F. SAMUELSON.

GOVERNING MECHANISM FOR TURBINES.

APPLICATION FILED OCT. 31, 1907.

963,074.

Patented July 5, 1910.

3 SHEETS—SHEET 1.

Fig. 1

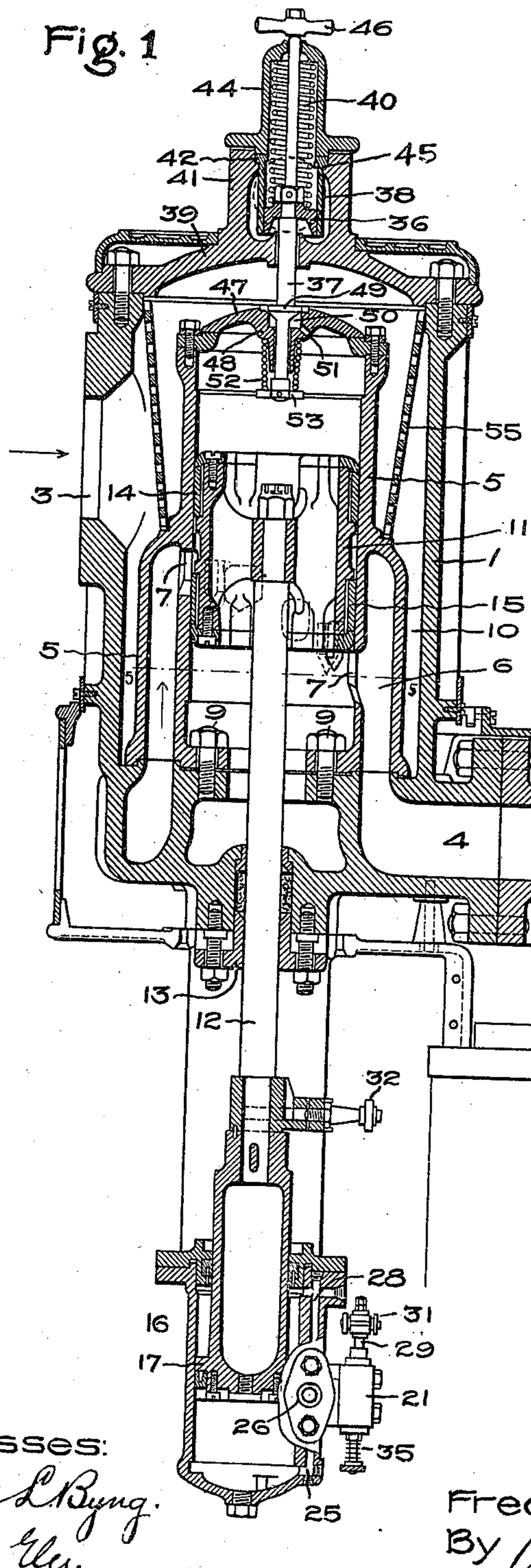


Fig. 4.

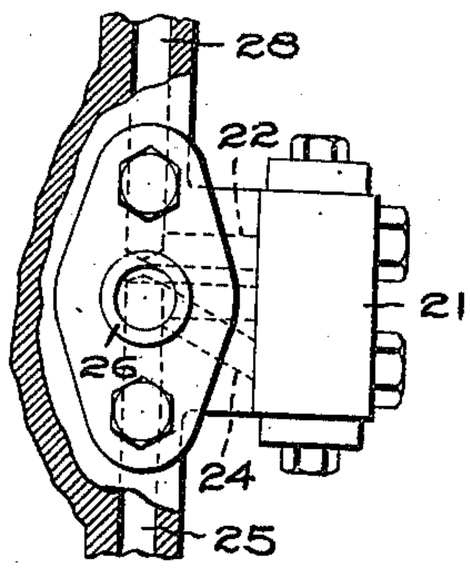
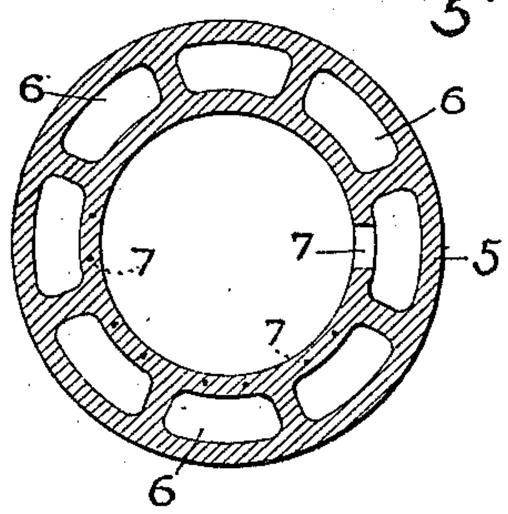


Fig. 5.



