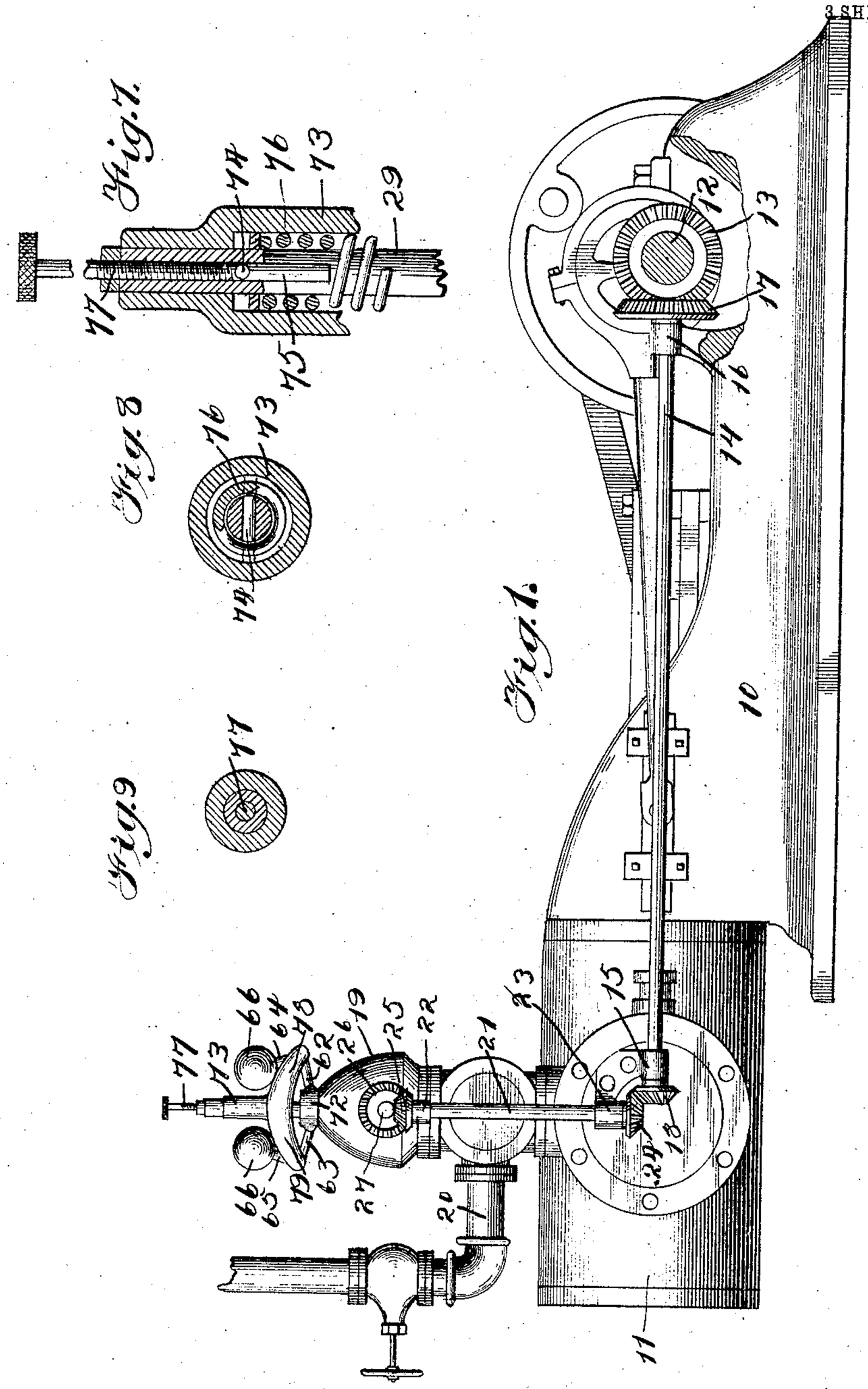
No. 785,498. PATENTED MAR. 21, 1905.

F. I. JOYCE.

GOVERNOR.

APPLICATION FILED JUNE 20, 1903.

