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MULTISTAGE BLEEDER TURBINE CONTROL

Filed April 10, 1929

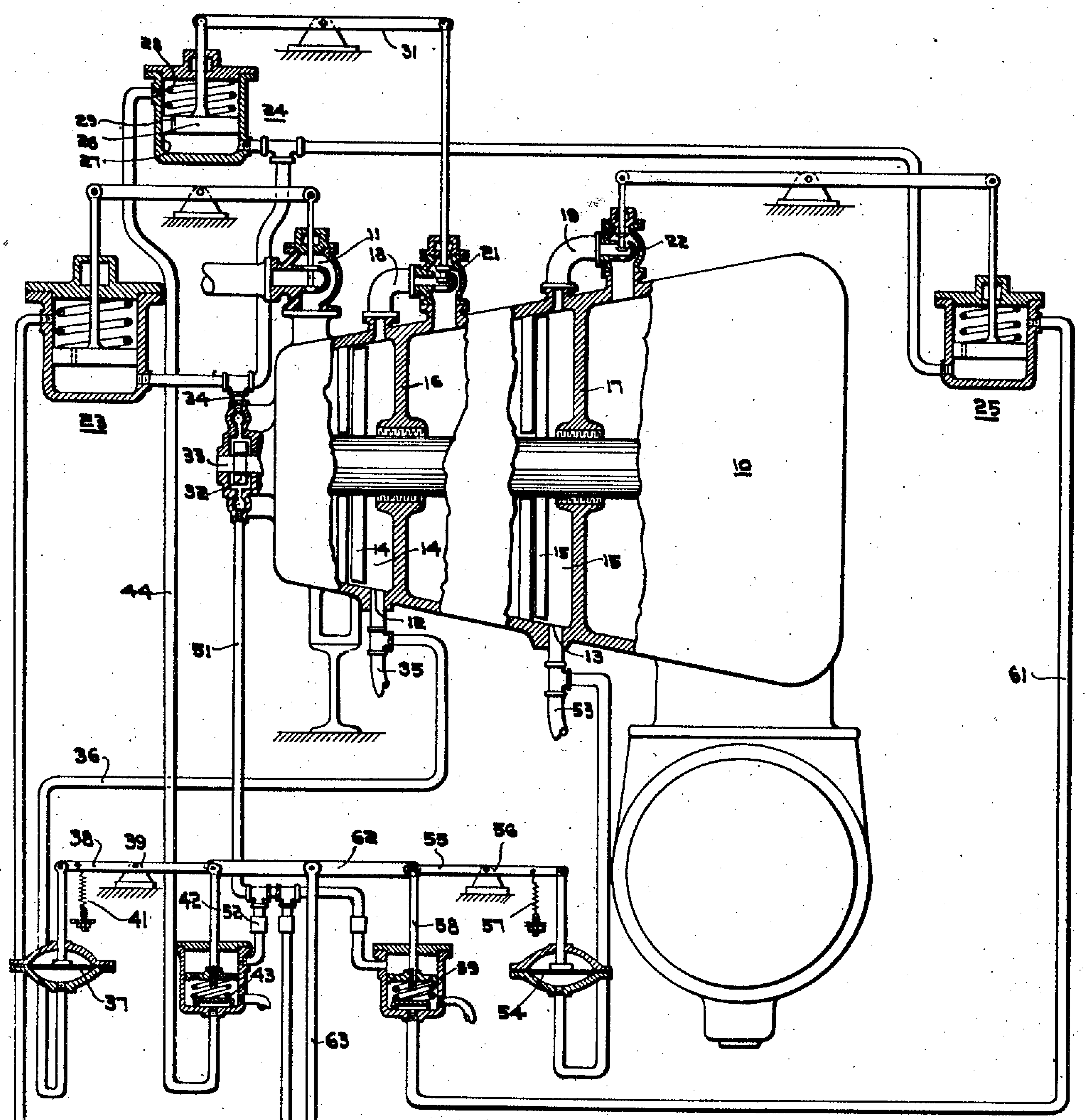
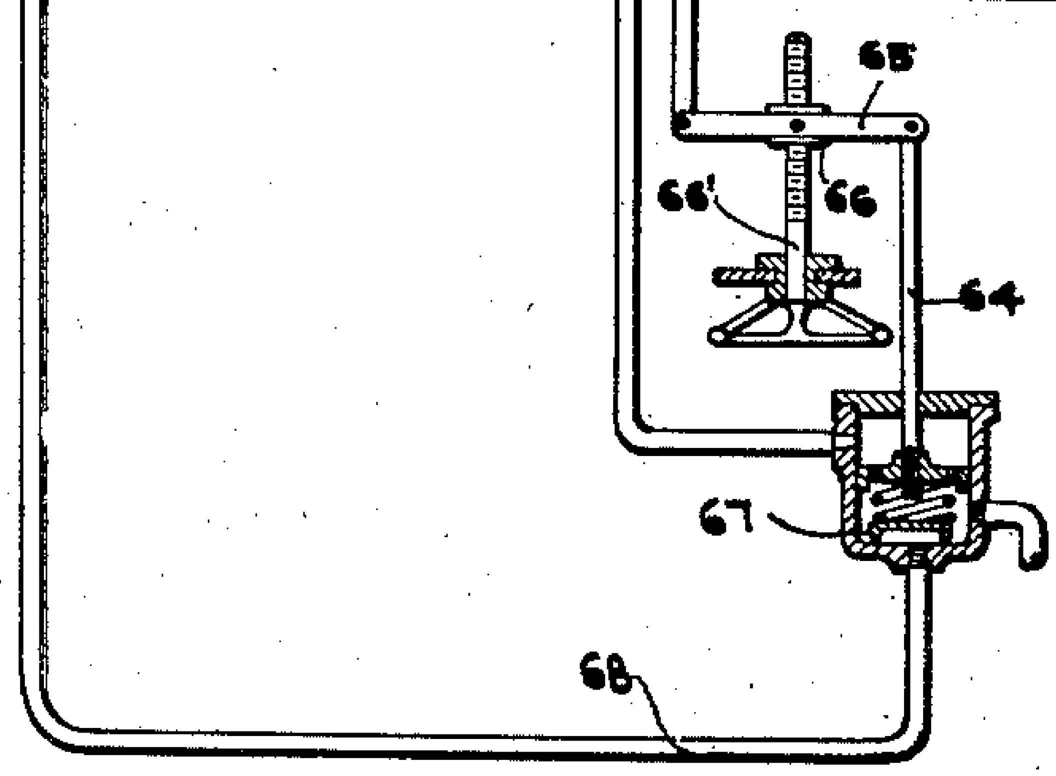