Witnesses:
Marcus L. Byng.
J. Ellis Glen.

Inventor,
Frederick Samuelson,
By Albert G. Davis
Att'y.

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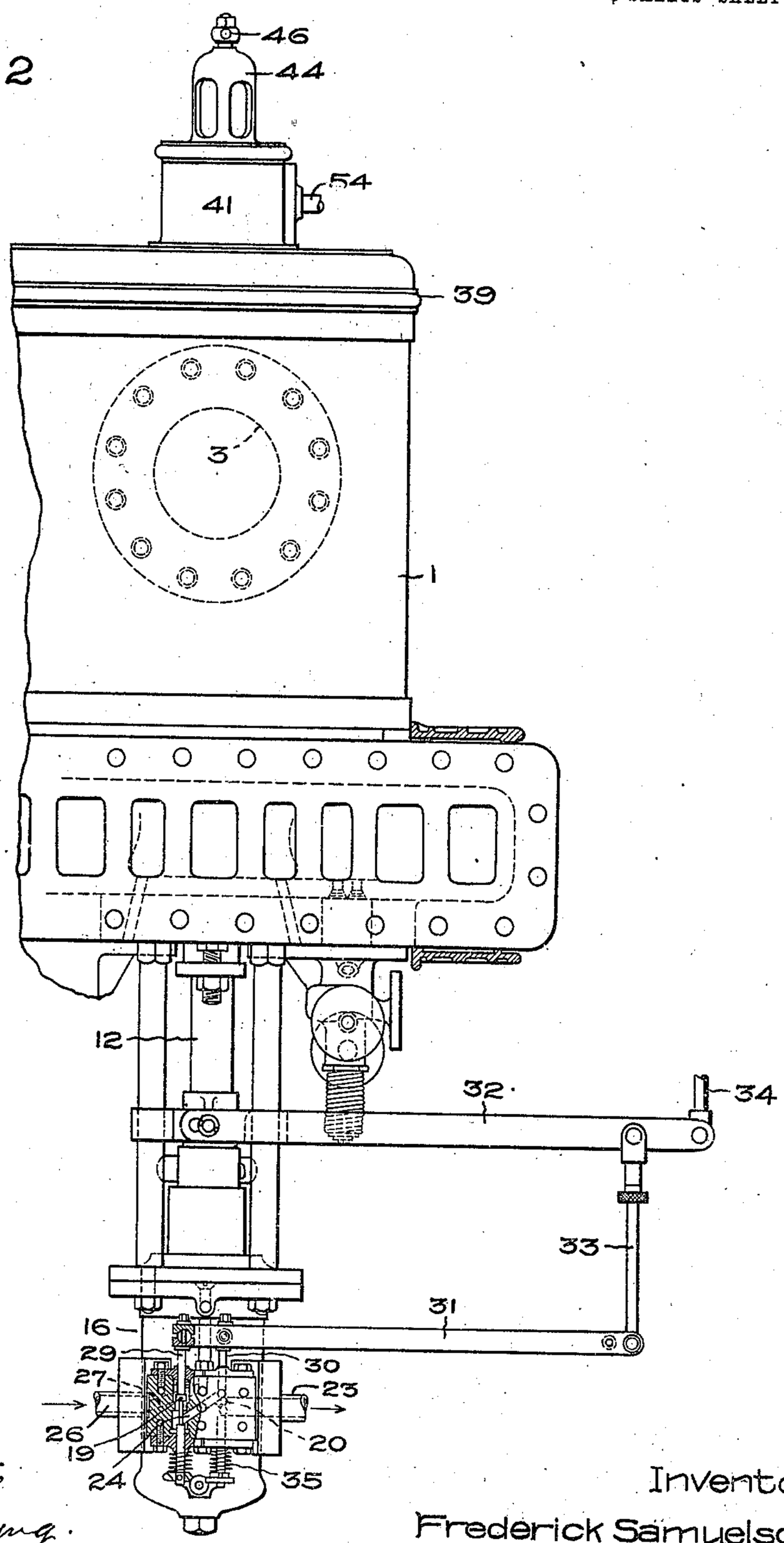
3 SHEETS—SHEET 2.

