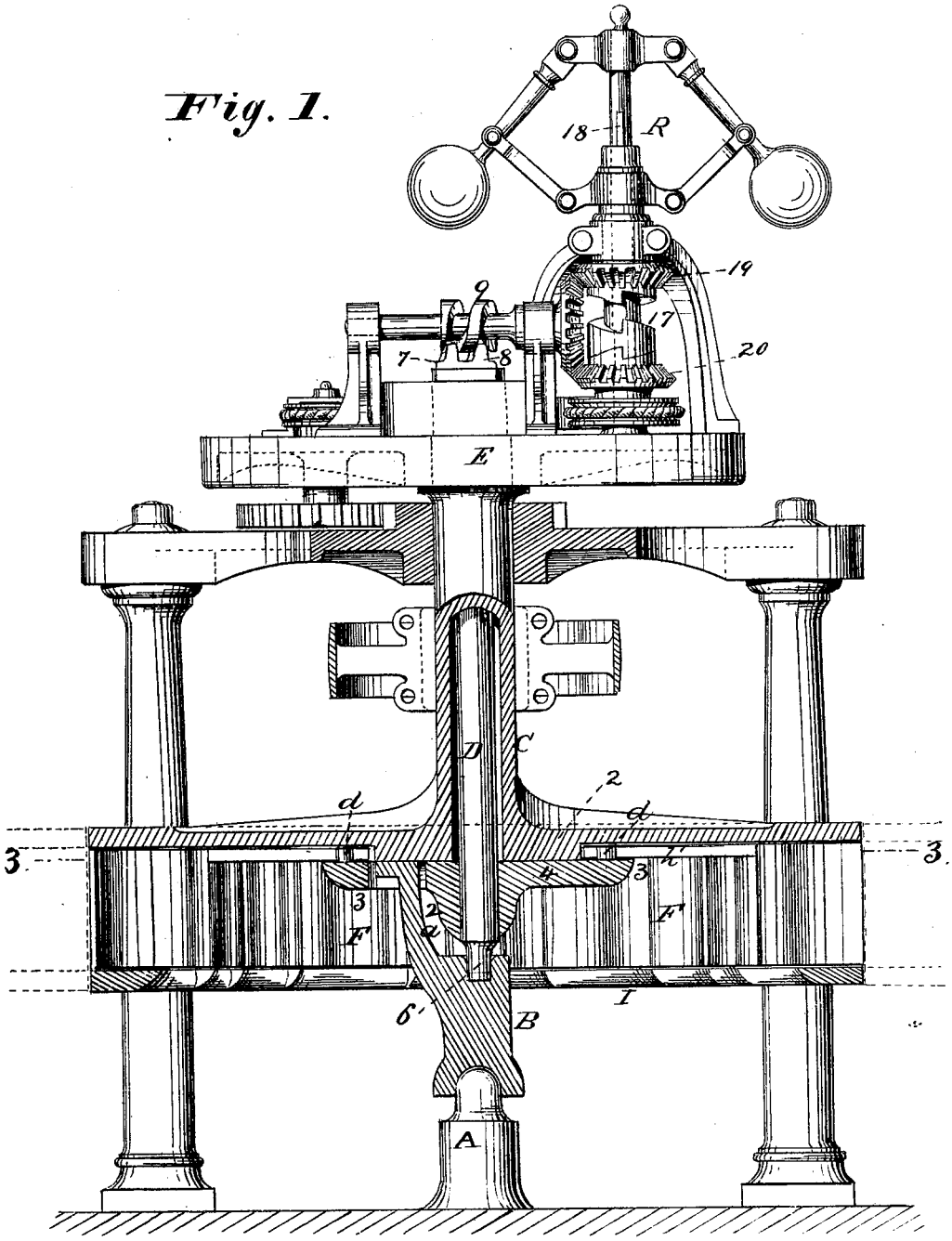
3 Sheets—Sheet 1.

A. BEE.

Turbine Water-Wheel.

No. 200,966. **Patented March 5, 1878.**

Fig. 1.



WITNESSES
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A. BEE.

Turbine Water-Wheel.

