No. 765,330. PATENTED JULY 19, 1904.

J. WILKINSON.

GOVERNING MECHANISM FOR BATTERIES OF TURBINES.

APPLICATION FILED APR. 20, 1904.

NO MODEL. 2 SHEETS—SHEET 1.

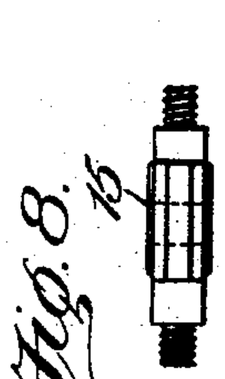
Fig. 8.

Fig. 7.

Fig. 5.

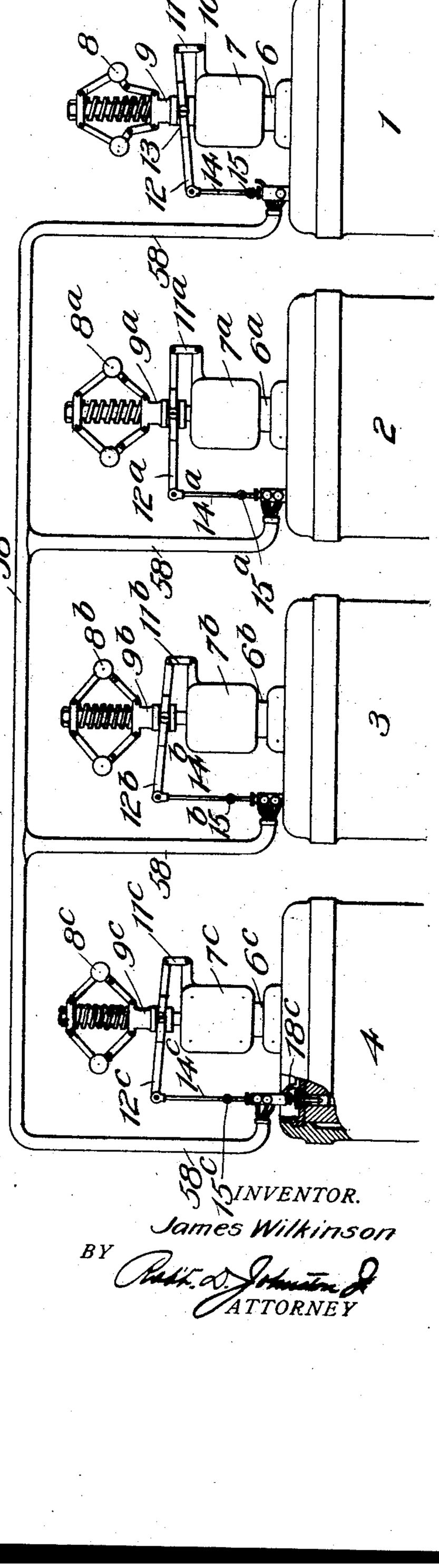
Fig. 1.

