt at commercial exploitation; although he was normally very patent active allegedly he never filed a patent for this which speaks volumes. It operated for over 12 years till Brush decided to switch over to mains electricity [5].

5. Professor Poul La Cour (1846–1908)

Poul La Cour was known as the "Danish Edison" and began experimenting with wind generation in Denmark in 1891 [6]. The

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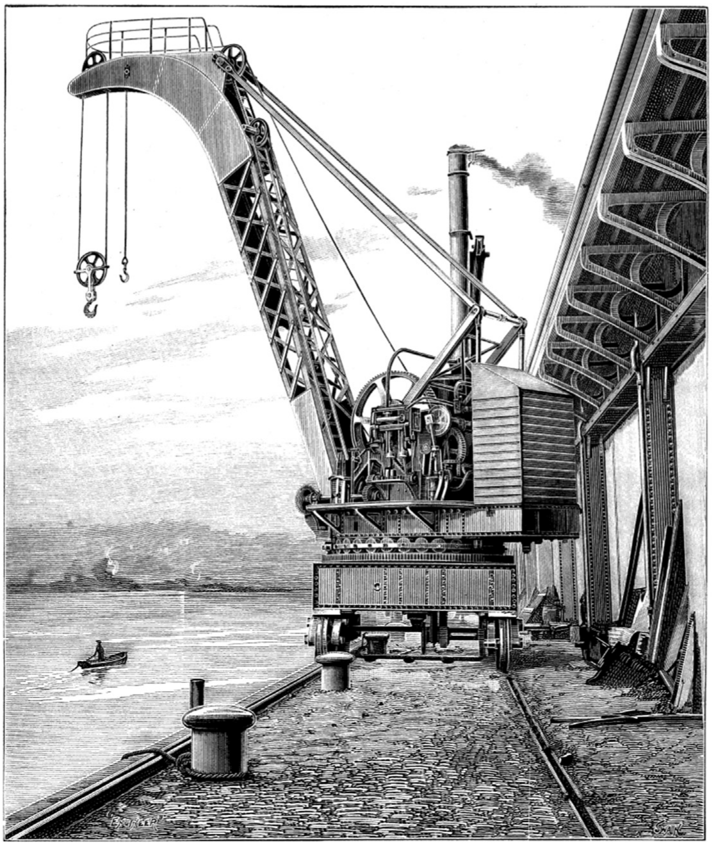
TWENTY-TON LOCOMOTIVE STEAM CRANE

MESSRS ALEXANDER CHAPLIN AND CO., GLASGOW, ENGINEERS



TWENTY-TON LOCOMOTIVE STEAM CRANE.

'HE above illustration represents a steam crane of the self-ropelling type, to be specially used for coaling purposes. It as recently been erected at the New Cessnock Docks, ilasgow, by Messrs. Alex. Chaplin and Co., for the service of ie well-known line of Transatlantic steamers of Messrs. ames and Alexander Allan.

The crane was tested with a load of 23 tons at a radius f 36ft., the height of the centre of the jib pulley being 51ft. bove the quay level, and it is thus one of the largest and iost powerful cranes of the kind yet constructed. The ifferent motions of hoisting, slewing round, and travelling, ave each a separate set of double-cylinder engines, thus voiding a complication of gearing and clutches. Steel wire opes are also used instead of chains, and the working is ius easy and as nearly noiseless as possible. A great part f the work of this crane is to be coaling the steamers, and or this purpose a second hoisting barrel is fitted and used for pping up the end of the wagons. This barrel may be used for 'orking light lifts when the crane is not in use for coaling. team is supplied from one vertical boiler, having cross ibes in the fire-box.

Messrs. Alex. Chaplin and Co. were among the earliest iakers—over thirty years ago—of portable steam cranes, and iis is one of the latest examples of their work in this branch 'hich they so long ago initiated.

ROLLASON'S WIND MOTOR.

WE recently had an opportunity of examining a new type f wind motor built by Rollason's Wind Motor Company, of erners-street, London. The motor has been designed to roduce motive power for electric lighting and other purposes, nd a specimen has been built and erected in a large field lose to Willesden Junction Station. A complete electrical istallation, consisting of dynamo, accumulators, and switch-oard, is installed in a wooden building at the base of the iotor, and the outward appearance of the plant is shown in 'ig. 1, which is taken from a photograph. The motor itself ; supported upon a light structure built of angle and tee :on, provided with a roof to cover the working parts. The escription naturally divides itself into two parts—firstly, hat dealing with the motor itself with its transmission haft and accessories; and, secondly, the electrical plant to 'hich motive power is supplied.

In designing the motor special care has been taken to iake it as stable as possible in order to avoid danger of ollapse in case of storms. The portion which receives otary motion from the pressure of the wind consists of five 'ooden vanes, each vane forming a segment of a tube of 'ery large diameter, and fixed so that it presents its concave urface to the direction of the wind. These vanes are fixed top and bottom to a five-armed star which is keyed to a vertical shaft. A space is left between the inner edge ot each vane and the shaft itself, in order to allow for escape of air, and so that the centre of pressure may be as far from the axis of rotation as possible. In the present case each vane is 20ft. high, and the chord of the arc of section is 7ft. long, while from the inner edge of the vane to the centre of the axis is 7ft. Each vane thus exposes a surface of 140 square feet, and it is assumed that two vanes are in action at the same time, so that a surface of 280 square feet is exposed to the action of the wind. The vanes themselves are protected by a movable shield which covers 120 deg. of the whole circumference, and this shield is caused to take up a suitable position by the directive action of the wind upon an arrow-shaped vane at the summit. Fig. 2 is a diagram showing the relative shapes and positions of the vanes and shield in plan. The wind acts upon vanes 1 and 2 and