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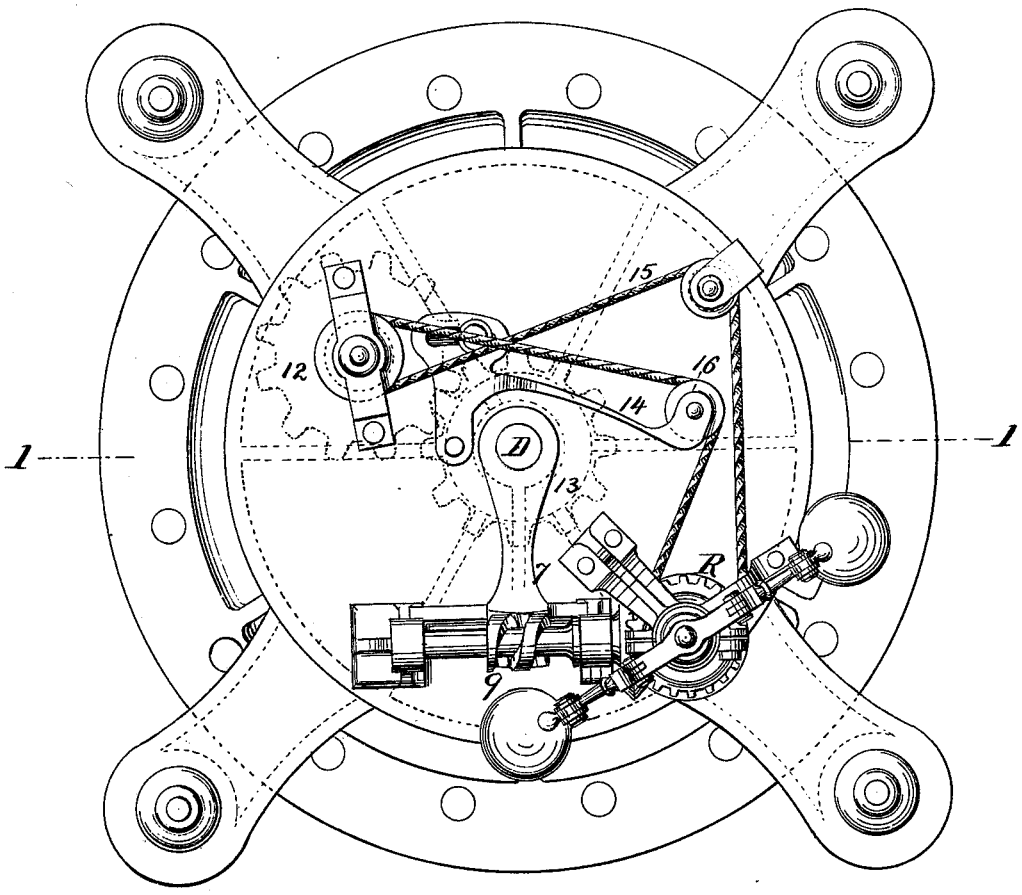
Fig. 2.



WITNESSES

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Turbine Water-Wheel.

