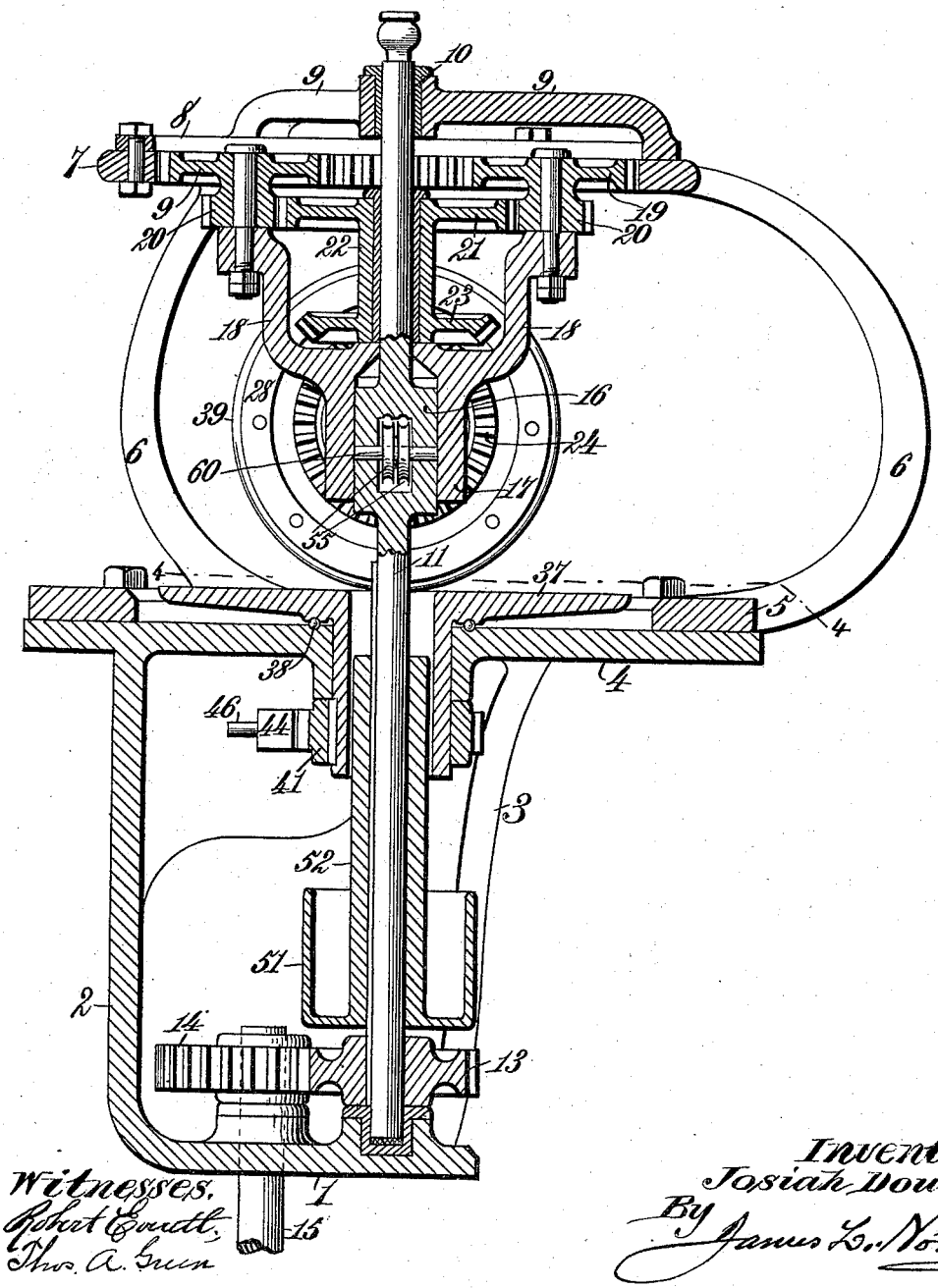
(No Model.) 5 Sheets—Sheet 1.

J. DOW.

GOVERNOR FOR MOTORS.

No. 526,301. Patented Sept. 18, 1894.

Fig. 1.



