O. D. H. BENTLEY.

GOVERNOR.

APPLICATION FILED APR. 17, 1912.

1,103,024.

Patented July 14, 1914.

3 SHEETS—SHEET 1.

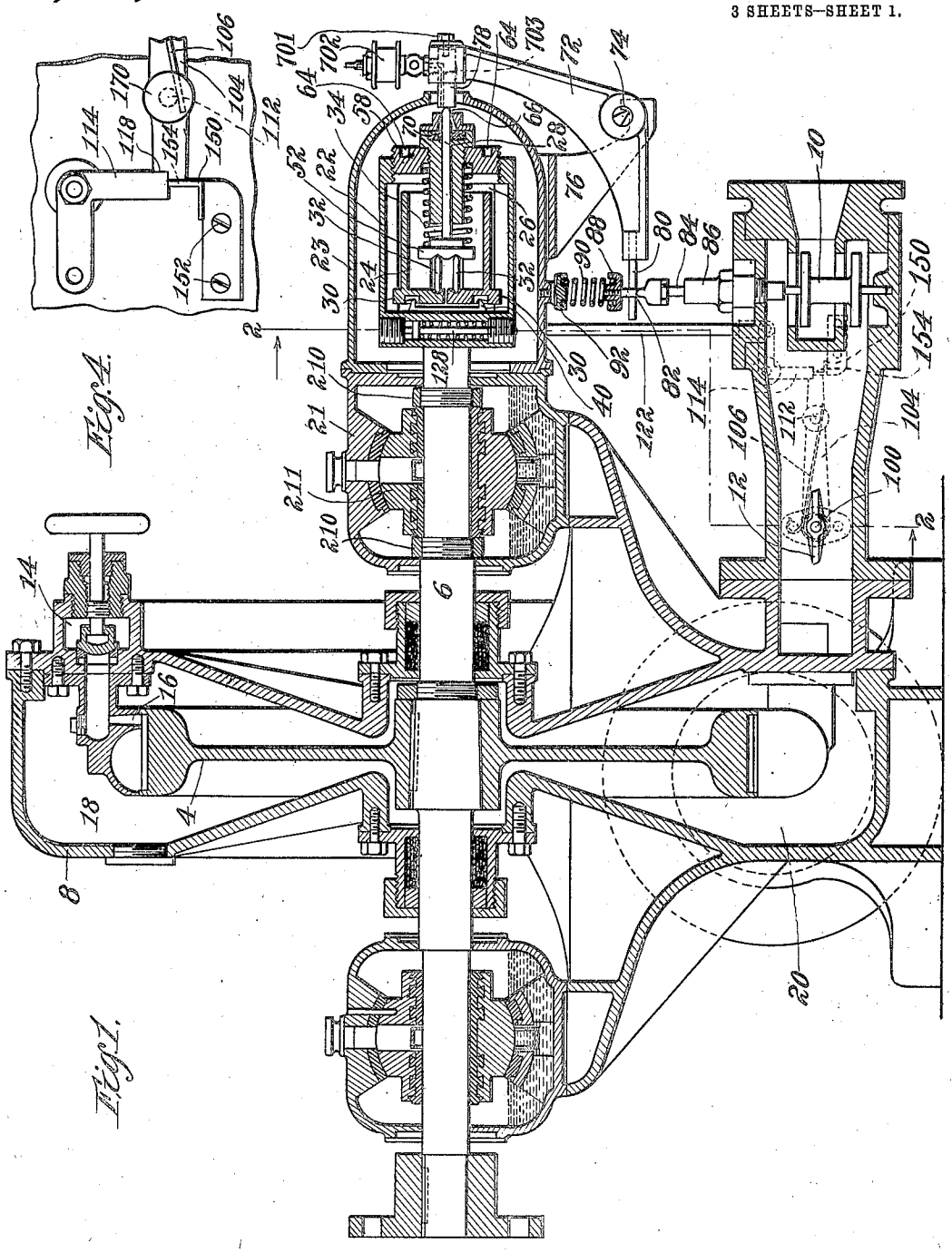

Fig. 1.

Fig. 4.

