March 9, 1926. 1,575,993

J. F. JOHNSON

AUTOMATIC STOP FOR TURBINES

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Fig. 1.

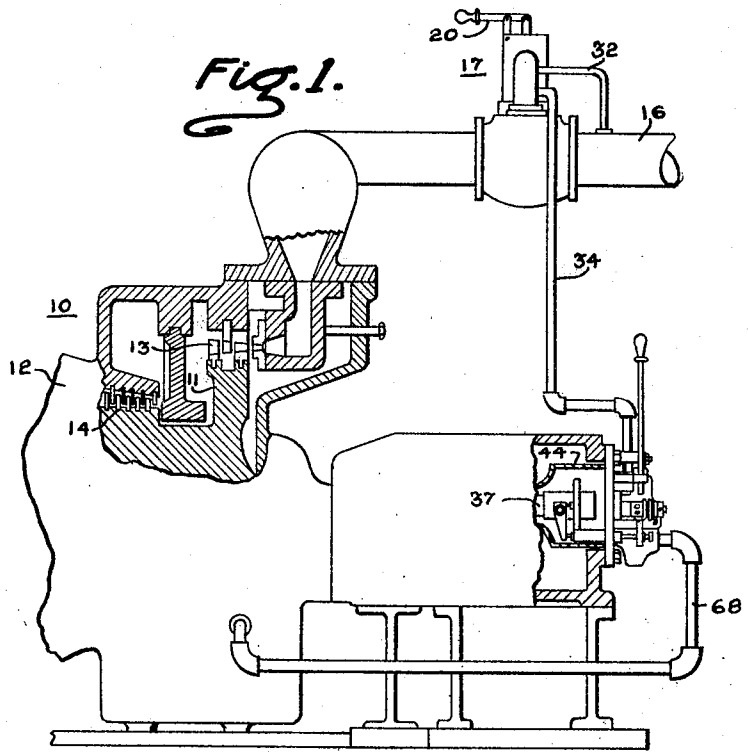
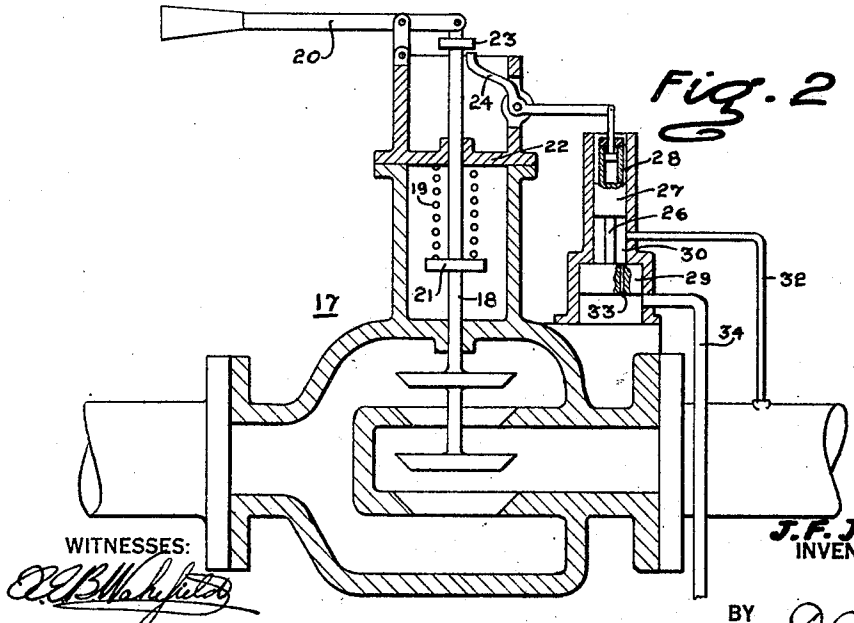


Fig. 2



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Fig. 3.

