No. 780,971. PATENTED JAN. 31, 1905.

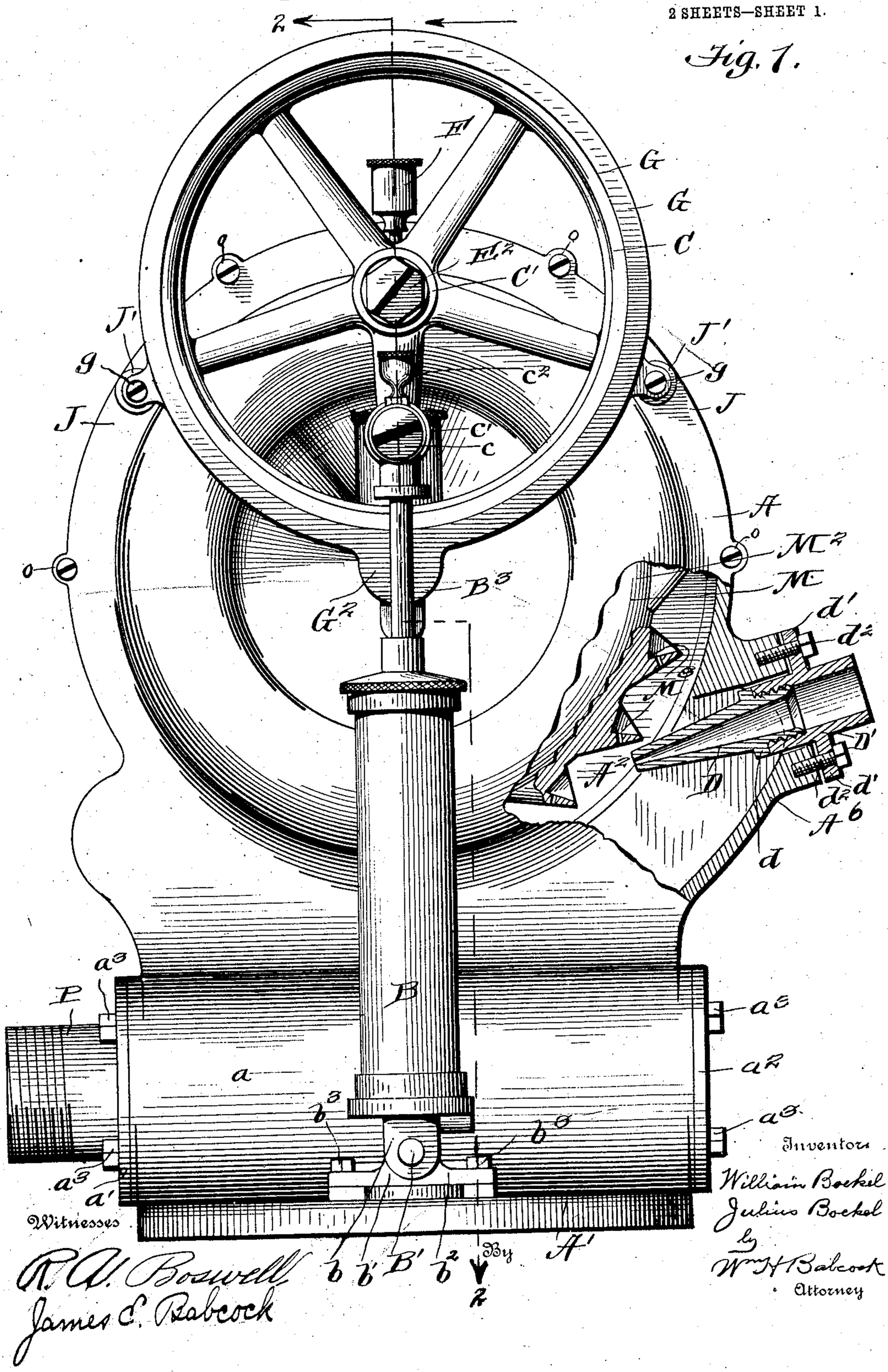
W. & J. BOEKEL.

