M. B. CARROLL.

GOVERNING MECHANISM FOR LOW PRESSURE TURBINES.

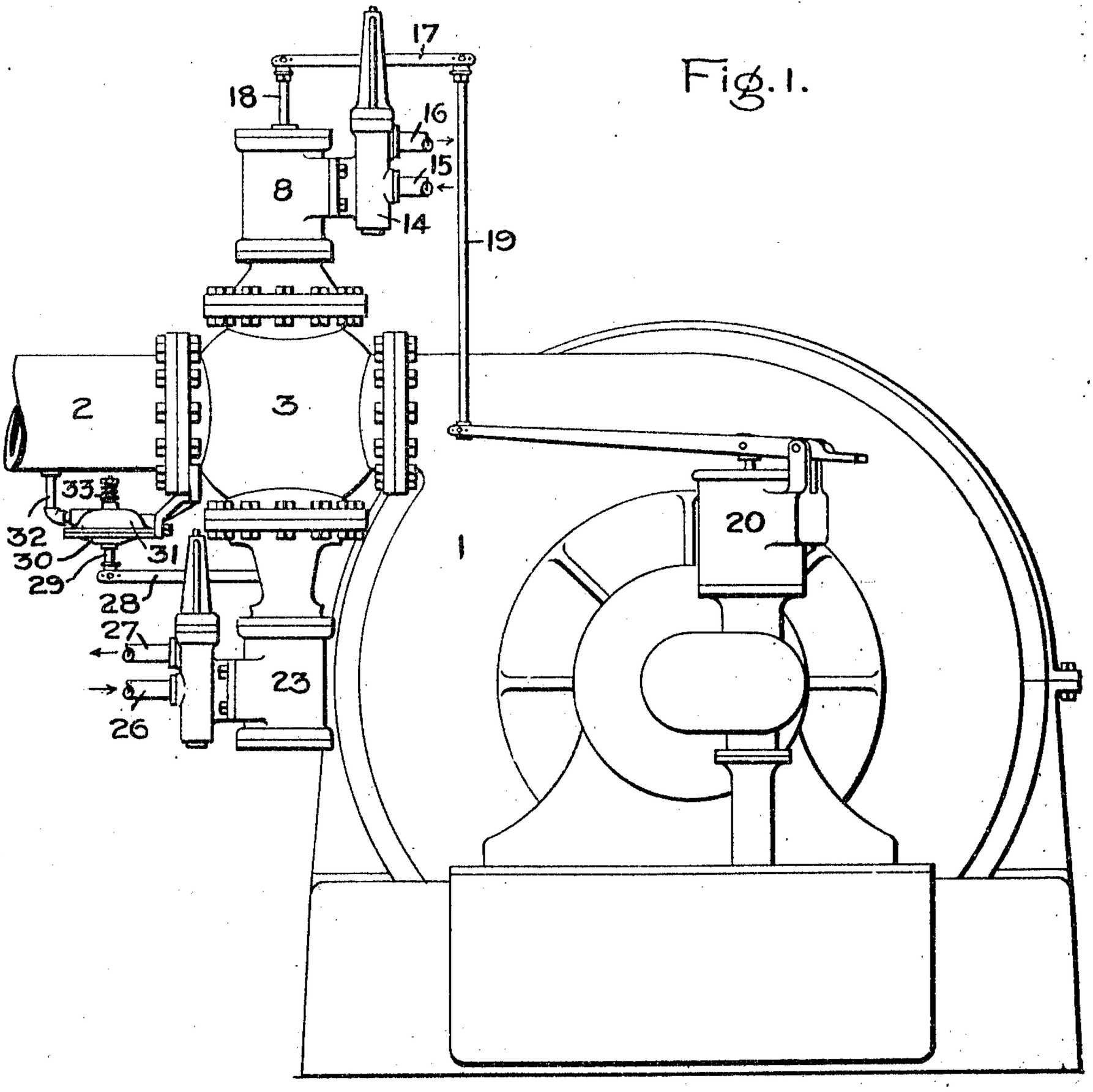
APPLICATION FILED DEC. 29, 1910.

