(No Model.) 4 Sheets—Sheet 1.

A. W. & E. E. WOODWARD.

GOVERNOR FOR WATER WHEELS.

No. 583,527. Patented June 1, 1897.

Fig. 1.

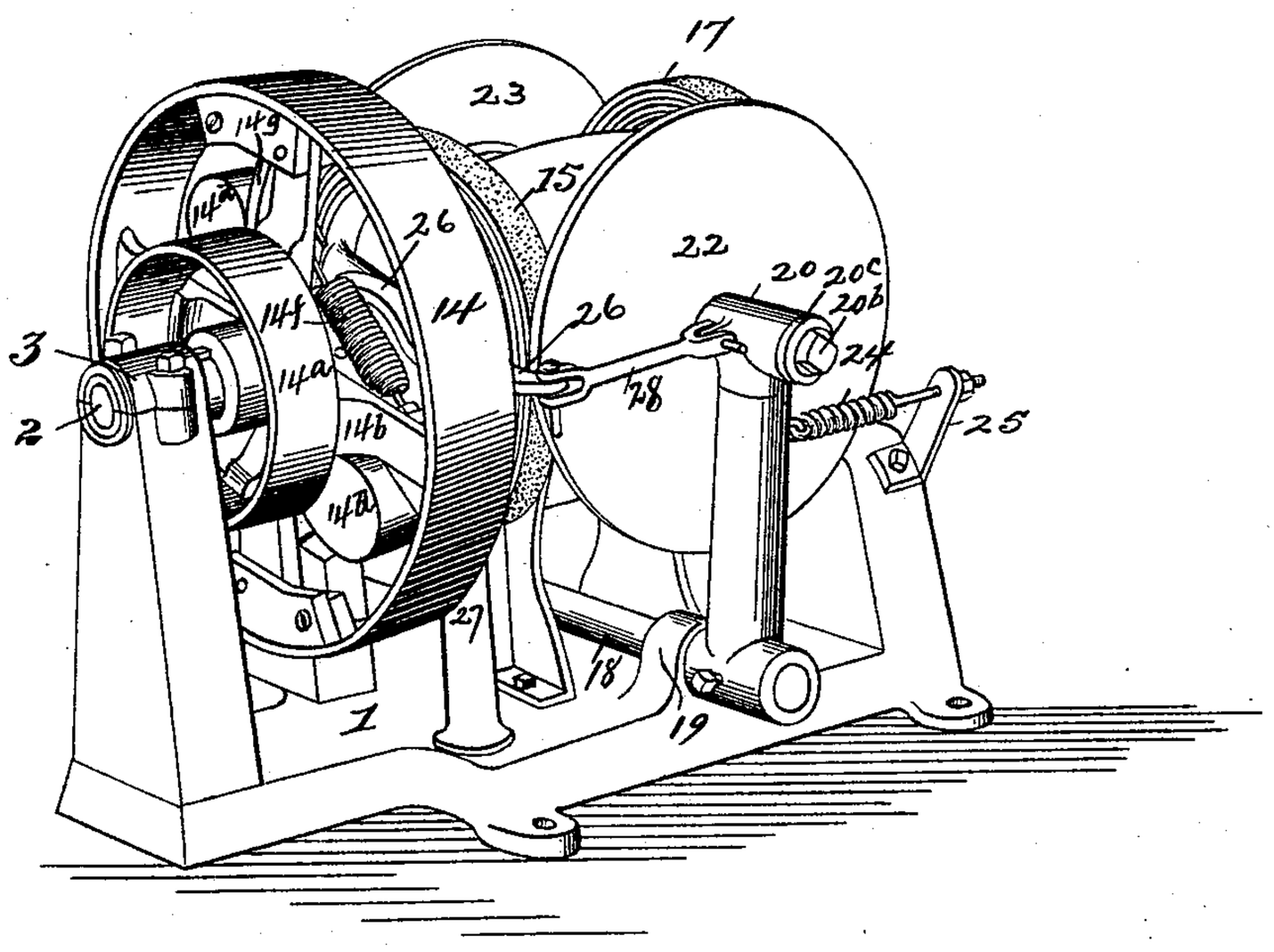

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Fig. 2.

