(No Model.)

3 Sheets—Sheet 1.

W. H. RIDGWAY.

WATER WHEEL SYSTEM.

No. 245,867. Patented Aug. 16, 1881.

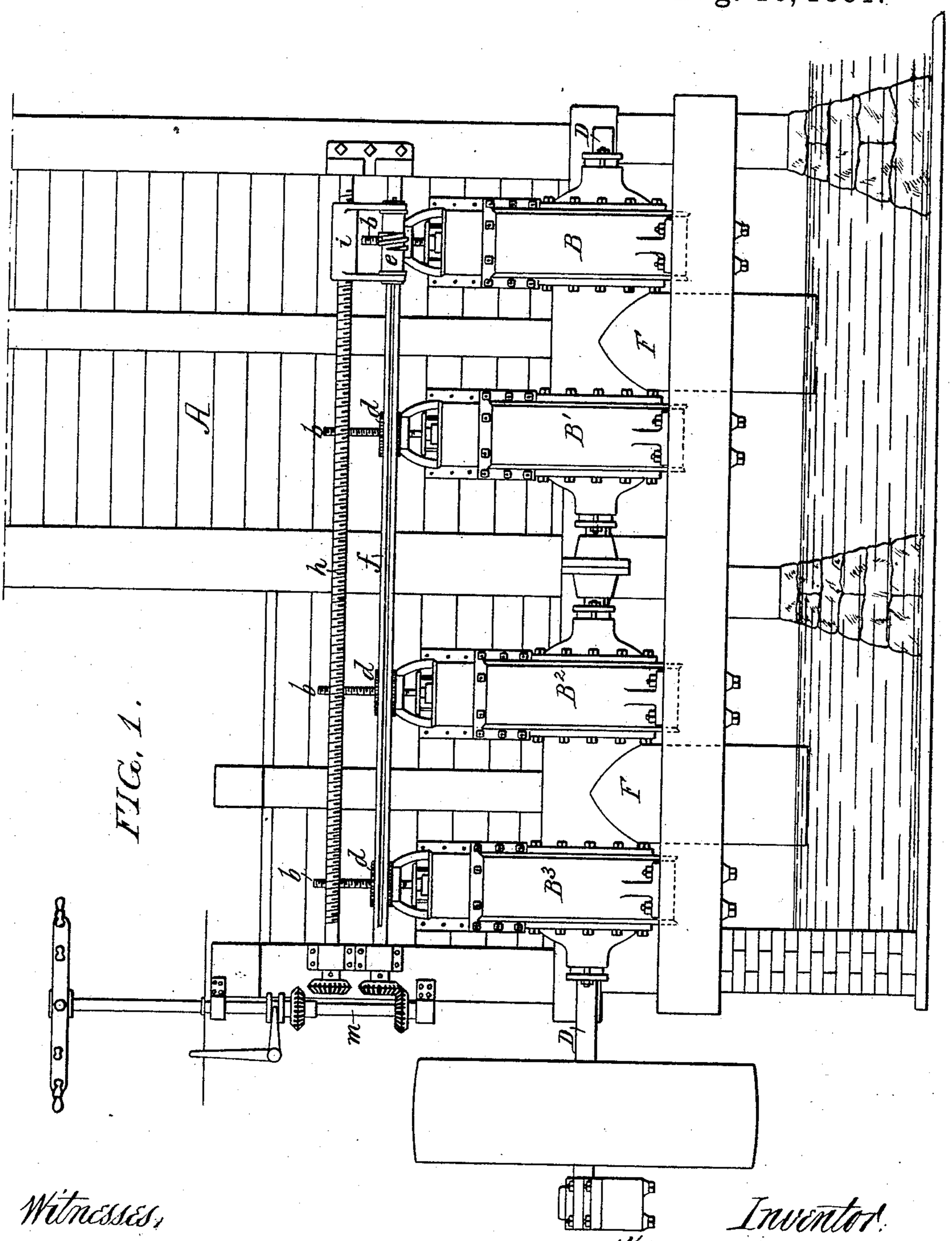

FIG. 1.

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H. C. Fulenwider

Inventor:
William H. Ridgway
by his Attorneys
Howson and Sons

(No Model.) 3 Sheets—Sheet 2.

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FIG. 2.