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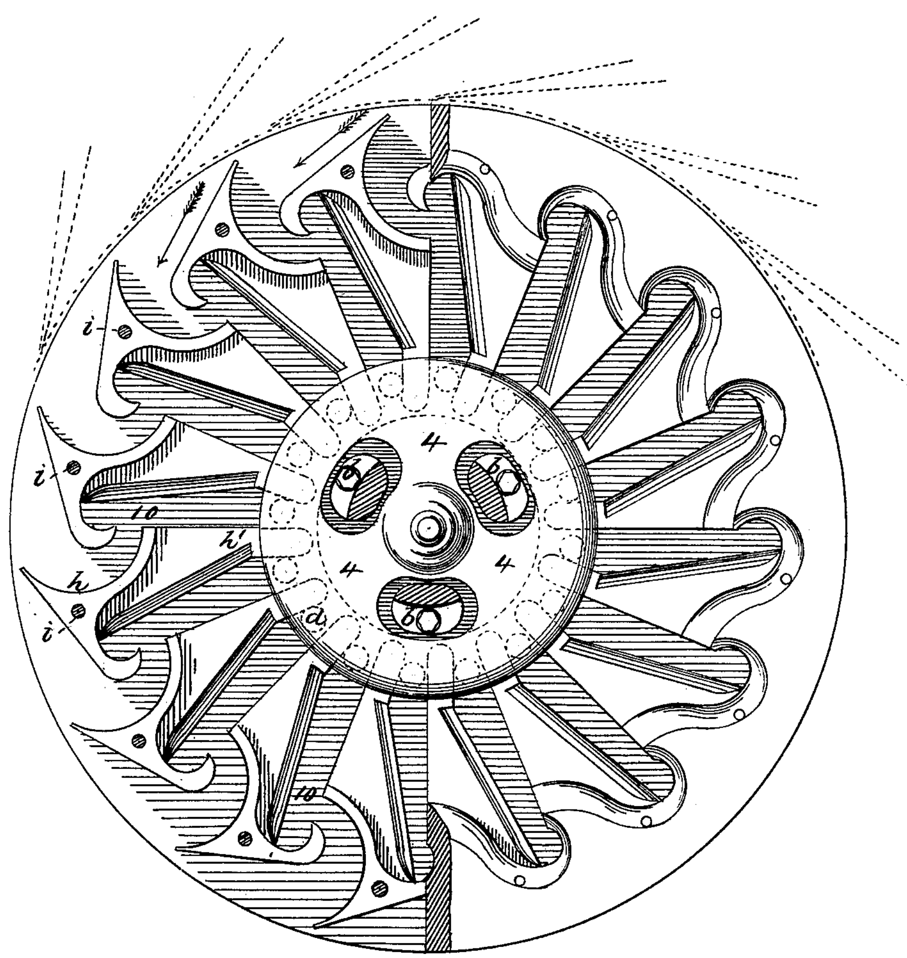
Fig. 3.



WITNESSES
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UNITED STATES PATENT OFFICE.

ASA BEE, OF LANCASTER, ASSIGNOR TO OLIVER W. TURNER, OF HARVARD, MASSACHUSETTS.

IMPROVEMENT IN TURBINE WATER-WHEELS.

Specification forming part of Letters Patent No. **200,966**, dated March 5, 1878; application filed August 23, 1877.

To all whom it may concern:

Be it known that I, ASA BEE, of Lancaster, in the county of Worcester and State of Massachusetts, have invented a certain new and useful Improvement in Turbine Water-Wheels, of which the following is a specification:

The object of this invention is to so construct a water-wheel as to give as high a percentage of power to the amount of water used when using little as when using much water.

Many wheels have been devised in which the inventors claim to attain as high a percentage of power with a partially-closed gate as with a full gate; but this result appears impossible while the capacity of the issue is unchanged, and it is manifestly impracticable to construct a central-discharge wheel which will operate to the best advantage, unless it can be made under all variations in the capacity of the stream to receive the impact of the water nearly in the line in which the bucket or float is moving, and to discharge the water nearly or quite in the opposite direction.

In order to accomplish these results, and to provide a central-discharge wheel which will operate as economically with a nearly-closed as with a wide-open gate, I construct my wheel with pivoted floats or buckets, the adjustment of which on their pivots will contract the issues without materially changing the direction in which the water is discharged. In practice the contraction of the issues by the adjustment of the floats is done simultaneously with the contraction of the inlet-gates, to agree with the amount of water to be used. All the floats or buckets may be adjustable, or every alternate one may be made adjustable and the intervening ones fixed.

The invention further consists in the combination of pivoted buckets and radial arms, connecting with a cog wheel or rim or a movable plate or other equivalent device, as a means of adjusting such pivoted buckets.

The invention further relates to a peculiar construction of shaft, hub, and arms, forming the center of the wheel.

The invention further consists in constructing a water-wheel with two concentric shafts capable of relative rotary motion, for the purpose of adjusting the buckets to correspond with the quantity of water to be passed through the wheel.

The invention further consists in the combination of a hollow shaft with a central shaft adapted to turn within it, and an arm attached to the central shaft and communicating with a suitable governor to transmit motion to regulate the capacity of the floats or of the gates.

The invention further consists in the combination of two concentric shafts, the outer of which connects, by arms passing through openings in the hub of the other, with a solid portion of the shaft, to which the transmitting mechanism is applied.

The invention further consists in constructing a central-discharge wheel with a bottom rim-plate notched to correspond with the space between the floats, to facilitate the discharge of water.

