No. 646,713. Patented Apr. 3, 1900.

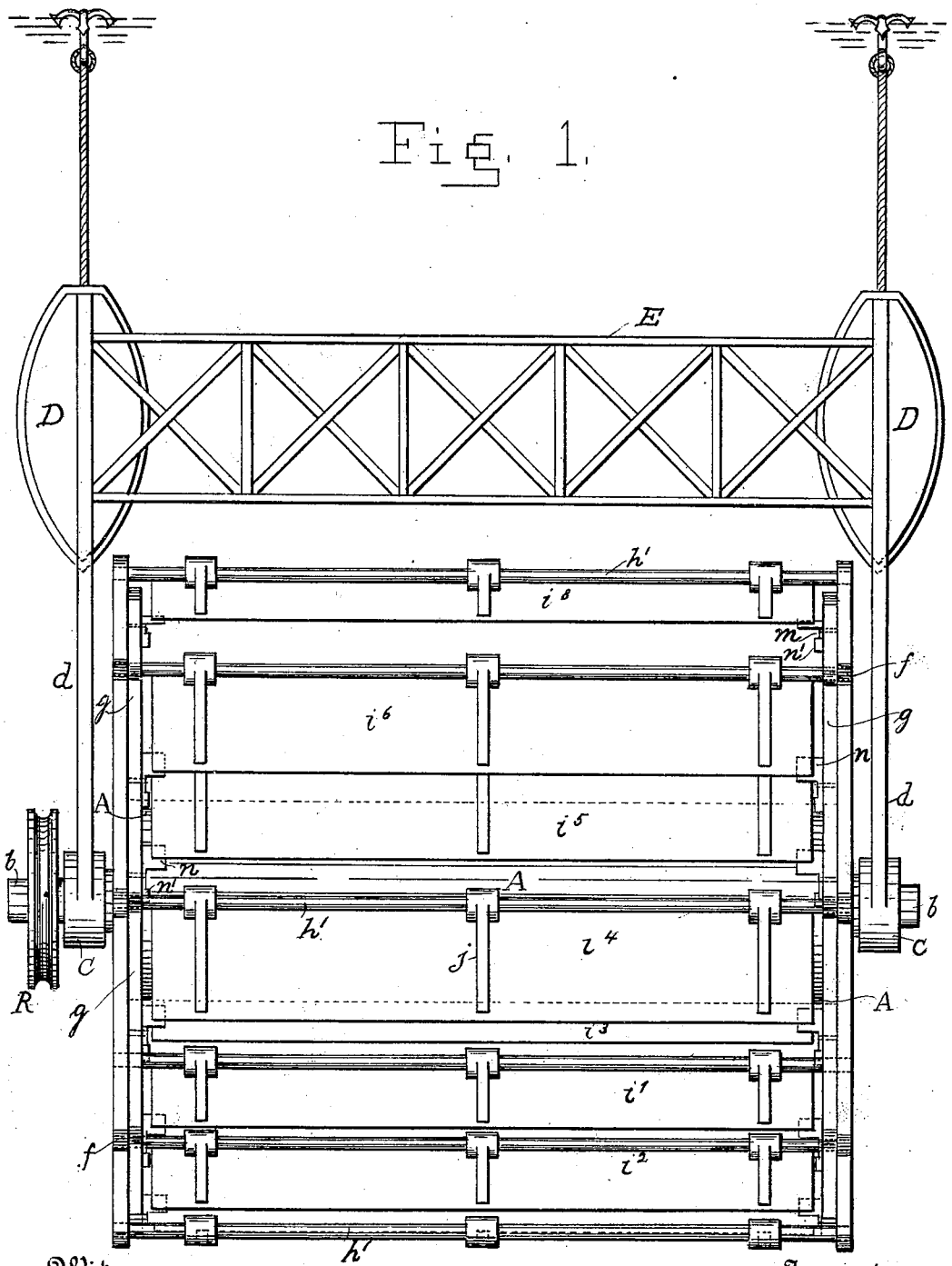
J. E. SYMONS.

