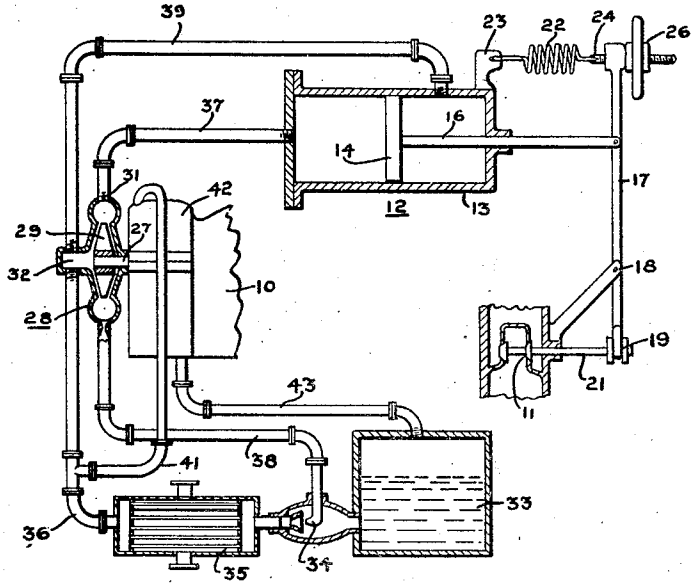
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H. R. TROTTER ET AL

FLUID PRESSURE GOVERNOR

Filed March 28, 1924



WITNESS

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UNITED STATES PATENT OFFICE.

HENRY R. TROTTER, OF SWARTHMORE, AND HENRY F. SCHMIDT, OF LANSDOWNE, PENNSYLVANIA, ASSIGNORS TO WESTINGHOUSE ELECTRIC & MANUFACTURING COMPANY, A CORPORATION OF PENNSYLVANIA.

FLUID-PRESSURE GOVERNOR.

Application filed March 28, 1924. Serial No. 702,498.

To all whom it may concern:

Be it known that we, HENRY R. TROTTER and HENRY F. SCHMIDT, citizens of the United States, and residents of Swarthmore and Lansdowne, respectively, in the county of Delaware, respectively, and State of Pennsylvania, have invented a new and useful Improvement in Fluid-Pressure Governors, of which the following is a specification.

Our invention relates to governors for prime movers, especially steam turbines, and to that class of governors in which the governing mechanism is actuated by a fluid motor subject to the variable fluid pressure developed by a centrifugal pump.

One of the objects of our invention is to provide apparatus of the character designated in which changes in position of the governing mechanism shall result only from changes in speed of the prime mover governed.

Another object is to provide a governor actuated by a variable fluid pressure motor which shall operate unaffected by variations in pressure at the inlet side of the fluid pressure developing means.

These and other objects are accomplished by apparatus illustrated in the accompanying drawing in which the single figure is a diagrammatic view of our improved apparatus as applied to a steam turbine.

In the operation of prime movers, especially steam turbines, a very reliable governor has been developed in which the governing mechanism is actuated by a fluid pressure motor, pressure for which is developed by a centrifugal pump driven directly by the shaft of the prime mover, or in synchronism with it. Inasmuch as the pressure developed by the impeller of the pump varies directly as the square of the speed of the driving shaft, as the speed of the prime mover increases, the pressure developed increases. By providing the fluid motor with a suitable leverage mechanism for utilizing the force exerted by this variable pressure, very dependable governing of the prime mover is accomplished.

As is well known, however, the total pressure of fluid delivered by a centrifugal pump is the sum of the suction head or inlet pressure of the pump and the pressure developed by its impeller. With a constant speed of the pump, there may be a variation in pressure delivered, due to variations in the suction head or inlet pressure of the pump.

It has been found very difficult in the design of this class of governors to provide the pump with a uniform suction head or inlet pressure. Hence, in such apparatus, as the suction head varies, the pressure delivered by the pump varies, resulting in variations in position of the governing mechanism without variations in speed.