WATER WHEEL.

APPLICATION FILED APR. 2, 1904.

2 SHEETS—SHEET 1.

Fig. 1.



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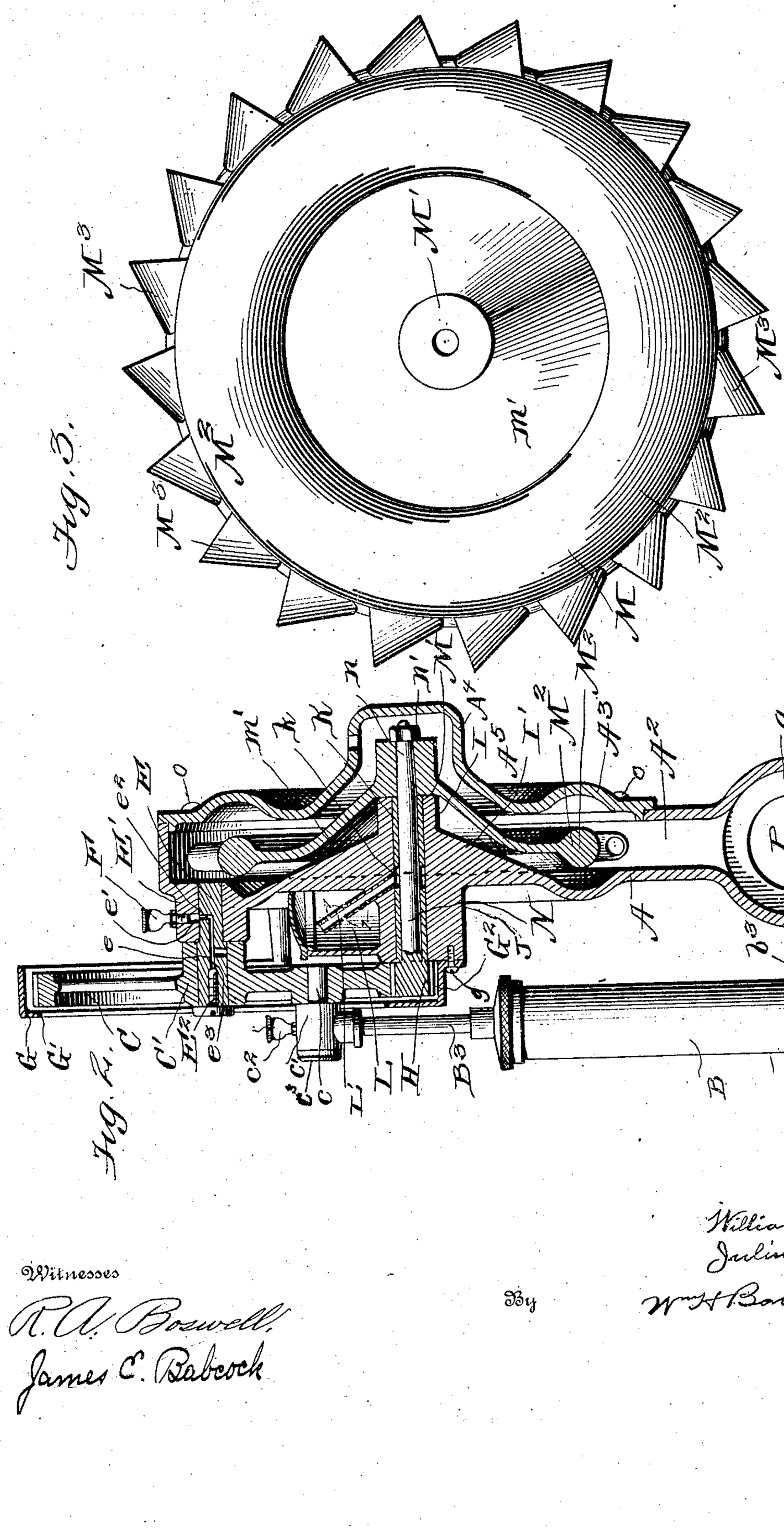
2 SHEETS—SHEET 2.