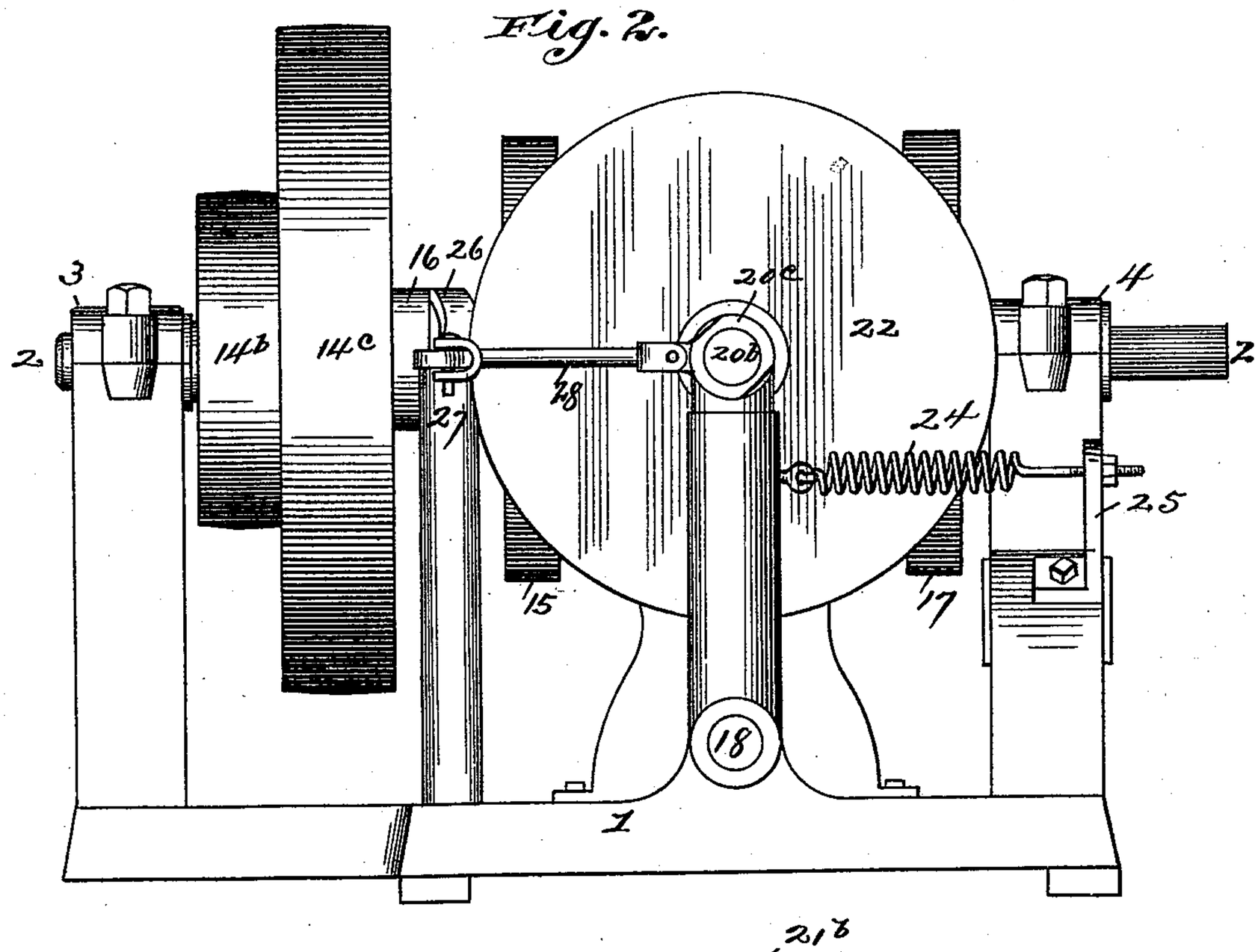
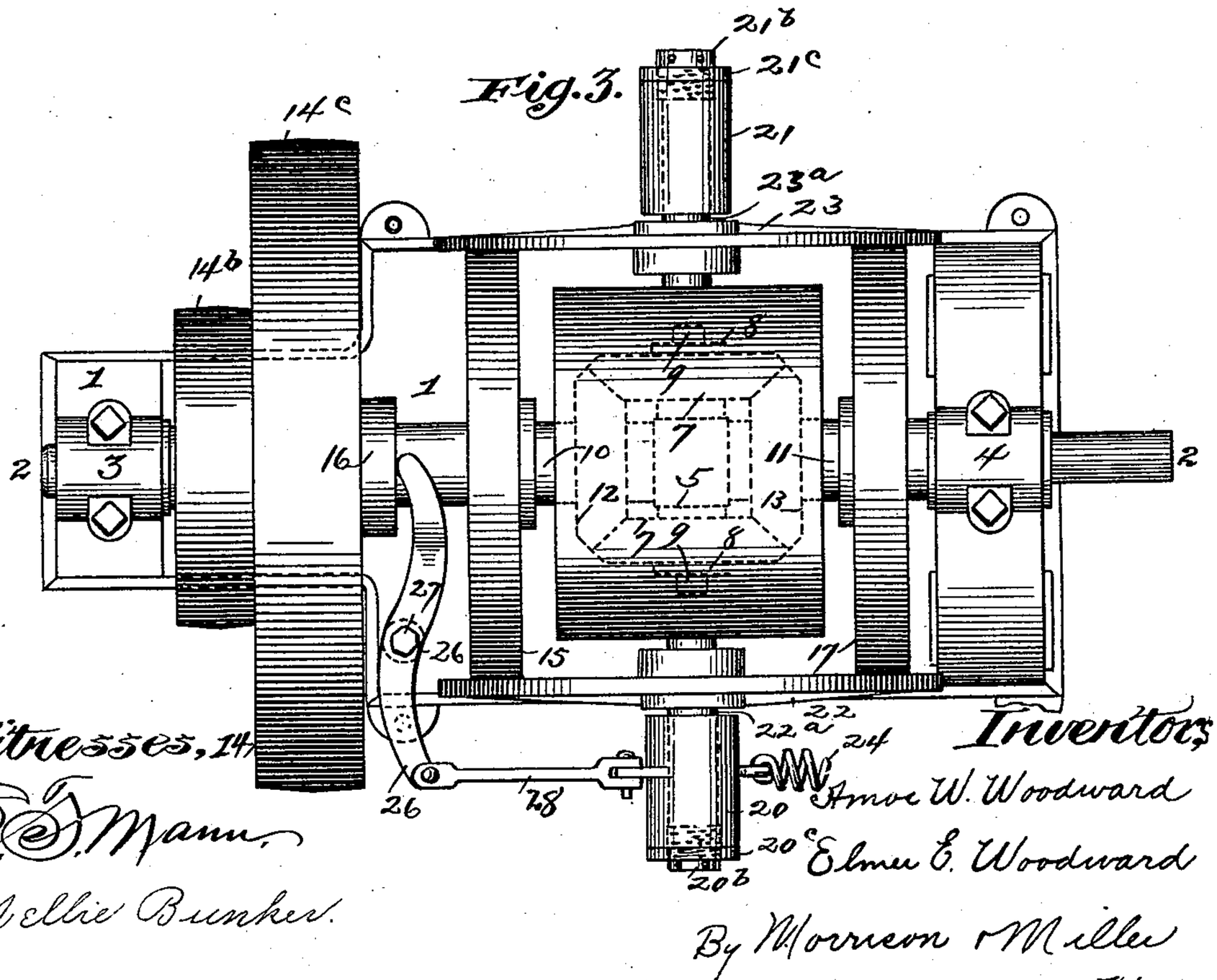