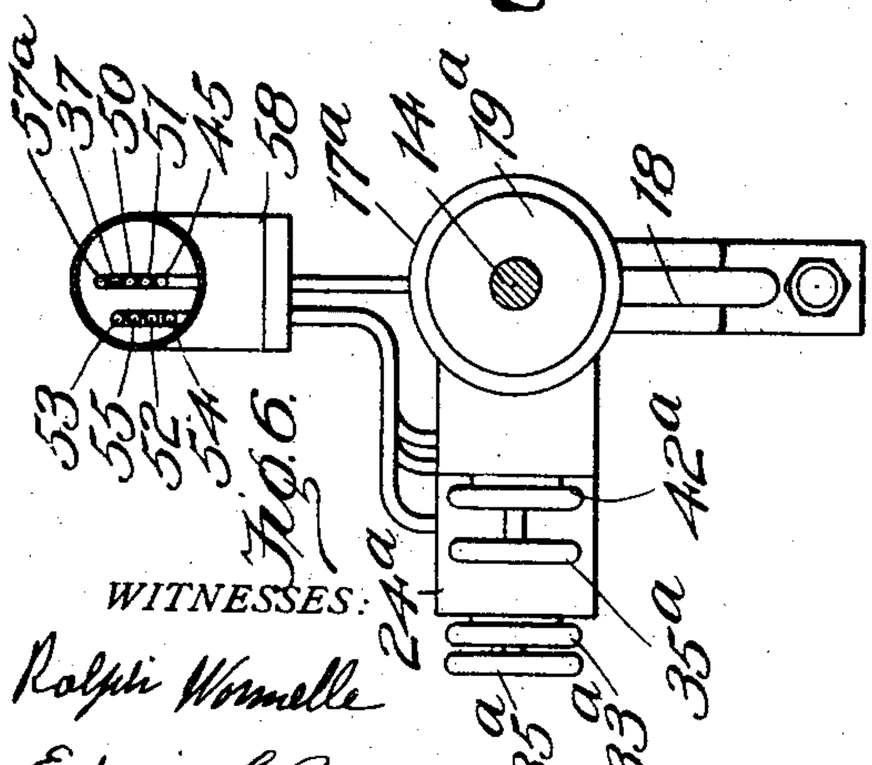
Fig. 6.

WITNESSES:

Rolfe Wormelle

Edwin L Bradford

INVENTOR.

James Wilkinson

BY Pollock & Johnston

ATTORNEY

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NO MODEL. 2 SHEETS—SHEET 2

Fig. 2.

