No. 820,912. PATENTED MAY 15, 1906.

J. G. CALLAN.

GOVERNING MECHANISM.

APPLICATION FILED FEB. 23, 1905.

3 SHEETS—SHEET 1.

Fig. 1.

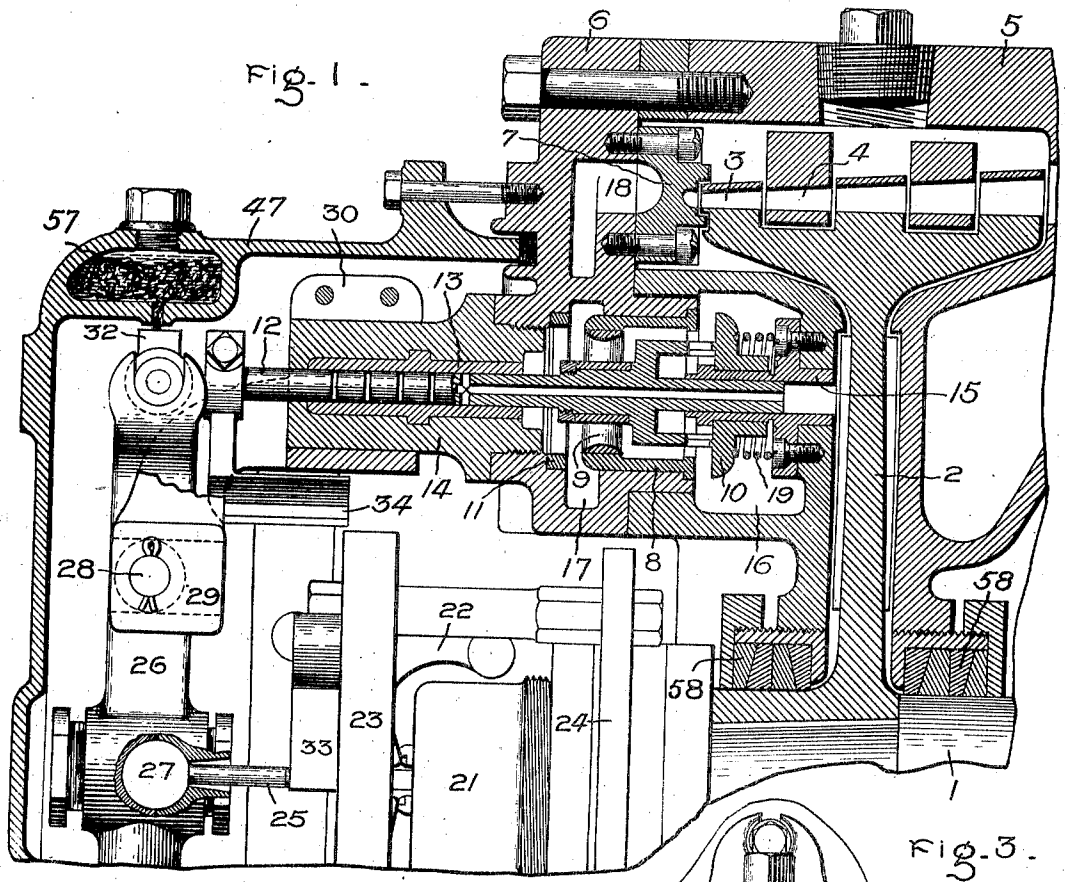


Fig. 2.

