No. 771,650. PATENTED OCT. 4, 1904.

W. H. LARRABEE.

CURRENT WATER METER.

APPLICATION FILED APR. 11, 1904.

NO MODEL. 2 SHEETS—SHEET 1.

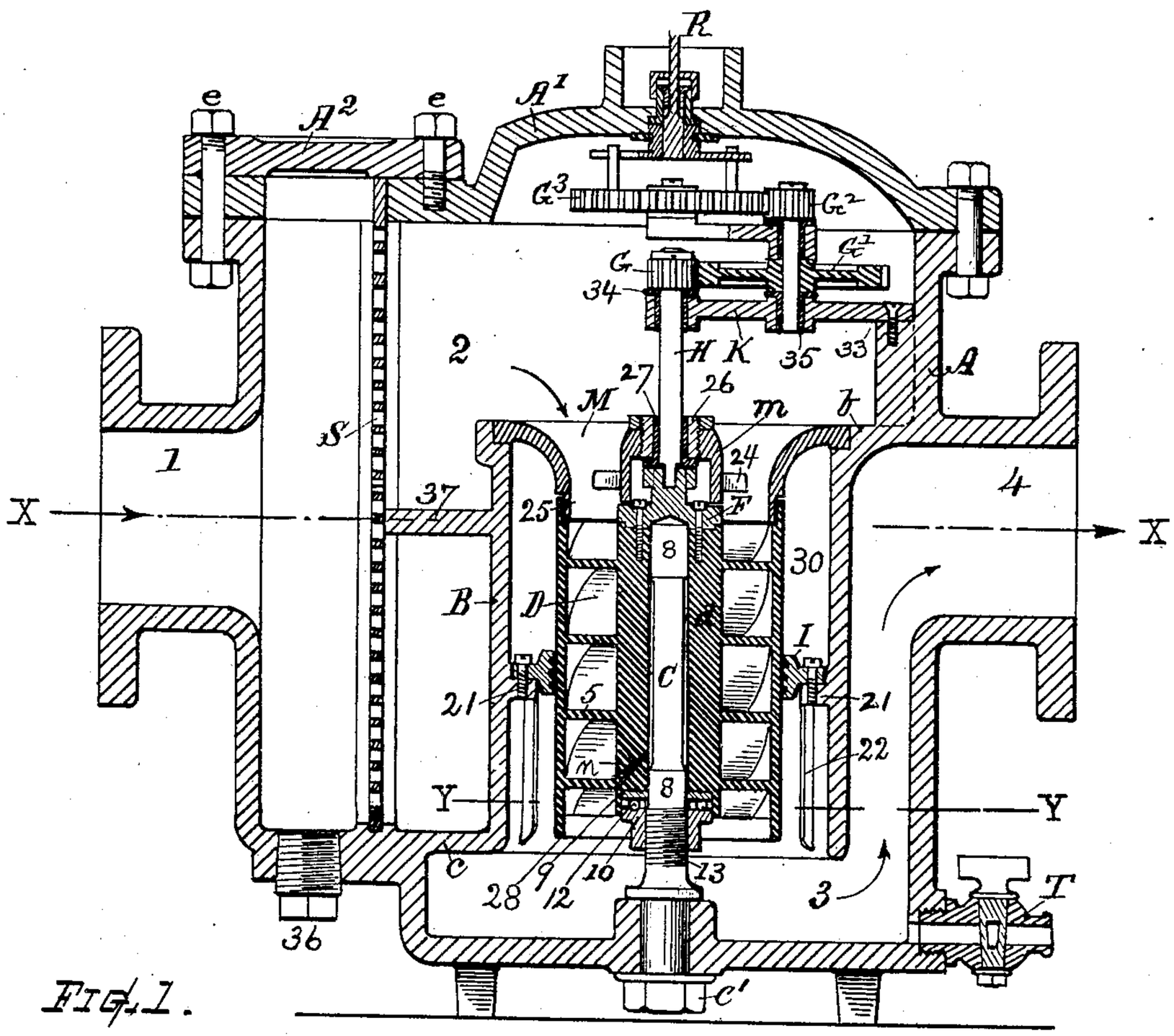

FIG. 1.