Fig. 3.



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No. 780,971. Patented January 31, 1905.

UNITED STATES PATENT OFFICE.

WILLIAM BOEKEL AND JULIUS BOEKEL, OF PHILADELPHIA, PENNSYLVANIA.

WATER-WHEEL.

SPECIFICATION forming part of Letters Patent No. 780,971, dated January 31, 1905.

Application filed April 2, 1904. Serial No. 201,306.

To all whom it may concern:

Be it known that we, WILLIAM BOEKEL and JULIUS BOEKEL, citizens of the United States, residing at Philadelphia, in the county of Philadelphia and State of Pennsylvania, have invented certain new and useful Improvements in Water-Wheels; and we do hereby declare the following to be a full, clear, and exact description of the invention, such as will enable others skilled in the art to which it appertains to make and use the same.

This invention relates to an improvement in water-wheels and their attachments for operating pumps and for other purposes; and it consists in the construction and combination of parts hereinafter more particularly set forth and claimed.

In the accompanying drawings, Figure 1 represents a side elevation of a water-wheel and its casing embodying my invention with the usual attachments for operating a pump, a part of the casing being broken away and the inlet-nozzle and a part of the wheel sectioned to show the interior construction. Fig. 2 represents a vertical section of the same on the line 2 2 of Fig. 1, the pump being shown in elevation. Fig. 3 represents a detail perspective view of the wheel.

A designates the casing of the wheel, the base A′ of which is provided with a cylindrical water-receptacle *a*, having an outlet-pipe P, one end of the said receptacle being reduced by an annular plate *a′* to fit the same, its other end being closed by a plate a^2 and these plates being secured in place by bolts a^3. A pump-cylinder B is mounted pivotally on a pintle B′, passed through lugs *b* on the bottom of said cylinder and also through raised lugs *b′* of a pump base-plate b^2, which is fastened by screws b^3 to the said base A′ of the casing. The piston-rod b^3 of this pump is operated by a wrist-pin *c* of a gear-wheel C, hereinafter described, driven by the water-wheel M, the connection between the said wrist-pin and said piston-rod being made by a suitable coupling *c′*, provided with a lubricator-cup c^2 and cap-plate c^3, the latter having a screw-threaded stem which turns into the end of the said wrist-pin for convenience in disengaging the parts. The said casing A is provided with a vertical passage A^2, communicating with the said cylindrical water-receptacle, and the circular hollow body of said casing above the said passage is provided with an annular expansion A^3 to provide room for the heavy annulus M^2 of the water-wheel, hereinafter described, and with a central outward extension A^4 in line with the axis of the water-wheel corresponding to the construction of the said water-wheel, as hereinafter described. At one point opposite the lower part of the said wheel the casing A is provided with a tubular arm or offset A^6, arranged to receive an inclined inlet-nozzle D, held in place by a tubular coupling or socket D′, which has an annular external flange *d′*, that is perforated to permit the passage of fastening-screws d^2 into screw-threaded recesses of the outer end of said tubular arm or offset, which end is presented obliquely upward. The said nozzle is provided with an external annular flange *d*, which serves as a stop and brace, being in contact with the lower end of the socket D′. These parts D D′ are screwed or tightly fitted together. The upper part of the body of said casing is provided with a short strong tubular offset E′, receiving a fixed shaft E, on which the gear-wheel C, above mentioned, turns, being held thereto by a screw E^2, having a broad head or cap that overlaps the hub C′ of said wheel on the outer side. The inner end of the said hub is extended to be in contact with the end of the said tubular offset E′. The latter has a vertical lubricant-inlet passage *e′*, extending down to its bore and screw-threaded to receive the stem of an oil-cup F, and the fixed shaft E is provided, in continuation of this passage, with a longitudinal oil-duct *e*, bored centrally therein and having terminal inlet and outlet branches e^2 e^3, which permit the oil to flow from the said oil-cup to the said shaft. The screw E^2 affords access at will to the outer end of the said duct for cleaning the same.

