

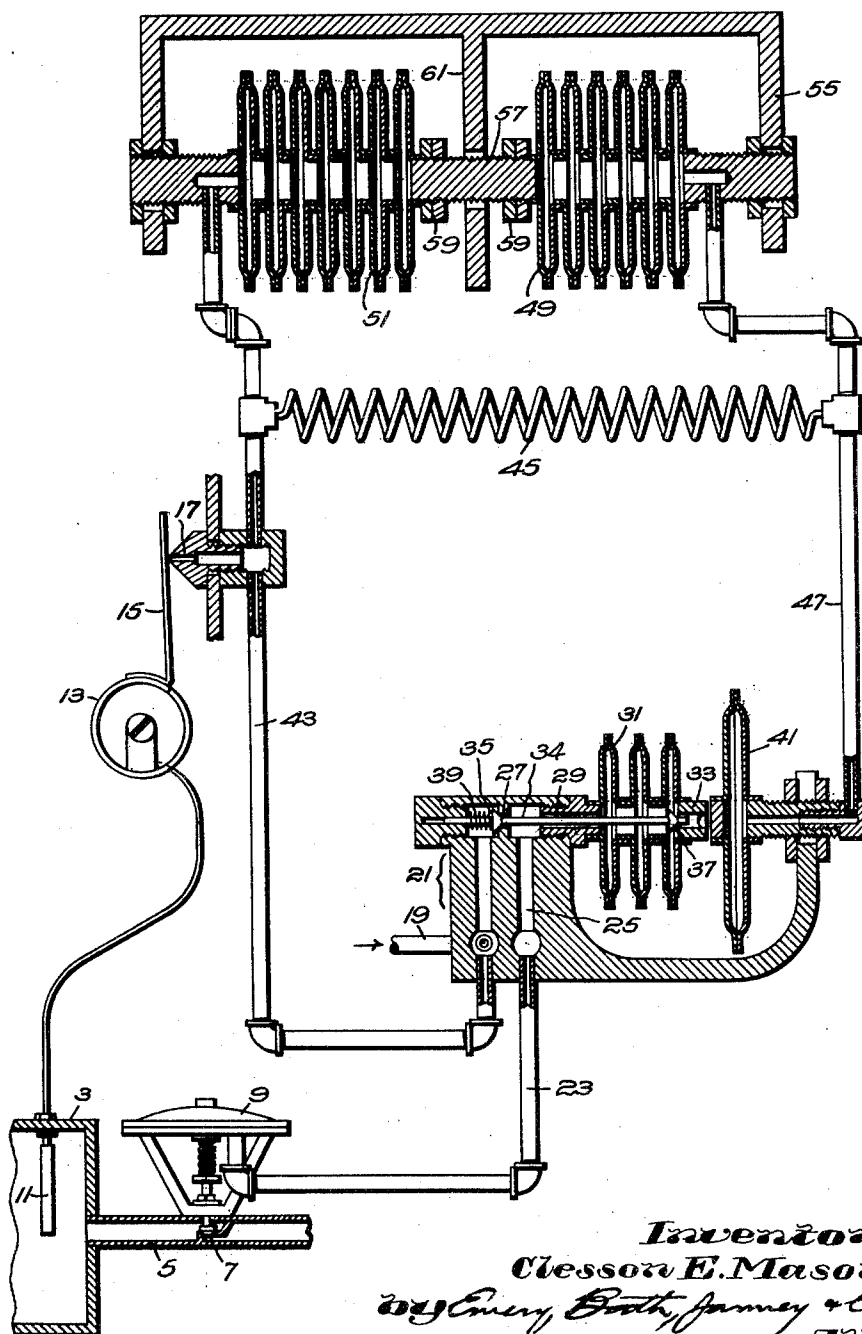
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CONTROL MECHANISM

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CONTROL MECHANISM

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This invention relates to control mechanism adapted to control the supply of fluid to a pressure-fluid-driven servomotor operating some mechanism, usually a valve in which case the servomotor usually takes the form of a diaphragm motor, and the object is to provide a mechanism having an initial rapid response to a governing action and slow response thereafter until the limit of response is reached. Otherwise described, the invention provides in a sluggish-acting mechanism means for effecting an initial rapid movement of the device controlled.

