No. 734,673. PATENTED JULY 28, 1903.

W. O. CROCKER.

TURBINE WATER WHEEL.

APPLICATION FILED AUG. 10, 1896.

MODEL.

Fig. 1.

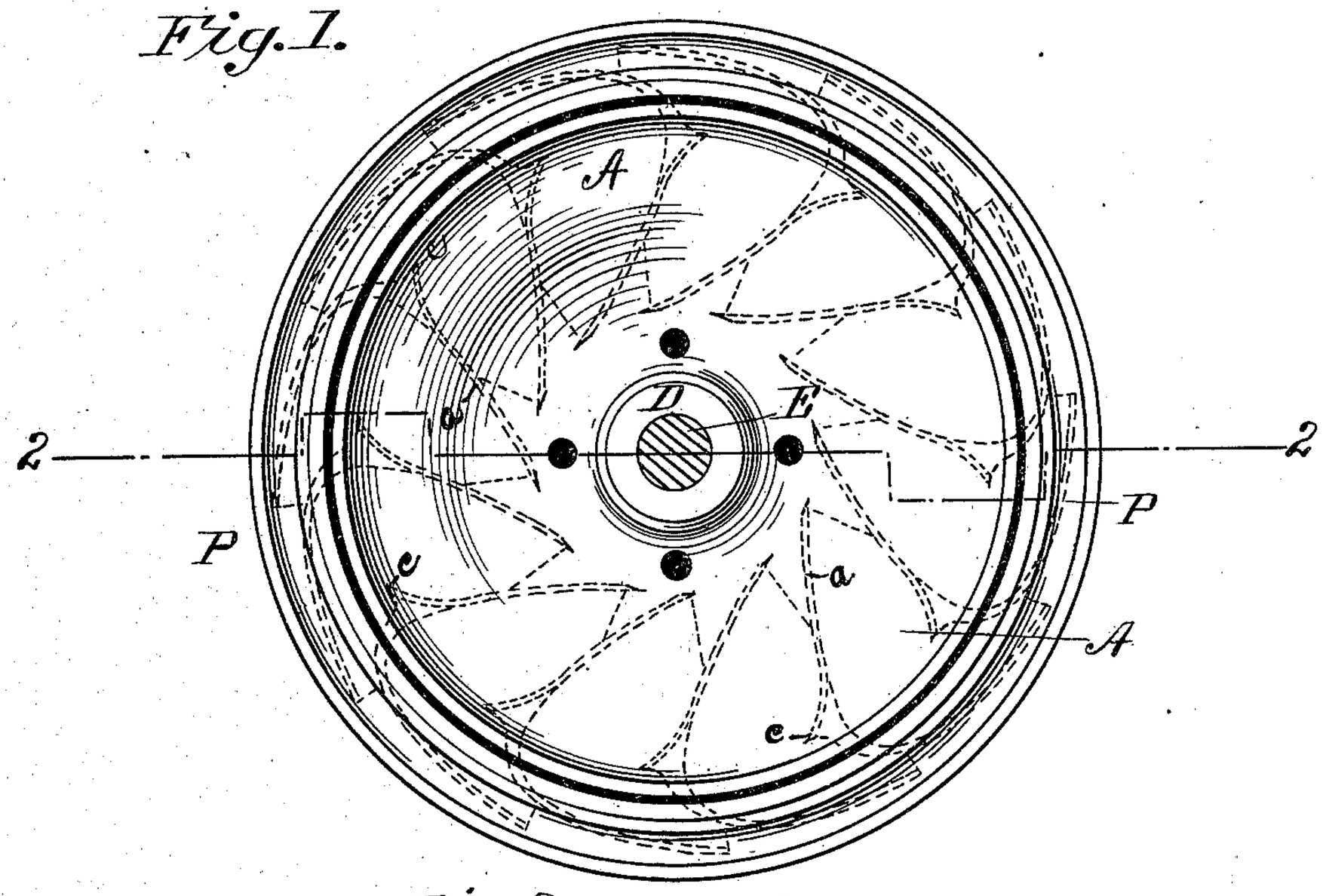

Fig. 2.