The peripheral part of the gear-wheel C is protected by a concentric annular wheel-casing G, which surrounds the same and has a vertical annular flange G′ extending inwardly

from its rear edge to cover the rear face of the cogs. The lower part of this wheel-casing is extended downward to form a pocket G^2, covering and protecting a gear-pinion H, meshing with the said gear-wheel to drive the same and carried by the shaft N of the water-wheel M. This shaft turns in a bearing cast with the main part of the casing A, said bearing consisting of a forward-extending hub I and a rearward-projecting block J, with the interposed integral rear wall of the casing, the said bearing being bored from front to rear to admit a bushing K immediately surrounding the said shaft. This bushing is provided at its middle with an annular oil-space *k*, supplied from an oil-reservoir L by means of an oil-pipe L′, perforated on its sides at *l* and extending through a part of the rear of said casing, which is obliquely bored to receive it, to the said oil-space *k*. The hub I is braced by webs I′, cast integral with it and the rear wall of the casing, and is in contact with the rear face of the hub M′ of the water-wheel M. The bushing K is in contact at its front end with the hub M′ and at the other end with the gear-pinion H. The shaft N has its forward end *n* extended in front of hub M′, where it receives a nut *n*′, serving to clamp the wheel M and the pinion H tightly in position against the forward and rear ends of the shaft-bearing integral with the rear part of the casing A.

The wheel-casing G is attached to the casing A by screws *g*, which enter, respectively, the block J and solid studs J′, the latter being rigid and preferably integral with the upper part of the rear wall of the casing and arranged on each side thereof a little below the horizontal plane of the center of the wheel C and the wheel-casing G. The top of the oil-reservoir L is also a separate piece cemented to the body of said reservoir and to the rear wall of the casing A or attached thereto in any other convenient way. The front wall A^5 of the said casing is also separate from the main casting which constitutes the rear and the greater part of the body thereof, and is held thereto by screws *o*. The few removable parts above mentioned permit easy access to the interior of any portion of the casing. The fact that by far the greater part of the article beside the wheels is in a single casting insures the maximum strength and durability and facilitates manufacture. The parts which are made separately and attached are such as by their position would prevent or greatly impede casting integrally. The wheel M also consists of a single piece comprising, besides the hub M′, a thin conoidal web *m*′, flaring therefrom rearwardly to a relatively heavy annulus M^2, having conoidal cups M^3 at properly-calculated intervals all around its periphery, these cups being presented outward to receive in succession the jet of water from the nozzle D. The position of the said nozzle and of each conoidal cup M^3 is such that the central line of discharge passes exactly through the apex of the interior of the cup at the point of rotation where this stroke will be most effective. The most effective angle for these cups is sixty degrees in longitudinal section. Greater obtuseness than this results in the spilling out or spreading out of more or less of the water without reaching the apex of the cup, while a more acute angle does not leave sufficient opening at the outwardly-presented base of the cone, and consequently a part of the jet will strike outside of it, especially in the beginning of impact. This construction insures the passing of the jet very quickly from the apex of one cup to the apex of the next, with no loss of power by the stroke of the water against the side of the cup toward the center of the wheel, since the outer part of each cup shields the inner part of the cup next before it in rotation, the cups being arranged at intervals determined by a line thus drawn from the nozzle, as indicated by Fig. 1, and the positions of the cups and the positions of the said parts being as above stated. The maximum efficiency of a wheel of this kind must depend, other things being equal, on doing away as far as possible with ineffective application of any part of the jet of water, whether carried by the inward stroke above referred to or by eddies incident thereto, which will oppose and diminish the effect of the stroke on the outer side and at the apex and by bringing the jet as nearly as possible to a focus without other direction of flow in the cup, also on making this action continuous, the jet passing quickly from cup to cup with no intervals and with scarcely even an instantaneous lessening at any time of the best focal and impulsive effect. The heavy annulus M^2 near the periphery makes this water-wheel also a fly-wheel, insuring by its momentum evenness of action when there is irregularity in the water-jet or elsewhere and counteracting any such slight differences of force applied as may be represented by the stroke on the edge of the cup and that at its apex—in short, insuring perfectly reliable rotation while the water-supply continues, from whatever quarter this reliability may be threatened, and continuing such rotation, if necessary, over a brief stoppage of flow. The said annulus is circular in cross-section or of such other form as will have its transverse diameter about equal to its radial diameter, using the latter term with reference to the radius of the wheel. This permits the said annulus to have a mass exceeding in weight all the rest of the wheel without undue extension sidewise, as would be necessary if a flat ring or similar weight were employed. Our construction leaves the annulus at once heavy, inconspicuous, and compact, permits a pile of such wheels to be arranged for storage or shipment in relatively small compass and without the sides or edges

