M. M. PEARSON.

GOVERNING MECHANISM.

APPLICATION FILED SEPT. 28, 1907.

954,646.

Patented Apr. 12, 1910.

2 SHEETS—SHEET 1.

Fig. 1.

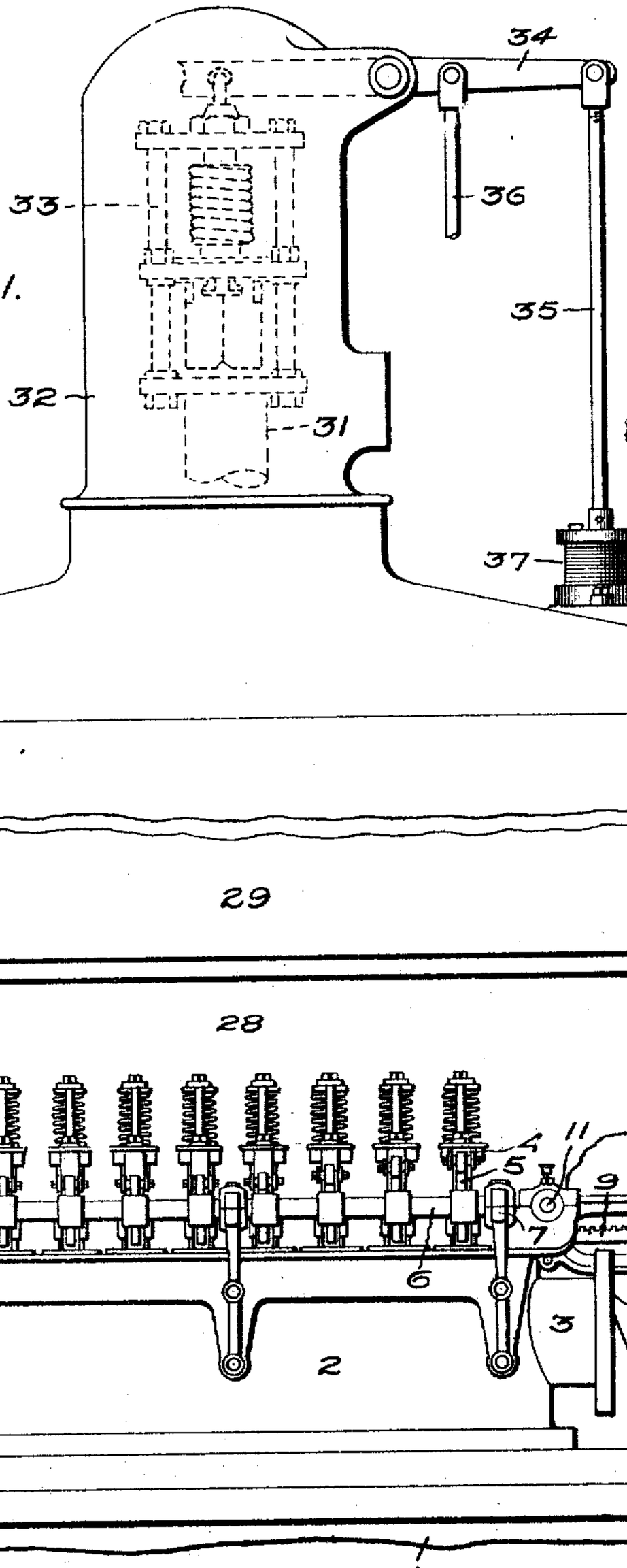

Fig. 2.

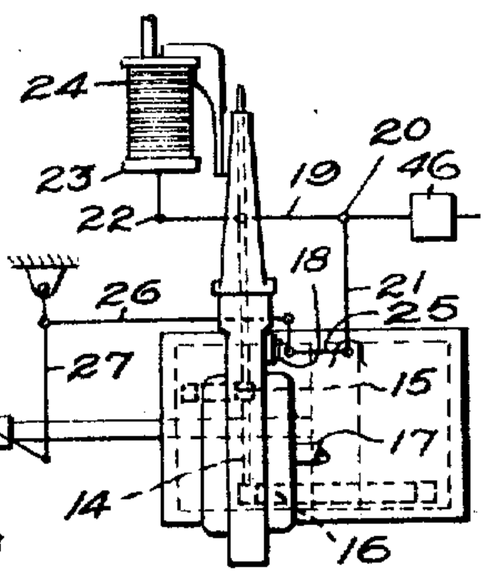

Fig. 3.