Fig. 2



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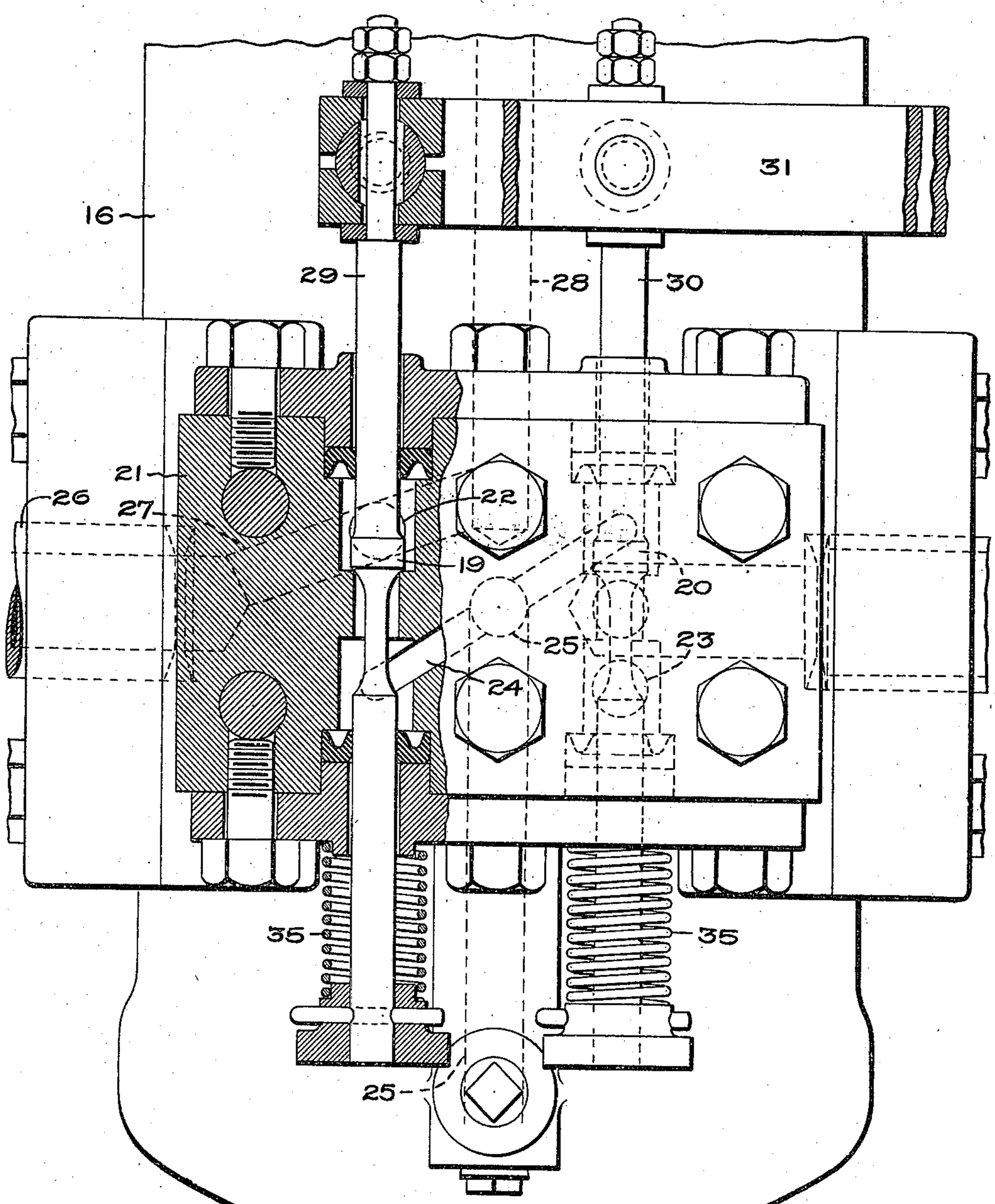
3 SHEETS—SHEET 3.

