

G. WESTINGHOUSE.  
ELASTIC FLUID TURBINE.  
APPLICATION FILED JULY 28, 1909.

Patented May 13, 1913.

3 SHEETS—SHEET 1.

1,061,792.

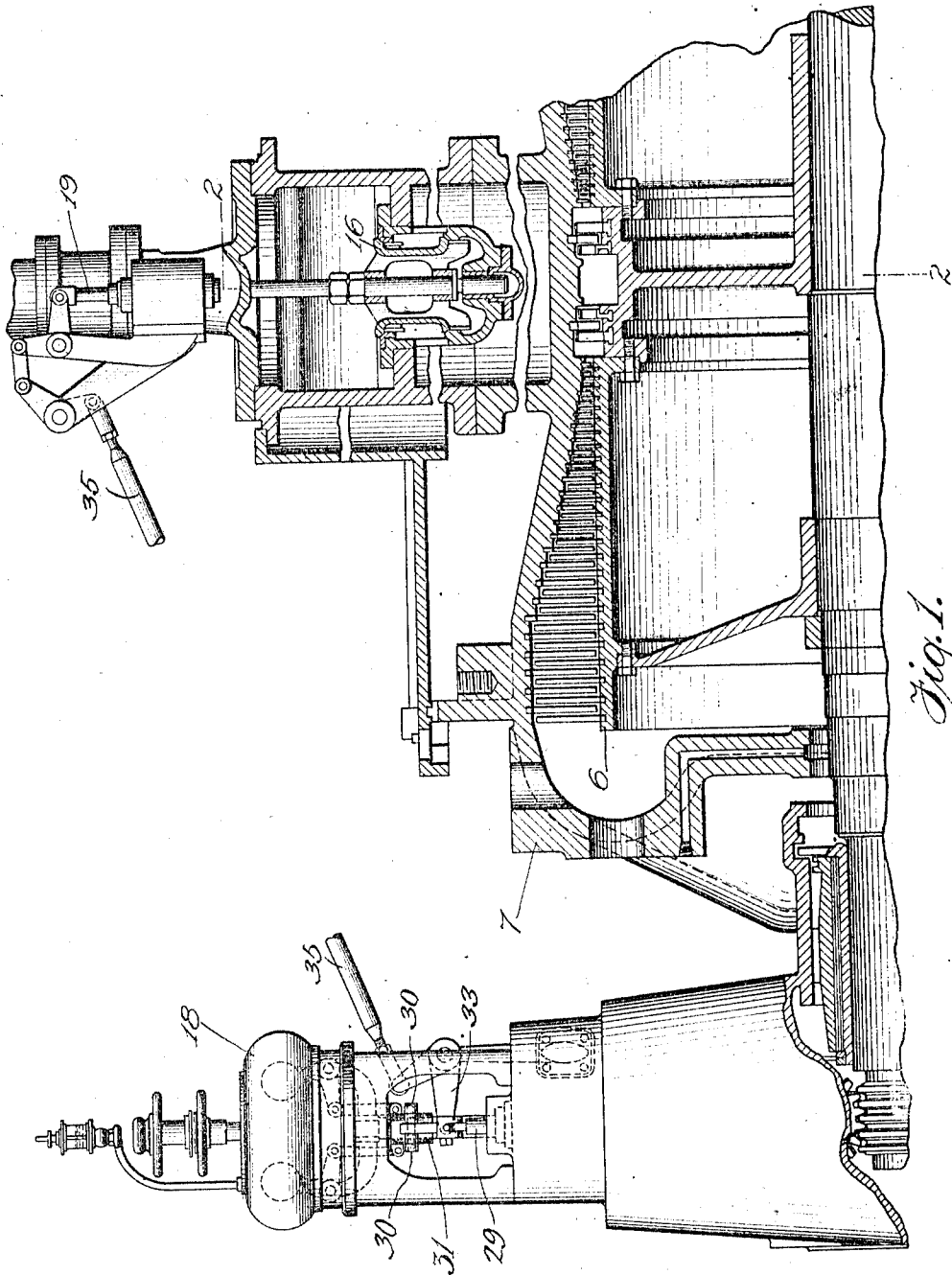


Fig. 1.