3 SHEETS—SHEET 1.



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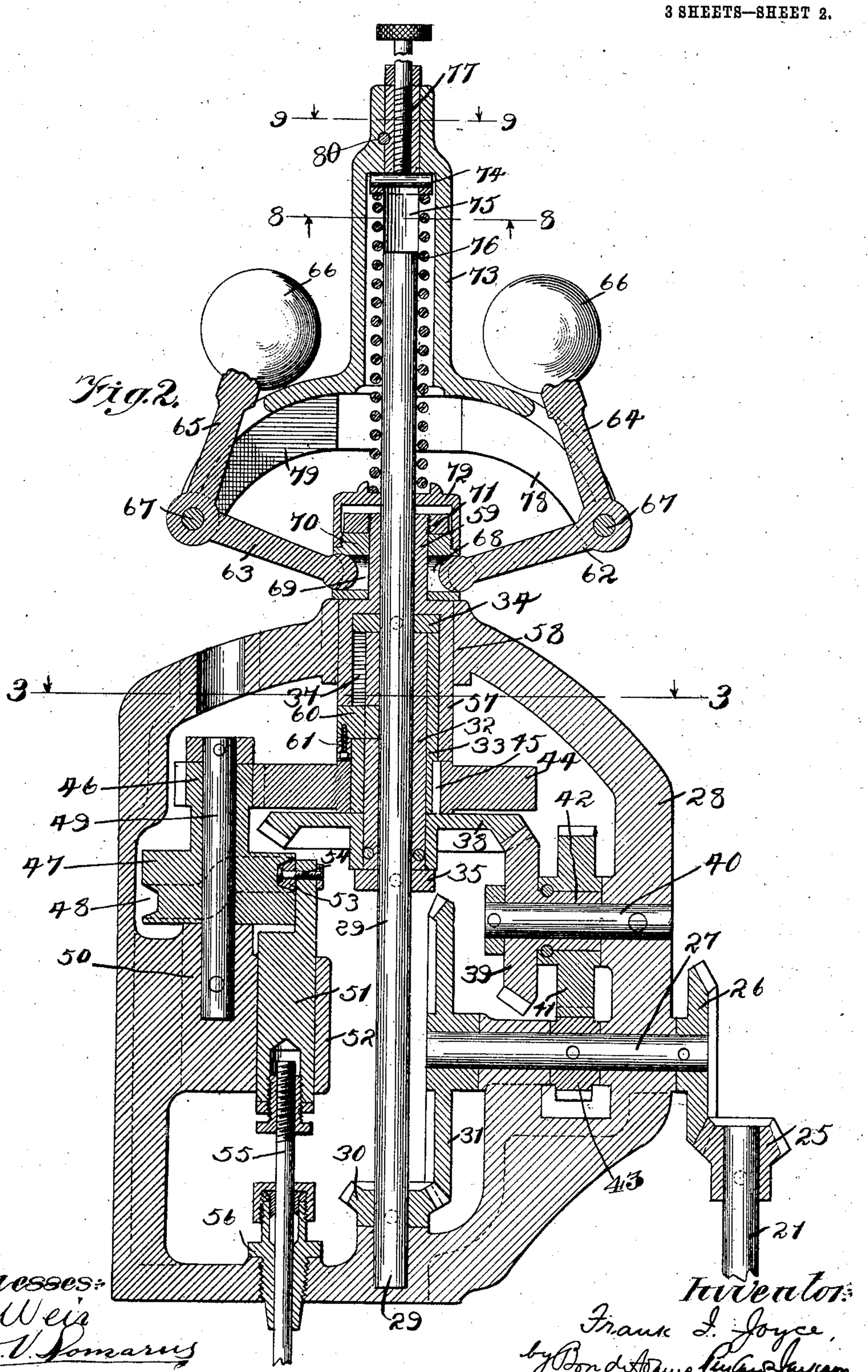
3 SHEETS—SHEET 2.

Fig. 2.



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3 SHEETS—SHEET 3.

Fig. 3.