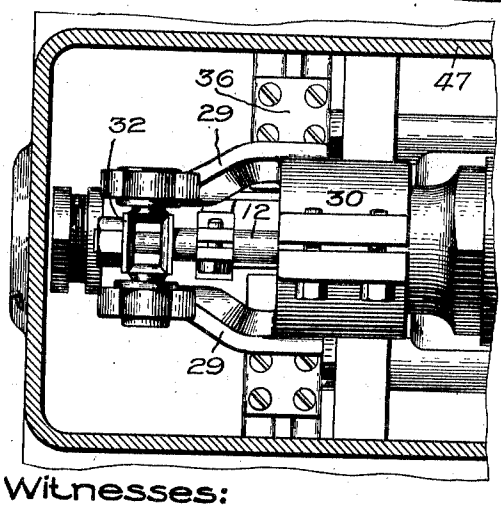
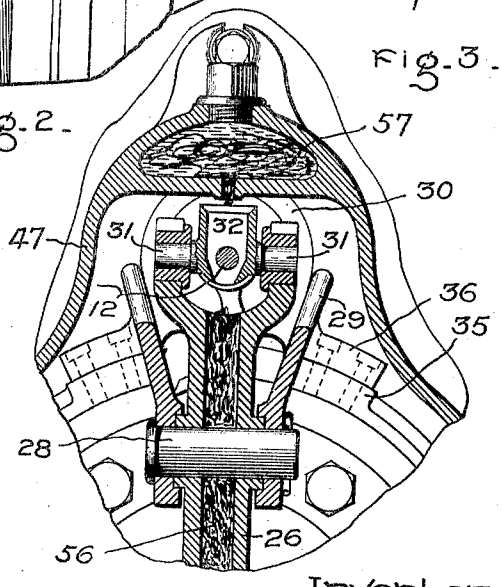


Fig. 3.



Witnesses:

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Inventor,

John G. Callan,

By Albert G. Davis

Atty.

No. 820,912. PATENTED MAY 15, 1906.

J. G. CALLAN.

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3 SHEETS—SHEET 2.

Fig. 4.

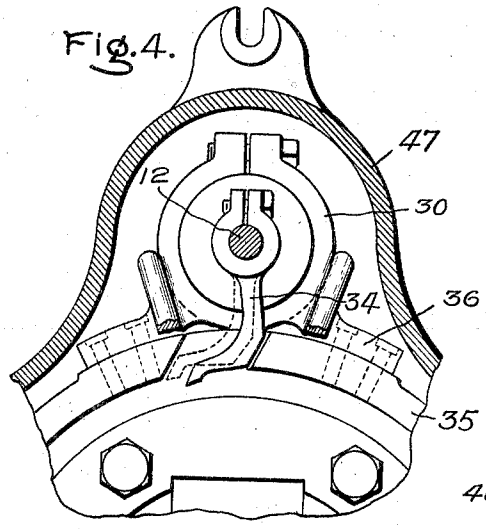


Fig. 5.

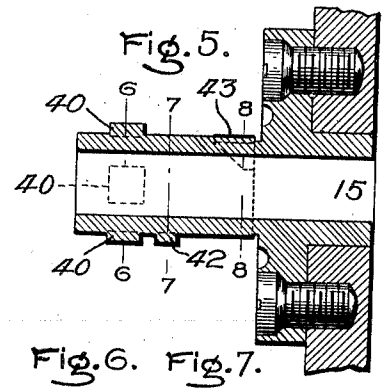


Fig. 6.

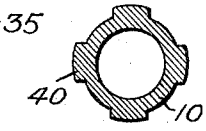


Fig. 7.

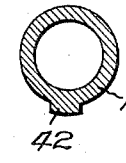


Fig. 8.

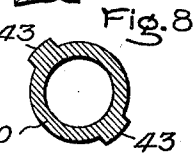


Fig. 9.

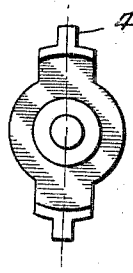


Fig. 10.

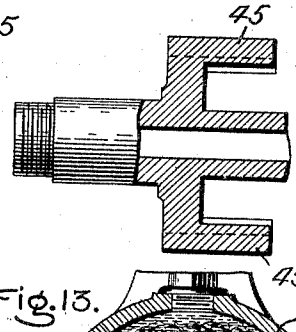


Fig. 11.