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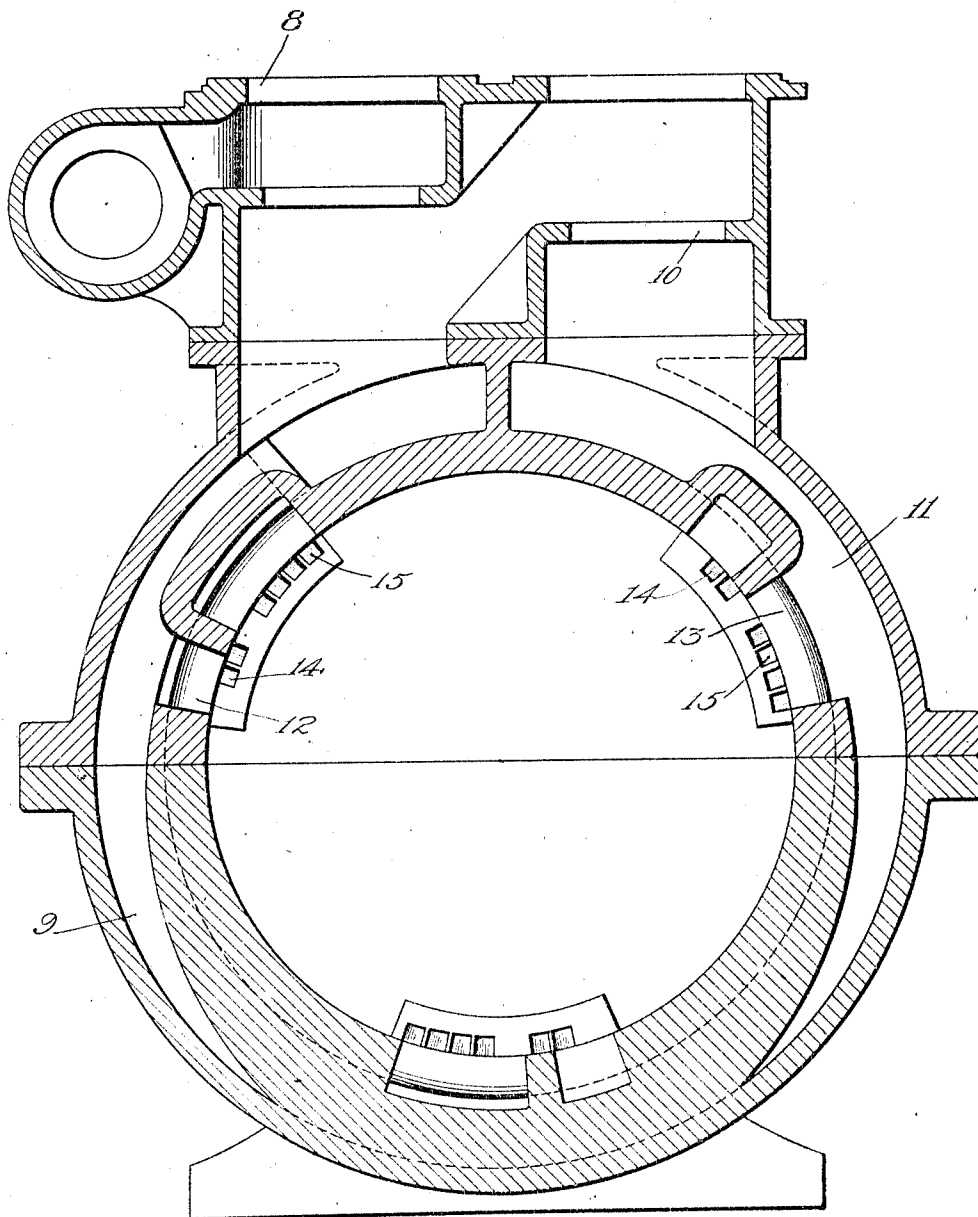


Fig. 2.