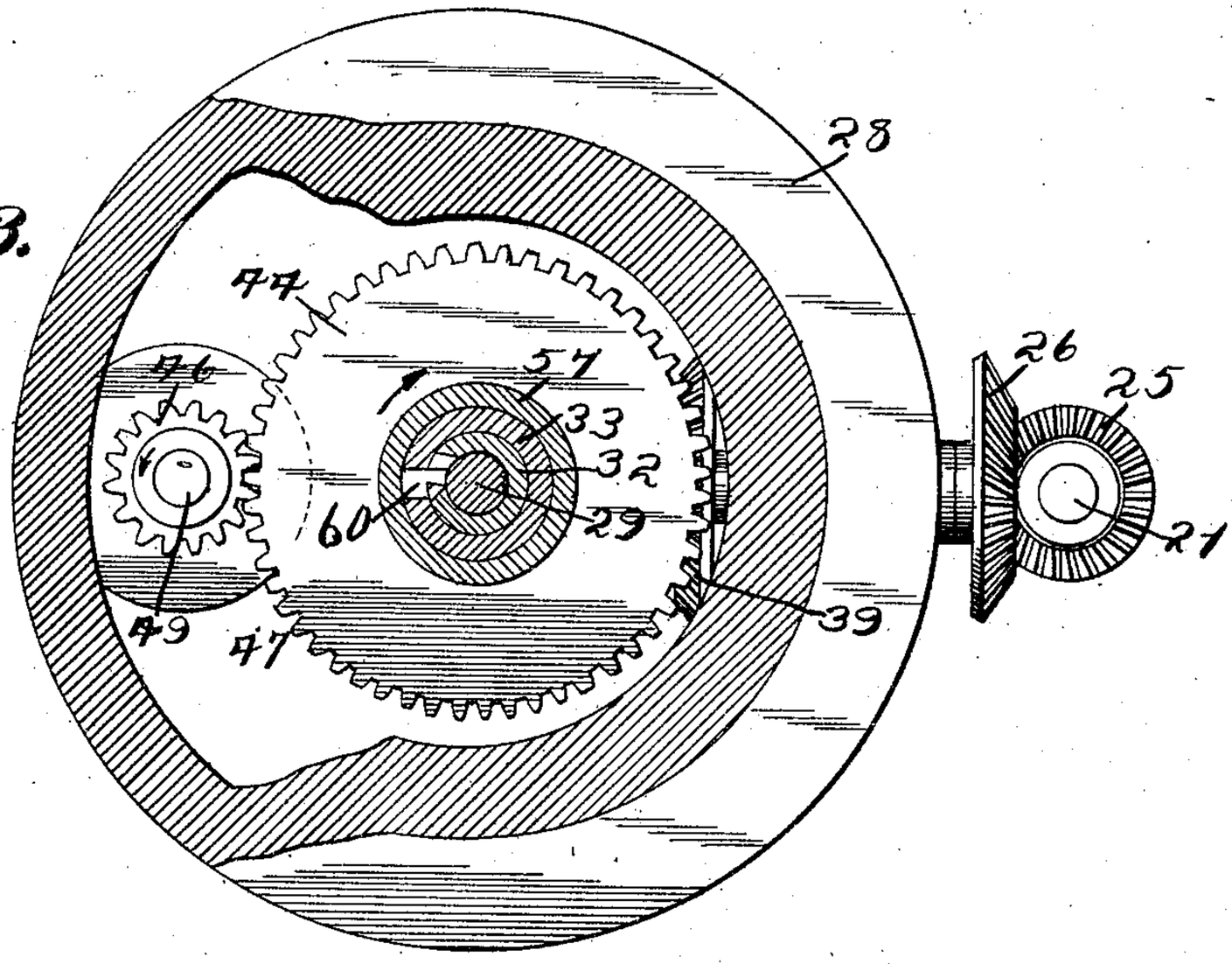


Fig 5.

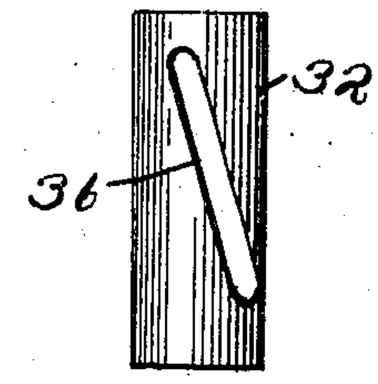


Fig 6

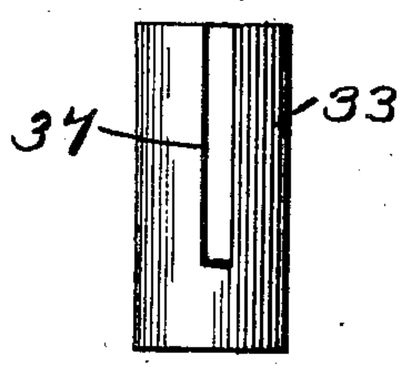
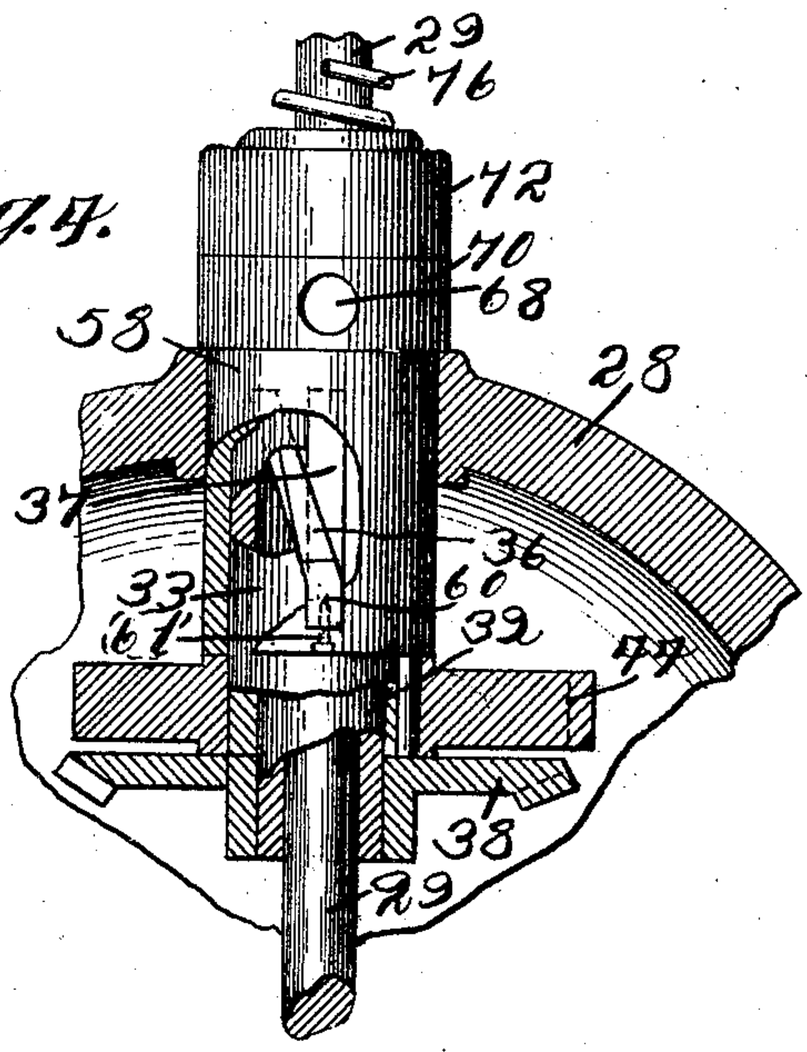


