C. H. WORSEY.

GOVERNING MECHANISM FOR TURBINES.

APPLICATION FILED DEC. 20, 1906.

963,107.

Patented July 5, 1910.

3 SHEETS—SHEET 1.

Fig. 1.

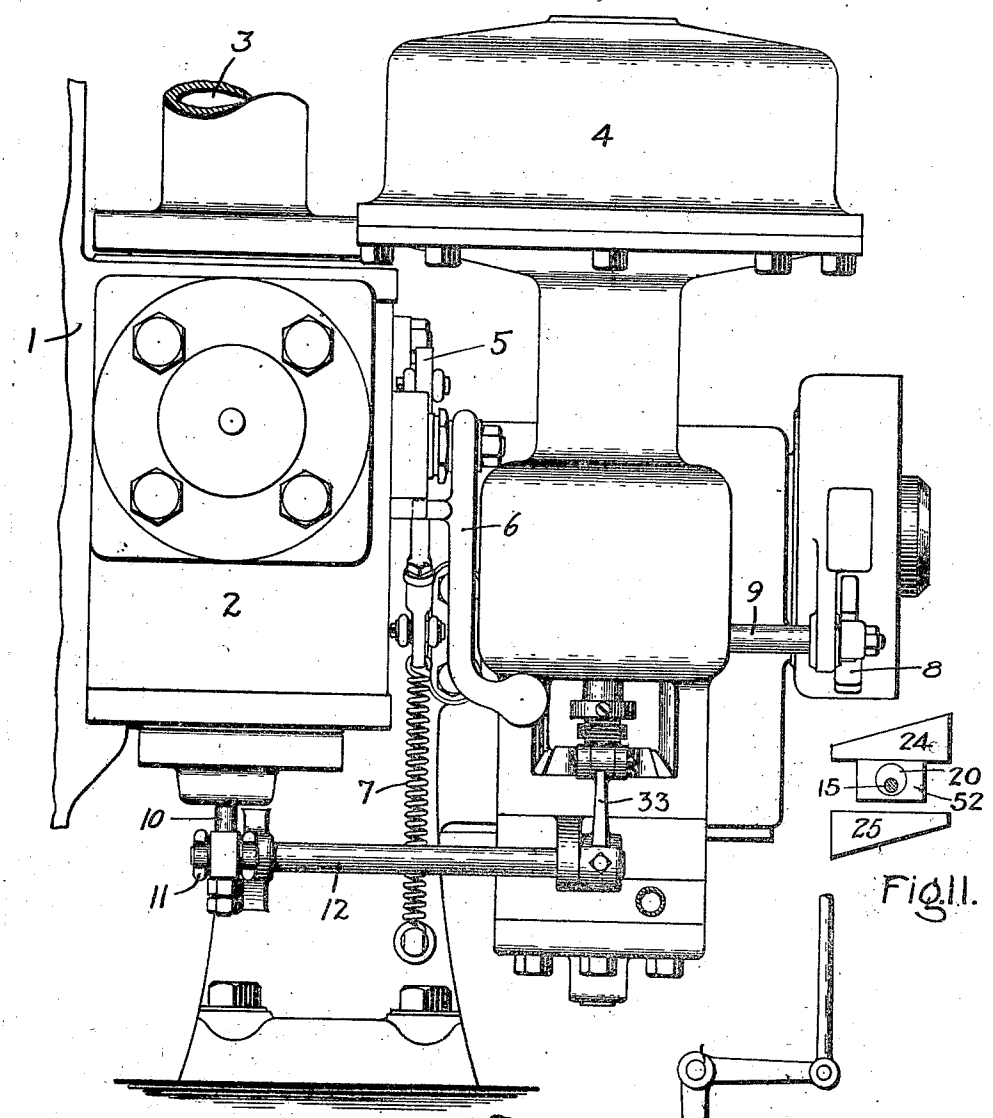
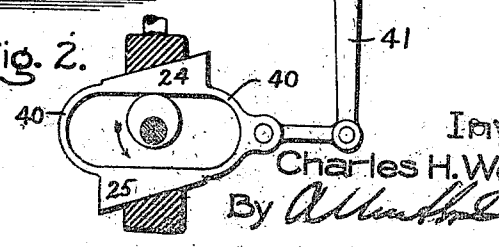






Fig. 11.

