No. 844,753. PATENTED FEB. 19, 1907.

F. SAMUELSON.

GOVERNING MECHANISM FOR ELASTIC FLUID TURBINES.

APPLICATION FILED MAY 24, 1905.

3 SHEETS—SHEET 1.

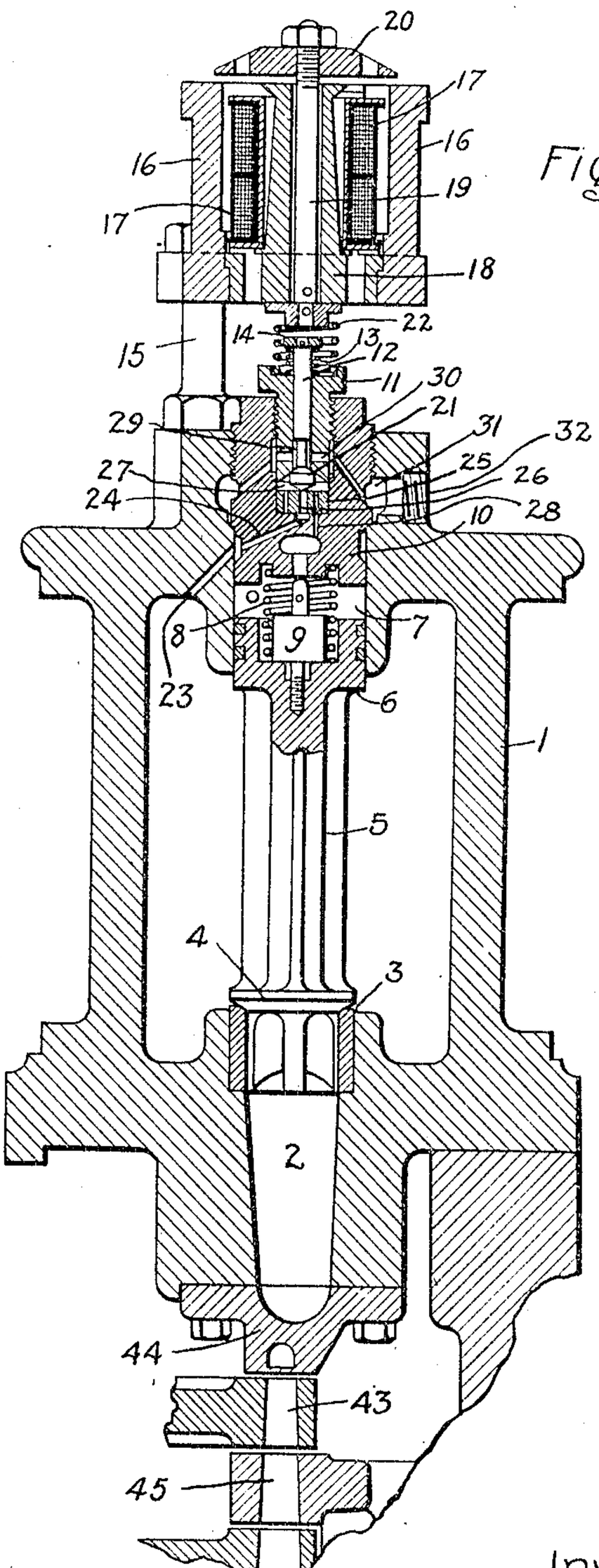

Fig. 1

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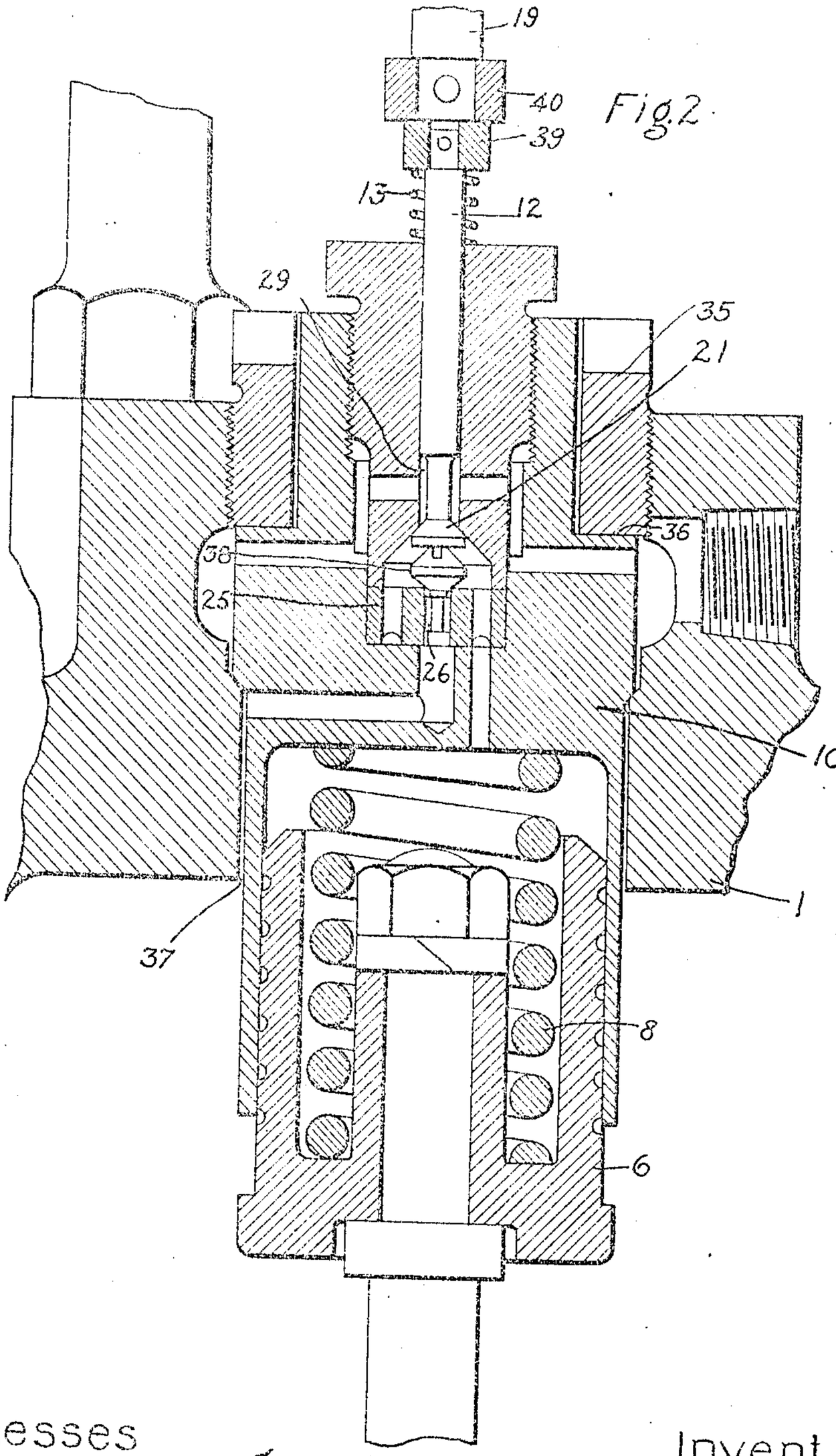
3 SHEETS—SHEET 2.

Fig. 2.



