(No Model.)

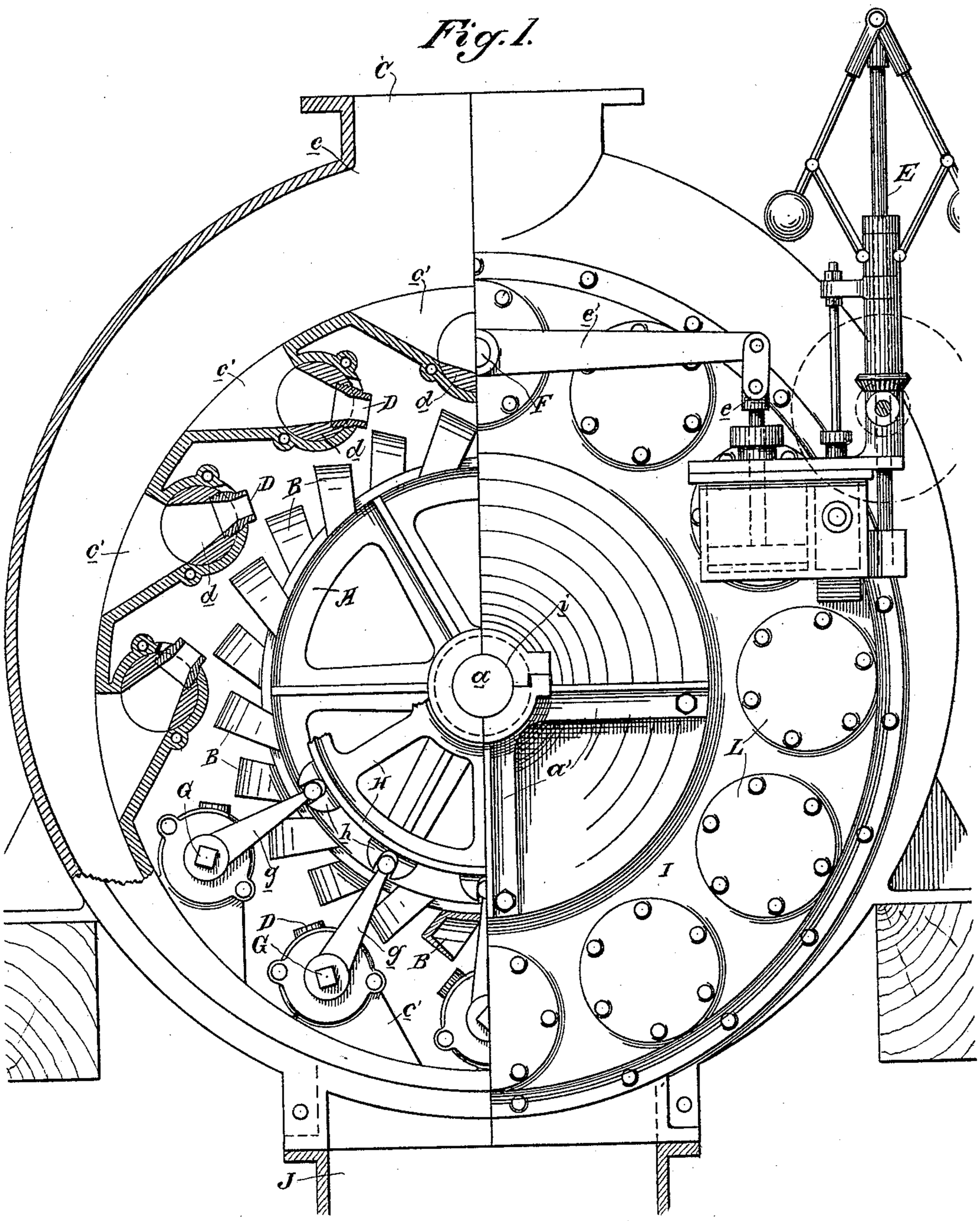
3 Sheets—Sheet 1.

J. B. PITCHFORD.

WATER WHEEL.

No. 460,758. Patented Oct. 6, 1891.

Fig. 1.