Fig. 2.

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3 SHEETS—SHEET 2.

Fig. 3.

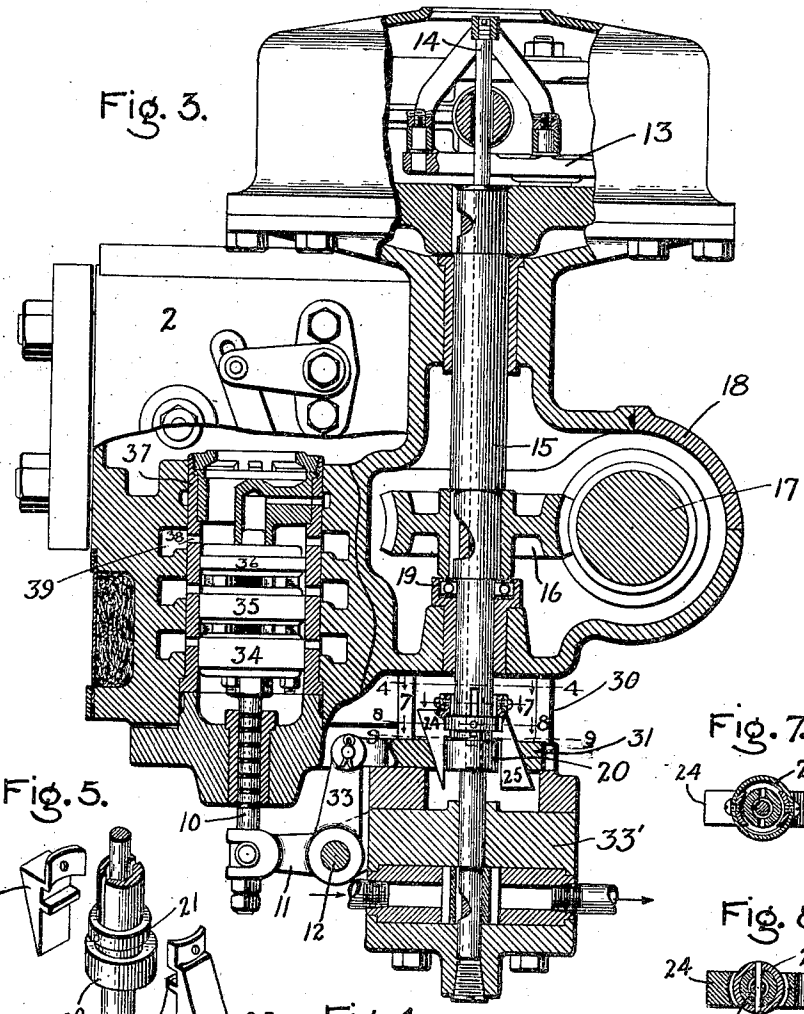


Fig. 5.




Fig. 7.




Fig. 8.

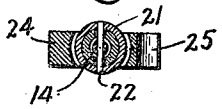


Fig. 4.

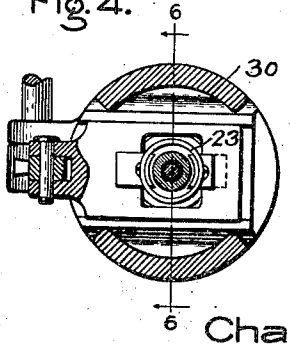


Fig. 6.

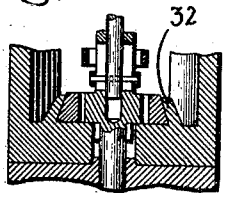


Fig. 9.