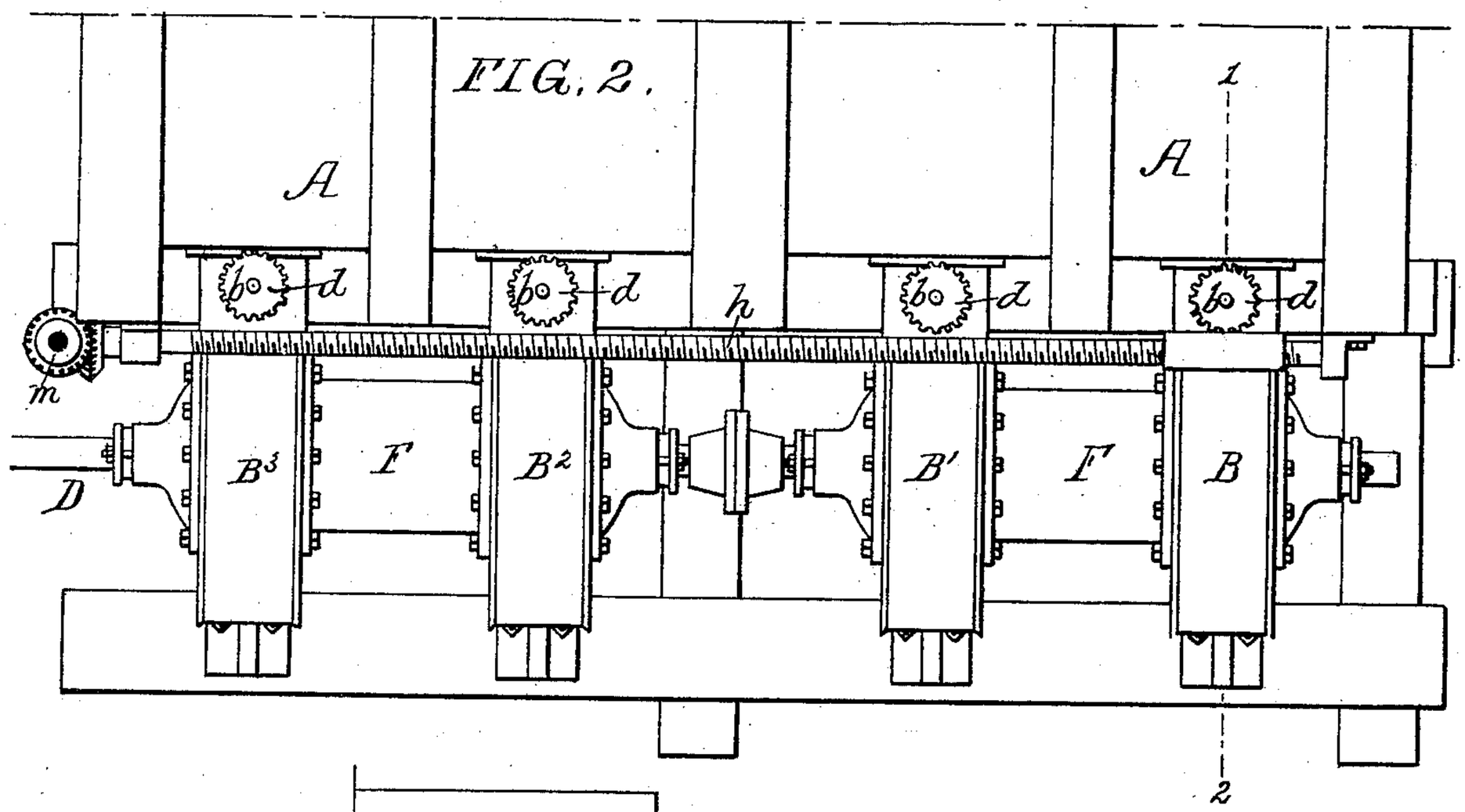
