

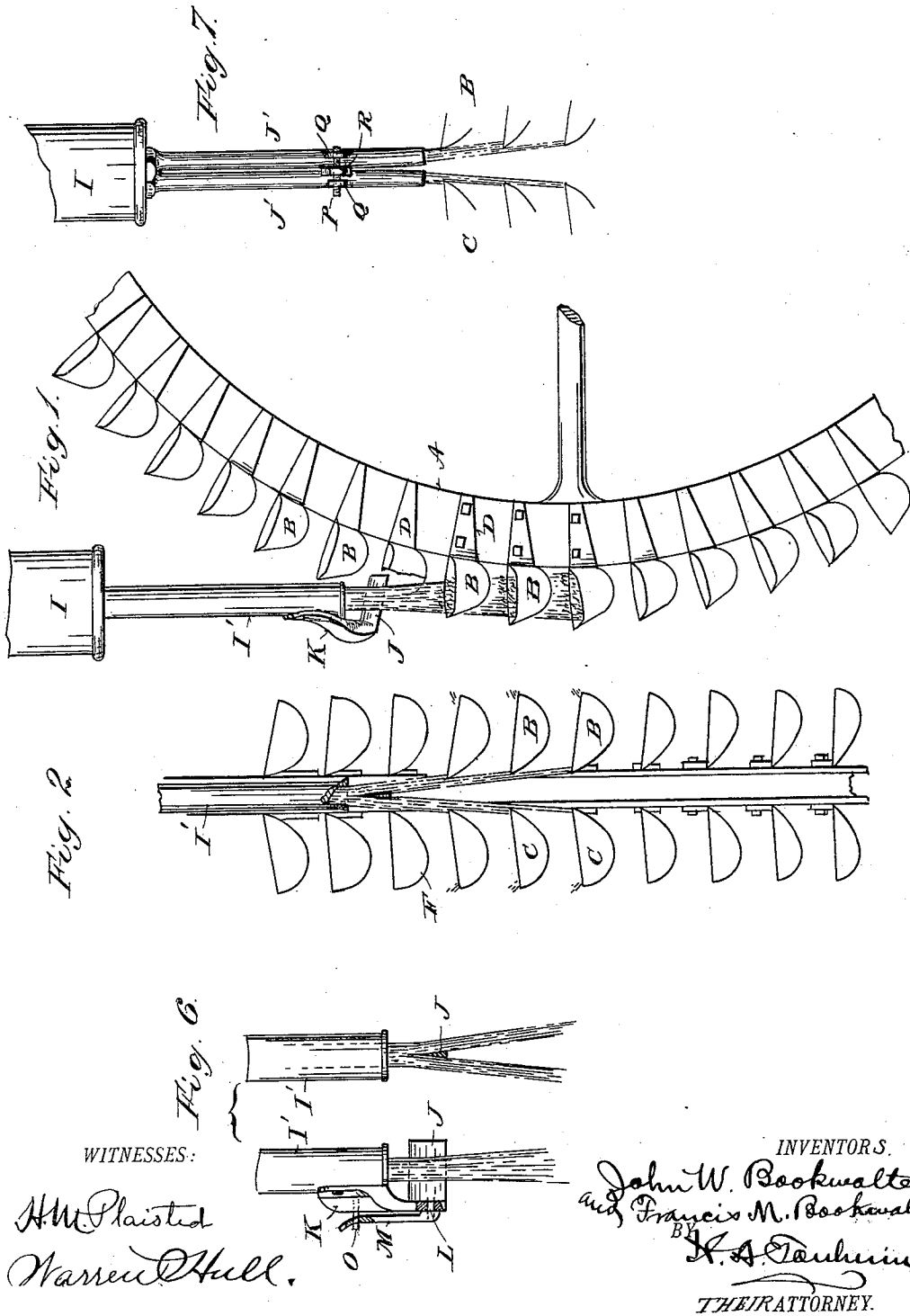
(No Model.)

2 Sheets—Sheet 1.

J. W. & F. M. BOOKWALTER.
WATER WHEEL.

No. 461,565.

Patented Oct. 20, 1891.



