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TURBINE CONTROL MECHANISM

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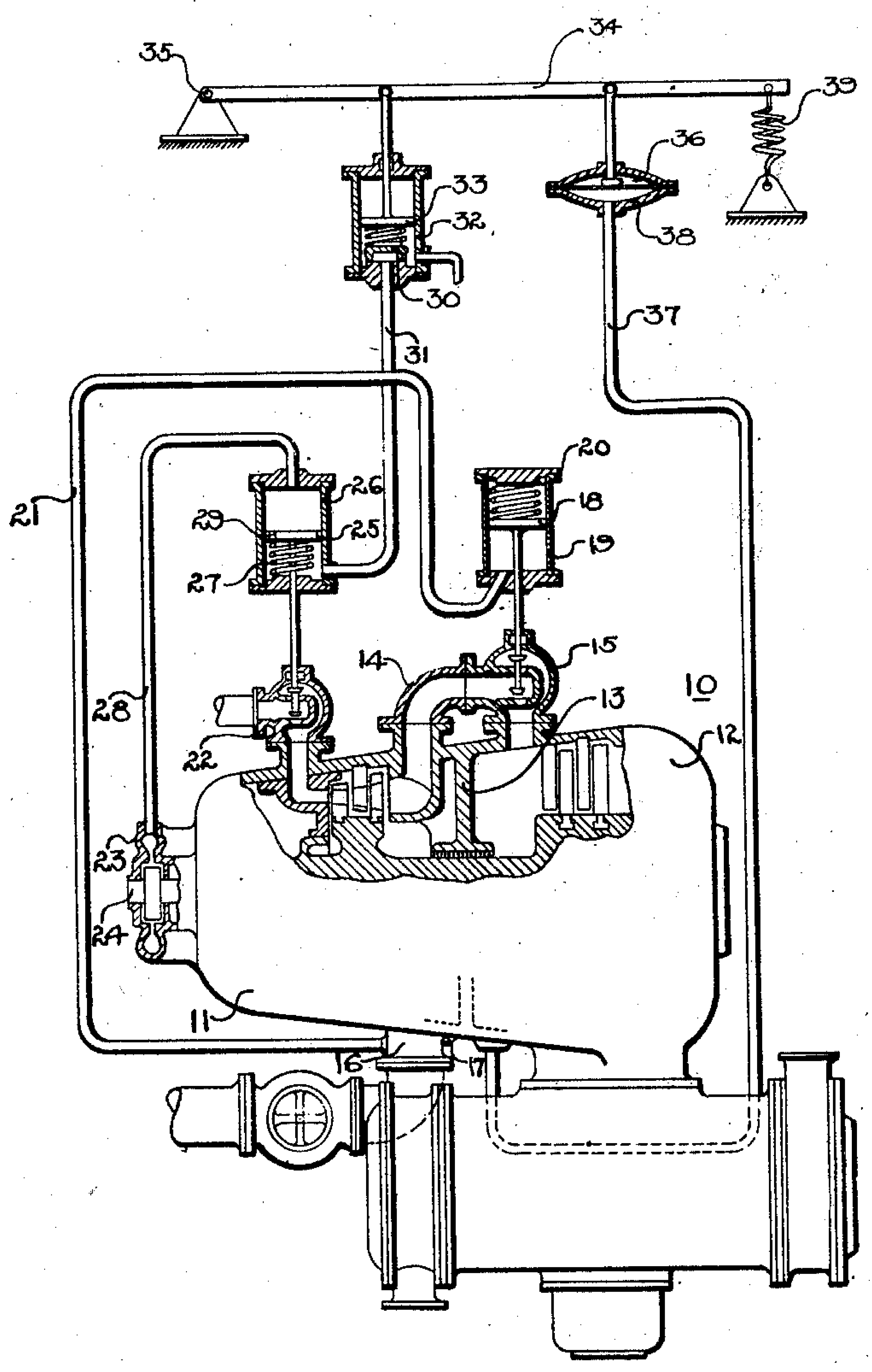

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TURBINE-CONTROL MECHANISM

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My invention relates to a control mechanism, more particularly to a control mechanism for an elastic fluid turbine having means at an intermediate stage for either extracting partially expanded motive fluid or for admitting low-pressure motive fluid thereto, and it has for its object to provide means for compensating the admission of high-pressure motive fluid to the turbine in accordance with the amount of partially expanded motive fluid extracted or the amount of low-pressure motive fluid admitted.

