F. SAMUELSON.

GOVERNING MECHANISM FOR TURBINES.

APPLICATION FILED AUG. 1, 1907.

1,063,603.

Patented June 3, 1913.

2 SHEETS—SHEET 1.

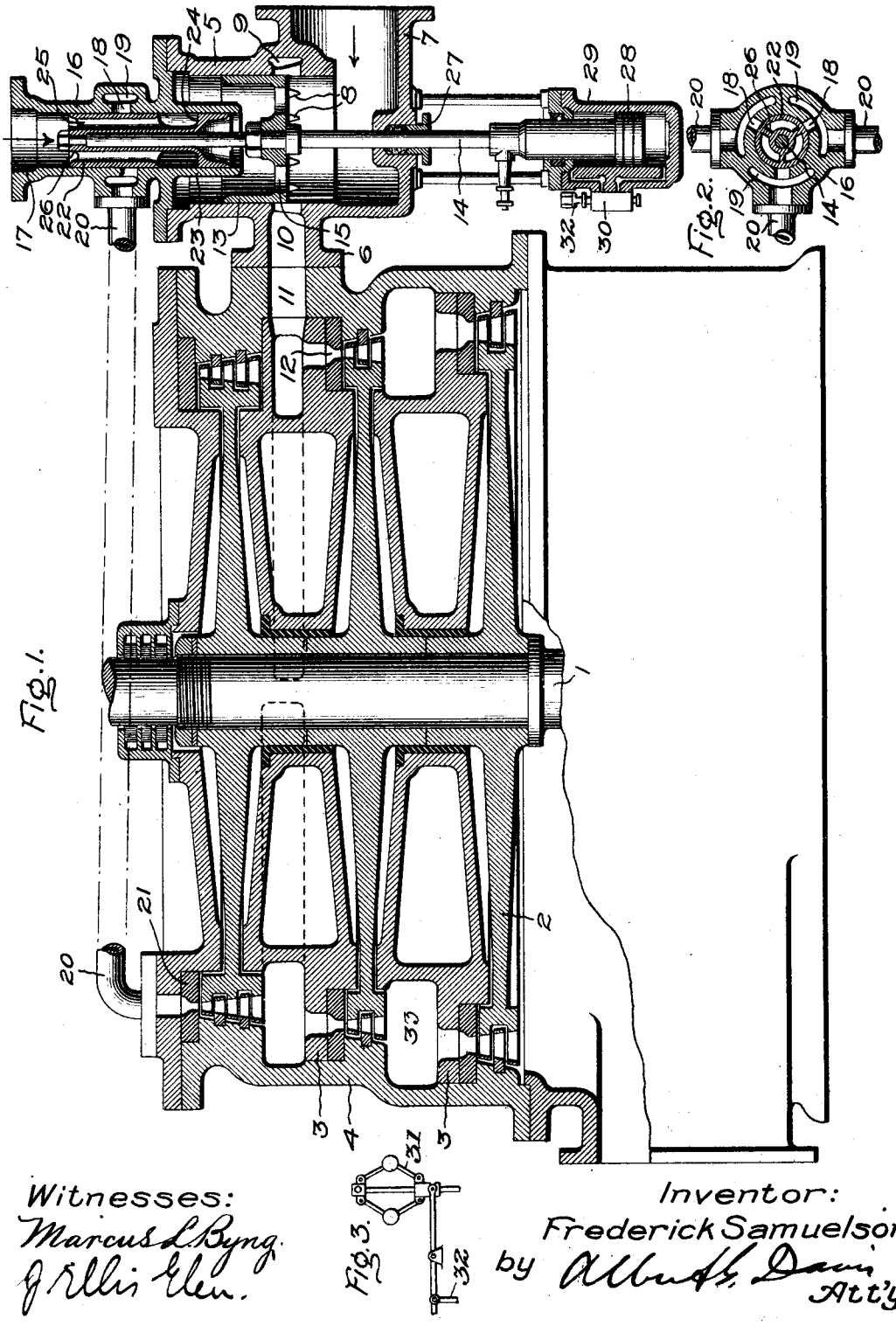

Fig. 1.

