R. N. EHRHART.

TURBINE CONTROLLING DEVICE.

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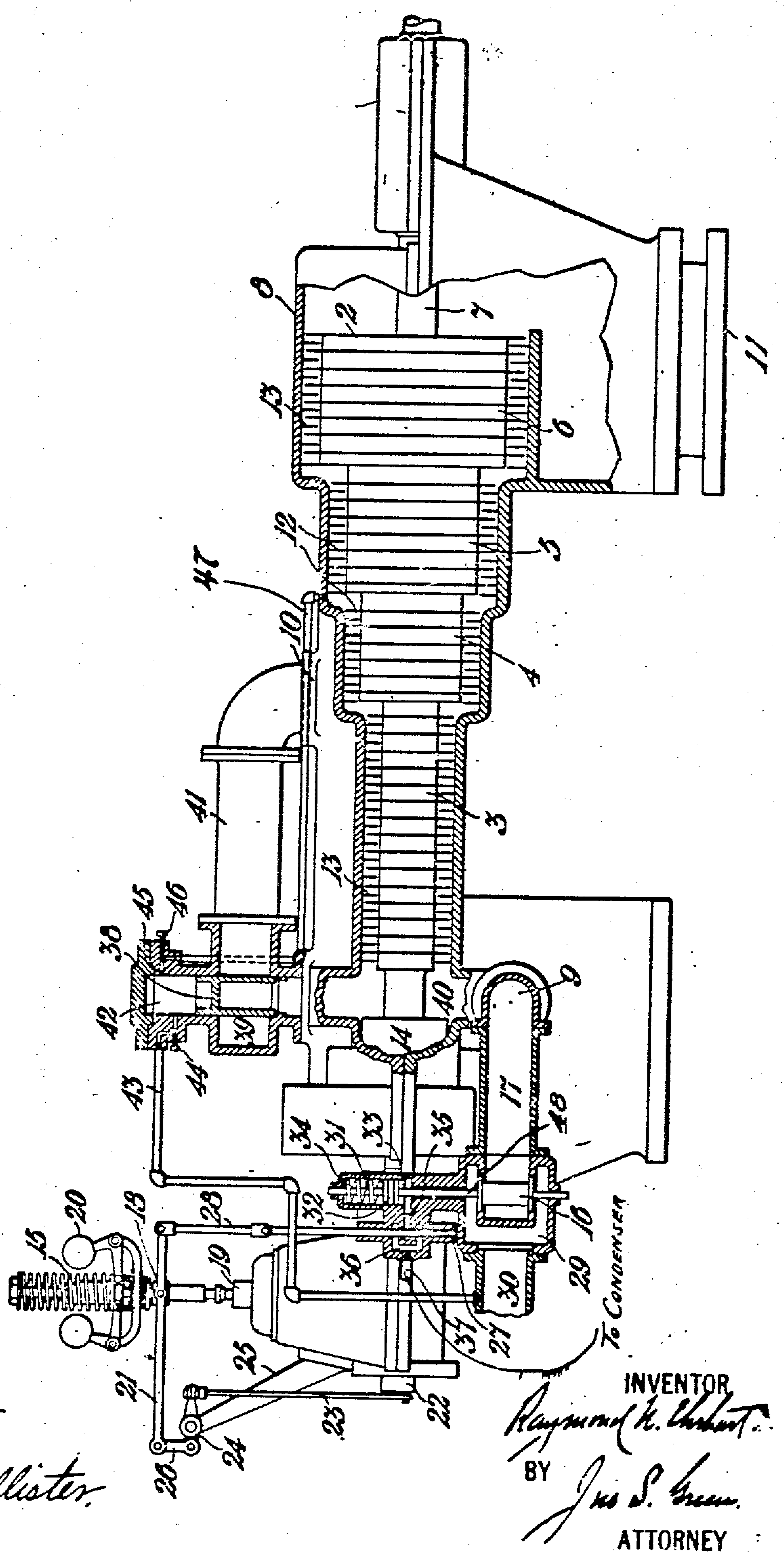
963,881. Patented July 12, 1910.