Control mechanisms for extraction turbines have heretofore been built wherein a speed-responsive governor is provided for controlling the admission of motive fluid to the turbine and wherein the action of the speed-responsive governor is modified or compensated in response to an operating condition or variable which varies with the amount of partially expanded motive fluid extracted from the turbine. Such compensating means have heretofore been designed, so far as I am aware, upon the premise that the amount of motive fluid extracted is a function of the pressure within the turbine at the point where it is extracted, or upon the premise that the amount of motive fluid varies with the pressure differences in the extraction conduit. While such control devices modify the action of the governor in a satisfactory manner for a portion of the range of extraction demands, they are usually inaccurate over the remaining portion of the range.

My invention, while compensating for the variations in amount of extracted fluid, is based upon the premise that the power developed by the low-pressure section is added to that of the high-pressure section and that the admission of motive fluid to the high-pressure section should, therefore, be decreased in proportion to the amount of power developed by the low-pressure section. To accomplish this, I utilize the pressure at the inlet or high-pressure end of the low-pressure section, inasmuch as this pressure is substantially proportional to the power developed by the low-pressure section; or, as commonly expressed in the art, it is a "straight line function" thereof. In this manner, an accurate compensation over the full range of extraction demand is obtained.

These and other objects are effected by my invention, as will be apparent from the following description and claims taken in connection with the accompanying drawings, forming part of this application, in which:

The single figure is a diagrammatic view of my improved control mechanism applied to an elastic fluid turbine.

Referring to the drawing more in detail, I show an elastic fluid turbine indicated generally at 10, for driving any driven machine (not shown), and including a high-pressure section 11 and a low-pressure section 12. A diaphragm 13 or other suitable means is provided for separating the high-pressure and low-pressure sections, and suitable valve-controlled means is provided for conveying partially expanded motive fluid from the high-pressure section to the low-pressure section, such as a by-pass conduit 14 having a valve 15 disposed therein. A conduit 16 also communicates with the discharge or low-pressure end of the high pressure section, as at the opening 17, through which partially expanded motive fluid is conveyed to the apparatus in which it is desired to be used.

The amount of fluid extracted through the conduit 16 may be controlled in any suitable manner to supply the demand for the same, for example, the valve 15 may be actuated by a piston 18. The piston 18 is disposed in a cylinder 19 and biased in a direction for closing the valve 15 by a spring 20. It is biased in opening direction by the fluid pressure in the conduit 16, communicated thereto through a conduit 21.

As will be readily apparent, upon an increase in demand for extraction fluid, the pressure in the conduit 16 decreases, whereupon the spring 20 moves the piston 18 and the valve 15 in closing direction, whereupon additional fluid is held back from the low-pressure section and supplied to the conduit 16. Upon decrease in demand, the pressure in the conduit 16 increases, actuating the piston 18 in the direction for opening the valve 15 and conveying a greater amount of fluid to the low-pressure section.

High-pressure motive fluid is admitted to the turbine, that is, to the high-pressure or inlet end of the high-pressure section 11, through an admission valve 22, controlled by any suitable governor, preferably a speed-responsive governor. I show, for example, a fluid pressure governor including a centrifugal pump 23 operated directly by the rotor 24 providing a fluid pressure varying as a function of the speed of the prime mover. A piston 25 is connected to the valve 22 for operating the same and is disposed in a cylinder 26. A spring 27 biases the piston 25 in the direction for opening the valve 13 and the fluid pressure developed by the pump 24 is conveyed through a conduit 28 to the cylinder 26 to bias the piston 25 in closing direction.

The operation of this form of fluid pressure governor will be readily understood. Upon increase in speed of the prime mover, fluid pressure developed by the pump 23 increases and moves the piston 25 in the direction for decreasing the opening of the admission valve 22. Upon decrease in speed, the fluid pressure is decreased and the spring 27 moves the piston 25 to provide increased opening of the valve 22.

The apparatus so far described is known in the art and in order to compensate the speed-responsive governor, I impose a back pressure on the piston 25. The piston 25 is provided with a restricted orifice 29 through which a small amount of fluid flows for providing the fluid pressure. A pressure relief valve 30 controls said back pressure through a passage 31. The valve 30 is biased to closed position by a spring 32 interposed between the valve and a spring abutment 33 movable by a lever 34. The lever 34 is pivoted to a stationary fulcrum at 35 and is actuated by a diaphragm 36. A conduit 37 communicates the pressure at the inlet or high-pressure end of the low-pressure section 12 to the chamber 38 provided on the lower side of the diaphragm 36 for controlling the movements of the lever 34. A spring 39 biases the lever 34 in opposition to the force of the diaphragm 36.

