July 18, 1933. J. M. BARRETT 1,918,891

MASTER CONTROL SYSTEM

Filed Oct. 17, 1928

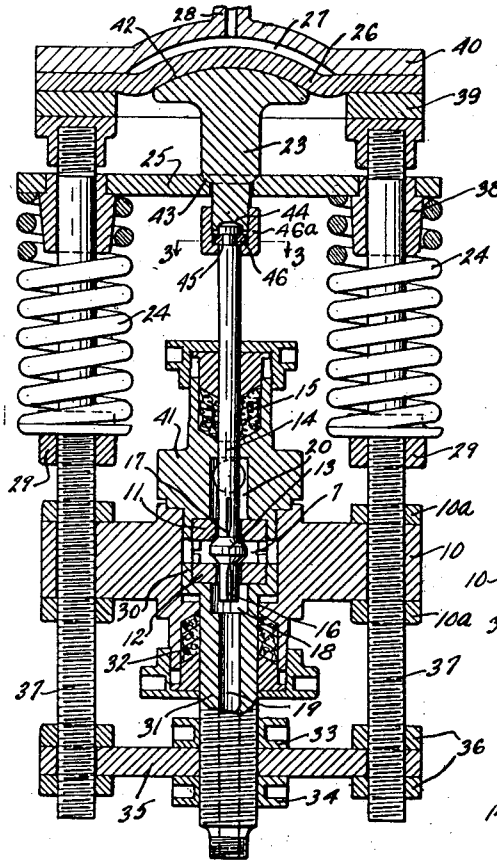

FIG. 1

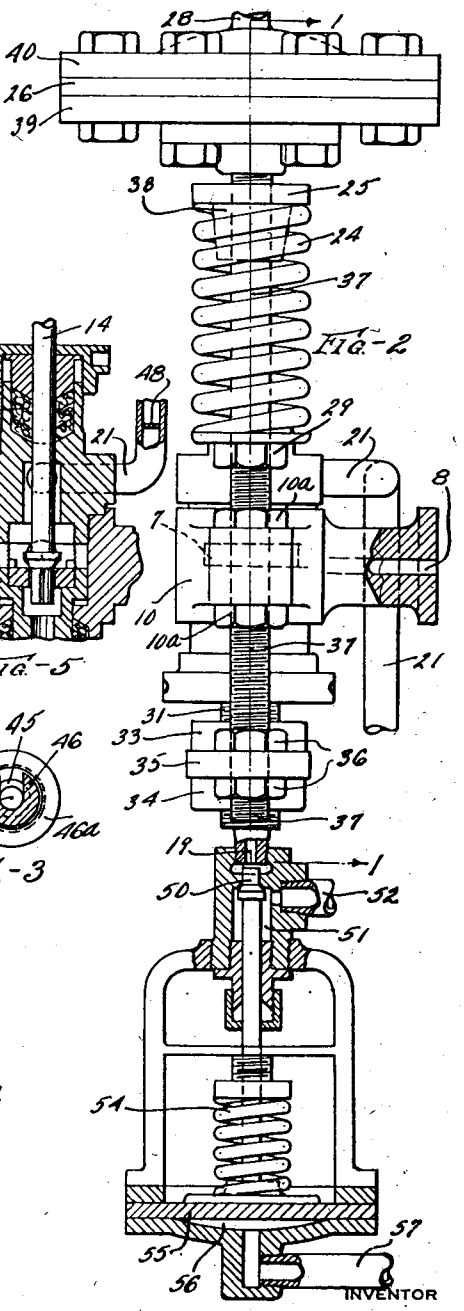

FIG. 2

FIG. 5

FIG. 3

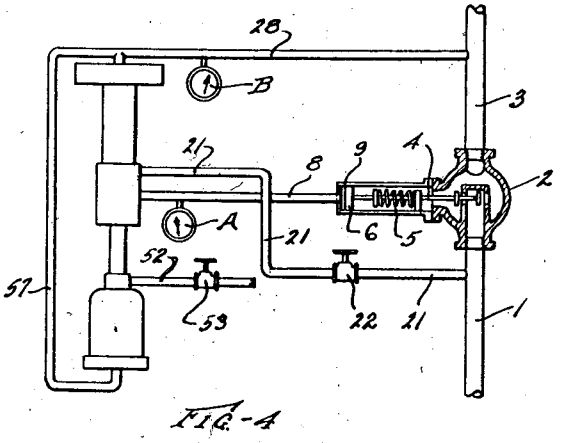

FIG. 4

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MASTER CONTROL SYSTEM

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This invention relates to master control systems such as are used for controlling fluid pressure in containers, and more particularly to controlling systems where some suitable device for varying or regulating the pressure of the container is operated or controlled by relay valve mechanism sensitive to or affected by the pressure to be controlled.

