Dec. 29, 1925.

1,567,666

H. L. MASON

GOVERNOR

Filed Feb. 14, 1925

2 Sheets-Sheet 1

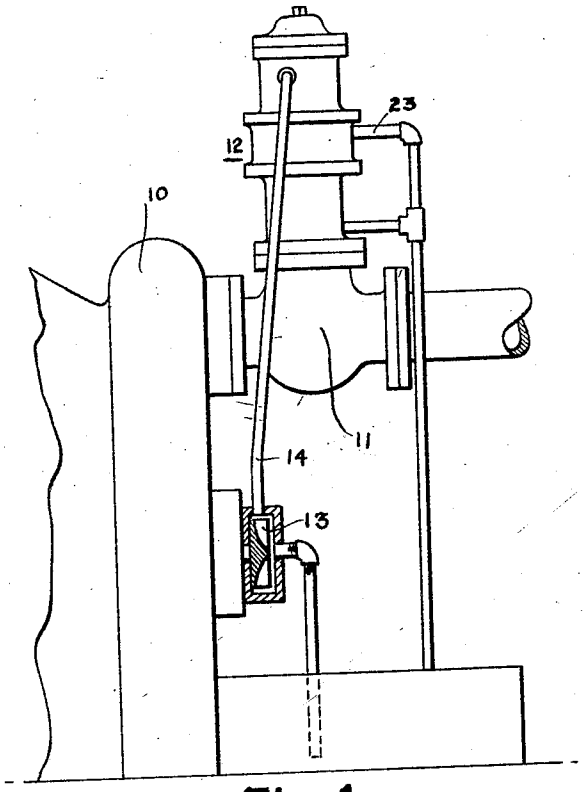

Fig. 1.

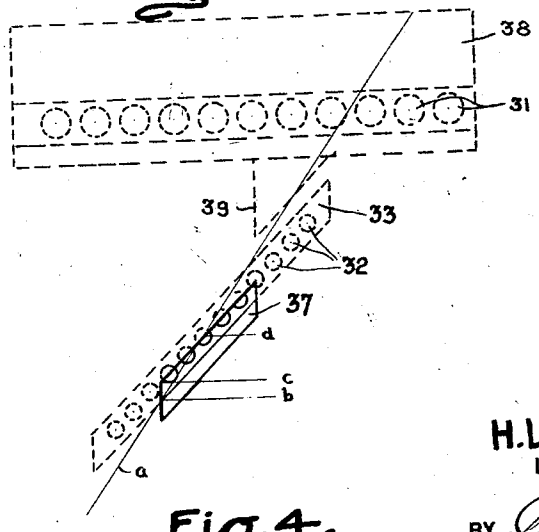

Fig. 4.