The invention further consists in constructing the aforesaid notched plate and the arms which carry it with beveled edges, to lessen obstruction or resistance of the water.

The invention further consists in the combination, with a water-wheel, of a horizontal plate or frame, carrying a governor and mechanism for transmitting motion to regulate the induction of the water or the capacity of the floats or of the gates.

The invention further relates to the combination, with a water-wheel, of a governor carried around with the wheel, and having motion on its own axis to regulate the gates or buckets.

The invention further relates to the combition, with a governor, of transmitting mechanism so arranged that it may remain out of gear while the action is normal, and will be thrown automatically into gear in either direction when required.

The invention further relates to the combination, with the aforesaid governor, with the bands for transmitting motion therefrom, of a spring, arranged as hereinafter described, to maintain the tension of the band.

In the accompanying drawing, Figure 1 is a vertical section on the line 1 1, Fig. 2, of a water-wheel illustrating my invention. Fig. 2 is a plan or top view of the same. Fig. 3 is a horizontal section on the line 3 3, Fig. 1.

A is the step on which the wheel runs. B is the lower end or part of the main shaft C, and is connected to its flange 1 by means of three upright arms, *a*, (see Figs. 1 and 3,) and screws *b b*. These arms *a* are simply enlargements of the shaft B, for the purpose of receiving the hub 2 of the gear-wheel 3, (see also Fig. 1,) and connected to it by means of arms 4, Fig. 3. These arms, as may be seen, pass through the openings in the enlargement which forms the arms *a*, so that the rim 3 is outside of the arms *a*. An inner shaft, D, which passes through the main shaft C, which is hollow, passes through and is fastened to the hub 2, and takes a bearing in a cavity, 6, in the crotch of the shaft B, for the purpose of giving a backward and forward motion to the gear-wheel 3 by means of the arm 7 at the top of the inner shaft D, and above the top of the main shaft C. With cogs 8 on the end of this arm meshes the worm-gear 9 of the regulator, as seen in Figs. 1 and 2. E is a plate fastened on the top of the main shaft C, for the purpose of carrying the regulator R with its accompanying machinery. This plate may be substituted by arms, or a skeleton frame.

Figs. 1 and 2 show how motion is communicated to the regulator R, and how, through its worm-gear, the required motion is, in turn, given to the cog-wheel 3 through the shaft D and its arm 7. The object of this motion is to open and close the issues 10, Fig. 3, of the wheel F. This is done by the cogs *d* of the wheel 3 operating the arms *h'* of the floats *h*. As the arms now stand, the issues are nearly wide open; but when the arms 4 of the cog-gear 3 are brought around against the arms *a* of the shaft B, the arms *h'* and floats *h* take the position shown in dotted lines, thus completely closing the issues 10, and so keeping the course of the water in the issues 10 the same until the issues are finally closed, provided, however, that the distance from the stud *i* on which the floats *h* are hinged to the two ends which form the issue is equal, which should be the case.

To get water onto the wheel in the exact direction of its motion and off it in exactly the opposite direction to its motion, which is the only correct course of application, the course of the float must, of necessity, turn ninety degrees, let the curves of the floats be what they may; but as yet I have not found any better shape for the passage of water through a wheel than to form its walls of parts of two perfect circles, so as to diminish the size of the aperture through which the water passes forty one-hundredths from the point of entrance to the point of discharge, and then cut off the issue at right angles with a line drawn from the center of the wheel to the center of the inner or smaller circle. This point is very important, because it is the only way in which the water can be taken away from a center-discharge wheel in exactly the opposite direction to its motion, and kept so while enlarging and diminishing the size of its issue, and is something which I do not think has ever before been accomplished, and I do not think it can be to advantage without giving the floats a shape similar to those I make, so as to give room for the water to leave the issues in the exact opposite direction to its motion.

In the ordinary center-discharge wheel it is customary with many to curve the end of the float so as to give the appearance of discharging in the exact opposite direction to its motion; but it does not do it, because the curve of the next float forms the other side of the issue, thus giving an oblique inward course to the water.

Now, it is evident that the pressure due to the water leaving a wheel of this description is not so nearly in the direction of its motion as it is in one constructed on my plan.

