No. 822,256. PATENTED JUNE 5, 1906.

W. L. R. EMMET.

GOVERNING MECHANISM FOR TURBINES.

APPLICATION FILED APR. 5, 1904.

2 SHEETS—SHEET 1

Fig. 1.

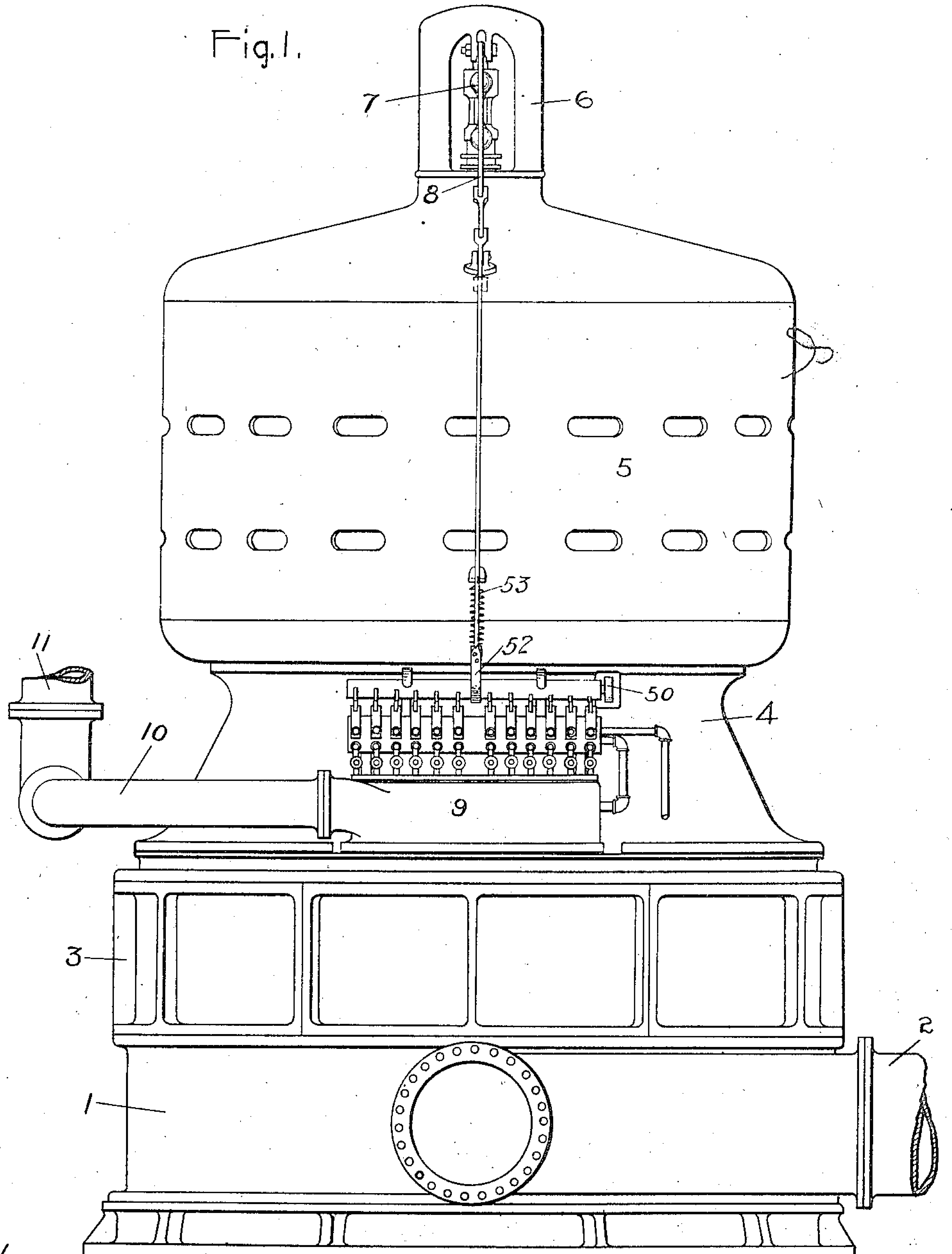

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Fig.3.