Witnesses

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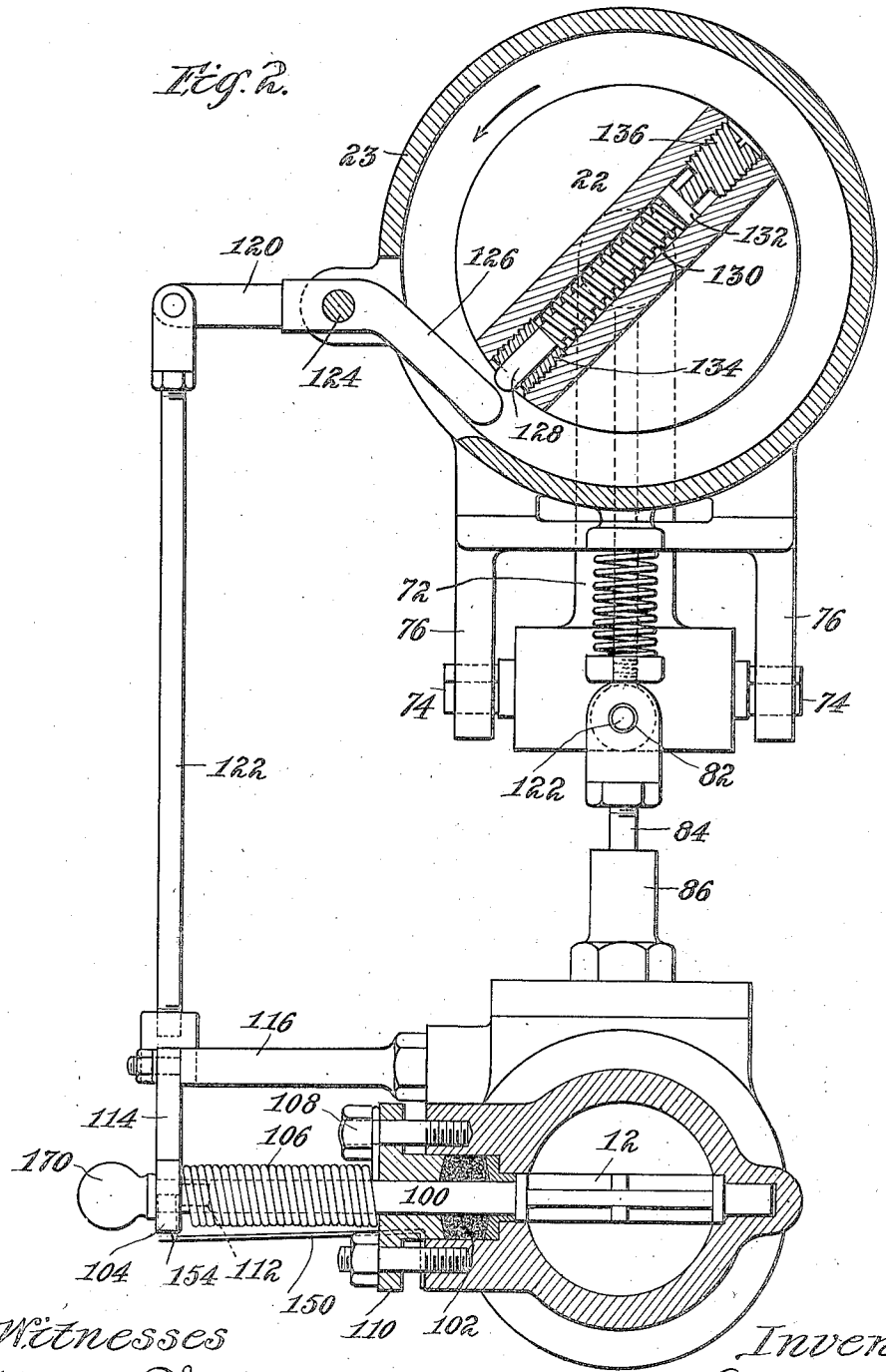
3 SHEETS—SHEET 2.

Fig. 2.



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3 SHEETS—SHEET 3.

