J. ATKINS.

2 Sheets--Sheet 1.

Water-Wheels.

No. 166,676. Patented Aug. 10, 1875.

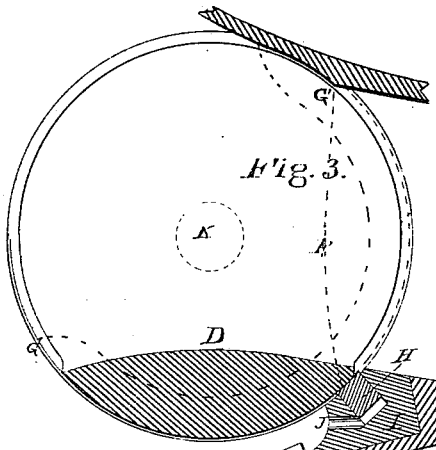

Fig. 3.

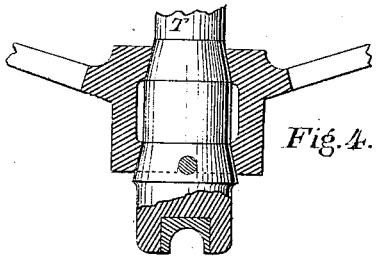

Fig. 4.

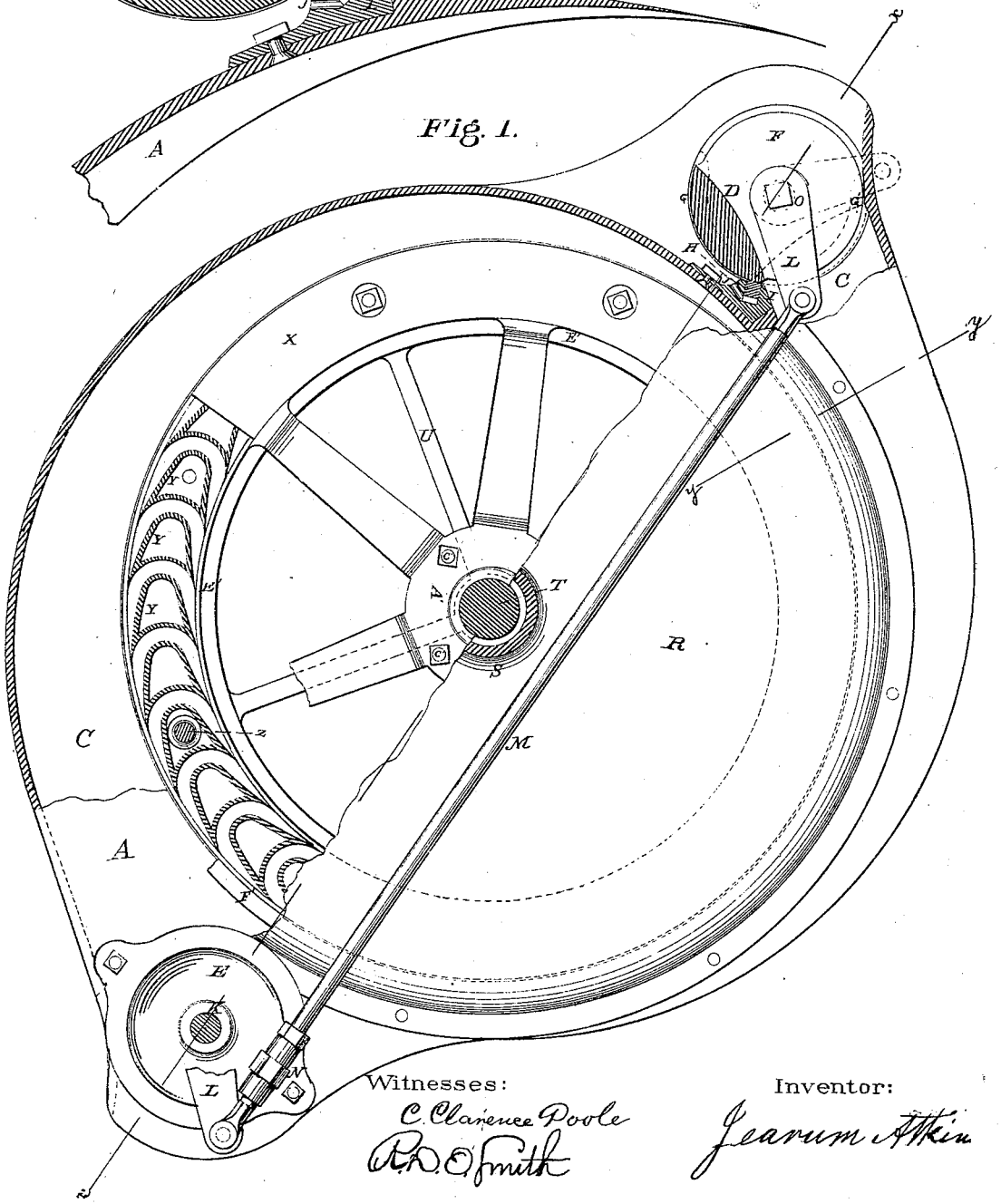

Fig. 1.

