

May 16, 1933.

K. H. HUBBARD
REGULATING APPARATUS

1,909,469

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2 Sheets-Sheet 1

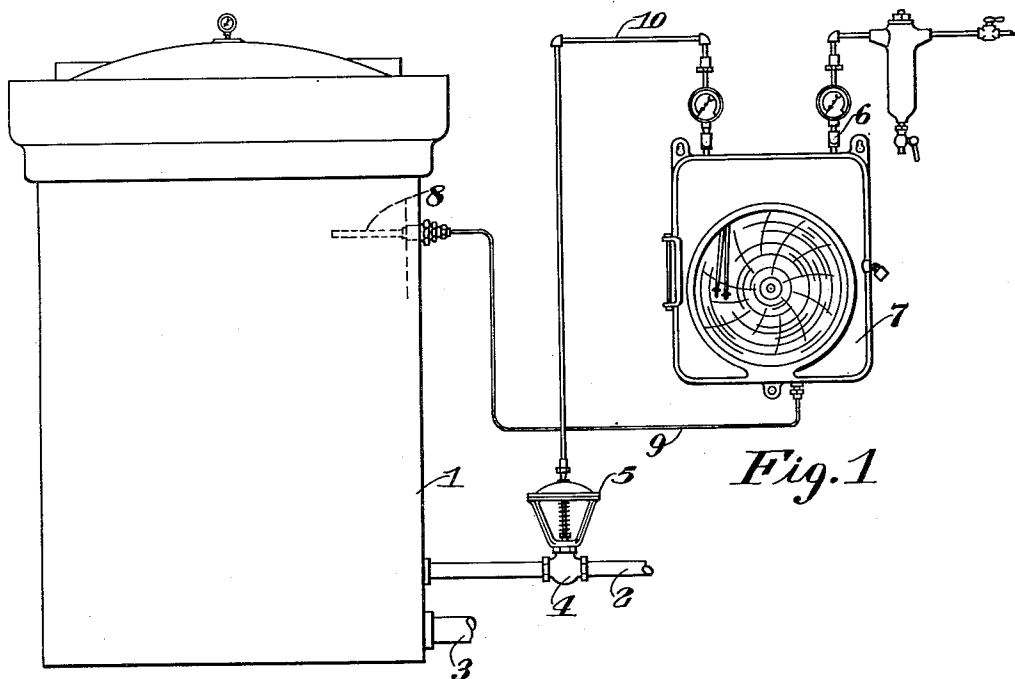


Fig. 1

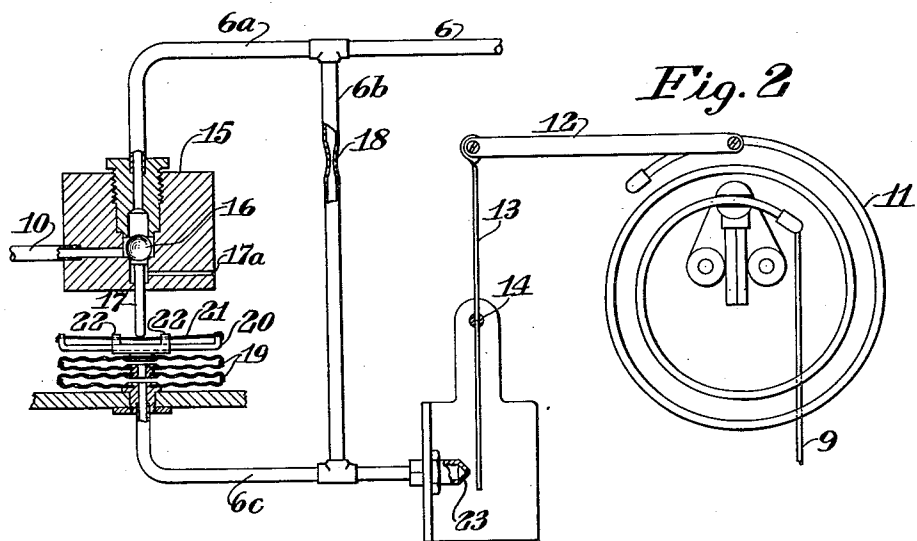


Fig. 2

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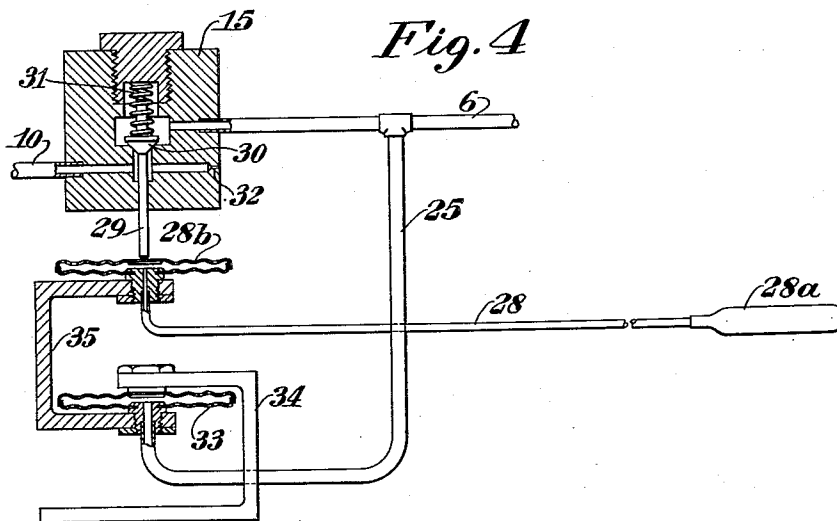
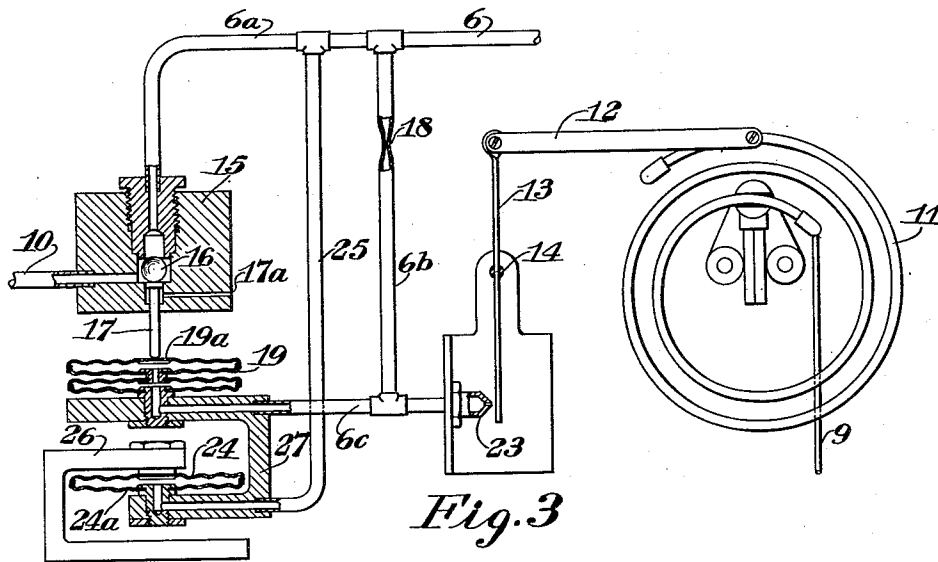
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REGULATING APPARATUS

Application filed October 16, 1929. Serial No. 399,982.

This invention relates to regulators, such as temperature and pressure regulators, of the type including a pressure-fluid for actuating valves or like controlling devices.

5 The invention relates, more in particular to means for compensating for variations of pressure in the pressure fluid supply line and to thereby make the operation of the valves or other controlling devices practically independent of fluctuations in the pressure fluid.