WITNESS

H. L. Mason
INVENTOR

BY

ATTORNEY

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2 Sheets-Sheet 2

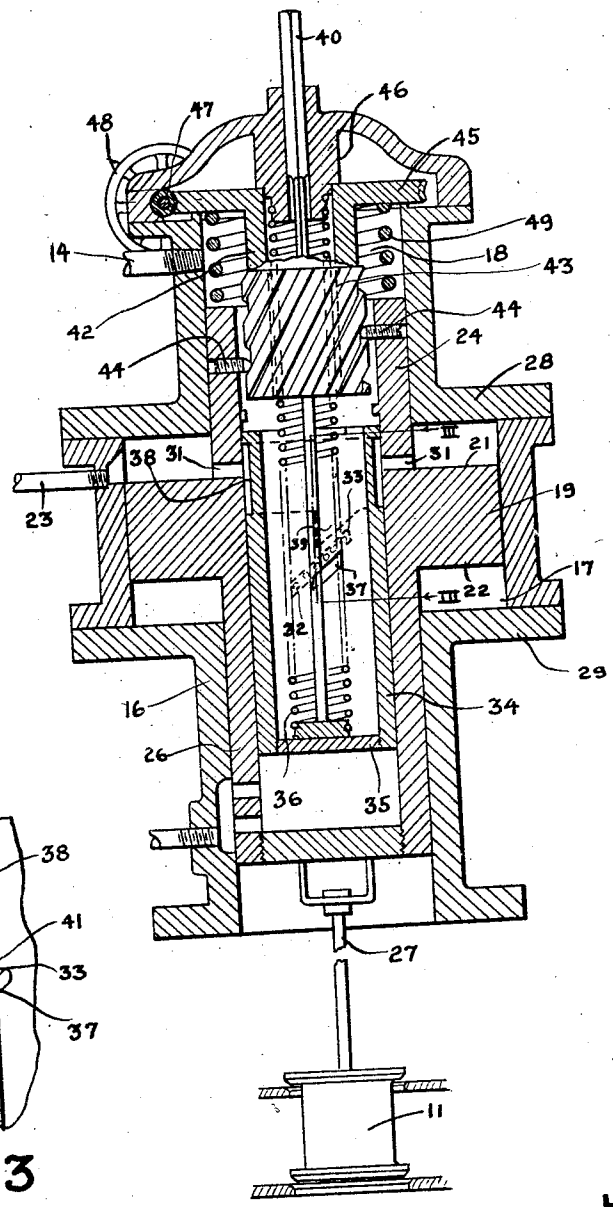

Fig. 2

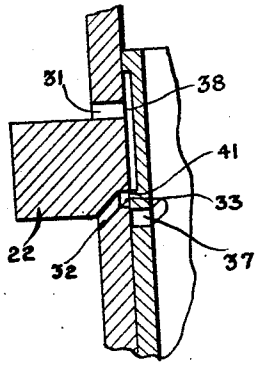

Fig. 3

WITNESS

H.L. Mason
INVENTOR

BY J.C. Davis

ATTORNEY

Patented Dec. 29, 1925. 1,567,666

UNITED STATES PATENT OFFICE.

HENRY LEA MASON, OF PHILADELPHIA, PENNSYLVANIA, ASSIGNOR TO WESTINGHOUSE ELECTRIC & MANUFACTURING COMPANY, A CORPORATION OF PENNSYLVANIA.

GOVERNOR.

Application filed February 14, 1925. Serial No. 9,103.

To all whom it may concern:

Be it known that I, HENRY LEA MASON, a citizen of the United States, and a resident of Philadelphia, in the county of Philadelphia and State of Pennsylvania, have invented a new and useful Improvement in Governors, of which the following is a specification.

My invention relates to governing apparatus, more particularly to that type operated by fluid pressure varying as a function of the speed of the prime mover, and has for its object the provision of apparatus of the character designated which shall be simple of design, and effective to provide adequate governing movements upon slight variations in speed.

Apparatus embodying features of my invention is illustrated in the accompanying drawings forming a part of this specification in which Fig. 1 is a view in elevation showing an elastic fluid turbine having my improved governing mechanism applied thereto; Fig. 2 is a vertical sectional view of the governing apparatus; Fig. 3 is a fragmentary sectional view of the pilot valve and operating piston in my improved governing apparatus taken along the line III—III of Fig. 2 and at a right angle thereto, and Fig. 4 is a developed view of the cooperating ports and passages of the governing apparatus and illustrating diagrammatically its operation.

Fluid pressure operated governors as heretofore known to me, have usually embodied an element actuated in response to the variations in fluid pressure in opposition to the force exerted by a spring. In order to exert a sufficient force to effect governing movements upon a slight variation of pressure, the initial load of the spring has, of necessity, been relatively great. With a relatively great initial load upon the spring, and with governing movements defined by the deflection of the spring per unit of change in governing force, it has been found necessary to provide a spring so long as to be impractical in order to secure governing movements of sufficient amplitude.

It has been proposed to overcome this difficulty by providing a spring of relatively small scale, or deflection per unit of change in pressure, and to provide for the spring a follow-up mechanism whereby the spring is moved in the direction of movement of the actuated element upon a change in governing pressure. While, by this means, comparatively wide governing movements per unit of change in pressure has been effected, the follow-up mechanism has complicated the apparatus.