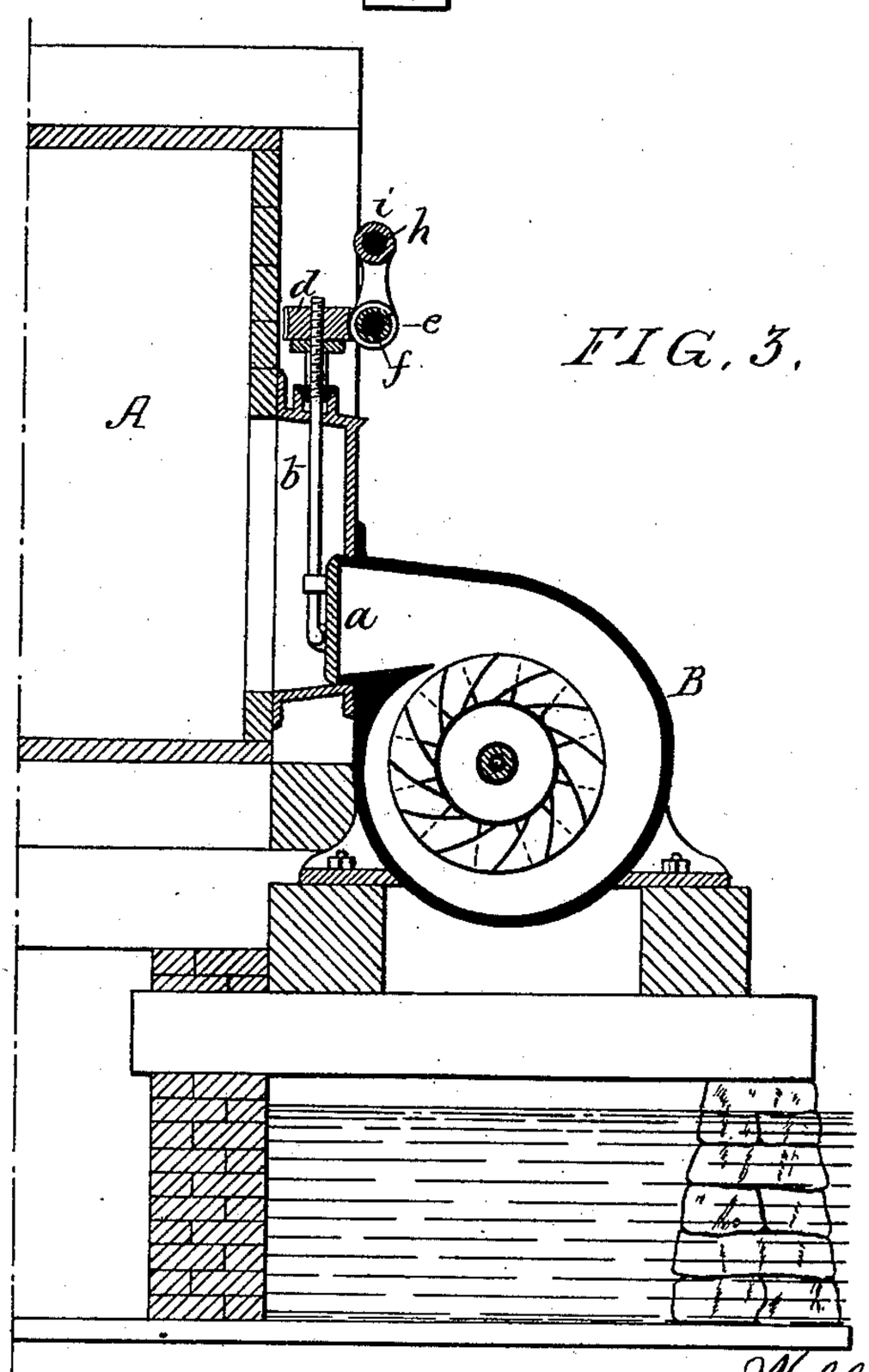


