F. W. BENTLEY.

EMERGENCY GOVERNOR.

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1,092,968.

Patented Apr. 14, 1914.

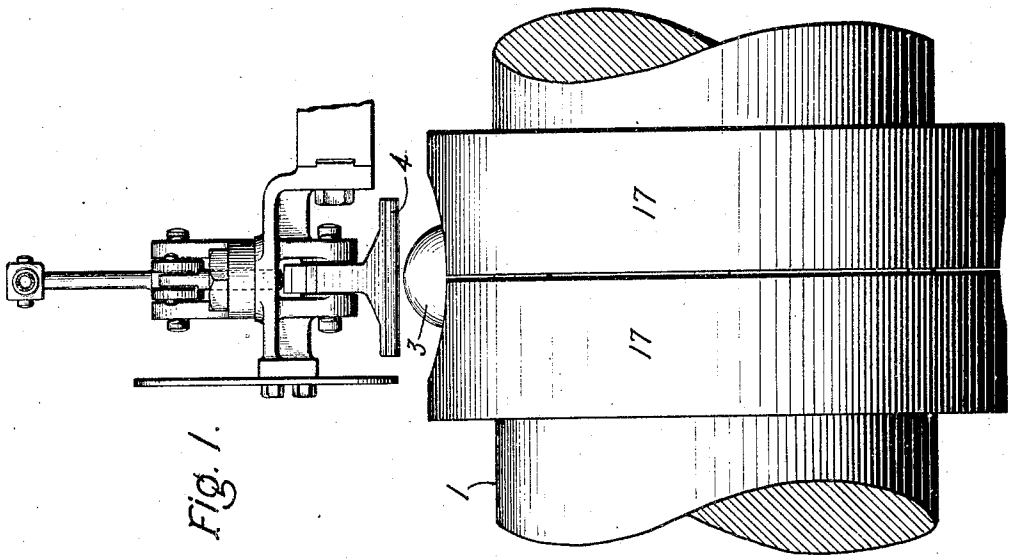


Fig. 1.

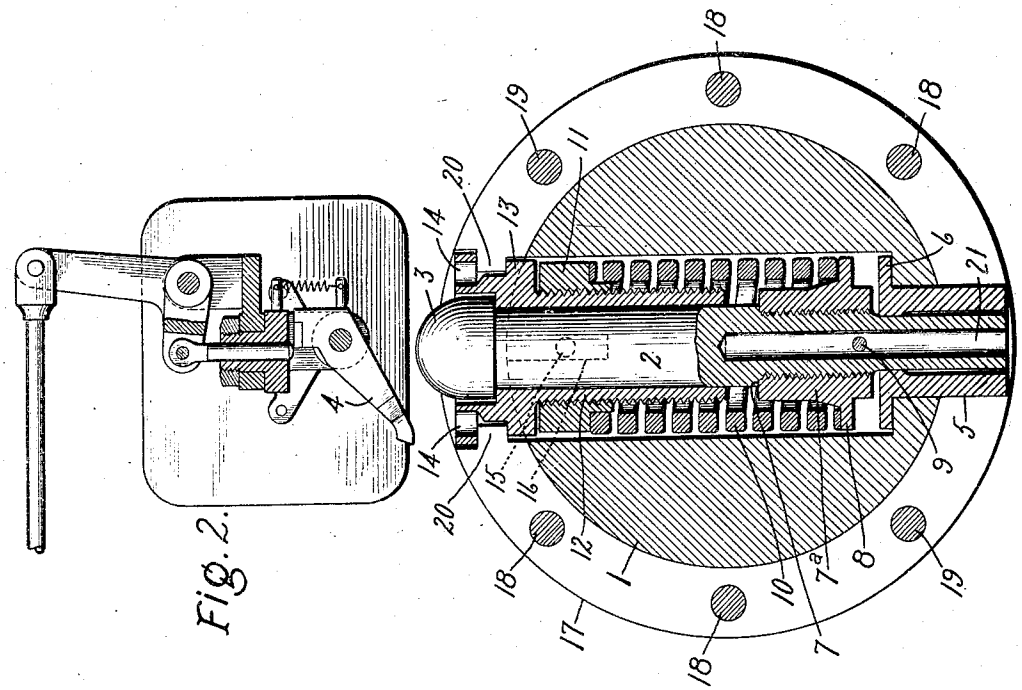


Fig. 2.

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UNITED STATES PATENT OFFICE.

FRED W. BENTLEY, OF SCHENECTADY, NEW YORK, ASSIGNOR TO GENERAL ELECTRIC COMPANY, A CORPORATION OF NEW YORK.

EMERGENCY-GOVERNOR.