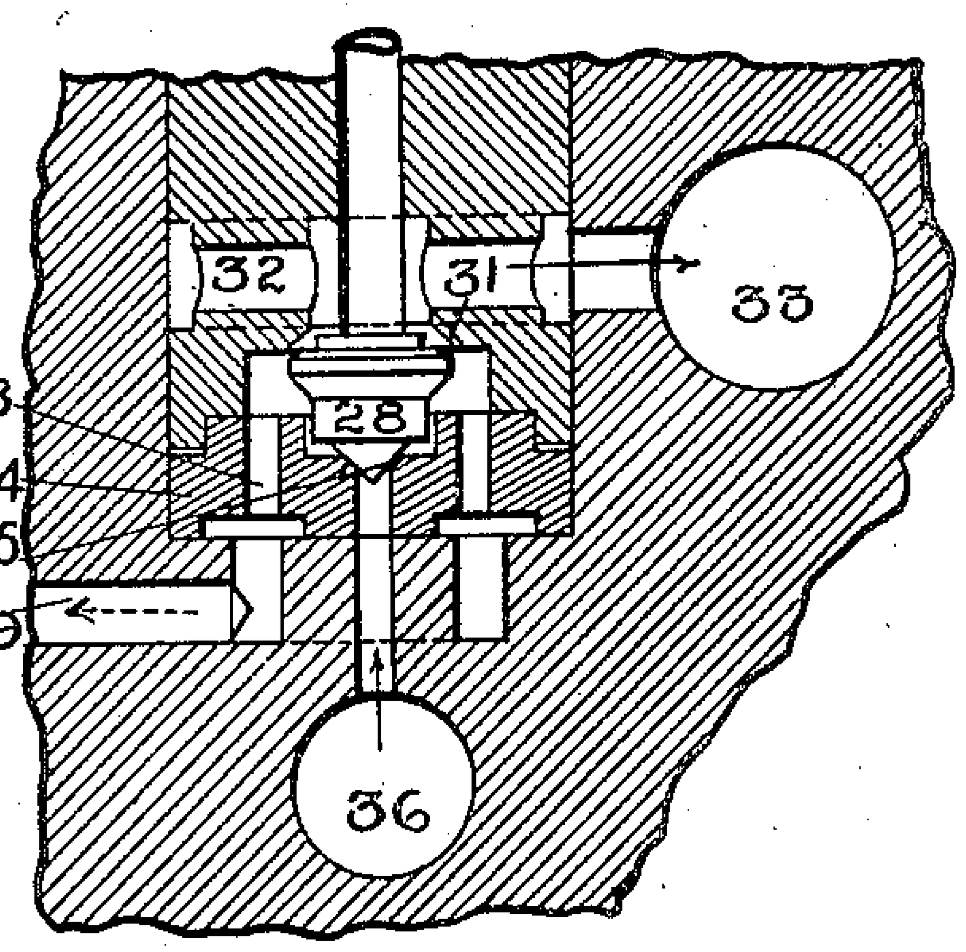


Fig.2.