Fig. 3.



Witnesses:
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J. Ellis Glen

Inventor,
Frederick Samuelson,
By Albert G. Davis
Att'y.

UNITED STATES PATENT OFFICE.

FREDERICK SAMUELSON, OF RUGBY, ENGLAND, ASSIGNOR TO GENERAL ELECTRIC COMPANY, A CORPORATION OF NEW YORK.

GOVERNING MECHANISM FOR TURBINES.

963,074. Specification of Letters Patent. Patented July 5, 1910.

Application filed October 31, 1907. Serial No. 399,986.

To all whom it may concern:

Be it known that I, FREDERICK SAMUELSON, a subject of the King of Sweden, residing at Rugby, England, have invented certain new and useful Improvements in Governing Mechanisms for Turbines, of which the following is a specification.

My invention relates to means for controlling the supply of motive fluid to steam turbines, and more especially to that type of controlling means which is operated by a motor that in turn is controlled by the turbine governor.

The object of my invention is to provide a combined governing and emergency stop mechanism of improved construction, particular reference being made to the arrangement of parts whereby their tendency to distort due to the presence of high temperature motive fluid is reduced to a minimum.

In carrying out my invention an improved controlling valve mechanism is provided for admitting motive fluid to one or more passages communicating with one or more nozzles or other fluid discharging devices. The valve is operated by a fluid pressure motor responsive to the turbine governor. In the same structure containing the controlling valve is an improved emergency or stop valve which is normally held open by the pressure of the motive fluid, which pressure is controlled by the emergency gear.

In the accompanying drawings is illustrated one of the embodiments of my invention in which,—

Figure 1 is a vertical section through the valve mechanism and hydraulic motor; Fig. 2 is an elevation, partly in section of Fig. 1 and at right angles thereto; Fig. 3 is an enlarged detail view of the valves for controlling the actuating motor; Fig. 4 is a further detail showing the passages leading from the valve casing to the motor cylinder; and Fig. 5 is a section of the valve liner on the line 5—5 of Fig. 1.

1 indicates a vertically arranged valve casing adapted to be fixed to the steam chest 2 of a turbine, and having ports 3 and 4 respectively, in communication with the steam supply on the one hand and the turbine nozzles or other devices on the other hand. Centrally arranged within this casing is a cylindrical valve liner 5 having passages 6 extending axially along its periphery and communicating with spirally arranged ports 7 in the liner. These ports are arranged at different heights and so disposed circumferentially that when the liner is in position they coincide and communicate with the passages 8 in the valve casing conveying steam to the nozzles.

In order to prevent distortion as far as possible and permit of free expansion when working with steam of high temperature, the valve liner is secured to the valve casing at one end by means of stud bolts 9, the other end being left perfectly free. To insure a practically uniform temperature of the liner, a sufficient space is left between its circumference and the inner surface of the valve casing to form an annular chamber 10 which allows free circulation of steam admitted to the valve casing through the port or opening 3.

In the interior of the liner fits a hollow piston valve 11, which uncovers or covers the ports 7 as it is moved up or down by the governor controlled motor with which it is connected by a rod 12 passing through a stuffing box 13 in the lower part of the valve casing. The piston valve in order to allow for slight differences in alinement between its rod 12 and the liner is made a slack fit in the liner, and to secure steam tightness is fitted with piston rings 14 and 15 at its ends, which rings are preferably made wide enough to cover the ports 7.

The motor which I prefer to use for operating the piston valve, comprises a hydraulic cylinder 16 working on the differential principle where the movement of the piston 17 up and down is obtained by varying the pressure on the under side of the piston, the pressure on the upper side, which has a smaller effective area, (in the present embodiment being approximately half that of the former,) being constant. This variation of pressure is obtained by an improved arrangement of parts comprising two miter seated valves 19 and 20, Fig. 3, arranged with parallel axes in a common valve chest 21. High pressure fluid is admitted above the valve 19 by the port 22, and the underside of the valve communicates with the top of the valve 20. The underside of valve 20 communicates with the exhaust 23. From

the passage 24, connecting the underside of valve 19 and the top of valve 20, is led a passage 25, Figs. 1 and 3, communicating with the lower side of the hydraulic piston 17.