1,092,968. Specification of Letters Patent. **Patented Apr. 14, 1914.**

Application filed February 1, 1912. Serial No. 674,703.

To all whom it may concern:

Be it known that I, FRED W. BENTLEY, a citizen of the United States, residing at Schenectady, county of Schenectady, State of New York, have invented certain new and useful Improvements in Emergency-Governors, of which the following is a specification.

This invention relates to governing devices for elastic fluid turbines and other rotating apparatus or machines, and especially to that type of governor which acts in an emergency to stop the machine when its speed rises to a dangerous point.

Broadly speaking, the present emergency governor belongs to that class in which a body is caused to rotate in proximity to a tripping mechanism connected to a butterfly or other throttle valve in the supply main or other regulator; said body being so arranged that its center of gravity is slightly out of coincidence with the axis of rotation of its driving shaft. This gives it a tendency to move outwardly from said axis by reason of centrifugal force. Under normal conditions of operation, this tendency is opposed by a spring, but when the speed becomes abnormal, the tension of the spring is overcome by the centrifugal force acting on the mass of the body, and it moves out to a position in which it will trip the valve closing mechanism or actuate the regulator. In the present invention, the movable body is a plunger located in a small diametrical recess in a revolving shaft of the machine. The features of novelty reside in details of construction aiming to simplify it and render it compact and durable and to permit of its being mounted in place or removed without changing the tension of the weight-opposing spring: all as will appear in the following description and particularly pointed out in the claims.

In the accompanying drawing, Figure 1 is a side elevation of my improved emergency governor, and Fig. 2 is a cross section thereof.

The shaft 1 has a small diameter cylindrical hole extending diametrically through it, said hole being counter-bored for the larger portion of its length to form a recess or socket to house the plunger or moving weight and its opposing spring. The length of the plunger 2 is such that it projects beyond the shaft at each end. The plunger is cylindrical and has at one end a head 3 to operate the trip or trigger 4 of the valve closing mechanism; said trip being arranged adjacent to the normal path of revolution of said head. The other end of the plunger is somewhat reduced in diameter in order to coöperate with and be guided by a bushing 5 which fills the smaller end of the hole in the shaft; having a flange 6 which rests on the bottom of the recess in said shaft and thus retains said bushing in place. This bushing is made of different metal than the plunger to prevent sticking of the parts. Other features restricting this bushing will be referred to later. Immediately above said bushing a shoulder 7 is formed upon the plunger and below it is a nut 7^a screwed thereon and provided with a flange 8. After it has once been screwed into place to give the initial tension to the spring (an operation taking place before the parts are mounted in the shaft) the nut is prevented from rotating backward by a cotter pin 9 driven through it and the plunger. Abutting this shoulder or flange 8 is one end of a helical compression spring 10, encircling the plunger and having its other end received by a nut 11 screwed upon the outside of a sleeve 12 which fits the plunger and has an enlarged head 13 above the nut 11. The spring should be made as small in diameter as possible to avoid reducing the section of the metal of the shaft more than is absolutely necessary. The head 13 should be slightly smaller in diameter than that of the shaft recess to compensate for inaccuracies in workmanship and to permit of its being readily mounted in place and removed.

The upper end of the head of the sleeve 12 abuts the under side of the head of the plunger, and is preferably countersunk to receive said head. In the upper end of the sleeve are formed sockets 14 to receive a wrench for turning said sleeve to adjust the tension of the spring from the outside; such rotation of the sleeve causing the nut 11 to ride along the screwthreads on said sleeve. A pin 15 on the nut shown in dotted lines, engages a longitudinal groove 16 in the wall of the recess in the shaft to prevent said nut from turning when the sleeve is rotated.

In order to retain the sleeve and its coöperating parts in the recess, two rings 17

are slipped upon the shaft on each side of the recess and are secured together by dowel pins 18 and bolts 19. Each ring is recessed to fit the bushing 5 and protect the same, so as to avoid danger of its catching the clothing of an attendant, said bushing preventing the rings from moving angularly or axially. The rings are also recessed to fit the upper end of the sleeve 12, and are provided with inwardly semi-circular projecting ribs 20 which enter a circumferential groove in the head 13 of the sleeve just below the sockets 14. These ribs lock the sleeve in the recess in the shaft and prevent it from flying out when the shaft is revolving at the same time permitting it to be turned.

