

D. B. REPLOGLE.  
WATER WHEEL.  
APPLICATION FILED JULY 7, 1909.

1,036,003.

Patented Aug. 20, 1912

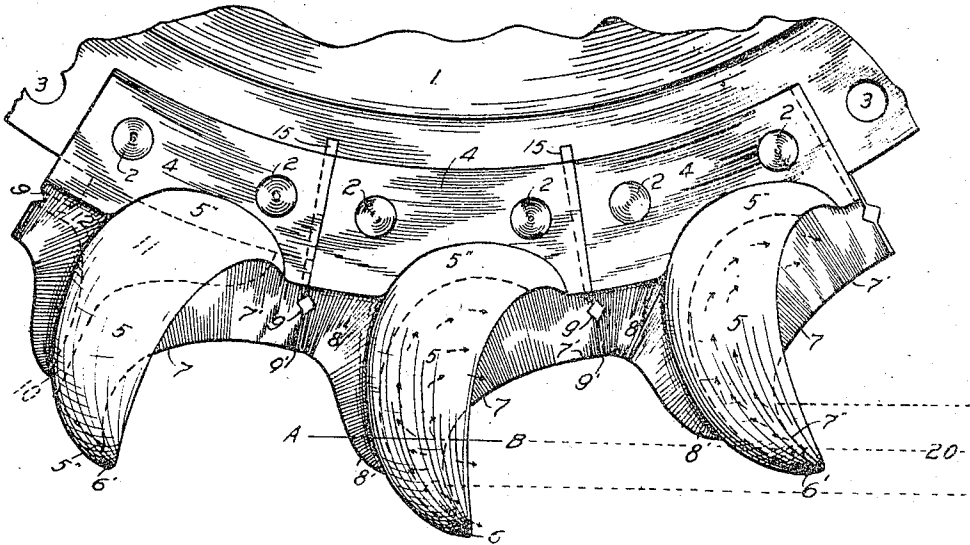


Fig. 1.

Fig. 3.

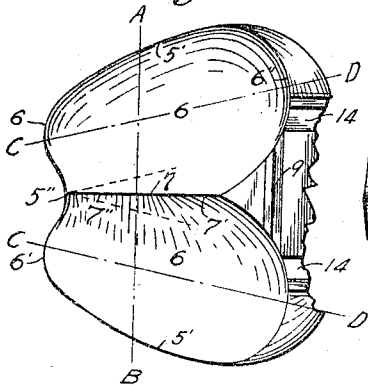


Fig. 2.

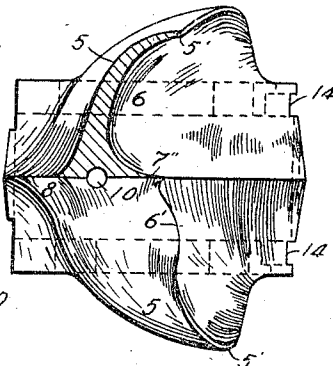


Fig. 4.

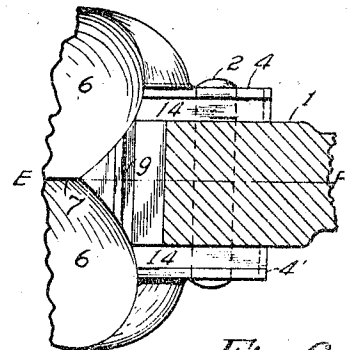


Fig. 5.

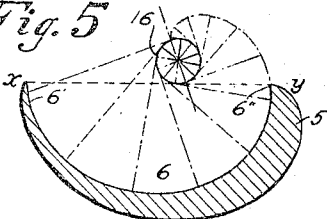


Fig. 8. Fig. 7.

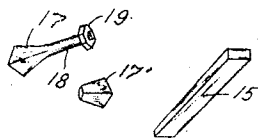
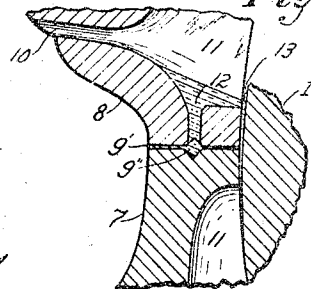


Fig. 6.



WITNESSES:

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## UNITED STATES PATENT OFFICE.

DANIEL BENSON REPLOGLE, OF BERKELEY, CALIFORNIA.

WATER-WHEEL.

1,036,003.

Specification of Letters Patent.

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*To all whom it may concern:*

Be it known that I, DANIEL BENSON REPLOGLE, a citizen of the United States, residing at Berkeley, in the county of Alameda and State of California, have invented a new and useful Water-Wheel, of which the following is a specification.

