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Improved Turbine Wheel.

Turbine wheels have been made to give out more power, in proportion to the water used, than the best over-shot or breast wheels under any circumstances. The conditions, however, under which those results were obtained, were in every possible way the most favorable. The most indispensable conditions are a gate ,wide open, and a load just adapted to the wheel. In no other way have high results been obtained. If the gate is opened only enough to use one-half the capacity of the wheel, or if by reason of drouth, or a severe frost in winter, the supply of water is reduced in proportion, the power is greatly reduced, and the more the gate is shut the worse the result in proportion to the water used. Hence these wheels are only adapted to constant streams of water. The contrary is the case with bucket wheels, the breast, and overshot. These motors can be overloaded with work and water, or water without work. Turbines cannot be overloaded with water, though they can be with work. The less water is applied to bucket wheels the more work in proportion. In fact, they are contraries in every thing, except that both give good results, if properly used. Turbines give just as good results under water as out of it. Bucket wheels give good results only out of water. It is claimed that the turbine here illustrated has the most essential advantages of the turbines heretofore designed, and also of the best bucket wheels in use, viz: they will run equally well in or out of water; consequently back water does not trouble them, except to reduce the head of water. They economize any stream of water, however small, in time of drouth, as well as any bucket wheel ever made. In fact, no advantage can be named in other wheels which is not found in this. It is claimed to be the best made and most durable wheel in the market, and can be regulated with the ease and quickness of a Corliss engine. The step never gets out of order, and it is less liable to obstructions by leaves, or anchor ice, than any other turbine. These wheels are set in iron or wood flumes, according to locality or choice of purchaser. The illustrations shows the wheel ready for use, and also the details. The details are as follows:

The perspective views, Figs. 1 and 2, show the external arrangement for raising the gate. This is a worm wheel, A, carried in suitable bearings, working a wheel, B, on the shaft of which there is a pinion, C, gearing into a rack, D, on the end of the gate rod, E, which passes through the stuffing box, F. The wheel and gate are contained in the case, G, and are shown in detail in the engravings below the principal ones. In these, Fig. 3 shows the wheel chamber, H, with the step, I, and gate, J, in place. The latter, it will be seen, surrounds the gate chamber and has 3 guides which keep it straight and true while rising. The wheel and cover are shown in Fig. 4, and the annular space, K, is allowed for the ends of the gate guides to rise into. In Fig. 5, the wheel is shown, as also the slots, L, through which the gate guides, L, (Fig. 6) pass; the lower band is removed in order to illustrate the form of the back as nearly as possible.