Fig. 2.

Fig. 3.

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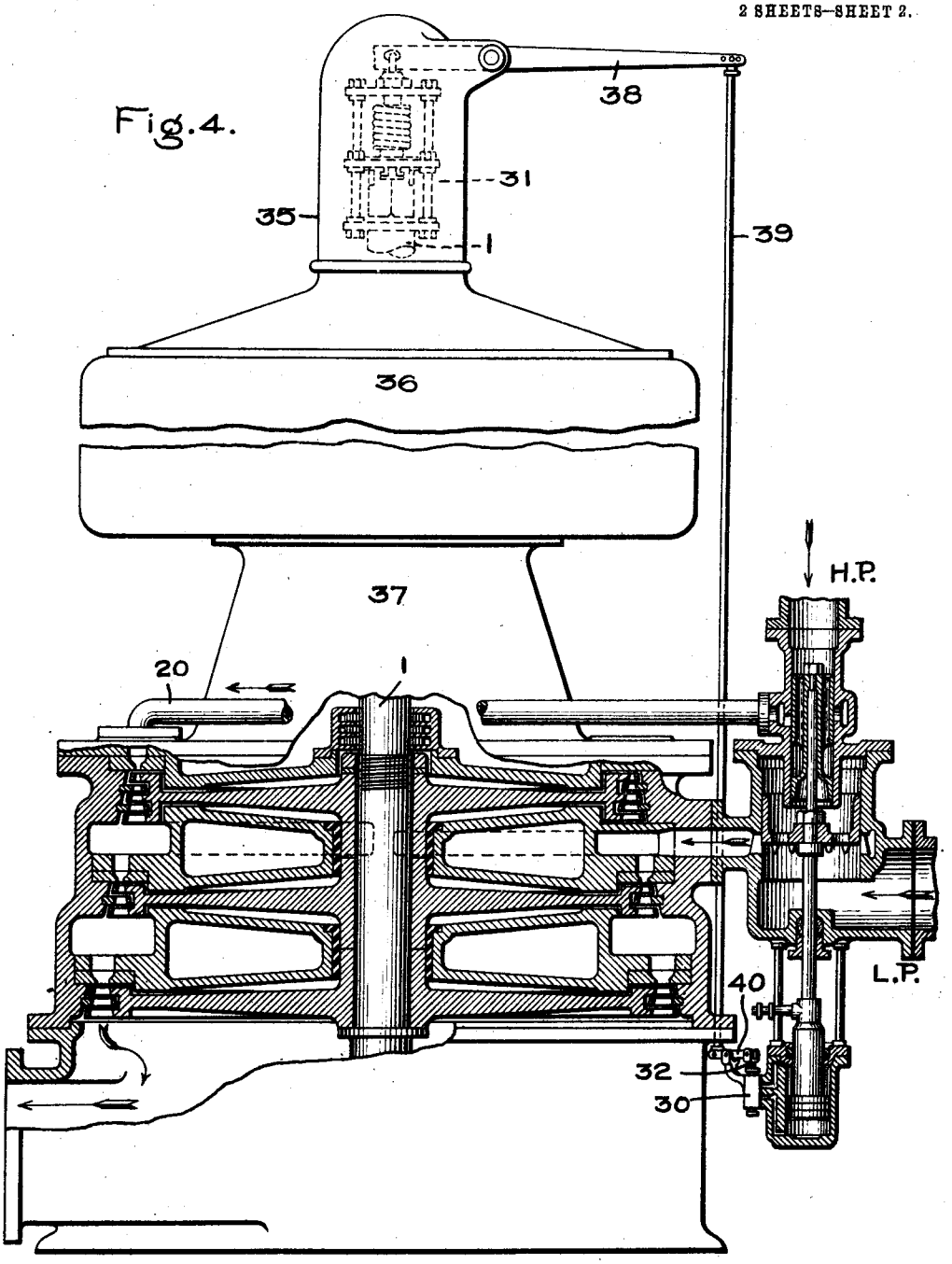
2 SHEETS—SHEET 2.

