Gibson's Steam Turbine Engine.

It is an interesting fact that the "turbine" steam engine which is engaging the attention of the engineers of ocean liners and naval authorities of this and other countries, and bids fair to revolutionize the application of steam power on land and sea in the not distant future, was the subject of discussion and practical experiment in this city thirty-four years ago. While it was known by a different name—"the Centrifugal Rotary Steam Engine"—the principle on which the machine was designated was practically the same as the more modern invention, and the claims made for it by the Lancaster inventor and promoters were set forth in almost the identical language now used by the advocates of the "turbine," viz.: "Three points in regard to this engine have been demonstrated (December, 1870): First, the economy of steam necessary; secondly, the economy of space requisite to accommodate, and, thirdly, its extraordinary power."

Samuel Gibson, a young man of Safe Harbor, if my memory is not at fault, at one time connected with the iron works at that place,by long study and a series of experiments had so far developed his ideas as to put his invention to a practical test. He made an arrangement with the late William Diller, then proprietor of the Water Street Machine Shops, to build an engine from the specifications he had prepared. His patent having not then been granted, and desirous of guarding his secret in the meantime, Mr. Diller had fitted up a private room in the rear of his shops, where

the engine was erected, and the experiments conducted in the presence of Hon. A. L. Hayes, Hon. O. J. Dickey, Postmaster H. W. Hager and Charles E. Hager, of the firm of Hager Bros., who, or some of whom, I think, had a direct interest in the enterprise. Being on intimate terms with Mr. Diller at the time, I was invited to witness some of these experiments, and was present at the one preceding the final and fatal test. This was in September, and it impressed all present as promising to realize the expectation of the inventor and promoters. Mr. Gibson, however, was not satisfied. He said the machine was not properly balanced, and other improvements suggested themselves to his mechanical mind. So further tests were postponed until the alterations were completed. The fact that the engine had run two lathes with marked economy of steam left no doubt that Mr. Gibson had struck the correct principle of steam application, and that it would, when perfected, be a complete success.

Judge Hayes, besides being a learned Jurist and a man of more than ordinary literary culture, was well versed in scientific and mechanical topics. After this test he wrote the following article for the Express, which first brought the invention before the public, and which I reproduce as justifying what I have just said of the Judge's knowledge of mechanics and his faith in the ultimate success of the rotary or turbine application of steam power:

"Gibson's Rotary Steam Engine.

"Among the labor-saving appliances which human ingenuity has invented the steam engine holds the first rank. Such is the extraordinary force concentrated by these engines that, under the management of one man, a single

machine is made to exert a power equal to the strength of several hundred horses. The power of the steam engine has been utilized in various modes to the incalculable benefit of mankind. The wonderful increase of trade and commerce, and the astonishing growth of cities, within the last thirty years, are chiefly owing to this invention. It has improved the means of transportation to such an extent as in a great measure to have superseded the old modes of conveyance both by sea and land. It has been brought to the aid of a great many mechanical and manufacturing operations, by which their productions have been augmented beyond all calculation.

"In the construction of these machines, their requisite strength and their transmission of power demand a great amount of heavy material, and the consumption of much of the force in overcoming the friction incident to the working of the machinery; which two causes involve the disadvantages of immense weight, considerable space, and a loss of power. An indispensable part of the machinery of a piston engine is the fly-wheel, which, turned by a crank, has two dead points in its revolution, where the crank exerts no force and beyond which the wheel is carried by its previously acquired impetus. The movement of the piston and wheel necessarily produces enormous friction, jar and concussion, which shake the largest factories and steamships in which these engines are placed.

"The construction of an engine which could dispense with these two movements of the piston and fly-wheel, and thus relieve the operation of the weight, the concussion and the friction, has long been a desideratum. Lives have been spent in this effort to

invent an engine by which steam would act directly on the wheel communicating the power, and the patent office exhibits many hundred instances of failures in the attempt. It has been reserved for one of our own mechanics to achieve success in this extraordinary and inestimable invention. Samuel Gibson, of Safe Harbor, starting from the true principle, the reactionary machine of Hero of Alexandria, described one hundred years before the Christian era, has by long study and a series of experiments invented a centrifugal rotary steam engine which, for economy of power, material and space, exceeds anything ever presented to the public. The simplicity of its action, its exemption from friction, its force, as shown by the velocity of its revolutions, are such as commended it at once to the examiners and commissioners of patents of the United States, and a patent was allowed and granted to him immediately upon his application and the exhibition of his working model.

"In the working of this engine there is no jar; the space required for one of these engines of considerable power will be small; and the construction is so simple and yet so strong, so free from friction that it is not liable to get out of order. The weight as well as the bulk is so inconsiderable that it may be adapted, by varying the and household purposes, to which it has not heretofore been supposed that a steam engine could be applied. Some one, in looking at its movements, remarked that it would hereafter become a household drudge. There seems, indeed, to be no limit to its utility, for it may be adapted by varying the size, to the lightest work, as well as that requiring the greatest amount of power—from the grinding of a coffee mill to the propelling of an ocean steamer.