The operation is as follows: The distribution of weight in the plunger is carefully regulated by drilling a central hole 21 into the end opposite the head 3, so as to remove some of the material and give the headed end sufficient preponderance to enable it to operate properly under changes in centrifugal force. The tension of the spring is finally adjusted by applying a wrench to the sockets 14 and turning the sleeve 12 to move the nut 11 in or out as may be desired. Under normal conditions of operation of the turbine, the plunger will be retained in the recess by the tension of the spring acting upon the flange 8 of the nut 7^a. But if abnormal speeds occur, the action of centrifugal force upon the unbalanced mass of the plunger will throw it outwardly until it strikes and trips the trip 4 of the valve-closing or other regulating mechanism. Upon a reduction of speed, the spring retracts the plunger into the recess. The inner end of the nut 7^a striking the inner end of the sleeve 12 will limit the outward movement of the plunger.

In the construction shown, the spring occupies a position at or near the middle of the recess in the shaft, so that it exerts little or no centrifugal force. The nut 7^a practically balances the head of the plunger, so that the unbalanced mass to be acted on by centrifugal force can be very accurately regulated by the size and depth of the drill hole 21.

It will be noted that the nut 7^a is fixed on the plunger 2 against longitudinal movement and that the nut 11 coöperating with the sleeve 13 is also normally fixed against longitudinal movement. This means that the spring 10 is held under initial compression and hence said parts can be removed or inserted in the shaft recess as a unit without altering the tension of the spring. This is of great practical advantage in taking down or assembling the parts. This arrangement avoids having to compress the heavy spring 10 when assembling, and insures the reëstablishment of the precise arrangement and relation of parts after having been taken down, thereby avoiding the necessity of retesting to obtain the proper tripping speed of the governor.

By using a small diameter spring I avoid cutting away the shaft to form the counter-bored recess more than is absolutely necessary. By placing the spring under initial tension by screwing the nut 7 against the shoulder on the plunger and prior to mounting the parts in the shaft recess, I am able to decrease the length of the counter-bored recess in the shaft which also means that less metal has to be cut away. By making a shoulder 7 on the plunger, a definite position or seat for the nut 7^a and one end of the spring 10 is assured. The bushing 5 has a forced fit in the shaft and in addition to acting as a guide for one end of the plunger has the important feature of holding the rings 17 from moving angularly or axially on the shaft. In other words, this bushing forms an anchor which definitely positions the rings, it being noted that some space is left around the cylindrical surfaces of the sleeve and between them and the corresponding surfaces of the rings to prevent pinching of the parts. The bolts 18 which unite the rings also serve to rigidly clamp them to the bushing.

My improved construction has great advantages in the way of adjusting the spring 10 to insure an exact tripping speed. The parts are so designed that the center of gravity of the mass of the plunger and nut 7^a is slightly eccentric to the axis of the shaft, said center being located on the same side as the head. It is impractical to employ the nut 7^a as an adjusting means because if its position is changed it will change the position of the center of gravity. For example, if it be desired to increase the tripping speed and the nut 7^a were threaded farther on to the plunger to increase the tension of the spring, the center of gravity would be changed in a manner to increase the eccentricity which is exactly what should not be done. On the other hand the nut 11 does not move with the plunger and hence it can be moved with respect to the sleeve to change the spring tension without changing the center of gravity of the mass, in other words, its eccentricity. A very little change in spring tension suffices for a considerable change in tripping speed; this change in position of the nut 11 on the sleeve is obtained by turning the latter. As a result of the various improvements specified, a governor is provided which has no loose parts that can fly off due to centrifugal force, the restraining parts having a high factor of safety. The governor further has the very great advantage that it can be adjusted with ease and certainty from the outside. Furthermore, the governor can be tested at the factory, removed from the test-

ing apparatus and sent to a customer for installation without reassembling of its parts or adjustment thereof, and with the definite assurance that it will trip or actuate at the desired and predetermined speed. Another and material advantage resides in the fact that very few and simply constructed parts are required. By confining the adjustability to one member, *i. e.*, the nut 11, there is no danger of an unskilled person getting the apparatus out of order. In other words, my improved governor is as nearly foolproof as it is possible to make it and yet attain the desired object.

In accordance with the provisions of the patent statutes, I have described the principle of operation of my invention, together with the apparatus which I now consider to represent the best embodiment thereof, but I desire to have it understood that the apparatus shown is only illustrative and that the invention can be carried out by other means.

What I claim as new and desire to secure by Letters Patent of the United States, is:—

1. An emergency governor, comprising a rotary member having a diametrical recess therein, a centrifugally movable plunger housed in said recess and provided with a shoulder, a nut in engagement with said plunger, a spring encircling said plunger and abutting said nut, a second nut encircling said plunger, a sleeve fitting said plunger and rotatable thereon in operative relation with said second nut for the purpose of adjusting said spring, and means for retaining said sleeve in said recess.