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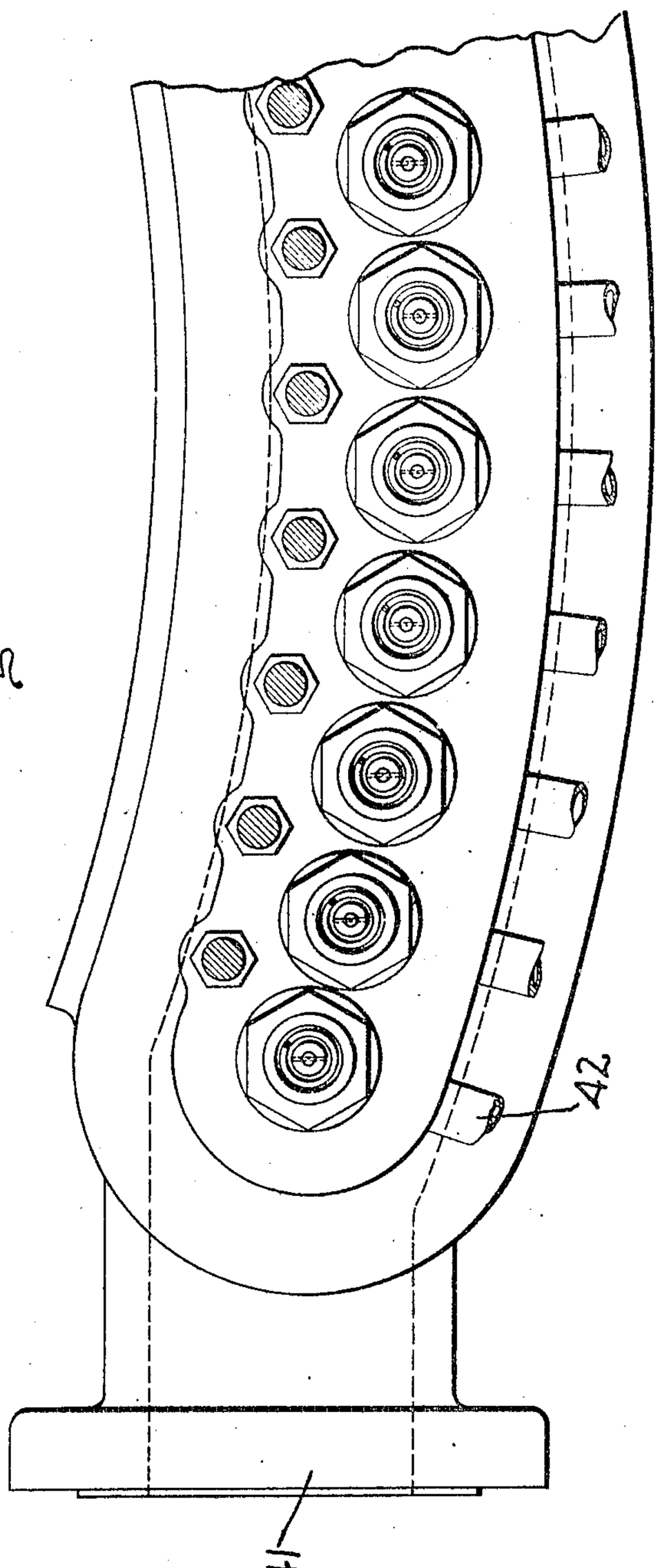
3 SHEETS—SHEET 3.

Fig. 3



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UNITED STATES PATENT OFFICE.

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

GOVERNING MECHANISM FOR ELASTIC-FLUID TURBINES.

No 844,753. Specification of Letters Patent. Patented Feb. 19, 1907.

Application filed May 24, 1905. Serial No. 261,927.

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 Mechanism for Elastic-Fluid Turbines, of which the following is a specification.

This invention relates to elastic-fluid turbines in which the governing is effected by varying the number of inlet nozzles or passages of the turbine by means of electromagnetically-controlled valves and in this manner varying the volume of fluid admitted to the turbine without, however, varying its velocity.

In governing mechanism of this kind as hitherto employed the constructions have been such as to make it difficult to gain access to the working parts of the mechanism for examination, repairs, or adjustment. In fact, it has only been possible to do so by breaking a large number of steam-joints, thereby involving the expenditure of considerable time and labor in packing these joints, so as to render them fluid-tight.

The object of the present invention is to overcome these difficulties by providing a simple construction in which the valves and other parts of the controlling mechanism may be readily taken apart, and this with the minimum of opening of steam-joints.

In the accompanying drawings, which serve to illustrate one embodiment of the invention, Figure 1 is a sectional elevation of a valve and its operating and controlling mechanism. Fig. 2 is a detail view, on an enlarged scale, of part of the valve-mechanism, shown constructed according to a modification; and Fig. 3 is a plan view of the valve chest or casing with the magnets removed.