In accordance with my invention, I provide a valve actuated by the variable fluid pressure in opposition to the force exerted by the spring. A piston for effecting governing movements is controlled by the valve and arranged to move with the valve and in the same direction. In order to secure a relatively wider movement of the piston per unit of movement of the valve, I provide cooperating ports and passages in the valve and piston, said ports being inclined to the longitudinal axis of movement of the piston. Upon movement of the valve followed by a movement of the piston the piston is caused to rotate, causing a given point thereon to describe a helical path, the pitch or inclination of said helical path being greater than the inclination of the cooperating ports and passages. I also provide in my improved apparatus, means for changing the initial relative position of the valve and the piston, thus changing the initial load upon the spring, and consequently the speed of the prime mover governed. I further provide a means for insuring a closing off of the admission valve of the prime mover upon a failure of fluid governing pressure.

Referring now to the drawing for a more detailed understanding of my invention, I show in Fig. 1 at 10, an elastic fluid turbine having an admission valve 11 controlled by my improved governing apparatus at 12. Fluid under pressure varying as a function of the speed of the turbine 10 is supplied to the governing apparatus 12 as by an impeller pump 13 through a conduit 14. The governing apparatus 12, Fig. 2, comprises a housing 16 defining an operating cylinder 17 and a supply chamber 18. Disposed within the operating cylinder 17 is an operating piston 19. The operating piston 19 is provided with an active face 22 and with an inactive face 21. The inactive face 21 is connected, at all times, to the exhaust through a connection 23. The operating piston 19 has an upper stem portion 24 extending into the supply chamber 18 and a lower stem portion 26 connected through a

rod 27 with the admission valve 11 so that movements of the operating piston 19 are transmitted directly to the admission valve. The upper stem portion 24 extends through a head 28 and the lower stem portion extends through a head 29 provided on the cylinder 17 and are so fitted therewith as to be approximately fluid tight. The piston 19 is made hollow and is provided with a series of ports 31—31 leading from the interior thereof to its upper face 21 and with a series of ports 32—32 leading from the exterior toward the interior thereof and connecting at the interior of the piston to a groove 33. The direction of the groove 33 and of the series of ports 32 is inclined to the longitudinal axis of the cylinder 17, as shown.

The supply chamber 18 is connected to the impeller pump 13 by the conduit 14 and, in operation, is supplied with fluid varying in pressure with the speed of the turbine 10. The upper stem portion 24 of the operating piston 19 is therefore subjected, at all times, to fluid pressure in the supply chamber 18 tending to force it downwardly. The area of the active face 22 of the piston 19 is made greater than the area of the upper stem portion 24 so that when fluid pressure is admitted beneath the face 22 through the ports 32 the piston 19 is forced upwardly against the pressure in the supply chamber 18, effecting an opening movement of the admission valve 11.

Arranged within the hollow piston 19 is a piston valve 34 which serves to admit fluid under pressure to, and to exhaust it from, the active face 22 of the piston 19. The valve 34 is also made hollow and is closed at its lower end by a cap member 35 which is subjected, at all times, to fluid under pressure tending to force it downwardly. Opposing the fluid pressure is a spring 36 secured to the upper part of the governor housing and at its lower end to the cap member 35. Secured to the cap 35 is a stem 40 extending upwardly and out through the top of the housing 14. The upper end of the stem 40 is squared and slides freely in a similarly shaped opening. The function of the stem 40 is to prevent rotation of the valve 34. Extending from the interior of the valve 34 to the exterior thereof, is a port 37 which, when in registry with groove 33, serves to admit fluid under pressure through said groove and ports 32 to the active face 22 of the piston 19. The port 37 is inclined similarly to the ports 32 and to the groove 33 so that its edges are parallel with the edges of the groove 33. Disposed above the port 37 is a reduced portion 38 of the valve 34. The reduced portion 38 has a V shaped recess 39 at the bottom thereof, (shown in dotted lines, Fig. 2), one side of which is parallel and adjacent to the edge of the groove 33 and ports 32. Separating the V shaped portion 39 and the ports 37 is a bridge portion 41 which, when in registry with groove 33, prevents the admission to or exhaust of fluid from the active face 22 of the piston 19. The reduced portion or recess 38 is at all times in communication with the upper ports 31 of the piston 19 so that when the V shaped portion 39 is in registry with the groove 33, fluid from beneath the piston 19 can pass to the upper face 21 thereof and from thence outwardly to the exhaust through the connection 23.