Fig. 4.



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No. 785,498. Patented March 21, 1905.

UNITED STATES PATENT OFFICE.

FRANK I. JOYCE, OF DAYTON, OHIO.

GOVERNOR.

SPECIFICATION forming part of Letters Patent No. 785,498, dated March 21, 1905.

Application filed June 20, 1903. Serial No. 162,327.

To all whom it may concern:

Be it known that I, FRANK I. JOYCE, a citizen of the United States, residing at Dayton, in the county of Montgomery and State of Ohio, have invented certain new and useful Improvements in Governors, of which the following is a specification, reference being had to the accompanying drawings.

My invention relates to governors, and particularly to governors of the type illustrated and described in Letters Patent No. 251,016, dated December 13, 1881, to S. A. Goodwin, in which a main slide-valve is used for the admission and release of steam, while the governor acts to regulate the operation of an auxiliary or cut-off valve which slides upon the back of the main slide-valve.

The objects of my invention are to provide certain improvements in the operation of governors as heretofore constructed by which I increase the range of action and secure greater compactness. I accomplish these objects as hereinafter described and as illustrated in the accompanying drawings.

What I regard as new is set forth in the claims.

In the accompanying drawings, Figure 1 is an elevation illustrating my improved governor applied to a horizontal engine. Fig. 2 is a vertical section of my improved governor. Fig. 3 is a horizontal section on line 3 3 of Fig. 2. Fig. 4 is an enlarged detail, partly in section, illustrating the slotted sleeves by which the adjustment of the valve-operating mechanism is secured. Figs. 5 and 6 are elevations of the slotted sleeves. Fig. 7 is a vertical section of the upper portion of the governor, some parts being in elevation. Fig. 8 is a horizontal section on line 8 8 of Fig. 2 looking up, and Fig. 9 is a horizontal section on line 9 9 of Fig. 2 looking down.

Referring to the drawings, 10 indicates the frame of an engine; 11, the cylinder; 12, the shaft; 13, a beveled gear mounted on said shaft; 14, a shaft mounted in suitable bearings 15 16 and extending longitudinally of the engine from the shaft 12 to a point near the governor; 17, a beveled gear mounted on one end of the shaft 14 and meshing with the gear 13, and 18 a beveled pinion mounted on the opposite end of said shaft 14. These parts are illustrated for convenience in understanding the application of the governor; but their construction and arrangement form no essential part of my present invention.

19 indicates the governor, which is mounted above the cylinder 11 or in some other appropriate situation where the connections between the governor and the auxiliary or cut-off valve may be conveniently made.

20 indicates the steam-supply pipe.

21 indicates a vertical shaft which is mounted in suitable bearings 22 23 and carries at its lower end a beveled pinion 24, which meshes with the pinion 18, as shown in Fig. 1. Also it carries at its upper end a beveled pinion 25, which meshes with a pinion 26, through which the governor is operated. The pinion 26 is mounted upon the outer end of a short shaft 27, fitted in suitable bearings in the casing 28 of the governor, as best shown in Fig. 2.

29 indicates the main shaft of the governor, which is centrally disposed and in the form of governor illustrated is in a vertical position, suitable bearings being provided for it in the casing 28. Preferably near its inner end the shaft 29 is provided with a beveled pinion 30, which meshes with a gear 31, mounted on the inner end of the shaft 27, so that the rotation of said shaft 27 drives the main shaft 29, and as the pinion 30 is of considerably less diameter than the gear 31 the shaft 29 is driven at a much higher rate of speed.