FIG. 3.



Witnesses.
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(No Model.) 3 Sheets—Sheet 3.

W. H. RIDGWAY.

WATER WHEEL SYSTEM.

No. 245,867. Patented Aug. 16, 1881.

FIG. 4.

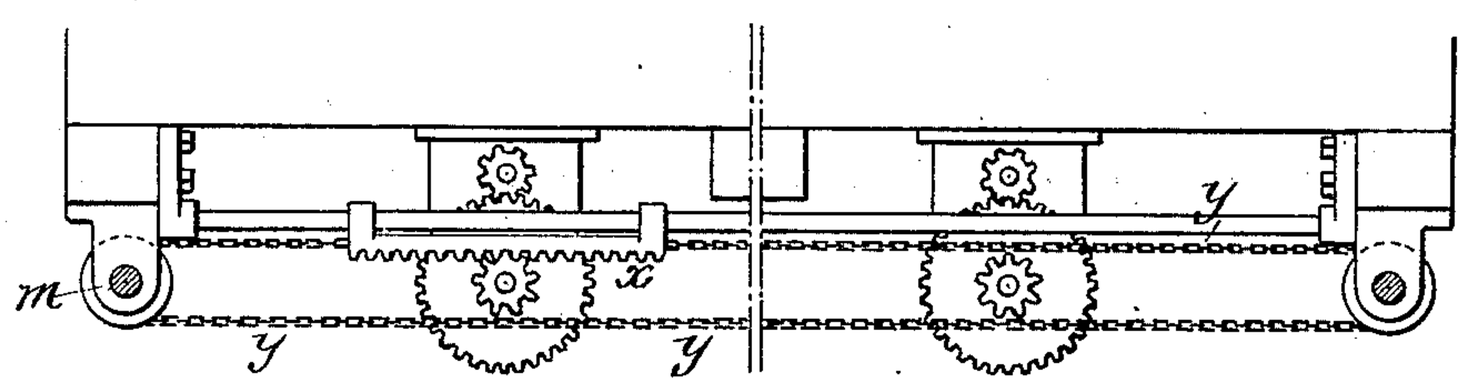


FIG. 5.

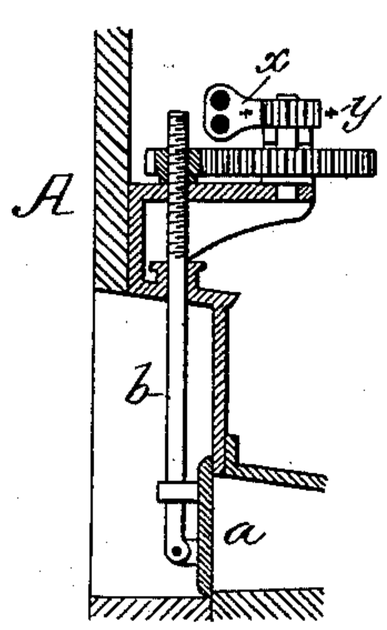
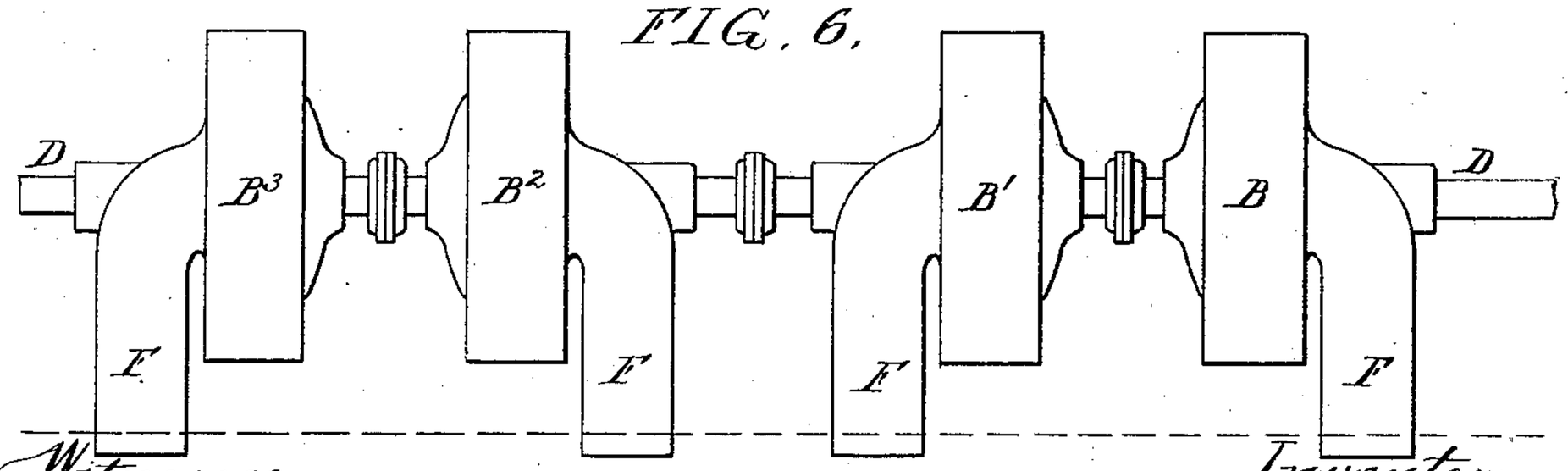


FIG. 6.