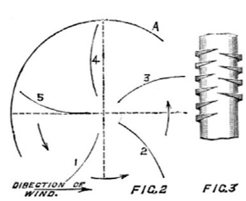
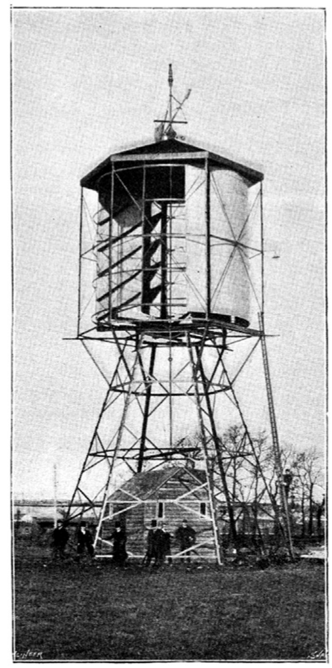


FIG.2 FIG.3

partially upon 3, while the space between the shield A and vane 3 allows for the escape of the air. It is claimed that, therefore, about one-half of the motor is under pressure, and the other half in a calm. The vertical shaft which supports the movable shield is independent of the shaft upon which the vanes are fixed. The whole of the bearings consist of rollers arranged similarly to those used in turntables, and the castings containing the rollers are bowl-shaped, and are filled with oil in order to diminish friction. The vertical shaft is connected by bevel gearing and a horizontal shaft, which transmits power to a shunt-wound dynamo by means of belting. This dynamo is by the Electric Construction Corporation, and developes 65 volts and 35 ampères when running at a speed of 510 revolutions per minute. The dynamo is used for charging a set of accumulators, consisting of 26 E.P.S. cells of the K 15 type in teak boxes. The rest of the mechanism consists of automatic apparatus arranged with the view of making it possible to leave the motor unattended during considerable periods. The same difficulty has been met with as is always found in train lighting by electricity, owing to the varying speed of the dynamo. Large sums have been spent upon automatic apparatus for train lighting; it is, therefore, of interest to examine the method used in the present case. In a direct line with the armature shaft, and connected rigidly to it, is a light shaft provided with a centrifugal governor, which is made to control a double-armed switch, which travels over a series of contacts similar to those of the ordinary charge and discharge switch. With this apparatus it is considered that it will be possible to switch cells in or out according to the pressure produced by the dynamo. We now come to the case in which the cells are being charged, and it is desired to stop the dynamo automatically after a complete charging. This apparatus is somewhat complicated, and although ingenious, we fear it will be liable to get out of order.

The whole control is obtained from the rise and fall of an ordinary hydrometer in the electrolyte, a movement due of course tc the changing specific gravity of the liquid as the process of charging proceeds. As soon as the liquid attains its greatest density the hydrometer rises and closes a small contact, which permits a current to pass through a relay and releases a switch, breaking the circuit through the relay and actuating a clutch which puts clockwork into motion. This clockwork may be set to run for two, three, or four hours as desired, and during that time the



ROLLASON'S WIND MOTOR

cells are still receiving a charge so as to cause thorough boiling. At the close of this period, when it is desirable to cease charging altogether, the clockwork actuates a switch which permits a current to pass into an electro-magnet controlling the belt fork gear. The belt gear is an ingenious contrivance, and has a right and left-handed interrupted or mangle screw. Over one half of the superficies of the screw spindle the left hand pitch predominates, and over the other half the right-hand thread, while upon two lines parallel with the axis there is no thread, as indicated in Fig. 3. Of course, in cutting one thread the other is partially cut away, and the portions of threads end in sharp points. At each side of the screw, which is driven by belting, is placed a half nut normally out of gear with the screw, but put into gear suddenly by the action of one or other of two electro-magnets. To return to the clockwork for a moment, we observed that it causes a circuit to be closed when the cell charging is completed, the current then passes through one of the electro-magnets, and by means of the double-threaded screw the belt fork moves the dynamo belt on to a loose pulley, thus leaving the wind motor itself perfectly free to rotate without doing any work. If power is being taken from the cells the density of the electrolyte will fall, and finally the hydrometer will close a lower contact which causes the belt to be put again upon the fast pulley and the dynamo to be restarted. The whole apparatus is theoretically perfect, but we are much afraid that the delicacy of the parts will lead to trouble. Messrs. Rollason, however, are upon the right track, and if they can devise a simpler mechanism should succeed. It must always be remembered that for such a wind motor and electrical plant to be of use it must be simple enough to be attended to by a gardener. If a skilled mechanic or electrician is needed it will much diminish its chances of usefulness. We hope to have an opportunity on a future occasion of describing the details more fully with the aid of illustrations, and it must be remembered that the plant we examined was the first built by the company, and therefore somewhat crude. We are informed that Messrs. Edmundsons, of Great George-street, Westminster, have carried out the whole of the electrical work required. There should be great scope for a successful and really trustworthy wind motor for electrical purposes, and we understand that a number of orders has already been received by the company, which is about to start works close to Willesden Junction station, where it will manufacture the complete plants.

Fig. 1. Rollason's Wind Motor, published here with the kind permission of the Editor of 'The Engineer'.