The object of the invention is to provide improved relay valve mechanism which is of simple form and can be made at low cost; in which adjustment or replacement of the valve parts and seat members is convenient and may readily be accomplished without entirely disassembling the valve mechanism; in which the valve is capable of very minute adjustment so that its amplifying or magnifying ability may be increased to a maximum, making it extremely sensitive; in which an improved arrangement of springs is employed for opposing the controlling pressure; in which the pressure bar or head actuated on the one hand by the movable abutment and on the other hand by the pressure of said springs is self-accommodating to its operating parts and is so arranged as to actuate the valve stem without lateral strains upon it; in which the valve stem and its operating head are readily separable for convenience in removal, replacements or adjustments; and which valve mechanism is provided with safety means capable of automatically controlling the mechanism in case of excessive or unusual rise in pressure to a dangerous extent, all as is more fully described hereinafter.

Other objects of the invention are in part obvious and in part will appear more in detail hereinafter.

In the drawing Fig. 1 represents an elevation, partly in section, on the line 1—1, Fig. 2, of one embodiment of relay valve mechanism constructed according to the invention; Fig. 2 is a side elevation thereof, and also showing the emergency or safety control means broken out and in section to expose interior parts; Fig. 3 is a detail sectional plan view on the line 3—3, Fig. 1; Fig. 4 is an elevation, somewhat diagrammatic, showing a complete system employing the invention; and Fig. 5 is a detail view of part of the mechanism shown in Fig. 1, and illustrating a modification.

The invention is capable of many different uses and of application for various purposes. As in the patent to J. M. Smith, No. 1,561,365, granted November 10, 1925, for Pressure regulator, it may be used as a relay subject to boiler pressure for controlling any one of the various instrumentalities or devices which are capable of adjustment or regulation to vary their effects upon boiler pressure, such as automatic stoker mechanism, the engine for which may be speeded up or slowed down to vary the rate of feed of fuel to the fire, blower mechanism for producing forced draft, which likewise may have the speed of its driving engine varied to increase or diminish the draft, or damper mechanism in the smoke pipe or the inlet pipe for the forced draft, which can limit in varying amounts the flow of air through the furnace. Likewise, it may be used in other places, where the pressure of a fluid, either liquid or gas, in a container, may be varied by any instrumentality, and the latter is thereby controlled by this relay valve mechanism subject to the pressure of the container to be controlled.

The container may be of any character, such as a boiler of any form, as in the said Smith patent, or a tank or drum, such as a receiver for condensate or, in other words, a drainage collector for the liquid of condensation in steam systems and the like, or may be a conduit or pipe containing or conducting steam or other fluid. The drawing, for simplicity of illustration, shows this latter arrangement and the control system is arranged to control the pressure delivered by a conduit through a reducing valve.

Referring to Fig. 4, 1 indicates a conduit for supplying fluid under pressure, such as steam, to a reducing valve 2 from which it is delivered to the low pressure conduit 3, which in this instance may be said to be the container, the pressure in which is to be controlled. The reducing valve 2 may be of any suitable form and is conventionally illustrated as a balanced valve with its stem 4 actuated by the differential opposing effects of the usual compression spring 5 and a movable abutment 6, shown as a piston, actuated by fluid pressure, as will appear. Increase in said pressure tends to move the valve toward closed position.

The relay valve mechanism, shown in detail in Figs. 1 and 2, includes an intermediate chamber 7 communicating by a pipe 8 with the reducing valve operating cylinder 9,

and supplies the pressure to actuate its movable abutment 6. The position of the reducing valve 2 therefore depends upon the pressure in said intermediate chamber.

Said chamber is located within a valve body member 10 between upper and lower valve seat members 11, 12, having tapered seats cooperating with tapered upper and lower valve portions on a valve member 13 carried by a stem 14 passing out through a packing 15. On opposite sides of member 13 the stem is provided with fluid supply passages 16 which at their inner ends may have reduced graduating portions 17. As the valve member rises in Fig. 1 it seats on seat 11 and when it lowers it seats upon seat 12.

