No. 608,245. Patented Aug. 2, 1898.

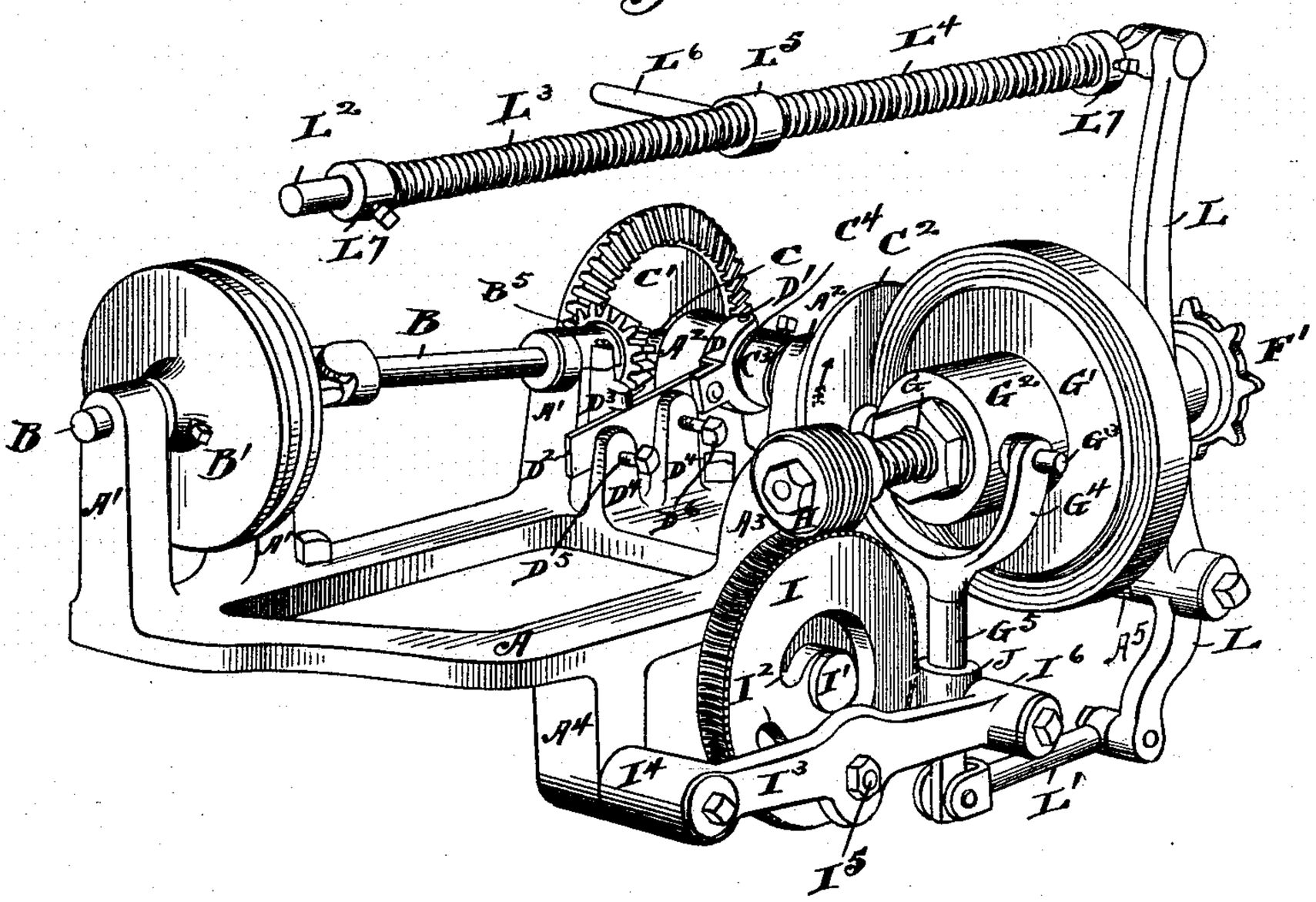
E. E. WOODWARD.

GOVERNOR FOR WATER WHEELS.

(Application filed July 3, 1897.)

(No Model.) 5 Sheets—Sheet 1.

Fig. 1.



Witnesses,
P. S. Spaun
Nellie Bunker.

Inventor,
Elmer E. Woodward
By Morrison & Miller
Attys.

No. 608,245. Patented Aug. 2, 1898.

E. E. WOODWARD.

GOVERNOR FOR WATER WHEELS.

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(No Model.) 5 Sheets—Sheet 2.