Witnesses:

C. Clarence Poole

R. D. O'Smith

Inventor:

Jeanum Atkins

J. ATKINS.

Water-Wheels.

2 Sheets--Sheet 2.

No. 166,676.

Patented Aug. 10, 1875.

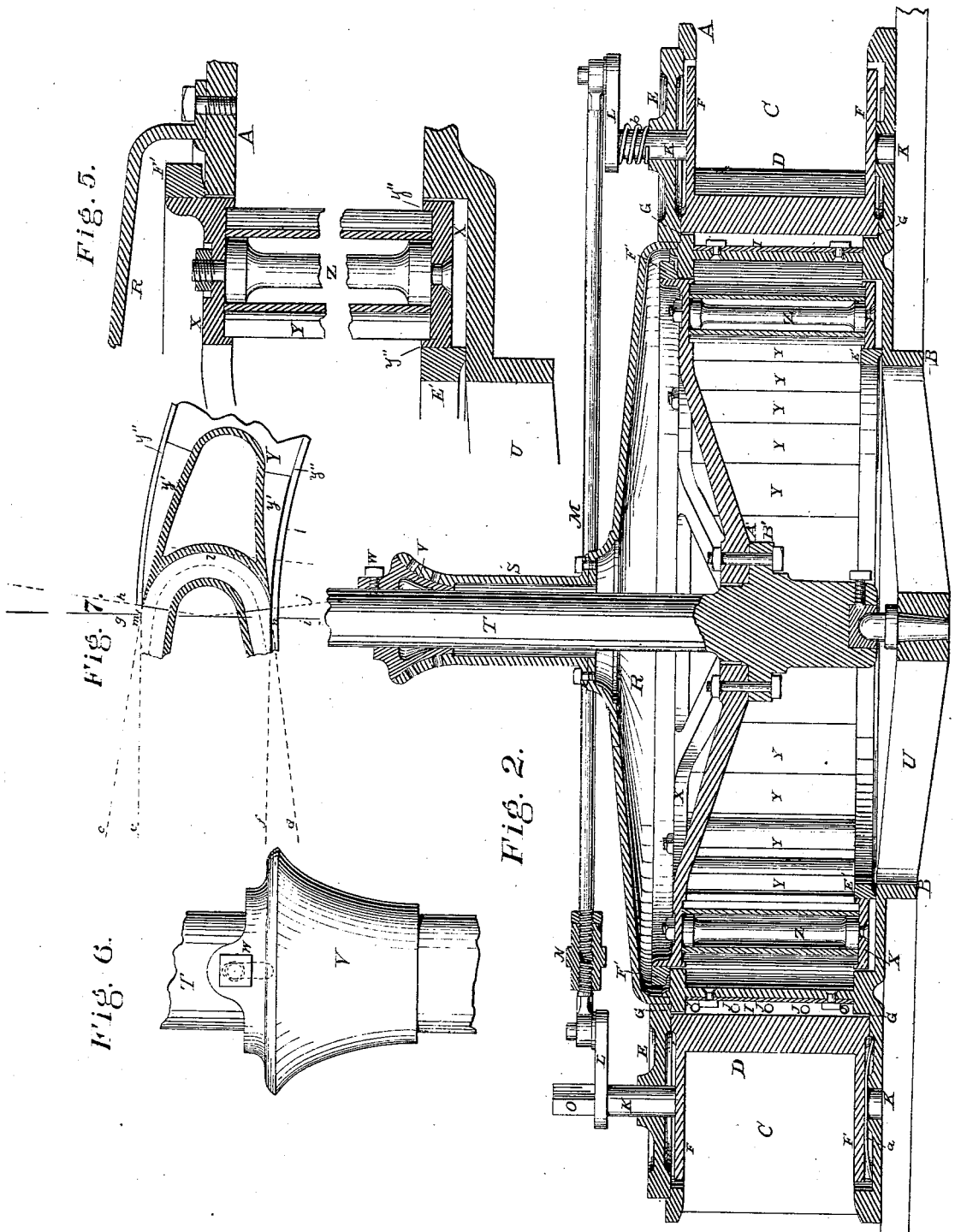

Fig. 5.