991,951.

Patented May 9, 1911.

3 SHEETS—SHEET 1.

Fig. 1.



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3 SHEETS—SHEET 2.

Fig.3.

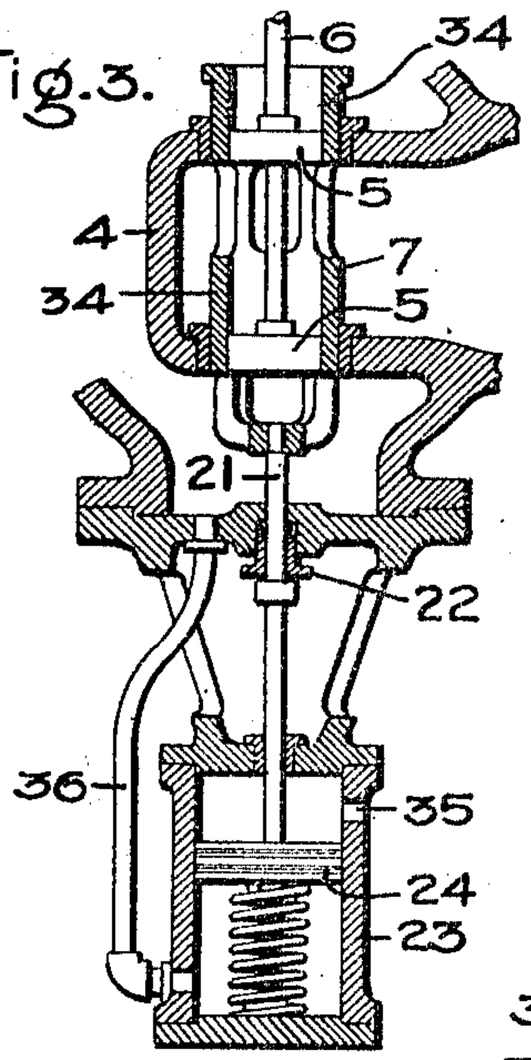

Fig.2.

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3 SHEETS—SHEET 3.

Fig. 4.

