May 9, 1944. S. HEDGECOCK 2,348,383

MEANS FOR CONTROLLING MOVEMENTS OF VALVES OR OTHER ELEMENTS

Filed Oct. 9, 1941

FIG. 1.

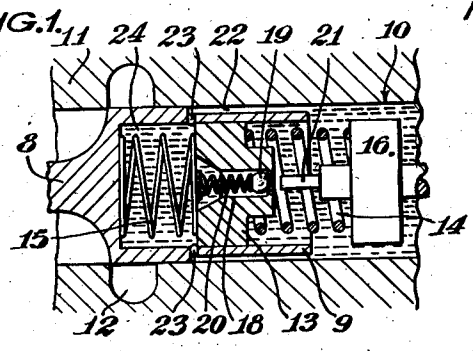


FIG. 6.

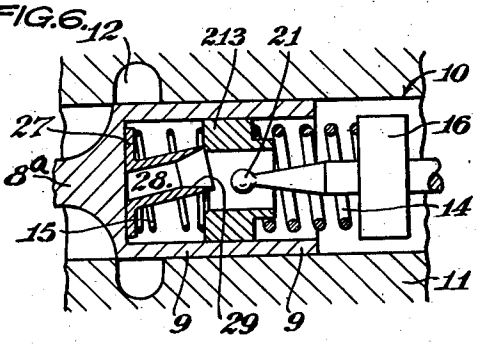


FIG. 2.

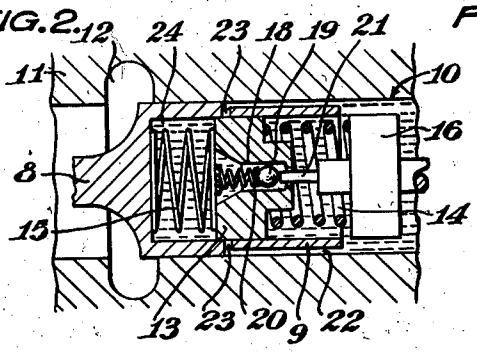


FIG. 7.

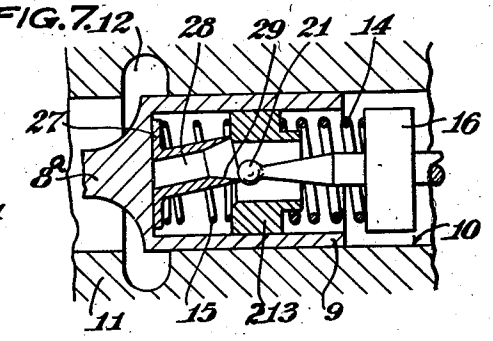


FIG. 3.

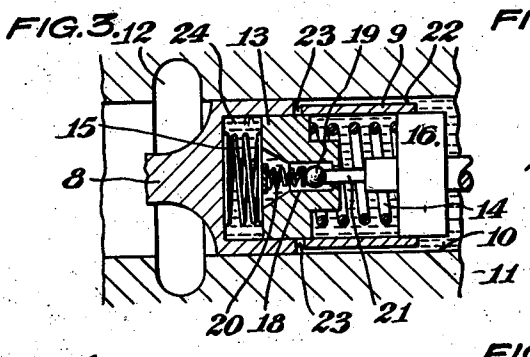


FIG. 8.

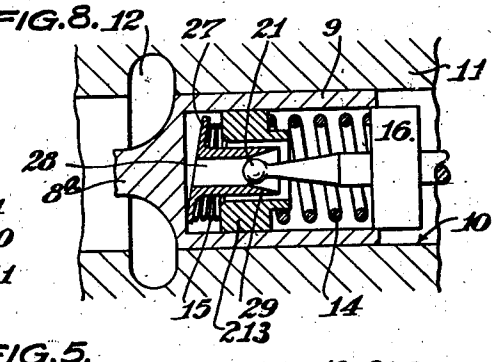


FIG. 4.

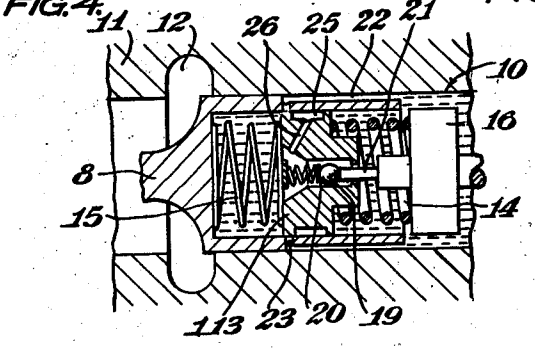
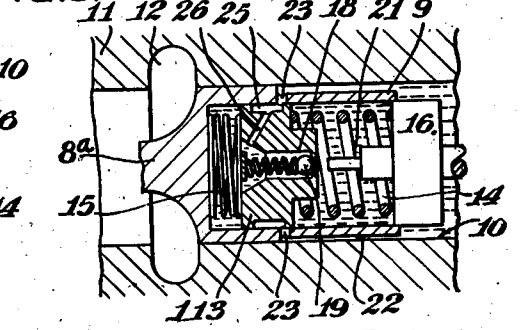


FIG. 5.