Fig. 7.

Fig. 6.

Fig. 2.

Witnesses:

C. Clarence Poole

R. D. O. Smith

Inventor:

Jearum Atkins

UNITED STATES PATENT OFFICE.

JEARUM ATKINS, OF WASHINGTON, DISTRICT OF COLUMBIA.

IMPROVEMENT IN WATER-WHEELS.

Specification forming part of Letters Patent No. **166,676**, dated August 10, 1875; application filed March 26, 1875.

To all whom it may concern:

Be it known that I, JEARUM ATKINS, of Washington, D. C., have invented a new and useful Improvement in Water-Wheels, of which the following is a description, reference being had to the drawings which accompany and form a part of these specifications—

Figure 1 being a partial plan over all, a partial plan of the wheel, with a portion of the top casing broken away, and a partial horizontal section of the wheel, one-quarter of the top rim being removed to show the form of the buckets; Fig. 2, a vertical section on line X X on Fig. 1; Fig. 3, a partial horizontal section, showing one of the gates and its immediate connections; Fig. 4, a partial vertical section through the lower portion of the shaft; Fig. 5, a partial vertical section through one side of the wheel, on line Y Y on Fig. 1; Fig. 6, an enlarged detached view of the box which supports the upright shaft, and Fig. 7 an enlarged view of one of the buckets detached.

This invention relates to improvements in turbine water-wheels; and consists, first, in a mode of constructing the gates and devices connected therewith, whereby the friction is greatly reduced and leakage is avoided; second, in an improved mode of constructing the buckets and securing them in the wheel; third, in a new mode of introducing water-pressure under the wheel, for the purpose of relieving the stepping from friction and consequent wear; fourth, in introducing self-adjusting packing-rings between the wheel and its trunk, for the purpose of preventing leakage; fifth, in an improved mode of securing the wheel to its shaft, whereby it is easily detached therefrom for repairs, &c.; sixth, in a self-adjusting water-tight shaft-boxing, where the wheel emerges from its trunk.

The general form of this wheel bears a strong resemblance to some of those in common use.

My wheel, when constructed as represented in the accompanying drawings, is designed to be placed within the flume, in which case it will be entirely submerged, the shaft extending up through the water. With very slight changes, however, in the construction of the trunk, it might be equally well adapted to be placed outside of the flume, in which case the cap which overlays the wheel might be dispensed with.

The trunk A, by which water is supplied to the wheel, has upon its under side a cylindrical flange, B, which fits into a circular opening in the bottom of the flume, through which the water escapes from the wheel and passes off under the bottom of the flume. This trunk is in the form of a double scroll, having two chutes, C, each of which extends half-way round the wheel, two gates, D, being employed to open and close the chutes. Any other number of chutes, with a corresponding number of gates, may, however, be used, if desired. These gates are of the kind known as oscillating, being sections of cylinders, which are pivoted to the trunk at the bottom, and at the top to the detachable gate-caps E.

These gate-caps fit into circular openings in the top of the trunk, and are held down by screw-bolts. These openings in the trunk are a trifle larger than the gates, and upon removing the caps E the gates may be conveniently removed from the trunk. The gates are formed with disks F at top and bottom, which are of a little less diameter than the cylindrical portions, the bottom disks occupying recesses in the bottom of the trunk, and the upper ones fitting loosely into the circular openings in its top, which openings are closed by the gate-caps; a little vacant space being allowed between the lower disks and the bottom of the trunk, and between the upper disks and the gate-caps, and also all around the edges of the flanges, to prevent the movements of the gates from being impeded by deposits of mud, sand, &c. There is also a little space between the faces of the gates and the trunk, both at top and bottom, at G, so that the pressure of the water upon the gates shall be sustained by the trunnions, in order to avoid friction in opening and closing. A further advantage which is secured by this mode of construction is, that while the disks revolve freely within the recesses formed for them, as described, the cylindrical portions of the gates projecting out beyond them, and their front edges being properly beveled, make a fair joint with the back side of the trunk in closing.

For the purpose of avoiding leakage between the gates and the breast of the trunk, I introduce the self-adjusting packing-rods H, which are set in grooves in the bed-pieces I, the bed-pieces being riveted or bolted to the trunk. Both the packing-rods and bed-pieces should be of brass or other metal which will not be corroded by the action of the water.