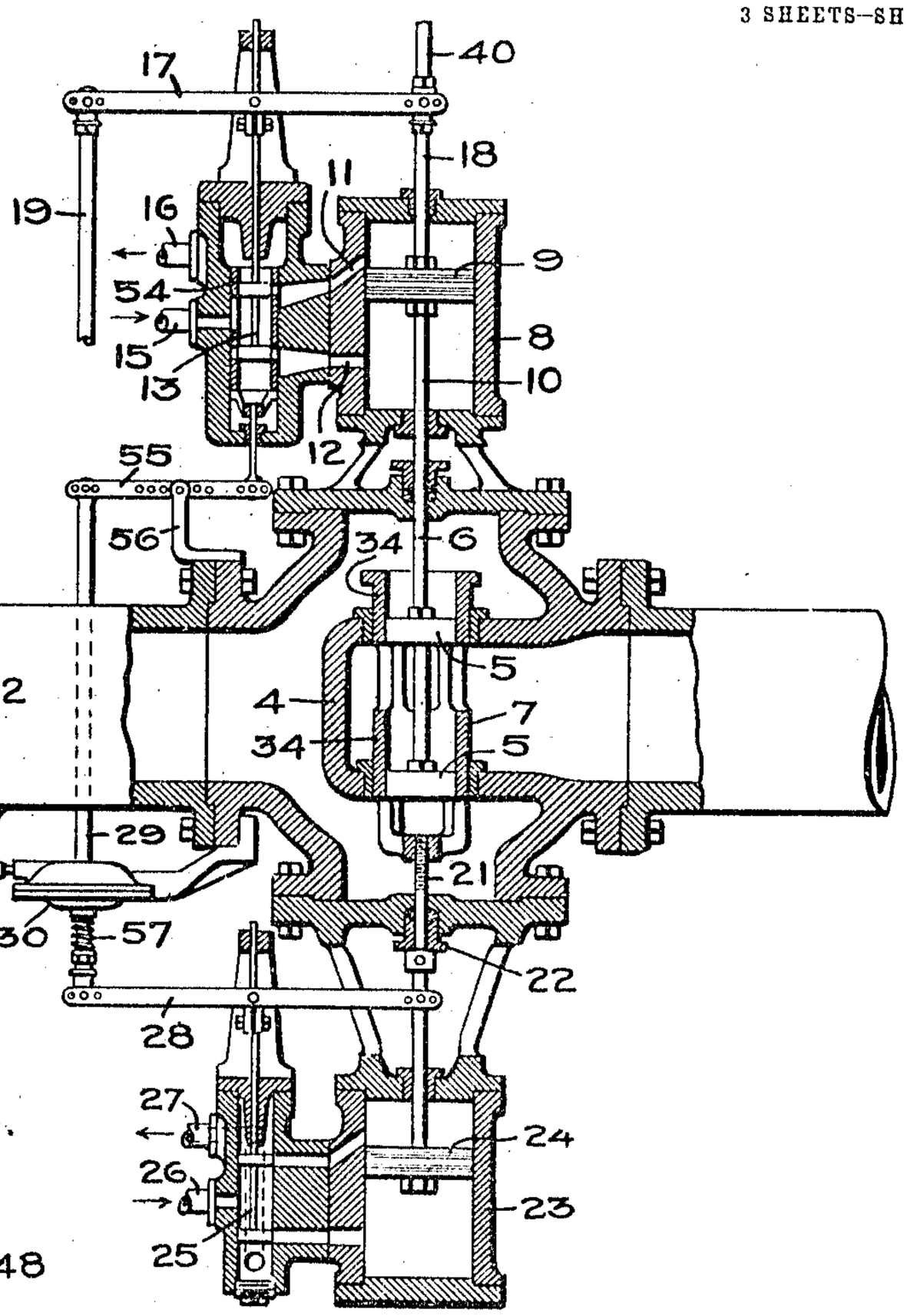


Fig. 5.

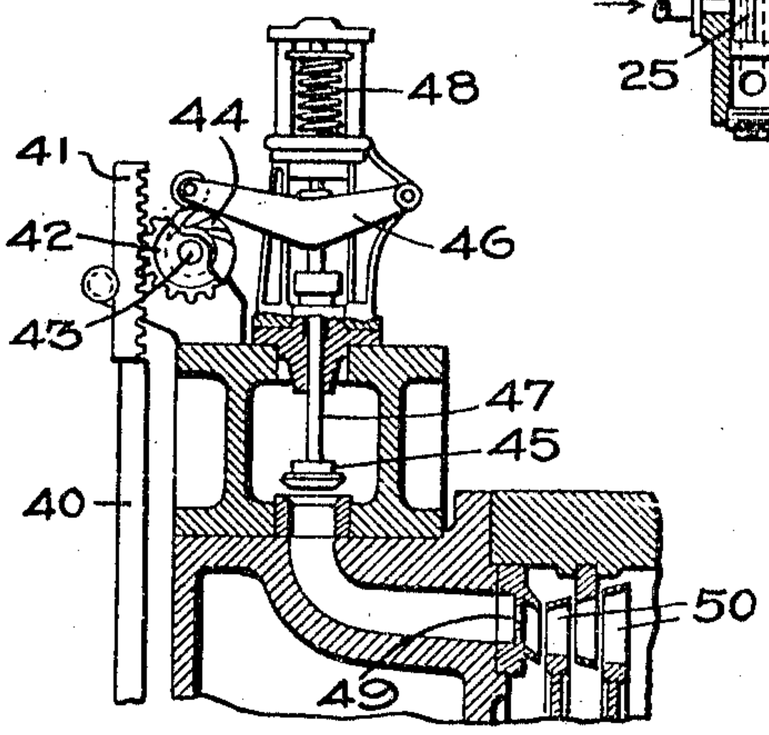
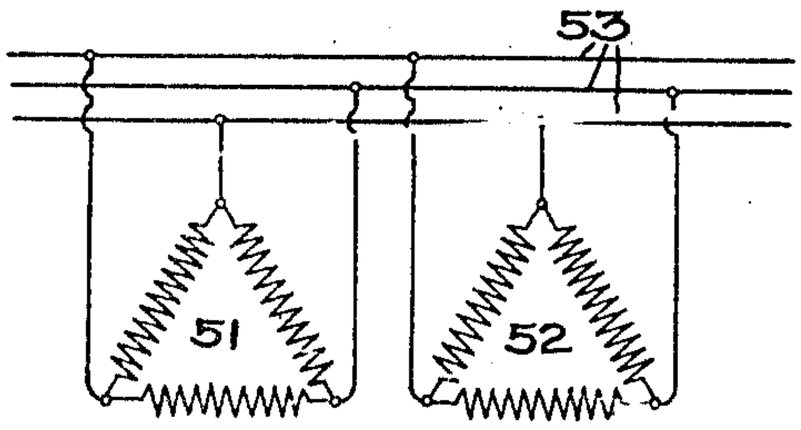