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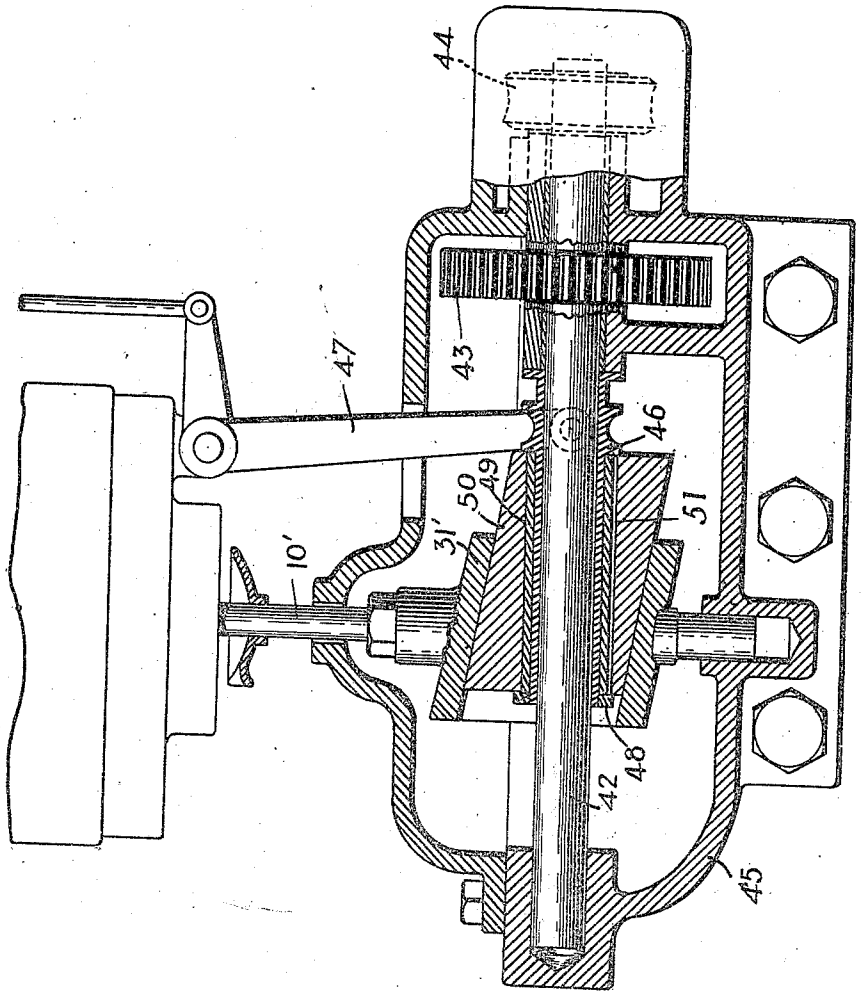
3 SHEETS—SHEET 3.

Fig. 10.

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# UNITED STATES PATENT OFFICE.

CHARLES H. WORSEY, OF LYNN, MASSACHUSETTS, ASSIGNOR TO GENERAL ELECTRIC COMPANY, A CORPORATION OF NEW YORK.

## GOVERNING MECHANISM FOR TURBINES.

963,107. Specification of Letters Patent. Patented July 5, 1910.

Application filed December 20, 1906. Serial No. 348,729.

*To all whom it may concern:*

Be it known that I, CHARLES H. WORSEY, a citizen of the United States, residing at Lynn, county of Essex, State of Massachusetts, have invented certain new and useful Improvements in Governing Mechanism for Turbines, of which the following is a specification.

The present invention has for its object to provide a governing mechanism of improved construction wherein the load on the speed governor is reduced to a minimum and the actual work of opening and closing one or more admission or stage valves is performed by a suitable source of power such as the shaft of the machine being governed.

In carrying out my invention, one or more valves are provided to control the passage of fluid to one or more nozzles or other fluid discharging devices which may direct the passage of fluid into the first stage or into one or more of the succeeding stages. The valve or valves are actuated by a constantly moving means driven by the main shaft of the turbine, and interposed between said shaft and the valves is a wedge for changing the effective action of the shaft on the valves.

For a fuller description of what I consider to be novel in my invention attention is called to the accompanying specification and the claims appended thereto.

In the accompanying drawings which illustrate embodiments of my invention, Figure 1 is a view in side elevation of the governing mechanism attached to a turbine; Fig. 2 is a modification of the governor controlled means for determining the movements of the valves; Fig. 3 is a vertical section through the regulating valves and mechanism for actuating them; Fig. 4 is a sectional view taken on line 4—4 of Fig. 3; Fig. 5 is a perspective view of a wedge member that is set by the shaft governor; Fig. 6 is a section taken on line 6—6 of Fig. 4; Fig. 7 is a section taken on line 7—7 of Fig. 3; Fig. 8 is a section taken on line 8—8 of Fig. 3; Fig. 9 is a section taken on line 9—9 of Fig. 3 showing the relation between the driving eccentric and the parts of the wedge member at one point in the stroke; Fig. 10 is a sectional view showing a slightly modified form of wedge member; and Fig. 11 shows a means for preventing undue wear on the wedge member.