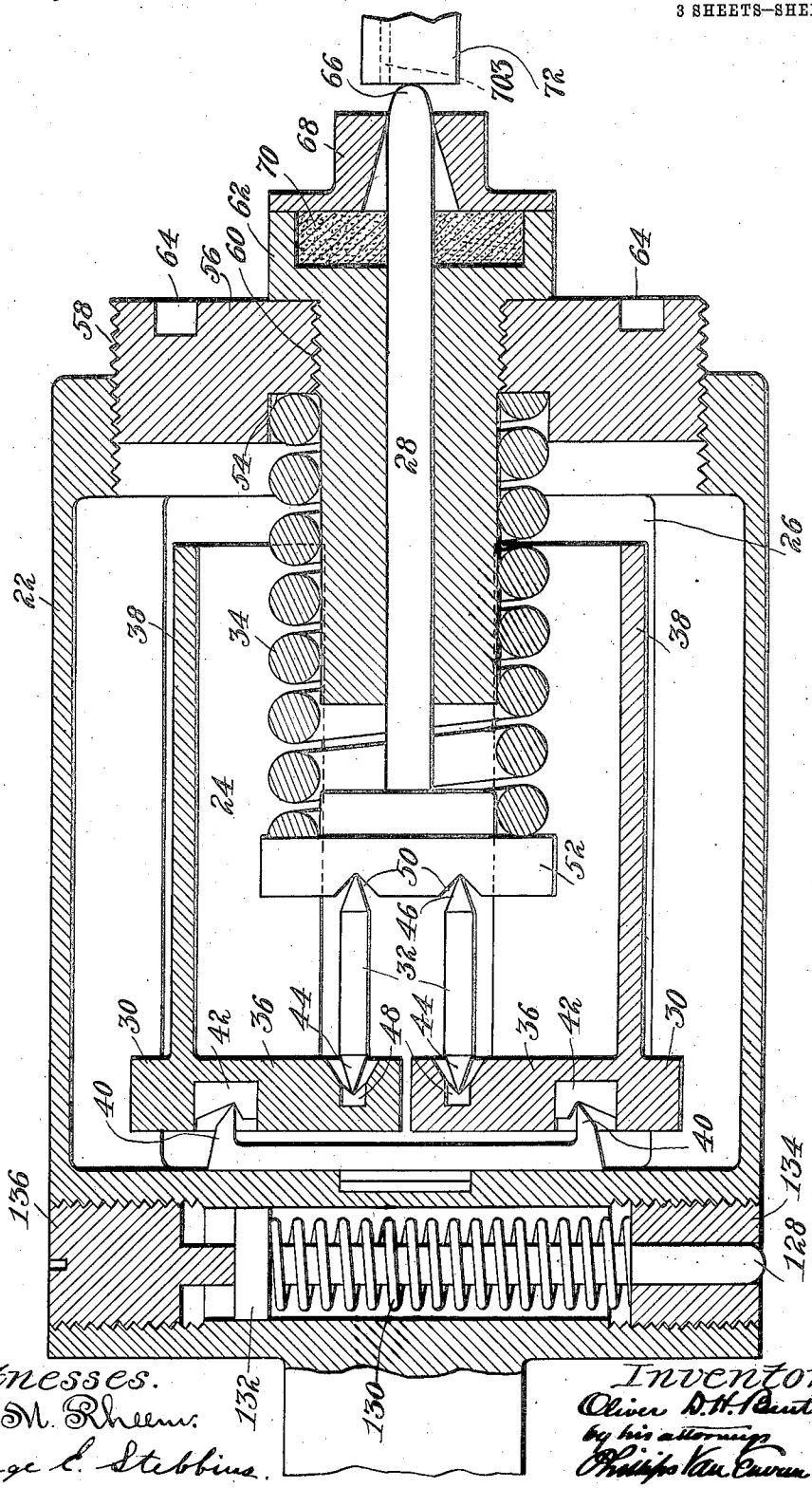

Fig. 3.

Witnesses.
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UNITED STATES PATENT OFFICE.

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GOVERNOR.

1,103,024. Specification of Letters Patent. Patented July 14, 1914.

Application filed April 17, 1912. Serial No. 691,315.

To all whom it may concern:

Be it known that I, OLIVER D. H. BENTLEY, a citizen of the United States, residing at Hyde Park, Boston, in the county of Suffolk and State of Massachusetts, have invented certain new and useful Improvements in Governors; and I do hereby declare the following to be a full, clear, and exact description of the invention, such as will enable others skilled in the art to which it appertains to make and use the same.

The present invention relates to elastic-fluid engines, and more particularly to governor mechanism for such engines.