Fig. 6.



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UNITED STATES PATENT OFFICE.

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GOVERNING MECHANISM FOR LOW-PRESSURE TURBINES.

991,951. Specification of Letters Patent. Patented May 9, 1911.

Application filed December 29, 1910. Serial No. 599,993.

To all whom it may concern:

Be it known that I, MORRIS B. CARROLL, 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 Mechanism for Low-Pressure Turbines, of which the following is a specification.

This invention relates to elastic-fluid turbines which are actuated either wholly or in part by steam at low pressure, such as the exhaust from a high-pressure engine or from industrial apparatus using high-pressure steam. In such turbines, there is danger of the entrance of air into the turbine casing when the pressure of the steam falls below that of the atmosphere. Air thus admitted will obviously interfere with the action of the condenser.

One object of the present invention is to prevent this, utilizing for that purpose the same valve which controls the supply of steam to the turbine, and providing means for causing said valve to close the supply main when the pressure falls below a predetermined limit.

A further object of my invention is to provide a valve mechanism which is so organized and constructed that it will control a mixed-pressure turbine in such manner that it may be employed to drive an alternating-current generator which is connected in parallel with one or more other generators supplying current to bus bars or other parts of an electric system, and at the same time prevent the admission of air to the turbine in the manner described above when the pressure of the low-pressure steam falls below atmosphere.

In the accompanying drawings, Figure 1 is an end elevation of a low-pressure turbine equipped with my invention; Fig. 2 is a section of the steam main, valve and controlling devices; Fig. 3 shows a modification; and Figs. 4, 5 and 6 show my invention applied to a mixed-pressure turbine.

The working parts of the turbine are inclosed in a casing 1 which is illustrated as being that of a horizontal turbine. The low-pressure steam is conveyed to the steam chest of said turbine by the main 2 in which is inserted the controlling throttle valve casing 3. Inside of said valve casing is a septum 4 (Fig. 2) in which are two ports at the top and bottom for the passage of steam, said ports being controlled by a throttle valve, preferably a balanced valve, comprising two pistons 5 attached to a common stem 6 and sliding in a sleeve or bushing 7 which is movable longitudinally in said ports. The sleeve or bushing is slotted lengthwise to form ports to permit the passage of steam into the steam chest of the turbine. The valve will be seen to comprise two principal parts, (*a*) the piston portion actuated by a motor controlled by the speed governor and (*b*) the sleeve or bushing containing the valve seats and actuated by a motor under the control of a pressure-responsive device as will appear more fully hereinafter.