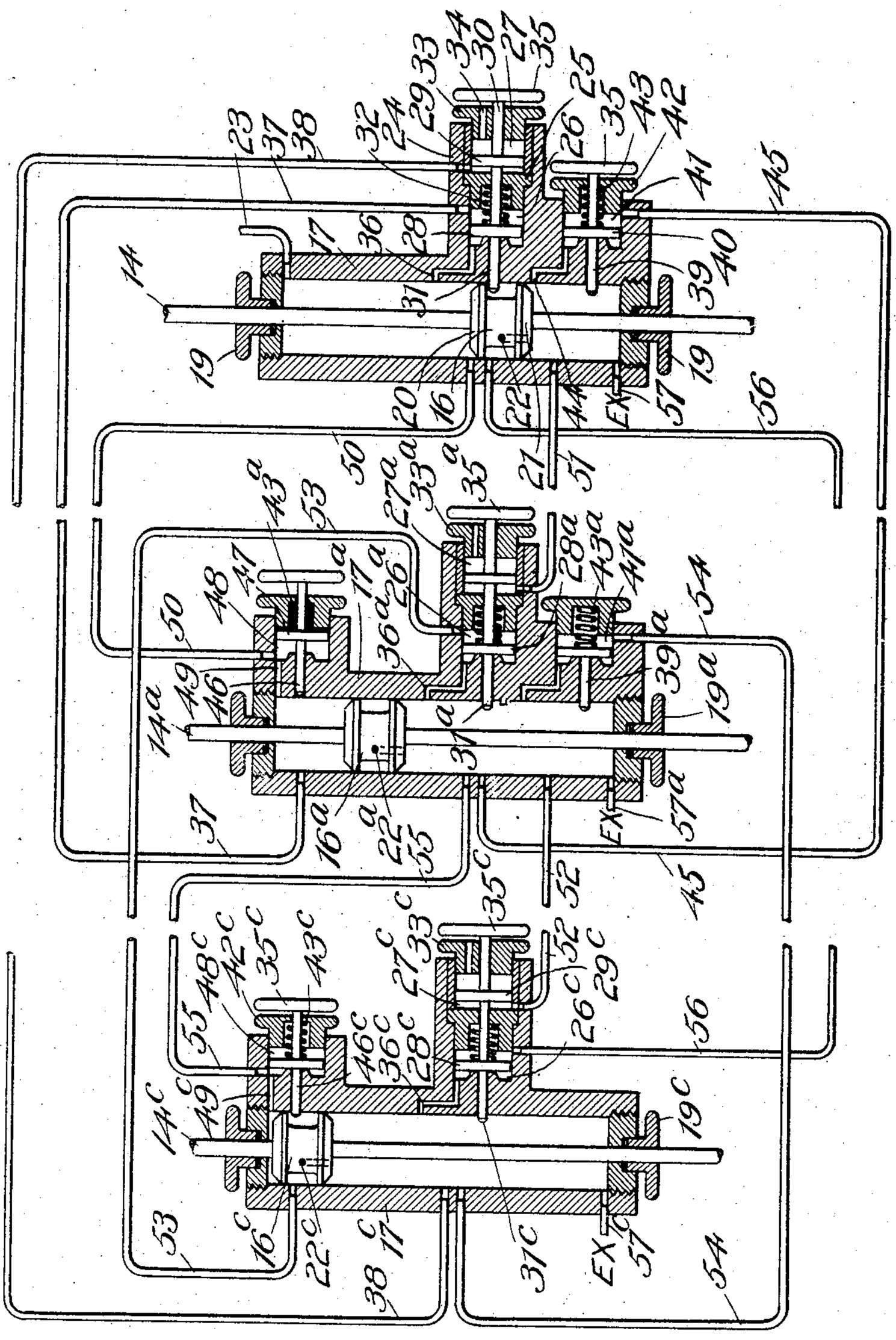

Fig. 3.

Fig. 4.

WITNESSES:

Ralph Wormdle

Edwin L. Bradford

INVENTOR.

James Wilkinson

BY Robt. D. Johnston Jr.

ATTORNEY.

No. 765,330. Patented July 19, 1904.

UNITED STATES PATENT OFFICE.

JAMES WILKINSON, OF BIRMINGHAM, ALABAMA, ASSIGNOR TO THE WILKINSON STEAM TURBINE COMPANY, OF BIRMINGHAM, ALABAMA, A CORPORATION OF ALABAMA.

GOVERNING MECHANISM FOR BATTERIES OF TURBINES.

SPECIFICATION forming part of Letters Patent No. 765,330, dated July 19, 1904.

Application filed April 20, 1904. Serial No. 204,114. (No model.)

To all whom it may concern:

Be it known that I, JAMES WILKINSON, a citizen of the United States, residing at Birmingham, in the county of Jefferson and State of Alabama, have invented new and useful Improvements in Governing Mechanism for Batteries of Turbines, of which the following is a specification.

My invention relates to a controller mechanism for a battery of turbines whereby they are caused to successively take on their full loads and in a similar succession to assume their overloads. Heretofore this control has been effected by providing a common governor for the battery of turbines which acts to place the turbine units into service successively and to directly control the supply of motor fluid to the turbine which is acting to compensate variations in the load. This arrangement will prove very complicated when a battery of multiple-stage turbine units having each a plurality of supply-valves is used and in addition to this has the effect of rendering each of the units dependent upon a common governor, and therefore without independent value.

It is the principal object of my invention to overcome these objections and to provide a controller means which may be readily applied to a number of independent turbines to cause them to operate as a battery of units which cooperate at high efficiency in successively taking on their full and over load. In carrying this object into effect it is my purpose to utilize the governors of the several units, which may operate independently in controlling their respective units to successively and automatically lock all but the governor of the turbine engaged in compensating variations in the load in one of three positions, representing, respectively, a friction load, full load, and overload supply of motor fluid. Suitable latches or engaging means are provided to lock the several governors against movement, and in controlling the operation of these latches to successively release their respective governors I utilize, preferably, fluid-pressure motors which are coupled up to each other and to controller-cylinders. I provide a controller-cylinder for each turbine, within which a valve connected to a governor-actuated controller-rod is disposed and which acts to admit or exhaust pressure from latch-motors to lock or release the governors of adjacent turbine units. This transmission of an actuating power from one to another of the otherwise independent turbine-governors to control the successive assumption of load throughout the battery constitutes the essential feature of my invention, and the apparatus shown merely illustrates a preferred means, to which, however, I do not desire to limit myself, since it may be carried into effect with equal success by the application of electricity or even mechanical means.