The specific embodiment of the invention disclosed by way of example herein is a construction which embodies features disclosed and claimed in a co-pending application of Webster W. Frymoyer, Serial No. 299,572, filed Aug. 14, 1928, and in a sense may be considered an improvement on the mechanism disclosed in that application adapting it for uses in which the manner of operation above described is desirable.

The accompanying drawing, to which reference is made in the following detailed description, is a diagrammatic disclosure of said specific embodiment of the invention as applied to a heating control installation with parts in section.

To facilitate understanding of the invention, there will first be described specifically those parts of the installation which are shown and fully described in the Frymoyer application referred to, but it will be understood that the construction thus described is illustrative merely and the detailed description has for its purpose making understood that specific mechanism herein disclosed in connection with which the present invention is used and that the scope of the invention is not limited to the application shown or the mechanism illustrated.

Referring to the drawing, there is there shown a chamber 3 to which heating fluid is supplied through a pipe 5 under control of the valve 7 actuated by a diaphragm motor 9. In the chamber may be disposed a bulb 11 of a vapor pressure thermometer embodying a helical Bourdon tube 13 which is adapted to operate a valve or "flapper" 15 closing against the valve seat or "nozzle" 17 constituting an exhaust port for a pressure system as will presently be described. This thermometer constitutes an example of a mechanism adapted to operate a control valve in accordance with the fluctuations of a variable, ordinarily one the value of which is dependent in part on the operation of the valve 7 or similar mechanism. The flapper 15 is herein shown as directly attached to the helical tube 13 and the

nozzle 17 as stationary, but in practice the construction may conveniently be similar to that disclosed in the patent to Dixon 1,582,868, April 27, 1926.

To operate the diaphragm motor, fluid under pressure is supplied from a suitable source through the pipe 19, through the control head 21 and pipe 23 to the chamber of the diaphragm motor. The chamber 25 in the control head from which the pipe 23 is supplied may have in one wall thereof an intake port 27, and in alignment therewith an opening 29. Supported exteriorly of the opening and in communication with chamber 25 through the same is a set of expansible diaphragms 31, and the opposite wall of the chamber formed thereby, which moves when the chamber expands under pressure, is provided with an exhaust port 33. Cooperating with these ports is a suitable double valve embodying a valve stem 34 having heads 35 and 37 adapted to close the intake and exhaust ports respectively and being spaced apart on the stem a distance slightly less than the normal distance between these ports. A spring 39 normally presses the valve to the right and the supply port is closed but the waste or exhaust port is open, the seat of the head 37 being supported by the diaphragms 31 away from that head. This double valve serves as an example of a supply and waste valve and in the position shown pressure fluid from pipe 19 is cut off from the diaphragm motor and the chamber of the diaphragm motor is exhausted to the atmosphere through the open waste port at 33.

To permit pressure fluid to flow to diaphragm motor 9 the supply and waste valve may be operated by a pressure operated motor which herein takes the form of an expansible diaphragm 41 opposing the diaphragms 31 and adapted when dilated to make contact with the ported wall of the latter, compressing diaphragms 31, moving the seat of the waste valve against head 37 and closing port 33 and then by bodily movement of valve stem 34 with its attached valve heads opening the supply valve against the spring 39. To expand diaphragm 41 air may be admitted from the main source of supply, through pipe 43, in which is located the exhaust port provided by the nozzle 17, through a restricted connection 45 adapted to permit only a slow seepage of pressure fluid therethrough and which in the example illustrated takes the form of a length of capillary tubing, and through pipe 47.

The mechanism as so far described is as disclosed in said Frymoyer application and provides

for a floating controlled valve 7 having a sluggish response to the governing movements of control valve 15, as will be understood from the following description. Air under suitable pressure, say fifteen pounds per square inch is admitted at pipe 19. Let us suppose valve 7 to be held partly open by a pressure of ten pounds in the diaphragm motor 9. The same pressure will exist in the diaphragms 31, and if balanced by the pressure in diaphragm 41, the controlled valve will remain in its adjusted position for if the pressure in the diaphragm motor 9 increases, tending to open the valve further, diaphragms 31 will expand, compressing diaphragm 41, cracking open valve 37 and releasing the excess pressure. Conversely, if the pressure in the diaphragm motor 9 and diaphragms 31 falls, diaphragm 41 expanding will further compress diaphragms 31, closing waste valve 37 and opening supply valve 35 wider. Now, if the temperature in the chamber 3 increases, the thermometer will move flapper 15 away from nozzle 17, exhausting pipe 43. Pressure fluid will slowly seep through connection 45, diaphragm 41 will slowly collapse permitting diaphragms 31 to expand, supply valve 35 to close and waste valve 37 to open, reducing the pressure in diaphragm motor 9 and moving controlled valve 7 towards closed position to reduce the supply of heating medium.

