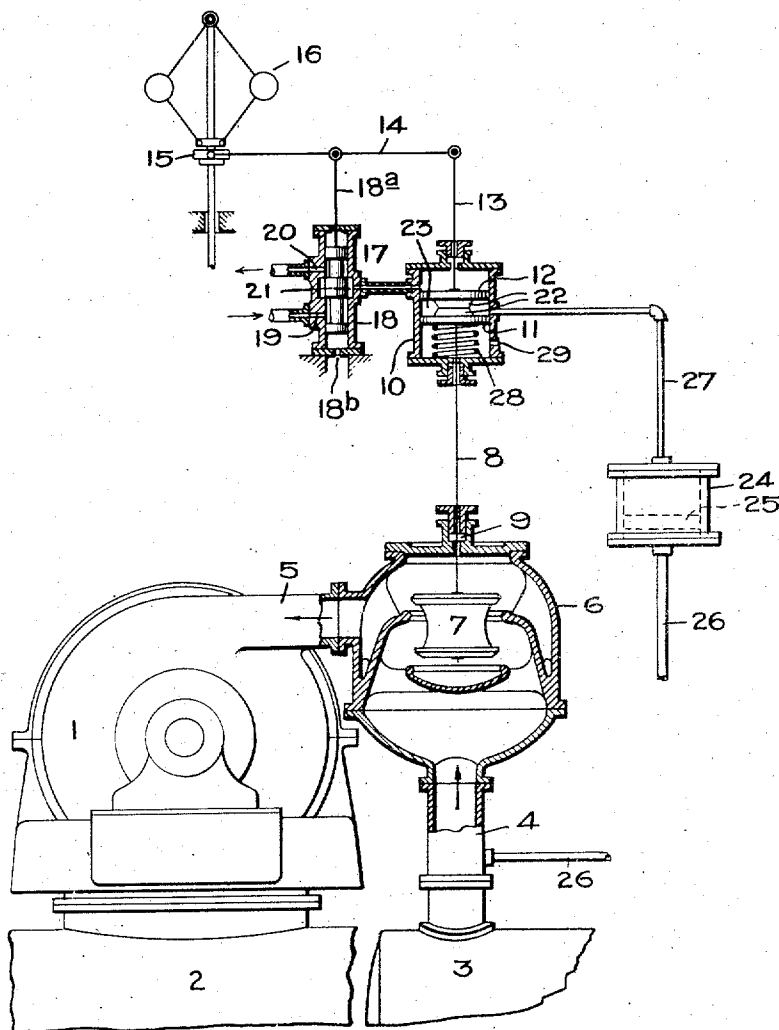


L. CUBELIC.
GOVERNING MECHANISM FOR LOW PRESSURE TURBINES.
APPLICATION FILED JUNE 7, 1911.

1,050,006.

Patented Jan. 7, 1913.



Witnesses:

Marcus L. Byng
J. Ellis Allen

Inventor,
Ludwig Cubelic,
by *Alfred B. Davis*
Att'y.

UNITED STATES PATENT OFFICE.

LUDWIG CUBELIC, OF CHARLOTTENBURG, GERMANY, ASSIGNOR TO GENERAL ELECTRIC COMPANY, A CORPORATION OF NEW YORK.

GOVERNING MECHANISM FOR LOW-PRESSURE TURBINES.

1,050,006.

Specification of Letters Patent.

Patented Jan. 7, 1913.

Application filed June 7, 1911. Serial No. 631,684.

To all wh in it may concern:

Be it known that I, LUDWIG CUBELIC, a subject of the King of Prussia, residing at Charlottenburg, Germany, have invented certain new and useful Improvements in Governing Mechanism for Low-Pressure Turbines, of which the following is a specification.

The present invention relates to governing mechanism for low pressure turbines and has for its object to provide such a mechanism of improved construction that is primarily responsible to speed changes of the turbine and secondarily to pressure variations of the source of low pressure steam supply.

The accompanying drawing illustrates partly in section an embodiment of my invention.

1 indicates a low pressure turbine that exhausts into the condenser 2. Steam or other low pressure vapor is received from the accumulator, header or other vessel 3 which in turn is connected directly or indirectly to the exhaust pipe of one or more reciprocating engines. The accumulator may be omitted if desired and low pressure steam taken directly from an engine or a header or other conduit means connected thereto.

4 indicates the discharge pipe from the accumulator and 5 the supply pipe to the turbine. Between these two pipes is a throttle valve comprising a casing 6 and a valve 7 mounted therein and actuated by the rod 8, the latter being provided with a packing 9 to prevent the entrance of air or the escape of steam.