In carrying this invention into effect, I provide a suitable valve-casing 1, which may be of cylindrical or other suitable form and is adapted to be secured at its lower end to a turbine-casing above the inlet-nozzles. The lower end of this chamber has formed in it a passage 2, which connects with one or more inlet-nozzles or nozzle-sections of the turbine. The top of this passage is fitted with a removable seat 3 for a valve 4, which controls the opening between the interior of the casing 1 and the nozzle-supply-passage. On the top of this valve is formed a stem 5, which extends axially upward through the chamber and carries at its upper end a piston 6, fitting a cylinder 7 in the top of the chamber-casing. Above this piston and separated therefrom by a controlling-spring 8, centered on a pin 9, which is screwed into the piston, is a removable plug 10, the latter being in line with the piston and screwed into the head of the casing or chest. When the pin 9 moves upward with the piston, it loosely enters the opening in the disk above it and restricts the escape of steam. This causes a certain amount of steam to be trapped between the piston and the cylinder-head, which acts as a cushion for the piston and valve. The plug is slightly larger in diameter than the piston and is bored out centrally to receive a removable gland 11, through the center of which passes a pilot or relay valve spindle 12. This valve-spindle is surrounded at its upper end by a small controlling-spring 13, which is located between the top of the gland and a collar 14, secured to the top of the spindle. The top of the valve-casing supports on suitably-arranged columns 15 a magnetic core structure 16, which carries the exciting-solenoids 17 of the electromagnetic controlling mechanism of the valve. This electromagnet is of the iron-clad type and has its solenoid arranged round a central core 18, forming a guide for a plunger 19, fitted at its upper end with a disk-armature 20. The lower end of this plunger is situated directly above the stem 12 of the pilot-valve 21 and is normally out of contact therewith, so that when the solenoid is energized it operates on the pilot-valve with a hammer-blow, so as to cause a definite closure of the valve. The shock on the valve-stem is lessened by a controlling-spring 22, interposed between the end of the plunger and the top of the gland 11, which spring also serves to hold the armature 20 normally out of contact with the top of the electromagnet.

The interior of the chamber is connected to the main steam or other fluid supply for the turbine and at its upper end is formed with a passage 23 in free communication with an opening 24, drilled through the removable plug 10 into the center of the space occupied by the removable gland 11. The bottom of this space is filled by a small disk 25, held in position by the gland, and this disk has drilled centrally through it an opening 26, registering with the opening above referred

to in the removable plug. The upper end of this opening forms a seat for the conical extremity of the pilot-valve 21. Between the lower extremity of the gland 11 and the upper surface of the disk 25 is a transverse recess 27, which communicates by a vertical passage 28, extending through the disk and plug, with the cylinder-space 7 between the bottom of the plug and the top of the piston attached to the main-valve stem. It will thus be seen that by opening or closing the pilot-valve 21 communication may be established or cut off between the main steam-chamber and the space between the plug and the main-valve-operating piston 6. The pilot-valve stem above the recessed end of the gland is reduced, as shown, so that an annular space 29 is formed within the gland, which space communicates by side openings 30, drilled through the gland and plug surrounding it, with an annular channel 31, communicating with an opening 32 for receiving a pipe adapted to be coupled to the exhaust or condenser of the turbine. The pilot-valve is normally held against its upper seat by its controlling-spring 13, so that it cuts off the connection between the atmosphere or condenser and the interior of the recess. In this position of the stem the conical end thereof is raised off the seat formed at the upper end of the passage 26 in the disk 25, and steam-pressure, as above described, is admitted to the upper side of the piston 6, attached to and operating the main valve. In this condition of affairs the steam-pressures on both sides of the piston are practically balanced, the main or nozzle valve being kept on its seat by the difference in pressure existing on the two sides of the valve as well as by the action of the spring 8. When, however, the governor causes the solenoid 17 to be energized, the pilot-valve stem 12 is given a hammer-blow and forced downward by the plunger, so that its conical extremity becomes seated on the top of the passage 26, thereby cutting off communication between the passages 23 24 and recess 27 and the cylinder-space 7 above the piston 6 and establishing communication between the cylinder-space 7 and the vacuum or exhaust through the vertical passage 28 in the plug 10 and disk 25, the recess 27 in the gland, the annular space 29 surrounding the pilot-valve stem, and the side openings 30 in the gland and plug, annular passage 31, and pipe 32, which communicates with the exhaust or condenser. In this way the pressure above the piston 6 is relieved and the steam-pressure acting on the under side of the piston causes the main valve 4 to open and admit steam to the turbine-nozzles. The main valve returns to its seat when the electromagnet is deënergized, so as to allow the pilot-valve stem to lift, due to the pressure thereon and the spring 13, and reëstablish communication between the steam-space of the casing and the cylinder-space 7 above the piston 6 and at the same time close the connection between the steam-chamber and the exhaust, as already described.