Fig. 3.



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GOVERNOR FOR WATER WHEELS.

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Fig. 4.

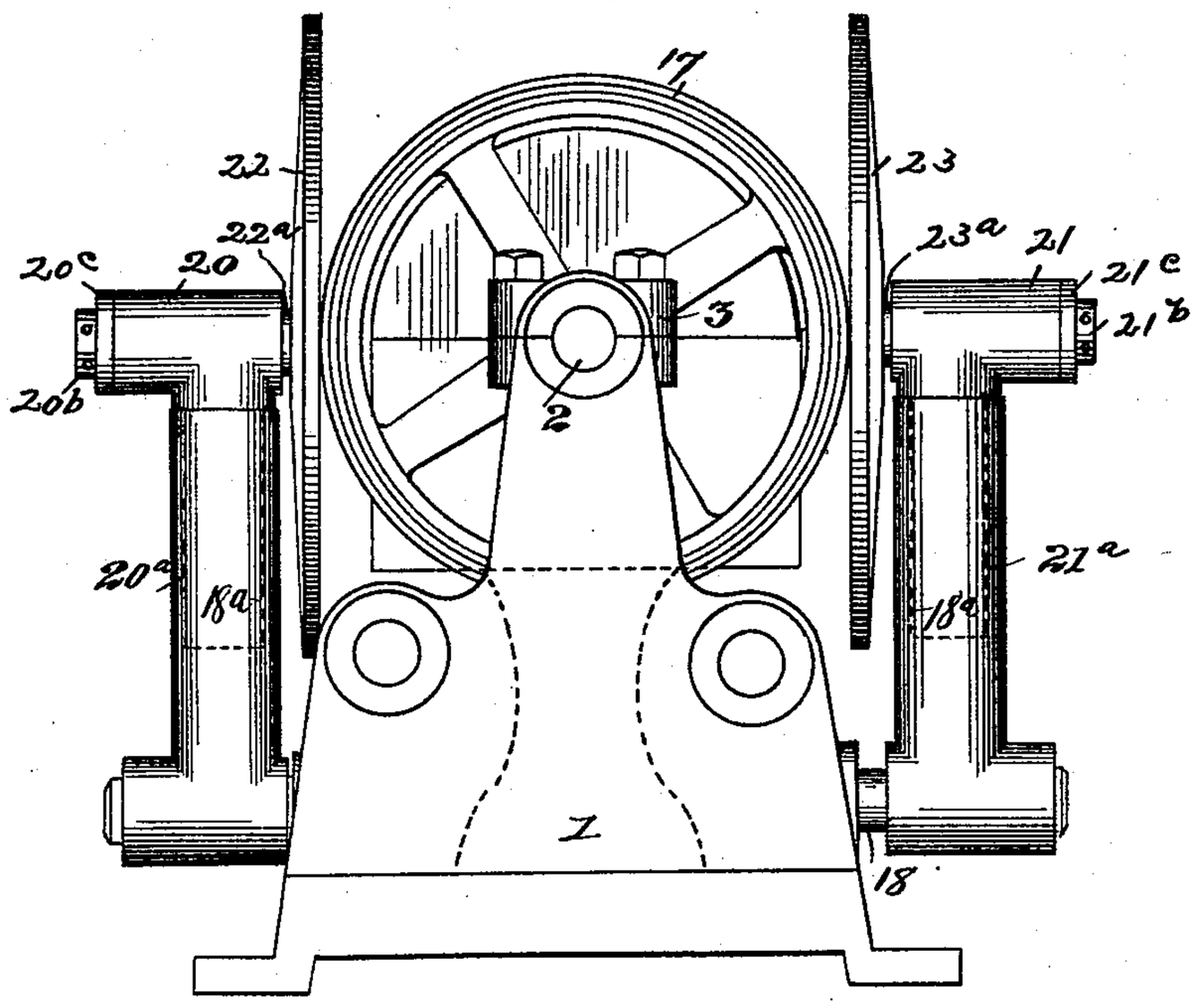
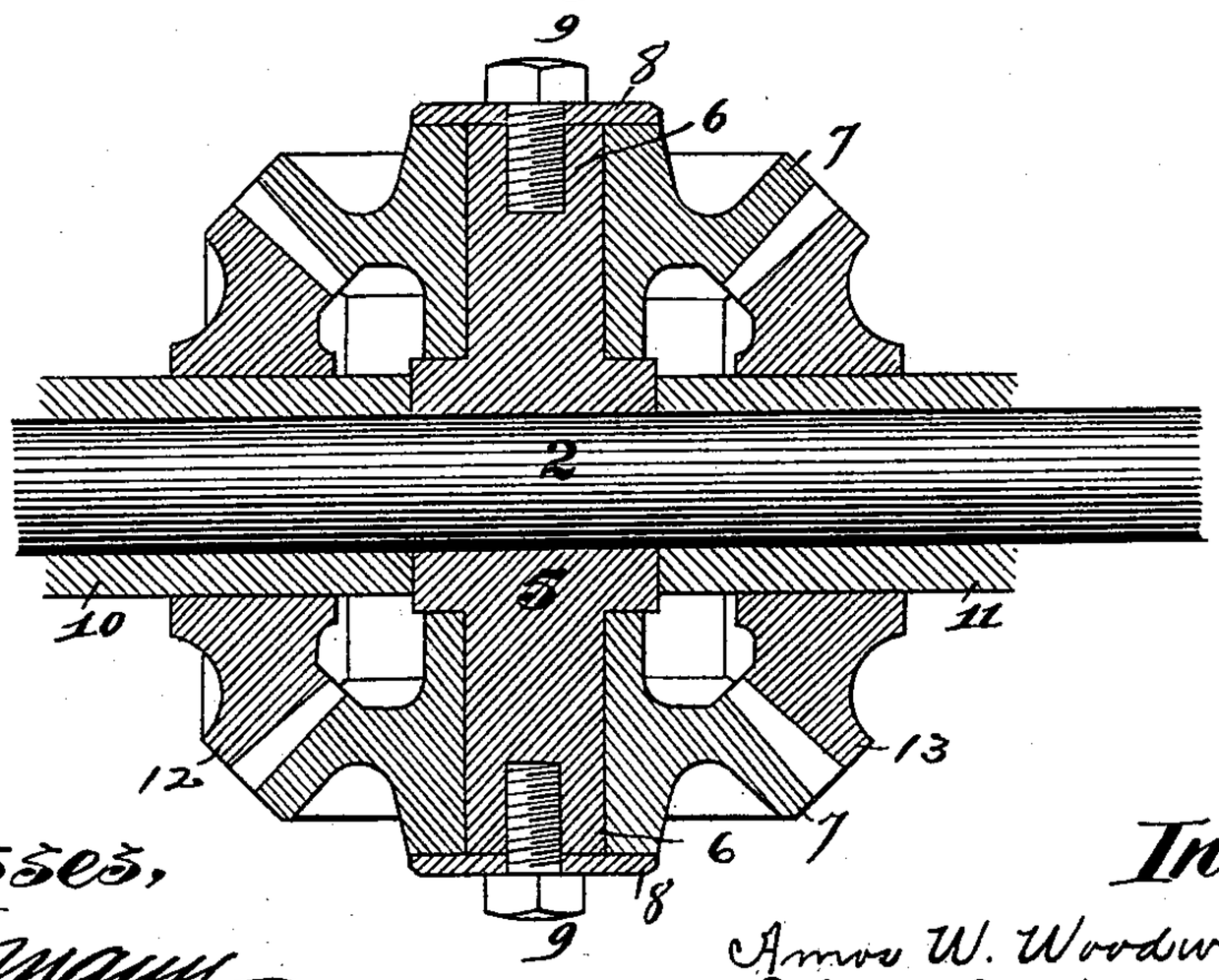


