No. 633,184. Patented Sept. 19, 1899.

W. A DOBLE.

TANGENTIAL WATER WHEEL.

(Application filed Jan. 19, 1899.)

(Model.)

Fig. I.

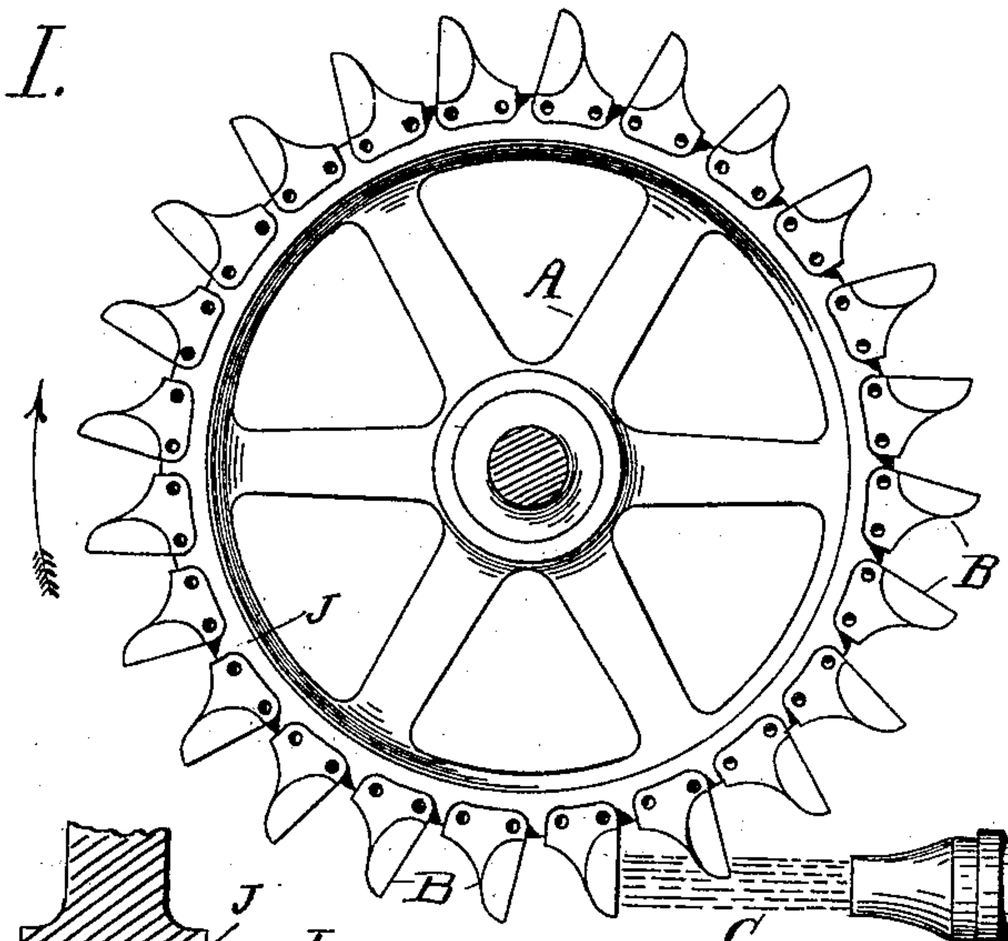


Fig. II.