Witnesses:
Marcus L. Byng
J. Ellis Glen.

Inventor:
Millard M. Pearson,
by Allen B. Davis
Att'y.

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2 SHEETS—SHEET 2.

Fig. 4.

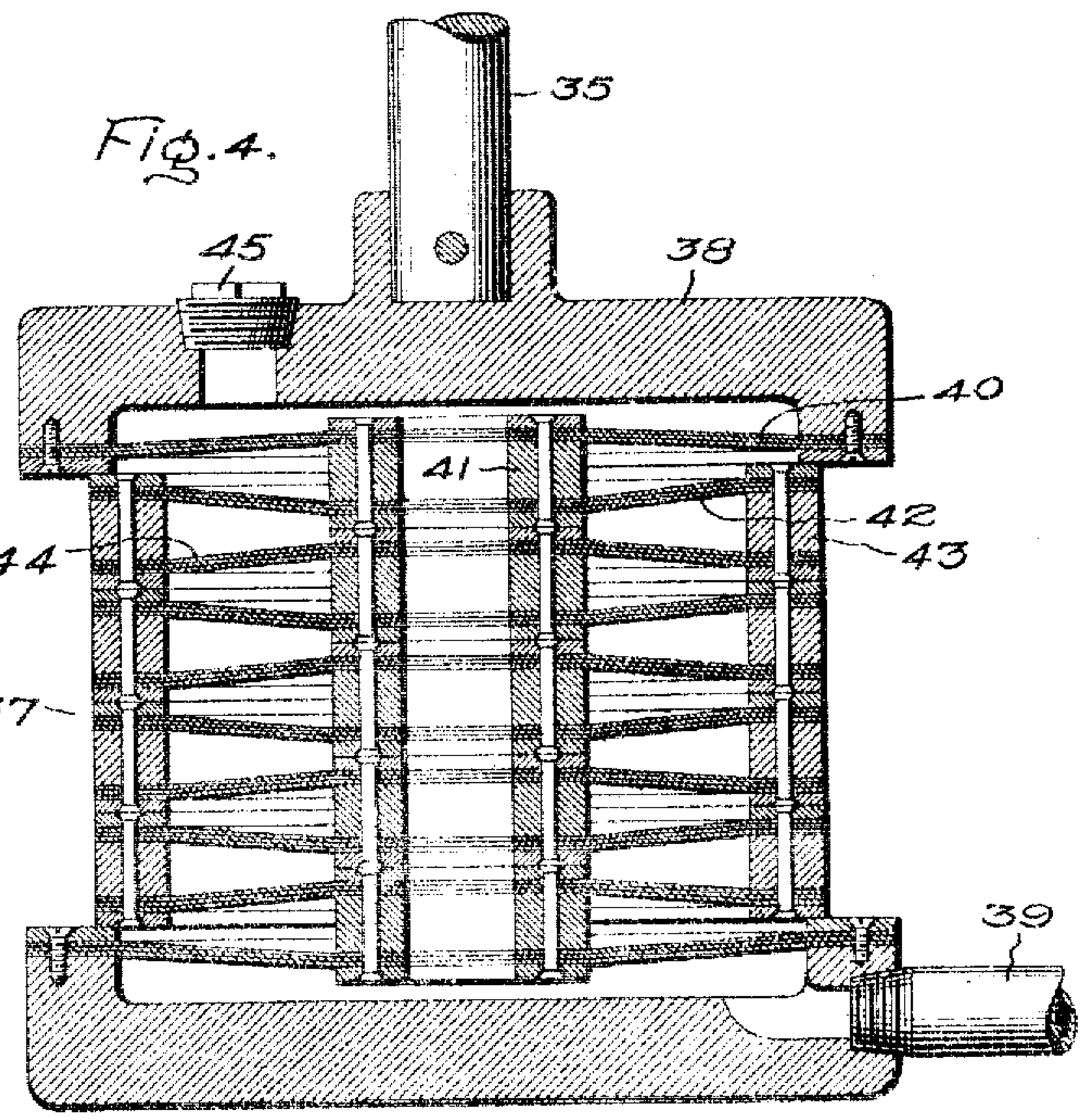
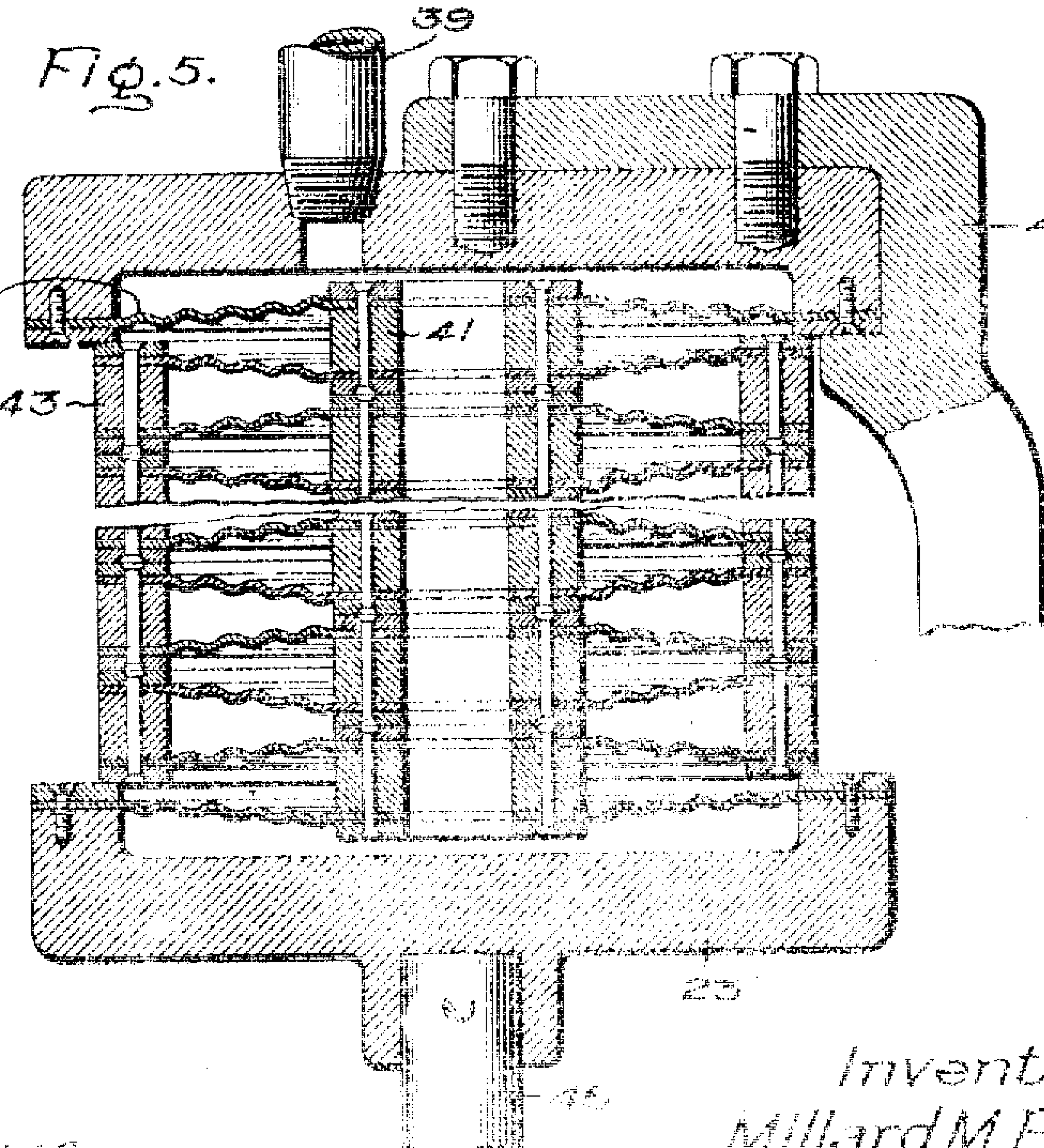


Fig. 5.