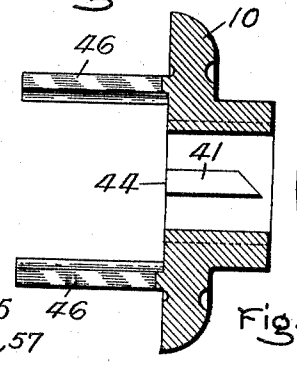


Fig. 12.

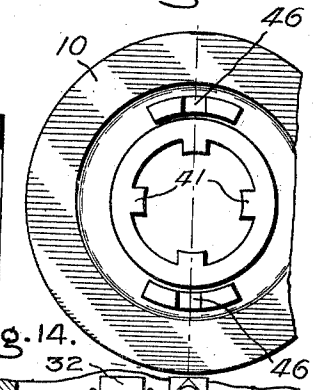


Fig. 13.

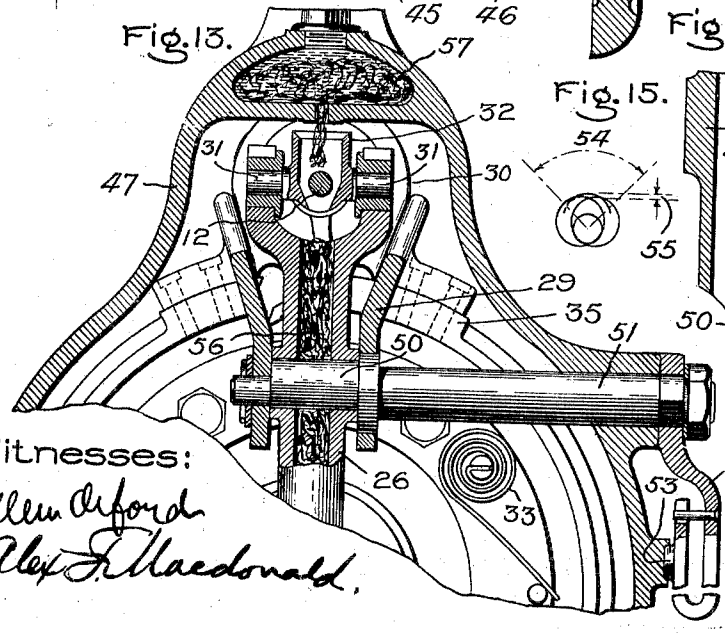
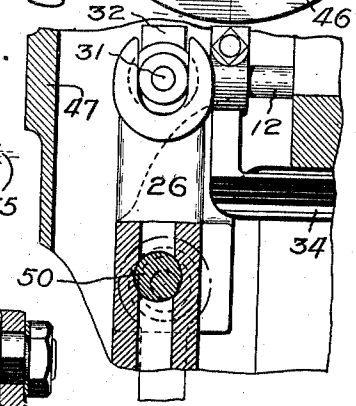


Fig. 15.

Fig. 14.



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No. 820,912. PATENTED MAY 15, 1906.

J. G. CALLAN.

GOVERNING MECHANISM.

APPLICATION FILED FEB. 23, 1905.

3 SHEETS—SHEET 3.

Fig. 16.

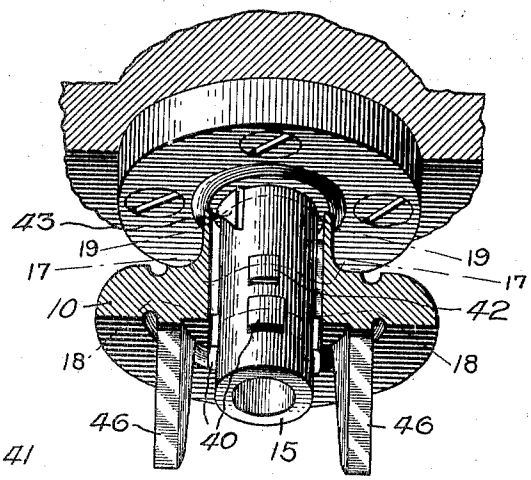


Fig. 17.