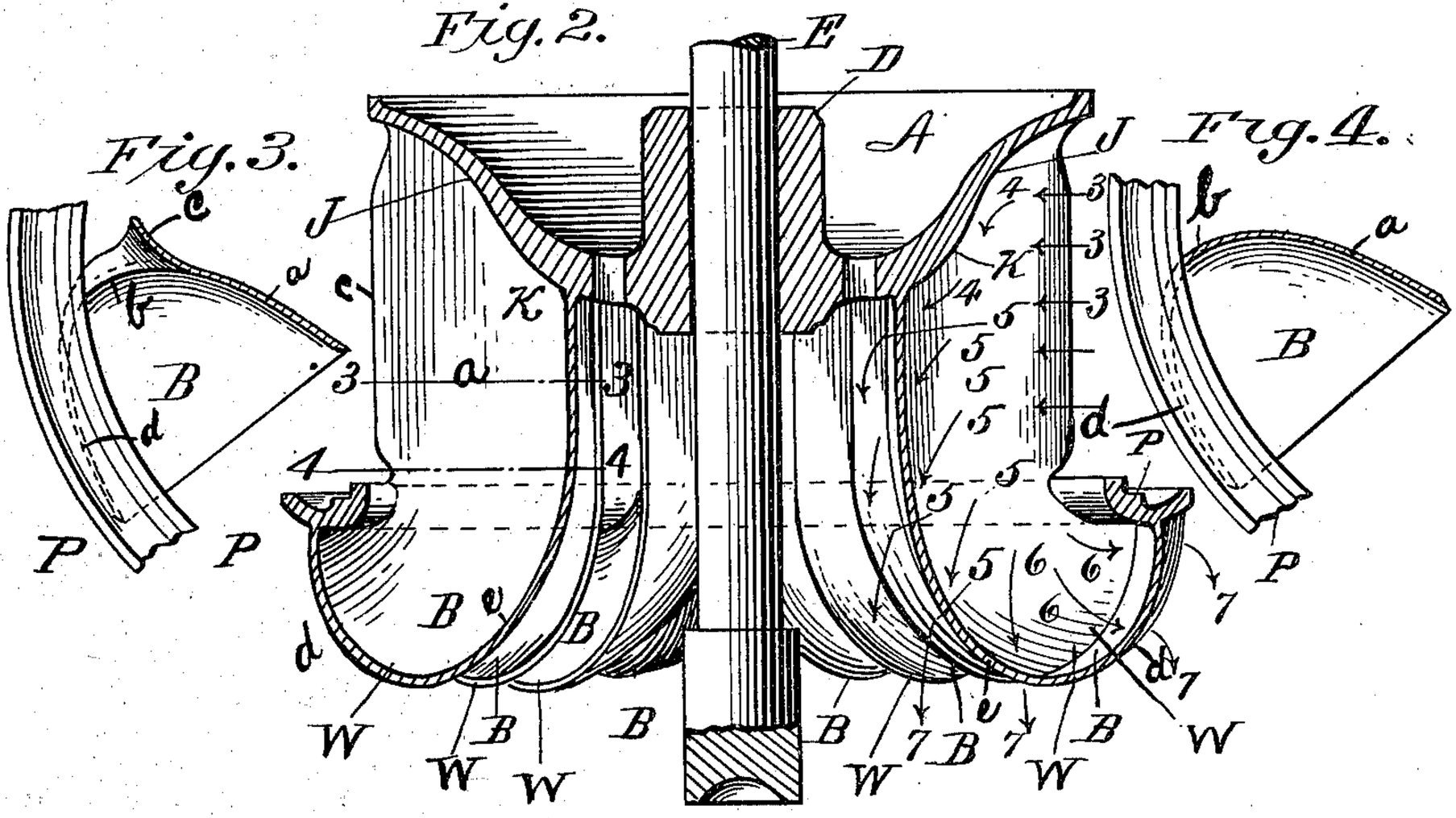

Fig. 3.