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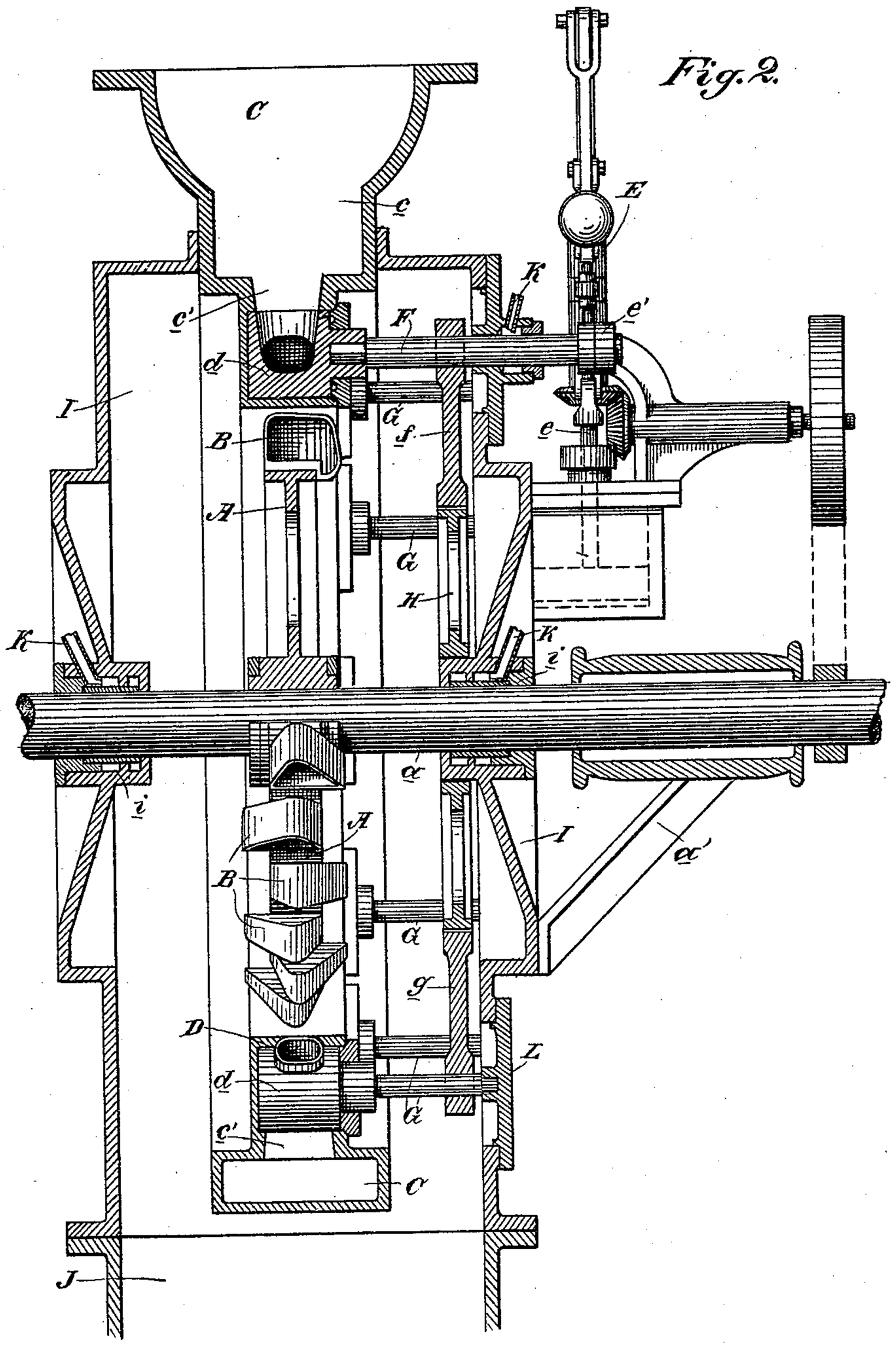
(No Model.) 3 Sheets—Sheet 2.

J. B. PITCHFORD.

WATER WHEEL.

No. 460,758. Patented Oct. 6, 1891.

Fig. 2.



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(No Model.) 3 Sheets—Sheet 3.

J. B. PITCHFORD.

WATER WHEEL.

No. 460,758. Patented Oct. 6, 1891.

Fig. 3.