WATER WHEEL.

(Application filed Dec. 21, 1895.)

(No Model.) 3 Sheets—Sheet 1.

Fig. 1.



Witnesses
L. Gutmann.
W. Clyde Jones.

Inventor
Josiah E. Symons
By his Attorney,
Albert H. Bates.

No. 646,713. Patented Apr. 3, 1900.

J. E. SYMONS.

WATER WHEEL.

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(No Model.) 3 Sheets—Sheet 2.

Fig. 2.

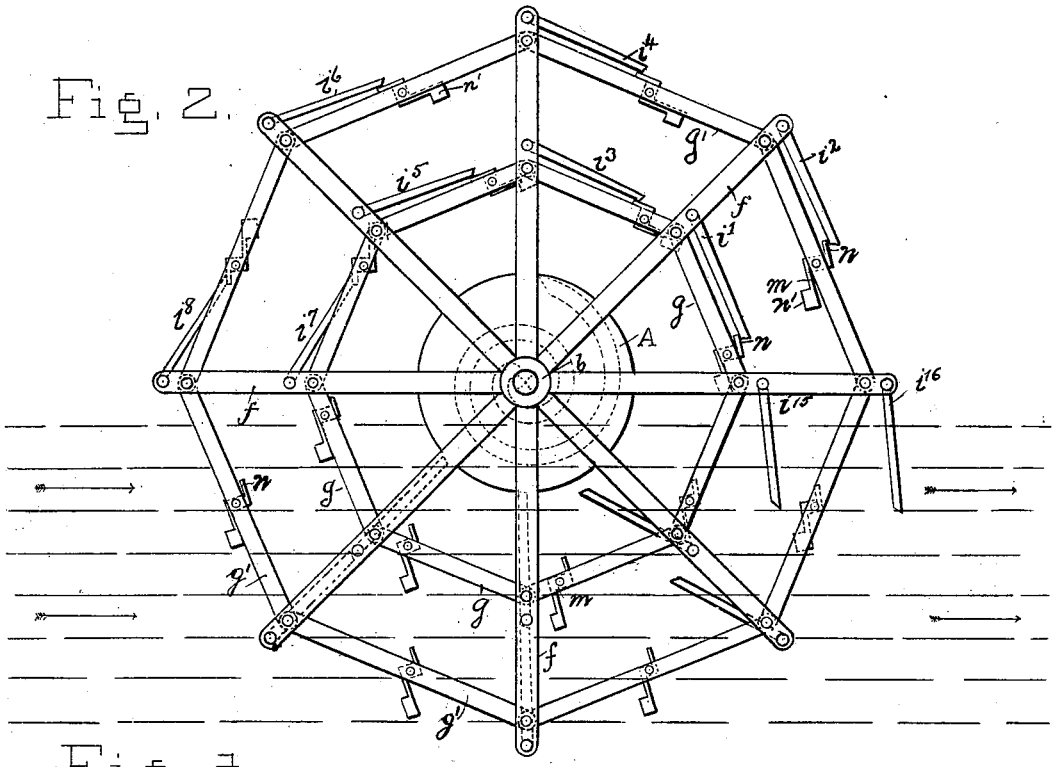


Fig. 3.

