(No Model.)

J. B. McCORMICK.

WATER WHEEL.

No. 560,301. Patented May 19, 1896.

Fig-1-

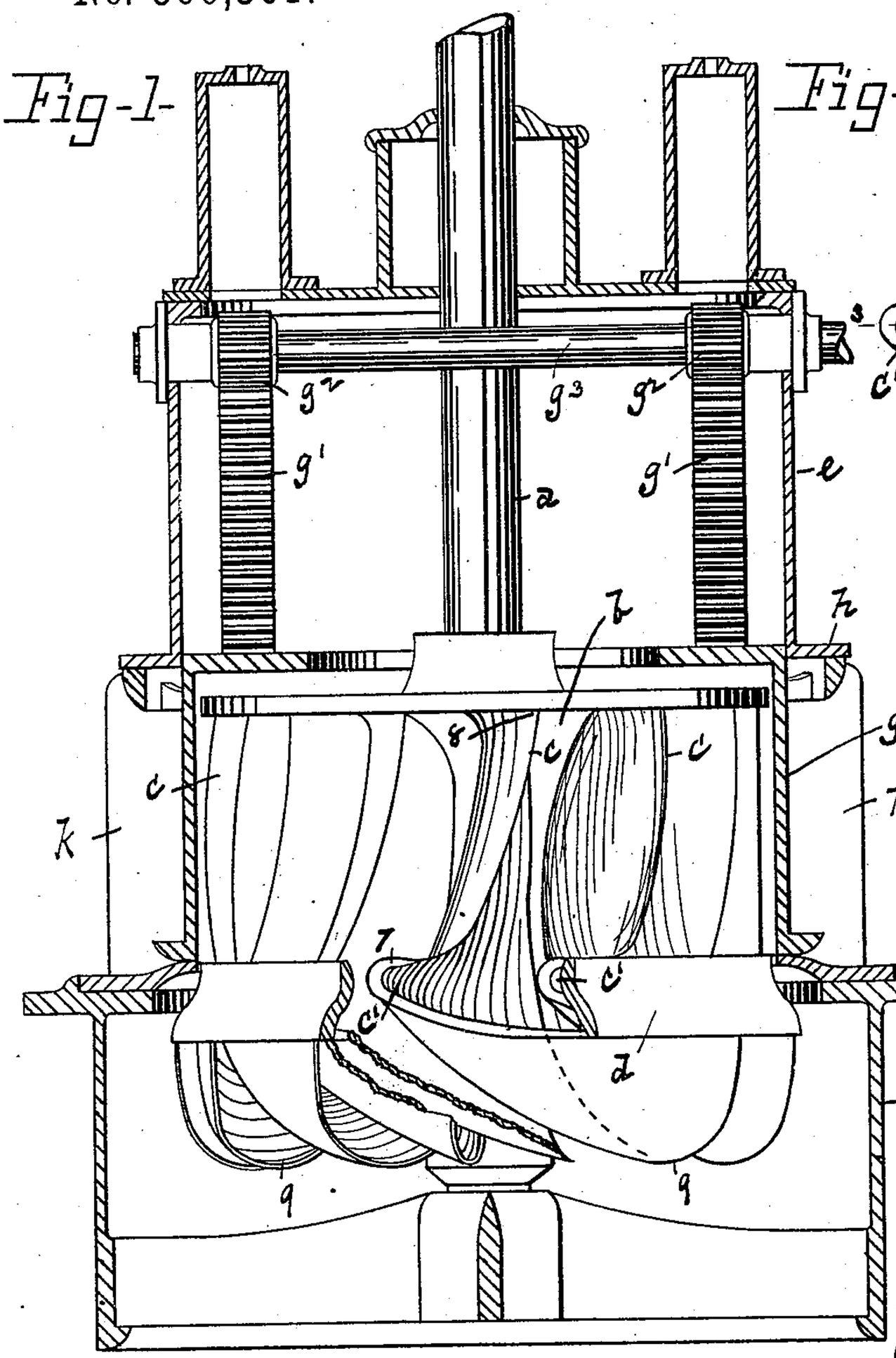


Fig-2-

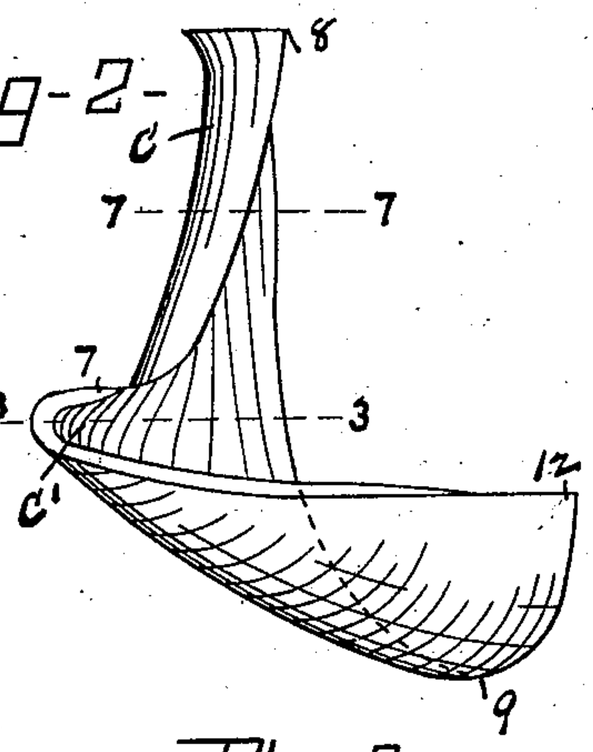


Fig-3-

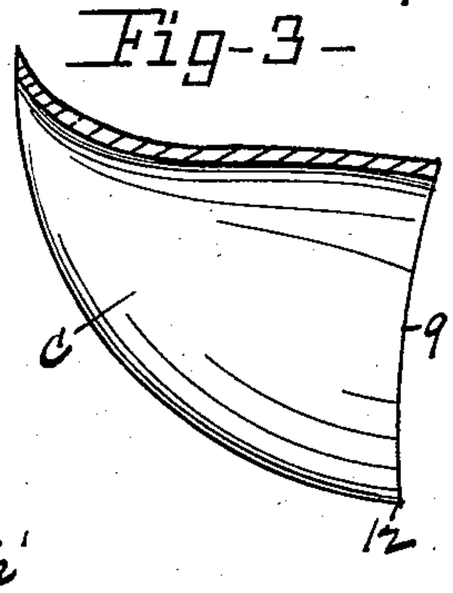


Fig-4-

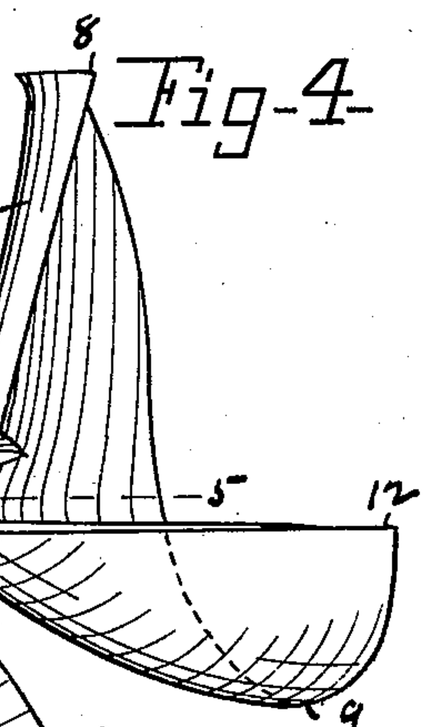


Fig-5-

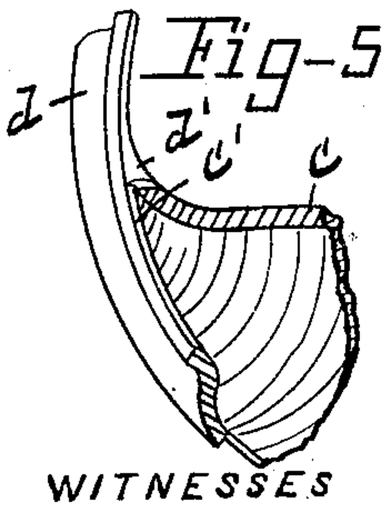
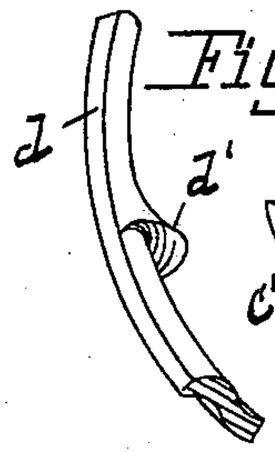


Fig-6-



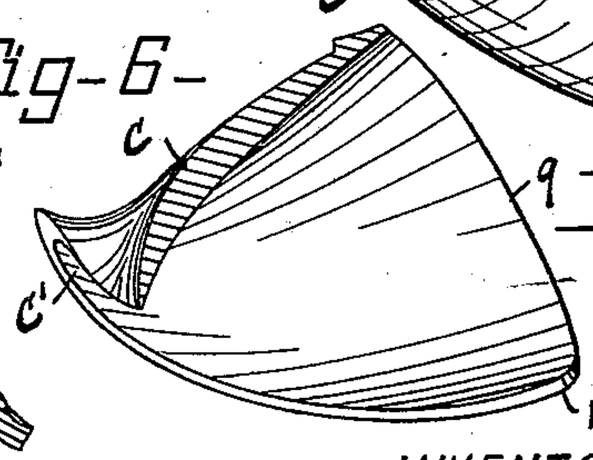


Fig-7-

WITNESSES

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JOHN B. McCORMICK, OF HOLYOKE, MASSACHUSETTS.

WATER-WHEEL.

SPECIFICATION forming part of Letters Patent No. 560,301, dated May 19, 1896.

Application filed April 8, 1892. Serial No. 428,268. (No model.)

To all whom it may concern:

Be it known that I, JOHN B. McCORMICK, of Holyoke, in the county of Hampden and State of Massachusetts, have invented a new and useful Improvement in Water-Wheels, of which the following is a specification, reference being had to the accompanying drawings, forming part thereof.