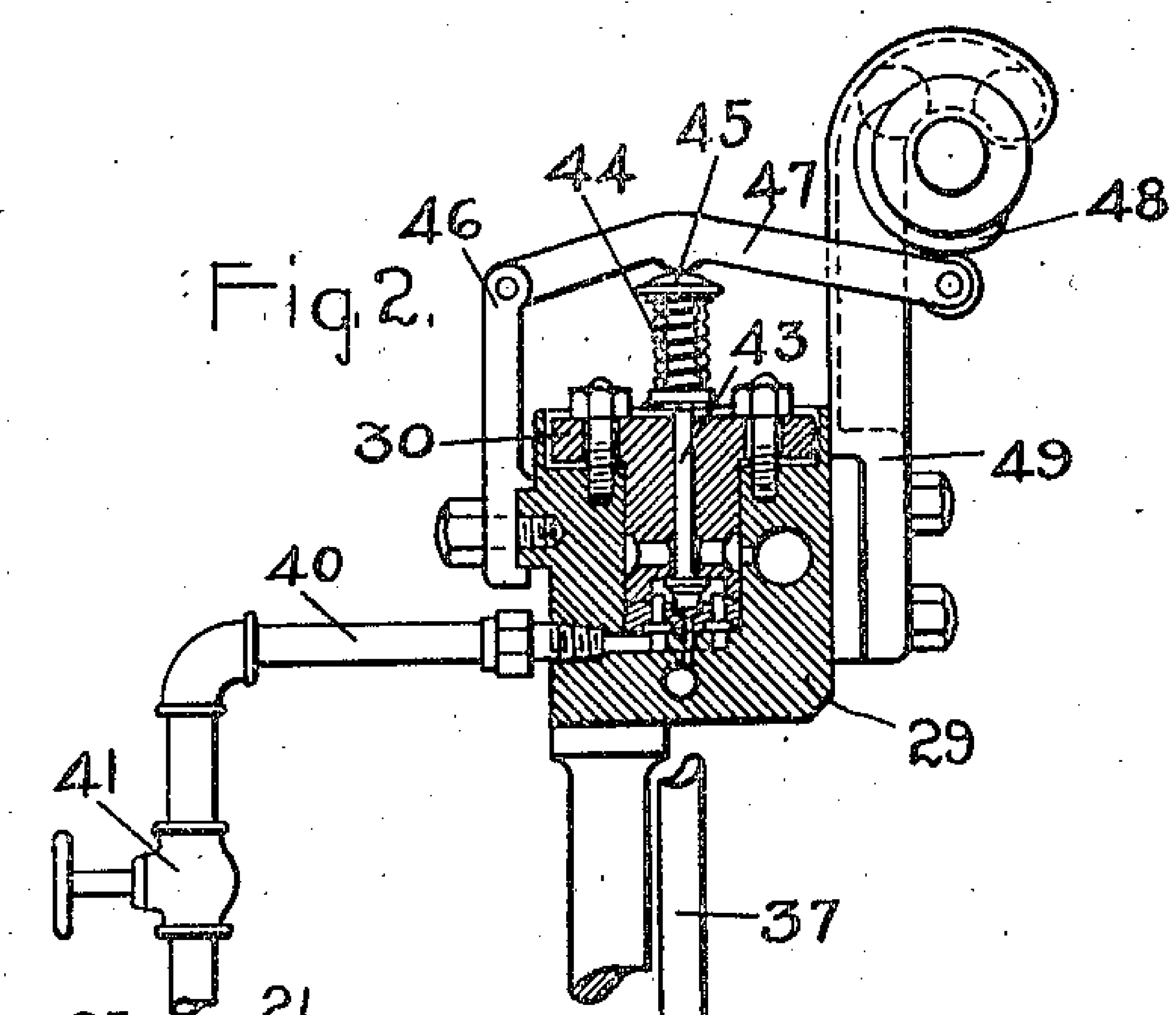
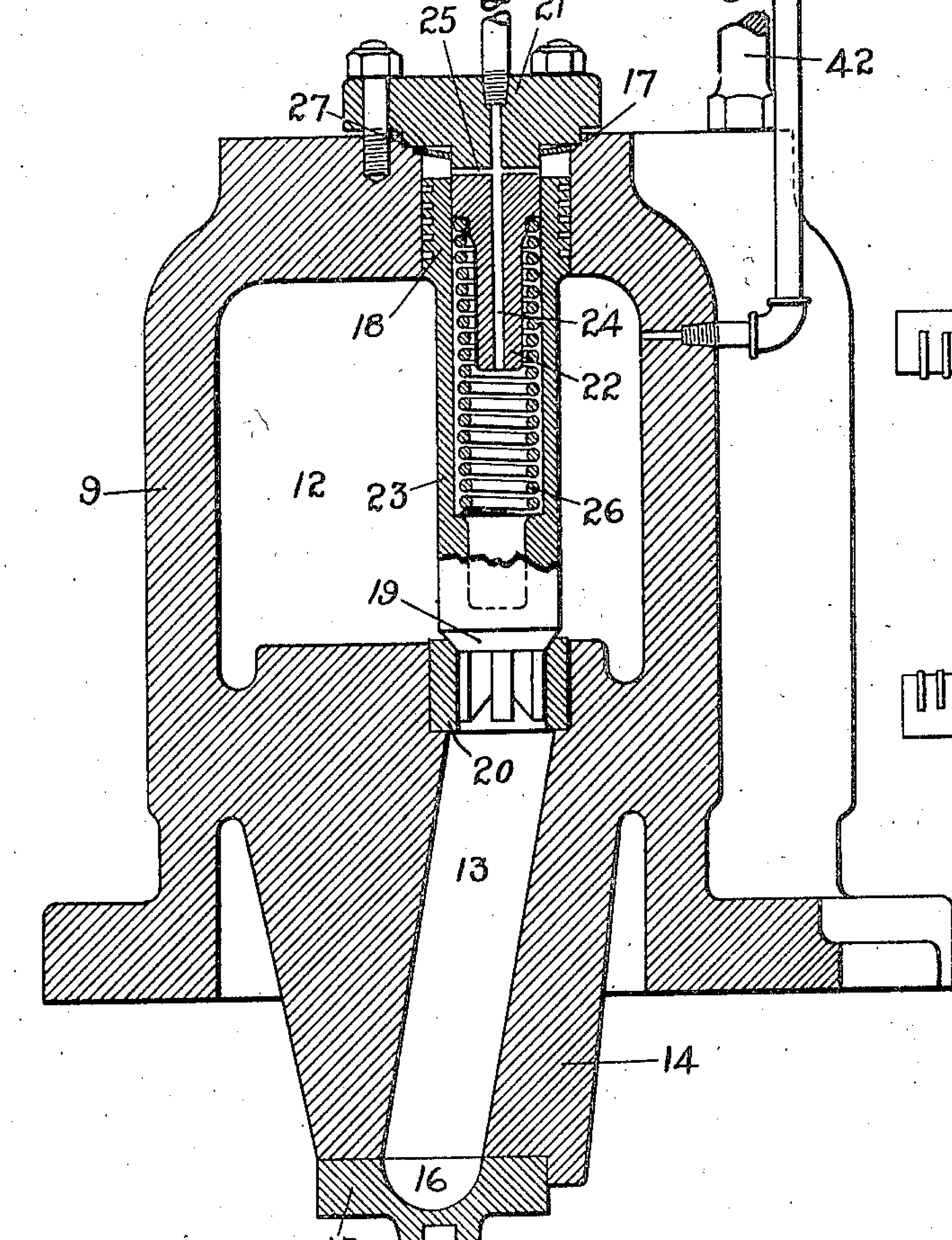