In the modification illustrated in Fig. 2 intsead of the piston 6 operating in a cylinder formed in a wall of the casing 1 it operates in a cylindrical aperture formed in the end of the removable plug 10 which loosely fits into the casing 1 and is secured in place by a nut 35, screwed into the casing and bearing against shoulders 36, formed on the plug. The outside diameter of the lower end of the plug is of smaller diameter than the aperture in the casing through which it passes, thereby leaving an annular passage 37, corresponding to and for the same purpose as passage 23 in Fig. 1. Instead of forming the cylinder-wall integral with the plug it may be separate therefrom and suitably connected. In this modification the valve 21 is single-ended and controls only the passage of fluid from the chamber in the main-valve casing to the annular space 29 around the relay-valve stem. The passage 26 in the disk 25 is controlled by a separate valve 38, which may be entirely disconnected from the valve 21, or the valve 21 may have a projecting pin or rib engaging with a hole or slot in the top of the valve 38 to keep it in alinement.

When it is desired not to operate the valve with a hammer-blow, the spring 22 may be omitted, in which case the upper end of the pilot-valve rod 12 will be attached to the collar 39, the latter engaging a collar 440 on the plunger 19. In this case the spring 12 has to be made strong enough to sustain the weight of the armature 20 and plunger or rod 19 and also to hold the valve 21 on its seat when the electromagnet is deënergized.

The operation of the modification illustrated in Fig. 2 is the same as described above with reference to the first modification, except that the valve 38 instead of being positively raised by the valve-rod 12 when the electromagnet is deënergized is forced upward by the fluid-pressure acting on its under side as soon as the pressure on its upper side is relieved by the opening of the valve 21.

The construction shown in Fig. 2 possesses certain advantages over the construction shown in Fig. 1 in the way of mechanical construction, the principal advantages being that the cylinders for the motor-pistons for actuating the valves are formed in separate pieces, which pieces may readily be removed, rebored, &c., as occasion demands. The cylinders having relatively thin walls are not liable to be distorted and cause the valves to stick at intermediate points. The valves and their operating pistons or motors have an open and a closed position, but no intermediate. A further advantage resides in the fact that the springs 8, which assist in closing the

valves, may be made considerably larger in diameter and of heavier stock. Again, each piston can be made separate from its valve with a long bearing-surface between the stem and the piston. This renders it possible to use dissimilar metals for the different parts. The cylinders being supported by beveled shoulders, distortions of the valve-casing exert a minimum effect on the pistons, and the construction further insures a self-centering and steam-tight joint and one that is free from packing. The feature of removing the parts through the wall of the casing is preserved in both cases and is a most important one.

In Fig. 3 is shown a partial plan view of the valve chest or casing with the magnets or solenoids for operating the pilot or relay valves removed. 41 represents the conduit which admits fluid to the chamber within the valve-casing, the said chamber supplying fluid to all of the nozzles or nozzle-sections, as shown in Fig. 1. The pipes 42, connected to the screw-threaded orifices 32, Fig. 1, may be connected together or they may be connected individually to a suitable exhaust.

Instead of having all of the nozzle-valves mounted in a common casing I may in some instances provide each valve with an individual casing having a suitable inlet. The nozzle-valves may control the initial admission of steam or other motive fluid to the turbine, or they may control the passage of fluid from one stage to another in a multistage machine. Some or all of the stages may be valved as desired.

The magnets are connected to suitable circuit-wires and contacts, and the supply of current thereto is made and broken by one or more suitable contact cylinders or switches, the latter being connected to and moved by a device responding to speed changes of the main shaft which carries the wheel-buckets 43, the latter abstracting the velocity of the fluid discharged by the nozzles 44. One or more rows of wheel-buckets may be provided for each stage, and where more than a single row is provided intermediate buckets 45 are employed between the rows to properly reverse and direct the motive fluid against the wheel-buckets. The intermediate buckets may be stationary or rotary, as desired.