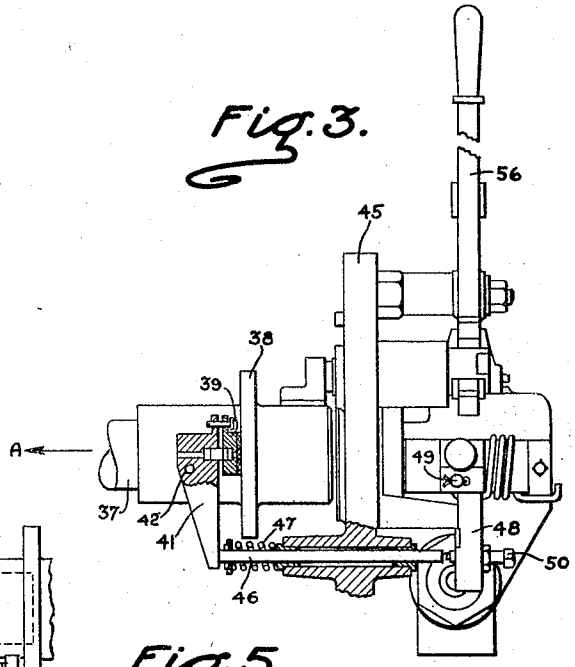
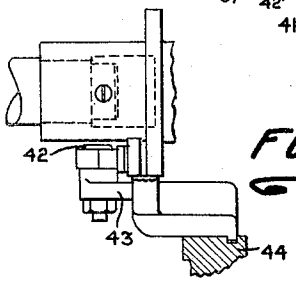


Fig. 5.



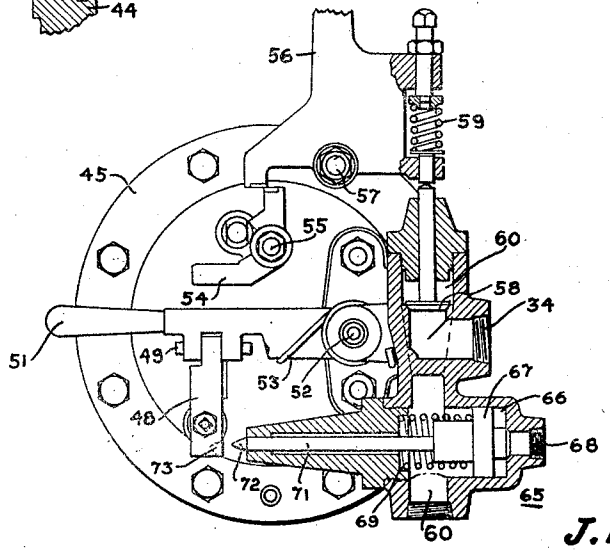


Fig. 4.

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Patented Mar. 9, 1926. 1,575,993

UNITED STATES PATENT OFFICE.

JOSIAH F. JOHNSON, OF SWARTHMORE, PENNSYLVANIA, ASSIGNOR TO WESTINGHOUSE ELECTRIC & MANUFACTURING COMPANY, A CORPORATION OF PENNSYLVANIA.

AUTOMATIC STOP FOR TURBINES.

Application filed June 9, 1924. Serial No. 718,959.

To all whom it may concern:

Be it known that I, JOSIAH F. JOHNSON, a citizen of the United States, and a resident of Swarthmore, in the county of Delaware and State of Pennsylvania, have invented a new and useful Improvement in Automatic Stops for Turbines, of which the following is a specification.

My invention relates to auto-stop mechanism for elastic fluid turbines and has for its object the provision of apparatus of the character designated which shall be effective to close off the supply of energy to the turbine upon a predetermined axial movement of the turbine shaft and also upon the attainment of a predetermined pressure within the turbine casing.

Apparatus made in accordance with my invention is illustrated in the accompanying drawings forming a part of this application in which Fig. 1 is a view, partly in section, of an elastic fluid turbine having my invention applied thereto; Fig. 2 is a sectional view showing a throttle valve and trip mechanism therefor employed with my invention; Fig. 3 is a sectional view of my invention drawn to a larger scale than Fig. 1; Fig. 4 is an end view of Fig. 3; and Fig. 5 is a fragmentary plan view partly in section, showing a detail of my invention.

In elastic fluid turbines, wherein there are a plurality of rows of blades and wherein each row of moving blades alternates with a row of stationary blades or nozzles, relatively close clearances are maintained between the rows of stationary and moving blades. In order to prevent axial movement of the rotor, entailing rubbing of the blades and their consequent destruction and possible rupture of the turbine, great care has been exercised in the design of thrust bearings to prevent axial movement of the rotor. It occasionally occurs, however, that axial movement of the rotor takes place, in spite of all precautions, and great damage is done to the turbine before it can be shut down.

Another grave danger of rupture of a turbine exists in the building up of pressure within the turbine casing above a safe limit. Turbines are ordinarily designed so that steam or other elastic fluid admitted thereto is given an initial expansion in one or more nozzles, reducing its pressure, before entry into the turbine casing. The casing is designed to withstand a pressure within safe limits above the pressure of the elastic fluid after its initial expansion. Under certain conditions, for example, in the case of a turbine designed for a relatively large expansion in the first stage or a turbine of the bleeder type, back-pressure may at times build up in the turbine casing above the pressure said casing is designed to withstand. Under such conditions casings have been known to rupture from the excessive pressure therein.