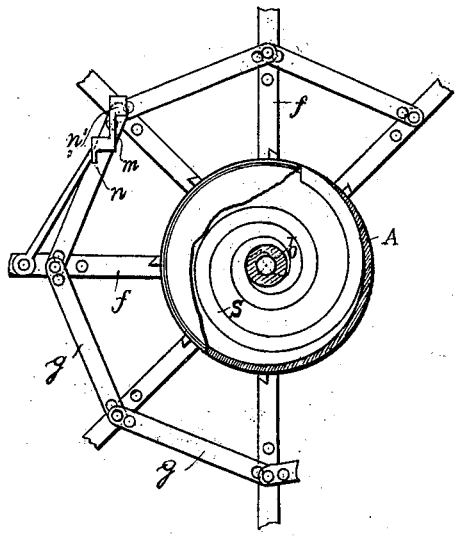
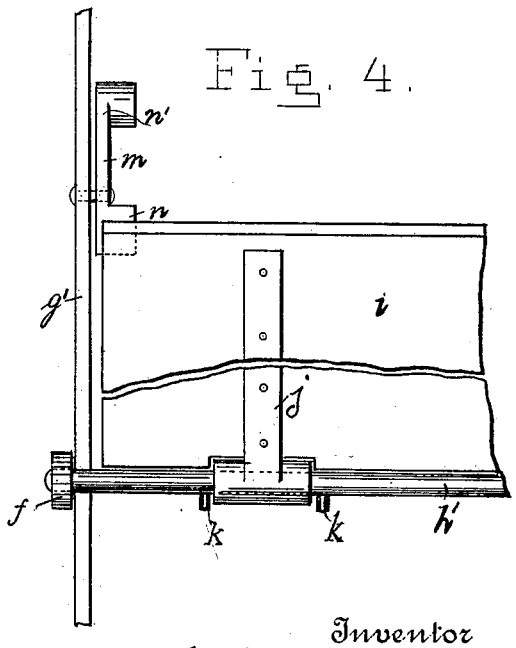


Fig. 4.



Witnesses
W. Clyde Jones
Charles L. Hine

Inventor
Josiah E. Symons
By his Attorney,
Albert H. Bates.

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J. E. SYMONS.

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(No Model.) 3 Sheets—Sheet 3.

Fig. 5

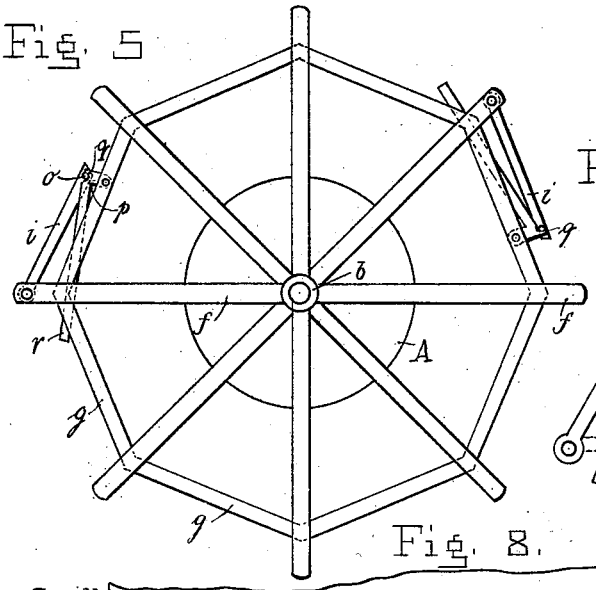


Fig. 6.

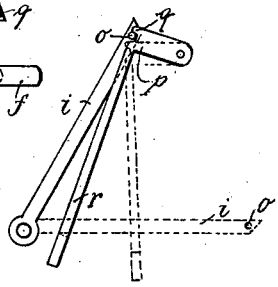


Fig 7

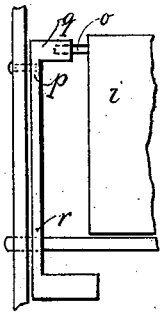


Fig. 8.

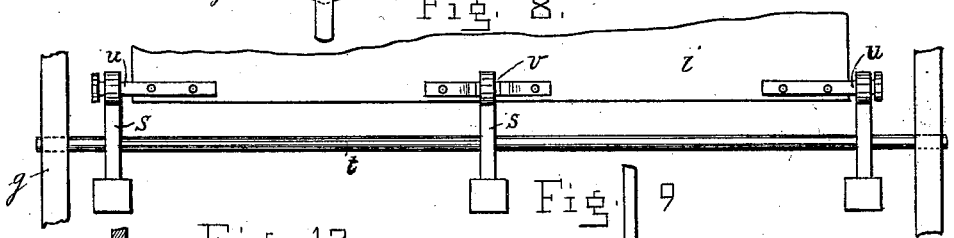


Fig. 9

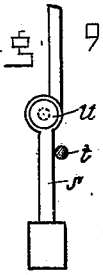


Fig. 12.