Fig. 5.



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(No Model.) 4 Sheets—Sheet 4.

A. W. & E. E. WOODWARD.

GOVERNOR FOR WATER WHEELS.

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Fig. 8.

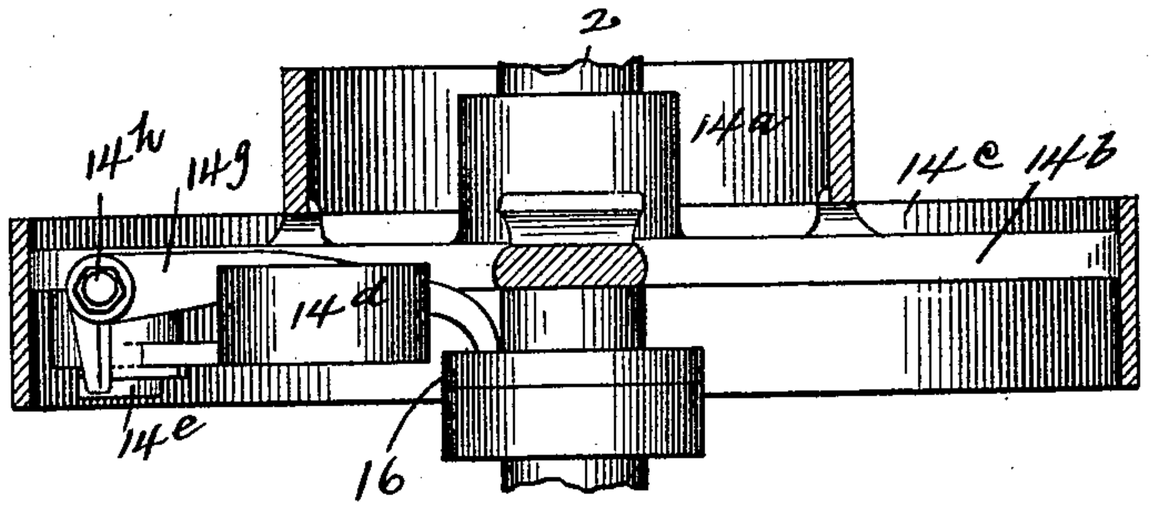


Fig. 7.

