W. PAPE.

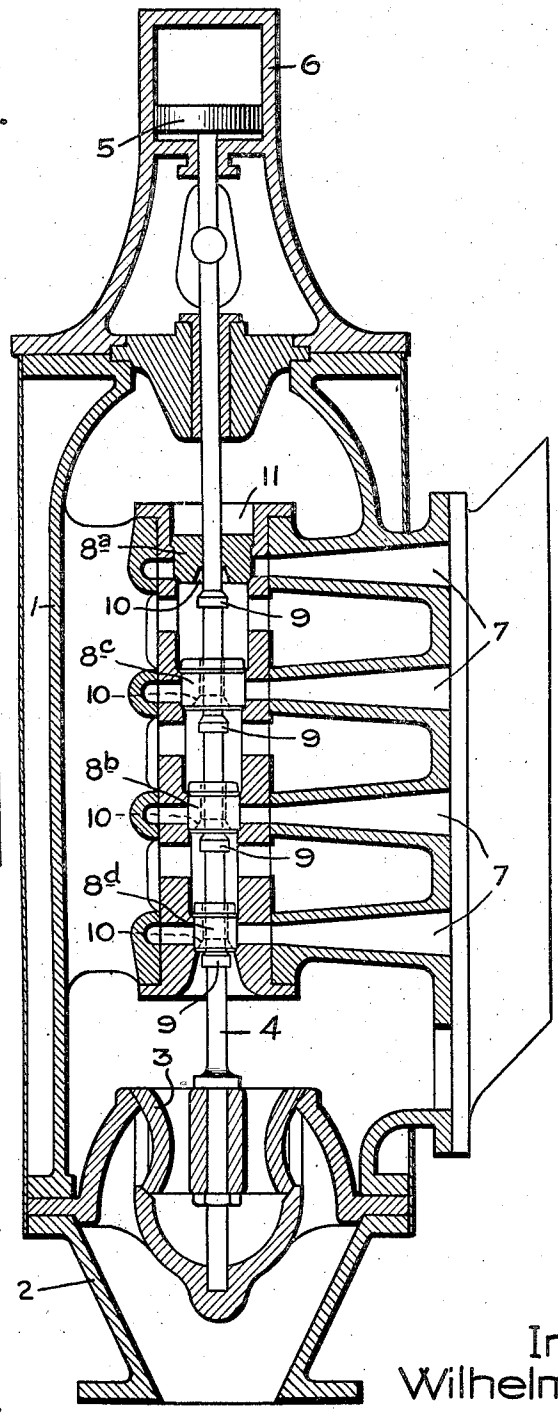
STEAM REGULATOR FOR TURBINES.

APPLICATION FILED MAY 4, 1912.

1,076,446.

Patented Oct. 21, 1913.

Fig. 1.



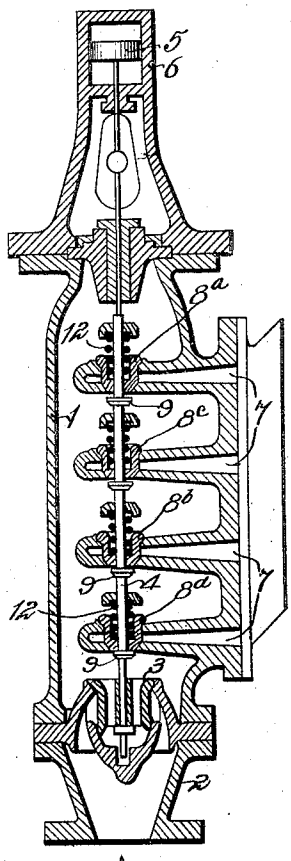


Fig. 2.

Witnesses:

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Att'y.

UNITED STATES PATENT OFFICE.

WILHELM PAPE, OF CHARLOTTENBURG, GERMANY, ASSIGNOR TO GENERAL ELECTRIC COMPANY, A CORPORATION OF NEW YORK.

STEAM-REGULATOR FOR TURBINES.

1,076,446. Specification of Letters Patent. Patented Oct. 21, 1913.

Application filed May 4, 1912. Serial No. 695,151.

To all whom it may concern:

Be it known that I, WILHELM PAPE, a subject of the King of Prussia, residing at Charlottenburg, Germany, have invented certain new and useful Improvements in Steam-Regulators for Turbines, of which the following is a specification.

This invention relates to elastic fluid turbines, and its object is to provide a regulator for the steam supplied to such a turbine, so that the quantity of steam will vary with the load, and the pressure of the steam supplied to the inlets of the high pressure nozzles will be maintained at a constant value, even at small load; whereby the entire drop in pressure may always be utilized for the purpose of imparting energy, and also so that danger of racing due to possible leakage through the nozzle valves will be obviated.

To this end the invention consists in a plurality of ports each controlled by its own valve, a common operating rod adapted to open said valves in succession, and a valve in advance of the nozzle valves which is operated by the same rod and arranged to open to permit substantially full flow before the regulating valves begin to open and to close after said valves. The operating rod or spindle is under the control of a motor device which is responsive to variations in load or speed or both as may be desired.

In the accompanying drawings, Figure 1 is a vertical axial section of my improved regulator, and Fig. 2 is a similar view of a modification thereof.

In both figures there is a casing 1 having at one end a neck 2 through which the high pressure steam is supplied. The entering steam is controlled by a valve 3 preferably of the balanced type, as shown. Said valve is mounted on a spindle or rod 4 which passes lengthwise through the casing and is connected to a piston 5 in a cylinder 6, said piston being adapted to be moved by hydraulic pressure governed by any suitable load or speed responsive device (not shown).