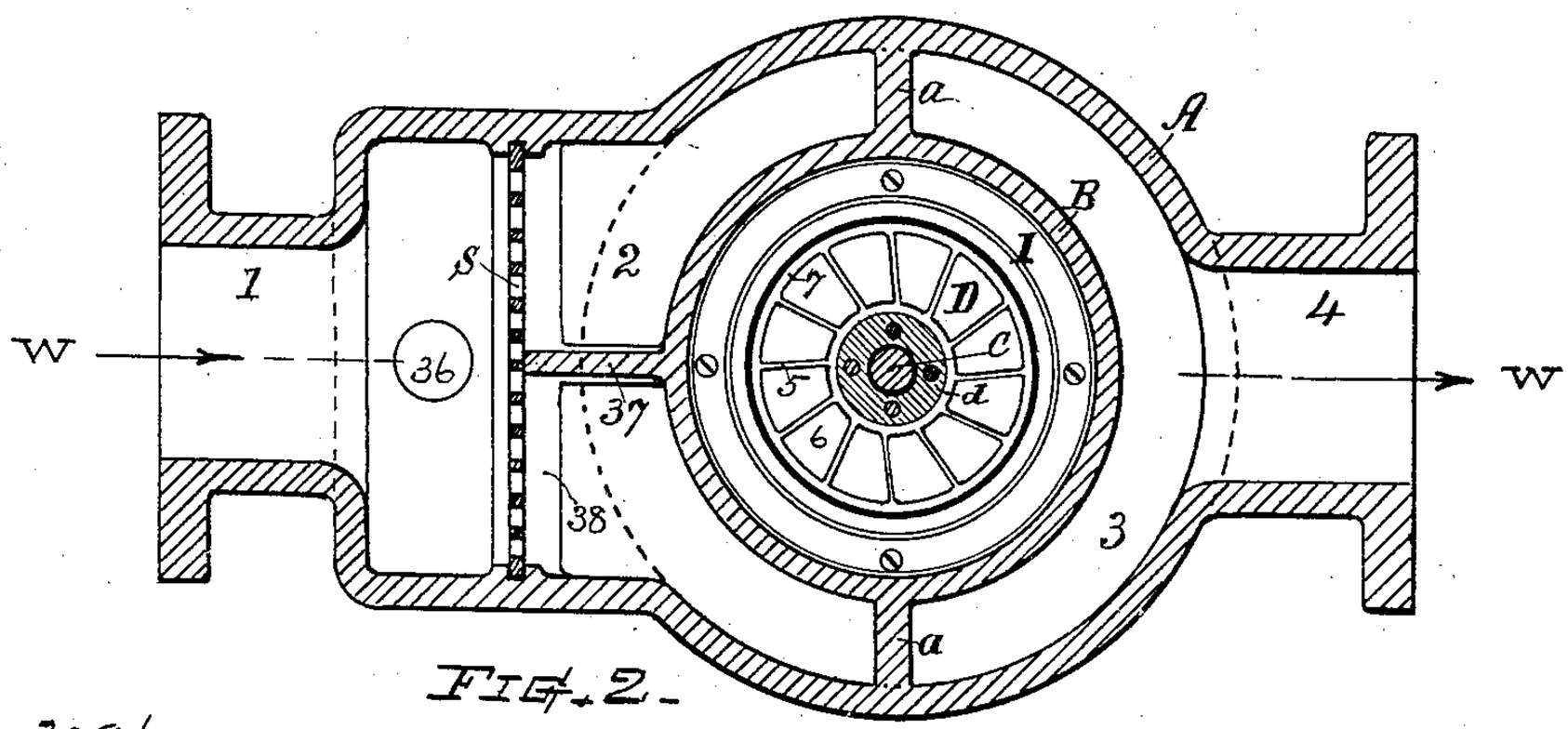

FIG. 2.

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NO MODEL. 2 SHEETS—SHEET 2.