One object of the present invention is to produce an elastic-fluid engine having a speed regulating governor which will respond to very slight changes in speed and which is compact and easy to build.

Another object of the present invention is to produce an elastic-fluid engine having an emergency governor which will operate with certainty whenever the speed of the machine rises above a predetermined point, and which is simple and cheap to construct.

Still another object of the present invention is to produce an elastic-fluid engine having the regulating and the emergency governors, and particularly the rotating parts thereof, so combined as to produce a very compact structure.

With the above objects in view, the present invention consists in the elastic-fluid engine hereinafter described and particularly pointed out in the claims.

In the drawings which illustrate the preferred embodiment of the present invention, Figure 1 is a longitudinal vertical section of an elastic-fluid engine showing my improved governor mechanism; Fig. 2 is a cross section on the line 2—2 of Fig. 1; Fig. 3 is an enlarged vertical section of the rotating parts of the governor mechanism; and Fig. 4 is a fragmentary side view of the spring latch for holding the cam arm of the emergency governor out of contact with the striker.

Referring to the drawings, the present invention is illustrated as embodied in a steam turbine. The turbine comprises a bucket wheel 4 mounted on a shaft 6 and inclosed in a casing 8. The steam passes through a balanced throttle valve 10 and a butterfly emergency valve 12 into an annular steam chest 14 from which it is discharged through a number of expanding nozzles 16 to buckets milled in the periphery of the bucket wheel 4 and to coöperating stationary return buckets. The steam escapes from the buckets at a low velocity and pressure into an exhaust chamber 18 within the casing 8 and is discharged from the turbine through an exhaust pipe 20. The rotating parts of the governing mechanism of the turbine are mounted in a head 22 upon the end of the shaft 6. The head 22 is inclosed in a protective casing 23 which is secured to the end of the bearing box 21. Two threaded thrust collars 210, one on either side of the bearing 211, position the shaft 6 longitudinally.

The turbine is provided with a speed regulating governor which comprises the rotating parts, indicated generally by reference numeral 24, mounted in the head 22, the throttle valve 10 and connecting mechanism for transmitting motion from the rotating parts of the throttle valve. The sides of the head 22 are cut away at 26 to provide access to the inclosed parts of the governor mechanism. The rotating parts 24 comprise a hardened steel spindle 28, two governor weights 30, struts 32 between the spindle and weights, and a helical spring 34 for resisting the action of the weights on the spindle 28. The weights 30 have substantially rectangular end plates 36 and substantially semi-cylindrical arms 38 which project longitudinally over the spindle 28 and spring 34 so that the two weights 30 together form a sort of split shell or cup which surrounds the spindle and spring and the two halves of which have a limited relative motion. The weights 30 are fulcrumed upon hardened steel knife edges 40 which bear against hardened steel groove pieces 42 set into the weights 30. When the turbine is running the distal ends of the drums 38 tend to separate under the action of centrifugal force and the weights 30 turn like bell crank levers about their knife edge fulcrums 40. The motion of the weights 30 is transmitted through the hardened steel struts 32 to the spindle 28 which is moved against the resistance of the spring 34 and is gradually projected as the speed of rotation of the shaft increases. The struts 32 are provided at both ends with knife edges 44 and 46 which bear respectively against hardened steel groove pieces 48 set into the weights 30 and grooves 50 in the face of a hardened

steel head 52 which is mounted upon the end of the spindle 28. The knife edges 40, 44 and 46 provide very delicate as well as durable bearings so that the slightest motion on the part of the weights 30 is transmitted to the spindle 28. The helical spring 34 which resists the force of the weights 38 bears between the head 52 and an annular seat 54 cut in the inner face of an adjusting sleeve 56. The outer face of the adjusting sleeve 56 is screw-threaded at 58 to be screwed into the end of the head 22. The inside of the sleeve 56 is screw-threaded at 60 to receive the sleeve 62 which slidingly supports the spindle 28. Recesses 64 are formed in the face of the adjusting sleeve 58 to receive the pins of a spanner wrench. The screw threads 58 and 60 are of the same pitch and are cut in the same direction so that when the adjusting sleeve 56 is turned it does not affect the position of the spindle supporting sleeve 62, but acts only to compress or loosen the spring 34. The adjustment of the pressure of the spring 34 affords a speed adjustment for the turbine.