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By James L. Norris,
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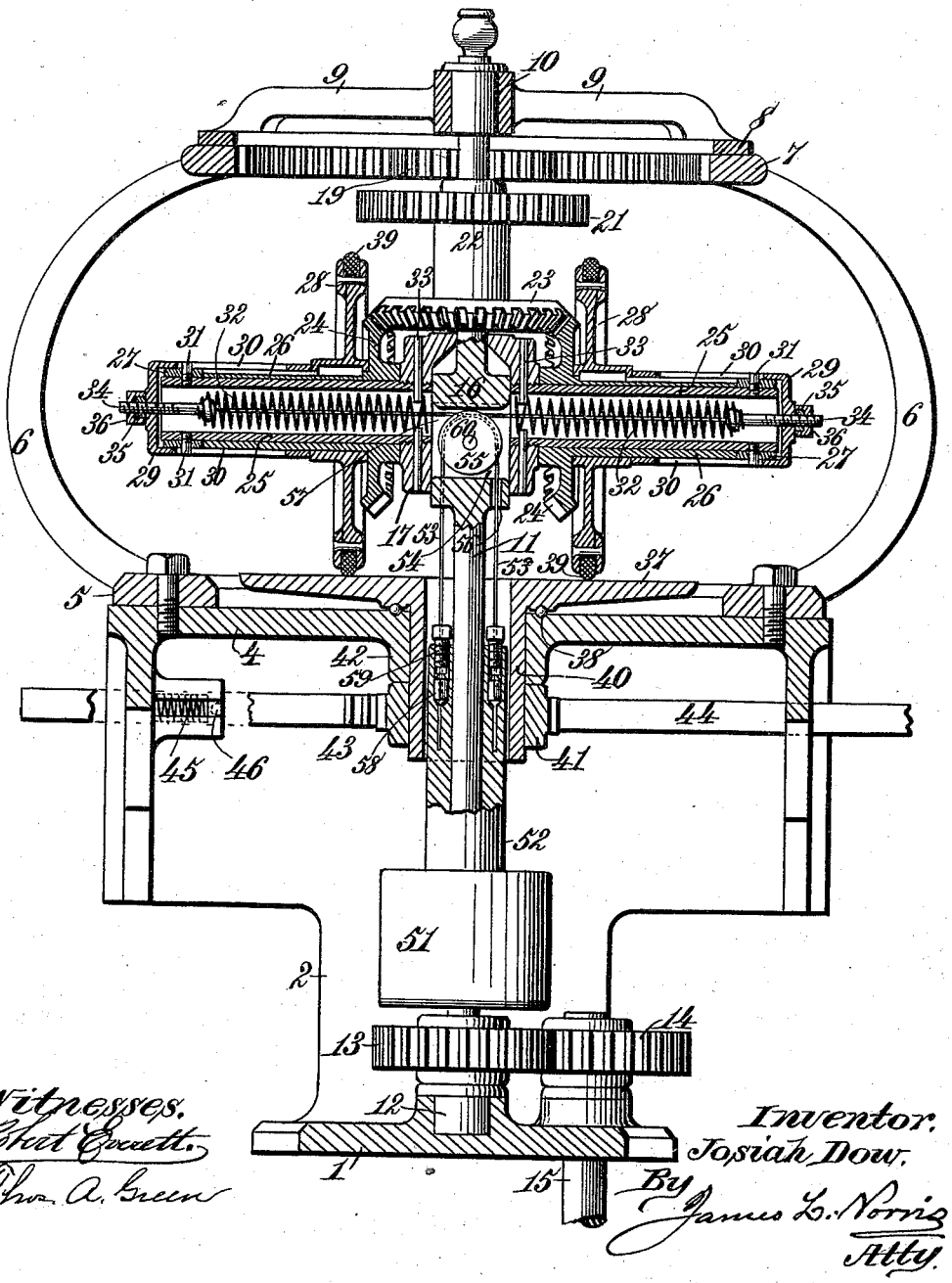
(No Model.) 5 Sheets—Sheet 2.

J. DOW.

GOVERNOR FOR MOTORS.

No. 526,301. Patented Sept. 18, 1894.

Fig. 2.



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(No Model.) 5 Sheets—Sheet 3.

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GOVERNOR FOR MOTORS.

No. 526,301. Patented Sept. 18, 1894.

Fig. 3.

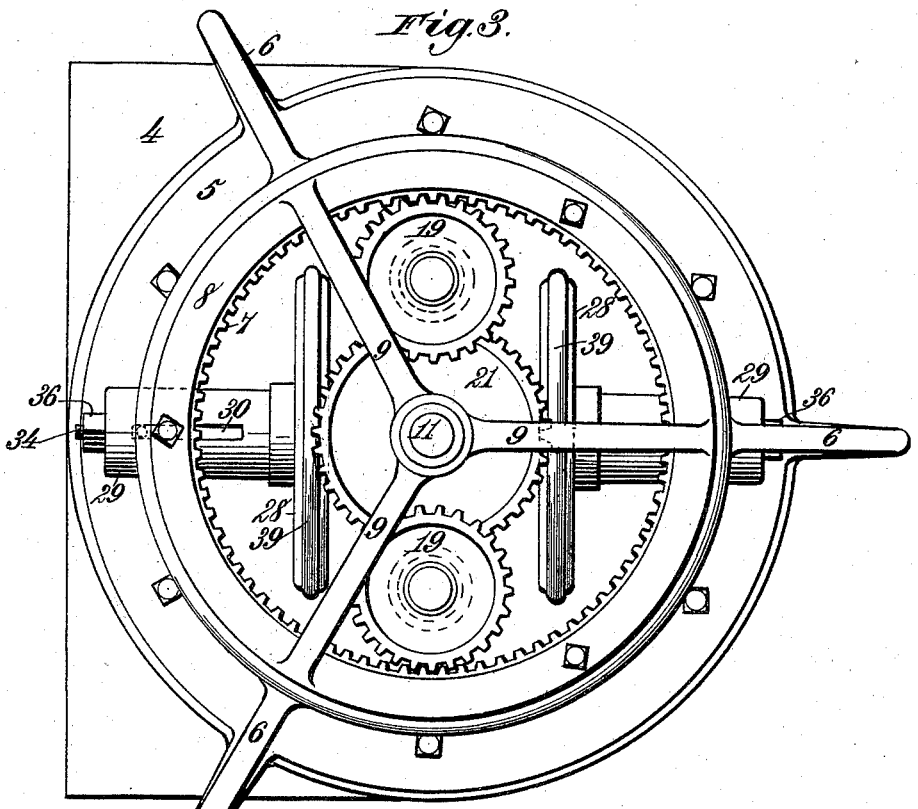
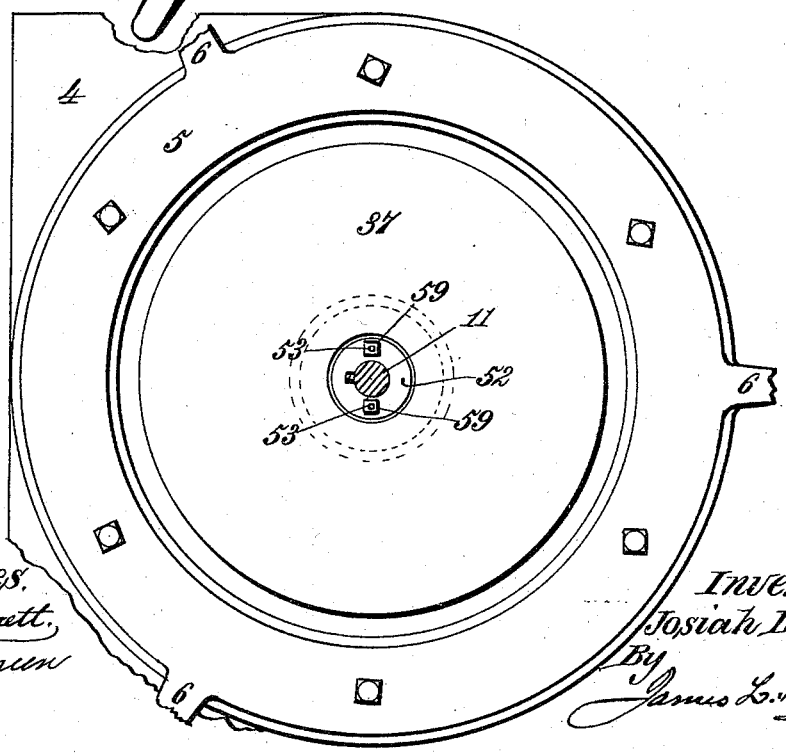