I do not wish to be understood that no wheel has ever before been invented in which the water entered the wheel in the exact direction of the wheel's motion, and left it in exactly the opposite direction, for I accomplished that in my own wheel patented October 3, 1871; but the construction of that wheel was such as to render it impossible to enlarge or diminish the size of the issues by any adjustable device of value—hence the advantage of this wheel over that, as also the novelty.

To increase the area of the space through which the water must pass immediately on its leaving the issues, I cut away a portion of the inner edge of the lower plate I of the wheel, answering in shape to the inner shape of the floats.

The object of beveling both the lower rim and the edge of the arms *h'* of the floats *h* is that they may offer less resistance to the wheel in its onward motion.

The manner of applying the regulating device by a plate, E, which carries the regulator, giving it motion by means of a gear, 12, revolving around a stationary gear, 13, and the spring 14, which tightens the band 15, constitutes a valuable improvement, because when the regulator R is closing the issues 10, if any foreign substance should pass in with the water which was too large to pass through—say, when the issues were half or two-thirds closed—the regulator R would, if the wheel was running too fast, continue to close the floats, and become tighter and still more tight until the speed of the wheel would become changed. This would be very trying, not only to the regulator, but also to the ends of the floats, where said foreign substance is lodged; but by providing the pulley 16, which tightens the driving-belt 15 of the regulator, with an adjustable spring, 14, the belt is made of sufficient tightness to operate the floats until it stops them, when the spring will yield so as to allow the belt to slip until the speed of the wheel has changed, when it will immediately begin to operate so as to open the issue and let said foreign substance pass out, the screens above the wheel being of such size as to prevent anything passing into the

wheel which will not pass out when the issues 10 are wide open. When the two cogs on the end of the arm 7 have been drawn toward the regulator the full length of the worm, the issues of the wheel are closed, and a light strain is constantly held on the arm 7 and shaft D, keeping the cogs constantly in readiness to pass into the worm again as soon as the speed of the wheel shall have so changed as to reverse the action of the regulator, and when the reverse motion of the worm shall have thrown the issues 10 wide open the same effect is again produced at the other end of the worm. This obviates the necessity of the slipping of the regulator-belt, except when any foreign substance has lodged itself in the floats or issues, as already described.

17 is a sliding clutch, formed with a sleeve, sliding on spline 18 on the governor-shaft, so as to communicate the motion of the governor to either one of the beveled pinions 19 20, as the acceleration or slackening of the motion may require, so as to turn the worm 9 in either direction.

Having thus described my invention, the following is what I claim as new therein and desire to secure by Letters Patent:

1. As an improvement in center-discharge turbine water-wheels, a float or bucket, adjustable on a vertical pivot, for the purpose of regulating the capacity of the issue, and constructed to discharge the water in a direction about opposite to the motion of the bucket.

2. The combination of the pivoted floats *h*, radial or oblique arms *h'*, and adjusting cog wheel or plate 3, for regulating the position of the floats as required.

3. The base-shaft B, constructed with arms, connecting with the shaft C through apertures in the gear-wheel 2 3, substantially as described.

4. The hollow shaft C and inner shaft D, combined so as to have a limited independent rotation, substantially as for the purpose set forth.

5. The combination of the shaft D and arm 7 with a governor and suitable transmitting mechanism for regulating the capacity of the wheel, substantially as described.

6. The main shaft B C, constructed in two parts, connected by arms, and provided below the plate E with a gear or pulley for transmitting the power.

7. The annular bottom plate I, notched, as represented, to correspond with the float-cavities.

8. The beveled arms *h* and notched plate I, for the purposes set forth.

9. The combination, with a water-wheel, of the governor R, mounted on a plate or frame, E, so as to be carried in an orbit around the axis of the wheel, as described.

10. The combination, with a water-wheel, of the governor R, the clutch 17, the worm-shaft 9, and the transmitting-arm 7, constructed and arranged as described, permitting the regulating mechanism to remain out of gear while the action is normal, and causing it to be thrown into gear automatically when required.

11. The combination, with a water-wheel, of the governor R, plate or frame E, belt 15, and spring 14, constructed, arranged, and operating as described, for the purposes set forth.

ASA BEE.

Witnesses:
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R. P. BEMIS.