(No Model.) 2 Sheets—Sheet 1.

J. DOW.

GOVERNOR FOR MOTORS.

No. 334,112. Patented Jan. 12, 1886.

Fig. 1.

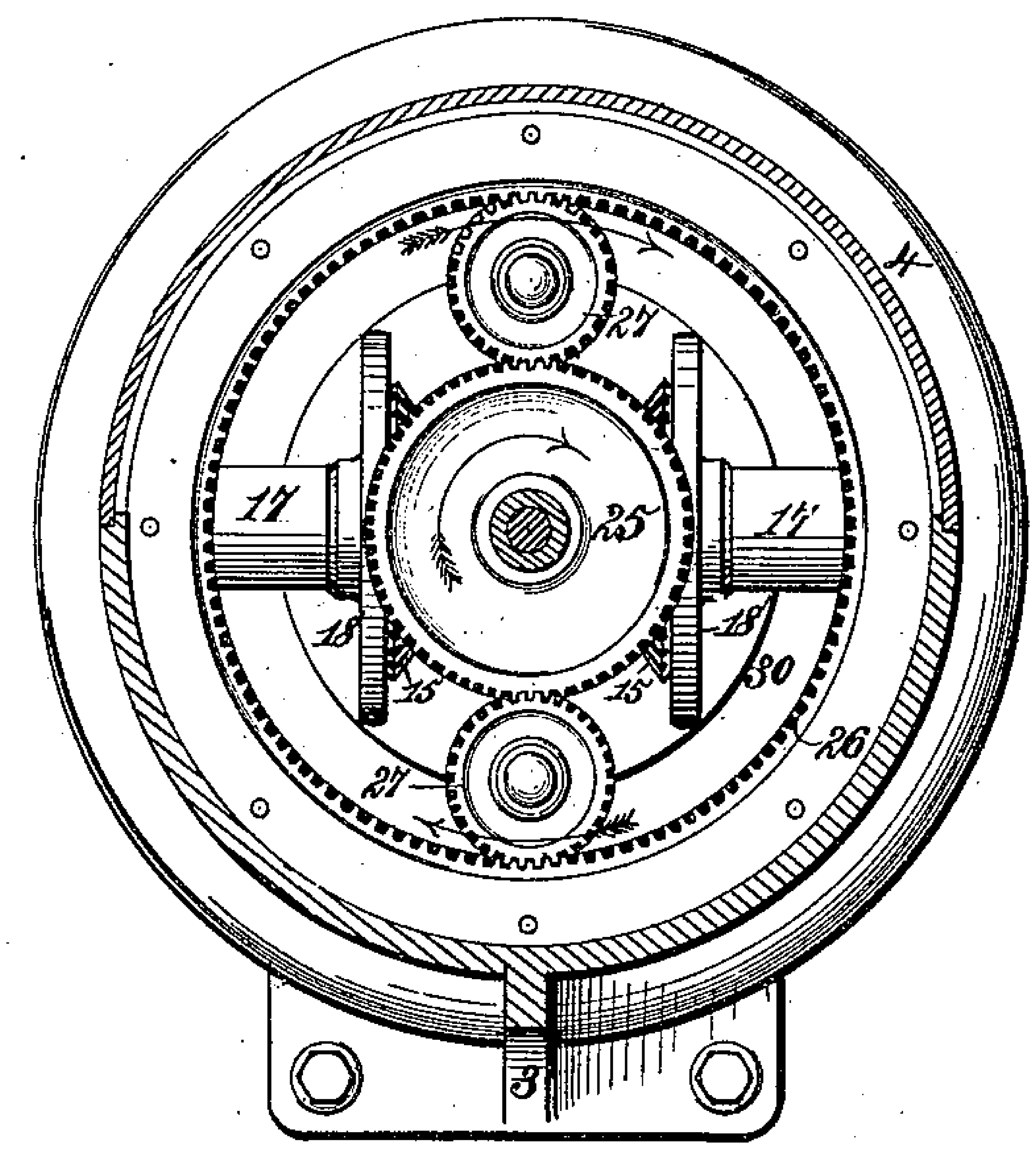
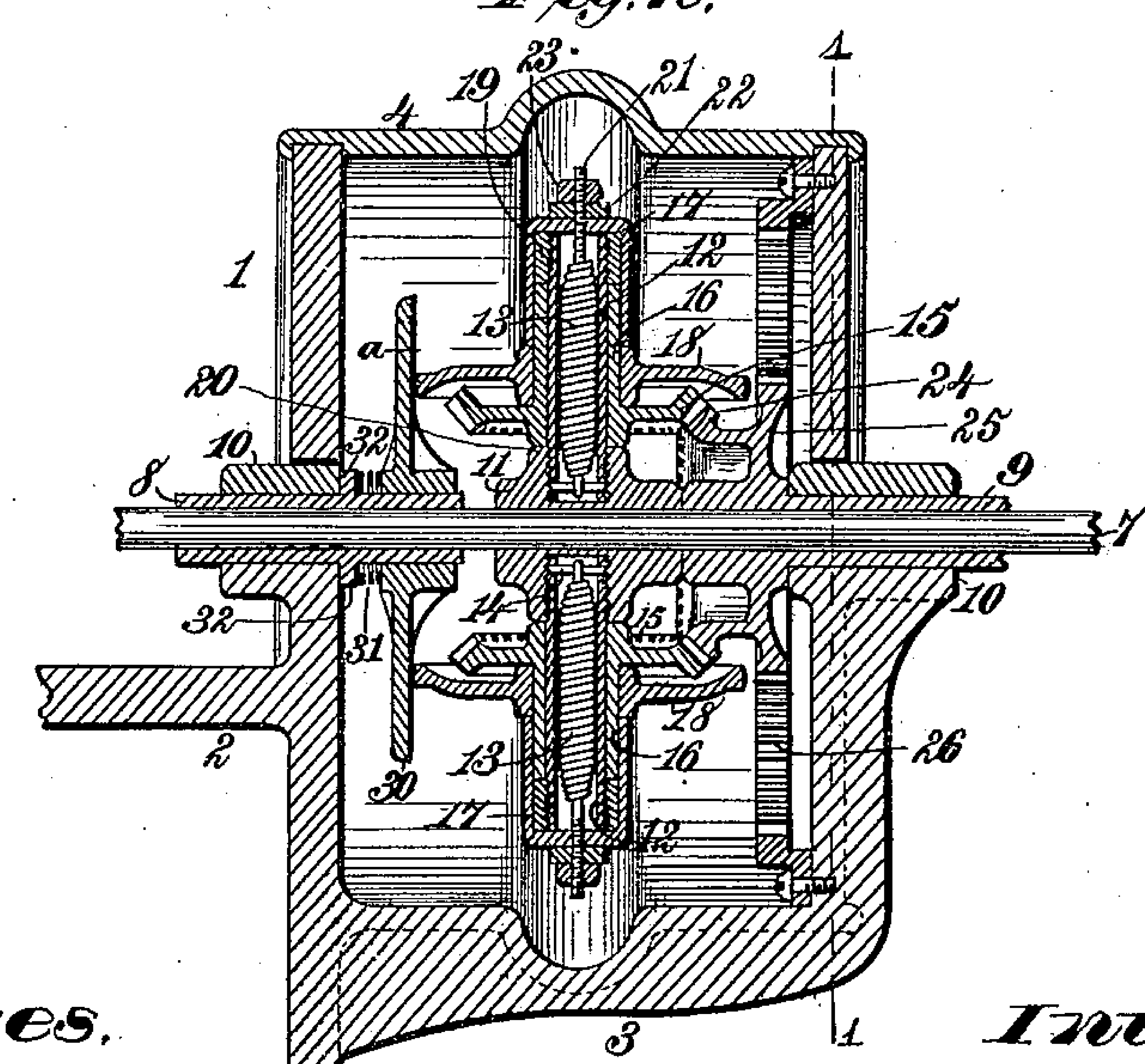