My novel control mechanism operates in the following manner:

Upon an increase in the demand for extraction fluid, the valve 15 is moved in closing direction and admits a decreased amount of fluid to the low-pressure section, resulting in a decrease in power developed by said section. The decrease in admission of motive fluid to the low-pressure section also results in a decrease in pressure in the high-pressure or inlet end thereof, proportional to the decrease in power, which reduced pressure is communicated to the diaphragm 36 and results in a downward movement of the lever 34. The downward movement of the lever 34 provides increased pressure of the spring 32 and an increase in the back pressure on the piston 25. Hence the piston 25 moves the valve 22 in opening direction to provide increased admission of motive fluid to the high-pressure section to compensate for the decrease in power developed by the low-pressure section.

Upon a decrease in demand for extraction fluid, the valve 15 is moved in opening direction as above described and increases the flow of fluid to the low-pressure section. An increased pressure is thus communicated through the conduit 37 to the diaphragm 36, and an upward movement of the lever 34 is effected. The compression of the spring 32 is decreased and the relief valve 30 effects a decreased back pressure on the piston 25. The piston 25 is thereupon moved in the direction for moving the admission valve 13 in closing direction to decrease the admission of motive fluid to the high pressure section to compensate for the increase of power developed by the low pressure section.

The advantage of my novel control or compensating mechanism is that the pressure in the low-pressure section is substantially proportional to the amount of power developed by the low-pressure section throughout the entire range of variation in demand for extraction fluid; in other words, it is substantially a "straight line function" of the power developed, so that an accurate modification of compensation of the action of the speed-responsive governor is effected in response to this pressure. Thus the turbine continues to carry its load without requiring a change in speed to obtain the necessary motive fluid admission.

While I have described the turbine as discharging fluid through the opening 17, it will be apparent that low-pressure motive fluid may be admitted therethrough. The control mechanism operates in exactly the same manner as described above, an increase in pressure and power of the low pressure section resulting in a decreased admission to the high-pressure section and vice versa.

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 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 a control mechanism, the combination with a prime mover having a high-pressure section, a low-pressure section and an opening communicating with the discharge end of the high-pressure section, of a control mechanism therefor comprising means responsive to the speed of the prime mover for controlling the admission of motive fluid to the high-pressure section, means

for controlling the distribution of partially expanded motive fluid discharged from the high-pressure section between the low-pressure section and said opening in response to an operating condition, and means responsive to the pressure at the inlet end of the low-pressure section for modifying the action of the speed-responsive means.

2. The combination with a prime mover having a high-pressure section, a low-pressure section, and an opening providing communication between the exterior of the turbine and the interior of the prime mover at the discharge end of the high pressure section, a valve controlling communication between the high-pressure and low-pressure sections, means responsive to an operating condition of the prime mover for controlling the admission of motive fluid thereto, and means responsive to the pressure in the inlet end of the low-pressure section for modifying the action of the means controlling the admission of motive fluid to the prime mover.

3. In combination, an elastic fluid multistage turbine, said turbine having a diaphragm between two successive pressure stages thereof and an extraction opening before the diaphragm in the direction of motive fluid flow, means for controlling the distribution of fluid between the extraction opening and the pressure stage beyond the diaphragm, means responsive to the speed of the turbine for controlling the admission valve, and means responsive to the pressure of fluid within the turbine immediately beyond the diaphragm for modifying the action of the speed-responsive means.

4. The combination with a prime mover having a high-pressure section, a low-pressure section, and an opening providing communication between the exterior of the turbine and the interior of the prime mover at the discharge end of the high-pressure section, means responsive to an operating condition of the prime mover for controlling the admission of motive fluid thereto, and means responsive to the pressure in the inlet end of the low-pressure section for modifying the action of the means controlling the admission of motive fluid to the prime mover.

5. The combination with a prime mover having a high-pressure section, a low-pressure section, and an opening providing communication between the exterior of the turbine and the interior of the prime mover at the discharge end of the high-pressure section, means responsive to an operating condition of the prime mover for controlling the admission of motive fluid thereto, and means responsive to the variable pressure of the motive fluid in the low-pressure section for modifying the action of the means controlling the admission of motive fluid to the prime mover.

In testimony whereof, I have hereunto subscribed my name this 12th day of April, 1929.

CLARENCE B. CAMPBELL.