Fig. 4.



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(No Model.) 5 Sheets—Sheet 4.

J. DOW.

GOVERNOR FOR MOTORS.

No. 526,301. Patented Sept. 18, 1894.

Fig. 5.

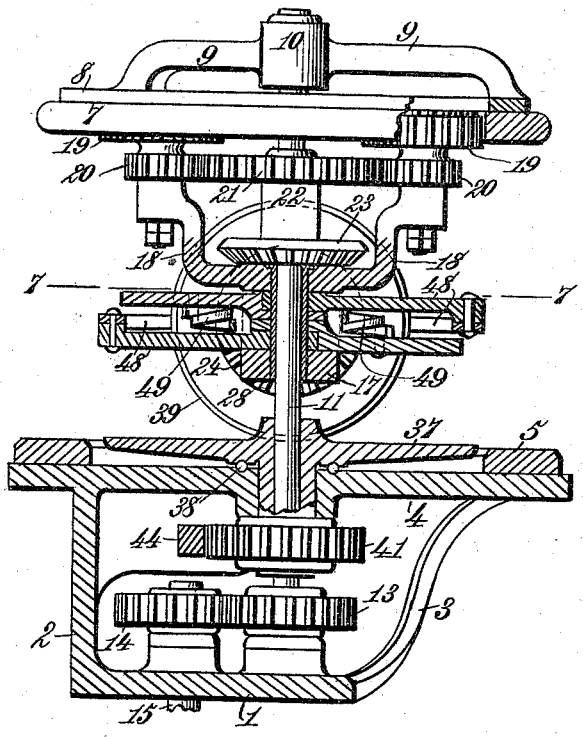
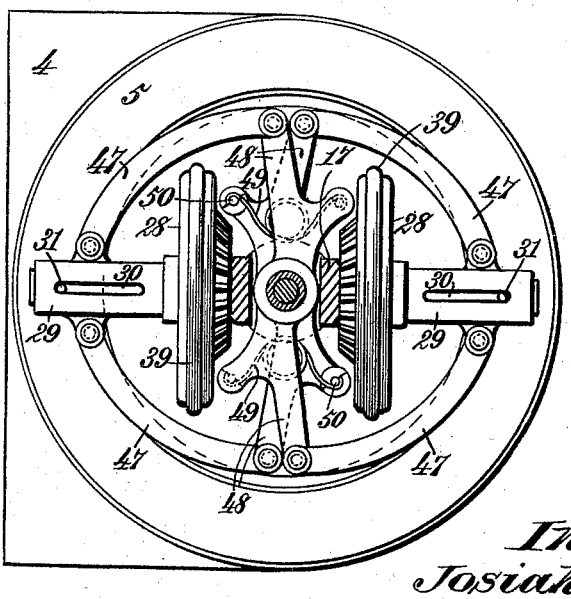


Fig. 7.



