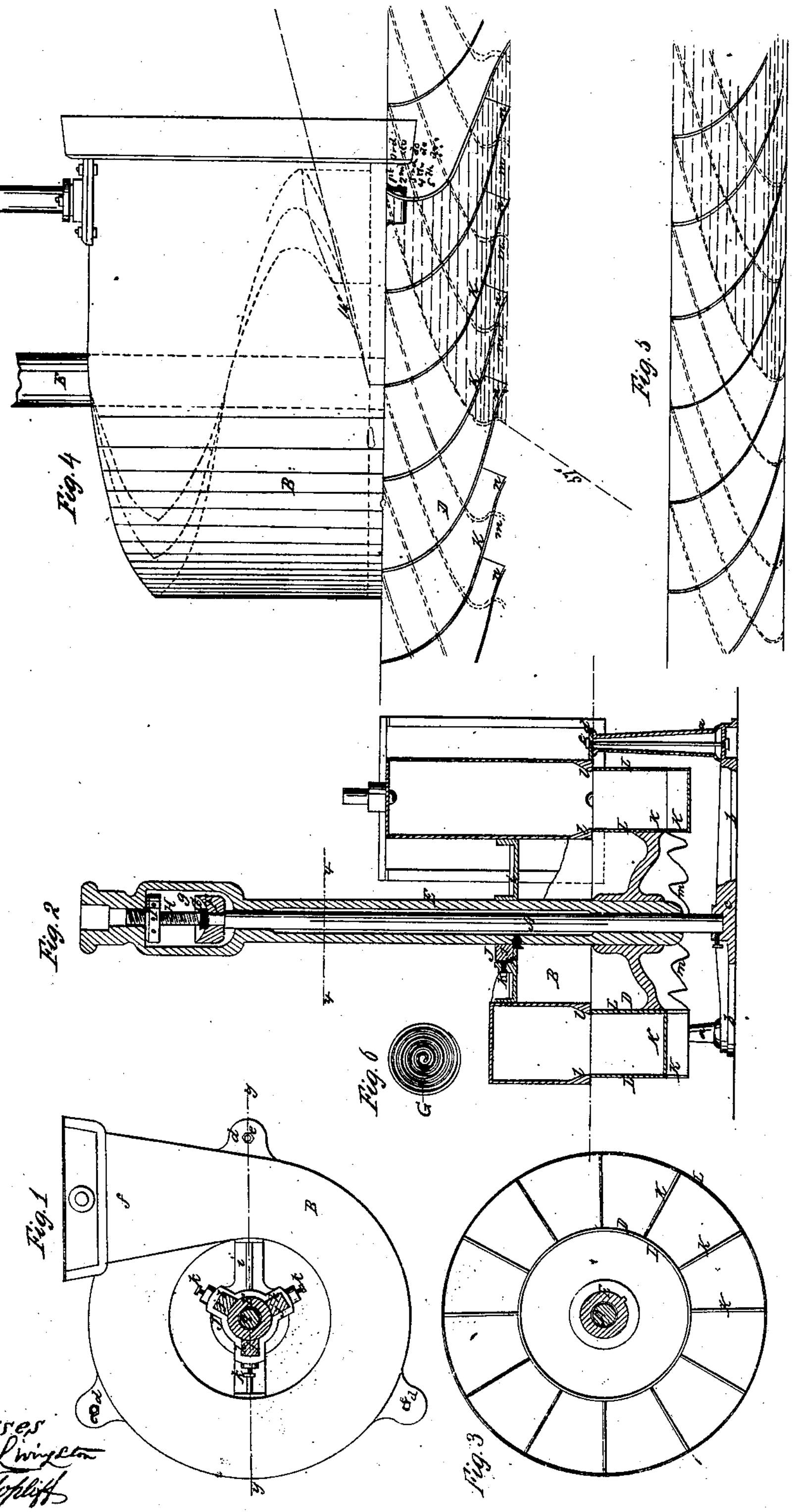
No. 48,737. PATENTED JULY 11, 1865.

J. E. STEVENSON.

WATER WHEEL.



Witnesses
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IMPROVEMENT IN WATER-WHEELS.

Specification forming part of Letters Patent No. 48,737, dated July 11, 1865.

To all whom it may concern:

Be it known that I, JAMES E. STEVENSON, of No. 200 Broadway, in the city, county, and State of New York, have invented a new and Improved Water-Wheel; and I do hereby declare that the following is a full, clear, and exact description thereof, which will enable others skilled in the art to make and use the same, reference being had to the accompanying drawings, forming part of this specification, in which—

Figure 1 is a plan or top view of the wheel and helix, the tubular shaft and spindle being in section, as indicated by the line *x x*, Fig. 2; Fig. 2, a vertical section of the wheel, helix, and shaft, taken in the line *y y*, Fig. 1; Fig. 3, a detached plan or top view of the wheel. Fig. 4 is a diagram of the wheel, the buckets being developed on a plane for the purpose of showing the passage of the water through the wheel; Fig. 5, a diagram of an ordinary wheel of the same class, drawn on the same plan, for the purpose of showing the difference between my improved wheel and one of the ordinary construction; Fig. 6, a detached and enlarged plan or top view of an improved step pertaining to my invention.