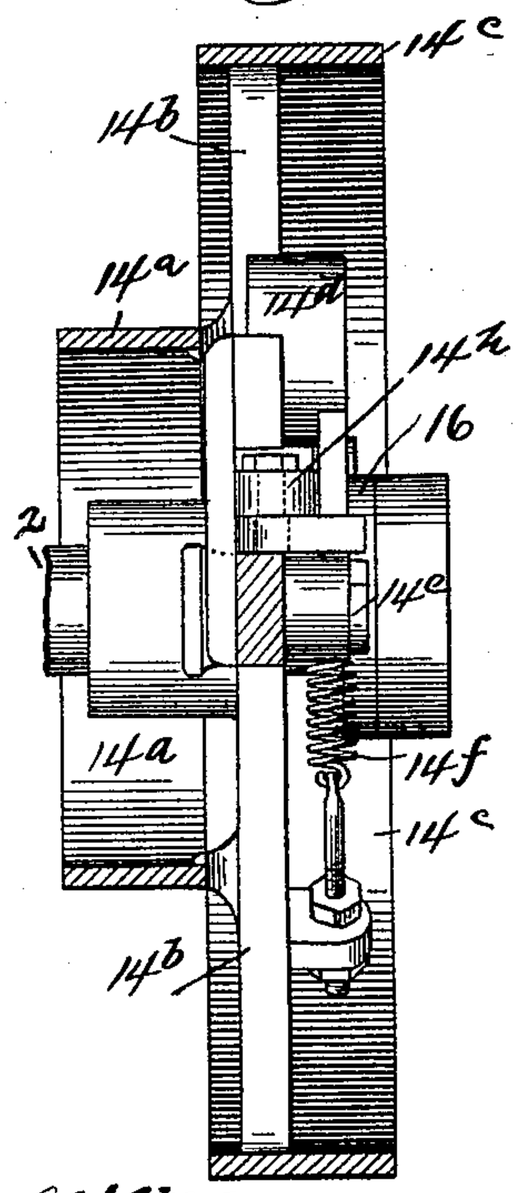
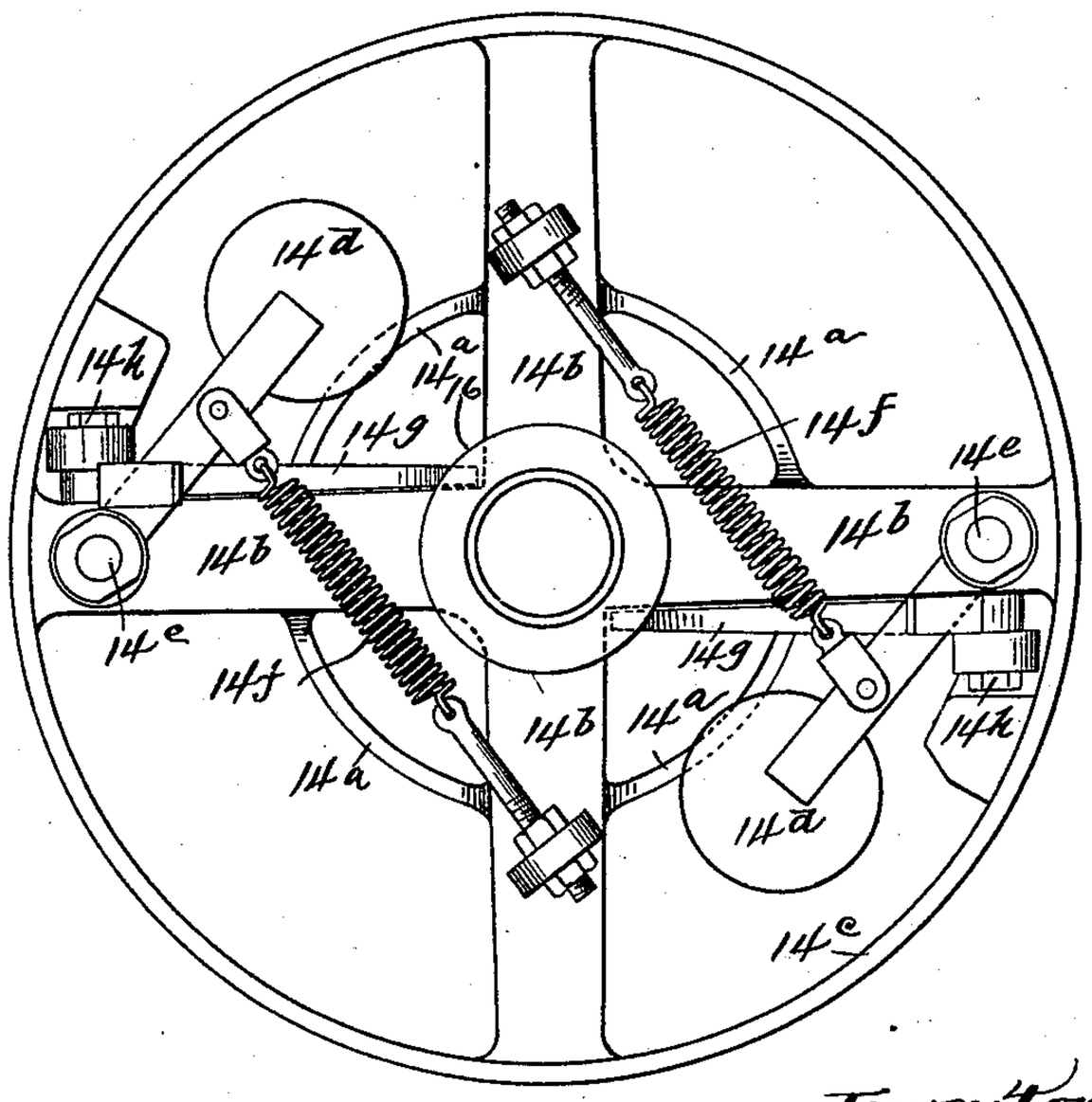