Below the lower seat the steam enters an exhaust cavity or chamber 18 open to atmosphere or to a low pressure line or container by a passage 19, as will later appear. Above the upper seat the valve stem passes through a pressure supply cavity or chamber 20 communicating by a pipe 21 with a suitable source of motive pressure. This motive pressure may come from any source, such as a separate or distinct source of air pressure, water pressure, or any fluid pressure. For convenience the motive pressure employed may come from the system which includes the container whose pressure is to be controlled, and in the arrangement shown in Fig. 4 the pipe 21 communicates by way of hand valve 22 with the high pressure main 1 supplying pressure to the reducing valve 2. It may be connected to the low pressure side of the valve 2, if the pressure in line 3 is high enough for motive purposes.

Valve stem 14 is provided with a head 23 subject in one direction to the pressure of two springs 24 effective upon a cross-bar 25, and in the opposite direction to the pressure of a movable abutment, such as a diaphragm 26 sensitive to or actuated by the pressure in a chamber 27 communicating by a pipe 28 with the container whose pressure is to be controlled, which in the instance shown is the low pressure conduit 3.

It is obvious that if valve 13 is in its extreme lower position against the lower seat 12 communication with the exhaust passage 19 is cut off and full pressure from the motive pressure line 21 flows to and is effective in the intermediate chamber 7. Consequently, the piston 6 is moved over against its spring 5 to fully close the valve 2 or at least to move it toward its closed position to the maximum amount. On the other hand, if valve 13 is in its extreme upper position against the upper seat 11 the supply of motive pressure to the intermediate chamber 7 is fully cut off and said chamber is fully open to exhaust. Therefore, the pressure of the intermediate chamber is zero and the piston 6 is moved over to the left in Fig. 4, moving the valve 2 to its maximum open position. In the various intermediate positions of the valve 13 the pressure in the chamber 7 will vary from zero to the maximum, the particular pressure at any valve position being a function of the relation between the areas of the valve openings from chamber 7 to the upper and lower chambers 20, 18. This extreme range of pressure from zero to the maximum is obtained by a full movement of the valve 13 obtained by similar movement of the abutment 26. The movement of abutment 26 in turn is dependent upon the adjustment of springs 24, which may be adjusted by the nuts 29 to load the abutment against the pressure in chamber 27, so that any desired variation of pressure in the container 3 may produce complete travel of valve 13. In other words, the springs 24 may be adjusted so that five, ten, twenty, or one hundred pounds, or any value of pressure variation in container 3, will produce complete travel of valve 13 from its upper to its lower seat, and vice versa. Consequently the mechanism supplies a relay valve mechanism which according to its adjustment more or less amplifies pressure variations in the container 3 into maximum variations in chamber 7 between zero and the total pressure of the motive supply, with the obvious advantage of always supplying sufficient pressure to produce positive actuation of the valve 2 or any other device controlled by this system.

Means is provided for conveniently adjusting the valve mechanism and particularly for adjusting the upper and lower seat members relatively to each other, because, obviously, the distance between the valve seats is equal to the amount of movement of valve 13 and the less said distance the more sensitive does the relay valve mechanism become. For this purpose and also to enable the seats to be readily replaced, the lower seat 12 is a separate part threaded into a cylindrical head 30 on a stem 31 slidable longitudinally through a packing 32. Said stem has its exposed end threaded to receive the check and adjusting nuts 33, 34 located above and below a cross bar 35 secured by the nuts 36 to the same threaded rods 37 which support the main body 10 and its securing and adjusting nuts 10a and upon which the spring adjusting nuts 29 are mounted. Said rods at their upper ends have smooth or unthreaded portions forming guides for spring pilots 38 on the cross bar 25 and are threaded into bosses upon a ring 39 serving to clamp the diaphragm 26 against its casing head 40. This arrangement of the parallel rods and cross heads is a very convenient feature, enabling the entire valve mechanism to be readily constructed and assembled at low cost. By adjusting the nuts 33 and 34 the hollow stem 31 may be slid up or down to adjust the lower valve seat, for the purpose before described. The valve body 10 is also adjustable along rods 37 when necessary or desirable.