Fig. 2.



Witnesses.
Robert Everett,
J. A. Rutherford

Inventor.
Josiah Dow.
By James L. Norris.
Atty.

(No Model.)

2 Sheets—Sheet 2.

J. DOW.

GOVERNOR FOR MOTORS.

No. 334,112. Patented Jan. 12, 1886.

Fig. 3.

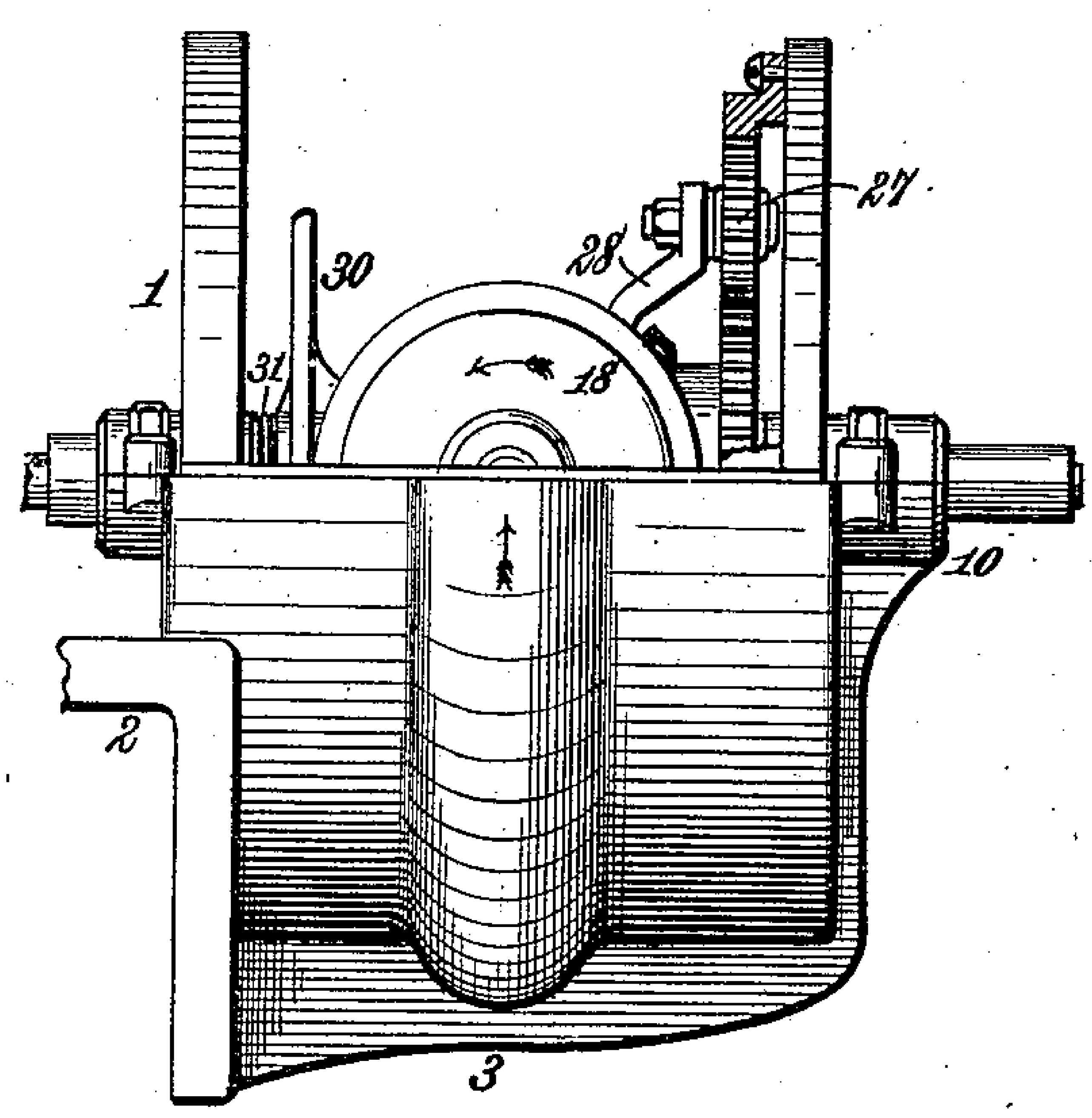


Fig. 5.