Fig. 6.



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UNITED STATES PATENT OFFICE.

AMOS W. WOODWARD AND ELMER E. WOODWARD, OF ROCKFORD, ILLINOIS.

GOVERNOR FOR WATER-WHEELS.

SPECIFICATION forming part of Letters Patent No. 583,527, dated June 1, 1897.

Application filed October 5, 1896. Serial No. 607,960. (No model.)

To all whom it may concern:

Be it known that we, AMOS W. WOODWARD and ELMER E. WOODWARD, citizens 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 or other Motors, of which the following is a specification.

The object of this invention is to produce a sensitive, accurate, and positive governor for the class of motors mentioned.

In the accompanying drawings, Figure 1 is a perspective view of a governor embodying the features of our invention. Fig. 2 is a side elevation, and Fig. 3 is a plan view, of the same. Fig. 4 is a rear end elevation of the governor. Fig. 5 is a central section through the main shaft and the differential gearing. Fig. 6 is an elevation of the centrifugal weight-head; and Figs. 7 and 8 are side views of the same, the rim being cut away to show the operative parts.

1 is a main frame.

2 is a main shaft journaled in the bearing-boxes 3 and 4 in the frame 1.

5 is a hub fast to the shaft 2 about midway of its length.

6 are bearing-studs integral with said hub and projecting from opposite sides thereof.

7 are two miter-gears, one of which is loosely mounted on each of the studs 6.

8 are circular washers.

9 are set-screws, by means of which and the washers 8 the miter-gears 7 are held in position on their studs 6.

10 and 11 are sleeves fitting somewhat loosely over the main shaft 2 and located one on either side of the hub 5.

12 and 13 are miter-gears fixed on the adjacent ends of the sleeves 10 and 11, respectively, and meshing with the gears 7.

14 is the centrifugal weight-head rigidly mounted on the sleeve 10.

15 is a leather-faced friction-wheel rigidly mounted on the sleeve 10, between the head and the gear 12.

16 is a collar on the sleeve 10, between the head 14 and the friction-wheel 15, free to slide on the sleeve.

17 is a friction-wheel identical with the wheel 15, but fast to and rotating with the sleeve 11.

18 is a rock-shaft lying at right angles to and below the main shaft 2.

18^a are upright tubular arms rigidly fixed to the rock-shaft 18.

19 are the bearings for the rock-shaft 18 on the base of the main frame.

20 and 21 are tubular journal-boxes internally threaded at their outer ends and having the stems 20^a and 21^a, respectively, extending at right angles to the length of the journal-boxes, which stems are adapted to fit within the tubular arms 18^a.

20^b and 21^b are threaded adjusting-steps adapted for the internal screw-threads in the outer ends of the journal-boxes 20 and 21.

20^c and 21^c are lock-nuts for retaining the adjusting-steps 20^b and 21^b in any desired adjustment.

22 and 23 are rotatable friction-disks having bearing-spindles 22^a and 23^a, formed integrally therewith and adapted to the journal-boxes 20 and 21, respectively. The stems 20^a and 21^a being free to turn in the tubular arms 18^a permit the disks 22 and 23 to accommodate themselves to any slight differences in diameter or slight irregularities in the faces of the friction-wheels 15 and 17.

24 is a spring tending to draw the yoke-frame away from the weight-head.

25 is a fixed bracket to which one end of the spring 24 is attached.

Referring to the centrifugal weight-head 14, 14^a is a drive-pulley integral with the head.

14^b are arms radiating from the central hub of the head for supporting the inclosing rim of the latter.

14^c is the inclosing rim of the head, upon which a belt may be run, if desirable, instead of on the drive-pulley 14^a.

14^d are the centrifugal weights and their supporting-levers.

14^e are pivotal supports for the same.

14^f are coil-springs for restraining the outward throw of the centrifugal weights.

14^g are substantially right-angled levers, the short arm of each of which is engaged by the weight-levers, and the long arm of each engages the sliding collar 16.

14^h are pivotal supports for the lever 14^g.

26 is a lever, one end of which is forked to permit it to partially surround the sleeve 10 and engage the collar 16 at two opposite points.

27 is a supporting-pivot for the lever 26.