10 For a full understanding of the invention, the principle of operation on which it is based and its advantages, reference is made to the accompanying drawings, wherein

Fig. 1 is a more or less diagrammatic representation of an apparatus embodying one form of the invention;

20 Fig. 2 is a partly sectional view of a detail arrangement thereof;

Fig. 3 is a diagrammatic representation of a different form of the invention; and

25 Fig. 4 is a view, similar to Fig. 3, of a modification of the form shown in Fig. 3.

30 Having reference to Fig. 1, 1 by way of example represents a vulcanizing chamber or the like wherein the temperature is to be regulated. As is usual, the heat is supplied in the form of steam, which in the particular arrangement enters through the pipe 2, the exhaust steam and condensate leaving the chamber through the pipe 3. The steam supply is controlled by means of a valve 4 actuated by a pressure-fluid operated diaphragm mechanism 5 of well known construction. The flow of the pressure fluid, which latter is derived from a suitable supply indicated by the supply pipe 6, is regulated by a regulating mechanism 7 not shown in detail in Fig. 1. So far as the general arrangement in Fig. 1 is concerned, it is sufficient to say that the regulating mechanism contains a valve mechanism which is actuated in response to the temperature conditions in the vulcanizing chamber through the expansive force of a temperature-sensitive medium contained in the bulb 8 and the capillary transmission system indicated generally by the conduit 9.

Due to the temperature-controlled valve action just described, the flow of the pressure fluid through the conduit 10 is regulated to effect the proper action of the diaphragm mechanism 5.

55 The apparatus and arrangement thus far described are well known and well understood. The present invention is an improvement upon the apparatus 7 indicated only generally in Fig. 1.

60 Having now reference to Fig. 2, which represents so much of the detail of the apparatus 7 of Fig. 1 as is necessary for a full explanation of the invention, 11 is a spring of the Bourdon tube type in fluid connection through the capillary tube 9 with the bulb 8. To the movable outer end of the tube 11 is connected a link 12 which in turn is connected with a lever 13 pivotally supported by pin 14. This lever 13 is in effect a baffle plate adapted to move at its free end toward and away from the orifice of nozzle 23 thereby variably affecting the flow of fluid out of the orifice.

75 From the supply pipe 6 of the pressure fluid, one branch 6a leads to the intake side of the valve mechanism 15, the outlet side being connected to the pipe 10. The valve, in the particular instance is composed of a ball 16 and a stem 17. It may be mentioned in this connection that the range of movement of the stem and the ball is of the order of about .006". In Fig. 2, the ball 16 is shown in its lowermost position allowing a maximum of pressure fluid to enter through pipe 6a and pass out through pipe 10 to the diaphragm mechanism 5.

85 A second branch 6b, which has a constriction 18 leads, on the one hand, to the nozzle 23 and, on the other hand, by means of a connection 6c to a flexible diaphragm mechanism 19.

90 The space around the stem 17 within the body of the valve mechanism is in free communication with the atmosphere, as indicated by the channel 17a. The object of this provision is to maintain atmospheric pressure or substantially constant pressure in the space below the ball 16 or, expressed dif-

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ferently, to prevent variable pressure reaction against the ball in upward direction.

The detail above recited is likewise generally old and well understood.

5 The invention proper is, in the particular case, the provision of a frame 20 supporting at its opposite ends a bridge 21 of thin resilient material. As a matter of expedience, the bridge 21 freely rests on the up-
10 turned ends of the frame 20 and has its edges turned down to prevent longitudinal sliding on the frame while an arm 22 disposed between the ends of the frame pass over the bridge to hold it in position.

15 The significance of this frame 20 together with the spring bridge 21 is as follows:

Heretofore the stem 17 was directly acted upon by the upper surface of the diaphragm device 19. Whenever the pressure of the
20 pressure fluid, due to some cause, increased or decreased, the pressure in the diaphragm 19 varied proportionately causing a movement of the stem and the ball which move-
25 ment, in turn, causes a change in the position of the diaphragm 5 and the valve 4 whereas a change in the pressure of the pressure fluid of the supply should not cause any variation in the position of valve 4
30 since the control should be effected solely by the bulb 8 and spring 11 through the baffle plate 13. Such variations due to changes of pressure in the pressure fluid supply are highly objectionable.

35 Assume now that in the arrangement according to the invention, the pressure in the conduit 6 drops from 25 lbs. to 22 lbs. while the baffle plate partially closes the orifice of the nozzle. Naturally the pressure in the bellows diaphragm 19 drops correspondingly
40 and the bellows slightly contracts thereby correspondingly lowering frame 20. Similarly, the pressure upon the upper surface of the ball 16 decreases.