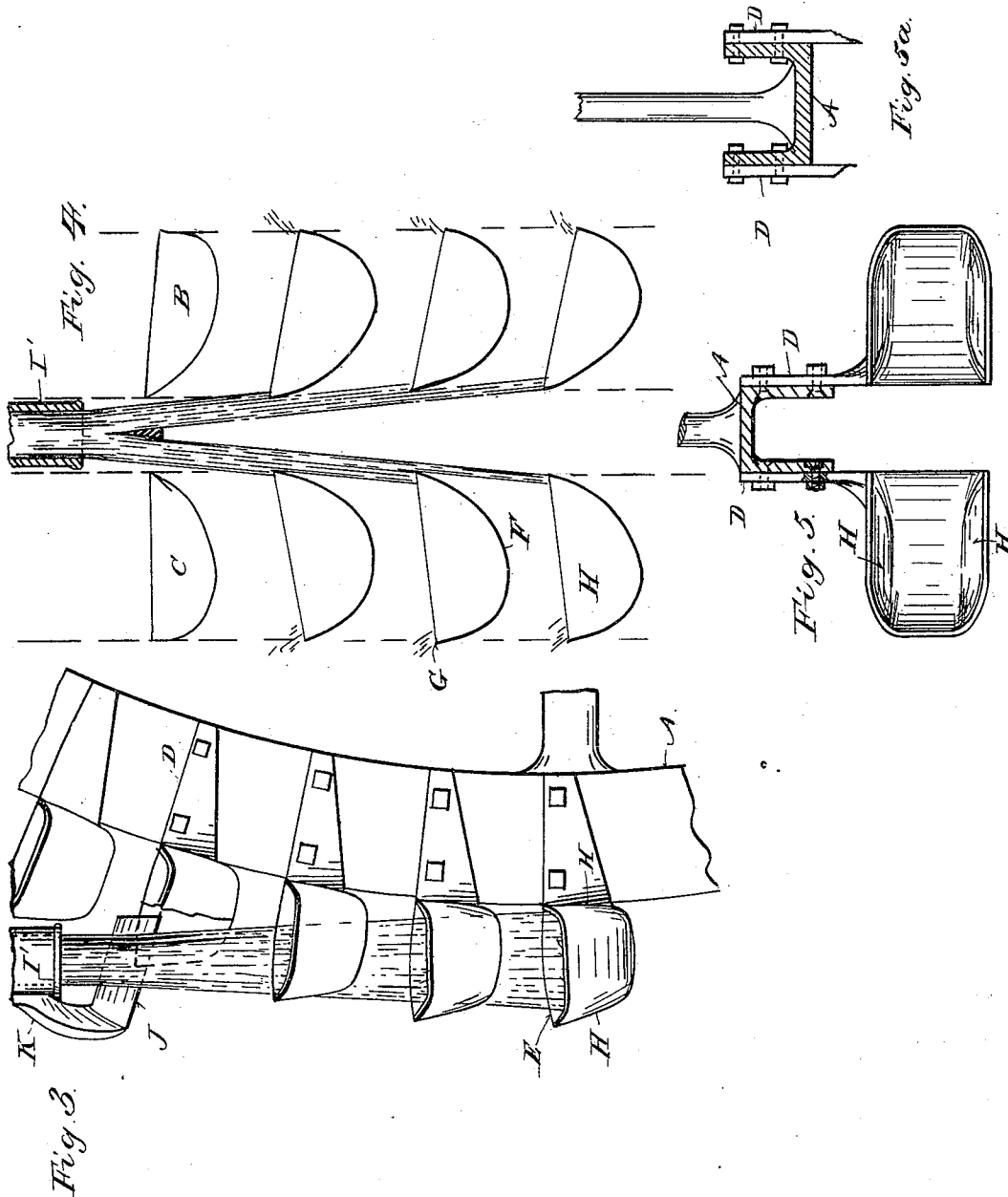
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WITNESSES:

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UNITED STATES PATENT OFFICE.

JOHN W. BOOKWALTER AND FRANCIS M. BOOKWALTER, OF SPRINGFIELD,
OHIO, ASSIGNORS TO THE JAMES LEFFEL & COMPANY, OF SAME PLACE.

