R. H. RICE.

TURBINE.

APPLICATION FILED AUG. 5, 1909.

989,723.

Patented Apr. 18, 1911.

Fig. 1.

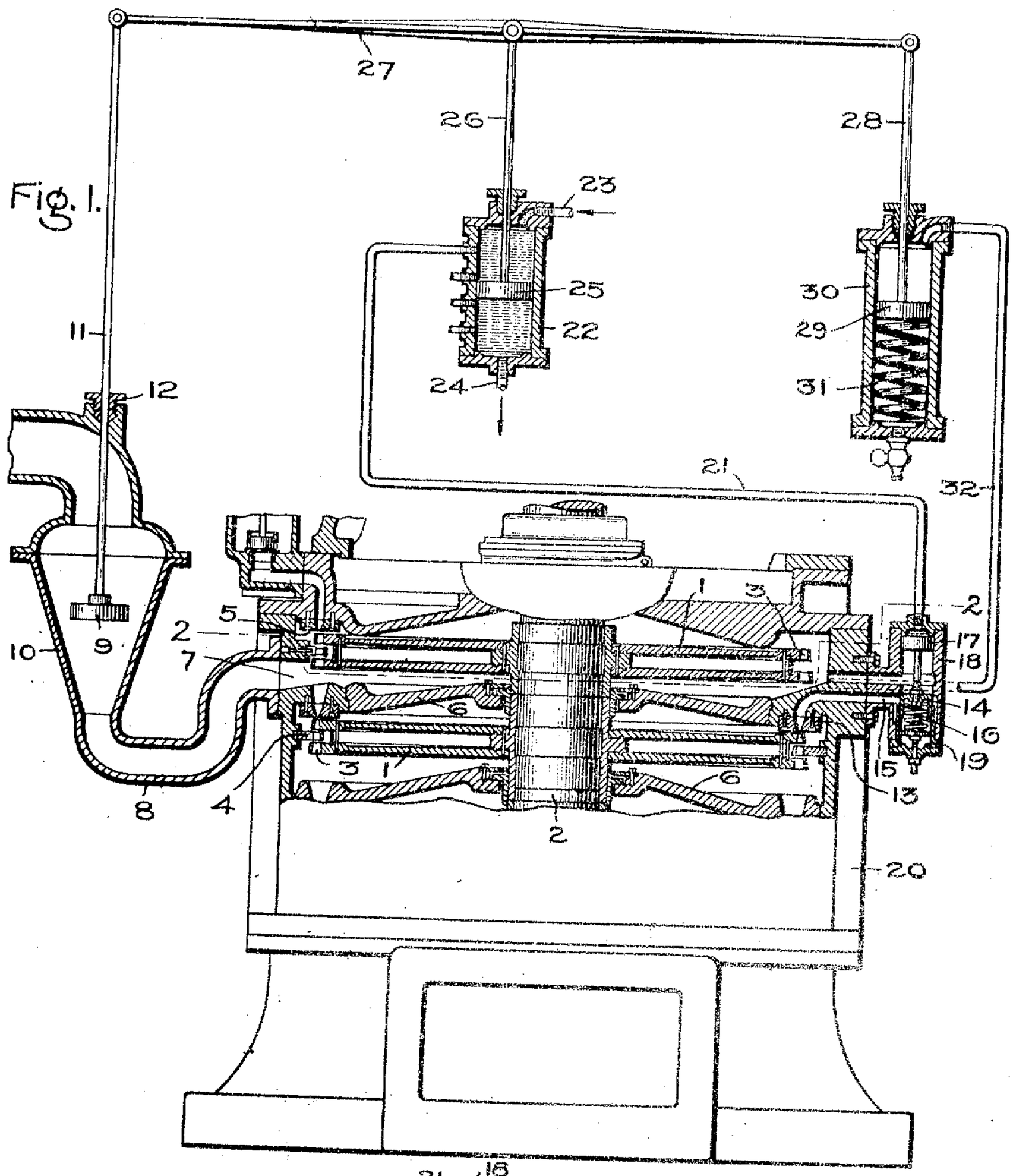
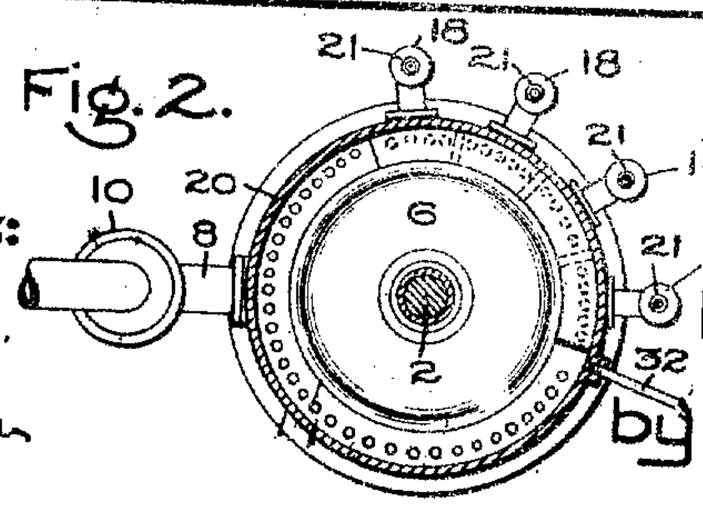


Fig. 2.