Fig. 4.



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UNITED STATES PATENT OFFICE.

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GOVERNING MECHANISM FOR TURBINES.

1,063,603. Specification of Letters Patent. Patented June 3, 1913.

Application filed August 1, 1907. Serial No. 386,591.

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 Turbines, of which the following is a specification.

My invention relates to the control of the supply of fluid to turbines of the type adapted to be operated either with high pressure fluid or with the exhaust fluid from another prime mover or machine, or with both, and the object of the invention is to provide a simple arrangement of devices for efficiently controlling the turbine.

A structure made in accordance with my invention comprises a pair of mechanically coupled valves one of which operates on the supply of fluid to the high pressure end of the turbine while the other controls the supply of exhaust fluid to an intermediate stage of the turbine, the valves being preferably operated by means of a motor working under the control of the governor.

In the accompanying drawings which illustrate one of the embodiments of my invention, Figure 1 is a vertical section through a mixed pressure steam turbine of the Curtis type, having a combined high and low pressure controlling valve attached thereto, Fig. 2 is a section through the high pressure part of the combined valve mechanism, Fig. 3 is a diagrammatic view of a speed governor for controlling the motor that actuates the controlling valve, and Fig. 4 is a view showing my invention as applied to a vertical shaft turbo-generator.

Referring to the drawing, 1 is the turbine shaft carrying the bucket wheels 2 between which are located the diaphragms 3, these parts being inclosed by the casing 4. The valve casing 5 is secured to the wheel casing 4 by bolts passing through the flange 6 and is preferably substantially cylindrical and arranged vertically with the inlet 7 for admitting exhaust steam situated at its lower extremity. Situated in the wall of the valve casing 5 are a number of ports 8 communicating with passages 9 and 10 the latter admitting exhaust steam which enters at 7 and passes through the ports and passages, into the duct 11 in the turbine casing which supplies the intermediate stage nozzles 12.

13 is a valve of the piston type carried by the valve rod 14 and having perforations 15 so as to permit of balancing the pressure on both sides. This valve controls the supply of exhaust steam to the intermediate stage nozzles by covering and uncovering the ports 8.

The low pressure valve casing 5 supports a second or high pressure valve casing 16 substantially cylindrical and having an inlet 17 admitting high pressure steam from the supply main. The body of this high pressure valve casing is provided with ports 18 connecting the valve cylinder with ducts 19 each of which communicates by means of one or more pipes 20 with an individual inlet nozzle or set of nozzles 21 of the first or high pressure stage of the turbine. Ports 18 are controlled by the piston valve 22 secured to the valve rod 14 and moving in unison with valve 13. The lower portion of valve 22 slides in a downwardly extending portion 23 of the casing 16 and is separated from the upper part by the annular groove 24 which is filled with live steam at high pressure entering at 17 and passing through the passages 25 formed by the septa 26 in the upper part of the piston. When the piston moves upwardly until the annular groove or chamber 24 is opposite the ports 18 live steam is admitted to the pipes 20 and first stage nozzles 21. The ports 18 are so arranged one above the other that when one is fully uncovered the next one is just commencing to open. By this arrangement nozzles or other fluid discharging devices are cut into and out of service successively. The valves 13 and 22 are preferably arranged so that the high pressure ports are not uncovered until the exhaust inlet ports are fully uncovered.

The valve rod 14 passes through a stuffing box 27 in the bottom of the low pressure valve casing 5 and carries the ram or piston 28 of a hydraulic motor 29 the cylinder of which may be conveniently bolted to the valve casing.

The valves may be operated in any suitable manner, but I preferably employ a hy-

draulic motor which receives its supply of motive fluid from a suitable source and is controlled by the relay valve 30 responsive to variations of speed through the intermediary of the turbine governor 31, the latter being connected to said valve by the stem 32.