The piston throttle valve is actuated by a motor, preferably of the hydraulic type and comprising a cylinder 8 in which is a piston 9 whose rod 10 is a continuation of the stem of the valve. Hydraulic pressure is admitted to and exhausted from said cylinder through the ports 11 and 12 opening respectively above and below the piston. Said ports are controlled by a balanced pilot valve 13 moving in a suitable chest 14 to which the hydraulic pressure is conveyed by a pipe 15 and from which it can exhaust through the pipe 16. The pilot valve is actuated by a floating lever 17 pivoted at one end to an extension 18 of the piston rod and at the other end to the rod 19 which is moved by the speed governor 20 geared or otherwise connected to the main shaft of the turbine in the usual manner.

The sleeve or bushing 7 is provided with a rod 21 which passes out through a stuffing box 22 in the bottom of the throttle valve casing and enters a cylinder 23 where it is attached to a piston 24. A pilot valve 25 of the balanced type controls the entrance and exhaust of fluid pressure to and from said cylinder to actuate the piston 24 in either direction, said pressure being conveyed to the casing of the pilot valve by the pipe 26 and exhausted through the pipe 27. The valve is actuated by a floating lever 28 pivoted at one end to the rod 21 and at the other to a stem 29 connected to a movable abutment, such as a diaphragm 30 in a suitable casing 31 connected by a pipe 32 with the steam main 2.

The operation is as follows:—When the

speed of the turbine falls, for instance, the rod 19 is pushed up by the speed governor and moves the pilot valve 13 to admit pressure on top of the piston 9 which thereupon moves downwardly and causes the piston valve 5 to admit more steam to the turbine. On an increase of speed, the governor pulls down the rod 19 and the opposite effect is produced; that is to say, the steam is partly or wholly shut off. In either case, the movement of the motor piston 9 acts through the extension 18 of the piston rod upon the floating lever 17, causing it to return the pilot valve to its mid-position and arrest the movement of the piston 9. Now, if the pressure of the steam falls below atmospheric pressure, or below any predetermined value, its effect upon the diaphragm is no longer sufficient to overcome the atmospheric pressure and the tension of the spring 33, both of which act upon the opposite side of said diaphragm, and the stem 29 is therefore lifted, carrying with it the lever 28 and the pilot valve 25. This admits fluid pressure on top of the motor piston 24, which moves downwardly carrying with it the sleeve or bushing 7. The solid portions 34 of said bushing are thus drawn down to meet the pistons 5 and the effect is to close the throttle valve so that no air leaking into the main can enter the casing of the turbine and break the vacuum therein, nor can the turbine by its operation lower the pressure in the main below the predetermined value in the event that such value is above atmospheric pressure. In other words the admission of steam to the turbine is throttled and the pressure backs up in the main 2 until the pressure equals that of the atmosphere or other predetermined pressure and air is prevented from backing into the system through the joints in the mains or through the stuffing boxes, etc. If the pressure is to be maintained above atmosphere the closing of the valve will hold said pressure at the desired value.

In the modification shown in Fig. 3, the sleeve or bushing 7 is connected to a piston or other movable abutment, as before, but the casing in which said abutment moves is open to the atmosphere above said abutment, as by means of the opening 35, while the closed space below said abutment is connected directly with the steam main by the pipe 36 so that any drop of the steam pressure below atmospheric pressure will permit said atmospheric pressure, acting upon the upper side of the abutment, to pull down the bushing and close the throttle valve, as in the former case,

It will be seen that a single operating or speed governor is provided and a single regulating valve, the latter being so arranged that it acts to regulate the admission of fluid to the turbine and also to prevent air from entering the turbine due to leaks in the joints in the piping and to leaks in the bushings on the engine or other source from which the turbine derives its supply. Where the piping is large, as it necessarily is with low-pressure apparatus, the leakage of air is a serious matter, it being difficult to maintain tight joints at all places. It is also to be noted that the regulating valve serves also as an automatic pressure-actuated shut-down valve in case the supply of low-pressure steam is not maintained at atmospheric pressure or at a predetermined value above atmosphere as is sometimes necessary where steam is used for industrial purposes, such for example as in heating systems. In heating systems it is sometimes desirable to maintain a pressure of say five pounds above atmosphere. I have mentioned one pressure that is sometimes required but it can be greater or less as desired. Where such a pressure is desired the pressure-responsive regulator will of course be correspondingly adjusted. It will be further noted that the regulating valve is sensitive to changes in pressure of the source of supply as well as to changes in speed of the turbine, and that the speed governor and the pressure governor are arranged to operate independently or in unison as occasion requires.