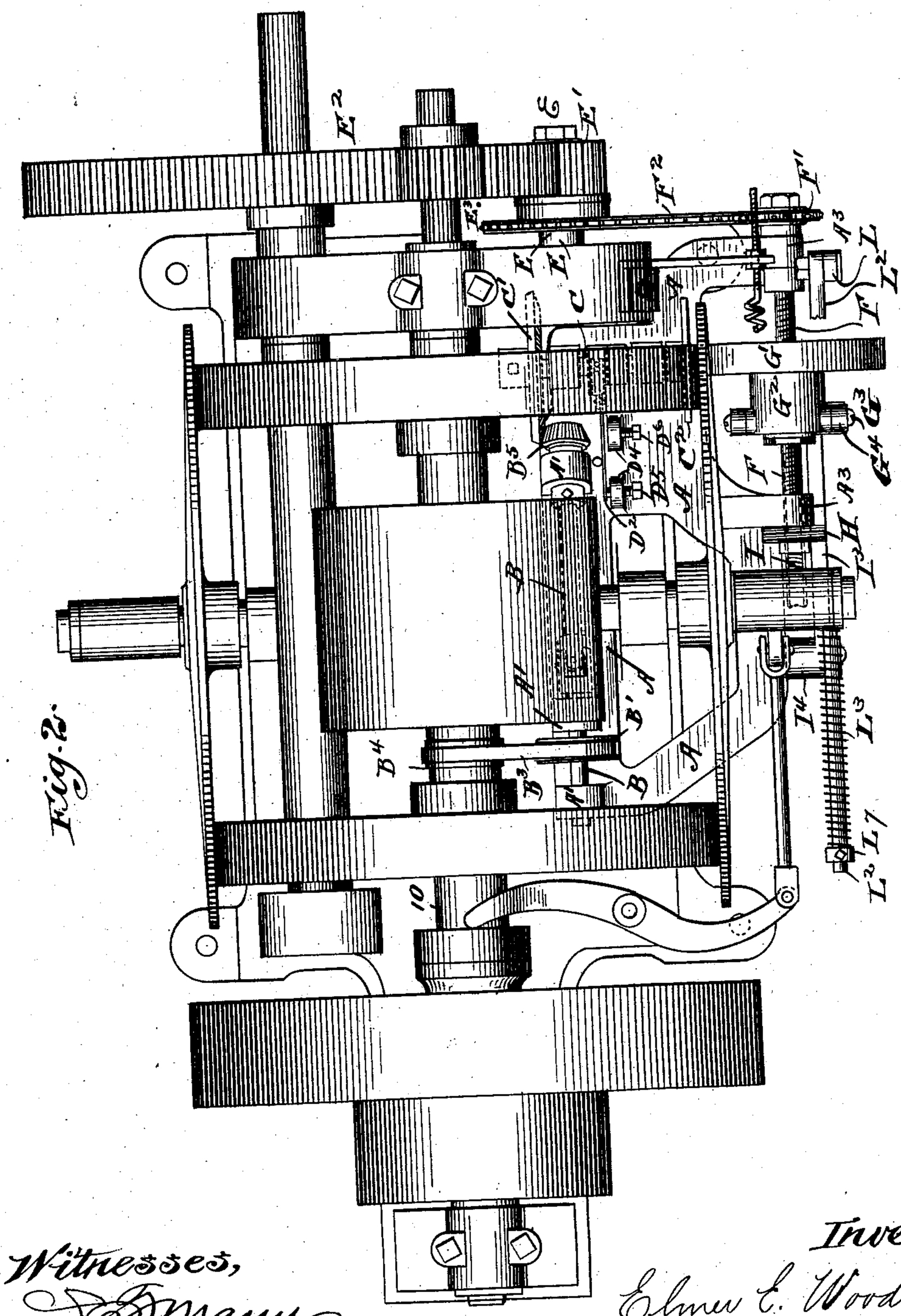

Fig. 2.

Witnesses,
D. S. Mann,
Nellie Bunker.

Inventor,
Elmer E. Woodward
By Morrison & Miller.
Att'ys.

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E. E. WOODWARD.

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(No Model.) 5 Sheets—Sheet 3.