Similar letters of reference indicate like parts.

This invention relates to certain improvements in horizontal water-wheels of that class commonly termed "turbine wheels;" and it consists in a peculiar manner of constructing the buckets, and in the arrangement of the same, the manner of hanging the wheel, and in the construction of the step or bearing which supports the same, and also in the construction of the helix, all of which will be hereinafter fully shown and described, whereby it is believed that several advantages are obtained over the water-wheels of this class as previously constructed and a larger percentage of the power of the water obtained. The framing of the wheel may be composed of three uprights, *a a a*, secured at their lower ends to three radial bars, *b*, having a central hub, *c*, in which the lower end of a fixed upright spindle, A, is secured, as shown in Fig. 1.

B represents the helix, which is supported by the uprights *a*, the helix being provided with lips *d* at its lower edge, which are secured by bolts *e* to the uprights. This helix is of circular form in its horizontal section, a portion at the end which receives the water being tangential, as shown at *f* in Fig. 1, and of flaring form laterally. The helix, in its vertical section, is of spiral form, gradually decreasing in depth from its outer end or orifice to its inner end, as will be understood by referring to Fig. 2. The helix, at its orifice, is provided with a gate, which is hung on a vertical axis.

D represents the wheel, which is attached or keyed to a tubular shaft, E, in which the fixed spindle A is fitted closely, so that the former may turn freely on or around the latter. The tubular shaft E, near its upper end, is enlarged to form a chamber, *g*, to receive a socket, F, which is on the upper end of the spindle A, and in which a step, G, is placed to serve as a rest or bearing for the lower end of a screw, H, the upper part of which is connected with the tubular shaft E by means of a feather and groove, so as to cause the screw to turn with the tubular shaft and admit of the latter being raised and lowered independently of the screw or without communicating said movement to the screw. The screw H has a nut, I, upon it, on which the upper end of the chamber *g* rests and by which the weight of the wheel and tubular shaft is transmitted to the screw H and step G, and it will be seen that by turning the nut I the tubular shaft E and wheel D may be raised or lowered and adjusted vertically as desired, so as to keep the upper edge of the wheel as close to the bottom or lower edge of the helix as may be without causing undue friction. (See Fig. 2.)

The step G is constructed in a peculiar manner in order to insure perfect lubrication between it and the lower end of the screw H. It is composed of a piece of steel of flat or rectangular form in its transverse section and bent in coil or spiral shape, as shown in Fig. 6, so as to have its upper surface smooth or in one and the same plane, with a spiral groove extending from its center to its periphery. This spiral groove form a receptacle for oil and insures perfect lubrication for the lower end of screw H even if the whole surface of the bottom of H is in close contact with the upper surface of G. The ordinary solid steel steps frequently heat badly, on account of the spindle or shaft which rests upon them running so close in contact as to prevent the admission of oil between them, even if the socket F be well supplied and perfectly free from dirt and filth. This contingency is fully obviated by the spiral or coil shaped step G, and by the use of the tubular shaft E and fixed spindle A the step is above the surface of the water, never submerged, and, consequently, is always accessible both for repairs and lubrication.

The tubular shaft E is retained in a vertical position by means of a bearing, J, which is composed of three radial chambers, *h*, on a bar, *i*, which extends across the opening at the center of the helix, said chambers being provided with wooden keys *j*, which are regulated by set-screws *k*, as shown clearly in Fig. 1.

The helix B is of greater width than the buckets K of the wheel, as will be seen by referring to Fig. 2, and at the lower part of the helix and extending all around above the wheel there are beveled plates *l l*, one at each side, said plates gradually contracting the width of the helix to correspond to the width of the buckets, as clearly shown in Fig. 2. This enlargement of the helix laterally is a very important feature, for it is well known that water in passing through pipes is always retarded at the exterior of its column on account of friction produced by the contact of the column with the pipe, and that consequently the interior of the column of water will move faster than its exterior. It will be seen therefore that in all turbine wheels which have been hitherto constructed, all of which have their helices equal in width to their buckets, considerable power is lost in consequence of the retardation of the water in the helix by the friction produced by the contact of the former against the sides of the helix. My improvement effectually obviates this difficulty, for by the increased width of the helix over that of the buckets the column of water directly over the buckets and equal in width to them is not retarded by friction.