Fig. 4.

Fig. 5.

Witnesses:

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No. 734,673. Patented July 28, 1903.

UNITED STATES PATENT OFFICE.

WILLIAM O. CROCKER, OF TURNERS FALLS, MASSACHUSETTS.

TURBINE WATER-WHEEL.

SPECIFICATION forming part of Letters Patent No. 734,673, dated July 28, 1903.

Application filed August 10, 1896. Serial No. 602,259. (Model.)

To all whom it may concern:

Be it known that I, WILLIAM O. CROCKER, a citizen of the United States of America, residing at Turners Falls, in the county of Franklin and State of Massachusetts, have invented new and useful Improvements in Turbine Water-Wheels, of which the following is a specification.

This invention (for which a patent was granted to me by the Dominion of Canada on May 19, 1896, No. 52,308) relates to water-wheels, and particularly to that class thereof known as "turbine-wheels," the object being to provide a wheel of this class so constructed as to the buckets and other parts thereof as to increase its efficiency and at the same time to produce a wheel of simple and economical construction; and the invention consists in the peculiar construction and arrangement of the parts of the wheel, all as hereinafter fully described, and more particularly pointed out in the claims.

In the drawings forming part of this application, Figure 1 is a top plan view, and Fig. 2 is a vertical sectional view on line 2 2, Fig. 1, of a turbine water-wheel embodying my improvements. Fig. 3 is a sectional view of one of the buckets on line 3 3, Fig. 2, showing also a portion of the band. Fig. 4 is a view similar to Fig. 3, but taken on line 4 4, Fig. 2. Fig. 5 is a perspective view of a section of said band.

In the drawings, A is the crown of the wheel. D is the hub through which the shaft E passes and to which the wheel is secured in the usual manner. B indicates the buckets of the wheel, and P the circumferential band surrounding the outermost extremities of the buckets. Said crown, hub, buckets, and band are all formed integrally, being cast as one piece, and thus constitute a strong and rigid wheel.

The under surface of the crown A, as shown in Fig. 2, is formed with reverse or concavo-convex curves, (indicated, respectively, by J and K,) and said surface configuration of the crown causes the water (which enters the buckets under and near the crown, as indicated by the arrows 3, Fig. 2) to subsequently take the courses indicated by the arrows 4, the latter indicating the direction of flow against the crown and that part of the bucket immediately adjacent thereto. The subsequent direction of flow is indicated successively by the arrows 5 and 6. The arrows 7 indicate the direction of the outflow at different points on the discharge end of the bucket.

The buckets are arranged in a circle under the crown, their positions being shown clearly in dotted lines in Fig. 1 and in elevation in Fig. 2. Water entering the buckets, as clearly indicated by the arrows on Fig. 2, will upon entering strike the crown and be thereby guided first centrally, then downwardly and outwardly, and finally upwardly under the band P.

The buckets arranged about the shaft E have their upper ends secured to the surfaces of the crown-piece A. These buckets consist of vertically-arranged side walls *a* at their upper portions, which are concave on their impact-faces and together with the curved portion *b* form a water-pocket which in cross-section has the form of a parabolic curve, as shown in Figs. 1, 3, and 4. The outer edge of the buckets B, against which the water first impacts, is curved outwardly to form a lip, as at *c*, in the direction of the movement of the wheel. This reversely-formed or outwardly-extending portion *c* at the outer edge of the bucket serves to direct the full volume of the water into the impact portion of the bucket and prevents loss of the power by the otherwise possible impact of the water against the back of the buckets, and a better pressure is obtained by confining the full force of the water to the impact-surfaces. At their lower extremities the side walls *a* terminate in the curved portions *d* and *e* to form a water-pocket W, which receives the water which has not escaped from the upper portion through the vertical openings above the said curve *e* in order to utilize the full force of the water, which finally escapes through the space adjacent to the curve *d*. This curve is integrally joined with the rim P, which extends within the bucket to retard the upward flow of the water which has been retained within the bucket and prevent its interference with the incoming water in the upper portion of the said bucket. It will be seen that by these curves the water is given a circuitous passage at all points of which it exerts pressure

against the various parts of the buckets, the general direction of the flow being indicated by the arrows 3, 4, 5, 6, and 7.