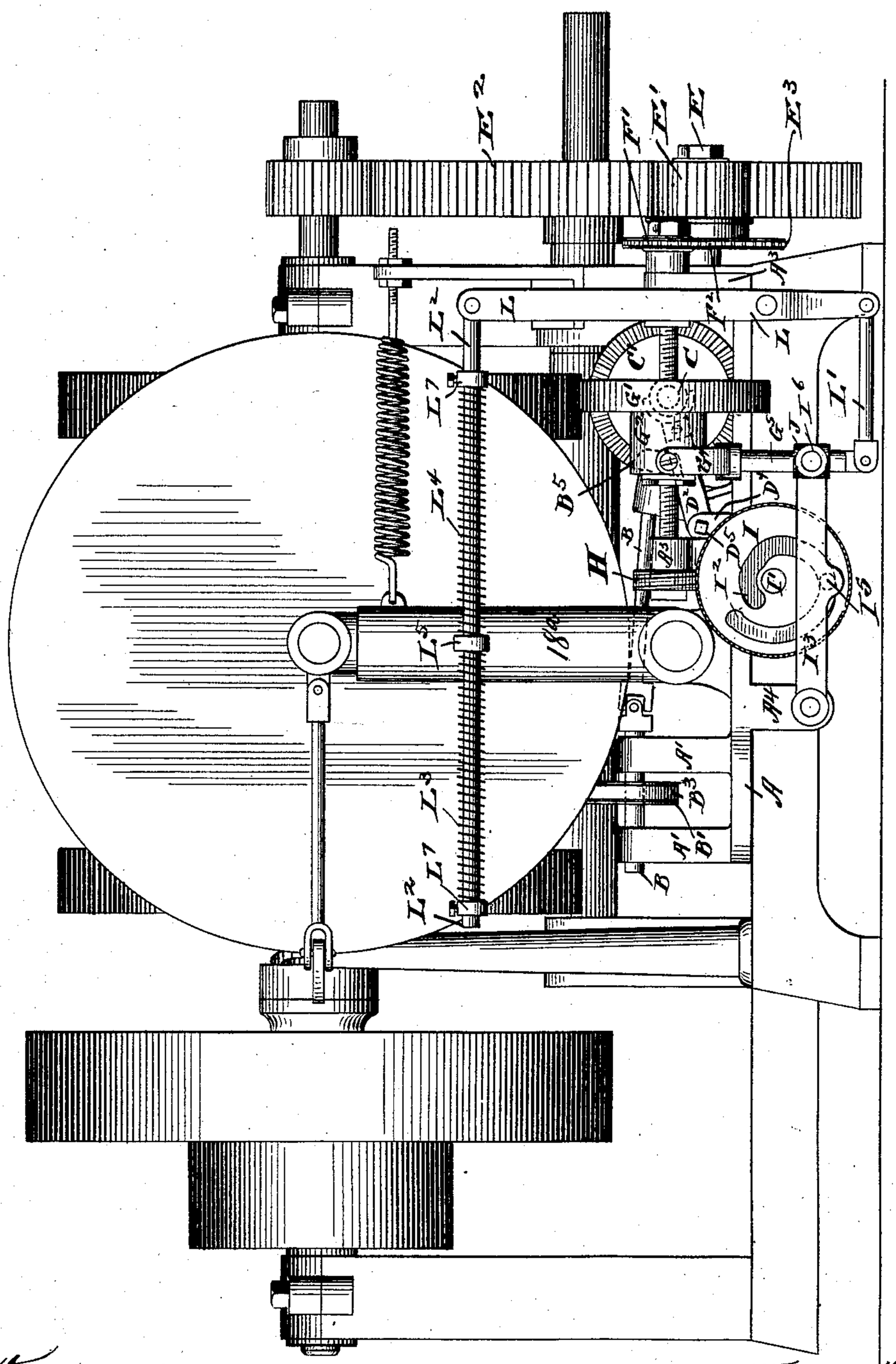

Fig. 3.

Witnesses,
D. D. Mann,
N. Ellie Bunker.

Inventor,
Elmer E. Woodward
By Morrison & Miller
Att'ys.

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E. E. WOODWARD.

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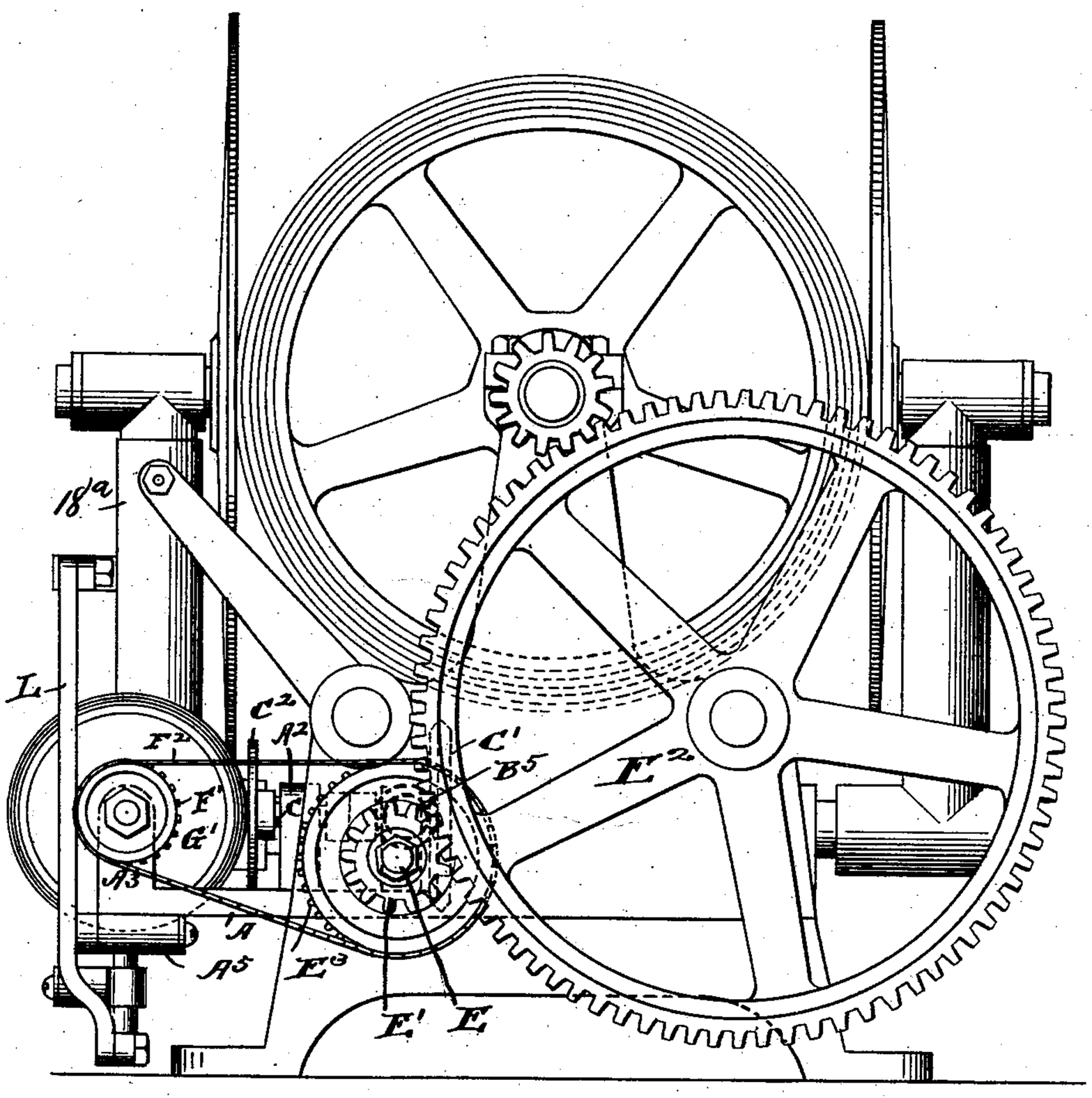
(No Model.) 5 Sheets—Sheet 4.