Witnesses.
Marcus L. Byng
J. Ellis Glen

Inventor:
Millard M. Pearson,
by Albert G. Davis
Att'y

UNITED STATES PATENT OFFICE.

MILLARD M. PEARSON, OF SCHENECTADY, NEW YORK, ASSIGNOR TO GENERAL ELECTRIC COMPANY, A CORPORATION OF NEW YORK.

GOVERNING MECHANISM.

954,646. Specification of Letters Patent. Patented Apr. 12, 1910.

Application filed September 28, 1907. Serial No. 394,969.

To all whom it may concern:

Be it known that I, MILLARD M. PEARSON, a citizen of the United States, residing at Schenectady, county of Schenectady, State of New York, have invented certain new and useful Improvements in Governing Mechanism for Turbines, of which the following is a specification.

The present invention relates to governing mechanism for turbines, and while more especially directed to those wherein a fluid actuated motor is employed to move the valve or valves controlling the admission of motive fluid to the turbine, is not limited thereto.

The invention has for its object to improve the construction of said mechanisms whereby the same parts can be used for a greater number of turbines than at present and especially for turbines of different outputs, particular reference being made to the means for communicating motion from the speed governor to the device controlling the valve actuating motor.

In one type of machine with which I am especially familiar the shaft is arranged vertically with the turbine at the lower end and an electric generator mounted on top of the turbine, the rotor of which is mounted on the bucket wheel shaft. At the top of the shaft is a speed governor acting on a comparatively long horizontally disposed lever. The valve mechanism is mounted on the turbine casing and the operating motor therefor is disposed at a convenient point, usually at or about the level of said casing. The distance between the end of the governor lever and the pilot valve is commonly a number of feet, from two to fourteen not being unusual. These parts are connected by a rod whose length is determined by the distance between them. As now arranged the length of the governor lever is changed for practically every different size turbine because of a difference in diameter of the turbine or the generator or both. A change in the length of the governor lever results in a change not only of the parts directly connected therewith but also in changes in the parts constituting the follow-up device which restores the pilot valve to its initial position after a change has taken place in the amount of fluid admitted to the turbine. The total number of changes is large and as a result new drawings, patterns, castings, etc., are required, all of which materially increases the cost of production. By my invention I obviate these changes, new drawings, patterns, castings, etc., and so arrange the parts that they can be used on machines differing widely in output and diameter. Usually it will be found best to divide the total number of sizes into groups and to standardize one governing mechanism for each group.

In carrying out my invention the valve mechanism, the actuating motor, whatever be its character, and the governor are located as before or in other suitable positions. The horizontal governor lever may be of any desired length, I prefer to make it shorter than formerly, and is supported and connected to the governor in the usual way. Mounted on the generator casing, or other suitable support, is a means or container containing a body of non-compressible fluid whose cubical contents can be changed by the application of external pressure. Mounted on the turbine or other support and connected to the controller of the actuating motor is a second means or container also containing a body of non-compressible fluid whose cubical contents can be changed by the application of internal pressure. The change in cubical contents of these containers is accompanied by the movement of one or more parts which movement is utilized to perform useful work. Connecting the two containers is a conduit for conveying fluid from one to the other. When pressure due to the governor is applied externally to one of the containers it reduces its cubical contents, and the fluid discharged therefrom passes through the conduit into the second container and by the internal pressure thus created dilates, expands or enlarges it in the direction of its length, and the movement of some part thus produced is transmitted to the pilot valve or to the controller of the motor whatever its character. Conversely when the governor acts on the first container in a manner to increase its cubical contents fluid flows from the second into it assisted by the elastic

nature of the material employed in the construction thereof and by the action of the atmosphere on some part or parts. Other arrangements for assisting this transfer of fluid may be utilized. Connected with the second container and the motor controller is a follow-up device actuated by the same motor that operates the main admission valve or valves to restore the motor controller to its initial position.