The casing is provided with a plurality of ports 7 through which the steam can reach the high pressure nozzles of the turbine. Each port is controlled by a valve 8^a, 8^b, 8^c or 8^d, all strung loosely on the spindle 4. Underneath each valve is a collar 9 on the spindle, and these collars are so spaced that they will pick up their valves in succession when the spindle is lifted by the piston 5 and close them in the reverse order. In Fig. 1, the valves are of successively increasing diameter in the order in which they will open, which is preferably from the bottom upward. Each valve has a recess 10 in its under side to receive the collar 9 which thereby centers the valve as it lifts it. Both the upper and the lower faces of the valves are exposed to the steam pressure, but the upper face is slightly larger in diameter than the lower, so that there is always an unbalanced pressure tending to close the valve. The valve works in a cylindrical chamber 11 so that the gap around its upper edge or seat will always be the same at all heights to which it may be lifted by the spindle while the lower edge regulates the flow of steam to the nozzles.

The valve 3 is made of such large proportions that the flow cross section when opening increases many times faster than that afforded by the regulating valves, so that the valve assumes only in its lowest position the function of throttling the steam and contingently also a limited throttling of the steam for the first group of nozzles. At higher load and when in a higher position this valve 3 effects no more throttling. By this combination of such a valve for the entire quantity of steam, with a number of individual regulating valves, the result is attained that even with very imperfect tightness of the regulating valves, racing of the turbine is prevented, without involving any throttling loss at higher load.

An important requirement in the mechanism for automatically regulating the amount of steam supplied to the nozzles is a sufficient clearance between the regulating valves and the portions of the casing in which they work and also between said valves and the spindle. At the high pressures and temperatures and the great variations of temperature occurring in operation, the existing strains of the material may become freely equalized, and thus not only the regulator casing but also the spindle may be moved a certain amount without thereby impairing the certainty of operation of the device. The clearance between the spindle and the regulating valves insures their closing as completely as possible, so that the leakage of steam may be as slight as possible and have no disadvantageous

influence upon the efficiency of the turbine. The regulating operation is so planned that the first valve 8^a begins to open as soon as the valve 3 has opened to a point where practically no further throttling occurs. The regulating valves open in succession as the spindle is lifted, each rising to a completely open position before the next one assumes the function of regulating.

In the modification shown in Fig. 2, the regulating valves are all of the same diameter, and springs 12 are used to seat them instead of relying upon unbalanced steam pressure, as in Fig. 1. In other respects this form of the device is substantially the same as that shown in Fig. 1 and the operation is similar.

By my invention the supply of steam to the first running wheel of the turbine automatically adapts itself to the load, so that the steam pressure at the inlets of the high pressure nozzles remains at the same height even with small loads, and the entire fall of pressure can be utilized for delivering energy. The device operates simply and steadily, all loss by throttling is avoided, and a considerable reduction in the steam consumption at small load is obtained as compared with pure throttling systems while danger of racing at light load is obviated.

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. A steam regulating device for elastic fluid turbines, comprising a casing, a valve mounted in and controlling the admission of steam to said casing, a plurality of regulating valves controlling the flow of steam from said casing to the turbine, and means including a common stem on which the valves are mounted for operating said valves in succession.

2. A steam regulating device for elastic fluid turbines, comprising a casing, a valve controlling the admission of steam to said casing, a plurality of regulating valves controlling the flow of steam from said casing to the turbine, means including a common stem on which the valves are mounted for operating said regulating valves in succession, and means for opening said admission valve before said regulating valves are opened.

3. The combination with a casing, of means for admitting steam thereto, a plurality of regulating valves controlling the flow of steam out of the casing, upper and lower seats for each valve carried by the casing, a cylinder adjacent the upper seat in which the portion of valve that coöperates with said seat moves so that the flow area to the upper seat remains substantially constant while the flow area between the lower portion of the valve and its seat varies as the valve is moved, a spindle passing through all of the valves, devices on the spindle for operating the valves in succession, and means for operating the spindle.

4. The combination with a casing, of a valve for admitting steam thereto, a plurality of regulating valves controlling the flow of steam out of said casing, a spindle passing through all of said regulating valves and connected to the admission valve, collars on said spindle for opening said regulating valves in succession, and means for operating said spindle.

5. The combination with a casing, of a valve for admitting steam thereto, a plurality of regulating valves controlling the flow of steam out of said casing, means including a common stem on which the valves are mounted for opening said valves in succession said stem being connected to the admission valve, and means for producing an unbalanced pressure on said regulating valves to cause them to close automatically.

6. The combination with a casing, of means for admitting steam thereto, a plurality of regulating valves controlling the flow of steam out of said casing, said valves having portions of different diameters, cylinders in which the portions of larger diameter work, and a spindle passing through all of said valves and provided with collars for engaging and lifting them in succession.

7. The combination with a casing, of means for admitting steam thereto, a plurality of regulating valves controlling the flow of steam out of said casing, there being a conical recess in each valve, a spindle passing loosely through all of said valves, and collars on said spindle arranged to act upon said valves in succession for lifting them, the collars having conical portions that engage said recesses to center the valves as they are lifted.

In witness whereof, I have hereunto set my hand, this fourth day of April, 1912.

WILHELM PAPE.

Witnesses:

HENRY HASPER,

WOLDEMAR HAUPT.

Copies of this patent may be obtained for five cents each, by addressing the "Commissioner of Patents, Washington, D. C."