When a turbine which utilizes low-pressure steam and also high-pressure steam (commonly called a mixed-pressure turbine) is used to drive an alternating-current electric generator connected in multiple with one or more other generators of the same frequency driven by separate prime movers, the turbine tends to lose its load when changing from low to high-pressure operation, or if adjusted to carry a given load under high-pressure steam it will tend to take more than its share of the load when the governing mechanism changes the supply of motive fluid to the turbine from high to low-pressure steam. I overcome these objections by my improved mechanism, one form of which is illustrated more or less diagrammatically in Figs. 4 and 5. Referring to said figures, the piston rod 18 is provided with an extension 40 on the upper end of which is a rack 41 that meshes with a gear 42 on a rock-shaft 43. This shaft is provided with as many cams 44 as there are high-pressure valves 45, it being desirable to provide a number of such valves when the invention is applied to a Curtis turbine. Each valve is operated by a lever 46 having a roller that engages a cam. The lever is connected to the valve stem 47 and as the cam moves in the proper direction it raises the valve from its seat. The closing of the valve is accomplished by a compression spring 48. 49 indicates a nozzle of suitable construction and 50 the buckets on a wheel

that is carried by a suitable shaft. The turbine drives an alternating-current generator 51 which is connected in multiple with the generator 52, driven by a separate prime mover, by the conductors or bus bars 53. The pilot valve 13 is operated by the lever 17 which in turn is actuated by the speed governor as before. Surrounding the pilot valve is a ported sleeve 54 which is capable of being moved axially by the pressure-responsive device 30. This device also controls the action of the pilot-valve 25 as before. The rod 29 is extended through the diaphragm of the pressure-responsive device and is connected to the lever 55 which is supported by the bracket 56 attached at a suitable point on the apparatus. The lever is provided with a series of holes to receive the pins connecting the parts. This is to afford the necessary adjustment. The pressure at which the diaphragm operates is controlled by the spring 57 which encircles the rod 29 and rests on an adjusting nut. As the load increases the governor raises the rod 19 and causes the pilot valve 13 to admit fluid to the motor and as the piston is moved downward it opens the main low-pressure valve 5. This operation continues as the load increases until the low-pressure valve 5 is wide open. If now the supply of low-pressure steam fails or decreases below a certain value the pressure-responsive device 30 causes the sleeve 7 of the low-pressure valve to move downwardly and close its ports. This same action causes the lever 55 to move the sleeve 54 of the pilot valve 13 in a direction to uncover the ports therein, and this without the speed governor changing the position of the pilot valve. The effect of this is to admit fluid to the cylinder 8 and move the piston 9 downward and cause it, through the rod 40, rack 41 and associated parts (Fig. 5), to open one or more high-pressure valves 45. As soon as the supply of steam equals the demand the speed governor will move the pilot valve 13 in a direction to close the ports. Assuming that the turbine is working solely with high-pressure steam and the supply of low-pressure steam returns to normal, the pressure governor will restore the sleeve 54 to its normal position and the speed governor will then control the main low-pressure throttle valve as before. Since the action of the low-pressure throttle valve has been previously described further statements as to its operation seem unnecessary.

It will be seen from the foregoing that I have provided a single governing mechanism so organized and constructed that it permits of utilizing a mixed-pressure turbine to drive an alternating-current generator connected in multiple with another generator driven by a separate source and having an approximately constant frequency and also permits of utilizing a source of variable low-pressure steam supply while at the same time preventing the admission of air to the turbine when the pressure of the low-pressure source falls below atmosphere.