As best shown in Fig. 2, the shaft 29 projects a considerable distance beyond the upper portion of the casing 28, and within said casing said shaft carries inner and outer slotted sleeves 32 33, respectively. 34 35 indicate collars mounted upon and secured to the shaft 29 opposite the ends of the inner sleeve 32. The diameter of the collars 34 35 is equal to that of the outer sleeve 33, so that said collars operate to hold said sleeves in place, as will hereinafter more fully appear. As best shown in Fig. 5, the sleeve 32 is provided with an inclined slot 36, which slot extends from near

one end to near the other end of said sleeve and is slightly inclined from a longitudinal line. The sleeve 33 is provided with a straight longitudinally-extending slot 37, said slot being equal in width to the slot 36, with some portion of which it is always in register.

As shown in Fig. 2, the lower end of the inner sleeve 32 rests upon the collar 35 and carries an inverted beveled gear 38, which meshes with a beveled gear 39, mounted on a stud 40, supported by the casing 28, parallel with and adjacent to the shaft 27. The stud 40 also carries a spur-gear 41, which is mounted on a sleeve 42, formed integral with the pinion 39. The gear 41 meshes with a pinion 43, mounted on the shaft 27, so that by the rotation of the shaft 27 the beveled gear 38 is rotated, and with it the sleeve 32, to which it is keyed. The different gears are so proportioned that the sleeve 32 rotates more slowly than the engine-shaft, its speed being preferably about one-third that of the engine-shaft, for reasons hereinafter given.

44 indicates a spur-gear mounted upon the lower portion of the sleeve 33 directly above the beveled gear 38, as shown in Fig. 2. The gear 44 is keyed to the sleeve 33, as shown at 45, so that said sleeve and gear rotate in unison. The gear 44 meshes with a pinion 46, which is preferably formed integral with a disk 47, provided with a cam-groove 48 in its periphery, as shown in Fig. 2. The disk 47 and pinion 46 are rotatably mounted upon a vertically-disposed stud 49, carried in a support 50, which is preferably formed integral with the casing 28, as shown in Fig. 2.

51 indicates a reciprocating rod mounted in a suitable bearing 52 in the support 50, said rod being arranged so that the upper portion thereof extends over the periphery of the disk 47, as shown in Fig. 2. The rod 51 carries a conical block 53, pivotally mounted on a pin 54, which block extends into the groove 48. The arrangement is such that as the disk 47 rotates the rod 51 is caused to reciprocate by reason of the shape of said groove. A connecting-rod 55 connects the rod 51 with the auxiliary slide-valve, so that the reciprocating movement of the rod 51 is transmitted to said valve. The rod 55 passes through a stuffing-box 56, as shown in Fig. 2.

57 indicates an endwise movable and rotatable sleeve which is fitted in a suitable bearing 58 in the upper portion of the casing 28, fitting over the sleeve 33 and collar 34, the lower end of said sleeve extending down to the gear 44, while the upper end thereof extends beyond the upper portion of the collar 34 and is reduced in diameter to fit closely upon the shaft 29, as shown at 59 in Fig. 2.

60 indicates a key which is secured in one side of the sleeve 57, preferably by a screw 61, as shown in Fig. 2, and extends through the slots 36 and 37 in the sleeves 32 33, respectively. By this construction it will be evident that the endwise-movable sleeve 57 and the outer sleeve 33 must at all times rotate in unison with each other, that so long as the sleeve 57 is not moved longitudinally the inner sleeve 32 will also move in unison with the others, and that longitudinal movement of the endwise-movable sleeve 57 independently of the other sleeves is permitted, notwithstanding the fact that the other sleeves cannot move longitudinally by reason of the fact that the key 60 moves in the slots 36 37. Such longitudinal movement of the sleeve 57, however, causes the outer sleeve 33 and the sleeve 57 to rotate to a greater or less extent upon the sleeve 32, owing to the inclination of its slot 36. The sleeve 33 cannot rotate independently of the sleeve 57, because its slot 37 is not inclined. Furthermore, as the sleeve 32 is positively driven through gear 38 and the intermediate gearing from shaft 21, while sleeves 33 and 57 are driven only through their connection with sleeve 32 by means of key 60, longitudinal movement of the sleeve 57 does not affect the rotation of the sleeve 32, which continues its regular rotation without variation, except as the speed of the shaft 21 is altered. As will be hereinafter described, the longitudinal or endwise movement of the sleeve 57 is controlled by the speed of the engine. Consequently the position of the key 60 in the inclined slot 36 of the sleeve 32 and the relative positions of sleeves 32 and 33 are also controlled by the speed of the engine, which therefore controls the position of the disk 47 and through it the operation of the auxiliary slide-valve.