of any annulus interfering with others in the pile, and still insures the maximum efficiency of fly-wheel action. The flaring construction of the web *m'* leaves space for the thickening of the central part of the rear wall of the casing and the forward extension of the shaft-bearing necessary to resist the strain on the shaft.

The wheel is first cast in the form shown, the conical cups being afterward bored out accurately and smoothly. The wheel as a whole, and especially the annulus and conical cups constructed as described, constitute the most important parts of our invention.

The general operation is as follows: The interior of the nozzle being tapered, as shown, to a narrow neck, the water of the jet is compressed by the force of the current behind it and issues compactly as a projectile aimed at the apex of each cup as the cups are presented in turn, practically no water spreading or flying aside before the cup is reached. Its work there being done, each cup on turning beyond the stroke of the jet drops its charge of water through passage A^2 into the water-receptacle *a*, whence it escapss through the outlet-pipe. Of course the impact of the water turns the wheel as usual within the casing, and any water not thus discharged drips from the ascending cups through the surrounding space and the said passage to the said receptacle, the cups being presented quite empty to the jet.

This water-wheel is found very effective for operating an air-pump, but of course may be used with other apparatus or machinery, the pump being shown merely by way of illustrating one serviceable application of our invention. For ordinary purposes we make the wheel to weigh about seventeen pounds, mostly in the annulus M, near the periphery for greater leverage. The gear-pinion and gear-wheel are most conveniently provided with cogs in the ratio of one to ten, causing converse reduction of speed, though of course we do not limit ourselves to this ratio nor to the construction of gearing described.

In many cities the use of water is greatly restricted by law, hence the importance of devising a water-wheel which will get the utmost possible results from the action of a small stream under moderate pressure. This we have approximately accomplished.

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

1. A water-wheel in one piece comprising a hub, a thin flared conoidal web, a peripheral annulus and peripheral cups, whereby the greater part of the wheel is near its periphery, in combination with a casing adapted to the form of said wheel and supporting the same and means for supplying motive fluid for driving the said wheel substantially as set forth.

2. In combination with a water-wheel and its shaft, a casing therefor consisting of a single casting and a front plate, the said casting including bearings for the said shaft and thickened parts adjacent thereto and gearing operated by said wheel for driving mechanism, the said wheel between its hub and periphery being given a flared or conoidal form to allow space for said bearing and thickened parts, this flared part being thin and the greater part of the weight of the wheel being near its periphery for the purpose set forth.

In testimony whereof we have signed our names to this specification in the presence of two subscribing witnesses.

WILLIAM BOEKEL.
JULIUS BOEKEL.

Witnesses:
JOHN H. SCHERER,
GUSTAV A. MAIER.