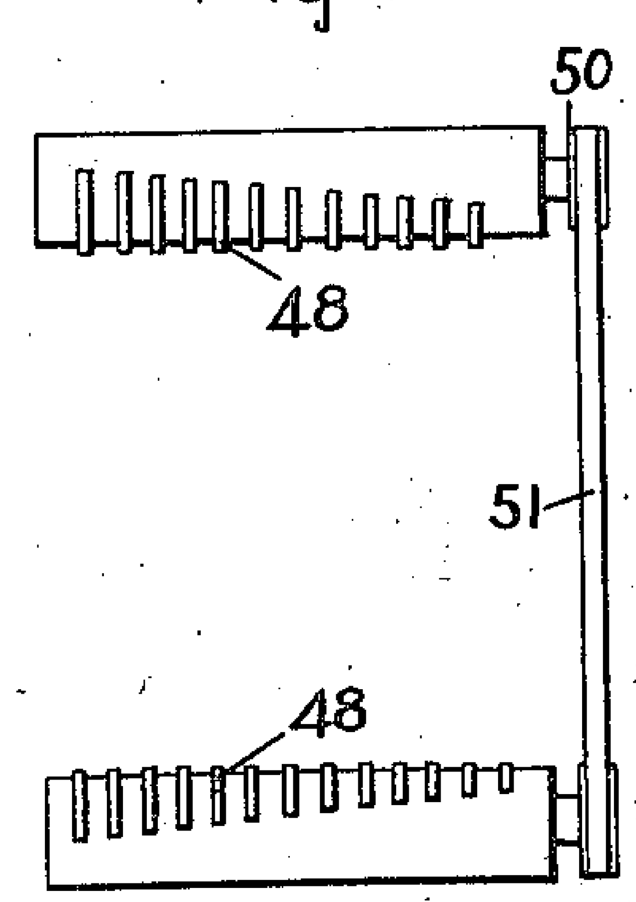