My invention relates to turbine water-wheels, and particularly to that class of such wheels known as "side-supply" wheels, in which the water is received upon the buckets thereof in a horizontal or substantially horizontal plane, as distinguished from those wheels which receive their water vertically.

The object of the invention is to provide a water-wheel of this character with buckets so shaped as to prevent the formation of eddies in the water in front of said buckets, the term "front" being herein used with reference to the direction in which the buckets move in the operation of the wheel.

A further object is to provide a wheel of this description with buckets so shaped as to present a more or less oblique surface to the impelling column of water from the time the latter first engages the acting face thereof until it is discharged therefrom, and thereby ovent a direct impact of the water against he bucket in a plane perpendicular to the ting face thereof, whereby all shock to the heel is avoided and the percentage of use- l effect derived from the water is increased.

To these ends my invention consists in the water-wheel constructed and operating as hereinafter fully described, and particularly pointed out in the claim.

Referring to the drawings, in which like letters designate like parts in the several figures, Figure 1 is a side elevation of a water-wheel embodying my invention and a vertical section of its case, a portion of the band and parts of two of the buckets being broken away for the sake of clearness. Fig. 2 is a side elevation of one of the buckets removed from the wheel as the same appears in looking radially toward the wheel-hub. Fig. 3 is a cross-section of said bucket, taken upon line 3 3 of Fig. 2. Fig. 4 is a view similar to Fig. 2, showing a slight modification in one portion of the bucket. Fig. 5 is a plan view of a portion of the wheel-band and a partial cross-section of the bucket shown in Fig. 4, taken upon line 5 5 of said figure. Fig. 6 is a view in perspective of a portion of the band used in connection with the bucket shown in Fig. 4. Fig. 7 is a cross-section of the bucket shown in Fig. 2, taken upon line 7 7 of said figure.