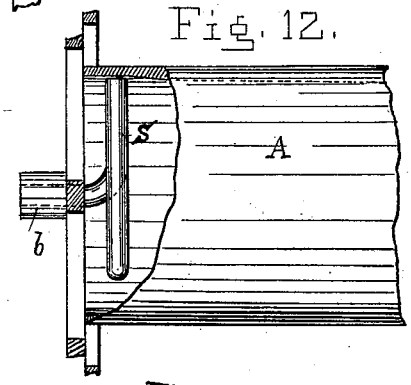


Fig. 10.

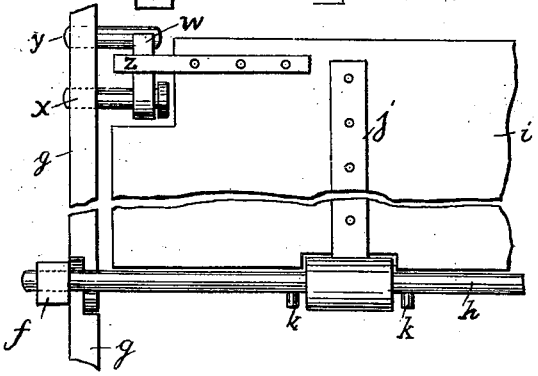
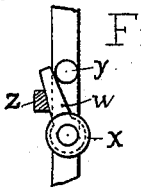


Fig. 11.



Witnesses
W. Clyde Jones.
Charles L. Shine

Inventor
Josiah E. Symons
By his Attorneys,
Albert H. Bates.

UNITED STATES PATENT OFFICE.

JOSIAH E. SYMONS, OF BOISE, IDAHO.

WATER-WHEEL.

SPECIFICATION forming part of Letters Patent No. 646,713, dated April 3, 1900.

Application filed December 21, 1895. Serial No. 572,869. (No model.)

To all whom it may concern:

Be it known that I, JOSIAH E. SYMONS, a citizen of the United States, and a resident of Boise city, in the county of Ada and State of Idaho, have invented a certain new and useful Improvement in Water-Wheels, of which the following is a specification.

My invention relates to that class of water-wheels which receive their power from the force of the current of a stream running under them; and its object is, first, to provide such wheels with a capacity for being so confined in the stream as to transform power therefrom, while being able to be conveniently moved about as the changing channel or the place of utilization of the power may make expedient and at the same time rendering them self-supporting in the water and thereby doing away with the supporting-bearings and the large amount of friction due to the weight of the wheel.

Another object of my invention is to increase the efficiency of these wheels by providing them with feathering-blades which present their surfaces in desirable position in the water and do not waste the power of the wheel by forcing the water downward as they enter the water or by lifting water as they rise or by encountering an unnecessary resistance of air as they rotate out of the water.

It consists of a drum of sufficient size to float the wheel in the water, in connection with a series of blades supported by arms extending from said drum, together with means for anchoring the same at a desired point in the stream.

It also consists in propeller-blades, so hinged as to lift substantially vertically out of the water after having acted substantially radially during the effective portion of the revolution of the wheel.

It consists also in the combination of parts for effecting the objects desired, as hereinafter specified, and definitely pointed out in the claims.

In the drawings, Figure 1 is a plan of a desirable form of my improved water-wheel anchored in a stream. Fig. 2 is an end elevation of the same with the anchoring attachments removed. Fig. 3 is an end elevation of a portion of this form of wheel, showing the manner in which the blades are held and their inclination determined. Fig. 4 is a detail view of a portion of one of the propeller-blades and its attachments, showing the manner in which it is hinged and its free end supported in this embodiment of my invention. Fig. 5 is an end elevation of a portion of a wheel, showing a modified form of the latch for holding the free end of the propeller-blade. Figs. 6 and 7 are enlarged detail views of the latch shown in Fig. 5, Fig. 7 being a view taken at right angles to Fig. 6 and showing a portion of the propeller-blade. Fig. 8 is a view of a propeller-blade with another form of latch for supporting its free end, and Fig. 9 is an end view of the same. Fig. 10 is an elevation of a portion of a blade and attached parts, showing still another form of supporting the free end of the blade, and Fig. 11 is a detail view of the latch shown in Fig. 10. Fig. 12 is a front elevation of a portion of the drum of the wheel, the same being broken open to afford a view of the interior.