High pressure fluid is admitted to the valve casing 21 by the conduit 26, Fig. 2, and by passage 27, shown in dotted lines, and passage 28, Fig. 1, is conveyed to a point above the motor piston. It will thus be seen that the upper side of the piston is always exposed to high pressure tending to force it downward, and this tendency is resisted by the body of fluid below the piston, subject to the control of the valves 19 and 20. When the piston is raised, the effective pressure on the under side overcomes that on the upper and the fluid in the cylinder is forced back against the source. It is to be understood that when the piston is moving upwardly, the exhaust valve 20 remains closed. When the piston is to be lowered the exhaust valve 20 is opened, thus reducing the pressure below the piston until the effective pressure above the piston predominates, when the latter moves downward until arrested by the closing of valve 20.

The two valve spindles 29 and 30 are connected by cross-heads to a common lever 31, the outer end of which is joined to the neutral point of a floating lever 32 by an adjustable rod 33. The two ends of the lever 32 are pivotally connected, one to the piston rod 12 transmitting the motion of the hydraulic piston to the main piston valve, and the other to the governor actuated rod 34. The effect of this arrangement is that each cross-head on a hydraulic valve spindle forms a fulcrum for the lever when the other one is moved; thus, when one valve is lifted, the downward thrust of the lever first closes the other valve, if open, and said valve then supports the said fulcrum. When the lever is in mid-position, both valves are shut, thus minimizing leakage. Small springs 35 are fitted to the lower ends of the valve spindles to assist the difference in pressure on the two sides of the valves in keeping them shut. The governor acting through the rod 34 either depresses or raises the outer end of the floating lever 32 as occasion requires. This action opens one pilot valve or the other and the piston starts into motion in one direction or the other, and with it the opposite end of the floating lever. When the motor and main controlling valve have moved the required distance for a given governor movement, the end of the floating lever attached to the rod 12 will have moved such an amount as will restore the pilot valves to their normal positions. Such an arrangement forms a follow-up device and prevents over-travel of the parts, which would result in objectionable speed variations.

On the top of the main piston valve liner 5 is a valve 47 which, when closed, cuts off the supply of steam to the inside of the liner and consequently to the turbine. This valve is normally held open by steam pressure acting on a piston 36 secured to the end of the valve spindle 37, the clearance around the spindle permitting this action to take place. The piston slides in a cylinder 38 supported by the cover 39 of the main valve casing 1, and is exposed to atmospheric pressure on one side and is also acted on by a compression spring 40 which closes the valve when the supporting steam pressure under the piston 36 is reduced below a certain predetermined value.

The cylinder 38 is preferably formed by a bushing fitting in an annular upwardly projecting flange 41 on the outside of the cover 39, the bushing having an exterior shoulder 42 on its upper end fitting in a recess in the flange, being thus free to expand downward, and being held in position by a dome-shaped cap 44 inclosing the spring 40. The bushing is also preferably provided with a small internal shoulder 45 at the top of the bore against which the piston 36 fits when at the upward limit of its travel, thus forming a valve seat and minimizing leakage. The valve spindle 37 may be prolonged beyond the piston and taken through the top of the spring dome 44 and may be fitted with a handle 46 by which the piston and valve can be given an occasional turn to prevent sticking and to keep the valve faces in good order.

The emergency valve is preferably a mushroom-shaped disk 47 provided at its center with a downwardly projecting hub portion 48 through which the spindle 37 passes. This disk is bored out at its top to accommodate a flange or collar 49 on the spindle and to form a chamber 50 below said collar, which chamber communicates by means of ducts 51, located in the hub portion, with the under side of the valve. The flange or collar 49 on the spindle has a seat on the valve disk and thus constitutes a valve, this valve being held normally closed by a compression spring 52 arranged about the depending hub and between it and a flanged collar 53 screwed and locked to the lower end of the valve spindle. In this way a by-pass or pilot valve is formed within the main emergency stop valve and the disposition of the parts is such that the spring tends to keep the main valve tight against the collar on its spindle. The pressure area of the piston 36 on the emergency valve spindle is greater than that of the by-pass valve, so that when live steam at boiler pressure is admitted to both the valve casing and the emergency valve cylinder, the by-pass valve immediately lifts from its seat admitting steam into the valve liner and establishing approximately equal pressures upon both

sides of the emergency valve, which is opened by a further movement of the piston and is pressed up against the collar 49 forming the by-pass valve by the spring 52.