It will be seen that pressure acting against the stem portion 24 of the piston 19 tends, at all times, to force it downwardly, while fluid beneath the piston 19 acts against the face 22 and resists the pressure acting against the stem portion 24. Upon upward movement of the pilot valve 34 bringing the ports 37 and groove 33 in registry, fluid under pressure passes beneath the piston 19 forcing it upwardly. Upon downward movement of the pilot valve 34, placing the V shaped portion 39 of the recess 38 in communication with the groove 33, fluid from beneath the piston 19 passes to the exhaust as already described, and pressure acting against the stem portion 24 forces it downwardly. When the bridge portion 41 is in registry with the groove 33, no fluid can pass to or from the active face 22 of the piston 19 and the piston is held stationary by the force of fluid pressure acting against the stem portion 24. It is thus seen that for each movement of the pilot valve 34 there is a movement in the same direction by the piston 19. Said movement continues until the bridge portion 41 covers the groove 33. In accordance with my invention I provide means whereby the movement of the piston is relatively greater than each movement of the pilot valve, which will now be described.

Disposed within the supply chamber 18 is a cylindrical member 42 provided on its outer face with helical grooves 43. The upper stem portion 24 of the piston 19 is provided with suitable projections 44—44 which fit into the grooves 43 so that upon longitudinal movement of the piston 19 the projections 44—44 cooperate with the grooves 43, imparting to the piston a rotating motion. At the same time the pilot valve 34 is held again rotation by the stem 40. Assuming that ports 37 and 33 are in registry, admitting fluid beneath the piston 19 and forcing it upwardly, it will be apparent that if the pitch of the grooves 43 is of the same inclination as the ports 37 and 33, the piston 19 will continue to move upwardly until the lower end of the groove 33 has passed beyond the upper end of the port 37, no matter how small the opening leading from port 37 to ports 32. The movement of the oper-

ating piston 19 obtained for each movement of the pilot valve 34 would not then bear any relation to the change in governing pressure. In order to overcome this and in order to secure a movement of the operating piston 19 which is a definite multiple of the controlling movement of the valve 34, I make the helical grooves 43 of a steeper pitch or inclination than the inclination of the ports 37 and 33. With this arrangement, upon an upward movement of the piston 19, the helical path described by a selected point thereon causes the groove 33 to move upwardly and out of registry with the port 37 until the groove 33 is covered by the bridge portion 41, stopping further movement.

The member 42 is secured to a gear wheel 45 centered about a projection 46 serving as a spring anchor for the spring 36 and depending from the upper part of the housing 16. Cooperating with the gear 45 is a worm 47 which may be operated from the outside of the governor apparatus as by manual means 48. By rotating the gear 45, the piston 19 is caused to be raised or lowered by the screw action of the member 42 thus changing its position relative to the valve 34 and, in effect, changing the tension of the spring 36 and the speed of the turbine 10.

Inasmuch as a closing movement of the admission valve 11 is only secured upon an increase in governing pressure, it follows that, lacking other means, upon a failure of governing pressure no force would be available to cause a closing movement of the admission valve and the turbine would overspeed. I accordingly provide a spring 49 disposed between the gear 44 and the stem portion 24 of the piston 19, said spring being of sufficient strength to move the admission valve 11 in a closing direction upon a failure in governing pressure.