Located above the valve or at any other suitable point is a cylinder 10 containing two pistons 11 and 12. The former is attached to the valve rod 8 and the latter to the piston rod 13 which in turn is pivotally connected to the governor lever 14. The left hand end of the lever is connected to the sliding collar 15 of the speed governor 16, the latter being driven by the turbine shaft either at the same speed or at a reduced speed. Situated at a convenient point with respect to the cylinder 10 and the governor 16 is a pilot valve 17 comprising a movable element having three piston heads and a casing 18. The piston is connected to the governor lever by the rod 18^a. The casing has supply and exhaust ports 19 and 20 that are connected respectively to supply

and exhaust conduits. The middle piston head controls the port 21 through which fluid under pressure, such as oil, is admitted to and exhausted from the cylinder 10 at a point above the upper piston 12. The valve casing is provided with a drainage port 18^b at its lower end to carry off any oil that leaks around the lower piston head. Any leakage above the upper piston head can escape around the rod 18^a. The pistons 11 and 12 are provided with projections 22 that contact under certain conditions yet hold the pistons a sufficient distance apart to form a chamber 23 to receive liquid, such as oil, under pressure. The pressure in this chamber varies in response to that of the steam discharged by the accumulator. As a convenient means of communicating this pressure from one place to the other a cylinder 24 is provided containing a piston 25, the portion of the cylinder above said piston being filled with oil. Steam under pressure is admitted to the under side of the piston by the pipe 26. Oil under pressure is conveyed from the upper side of the piston to the chamber 23 by the pipe 27. Under the piston 11 is a compression spring 28 that tends to hold the pistons 11 and 12 in contact. The cylinder 10 has an outlet port 29 to permit oil leaking from above the piston 11 to escape.

The action of my improved mechanism is as follows: Assuming an increase in load, the steam pressure remaining constant, the pilot valve is depressed by the governor and associated parts. This uncovers the port 21 and permits the spring 28 to expand and force the pistons 11 and 12 upward and discharge oil to the left through the ports 21 and 20. Since the size of the chamber 23 is not changed by this action, the relation of pistons 11 and 12 is preserved but more steam will be admitted by reason of the new position of the valve 7. As the piston 12 moves upward it carries with it the pivot at the right hand end of the governor lever, which movement continues until the pilot valve is restored to its normal position, as shown, where it covers the port 21. To state the matter in another way, the rod 13 combined with the governor lever 14 in the manner illustrated forms a follow-up device or a pilot valve restoring device to prevent overtravel of the parts. With an increase in speed the pilot valve is raised and oil

under pressure is admitted to the upper side of the piston 12 forcing it and piston 11 downward against the spring 28 and further compressing it. The downward movement of the piston restores the pilot valve to its normal position by moving it downward. Assuming now an increase in pressure of the steam supply, the load remaining constant, oil will be forced into the chamber 23 and separate the pistons. Since the fluid above the piston cannot escape because the port 21 is closed, the effect of the increased pressure is to force the lower piston 11 downward against the spring 28 and close the valve 7 by an amount that is proportional to the increased pressure. If the pistons 11 and 12 are separated, a decrease in steam pressure will permit the lower piston 11 to rise forcing oil out of the cylinder and open the valve wider, thus restoring the parts to equilibrium. When the pressure-responsive feature of the apparatus is in operation the piston 12 forms an abutment which is stationary, changing its position only with a change in speed. Of course speed and pressure changes may take place simultaneously, but for the sake of simplicity the operations have been described separately.

It is a desirable arrangement to use a column of liquid to transmit the effects of changes in pressure from the steam supply to the cylinder because small piping can be used and the cylinder located where it is the most convenient. I have illustrated the pressure-responsive means diagrammatically for the purpose of simplicity. It is to be understood, however, that this feature of my invention can be carried out by any other suitable means which will cause the lower piston 11 to act in the manner stated. In the normal operation of my invention, the pistons 11 and 12 will usually be separated to a greater or less extent.

My improved governing mechanism is quick and positive in its action, is simple in construction when viewed in the light of the complex governing problem presented and the regulating valve is responsive both to speed changes and to changes in pressure of the source of supply. It is obviously of material advantage in the way of simplicity and reduced cost to use one and the same valve for controlling both for speed and pressure changes. Furthermore, my improved mechanism includes an emergency device responsive to abnormal pressure because, if the pressure in the accumulator exceeds a predetermined value, the oil acting on the piston 11 will close said valve.

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 ap-

paratus 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. In a governing mechanism for turbines, the combination of a controlling valve, motors that simultaneously act to move the valve under one operating condition, and means for causing one of the motors to move independently of another to vary the position of the valve under other operating conditions.

2. In a governing mechanism for turbines, the combination of a controlling valve, motors whose movable members act in unison to move the valve toward and away from its seat under one operating condition, means for applying force to move the members in one direction, means acting in opposition to said force, and fluid pressure means for causing one of said members to move the valve to the exclusion of the other member.

3. In a governing mechanism for turbines, the combination of a controlling valve, a pair of pistons, a means connecting one of the pistons with the valve, a cylinder common to the pistons, means responsive to an operating condition for moving the pistons in unison in one direction, means for moving them in unison in the opposite direction, and means admitting fluid under pressure between the pistons to move one of them independently of the other.