The buckets K of the wheel are between rims L L, the lower parts of which do not extend down to a common level with the lower ends or issues of the buckets, but are notched or have recesses, so that the lower parts of the buckets—say, a distance about one-third of their length—are fully exposed at each side, as shown by *m* in Figs. 2 and 3. By this means a free lateral discharge is allowed the water as it leaves the issues of the buckets. It is not obstructed, hemmed in, or confined in the least, as is the case with the ordinary wheels or those which have their rims *m m* extending down to a level with the issues of the buckets all around the wheel. The buckets K are of spiral form, and are curved slightly downward at their lower ends, as shown at *n* in Fig. 4. The giving of this slight curvature to the lower parts of the buckets, although it may seem trival at first blush, is attended with the most important result.

It is well known by experiments made with working wheels that the angle that the water forms with the bottom of the wheel in leaving it depends on the velocity of the wheel. If the latter be stationary the water will be discharged at an angle of about fifteen degrees with the horizontal line. If the wheel is running up to the velocity of the water, the latter will be discharged in a direction coinciding with the direction the wheel is turning and at the same angle that the water enters the wheel—fourteen degrees; and if the wheel is running at its working velocity, or seventy-two per cent. of the velocity of the water, the angle of discharge is found to be about fifty-seven degrees to the horizontal line in the direction the wheel is running. In consequence of the downward curve *u* at the lower parts of the buckets the discharge of the water is facilitated by giving or allowing it its natural direction on or a little before leaving the wheel, thereby reducing friction and producing a greater percentage of discharge by increasing the velocity, on the principle of water discharging through conically-divergent tubes, producing a greater ratio of useful effect, and also giving a greater power to the same-sized wheel over the old form of bucket.

To render the above clear, I will proceed to describe the path of a particle of water through one of my wheels, as follows:

Head and fall	16 feet.
External diameter of wheel	48 inches.
Average diameter	$39\frac{1}{4}$ inches.
Number of buckets	12
Area of discharge	220 sq. inches.
Discharge of all the buckets in cubic feet per second	48.94312
w=discharge of one bucket in cubic feet per second	4.07859
a=cubic feet in each division of buckets	0.05063
v=velocity in feet per second of wheel	22.9475
Velocity of discharge of water from wheel	80 per cent.
Length of first ordinate in feet	0.28486

$\frac{v}{w}a$=length of first ordinate=0.28486=x.

$2x$=length of second ordinate=0.5697

$3x$=length of third ordinate=0.8545

$4x$=length of fourth ordinate=1.1394

In order to describe the path of a particle or molecule of water passing through a wheel of this kind I have assumed the above head and fall, diameter of wheel, &c., and made my calculation from a wheel actually at work and moving at a velocity of seventy-two per cent. of the maximum velocity of water under the above specified head and fall on the average diameter of wheel equal thirty-nine and one-fourth inches, and the known actual discharge of wheel being eighty per cent. of its actual measurement of issues.

The diagram Fig. 4 is made on a scale of one and one-half inch to one foot, or one-eighth size, and the wheel being thirteen and one-half inches in depth, and the buckets shown developed on a plane, we divide this into as many equal parts or divisions, and the hypothesis assumed is that all the water contained in the wheel at the same distance from the center moves with the same velocity as regards its perpendicular descent through the wheel. Consequently, if we calculate the quantity of water contained in each division between two buckets, and knowing the velocity of the wheel in feet per second of time, by the above formula we determine the space the wheel passes through in one second, or in the time the water passes through one division, which we find to be 0.28486 feet, and by slipping off on each successive division of the wheel this distance a number of times corresponding with the divisions from a certain bucket, we trace the course of the water through the wheel.

In Fig. 5 the discharge of water from the ordinary wheel of the same dimensions is shown by the same formula, the difference being solely due to the curvature at the issues of the buckets of my improved wheel.

I claim as new and desire to secure by Letters Patent—

1. The curving of the lower parts of the buckets K of the wheel, substantially as and for the purpose herein set forth.

2. The exposing of the lower parts of the buckets by having the rims *m m* of the wheel at their lower ends cast or formed with recesses, substantially as described, to admit of a free lateral discharge of the water from the issues.

3. The spiral or coil-shaped step G, in connection with the tubular shaft E, fixed spindle A, and screw H, and with or without the bearing J, substantially as and for the purpose specified.

4. The laterally-enlarged helix B, provided with the beveled or inclined plates *l l*, or their equivalents, for the purpose set forth.

5. The employment or use of a screw, J, when applied to or used in connection with a wheel provided with a tubular shaft and a helix in such a manner that the joint or space between the wheel and helix may be regulated as occasion may require.

6. The combination of the wheel D, provided with the buckets curved at their lower ends or issues and laterally exposed, the tubular shaft E, fixed spindle F, screw H, and bearing J, all arranged substantially as described.

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