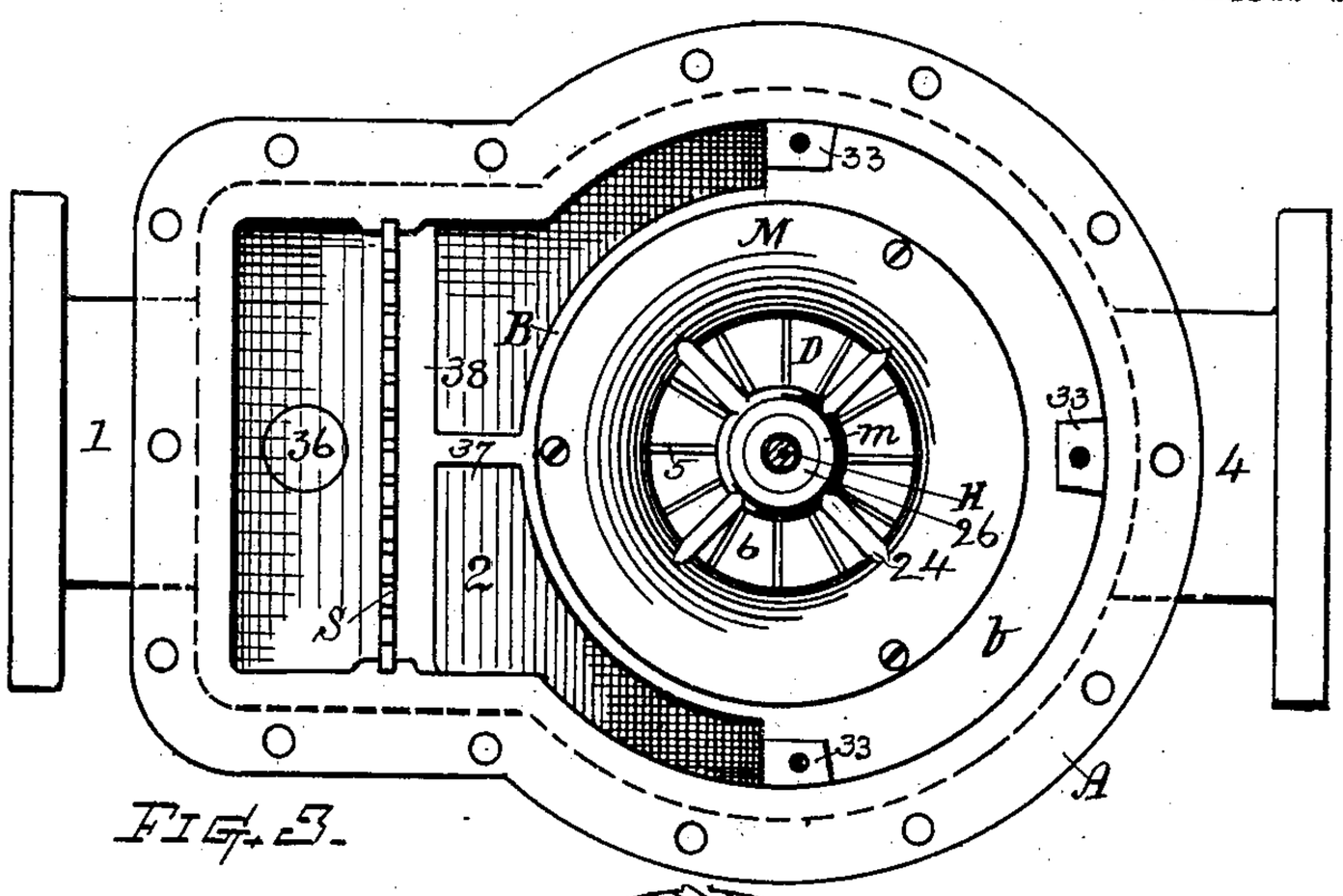

FIG. 3.

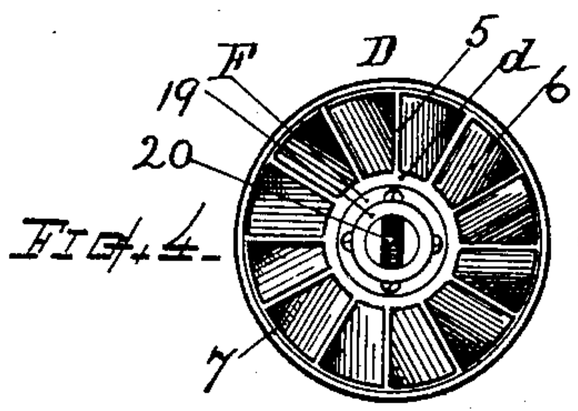

FIG. 4.

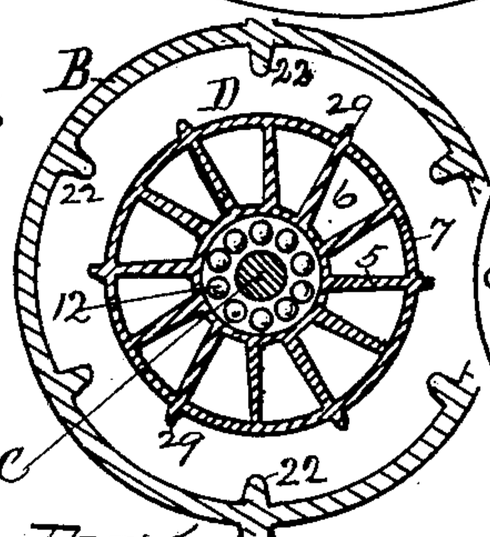

FIG. 6.

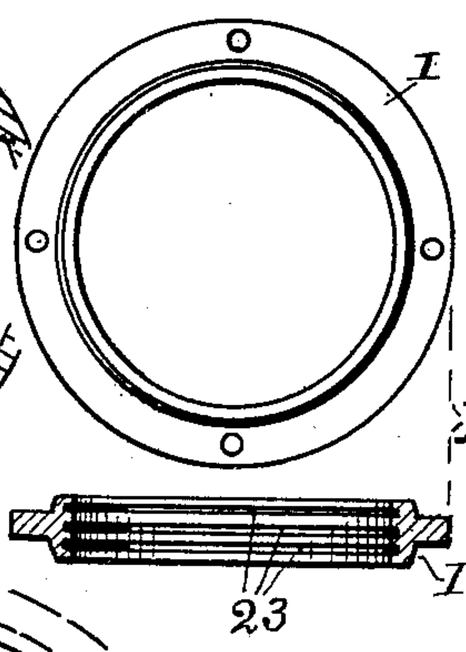

FIG. 7.

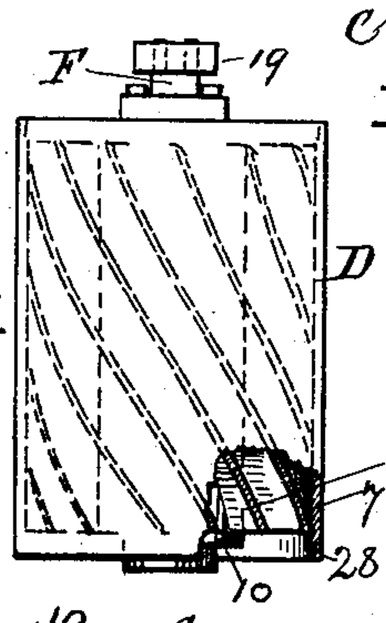

FIG. 5.