Referring to Fig. 1, 1 represents the casing of a turbine of the elastic fluid type, which may be of the reaction, impact, or other type. In the present illustration my invention is applied to a machine of the Curtis type. Mounted on the front of the turbine casing is a valve chest 2 having an inlet 3 connected with a suitable source of supply. 4 represents a casing surrounding the speed governor, which governor is driven by the main shaft of the turbine as will appear later. Located inside of the valve chest are one or more regulating valves and an emergency valve mounted on a stem attached to the arm 5. 6 is a handle for re-setting the emergency valve and 7 is a spring which tends at all times to close the valve when tripped or released. 8 is a trigger mounted on the rock shaft 9 and actuated by an emergency governor for tripping the emergency valve when the speed exceeds a certain predetermined amount. The regulating valve or valves are mounted on the vertically extending stem 10, which stem is moved vertically by arm 11 on the rock shaft 12, the latter being moved to and fro by an eccentric under the control of a governor, as will appear more fully in connection with the succeeding figures.

Referring to Fig. 3, 13 represents the speed governor acting by centrifugal force and inertia to raise or lower the rod 14 as the load changes. The rod passes through a tubular shaft 15 having a worm wheel 16 keyed thereto. This wheel meshes with a worm 17 that is driven by the main shaft of the turbine, or a double speed reduction may be provided as in Fig. 10. The gearing is inclosed in a suitable casing having a removable cover 18 giving access thereto. Situated below the worm wheel is a ball bearing 19 for taking up the thrust on the vertical tubular shaft 15. Mounted on the tubular shaft and keyed or otherwise rigidly secured thereto is an eccentric 20 which rotates a predetermined number of times per minute. Mounted on the shaft and turning with it but arranged to slide freely thereon is a collar 21. This collar is connected by a transverse pin 22, Fig. 8, to the vertically extending rod 14 connected to the governor,

and hence rises and falls with speed changes. The pin 22 works in a vertical slot formed in the tubular shaft. Secured to a loose ring 23 is a wedge member comprising oppositely disposed wedges 24 and 25. The wedges are shown connected together at the top by the ring and unconnected at the bottom, but where the strains are considerable they will be connected both top and bottom. The ring 23 and the upper ends of wedges are separated from the shaft by a space so that they will not offer resistance to the rotation of the shaft at this point or require lubricant. The wedges are so shaped that the angle of inclination is less than the angle of friction so that the action of the eccentric thereon will not impart vertical movement to the rod 14 and thus interfere with the proper action of the governor. The wedges are provided with slots 26 which receive the collar 21 that rotates with the shaft and is actuated by the governor. Extending downwardly from the casing surrounding the gearing is a frame 30 which forms a support for the sliding cross-head 31, the latter being moved to and fro by the eccentric 20 in the dove-tail guides 32, as shown more particularly in Fig. 6. The cross head is pivotally connected to the upright lever 33 that is mounted on the rock shaft 12. It will be seen that the lever 33, rock shaft 12 and forked arm 11 form a bell crank lever for actuating the valve stem 10. Attached to the underside of the frame 30 is the casing 33′ of a gear pump for supplying lubricant to the various bearings of the turbine.

Mounted on the valve stem are one, two or more valves. In the present instance three balanced valves are shown 34, 35 and 36, which are so arranged that they can assume intermediate throttling positions. Each one of these valves controls the passage of motive fluid from the valve chest 2 to the nozzles or other fluid discharging devices of the turbine. As shown the valves are mounted one above the other on the same stem and are inclosed by a sleeve 37, the latter having accurately formed ports 38 communicating with passages 39 leading to the nozzles or other devices discharging fluid against the buckets.