In describing my preferred form of apparatus reference is made to the accompanying drawings, in which—

Figure 1 illustrates a battery of turbines provided with my controller apparatus. Fig. 2 is a vertical section through the controller-chamber for the initial turbine of the series or battery. Fig. 3 is a similar view through a controller-chamber for one of the intermediate turbines and Fig. 4 for the last turbine, these several views showing the manner of effecting the pipe connections between the several controller-chambers. Fig. 5 is a different sectional view taken through a controller-chamber and illustrating the method of mounting the same upon the turbine. Fig. 6 is a top plan view of one of the controller-chambers. Fig. 7 is a view broken away, showing the conduit for the several fluid-conducting pipes between the controller-chambers. Fig. 8 shows the swivel-joint in the governor controller-rod.

Similar reference characters refer to the same parts throughout.

In Fig. 1 I illustrate a battery of turbines comprising turbine units 1, 2, 3, and 4, which may be of any desired construction, but preferably that shown in my Letters Patent No. 753,774. Each of these turbine units comprises a head-section 5, through which the main shaft 6 passes and enters a suitable bear-

ing 7. A governor 8 of any desired description may be driven directly or indirectly from this shaft 6, being provided with a collar 9. To an extension 10 of the bearing 7 a link 11 is pivoted, and a lever 12, which is pivotally connected to a slip-collar 13, mounted in the collar 9, is also pivotally connected at one end to the link 11 and at the other end to a controller-rod 14, which is adapted to engage and actuate a device of any character, such as that shown and described in my patent aforesaid, which is designed to control the admission of motor fluid to the turbine. As shown in Fig. 5, I provide a swivel-joint 15 in this controller-rod 14 to enable the lower section thereof to move always in the same vertical line. This arrangement is necessary in view of the fact that the rod 14 has mounted thereon a valve 16, which moves in a cylinder 17, mounted upon a standard 18, bolted to the head 5 of the turbine. The cylinder 17, which I term the "controller-cylinder," is of a length corresponding with the stroke of the controller-rod 14 and is closed pressure-tight at its ends by packing-glands 19, through which the rod passes. The valve 16 is reduced in its central portion and provided with two outwardly-beveled ends 20 and 21, respectively, and a passage-way 22, leading from the reduced central portion through the end 20.

Each of the turbine units 2, 3, and 4 is provided with similar parts, which will hereinafter be distinguished by the respective exponents "a," "b," and "c."