28 is a link connecting the journal-box 20 with the outer end of the lever 26.

In the practical application of this invention to a governor the springs 14^e and the centrifugal weights 14^d are arranged for a certain speed, and a belt running from any suitable part of the driven machinery is carried over either the drive-pulley 14^a or the rim 14^c, giving to the head 14 a rotary motion. The main shaft 2 has a connection with the gate by gearing or other suitable means, but the mere manner of its attachment not being a feature of our invention is not described herein.

When the head 14 is rotated by its driving-belt, the centrifugal weights fly outward against the restraining action of the springs 14^f and rock the weight-levers 14^d on their supporting-pivots 14^e. These levers engage with the short arms of levers 14^g and motion is thereby imparted to the latter, causing them to rock on their pivots 14^h and their free ends to push the collar 16 along the sleeve 10 and in a direction away from the head 14. The movement of this collar causes the lever 26 to be slightly oscillated on its pivot 27, and this oscillation draws the yoke toward the weight-head by reason of the link connection between the lever and the yoke. As the rapidity of revolution increases, this action continues until the yoke has reached such a position that the points of contact of the two friction-wheels 15 and 17 with the friction-disks 22 and 23 are equally distant from the centers of the disks, which is the normal position toward which the governor is constantly tending. The rotary motion imparted to the head 14 also causes the sleeve 10 and the friction-wheel 15 to revolve, and this motion is transmitted to the friction-wheel 17 and its supporting-sleeve 11 through the friction-disks 22 and 23. The same motion also is transmitted by the miter-gear 12 through the like gear 7 to the gear 13, and so long as the friction-wheels 15 and 17 revolve at an equal rate of speed they will not cause the main shaft 2 to rotate. In other words, so long as the friction-wheels 15 and 17 have contact with the friction-disks 22 and 23 at equal distance from the centers of the disks, and therefore have the same rate of rotation, the differential gearing between the sleeves 10 and 11 will merely transmit that motion without effect on the main shaft; but a difference in the relative speed of rotation of the friction-wheels will effect a rotation of the main shaft 2 through this gearing, the direction of the rotation of that shaft being reversed as one or the other of the friction-wheels rotates the more rapidly. If now the parts are in this normal position, where the friction-wheels 15 and 17 revolve at equal speed and the differential gearing transmits the same motion that it receives, imparting no movement to the main shaft 2, and a considerable load is suddenly thrown upon the machinery, the result will be a slackening of the speed of the head 14 and a consequent diminution of the centrifugal force in the weights 14^d, by reason of which they will be drawn inward by their restraining-springs 14^f. The movement of the levers 14^d will also oscillate the levers 14^g, permitting the collar 16 to recede toward the head 14 and the spring 24 to draw the yoke away from the head. This movement, it will be seen, will move the centers of the friction-disks 22 and 23 toward the friction-wheel 17, thereby diminishing the relative rapidity of its rotation. This difference in speed is taken up by the differential gearing and imparted to shaft 2, rotating that shaft in a direction which by prearrangement opens the gate and increases the power. With added power comes increased speed, and as the head is rotated more rapidly the centrifugal force of the wheel 14^d is rendered greater, and the yoke is thereby again oscillated toward the head. This movement also changes the relative speed of the friction-wheels 15 and 17, and they are brought back to an equal rate of rotation, when the main shaft 2 will cease to revolve, and the position of the gate will remain unchanged so long as the normal speed of the machinery is maintained. If, however, a portion of the load be thrown off from the machinery at this time, the speed of the latter will increase, the centrifugal force of the weights 14^d will continue to draw the friction-disks toward the head 14, and the friction-wheel 17 will rotate relatively more rapidly than the wheel 15, producing a rotation of shaft 2 in contrary direction through its differential gearing. This movement of the shaft 2 is arranged to close the gate somewhat, and thereby diminish the power.

It is manifest that a governor might be constructed wherein one friction-disk is moved across the faces of two friction-wheels with somewhat the same result that we have here obtained, but in practice it will be discovered that to produce the necessary frictional contact between the disk and the friction-wheels will cause such great end pressure against the bearings of the disk as seriously to interfere with the free movement of that disk. This objection is entirely overcome by employing two friction-disks and the rocking yoke of our invention, whereby any desired frictional contact between the wheels and the disks may be produced without in any measure interfering with the free oscillation of the yoke in its bearings. We have also found that the tendency of the friction-wheels rotating against a single friction-disk is to rock the yoke and hinder the free action of the centrifugal weights. This tendency not being a constant factor cannot be guarded against otherwise than to neutralize the effect

upon one friction-disk by the exactly opposite effect produced by the friction-wheels rolling in a contrary direction against another friction-disk mounted in the yoke and deriving its motion from the opposite sides of the friction-wheels, as developed in the invention of this governor.

We claim as our invention—

1. In a governor, in combination, a supporting-frame, a main shaft, two friction-wheels revolving freely with relation thereto, a rotatable friction-disk bearing upon said wheels, a differential gearing for the shaft comprising a gear-wheel rotating with each friction-wheel, a hub fast to the main shaft, and a gear-wheel journaled on said hub, meshing with the two gear-wheels before mentioned and means for moving the friction-disk across the faces of the friction-wheels, substantially as and for the purpose specified.