The action of my improved governing mechanism is as follows: Assuming that the load decreases, the speed of the bucket wheel and shaft 17 will rise and the governor will raise the rod 14 and the collar 21 attached thereto. This results in setting the wedge member in a new position where the part 25 will on the first turn of the eccentric force the cross-head to the right and raise the valve stem 10 and shut the valve at the critical point in the regulation by a greater or less amount. As shown, valve 34 is closed, valve 35 is at the critical point and would close first, and valve 36 is wide open. The valves and ports are so arranged that they act successively both in opening and closing. The wedges 24 and 25 pass through rectangular slots in the cross-head and are prevented from turning thereby. Assuming that the load increases, the reverse action takes place, the wedge 24 after being set will on the first revolution of the eccentric move the cross-head to the left and open one or more valves. It will be noted that the eccentric can move the cross-head to the right once for every revolution, or it can move it to the left once for every revolution, or it can revolve without moving it in either direction according to the position assumed by the wedge member. It also follows that the governor can either freely raise or lower the said member twice during each revolution of the eccentric because the latter is out of engagement therewith. Each revolution of the eccentric may be divided into four parts, first where the high spot engages with the wedge 24; second, where it assumes a position 90° ahead of that shown in Fig. 9, and the governor is perfectly free to move the wedge member without opposition due to frictional engagement of the parts; third, where it engages the wedge 25; and, fourth, where it is 90° ahead of the last-mentioned position and the governor is free to act.

In Fig. 2 is shown a slight modification where the wedge member comprises two wedges 24 and 25 as before. These are connected by straps 40 at opposite ends and the strap on the right is connected by a system of links and levers 41 with the speed governor. In Fig. 3 the wedge member moves longitudinally of the tubular shaft 15 while in Fig. 2 it is moved transversely thereof.

In Fig. 10 is shown a further modification. 42 represents a low-speed shaft having a gear 43 thereon meshing with a pinion located in back thereof. The pinion is mounted on a suitable shaft and is driven by worm gearing 44 from the main turbine shaft. This arrangement means that there is a double reduction in speed between the driving and the driven shaft. The shaft 42 is provided with suitable bearings mounted in the casing 45, the latter inclosing the gearing. Splined on the shaft is a sleeve 46, and the latter is moved to and fro by a lever 47 connected to the speed governor. Mounted on the sleeve 46 to revolve therewith and held against longitudinal movement by a shoulder at one end and a nut 48 at the other, is an eccentric 49. Surrounding the eccentric is a wedge member 50 which is prevented from axially moving independently of the eccentric by the nut and the shoulder holding the said eccentric. Inclosing the wedge member is a cross-head 31′ having suitable guides for directing its

movements. The opening through the cross-head may in cross section be cylindrical or otherwise formed. The operation of the apparatus is as follows: The shaft 42 is constantly rotated by the turbine or other source of power and with it move the sleeve and eccentric. In the position shown, the valve or valves on the stem 10′ occupy definite positions and the portion of the eccentric of greatest diameter is in contact with the wedge member on the upper side of the shaft, there being a clearance 51 on the lower side. As the shaft revolves, the eccentric leaves the surface of the wedge member on the upper side and taking up the clearance 51 just touches the surface on the lower side, without however moving the valve or valves. Moving the wedge member in either direction will actuate the valve stem 10′ accordingly.

In Fig. 11 is shown an arrangement for reducing the wear on the surface of the wedges adjacent the eccentric. The eccentric 20 is mounted on the shaft 15, and surrounding the eccentric is a guide-block 52 having generous wearing surfaces on opposite sides for engagement with the parts 24 and 25 of the wedge member.

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 it to be 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 a governing mechanism, the combination of a regulating valve, a shaft, an eccentric mounted on and moving with the shaft, a governor-controlled means that is interposed between the valve and the eccentric adjacent the periphery of the latter to be engaged thereby for transmitting motion from the latter to the former, and a device for guiding said means to move rectilinearly under the control of the governor.

2. In a governing mechanism, the combination of a regulating valve, an actuator attached thereto, a shaft, an eccentric having a constant eccentricity mounted on and moving with the shaft, a means for transmitting motion from the eccentric to the actuator, which is engaged by the periphery of the eccentric and by its position determines the direction and extent of movement of the valve, a device for guiding said means to move rectilinearly, and a governor which adjusts the means rectilinearly in accordance with the load to vary the position of the valve with respect to its port.

3. In a governing mechanism, the combination of a valve, an actuator for moving the valve, an eccentric driving device, a governor, and a wedge member in engagement with the actuator and the device which is acted upon by the governor to bring different portions of said member into action to vary the extent and direction of movement imparted by the actuator to the valve.