Witnesses:
James F. Tobin
H. L. Fulenwider

Inventor:
William H. Ridgway
by his attorneys
Howson and Sons

UNITED STATES PATENT OFFICE.

WILLIAM H. RIDGWAY, OF COATESVILLE, PENNSYLVANIA.

WATER-WHEEL SYSTEM.

SPECIFICATION forming part of Letters Patent No. 245,867, dated August 16, 1881.

Application filed May 13, 1881. (No model.)

To all whom it may concern:

Be it known that I, WILLIAM H. RIDGWAY, a citizen of the United States, residing in Coatesville, Chester county, Pennsylvania, have invented certain Improvements in Water-Wheel Systems, of which the following is a specification.

The main object of my invention is to obtain a high percentage of power in proportion to the amount of water used, and to permit ready access to one wheel without interfering with the operation of the others, a further object being to relieve the draft-tubes of the wheels from the strain of the shafts, and thus permit said tubes to be made of lighter material than usual. These objects I attain in the manner which I will now proceed to describe, reference being had to the accompanying drawings, in which—

Figure 1, Sheet 1, is a front view of a system of water-wheels embodying my invention; Fig. 2, Sheet 2, a plan view; Fig. 3, a transverse section on the line 1 2; and Figs. 4, 5, and 6, Sheet 3, views illustrating modifications of my invention.

Heretofore, in obtaining power by means of turbine water-wheels, it has been the prevailing practice to use a wheel of a size proportionate to the amount of power required, the gate of the wheel being partly closed when it was desired to reduce the power, or when the supply of water was not sufficient to permit the wheel to be run at full-gate, the wheel in such case being said to run at "part gate."

It is well known that the power developed by a water-wheel from the volume of water used decreases rapidly as the gate is closed. For instance, it has been estimated that a wheel which, when running at full-gate, develops about eighty per cent. of the power of the water used will develop but about from fifty to sixty per cent. of the power at half-gate, and but about twenty to thirty per cent. at quarter-gate. Hence under the present system the water is used most disadvantageously at the time when it is important to develop as much power as possible in proportion to the amount of water used—that is to say, at low stages of water.

In carrying out my invention I use a number of small water-wheels on a single driving-shaft, and operate the gates of the wheels independently of each other and in succession, so that the supply of water to one or more of the wheels may be entirely cut off without affecting the remainder of the wheels, which continue to run at full-gate, and consequently develop the highest possible percentage of power.

In the drawings, A represents part of a sluiceway or penstock for supplying water to a number of wheels, four being shown in the present instance, and being lettered respectively B, B′, B^2, and B^3.

D is the driving-shaft, which is made in sections, for a purpose explained hereinafter, the sections being coupled together, and each section carrying two of the wheels.

Each wheel-casing has a gate, *a*, operated by a rod, *b*, the upper end of the latter being threaded and adapted to an internally-threaded worm-wheel, *d*, with which engages a worm, *e*, carried by a longitudinal shaft, *f*, a key-seat extending throughout the length of the latter, and being adapted for the reception of a feather in the hub of the wheel, so that the latter is free to slide longitudinally on the shaft *f*, but cannot turn independently thereof. The longitudinal position of the worm on the shaft is determined by the operation of a screw-shaft, *h*, and a nut, *i*, on which are arms, forming bearings adapted to the reduced ends of the hub of the worm, so that the latter can turn freely with the shaft *f*, but is compelled to move longitudinally with the nut *i*.