Referring now to Sheet 2 of the drawings, it will be noted that I admit a fluid-pressure—either steam, air, water, or oil, which latter is preferable—through a pipe 23, entering the upper end of cylinder 17. At an intermediate point in this cylinder, representing the position of the valve 16 when the governor will have opened the turbine-valves to admit a full-load volume of motor fluid, I provide an extension 24, having a reduced chamber therein, in which I interpose a block 25, which subdivides it into cylinders 26 and 27, within which the pistons 28 and 29, secured to a common stem 30, are disposed. These pistons move a latch-pin 31, which enters the cylinder 17 through a suitable opening in its casing. The block 25 is recessed to provide a seat for a coiled spring 32, which engages piston 28 and tends to move the latch 31 into its operating position in the cylinder. A plug 33, having a normally open port 34, closes the outer end of cylinder 27 and is provided with a central opening through which the stem 30 passes. At its outer end this stem is provided with a button 35, by which it may be manually moved to its operating position. A small passage 36 leads from the upper end of cylinder 17 through the casing and enters the inner end of cylinder 27, from the outer end of which a passage 37 leads to the upper end of cylinder 17^a. A pipe 38 leads from the inner end of cylinder 27 to a central portion of the controller-cylinder for the last turbine of the series, here represented by cylinder 17^c. Opposite the position of valve 16 in its lowered position, which represents the position of the governor when the turbine is operating under its maximum load, I provide a second latch-pin 39, actuated by a piston 40, which moves in a cylinder 41, formed in the side of the casing and closed at its outer end by a plug 42, between which and the piston is disposed a spring 43, corresponding to 32. A button is mounted on the outer end of the stem for the pin 39, and a passage 44 connects the lower end of cylinder 17 with the inner end of cylinder 41. A pipe 45 leads from the opposite end of this latter cylinder to an intermediate point in the cylinder 17^a. It will be noted that the controller-cylinder for the intermediate turbine unit B of the series will be provided with a latch-pin 39^a, corresponding to 39 and similarly placed, and will also be provided with a latch-pin 46, disposed at the upper end of the cylinder opposite the position of the valve 16^a when the governor is running under a friction-load. This latter pin 46 is actuated by a piston 47, similar to 40, which is disposed in a cylinder 48, connected by a passage 49 with the cylinder 17^a and by a passage 50 with an intermediate portion of the cylinder 17. The parts for the other intermediate cylinder or cylinders of the series will correspond to the parts just described, and it will be understood that there may be as many of these cylinders as the occasion may require. The controller-cylinder for the last turbine of the series is provided with parts similar to those of the first turbine, with the exception that the pin 39^c is disposed at the upper end of the controller-cylinder. The cylinder 27^a is connected at its inner end by a pipe 51 with the lower part of cylinder 17 at a point above valve 16 when locked in its bottom position, and a similar connection is provided by a pipe 52 between the cylinder 27^c and the preceding cylinder 17^b, corresponding to 17^a in the series. The pipes 53 and 54, corresponding to 37 and 45, connect the cylinders 26^a and 41^a with the cylinder 17^c. Pipe 55, corresponding to pipe 50, connects cylinder 48^c with the center of the cylinder preceding it in the series. A pipe 56 leads from the outer end of cylinder 26^c to the central portion of cylinder 17, and by the central portion throughout I mean the portion of the cylinder opposite the position of the several valves 16 when at their full-load position. I provide each of the several cylinders with an exhaust-pipe 57, leading from the lower end either to the atmosphere or in case liquid is used to a suitable reservoir. I bevel the ends of the several valves 16 so that if the fluid-pressure

has failed to move the latch-pins inwardly these beveled ends of the valves will trip the pins and pass by them.