As a specific embodiment of my invention I have shown the containers made out of metal and somewhat similar in construction to bellows. One end of the structure is fastened to a support and the other end is movable. The containers are filled with such an amount of liquid as will cause them to be somewhat distended at all times. Oil will be found to be satisfactory for transmitting motion from one container to the other, but other fluids may be substituted. The structure and type of container can be widely varied without departing from my invention, as will readily be understood by those skilled in the art to which this invention relates. The main thing is to provide an arrangement whereby the governor can act through a fluid column on the motor controller and thus avoid the use of long levers, moving rods, connections, etc., which are in the way and are liable to be injured.

Since the conduit connecting the container can be made of metal and of any length and bent to any desired form, it follows that the same mechanism can be used on machines of widely different output, diameter and shape by merely lengthening the pipe, changing its shape, or both. A conduit arranged in the manner described will not readily be injured for it can closely follow the outline of the generator, and will be out of the way. It will not interfere with the position of brackets for supporting the gallery around the generator, and it avoids the use of any moving part between the governor and the motor controller which has heretofore been necessary.

In the accompanying drawings which illustrate one of the embodiments of my invention, Figure 1 is a partial view of a turbo-generator fitted with my improved turbine governing mechanism; Fig. 2 is a diagrammatic view illustrating the operation of the motor, controller and follow-up device; Fig. 3 is a detail view illustrating the driving connection between the motor and the cam-shaft actuated thereby; Fig. 4 is a vertical section of the fluid container actuated by the governor; and Fig. 5 is a vertical section of the fluid container which is connected to and operates the motor controller.

1 indicates a turbine, and mounted thereon is a valve chest 2 having an admission conduit 3. Mounted within the chest are a plurality of valves each operated by a lever 4 and a cam 5, the latter being mounted on and moving with the oscillating cam-shaft 6. The shaft is supported in the bearings 7. The cam-shaft is moved by the hydraulic motor 8 through a rack 9 which meshes with a pinion 10, Fig. 3, carried by a horizontal shaft 11; the latter may operate only one set of valves or it may extend across the top of the turbine and operate two sets, one on each side. Mounted on the shaft 11 is a beveled gear 12 meshing with a pinion 13 mounted on the cam-shaft 6. The motor is controlled by a pilot valve 14 shown in dotted lines, Fig. 1. This valve controls ports 15 and 16, Fig. 2, leading to opposite ends of the motor cylinder. The valve normally stands in the position shown and both ports are closed. Fluid under pressure is admitted by the pipe 17 to the space between the heads of the valve and is exhausted by the pipe 18. The valve is actuated by a lever 19 which is connected by pivot 20 to the link 21, and by pivot 22 to the moving wall or head 23 of the fluid container 24. The lower end of the link 21 is connected to a bell-crank lever 25; the other end of the lever is connected by the rod 26 to the lever 27 and the lower end of the lever 27 is pivotally connected to the rack 9 or to some part moving with the motor. The lever 19, link 21, bell-crank lever 25, rod 26 and lever 27 form a follow-up device for restoring the pilot valve to the initial position after one or more valves have been opened or closed by the motor, as will appear more fully hereinafter.

Mounted on the top of the turbine is a stool 28 which supports the electric generator 29, the rotor of which is mounted on the shaft 31, which shaft is driven by the bucket-wheels of the turbine. The generator is provided with a suitable cover and mounted on the top thereof is a dome 32 which incloses the centrifugal governor 33 shown in dotted lines. Pivotally mounted on the dome is a governor lever 34 which is attached to the governor at the inner end, and at its outer end to an adjustable rod 35. It is also connected to a rod 36 which may be attached to a spring employed for synchronizing the speeds of two or more machines, or for changing the speed at which the turbine will operate, as is well understood. Mounted on a pad formed on the cover is a fluid container 37, the upper wall or head 38 of which is attached to the rod 35. The containers 24 and 37 may be located wherever desired in line or not and are connected by the conduit 39 so that fluid may be transferred from one to the other. The outer end of the governor 11 in the present

instance is intended to have about two inches of movement between the no-load and full-load positions and the head or wall 38 has a corresponding movement. It is desirable, however, to have a greater movement for the head or wall 23 of the container 24 and I, therefore, arrange the latter so that it has such movement. In the present instance the movement is about twice that of the end of the governor lever.