The operation of the controlling valve is as follows: The valve 13 controls the speed of the turbine in the ordinary manner when there is a sufficient supply of exhaust steam, but if the requisite quantity of low pressure steam is not supplied to the intermediate stage, the speed falls whereupon the turbine governor actuates relay valve 30 to cause the motor 29 to lift the valves 13 and 22 thus uncovering one or more of the high pressure steam inlet ports 18 and admitting high pressure steam to the first stage nozzles 21 whence the steam passes through the first stage wheel and then into the succeeding stages of the turbine and mixes with the exhaust steam admitted to the intermediate stage controlled by the exhaust steam inlet valve. The turbine now speeds up and should the speed be too high the governor causes the relay valve 30 to operate and the ram 28 to descend thereby operating the high pressure valve 22 to reduce the supply to the first stage nozzles and the valve 13 to throttle the supply of exhaust steam to the intermediate stage. The nozzles 12 are shut off from the other nozzles of the same stage, (see dotted lines Fig. 1) and also from receiving fluid from the first stage. The first and second stage nozzles located at the left of the shaft receive motive fluid, if at all, from the high pressure source, while the third stage nozzles on the same side being in communication with the annular chamber 33 receive fluid either from the high or low pressure source or from both as the case may be.

The turbine structure just described forms the subject matter of a copending application which has resulted in Patent 875,111 of December 31, 1907.

In Fig. 4 I have shown my invention as applied to a vertical shaft, turbine driven electric generator, although the invention is not to be construed as being so limited. In this figure 31 indicates the speed governor which is driven by the main shaft 1 of the turbine. It is inclosed in a dome 35 that is mounted on top of the electric generator 36. This generator is supported on the turbine by a stool 37. Movements of the governor weights are transmitted to the governor lever 38. To the free end of the lever is adjustably attached a rod 39. The lower end of this rod is connected to a lever 40 which actuates the pilot valve 30 to control the operation of the hydraulic motor which actuates the high and low pressure governing valves in a manner heretofore described.

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. An elastic-fluid turbine arranged to receive and operate on motive fluid from two separate sources, in combination with governing valves that control the admission of fluid to the turbine from both sources of supply and a motor which is common to and actuates said valves.

2. In combination, a turbine having an inlet connected to a source of high pressure fluid, an inlet connected to a source of low pressure fluid, mechanically connected valves for regulating the flow through the inlets, and a speed governor constituting the sole means for controlling the valves whereby the high pressure valve will be opened after the low pressure valve to supply high pressure steam to the turbine when the supply of low pressure steam is insufficient to drive the turbine at normal speed, the valves being closed in the reverse order.

3. An elastic-fluid turbine arranged to receive motive fluid from separate sources at high and low pressure, the said pressures being independently variable, in combination with valves controlling the admission of fluid from both of said sources, and fluid actuated means for operating the valves which under conditions of increasing load fully opens the low pressure controlling valve and subsequently opens the high pressure controlling valve, and which closes the latter and then the former under decreasing load conditions.

4. An elastic-fluid turbine having an inlet for low pressure motive fluid, and a second inlet for high pressure fluid, in combination with a valve casing having ports communicating with both inlets, valves in the casing which control the ports, a motor for moving the valves, and a governor for the motor.

5. An elastic-fluid turbine having an inlet for low pressure motive fluid, and a second inlet for high pressure fluid, in combination with a valve casing having a port communicating with the low pressure inlet and the turbine, ports communicating with the high pressure inlet and the turbine, a valve which controls the low pressure port by a throttling action, and a valve which cuts the high pressure ports into and out of service successively.

6. In a governor mechanism, the combination of a casing having ports leading therefrom, an inlet for the casing, a valve mounted in the casing for changing the effective

area of the discharge ports, a second casing having ports leading therefrom and located in different planes so as to come into operation successively, a valve mounted in the second casing, a fluid-actuated motor for moving both valves, and a pilot valve for controlling the motor.

7. A multi-stage elastic fluid turbine comprising high pressure nozzles, bucket wheels, a casing common thereto, ports communicating with the said nozzles that receive high pressure fluid only, and other ports communicating with stage nozzles which receive low pressure fluid only, stage nozzles that receive high pressure fluid only, and stage nozzles that receive low pressure fluid only, in combination with means which supply the turbine with fluid from one source so long as it satisfies the load and from both sources when the demand for fluid cannot be satisfied by one source, and an actuator that is common to the means.