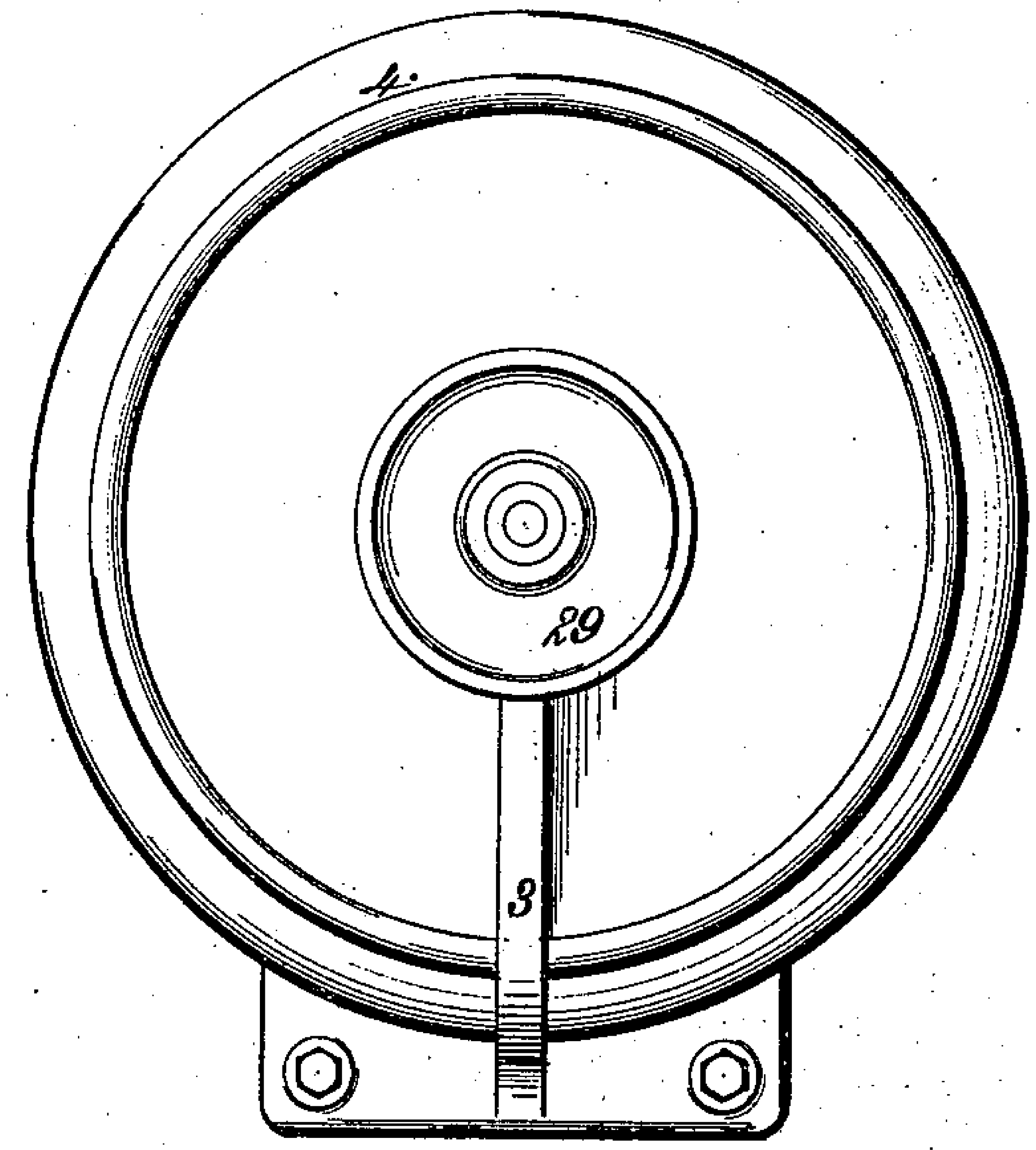
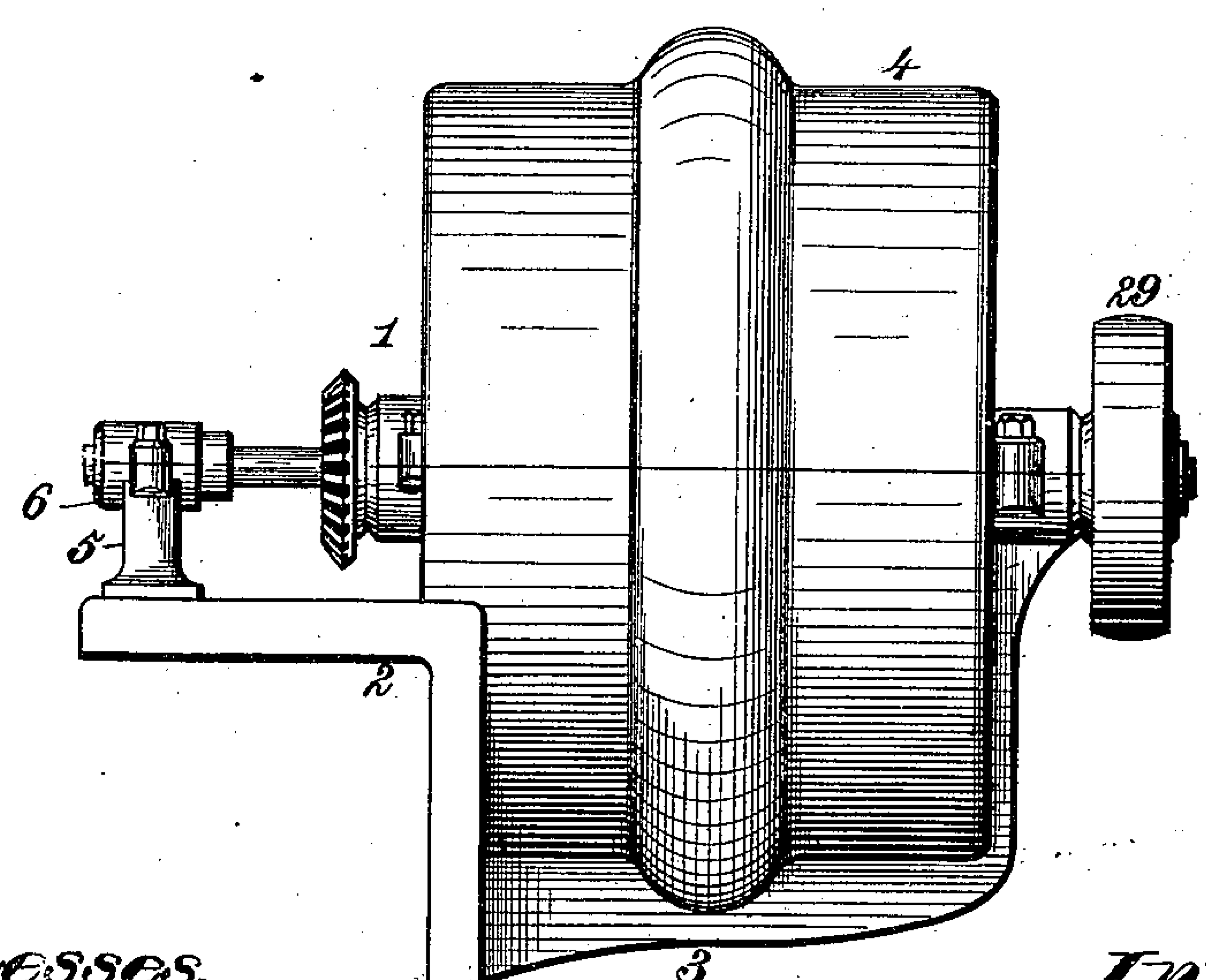