"Mr. Gibson is preparing for exhibition at the coming fair an engine of several horse power, with its boiler attached, when the public will be gratified by a sight of this admirable invention in actual operation.

"It is intended to establish a manufactory of these engines in this city, numerous orders for them having already been received. L."

Final Experiment Ends in Tragedy!

Mr. Gibson did not get his alterations to the engine completed until the early part of December, when he and Mr. Diller were confident they had it perfected, and those interested were invited to witness a test on Saturday evening, December 10, 1870, between 7 and 8 o'clock. There were present Hon. A. L. Hayes, Hon. O. J. Dickey, Postmaster Harry Hager and son, Chas. E. Hager, of the firm of Hager Brothers, Mr. Gibson, Mr. Diller, his engineer, and the machinists who had worked on the machine, eight or ten persons in all, in a room 12 by 14 feet square. The writer had been invited to witness this test, but was unexpectedly detained at the office. After the engine had been running fifteen or twenty minutes, attaining a great velocity, so great that Mr. Dickey remarking he did not hink it safe, himself and others stepped back a few paces, which doubtless saved them from injury, for a minute later the revolving wheel burst with a loud report, breaking the solid rim of the engine, and hurling the fragments with great violence. Mr. Diller, who was holding a light, was knocked down and the light extinguished. Another light was procured, when it was found Mr. Diller had his right leg broken and Mr. Gibson was struck by a fragment on the forehead which had rebounded from the ceiling, cutting a

gash in to the bone. He was also struck on the instep and knocked down. He was able to visit the scene of the accident the next day, but Mr. Diller never fully recovered, dying about a year later (January 16, 1872). It was regarded as a remarkable fact that all present, except Mr. Diller and Mr. Gibson, escaped entirely. Judge Hayes attributed it to "the providential circumstance that the parts of the wheel which first gave way broke at the instant they were turning from the zenith to the east (the wheel was vertical and ranged east and west), the heaviest fragments having struck the east wall when the bystanders were on the west and south side of the engine."

The Rotary Principle Not at Fault.

Whatever effect this accident may have had upon the promoters of the enterprise, it did not cause Judge Hayes to change his opinion or lose faith in the ultimate success of the principle on which Mr. Gibson had been working, and which now, after thirty-four years, is being practically revived with the endorsement of eminent land and marine engineers, thus verifying his prediction that it might be adapted to "propelling an ocean steamer." A day or two after the accident he wrote the following explanation of the cause of the accident and the construction of the engine. It is as interesting, from a mechanical point of view, as his first article in which he brought the Gibson engine to the attention of the public:

"As there is some misconception relative to the cause of the accident on Saturday evening, it may be proper to explain that there was no explosion of steam. In fact, the steam was shut off at the very instant of the bursting of the wheel, the engineer having his hand on the register of the steam

valve at the time. Not more than one-quarter of the quantity of the steam that the pipe would pass was allowed to enter the machine; and none of the party present perceived any steam in the room after the engine exploded. The sole cause of the accident was the strain of the centrifugal motion, which was too strong for the revolving wheel, which, after it had been cast, had been incautiously weakened by cutting series of rectangular buttresses into its circumference to receive the impact of the escape steam and by perforating the same circumference with several apertures on one side to balance the wheel. This wheel was cast in two parts, containing, when put together, four curved arms in the form of a double S, two of these arms having a double groove or channel, through which the steam rushed from the centre to the circumference, at opposite points; there, issuing against a series of buttresses in an exterior fixed circle, and by its reactionary force, causing the wheel to revolve with great velocity. It was this centrifugal force, increased incalculably on this occasion, which burst the wheel when the tendency from the centre of or strain became greater than the reduced power of cohesion; the steam had nothing to do with it except in giving impetus to the revolution. Weakened as the wheel was, had there been the gearing which was some days before attached to it, running two lathes belted up and down to and from the shaft, by which the speed of the wheel was diminished more than one-half, it would not have parted. Mr. Diller has an emery wheel which revolves 3,400 times in a minute, and he is of the opinion that the pulley on the countershaft on the centrifugal rotary engine, was, on Saturday evening, driven at twice that velocity. There are two methods of

guarding against a recurrence of a similar accident; one is by having the engine well loaded while in motion; the other by increasing the strength of the revolving wheel, using for that purpose metal of greater tenacity; or casting the wheel solid.