The longitudinal movement of the sleeve 57 is effected by means of governor-arms adapted to be operated by centrifugal action. I prefer to employ governor-arms in the form of bell-crank levers having inwardly-projecting arms 62 63 and upwardly-projecting arms 64 65, as shown in Fig. 2, the arms 64 and 65 carrying weights 66 at their upper ends. Pivots 67 support the governor-arms in the usual way. The inwardly-projecting arms 62 63 fit in sockets 68 69, respectively, in a ring 70, which is mounted on the reduced portion 59 of the sleeve 57 and is held in place by a nut 71, (shown in Fig. 2,) which is screwed upon the upper end of the sleeve 57. A cap 72 is provided, which extends over the upper end of the sleeve 57 and is screwed to the ring 70. 73 indicates the head-piece of the governor, which is in the form of a cap which fits upon the upper end of the shaft 29 and is secured thereto by any suitable means, such as a pin 80. (Shown in Fig. 2.) At the upper inside part of the head-piece 73 the shaft 29 is provided with a transverse slot 75, through which passes a cross-pin 74, as shown in Fig. 2. A spiral spring 76 is provided upon the shaft 29 between the cap 72 and the cross-pin 74.

77 indicates a screw placed in the upper end of the shaft 29 and extending down into the slot 75, so as to bear against the pin 74. By this construction by adjusting the screw 77 the spring 76 may be compressed to a greater or less extent to vary the tension of the spring and alter the speed of the engine.

The head-piece 73 at its lower end carries laterally-projecting arms 78 79, which support the pivots 67, upon which the governor-arms are mounted, as shown in Fig. 2. The head-piece 73 is keyed to the shaft 29 in any suitable manner so that it rotates therewith. By this construction when the shaft 29 is caused to rotate, which, as hereinbefore described, is effected by means of the shaft 21, pinion 30 on the shaft 29, and the intermediate gearing shown, the head-piece 73, with the governor-arms, is caused to rotate at a high rate of speed, throwing the weights 66 outward, the arms 62 63 consequently moving upward, lifting the sleeve 57 approximately to the point at which it stands when the engine has acquired the desired speed. As soon as the engine is started the inner sleeve 32 is caused to rotate through gear 38, shaft 21, and the intermediate connections, and through said sleeve 32 sleeves 33 and 57 are also caused to rotate, thus rotating gear 44, pinion 46, and disk 47. Consequently the reciprocating rod 51 is caused to reciprocate, operating the auxiliary slide-valve. It will be understood that the main slide-valve is reciprocated in the ordinary manner by means of an eccentric or other equivalent device and that the parts are so adjusted that the auxiliary slide-valve as it is operated by the reciprocating rod 51 operates to cut off the steam-supply first on one end and then on the other. The action of the auxiliary slide-valve is adjusted to vary the steam-supply by partly rotating the disk 47 independently of its normal rotation, thereby altering the time of the stroke of the rod 55 and the auxiliary slide-valve operated by it relatively to that of the main slide-valve. This independent rotation of the disk 47 is controlled entirely by the position of the governor-arms, as hereinafter explained.

When the engine is started, its speed is of course slow, and consequently the sleeve 57 occupies its lowermost position. The parts are so adjusted that at this time the auxiliary or cut-off slide-valve operates with reference to the main slide-valve, so as to leave the steam-inlet passages open for the longest period possible. When, however, the sleeve 57 rises under the action of the governor-arms when operating at a higher rate of speed, the key 60 rises in the inclined slot 36, and consequently rotates the sleeves 57 and 33 in the direction indicated by the arrow in Fig. 3, thereby rotating the pinion 46 and disk 47 in the opposite direction, as indicated by the arrow in Fig. 3. The extraordinary movement given the disk 47 therefore adjusts the action of the auxiliary slide-valve with reference to that of the main slide-valve and reduces the steam-supply.

When the engine is running at the speed for which the governor is set, the disk 47 rotates regularly, being driven in the manner hereinbefore described from the sleeve 33, which rotates uniformly with the sleeves 32 and 57. If the speed of the engine falls below that desired, the action is the reverse of that described, with the result that a greater supply of steam is admitted.

By my improved construction I am enabled to make the spiral or inclined slot by which the adjustment of the auxiliary slide-valve is controlled at an angle of within approximately eleven degrees with a line parallel with the axis, which is the angle of repose, so that as the strain of adjusting the auxiliary slide-valve is imposed upon it there is no tendency on the part of the key 60 to slide down said slot, the result being that the governor is steady in any position until a change in the load changes the speed of the governor and calls for a new adjustment of the point of cut-off. I am enabled to rotate the sleeves 32 and 33 at a slower speed than that of the engine and to use the above-described slight angle in the spiral slot, because the adjustment of the sleeve 33, effected by the operation of the governor-arms, may be multiplied to any desired extent in transmission to the disk 47. By the construction described it is possible to provide a range for the point of closing the governor-valve from before the commencement of any given stroke to seven-eighths of the same stroke.

While the governor illustrated is designed to operate in a vertical position, it is equally well adapted for operating in a horizontal position, since all the change necessary is to alter the gearing by which the governor-shaft and sleeves are driven. Instead of using a disk 47, having the groove 48, any other equivalent device may be employed, such as a cam. I prefer to use the form shown, however, as the disk 47 permits a much quicker closing of the governor-valve than is possible with earlier constructions. In the latter one-fourth of the stroke is required to close the valve, while with the disk 47 the valve is closed in one-tenth of the stroke of the engine.