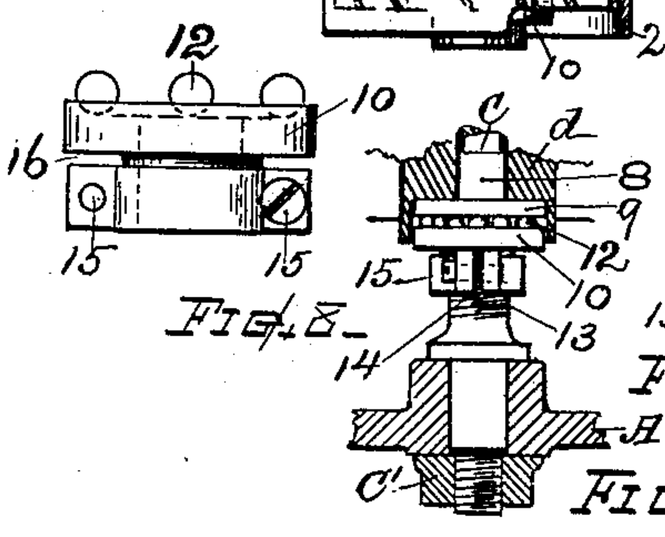

FIG. 8.

FIG. 9.

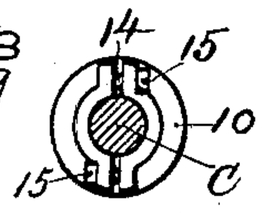

FIG. 10.

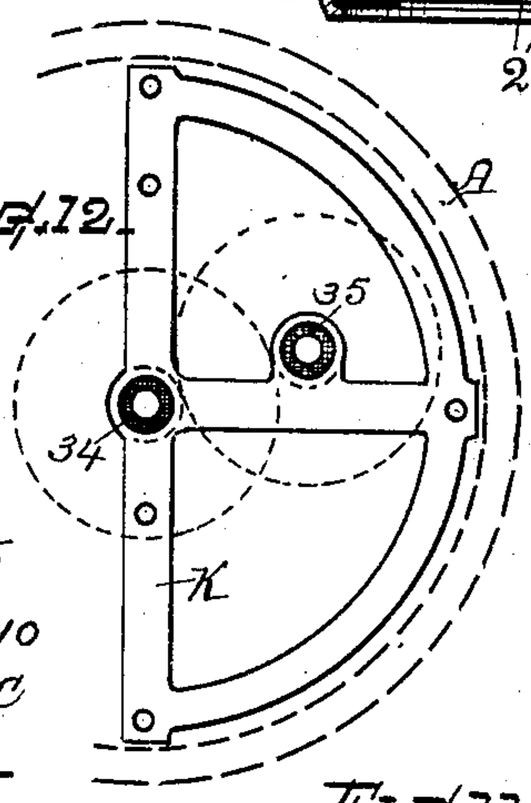

FIG. 12.

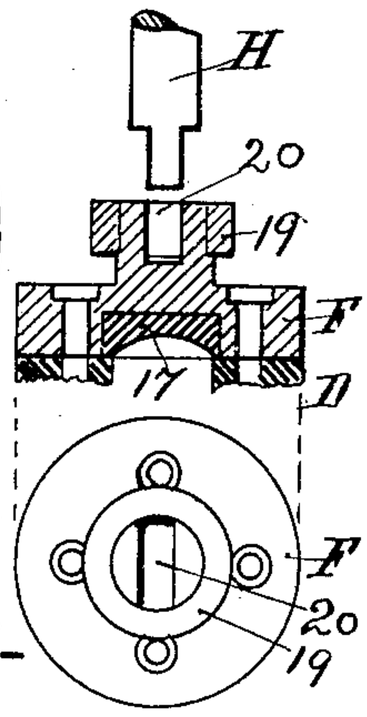

FIG. 11.

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PHOTO-LITHOGRAPHED BY SACKETT & WILHELMS LITHO. & PTG. CO. NEW YORK.

No. 771,650. Patented October 4, 1904.

UNITED STATES PATENT OFFICE.

WILLIAM H. LARRABEE, OF WORCESTER, MASSACHUSETTS, ASSIGNOR TO UNION WATER METER COMPANY, OF WORCESTER, MASSACHUSETTS, A CORPORATION OF MASSACHUSETTS.

CURRENT WATER-METER.

SPECIFICATION forming part of Letters Patent No. 771,650, dated October 4, 1904.

Application filed April 11, 1904. Serial No. 202,496. (No model.)

To all whom it may concern:

Be it known that I, WILLIAM H. LARRABEE, a citizen of the United States, residing at Worcester, in the county of Worcester and State of Massachusetts, have invented new and useful Improvements in Current Water-Meters, of which the following, together with the accompanying drawings, is a specification sufficiently full, clear, and exact to enable persons skilled in the art to which this invention appertains to make and use the same.