WITNESSES:

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TURBINE-CONTROLLING DEVICE.

963,881. Specification of Letters Patent. Patented July 12, 1910.

Application filed December 29, 1905. Serial No. 293,787.

To all whom it may concern:

Be it known that I, RAYMOND N. EHRHART, a citizen of the United States, and a resident of Pittsburg, in the county of Allegheny and State of Pennsylvania, have invented a new and useful Improvement in Turbine-Controlling Devices, of which the following is a specification.

This invention relates to elastic fluid turbines, and more particularly to automatic governing means for such turbines.

It has been customary for some time to provide elastic fluid turbines with what is known as a secondary valve, through which high pressure motive fluid is introduced, as occasion demands, to a part of the turbine which is normally subjected to motive fluid at a lower pressure. This is done for the purpose of increasing the capacity of the turbine.

The object of this invention is the production of an automatic secondary valve for the above purpose which is of simple construction and effective and certain in operation. This object I attain in an apparatus embodying the features hereinafter described and illustrated.

In the single sheet of drawing accompanying this application and forming a part thereof, a somewhat diagrammatic view of an elastic fluid turbine is shown, in connection with a sectional view of a valve mechanism embodying this invention.

A turbine rotor 2, comprising a high pressure drum 3, two intermediate pressure drums 4 and 5 and a low pressure drum 6, is mounted on a suitably journaled shaft 7. The casing 8 is divided on the horizontal plane passing through its axis and is provided with a steam inlet port 9, a secondary steam inlet port 10 and an exhaust port 11. Each drum of the rotor is provided with a suitable number of annular rows of blades 12 which are adapted to convert the energy of the motive fluid, (which for convenience will hereafter be called steam) into rotary motion; between the rows of blades 12 annular rows of stationary directing vanes 13 are arranged. Dummy pistons 14, suitably mounted on the shaft 7, are arranged to counterbalance the end thrust occasioned by the steam pressure on the several working drums. A fly ball governor 15, mounted on the casing 8, is operated by the shaft 7 through suitable gears not shown, and is adapted to vary the supply of steam to the turbine in accordance with the load demands or speed variation.

A puppet valve 16 is arranged to deliver live steam periodically, or in puffs, to the turbine through a pipe 17 which is connected to the steam port 9. The duration of the puffs, or the amount of steam periodically admitted to the turbine by the valve 16, is controlled by the governor 15. Fulcrumed on a reciprocating collar 18, which is carried by the governor standard 19 and is actuated by the centrifugal balls 20, is a floating lever 21; one end of this lever is attached to an operating eccentric 22 by a link 23, a lever 24 (which is fulcrumed on a bracket 25 mounted on the casing 8) and a link 26; the other end of the lever is connected to a pilot valve 27 by a link 28.

The main or primary admission valve 16 is provided with a valve chamber 29 which is connected to a steam supply pipe 30 and to the pipe 17. The valve 16 is connected to an operating rod 31 on which is mounted a piston 32 reciprocable within a cylinder 33.

A steam passage 48, surrounding the stem 33, connects the lower portion of the cylinder 33 with the valve chamber 29, thereby admitting steam into the cylinder which forces the piston 32 against a spiral spring 34, surrounding the rod 31, and opens the valve 16. An exhaust passage 35 connects the cylinder 33 with a chamber 36 which is connected to the atmosphere or to a condenser by a pipe 37. The pilot valve 27 is periodically reciprocated by the lever 21 and controls the exhaust from the cylinder 33, and the arrangement is such that when the turbine is running the pilot valve periodically exhausts the steam from the cylinder 33 and thereby periodically closes the valve 16. Since the operating lever 21 is fulcrumed on the collar 18, the throw of the pilot valve, relative to the passage 35, varies with the speed of the turbine and the period during which the exhaust passage 35 is open is increased or decreased in accordance with the load demands. When the load on the turbine is so great that it slows down an appreciable amount, the time during which the exhaust passage 35 is open is so short that the valve 16 does not reach its seat and steam is admitted to the turbine in a continuous stream.