When the emergency gear is operated, exhausting the steam from under the piston 36 by the conduit 54, Fig. 2, the spring 40 above the piston forces it and the emergency valve down and the latter seats, thus cutting off the steam supply from the turbine altogether. The controlling piston valve will be open, but since the passage of steam into the liner is cut off it has no effect. The emergency gear may be of any desired type or construction which is responsive to an abnormal condition, as for example, to excess speed. It acts to relieve the pressure under the piston 36, as by opening a valve in the pipe 54, and since the steam can escape from the cylinder under the piston and from the chamber around the cylinder faster than it can enter through the clearance around the spindle 37, it follows that the piston will close the valve, which action is aided by the spring 40 and the weight of the parts.

A steam strainer, which may consist of a tapered cylinder 55 of perforated sheet metal may be conveniently arranged around the valve liner, its bottom edge fitting closely to the exterior of the liner and its top edge fitting inside the top of the valve casing so that all the steam has to pass through the strainer on its way to the valve liner.

As the main controlling valve moves over the ports 7 it cuts them into or out of service successively. The ports overlap slightly so that before one is fully opened the next higher one begins to open. There is a throttling action of each port both in opening and closing, and by reason of this fact, the quantity of steam admitted to the turbine can be accurately regulated to suit the requirements. When once a port is fully opened the throttling at that point ceases, which is an advantage in impulse machines because the velocity of the fluid passing to the buckets will not be disturbed. In other words, there is a throttling of the fluid column near the critical point of regulation, but not elsewhere.

Among the principal advantages claimed for this construction are, that a very compact arrangement is secured which is, at the same time, easy of access for examination or repairs, and the various parts are so disposed that the efficiency is not impaired by the expansion, due to use of high temperature steam.

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. In combination, a casing, a liner mounted therein which is supported at one end only, ports in the liner, a controlling valve mounted in the liner, and a motor for moving the valve back and forth over the ports.

2. In combination, a casing, a liner mounted therein which is supported at one end only, a fluid containing chamber located between the liner and the inner wall of the casing to reduce the tendency of the liner to distort, a piston valve within the liner, ports that are controlled by the piston, and a motor for moving the piston.

3. In combination, a casing, a liner mounted therein which is provided with a plurality of axially extending passages, ports in the wall of the liner communicating with the passages, an annular fluid containing chamber located between the inner wall of the casing and the liner to reduce the tendency to distortion, a piston valve located in the bore of the liner, a rod therefor, and a motor, the moving member of which is connected to the rod.

4. In combination, a casing, a liner mounted therein and supported at one end only, a plurality of ports spirally arranged in the liner, a valve for controlling the ports, and a means for actuating the valve.

5. In combination, a casing, a liner mounted therein and provided with axially extending passages and ports therefor, a steam-receiving chamber surrounding the liner and located between it and the wall of the casing to reduce distortion, and a fluid actuated motor for causing the valve to cut the passages into and out of service as it moves over the ports.

6. In combination, a casing, a valve mounted therein for controlling the passage of fluid, an emergency valve also mounted in the casing, a piston actuated by the fluid entering the casing for opening the emergency valve, and a means acting in opposition to the piston for closing the valve when the pressure on the piston is reduced.

7. In combination, a casing, a valve mounted therein for controlling the passage of fluid, an emergency valve also mounted in the casing, a pilot valve, a piston actuated by the fluid entering the casing for opening the pilot valve, balancing the pressure on the emergency valve and thereafter opening it, and a means acting in opposition to the piston for closing the emergency valve when the fluid pressure on the piston is reduced.

8. In combination, a casing, a controlling and an emergency valve mounted therein, a means for actuating the controlling valve, a pilot valve seated on the emergency valve, a piston for operating the pilot valve and

through it the emergency valve, and a spring for closing the pilot and emergency valves when the fluid pressure on the piston is reduced.

9. In combination, a casing, a controlling and an emergency valve mounted therein, a means for actuating the controlling valve, a pilot valve seated on the emergency valve, a piston for operating the pilot valve and through it the emergency valve, a spring between the emergency valve and the stem of the pilot valve, and a second spring which closes the pilot and emergency valves when the fluid pressure on the piston is reduced.