This invention relates to that class of meters wherein a current of water or fluid is passed in contact with a helically-vaned revoluble device for generating motion to operate a registering mechanism; and it consists in the novel construction of parts and the combinations of the mechanism, as hereinafter explained, the particular subject-matter claimed being definitely stated in the summary.

The object of this invention is to render the construction economical, efficient, and durable and to provide a water-meter that will accommodate and register a large or rapid volume of water under various conditions without materially obstructing the flow of water through the meter or reducing the pressure at the service delivery.

In the drawings, Figure 1 represents a central vertical section of a water-meter embodying my invention, taken at line W W, Fig. 2. Fig. 2 represents a horizontal section at line X X on Fig. 1. Fig. 3 represents a plan view with the cover and gearing removed. Fig. 4 represents a separate top end view of the whirler or power-wheel. Fig. 5 is a side view of the whirler, a portion of one end shown broken away. Fig. 6 is a bottom end section of the whirler at the position of line Y Y on Fig. 1. Fig. 7 shows a plan and section of the whirler-pack annulus. Figs. 8, 9, and 10 are views showing parts in detail of the ball-bearing device. Fig. 11 shows details in section and top view of the whirler-cap, and Fig. 12 represents a plan view of the spider-frame for carrying the gear-axle bearings.

In the drawings, A denotes the main casing, having the inlet spud and passage 1 and the outlet spud and passage 4 preferably disposed on a line with each other and adapted for connection with the service-pipes in usual manner. Within the main casing and cast integral therewith there is an upright cylindrical inner casing B, which surrounds the whirl-race and is joined to the outer casings by radial side partitions *a*, an upper horizontal partition *b*, and a lower horizontal partition *c*, thereby separating the interior into an inflow-chamber 2, that extends over the inner cylinder, and an outflow-chamber 3, that extends beneath the lower end of the raceway-casing. The main casing is provided with a removable cover A′, upon which at R may be arranged suitable registering mechanism (not shown) of any approved kind.

D indicates the whirler or power-wheel, disposed axially upright within the cylindrical raceway or inner casing B, as indicated. Said whirler is a cylindrical body, preferably made of hard rubber or vulcanite, and comprises a central hub *d*, around which is formed a series of helicoid vanes 5 of any convenient angle or pitch, with corresponding intervening waterway or channels 6, while round the circumference and extending for a short distance beyond the ends of the helicoid is a cylindrical shell 7 of any convenient thickness integral with or permanently attached to the vanes and forming a part of the whirler. The radial edges of the vanes that receive the intake of water are made nearly sharp and tapering from the full thickness, thus adapting them to receive the force of the water in an easy manner and reducing the end-thrust effect. Through the central hub and concentric with it is a hole of suitable size for the post or spindle C, upon which the whirler is mounted. On the upper end of the hub is fastened a cap F by any suitable means. I have shown it fastened by screws, but other means may be employed. This cap forms the upper bearing on the axis-post, and its other functions will be described later.

The axis post or spindle C, upon which the whirler is mounted to freely revolve, is securely fastened in vertical position to the

bottom of the main casing by any suitable means, as by a screw shank and nut c'. It consists, preferably, of a bronze post having its upper end slightly convex, the central portion of the post being of lesser diameter than its end bearings to reduce friction, also to afford a water-space for balancing and lubricating the whirler, means being provided for admitting water to the space—as, for instance, a small hole n, bored through the tube d, as indicated on Fig. 1. As there is practically no side thrust, very little side bearing is necessary other than to keep the whirler central, and short bearings 8 at the top and at the bottom of the post are provided.

At the lower end of the whirler there is a ball-bearing device for sustaining the downward thrust and wear caused by the pressure of the water flowing in that direction. In the lower end of the hub there is formed a central recess into which a bronze plate 9, having a hole through its center, is fitted, and secured to the post beneath this plate there is an adjustable ball-cup 10 and series of balls 12, that forms the bearing for the lower or outlet end of the whirler. For taking up the wear and adjusting the ball-bearing cup on the post the bronze casting of the cup is provided with a central hole in which is a fine thread, this being screwed onto the post, the lower part of which has a corresponding thread 13 formed thereon for that purpose. The upper part of the ball-cup is nearly the diameter of the recess in the hub of the whirler and contains a ball-race of any approved form and balls 12 of any number and diameter suited to the work. These balls are best made of a metal not readily acted on by water, preferably phosphor-bronze. The lower part of the ball-cup is of lesser diameter and has a slot 14 formed transversely through it extending up to the larger part, which contains the ball-race, and on opposite sides of the slot are screws 15, arranged for drawing the slot together for clamping the threads to secure the parts firmly in position. A groove 16 is cut in this slotted part close up to the flange and sunk nearly to the threaded hole, leaving of course sufficient metal for strength. This groove affords slight flexibility, so that the clamping can be done without liability of springing or distorting the ball-race.

While the principal bearing of the whirler is on the balls and ball-race, an additional bearing is afforded at the upper end of the hub by means of the cap F, before mentioned, which cap is screwed to the hub and preferably has a hard-rubber plug 17 in its lower central part. (See Fig. 11.) Said plug resting on the post or spindle forms a top bearing for the whirler. Adjustment of the ball-bearing cup can be so made that the pressure on the whirler will be distributed at the top and bottom bearings. Should the adjustment not be so made, the wear on a single bearing will in time bring the parts down so that it would bear at both ends. In either case no serious result would occur; but the whirler is mounted in a manner to rotate with accuracy of balance and practically with frictionless freedom of movement.

