

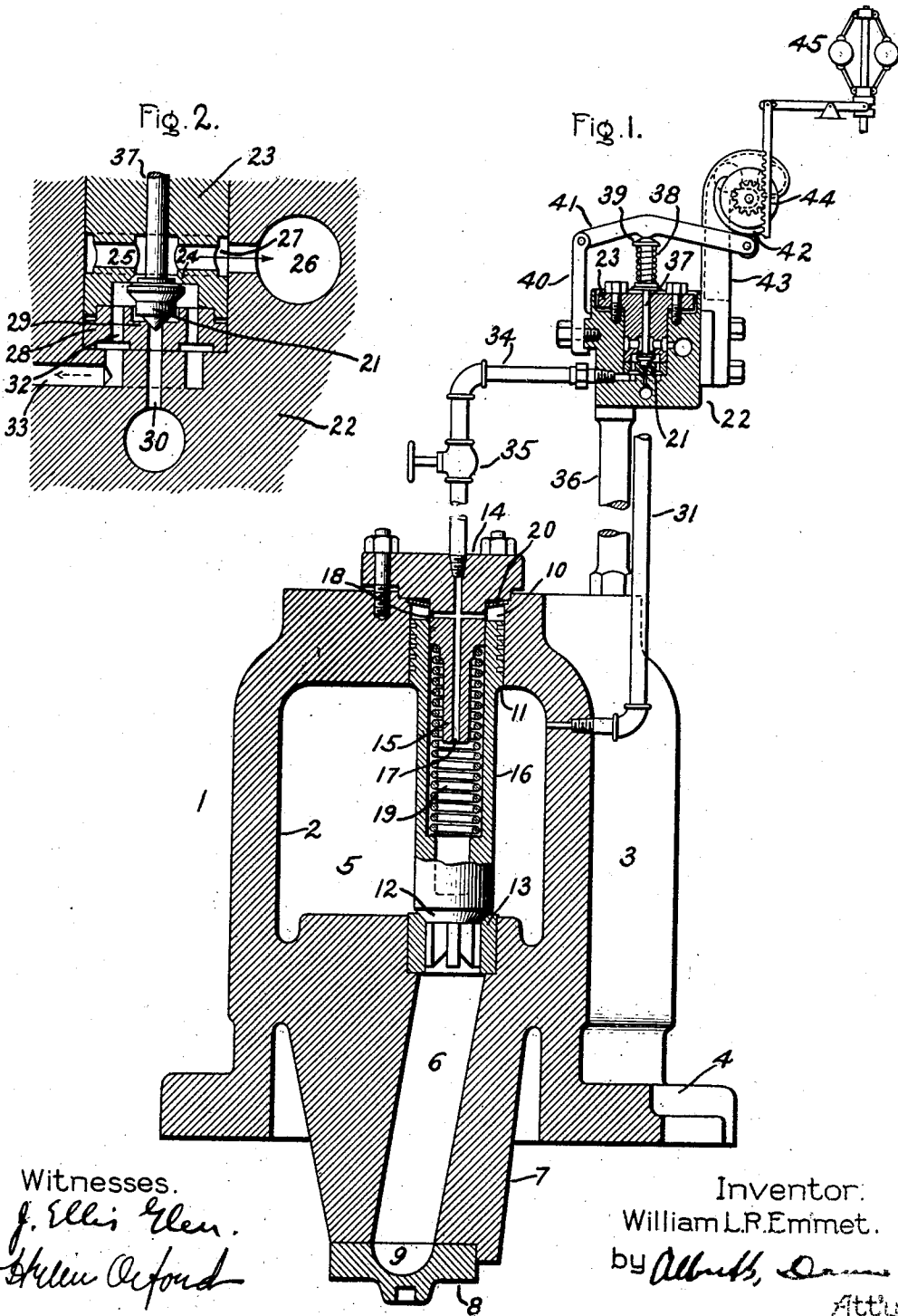
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W. L. R. EMMET.

GOVERNING MECHANISM FOR ELASTIC FLUID TURBINES.

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Witnesses.

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UNITED STATES PATENT OFFICE.

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GOVERNING MECHANISM FOR ELASTIC-FLUID TURBINES.

No. 822,887.