Fig. 1.

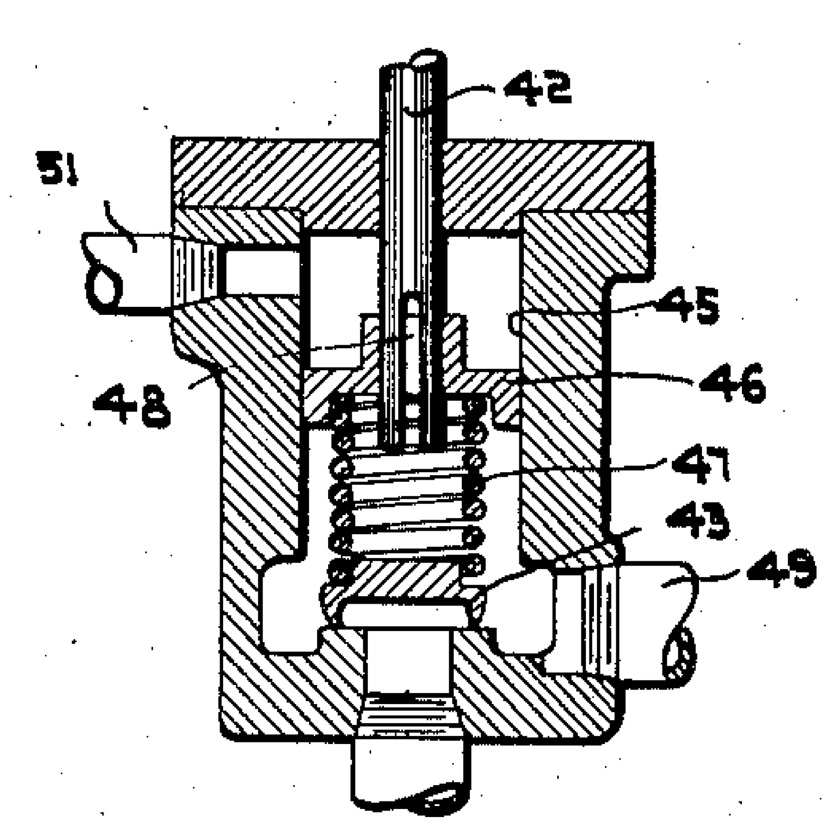

Fig. 2.