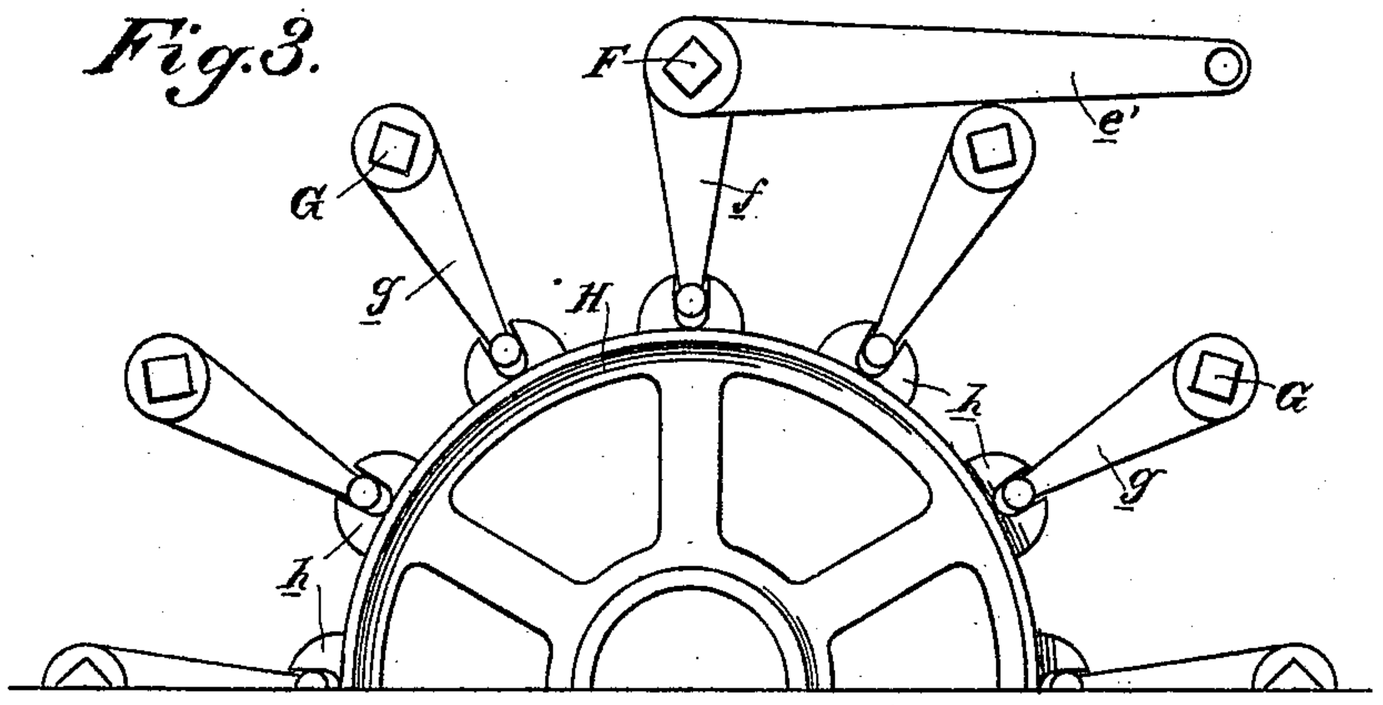


Fig. 4.

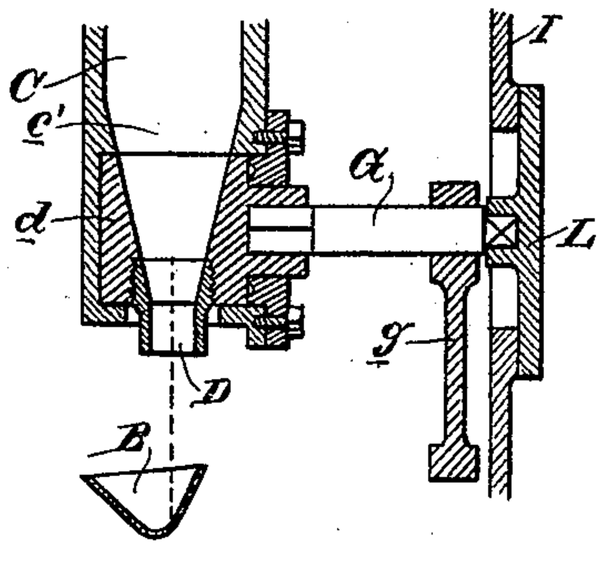
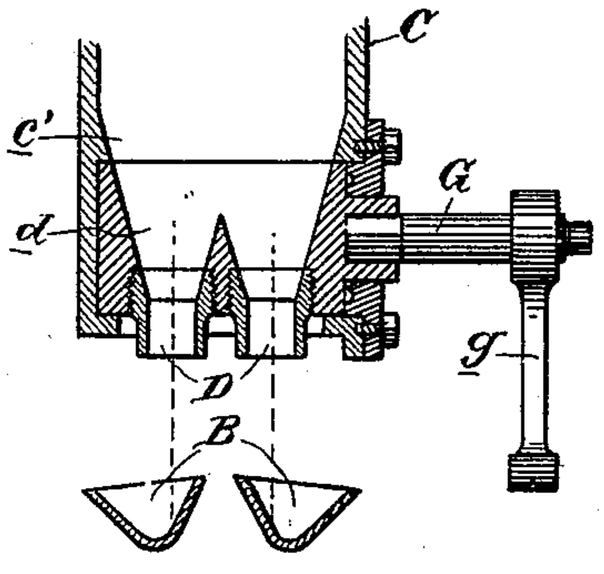