Fig 4.



Witnesses,
F. D. Mann.
Nellie Bunker.

Inventor.
Elmer E. Woodward
By Morrison & Miller
Attys.

No. 608,245. Patented Aug. 2, 1898.

E. E. WOODWARD.

GOVERNOR FOR WATER WHEELS.

(Application filed July 3, 1897.)

(No Model.) 5 Sheets—Sheet 5.

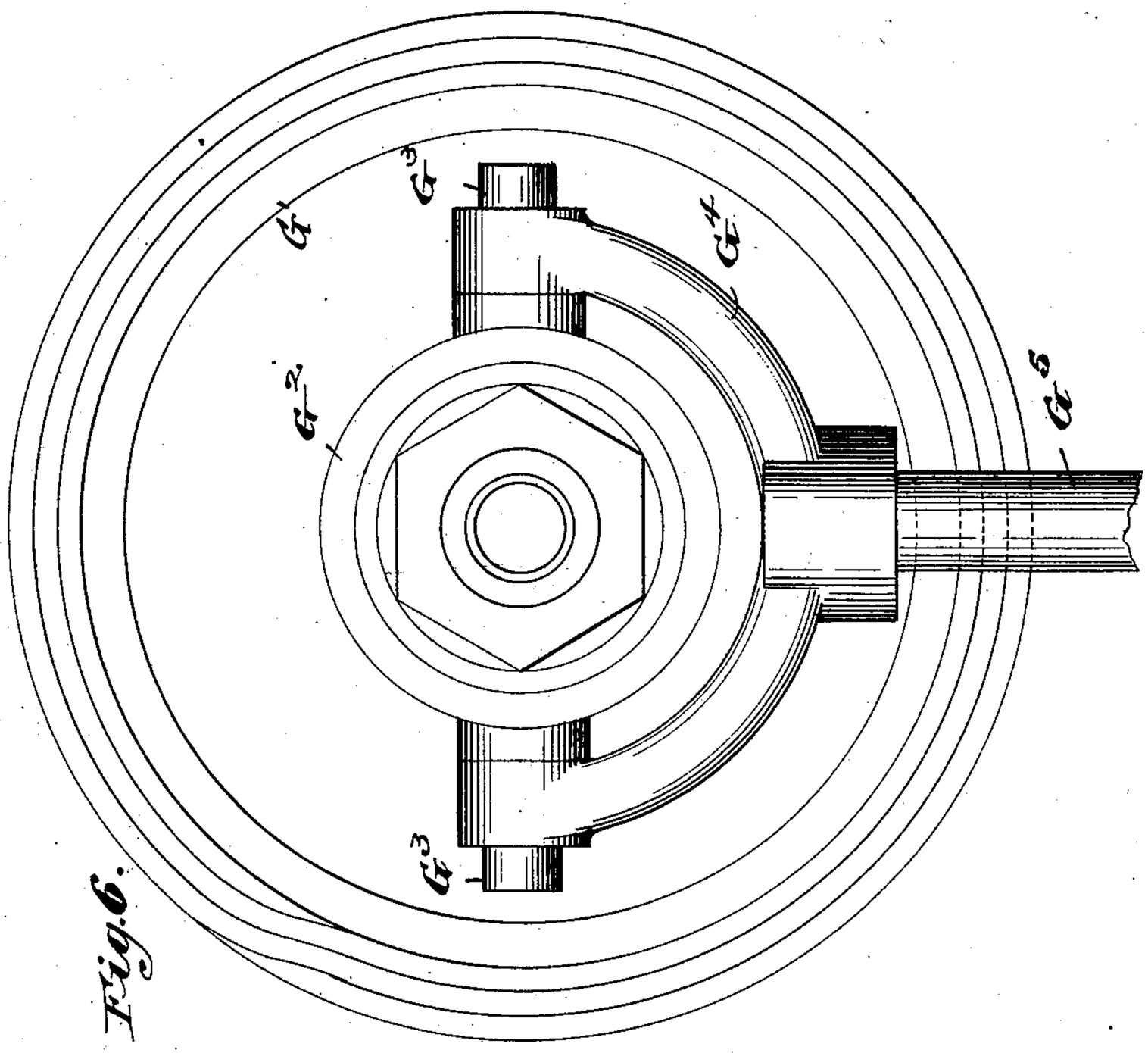


Fig. 6.

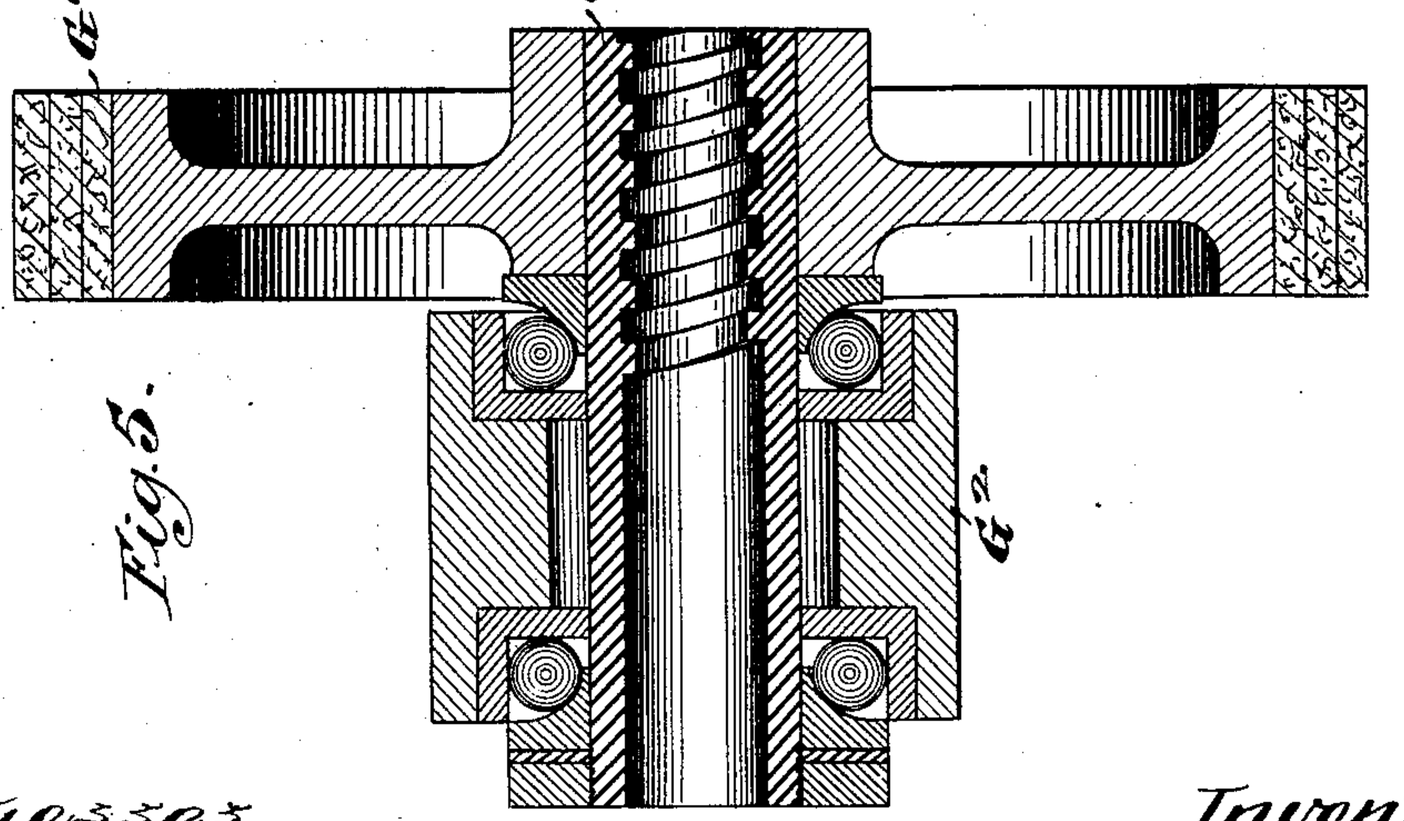


Fig. 5.