Various other modifications may be made without departing from my invention, which not only includes the specific construction illustrated and described, but also the generic improvements set forth in the broader claims, and I wish it to be understood that my invention, so far as the broader claims are concerned, is not restricted to the details of the construction shown and described.

From the foregoing description it will be seen that in the construction described the

centrifugally-operated governor-arms, which may generically be termed "controlling mechanism," operate to adjust the governor-valve by moving the longitudinally-movable sleeve longitudinally with reference to the sleeve having the inclined slot and that a relatively slight rotation of the longitudinally-movable sleeve is multiplied or magnified in transmission to the governor-valve, so that only a slight rotation of the sleeve 33 relatively to the sleeve 32 is sufficient to radically adjust the time of closing of the governor-valve, thus permitting the use of a slot whose inclination is within the angle of repose, as above described. So far as I am aware, this feature is generically new.

In practice the governor-shaft runs at a rate of about three hundred revolutions per minute regardless of the speed of the engine, and in order that the amount of rotation of the sleeve 33 on the sleeve 32 may be multiplied on reaching the disk 47, the speed of which is the same as that of the engine, the sleeve 32 is geared to run more slowly than the engine, preferably about one-third as fast.

What I claim as my invention, and desire to secure by Letters Patent, is—

1. A governor, consisting of centrifugally-operated controlling mechanism, a governor-valve, means for actuating said valve, means actuated by said controlling mechanism for adjusting said valve, and means for magnifying the adjustment of the valve as compared with the movement of said controlling mechanism, substantially as described.

2. A governor, consisting of centrifugally-operated controlling mechanism, a governor-valve, means for actuating said valve, a longitudinally-movable member actuated by said controlling mechanism, means operated by longitudinal movement of said member for adjusting said valve, and means for magnifying the adjustment of said valve as compared with the movement of said member, substantially as described.

3. A governor, consisting of centrifugally-operated controlling mechanism, a governor-valve, a rotary member connected with said valve for actuating the same, a longitudinally-movable member actuated by said controlling mechanism for adjusting said valve, and means for magnifying the adjustment of said valve as compared with the movement of said longitudinally-movable member, substantially as described.

4. A governor, consisting of centrifugally-operated controlling mechanism, a governor-valve, a rotary member connected with said valve for actuating the same, a longitudinally-movable member actuated by said controlling mechanism for adjusting said valve, means operated by longitudinal movement of the latter member for rotating one of said members relatively to the other, and means operated by such rotation for adjusting said valve and for multiplying the effect thereof as applied to said valve, substantially as described.

5. A governor, consisting of centrifugally-operated controlling mechanism, a governor-valve, a rotary member connected with said valve for actuating the same, a longitudinally-movable member actuated by said controlling mechanism for adjusting said valve, means for normally rotating said members in unison, means operated by longitudinal movement of said longitudinally-movable member for rotating one of said members relatively to the other, and means operated by such rotation for adjusting said valve and for multiplying the effect thereof as applied to said valve, substantially as described.

6. A governor, consisting of centrifugally-operated controlling mechanism, a governor-valve, a rotary member connected with said valve for actuating the same, a longitudinally-movable member actuated by said controlling mechanism for adjusting said valve, means operated by longitudinal movement of said latter member for rotating the same, and means operated by such rotation for adjusting said valve and for multiplying the effect thereof as applied to said valve, substantially as described.

7. A governor, consisting of centrifugally-operated controlling mechanism, a governor-valve, a rotary member connected with said valve for actuating the same, a longitudinally-movable member actuated by said controlling mechanism for adjusting said valve, an inclined slot in said rotary member, a key carried by said longitudinally-movable member and fitting in said slot, whereby longitudinal movement of said longitudinally-movable member will effect the rotation of one of said members relatively to the other, and means operated by such rotation for adjusting said valve and for multiplying the effect thereof as applied to said valve, substantially as described.

8. A governor, consisting of centrifugally-operated controlling mechanism, a governor-valve, a rotary sleeve connected with said valve for actuating the same, a longitudinally-movable sleeve actuated by said controlling mechanism for adjusting said valve, means operated by longitudinal movement of the latter sleeve for rotating said sleeves relatively to each other, and means operated by such rotation for adjusting said valve and for multiplying the effect of such rotation as applied to said valve, substantially as described.

9. A governor, consisting of centrifugally-operated controlling mechanism, a governor-valve, a rotary sleeve connected with said valve for actuating the same, a longitudinally-movable sleeve actuated by said controlling mechanism for adjusting said valve, means operated by longitudinal movement of the lat-

ter sleeve for rotating the same, and means operated by such rotation for adjusting said valve and for multiplying the effect thereof as applied to said valve, substantially as described.