I have shown the pilot or relay valves as being operated by electromagnetic means; but they may be operated mechanically or by other suitable arrangements.

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 is only illustrative and that the invention shown 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 valve mechanism for turbines, the combination of a main valve, a casing therefor, a pilot-valve, a removable plug fitted in the casing and in line with the main valve, a pilot-valve located within the plug, and a means for operating the pilot-valve with a hammer-blow.

2. In a valve mechanism for turbines, the combination of a main valve, a casing therefor, a pilot-valve, a removable plug fitted in the casing and in axial alinement with the main valve, a gland located in the plug which acts as a guide for the stem of the pilot-valve, the said stem alining with the axis of the main valve, and a means for actuating the pilot-valve.

3. In a valve mechanism for turbines, the combination of a main valve, an actuating-piston, a casing for the valve, a removable plug fitted in the casing and provided with an extension forming a cylinder for the piston, a pilot-valve carried by the plug for controlling the passage of fluid to and from the cylinder, and a means for actuating the pilot-valve.

4. In a valve mechanism for elastic-fluid turbines, the combination of a casing, a valve located therein, a piston for actuating the valve, a removable plug located in line with the piston and of larger diameter than the piston so that the latter can be removed through the plug-opening, a pilot-valve located within the plug, and removable therewith for controlling the movements of the piston, and a means for actuating the pilot-valve.

5. In a valve mechanism for elastic-fluid turbines, the combination of a casing, a valve located therein, a piston for actuating the valve, a removable plug located in line with the piston and of larger diameter than the piston so that the latter can be removed through the plug-opening, a screw-threaded means for securing the plug in place, a pilot-valve for controlling the movements of the piston located within and removable with the plug, and a means for opening and closing the pilot-valve with a hammer-blow to control the action of the piston and its valve.

6. In a valve mechanism for elastic-fluid turbines, the combination of a casing, a valve located therein, a piston for actuating the valve, a removable plug located in line with the piston and of larger diameter than the piston so that the latter can be removed through the plug-opening, a shoulder for supporting the plug in a manner to minimize the effects of distortion, and a means for opening and closing the pilot-valve to control the action of the piston and its valve.

7. In a valve mechanism for elastic-fluid turbines, the combination of a casing, a valve

located therein, a piston for actuating the valve, a removable plug located in line with the piston and of longer diameter than the piston so that the latter can be removed through the plug-opening, a cylinder for the piston carried by the plug, the cylinder being of smaller diameter than the plug-opening, means for alining and securing the plug in place, and mechanism for controlling the movements of the piston and its attached valve.

8. In a valve mechanism for elastic-fluid turbines, the combination of a casing, a valve located therein, a piston for actuating the valve, a removable plug located in line with the piston and of larger diameter than the piston so that the latter can be removed through the plug-opening, a cylinder for the piston carried by the plug, the cylinder being of smaller diameter than the plug-opening, means for alining and securing the plug in place, a controlling-spring located within the cylinder and between the head and the piston, and mechanism for controlling the movements of the piston and its attached valves.

9. In a valve mechanism for turbines, the combination of a valve-casing, a plurality of valves arranged therein, pistons for operating the valves, individual and removable plugs located in line with the pistons and of larger diameter to permit removal of the pistons, pilot-valves located in and carried by the plugs and means for controlling the movements of the pilot-valves.

10. In a governing mechanism for turbines, the combination of a main valve, a piston and cylinder therefor, a pilot-valve for controlling the passage of fluid to the cylinder, a spring which tends to seat the valve, an actuator for the pilot-valve which is separate from the stem of the pilot-valve, and a spring which opposes the actuator and normally holds it out of engagement with the stem of the pilot-valve so that the actuator will strike a hammer-blow.

In witness whereof I have hereunto set my hand this 9th day of May, 1905.

FREDERICK SAMUELSON.

Witnesses:
ERNEST HARKER,
ETHEL WEBB.