Fig. 4.



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UNITED STATES PATENT OFFICE.

JOSIAH DOW, OF LOWELL, MASSACHUSETTS.

GOVERNOR FOR MOTORS.

SPECIFICATION forming part of Letters Patent No. 334,112, dated January 12, 1886.

Application filed June 15, 1885. Serial No. 168,771. (No model.)

To all whom it may concern:

Be it known that I, JOSIAH DOW, a citizen of the United States, residing at Lowell, in the county of Middlesex and State of Massachusetts, have invented new and useful Improvements in Governors for Motors, of which the following is a specification.

My invention relates to governors for steam-engines, water-wheels, and similar motors; and the purpose thereof is to provide an apparatus whereby an accurate differential adjustment shall be given to the valve or gate, through which the vapor or fluid passes to the motor, wherein the adjusting devices shall be driven by positive mechanism and the entire mechanical organization be greatly simplified and reduced in bulk.

The invention consists in the several novel features of construction and combinations of parts hereinafter fully set forth, and definitely pointed out in the claims.

In the accompanying drawings, Figure 1 is a vertical section in the plane 1 1, Fig. 2, showing the casing with its interior mechanism, the cylinder-head being removed. Fig. 2 is a central vertical section of Fig. 1, taken in the plane of the axis of the common shaft. Fig. 3 is a side elevation of the parts shown in Fig. 1, part of the cylindrical shell of the casing being removed. Fig. 4 is a side elevation of the closed casing, showing the driving-shaft with its pulley and the adjusting-gear sleeved thereon at the opposite end of the shaft. Fig. 5 is an end elevation of the closed casing, taken from the right of Fig. 4.