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 combination, a prime mover, a source of supply therefor, a valve for controlling the supply of motive fluid to the prime mover comprising two principal parts that are in sliding engagement with each other, a speed governor for controlling the action of one of the parts of said valve, and a pressure-responsive device for controlling the action of the other part of said valve.

2. In combination, a low-pressure turbine, a source of fluid supply therefor, a regulator comprising two principal parts that are in sliding engagement with each other, a governor acting on one of the parts to control the admission of fluid to the turbine in accordance with the load requirements, and a second governor acting on another of the parts of the regulator to control the admission of fluid to the turbine in accordance with the pressure of said source.

3. In combination, a low-pressure turbine, a source of fluid supply therefor, a regulator comprising two principal parts that are in sliding engagement with each other, a motor for actuating one of said regulator parts, a speed governor controlling said motor, a second motor for moving the other of said parts in a manner to shut off the supply of fluid to the turbine irrespective of the action of the speed governor and the first motor, and a second governor for controlling the second motor which is sensitive to pressure conditions.

4. The combination with a piston valve controlling the flow of elastic fluid through a conduit to a turbine, of a slotted sleeve in which said valve operates, a motor for moving said sleeve lengthwise and a pressure responsive regulator for controlling the action of the motor.

5. The combination with a piston valve controlling the flow of elastic fluid through a conduit to a turbine, of a slotted sleeve in which said valve operates, and means responsive to the pressure of said fluid for moving said sleeve lengthwise.

6. The combination with a piston valve controlling the flow of elastic fluid through a conduit to a turbine, of a slotted sleeve in which said valve operates, an abutment ex-

posed to the pressure of said fluid, and operative connections between said abutment and said sleeve whereby said sleeve will be moved lengthwise by variations in said fluid pressure.

7. The combination with a conduit supplying low-pressure steam to a turbine, of a piston valve controlling the flow of steam through said conduit, a slotted sleeve in which said valve operates, and an abutment exposed to the incoming steam and adapted to move said sleeve to close said valve when the pressure of said steam falls below a predetermined pressure.

8. The combination with a conduit supplying low-pressure steam to a turbine, of a piston valve controlling the flow of steam through said conduit, a slotted sleeve in which said valve operates, an abutment exposed on one side to the incoming steam and on the other side to atmospheric pressure, and operative connections between said abutment and said sleeve.

9. In a governing mechanism for prime movers, the combination of a source of high-pressure fluid, a source of low-pressure fluid, a high-pressure admission valve, a low-pressure admission valve comprising members in sliding engagement with each other, a speed governor for controlling the action of the valves, and a pressure-controlled means for moving the members of the low-pressure valve relative to each other to prevent air leaking into the prime mover when the pressure of the low-pressure supply decreases below a certain value and for modifying the action of the governor on the high pressure valve so as to permit the admission of high-pressure fluid to the prime mover unaccompanied by a change in speed.

10. In a governing mechanism for prime movers, the combination of a high-pressure valve, a two-part low-pressure valve, said parts being in sliding engagement with each other, a motor for moving the high-pressure valve and a part of the low-pressure valve, a second motor for moving the other part of the low-pressure valve, a speed governor controlling the first motor, and a device responsive to the supply of low-pressure fluid to the prime mover for controlling the action of the second motor and modifying the action of the governor on the first motor.

11. In a governing mechanism for turbines, the combination of a valve comprising two axially alined parts which are independently movable, independent motors for actuating said parts, a speed governor for controlling one of said motors, and a pressure-responsive device for controlling the other motor, said device also acting to modify the action of the governor on the first motor.

12. The combination with a valve controlling the flow of elastic fluid through a conduit of a turbine, of a ported member coöperating with said valve, and a means for moving said member in a manner to vary the flow of fluid through said conduit, said member being responsive to variations in pressure of the fluid in said conduit.

In witness whereof, I have hereunto set my hand this 28th day of December, 1910.

MORRIS B. CARROLL.

Witnesses:

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HELEN ORFORD.