In order to render these rods self-adjusting, space is left back of them in the grooves in the bed-pieces, into which water enters through holes J, which presses them up against the gates, and yet will allow them to yield a little to compensate for the wearing away of the trunnions or any irregularities in the construction of the parts. Should these water-passages be found liable to become clogged with mud or otherwise, thus rendering the water-pressure inefficient for the purpose stated, springs of india-rubber or other material for holding these packing-rods up against the faces of the gates may be substituted.

I propose also to use springs to sustain the weight of the gates, and thereby avoid the friction which would arise from their bearing upon the bottom of the trunk. These springs may be of the form which is represented at *a*, which is flat, and perforated at its middle point to receive the trunnion of the gate, its ends bearing upon the bottom of the trunk, and supporting the weight of the gate at its center; or they may be of the spiral form, like that shown at *b*, which surrounds the gate-trunnion, its foot resting upon the gate-cap, and acting upward upon the crank L.

To the upper gate trunnions or spindles K are fixed the cranks L, which are joined by the connecting-rod M, in order that the gates may open and close simultaneously. This rod is in two parts, said parts being united by means of a reversible nut, N, which is screwed upon them, the screw upon one part being a right and that upon the other a left hand screw. Upon turning this nut in opposite directions the rod will be lengthened or shortened, as the case may be, by which means the gates may be adjusted, so that they will both be closed at the same instant. One of the gate-trunnions extends up some distance through the crank at O, and is made square, in order that power may be conveniently applied for operating the gates.

It will be seen by a glance at Fig. 1 that the gates, which are represented as being open, will be closed by turning them upon their trunnions through an arc of ninety degrees, or to the position shown in dotted lines.

Upon the trunk A is placed the circular disk or wheel-cap R, which, in conjunction with the trunk, entirely incloses the wheel. The upright tube S, which is flanged and bolted to the cap R, serves as a bearing for the upper end of the wheel-shaft T, the foot of the shaft having its step in the hub at the junction of the cross-arms U of the trunk.

A self-adjusting tubular packing-box, V, which is shown in a magnified view at Fig. 6, is carried upon the shaft T, which forms a water-tight joint between the shaft and the tube S. The outer circumference of this box is of the form known as the "anti-friction curve," the top of the tube S being bored out trumpet-shaped to receive it. This box is prevented from turning upon the shaft, upon which it fits loosely, by the screw-bolt W, the point of which enters a longitudinal slot in the shaft, by which the box is allowed a little end play, to compensate either for the wearing down of the shaft, or any depression which might take place in the cap R, owing to the weight of the water upon it. The wheel is formed of two disks, X, the curved-faced buckets Y, placed vertically between them, and the flanged screw-bolts Z, by which the disks are bound together, and the buckets held firmly between them. The upper disk is provided with arms, and a large flattened eye or hub, A′, which rests upon a broad flange, B′, formed upon the shaft, to which it is secured by screw-bolts C′.

Should it ever be required to remove the wheel from the trunk, it will only be necessary to unscrew the bolts which hold down the cap R, and also the bolts C′, by which the wheel is secured to the shaft, when both the wheel and the cap may be lifted up to any height which may be desired.

Fig. 4 represents another mode of attaching the wheel to the shaft, which is by a conical joint, a notch in the bottom of the hub of the wheel fitting over a pin in the shaft to prevent the wheel from turning thereon. Upon lifting the wheel a little upon the shaft, it is immediately detached therefrom, and may be lifted up as before. The faces, as also the backs of the buckets, are semi-cylindrical, the back of each being elongated, extending into the face of the next one to it, so as to form semicircular channels between them of uniform width. The aggregate sectional area of all these channels should be equal to twice the aggregate sectional area of the two chutes C in the trunks, as will appear hereafter. The buckets Y have flanges at top and bottom, which flanges fit tightly between the fillets, which project from the edges of the disks, by which they are held firmly in their proper positions.

The lower disk of the wheel occupies an annular recess in the bottom of the trunk, in which it fits loosely, a considerable space being left under it to allow for the wearing down of the stepping.

The inner edge of the trunk projects inward beyond the inner edge of the lower disk of the wheel, and upon this projection rests the self-adjusting packing-ring E′, which serves the double purpose of preventing leakage and causing the water to exert an upward pressure upon the wheel, thereby relieving the stepping of much friction, and consequent wear. This lifting pressure is due to the water being prevented by the ring from escaping from the chamber under the wheel, while it is allowed free admission thereto through the annular space between the wheel and the

trunk. The inner edge of the disk, as also the outer circumference and bottom of the packing-ring, is truly turned, and fits closely, to allow of the least possible escape of water.