In the application of Henry F. Schmidt, Serial No. 688,292, filed January 24, 1924, and assigned to Westinghouse Electric and Manufacturing Company, there is illustrated and described apparatus for insuring at all times a positive supply of fluid to the inlet of the circulating pump. In our governing device, we prefer to employ apparatus similar to that described in the application aforesaid for supplying the pump with a positive inlet pressure, although it will be apparent that any other suitable means may be employed.

While the apparatus disclosed in the application aforesaid insures a positive pressure at the inlet side of the pump, it cannot insure a constant or uniform pressure at that point, due to various operating conditions. This is equally true of any arrangement, with which we are familiar, employed to accomplish the same object.

To overcome the effect of this variable inlet pressure on the governing apparatus, we provide a fluid motor having a cylinder with a piston for actuating the governing mechanism. On one side of the piston, we convey the pressure delivered by the pump, while on the other side, we impose the same pressure as that existing at the inlet of the pump. Inasmuch as the pressure existing at the inlet side of the pump is conveyed to both sides of the piston, the force exerted by it against the piston in either direction is neutralized, and the pressure effective for governing is solely that developed by the impeller of the pump which varies as the square of the speed of the driving shaft. As a result of this neutralization of forces, any movement of the governing mechanism in operation will be caused only by changes in speed.

Referring now to the drawing for a fuller understanding of our invention, we show at

10 a fragment of a prime mover such as a steam turbine, and at 11, a valve for supplying a motive fluid to the prime mover, said valve being controlled by our improved governing mechanism. At 12 is shown a fluid motor for actuating the governing mechanism. This motor embodies a cylinder 13 having a piston 14, and a piston rod 16. The piston rod 16 is operably connected to a lever 17 fulcrumed at 18 and connected at 19 to a stem 21 which actuates the valve 11. The piston 14 is biased in one direction by a spring 22, which is in tension between a stationary abutment 23 attached to the cylinder 13 and an adjustable abutment 24 attached to the lever 17. To vary the tension of the spring 22, regulating means 26 are provided.

At 27 we show a shaft of the prime mover 10 which we employ to drive the centrifugal pump 28 used to develop pressure for the fluid motor 12. The pump 28 is of the conventional design and has an impeller 29, an outlet 31 and an inlet 32.

In the operation of the pump 28, fluid is taken from a reservoir 33. In order to insure a positive suction head or inlet pressure for the pump 38, an ejector 34 is associated with the reservoir 33 and delivers fluid at a relatively low pressure into a cooler 35 from which it passes through a conduit 36 to the inlet side 32 of the pump 28.

In operation the pump 28 is driven by the shaft 27 of the prime mover and develops a pressure varying with the speed of the prime mover, which pressure plus the pressure at the inlet side of the pump is delivered through the outlet 31 and a conduit 37 to the cylinder 13 on one side of the piston 14. In order to supply motive fluid to the ejector 34 a part of the fluid at a relatively high pressure is delivered through a conduit 38, leading from the pump 28 to said ejector. As previously pointed out, the ejector 34 delivers fluid under a relatively low pressure to the inlet side 32 of the pump 28.

While the action of the ejector 34 insures a positive pressure at the inlet side of the pump 28 at all times, this pressure will vary somewhat with the pressure of the motive fluid employed in the operation of the ejector and by reason of other operating conditions so that the inlet pressure will vary to some extent. In order to overcome the effect of this variable pressure at the inlet side of the pump, we provide a conduit 39 leading from the inlet side of the pump to the cylinder 13, on the opposite side of the piston 14 to that subjected to the fluid at a relatively high pressure. Inasmuch as the piston 14 is subjected on one side to the fluid pressure developed by the impeller 29 of the pump 28 plus the pressure existent at the inlet side of the pump at 32, and on the opposite side is subjected at all times through the conduit 39 to the pressure existent at the inlet side of the pump, the pressure at the inlet side of the pump acting on both sides of the piston 14 is equalized and has no effect on the operation of the apparatus. It follows, therefore, that the effective governing force is solely that resultant from variations in speed of the impeller 29 of the pump 28.