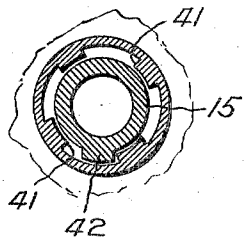


Fig. 18.

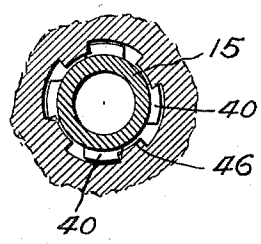
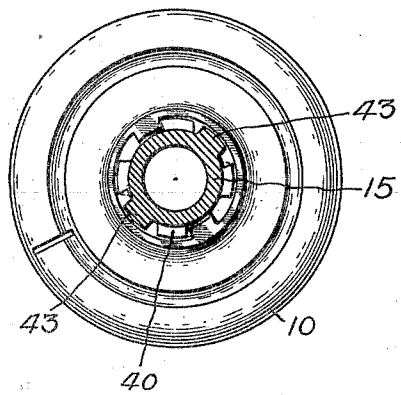


Fig. 19.



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UNITED STATES PATENT OFFICE.

JOHN G. CALLAN, OF LYNN, MASSACHUSETTS, ASSIGNOR TO GENERAL ELECTRIC COMPANY, A CORPORATION OF NEW YORK.

GOVERNING MECHANISM.

No. 820,912. Specification of Letters Patent. Patented May 15, 1906.

Application filed February 23, 1905. Serial No. 246,859.

To all whom it may concern:

Be it known that I, JOHN G. CALLAN, a citizen of the United States, residing at Lynn, county of Essex, State of Massachusetts, have invented certain new and useful Improvements in Governing Mechanisms, of which the following is a specification.

The present invention relates to governing mechanisms for elastic-fluid motors, and more especially to turbines driven by steam or other elastic fluid.

The object of the present invention is to provide a governing mechanism of improved construction which will regulate the amount of motive fluid supplied to the motor under normal conditions and which will shut down the motor irrespective of the position of the regulating valve or valves when the speed exceeds a certain predetermined limit.

The novel features will be fully described hereinafter, and pointed out with particularity in the claims.

In the accompanying drawings, which illustrate one embodiment of my invention, Figure 1 is a partial axial section of an elastic-fluid turbine of the Curtis type. Fig. 2 is a plan view of a portion of the valve-actuating mechanism with its inclosing casing in section. Fig. 3 is a vertical section through the lever that transmits motion from the shaft-governor to the regulating-valve. Fig. 4 is a detail view showing the trigger employed to trip the emergency-valve. Fig. 5 is a detail sectional view of the tubular support and guide for the emergency-valve. Fig. 6 is a sectional view taken on the line 6 6 of Fig. 5. Fig. 7 is a sectional view taken on line 7 7 of Fig. 5. Fig. 8 is a sectional view taken on the line 8 8 of Fig. 5. Figs. 9 and 10 are detail views of the emergency-valve actuator. Figs. 11 and 12 are detail views of the emergency-valve, the former being a section taken on line 11 11 of Fig. 12. Figs. 13 and 14 are detail sectional views of a modification, showing means employed to reset the emergency-valve. Fig. 15 is a diagrammatic view showing the extent of movement of the eccentric employed to reset the emergency-valve. Fig. 16 is a perspective view, partially in section, of the emergency-valve and its support. Fig. 17 is a sectional view taken on the line 17 17 of Fig. 16. Fig. 18 is a sectional view taken on the line 18 18 of Fig. 16, and Fig. 19 is a sectional view taken on line 19 19 of Fig. 16.

1 represents the main shaft of the turbine, upon which is mounted a bucket-wheel 2, having one or more rows of wheel-buckets 3 of suitable shape. Between the rows of wheel-buckets are situated intermediate buckets 4, that are carried by a suitable support. This support may extend wholly or partially around the wheel, as desired. The arc covered by the intermediate buckets will vary for different machines. Only one stage of a multistage turbine is shown in the illustration; but it is to be understood that this invention is applicable to machines having two or more stages, also that all of the buckets in the machine may be rotary. The wheel and intermediate buckets are inclosed in a casing 5. To the left-hand side of the casing is secured a valve-chest 6, the latter also acting as a support for the sectionalized nozzle 7. This nozzle preferably comprises a plurality of individual passages which are closely associated and discharge steam or other motive fluid in the form of a solid jet against the wheel-buckets.