45 The bridge 21 is always in a condition of balance between the pressure reaction upon ball 16 and stem 17 in downward direction, on the one hand, and the pressure exerted by the bellows diaphragm in upward direction, on the other hand. During the
50 drop of pressure both upon the ball 16 and in the bellows this balance is disturbed. The pressure action between the stem 17 and the bridge has decreased and as the result of this decrease the bridge straightens out
55 until a new balance is reached. When this new balance is reached, according to the invention, the ball 16 is in a slightly different position than before. The compensating effect is substantially such that with the
60 change of position of the ball the pressure at the diaphragm 5 remains substantially constant in spite of the change of pressure in the line 6, 6a.

65 During an increase of pressure, the pressure reaction between the stem 17 and the

bridge increases correspondingly with the result that the increased load upon the bridge causes the latter to sag more.

At any rate, the physical properties, such as the length, width, thickness, modulus of
70 elasticity of the material, etc., may be so chosen that for a given maximum change of pressure in the pressure fluid, the ball remains substantially stationary.

75 While it is not possible to obtain perfect compensation, the compensating effect is sufficiently close to satisfy all practical requirements of maximum accuracy of regulation.

80 Having now reference to Fig. 3, the arrangement is similar to the apparatus just described in the sense that the arrangement aside from the compensating mechanism is the same as before. The compensating
85 mechanism, in this arrangement comprises a separate bellows diaphragm 24 in fluid connection with the pipe 6 through a conduit 25. The diaphragm 24 is on one side supported on a stationary frame 26 and carries
90 on its other side a frame 27 which forms the support for the diaphragm 19. The action of the diaphragm 19 is thus affected by the action of the diaphragm 24.

The compensating adjustment is as follows:

95 Assume that the pressure in the pressure-fluid supply decreases from 25 lbs. to 22 lbs. This decrease of pressure causes, in the first instance, a disturbance of the balance between stem 17 and the diaphragm 19, since
100 the pressure upon ball 16 has changed and the pressure in the diaphragm 19 has caused a contraction thereof just as described in connection with Figs. 1 and 2. In addition
105 to these changes, the decrease of pressure also causes a contraction of the diaphragm bellows 24. However, while the contraction of diaphragm 19 signifies a downward move-
110 ment of its contact surface 19a, the surface 24a of the diaphragm 24, on which the diaphragm 19 is supported, moves upwardly when the pressure decreases. The move-
115 ment of the diaphragm 24 is therefore opposite to the movement of the diaphragm 19 and thus compensates for the undesired movement of the latter. By properly proportioning the diaphragm 24, a degree of compensation may be obtained which may be considered as complete for all practical
120 requirements.

125 The arrangement in Fig. 4 differs from the above described two embodiments of the invention principally in that the temperature-responsive system is entirely independent of the pressure-fluid operated system. 28 represents the capillary connection from
130 a bulb 28a to the diaphragm 28b. The valve mechanism 15 includes a valve stem 29 on which the valve 30 is carried. The valve 30 is acted upon by a spring 31 tending to move
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it to closing position. The service side or outlet side of the valve is connected with the atmosphere by a small orifice leak 32. The arrangement just described merely represents another well known form of mechanism in general use and does not itself form part of the invention. The compensating mechanism comprises a diaphragm 33 mounted, as in Fig. 3, on a stationary support 34 and carries frame 35 which, in turn carries diaphragm 28b.

During an increase or a decrease of pressure in the pressure-fluid supply, the pressure at the fluid-operated diaphragm valve (indicated by numerals 4 and 5 in Fig. 1) ordinarily varies correspondingly. The diaphragm 33 is so designed as to move the valve 30 a slight distance just sufficient to correct for the increase or decrease of pressure in the pressure-fluid system and maintain the regulating valve 4 in a position independent of pressure changes in the latter.

In the particular embodiments shown in Figs. 3 and 4, the connections 25, 6c and 28 must be so constructed and arranged as to yield freely to changes of position of the movable surface of the diaphragm 24 and 33, respectively.

In the foregoing I have described several arrangements embodying the invention to explain the principle of operation. It is understood that the invention is in no wise limited to the particular forms shown and described.