Witnesses:

Marcus L. Byng.

J. Ellis Glen

Inventor,

Richard H. Rice,

by Albert G. Davis

Att'y.

UNITED STATES PATENT OFFICE.

RICHARD H. RICE, OF LYNN, MASSACHUSETTS, ASSIGNOR TO GENERAL ELECTRIC COMPANY, A CORPORATION OF NEW YORK.

TURBINE.

989,723. Specification of Letters Patent. Patented Apr. 18, 1911.

Application filed August 5, 1909. Serial No. 511,309.

To all whom it may concern:

Be it known that I, RICHARD H. RICE, a citizen of the United States, residing at Lynn, county of Essex, State of Massachusetts, have invented certain new and useful Improvements in Pressure-Maintaining Mechanism for Turbines Supplying Steam for Industrial Purposes, of which the following is a specification.

This invention relates to elastic-fluid turbines, and especially those from which low pressure steam is drawn to supply industrial apparatus of various kinds, such as heating appliances, dye kettles, and the like. In such a plant, the demand for low pressure steam may vary between wide limits and quite independently of the power load on the turbine. Indeed, it may happen that the mill load may be at a maximum when the power load is at a maximum, or vice versa. From this it follows that the ordinary mechanism which merely governs the admission of steam to the turbine in accordance with the power load must be supplemented by some device which will independently take into account the demand of the mill for low pressure steam, so that both the power load and the mill load will be effectively handled, each independently of the other.

In carrying out my invention, a Curtis multi-stage turbine is preferably employed. At some place in the working passage of the turbine where the normal pressure at, say, full load corresponds approximately with that desired for the auxiliary devices, a conduit is led off to supply steam to said devices. It is very desirable, however, to maintain a constant pressure in these devices irrespective of the volume consumed, and since the pressure in any given region of a turbine varies greatly under different conditions of the power load, provision must be made for maintaining the constant pressure required by the mill, and this must be done under variations not only of the power load but of the mill load as well.

The present invention is a modification of the apparatus set forth in the application of Lewis Sanders, filed April 22, 1909, Serial No. 489,517. It comprises a pilot valve controlling nozzle valves between the constant pressure region or stage of the turbine and the next stage, with a device responsive to variations in the volume of the steam withdrawn for mill purposes, and a device responsive to the pressure in said steam-supplying region or stage; both of these devices exerting control over the pilot valve. From this it results that any variation in the volume of the steam withdrawn or in the pressure in said stage will be counteracted by the opening or closing of the nozzle valves, thereby relieving or building up the stage pressure, as the case may be, in order to maintain it as nearly constant as possible.

The apparatus is hereinafter set forth in detail, and will be readily understood upon reference to the description, taken in connection with the accompanying drawings, in which—

Figure 1 is a diagrammatic representation of a turbine equipped with my improved pressure-maintaining apparatus; and Fig. 2 is a sectional plan view, on a smaller scale, taken on the line 2—2, Fig. 1.

The turbine shown is simply illustrative, as the particular design is not essential. I have shown an upright Curtis multi-stage turbine having its bucket wheels 1 secured to the shaft 2 and carrying two sets of buckets 3 coöperating with stationary intermediates 4 and taking steam from suitable steam-chest nozzles 5. The several stages are separated by diaphragms 6.

From one of the chambers 7 into which the steam exhausts from one of the stages, a steam pipe 8 leads to heating apparatus of some kind, such as a dye kettle, a steam table, or other mill appliances. In this pipe is included a device sensitive to changes in the volume of fluid flowing through it. This consists preferably of a float 9 moving axially in a conical enlargement 10 of said pipe and attached to a rod 11 which passes out through a stuffing box 12. When the volume of steam drawn off by the heating apparatus increases, the float is moved upwardly, and vice versa. I provide one or more stage nozzles 13, controlled by valves 14 located in auxiliary passages 15 leading from the chamber 7. These valves are held closed by springs 16, but can be opened by fluid pressure acting on pistons 17 working in cylinders 18 in opposition to the tension of said springs. The valves, springs, pistons and cylinders are contained in casings 19 secured to the casing 20 of the turbine. Each casing 19 is connected by a pipe 21 to a valve chest 22, the several pipes entering said chest at different distances from the

pipe 23 which supplies hydraulic or other fluid pressure to said chest. At the other end of said chest is an exhaust pipe 24, and in said chest moves a pilot valve 25 adapted to open one or more of said pipes to the supply or the exhaust as the case may be. The valve stem 26 is pivoted to the middle of a floating lever 27 which at one end is pivoted to the rod 11 of the float 9. The other end of said lever is pivoted to a rod 28 which is attached to a movable abutment exposed to the pressure of the steam in the chamber 7; preferably a piston 29 working in a cylinder 30 and urged upwardly by a spring 31. A pipe 32 connects the upper end of said cylinder with the chamber 7 of the turbine. The tension of the spring just balances the thrust of the piston when the pressure in the chamber 7 is at its normal value.