Specification of Letters Patent.

Patented June 5, 1906.

Original application filed April 5, 1904, Serial No. 201,747. Divided and this application filed September 20, 1905. Serial No. 279,310.

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.

The present invention is a division of my pending application, Serial No. 201,747, filed April 5, 1904, and is made at the requirement of the United States Patent Office under the provisions of Rules 41 and 42.

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 nozzle-valves, a relay-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. 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 construction heretofore employed they are too short unless the mechanism as a whole is made unduly large. Some difficulty has also been experienced with relay-valves and the mechanism for operating them.

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 an enlarged sectional view through the valve-chest, nozzle-valve, and relay-valve mechanism, and Fig. 2 is an enlarged

sectional detail view of a relay-valve for controlling the motor which actuates the nozzle-valve.

In practice the nozzles or fluid-discharge passages are arranged in groups around the wheel-casing of the turbine and motive fluid is supplied to each group from a chest. These chests are segmental in horizontal section, so as to conform to the curvature of the wheel-casing upon which they are supported.

1 represents a steam-chest having a front or convex wall 2, a rear or concave wall 3, and a flanged base 4, by which latter it is bolted to the turbine-casing. The chest is cored out to form a chamber 5, which contains the nozzle-valves.

Extending from the chamber are as many nozzle-passages 6 as there are nozzle-sections. These passages are formed in the projection 7, that constitutes an extension of the bottom wall of the chest. To the lower end of the projection is bolted or otherwise attached a nozzle 8, comprising a plurality of closely-associated nozzle-sections, each of which is provided with a well-rounded bowl 9 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 6 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. Since the nozzle-valves and their operating mechanism are duplicates a description of one of them will be sufficient.

The upper wall of the chest is bored out to form a cylinder 10 for the motor-piston 11, which opens and closes the nozzle-valve 12. A removable seat 13 is provided that is carried by the lower part of the valve-chest. 14 represents the head of the cylinder, which is provided with an elongated projection 15, that enters the barrel 16, that connects the motor-piston 11 and the valve 12. The projection is provided with a vertically-extending passage 17, which conveys high-pressure fluid to the inside of the barrel. It is also provided with one or more transverse passages 18, which communicate with the vertical passage 17 and discharge steam into the cylinder 10 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 projec-

tion 15." Surrounding the projection and located between it and the barrel is a compression-spring 19, which tends at all times to close the valve against the pressure exerted upon the piston by the fluid in the chamber 5. One end of the spring is seated on the projection 15, which forms a fixed abutment and the other end is seated on an internal shoulder at the inner end of the barrel-bore. 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 also 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 20, 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 18 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-valve, corresponding relay-valves 21 are provided, each valve being mounted in a suitable valve-chest 22, 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. The relay-valve chest is provided with as many cylindrical openings as there are relay-valves and each opening is provided with a head or cover 23, which has a projection on its under side, the said projection being provided with a valve-seat 24, Fig. 2. Extending transversely and just above the valve-seat is a passage 25, that communicates with the exhaust 26. In addition to the transverse passage is a circumferential groove 27, 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 28, containing a valve-seat 29 for the lower end of the relay-valve 21 and also a vertically-extending passage 30, which communicates with the source of high pressure—such, for example, as the pipe 31, Fig. 1, the latter being connected to the chamber 5. In addition to the passage 30 two or more vertically-extending passages 32 are provided in the piece 28, which when the relay-valve 21 is raised from its seat admit high-pressure fluid into the passage 33, the latter being connected by the pipe 34, Fig. 1, with the passage 17 and the upper side of the motor-piston. In the pipe 34 and in a position where it is readily accessible is a cut-off valve 35, by means of which any given motor and its nozzle-valve can be cut into or out of service.