From the foregoing the operation of apparatus made in accordance with my invention will be apparent. Fluid under pressure varying, for example, as the square of the speed of the turbine 10 is delivered to the supply chamber 18 through the conduit 14. Fluid pressure acting against the stem portion 24 of the piston 19 tends to force it downwardly while fluid beneath the face 22 of the piston 19 tends to hold it in a stationary position with the ports 33 covered. Fluid pressure also acts against the valve 34, tending to force it downwardly, said force being resisted by the tension of the spring 36. Assume now that there is an increase in load on the turbine 10 and a decrease in speed with a consequent decrease in governing fluid pressure. The tension of the spring 36 is such as to pull the pilot valve 34 upwardly against the decreased fluid pressure until the port 37 is in registry with the ports 32 and groove 33 as shown diagrammatically in Fig. 4. Fluid pressure now passes beneath the piston 19 forcing it upwardly, while the groove 43 of the member 42 causes the piston to rotate. In Fig. 4 the direction of rotation is indicated by the line *a* superimposed over the ports 37 and groove 33. It will be seen that the lowest point of opening of the groove 33 is opposite *b* and that the longitudinal movement of the pilot valve 34 in registering with the groove 33 is the distance from *b* to *c*. As the piston 19 moves upwardly, however, the point *b* rotates until it reaches the point *d* when the groove no longer registers with port 37, and movement of the piston 19 is stopped. Thus, while the pilot valve 34, in opening the groove 33, only moves from *b* to *c*, the movement of the piston 19 effected thereby is from *b* to *d*. Similarly upon an increase in governing pressure, the spring 36 is elongated and the pilot valve 34 is moved downwardly until the V-shaped part 39 of the recess 38 is in registry with the groove 33 permitting fluid to pass from beneath the piston 19 and allowing fluid pressure acting against the stem 24 to force the piston downwardly. Upon downward movement of the piston 19 it rotates to the left in the direction of line *a*, Fig. 4, causing an increased downward movement of the piston 19 per unit of movement of the valve 34 in the same manner as has been described upon a decrease in governing pressure. Should the pressure within the supply chamber 18 fail, the port 37 and groove 33 will be brought into registry by the spring 36 and the piston is forced downwardly by the spring 49, closing the admission valve 11.

From the foregoing, it will be apparent that I have invented an improved governing apparatus embodying an element actuated by the governing fluid pressure in opposition to the force exerted by a spring and in which relatively wide governing movements are effected per unit of deflection of the spring.

While I have shown my invention in but one form, it will be obvious to those skilled in the art that it is not so limited, but is susceptible of various other changes and modifications, without departing from the spirit thereof, and I desire, therefore, that only such limitations shall be placed thereupon as are imposed by the prior art or as are specifically set forth in the appended claims.

What I claim is:

1. In a fluid pressure operated governing apparatus, means for effecting governing movements comprising a cylinder, a hollow piston within the cylinder and adapted to reciprocate therein, said piston having a port inclined to the longitudinal axis of the cylinder and permitting the passage of motive fluid to and from one side of the piston,

a pilot valve within the piston and having a similarly inclined port adapted when in registry with the port in the piston to admit motive fluid thereto and effect a movement thereof longitudinally of the cylinder, and means effecting a relative rotational movement of the piston to the pilot valve in the direction of inclination of the ports during longitudinal movement of the piston, whereby a port opening in the piston, longer than the longitudinal movement of the pilot valve, is effected.

2. In a fluid pressure operated governing apparatus, means for effecting governing movements comprising a cylinder, a hollow piston within the cylinder and adapted to reciprocate therein, said piston having a port inclined to the longitudinal axis of the cylinder and permitting the passage of motive fluid to and from one side of the piston, a pilot valve within the piston and having a port and an exhaust cavity each inclined similarly to the port in the piston and adapted when in registry with the port in the piston to admit motive fluid thereto or exhaust motive fluid therefrom and effect reciprocatory movements of the piston longitudinally of the cylinder, and means effecting a rotational movement of the piston in the direction of inclination of the ports during longitudinal movement of the piston.

3. In a fluid pressure operated governing apparatus, means for effecting governing movements comprising a cylinder, a hollow piston within the cylinder and adapted to reciprocate therein, said piston having a port inclined to the horizontal axis of the cylinder for permitting the passage of motive fluid to and from one side of the piston, a pilot valve within the piston and having a port and an exhaust cavity each inclined similarly to the port in the piston and adapted when in registry with the port in the piston to admit motive fluid thereto or exhaust motive fluid therefrom and effect reciprocatory movements of the piston longitudinally of the cylinder, and means effecting a rotational movement of the piston in the direction of inclination of the ports during longitudinal movement of the piston so arranged that a given point on the piston describes a helical path during longitudinal movement thereof of a steeper pitch than the inclination of the ports.