In the said drawings, the reference-numeral 1 designates the casing within which the operative parts are assembled. This casing is preferably made in cylindrical form, as shown, for the purpose of giving compactness and reducing the bulk; but otherwise it forms no essential feature of my invention. An angle-plate, 2, is cast upon the lower portion of the casing and strengthened by a central rib, 3, crossing the bottom of the cylindrical shell 4. This angle-plate not only forms a convenient means of attaching the casing to a suitable support, but it also serves as a mounting for a post, 5, carrying a journal-box, 6, for one end of the central shaft. The cylindrical casing or shell 4 is divided upon a central horizontal plane into two equal parts, as shown in Figs. 3 and 4; but the casing may be divided in any other suitable manner. Through the casing and coincident with its cylindrical axis is passed a shaft, 7, having its bearing in sleeves 8 and 9, mounted upon or near each end of the shaft. These sleeves are supported in journal-boxes 10, cast integral with the cylinder-heads, and each has revolution independently of the movement of the shaft 7. Centrally mounted upon said shaft and rigid therewith is a hub, 11, and projecting radially from opposite sides thereof are two tubes, 12, tapped into said hub and containing in each a spiral spring, 13, attached at the end nearest the shaft to rigid pins 14. Sleeved upon each of said tubes 12 is a miter-gear, 15, having a hub, 16, which is prolonged outwardly, as shown in Fig. 2. Surrounding these prolonged hubs or sleeves are cylindrical caps 17, which rest upon the hubs of friction-gears 18, splined upon the prolonged hubs 16, and not only having revolution therewith, but being capable of radial adjustment upon the same by the means presently to be described. Upon the outer end of each tube 12 is turned a threaded tube-section, 19, by which each miter-gear 16 is held down upon a boss, 20, formed upon the hub 11, each of said tube-sections 19 being outwardly flush with the prolonged hubs 16. Passing through the outer ends of the cylindrical caps 17 are rods 21, connected to the outer extremities of the springs 13, and upon the exterior threaded ends of these rods are turned nuts 22, held by jam-nuts 23. By this construction it will be seen that while the friction-gears 18 must turn with the miter-gears 15 they may at the same time, under a sufficient centrifugal force, be projected outwardly upon the prolonged hubs 16, upon which they are splined. When the centrifugal force producing this movement is expended, the gears 18 will be returned to their original position by the tension of the spring 13. The cylindrical cap 17 moves freely outward and inward relatively to the shaft 7, but is prevented from turning by means of pins fixed upon the tube-sections 19 and engaging with slots cut longitudinally in the inner faces of said cap.

Mounted or formed upon the inner end of the sleeve 9 is a double gear composed of a miter-gear, 24, of such diameter that it meshes with both of the miter-gears 15 and a gear, 25, concentric with and lying in the same vertical plane with an internal gear, 26, rigidly mounted upon the cylinder-head. The diameter of the internal gear is twice that of the gear 25, and between the two, upon opposite sides of the gear 25, are placed planet-gears 27, meshing with both and having their axes arms 28, which are rigidly attached to the hub 11. Upon the outer end extremity of the sleeve 9 is mounted a pulley, 29, by which rotation is imparted to the gear 25 and the miter gears 24, said pulley being driven by a belt from any suitable part of the mechanism driven by said motor. Upon the sleeve 8 is splined a disk, 30, having a diameter in excess of that of the friction-gear 18, said disk being held in frictional contact with the gears 18 by means of springs 31, interposed between a flange, 32, upon the sleeve 8, and the hub of the friction-disk 30.