The relay valve-chest is mounted on two

or more posts 36, 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 37, which passes up through to the cover 23 and the projection thereon and terminates in a head that is adapted to receive and retain the lower end of the compression-spring 38. The stem 37 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 38 is attached to the cap 39. The spring 38 forms the only connection between the stem 37 and the cap 39, and in this manner all trouble due to binding and non-alinement of the parts is prevented. When the relay-valve is on its lower seat, only a relatively small area is exposed to the high-pressure steam; but as the lever 41 decreases the pressure on the spring 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 reverse action takes place when the lever compresses the spring to a point where it overcomes the steam-pressure. This action is assisted by the shapes of the valve and seats. On the left-hand side of the valve-chest is an upright 40, that carries the fulcrum for the horizontally-extending lever 41. The outer end of the lever is provided with an antifriction-roller that engages with a projection 42 on the cam-roller. On the lever at the point directly over the cap 39 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 43, that carry bearings for the rock-shaft or spindle of the cam-roller. The cam-roller is provided with projections of progressively-increasing lengths to cause successive operation of the valves. It is actuated by a rack-and-pinion gearing 44, the rack of which is connected with the speed-responsive device 45. The speed-responsive device may be mounted on the turbine-shaft or on another shaft driven by the turbine through suitable intermediate mechanism. As the governor is brought into play, 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 more or less frequently to govern the machine. The cam-cylinder is so arranged that all of the nozzle-valves may be cut into or out of service.

Assuming the parts to be in the position shown, the nozzle-valve 12 is supposed to be in the act of opening and the cam-cylinder has depressed the relay-valve 21. 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 24, which controls the passage of the exhaust. The steam, which has been in the cylinder-space 10 and in the space within the barrel 16, is now permitted to pass through the pipe 34 and the passage 33 in the direction of the arrow, past the valve 21 and its upper seat into the exhaust 26 in the direction of the arrow. This means that the pressures on the opposite sides of the motor-piston are unbalanced, the pressure on the face adjacent to the steam-containing chamber 5 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 is necessary to close one of the nozzle-valves, the projection on the cam-cylinder will pass off of the roller on the actuating-lever 41 and the steam-pressure on the under side of the valve 21 would cause it to rise with a jump and engage the seat 24 and cut off the passage to the exhaust. High-pressure steam will then pass from passage 30 past the valve into passage 33 in the direction of the dotted arrow, thence through the pipe 34 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 18 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.

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 valve, a motor for operating it, a barrel for connecting the valve and motor, a spring inclosed by the barrel which urges the valve in one direc-

tion, and means responsive to load changes for controlling the operation of the motor. 65

2. In a governing mechanism for elastic-fluid turbines, the combination of a valve, a motor for operating it, comprising a piston and cylinder, a barrel connecting the valve and piston, a projection on the cylinder-head that enters the barrel, and a fluid-carrying passage in the projection that admits fluid to the cylinder-space back of the piston to form a cushion for the latter. 70

3. In a governing mechanism for elastic-fluid turbines, the combination of a valve, a motor for operating it, comprising a piston and cylinder, a barrel connecting the valve and piston, a projection on the cylinder-head that enters the barrel, a passage in the projection that admits fluid to the space within the barrel, and a second passage communicating with the first which admits fluid back of the piston to form a cushion for the latter. 80

4. In a governing mechanism for elastic-fluid turbines, the combination of a valve, a motor for operating it, comprising a piston and cylinder, a barrel connecting the piston and valve, a projection on the cylinder-head which enters the barrel and is provided with a fluid-carrying passage, and a spring which surrounds the projection and is located within the barrel for urging the piston and valve in one direction. 85

5. In a governing mechanism for elastic-fluid turbines, the combination of a valve, a motor for operating it, comprising a piston and cylinder, a barrel connecting the piston and valve, a passage for admitting fluid back of the piston to cushion it; and a spring-plate located in the cylinder-space that also acts as a cushion. 95

6. In a governing mechanism for elastic-fluid turbines, the combination of a valve, a seat therefor, means for guiding the movement of the valve, a barrel connecting the valve and the said means, a spring in the barrel which urges the valve toward its seat, a stationary abutment for the spring at the open end on the barrel, and means for opening the valve. 105

7. In a governing mechanism for elastic-fluid turbines, the combination of a valve-chest, a valve therein, a piston subjected to the pressure of the fluid in the chest, a barrel connecting the valve and piston, a spring inclosed in the barrel which tends to seat the valve, and means controlling the fluid-pressure acting on the piston to open and close the valve. 115

In witness whereof I have hereunto set my hand this 18th day of September, 1905.

WILLIAM L. R. EMMET.

Witnesses:

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