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MEANS FOR CONTROLLING MOVEMENTS OF VALVES OR OTHER ELEMENTS

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Application October 9, 1941, Serial No. 414,388
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9 Claims. (Cl. 251—143)

This invention relates to the control of sliding valves and other elements which are actuated by a force acting in opposition to loading means provided for the valve or the like, the loading means being of a nature such that a progressively increasing effort has to be applied by the actuating means as the valve or the like is further displaced. Such a loading may comprise a spring means or a fluid buffer, the invention being principally concerned however with spring loading arrangements; the actuating means may be any force such as, in the case of a valve, effort mechanically applied from a centrifugal governor or fluid pressure or suction.

Although it is necessary for the loading means to impose a resistance such that a predetermined actuating effort has to be applied in order to effect initial movement of the valve or the like, it is sometimes an objection that the actuating effort has to be progressively increased in correspondence with further movement.

The present invention has in view to overcome the above objection and provides a loading means of a nature such that after having obtained a predetermined extent of movement of the actuated member by applying a sufficient actuating force, the actuated member can be further moved without having to increase the applied effort at the original rate, or (depending upon the design adapted) can be maintained in the position then assumed or be further operated by the application of decreased effort, as distinct from a lower rate of increase.

The invention provides a method of controlling a sliding valve or other actuated member, which consists in loading same by a primary loading means, and by a weaker secondary loading means, providing a means for resisting the deflection of said secondary loading means whilst the primary loading means is overcome during a predetermined extent of movement of the valve or the like, and then automatically releasing the said resisting means associated with the secondary loading means thereby to allow said secondary loading means to be overcome either in allowing the primary spring to exert itself and/or in permitting the actuated member to have further movement without increasing the loading of the primary loading means.

The invention is primarily concerned with an apparatus in which the primary and secondary loading means consist of springs, but nevertheless is applicable to arrangements wherein one or each of the primary and secondary loading means is some other force (e. g. pneumatic or hydraulic) of such a nature that a progressively increasing effort needs to be applied to overcome same. In the preferred case where spring means is employed a convenient arrangement is to provide primary and secondary compression springs acting on opposite sides of a floating member. In this case the resisting means associated with the secondary spring is of such a form that said floating member is prevented from having substantial movement with respect to the actuated member until the primary spring has been compressed to a predetermined extent, the said primary spring bearing against any suitable stationary member. The actuated member may incorporate a sleeve-like portion in which the floating member is freely mounted, said sleeve-like portion being adapted to house the primary and secondary springs. The resisting means associated with the secondary spring may consist of a fluid chamber in which fluid is trapped until released when the said secondary spring is to come into action, or any suitable mechanical device may be provided for spacing the floating member from the actuated member to prevent compression of said secondary spring until same is required to come into action, any suitable mechanical means being provided for displacing said spacing device.

In order that the invention may be readily understood reference is directed to the accompanying drawing, wherein:

Figures 1, 2 and 3, are sectional views of a control device according to one embodiment of the invention and showing the component parts in the different relative positions taken up during operation,

Figures 4 and 5 are similar views of a modification, and

Figures 6, 7 and 8 are sectional views of a control device constructed according to another embodiment of the invention.

In each of the embodiments illustrated, the stem 8 of a valve or other actuated member is provided with a cylindrical sleeve-like extension 9 adapted to slide in the bore 10 of a body 11. If the actuated member is a valve, said extension 9 may be adapted to control the opening of ports 12. In the said sleeve 9 there is freely mounted a floating bush 13 which divides the extension into primary and secondary chambers. On the opposite sides of said bush bear a primary compression spring 14 and a weaker secondary spring 15, the distant end of the primary spring bearing against a stationary base member 16 which has a loose fit in the sleeve 9 whilst

the distant end of the secondary spring bears against the bottom of the extension 9 of the actuating member 8 both springs resisting motion of the valve or other actuated member.

Referring now to Figs. 1 to 5, inclusive, floating bush 13 is a fluid-tight sliding fit in the sleeve 9 to constitute a piston, and is formed with a central bore 18 at one end of which is a ball valve 19 urged on to a seating by a spring 20. The stationary base member 16 is provided with a projecting pin 21 adapted, when the bush 13 reaches a predetermined position with respect to the said base member 16, to contact with and open the ball valve 19 as later explained. The sleeve 9 is peripherally recessed from its end to form a channel 22 between said sleeve 9 and the body 11, and orifices 23 formed through the wall of the sleeve 9 establish communication between the channel 22 and the chamber 24 behind the bush 13 when the actuated member 8 is in its normal position, that is to say, the position in which the said member 8 is closing the ports 12 (Fig. 1). The entire space contained within the bore 10 and within the extension 9 of member 8 and which comprises the chamber 24, the chamber enclosing spring 14, the central bore 18, the channel 22 and the orifices 23, is completely filled with oil or other liquid.