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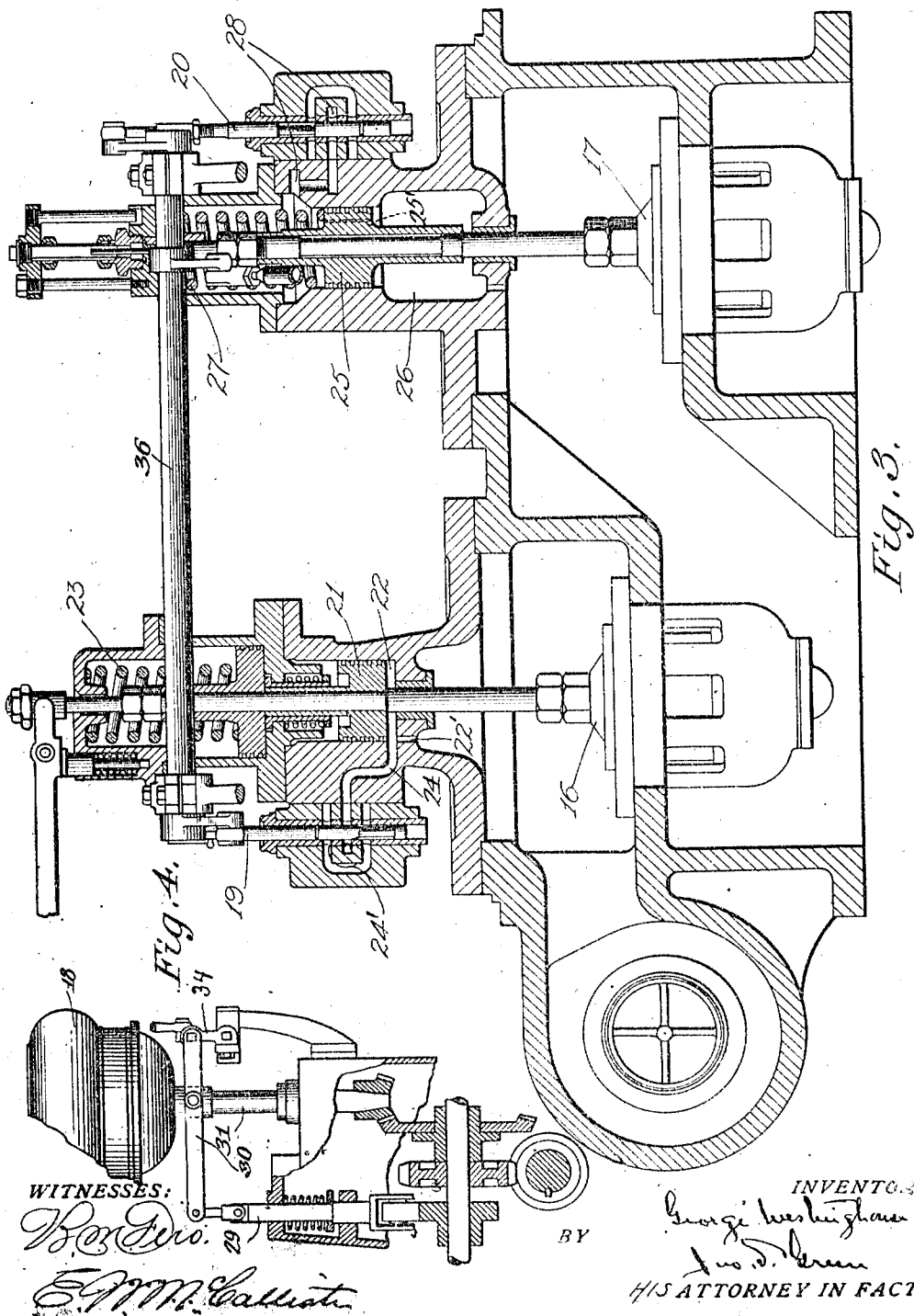
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# UNITED STATES PATENT OFFICE.

GEORGE WESTINGHOUSE, OF PITTSBURGH, PENNSYLVANIA, ASSIGNOR, BY MESNE ASSIGNMENTS, TO THE COLONIAL TRUST COMPANY, TRUSTEE, OF PITTSBURGH, PENNSYLVANIA, A CORPORATION OF PENNSYLVANIA.

## ELASTIC-FLUID TURBINE.

1,061,792.

Specification of Letters Patent.

Patented May 13, 1913.

Original application filed August 8, 1904, Serial No. 219,731. Divided and this application filed July 28, 1909. Serial No. 510,076.

*To all whom it may concern:*

Be it known that I, GEORGE WESTINGHOUSE, a citizen of the United States, and a resident of Pittsburgh, in the county of Allegheny and State of Pennsylvania, have invented new and useful Improvements in Elastic-Fluid Turbines, of which the following is a specification, this application being a division of an application filed by me on August 6, 1904, Serial No. 219,731.