WATER-WHEEL.

SPECIFICATION forming part of Letters Patent No. 461,565, dated October 20, 1891.

Application filed December 29, 1890. Serial No. 376,016. (No model.)

To all whom it may concern:

Be it known that we, JOHN W. BOOKWALTER and FRANCIS M. BOOKWALTER, citizens of the United States, residing at Springfield, in the
5 county of Clark and State of Ohio, have invented certain new and useful Improvements in Water-Wheels, of which the following is a specification, reference being had therein to the accompanying drawings.

10 This invention relates to certain new and useful improvements in water-wheels, and belongs to the hurdy-gurdy variety of wheels.

Our improvements have reference to the provision of a double series of buckets, there
15 being one series on each side of the wheel-rim and the series being somewhat remote in a lateral direction from each other and in combining therewith a duplex stream, one branch of which enters the buckets of one series and the other branch of which enters the
20 buckets of the other series, the divergence of the branches being substantially equal, so that the wheel is not moved laterally by either branch, and the full effect of the stream developed in a rotative direction; have reference
25 to so arranging this duplex series of buckets and forming their inner edge to receive the stream, so that such edge shall be the entrance side of the bucket, whereby the stream
30 will continue to enter the buckets through a considerable arc of a circle, the water-entering edge of the bucket traveling in a straight line, such arrangement resulting in lessening the number of buckets to a wheel, because
35 each bucket remains longer in the path of the stream; have reference to so shaping the entering edge of the bucket that the stream shall strike it approximately perpendicularly at all times, whereby the stream is not deflected
40 radially in nor out as it enters the buckets; have reference to forming a duplex stream by dividing one stream into branches, and have reference to certain details, hereinafter pointed out.

45 In the accompanying drawings, forming a part of this specification, and on which like reference-letters indicate corresponding parts, Figure 1 represents a side elevation of a portion of a wheel with a series of buckets and
50 of a nozzle and stream-dividing device; Fig.

2, an edge view of a portion of the same parts; Fig. 3, an enlarged view of the parts shown in Fig. 1, more clearly illustrating the action of the same; Fig. 4, an enlarged diagrammatic view, also more clearly showing the arrange-
55 ment and action of the parts; Fig. 5, a sectional view of the wheel-rim, looking into a pair of buckets; Fig. 5^a, a similar view without the buckets; Fig. 6, detail views of a nozzle and a stream-dividing device, and Fig. 7
60 a modified form of nozzle and stream-dividing device.

The letter A designates a portion of a wheel of any approved type, but preferably having the sides of its rim faced off. The width or
65 breast of this rim will vary in wheels of different sizes; but it is designed to be such as to so locate the buckets secured to the opposite sides thereof that a plurality of them—
70 say three—will be reached at the same time by each branch of a divided stream when the branches are so diverged as not to interfere materially with their force and speed.

The letters B and C designate two series of
75 buckets, the one secured to one side of the rim and the other secured to the other side of the rim. Each bucket of each series has a shank D, adapted to be bolted or otherwise fastened to the wheel-rim. It is preferred to
80 arrange the buckets so that each bucket of one series shall be opposite to a bucket of the other series, as suggested in Figs. 2 and 4. They may, however, be otherwise arranged; but this is the preferred relative position of
85 the buckets of one series with respect to those of the other series. These buckets are peculiar in several respects. Viewing them in
90 Figs. 1 and 3, they will be seen to have the inner edge E higher than the remaining edges. This inner edge is also peculiarly shaped. It is so shaped that the projecting stream strikes it at approximately a perpendicular, irres-
95 pective of whether it has just crossed the stream, is midway in the length of the path of the stream, or has just passed out of the reach of the stream; or, otherwise expressed, this entering edge of the buckets is so shaped that the stream is approximately perpendicular thereto during all of the time that the
100 stream is entering the bucket. This is clearly