This invention relates to improvements in water wheels and buckets, in the type of wheel known as hurdy-gurdy or tangential; and the objects of the invention are, the elimination of improper angular obstructions curtailing efficiency, the construction of every part of the exposed surface of the bucket so as to offer least resistance to air and water in revolving, to preserve the maximum efficiency throughout the arc of stream engagement, and to provide means for rigid attachment to the rim and solid impingement of the several buckets to consecutive ones on the entire periphery of the wheel. These improvements are attained by the construction herein set forth and illustrated in the accompanying drawing, in which—

25 Figure 1 is a side view of three consecutive buckets of a tangential water wheel, constructed and attached according to my invention, the action of the same being partly illustrated by dotted lines; Fig. 2, 30 a front view, partly in cross section of one of the buckets sectioned on the line A B of Figs. 1 and 3; Fig. 3, a top plan view of the basins or upper face of one of my buckets; Fig. 4, a top plan view of the connecting lugs of the bucket secured to a portion of the rim shown in cross section; Fig. 5 shows a cross section taken on the line C D of Fig. 3, and especially showing the longitudinal curvature of the bottom of the basin and the 40 method for determining said curvature; Fig. 6 is a view in cross section of portions of two consecutive buckets taken on the line E F of Fig. 4, and showing the method of completing impingement between two consecutive buckets; Fig. 7 shows a wedge or key 45 used in securing the buckets; Fig. 8 shows the details of a form of bolt and washer which may be used as an alternative means for completing impingement.

50 Similar characters of reference refer to like or corresponding parts in the several views.

The rim or disk 1 is fitted with transverse pins 2, 2', etc., passing through drill holes 3 of the rim and corresponding holes in the lugs 4, 4' of the bucket. The pins may be

substituted by bolts if desired, but they are preferably headless and tight-fitting, extending but little if any beyond the surface of the lugs. The main body 5 of the bucket 60 is composed of two basins, 6—6' separated by a dividing jetty ridge 7, the vertex line of which ridge merges from a circumferential direction or vertical position at 7' to a radial direction or level position in the vicinity of 7'' and vanishes in an upwardly curved position at the recurved tip of the bucket 5''. The axes of the basins of the bucket converge from base to tip, the side walls of each approximating an ovoid in outline so that the capacity of each increases from tip to base. The curvature at the bottom of each basin is gradually increased from tip to base as shown in the cross section of one of the basins in Fig. 5. A proper curvature for this part may be projected or generated by using a circle 16 having a diameter of one sixth of the intended long diameter of the basin, as an evolute and that part of the evolvent used lying beyond the tangent X Y, the said tangent being extended in both directions and equaling in length six times the diameter of said circle. The transverse curvature of the bottoms of the basins may be similarly made as shown in the curve 7'' 5' Fig. 2, the steeper part of the curve in the transverse being in the middle, so as to more gradually lead the stream which is to be divided to the reverse tangential direction whence it came. The outer end of the curves at 5', as well as the balance of the external brims of the basins, terminate in a vertical or an approximately vertical aspect when the bucket is placed in the position shown in Fig. 2. The incurved part of the brims meeting at 5'' is gaged by means of a radius a little greater than half the diameter of stream to be used; and the aspect of the bottom wall at this point or lip is such as to be parallel to the stream at the initial of its engagement therewith, and the exterior surface in that vicinity merges into a bottom splitting ridge or keel 8', the surface and vertex of which also merge into the circumferential ridge 8 which is adapted to register with the similar upper ridge of a consecutive bucket as at 9', the vertex being in a circumferential line of the wheel plane. A bore hole or other opening 10 extends from the exterior of the bucket to the hollow cavity 11 of the interior, which cavity is made mainly for the purpose of

lighter construction and added strength, it having no communication with the basins of the bucket. A transverse groove 9 is cut in the registering faces of the bucket base and is communicated with by means of a bore hole 12 also leading to the interior 11. When the buckets are placed in position these grooves form a transverse hole, which may be square, round or other shape, and is adapted to receive an expanding bolt or other expanding material used for making solid attachment and perfect impingement.

The attachment of the bucket is effected as follows: The lugs are shaped so that the required number of buckets when placed on the rim of the wheel will approximately fit up as shown, the lug portions tapering on radial lines according to the curvature of the wheel. Each is first secured by the two pins; then wedges or keys 15 are driven into the grooves 14 each being driven radially outward, throughout the circumference of the wheel. In this way all the buckets are forced to draw outward on the transverse pins 2, 2, etc., tightly gripping on the outer ends of said pins. While held in this rigid condition, transverse bolts having heads as 17 may be inserted at 9, 9, etc., and with washer 17', placed on the shanks 18 may be drawn tightly at 9 by means of a nut 19, so that impingement is maintained at a point outward of the pins and each bucket is held securely from rocking or shaking by the consecutive buckets between which it is placed. Instead of the transverse bolts last named, hot Babbitt metal may be poured through the bores 10 and 12 and allowed to completely fill the groove 9 and any possible space at 9' between the buckets, at the same time filling any space as 13 which may exist between the lower portion of the bucket base and the outer edge of the rim 1.