Witnesses,
E. E. Mann.
Nellie Bunker.

Inventor,
Elmer E. Woodward
By Monroe & Miller
Attys.

UNITED STATES PATENT OFFICE.

ELMER E. WOODWARD, OF ROCKFORD, ILLINOIS.

GOVERNOR FOR WATER-WHEELS.

SPECIFICATION forming part of Letters Patent No. 608,245, dated August 2, 1898.

Application filed July 3, 1897. Serial No. 643,420. (No model.)

To all whom it may concern:

Be it known that I, ELMER E. WOODWARD, a citizen of the United States, residing at Rockford, in the county of Winnebago and State of Illinois, have invented certain new and useful Improvements in Governors for Water-Wheels and other Motors, of which the following is a specification.

In this instance I have shown my invention as adapted to be used in connection with the form of a governor shown in Letters Patent of the United States No. 583,527, bearing date June 1, 1897, granted to Amos W. Woodward and myself for improvements in water-wheel governors, though, as will plainly appear, it may be applied to governors of other patterns.

The object of this invention is to provide an attachment for water-wheel governors by which the governor will be caused to operate the gate quickly and accurately without racing. By the term "racing" I mean the tendency of any governor to let on or shut off more power than it should, causing the speed of the machinery to vary from the normal rate. This is owing to the fact that speed is not instantly changed to correspond to an altered position of the gate; but, on the contrary, when the governor is caused to act on the gate by a change of load it continues until the speed returns to the normal, producing too great a movement of the gate. As soon as the effect of this excessive change of gate is felt the governor acts in the contrary direction, also too far, thus keeping the gate in continual motion. To cause the governor to thus set the gate accurately for each change of load, I accomplish by applying a limiting pressure to the centrifugal weights of the governor whenever the gate is moved, whereby the weights are returned to the position which they should assume at normal speed and gradually remove that pressure as the speed of the machinery, influenced by the change of the position of the gate, is returned to the normal rate. This limiting influence upon the action of the centrifugal weights is produced only when the position of the gate is being changed, it being put in operation by the mechanism which actuates the gate.

In the accompanying drawings, Figure 1 is a perspective view of my attachment separate from the governor. Fig. 2 is a plan view of a governor fitted with the attachment. Fig. 3 is a side elevation of a governor having the attachment. Fig. 4 is a rear end elevation of a governor and attachment. Fig. 5 is a central section through the friction-wheel and sleeve of the attachment. Fig. 6 is an elevation of said friction-wheel and sleeve.

Like letters and figures of reference indicate corresponding parts throughout the several views.

A is the framework which supports the attachment. It is secured to the base of the governor in any suitable manner.

A′ are three upright standards integral with the frame A.

A^2 also are two bearing-standards.

A^3 are two other bearing-standards extending upward from the frame of the attachment.

A^4 and A^5 are bearing-studs projecting from the frame A.

B is a two-part shaft, the parts of which are connected by a universal joint. It is provided with bearings in the upright standards A′.

B′ is a grooved pulley fixed to one part of the shaft B and receives a belt B^3, which passes over a ring B^4 on the sleeve 10 of the governor. This pulley B′ is continuously rotated during the action of the governor.

B^5 is a bevel-gear fixed on the opposite end of the two-part shaft B.

C is a shaft having journal-bearings in the standards A^2, extending at right angles to the shaft B.

C′ is a bevel-gear fixed on the shaft C at one end thereof, meshing with the bevel-gear B^5.

C^2 is a friction-disk fixed on the shaft C on the end opposite that occupied by the bevel-gear C′.

C^3 is a collar fast on the shaft C.

C^4 is a collar loosely mounted on shaft C and lies in contact with the fixed collar C^3.

D is a yoke having pivotal connection with the collar C^4 by means of the pins D′.

D^2 is a flat spring fixed to the yoke and bears on the knife-edge D^3.

D^4 are lugs threaded for and provided with set-screws D^5 and D^6, bearing against the flat spring D^2 on opposite sides of the knife-edge bearing D^3.

E is a bearing-stud fixed on the rear end of the governor-frame.

E′ is a gear loosely mounted on the stud E, meshing with the gate-wheel E^2 of the governor.

E^3 is a sprocket-wheel fixed to the gear E′.

F is a shaft having journal-bearings in the standards A^3. It extends at right angles to the shaft C at a little distance from the face of the friction-disk C^2 and is threaded between its bearings.

F′ is a sprocket-wheel fixed on the shaft F in line with the sprocket E^3.

F^2 is an endless chain running over the sprockets E^3 and F′, by means of which motion is communicated from the gate-wheel to shaft F whenever the position of the gate is changed.

G is a sleeve internally screw-threaded to correspond with the threads on shaft F, upon which it is mounted.

G′ is a leather-face friction-wheel fixed on the sleeve G.