In accordance with my invention I provide a valve in the path of the motive fluid to the turbine having releasable means for quickly closing the same, together with a trip mechanism for operating the releasable means. The trip mechanism is actuated in response to axial movement of the turbine rotor and is further actuated by a pressure responsive device in communication with the interior of the turbine casing.

Referring now to the drawings for a better understanding of my invention, I show in Fig. 1 at 10 a turbine having a rotor 11 and a casing 12. The rotor 11 is provided with rows of impulse blading 13 and with a plurality of rows of reaction blading 14. Elastic fluid for the turbine (hereinafter referred to as steam) is supplied through a conduit 16 within which is disposed a valve 17. The valve 17 as illustrated in Fig. 2, is of the balanced, or approximately balanced type, and has an actuating stem 18 surrounded by a spring 19. It should be understood, however, that a valve of any suitable design may be employed. The spring 19 is positioned between an abutment 21 carried by the stem 18 and an upper abutment 22 formed by the valve casing. Manual means 20 are provided for opening and closing the valve when desired.

At the upper end of the stem 18 is a shoulder 23, bearing against which is a latch 24 for normally holding the throttle valve in an open position. The latch 24 is controlled by a differential piston 26 having a relatively small head 27 and a relatively large head 29. Connected to the small head 27 is a lost motion device 28. The piston 26 is normally held in its uppermost position as shown in the drawing. Upon downward movement of the piston 26, the latch 24 is struck a hammer blow through the

lost motion device 28, causing immediate disengagement of the latch. The spring 19 then forces the throttle valve 17 to a closed position. The differential piston 26 is disposed within an operating cylinder 30 to which steam is admitted between the two heads of the piston 27 and 29, through a conduit 32. The head 29 is provided with a restricted passage 33 through which steam may pass permitting a balancing of pressures on the two sides of the relatively large head 29 whereupon steam acting against the smaller head 27 forces the piston to its upward position as shown in the drawings. The lower end of the cylinder 30, beneath the piston 29, has leading therefrom a conduit 34 to a trip mechanism to be hereinafter described.

Referring to Figs. 1 and 3, the shaft of the turbine is shown at 37, and has a direction of thrust as indicated by the arrow A in Fig. 3. Secured to, or formed on the shaft 37 is a collar 38. The inner side of the collar 38 is machined true to form a thrust bearing surface. Adjacent to the inner side of the collar 38 is a bearing shoe 39. The bearing shoe 39 is carried by a lever 41 which is pivoted at 42, said pivot having a support 43 which is attached to a housing 44 surrounding the shaft 37. The housing 44 is provided with a cap 45 which supports other parts of the mechanism. The lower end of the lever 41 acts against a push rod 46 which is, at all times, held in engagement with the lower end of the lever by means of a spring 47. The push rod 46 actuates a latch 48 which is pivoted at 49 on a lever 51. Adjusting means 50 are provided on the latch 48 so that a predetermined movement of the push rod 46 may be required for its disengagement.

The lever 51 is pivoted at 52 on the housing cap 45. A spring 53 is attached, at one end, to the housing cap 45 and at the other end to the lever 51 so that when the lever 51 is in the position shown in the drawings, the spring 53 is subjected to a torsional stress and, upon disengagement of the latch 48, the free end of the lever moves upwardly. Upon upward movement of the lever 51 it comes in contact with a trip latch 54 pivoted at 55 and normally supporting a trip lever 56. The trip lever 56 is pivoted at 57 on the housing cap 45 and, when in the position shown in the drawings, serves to hold a valve 58 on its seat. In order to maintain a fixed pressure for firmly holding the valve 58 on its seat, a spring 59 is provided and is under compression bearing against the stem of the valve 58 when the trip lever 56 is in the position shown and said valve is seated. Fluid under pressure from beneath the head 29 of the differential piston 26 is conveyed to the space beneath the valve 58, through the conduit 34. So long as the valve 58 is on its seat, pressure is allowed to accumulate beneath the head 29 and the pressure on both sides of said head are equal. Pressure then acting against the smaller head 27 forces the piston 26 to its uppermost position. When the trip 54 is struck by the lever 51 allowing the trip lever 56 to move to the left, pressure beneath the valve 58 forces it off its seat and passes to the atmosphere through an exhaust port 60, suddenly relieving pressure from beneath the large head 29 of the differential piston 26. Upon relief of pressure from beneath the piston head 29, pressure acting against the upper face thereof forces the piston 26 downwardly and the lost motion device 28 is struck a hammer blow, disengaging the latch 25 and permitting the throttle valve 17 to be closed as already described.