The upper valve seat 11 is likewise a separate part threaded into a plug 41 carrying the packing 15 and threaded home to a seat in an opening in the body 10.

Relative adjustment between the two seats obviously may be accomplished by means external to the valve chambers and without disassembling or disturbing any of the valve mechanism. The adjustment takes place at the relay valve mechanism and by attaching suitable gauges A, B, to the container line 28 and intermediate chamber line 8 at some place adjacent to the relay valve mechanism, as shown in Fig. 4, the effects of the adjustment upon the system may be readily observed, even though valve 2 and container 3 are located a considerable distance away, or in some inaccessible place.

The use of two springs 24 is desirable not only for convenience in their mounting and assembly, but also said springs may be shorter and smaller than when a single spring is used; and the springs are taken away from their usual position around the valve stem, so that the latter may be readily manipulated or even taken out for replacement or repair.

The valve stem head 23 has its upper surface convex or spherical, as at 42, while its lower end is also curved spherically or approximately so at 43, where it rests upon the cross-bar 25. This enables said head to more or less accommodate itself to adjustments of the parts so that motive force applied to the valve stem is in the direction of its axis and not askew. Moreover, the valve stem 14 is provided with a convenient detachable connection to the head 23. As shown, it has its upper end convexly curved at 44 to fit a correspondingly curved seat in the lower end of the head, and is provided with an annular groove 45 to receive a horseshoe washer or collar 46, pushed in from one side, as shown in Fig 3, said washer forming an abutment for the union nut 46*a*. To disconnect the parts the union nut is backed off and the washer 46 is slipped out at one side, whereupon the plug 41 may be backed out and the valve stem and other parts removed.

The hand valve 22 may be placed at any suitable or convenient location in the motive fluid line 21. By closing it the supply of motive pressure is cut off and the pressure in the intermediate chamber and pipe 8 drops to zero, so that the spring 5 moves the valve 2 fully over to open position. This hand valve is useful where for any purpose a full supply of pressure to the line 3 is desirable and the controlling effect of the relay valve mechanism is unnecessary or undesirable.

The upper half of the valve 13 and the corresponding upper valve seat are sometimes unnecessary and may be omitted. In Fig. 5 the intermediate chamber 7 communicates directly with the motive fluid supply pipe 21, but the line of communication from the motive pressure source to the piston chamber 9 somewhere contains a restriction, such as the restricted port 48, limiting the possible rate of pressure flow to the chamber 9 to a small value. With this arrangement downward movement of the stem 14 seats the valve 13 against the lower seat, permitting pressure to more or less build up in the piston chamber 9 and move over the piston 6 to close the valve 2. As the valve 13 rises the outlet to exhaust is more or less opened, which reduces the pressure in the supply line to the chamber 9. If the exhaust opening is larger than the restricted port 48, it is obvious that the pressure in the chamber 9 may reduce to zero, permitting the spring 5 to move the valve 2 over to open position.

Emergency control means may also be provided. In the arrangement shown in Fig. 2, the exhaust passage 19 communicates by way of an upwardly seating valve 50 with a chamber 51 open to exhaust through a pipe 52 which may be supplied with a hand valve 53, Fig. 4. The valve 50 is opened by a spring 54 and is seated by the effect of a movable abutment 55 subject to the pressure in a chamber 56 which may communicate by a pipe 57 with the container 3, such as by way of the pipe 28 in Fig. 4. Closing of the exhaust passage 19 in any manner permits the pressure in the chamber 7, either in Fig. 1 or in Fig. 5, to build up to a maximum and move the valve 2 over to its extreme closed position. This outlet passage of course may be closed by the hand valve 53, which has the effect of manually reducing the pressure in the container 3 to the minimum. However, the automatic control of valve 50 by the movable abutment 55 subjects the exhaust passage automatically to the effect of variations in pressure in the container. Therefore, if the relay valve mechanism, including valve member 13 and its related parts, refuses to work for any reason, such as because of an obstruction or sticking of the parts, and therefore fails to reduce the pressure in the container upon an abnormal rise, then the emergency valve mechanism promptly closes the valve 50 and compels movement of the reducing valve 2 toward closed position. Other arrangements are also suitable for the purpose.