The coupling or cap F preferably consists of a circular piece of bronze or other suitable material formed of different diameters, the larger or lower portion being nearly the diameter of the whirler-hub and is attached thereto. At a suitable distance up this piece is reduced to a diameter that will admit of passing the screws through its lower part to attach it to the hub d. Above it is still further reduced in diameter to form a shoulder upon which a collar 19 is fixed or fastened in any suitable manner. In the upper end of the cap is a square or irregular shaped hole, slot, or socket 20 for receiving the end of the shaft H. The collar encircles the hole or slot, so as to strengthen the upper part of the cap, also, in connection with the rubber bushing, hereinafter mentioned, forms the upper thrust-bearing. This hole or slot 20 is the coupling means by which the shaft that drives the intermediate gearing G is driven, said shaft having its lower end reduced or made of proper form to loosely fit the corresponding socket or hole 20 in the cap. The shaft being thus loosely fitted, but with sufficient closeness so that it cannot turn in its socket, forms a flexible coupling and at the same time gives a positive drive for intermediate gearing.

The cylindrical shell 7 of the whirler D is externally smooth for the greater part of its length and is of considerably less diameter than the interior of the raceway-chamber within which it rotates. Surrounding said whirler at an intermediate position in its length I provide a water-pack annulus or partition-ring I, seated upon a ledge or lugs 21, formed upon and projecting inward from the inner casing B. Said annulus is preferably a bronze ring of any convenient thickness, closing the space and completely surrounding the outer circumference of the whirler and nearly but not quite touching its surface. The inner face of the ring is best provided with one or more small grooves 23, that become filled with water, so that in combination with raceway, casing, and whirler the ring forms a complete barrier and water-pack that effectually prevents the water from passing, except that which passes through the whirler, thus enabling the meter to register with a great degree of accuracy various-sized streams and at varied velocity of current.

At the upper end of the whirl-race and supported at its periphery upon a ledge or recess on the casing-casting I provide an annular member M, which is herein termed a "vortex-guide" and serves for concentrating and directing the flow into the end of the whirler.

This vortex-guide is preferably made of bronze, with inwardly-rounded or funnel-shaped interior to give an easy smooth flow to the water as it passes from the upper chamber into the race. The guide extends downward for a distance of about one-fourth, more or less, the length of the raceway, merging into cylindrical form at its lower edge and matching upon or fitted within the upwardly-projecting rim of the cylindrical shell of the whirler at 25, terminating near the ends of the helicoid vanes. The edge of the guide stands in close proximity to but not touching the whirler-cylinder, so that said whirler is free to revolve without friction on the guide.

In the center of the vortex-guide there is a hub *m*, connected to the outer part by radial arms 24. This hub is approximately of the same diameter as the central hub of the whirler and extends downward to nearly touch the latter, leaving an annular space for the passage of the water to the vanes 5. The lower portion of the hub *m* is a shell, which covers or surrounds and protects the cap F, while the upper portion has a threaded hole through its center, in which an adjustable bearing 26 is screwed. Said bearing is best composed of a bronze plug having a central hole, in which is secured a bushing 27, of hard rubber or other suitable material, having a flange or shoulder on its lower end. This rubber bushing forms the lower bearing of the shaft H, that drives the intermediate gearing. Its enlarged shoulder and the cap F serve as an upward thrust-bearing for the whirler when the meter runs backward.

The annular chamber 30, surrounding the whirler above the ring, is filled with what is technically known as "dead water." This water being maintained at or near the initial pressure keeps the whirler in equilibrium, thus increasing the sensitiveness of action and decreasing the liability to wear and breakage of the whirler. Liability of damage to the whirler by breakage or stoppage is further reduced by the shell which surrounds the vanes forming part of and revolving therewith, since it prevents foreign substances that might get into the meter from becoming lodged between the edges of the vanes and the stationary casing in which they revolve.

The lower end of the cylindrical shell is best extended as a circular rim 28 below the ends of the helicoid vanes, thereby causing the water to leave the whirler in a smooth current and avoiding the unbalancing effect of interrupted or side currents acting against the vanes at the foot of the whirler. In some instances, if desired, the exterior of the whirler-shell below the ring I can be provided with small outstanding projections or ribs 29 for retarding or preventing the spinning of the whirler when the flow of water is arrested. Such ribs may not, however, in many instances be required. The interior of the inner casing B may also be provided with ribs, if desired, to interrupt circular flow of water in the annular space surrounding the whirler. An example of such ribs is indicated at 22 on Fig. 6.

In the compartment above the whirler is placed the intermediate gearing. The bearings for the shaft H and intermediate-gearing axles are supported by a segmental spider-frame K, supported on ledges 33, formed on the interior of the main casing, as shown. The power and motion is transmitted from the whirler-shaft H through the train of pinions and gears G, G′, G^2, and G^3 to the spindle R, which operates the register mechanism. (Not shown.) The bearings in the spider-frame are preferably provided with hard-rubber bushings 34 and 35, as indicated in Figs. 1 and 12. The gearing is placed sufficiently high above the whirler as not to obstruct the flow of water through the vortex-guide; but they are located in a circulation enough to prevent sediment from collecting on them and interfering with their easy working.