In describing the operation of my invention I will assume that the several turbines are running under a friction load. In this case the several valves 16 will be moved by the governors to the upper end of their cylinders, when 16^a, 16^b, and 16^c will be locked by pins 46, which are moved inwardly by springs 43, there being no pressure in cylinders 48. The governors for turbines 2, 3, and 4 are thus locked against movement, and thus can not take on the load until turbine 1 has taken on its full load. In taking on this load the valve 16 will be moved downwardly with the rod 14 until the pressure entering cylinder 17 above is admitted to passage 36 and moves piston 28 inwardly against spring 32 to withdraw pin 31 and permit end 21 of the valve to pass it. Shortly after this occurs, if the load continue to increase, valve 16 will move downwardly until it opens pipe 50 to the pressure which flows therethrough and enters cylinder 48 of turbine 2. Here it moves piston 47 and pin 46 outwardly to release valve 16^a, thus permitting the governor of turbine 2 to respond to the load, which the latter turbine will now commence to take on. As valve 16^a moves downwardly it opens pipe 37 to the pressure admitted to cylinder 17^a through passage 49, and through 37 pressure is equalized on both sides of piston 28, and spring 32 moves it into the position shown in Fig. 2, when valve 16 will be locked and turbine 1 held at full load while variations are being compensated by the governor of turbine 2. If the load should decrease now, valve 16^a would move upwardly until it cut off pressure in pipe 37 and exhausted it through passages 22^a and 57^a, when piston 28 would open and valve 16 be free, so that its governor could begin to reduce the load on turbine 1. As valve 16 rose it would cut off pressure from pipe 50, exhausting it through passages 22 and 57, when pin 46 would lock 16^a against movement. This same action will continue throughout the series until the last turbine is reached. Here it will be noted that at full load pipe 38 will be opened to pressure, which enters cylinder 27 of turbine 1 and acts against piston 29 to overcome spring 32 and release valve 16. As turbine 1 thus commences to take on an overload valve 16 admits pressure through pipe 56 to cylinder 26^c, causing pin 31^c to lock turbine 4 against taking on an overload or varying at all from its full-load capacity. When the overload exceeds the capacity of turbine 1, valve 16 will open pipe 51 to the pressure, which enters cylinder 27^a and releases valve 16^a. Turbine 2 then commences to take on the overload, and pressure through pipe 45 causes pin 39 to lock valve 16 at the bottom of cylinder 17, when turbine 1 will be no longer sensitive to load variations, which will be taken care of by governor 8^a. In this same manner the several turbines will take on the overload successively until all are fully open. As the load decreases from this maximum point valve 16^c will rise until it exhausts the pressure from pipe 54 and cylinder 41^b, corresponding to 41^a, Fig. 3, and causes pin 39^b to release piston 16^b. As governor 8^b commences to reduce the fluid-supply to turbine 3 valve 16^b rises and by exhausting pressure from pipe 52 and cylinder 27^c causes pin 31^c to move inwardly and lock governor 8^c against movement. The overload-supply of the turbines will thus be successively cut off until governor 8 is varying the supply in accordance with the load. Pipe 38 being exposed to pressure in cylinder 17^c, pin 31 will be withdrawn to permit valve 16 to move upwardly as the overload decreases until at full overload it occupies the position shown in Fig. 2, when by exhausting pressure from pipe 56 and cylinder 26^c piston 16^c will be released and governor 8^c will commence to reduce the full-load supply of turbine 4. As valve 16^c moves over the part of pipe 38 pressure will be exhausted from cylinder 27 and valve 16 locked in its full-load position. For convenience the several pipes are disposed within a conduit 58, which leads to the several cylinders 17. It will thus be seen that the several governors are utilized to successively lock the succeeding or preceding governor, according to the variation of the load, at definite points, when the turbine under its control will be operating under a friction, full, or overload supply of motor fluid, and that only one of the governors will be sensitive to speed or load variations at a time. By this management each turbine constitutes an independent unit so far as its governing mechanism is concerned, which can be cut out of the series and operated independently. By a modification of the system of piping any one of the battery of turbines may be cut out of service for repairs or when the load does not necessitate its use.

The governing means and turbine herein shown form no material part of my present invention, which is equally applicable to the various types of governor and turbine now in general use. In the same manner magnets may be substituted for the fluid-motors and electricity used as the controlling agent without departing from the spirit of my invention.

Having thus described my invention, what I claim as new, and desire to secure by Letters Patent, is—

1. The combination with a battery of elastic-fluid turbines, of a plurality of governing means for said turbines, and means to control

the successive application by said governing means of the full load to the turbines under their control.

2. The combination with a battery of elastic-fluid turbines, of a plurality of governing means for said turbines, and means to control the successive application by said governing means of the overload to the turbines under their control.

3. The combination with a battery of elastic-fluid turbines and separate governing means for the units thereof, of means to cause said governing means to become successively sensitive to the load and to apply load up to full load to the turbines in succession.

4. In combination with a battery of turbines, means to apply the full load to the turbines in succession, and means whereby each turbine governs its supply of motor fluid during the time it is actively compensating variations in the load on the said battery.

5. In combination with a battery of turbines, means to apply the full load fractionally to the turbines in succession, and means, under the independent control of each turbine, which govern the supply of motor fluid thereto as it takes on fractions of its full load in compensating variations in the load on the said battery.