A secondary valve 38, adapted to control the steam supplied to the secondary admission port 10, is located within a valve chamber 39, which communicates with the primary admission port 9 through a passage 40 and the secondary admission port 10 through a pipe 41. The valve 38 is cylindrical and is adapted to reciprocate within its chamber, which is formed with a cylindrical extension 42, which is supplied with steam through a pipe 43 connected to the steam supply pipe 30. The flow of steam through the pipe 43 and into the extension 42 is controlled by a needle valve 44. An exhaust port 45 connects with the atmosphere or with a low pressure stage of the turbine through a suitable pipe 47, and is provided with a needle valve 46. The flow of steam through the valves 44 and 46 is so adjusted that the pressure in the extension 42 of the valve chamber will be some predetermined amount lower than the initial pressure of the steam in the pipe 30.

As has been described, the main or primary admission valve 16 admits steam to the pipe 17 and the annular passage 40 in puffs, the duration of which is determined or controlled by the governor. When the turbine is working under light load, the steam admission period of the main valve is very short and consequently the small amount of steam admitted to the turbine will exert little pressure in the passage 40 from which it is discharged into the high pressure stage of the turbine through suitably arranged nozzles. As the load on the turbine increases the steam admission period lengthens and the velocity of the increased amount of steam passing through the passage 40 will be somewhat decreased by the limited discharge areas of the steam nozzles, and consequently the pressure exerted by the steam in the passage 40 increases until—for some predetermined load—it is sufficient to overcome the adjusted pressure in the extension 42 and lift the secondary valve 38, thereby allowing high pressure steam to enter the intermediate stage of the turbine. As the valve 16 is constantly pulsating, the valve 38 will be subjected to periodic increases of pressure, and, when operating will pulsate synchronously with the valve 16 and admit high pressure steam to the intermediate portion of the turbine in puffs. The passages 17 and 40 may be so designed, however, that for some predetermined load on the turbine the valve 38 will supply the intermediate section of the turbine with a constant stream of high pressure steam.

Having now described my invention, what I claim as new and useful and desire to secure by Letters Patent is:

1. In an elastic fluid turbine having an initial-stage fluid inlet, an intermediate-stage fluid inlet, a valve controlling the intermediate-stage fluid inlet sensitive to the variations in pressure in the initial stage, and means whereby said valve is held closed by fluid pressure, until the pressure in said initial stage is sufficient to overpower said closing pressure.

2. In an elastic fluid turbine having an initial-stage fluid inlet, an intermediate-stage fluid inlet, a valve controlling the intermediate-stage fluid inlet sensitive to the variations in pressure in the initial stage and means whereby said valve is held closed by an adjustable fluid pressure until the pressure in said initial stage is sufficient to overpower said adjusted pressure.

3. In an elastic fluid turbine having an initial-stage fluid inlet and an intermediate-stage fluid inlet, a governor-controlled valve controlling the initial fluid inlet, mechanisms whereby said valve is caused to pulsate the fluid passing it, a valve controlling the intermediate-stage fluid inlet, means whereby said valve is held closed by an adjustable fluid pressure until the pressure in the intermediate stage exceeds a predetermined pressure.

4. In an elastic fluid turbine having an initial-stage fluid inlet and an intermediate-stage fluid inlet, a governor-controlled valve controlling the initial fluid inlet, mechanisms whereby said valve is caused to pulsate the fluid passing it, a valve controlling said intermediate-stage fluid inlet, comprising a piston, a chamber located above said piston, provided with a valved inlet port and a valved outlet port and means for admitting a definite amount of fluid to said chamber and for proportioning the pressure of said fluid whereby said valve is held closed until the pressure in the initial stage exceeds a certain predetermined amount.