In addition to supplying a positive suction head or inlet pressure for the pump 28 and for imposing on one side of the piston 14 the pressure existent at the inlet side of the pump, the ejector 34 may also supply fluid under pressure for use in lubricating the prime mover. For this purpose, we show a conduit 41 leading from the conduit 36 to a bearing housing 42 of the prime mover 10. After the fluid has been used as a lubricant in the bearings of the prime mover it drains back to the reservoir 33 through a conduit 43 as shown.

From the foregoing, it will be apparent that we have invented an improved governor actuated by fluid pressure in which the movements of the governing mechanism are actuated solely by changes in speed of the fluid-pressure developing means.

While we have shown our 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 we 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 we claim is:

1. In a fluid pressure governing system, the combination of a fluid motor embodying a pressure responsive element, a rotating shaft, a centrifugal pump driven by the shaft for delivering fluid under pressure to the motor, means for supplying the pump with fluid under pressure, and means for delivering a counteracting pressure of fluid to the pressure responsive element for off-setting the effects of variations in supply pressure to the pump on the operation of the motor.

2. In a governing mechanism actuated by a fluid motor embodying a pressure responsive element, the combination of a pump for delivering liquid at a relatively high pressure to the motor, means for supplying the pump with liquid at a relatively low pressure, and means for delivering a counteracting pressure to the pressure responsive element to eliminate the effect of variations in supply pressure on the pressure delivered to the motor.

3. In a governing mechanism, the combination of a valve to be controlled, a fluid motor for controlling the valve, said motor

embodying a cylinder and an operating piston within the cylinder, said piston being actuated by fluid pressure, a pump for delivering fluid at a relatively high pressure to one side of the piston, means for supplying the pump with fluid at a relatively low pressure, and means for delivering fluid to the other side of the operating piston at the same pressure as that supplied to the pump.

4. In a governing mechanism, the combination of a valve to be controlled, a fluid motor for controlling the valve, said motor embodying a cylinder and an operating piston within the cylinder, said piston being actuated by fluid pressure, a pump for delivering fluid at a relatively high pressure to one side of the piston, and means for supplying the pump and the other side of the piston with fluid at a relatively low pressure to offset variations in pressure supplied to the pump.

5. In a fluid pressure governing system, the combination of a cylinder, a piston within the cylinder, a rotating shaft, a pump driven by the shaft for delivering fluid under pressure to the cylinder on one side of the piston to actuate the latter, said pressure varying with the inlet pressure of the pump and with the speed of the rotating shaft, and means for delivering fluid under pressure to the cylinder on the other side of the piston, said pressure varying only with the inlet pressure at the pump.

6. In a prime mover governing mechanism actuated by a fluid motor, the combination of a cylinder, a piston within the cylinder, a rotating shaft driven by the prime mover, a centrifugal pump for developing a relatively high fluid pressure, said pump being driven by the shaft, means for delivering fluid from the pump to the cylinder on one side of the piston, a fluid reservoir, an ejector associated with the reservoir for supplying fluid to the pump intake and to the cylinder on the other side of the piston at a relatively low pressure to offset variations in pressure at the pump intake, and means for conveying the fluid at a relatively high pressure from the pump to the ejector as motive fluid therefor.

7. In a governing mechanism for a prime mover, the combination of a valve to be controlled, a fluid motor for operating the valve, said motor embodying a cylinder having a piston actuated in one direction by fluid pressure and biased in the opposite direction by a spring, a centrifugal pump driven by the prime mover for delivering fluid under a relatively high pressure to the cylinder on one side of the piston, an ejector for developing a relatively low pressure of fluid, means for conveying the fluid under a relatively high pressure from the pump to the ejector for operating the latter, means for conveying fluid from the ejector to the inlet of the pump to supply the latter with positive inlet pressure, and means for conveying fluid from the ejector to the opposite side of the piston imposing a load thereon in addition to the spring and off-setting the effect of inlet pressure on the pressure delivered by the centrifugal pump.

In testimony whereof, we have hereunto subscribed our names this 26th day of March 1924.

HENRY R. TROTTER.
HENRY F. SCHMIDT.