2. An emergency governor, comprising a rotary member having a diametrical recess therein, a centrifugally movable plunger housed in said recess and provided with a shoulder, a nut in engagement with said plunger, a spring encircling said plunger and abutting said nut, a second nut encircling said plunger, a sleeve rotatable on said plunger in operative relation with said second nut and adapted to adjust the tension of said spring, and rings on said member engaging with said sleeve and retaining it in said recess.

3. An emergency governor, comprising a rotary member having a diametrical recess therein, a centrifugally movable plunger housed in said recess and provided with a shoulder, a nut in engagement with said plunger, a spring abutting said nut and located at or near the middle of said recess, a sleeve having external screwthreads and rotatable on said plunger, a nut meshing with said screwthreads and abutting one end of said spring, and means for retaining said sleeve in said recess.

4. An emergency governor, comprising a rotary member having a diametrical recess therein, a centrifugally movable plunger housed in said recess and provided with a shoulder, a nut in engagement with said plunger, a spring encircling said plunger and abutting said nut, a nut engaging the other end of said spring, a screwthreaded sleeve rotatable on said plunger and meshing with said nut, said sleeve having a circumferential groove, and collars on said shaft having ribs engaging with said groove.

5. An emergency governor, comprising a rotary member having a diametrical recess therein, a bushing in one end of said recess, a plunger having one end guided by said bushing, a screwthreaded sleeve surrounding the other end of said plunger and rotatable thereon, a nut screwed upon the inner end of said plunger, a nut meshing with the screwthreads on said sleeve, a spring located between and abutting said nuts, a pin on the sleeve-engaging nut, a longitudinal groove in the wall of said recess to coöperate with said pin, a circumferential groove in said sleeve, and rings on said shaft having ribs fitting said circumferential groove.

6. A revolving member containing a diametrical recess, in combination with a plunger, an opposing spring, a holder for the spring and plunger located in the recess, and ring means for locking the holder within the member.

7. A revolving member containing a recess extending perpendicularly to its axis, in combination with a centrifugally acting plunger, a coiled compression spring opposing its action, holding means in operative relation with the plunger that maintains the spring under initial compression, said holding means being located in the recess and adapted to be inserted or removed with the plunger without changing the stress of the spring, and means for securing the holding means within the revolving member.

8. An emergency governor, comprising a rotary member having a diametrical recess therein, a plunger located in the recess whose center of gravity is eccentrically disposed to the axis of the member, a spring opposing the outward movement of the plunger, a sleeve encircling the plunger, and means that serve to retain the spring in place and limit the outward movement of the plunger, said means being engaged and definitely fixed in position by said sleeve.

9. An emergency governor, comprising a diametrically recessed rotary member, a plunger located in the recess which moves radially, a coiled compression spring which opposes the outward movement of the plunger and is under initial tension, a nut carried by the plunger and forming one abutment for the spring, the center of gravity of the plunger and nut being eccentrically disposed to the axis of the member, a second nut which is held against movement with the plunger and serves as the other abutment for the spring, and means

for changing the position of the second nut to change the tripping speed of the plunger without altering the position of said center of gravity.

10. An emergency governor, comprising a rotary member having a diametrical recess therein, a plunger located in the recess that tends to move outwardly under the action of centrifugal force, a spring opposing this action, a pair of nuts that form abutments for the spring, one of said nuts being carried by the plunger and the other by said member, the center of gravity of the mass of the plunger and its nut being located eccentrically to the axis of the member, and means for moving the nut carried by the member to change the tension of the spring without changing the position of the center of gravity of said mass.

11. An emergency governor, comprising a rotary member having a diametrical recess therein, a plunger located in the recess that tends to move outwardly under the action of centrifugal force, a spring opposing this action, a holder that is carried by and rotates with the member, a pair of nuts between which the spring is located and which hold the same under initial tension, one of said nuts being mounted on the plunger, the center of gravity of the mass of the plunger and nut being slightly eccentric to the axis of the member, the other nut being carried by the holder and held against rotation, and means for rotating the holder within the nut to change the tripping speed without disturbing the center of gravity of said mass.

12. An emergency governor, comprising a rotary member having a diametrical recess therein, a shouldered plunger located in the recess, a nut on the plunger that is seated on the shoulder, the center of gravity of the mass of the plunger and nut being slightly eccentric to the axis of the member, a screw-threaded sleeve surrounding the plunger whose inner end acts as a stop for the outward movement of the plunger by engaging the nut, a second nut that is carried by the sleeve, a coiled compression spring that is held under initial tension between the nuts, a means for holding the sleeve against radial movement, and means for adjusting the second nut to change the tension of the spring without changing the center of gravity of said mass.

In witness whereof I have hereunto set my hand this 30th day of January, 1912.

FRED W. BENTLEY.

Witnesses:

BENJAMIN B. HULL,

HELEN ORFORD.