It will be noted that the valve-chest overhangs the speed-responsive device, and in this manner the longitudinal dimension of the turbine is reduced to a minimum. Mounted in the valve-chest is a sleeve 8, that acts as a guide for the regulating-valve 9 and a seat for the emergency-valve 10. The ring 11 forms the seat for the regulating-valve 9. The regulating-valve is made after the fashion of a spoked wheel and is so mounted upon the valve-stem 12 that the stem may rotate within it, while it is held in place longitudinally by a nut or other suitable means. The object of this is to permit the stem to turn and trip the emergency-valve. The outer surface of the stem is grooved to form a water packing. The center of the stem is provided with an opening which communicates at one end with one or more of the grooves and at the opposite end with the interior of the wheel-casing. In this manner any steam which leaks around the valve-stem will pass through the opening in the stem and thence into the wheel-casing, because the pressure in the latter is less than that of the escaping steam. The valve-stem extends parallel with the wheel-axis and is mounted within a sleeve 13, which in turn is carried by a head 14, the latter being threaded into the valve-chest. This arrangement provides a long bearing-surface for the valve-stem on the left-hand end. The

right-hand end of the valve-stem is supported and guided by the support 15 of the emergency-valve. Steam or other elastic fluid first enters the chamber 16 in the turbine by a pipe or other conduit and flows from there into the chamber 17, the latter being in communication with the chamber 18, which feeds the nozzle-sections.

The emergency-valve is carried by the support 15 and is normally locked in the open position, as shown in Fig. 1. In order to shut this valve, it is necessery to rotate it slightly about its axis, as will be more fully described hereinafter. For the present, however, it is sufficient to say that the regulating-valve has a reciprocating motion, due to the valve-stem, and that the emergency-valve, while normally stationary, is given a slight oscillatory motion about its axis when it is desired to close it. The valve is continually urged toward its seat by the compression-spring 19, and when once the valve is seated it is held there by the steam-pressure in the inlet-chamber 16.

Mounted on the end of the wheel-shaft is a speed-responsive device of any suitable construction. The one shown comprises a sleeve 21, that incloses a spring, weight-arms 22, of which only one is shown, a movable abutment, and a frame 23, that is carried by suitable posts, which in turn are mounted in the ring 24. The movable abutment assumes different positions, due to the resultant action of the weights and opposing spring, and a rod 25 is employed to transmit this motion to the actuating-lever 26. Between the lever and the rod is located an adjustable spherical bearing 27. The actuating-lever is supported by the pivot 28, the latter being carried by a frame 29, which comprises two arms provided with a common support 30, the said support being in the form of a band and is mounted upon the projection or head 14, that carries the valve-stem. The upper end of the actuating-lever 26 is forked to receive the trunnions 31, formed on the hollow block 32. Extending through the block and engaging it in such a manner that it is free to rotate within it, but is actuated by it in longitudinal translation, is the valve-stem 12.

From the foregoing it is apparent that as the rod 25, which is attached to the governor, is moved to and fro motion will be transmitted to the actuating-lever 26 and cause it to swing to and fro about its pivot 28. This motion is transmitted to the valve-stem through the trunnion-block 32, and in this manner the regulating-valve 9 is caused to move to and fro and throttle or otherwise control the admission of steam to the nozzles 18. This motion, however, has no effect upon the emergency-valve.