Within the inlet-compartment there is a foraminous plate or screen S for the interception of fish or large foreign substance, and means, as a plug or hand hole 36, is provided in the bottom of the meter on the inlet side of the screen for the easy removal and washing out of sediment, the bottom of the trap-space being high enough above the bottom of the main body of the meter to be easily got at. By placing the plug or hand hole in the bottom of the casing instead of at the side, as is usually done, the sediment can be more easily washed out, and the workman can remove the plug without the liability of getting wet, as would be the case were the plug in the side wall. A strut or brace 37 is formed on the inner casing for supporting the central part of the screen, and said strut may be connected by an integral cross-bar 38 with the sides of the main casing, this being a desirable construction in meters of large size.

The top closure-plate A′ of the casing is made as one piece to cover the whole body of the meter, but has an opening or recess therein corresponding with the trap-space and a supplementary cover A^2, which covers the trap-space and forms a part of the main closure. The same bolts *e* that fasten the main cover down also fasten this supplementary cover. Should it be desirable to get at the screen, the bolts *e* can be removed and the supplementary cover taken off without disturbing the main cover or its packing.

At T on Fig. 1 I have shown a drainage-cock arranged at the bottom of the outflow-chamber 3 for starting a small stream of water through the meter in cases where the meter may be located in a long line of pipe, as when used on a fire service-line, and thereby testing or ascertaining if the meter is in running order. It also serves for letting out of

the casing the contained water below the spuds after the supply has been shut off to avoid liability of damage to the mechanism by frost in cases where the meter is in common service or in exposed places.

In the operation the water enters the inlet 1, passes through the screen S into the upper inflow-chamber 2, thence down through the vortex-guide M, filling the raceway and flowing through the whirler D in contact with the helicoid vanes 5 and by its action thereon causing said whirler to revolve and by its shaft H operate the register-actuating gearing, the water at the bottom of the raceway passing into the lower outflow-compartment 3, thence up and out at the exit-passage 4. The water fills the annular chamber 30 around the whirler, giving balance and support therefor, but is cut off therein by the pack-annulus I, and as the helicoid vanes are surrounded and laterally inclosed by the integrally-revolving shell no material amount of water can pass through the meter without passing through the whirler, and as the whirler is fitted so closely and revolves so freely it is moved by the smallest amount of water passing through it.

I am aware that prior to my invention different form of whirlers or power-wheels having helically-arranged vanes have been employed in water-meters. Therefore I do not broadly claim such type of power-wheel irrespective of construction; but my invention embraces the improved structure and combinations, substantially as set forth, including such mere modifications as may be apparent to persons skilled in the art without departing from the nature and scope of the invention as expressed in the claims.

What I claim as of my invention, and desire to secure by Letters Patent, is—

1. In a current-meter, the meter-casing comprising the outer or main casing provided with lateral inlet and outlet connecting-spuds, and having the interior cylindric raceway-casing cast integral with said main casing, and united thereto by upright side partitions and lower and upper horizontal partitions, forming within said main casing an inflow-chamber that extends over the raceway, and an outflow-chamber that extends beneath the raceway, as described; in combination with a helicoid whirler or power-wheel within said raceway, an axial support therefor, and means connected with said whirler for operating register mechanism.

2. In a current water-meter, a whirler or power-wheel comprising an integrally-formed hard-rubber cylindrical body having a continuous peripheral surface, a central longitudinal axial opening through said body, and a series of helicoid waterways and partition-vanes between said opening and the periphery; in combination with a metal end bearing-cap having a shaft-engaging recess therein, fixed on one end of said body, and a metal annulus fitted in the opposite end of said body.

3. In a current water-meter, the revoluble helicoid whirler provided with a cylindrical shell integral with the edges of the helicoid vanes, and forming the periphery of the whirler; in combination, with a stationary axial post whereon said whirler revolves, a cylindrical race-casing surrounding said whirler, and an intermedially-disposed partition-ring within the annular space between the race-casing and whirler-shell.

4. In a water-meter mechanism, a revoluble helicoid whirler or power-wheel provided with a circumferential cylindrical shell; in combination with a stationary axis-post whereon said whirler revolves, a raceway-casing surrounding the whirler and a pack-annulus disposed about the central part of said whirler within said casing, and provided with water-pack grooves in its inner face, as set forth.

5. In a water-meter of the class specified, in combination, with the main casing having the interior raceway-casing, an inflow-chamber and outflow-chamber; a stationary axis-post, a helicoidly-vaned whirler or power-wheel rotatably mounted on said post, with an end bearing-cap at its upper end and a ball-bearing device at its lower end, means for supporting said ball-bearing device upon the post, and means connecting said whirler with register-driving gearing.