6. In combination with a battery of turbines, governors for said turbines and means to successively apply the load to said turbines by controlling said governors.

7. The combination with a battery of turbines, of a plurality of governing means, and means to apply first the full load and then the overload to said turbines in succession by controlling the operation of said governing means in regulating the motor-fluid supply.

8. The combination with a battery of turbines, of a plurality of governing means, and means to apply first the full load fractionally and then the overload to said turbines in succession by controlling the operation of said governing means.

9. The combination with a battery of turbines, of a plurality of governing means, and means to apply first the full load fractionally and then the overload fractionally to said turbines in succession by controlling the regulation of the motor-fluid supply by said governing means.

10. The combination with a battery of turbines, of governing means for the several turbines which are capable of independently regulating their supply of motor fluid, and means under the control of said governing means to successively apply the load to the turbines.

11. The combination with a battery of turbines, of governors therefor, and means to cause said governors to successively vary the motor-fluid supply to their respective turbines and apply the full load to them in succession fractionally.

12. The combination with a battery of turbines, of governors therefor, and means to cause said governors to successively vary the motor-fluid supply to their respective turbines and apply the overload to them in succession fractionally.

13. A controller mechanism for a battery of turbines comprising governors for the turbines, means to lock said governors against movement and power means to successively release said governors.

14. The combination with a battery of turbines, of governors therefor, controller means for each governor whereby it may be locked at its full-load position, and connections between said means to successively release them and lock them at their full overload position.

15. The combination with a battery of turbines, of governors therefor, and means serially connected up to lock all said governors at their full-load position, all but the initial governor of the series at a friction-load position, and all but the last turbine of the series at full overload position, which means act automatically to release the governors successively from one position and lock them in another position determined by the load.

16. The combination with a battery of turbines, of an independently-governed unit, a governor therefor, a movable controller element actuated by said governor, stops to engage said element and retain it at either a friction-load, full-load, or full overload position, and power means under the control of said element to cause another turbine to take on the load.

17. A controller mechanism for a battery of turbines comprising governors for the turbines, means to retain all but one of the governors against movement responsive to variations in speed or load, and means whereby the active governor controls the releasing of the governor for the turbine which in the succession will next take on the active control of the motor-fluid supply.

18. A battery of turbines, a governor-actuated controller element for each turbine, latches adapted to engage and hold said elements in definite positions, means to actuate said latches, and a controller means for the battery which successively unlatches elements and permits the turbines to take on or cut off the load in succession.

19. A battery of turbines, a valve means to vary the admission of motor fluid to each turbine, a movable controller element for the valve means of each turbine, and a controller means for the battery which permits said elements to successively apply the load to the turbines and intercepts the movement of said elements when they have applied the full load to their respective turbines.

20. In a battery of turbines, a plurality of controller devices which respond to variations

in load and are capable of independent action in governing the supply of motor fluid to the several turbines, in combination with controller mechanism for the battery of turbines utilizing fluid-pressure-actuated devices to permit said controller elements to apply the load successively to the turbines.

21. The combination with a plurality of turbines, a governing means for each turbine which varies the supply of motor fluid thereto in response to variations in its load, and means to successively render said governing means active in compensating variations in the load on the battery of turbines while the other governing means are maintained inactive.

22. The combination with a battery of turbines, of governors therefor, and means to cause said governors to act successively in compensating changes in the load on the battery of turbines by varying the supply of motor fluid to their respective turbine units.

23. In a governing mechanism for a battery of turbines, the combination of a plurality of turbine units, a separate governing mechanism for each unit which controls the motor-fluid supply thereto, and a battery-governing means which causes one of said governing mechanisms at a time to compensate variations in the load on the battery of turbines.

In testimony whereof I have signed my name to this specification in the presence of two subscribing witnesses.

JAMES WILKINSON.

Witnesses:
NOMIE WELSH,
R. D. JOHNSTON.