5. In an elastic fluid turbine, an initial stage fluid inlet, a secondary stage fluid inlet, a valve controlling the initial stage inlet, and means subjected to fluid pressure and sensitive to the pressure admitted by said valve for admitting fluid to said secondary stage fluid inlet.

6. In an elastic fluid turbine, an initial stage fluid inlet, a secondary stage fluid inlet, a valve controlling the passage of fluid through said initial inlet, and a fluid restrained means, sensitive to the variations of pressure admitted by said valve, for admitting fluid to said secondary inlet.

7. In an elastic fluid turbine, a primary stage fluid inlet, a secondary stage fluid inlet, a fluid restrained valve sensitive to the pressure admitted by said primary inlet for controlling said secondary inlet.

8. In an elastic fluid turbine, a primary stage fluid inlet, a main supply valve con-

trolling said inlet, a secondary stage fluid inlet, a fluid restrained valve sensitive to the pressure admitted by said main supply valve for controlling the amount of fluid delivered to said secondary inlet.

9. In an elastic fluid turbine, a primary stage fluid inlet, a secondary stage fluid inlet, a fluid restrained valve for said secondary inlet sensitive to the pressure delivered by said primary stage inlet and means for causing said valve to pulsate.

10. In an elastic fluid turbine, a primary stage fluid inlet, a main supply valve controlling said inlet, a secondary stage fluid inlet, a fluid restrained valve sensitive to the pressure admitted by said main supply valve for controlling the amount of fluid delivered to said secondary inlet, and means for causing said fluid restrained valve to pulsate.

11. In an elastic fluid turbine having an initial stage fluid inlet, an intermediate stage fluid inlet, a valve controlling the intermediate stage fluid inlet, sensitive to variations in pressure in the initial stage, and means whereby said valve is subjected to a constant closing pressure.

12. In an elastic fluid turbine having an initial stage fluid inlet, an intermediate stage fluid inlet, a valve controlling the intermediate stage inlet, sensitive to variations of fluid pressure delivered by said initial stage inlet, and means for transmitting a closing pressure to said valve, which remains constant during the operation of said valve.

13. In an elastic fluid turbine, an initial stage fluid inlet, an intermediate stage fluid inlet, a valve controlling said initial inlet, a secondary valve controlling said intermediate inlet, means whereby said secondary valve is held closed by fluid pressure until the pressure delivered by said initial inlet is sufficient to overpower said closing pressure, and mechanisms whereby the fluid passing said primary valve is caused to pulsate.

14. In a multi-stage elastic fluid turbine, an initial stage, a secondary stage, a fluid inlet communicating with said initial stage, a fluid inlet communicating with said secondary stage, a valve controlling the delivery of fluid through said initial stage, and a fluid-restrained valve, sensitive to variations of fluid pressure delivered to said initial stage, for by-passing fluid around said initial stage.

15. In a multi-stage elastic fluid turbine, a valve controlling the delivery of fluid to the initial stage of said turbine, and means, subjected to fluid pressure and sensitive to pressure admitted by said valve, for by-passing fluid admitted to said valve around the initial stage of the turbine.

16. In a multi-stage elastic fluid turbine, a governor-controlled fluid admission valve, and a fluid-restrained valve, sensitive to fluid pressure admitted to a stage of said turbine, for by-passing fluid around said stage and delivering it to a stage of lower pressure.

17. In a multi-stage elastic fluid turbine, a fluid admission port delivering fluid to said turbine, a fluid restrained valve, sensitive to fluid pressure admitted to a stage of said turbine, for by-passing fluid around said stage and delivering it to a stage of lower pressure, and means whereby the fluid passing said valve is caused to pulsate.

In testimony whereof, I have hereunto subscribed my name this 27th day of December, 1905.

RAYMOND N. EHRHART.

Witnesses:

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