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MULTISTAGE-BLEEDER-TURBINE CONTROL

Application filed April 10, 1929. Serial No. 354,027.

My invention relates to a governing system, more particularly to a governing or control system for a double or multiple extraction turbine, and it has for its object to provide improved regulation.

A specific object is to regulate the flow at each extraction opening in response to the pressure of the extracted steam, and to compensate the admission of motive fluid to the turbine in accordance with the amount of steam extracted at each of the extraction openings.

These and other objects are effected by my invention, as will be apparent from the following description and claims taken in connection with the accompanying drawings, forming a part of this application, in which:

Fig. 1 is a diagrammatic representation of my governing system; and,

Fig. 2 is a sectional view of a detail.

Referring now to the drawing more in detail, I show a turbine 10 having an admission valve 11, and extraction openings 12 and 13 communicating with intermediate pressure stages in the turbine indicated at 14 and 15, respectively. Diaphragms 16 and 17 are interposed between the pressure stages 14 and 15 and the succeeding turbine stages, and conduits 18 and 19 provide by-passes around the diaphragms, through which the motive fluid not extracted may be conveyed to continue its expansion in a lower pressure stage or stages of the turbine.

Valves 21 and 22 are provided in the by-pass conduits 18 and 19 to control the flow of motive fluid therethrough. By controlling the amount of fluid held back from the lower pressure stages, these valves regulate the flow through the extraction openings 12 and 13. It will be apparent to those skilled in the art that any other construction which regulates the distribution of fluid between the bleeder opening and the succeeding turbine stages may be used as the equivalent of the by-pass valve.

The admission valve 11 and the by-pass valves 21 and 22 are controlled by governors 23, 24 and 25, respectively, which may be and are shown as similar in construction. Each governor includes a piston 26 operating in a cylinder 27. Fluid pressure varying as a function of the speed of the turbine is preferably provided by an impeller 32 mounted directly on the turbine rotor shaft 33, and is conveyed through a conduit 34 to the lower end of each governor cylinder 27. The variable fluid pressure is admitted to the lower end of the cylinder to bias the piston upwardly, and a spring 28 biases the piston 26 downwardly in opposition to said fluid pressure. The piston 26 is provided with a restricted orifice 29, through which some of the fluid under pressure beneath the piston flows to the upper side of the piston.

A back pressure is imposed on the fluid flowing through the orifice by controlling its escape from the upper end of the cylinder, and this pressure biases the piston 26 in cooperation with the spring 28 and in opposition to the variable fluid pressure beneath the piston. Each piston is connected to its valve in any suitable manner known to the art, as through a fulcrumed lever 31.

The back pressure in the governor 24 is controlled in response to pressure at the extraction opening 12, that in the governor 25 in response to pressure at the opening 13, and that in the governor 23 in response to both of said pressures. The mechanism for accomplishing this will now be described.

The pressure of the fluid flowing through the extraction opening 12 and the conduit 35 is communicated through a conduit 36 to a diaphragm 37, connected to and controlling a lever 38 fulcrumed intermediate its ends, as at 39. An adjustable spring 41 biases the lever 38 in opposition to the diaphragm and gives it a position corresponding to the pressure imposed on the diaphragm 37.

Connected to the lever 38 on the other side of the fulcrum 39 is a stem 42 controlling a relief or back-pressure valve 43. The valve 43 communicates with the upper end of the cylinder of the governor 24 through a conduit 44, and controls the pressure therein by controlling the escape of fluid therefrom.

Referring now to Fig. 2, the stem 42 extends through the cylindrical valve casing 45 and through a piston 46 operating therein.

The piston 46 abuts the upper end of a spring 47, which biases the valve 43 to closed position. A passage 48 is formed in the lower end of the stem 42 and extends from a point which is normally just above the top face of the piston 46 to the lower end thereof. A drain conduit 49 communicates with the valve casing between the piston 46 and the valve 43.

Fluid pressure from the impeller 32 is supplied to the valve casing 45 above the piston 46 through a conduit 51, in which an orifice 52 is interposed to restrict the flow to the valve casing. This pressure is imposed on the piston 46 and moves the same downwardly until the upper end of the passage 48 is uncovered sufficiently to permit the escape of as much fluid as flows into the casing.