2. In a governor, in combination, a supporting-frame, a main shaft, two friction-wheels revolving freely with relation thereto, two rotatable friction-disks bearing upon said wheels, a differential gearing for the shaft comprising a gear-wheel rotating with each friction-wheel, a hub fast to the main shaft, and a gear-wheel journaled on said hub, meshing with the two gear-wheels before mentioned and means for moving the friction-disks across the faces of the friction-wheels, substantially as and for the purpose specified.

3. In a governor, in combination, a supporting-frame, a main shaft, two sleeves loosely mounted thereon, a friction-wheel fast on each of the sleeves, two rotatable friction-disks bearing upon the peripheries of the friction-wheels at substantially opposite points thereon, miter-gears on the adjacent ends of the sleeves, gears meshing therewith, which latter gears are free to revolve on their own axes but rotate with the main shaft, and means for moving the friction-disks across the faces of the friction-wheels, substantially as and for the purpose specified.

4. In a governor, in combination, a supporting-frame, a main shaft journaled therein, two sleeves loosely mounted on the shaft, a friction-wheel fixed on each of the sleeves, miter-gears on the adjacent ends of the sleeves, a hub fixed on the shaft between the gears, two miter-gears loosely mounted on the hub and meshing with the gears on the sleeves, a movable yoke on the supporting-frame, two rotatable friction-disks mounted in the yoke and having contact with the friction-wheels, at substantially opposite points on their peripheries, and means for moving the yoke substantially as and for the purpose specified.

5. In a governor, in combination, a supporting-frame, a main shaft journaled therein, two sleeves loosely mounted on the shaft a friction-wheel rotatable with each of the sleeves, a hub fixed on the shaft between the sleeves, two miter-gears journaled on the opposite sides of the hub, two miter-gears meshing therewith and fixed on the adjacent sleeve ends, an upright swinging yoke in the supporting-frame, two rotatable friction-disks mounted on opposite sides of the yoke and having contact with the friction-wheels, at substantially opposite points on their peripheries, and centrifugal weights for moving the yoke substantially as and for the purpose specified.

6. In a governor, in combination, a supporting-frame, a main shaft journaled therein, two sleeves loosely mounted on the shaft, a friction-wheel rotating with each of the sleeves, a hub fixed on the shaft between the sleeves, two miter-gears journaled on the hub on opposite sides thereof, two miter-gears meshing therewith and fixed on the adjacent sleeve ends, an upright swinging yoke in the supporting-frame, two rotating friction-disks mounted on opposite sides of the yoke and having contact with the friction-wheels at substantially opposite points on their peripheries, a spring for the yoke, and centrifugal weights for moving the yoke against the action of the spring, substantially as and for the purpose specified.

7. In a governor, in combination, a main frame, a main shaft journaled therein, two sleeves loosely mounted on the shaft, a friction-wheel rotating with each of the sleeves, a hub fixed on the shaft between the sleeves, two miter-gears journaled on opposite sides of the hub, two miter-gears meshing therewith and fixed on the adjacent sleeve ends, an upright swinging yoke in the supporting-frame, two rotatable friction-disks mounted on opposite sides of the yoke and having contact with the friction-wheels, at substantially opposite points on their peripheries, a rotatable head, a centrifugal weight therein, a spring for restraining the centrifugal force of the weight and a lever for moving the yoke, substantially as and for the purpose specified.

8. In a governor, in combination, a main frame, a main shaft journaled therein, two sleeves loosely mounted on the shaft, a friction-wheel rotating with each of the sleeves, a hub fixed on the shaft between the sleeves, two miter-gears journaled on opposite sides of the hub, two miter-gears meshing therewith and fixed on the adjacent sleeve ends, an upright swinging yoke in the supporting-frame, two rotatable friction-disks mounted on opposite sides of the yoke and having contact with the friction-wheels, at substantially opposite points on their peripheries, a weight-head fixed on one of the sleeves, two centrifugal weights in the head, levers for the weights having a pivotal bearing in the head, springs for restraining the centrifugal force of the weights, a collar free to slide on the sleeve, two right-angled levers between the weight-levers and collar, a pivotal bearing for each of the right-angled levers, a lever engaging the collar, a link connecting the lat-

ter lever with the yoke and a pivot for the last-named lever, substantially as and for the purpose specified.

9. In a governor, in combination, a main frame, a main shaft journaled therein, two sleeves loosely mounted on the shaft, a friction-wheel rotating with each of the sleeves, a hub fixed on the shaft between the sleeves, two miter-gears journaled on opposite sides of the hub, two miter-gears meshing therewith and fixed on the adjacent sleeve ends, a shaft journaled in the frame and extending at right angles to the main shaft, two upright tubular arms fixed to the shaft, two hubs each having a stem extending at right angles thereto adapted for the tubular arms, two friction-disks having bearing-studs fixed thereto, said bearing-studs adapted for the hubs before mentioned, an adjusting-step in the hubs, whereby suitable contact between the friction-wheels and the friction-disks is obtained, a weight-head fixed on one of the sleeves, two centrifugal weights in the head, levers for the weights having a pivotal bearing in the head, springs for restraining the centrifugal force of the weights, a collar free to slide on the sleeve, two right-angled levers between the weight-levers and the collar, a pivotal bearing for each of the right-angled levers, a lever engaging the collar, a link connecting the latter lever with the yoke and a pivot for the last-named lever, substantially as and for the purpose specified.

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