Fig. 5.



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UNITED STATES PATENT OFFICE.

JOHN B. PITCHFORD, OF SAN FRANCISCO, CALIFORNIA.

WATER-WHEEL.

SPECIFICATION forming part of Letters Patent No. 460,758, dated October 6, 1891.

Application filed October 16, 1890. Serial No. 368,355. (No model.)

To all whom it may concern:

Be it known that I, JOHN B. PITCHFORD, a citizen of the United States, residing in the city and county of San Francisco, State of California, have invented an Improvement in Water-Wheels; and I hereby declare the following to be a full, clear, and exact description of the same.

My invention relates to that class of water-wheels in which buckets are carried upon the rim or periphery of the wheel and receive the impact of a stream of water under head or pressure.

My invention consists in the several improvements hereinafter fully described, and specifically pointed out in the claims.

The objects of my invention may be generally stated to be increased capacity and a widely varying range of power. The first object is attained by bringing a large number of streams to play on the buckets at one time and the second is gained by changing the number of streams and the size of the nozzles to suit the quantity of water available.

Referring to the accompanying drawings for a more complete explanation of my invention, Figure 1 is a half-section and half-elevation of my wheel. Fig. 2 is a vertical cross-section of same. Fig. 3 is a side elevation of a portion of the nozzle-regulating gear. Fig. 4 is a detail section of a single nozzle and its adjusting connections. Fig. 5 is a detail section of twin nozzles and twin buckets.

A is the wheel, on the periphery of which are the buckets B. The shape of the buckets is shown in Fig. 5, from which it will be seen that one side of each bucket is less inclined from the line of the stream than the other, and the stream being directed into this straighter side is discharged from the other side. Where single buckets are used, they are placed staggering, as shown in Fig. 2, and with their discharge sides outwardly, so that adjacent buckets will discharge to opposite sides, while their receiving sides are in line to receive the impact of the streams. Where twin buckets are used, they are placed side by side, as shown in Fig. 5, with their discharge sides on the outside and their receiving sides adjacent. In the use of either single or twin buckets so placed all side thrust is avoided, and this form of bucket can be used for either single or twin nozzles.

Encircling the wheel either partially or wholly, but separated therefrom a sufficient distance to permit of the intervention of the nozzles, is a water-supply pipe C. This pipe tapers from its inlet *c* above equally on each side of the bottom, as is shown in Fig. 1. To this pipe are attached the nozzles D, which can be stationary, or they can be movable, as will be presently described. These nozzles are arranged around the interior of the pipe at suitable distances apart to get any required number of streams, and their angle is such as to direct their streams properly into the buckets. These nozzles may be single ones, as shown in Fig. 2, or they may be twin nozzles, as shown in Fig. 5. The nozzles are here shown as movable or adjustable ones, the object of which is to enable the streams to be directed above or over the buckets when, for any reason, it becomes desirable to reduce the speed of the wheel without shutting off the water.

In Fig. 1, *c'* are nozzle branches issuing from pipe C. Their inner ends are formed with cylindrical seats, into which are fitted the plugs *d*, which have an oscillatory movement in said seats. Into the front of these plugs are screwed the nozzles D. Different sizes of nozzles may be fitted to the plugs, as required. From this it will be seen that the nozzles can be raised or lowered to direct their streams over or into the buckets. It is intended to adjust them all simultaneously, either by hand or automatically, as will now be described.