I claim:

1. In apparatus of the character described, the combination with control mechanism and pressure-fluid actuated means for operating the same, including a pressure-fluid conduit having a supply portion and an output portion and means in said conduit for regulating the flow of the fluid from said supply portion to said output portion, of means sensitive to conditions to be regulated, for varying the position of said regulating means in accordance with the changes in the conditions to be regulated and means responsive to variations of pressure in the supply portion of the pressure-fluid conduit for separately varying the position of said regulating means.

2. In apparatus of the character described, the combination with control mechanism and pressure-fluid actuated means for operating the same, including a pressure-fluid conduit having a supply portion and an output portion and means in said conduit for regulating the flow of the fluid from said supply portion to said output portion, of means sensitive to conditions to be regulated, for varying the position of said regulating means in accordance with the changes in the conditions to be regulated and means responsive to variations of pressure in the supply portion of the pressure-

fluid conduit for separately varying the position of said regulating means, said responsive means being operatively associated with the said sensitive means for action upon the said regulating means.

3. In apparatus of the character described, the combination with control mechanism and pressure-fluid actuated means for operating the same, including a pressure-fluid conduit having a supply portion and an output portion and means in said conduit for regulating the flow of the fluid from said supply portion to said output portion, of means sensitive to conditions to be regulated, for varying the position of said regulating means in accordance with the changes in the conditions to be regulated, and means responsive to variations of pressure in the supply portion of the pressure-fluid conduit for separately varying the position of said regulating means, said sensitive means and said responsive means being disposed in series to have combined action upon the regulating means.

4. In apparatus of the character described, the combination with control mechanism and pressure-fluid actuated means for operating the same, including a pressure-fluid conduit and valve mechanism therein for regulating the flow of fluid from the supply portion of said conduit to the output portion thereof, of means sensitive to conditions to be regulated, for varying the position of the valve mechanism in accordance with the changes in the conditions to be regulated, and means responsive to variations of pressure in the supply portion of the pressure conduit for modifying the action of the said sensitive means upon the valve mechanism.

5. In apparatus of the character described, the combination with control mechanism and pressure-fluid actuated means for operating the same, including a pressure-fluid conduit and means therein for regulating the flow of the fluid from the supply portion of said conduit to the output portion thereof, of means sensitive to conditions to be regulated, for actuating the regulating means, and means responsive to variations of pressure in the supply portion of the pressure-fluid conduit for acting upon the regulating means to cause the latter to maintain the fluid pressure at the control mechanism substantially independent of the variations of pressure in the supply portion of the conduit.

6. In apparatus of the character described, the combination with control mechanism and pressure-fluid actuated means for operating the same, including a pressure-fluid conduit and valve mechanism therein for regulating the flow of the fluid from the supply portion of said conduit to said pressure-fluid actuated means, of an expansible

diaphragm for operating the valve mechanism and means responsive to variations of pressure in the supply portion of the conduit, for modifying the action of the expansible diaphragm upon the valve mechanism so as to make the pressure at the control mechanism substantially independent of the variations of pressure in the supply portion of the pressure conduit.

7. In apparatus of the character described, the combination with control mechanism and pressure-fluid actuated means for operating the same, including a pressure-fluid conduit having a supply portion and an output portion and means in said conduit for regulating the flow of the fluid through the output portion thereof to said pressure-fluid actuated means, of means responsive to variations of pressure in the supply portion of the pressure-fluid conduit for acting upon the regulating means to maintain the fluid pressure at the control mechanism substantially independent of the variations of the pressure in the supply portion of the fluid-pressure conduit, and means sensitive to conditions to be controlled for acting upon the regulating means to vary the fluid pressure at the output portion of said conduit in accordance with the variations in the conditions to be regulated.

8. In apparatus of the character described, the combination with control mechanism and pressure-fluid actuated means for operating the same, including a pressure-fluid conduit having a supply portion and an output portion and valve mechanism in said conduit for regulating the flow of the fluid to said output portion, of an expansible diaphragm for operating the valve mechanism, a spring element between the expansible diaphragm and the valve mechanism, said spring element being constructed and arranged to substantially counteract the effect of variations of pressure in the supply portion of the pressure-fluid conduit upon the expansible diaphragm, and means sensitive to conditions to be regulated for operating the expansible diaphragm.