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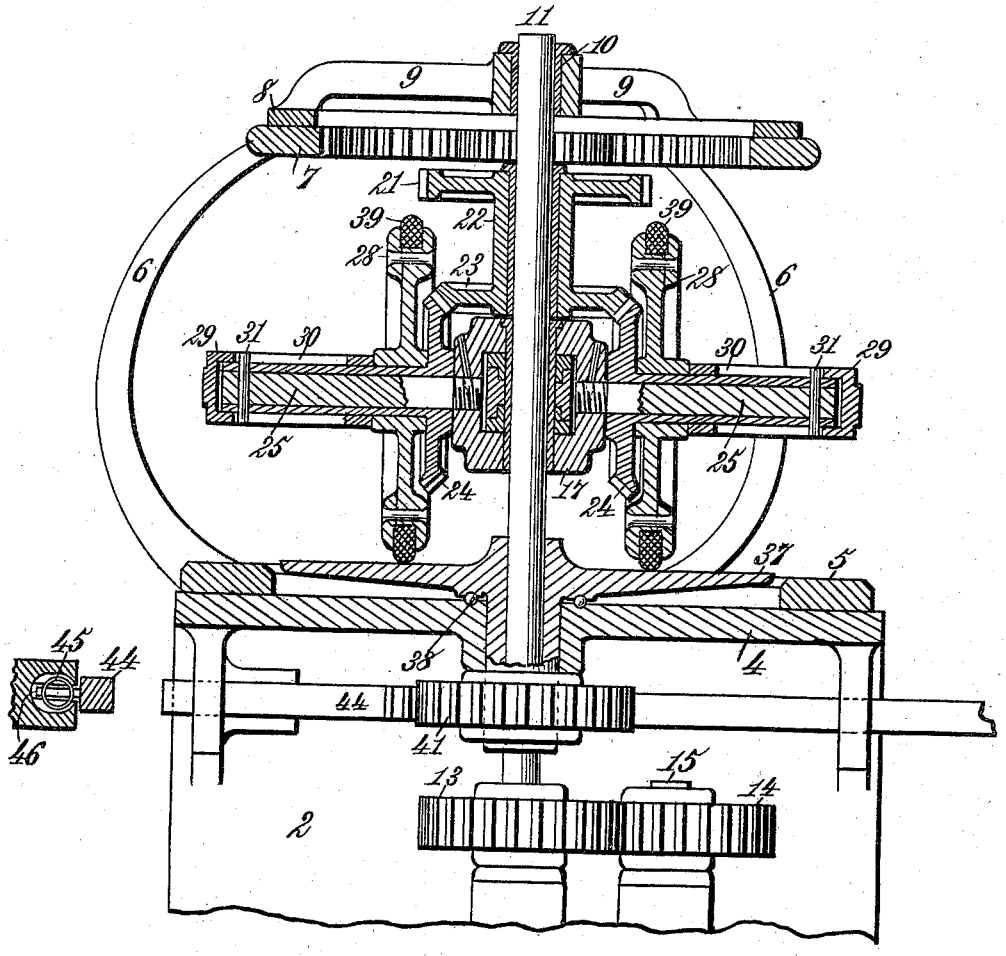
(No Model.) 5 Sheets—Sheet 5.

J. DOW.

GOVERNOR FOR MOTORS.

No. 526,301. Patented Sept. 18, 1894.

Fig. 6.



Witnesses,
Robt Everett
Thos. A. Green

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

UNITED STATES PATENT OFFICE.

JOSIAH DOW, OF PHILADELPHIA, PENNSYLVANIA.

GOVERNOR FOR MOTORS.

SPECIFICATION forming part of Letters Patent No. 526,301, dated September 18, 1894.

Application filed April 28, 1894. Serial No. 509,337. (No model.)

To all whom it may concern:

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

This invention relates to governors for steam engines and other motors, and has for its object to provide an improved construction and arrangement of the parts of a differential governor of the general character described in Letters Patent No. 334,112, granted to me January 12, 1886.

The invention consists in the features of construction and novel combinations of devices in a governor for motors, as hereinafter more particularly described and claimed.

In the annexed drawings illustrating the invention—Figure 1 is a vertical section of my improved governor provided with weight-pot compensation. Fig. 2 is a similar section taken at a right angle to the preceding figure. Fig. 3 is a top view. Fig. 4 is a section on the line 4—4 of Fig. 1. Fig. 5 is a vertical section illustrating a modification in the compensation mechanism of the governor. Fig. 6 is a view of the same construction in vertical section taken at a right angle to the preceding figure. Fig. 7 is a horizontal section on the line 7—7 of Fig. 5.

Referring to the drawings, the numeral 1 designates the base plate of a pedestal or bracket 2 comprising, also, the arms 3 that support a horizontally arranged and centrally perforated main plate 4 on which is bolted the ring-shaped base 5 of an upper frame that is preferably open. The curved arms 6 of this upper frame are arranged at suitable intervals to afford a rigid support for an upper horizontally arranged and internally toothed gear ring 7 to which may be bolted a ring shaped frame 8 having radial arms or spokes 9 by which a shaft bearing 10 is supported. In this bearing 10 is journaled the upper end of the vertically arranged main governor shaft 11 the lower end of which is stepped in a bearing 12 on the base plate 1 of the supporting bracket or pedestal.

At a suitable or convenient point on the shaft 11, preferably near its lower end, may be keyed a pinion 13 meshing with a gear 14 on one end of a shaft 15 that may be connected with the main shaft of an engine by positive gearing, not shown. Although it is preferable that the driving of the governor be thus effected through positive gearing, that it may have the fullest possible sensitiveness to every variation in speed of the engine, it will be obvious that its motion may be derived through ordinary belting, if desired.