illustrated in Figs. 1 and 3, in which three buckets are shown to be in action, having their entering edges approximately perpendicular to the line of the stream. This insures the full effect of the stream and prevents the buckets from tending to deflect the stream from its straight course. It will also be seen that this entering edge is the inner edge of the bucket, and that the bucket-bottom curves downward and outward for the greater portion of its length and then upward and slightly outward, as seen in Figs. 2 and 4, viewing the line F, which is outside of the bottom of the bucket. It will further be seen that the outer or discharge edge G of the buckets is lower than the entering edge. This facilitates the discharge. It will be seen that the forward and rear sides of the bucket, looking toward the rim from a position radially beyond the rim, are inclined and curved, so as to narrow up the bottom of the bucket as compared to the top or edge thereof, such sides being shown at H. It will also be understood that as the water enters the inner edge of the bucket and discharges at the outer side it merely makes one change in its direction, being guided or turned outward, and by this time operating with reactionary effect to propel the wheel.

Referring to the nozzle proper, it is designated by the letter I, and is in practice connected with a head of water, by which the stream receives great velocity and force. This nozzle is so located with respect to the wheel proper that its stream can be divided into equal portions, constituting two branches which enter the respective series of buckets at the same angle to the plane of rotation, whereby the wheel is balanced in the sense that there is no tendency of it to be shifted laterally by either branch of the stream, as each branch acts equally in its lateral effects. There are several ways of dividing the stream into two branches. We have shown two of these ways, one of which we prefer to the other. The preferred form consists of a wedge-shaped blade J, supported in the path of the stream a suitable distance from the nozzle extension I'. The sharp edge of the blade is toward the nozzle extension, and its cross-section is such that it gradually, but promptly, divides the stream into two equally diverging members. A bracket K may be secured to the nozzle extension and the blade pivoted to it by means of a stud L. An arm M is secured to this stud and held by a pin O, passing through it and into the hole in the bracket. By withdrawing the pin the blade can be turned sidewise more or less to adjust its edge to equally divide the stream to free it of any accumulations—such as weeds—that may possibly adhere to it. It is intended, however, that the reduced edge of the blade will sever the foreign matter and prevent accumulations. Any form of device may be used for holding the blade and allow-

ing it to be turned sidewise for the purpose described. In Figs. 1 and 3 the blade is shown as inclined, so that it will allow of more readily freeing itself of foreign matter. The inclination is slight, however, so as not to change the direction of the stream. In these figures the blade is made in one piece with the bracket and the latter firmly secured to the nozzle extension.

Referring to Fig. 7, it will be seen that we provide two nozzle extensions, (designated J',) and that the two are diverged near their discharge ends and connected by a right and left hand screw-threaded rod P, which engages with the lugs Q on the respective extensions, and is provided with a nut R or other means of manipulating it, so as to adjust the extensions the proper distance apart. In this manner the stream is divided into two, and the branches are diverged to agree with the distance between the entering edge of one series of buckets from the entering edge of the other series of buckets.

Referring to the mode of operation, the same will be understood from the foregoing, taken in connection with the following: As before described, the branches of the stream enter, respectively, the respective series of buckets. Looking at Figs. 3 and 4, where this is most clearly shown, it will be noticed from the former that three buckets are being filled at different points, measured radially along their entering edge, and it will be seen from the latter figure that one-third of each branch enters a bucket. As the entering edge of the bucket travels in a straight line and as the stream may enter the entering edge all along its length, it will be seen that each bucket is in action during a comparatively protracted period. This will be appreciated if this mode of operation is compared to directing the water against the outer or peripheral side of the bucket, which side, having no length in the direction of rotation, quickly passes into and out of the line of the stream which is just opposite, to the fact when the water enters the inner edge, as herein indicated. By reason of the prolonged period of action by each bucket fewer buckets may be employed, and so lessen the weight and incurring less expense while equal results are obtainable. The water entering such inner edge gradually turns outward and discharges at the outer edge after operating with reactionary effect. It is important that the spent water in leaving the buckets should so fall as to not interfere with or be struck by the oncoming bucket. It is also necessary to change the direction of the water from entering to discharging as little as possible. These two results flow from the organization and arrangement herein shown and set forth.