6. In a water-meter, the combination with the meter-casing having an interior cylindrical raceway-casing, an upright axial bearing-post concentric therewith, and a helically-vaned power-wheel or whirler rotatably mounted on said post; of a funnel-shaped vortex-guide disposed at the entrance to the raceway and having an inwardly-converging annular surface for directing the flow, the lower end of said guide matching into or in close non-contacting proximity to the end of the whirler and a register-actuating means connected with said whirler.

7. In a current water-meter, the combination, with the main casing, inner raceway-casing, and whirler rotatably supported within the raceway; of a vortex-guide having an outstanding rim-flange supported on the casing about the raceway, and inwardly-rounding sides merging into a cylindrical form that countermatches at its edge with the end rim of the whirler, substantially as and for the purpose set forth.

8. In a current water-meter, the combination, of a whirler having helicoid vanes and waterways, and a surrounding cylindrical shell attached to said vanes, a raceway-casing of greater diameter than said whirler, with annular space between the whirler and raceway-casing, means for axially supporting said whirler to rotate within the raceway, an inwardly-tapering vortex-guide, and means stopping off the annular space for prevent-

ing the flow of water between the whirler-cylinder and raceway-casing below said guide.

9. The combination, substantially as described, of the meter-casing, an inner raceway-casing, an axis-post fixed within said casing, a revoluble helicoid whirler mounted on said post, and having an integral cylindrical peripheral shell, an inwardly-rounded vortex-guide leading from the inflow-chamber into the end of said whirler, an annular intermedial partition surrounding said whirler, a dead-water chamber between said partition and vortex-guide, a central bearing supported on said guide, and a drive-shaft mounted in said bearing and engaging or coupled with the whirler.

10. The combination, with the whirler and meter-casing; of the axis-post provided with screw-threads, the ball-cup having a slotted hub fitted thereon, means for clamping said slotted hub, a ball-bearing plate within the whirler-hub, and a series of bearing-balls between said cup and plate, for the purpose set forth.

11. The combination, with the meter-casing, and whirler provided with a central opening and ball-race; of the axis-post supported in the casing and having side bearing-surfaces and a screw-thread, the ball-bearing cup comprising an internally-threaded annular ball-race and a slotted clamping-hub fitted on the screw-threaded part of said post, said bearing-cup having a circumferential groove adjacent to the ball-race flange, and means for clamping said slotted hub firmly upon the threaded post, substantially as set forth.

12. In a current water-meter, in combination, with the intermediate gearing, a vortex-guide having a central hub carrying a journal-bearing, and an operating-whirler provided with a top end cap; a gear-driving shaft supported in said journal-bearing and having its end detachably united with said top end cap in a manner that permits removal and replacement of said shaft without disturbing said cap or journal-bearing.

13. In a water-meter mechanism, the combination as described, of the whirler having the recessed cap, the vortex-guide having the center bearing-hub in alinement with said cap, the train of intermediate gearing, the gear-driving shaft having its lower journal within said center bearing-hub, and its end interlockingly engaging with the recess in the whirler-cap, for the purposes set forth.

14. In a current water-meter, the combination, with the casing, the axis-post, the gear-driving shaft, and the whirler rotatably mounted on said post and provided with a shaft connecting and bearing cap on its end; of a current-directing guide at the entrance end of said whirler, and a central hub supported within the guide, said hub carrying a bearing for the shaft, and provided with a rim or shell whereby it is adapted for covering or protecting said cap.

15. In a current water-meter, in combination, with the main casing, inner raceway-casing, rotatable whirler having the bearing-cap with means for coupling the shaft thereto, and the gear-actuating central shaft; of the inwardly-converging vortex-guide provided with a central hub, a journal-bearing for said shaft supported within said hub, and means for effecting endwise adjustment of said bearing in relation to the hub and whirler-cap.

16. In a current-meter of the character described, a revoluble power wheel or whirler provided with a central body, a series of radial helical vanes and waterways, and a cylindrical circumferential shell attached to and connecting the outer part of the vanes, said cylindrical shell being of greater length than the helical vanes and projecting at the discharge end thereof as a cylindrical extension-rim.

17. In a current-meter, a whirler comprising a central bearing-hub, a series of helicoid vanes with intervening waterways, and a peripheral cylindrical shell; said shell projecting as a circular rim beyond the ends of the helicoid vanes at both ends of the whirler; in combination with means for axially supporting said whirler, and means for directing the water therethrough.

18. In a meter of the character described, in combination, with the meter-casing, inner cylindrical raceway-casing, a central supporting-axis, and means for operating register-actuating gearing; of a rotatable power-wheel or whirler provided with a peripheral cylindrical shell surrounding its helicoid vanes and having retarding ribs or projections upon the exterior of said shell, for the purpose set forth.

19. The combination, with the meter-casing provided with a screen and trap-space, of the main cover-plate extending over the entire casing, but having an opening therethrough corresponding to said trap-space, and a supplementary closure-plate superimposed upon said main cover-plate and covering said trap-space opening, and secured by bolts or fastenings that secure the main cover, substantially as set forth.

Witness my hand this 7th day of April, 1904.

WILLIAM H. LARRABEE.

Witnesses:
CHAS. H. BURLEIGH,
ELLA P. BLENUS.