The shaft *f* is operated by means of bevel-gearing from a vertical shaft, *m*, having a suitable hand wheel or crank, and the shaft *h* is also operated from the shaft *m* by means of bevel-gearing, the pinion on said shaft *m*, however, being keyed to the same, and free to slide thereon, under control of a suitable lever, so that the shaft *m* can be geared to or released from the shaft *h* at pleasure. This arrangement provides for the independent operation of the valves or gates of the wheels, the shaft *f* and its worm being operated until the gate of the first wheel, B, of the system has almost reached the limit of its downward movement, when the shaft *h* is thrown into gear with the shaft *m*, and the continued operation of the latter causes the rotation of both shafts and a longitudinal movement of the worm on the

shaft *f*, under the control of the nut *i* of the shaft *h*, the worm freeing itself from the first wheel *d*, and being traversed on the shaft until it engages with the second wheel *d*, when the shaft *h* is disengaged from the operating-shaft *m* by throwing the pinion of the latter out of gear. When the gate of the second wheel has been closed the above operation is repeated, and the supply of water to one wheel after another of the system is thus cut off, as the volume of the supply or the amount of work to be performed may suggest, those wheels to which the water is admitted, however, always running at full-gate and developing the greatest possible percentage of power. When the shaft *m* is turned in a direction opposite to that above described the gates of the wheels will be opened in succession in a manner which will be readily understood.

When the shaft D is continuous there must always be more or less friction and wear of said shaft due to the rotation of the same in dry bearings in the wheel casing or casings, from which the water has been cut off, and there is also dead weight to be carried by the operating-wheels; hence, in order to overcome these objections, I make the shaft D in sections, connected by suitable couplings, so that when the water has been cut off from the wheels B B′ the section of shaft carrying said wheels can be disconnected from the section carrying the wheels B^2 B^3. The sectional shaft also permits the repairing of one member of the system without impairing the action of the other member or members or necessitating the stoppage of the mill.

Changes in the arrangement and construction of the wheels within the scope of my invention will readily suggest themselves to those skilled in the art. For instance, in place of the worm-wheel, nut, and duplex-shaft arrangement, (shown in Figs. 1, 2, and 3,) the gate-operating nut may form part of a pinion operated, through the medium of suitable intervening gearing, by a rack, *x*, carried by an endless chain, *y*, as in Figs. 4 and 5, the rack having lugs adapted to suitable guide-rods, and being traversed by the chain, so as to successively close or open the gates of the wheels.

In Figs. 1, 2, and 3 I have shown a single draft-tube, F, for each pair of wheels, the wheel-casings being arranged side by side and the draft-tube being bolted to the inner or adjacent sides of said casings, while the bearings for the wheel-shaft are formed in the outer sides of the casings. By this means the draft-tubes are entirely relieved from the strain of the shaft, and can therefore be made of much lighter metal than usual. The main feature of my invention, however, is not limited to wheels thus arranged in pairs with a single draft-tube. For instance, I have shown in Fig. 6 four single wheels, each carried by a section of shaft independent of the others, the sections being provided with suitable couplings, whereby they may be readily connected to or disconnected from each other.

I am aware that a duplex wheel on a vertical shaft has been combined with a horizontal casing having a gate for each wheel and two outlets, one discharging upward and the other downward; but this invention differs materially from mine, in which any number of wheels can be used on a single driving-shaft, all of the wheels having the same head. It also differs from it in not affording the same facility for gaining access to the wheel—a remark which applies to all arrangements in which a number of wheels are contained in a single casing.

I claim as my invention—

1. The combination of a horizontal driving-shaft with a series of vertical turbine wheels secured thereto, and each furnished with an inclosing-casing and controlling-gate, independent of those of the other wheels, as set forth.

2. The combination of a series of water-wheels with a driving-shaft made in sections, each section carrying a wheel or pair of wheels, and the sections being coupled, so as to be readily connected to or disconnected from each other, as set forth.

3. The combination of a driving-shaft, a series of wheels thereon, a gate-actuating device, a single operating-shaft, *m*, and means, substantially as described, whereby the operation of said shaft *m* effects the traversing of the gate-actuating device, as set forth.

4. The combination of a pair of water-wheel casings arranged side by side, a driving-shaft adapted to bearings formed on the outer sides of the casings, and a draft-tube connected to the inner or adjacent sides of the casings and relieved from the strain of the shaft, as set forth.

In testimony whereof I have signed my name to this specification in the presence of two subscribing witnesses.

WILLIAM H. RIDGWAY.

Witnesses:

WM. P. LOGAN,

HARRY SMITH.