When the stem 42 is moved downwardly, the escape of the fluid flowing into the casing is cut off and the piston 46 moves downwardly until the passage 48 is again slightly uncovered to permit sufficient escape, and when the stem moves upwardly, the passage 48 permits a greater amount of fluid to escape until the spring 47 moves the piston 46 upwardly to restore the required escape opening.

It will thus be seen that the piston 46 is moved to follow the stem 42 without any substantial resistance to movement of the stem, thereby applying a spring pressure on the valve 43 in accordance with the position of the stem 42.

The pressure of the fluid flowing through the extraction opening 13 to the conduit 53 is communicated to a similar diaphragm 54, which acts on a lever 55 fulcrumed at 56 and biased by an adjustable spring 57. The other end of the lever 55 actuates a stem 58 controlling a back pressure valve 59 in the same manner that the stem 42 controls the valve 43. The valve 59 communicates through a conduit 61 with the upper end of the cylinder of the governor 25, and controls the back pressure therein.

A floating lever 62 is connected at its ends to the levers 38 and 55, and intermediate its ends is connected to a link 63. The link 63, in turn, is connected to a stem 64 by a lever 65 pivoted to a fulcrum at 66. The stem 64 controls, in the manner in which valve 43 is controlled, a back-pressure valve 67, which communicates with the admission valve governor 23 through a conduit 68 and controls the back pressure therein.

The fulcrum 66 is vertically adjustable, by means of a screw-threaded stem 66′, to vary the back pressure imposed by the valve 67 relative to the link 63, thereby controlling the speed setting of the governing system.

The operation of this embodiment of my invention is as follows:

The admission valve 11 and the by-pass valves 21 and 22 all move in response to changes in speed of the turbine by reason of the impeller pressure imposed on the under side of each governor piston 26. Upon an increase in speed, the impeller pressure increases, moving the pistons 26 upwardly against the spring 28 and closing the valves. The flow of fluid is thus decreased through the length of the turbine. The pressure at each extraction opening, however, remains substantially the same.

Upon decrease in speed and decrease in fluid pressure, the springs 28 move the pistons 26 to increase the valve openings.

The correct extraction pressures are maintained in the following manner: Assume that the demand for steam from the pressure stage 14 increases, resulting in a decreased pressure. The decreased pressure is communicated to the diaphragm 37, permitting the spring 41 to act on the lever 38 to raise the stem 42. Raising of the stem 42, as explained above, causes upward movement of the piston 46, which decreases the compression of the spring 47 and thereby decreases the back pressure which the valve 43 imposes on the fluid escaping from the upper end of the cylinder in the governor 24. The impeller pressure below the piston 26 in the governor 24 now preponderates and moves the piston upwardly to decrease the opening of the by-pass valve 21. More fluid is thus held back from the lower pressure stages to supply the bleeder demand.

Upon decrease in demand and increase in bleeder pressure, the reverse operation takes place, as will be apparent, increasing the by-pass valve opening to pass the excess steam to the lower pressure stages of the turbine.

Changes in bleeder pressure in the conduit 53 are likewise communicated to the diaphragm 54, moving the lever 55 and the stem 58 to vary the back pressure in the governor 25 and controlling the by-pass valve 22 to hold back sufficient steam for bleeder demand.

The changes in bleeder demand at either opening affect the amount of work done by the fluid in carrying the turbine load, since, as will be apparent, the fluid extracted does not complete its expansion in the lower pressure stage or stages. It is, therefore, necessary to compensate the admission valve for the amount of fluid extracted through the bleeder openings and, in accordance with the present invention, the admission valve governor 23 is directly compensated without waiting for the speed to change to vary the admission. This is accomplished by the floating lever 62 and the mechanism connected thereto.

As the demand for fluid from the pressure stage 14 increases, for example, the pressure drops and the lever 38 is actuated to raise the connected end of the lever 62. Upward movement of the lever 62 results in upward movement of the link 63 and downward movement of the stem 64. The spring 47 is further compressed and the valve 67 imposes an increased back pressure, which is communicated to the governor 23. The piston 26 is, therefore, moved downwardly to increase the admission valve opening. Additional motive fluid is thus supplied to carry the turbine load and to supply a part of the increased demand for steam at the extraction opening 12.

Upon decrease in demand for extraction steam, the reverse operation taken place.

Upon an increase in demand for extraction steam at the opening 13, the pressure drops, and, as explained above, the end of the lever 55 to which the stem 58 and the lever 62 are connected, is moved upwardly, moving the lever 62 and the stem 63 upwardly. The admission valve opening is increased, as before explained, thus admitting more steam to compensate for the increased amount of bleeding.