Further means for disengaging the latch 48 upon a predetermined accumulation of pressure within the turbine casing 12 are provided in a pressure-responsive device 65, shown in Fig. 4. The pressure-responsive device 65 embodies a cylinder 66 mounted upon the housing cap 45 and having an operating piston 67 disposed therein. The operating piston 67 is subjected on one side to pressure within the turbine casing 12 through a conduit 68. The other side of the piston 67 is subjected to the force exerted by a spring 69. The piston 67 actuates a push rod 71 toward the left upon an accumulation of pressure within the turbine casing 12 sufficient to overcome the force of the spring 69. The push rod 71 is provided with a pointed end 72 for engagement with a beveled recess 73 on the inner side of the latch 48. Upon movement of the rod 71 to the left the pointed end 72 engages the latch 48, disengaging said latch, and allowing the lever 51 to strike the trip 54 which, in turn, causes a closing of the throttle valve 17 in a manner already described.

The operation of the apparatus will be apparent. As before pointed out, the direction of thrust, or tendency for axial movement of the rotor 11 is in the direction of the arrow A in Fig. 3. Should there occur an axial movement of the rotor beyond the setting of the adjusting means 50, the collar 38 on the shaft 37 engages with the bearing shoe 39 forcing it toward the left. This movement forces the lower end of the lever 41 and the push rod 46 toward the right disengaging the latch 48. Upon disengagement of the latch 48, the lever 51 moves upwardly, striking the trip 54, disengaging it from the trip lever 56, permitting the valve 58 to be unseated, and relieving pressure from beneath the head 29 of the differential piston 26. This causes the throttle valve 17 to be closed as already described.

The latch 48 may also be disengaged by the push rod 71 in event of accumulation of

pressure within the turbine casing 12 sufficient to overcome the force exerted by the piston 69 as previously pointed out.

From the foregoing it will be apparent that I have invented an auto-stop governor for steam turbines, wherein the stop mechanism is actuated upon a predetermined axial movement of the shaft and also in event there should be an accumulation of pressure within the turbine casing above safe limits.

While I have shown my invention in but one form, it will be obvious to those skilled in the art that it is not so limited, but is susceptible of various other changes and modifications, without departing from the spirit thereof, and I desire, therefore, that only such limitations shall be placed thereupon as are imposed by the prior art or as are specifically set forth in the appended claims.

What I claim is:

1. In an auto-stop governing mechanism for a turbine having a casing, a rotor, a throttle valve and releasable means for closing said throttle valve, the combination of means responsive to axial movement of the rotor, and means responsive to a predetermined pressure in the turbine for releasing said releasable means.

2. In an elastic-fluid turbine, the combination of a valve for admitting motive fluid to the turbine, releasable means for closing the valve, means responsive to pressure within the turbine for releasing the releasable means, and further means responsive to axial movement of the shaft for releasing the releasable means.

3. In an auto-stop governor, the combination of a shaft, a trip mechanism, a lever for tripping the trip mechanism, a spring for actuating the lever, a latch for normally holding the lever out of engagement with the trip mechanism, a pressure-responsive device, a member adapted to engage with and be moved by the shaft upon axial movement thereof, means actuated by the pressure-responsive device for disengaging the latch and further means actuated by the member for disengaging said latch.

4. In an auto-stop governor for a steam turbine having a throttle valve, a region normally subjected to a relatively low pressure and a rotor with a shaft, the combination of trip mechanism for closing the throttle valve, and means for tripping said trip mechanism, said means being actuated by a predetermined axial movement of the shaft and also by a predetermined pressure in said relatively low pressure region.

5. In an auto-stop governor for a steam turbine having a rotor with a shaft subjected to an axial thrust in one direction and a throttle valve, the combination of releasable means for closing the throttle valve, trip mechanism for releasing the releasable means, a spring-actuated lever for tripping the trip mechanism, a latch for normally holding said lever out of engagement with the trip mechanism, a push rod for disengaging said latch, a lever for operating the push rod, a bearing shoe carried by the lever, a collar provided on the shaft and rotating therewith in close proximity to the bearing shoe, whereby upon a predetermined axial movement of the shaft, the bearing shoe is engaged by the collar, and the lever is moved, actuating the push rod and the trip mechanism.

In testimony whereof, I have hereunto subscribed my name this nineteenth day of May 1924.

JOSIAH F. JOHNSON.