In the construction so far described a change in the pressure conditions on the intake side of the restricted connection 45 which takes place rapidly is felt very slowly on the discharge side and the diaphragm 41. In embodying my invention in a construction of this type I provide for means independent of the restricted connection whereby the change on the intake side effects a quick initial change on the discharge side with a corresponding quick movement of controlled valve 7 to be followed, if necessary, by a slow change to the final pressure called for by the control.

To obtain this effect I place in communication with the pressure system of the diaphragm 41 on either side of the connection 45 by means of branch pipes tapped off from either side thereof expansible chambers 49 and 51 which may take the form of bellows or sets of diaphragms, each supported at one end on a frame 55 and having the movable walls at their opposite ends facing each other and rigidly connected by a member 57 in such manner that the expansion of one compresses the other. I have herein shown the member 57 as threaded and carrying the nuts and lock nuts 59 adjustable therealong and adapted to cooperate with an arm 61 carried by the frame to limit the movement of the diaphragms in one direction or another in an amount controlled by the position of these nuts along the thread.

The operation is as follows. Assume that the flapper valve 15 closes exhaust port 17 and the pressure rapidly rises in pipe 43 to be transmitted only slowly through the restricted connection 45. The increased pressure, however, is quickly felt in diaphragm 51 which expands, collapsing diaphragm 49 and reducing the volume of the system on the discharge side of the connection 45 and consequently causing a quick increase in pressure therein which is felt in the diaphragm 41, and causes a quick response of the control mechanism. This pumping movement of the diaphragms is halted by the left-hand stop 59 and the volume of chamber 49 is now for all practical purposes fixed. Pressure seeping through the connection 45 continues to build up

in the chamber 41 providing a sluggish response of the mechanism following the initial rapid response until the desired conditions are obtained. Now, if we suppose that the control valve 7 has opened so wide that the indications of the instruments are higher than the control point, control valve 15 will open, rapidly exhausting pipe 43 and diaphragm 51, the pressure in which is then overbalanced by the pressure in 49 so that the latter expands, compressing the former and causing a sudden drop in pressure on the discharge side of the system and in chamber 41 providing a rapid initial response of the mechanism to be followed by a slower response due to seepage of fluid through connection 45.

I am aware that the invention may be embodied in other specific forms without departing from the spirit or essential attributes thereof, and I therefore desire the present embodiment to be considered in all respects as illustrative and not restrictive; reference being had to the appended claims rather than to the foregoing description to indicate the scope of the invention.

I claim:

1. A pneumatic control mechanism comprising a pressure operated motor for operating valves governing the supply of pressure fluid to the controlled mechanism, a control valve governing the supply of fluid to said motor, a restricted connection between said valve and motor, and chambers of variable capacity in communication with the system at either side of said connection and so connected that change in volume of one will change the volume of the other in opposite sense.

2. A pneumatic control mechanism comprising an expansible chamber serving as a motor for operating valves governing the supply of pressure fluid to the controlled mechanism, means including a control valve for causing a slow flow of pressure fluid to and from said chamber, and pumping means also governed by said control valve to effect a relatively rapid change in pressure conditions in said chamber on operation of said valve.

3. A pneumatic control mechanism comprising an expansible chamber serving as a motor for operating valves governing the supply of pressure fluid to the controlled mechanism, a control valve governing flow of pressure fluid to and from said chamber, a restricted connection between said valve and chamber, dilatable chambers in communication with the system on either side of said connection and acting one on the other in opposition, and stop means to limit the corresponding dilation of one chamber and diminution in volume of the other.

4. A pneumatic control mechanism comprising a supply and waste valve, means responsive to the controlled pressure tending to shift the valve to waste position, a pressure responsive device for shifting the valve to supply position in opposition to said means, means to control the flow of pressure fluid to and from said device comprising a control valve responsive to the fluctuations of a variable, a connection of minute capacity between said control valve and said device, and means actuated by the change in pressure on the intake side of said connection due to the operation of said valve to effect an initial change in the pressure conditions on the discharge side independently of flow through said connection.