What I claim is:

1. Valve mechanism of the class described, comprising a valve body having a chamber adapted for connection to a device for controlling a factor which tends to vary, a duplex valve member in said chamber controlled in accordance with variations in said factor, two opposed valve seats therefor, means for supplying fluid pressure to said chamber, said valve member by its relation to said seats controlling the fluid pressure in said chamber, and means for adjusting each of said valve seats with relation to the valve member, for the purpose described.

2. Valve mechanism of the character described in claim 1, in which the adjusting means for each valve seat extends and is operatable externally of the valve without disturbing the fluid pressure connections thereto.

3. Valve mechanism of the class described, comprising a valve body provided with a chamber, a duplex valve member operatable in said chamber, opposed valve seat members cooperating with said valve member, and a supporting device for each valve seat member mounted for movement in the valve body and having an operating member external thereto.

4. Valve mechanism of the class described, comprising a valve body provided with a chamber, a duplex valve member operatable in said chamber, opposed valve seat members cooperating with said valve member, and a supporting device for each valve seat member mounted for movement in the valve body and having an operating member external thereto, said valve member having an operating stem extending through one of said supporting devices.

5. Valve mechanism of the class described, comprising parallel supporting rods, a valve body attached to and connecting said rods, a valve in said body having a stem parallel to said rods and lying between them, and a fluid pressure actuator for said valve connecting said rods and having a movable abutment opposite the end of the valve stem for actuation thereof.

6. Valve mechanism of the character described in claim 5, including a cross bar extending from rod to rod and engaging the valve stem, and springs, one coiled around each rod, for actuating said cross bar to oppose the effect of the fluid pressure actuator.

7. Valve mechanism of the character described in claim 5 in which the valve body is provided with an internal seat for said valve, and includes means adjustable along said rods for varying the relation of said valve and its seat.

8. Valve mechanism of the character described in claim 5, in which the valve stem is provided with a detachable head having a convex surface engaged by the fluid pressure actuator.

9. Valve mechanism of the character described in claim 5, in which the valve stem includes a separate head, a horseshoe washer forming a shoulder, and a union nut engaging said shoulder and threaded to the head for securing the latter to the stem.

10. Valve mechanism of the character described in claim 5, in which the valve stem includes a separate head abutting the stem by a curved surface, said head having a curved surface abutting the actuator, and a cross bar connecting said rods and having a curved surface engaging said head, the pressure springs engaging said cross bar, whereby said head is self-accommodating to the forces effective upon it.

11. Valve mechanism of the class described, comprising a valve body having a control chamber adapted for connection to a pressure controlling passage, a valve member in said chamber whose movement is controlled by variations in pressure, means for supplying fluid pressure to said chamber, an exhaust passage for said chamber controlled by said valve, and means independent of said valve for closing said exhaust passage.

12. Valve mechanism of the character described in claim 11, in which said last named means is sensitive to and is automatically actuated by variations in the pressure controlling the movement of said valve member.

13. Valve mechanism of the class described, comprising a valve body having a chamber having two outlets, a valve seat member at one of said outlets, a valve cooperating with said seat, a movable abutment subject to variations in pressure and to an opposed yielding means for positioning said valve relative to its seat to vary the distribution of pressure between said outlets, and means operatable from outside the valve body for adjusting the seat member relative to the valve, to thereby vary the pressure necessary to seat the valve.

14. Valve mechanism of the class described, comprising a valve body having a chamber adapted for connection to supply pressure to a device for controlling a factor which tends to vary and also having a separate outlet, a valve member in said chamber controlled in accordance with variations in said factor, a valve seat at the mouth of the outlet from said chamber, means for supplying fluid pressure to said chamber, said valve member by its relation to its seat controlling the distribution of fluid pressure from said chamber to either or both of said device and outlet, and means for adjusting said valve seat with relation to the valve member, for the purpose described.

15. Valve mechanism of the class described, comprising a valve body having a chamber adapted for connection to supply pressure to a device for controlling a factor which tends to vary and also having an inlet and a separate outlet, a duplex valve member in said chamber controlled in accordance with variations in said factor, two opposed valve seats therefor, one at the supply inlet to said chamber and the other at said separate outlet therefrom, means for supplying fluid pressure to the inlet to said chamber, said valve member by its relation to said seats controlling the distribution of fluid pressure from said chamber to either or both of said device and outlet, and means for adjusting at least one of said valve seats with relation to the valve member, for the purpose described.

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