Fig.4.



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UNITED STATES PATENT OFFICE.

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GOVERNING MECHANISM FOR TURBINES.

No. 822,256. Specification of Letters Patent. Patented June 5, 1906.

Application filed April 5, 1904. Serial No. 201,747.

To all whom it may concern:

Be it known that I, WILLIAM L. R. EMMET, 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 Mechanisms for Elastic-Fluid Turbines, of which the following is a specification.

Certain types of turbines as commonly constructed are provided with separately-actuated nozzle-valves, each valve being capable of opening and closing independently of every other valve. Each nozzle-valve is operated by a fluid-actuated motor, and in order to control the motors, and therefore the valves, a relay or auxiliary valve is provided for each motor, the relay-valves in turn being controlled by a device responsive to load changes—such, for example, as a fly-ball governor. As constructed the nozzle-valves, motors, and relay-valves are included in the same structure. Practice has demonstrated that owing to the frequency with which the nozzle-valves are opened and closed by the motors the force exerted by each motor has a tendency to break the stem or connection between it and the valve.

In order to start the motors from a position of rest and in a direction to close the valve, springs are employed, which are located between the head of the motor-piston and the cylinder-head. I have found that these springs are liable to lose their temper when subjected to superheated steam or other fluid and also that with the constructions heretofore employed they are too short unless the mechanism as a whole is made unduly large. Some difficulty has also been experienced in operating the relay-valves.

The present invention has for its object to improve the governing mechanism of elastic-fluid turbines by obviating the objections set forth above. The means by which these objections are obviated will be set forth more fully hereinafter, together with certain other features of improved construction.

In the accompanying drawings, which illustrate one embodiment of my invention, Figure 1 is a view in side elevation of an elastic-fluid turbine of the multistage jet type. Fig. 2 is an enlarged sectional view through the valve-chest and a nozzle-valve. Fig. 3 is an enlarged sectional detail view of a relay-valve for controlling the motor which actuates the nozzle-valve; and Fig. 4 is a detail view of the cam-cylinders situated on opposite sides of the turbine, with means for transmitting motion from one to the other.

1 represents the base of the machine, which is connected to a condenser or atmosphere by the conduit 2. Mounted above the base is the casing 3, which includes one or more bucket-wheels, as the case may be. Usually a number of valves will be provided. Mounted upon the casing is a stool 4, that supports the dynamo-electric machine or other load device 5.

The upper end of the dynamo is provided with a cover, which supports the dome 6, the latter surrounding the speed-responsive device 7 and carrying the lever 8 for transmitting motion from said device to the mechanism for controlling the relay-valves. The speed-responsive device is attached to the upper end of the turbine-shaft, which also carries the revolving member of the dynamo. Mounted on top of the turbine-casing are one or more steam-chests 9, containing a plurality of individual nozzle-valves which have an open and a closed position, but no intermediate. In order to distribute the strain evenly about the wheel, I prefer to arrange the nozzle and other controlling valves in groups. In the present illustration two groups of nozzles are shown, each comprising a plurality of sections, twelve being shown in the present illustration. Steam or other elastic fluid is delivered to the chest by a conduit 10, which surrounds or partially surrounds the stool. The conduit is in turn supplied from the pipe 11, leading from the boiler.