The letter E represents any suitable form of governor. A hydraulic governor is here shown, which needs no further description than to say that by the action of the balls a valve is operated which admits water to move a piston, the rod *e* of which is connected with an arm *e'*, one end of which is connected with a rock-shaft F. This shaft extends inwardly to and is connected with the plug *d* of one of the nozzles, (here shown as the top one.)

Extending outwardly from the plugs of each of the other nozzles is a rock-shaft G, from each of which extends a radial crank-arm *g*, and from rock-shaft F extends a similan crank-arm *f*.

H is the regulating gear-wheel, mounted so as to turn concentric with the wheel A. The rim of this gear is provided with grooved lugs *h*, into which the inner ends of all the crank-arms *g* and *f* fit. Now when the speed of the water-wheel increases the governor acts to turn shaft F, which thereupon directly turns the nozzle-plug, to which it is attached, and thereby adjusts said nozzle, and this same movement of shaft F, through its crank-arm *f*, turns gear H, which, through the crank-arms *g*, turns shafts G, whereby all the other nozzle-plugs are turned, and their nozzles are thereby adjusted equally and simultaneously with the first nozzle. By these means an absolute steady speed can be maintained by the wheel, even if the work being done varies considerably. For low heads of water and where there is a fall below the wheel I inclose said wheel in an air-tight case, in order to provide for a partial vacuum within, which said vacuum is produced and maintained by a draft-tube attached to the bottom discharge-outlet, and having its lower end submerged in the tail-water. This inclosing-case is designated by I and consists of side pieces fitted up closely to the annular pipe C and covering the nozzles and wheel. These side pieces have the stuffing-boxes *i* for the wheel-shaft *a*, and said shaft has its bearings in arms *a'*, attached to the annular supply-pipe. Suitable brackets can be cast on this pipe to sustain the machine on its foundation.

J is the draft-tube connected with the bottom outlet, and the lower end of said tube may be supposed to be submerged in water. The stuffing-boxes *i* of the casing are kept air-tight by the introduction thereto through small pipes K of water under a pressure about equal to the external air-pressure. A similar water-pressure is to be introduced to and maintained in the stuffing-box where the rock-shaft F passes through the casing.

A wheel of this construction can be made to work up to the same percentage of efficiency when using a very little part of the water that it would use at full capacity. This gives my wheel great advantage over others, and especially over turbines, in the manipulation of which it is well known that there is a great loss of efficiency when the wickets or registers are closed to suit a smaller quantity of water than that for which the wheel is calculated.

The object in tapering the annular supply-pipe is to regulate its capacity at different points to supply the series of nozzles. For example, taking one side, the pipe at its upper portion must be large enough to supply all the nozzles on that side, while at its lowest point it has to supply but one, and can therefore be smaller.

Small cap-plates L are secured to the casing side and cover access-apertures over the nozzles, whereby they can readily be reached.

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

1. In a water-wheel, and in combination with the peripheral buckets thereof, the oscillatory plugs and the nozzles carried thereby and adapted to be turned with the plugs to direct the water into or over the buckets, substantially as herein described.

2. In a water-wheel, the combination of a series of adjustable nozzles arranged about the wheel and connections between all of said nozzles, whereby they may be moved simultaneously to vary the direction of their streams, substantially as and for the purpose herein described.

3. In a water-wheel, the series of adjustable nozzles arranged about the wheel and the turning-plugs carrying them, in combination with the rock-shaft F, connected with one of said plugs, the rock-shafts G of the remaining plugs, the gear-wheel, and the crank-arms *f* and *g* of the rock-shafts engaging the gear-wheel, whereby all of said plugs may be turned simultaneously to adjust their nozzles, substantially as and for the purpose herein described.

4. In a water-wheel, the series of adjustable nozzles arranged about the wheel and the turning-plugs carrying them, in combination with a governor, the rock-shaft F, operated by the governor and connected with one of said plugs, the rock-shafts G of the remaining plugs, the gear-wheel, and the crank-arms *f* and *g* of the gear-wheel, whereby all the nozzles are adjusted simultaneously to regulate the speed of the wheel, substantially as herein described.

In witness whereof I have hereunto set my hand.

JOHN B. PITCHFORD.

Witnesses:
S. H. NOURSE,
H. C. LEE.