It will be seen that the packing-ring touches the bottom of the trunk only at its outer edge; therefore the small amount of water which may escape under it can exert no lifting pressure upon the ring. It is also apparent that as the outer circumference of the ring is truly cylindrical, the water can exert no downward pressure upon it; therefore the ring will be free to move to adapt itself to any changes in the position of the wheel, owing to unequal wear upon the stepping or other causes, with no other resistance to its motion than that which is due to overcoming the friction which is caused by its own weight.

The self-adjusting packing-ring F′, which rests upon the top of the trunk and encircles the upper disk of the wheel, serves to prevent the water from escaping between the trunk and the upper disk, as does the ring E′ to prevent leakage from the water-chamber under the wheel.

It will be observed that the water, in its efforts to escape from the trunk, will exert a lifting pressure upon this ring, tending to raise it from its seat, and it will, therefore, be necessary that the weight of the ring should be sufficient to preponderate over the upward pressure of the water, the amount of which pressure will correspond to the width of the space between the wheel and the trunk.

The advantage gained by the use of these packing-rings is, that while very tight-fitting joints are secured, the wheel may be allowed a considerable amount of play in the trunk, so that it will not be thrown in contact therewith in consequence of any unequal wear upon the stepping or the settling of the foundation, &c., from which causes much difficulty is often experienced.

Having described the mechanical construction of my wheel, I will now proceed to explain the principles upon which the water acts in propelling it.

It was stated above that the aggregate sectional area of all the channels between the buckets should be double that of the two chutes in the trunk, through which water is supplied to the wheel. In connection with the above, I will make the further statement that the velocity of the wheel, in order to obtain the maximum amount of power, or an amount equal to the whole momentum or living force of the water acting upon it, must equal one-half the velocity of the water at the instant of contact with the buckets.

I will next undertake to explain why it is necessary that the aggregate sectional area of all the channels through the buckets should be equal to twice that of the chutes.

Suppose, now, that the wheel is barred so that it cannot move, and that the gates are opened; we shall find that as the water flows through the buckets with the same velocity as in the chutes, so long as the wheel remains stationary, the water will only one-half fill the water-channels, the remaining one-half of each channel remaining empty; but on allowing the wheel to run with its maximum speed of half that of the water, the velocity of the water in its passage through the buckets will be only half what it was while the wheel remains stationary. Therefore its volume will be double, and consequently will exactly fill the channels, thus excluding all backwater from the wheel, which, were it allowed to be carried around with it, would, by its centrifugal force, greatly impede the passage of the water through the buckets, and thus reduce the power of the water upon the wheel.

A still further advantage which is derived from this mode of construction is, that the wheel becomes self-regulating, and needs no governor to adapt it to ordinary purposes. To illustrate: Suppose the wheel is running at its proper speed of one-half the velocity of the water, when, as stated, the water will exactly fill the space between the buckets. Now let a portion of the load be removed from the wheel; the result will be that its motion will be slightly increased, when the velocity of the water through the buckets will be correspondingly reduced, and its volume, were there room for it in the channels, would be further increased; but the channels being already full, no more water can enter, and there is consequently a back-pressure upon the water in the chutes, which greatly reduces its power upon the wheel, and prevents any further acceleration of its motion.

On the other hand, suppose we increase the load upon the wheel, which will check its velocity; the consequence will be that the velocity of the water, in passing over the buckets, will be increased correspondingly, and since the centrifugal force of the water increases in the ratio of the square of its velocity, it is plain that we have a greatly-increased power, tending to bring its motion up again to the maximum.

Having thus described my invention, what I claim as new is—

1. In combination with the chute C, the buckets Y, of the form shown and described, having circular passages of uniform width, the sectional area of which in the aggregate is double that of the chutes in the aggregate, substantially as described.

2. The buckets Y, constructed with flanges y', and in combination therewith the flanges y'', raised upon the edges of the disks X.

3. The gate D, constructed with the disks F, the periphery of the gate having a less diameter than the openings which they occupy in the trunk, and a longer radius than the periphery of the disk F, for the purposes set forth.

4. The detachable gate-cap E, combined with the gate D and trunk A.

5. The self-adjusting packing H, with wa-

ter-passages J behind it, combined with the water-gate of a hydraulic motor.

6. The self-adjusting packing-rings E′ and F′, substantially as set forth.

7. The self-adjusting box V, substantially as set forth.

8. In combination with the flange B′ of the shaft T, the flattened hub A′ of the wheel, resting upon said flange, and secured thereto by bolts, whereby the wheel may be raised from the shaft without disturbing the same, substantially as described.

Subscribed and sworn to this 26th day of March, 1875.

JEARUM ATKINS.

Witnesses:

A. WATSON,

C. T. GARLAND.