Referring to Fig. 2, the construction and arrangement of the nozzle-valves and their actuating mechanism will be described. Since all of the parts are duplicates, a description of one of them will be sufficient. 9 represents the steam or valve chest, which is provided with front and rear curved walls to make it conform to the shape of the turbine-casing and stool. In Fig. 2 the left-hand wall of the chest is the front wall in Fig. 1. The interior of the chest is cored out to form a chamber 12, which is or may be common to all of the valves. Extending downwardly from the chamber are as many nozzle-passages 13 as there are nozzle-sections. These passages are formed in the projection 14, that constitutes an extension of the bottom wall of the chest. To the lower end of the projection is bolted or otherwise attached a sectional nozzle 15, comprising a plurality of closely-associated nozzle-sections, each of which is provided with a well-rounded bowl 16 and a throat and discharge-orifice of suitable shape. These sections should have the same angle of delivery and the same ratio of expansion where expansion is necessary. Each passage 13 may supply one or more sections of the nozzle, as desired, and each nozzle-passage may and preferably does cover more than one bucket-space. The upper wall of the chest is bored out to form a cylinder 17 for the motor-piston 18, which opens and closes the nozzle-valve 19. The valve is provided with a removable seat 20, that is carried by the lower part of the valve-chest. 21 represents the head of the cylinder, which is provided with an elongated projection 22, that enters the barrel 23, that connects the motor-piston 18 and the valve 19. The projection is provided with a vertically-extending passage 24, which conveys high-pressure fluid to the inside of the barrel. It is also provided with one or more transverse passages 25, which communicate with the vertical passage and discharge steam into the cylinder 17 behind the piston. The piston is provided with a suitable packing—such, for example, as a plurality of grooves—and on the inside makes a close fit with the cylindrical surface on the upper end of the projection 24. Surrounding the projection and located between it and the barrel is a compression-spring 26, which tends at all times to close the valve against the pressure exerted upon the piston by the fluid in the chamber 12. By placing the spring inside of the barrel it is in a measure protected from the hot steam in the chest, and by reason of its having considerable length it is not so liable to injury as a short spring. It is more reliable in operation, since it is easier to make a long spring with the desired scale than it is a short one. Situated in the cylinder and above the piston is a spring-plate 27, that serves to reduce the shock caused by the opening of the valve. As the piston moves upwardly and passes the ends of the transverse passage 25 a certain amount of motive fluid is trapped in the cylinder, which fluid acts as a cushion for the opening-valve.

In order to control the opening and closing of the nozzle-valves corresponding relay-valves 28 are provided, each valve being mounted in a suitable valve-chest 29, that is straight in a longitudinal direction instead of curved, like the steam-chest. This is done in order that a single cam will be sufficient to operate all of the valves and also that the relay-valves may be of corresponding length. When the relay-valve is on its lower seat, a relatively small area is exposed to the high-pressure steam; but as the lever 47 decreases the pressure on the spring 44 by a certain amount the steam-pressure thereon will be sufficient to start the valve, and since the exposed area suddenly increases the valve will open with a sudden movement or jump, and thus prevent cutting of the valve or its seat. The relay-valve chest is provided with as many cylindrical openings as there are relay-valves, and each opening is provided with a cover 30, which has a projection on its under side, the said projection being provided with a valve-seat 31, Fig. 3. Extending transversely and just above the valve-seat is a passage 32, that communicates with the exhaust 33. In addition to the transverse passage is a circumferential groove that connects with the ends of the passage and opens into the exhaust. Situated below the projection on the cover and seated on the valve-chest is a detachable piece 34, containing a valve-seat 35 for the lower end of the relay-valve, and also a vertically-extending passage 36, which communicates with the source of high pressure—such, for example, as the pipe 37, the latter being connected to the chamber 12. In addition to the passage 36 two or more vertically-extending passages 38 are provided, which when the relay-valve 28 is raised from its seat admit high-pressure fluid into the passage 39, the latter being connected by the pipe 40 with the passage 24 and the upper side of the motor-piston. In the pipe 40 and in a position where it is readily accessible is a cut-off valve 41, by means of which any given motor and its nozzle-valve can be cut out of service.