If anything happens to the regulating-valve or the mechanism for operating it, it is necessary to provide an emergency-governor for shutting down the machine to prevent it from running away and perhaps destroying itself. In the present instance this feature of the invention is carried out by the following means: Mounted upon the frame 23 of the shaft-governor are one or more springs 33 of the clock-spring type, as shown more fully in Fig. 13. As the speed of the turbine increases above a certain point the free end of the spring or springs moves outwardly until it or they strike the trigger 34. This trigger is mounted on the end of the valve-stem 12, and when moved by the clock-spring rocks the valve-stem about its longitudinal axis and unlocks or releases the emergency-valve 10 and permits the latter to close under the action of the compression-spring 19.

In order to prevent the free end of the clock-spring or emergency-governor from overreaching when the speed becomes excessive, a damper or limiting device 35 in the form of a ring forming an orbit about the circle traveled by the fully-extended extremity of the clock-spring is provided, which is supported from the clamp 30 by feet 36. The ring is provided with a slot through which the lower end of the trigger extends. In the preferred construction the heel and toe of the projecting trigger form when the valve is tripped a portion of the arc of a circle constituted by the damping ring or orbit 35, which confines the outward movement of the governor. Other arrangements can be used, however. The clock-spring therefore does not jump over any very large gap after the shut-off valve is tripped nor is it permitted to fly outward far enough beyond the limiting-orbit to strike the trigger a heavy blow, and thereby incur the danger of breakage.

It is to be noted that the lower end of the trigger, Fig. 1, has considerable length in an axial direction. This is to permit the trigger as a whole to move back and forth with the valve-stem without disturbing its operative relation with respect to the emergency-governor.

Referring now to Figs. 5 to 12 and 16 to 19, inclusive, the construction of the emergency-valve will be more fully described. 15 represents the tubular support and guide for the emergency-valve, and formed on the periphery of the tubular extension are one or more projections 40. In the present instance four of these projections are shown; but the number can be varied to suit the requirements. These projections coöperate with projections 41 on the valve and form a lock to hold the valve in the open position. In addition to forming a part of the lock the projections act as guides for the valve. In order to lock or set the valve in its open position, it is necessary to impart a slight rocking or oscillatory motion thereto about its support, and to limit this movement a stop 42 is provided, with which the side of one of the

projections 41 on the valve engages. In order to rock the valve about its support, and thus lock it, suitable means are employed. In the present illustration two cam projections 43 are provided, Figs. 5 and 8, which, engaging with the projections 41 on the valve as the latter is moved away from its seat, rock or oscillate the valve about its axis sufficiently to cause the side of one of the projections 41 to strike the stop 42 and the ends 44 to rest upon the projections 40. On referring to Fig. 11 it will be seen that the right-hand end of the projection 41, which engages with the cam 43, is beveled to assist in this action. From the foregoing it will be evident that longitudinal movement of the valve in either direction is accompanied by a slight oscillatory movement. It is to be understood that this oscillatory motion is only sufficient to cause the parts to lock and unlock. The amount that the parts overlap is shown more particularly in Fig. 18.

The means employed for resetting and tripping the valve will now be described. Mounted upon the valve-stem are one or more arms 45, Figs. 9 and 10, which enter jaws 46, formed on the side of the valve adjacent to the seat. The arms 45 and the jaws 46 form a telescopic joint, so that the regulating-valve 9 and the stem 12 can move to and fro without affecting the emergency-valve. Spring 19, Fig. 1, has sufficient torsional effort in addition to its compression effect to maintain this relation once it is established. The length of the arms 46 and the depth of the slot in the jaws are such that rotational engagement is maintained throughout the working travel of valve 9 and at the same time valve 10 is free to completely close, even when valve 9 and arms 45 are at the inward extremity of their travel. When the valve-stem 12 is moved to the extreme right-hand position of its "emergency resetting," travel-arms 45 will move the emergency-valve from its seat and carry it to the right until cams 43 engage the beveled projections 41, causing valve 10 to twist or rotate until one of the projections 41 strikes the stop 42, which will occur when the rotation has been sufficient to cause proper engagement between 40 and 41, thereby resetting valve 9. Attention is called to the fact that the T shape of arms 45 causes them to engage with forks 46 in such fashion as to prevent the elements of forks 46 from departing in either plane from their symmetrical relation with the axis of the valve-stem and concentric parts. This acts to prevent cramping in valve 10, which otherwise has, axially measured, a short bearing-surface.