10. In combination, a casing, a ported liner mounted therein, a controlling valve arranged to move over the ports, an emergency valve, a seat therefor at one end of the liner, a piston for opening the emergency valve which is subjected to the pressure of the fluid entering the casing, and a spring for seating the emergency valve when the pressure on the piston is reduced.

11. In combination, a casing, a valve mounted therein, a pilot valve therefor, seats for the valves, a piston for opening the valves, a means for closing them, and a handle external to the casing for turning one of the valves on its seat.

12. In combination, a casing, a valve mounted therein, a piston for opening the valve, a cylinder for the piston having an internal shoulder forming a seat for the piston when the valve is open to prevent leakage.

13. In combination, a casing, a valve mounted therein, a cover for the casing, a cylinder mounted in the cover and provided with an external shoulder to support it at one end only and an internal shoulder forming a seat for the piston at one end of its stroke, a piston connected to the valve for opening it, and a spring for moving the piston in the opposite direction and closing the valve.

14. In combination, a casing, a shouldered liner mounted therein and supported at one end only and surrounded by a steam chamber to reduce distortion, a strainer inclosing the free end of the liner and resting on the shoulder, and a cover closing one end of the casing and the strainer.

15. In combination, a chest having a number of passages, a casing, a liner in the casing having spirally arranged ports and axially extending passages communicating with those in the chest, a valve in the liner, a fluid actuated motor for moving the valve over the ports in the liner, and valve means controlled by the governor for regulating the action of the motor.

16. In combination, a casing, a valve mounted therein for controlling the passage of motive fluid, a fluid-actuated motor, a differential piston for the motor which is exposed on one side to the inlet pressure of said fluid, a valve means for controlling the pressure on the other side of the piston, a cylinder for the piston that is separate from the casing of said controlling valve, a piston-rod which also forms a stem for the controlling valve, a lever for moving said valve means, a governor-actuated lever pivotally connected to the piston-rod between the cylinder and the casing, and means connecting the two levers.

17. In combination, a casing, a valve mounted therein for controlling the passage of motive fluid, a fluid-actuated motor for moving the controlling valve comprising a piston, a cylinder and a piston-rod, pilot valves for controlling the passage of fluid to and from the motor, a governor-actuated lever which is pivotally connected to the piston-rod, a lever pivotally connected to the pilot valves, and means connecting the two levers.

18. In combination, a casing, a controlling valve located therein, a fluid-actuated motor for moving the valve, said motor comprising relatively movable members, a pair of pilot valves for controlling the motor, a lever which is pivotally connected to both valves adjacent one of its ends, means attached to the opposite end of the lever for moving it, one of said pivotal connections acting as a fulcrum for the lever when it is moved in one direction and the other when it is moved in the opposite direction, and means moving with one of said members for restoring the valves to their initial positions after the motor has moved the controlling valve a predetermined distance.

19. In combination, a casing, a controlling valve located therein, a fluid actuated motor including a rod for moving the valve, a valve chest for the motor, valves mounted in the chest and disposed with their stems parallel, a lever connected to the valves in such manner that when one is opened the other is closed, and a second lever attached to the rod and to the first-mentioned lever for restoring the valves to their initial positions.

20. In combination, a casing, a balanced valve mounted therein for controlling the passage of motive fluid, a hydraulic motor for moving the valve, a differential piston for the motor, one side of which is always exposed to the inlet pressure of the actuating liquid, a pair of valves controlling the admission of fluid to the opposite side of the piston, a lever which when moved in one direction or the other opens one valve and closes the other, and means for transmitting motion from the piston to said lever to restore the valves to their initial position and thereby prevent overtravel of the controlling valve.

21. In combination, a casing, a control-

ling valve mounted therein, a fluid actuated motor for moving the valve, a differential piston for the motor, one side of which is always exposed to inlet pressure, valves controlling the motor, a single lever attached to both valves for operating them, and a means moving with the motor piston for restoring the valves to their initial positions after a predetermined movement has been made.

In witness whereof, I have hereunto set my hand this 15th day of October, 1907.

FREDERICK SAMUELSON.

Witnesses:

CHARLES H. FULLER,

J. A. FOSTER.