On an enlarged or swelled portion 16, Figs. 1 and 2, of the governor shaft 11 is splined a hub 17 that is so fitted as to be capable of sliding easily up or down on the shaft while rotating therewith. This hub 17 is provided at opposite points with two upward and outward projecting arms 18 on which are mounted the axes of planet gears 19 that mesh with the teeth of the stationary internal gear ring 7 forming part of the upper portion of the governor frame. Integral with or securely fastened to the under side of each planet gear 19 is a pinion or small gear 20, about half the size of its accompanying planet gear. The smaller gears or pinions 20 mesh with a spur gear 21 having on its under side an elongated hub 22 that is loosely mounted on the governor shaft, above and in contact with the hub 17 on which the planet gears 19 are carried. The loose hub 22 carries on or near its lower end a miter gear 23 meshing with two miter gears 24 loosely mounted on arms 25 projecting radially from the hub 17 and in opposite directions, as shown in Figs. 2 and 6. Each of the miter gears 24 is provided with an outwardly prolonged hub 26; and on the outer end of each arm 25 is secured a collar 27 so arranged as to prevent endwise movement of the said hubs 26 and thus hold the miter gears 23 and 24 in engagement.

It will be observed that by providing the planet gears 19 with the pinions 20, which are of smaller pitch diameter than said planet gears, the spur-gear 21 may be conveniently meshed with said pinions and be arranged out of direct line of gearing with the stationary internally toothed gear ring 7 and in such manner as to lap the planet gears. By this arrangement of gearing the pinions 20 permit a proper proportioning of the pitch diameters of the several gears to provide the proper rate

of movement throughout the planetary train, for giving the governor the requisite sensitiveness and accuracy.

To the elongated hubs 26 of the miter gears 24 are splined friction gears 28 that revolve with said miter gears and are at the same time capable of automatic adjustment outward upon the hubs 26 under centrifugal force, or inward under the action of springs arranged either within or on the outside of the arms 25, as presently explained. The outward adjustment of the friction gears 28 is limited by means of cylindrical caps 29 placed on the arms 25 in such position as to be in bearing contact with the hubs of said friction gears and move longitudinally therewith. These caps 29 are furnished on opposite sides with longitudinal slots 30 in which are engaged stop pins 31 fastened in the arms 25 on which the gears and caps are supported. The cylindrical caps are adapted to move freely outward and inward but are prevented from turning by the engagement of the pins 31 in their slots.

As shown in Fig. 2, the arms 25 may be hollow or tubular and in these tubular arms may be placed spiral springs 32 for returning the friction gears 28 to their original position when the centrifugal force that carried them outward has been expended or diminished. The inner ends of the springs 32 are attached to the hub 17 of the governor shaft 11 by means of pins 33 and their outer ends are connected to the heads of bolts 34 that are passed from within outward through the heads of the cylindrical caps 29 and secured therein by turned nuts 35 and jam nuts 36 placed on the threaded outer ends of the bolts.

The arms 25 may be screw tapped into the hub 17, or be otherwise secured thereto, and the pins 33 for securing the inner ends of the springs 32 may be so arranged as to also assist in fastening said arms to the hub.

The friction gears 28 are in contact with a turn-table or disk 37 mounted on the centrally perforated main plate 4 of the governor frame. This disk or turn-table is preferably supported on ball bearings 38 to diminish noise and friction. I also prefer to mill or roughen the upper face of the turn-table to increase the hold of the friction gears 28 thereon. For a similar purpose and to insure noiseless running the friction gears 28 may each have its periphery provided with an inserted ring 39 of indurated fiber, hide or other friction material, or the said ring 39 may consist of a partially elastic band sprung into a groove in the periphery of the gear.

It will be seen that by reason of splining the hub 17 onto the governor shaft 11 so as to have a free longitudinal movement thereon, as well as rotating therewith, the weight of said hub and super-incumbent gearing will assist the friction gears 28 in maintaining a frictional bearing on the turn-table. This arrangement of the hub 17, through which it derives power from the governor shaft, also has the advantage of taking the strain from the planetary train which has only to keep the friction gears 28 running in the proper number of revolutions.

On its under side the turn table 37 is provided with a depending hub 40 extended through the central perforation of the plate 4 and carrying a pinion 41 that may revolve beneath and nearly in contact with a boss 42 on the under side of said perforated plate. This pinion 41 is adapted to mesh with the teeth 43 of a reciprocatory rack bar 44 connecting with mechanism, not shown, through which a valve gear or "cut off" may be controlled.

The rack 44 moves in one direction or the other as actuated by the turn-table 37 revolving in one direction or the other under the action of the superimposed friction gears. The teeth of the rack are extended along the same only so far that the full opening or closing of the cut-off may be reached just as the last tooth of the rack, in either direction, is released from the pinion 41, when by means of a spring 45 adapted to press against a pin 46 on the rack bar the said last tooth of the series is held against the pinion 41, in readiness for the reverse action. Thus, the disk or turn-table 37 may continue to revolve after the steam is entirely shut off, or when the cut-off is open to its fullest extent, without moving the rack bar until the reverse action becomes necessary, for which the rack is held ready to quickly respond.