It is evident many of the details may be varied according to the size of the wheel on which the buckets are to be used; for example in large sized buckets a square tubular hole would appear in place of the bore hole 10, and the inner sides of the lugs 4 might be bossed around the pins leaving a comparatively thin shell midway between the pins. It should be especially noted that impingement is effected well forward of the pins 2, 2, and approximately in the line of press are produced by the acting stream 20. The babbitt used should have a sufficient quota of antimony for to slightly expand during cooling and said babbitt may even take the place of steel or iron in the wedges 15. The strain tending to spread the buckets on the rim, whether caused by driving the wedges radially, inserting taper bolts or pouring expanding metal, tends to increase the diameter of the circle or arch in which the buckets are arranged thus cramping each out against its transverse pins or bolts. This

effect is important and securing it one, of the main objects of the invention. If the buckets are not so forced outward on their fastenings by means under control, the centrifugal force due to use will later force them outward and leave them in a rocking or loose condition. The curvatures detailed coöperate to keep the buckets secure, by reason of their modifying the impact so as to extract the power of the stream without its hammering shock. In the operation of this bucket it will be noted that at the initial part of its engagement the nearer half of the stream being received on a steep slope of the tip, by reason of the aspect of the bucket, is largely directed backward, the main portion of it leaving at 6". The greater curvature due to the involute shape maintains greater degree of impact throughout this range, by reason of compensating for decreasing radial distance from center of the wheel, and also for the slowing effect due to the friction of the water itself on the concave surfaces of the basins. The widening ovoid shaped form of the outlines and the downwardly curving brims of the outer side walls also furnish increased facility for efflux of the used water, to compensate for increased volume due to the slowing effect of the surfaces, on the stream. When the bucket is receiving the further or outer half of the stream, its basins are in a crowded condition, and the front or tip walls now being brought to a more favorable aspect for exit of the water, much of the latter water is discharged tangentially off the tips at 6', 6'. The inner surface of the side boundary rim of the bucket, being adapted to return the water in a direction parallel to the impact, would have a tendency to throw it forcibly against the outside walls of the next succeeding bucket and thus interfere with the efficiency of the wheel, but this tendency is obviated by tapering the bucket rapidly from base to tip making the basins ovoid as aforesaid, so that the water discharged by any side portion of the rims of said basins when directed backward parallel to the impact stream aforesaid, will pass said succeeding bucket in a latitude where it is narrower than that part of the preceding bucket whence it was ejected. The splitting ridge extending over the exterior bottoms of the buckets tend to reduce wind resistance and also aid in voiding spray water, which may be deflected into the wheel by neighboring wheels or defective wheel pit arrangements. Should the impact stream be directed tangentially too close to the wheel, this construction of bucket is adapted to void the water with less resistance than in constructions heretofore used, so that greater efficiencies may be attained through a larger range of nozzle positions; thus obviating the difficulties due to slight mis-

placements, of nozzle or wheel, at the time of installation, or afterward. When a broken bucket is to be replaced the babbitt 9" or expanding bolt 17 is first forced out from between adjacent buckets and one to be removed, the wedges or keys are then backed out and finally the pins driven out. In replacing, the pins are driven first, then the wedges and finally the babbitt 9" is poured in, or expanding bolt placed.

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

1. In combination with a water-wheel rim of a series of peripheral buckets, lugs on said buckets, and means for fastening said lugs to the rim, said lugs having registering faces with grooves, wedges fitting into said grooves and adapted to be driven radially outward, and having additional faces outward with transverse registering grooves, and expanding members in the last mentioned grooves, for the purpose specified.

2. In combination with a water-wheel rim having drill holes, a series of buckets with lugs having corresponding holes, pins extending through the holes and securing the buckets consecutively to the rim, bases on the buckets with hollow interiors and adapted to receive expanding metal to complete impingement of the buckets and force them into a greater circle, cramping the lugs on the pins aforesaid as specified.

3. In the bucket of a water wheel of the kind described, the combination of side walls having rims lying in curves dipping downward of a horizontal plane intermediate of the ends of the bucket outlining a pair

of intersecting ovoid shaped basins, a dividing jetty ridge separating said basins, said jetty ridge merging from a vertical position, to the axes of said oval basins to a level position longitudinal with respect to them and vanishing at the tip of the bucket, where the small ends of the oval basins intersect, substantially as specified.

4. In the bucket of a water-wheel, side walls and bottom walls delineating a pair of equal and similar intersecting basins, the side walls of each of said basins having surfaces conforming to involute curves increasing from sides inward as specified.

5. In a water wheel bucket of the kind described, side walls including a pair of ovoid shaped basins widening from tip to base, the bottoms of said basins increasing in curvature from tip toward base and from brim toward middle, and the outlines of said brims curved outward and downward in conformity to the depth of the basins aforesaid as and for the purpose specified.

6. In a water-wheel bucket of the kind described, side walls and bottom walls, a base or lug portion from which said walls project and said walls disposed to configure a pair of intersecting ovoid or egg-shaped basins with converging axes, their ampler ends contiguous to the base portion of the bucket and the side walls having brims dipping downward of a plane horizontal to said axes and in partial conformity to the depth of the basins substantially as specified.

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Witnesses:

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