4. In a governing mechanism, the combination of a plurality of valves, an actuator common to the valves, an eccentric driving device, a speed governor, and a wedge member in engagement with the actuator and the device which is controlled by the governor to bring different portions of said member into action to vary the extent and direction of movement imparted by the actuator to the valves.

5. In a governing mechanism, the combination of a valve, a constantly rotating member, a governor, a means receiving motion from the member and transmitting it to the valve, and a wedge member forming the sole connection between the rotating member and said means which is controlled by the governor and determines the extent and direction of movement imparted by the said means to the valve.

6. In a governing mechanism, the combination of a valve, a rotary shaft, a governor, a reciprocating cross-head attached to the valve, a device on the shaft adapted to move the cross-head, and a means under the control of the governor which determines the direction and extent of movement of the cross-head, said means forming the sole connection between the device and the cross-head.

7. In a governing mechanism, the combination of a valve, a rotary shaft, a governor, a reciprocating cross-head attached to the valve, an eccentric on the shaft adapted to move the cross-head, and a wedge member under the control of the governor, which is directly engaged by the periphery of the eccentric and by its position determines the direction and extent of movement of the cross-head.

8. In a governing mechanism, the combination of a valve, a rotary low-speed shaft, a governor, a cross-head attached to the valve, a wedge member mounted to slide on the shaft, means for preventing the wedge member from rotating, a device secured to the shaft for actuating the cross-head through the medium of said member, and a connection between the governor and the wedge member for transmitting motion from the former to the latter.

9. In a governing mechanism, the combination of a valve, a governor, an actuator for the valve, a shaft, a wedge member moved by the governor and comprising oppositely disposed and connected wedges, and a means on the shaft which moves the valve actuator through the medium of the wedge

member by an amount and in a direction determined by the position of the governor, said member receiving motion directly from said means and transmitting it to the actuator.

10. In a governing mechanism, the combination of a valve, a speed governor, a cross-head connected to the valve for moving it, a rotary shaft, a means for transforming the rotary motion of the shaft into reciprocating motion of the cross-head, a device interposed between and directly engaging the means and the cross-head, which determines the direction and extent of movement of the latter, means for preventing the device from rotating, and a connection for transmitting motion from the governor to said device.

11. In a governing mechanism, the combination of a valve, a speed governor, a driving shaft, a low speed shaft, gearing between the shafts, a cross-head connected to the valve, means for transmitting motion from the low-speed shaft to the cross-head including a double wedge movable lengthwise of the shaft, means for preventing the wedge from rotating, a collar adjustable on the shaft for moving the wedge, and a connection for transmitting motion from the governor to the collar.

12. In a governing mechanism, the combination of a valve, a speed governor, a shaft, an eccentric device on the shaft, a cross-head for moving the valve, guides therefor, a double wedge upon which the device acts directly to transmit motion to the cross-head, and a connection between the governor and wedge for regulating the movement of the valve.

13. In a governing mechanism, the combination of a valve, a speed governor, a shaft, a means driven thereby, an actuator for the valve, a wedge comprising members located on opposite sides of the said means and oppositely disposed, said members forming a direct connection between the means and the actuator for transmitting motion from one to the other, and a device actuated by the governor for simultaneously moving the wedge members to vary the action of said means on the actuator.

14. In a governing mechanism, the combination of one or more balanced regulating valves, an actuator attached thereto, a driving shaft, a wedge member in engagement with the actuator and movable longitudinally with respect to the shaft, an eccentric located within the member, said member being engaged by the periphery of the eccentric, and a governor for shifting the member to and fro so that the eccentric will move the valve or valves in one direction or the other to satisfy the load requirements.

15. In a governing mechanism, the combination of one or more regulating valves, an actuator attached thereto, a low-speed shaft, an eccentric having a constant throw, a wedge member mounted on the shaft and interposed directly between the eccentric and the actuator, and a governor controlled means which shifts the wedge member and eccentric longitudinally of the shaft to open or close the valve or valves as the load conditions require.

In witness whereof, I have hereunto set my hand this seventeenth day of December, 1906.

CHARLES H. WORSEY.

Witnesses:
JOHN A. McMANUS, Jr.,
PHILIP F. HARRINGTON.