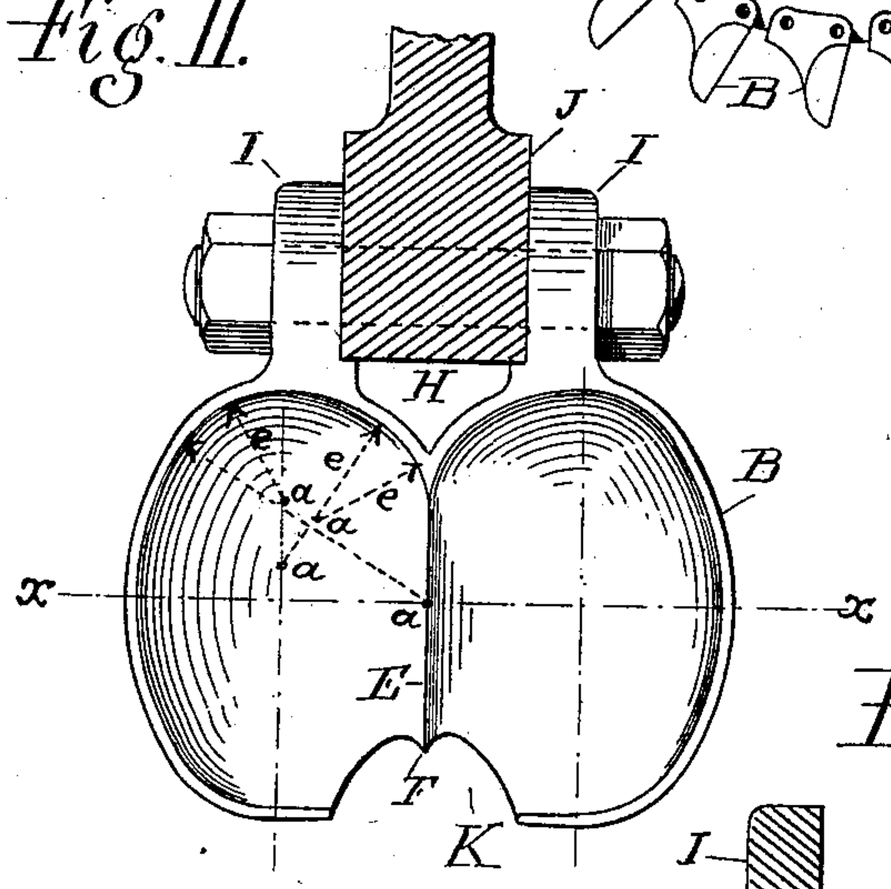


Fig. III.

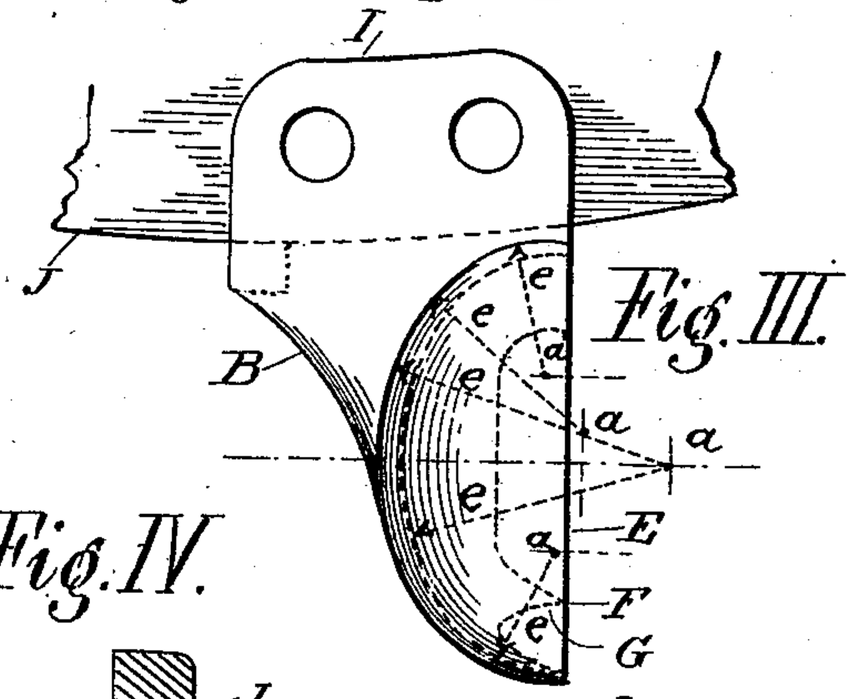


Fig. IV.