This invention relates to turbines and particularly to governing means for such engines.

An object of this invention is to produce a simple and effective governing means which will render the turbine more efficient under all normal loads and render it capable of carrying large overloads with high economy. This and other objects I attain in an apparatus embodying the features herein described and illustrated.

In the drawings accompanying this application and forming a part thereof, Figure 1 is a fragmental longitudinal section of a turbine equipped with my invention; Fig. 2 is a section along the line 2-2 of Fig. 1, the valves and valve operating mechanism being removed; Fig. 3 is a transverse section illustrating the valves and the valve operating mechanism of the turbine; and, Fig. 4 is a fragmental view showing a turbine governor in connection with a floating lever which forms a detail of my invention.

My invention is illustrated in connection with a double flow turbine, but it is applicable to various types of turbines and is in no way limited to the type of turbine or the specific details illustrated.

The turbine shown consists of a rotor element 6, on which the rotating blades are mounted, and an inclosing casing or stator element 7 on which the stationary vanes are mounted and which is provided with a motive fluid inlet port 8. The port 8 communicates directly with a spiral passage 9 and through a secondary port 10 with a spiral passage 11. The passages 9 and 11 are formed in and extend around the casing and respectively communicate with the fluid-delivery nozzles 14 and 15 through the ports 12 and 13.

The nozzles 14 and 15 are located within the turbine, extend peripherally around the casing and deliver motive fluid to the initial stage of the turbine.

The delivery of motive fluid to the turbine is controlled by a primary valve 16 which regulates the passage of motive fluid through the admission port 8. A secondary valve 17 controls the delivery of motive fluid to the passage 11. These valves are governor controlled and their operating mechanism is so adjusted that the valve 16 admits motive fluid to the turbine through the nozzles 14 during normal loads on the turbine and the valve 17 admits additional amounts of motive fluid to the turbine during excessive or over loads. The arrangement is such that the valve 16 opens periodically and admits intermittent puffs of motive fluid through the nozzles 14 during light loads. The duration of the puffs increases as the load on the turbine increases until, at some predetermined load, the valve 16 ceases to close, but continuing to pulsate admits a continuous stream of motive fluid to the turbine. As the load further increases the secondary valve 17 starts to open periodically and to admit motive fluid to the turbine through the nozzles 15. The puffs of fluid admitted by the secondary valve 17 increase in duration as the load increases until at some predetermined overload both sets of nozzles 14 and 15 are delivering continuous streams of motive fluid to the turbine.

The valves 16 and 17 are controlled by a governor 18 through the agency of pilot valves 19 and 20 and fluid actuated valve operating motors. I will now describe a preferred form of valve operating mechanism.

The primary valve operating means consists of a piston 21 mounted on the stem of the valve 16 and located within a cylinder 22. Motive fluid is admitted to the cylinder 22 below the piston 21 through a restricted orifice 22' which is continually open and which communicates with a constant supply of motive fluid. The fluid pressure thus admitted raises the piston 21 against the pressure of a spring 23 and opens the valve 16. The cylinder 22 is exhausted through an

exhaust passage 24 controlled by the pilot valve 19 and which is of such cross-sectional area relative to the admission orifice 22' that the pressure in the cylinder drops to approximately exhaust pressure when the passage 24 is open and permits the spring 23 to close the valve. The pilot valve 19 controls the communication between the passage 24 and the U-shaped passage 24' which is in direct communication with the atmosphere or with the condenser to which the turbine is connected. A dash-pot or timing device is provided so that the valve 16 is brought to its seat without unnecessary jar.

The secondary valve is provided with a somewhat similar operating means. A piston 25 is mounted on the stem of the valve 17 and is located within the cylinder 26. Motive fluid is delivered to both sides of the piston 25 so that it is balanced and the valve 17 is held closed by means of a spring 27 located in the cylinder above a piston 25.

The motive fluid is delivered to the cylinder above the piston 25 through a restricted orifice or passage 25' and is exhausted therefrom through ample passages 28 and 28', the latter of which is in direct communication with the atmosphere or with the condenser to which the turbine is connected.

Communication between these passages is controlled by the pilot valve 20. When the exhaust passage 28 is open to the exhaust the pressure in the cylinder 26 below the piston 25 overcomes the pressure of the spring 27 and raises the valve 17.