It will thus be seen that I have devised a novel fluid pressure governing system for a multiple extraction turbine wherein the admission valve governor is compensated for the amount of partially expanded steam extracted from the turbine at a plurality of pressure stages.

While I have shown my invention in but one form, it will be obvious to those skilled in the art that it is not so limited, but is susceptible of various changes and modifications, without departing from the spirit thereof, and I desire, therefore, that only such limitations shall be placed thereupon as are imposed by the prior art or as are specifically set forth in the appended claims.

What I claim is:

1. The combination with a turbine having an admission valve and a plurality of extraction openings, of governing means for the admission valve comprising means providing a fluid pressure varying in accordance with the extraction at two of said openings and means responsive to said fluid pressure for controlling the admission valve.

2. The combination with a turbine having an admission valve and a plurality of extraction openings, of governing means for the admission valve comprising means providing a fluid pressure varying in accordance with the extraction at two of said openings and means responsive to said fluid pressure and to speed of the turbine for controlling the admission valve.

3. The combination with a turbine having an admission valve and a plurality of extraction openings, of governing means for the admission valve comprising means providing a fluid pressure varying in accordance with the extraction at two of said openings, means providing a fluid pressure varying as a function of the speed of the turbine, and means responsive to both of said fluid pressures for controlling said admission valve.

4. The combination with an elastic fluid turbine having an admission valve and openings communicating with two intermediate pressure stages therein, of means providing a fluid pressure variable in response to the pressures at both of said pressure stages, and means responsive to said variable fluid pressure and to the speed of the turbine for controlling said admission valve.

5. The combination with an elastic fluid turbine having an admission valve and openings communicating with a plurality of pressure stages therein, of a governing system therefor including means associated with each of said openings for controlling the flow of fluid therethrough in accordance with the pressure thereof, means providing a fluid pressure varying with the pressures at a plurality of said openings, and means responsive to said variable fluid pressure for controlling said admission valve.

6. The combination with an elastic fluid turbine having an admission valve and openings communicating with two pressure stages therein, of a governing system therefor comprising means for regulating the flow of fluid at each of said openings in response to the pressure thereof, means providing a fluid pressure variable in response to the pressures at both of said pressure stages, and means responsive to said variable fluid pressure and to the speed of the turbine for controlling said admission valve.

7. The combination with a turbine having openings communicating with a plurality of pressure stages therein, a valve regulating the flow of fluid at each of said stages and an admission valve, of means controlling the valve at each stage in response to the pressure therein and to the speed of the turbine, means providing a fluid pressure varying in response to the pressures in a plurality of said stages, and a governor responsive to the speed of the turbine and to said variable fluid pressure for controlling the admission valve.

8. The combination with an elastic fluid turbine having an admission valve and openings communicating with two intermediate pressure stages therein, of a governing system therefor comprising means associated with each of said pressure stages for providing a fluid pressure varying in response to the pressure at the pressure stage and regulating the flow of fluid at the pressure stage in response to said variable fluid pressure, means operated by both of said means and providing a variable fluid pressure, and means responsive to said last-mentioned fluid pressure for controlling said admission valve.

9. The combination with an elastic fluid turbine having an admission valve and open-

ings communicating with two intermediate pressure stages therein, of a governing system therefor comprising means associated with each of said pressure stages for providing a fluid pressure varying in response to the pressure at the pressure stage and for regulating the flow of fluid at the pressure stage in response to said variable fluid pressure, means operated by both of said means and providing a variable fluid pressure, and means responsive to said last-mentioned fluid pressure and to the speed of the turbine for controlling said admission valve.

10. The combination with a turbine having a plurality of extraction openings, an admission valve, and a valve regulating the flow at each of said openings, of means for controlling said valves comprising means providing a fluid pressure varying as a function of the speed of the turbine, a governor for each valve, each governor having a pressure-responsive element subjected to said fluid pressure, means associated with each extraction opening providing a fluid pressure varying with the pressure of the extracted fluid, means for subjecting said variable fluid pressure to the pressure-responsive elements of the associated governor, means providing a fluid pressure varying with the pressures of the extracted fluid at a plurality of said extraction openings, and means for applying said last-mentioned fluid pressure to the pressure-responsive element in the admission valve governor.

In testimony whereof, I have hereunto subscribed my name this 27th day of March, 1929.

ROLAND MARSLAND.