The relay-valve chest is mounted on two or more posts 42, which support it at a point some distance from the nozzle-valve chest. By this arrangement the parts are rendered easily accessible and the heat from the nozzle-valve chest is not imparted to it. By keeping the temperature of the relay-valve chest down the troubles due to overheating are reduced to a minimum. To each relay-valve is attached a stem 43, which passes up through to the cover 30 and the projection thereon and terminates in a head that is adapted to receive the lower end of the compression-spring 44. The lower end of the spring is secured to the head by any suitable means. The stem 43 should be packed to prevent the escape of steam. In the present instance the stem passes through a long hole, and the water collected in the space between it and the adjacent walls is relied upon to act as a water packing. The upper end of the spring 44 is attached to the cap 45. The spring 44 forms the only connection between the head on the stem 43 and the cap 45, and in this manner all trouble due to binding and non-alinement of the parts is prevented. On the left-hand side of the valve-chest is an upright 46, that carries the fulcrum for the horizontally-extending lever 47. The outer end of the lever is provided with an antifriction-roller that engages with a projection 48 on the cam-roller. On the lever at the point directly over the cap 45 is a projection which engages with the latter for actuating it. Bolted or otherwise secured to the right-hand side of the relay-valve chest are two or more uprights 49, that carry bearings for the rock-shaft or spindle of the cam-roller. The cam-roller is actuated by a flexible band 52, Fig. 1, which is wrapped wholly or partially around it. The opposite end of the band is connected to a rod, and the latter is in turn connected to the speed-responsive device by the lever 8. The cam-roller is moved in the opposite direction by an extension-spring 53, which is attached to one end of the band and to a stationary abutment, the said band being suitably secured to the roller. As the position of the balls changes, due to changes in speed, the cam-cylinder is rocked forward or backward, as occasion demands. Under normal load conditions certain of the relay-valves will be depressed, certain of the other valves will be in a raised position, and one valve will be doing the governing. From this it follows that certain of the nozzle-valves will be closed, while others are open, and that one nozzle-valve is opening and closing to govern the machine. The cam-cylinder is so arranged that all the nozzle-valves may be cut into or out of service.

In Fig. 4 are shown two cam-cylinders 48, which are located on opposite sides of the turbine-shaft. On one end of each cylinder is a gear or pulley 50, that is connected to the corresponding gear or pulley on the opposite cam-cylinder by a chain or belt 51. By means of this arrangement motion imparted to one cylinder is transmitted to the opposite cylinder. It is preferable to so arrange the projections on the cam-cylinders that a nozzle-valve will first open on one side of the machine and a second nozzle-valve open on the opposite side of the machine, and so on. To state the matter in a different way, the projections on the two cylinders are staggered. In this manner the load is distributed evenly over the wheel. If desired, however, several nozzle-valves may be operated successively in one group, and then some or all of the valves in the second group, after which the valves in the first group will be acted upon by the governor.

Assuming the parts to be in the position shown, the nozzle-valve 19 is supposed to be in the act of opening and the cam-cylinder has depressed the relay-valve 28. The supply of high-pressure fluid to the back of the motor-piston is now cut off and the relay-valve has been moved away from the seat 31, which controls the passage of the exhaust. The steam which has been in the cylinder-space 17 and in the space within the barrel 23 is now permitted to pass through the pipe 40 and the passage 39 in the direction of the arrow and past the valve 28 and its upper seat into the exhaust 33 in the direction of the arrow. This means that the pressures on opposite sides of the motor-piston are unbalanced, the pressure on the face adjacent to the steam-containing chamber 12 exceeding that on the upper side. As soon as the valve opens slightly the motor-piston is unbalanced to a greater degree, because the steam then has access to the under side of the valve. Hence its area is added to that of the piston. On the other hand, assuming that it was necessary to close one of the nozzle-valves, the projection on the cam-cylinder would pass off of the roller on the actuating-lever 47 and the steam-pressure on the under side of the valve 28 would cause it to rise with a jump and engage the seat 31 and cut off the passage to the exhaust. High-pressure steam would then pass from passage 36 past the valve into passage 39 in the direction of the dotted arrow, thence through the pipe 40 into the barrel of the nozzle-valve and motor-piston. The pressure exerted by the fluid plus that of the spring will start the valve into operation, and as soon as the passage 25 is uncovered the additional area of the piston thus exposed is added to that already in service for moving the nozzle-valve toward its seat.

The nozzle-valve and the mechanism for actuating it form the subject-matter of a divisional application, which division was made subject to the requirement of the Patent Office under the provisions of Rules 41 and 42 and bears Serial No. 279,310, filed September 20, 1905.