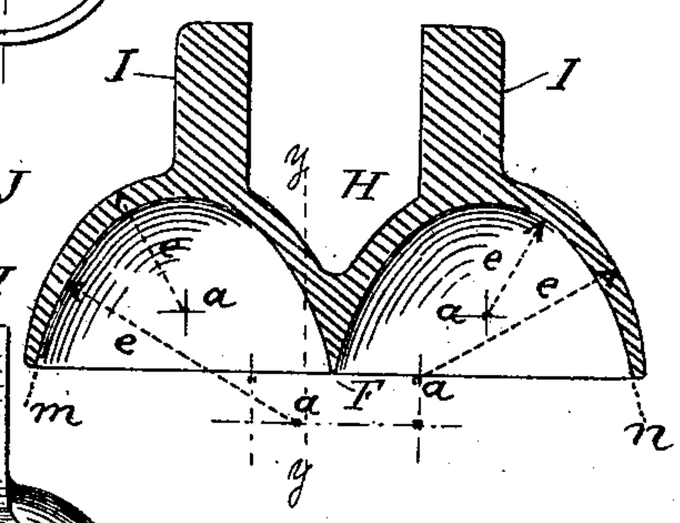


Fig. V.

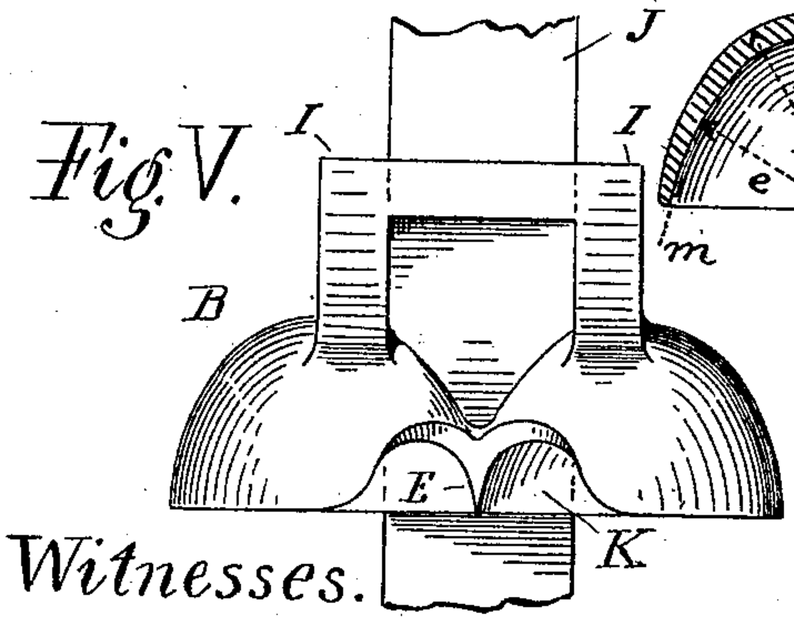
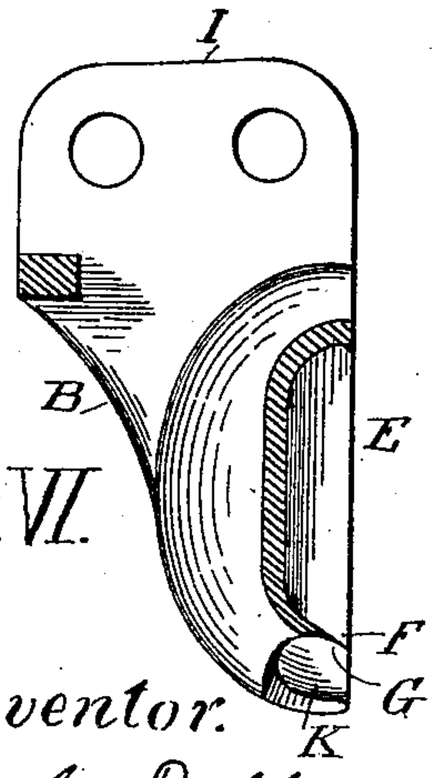


Fig. VI.



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UNITED STATES PATENT OFFICE.