The operation of the turbine is as follows:—the

Fig. 2

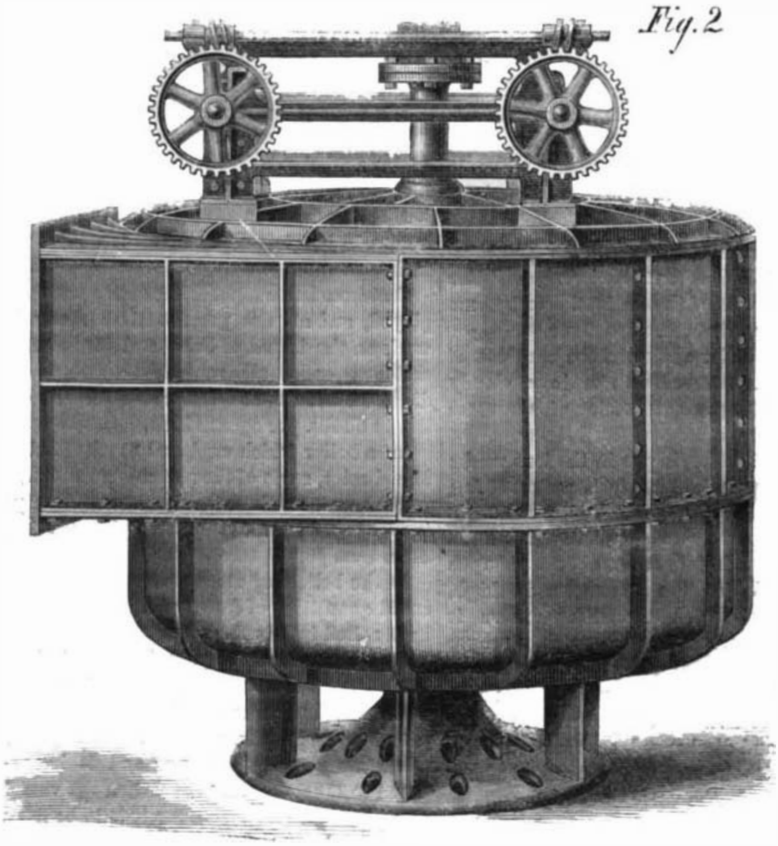
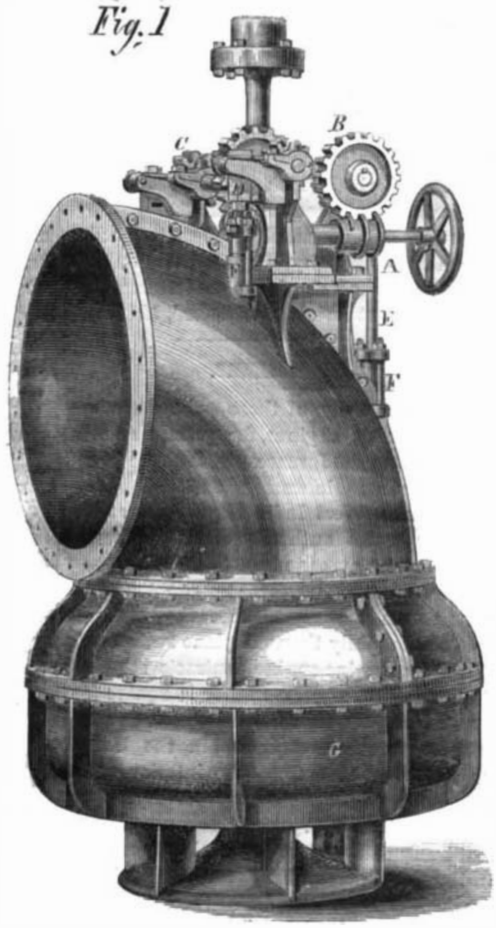
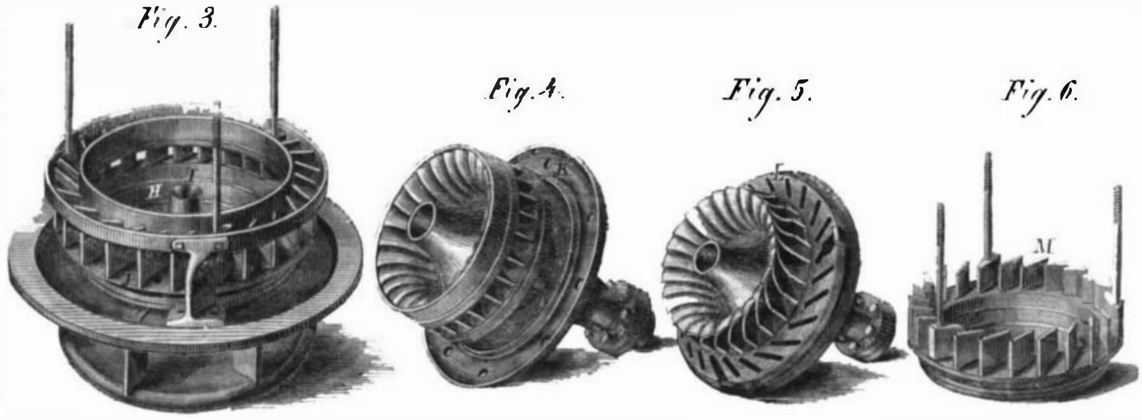


Fig. 1



SWAIN'S TURBINE WHEEL.

Fig. 3. Fig. 4. Fig. 5. Fig. 6.



flume, A, containing the turbine, is supposed to be kept constantly filled with water, in such mass as to maintain an equal pressure upon all sides, and in every chute of the gate, E. Now turn the wheel, A, to the left, and the gate, E, with guides, G G, will be moved downward, out of and from the slotted chamber, H, thus making a small but perfectly contracted opening all around the wheel; the water thus impinging on the float, Q, at its top edge, and immediately under the upperrim, P, of the wheel, K. Now if this thin stream or streams of water could pass vertically down, after the first impulse, no more power would be taken from the water. To prevent this loss of power the floats, G G, are carried backward so as to receive the water in its downward passage, continually changing its direction from a horizontal to a vertical motion, at the point of leaving the float. It will be perceived that the direction of the floats is very gradually and gently changed from a vertical to nearly a horizontal direction. The direction of the water is changed in the same proportion, in the reverse direction. It will be perceived that, no matter whether the gate is wide open, or only the thickness of paper, there are at all points the same perfection of opening for the water to pass in the wheel. To shut off all water the wheel is turned toward the right, when the gate with its guides is drawn into and against the slotted chamber, with which it forms a water-joint, as perfect as the lathes can make it.

This invention was patented through the Scientific American Patent Agency, May 15, 1860. Further information can be obtained by addressing the Swain Turbine Co., at North Chelmsford, Mass.

NOTES ON BOILERS.