The letter *a* designates the wheel-shaft, *b* the conical hub, *c* the buckets, and *d* the band, of a water-wheel embodying my invention. Said wheel is shown in Fig. 1 as being set in a case, of which *e* is the dome; *f*, the draft-tube; *g*, the cylinder-gate, operated by the racks g' and pinions g^2 on shaft g^3; *h*, the upper guide-rim; h', the lower guide-rim, and *k* the tangentially-disposed guides or chutes which direct the water to the wheel; but it will be understood that any form of case, gate, and guides can be employed which are adapted to be used with a side-supply wheel.

The receiving portion of the buckets *c* is that portion between the upper side of the band *d* and the top of the bucket, or between the points 7 8, Fig. 1, and the discharging portion thereof is that portion between the lower end of said receiving portion and the lower end of the bucket, or between the points 7 9, Fig. 1.

Heretofore, so far as I am aware, all side-supply wheels have had their discharging portion located wholly to the rear of the vertical plane of the receiving portion, said portions being united either by an obtuse angle or by a downward and rearward curve, thereby forming a pocket at the front side of the bucket, in the angle formed by the bucket with the encircling band, within which pocket, as the wheel revolves, is formed an eddy of water which tends to retard the forward motion of the wheel, it having been demonstrated by actual test that the extreme outer edge of the buckets of a side-supply wheel moves faster than the water issuing from the guides or chutes against said buckets. Not only does the formation of such eddies retard the motion of the wheel, as stated, but it has been found by actual use that when the wheel is operated with water containing considerable gritty matter, such gritty matter, being rapidly revolved by the eddy against the front side of the bucket and the inner side of the band, wears away the bucket and band to

such an extent as to render the wheel worthless in a comparatively short time.

I have discovered that by causing the discharging portion of the bucket to begin at a point in front of the vertical plane of its receiving portion at the outer edge of the bucket, the formation of said eddies in front of the buckets can be entirely obviated. Such construction is clearly shown in Figs. 1 and 2, in which, it will be observed, the bucket *c* has the line joining its receiving portion to its discharging portion carried forward, at its outer edge, beyond the vertical plane of said receiving portion to such an extent as to form a forwardly-projecting pocket *c'* in the rear side of the bucket, next to the band *d*. When joined to the band, the front side of said projecting portion of the bucket forms a cut-water which effectually prevents the formation of an eddy in front of the bucket. In Figs. 4, 5, and 6 I have shown a slightly-modified form of this part of my invention, in which a portion of said cut-water is formed upon the inner side of the band *d*, in the form of an undercut lip *d'*, and the bucket has its forwardly-projecting portion somewhat shortened (see Fig. 4) and adapted to make a close contact with said lip, thereby causing the lip to form practically a continuation of the bucket. The bucket shown in Fig. 4 also, instead of having its outer edge extend by a continuous curve from the top of the bucket to the point where its receiving portion joins its discharging portion, like the bucket shown in Figs. 1 and 2, has said outer edge made straight and slightly inclined forwardly from the top of the bucket to the upper side of the pocket *c'*, and has said outer edge cut away slightly, thereby causing the wheel to be of slightly less diameter above the band *d* than below said band. The action of the two forms of buckets in preventing the formation of eddies in front thereof is the same, and it is obvious that other modifications in the particular shape of the receiving or discharging portions of the bucket can be made within the spirit of my invention so long as the novel feature of the forward projection at its outer edge and in the plane of the band *d* is retained. The location of the forwardly-projecting pocket *c'* in the rear or acting face of the bucket secures another important and valuable result, in that it permits a portion of the water acting against said face to travel ahead of the receiving portion of the bucket, to the bottom of said pocket, whence it passes rearwardly again along the discharging portion and is discharged from the latter, thus prolonging its time of contact with the bucket and increasing its useful effect thereon. In connection with this feature of my invention I form the rear or acting face of the bucket in such manner that said face will present a more or less oblique surface to the column of water issuing from the guides or chutes from the time said water first engages said face until it is discharged therefrom, and for this purpose I make said acting face, at the upper end of the bucket, very slightly concave horizontally, as shown by the cross-section in Fig. 7, which concavity gradually merges into a convex surface horizontally at or near the lowest receiving-point of the bucket, or, in other words, in the plane of the upper side of band *d*, as shown by the cross-section in Fig. 3, below which point said horizontal convex surface gradually merges into the vertically-concaved discharging portion of the bucket. Furthermore, said acting face of the bucket is made convex upon lines drawn from the bottom of pocket *c'* to any given point on the inner edge of the bucket, from the top of the latter to, or nearly to, its lowest point of discharge at the point marked 9, and is made concave upon lines drawn from the same point to any given point on the inner edge of the bucket, from said lowest point of discharge to the point where its inner and outer edges join, (marked 12.) It follows from such conformation of the acting face of the bucket that no portion of said face is presented perpendicularly to the column of water issuing from the guides, and therefore all shock to the wheel from the water is avoided. In other words, the water is caused to pass inwardly and downwardly with a continuous impinge against said acting face from the time it first engages the bucket until it is discharged therefrom. I am thus enabled to obtain a very high percentage of useful effect from the water, and this is particularly true of part-gate results when a cylinder-gate is used, as is preferred.