The spindle 28 is mounted co-axially with the shaft 6 and has its projecting end formed with a rounded point 66 in line with the axis of the shaft 6. A cap 68 is secured to the end of the sleeve 62 to cover an annular cavity in which is held a felt washer 70. The mechanism for transmitting the motion of the spindle 28 and the valve 10 comprises a bell crank lever 72 which is fulcrumed upon a knife edge bearing 74 on the bracket 76 which is formed on the casing 23. The upper end of the bell crank lever 72 bears a hardened steel abutment 78 which has a substantially flat bearing surface adapted to bear against the projecting end 66 of the spindle 28. The abutment block 78 is held in a cylindrical socket in the head of a bell crank lever 72 by means of a screw 701. An oil cup 702 is screw-threaded into the head of the bell crank lever 72 and supplies oil to lubricate the bearing between the point 66 and the abutment 78 through an oil duct 703 which opens on the flat bearing surface of the abutment 78 just above the point of contact of the point 66. The oil spreads along the spindle 28 and saturates the felt washer 70. As the spindle 28 reciprocates during changes of load, the oil from the felt washer works into the sliding bearing between the spindle 28 and the sleeve 62, and keeps it lubricated. The other end of the bell crank lever 72 bears a pin 80 which is slidingly received in an eye 82 upon the upper end of the valve stem 84. The valve stem 84 passes through a steam-tight bushing 86 and bears on its lower end the valve 10. A cupped collar 88 is screw-threaded to an extension on the valve stem 84 above the eye 82 and forms an adjustable abutment for a spring 90. The other end of the spring 90 is held in a cupped abutment 92 on the casing 23. The spring 90 presses down on the valve stem 84 and holds the upper side of the eye 82 always in contact with the pin 80 to prevent any lost motion. The spring 90 holds the knife edges of the knife edge bearing 74 against their bearing grooves to prevent any lost motion and also holds the abutment 78 snugly against the end of the spindle 28 to prevent any lost motion between them. In this connection it is to be noted that the spring 34 holds the knife edges 40, 44 and 46 snugly against their respective grooves so that there is no lost motion in the bearings of the moving parts of the speed regulating governor mechanism. There is but a single point of contact between the rotating part of the governor mechanism and the stationary part, and this point 66 is located in line with the axis of the shaft 6. There is, therefore, very little friction between the point 66 and its abutment 78. As the only motion transmitted by the spindle 28 is a reciprocatory motion longitudinally of the shaft 6, any springing of the shaft or lateral swing of the head 22 has a negligible effect upon the bell crank lever 72. As above pointed out, all of the points which act as pivot points in the mechanism are provided with knife edge bearings, and the springs 34 and 90 are so arranged that the knife edges are always held tightly in place. The knife edges provide ideal pivotal connections, and since they are always held tightly in place, any lost motion is obviated. The bearing point 66 and abutment 78 form a tightly held and practically frictionless point of contact between the rotating and stationary parts of the mechanism. The bearing between the pin 80 and the eye 82 is tightly held by the spring 90, and consequently there is no lost motion. It will be seen, therefore, that the governor mechanism will respond to very slight changes of speed in the shaft 6 and insures a very close speed regulation for the turbine. The turbine is also provided with an emergency governor mechanism which comprises a butterfly valve 12 and mechanism arranged to automatically close the valve if the turbine speed exceeds a certain predetermined maximum. The stem 100 of the valve extends through a stuffing box 102 and bears at its outer end an arm 104. A spring 106 is wound around the valve stem 100. One end of the spring is anchored to one of the bolts 108 which hold the gland 110 of the stuffing box 102. The other end of the spring 106 projects along the arm 104 and is held beneath a lug 112 near the end of the arm and tends to lift the arm 104 to close the valve 12. The arm 104 is, however, normally held down to keep the valve 12 open by means of a latch 114. The latch 114 is a