G^2 is a collar loosely mounted on the sleeve G, having ball-bearings thereon.

G^3 are trunnions on the collar G^2.

G^4 is a yoke for receiving the trunnions.

G^5 is a stem for the yoke G^4.

The frictional contact between the friction-disk C^2 and the friction-wheel G′ is regulated by the set-screws D^5 and D^6. The latter, however, is chiefly intended to relieve all contact between the wheel and the disk when it is desirable to operate the gate by hand.

H is a worm fixed on the shaft F.

I is a worm-wheel meshing with the worm H, loosely mounted upon the stud I′, free to rotate when movement of the gate-wheel E^2 is communicated to the shaft F.

I^2 is a cam-groove formed in the face of the worm-wheel I.

I^3 is an arm having a hollow hub I^4 pivoted on the bearing-stud A^4, also having the stud I^5 near to its middle portion for engaging the cam-groove I^2.

I^6 is a transverse hollow hub at the free end of the arm I^3.

J is a fulcrum-sleeve surrounding the yoke-stem G^5 and in which that stem is free to slide. It has a bearing in the hollow hub I^6 of the arm I^3 and is free to turn in that bearing as the movement of the friction-wheel causes the yoke-stem G^5 to oscillate.

L is a vertical lever pivoted on the stud A^5 of the frame A.

L′ is a pivoted link connecting the lower end of the lever L with the lower portion of the stem G^5, the latter being flattened at its lower end for receiving the link L′.

L^2 is a rod having pivotal connection at one end with the upper end of the arm L.

L^3 and L^4 are two coiled springs surrounding the rod L^2, one lying on each side of an eye L^5, through which the rod is free to slide.

L^6 is a stem for the eye, by means of which the latter is connected with one of the upright arms of the tilting yoke 18^a, which supports the friction-disks of the governor.

L^7 are collars adjustably fixed on the rod L^2 by set-screws to receive the thrust of the coiled springs L^4 and retain the springs in position on the rod L^2.

The constant tendency of the rotating friction-disk C^2 is to cause the friction-wheel G′ to travel along the screw-threads on shaft F to the center of the friction-disk C^2, where it stands at rest; but any movement of the gate by the governor rotates the shaft F (through its endless chain and gear connection with the gate-wheel E^2) and causes the friction-wheel to be fed along the shaft F, across the face of the friction-disk C^2. This movement of the friction-wheel exerts a pressure upon the centrifugal weights to force them into their normal position, and thus limit the action of the governor upon the gate.

When the load is diminished and the speed of the machinery increases sufficiently to cause the centrifugal weights to tilt the yoke 18^a toward the left, as shown in Figs. 2 and 3, the governor shuts off water and rotates the shaft F, sliding the friction-wheel G′ toward the right. This movement of the friction-wheel G′ moves the yoke G^4, and through the link L′ actuates the upright arm L, compresses the spring L^3, and applies sufficient power to the governor-yoke 18^a and thence to the centrifugal weights to cause the latter to return to their normal position and the governor to cease working as soon as sufficient water has been shut off and while the speed is still a little high. This diminished flow of water permits the speed gradually to return to the normal rate. The pressure of the spring L^3 on the yoke 18^a would now tilt the yoke 18^a to the right and open the gate had that pressure not meanwhile been removed by the friction-wheel gradually traveling across the face of the disk C^2 to the center of that disk and slowly releasing the pressure of the spring L^3.

When the load upon the wheel is increased, the action of the governor is directly the reverse of that already described, the speed slackens, and the centrifugal weights drawing inward tilt the yoke 18^a toward the right, then the governor partially opens the gate, and in so doing rotates the shaft F, forcing the friction-wheel G′ from its normal position opposite the center of the friction-disk C^2 toward the left. This movement of the friction-wheel places a pressure upon the yoke 18^a through the spring L^4 and checks the action of the centrifugal weights in opening the gate. The gate, however, has meanwhile been opened sufficiently, and as the effect of the water is felt and the speed gradually increases the friction-wheel G′ is slowly fed toward its normal position opposite the center of the friction-disk C^2, relieving the pressure of the spring L^4 upon the yoke 18^a, and thereby upon the centrifugal weights of the gov-

ernor. The friction-wheel G′, as before stated, remains opposite the center of the friction-wheel C^2 until some movement of the gate rotates the shaft F and causes the wheel to be fed to one side or the other of the center of the friction-disk, placing a pressure upon the tilting yoke 18^a through one or the other of the springs L^3 and L^4. The constant rotation of the friction-disk C^2 always tends to feed the friction-wheel along the threaded shaft F to its normal position, where the wheel is not rotated by the disk, and no influence is exerted upon the free action of the centrifugal weights.