While I have thus particularly described the contour of the acting face of the bucket in all directions from the bottom of the pocket *c'* to the inner edge of the bucket, I wish to call especial attention to the vertical convexity of said face from the plane of the band *d* upwardly to the top of the bucket, as it is mainly due to such contour that I am able to obtain the high part-gate percentages with a cylinder-gate, the convexity mentioned tending to prevent upward diffusion of the water, and because such construction forms a marked departure from what has heretofore been considered to be the necessary and proper contour of the receiving portion of the buckets of this class of wheels—namely, that they should be more or less concaved vertically. For this reason I do not wish to limit myself to the exact contour, horizontally, of this portion of the bucket as hereinbefore described, as the extreme upper portion of the acting face could be made very nearly straight or even slightly convex horizontally, instead of concave, as before described, without material detriment to the operation of the wheel, so long as said vertical convexity is retained.

It will be observed that by reason of the peculiar curvature of the outer edge of the bucket herein described the water issuing from the guides against the bucket is divided vertically by said outer edge above the plane of band *d*, while in the plane of said band it

is divided horizontally, which is a direct reversal of the dividing action of side-supply buckets as heretofore constructed. Such dividing action of the outer edge of my bucket secures two highly-important results: First, it greatly facilitates the forward movement of the wheel through the water, and, second, it facilitates the free inward and downward movement of the water through the wheel and secures a useful effect upon the wheel from the entire volume of water passing therethrough, the water which passes over the horizontal portion of the edge of one bucket engaging the next preceding bucket in a direct line at a point substantially midway between its inner and outer edges. By thus providing means for utilizing all of the water which passes through the wheel I gain an important advantage over this class of wheels as heretofore constructed and secure a result which has at all times been the aim of the makers of such wheels.

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

In a turbine water-wheel, the combination with the wheel, composed of a central hub, a series of buckets, and a band surrounding said buckets, said buckets having their outer edges, at the point where they join the band, extended forwardly of the vertical plane of that portion thereof lying above the band, and having said latter portion made convex vertically upon their rear or acting sides, of a series of tangentially-disposed guides for directing water to said wheel, and a cylinder-gate for governing the passage of the water through said guides, arranged and operating substantially as described.

JOHN B. McCORMICK.

Witnesses:
W. H. CHAPMAN,
J. E. CHAPMAN.