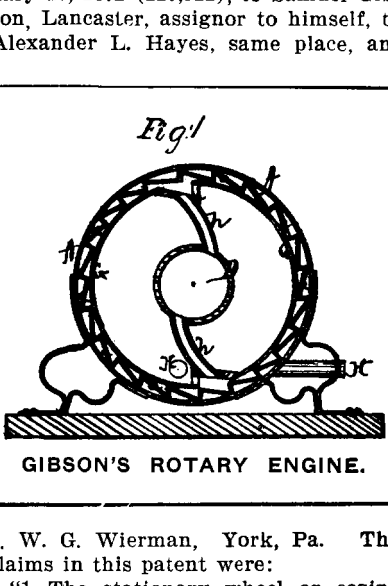
"Three points in regard to this engine have been demonstrated by the experiments: First, the economy of steam necessary; secondly, the economy of space necessary to accommodate it; and, thirdly, its extraordinary power. L."

This was the sad ending of a notable Lancaster invention that was launched with high hopes of its inventor and promoters. This is why a Gibson engine was not exhibited at the county fair, and why a factory for building them was not established. I can find no record of the future movements of the inventor or the promoters of the enterprise; but my recollection is that the accident to Mr. Diller,which caused a great shock to the community, and the narrow escape of the others interested, prevented Mr. Gibson from raising the necessary capital to continue his work, all except himself and Judge Hayes having lost faith in its success, as well as the community at large; in fact, I well remember it having been spoken of as "Gibson's folly!" and Mr. Gibson had no capital of his own to invest in the enterprise.

We are indebted to Col. D. H. Herr, the Lancaster patent attorney, for the courtesy of looking up the details of the Gibson patents in his files of the patent office reports, which he has complete from the beginning. His first patent for "Rotary Engine" (108,-016) was issued October 4, 1870, "to Samuel Gibson, Lancaster, assignor to himself and J.W.G.Wierman,York, Pa." The claim was as follows: "The com-

bination of the wheel E, with its casing d, and buckets a, a, stationary steam tubes b, b, and heads d, d, all constructed and arranged substantially as and for the purposes herein set forth." The accompanying illustration shows a front view of the engine, with steam pipes connecting it with vertical boiler.

A second patent was granted, January 10, 1871 (110,912), to Samuel Gibson, Lancaster, assignor to himself, to Alexander L. Hayes, same place, and



GIBSON'S ROTARY ENGINE.

J. W. G. Wierman, York, Pa. The claims in this patent were:

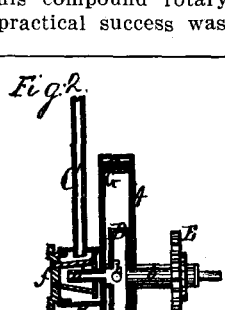
"1. The stationary wheel or casing A, provided with a series of buckets a, a, extending around its entire inside circumference, in combination with the inner revolving wheel G, provided with two buckets, i, i, all constructed and operating substantially as and for the purposes herein set forth.

"2. The combination of the outer stationary wheel A, with buckets a, a, steam chest B, box D, journals b, d, disk e, arms h, h, inner revolving wheel G, buckets i, i, and outlet or exhaust pipe H, all constructed and ar-

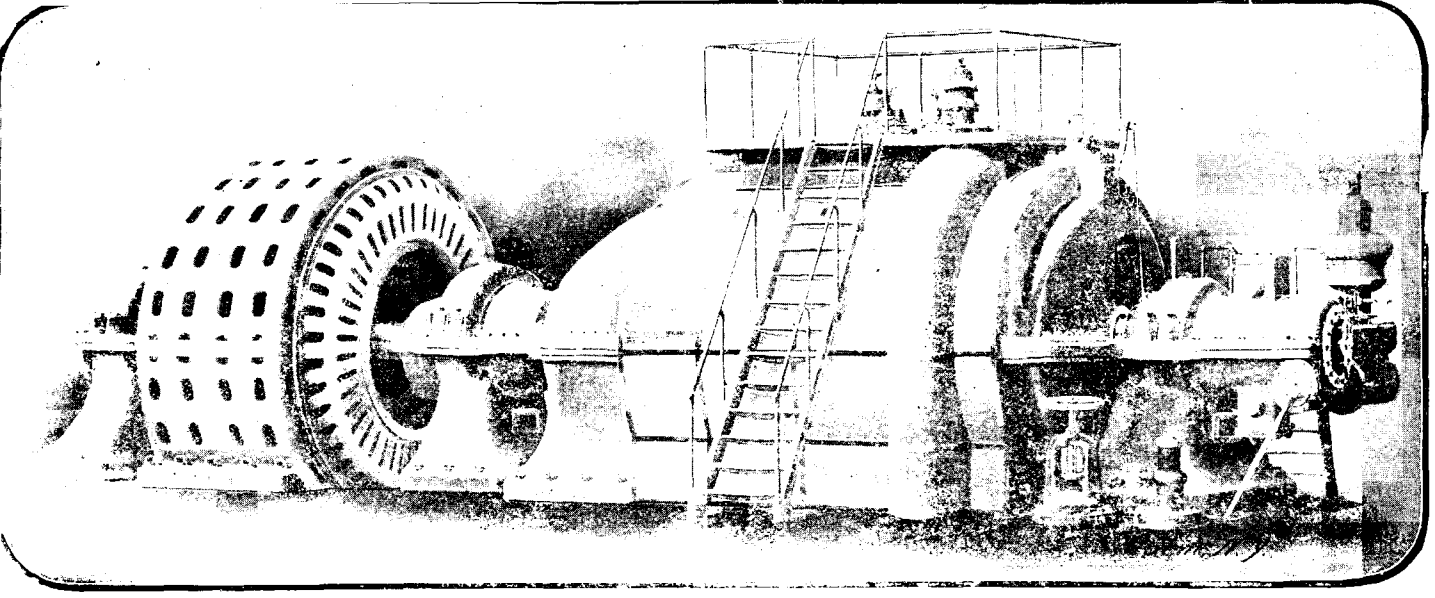
ranged to operate substantially as and for the purposes herein set forth. The accompanying illustrations show a front and side view of the engine without boiler or connecting steam pipes."