bell crank lever fulcrumed on the end of a stud 116. The lower end of the latch 114 is received in a notch 118 in the end of the arm 104. The latch 114 is arranged to be moved to release the arm 104 by means of a cam lever 120 which is connected to the horizontal arm of the latch 114 by a link 122. The cam lever 120 is fulcrumed on a pin 124 in the side of the casing 23 and has a cam surface 126 arranged to be struck by a striker 128. The striker 128 is a plunger mounted in the head 22 transversely to the axis of the shaft 6 and arranged to be suddenly projected by centrifugal force when the speed of the turbine exceeds a predetermined maximum. The striker 128 is normally retained in retracted position by means of a spring 130 which surrounds the striker between an enlarged head 132 upon the inner end of the striker and a bushing 134 screw-threaded into the head. The bushing 134 may be used to adjust the tension on the spring 130. A plug 136 is screw-threaded in the head 22 to bear against the inner end of the striker 128. This plug may be turned by means of a screw-driver to shift the position of the striker 128 and change the tension of the spring to adjust the critical speed at which the striker will be projected.

When the speed of rotation of the shaft exceeds the predetermined maximum, the centrifugal force of the striker 128 overbalances the restraining force of the spring 130 and the striker 128 is suddenly projected outward, where it strikes a blow against the cam surface 126. Under the force of the blow the lever 120 is turned to raise the link 122 and release the end of the arm 104 from the latch 114, whereupon the emergency valve 12 is closed by its spring 106. When the striker 128 is moved outwardly, its center of mass is shifted away from the axis of rotation, so that the centrifugal force acting upon the striker increases as it moves out. This not only causes the striker to move out suddenly, but also holds the striker in projected position until the speed of the turbine has dropped considerably below the critical speed at which the striker was projected. To hold the face 126 of the cam lever 120 out of the path of the outwardly projected striker 128 while the speed of the turbine is being reduced sufficiently to allow the striker 128 to be retracted, a latch 150 is provided to engage the latch 114 and hold the link 122 elevated. The latch 150 comprises a leaf spring secured by screws to the emergency valve casing. The end of the spring 150 has an upwardly extending finger 154 which bears against the lower end of the latch lever 114. When the striker 128 delivers its blow against the lever 120, the latch lever 114 is turned sufficiently to move its lower end off the top of the finger 154, whereupon the finger 154 rises and engages the side of the latch lever 114, thus locking the latch lever 114 in its turned position and holding the cam lever 120 out of the path of the centrifugally projected striker 128. The emergency valve thus shuts off the steam when the speed of the turbine for any cause rises above a predetermined amount, and keeps the steam shut off until the engineer desiring to again start the turbine, raises the arm 104 by means of the handle 170 to open the valve 12.

While the preferred embodiment of the present invention has been specifically illustrated and described, it is to be understood, however, that the present invention may be embodied in other constructions within the scope of the invention as defined in the following claims:

I claim—

1. In an emergency governor, the combination with a rotary member having a transverse chamber, of a striker having a straight shank and an enlarged head mounted to slide in the chamber, a compression spring coiled around the shank of the striker and abutting against the enlarged head of the striker, an abutment for the other end of the spring at one end of the chamber, and a screw threaded member in the other end of the chamber bearing against the head of the striker for adjusting the position of the striker in the chamber, substantially as described.

2. In an emergency governor, the combination with a rotary member having a transverse chamber, of a striker loosely mounted to slide in the chamber, a spring connected to the striker, and a member threaded in the end of the chamber and engaging the striker for adjusting its position in the chamber, substantially as described.

3. In an emergency governor, the combination with a rotary member having a transverse chamber therein, of a striker having a straight shank and an enlarged head mounted to slide in the chamber, a compression spring coiled around the shank, a bushing threaded in one end of the chamber, loosely surrounding the shank and forming an abutment for the other end of the spring, and a plug threaded in the other end of the chamber and engaging the head of the striker to adjust its position in the chamber, substantially as described.

4. In an emergency governor, the combination with a rotary member having a transverse chamber therein, said chamber having its ends internally threaded and having its middle portion smooth, of a striker having a straight shank and having an enlarged head fitting in and arranged to slide in the smooth middle portion of the chamber, a compression spring coiled around the striker shank and abutting against the head of the

striker, a bushing threaded in one end of the chamber, loosely surrounding the shank of the striker and forming an abutment for the other end of the spring, and an adjustable plug threaded in the other end of the chamber and having on its inner end a reduced portion or projection extending into the smooth middle portion of the chamber and engaging the head of the striker to adjust the position of the striker, substantially as described.

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Witnesses:
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