WILLIAM A. DOBLE, OF SAN FRANCISCO, CALIFORNIA.

TANGENTIAL WATER-WHEEL.

SPECIFICATION forming part of Letters Patent No. 633,184, dated September 19, 1899.

Application filed January 19, 1899. Serial No. 702,707. (Model.)

To all whom it may concern:

Be it known that I, WILLIAM A. DOBLE, a citizen of the United States, residing at San Francisco, county of San Francisco, and State of California, have invented certain new and useful Improvements in Tangential Water-Wheels; and I hereby declare the following to be a full, clear, and exact description of the same, reference being had to the accompanying drawings, forming a part of this specification.

My invention relates to what are called "tangential" water-wheels, and especially to certain improvements in the form of the buckets for such wheels.

My improvements consist in forming such buckets with modified or elliptical instead of circular curves, so as to reverse the direction of the impinging stream on the lines of a true hydraulic curve, and thus secure the greatest value of the energy of the impinging stream in its impact on the bucket and of the reactive effect of the reversed stream. This is secured by causing the flow of the water in the buckets to be accomplished with the least possible disturbance of the stream and avoidance of eddy-currents or irregular flow, as is the result when buckets for this class of wheels are not designed as herein shown. By securing this flow free from eddy-currents in the buckets the efficiency of the wheel is materially increased, none of the energy in the stream being wasted or diverted by such losses. This has been demonstrated most successfully in the buckets constructed according to my methods, the increased efficiency gained having been very materially above the best results secured with buckets of other form and as hitherto constructed. In addition to this the regular flow free from eddy-currents in the buckets has lessened eroding or wearing effect, securing a much greater endurance of the buckets, reducing the cost of maintenance accordingly. This latter is of great importance where wheels are working under high pressures or when the water contains particles of grit or sand.

The improvement also consists in certain constructive features, hereinafter pointed out, being an improvement on my invention in water-wheels set forth in an application for Letters Patent filed on the 29th day of December, 1897, and serially numbered 664,344.

The object of my invention is to more effectually utilize the energy of the water than is possible by means of buckets having curves of equal radius.

To these ends I construct tangential-water-wheel buckets as shown in the accompanying drawings, forming a part of this specification.

Figure I is an elevation of a water-wheel provided with my improved buckets. Fig. II is an enlarged face or plan view of one of the buckets and a broken section of the wheel-rim, to which the buckets are attached. Fig. III is a side or edge view of one of my improved buckets. Fig. IV is a section on the line $x\,x$ in Fig. II. Fig. V is a bottom or reverse view of Fig. II. Fig. VI is a section on the line $y\,y$ in Fig. IV.

Similar letters of reference on the different figures indicate corresponding parts.

Referring to the drawings, A is a water-wheel, to the periphery of which is attached a series of buckets B, against which is directed a jet or stream of water C from one or more nozzles D in the usual manner of tangential water-wheels.

B represents the bucket, comprising a shell formed with two ellipsoidal cavities in close proximity centrally divided by a wedge-shaped ridge or projection E, standing in the plane of revolution of the wheel, the function of which is to split or divide the impinging stream C into two equal parts and initiate the deflection of these parts subsequently effected by the configuration of the said cavities, by which the direction of motion of said split portions is gradually changed to complete reversal. The form of the said cavities in two planes is indicated in Figs. III and IV and the face or rim in Fig. II, presenting ellipsoids of revolution developed from radii approximately as shown, so the curves traversed by the water after its impingement are the same in whatever direction it may flow.