The current testimony of those who have employed fans or blowing engines, for promoting combustion in steam engine furnaces, is, that the forced draft causes a considerable waste of coal.

The boilers of the West India Royal Mail steamships, according to the authority of Mr. Pitcher, of Northfleet, last on an average but six years.

The old notion that the three-legged tea-kettle boiled soonest was correct, because the legs conducted heat more rapidly than the plane surface.

The Admiralty marine-engine contracts stipulate for ·68 of a square foot of grate and for 18 square feet of heating surface per nominal horse-power.

Gum catechu is extensively used in the United States for removing scale from the interior of locomotive boilers. It is found not to injure the boiler or tubes in the least.

The heat-transmitting power of boiler tubes has been considerably increased by cutting their exterior surfaces into ridges like screw threads.

The boilers of several of the Collins mail steamships had two grates superposed, one above the other, in the same furnace. [So have a dozen other American ships to-day.—EDS. SCI. AM.]

The Giffard injector will commence working, throwing a jet of water into a locomotive boiler, when the pressure of steam is so low as to be incapable of blowing the whistle. It will often start when the steam-gage pointer stands at zero, although, of course, in such case, the gage cannot be correct in its indications. Few high-pressure gages, indeed, can be depended upon, to a pound or so, at the commencement of the scale.

Many American locomotives have iron tube plates $\frac{5}{16}$-inch and, in some cases, only $\frac{1}{4}$-inch thick at the fire box end, cast-iron ferrules being used. No ferrules are ever used at the smoke-box ends of the tubes in American engines.

Boilers are often worked at a saltness of four thirty-thirds, or at twice the density commonly regarded as safe.

Feed-water heating apparatus has been suddenly and violently collapsed on the sudden admission of cold water while the exhaust steam was passing through.

Professor Miller has stated that water, entirely deprived of air, may be heated in the open air to 360 deg. before boiling, and that ebullition is then explosive.

The late Mr. J. U. Rastrick once cast some iron cylinders 8 feet in diameter and 8 feet long, wherewith to construct a cast-iron high-pressure steam boiler. After a thunder storm these cylinders cracked, with a loud report, from end to end. Mr. Rastrick was disposed to attribute this result to the fact that the castings were made, without mixture, from a single brand of iron, and he afterward cast similar cylinders from mixed irons, and with complete success.

The whole ordinary pressure upon all the internal surfaces of a locomotive boiler of the largest class (including the tubes) is about 15,000 tuns.

In some experiments recorded in Mr. D. K. Clark's "Recent Practice," it appeared that a single-riveted seam in $\frac{1}{2}$-inch plates was only 40 per cent as strong as the whole plate, or 20 per cent as strong as a solid plate 1 inch thick; a similar seam of $\frac{7}{16}$-inch plate was 50 per cent as strong as the whole plate, or nearly 22 per cent as strong as a solid plate 1 inch thick, while a similar seam of $\frac{3}{8}$-inch iron had 60 per cent of the strength of the whole plate, or $22\frac{1}{2}$ per cent of the strength of a solid 1-inch plate, the $\frac{3}{8}$-inch iron, when riveted, being actually stronger than $\frac{1}{2}$-inch iron similarly riveted!

Messrs. Beyer, Peacock & Co., frequently weld the longitudinal seams of their locomotive boilers.

The earlier Cunard steamships, with the exception of the *Persia* and *Arabia*, have flue boilers. These boilers have lasted ten years.

Hydrogen gas, the presence of which has been so often suggested in boiler explosions, is not explosive, and, by itself, it is absolutely uninflammable. It can only burn silently when allowed to mix gradually with oxygen, and can only explode when it has been previously mixed with nine times its weight of oxygen.

In the experience of the officers of the Manchester Association for the Prevention of Steam Boiler Explosions, one boiler in eight is found to become defective, every year, from corrosion alone.

In several cases of boiler explosion the contents of the boiler have been observed to rise in a cloudy mist, showing the minute subdivision of the water by the disengagement of its contained steam.

Some of the largest boilers in use in the iron works in Staffordshire are vertical, 10 feet in diameter, 30 feet high, and have a 4 feet flue from top to bottom.

The pressure of the air upon the safety valves of steam boilers varies with the pressure of the air upon all other objects. When the barometer is high, therefore, a boiler, of which the safety valve is weighed to a given pressure, will work stronger steam than when the atmospheric pressure is lower.

In a locomotive boiler fitted with one of Baillie's 12-inch safety valves, 80 cubic feet of water were evaporated in one hour, and discharged, as steam, through the safety valve without raising the pressure above 76 lbs. per square inch, the valve having been originally loaded to 64 lbs.

Glass gage tubes for steam boilers are seldom used in the United States. Gage cocks are still relied upon, and occasionally as many as seven are applied at different levels to a locomotive boiler. [An absurd statement; the *law* requires a glass gage to be on every boiler.—EDS. SCI. AM.]