Referring to Fig. 4, 38 indicates the movable head or wall of the container 37. It is attached air tight to a laminated metal disk 40 which is in turn fastened to the small ring 41. The ring 41 is also fastened air tight near the center to a laminated metal disk 42 and the latter is attached at its periphery to the large ring 43. This ring is in turn connected to a laminated metal disk 44. The construction of the remaining elements of the container being the same, further description is unnecessary. It should be noted, however, that the lower head or wall is stationary and is attached to the cover of the generator. Fluid is admitted to the container through a suitable passage having a plug 45 for closing it and preventing air from entering. When in operation the container is filled with such an amount of fluid as will cause the rings 41 and 43 to be slightly separated at all times.

39 indicates the conduit for conveying fluid from one container to the other.

The lower container differs from the upper as shown in Fig. 5 in that the disks are made of one thickness of corrugated metal, the arrangement of the rings 41 and 43 being the same as before. The upper head is secured to a bracket 44 which is attached to a frame piece that guides the stem of the pilot valve. The lowest disk of the series is connected to head 23 and the latter is connected by part 45 and pivot 22, Fig. 1, with the lever 19. As the head 38 of the upper container is moved downward by the governor, fluid is discharged through the conduit 39 into the lower container and forces the head 23 downward. When the outer end of the governor lever 34 moves upwardly it raises the head 38 which tends to create a vacuum within the upper container and starts the fluid into motion. This is assisted by the elastic nature of the disks of the containers and also by the atmospheric pressure acting on the under side of the head 23. In order to balance the weight of the fluid column a weight 46 or its equivalent is provided and suitably arranged as on the lever 19.

Referring to Fig. 2, and assuming that the governor has decreased the cubical contents of the upper container by forcing the head 38 downward, this causes the head 23 of the lower container to move downward and with it the pilot valve 14, the pivot 20 being the fulcrum. Fluid on being admitted by the pilot valve to the right-hand end of the cylinder starts the piston toward the left, the exhaust being open, which action swings the lever 27 to the left and moves the rod 26 in the direction of the arrow. This motion is communicated to the link 21 and the movement of the latter raises the pivot 20; the pivot 22 now being the fulcrum. This action continues until the pilot valve is raised to its initial position where the ports are closed and the motor stops. This action is repeated each time the speed of the turbine is decreased until finally the proper amount of steam is admitted to the turbine to satisfy the load. Assuming that the speed of the turbine increases, the outer end of the governor lever 34 moves upwardly and the reverse operation takes place, as will readily be understood; the follow-up device restoring the pilot valve after the motor piston has moved a definite amount.

When the diameter of the turbine or generator or both is changed it usually becomes necessary to change the location of the motor by moving it toward or away from the shaft. Such a change with constructions heretofore used requires an angular change in the position of the governor lever to compensate therefor because the radial plane of the pilot valve is changed. Changing the angular position of the governor rod changes the angular position of the bolt holes in the dome and generator cover, hence the drilling can only be done after the position of the other parts is determined. This requires additional drawings and instructions and prevents the factory from making up a large number of standard parts. With my invention these objections are avoided.

I have shown my invention in connection with a vertical shaft turbine, but it is also applicable to horizontal shaft turbines, and is especially applicable where the governor is on one end of the shaft near the generator and the valve mechanism and motor at the other.

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. The combination of a turbine and its casing, a speed governor driven by the turbine shaft, a governor lever valve mechanism for controlling the admission of motive fluid to said turbine and suitably mounted

with respect to the casing, and a fluid transmission means connecting the governor lever with said valve-mechanism.

2. The combination of a turbine, a valve controlling the admission of fluid to the turbine, a motor for moving the valve, a controller for the motor, a speed governor driven by the turbine, and a fluid transmission means for communicating movements of the governor to the controller.