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 a governing mechanism for elastic-fluid turbines, the combination of a chest, a plurality of nozzle-valves therein, relay-valves, a chest therefor separate from the nozzle-valve chest, conduits for conveying fluid from one chest to the other, and means for operating the relay-valves.

2. In a governing mechanism for elastic-fluid turbines, the combination of a chest, a plurality of nozzle-valves in the chest, pistons for moving the valves, relay-valves for controlling the pistons, levers for operating the relay-valves, and a yielding medium between the valves and the levers.

3. In a governing mechanism for elastic-fluid turbines, the combination of a support,

a plurality of valves mounted therein, levers for operating the valves, a cam which moves the levers in a predetermined manner, and an elastic medium between each valve and lever.

4. In a governing mechanism for elastic-fluid turbines, the combination of a nozzle-valve chest which is shaped to conform to that of the casing, a relay-valve chest which is straight and which is separated from the nozzle-valve chest to prevent the transfer of heat, a cam which extends parallel to the relay-valve chest, a plurality of valves in each chest, levers for operating the relay-valves which are moved by the cam, and motors under the control of the relay-valves for actuating the nozzle-valves.

5. In a governing mechanism for elastic-fluid turbines, the combination of a chest containing nozzle-valves, a relay-valve chest supported in a definite position with relation to the nozzle-valve chest but separated therefrom by a space to prevent the transfer of heat, a plurality of relay-valves for controlling the nozzle-valves, and a cam for actuating the relay-valves in the proper sequence which is supported by the relay-valve chest.

6. In a governing mechanism for elastic-fluid turbines, the combination of a valve-chest, a plurality of individual valves mounted therein, levers for actuating the valves, a spring carried by each valve-stem which engages a lever, and a means for moving the levers in their proper sequence.

7. In a governing mechanism for elastic-fluid turbines, the combination of a valve-chest, a plurality of valves therein, a stem for each valve which extends through the chest, a plurality of levers which extend across the chest, a yielding medium interposed between each stem and its lever, fulcrums for the levers located at one side of the chest, and a means for actuating the levers located on the opposite side of the chest.

8. In a governing mechanism for elastic-fluid turbines, the combination of a valve-chest, a plurality of valves each mounted in a separate opening, a cover for each opening through which the valve-stem extends, a yielding medium which is attached to each stem, levers for actuating the valves that extend transversely of the chest, and a cam located at one side of the chest for actuating the levers.

9. In a governing mechanism for elastic-fluid turbines, the combination of a chest containing valves, means for actuating them, a second chest containing relay-valves, means for actuating the valves, conduits for conveying fluid between the chests, and cut-out valves for rendering the nozzle-valves inoperative.

10. In a governing mechanism for elastic-fluid turbines, the combination of a chest containing valves, means for actuating them, a second chest containing relay-valves, a support for the second chest which separates it from the first to prevent the transfer of heat, conduits for conveying fluid from one chest to the other, and cut-out valves which interrupt the passage of fluid from one chest to the other.

11. In a governing mechanism for elastic-fluid turbines, the combination of valves which are divided into groups and are arranged to open and close to admit fluid to the turbine, cams for operating the valves arranged in sets, and means for transmitting motion from one set of cams to the other.

12. In a governing mechanism for elastic-fluid turbines, the combination of valves which are divided into groups and are arranged to open and close to admit fluid to the turbine, cams for operating the valves arranged in sets, means for transmitting motion from one set of cams to the other, and a speed-responsive device for actuating one set of cams.

13. In a governing mechanism for elastic-fluid turbines, the combination of valves which are divided into groups and are arranged to open and close to admit fluid to the turbine, cam-cylinders for operating the valves, means for driving one cylinder from the other, and a speed-responsive device for imparting movement to the cams.

14. In a governing mechanism for elastic-fluid turbines, the combination of valves which are divided into groups and are arranged to open and close to admit fluid to the turbine, cams arranged in sets, the cams of the sets being staggered to actuate the valves in the groups alternately, and a means for operating the cams.

In witness whereof I have hereunto set my hand this 4th day of April, 1904.

WILLIAM L. R. EMMET.

Witnesses:

B. B. Hull,

Helen Orford.