4. In a fluid pressure operated governor, means for effecting governing movements comprising a cylinder, a hollow piston within the cylinder and adapted to reciprocate therein, said piston having a port inclined to the horizontal axis of the cylinder and permitting the passage of motive fluid to and from one side of the piston, a pilot valve within the piston and having a port and an exhaust cavity each inclined similarly to the port in the piston and adapted when in registry with the port in the piston to admit motive fluid thereto or exhaust motive fluid therefrom and effect reciprocatory movements of the piston longitudinally of the cylinder, a stationary cylindrical member associated with the piston and having helical grooves thereon inclined in a direction similar to the inclination of the ports and adapted to cooperate with suitable projections carried by the piston whereby a rotational movement of the piston is effected during longitudinal movements thereof.

5. In a fluid pressure operated governor, means for effecting governing movements comprising a cylinder, a hollow piston within the cylinder and adapted to reciprocate therein, said piston having a port inclined to the horizontal axis of the cylinder for permitting the passage of motive fluid to and from one side of the piston, a pilot valve within the piston and having a port and an exhaust cavity each inclined similarly to the port in the piston and adapted when in registry with the port in the piston to admit motive fluid thereto or exhaust motive fluid therefrom and effect reciprocatory movements of the piston longitudinally of the cylinder, a stationary cylindrical member associated with the piston and having helical grooves therein inclined to the longitudinal axis of the cylinder in the same direction and at a smaller angle to said axis than the inclination of the ports, said helical grooves being adapted to cooperate with suitable projections carried by the piston and effect a rotational movement of the piston during longitudinal movements thereof.

6. In a variable fluid pressure operated governor, the combination of a cylinder, a hollow piston within the cylinder and adapted to reciprocate therein, said piston having a series of ports inclined to the horizontal axis of the cylinder for permitting the passage of motive fluid to and from one side of the piston, a pilot valve subjected to the variable fluid pressure disposed within the piston and having a port and an exhaust cavity each inclined similarly to the port in the piston and adapted when in registry with the ports in the piston to effect reciprocatory movements of the piston longitudinally of the cylinder, a spring secured at one end to the pilot valve and at the other end to a stationary part for opposing the variable fluid pressure acting against the valve, a stationary cylindrical member associated with the piston and having helical grooves therein inclined to the longitudinal axis of the cylinder in the same direction and at a smaller angle to said axis than the inclination of the ports, said helical grooves being adapted to cooperate with suitable projections carried by the piston

and effecting rotational movement of the piston during longitudinal movements thereof, and means for rotating the cylindrical member whereby the initial relative position of the pilot valve and the operating piston and the initial tension of the spring may be varied.

7. In a variable fluid pressure operated governing apparatus, the combination of a housing defining an operating cylinder and a supply chamber, an operating piston within the cylinder and having a stem portion extending into the supply chamber, a pilot valve for controlling reciprocatory movements of the operating piston, said operating piston and said pilot valve having cooperating ports and passages inclined to the longitudinal axes thereof, means for effecting a rotating movement of the operating piston during longitudinal movement thereof for effecting a longer longitudinal movement of the piston than the longitudinal movement of the pilot valve, said means comprising a cylindrical member having helical grooves cooperating with suitable projections carried by the operating piston, and mean without the housing for effecting a rotating movement of the cylindrical member whereby its initial position with respect to the pilot valve may be varied.

8. In a variable fluid pressure operated governing apparatus, the combination of a cylinder, an operating piston within the cylinder actuated by the fluid pressure and effecting governing movements by longitudinal movement therein, a pilot valve controlling movements of the operating piston, and movable in response to variation in fluid pressure in opposition to the force exerted by a spring, said operating piston and said pilot valve having cooperating ports and passages disposed diagonally to the longitudinal axis of the cylinder for effecting movements of the operating piston, said movements being determined by the longitudinal opening of said ports and passages, and means effecing a relative rotational movement of the operating piston and the pilot valve upon longitudinal movement thereof, so arranged that the longitudinal opening of the ports and passages is greater than the longitudinal movement of the pilot valve.

In testimony whereof, I have hereunto subscribed my name this twenty-ninth day of January 1925.

H. LEA MASON.