3. The combination of a turbine, a valve controlling the admission of fluid to the turbine, a fluid actuated motor for moving the valve, a controller for the motor, a speed governor driven by the turbine shaft and located at a point remote from the controller, a fluid transmission means for communicating the movements of the governor to said controller, and a follow-up device for restoring the controller to its initial position.

4. The combination of a turbine, a valve mechanism controlling the admission of fluid thereto, a motor for actuating said mechanism, a controller for the motor, a speed governor, and fluid containers whose cubical contents are variable, one of which is mechanically connected to the governor and the other to the controller, the containers being so arranged that when one has its cubical contents decreased those of the other increase.

5. In a governing mechanism, the combination of a valve, a motor for actuating it, a controller for the motor, a fluid container which expands and contracts under changes in pressure for actuating the controller, and a speed governor for causing the container to act in response to load changes to move the controller.

6. In combination, a turbine, a valve controlling the admission of motive fluid thereto, a motor for actuating the valve, a controlling device for the motor, a fluid container which expands and contracts under changes in pressure, a governor responsive to changes in speed of the turbine shaft for causing the container to act, and a second container acted upon by the first for moving the controlling device.

7. In combination, a turbine, a valve controlling the admission of motive fluid thereto, a motor for actuating the valve, a controlling device for the motor, a fluid container which expands and contracts under changes in pressure, a governor responsive to speed changes of the motor for causing the container to act, a second fluid container acted upon by the first through a fluid column for moving the controlling device, and a follow-up device connected to the controlling device and to a part moving with the motor for restoring the controlling device to its normal position.

8. In combination, a turbine, a valve controlling the admission of motive fluid thereto, a motor for actuating the valve, a controlling device for the motor, a fluid container which expands and contracts with changes in external pressure applied thereto, a second fluid container remote from the first which expands and contracts with changes in internal fluid pressure and actuates the controlling device, and a governor responsive to changes in speed of the turbine shaft which varies the pressure on the first mentioned container.

9. In combination, a turbine, valve mechanism controlling the admission of motive fluid thereto, a motor for actuating said mechanism, a controlling device for the motor, a fluid container whose capacity can be varied, a second fluid container remote from the first whose capacity can also be varied and which acts on the controlling device, a conduit connecting the containers so that a change in capacity of one results in a change in capacity of the other, and a governor driven by the turbine shaft which acts on one of the containers in a manner to vary its capacity as the load changes.

10. In combination, a turbine, a valve for admitting motive fluid thereto, a motor for actuating the valve, a controlling device for the motor, a fluid container one part of which is capable of movement in the direction of the length of the container, a second fluid container one part of which is also capable of movement in the direction of the length of the container, the amount of movement of one of said parts being greater than that of the other, a conduit conveying fluid from one container to the other, a connection between one of said parts and the controlling device, and a governor for causing variations in the length of a fluid container as the load changes.

11. The combination of a turbine, a valve mechanism controlling the admission of motive fluid to the turbine, a motor for actuating the valve mechanism, a controlling device for the motor, a container having an elastic wall and containing liquid, a second container communicating with and situated at a point remote from the first, one wall of which is also elastic and is connected to the controlling device, and a governor responsive to load changes which acts on one of said containers in a manner to increase or decrease its cubical contents.

12. In combination, a turbine and its casing, a valve mechanism for controlling the admission of motive fluid thereto and supported by the turbine casing near its periphery, a controller for the motor, a speed governor mounted on the turbine shaft and situated at a point remote from the valve mechanism, a lever actuated by the gov-

ernor, and a fluid transmission means for communicating the movements of the lever to the controller.

13. In a governing mechanism, the combination of a valve, a motor for actuating it, a controller for the motor, a governor, means acting through a body of fluid for transmitting the motion of the governor to the controller, and a means for counterbalancing the weight of the fluid.

In witness whereof, I have hereunto set my hand this 27th day of September, 1907.

MILLARD M. PEARSON.

Witnesses:

BENJAMIN B. HULL,

HELEN ORFORD.