When a considerable proportion of the power of the wheel is in use, its action is much steadier and less pressure is required upon the springs L^3 and L^4 for a given movement of the gate to return the centrifugal weights to their normal position at the proper time. For this reason it is desirable to vary the action of the attachment according to the position of the gate. This is provided for by the movable fulcrum-sleeve J, which as the gate opens is thrust downward by the rotation of the cam-grooves I^2 in the face of the worm-wheel I, in which position a given movement of the friction-wheel G′ lengthwise of the shaft F will produce less movement of upright arm L, and thus less pressure upon the tilting yoke 18^a, of the governor than when little power is being used and the fulcrum-sleeve J is at its highest point.

I claim—

1. In a compensating attachment for governors, in combination, a power-valve, a speed-regulator, a connection between the power-valve and the speed-regulator for limiting the action of the speed-regulator upon the power-valve, and means for varying the said limiting action inversely to the opening and closing of the power-valve, substantially as and for the purpose specified.

2. In a compensating attachment for governors, in combination, a power-valve, a speed-regulator for operating the power-valve, a screw-threaded shaft, a friction-wheel having a threaded hub loosely mounted on the threaded shaft, a friction-disk for the friction-wheel, means for rotating the friction-disk, means for revolving the screw-threaded shaft and a connection between the friction-wheel and the speed-regulator for limiting the action of the regulator, substantially as and for the purpose specified.

3. In a compensating attachment for governors, in combination, a power-valve, a speed-regulator for operating the power-valve, a screw-threaded shaft, a friction-wheel having a threaded hub loosely mounted on the threaded shaft, a friction-disk for the friction-wheel, means for rotating the friction-disk, means for revolving the screw-threaded shaft and an arm for limiting the action of the speed-regulator, substantially as and for the purpose specified.

4. In a compensating attachment for governors, in combination, a power-valve, a speed-governor for operating the power-valve, an arm for limiting the action of the governor, and means for varying the limiting force of the arm upon the governor inversely to the load, substantially as and for the purpose specified.

5. In a compensating attachment for governors, in combination, a power-valve, a centrifugal governor for operating the power-valve, a screw-threaded shaft, a friction-wheel having a threaded hub loosely mounted on the threaded shaft, a friction-disk for the friction-wheel, means for rotating the friction-disk, means for revolving the screw-threaded shaft, an arm operated by the friction-wheel, for limiting the action of the centrifugal governor and means for regulating the limiting effect of the arm upon the governor inversely to the load, substantially as and for the purpose specified.

6. In a compensating attachment for governors, in combination, a power-valve, a centrifugal governor for operating the power-valve, a screw-threaded shaft, a friction-wheel having a threaded hub mounted on the threaded shaft, a friction-disk for the friction-wheel, means for rotating the friction-disk, means for revolving the screw-threaded shaft, and a yielding connection between the friction-wheel and the centrifugal governor, substantially as and for the purpose specified.

7. In a compensating attachment for governors, in combination, a power-valve, a centrifugal governor for operating the power-valve, a screw-threaded shaft, a friction-wheel having a threaded hub mounted on the threaded shaft, a friction-disk for the friction-wheel, means for rotating the friction-disk, a valve-operating wheel, a connection between the valve-wheel and the screw-threaded shaft for rotating the shaft when the valve is operated, and a yielding connection between the friction-wheel and the centrifugal governor, substantially as and for the purpose specified.

8. In a compensating attachment for governors, in combination, a power-valve, a centrifugal governor for operating the power-valve, a screw-threaded shaft, a friction-wheel having a threaded hub loosely mounted on the screw-threaded shaft, a friction-disk for the friction-wheel, means for rotating the friction-disk, means for revolving the screw-threaded shaft, accordingly as the power-valve is actuated, a yielding connection between the friction-wheel and the centrifugal governor, substantially as and for the purpose specified.

9. In a compensating attachment for governors, in combination, a power-valve, a centrifugal governor for operating the power-valve, a screw-threaded shaft, a friction-wheel having a threaded hub mounted on the screw-threaded shaft, a friction-disk for the friction-wheel, means for rotating the friction-disk, means for revolving the screw-

threaded shaft accordingly as the power-valve is actuated, and a connection between the friction-wheel and the centrifugal governor, substantially as and for the purpose specified.

10. In a compensating attachment for governors, in combination, a power-valve, a centrifugal governor for operating the power-valve, a screw-threaded shaft, a friction-wheel having a threaded hub loosely mounted on the screw-threaded shaft, a friction-disk for the friction-wheel, means for rotating the friction-disk, a valve-operating wheel, a connection between the valve-wheel and the screw-threaded shaft for revolving the shaft accordingly as the valve is operated, a worm-wheel, a worm for the worm-wheel fixed on the screw-threaded shaft, a cam-groove in the worm-wheel, a pivoted arm, a stud on the arm engaging the cam-groove in the worm-wheel, a fulcrum-sleeve pivotally mounted in the arm, an arm extending through the fulcrum-sleeve having a connection with the hub of the friction-wheel, an arm having a yielding connection with the centrifugal governor, and a link connection between the free ends of the two last-mentioned arms, substantially as and for the purpose specified.

ELMER E. WOODWARD.

Witnesses:
NELLIE BUNKER,
L. L. MILLER.