The crown to which the upper ends of the buckets are secured is made with a reversed curve in order that the water may take a direction of discharge toward the axis of the wheel along natural lines, whereby choking of the discharge below the band may be prevented. The edge of the buckets against which the water impacts first curves forwardly in the direction of movement of the wheel and presents a reversely-curved impact-surface to the water, whose discharge is central and at a sharp angle to the axis of the wheel. The forward edge of the bucket above the ring curves forward beyond the deepest part of the bucket below the ring in order that it may cut the water at the angle of least resistance.

The discharge from the upper portion of the bucket is central, from the middle portion it is downward, and from the lower and outside portion of the bucket is outward and upward. Hence to give free course to the latter part of the discharge the under surface of the ring must curve outwardly and upwardly.

To provide for the spreading of the discharge, as described, the buckets are formed, as shown—viz., on parabolic curves—whether viewed in a plane vertical to the direction of movement of said buckets or viewed in section on a vertical plane bisecting at right angles to the radius the discharge end of the bucket below the ring or viewed on a plane cutting through that portion of the buckets between the crown and the ring and at right angles to the axis. From all these points of view the walls of the bucket will be found formed, as stated, on a parabolic curve or on two of them combined.

When the bucket is viewed, for instance, in end elevation, as it recedes the rear edge will be seen to be composed of two parabolic curves which meet at the center of the lowest part of the bucket. Both of these curves are the same, however, and if the short one were prolonged it would be identical with the longer one on the opposite side. In the cross-section through the vertical wall of the bucket between the ring and crown the said wall shows only a slight recurve of the side toward the rear, which is given to the inner edge to insure a proper rearward discharge of the water. These parabolic curves are used because in practice they have been found the most efficient in effecting the distribution of the discharge. Wheels built as above described provide for perfect clearance over the rearward edge of the bucket along the lines of direction stated above and provide a greater area of effective impact-surface and a greater area of discharge relative to the impact-surface than any known to me.

Having thus described my invention, what I claim, and desire to secure by Letters Patent of the United States, is—

1. A turbine water-wheel comprising an integral structure having a crown-piece provided on its lower surface with a compound curve downwardly disposed, a series of buckets depending from said surface and having a rearwardly-flaring lip at their upper outer edges, a lower pocket formed of two parabolic curves, and a band integral with the outer edge of the pocket and extending within the same, the band as a whole being vertically external to the crown.

2. A turbine water-wheel comprising an integral structure having a crown-piece provided on its lower surface with a compound curve downwardly disposed, a series of buckets depending from said surfaces, the upper walls of which are formed of a parabolic-curved surface, and having a rearwardly-flared lip at their upper outer edges, a lower pocket formed of two parabolic curves, and a band integral with the outer edge of the pocket and extending within the same, the diameter of the inner edge of the band being greater than the external diameter of the crown.

3. A turbine water-wheel consisting of a bowl-shaped crown, the under surface of which is formed with reversed curves to guide the water at that point inwardly, downwardly and centrally, a band on the edge of the buckets whose under surface is formed in a curve having an increasing radius toward the outlet of the band, and which constitutes practically a continuation of the edge of the bucket, in combination with a bucket whose rear edge from a point above the band to the top of the bucket turns rearwardly.

4. A turbine water-wheel consisting of a bowl-shaped crown, the under surface of which is formed with reversed curves to guide the water at that point inwardly, downwardly and centrally, a band on the edge of the buckets whose under surface is formed in a curve having an increasing radius toward the outlet of the band, and which constitutes practically a continuation of the edge of the bucket, in combination with a bucket whose rear edge from a point above the band to the top of the bucket turns rearwardly; the discharge edge of the bucket being so disposed that the water may move successively from the crown first centrally, then downwardly, and outwardly, and finally upwardly under the band.

WILLIAM O. CROCKER.

Witnesses:
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