4. In a governing mechanism, the combination of a controlling valve, motors for operating the valve that operate simultaneously and also independently to move said valve, a speed-responsive device for controlling the simultaneous operation of the motors, and means for subjecting one of the motors to the effects of the pressure of the source of supply controlled by said valve for moving it independently of the said device.

5. In a governing mechanism, the combination of a controlling valve, means for operating it comprising two principal members, one of which is mechanically connected to the valve, the second acting through the first to move the valve, a speed governor controlling the second member, and means for subjecting the first member to the effects of the pressure of the source of fluid supply controlled by said valve for moving it.

6. In a governing mechanism, the combination of a controlling valve, a cylinder, independent pistons therein, a means connecting one of the pistons to the valve, means admitting fluid under pressure between the pistons, a pilot valve controlling the movements of the second piston, said second piston communicating its movements to the valve through the first piston, a speed governor for controlling the pilot valve, and

means acting in opposition to the pistons to open the valve.

7. In a governing mechanism, the combination of a controlling valve, a cylinder, a pair of mechanically independent pistons mounted therein, a means connecting one of the pistons with the valve, conduit means communicating the pressure of the source of supply controlled by the valve to one side of the piston, means acting on the piston in opposition to said pressure, a conduit means admitting fluid under pressure to the cylinder to act on the second piston, and a speed governor which controls the movements of the second piston by regulating the admission of fluid to its cylinder space.

8. In a governing mechanism, the combination of a controlling valve, a cylinder, a pair of mechanically independent pistons mounted therein, a means connecting one of the pistons with the valve, conduit means communicating the pressure of the source of supply controlled by the valve to the space between the pistons, a means acting on the piston connected to the valve in opposition to the fluid under pressure, a conduit admitting fluid under pressure to the cylinder space above the second piston, said piston as it moves the valve overpowering the opposition means, and a speed governor controlling movements of the second piston.

9. In a governing mechanism for turbines, the combination of a controlling valve, a pair of pistons, a cylinder common to the pistons, a speed governor, a pilot valve controlling the admission of fluid to the cylinder, a governor lever connected to the pilot valve and to one of the pistons, a means connecting the other piston and the controlling valve, a conduit for conveying fluid under pressure to the space between the pistons, said pressure varying with that of the fluid controlled by the valve and the first named piston acting as an abutment for said pressure, and a means that acts in opposition to said pressure.

10. In a governing mechanism, the combination of a controlling valve, a cylinder, independent pistons mounted therein and separated by a column of fluid, means for varying the amount of fluid between the

pistons, a governor for controlling the admission of motive fluid to one of the pistons to cause it to move the valve through the other piston and the column of fluid between, and an agent which opens the valve when the pressure controlled by the governor or that from the means is reduced.

11. In a governing mechanism for low pressure turbines, the combination of a valve, mechanism for actuating the valve in response to speed changes, means for operating the same valve in response to pressure changes of the fluid supplied to the turbine, and an agent that tends to open the valve against the closing action of said means.

12. In a governing mechanism, the combination of a valve, mechanism for actuating the valve in response to speed changes, means for actuating the valve in response to pressure changes that is mechanically independent of said mechanism, a means for conveying the effect of changes in pressure of the fluid supply to the first named means, and an agent that tends to open the valve.

13. In a governing mechanism for low pressure turbines, the combination of a main valve, means for actuating it comprising a hydraulic cylinder, a pair of pistons arranged in the cylinder and separated by a chamber formed between their adjacent faces, a piston rod for each piston, one of the rods being connected to the main valve, a pilot valve for controlling the supply of liquid to and its exhaust from the region between the piston that is not connected to the valve and the adjacent end of the cylinder, a speed governor for actuating the pilot valve, means responsive to variations in the supply of low pressure steam for regulating the flow of liquid to and from said chamber, and spring means arranged between the other end of the cylinder and the piston which is connected to the main valve that tends to open said valve.

In witness whereof, I have hereunto set my hand this twenty day of May, 1911.

LUDWIG CUBELIC.

Witnesses:

FRIEDRICH GANZERT,
OTTO SCHMIDT.

Correction in Letters Patent No. 1,050,006.

It is hereby certified that in Letters Patent No. 1,050,006, granted January 7, 1913, upon the application of Ludwig Cubelic, of Charlottenburg, Germany, for an improvement in "Covering Mechanism for Low-Pressure Turbines," an error appears in the printed specification requiring correction as follows: Page 1, line 13, for the word "responsible" read *responsive*; and that the said Letters Patent should be read with this correction therein that the same may conform to the record of the case in the Patent Office.

Signed and sealed this 11th day of February, A. D., 1913.

[SEAL.]

C. C. BILLINGS.

Acting Commissioner of Patents

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