The relative proportions of the several gears comprised in the differential mechanism of the governor should be such that the friction gears 28 will each turn once on its own axis while revolving once about the main shaft 11 of the governor. It will thus be obvious that if these friction gears 28 normally have bearing upon the turn-table 37 at a distance from the axis of the shaft 11 equal to the radius of said gears 28 the latter will merely have rolling contact with the disk or table, and the line in which they thus travel may be denominated the "neutral point" of the turn-table, or normal position of said gears. Should, however, the speed of the governor become so great as to generate sufficient centrifugal force to move the friction gears 28 outward upon their axes until said gears travel in a circle beyond the neutral or normal line they will then impart at each rotation a movement to the disk or turn-table 37 proportioned to the difference between the circumference of said gears and the larger circle on which they now travel. It will thus be seen that if the speed of the engine increases, the friction gears 28 will be carried outwardly upon their bearings a distance beyond the neutral point or line proportioned to the centrifugal force developed and will thereby cause a movement, or revolution, of the turn-table 37 in the proper direction to so actuate the rack bar 44 that it will effect a gradual diminution or cutting off of the flow of steam or

other fluid. On the other hand if the speed is so far decreased as to fall below the average required, the centrifugal action of the governor will be correspondingly diminished and will thus allow the springs 32 to draw the friction gears 28 inward, within the neutral point or line, so as to revolve the disk or turn-table 37 in the opposite direction, its degree of movement being equal to the difference between the circumference of the friction gears and their smaller circle of contact on the disk or table. By thus reversing the revolution of the turn-table the rack 44 geared therewith will be moved in such direction as to bring about an increase in the supply of motive power for the engine.

In order to provide for rotating the friction gears 28 at the proper rate of speed to give the governor the required delicacy and efficiency of action, the several gears of the planetary train should have certain definite proportions. The stationary internal gear 7 has a pitch diameter three times that of the planet gears 19 and twice that of the central gear 21; while the planet gears 19 have a pitch diameter twice that of their pinions 20 and the central gear 21 has a pitch diameter three times that of said pinions. By providing the under side of each planet gear 19 with a pinion 20 proportioned and arranged as described the central gear 21 will be brought out of direct line of gearing with the stationary internally toothed gear ring 7, and will be made to lap the planet gears. This arrangement of gearing will impart greater steadiness and accuracy of movement to the governor.

It is necessary that the friction gears 28 should have the same degree of centrifugal movement and maintain exactly the same distances from the governor shaft, so as to make sure that they will run upon exactly the same track around the table, otherwise there might be want of uniformity in their differentiation and one would thus drag against the other. Besides exerting an inward draft on the friction gears 28 when the centrifugal force is expended or diminished, the springs 32 inclosed in the hollow radial arms 25 are so arranged that they may have their tension adjusted approximately alike to produce some degree of uniformity in the inward and outward movement of the friction gears on their axes. Through the nuts 35 and 36 the tension of these springs 32 can be so adjusted as to adapt the friction gears to any variations in the requirements for the governor.

As an additional means for controlling the friction gears 28 and in such manner that they will have a positive compensating action and reaction on each other to secure perfect uniformity of longitudinal movement on their axes, the cylindrical longitudinally movable caps 29 may have pivoted to their opposite sides the curved links 47, Fig. 7, which connect with toggle levers 48 fulcrumed in the hub 17 of the governor shaft 11 and surrounding said shaft, as shown in Figs. 5, 6 and 7.

Instead of employing springs 32 arranged within tubular arms 25 as shown in Fig. 2, the arms may be made solid as shown in Fig. 6 and outside springs 49, Figs. 5 and 7, may be mounted on the toggle compensating mechanism. These outside springs 49 have their ends connected to or in bearing contact with lugs 50 carried by projections from opposite toggle levers of each pair and are so arranged as to exert an inward draft on the connected toggles, links, caps and friction gears when the centrifugal force is expended or diminished. Although I have shown this arrangement of springs 49 in connection with the toggle compensating mechanism it is obvious that the outside springs may be omitted and the inclosed spiral springs 32 be employed together with the toggles.

In place of the "toggle compensation" a weight pot 51, Figs. 1 and 2, may be splined on the vertical governor shaft 11 so as to slide freely thereon. This "weight pot" is provided with an elongated hub or tubular stem 52 through which it is suspended by means of wires 53 connecting with the interior of the cylindrical caps 29 on the tubular arms 25 carried on the hub 17 of the governor shaft. In the swelled portion 16 of the shaft 11 is an approximately central chamber 54 in which are mounted peripherally grooved sheaves 55 that serve as guides for the said wires 53 through which the weight pot is suspended. Vertical openings 56 and lateral openings 57 are provided in the swell 16 for passage of said wires. At their lower ends the wires 53 are secured to clamps 58 held in the upper end of the weight pot hub 52 by means of screw bolts 59, while the upper or outer ends of said wires may be passed through the screw bolts 34 in the heads of the cylindrical caps 29 and be riveted or brazed to the outer ends of said bolts. The pot 51 may be weighted to any required degree by means of lead placed therein.

The pin or journal 60, on which the sheaves 55 are mounted, may be supported in the shaft 11 so as to take weight off the turn-table 37 or it may be extended into and held in the hub 17 and run free through the shaft and be independent thereof so as to increase the weight and friction on the table. The wires 53 being drawn to equal tension, when the friction gears 28 are in identical positions, will maintain their uniformity of movement through all degrees of expansion or differences of distance from the main vertical axis of the governor, and will thus produce the same effect as the compensating toggles hereinbefore described.

With the "weight pot compensation" the depending sleeve or hub 40, carried by the turn-table 37, will be made of sufficient internal diameter to permit the passage and free vertical motion of the elongated hub 52 on the weight pot; while with the "toggle com-

pensation" the table sleeve or hub 40 is closed about the main shaft, although not actually touching it. In both arrangements the shaft 11 has free movement regardless of the movement of the disk or table.