Similar reference-letters designate similar parts in each figure.

A represents a drum made of suitable material and water-tight or as near thereto as practicable. Projecting from the heads of this drum are journals *b*. If desired, these journals may be formed on a shaft running longitudinally of the drum and extending at each end thereof, though I have shown them in the drawings as gudgeons projecting from the heads. These journals are surrounded by boxes *c* on the ends of bars *d*, extending from boats or buoys D, which are anchored in any desired manner. The boats are held rigidly in relation to each other by the truss E. Thus, although the anchors may be changed and the boats shifted as desired, the rods *d* and *d* and the truss E always remain rigid with relation to each other, and hence the bearings *c* will maintain their proper position and not bind. Projecting from each end of the drum are a convenient number of radial arms *f*. These are braced by rods *g* and *g'*, extending from one radial arm to the next, and thus forming polygons at each end of the wheel. These rods may be bolted to the arms or secured in other suitable manner. Rods *h* and *h'* extend longitudinally across the wheel from each radial arm to the arm opposite. On these rods are hinged the blades

i' to i^{16}, preferably by means of a strap j, secured to the blade and having a sleeve surrounding the rod h or h' and prevented from longitudinal shifting thereon by means of the pins k, projecting from said rod on each side of said sleeve. In the embodiment of my invention which is shown in the drawings there are two sets of blades coöperating to form practically one set when in operation. I consider this advantageous, as I thus secure a wide blade without adding unnecessary weight to maintain its stiffness and the feathering action as the blades enter the water or withdraw therefrom is more efficient and more convenient. In very shallow water, however, it might be convenient to use but one blade, while, on the other hand, in very deep water three or more blades might be used to each pair of radial arms.

Figs. 1 to 4, inclusive, show what I consider to be the preferable form of latch for supporting the free end of the propeller-blade. This latch consists of a lever m, pivoted to the rods g or g' and having one arm n, against which the propeller-blade rests near its free edge, and another and preferably longer arm n', which carries a weight of desirable form. This weight is of such mass that when the blades are in the positions marked i' to i^8, inclusive, it will support the free edge of the propeller-blade and prevent it swinging inward; but as the propeller-blade enters the water the weight n' comes over the pivot of its lever, and hence exerts no force on the propeller-blade, and the weight of the blade, aided by the action of the water, causes it to swing inward and lie radially, the weighted lever revolving around upon its pivot as the edge of the blade passes under it. By adjusting the mass of the weight and its position with reference to the pivot of its lever and by varying the inclination at which the propeller-blade lies when out of operation the blade can be caused to swing in radially at whatever point is most desirable. The blades will thus feather into the water and will not be called upon to do unnecessary work in shoving water downward, while they become radial and aid in revolving the wheel, as soon as their supporting-arms have come into the most desirable position for this operation. In order that the angularity of the blades may be varied to suit different conditions, the rods g and g' may be provided with two or more holes near each end, and additional holes may be provided in the radial arms whereby the position of the rods may be changed as desired. Fig. 3 illustrates such construction. After the propeller-blades have swung inward, so as to become radial, the beveled inner edge of the outer blade lies against the rod h, while the inner edge of the inner blade lies against a cleat provided for that purpose on the drum. The blades remain in this position during the most effective portion of the revolution, being held there by the force of the current. As the blades begin to rise toward the surface of the water they begin to drop downward by their weight and the weight of the water upon their upper sides, and as they pass out of the water they hang vertically (except as swung downstreamward by the current) in the position shown by the blades i^{15} and i^{16} in the drawings. Thus in lifting out of the water the blades feather and do not raise an unnecessary load thereof. After they have risen above the water their free edges swing in against the arm n of the weighted lever, which hanging loosely on its pivot has under the action of gravity assumed the desirable position. This is the position of the propeller-blades shown at i' and i^2, and the blades continue in this position throughout substantially half a revolution or until they are entering the water again. It will thus be seen that as the blades are entering the water they do not waste energy in forcing the same downward, that while they are under the active force of the water they coöperate to present a substantially-unbroken surface, that when they lift out of the water they hang loosely therein and do not drag water with them, and that while they are passing through the air they are held open, whereby the resistance of the air to the rotation of the wheel is diminished.