Final Success of the Turbine.

Although other patents had been issued and various experiments made during the succeeding fifteen years, on the line of the vertical steam rotary engine on which Gibson had worked, it was not until 1884, wnen Parsons developed his compound rotary engine, that its practical success was demonstrated. While there are several others operating on this principle, this is the type most generally in favor. The American patent for land service is controlled by the Westinghouse Electric Company, who have a plant of three units successfully operating in their works, which displaced plants of the old-style reciprocating engines. A series of elaborate tests demonstrated their great economy and especially their adaptation for furnishing power in the generation of



GIBSON'S ROTARY ENGINE.



11,000 HORSE-POWER TURBO-GENERATOR OF LATEST TYPE.

By Courtesy of the Scientific American.

electricity. It is notable that the claims made for economy in fuel, space occupied, weight and cost of material, absence of vibration, maximum of speed with minimum of liability to accident, as claimed by engineers who have written on the subject, are couched in almost the identical language used by Judge Hayes in presenting the claims of the Gibson engine thirty-four years ago.

During the past twenty years the rotary or "turbine" principle has steadily gained in the favor of the engineering profession. In 1901, Mr. Parsons, of the Turbinia Works, England, wrote that the power of turbines manufactured by that firm, for electrical purposes, exceeded 140,000 horse power, and that the two formidable torpedo boat destroyers, then fitted with these turbine engines, "can outstrip by many knots any other destroyers in the world, in smooth or heavy weather, and their complete absence from vibration at all speeds permits of an accurate sighting of guns and torpedoes, impossible with similar vessels propelled oy reciprocating engines." And he claimed that "steam turbines are quite as readily designed for battleships, cruisers, Atlantic liners, and all fast passenger vessels, and in such vessels will, in my opinion, give results as regards coal consumption at all speeds superior to those obtained with reciprocating engines," concluding with the prediction that "as the turbine in England and at Elberfield has surpassed in economy of steam the best triple expansion reciprocating engines, so in marine work the steam turbine is destined to replace the reciprocating engine in all fast vessels from moderate up to the largest tonnage."

As further evidence of the progress the turbine principle has made since

Gibson's experiments a generation ago, the Westinghouse Works are now building several 11,000-horse-power turbo-generators for the Pennsylvania Railroad tunnel from Jersey City to Long Island. They will furnish power for operating with electric locomotives the heavy Pullman trains which will enter the terminal station from the West. Three units are also in progress of construction at the same works for the Philadelphia Rapid Transit Subway system; also, eight units, aggregating 88,000-horse-power, which will furnish power for operating the London Underground system, while three 5,000-horse-power turbines are under construction for the street railway system of the same city.

At the time, two years ago, when the Scientific American illustrates the large 12,000-horse-power cross compound reciprocating engines of the Manhattan Elevated central power station, in New York city, we stated that probably these were the last engines of their size and kind that would be built for electric generation. If the great turbo herewith illustrated shows, as it undoubtedly will, the same and even higher economy than have been realized in the smaller units, it will undoubtedly become the future drive for electric power stations the world over.

And now comes the announcement in the New York Herald that the decision of the Cunard Company to use turbine engines in their new twenty-five-knot ships is the most decisive step yet taken towards the triumphs of the turbine, and thus again we make a revolution in the steam industries of the world.

Who knows what Lancaster lost in her industrial growth by the accident which interrupted Gibson's experiments! G.

Author: Geist, J. M. W. (Jacob Miller Willis), 1824-1905.

Title: Gibson's steam turbine engine / by J. M. Geist.

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