9. The method of operating a valve mechanism by pressure fluid which comprises varying the flow of pressure fluid from a variable pressure fluid source to said valve mechanism to actuate the same in accordance with variations in the conditions to be regulated, and further varying the flow of fluid pressure to said valve mechanism in response to and in inverse relation to variations in the pressure of the fluid at said source, to compensate for said variations at said source.

10. In apparatus of the character described, the combination with control mechanism and pressure-fluid actuated means for operating the same, including a pressure-fluid conduit having a supply portion and

an output portion communicating with said control mechanism, and a valve in said conduit for regulating the flow of the fluid from said supply portion to said output portion, of means including a diaphragm sensitive to conditions to be regulated, for varying the position of the movable element of said valve in accordance with the changes in the conditions to be regulated, and means responsive to variations of pressure in the supply portion of the pressure-fluid conduit for separately varying the position of the movable element of said valve.

11. In apparatus of the character described, the combination with control mechanism and pressure-fluid actuated means for operating the same, including a pressure-fluid conduit having a supply portion and an output portion communicating with said control mechanism and a valve in said conduit for regulating the flow of the fluid from said supply portion to said output portion, of a diaphragm for actuating said valve, means sensitive to conditions to be regulated, for varying the operation of said diaphragm in accordance with the changes in the conditions to be regulated, and means responsive to variations of pressure in the supply portion of the pressure-fluid conduit for changing the position of said diaphragm.

12. In apparatus of the character described, the combination with control mechanism and pressure-fluid actuated means for operating the same, including a pressure-fluid conduit having a supply portion and an output portion and a valve in said conduit for regulating the flow of fluid from said supply portion to said output portion, said valve including a movable element, of an expansible member for varying the position of the movable element of said valve in accordance with the changes in the conditions to be regulated, and means responsive to variations of pressure in the supply portion of the pressure-fluid conduit for varying the position of said expansible member.

13. In apparatus of the character described, a pressure-fluid conduit having a supply portion and an output portion, a valve in said conduit controlling the flow of fluid therethrough from the supply portion to the output portion thereof, said valve including a movable element, an expansible diaphragm in operative relation to said movable element, a branch conduit connecting the supply portion of said first conduit to said diaphragm, said branch conduit having a portion terminating in a nozzle and being provided with means therein for impeding the flow of pressure fluid to said diaphragm and to said nozzle, a baffle movable in relation to said nozzle in accordance with a change in a condition to be regulated,

and means including the movable element of said valve serving to compensate for variations in pressure of said fluid in the supply portion of said conduit.

5 14. In apparatus of the character described, a pressure-fluid conduit having a supply portion and an output portion, a valve in said conduit controlling the flow of fluid therethrough from the supply portion
10 to the output portion thereof, said valve including a movable element, an expansible diaphragm in operative relation to said movable element, a branch conduit connecting the supply portion of said first conduit
15 to said diaphragm, said branch conduit having a portion terminating in a nozzle and being provided with means therein for impeding the flow of pressure fluid to said diaphragm and to said nozzle, a baffle movable
20 in relation to said nozzle in accordance with a change in a condition to be regulated, a frame supporting said diaphragm, a second diaphragm on which said frame is supported, said second diaphragm operating in
25 the opposite sense from said first diaphragm, and a second branch conduit leading from the supply portion of the first conduit to said second diaphragm.

15. In apparatus of the character described, a pressure-fluid conduit having a
30 supply portion and an output portion, a valve in said conduit controlling the flow of pressure fluid from the supply portion to the output portion thereof, said valve being provided with a movable element, a diaphragm
35 in operative relation to said movable element, means including a bulb and a capillary system for actuating said diaphragm in accordance with changes in the condition to be regulated, a frame supporting
40 said diaphragm, a second diaphragm supporting said frame and operative in the opposite sense from said first-mentioned diaphragm, and a pressure-fluid connection
45 from the supply portion of said conduit to said second diaphragm.

In testimony whereof I affix my signature.

KARL H. HUBBARD.

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