A modified form of the latch for supporting the free edges of the propeller-blades is shown in Figs. 5, 6, and 7. In this form a pin o, extending from the end of a blade i (i representing a blade indiscriminately) rests against a shoulder q on a bell-crank p, one arm r of which is quite long and on the end of which is a small paddle. The weight of the arm r is not great and is insufficient to swing the bell-crank lever out of engagement with the pin o, but when the paddle on the end of the arm comes under the action of the water the arm is swung inward and the pin o passes over the shoulder q, the pressure of the blade against the shoulder having been much reduced by the blade having come into a nearly-vertical position. The blade thus assumes a radial position. The remaining operations of the wheel are as above described.

Figs. 8 and 9 show another form of latch. Here levers are pivoted at one end to the blade itself and at the other end carry weights, while at some intermediate points they rest against a rod t, extending across the wheel. The weights are of such mass as to be able to counterbalance and support the blades, and this is their operation while the blades are out of the water. After a blade has entered the water the desired distance the pivots of the weighted levers come nearly under the center of gravity of those levers and attached weights, and thus oppose little resistance to an inward passage of the blade, and the force of the current upon the blade causes the same to swing inward and assume a substantially-radial position. If these levers are supplied only at the ends of the blade, being pivoted to rods u,

projecting therefrom, they swing loosely and hang down vertically while the blade is traveling through the water. If they are pivoted at some other points than at the ends of the blade, as shown at *v*, they lie upon the back of the blade after it has swung in radially and until it has assumed a vertical position, after which they hang down vertically as before. After the blades have risen out of the water these weighted levers strike upon the rods *t* and hold the blades in the open position desired throughout the remainder of the revolution.

Figs. 10 and 11 show still another modified form of latch. Here a lever *w* is pivoted to a pin *x*, projecting from the rod *g* or *g'*, and has its free end lying against a pin *y*, projecting from the same rod. Against this lever *w* lies a rod *z*, extending from the propeller-blade. As the blade enters the water it is tipped upward by the force thereof, and the lever *w* swings downward under the action of gravity. After the blade has entered the water a greater distance the force of the current upon its upper side forces the same inward, and the rod *z* being now allowed to pass between the pins *x* and *y* the blade assumes a radial position. After the blade has risen from the water its free edge swings inward and the rod *z* comes against the lever *w*, which under the action of gravity has swung back against the pin *y*, and thereby closed the passage between the pins *x* and *y*. The blades are thus held in an open position until they again enter the water.

Should water accidentally leak into the drum, it may be pumped out in any suitable manner. In some cases it may be deemed advisable to provide means for causing the drum to automatically drain. I have shown a device for this purpose consisting of a spiral pipe S, having its entrance at a point on the inner cylindrical surface of the drum and its exit above the surface of the water, but such construction is not my invention and is hereby disclaimed.

Power may be conveyed from the wheel to some point on the land in any desired manner. I consider a rope-drive through a sheave R on one of the gudgeons a convenient method. In case considerable power is required and the stream is wide many of these wheels may be anchored side by side and connected with each other by tumbling-rods, thereby providing for any inaccuracy in presentation of their axles or change thereof due to swells in the current, &c. The power developed may thus be transmitted to the end wheel and taken off from it by a sheave with rope-drive or otherwise, as desired.