The governor may be used with only the internally arranged springs 32 to hold against the expansion of the differential friction gears 28 and caps 29, and without compensating appliances other than a uniform adjustment for the tension of said springs. By employing, however, a positive compensation such as furnished by the toggle mechanism, with either outside or inside springs, or the weight pot compensation with its suspending wires and inside springs, the governor will be greatly improved in efficiency and certainty of action.

What I claim as my invention is—

1. In a governor for motors, the combination of a rotary disk or table connected with mechanism for controlling a valve gear or cut-off, a rotary-shaft having a hub turning therewith and provided with oppositely arranged radial arms carrying differential friction gears in contact with said disk or table and adapted to actuate it in opposite directions, miter gearing through which said friction gears are revolved on their own axes, a central spur gear connected to one of the miter gears and sleeved therewith on said rotary shaft, planet-gears carried by the hub of the rotary shaft and provided with pinions of smaller pitch diameter in mesh with the central spur-gear sleeved on said shaft, and a stationary internal gear meshing with the planet gears and located therewith out of direct line of gearing with the said central spur-gear, whereby the planet gears will lap the central gear and provide for proportionate rates of movement in the gears of the planetary train, substantially as described.

2. In a governor for motors, the combination of a rotary shaft having a hub turning therewith and provided with oppositely arranged radial arms, miter gears provided with elongated hubs that are sleeved on said arms, friction gears splined on the miter gear hubs and radially movable thereon, a rotary disk or table in bearing contact with said friction gears and connected with mechanism for actuating or controlling a valve gear or cut-off, a miter gear and connected spur gear sleeved on the rotary shaft said miter gear being in mesh with the miter gears mounted on the radial arms of the shaft hub, pinions carried on the hub of the rotary shaft and meshing with said spur gear, planet gears connected to said pinions which are of smaller pitch diameter than the attached planet gears, a stationary internal gear meshing with said planet gears and located therewith out of direct line of gearing with the spur gear on the rotary shaft, cylindrical longitudinally movable caps mounted on the radial arms of the shaft hub in contact with the hubs of the radially movable friction gears, and positive compensating mechanism connecting said caps, substantially as described.

3. In a governor for motors, the combination of a rotary disk or table having a hub provided with a pinion, a rack-bar geared with said pinion and adapted to connect with mechanism for controlling a valve gear or cut-off, differential friction gears adapted to actuate said disk in opposite directions, a rotary shaft coincident with the axis of said rotary disk and about which the friction gears revolve, said shaft having a hub turning therewith and provided with arms on which the friction gears are mounted and radially movable, the miter gearing for revolving the said friction gears on their own axes, a planetary train for actuating the miter gearing, and positive compensating mechanism connecting the said differential friction gears, substantially as described.

4. In a governor for motors, the combination of a rotary disk or table carrying a pinion, a rack-bar to connect with mechanism for controlling a valve gear or cut-off and having teeth geared with said pinion and extended only so far that the full opening or closing of the cut-off may be reached just as the last tooth of the rack, in either direction, is released from the pinion, means for holding the said last tooth of the rack against the pinion in readiness for the reverse action, and differential gearing for actuating the disk or table in opposite directions, substantially as described.

5. In a governor for motors, the combination of a rotary disk or table provided with a hub carrying a pinion, a rack-bar to connect with mechanism for controlling a valve gear or cut-off, the teeth of said rack-bar being geared with the pinion and arranged in a series of such length that the full opening or closing of the cut-off will be accomplished just as the last tooth of the rack, in either direction, is released from the pinion, a spring adapted to bear on the rack-bar and hold the last tooth of the rack against the pinion in readiness for the reverse action, and mechanism for actuating the disk or table in opposite directions, substantially as described.

6. In a governor for motors, the combination of a rotary disk or table having a pinion geared with mechanism for controlling a valve gear or cut-off, differential friction gears having their peripheries provided with inserted rings of friction material, said gears being adapted to bear on and actuate the disk or table in opposite directions, a rotary shaft coincident with the axis of said disk or table and about which the friction gears revolve, said shaft having a hub turning therewith and provided with radial arms on which the friction gears are mounted and adapted to move longitudinally, gearing for revolving the friction gears on their own axes, and means for limiting the outward movement or radial adjustment of said friction gears and

drawing them toward the hub of the radial shaft on which they are carried, substantially as described.

7. In a governor for motors, the combination of a rotary disk or table geared with mechanism for controlling a valve gear or cut-off, a rotary shaft having a hub turning therewith and provided with oppositely arranged radial arms, differential friction gears mounted on said arms and adapted to actuate the disk or table in opposite directions, means for revolving the friction gears on their own axes, cylindrical longitudinally slotted caps mounted on the radial arms of the shaft hub and in contact with the hubs of the friction gears, pins engaged in the slots of said caps to limit their longitudinal movement and prevent them from turning, and a positive compensating mechanism connecting said caps, substantially as described.

8. In a governor for motors, the combination of a vertical rotary shaft having a hub splined thereon and provided with oppositely arranged radial arms, a turn-table or disk having its axis coincident with the axis of said shaft and geared with devices for controlling a valve gear or cut-off, differential friction gears carried on the radial arms of the shaft hub and adapted to actuate the turn-table in opposite directions, and compensating mechanism connecting the said friction gears, substantially as described.