Iron plates taken from a boiler which had exploded after fifteen years' use have been tested to a strength of 27 tuns per square inch.

A remarkable proportion of evaporation to the extent of heating surface employed was reported by Mr. Daniel Gooch, in 1845. The engine *Ixion*, having 97 square feet of fire-box surface and 135 tubes, 2-inch diameter and 10 feet 3 inches long, presenting 724 square feet of exterior surface, evaporated $200\frac{1}{2}$ cubic feet of water per hour. This is about twice the usual evaporation per unit of heating surface.

Many of the cylindrical boilers employed in Cornwall weigh one tun for each cubic foot of water evaporated per hour; a boiler working up to 100 indicated horse-power (evaporating 50 cubic feet hourly) weighing 50 tuns.

The steam jet was applied by Mr. Goldsworthy Gurney, in 1824, to increase the draft in steamboat chimneys. In 1826, Mr. Gurney applied the jet to increase the draft in the chimney of his road locomotive. Trevithick had discharged the waste steam up the chimney of his locomotive (but not as a jet) as early as 1804.

Boiler scale has been successfully removed in the following manner:—One door of the boiler is taken off. A steam pipe containing highly superheated steam is introduced; the steam acting upon the saline deposit on the surface of the tubes, and other parts of the boiler, expands and disengages it from the several parts. After this the boiler is again filled with water, and steam got up in the usual manner, and kept up for a few hours, and on afterward blowing off the boilers they are found to be as free from scale as when first made.

A "cup surface boiler," with an ingenious provision for securing the circulation of the water in the cups, was patented by Jacob Perkins in July, 1831. The cups were applied, as was stated. for the purpose of increasing the heating surface.

In the flue plates of American boilers internal flanges are turned on the plate for tubes as small as 5 inches in diameter—a test which only very tough iron would bear.

With large and heavily worked engines there is a disturbance of the pressure in the boiler at every stroke of the piston. A sensitive steam gage will always show this to be the case.

In many cases there is a sudden increase of pressure in steam boilers immediately after starting the engine. This occurs, no doubt, from the ascent of water upon some of the plates which have been heated beyond their proper temperature, as well as from the sudden conversion of water into steam by being raised in a divided state into intimate contact with steam already superheated.

The combustion chamber, as applied by Mr. McConnell and others to locomotive boilers, was patented June 2d, 1846, by Messrs. Stubbs & Grylls, of Llanelly, South Wales.

A boiler, 3 feet in diameter, with plates of $\frac{3}{8}$-inch iron, will burst at a pressure of 708 lbs. per square inch.

Cast-iron boilers were formerly extensively employed, and at the present time many boilers at work on the island of Cuba and elsewhere have flat cast-iron ends, although the boilers of 42-inch diameter are worked under a pressure of from 60 lbs. to 80 lbs. per square inch.

In a boiler which exploded at the Atlas Works, Manchester, some of the plates were afterwards found to have a strength no more than $4\frac{3}{4}$ tuns per square inch, the strength of the other plates being upward of 20 tuns per square inch.

In the boilers of steam fire engines in which only small quantities of feed water are carried, steam has been raised in less than four minutes.

Angle iron is not employed, either in France or in the United States, in the construction of locomotive boilers. [A mistake.—EDS.]

Iron tubes in steam vessels deteriorate very fast when the vessel is laid up; and it has been proposed to take out the tubes when the vessel is taken in, resetting them whenever it is to be got ready for sea.

The seventh division of James Watt's patent of 28th of April, 1784, describes a steam carriage intended probably for common roads. The boiler was to be of wood, strongly hooped to prevent bursting, and having an internal metal vessel containing the fire.

The application of felt to the outside of marine boilers has been sometimes found to accelerate their internal corrosion.

Not only is the resistance of tubes to collapse inversely as their length, but the resistance of cylindrical boilers to rupture from internal pressures bears some proportion, although contrary to that of their length. A cylindrical boiler, when subjected to gradually increasing pressure, yields first at the middle. It is believed by many that the strength of cylindrical boilers would be very considerably increased if hoops were shrunk at intervals around them.

As bearing upon the probability of steam boiler explosions by the admission of water upon heated iron, a simple experiment will show that the heat contained in a given mass of red-hot iron is insufficient to convert any part of its own weight of water into steam. A pint claret bottle may, when filled with cold water, be safely held in the hand while a red-hot poker is thrust into it. If care is taken to keep the hot iron from actual contact with the glass, the bottle will not be cracked, and there will be no disengagement of steam.

It is a somewhat remarkable fact that the boilers of sea-going steam vessels very seldom explode,