The embodiment of my invention here shown may be much varied and equivalents may be substituted for many of the parts so long as the essential method of operation is maintained. I do not wish to be construed as in any wise limiting myself to the specific forms here shown further than the claims themselves point out.

Having thus described my invention, what I claim as new, and desire to secure by Letters Patent, is—

1. A water-wheel having feathering-blades adapted to become radial by folding inward and means for preventing them from so folding while they are out of the water, for the purpose specified.

2. A vertical water-wheel supported by a hollow drum and having feathering-blades pivoted at or near their outer edges and adapted to become radial, and means for preventing their becoming radial until they have entered the water, for the purpose specified.

3. A water-wheel having around its axis a drum whose water displacement is enough greater than its own weight to support the wheel with the portion above said drum out of the water, in combination with a pair of buoys rigidly banded together, a rod extending from each buoy and carrying a bearing surrounding a journal extending from the end of said drum, and means for holding the buoys in desired position, for the purpose specified.

4. In a water-wheel, in combination, a horizontal axis, arms extending therefrom, blades pivotally supported by said arms and held in a position to enter the water at approximately a right angle to the surface thereof and adapted to become radial therein under the action of the current, by having their edges which are farthest from the pivots move toward the axis, and remain radial during a substantial portion of their working operation, pivoted levers serving to maintain the blades in a position substantially at right angles to the water as they enter the same for the purpose specified.

5. A vertical water-wheel supported by a drum around its axis, said drum having water displacement enough greater than its own weight to support the wheel with the portion above said drum out of the water, there being arms extending from said drum, blades carried by said arms, means for holding said blades in a position approximately perpendicular to the surface of the water as they are entering the same and allowing them under the action of the current to move freely and approximately with the current and thereby become radial and so remain during a substantial portion of their operation, whereby said wheel may support itself and be approximately half submerged and yet the blades always cut the water in entering the same and not oppose a horizontal plane thereto and assume their working positions without excessive loss of energy by being forced across the current of the water, for the purpose specified.

6. In a water-wheel, a horizontal axis, arms extending radially therefrom, blades pivotally connected to said arms, said blades hav-

ing those edges which are uppermost as they enter the water free and adapted to move toward the axis as the blades become radial, in combination with means for holding said blades at an angle to the arms when entering the water but allowing them to swing freely on their pivots after they have become submerged therein, whereby said blades may encounter little resistance in entering the water and may assume radial positions, by having their said free edges swing nearer the axis of the wheel and approximately with the current, at an indeterminate point dependent upon the action of the current and gravity, for the purpose specified.

7. In a water-wheel, a blade pivoted at or near one edge, in combination with a lever supported on a pivot a constant distance from the pivot of the blade and supporting the free edge of the blade when it is out of water and so counterbalanced as to leave it unsupported as the blade is entering or shortly after it has entered the water, for the purpose specified.

8. In a water-wheel, a pivotally-supported blade, in combination with a pivoted lever counterbalanced to support the free edge of the blade, the line of direction connecting the center of gravity and pivot of said lever being at an acute angle to the line of direction connecting the center of gravity and pivot of said blade whereby said lever will support said blade when either is substantially horizontal but in the rotation of the wheel will turn over and release said blade, before the center of gravity of said blade has come over the pivot thereof, for the purpose specified.

9. In a water-wheel, a pivotally-supported blade, in combination with a lever pivoted to said wheel at a point behind the blade whose distance from the pivot of the blade is greater than the width of the blade, said lever engaging on one side of its pivot with the free edge of the blade and carrying a weight on the opposite side of its pivot whereby the free edge of the blade is supported by the lever when the lever is approximately above the horizontal plane which passes through the axis of the wheel and whereby the free edge is released and allowed to swing past the lever by the lever's turning over when it reaches a position below said plane, for the purpose specified.

JOSIAH E. SYMONS.

Witnesses:
ALEXANDER P. WILSON,
HARRY K. EAGLESON.