The pilot valves 19 and 20 are reciprocated by means of a system of links and levers which is actuated by the turbine governor 18 and a reciprocating member 29. The system of links and levers includes a lever 30 which is fulcrumed on a sleeve 31 of the governor 18 and is pivotally connected at one end to the reciprocating member 29. The other end of the lever 30 is connected to a bell-crank 33 by means of a link 34 and the bell-crank is pivotally connected to a rod 35 which operates a shaft 36, and through the shaft and operating levers of the pilot valves 19 and 20. The member 29 is actuated by a cam 37 which is driven through suitable gearing by the shaft of the turbine. The sleeve 31 on which the lever 30 is fulcrumed is actuated by the balls of the governor 18, and, consequently, the position of the fulcrum of the lever 30 is varied in accordance with the speed of the turbine. These variations in the position of the lever 30 change the planes of reciprocation of the pilot valves.

The pilot valve 19 is so arranged that the valve 16 opens periodically during light loads on the turbine and delivers puffs of motive fluid to the working passages of the turbine. This is accomplished by so constructing the pilot valve 19 that it periodically

opens the exhaust passage 24 during light loads on the turbine and thereby exhausts the motive fluid from the cylinder 22 and permits the valve to close. As the load on the turbine increases and the speed decreases, the lever 30 is lowered by the governor balls; this changes the plane of oscillation or of reciprocation of the valve 19 so that it opens the passage 24 later on its upward stroke and closes it earlier on its downward stroke. At about full load on the turbine, the lever 30 occupies such a position that the period during which the cylinder 22 is in communication with the exhaust through the passage 24 is so short that the valve 16 does not reach its seat but merely oscillates or pulsates in response to reciprocations of the valve 19.

The pilot valve 20 is so constructed that it does not open the passage 28 until the valve 16 has ceased to close. It then starts to periodically open the passage 28 and by exhausting the upper portion of the cylinder 26 permits the valve 17 to rise against the pressure of the spring 27. As the load increases on the turbine the lever 30 is finally raised to such a position that the period during which the passage 28 is closed is so short that sufficient pressure does not pile up above the piston 25 to close the valve 17. While the valve 17 is open it never ceases to oscillate or pulsate in response to the reciprocations of the valve 20.

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 is:

1. In a turbine, a normal load valve, a plurality of normal load nozzles communicating therewith, an overload valve, a plurality of overload nozzles communicating therewith and a device for controlling the delivery of motive fluid to said nozzles in accordance with the speed of the turbine and for pulsating the fluid passing said valves.

2. In a turbine, a normal load fluid inlet, an overload fluid inlet, a plurality of fluid ports leading from each of said inlets to the primary portion of the turbine, a valve in each of said inlets, means for opening the valve more or less in accordance with the load demand of the turbine, means for opening the valve in the overload inlet in accordance with the load demand of the turbine when said normal load valve is fully open and means for pulsating the fluid passing said valves.

3. In a turbine, a normal load fluid passage, 130

an overload fluid passage, a plurality of fluid ports leading from each of said passages, a valve in each of said passages, means for opening the valve in the normal load passage more or less in accordance with the load demand of said turbine, means for opening the valve in the overload passage in accordance with the load demand of said turbine when said normal load valve is fully open and means for pulsating the fluid passing said valves.

4. In an elastic fluid turbine of the double-flow type, a plurality of normal load divergent nozzles discharging toward the exhaust of each end of the turbine, a plurality of normally inactive overload divergent nozzles discharging similarly to the normal load nozzles, a governor and means controlled by the governor whereby upon an overload motive fluid is admitted to all of said overload nozzles simultaneously and whereby the durations of said overload ad-

missions are made dependent upon the degree of the overload.

5. In an elastic fluid turbine of the double-flow type, a plurality of normal load nozzles discharging toward the exhaust of each end of the turbine, a plurality of normally inactive overload nozzles discharging similarly to the normal load nozzles, a governor and means controlled by the governor whereby upon an overload motive fluid is simultaneously admitted to all of said overload nozzles and the durations of said admissions are made dependent upon the degree of overload.

In testimony whereof, I have hereunto subscribed my name this 26th day of July, 1909.

GEO. WESTINGHOUSE.

Witnesses:

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