The operation is as follows: The float 9 is of constant weight, and by virtue thereof it rides or floats on the current of steam flowing through the pipe 8. There is a certain pressure difference between the upper and lower side of the float depending on the area of the annular opening around it. This pressure difference, multiplied by the area of the float, is just sufficient to balance its weight. When an increase in volume occurs, the pressure difference increases and the float rises and increases the annular opening around it until the pressure difference is reduced to the normal value again, and the float comes to rest in this new position. In other words, the float automatically adjusts itself up or down to maintain a constant pressure difference between its upper and lower sides. Now let it be assumed that the power load on the turbine is steady, and that one or more additional mill appliances, are put into use, calling for a greater flow of steam through the pipe 8. This tends to lower the pressure in the chamber 7. The greater volume raises the float 9, which lifts the pilot valve 25, shutting off pressure from one or more of the pipes 21 and causing the closing of one or more of the stage nozzles 14. This results in decreasing the steam outlet at the nozzles to a degree sufficient to compensate for the increase in such outlet due to the lifting of the float, and the steam pressure in the chamber 7 is, therefore, restored to normal in spite of the increased volume now flowing from said chamber. On the other hand, if some of the mill appliances are shut down, so that a lessened volume of steam is required, the float 9 will fall, but this causes the opening of one or more nozzles, and thus prevents any increase of the pressure in the chamber 7. Again assume a constant mill load, but let there be an increase in the power load. The turbine governor at once opens more steam-chest nozzles, admitting a larger volume of steam to the turbine and thereby raising the stage pressures. The increase in pressure in the chamber 7 tends to produce a greater flow through the pipe 8 and thereby lift the float, but the piston 29 is forced downwardly by the increased pressure, thereby pushing down the pilot valve and opening enough nozzle valves to relieve the extra pressure in the chamber 7 and bring it down to normal. With a lessening of the power load, an opposite effect is produced. It appears, therefore, that under all conditions, whether of varying demand for steam by the mill appliances, or of fluctuations in the power load, my apparatus maintains a practically constant pressure of steam in that stage, chamber or region of the turbine which supplies said mill appliances.

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. The combination with a turbine, of a pipe taking steam from a low-pressure region therein, and means governed by the flow of steam through said pipe for controlling the pressure in said region.

2. The combination with a turbine, of a pipe taking steam from a low-pressure stage therein, valves controlling the flow of steam from said stage to the next, and means controlled by the flow of steam through said pipe for opening and closing said valves.

3. The combination with a turbine, of a pipe taking steam from a low-pressure stage therein, valves controlling the flow of steam from said stage to the next, a float in said pipe, and operative connections between said float and said valves.

4. The combination with a turbine, of a pipe taking steam from a low-pressure stage therein, a conical enlargement in said pipe, a float in said enlargement, and means actuated by said float for maintaining a constant pressure in said stage.

5. The combination with a turbine, of a pipe taking steam from a low-pressure stage therein, a movable abutment exposed to the pressure in said stage, a float in the pipe that is controlled by the flow therethrough, and valves controlled by said abutment and float for regulating the flow of steam from said stage to the next.

6. The combination with a turbine, of a pipe taking steam from a low-pressure stage therein, a device responsive to the volume of steam flowing through said pipe, a device responsive to the pressure in said stage, and

means controlled in common by both said devices for maintaining constant pressure in said stage.

7. The combination with a turbine, of a pipe taking steam from a low-pressure stage therein, a device responsive to the volume of steam flowing through said pipe, a device responsive to the pressure in said stage, a floating lever connected with both of said devices, and valve mechanism connected with said lever and serving to maintain constant pressure in said stage.

8. The combination with a turbine, of a pipe taking steam from a low-pressure stage therein, fluid-pressure operated valves controlling the flow of steam from said stage to the next, a pilot valve controlling said valves, and devices respectively responsive to the flow in said pipe and to the pressure in the stage from which it leads, both of said devices exerting a control upon said pilot valve.

9. The combination with a turbine, of a pipe taking steam from a low-pressure stage therein, fluid-pressure operated valves controlling the flow of steam from said stage to the next, a pilot valve controlling said valves, a floating lever attached to said pilot valve, a float in said pipe connected to one end of said lever, and a spring-pressed abutment connected to the other end of said lever and exposed to the steam pressure in the stage from which said pipe leads.

In witness whereof, I have hereunto set my hand this third day of August, 1909.

RICHARD H. RICE.

Witnesses:
JOHN A. McMANUS, Jr.,
HENRY O. WESTENDARP.