It is to be understood that there is a certain definite movement of the throttle-valve 9 under working conditions and that this movement must not at the one extremity interfere with the closing of the emergency-valve 10 nor at the other be sufficient to throw the parts 45 and 46 out of engagement. The resetting movement causes a travel of the throttle-valve 9 and its attached parts toward the turbine-casing considerably in excess of the working travel, this being solely for the purpose of resetting the emergency-valve 10. As shown in Fig. 1, the parts are in the position occupied when the turbine is running at its normal speed. From the foregoing it is evident that only a very slight angular motion of the valve-stem 12 and arms 45, occasioned by the trigger 34, is necessary to disengage the lower ends 44 of the projections 41 on the valve from the projections 40 on the cylindrical support 15, and the compression-spring 19 will then move the valve against its seat and the steam-pressure will hold it. In order to reset the emergency-valve, the supply of steam to the inlet-chamber is cut off, the casing 47 removed, and the valve-stem 12 moved inward or to its extreme right-hand position, Fig. 1, which action resets the valve. The casing 47 is then mounted in place and steam is admitted to the inlet-chamber 10.

With the construction thus far described when the emergency-valve is tripped it is necessary to remove the casing and reset the valve by hand. Under some conditions this is desirable, since the fact that the emergency has tripped argues that the casing should be removed and the main governor examined. There are conditions, however, where it is of paramount importance to continue running, and in Figs. 13 to 15 is shown a means whereby the emergency-valve can be reset without removing the casing. The actuating-lever 26 is pivotally mounted in the frame 29, as before. The pivot, however, instead of being cylindrical, as in the previous figures, is made in the form of an eccentric 50. Extending from the eccentric to the outside of the casing is a spindle 51, the latter being provided with a squared end, to which the handle 52 is attached. The handle is normally prevented from turning by the projection 53, that enters a suitable slot formed in the casing or on a detachable plate. The free end of the handle is made in the form of a spring, so that by squeezing it slightly the projection will be removed from the slot, after which the handle and spindle 51 can readily be moved. The normal movement of the eccentric is indicated by the arc 54, Fig. 15, and owing to the way it is set the vertical movement imparted to the actuating-lever 26 is very slight, as is indicated at 55. It is necessary to limit the vertical movement of the actuating-lever 26 in resetting as much as possible, so as to avoid unduly straining the rod 25, connecting it with the shaft-governor. The remainder of the apparatus being the same as previously described, further description is unnecessary.

Where the parts are continually moving to and fro, as must be the case with a construction of this kind, it is necessary to provide lubricating means. To accomplish this, the actuating-lever 26 is made hollow and is filled with a suitable material to form a wick 56. This wick receives any lubricant which drips from the trunnion-box 32, the latter being directly under and receiving lubricant from the chamber 57, the latter acting as a measure which is filled once in so often with lubricant. This chamber is formed in the casing 47 and is normally closed by a screw-threaded plug. In the chamber may be a body of absorbent material containing lubricant which it feeds into the trunnion-box and thence to the wick 56, that lubricates the pivot 28 or the eccentric 50 and the spherical bearing 27. Experience shows that enough lubricant will work out from the parts specified to properly lubricate the balance of the governing mechanism. In order to prevent steam or other elastic fluid from escaping from the wheel-casing to the atmosphere or to the casing surrounding the governing mechanism, adjustable packings 58 are provided, which may be of any suitable construction.

My invention is shown in connection with what is known as a "jet" or "impulse" turbine; but it is not to be construed as being limited thereto, since it can be used in connection with reaction-machines or machines operating on other principles.

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 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. In combination, a fluid-actuated motor, a valve-chest mounted thereon, a valve mounted therein, a detachable head for the chest, a stem for the valve passing through the head, a speed-responsive device driven by the motor, a lever for transmitting motion from the speed-responsive device to the valve, and a frame for supporting the lever, which is carried by the valve-chest.