10. A governor, consisting of centrifugally-operated controlling mechanism, a governor-valve, a rotary sleeve connected with said valve for actuating the same, a longitudinally-movable sleeve actuated by said controlling mechanism for adjusting said valve, an inclined slot in said rotary sleeve, a key carried by said longitudinally-movable sleeve and engaging said slot, means operated by the movement of said key in said slot for adjusting said valve, and means for multiplying the effect thereof as applied to said valve, substantially as described.

11. A governor, consisting of centrifugally-operated controlling mechanism, a governor-valve, a rotary sleeve connected with said valve for actuating the same, said sleeve having a longitudinally-extending slot, a sleeve arranged adjacent to said first-mentioned sleeve and having an inclined slot, a longitudinally-movable sleeve arranged adjacent to said sleeves and having a key fitting in said slots, and means actuated by said controlling mechanism for moving said longitudinally-movable sleeve longitudinally, substantially as described.

12. A governor, consisting of centrifugally-operated controlling mechanism, a governor-valve, a rotary sleeve connected with said valve for actuating the same, said sleeve having a longitudinally-extending slot, a sleeve arranged adjacent to said first-mentioned sleeve and having an inclined slot, a longitudinally-movable sleeve arranged adjacent to said sleeves and having a key fitting in said slots, means actuated by said controlling mechanism for moving said longitudinally-movable sleeve longitudinally, and means for driving said inclined slotted sleeve from the engine, substantially as described.

13. A governor, consisting of centrifugally-operated controlling mechanism, a governor-valve, a rotary sleeve connected with said valve for actuating the same, said sleeve having a longitudinally-extending slot, a sleeve arranged adjacent to said first-mentioned sleeve and having an inclined slot, a longitudinally-movable sleeve arranged adjacent to said sleeves and having a key fitting in said slots, means actuated by said controlling mechanism for moving said longitudinally-movable sleeve longitudinally, means for driving said inclined slotted sleeve from the engine, and means for multiplying the effect of the rotation of said first-mentioned sleeve upon the governor-valve, substantially as described.

14. A governor, consisting of centrifugally-operated controlling mechanism, a governor-valve, a rotary sleeve having a longitudinal slot, a rotary sleeve having an inclined slot, a rotary and longitudinally-movable sleeve having a key fitting in said slots, means for driving said inclined slotted sleeve from the engine, and means operated by said controlling mechanism for moving said longitudinally-movable sleeve longitudinally, substantially as described.

15. A governor, consisting of centrifugally-operated controlling mechanism, a governor-valve, a rotary sleeve having a longitudinal slot, a rotary sleeve having an inclined slot, a rotary and longitudinally-movable sleeve having a key fitted in said slots, means for driving said inclined slotted sleeve from the engine, means operated by said controlling mechanism for moving said longitudinally-movable sleeve longitudinally, and means for multiplying the effect of the rotation of said first-mentioned sleeve upon the governor-valve, substantially as described.

16. A governor, consisting of centrifugally-operated controlling mechanism, a governor-valve, means for actuating said valve, means actuated by said controlling mechanism for adjusting said valve, and means operated by said valve-actuating mechanism for multiplying the adjusting effect of said controlling mechanism in transmission to said valve, substantially as described.

17. A governor, consisting of centrifugally-operated controlling mechanism, a governor-valve, means for actuating said valve, a longitudinally-movable member actuated by said controlling mechanism, means operated by longitudinal movement of said member for adjusting said valve, and means operated by said valve-actuating mechanism for multiplying the adjusting effect of said controlling mechanism in transmission to said valve, substantially as described.

18. A governor, consisting of centrifugally-operated controlling mechanism, a governor-valve, a rotary member connected with said valve for actuating the same, a longitudinally-movable member actuated by said controlling mechanism for adjusting said valve, and means operated by said rotary valve-actuating member for multiplying the adjusting effect of said longitudinally-movable member in transmission to said valve, substantially as described.

19. A governor, consisting of a governor-valve, means for actuating said valve, a rotating member, means for driving said member at a slower speed than that of the engine, and centrifugally-operated mechanism coöperating with said rotating member for adjusting said valve, substantially as described.

20. A governor, consisting of a governor-valve, means for actuating said valve, a rotating member, means for driving said member at a slower speed than that of the engine, multiplying mechanism adapted to be actuated by said rotating member for adjusting said valve,

and centrifugally-operated controlling mechanism therefor, substantially as described.

21. A governor, consisting of a governor-valve, a rotating sleeve, means for driving said sleeve from the engine and at a slower speed, multiplying mechanism adapted to be actuated by said sleeve for adjusting said valve, and centrifugally-operated controlling mechanism therefor, substantially as described.

22. A governor, consisting of controlling mechanism, a governor-valve, means actuated by said controlling mechanism for adjusting said valve, and means for multiplying the adjusting effect of said controlling mechanism in transmission to said valve, substantially as described.

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