In my application for Letters Patent hereinbefore referred to the buckets, while the same in general construction and disposition as those herewith illustrated, were formed with straight sides and bottoms, having circular curves only, and were based on the water

preserving during its flow over such surfaces a uniform velocity; but subsequent experiments have proved that a greater efficiency is attained by means of modified curves of an ellipsoidal form, as herewith presented and illustrated, known as the "hydraulic" curves for such surfaces. The curves shown in the drawings are those of an approximate ellipse empirically generated from centers marked *a* by the radii *e* in an example taken from practice, in which example the ratio of the axes of the generating-ellipse to each other approaches as near a ratio of equality as common practice admits. In other words, variations from the form shown are usually in the direction of an ellipse with greater variations between its major and minor axes, depending upon the size of the jets or streams and the size of the buckets in relation thereto. This ellipsoidal form of the surface, which guides and directs the flow of the water impinging on the buckets, produces a gradually-increasing deflection until the direction of flow is reversed, thus conserving the velocity of the jet with the least possible retardation and securing the maximum reactive effect thereby, avoiding irregular flow, and gaining a complete clearance of the water from the bucket after its energy is expended, also permitting a greater velocity of the wheel-rim in proportion to the head or pressure of the water and increasing the efficiency developed by the wheel.

The dividing-wedge E is so cut away at the bottom by a clearance-passage for the stream or jet through the bucket as to retreat upwardly and rearwardly from the extreme point F, as at G, whereby the said point or extreme of the wedge enters the jet or stream C in a manner to avoid disturbance or distortion of the water which has not previously come in contact with any part of the bucket. Below or beyond the end F of the wedge E the said clearance-passage is shown at K in Figs. II, V, and VI passing through the outer end of the bucket in such manner that the sides will not touch the impinging stream, but nevertheless furnish at each side in proper position the required surface for reactive discharge, which takes place approximately on the lines *m* and *n*, as indicated in Fig. IV. In this manner there is no division or disturbance of the stream except in the plane of the wheel's rotation, and it is to avoid this that the ends of the buckets are cut away at the bottom, omitting the usual end wall or other obstruction that enters and cleaves the stream transversely to the dividing-wedge E and directs it in various and devious ways before it is divided by this wedge.

The term "ellipsoidal" herein used to designate the form of the bucket-cavity is to be understood as including "paraboloidal," the paraboloid being of similar figure to the ellipsoid, generated by a similar conic section in revolution, and having the same properties in practice connected with hydraulics.

To lighten the buckets and render their section more uniform, also to prevent banking entrained water on their faces, I provide a central space H between the attaching-lugs I, that permits the passage of air and water between the lugs and around the wheel-rim J. This construction avoids inherent strains in casting, reduces the amount of metal in the buckets, and increases their strength.

I do not confine myself to the particular proportions here shown, as the radii of the curves can be modified without departing from the nature of my invention; but

What I claim, and desire to secure by Letters Patent, is—

1. A bucket for a tangential water-wheel, consisting of a shell comprising two ellipsoidal cavities in proximity, divided by a central wedge-shaped ridge in the plane of the wheel, said bucket having a clearance-passage for the impinging stream through said ellipsoidal portions at the outer extremity of said ridge, and means for attachment to said wheel, substantially as specified.

2. In a tangential water-wheel, a shaft, a rim supported on said shaft, a series of buckets, each consisting of a shell comprising two ellipsoidal cavities divided by a wedge E in the plane of the wheel, having a clearance-passage at the outer extremity of said wedge through the adjoining margins of said ellipsoidal cavities, and means for attachment to said rim, substantially as specified.

3. In a tangential water-wheel, a series of buckets each consisting of a shell comprising two ellipsoidal cavities in proximity divided by a central wedge-shaped ridge in the plane of the wheel, a clearance-passage for the stream at the outer extremity of said wedge-shaped ridge, through adjoining margins of the said ellipsoidal cavities, whereby the stream is partially surrounded by but not impeded by said cavities, the ridge alone encountering the stream and dividing the same, and the cavities serving to deflect the split portions thereof and gradually change the direction of their motion to reversal, substantially as specified.

4. In a tangential water-wheel, a series of buckets, each consisting of a shell comprising two ellipsoidal cavities with a central dividing-ridge, having a clearance-passage through the margins of said cavities at the outer extremity of said ridge, and lugs and bolts for attaching said buckets to said wheel, substantially as specified.

These features I believe to be novel and useful and ask that Letters Patent be granted therefor.

WILLIAM A. DOBLE.

Witnesses:
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