By the construction and combination of parts heretofore described it will be seen that the hub 11 will be caused to revolve about the shaft 7, carrying with it the gearing mounted upon the tubes 12, and it is also evident that the double gear 24 and 25 will accomplish two revolutions while the hub 11 is making a single rotation. This is due to the fact that the planet-gears 27 being one-half the diameter of the gear 25, the latter will revolve them twice to one of its own revolutions; but as said planet-gears also mesh with the internal gear 26, which being twice the diameter of gear 25 is therefore four times the diameter of said planet-gear, the latter must make four revolutions upon their own axes to pass once around the internal gear. To cause these four revolutions, and to produce therefrom one complete revolution of the hub 11, with its attendant gearing, the gear 25 must evidently make two revolutions. As the gears 24 and 25 make two revolutions about the common axis 7 to one made about the same axis by the gears 15, it follows that the gear 24 will cause gear 15 to revolve once upon its own axis in the same time—*i. e.*, it will revolve once upon its own axis, while the bearing upon which it is mounted revolves once about the common axis 7. Now, it is evident that if the friction-gears 18 have bearing upon the disk 30 at a distance from the axis of the shaft 7 equal to the radius of the gears 18, the latter will merely have rolling contact with said disk. In other words, let it be assumed that the friction-gears 18 have a radius of four inches, and consequently a diameter of eight inches, their circumference will measure twenty-four inches +. If, now, said gears have contact with the disk 30 at a point four inches from the axis of the shaft 7, and make a single turn upon their own axes, while the bearing upon which said axes turn makes a single revolution upon the common axis 7, the gears 18, which are driven, as already shown, by positive mechanism will simply roll upon the disk 30, and the line in which they travel may be denominated the "neutral point" of the disk. If, however, the speed becomes so great as to generate sufficient centrifugal force to project the friction-gears 18 outward upon their axes until they travel in a circle beyond said neutral point, then said gears will impart at each rotation a movement to the disk 30 proportioned to the difference between the circumference of said disks and the larger circle on which they travel, thereby carrying said disk in the direction in which they travel. For example, if the friction-gears make contact at a point on the disk 30 distant radially five inches from the axis of the disk, then at each revolution of the shaft 7 and of the gears 18 the disk will receive a movement in the direction traveled by the friction-gears of about six inches, measured upon the circle of contact, the equation being substantially (letting x represent the difference between the circumference of the gears and the line of travel) $10 \times 3.14159 = 8 \times 3.14159 - x$; or, performing the operations indicated, it will be found that the disk 30 will move with the gears a distance of 6.283 inches measured upon the circle of contact. On the other hand, let it be supposed that the speed is so far decreased as to allow the tension of the spring to draw the gears 18 inward toward the shaft 7 to a point, say, three inches of radial distance from the axis of said shaft. In this case the relative speed of the gears being a constant quantity, (as well as their travel about the common axis 7,) the disk 30 will be revolved in the opposite direction, its degree of movement being equal to the difference between the circumference of the actuating-gears and the circle of contact. Letting π represent the relation of the perimeter to the diameter of each, the equation will then read (letting x represent the difference as before) $8 \times \pi = 6 \times \pi + x$; or, in other words, the disk 30 will receive a motion opposite to that of the friction-gears equal to 6.223 inches for each revolution of said gears, said distance being measured upon the circle of frictional contact. Upon the outer extremity of the sleeve 8 is mounted a miter or other gear, 33, by which movement may be given to the device by which the steam-port or water-gate is opened and closed.

Now, by applying to the described mechanism the explanation given above, it will be seen that if the speed of the motor increases either suddenly or slowly the friction gears will be projected outwardly upon their bearings against the inward draft of the springs 13 a distance proportioned to the centrifugal force developed by such increase in speed, thereby carrying the gears 18 beyond the neutral line upon the disk 30, and causing a movement of the latter upon its own axis, which will gradually close the port and diminish the flow of steam. If, on the other hand, the speed falls below the average required, the tension of the springs 13 will draw the gears inward toward the common axis 7, giving frictional contact upon the disk 30 within the neutral circle, and producing at each revolution of the gears a movement of the disk, and consequently of the gear 33, whereby the port will gradually be opened and an increase of motive power supplied.

The device actuated by the disk 30 may be a train of gearing meshing with the gear 33, or a simple rack-bar meshing with a spur-gear upon the sleeve 8.

I have indicated upon the disk 30 the neutral point of contact for the gears 18 by a line designated by the letter *a*. If the centrifugal force is sufficient to project the gears beyond this point, the disk will move with said gears, as already described; but if the speed is so far diminished as to bring the gears within said point the disk will be driven in the opposite direction.

By adjusting the tension of the springs 13, by means of the nuts 22 and 23, the apparatus may be adapted to any load and to maintain a given speed under all circumstances.

What I claim is—

1. In a governor for motors, the combination, with a disk having independent bearing, of a friction gear or gears bearing thereon, bearings radiating from the axis of the disk-bearing upon which said gears are adjustable longitudinally, said bearings being mounted upon an axis coincident with that of the disk, mechanism for imparting to said friction gearing and to the bearing upon which it is mounted synchronous rotation, said mechanism being adapted to open and close a steam or other port by devices actuated by the revolution of said disk in opposite directions, substantially as described.