9. In a governor for motors, the combination of a vertical shaft geared with the main shaft of the engine or motor, a hub splined on said vertical shaft and provided with oppositely arranged radial arms, a turn-table or disk having its axis coincident with the axis of the vertical shaft, a rack-bar geared with said disk or turn-table and adapted to connect with mechanism for controlling a valve-gear or cut-off, differential friction gears carried on the radial arms of the shaft hub and adapted to actuate the turn-table in opposite directions, means for revolving the friction gears on their own axes, and springs for drawing said friction gears toward the vertical shaft, substantially as described.

10. In a governor for motors, the combination of a vertical shaft driven from the engine or motor, a hub splined on said shaft and provided with oppositely arranged radial arms, a turn-table or disk having its axis coincident with the axis of the vertical shaft and geared with devices for controlling a valve gear or cut-off, ball bearings on which said disk or turn-table is mounted, differential friction gears having a radial movement on the arms of the shaft hub in bearing contact with the turn-table and adapted to actuate the same in opposite directions, and compensating mechanism connecting said friction gears, substantially as described.

11. In a governor for motors, the combination of a vertical rotary shaft, a turn-table having its axis coincident with said shaft, a hub splined on the vertical rotary shaft and provided with radial arms, differential friction gears carried on said arms in bearing contact with the turn-table and adapted to actuate the same in opposite directions, miter gears for revolving the said friction gears on their own axes, a connected spur gear and miter gear sleeved on the vertical shaft, the said miter gear being in mesh with the miter gears of the differential friction gearing, planet gears carried on the shaft-hub and provided with pinions in mesh with said spur gear, a stationary internal gear in mesh with the planet gears, and positive compensating mechanism connecting the differential friction gears, substantially as described.

12. In a governor for motors, the combination of a turn-table geared with mechanism for controlling a valve gear or cut-off, differential friction gears bearing on the turn-table and adapted to actuate the same in opposite directions, a vertical rotary shaft having a hub splined thereon and provided with tubular arms on which the said friction gears are radially movable, the miter gearing for revolving said friction gears on their own axes, a planetary train for actuating the miter gearing, cylindrical caps mounted on the tubular arms of the shaft hub in contact with the hubs of the friction gears and radially movable therewith, and a weight pot splined on the rotary shaft below the turn-table and connected with said caps by means of suspension wires passed through said tubular arms of the shaft hub, substantially as described.

13. In a governor for motors, the combination of a turn-table, differential friction gears bearing on the turn-table and adapted to actuate the same in opposite directions, a vertical rotary shaft having an internally recessed or chambered swell portion to which is splined a hub provided with tubular radially arranged arms on which said friction gears are radially movable, means for revolving said friction gears on their own axes in equal time with their revolution about the vertical shaft, cylindrical caps mounted on the tubular arms of the shaft hub in contact with the hubs of the friction gears, and radially movable therewith, a weight pot having an elongated hub splined on the rotary vertical shaft below the turn-table and connected with said caps by means of suspension wires passed through the shaft hub and its tubular arms, sheaves mounted in the swelled portion of said shaft to serve as guides for said suspension wires, and springs inclosed in the tubular hub arms and connected therewith and with the cylindrical caps, substantially as described.

14. In a governor for motors, the combination of a vertical rotary shaft, a turn-table or disk having its axis coincident with the axis of the vertical shaft and geared with devices for controlling a valve gear or cut-off, a hub splined on said vertical shaft to slide thereon and provided with oppositely arranged radial arms, differential friction gears carried on

said arms in bearing contact with the table or disk and adapted to actuate the same in opposite directions, and gearing supported on or by the splined hub of the vertical rotary shaft and adapted to revolve the friction gears on their axes, whereby the weight of said hub and superincumbent parts will increase the frictional action of the differential gears on the turn-table, substantially as described.

15. In a governor for motors, the combination of a vertical rotary shaft having an internally recessed or chambered portion to which is splined a hub provided with tubular radially arranged arms, the said hub being adapted to slide vertically on the said shaft and to rotate therewith, a turn-table or disk mounted independent of the shaft below said hub and geared with devices for controlling a valve gear or cut off, differential friction gears carried on said arms in bearing contact with the table or disk and adapted to actuate the same, in opposite directions, cylindrical caps mounted on the tubular arms of the shaft hub in contact with the hubs of the friction gears and radially movable therewith, gearing for revolving the friction gears on their own axes, a weight pot splined on the rotary vertical shaft below the turn-table and connected with said caps by means of suspension wires passed through the shaft hub and its radial arms and sheaves mounted in the chambered portion of the shaft to serve as guides for said suspension wires, the weight of the splined hub and superincumbent gearing being utilized, either with or without the weight of the weight pot, to control the bearing of the friction gears on the turn-table, substantially as described.

16. In a governor for motors, the combination of a turn-table or disk having a hub provided with a pinion, a rack bar geared with said pinion and adapted to connect with mechanism for controlling a valve gear or cut-off, differential friction gears adapted to actuate said turn-table in opposite directions, a rotary vertical shaft coincident with the axis of the turn-table and about which the friction gears revolve, said shaft having a hub splined thereon and provided with arms on which the differential friction gears are mounted and radially movable, miter gearing for revolving said friction gears on their own axes, and a planetary train for actuating the miter gearing, the weight of said splined hub and superincumbent gearing being arranged to increase the frictional action of the differential gears on the turn-table, substantially as described.

In testimony whereof I have hereunto set my hand and affixed my seal in presence of two subscribing witnesses.

JOSIAH DOW. [L. S.]

Witnesses:

JABEZ GATES,

CHARLES H. WEISS.