5. A pneumatic control mechanism comprising a supply and waste valve, means responsive to the controlled pressure tending to shift the valve

to waste position, a pressure responsive device for shifting the valve to supply position in opposition to said means, means to control the flow of pressure fluid to and from said device comprising a control valve responsive to the fluctuations of a variable, a connection of minute capacity between said control valve and said device, and expensible and contractible chambers in communication with the system at opposite sides of said connection mutually connected whereby a change in volume of one effects a change in volume of the other in opposite sense.

6. In combination with a mechanism actuated by a pressure operated motor, a control valve responsive to the fluctuations of a variable the value of which is dependent on the adjustment of said mechanism, means including a sluggishly acting connection to render the pressure conditions set up by actuation of said valve effective to cause a slow variation in the pressure admitted to the motor tending to adjust said mechanism in manner to cause a change in said variable opposite in sign to that causing such movement of the control valve, and cooperating means operated on actuation of said valve to effect an initial rapid change in the pressure admitted to the motor independent of said sluggishly acting connection.

7. A control mechanism for a pressure fluid operated motor comprising a valve for controlling the supply of pressure fluid to said motor, pneumatic means for governing the same comprising a control valve, means including a sluggishly acting connection to render the pressure conditions set up by actuation of said control valve effective to cause a slow adjustment of said first valve, and cooperating means operated on actuation of said control valve to effect an initial rapid adjustment of said first valve independent of said sluggishly acting connection.

8. A pneumatic control mechanism comprising a supply and waste valve, a pressure operated device to shift the valve towards one position and on exhaust permitting its return towards the other position, a control couple governing the supply of pressure fluid to said device and mechanism operated thereby to move rapidly a considerable volume of fluid to or from said device and cooperating mechanism permitting a subsequent continued slow flow in the same direction.

9. In combination with pressure operated motor mechanism for controlling the flow of a fluid, means responsive to a measurable condition affected by such flow, means to supply on a predetermined response of said means to said valve mechanism in initial relatively rapid and powerful impulse and a secondary slower impulse comprising a supply and waste valve through which pressure fluid is supplied to the motor mechanism, a pressure operated device for moving the

same, a control couple actuated by said responsive means governing the supply of fluid to said device, means to transmit through said supply valve to the valve mechanism a rapid flow of fluid to said valve mechanism on operation of said couple, and cooperating means comprising a restricted seepage passage for the pressure fluid to provide a continued gradual flow.

10. In combination with pressure operated motor mechanism for controlling the flow of a fluid, means responsive to a measurable condition affected by such flow, means to supply on a predetermined response of said means to said valve mechanism an initial relatively rapid and powerful impulse and a secondary slower impulse comprising a supply and waste valve through which pressure fluid is supplied to the motor mechanism, a pressure operated device for moving the same, a control couple actuated by said responsive means governing the supply of fluid to said device, means to transmit through said supply valve to the valve mechanism a rapid flow of fluid to said valve mechanism on operation of said couple, and cooperating means comprising a restricted seepage passage and a chamber of relatively great volume in communication therewith at the discharge side thereof for the pressure fluid to provide a continued gradual flow.

11. In combination with valve means for controlling the flow of a fluid, pressure operated motor means for moving the same and means to convey to said motor means a relatively rapid flow of pressure fluid to cause a rapid response and an initial marked change of the controlled flow and a following slow flow of pressure fluid to cause a sluggish change in the rate of flow comprising a control couple operating to initiate a flow of pressure fluid, means freely receiving such flow to transmit its pressure substantially undiminished and a second cooperating passage for said fluid comprising a restricted portion through which it seeps.

12. In combination with valve means for controlling the flow of a fluid, pressure operated motor means for moving the same and means to convey to said motor means a relatively rapid flow of pressure fluid to cause a rapid response and an initial marked change of the controlled flow and a following slow flow of pressure fluid to cause a sluggish change in the rate of flow comprising a control couple operating to initiate a flow of pressure fluid, means freely receiving such flow to transmit its pressure substantially undiminished and a second cooperating passage for said fluid comprising a restricted portion through which it seeps and a chamber of relatively great volume in communication with said passage at the discharge side thereof.

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