2. In a governor for motors, the combination, with a disk opening and closing the port of the engine, of friction-gears bearing upon the flat face of said disk, radial bearings upon which said friction-gears are rotated and adjusted, a shaft carrying said bearings and having synchronous revolution with the friction-gears, and springs drawing said gears toward the axis about which their bearings rotate, substantially as described.

3. In a governor for motors, the combination, with a shaft driven by any suitable means, of a hub rigid thereon, tubes projecting radially from opposite sides of said hub, miter-gears sleeved upon said tubes and having prolonged hubs held in place by nuts on the threaded ends of the tubes, friction-gears splined upon said prolonged hubs, springs drawing said gears toward the revolving shaft, a friction disk sleeved upon said shaft with the plane face of which the friction-gears engage, and means for imparting to the shaft and to the said gears equal revolution in equal time, substantially as described.

4. In a governor for motors, the combination, with a disk journaled upon an independent axis, of friction-gears engaging with the plane face of said disk, rotating bearings upon which said gears are radially adjustable, and means for imparting to said bearing or to the gears mounted thereon equal and synchronous revolution in planes substantially at right angles to each other, substantially as described.

5. In a governor for motors, the combination, with a revolving shaft and hub rigid thereon, of tubular bearings radiating from said hub, miter-gears sleeved upon said bearings, friction-gears splined upon the prolonged hubs of said gears, a disk with a plane face of which the friction-gears engage, a miter-gear meshing with the miters upon the tubular bearings, a spur-gear carried by the miter-gear, a stationary internal gear in the same plane with the spur-gear, and planet-gears meshing with said spur and internal gear and rigidly connected with the hub upon the shaft, substantially as described.

6. In a governor for motors, the combination, with a friction-gear splined upon the prolonged hub of an actuating-gear, of a bearing for the latter mounted radially upon a rotating axis, a spring drawing said friction-gear toward the rotating axis, a disk with the plane face of which the gear engages, and gearing whereby the friction-gear receives a single rotation upon its bearing to each rotation of the axis carrying said bearing, substantially as described.

7. In a governor for motors, the combination, with a friction-gear splined upon the prolonged hub of an actuating gear, of a bearing for the latter mounted radially upon a rotating axis, a spring drawing said friction-gear toward the rotating axis, means for varying the tension of said spring, a disk with the plane face of which the friction-gear engages, gearing whereby the latter receives a single rotation to each rotation of the axis carrying its bearing, and devices actuated by the disk for opening and closing the steam-port, substantially as described.

8. In a governor for motors, the combination, with a rotating support, of tubular bearings rigidly mounted thereon and containing spiral springs, miter-gear revolving upon said tubular bearings and having prolonged hubs, friction-gears splined upon said hubs and drawn by the springs toward the axis of the rotating support, a disk with a plane face of which the friction-gears engage upon sides of its axis, and gearing for giving equal rotation in equal times to the friction-gears, and the support carrying the tubular bearings, substantially as described.

9. In a governor for motors, the combination, with a disk, with the plane face of which friction-gears engage upon opposite sides of its axis, of a spring coiled upon the sleeve of said disk and forcing it against the friction-gears, bearings upon which the latter revolve, a rotating shaft carrying said bearings, and means for imparting to said shaft and to the friction-gears equal rotation in equal times, substantially as described.

10. In a governor for motors, the combination, with a stationary internal gear and a concentric spur-gear, of planet-gears meshing

with both, a sleeve carrying said spur-gear and a miter-gear and driven by suitable means, miter-gears meshing with the miter on the sleeve and mounted on tubular bearings carried by a hub, which is rotated by arms connected with the planet-gears, friction-gears splined upon the prolonged hubs of the miters, springs coiled within the tubular bearings, and drawing the friction-gears toward the axis of the hub, devices for adjusting the tension of said springs, a disk with the plane face of which the friction-gears engage, a sleeve on which the disk is mounted, a spring bearing on the rear face of the disk, a common shaft carrying the sleeve of the disk, and of the actuating miter and spur gears, and gearing carried by the former sleeve and actuating the devices opening and closing the port of the engine, the parts being so proportioned that the friction-gears revolve upon their axes in equal time with the revolution of the hub carrying the tubular bearings, substantially as described.

In testimony whereof I affix my signature in presence of two witnesses.

JOSIAH DOW.

Witnesses:

SAMUEL B. WYMAN,
GEO. H. STEVENS.