8. In an elastic fluid turbine, the combination of a plurality of bucket wheels, a casing therefor, partitions which divide the casing into wheel compartments, individual high pressure nozzles, a plurality of conduits that supply high pressure motive fluid to said nozzles, a valve that cuts the conduits into and out of service successively, stage nozzles arranged in a group, a valve which governs the admission of fluid to said group by throttling, an operating means connecting the valves, a fluid actuated motor for moving the valves, and a governor for controlling the action of the motor.

9. In combination, a turbine, a valve controlling the supply of live steam to the turbine, a valve controlling the supply of low pressure fluid to the turbine, a motor which opens the valve controlling the low pressure fluid first and then that controlling the high pressure, and a speed governor which controls the action of the motor.

10. In a turbine, the combination of blading for a low pressure fluid, supplemental blading comprising a prior stage for an independent source of fluid at a higher pressure than that supplied the first mentioned blading, and means affected alone by changes in speed of the turbine for throwing the supplemental blading in and out of action.

11. In a turbine, the combination of blading for a low pressure fluid, supplemental blading comprising a prior stage for an independent source of fluid at a higher pressure than that supplied to the first mentioned blading, and a speed governor constituting the sole means for positively throwing the supplemental blading in and out of action.

12. In a turbine, the combination of blading for a low pressure fluid, supplemental blading comprising a prior stage for an independent source of fluid at a higher pressure than that supplied the first mentioned blading, and valves mounted relatively to each other so as when moved, to always simultaneously move either toward closed or open position, for controlling and regulating the supply of high pressure and low pressure motive fluid to said blading.

13. In a turbine, the combination of blading for a low pressure fluid, supplemental blading comprising a prior stage for an independent source of fluid at a higher pressure than that supplied the first mentioned blading, and valves rigidly mounted relatively to each other for controlling and regulating the supply of high pressure and low pressure motive fluid to said blading.

14. In a turbine, the combination of blading for a low pressure fluid, supplemental blading comprising a prior stage for an independent source of fluid at a higher pressure than that supplied the first mentioned blading, and valves mounted on the same rod for controlling and regulating the supply of high pressure and low pressure motive fluid to said blading.

15. A mixed pressure turbine having valves for regulating the supplies of high and low pressure steam to said turbine, and speed responsive mechanism constituting the sole means for controlling said valves whereby the high pressure valve will be opened after the low pressure valve to supply high pressure steam when the low pressure supply is inadequate to meet the demands of the turbine.

16. In combination, a turbine, high pressure and low pressure fluid conduits, valves for regulating the flow of fluid between the turbine and said conduits, a rod or stem on which the valves are mounted, and means including a speed responsive device for moving the stem to open and close the valves in successive order.

17. In combination, a turbine, conduit for high pressure motive fluid and a conduit for low pressure motive fluid, in combination with valve means for regulating the flow of high pressure fluid between the turbine and one conduit, valve means for regulating the flow of low pressure fluid between the turbine and the other conduit, a motor for actuating both of the valve means, and a speed governor that controls the motor.

18. The combination of a prime mover, with means for supplying it with motive fluid from a plurality of sources at different pressures comprising valves for regulating the admission of fluid from each of said sources, a motor common to and actuating the valves, and speed responsive mechanism for controlling the motor in a manner to cause the valve or valves regulating the admission of fluid from a source at lower pressure to open to full flow capacity before

opening the valve or valves regulating the admission of fluid from a source at higher pressure to supplement the low pressure supply, said mechanism closing the valves in the reverse order.

19. In a mixed pressure turbine, the combination of a conduit supplying the turbine with steam from a source at low pressure, a conduit for supplying steam from a source at relatively high pressure, a plurality of valves for controlling the flow from the conduits into the turbine, a fluid actuated motor for opening said valves one after another beginning with a low pressure valve and closing them in the reverse order, and a speed responsive device for controlling the motor.

In witness whereof I have hereunto set my hand this 16th day of July, 1907.

FREDERICK SAMUELSON.

Witnesses:
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