Referring again to the wheel A, we would observe that it is preferred to provide it with a space between the parts to which the buckets are bolted. In Figs. 5 and 5^a this con-

struction is shown. In the former figure the parts to which the buckets are bolted extend beyond the rim of the wheel, while in the latter figure the reverse construction is shown.

5 In either case an annular space is left to admit of applying the bolts, the heads of which may be within the space or outside of it. This space avoids the necessity of boring long holes from one side of the wheel to the other in
10 which to insert the bolts. Short holes only need to be bored and short bolts be used, there being a set of bolts for each bucket.

Having thus fully described our invention, what we claim as new, and desire to secure by
15 Letters Patent, is—

1. The combination, with a wheel and two series of buckets, one series being at one side of the rim and the other series being at the other side and separated by an annular space,
20 of a water-delivering nozzle located to discharge between the inner sides of the respective series of buckets, and means to divide the stream into a branch for each series of buckets before its impingement on said separate
25 inner sides.

2. The combination, with a water-wheel and two series of buckets secured thereto, one series at either side of the rim and separated from the other by an annular space to form
30 independent series, the inner edge of each bucket of each series being reduced and adapted to direct the water into its bucket, of a nozzle located to discharge between the inner sides of the respective series of buckets,
35 and means separate from the buckets adapted to divide the stream into a branch for each series before its impingement on said buckets, each branch entering a bucket at the said inner edge thereof.

3. The combination, with a wheel and two series of buckets, the buckets of each series being secured to opposite sides of the rim of the wheel and each bucket having its inner edge sharpened and raised above the remaining edges thereof, such edge being a receiving edge and the outer edge the discharging edge, of a nozzle located to discharge between the inner sides of the respective series of buckets, and a wedge-shaped blade located
45 in the path of the stream and adapted to divide it into two equally-diverging branches.
50

4. The combination, with a wheel and two series of buckets, each series being at the opposite sides of the wheel-rim and separated
55 from each other to form an independent series and each bucket of each series having its inner edge sharpened, of a nozzle located to discharge between the inner sides of the respective series of buckets and dividing means mounted between the nozzle and the
60 buckets and adapted to divide the stream

into a branch for each independent series, such branches entering the buckets at their said sharpened inner edges.

5. The combination, with a wheel, of two 65 series of buckets separated by an annular space, substantially as shown, one series being at either side of the rim and each bucket having its inner edge sharpened and curved upward and outward in the plane of the 70 wheel, so as to maintain its position perpendicular to the entering stream, substantially as described, a nozzle located to discharge between the inner sides of the said series of buckets thus separated, and means to divide 75 the stream into a branch for each series, such branches entering the buckets at said inner edge and intersecting the same perpendicularly thereto as each branch travels along said edge through the entering period. 80

6. In a water-wheel, a bucket, the entering edge of which is curved upward toward the entering stream in the plane of the wheel between the point where the propelling-stream first strikes said edge and where it 85 last strikes said edge, whereby it is adapted to receive the stream perpendicularly thereto during the entering period.

7. The combination, with a water-wheel, of a dividing-blade having a wedge-shaped cross-section provided with a sharp reduced edge, and pivotally mounted in the path of the issuing stream with the edge toward the stream, whereby obstructing materials may be cut 90 by impingement thereon, or the blade may be turned on its axis to free it of accumulations. 95

8. The combination, with a nozzle, of a pivoted dividing-blade having a sharp dividing edge and a deflecting wedge portion 100 adapted to gradually divide and then deflect the issuing stream into two planes or branches, a supporting bracket-bearing for the axle of said blade, and an operative arm secured to said axle. 105

9. The combination, with a water-wheel having its rim formed with side portions, between which is a space, of buckets secured to each side portion by a set of fastening devices for each bucket, such space admitting 110 of the use of short bolts and necessitating only the boring of short holes therefor.

In testimony whereof we affix our signatures in presence of two witnesses.

J. W. BOOKWALTER.

FRANCIS M. BOOKWALTER.

Witnesses for John W. Bookwalter:

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M. DERRICK.

Witnesses for Francis M. Bookwalter:

WARREN HULL,

H. M. PLAISTED.