2. In combination, a fluid-actuated motor, a valve-chest, regulating and shut-off valves mounted therein, an actuator which is common to the valves, speed-responsive devices for governing and shutting down the motor, a lever transmitting motion from one of the speed-responsive devices to the actuator, and a trigger located between the point of attachment of the actuator and lever and the valve-chest which is actuated by the emergency speed-responsive device.

3. In combination, a fluid-actuated motor, a valve-chest attached to the motor, a regulating-valve mounted in the chest, a detachable head for the chest, a speed-responsive device, a lever connecting the valve with the speed-responsive device, and a frame carried by the detachable head which carries the pivot for the lever.

4. In combination, a fluid-actuated motor, a speed-responsive device driven by the motor, a valve-chest which overhangs the speed-responsive device, a valve in the chest, a stem for the valve which extends parallel to the axis of the motor, and a lever for transmitting motion from the speed-responsive device to the valve.

5. In combination, a fluid-actuated motor, a speed-responsive device driven by the motor, a valve controlling the admission of fluid to the motor, a means actuated by the speed-responsive device for tripping the valve, and an eccentric for resetting the valve.

6. In combination, a fluid-actuated motor, a speed-responsive device driven by the motor, a valve controlling the admission of fluid to the motor, a lever actuated by the speed-responsive device for tripping the valve, a pivot for the lever, and a means for moving the pivot to reset the valve.

7. In combination, a fluid-actuated motor, a speed-responsive device driven by the motor, a valve controlling the admission of fluid to the motor, a lever actuated by the speed-responsive device for tripping the valve, an eccentric which acts as a pivot for the lever, a casing inclosing the parts, and a means external to the casing for moving the eccentric in a manner to reset the valve.

8. In combination, a fluid-actuated motor, a speed-responsive device driven by the motor, a valve controlling the admission of fluid to the motor, a lever actuated by the speed-responsive device, for tripping the valve, a casing for the parts, a means for resetting the valve, a handle located outside of the casing for actuating the resetting means, and a locking device for the handle.

9. In combination, a fluid-actuated motor, a speed-responsive device driven thereby, regulating and shut-off valves controlled by the speed-responsive device, and a sleeve which acts as a guide for one of the valves and a seat for the other.

10. In combination, a fluid-actuated motor, a speed-responsive device driven thereby, regulating and shut-off valves controlled by the speed-responsive device, a sleeve which acts as a guide for one of the valves and a seat for the other, and a stem for the regulating-valve which passes through the sleeve.

11. In combination, an elastic-fluid motor, a valve-chest, a valve located therein, a speed-responsive device for actuating the

valve, and a damper carried by the valve-chest for preventing excess movement of the speed-responsive device.

12. In combination, an elastic-fluid motor, a valve-chest, a controlling-valve located therein, a stem for actuating the valve, a trigger mounted on and moving longitudinally with the stem, and a speed-responsive device arranged to actuate the trigger under predetermined conditions as to speed.

13. In combination, a fluid-actuated motor, an admission-port for the motor between the shaft and the periphery of the casing, a regulating-valve and a shut-off valve having a common axis extending in a plane parallel to the axis of the motor, a speed-governor driven by the revolving element of the motor, a lever connecting the speed-governor with the regulating-valve, and a means for actuating the shut-off valve.

14. In combination, a fluid-actuated motor, an admission-port for the motor between the shaft and the periphery of the casing, a regulating-valve and a shut-off valve, a spindle common to the valves which extends in a plane parallel to the shaft of the motor, a speed-governor mounted on the shaft, a lever connecting the governor and the spindle for moving the regulating-valve, and a means for actuating the shut-off valve.

In witness whereof I have hereunto set my hand this 17th day of February, 1905.

JOHN G. CALLAN.

Witnesses:

JOHN A. McMANUS, Jr.,

DUGALD McK. McKILLOP.