Dealing now with the operation of the device, and assuming that the actuated member 8 is being opened from a normal position which is such that the said member 8 is closing the ports 12 (Fig. 1), the orifices 23 allow escape of liquid from the chamber 24 during the first fraction of movement of the actuated member, the secondary spring 15 becoming very slightly compressed. The floating bush 13 now substantially closes the orifices 23 and owing to liquid escape from chamber 24 being now prevented, the said chamber constitutes a buffer between the said floating bush and the actuating member causing the latter to move said bush substantially in unison with itself. Thus, during further movement of the member 8, the primary spring 14 will be compressed, whereas the buffer prevents the weaker secondary spring 15 being overcome. Loading of the primary spring continues until the actuated member 8 reaches such a position that the fixed pin 21 contacts with the ball valve 19; further movement beyond this point results in the pin depressing and opening the ball valve (Figure 2), with consequential escape of liquid from the chamber 24. In consequence the floating bush 13 hovers in the proximity of the said position and the primary spring 14 remains loaded to the same extent, the secondary spring 15 becoming deflected during the continued movement of the actuated member.

From the above description it will follow that the actuating force necessary to move the actuated member from the position shown in Figure 2 to the limit of its movement (Fig. 3) is the force necessary to maintain the loading of the primary spring 14 plus the effort necessary to overcome the weaker secondary spring 15. Thus the continued movement is obtained without having to increase the actuating effort at the original rate.

During return of the member 8 effected by the loaded springs 14 and 15, automatic depression of the ball valve 19 results in the replacement of liquid in chamber 24.

In the modified construction shown in Figures 4 and 5 there is provision for allowing the primary spring to expand after having been compressed to a predetermined extent. This construction accords with the above description of Figures 1, 2 and 3, but it will be seen that the floating bush or piston 113 is formed with a peripheral recess 25 which communicates with the bore 18 through said bush by means of a duct 26. The said recess 25 is adapted to co-act with the liquid escape orifices 23 in the following manner.

When the primary spring 14 has been compressed to a predetermined extent, such that the pin 21 contacts with the ball valve 19 as above explained, a very slight further movement of the actuated member 8 (the extent of which will depend on the position of the recess 25) will result in the orifices 23 coming into register with the recess 25. This provides escape from the buffer chamber 24 such as will allow the floating bush 113 to travel backwards with consequent expansion of the primary spring and loading of the secondary spring instead. Owing to such expansion of the primary spring the actuated member is maintained in its eventual position by a pressure lower than that which was required to operate same.

In the apparatus shown in Figures 6, 7 and 8 a mechanical spacing element is provided instead of a liquid buffer for resisting the deflection of the secondary spring. Accordingly in this case there is no need for the components to be immersed in oil. The said spacing element in the example shown consists of a disc 27 from which extends an inclined tube 28, the passage within said tube having a cam face 29 at the end of the tube.

When the actuated member 8*a* is in normal position Fig. 6, i. e. when the actuated member is closing the ports 12, the secondary spring 15 by bearing on the disc 27 brings same into a position in which the tube 28 is out of alignment with the bore 18 in the floating bush 213. Consequently, when the member 8*a* commences to move, the tube 28 abuts the bush 213 and functions as a spacing element to compel the bush to move as a unit with the said member 8*a*. Thus the primary spring 14 is compressed but deflection of the secondary spring is prevented during a predetermined extent of movement of member 8*a*. The pin 21 is so positioned that at the required moment it will engage the cam face 29 of the tube 28 (Fig. 7), the cam face being so shaped that further movement of member 8*a* will result in the tube 28 being laterally displaced and coming into alignment with the bore 18 in the bush, whereby said tube enters and slides into the said bore 18 (Fig. 8). Owing to the tube 28 no longer serving as a spacing element, the primary spring 14 is able to exert itself in displacing the floating bush 213, and consequently a reduced applied force will serve to maintain the actuated member 8*a* in the position now reached or will serve for further movement of said member.

I claim:

1. Means for controlling the movement of an actuated member, comprising, a body having a guiding bore, a stationary base in said bore, a tubular extension for said actuated member slidable in said bore, a floating member mounted to move within said extension with respect to said actuated member, and dividing said extension into primary and secondary chambers, primary and secondary loading means respectively located in said chambers and acting in opposite directions on said floating member, both loading means cooperating with said base to resist ac-

tuating effort applied to said actuated member, said primary loading means being of greater strength than the secondary loading means and imposing resistance on the actuated member which progressively increases with increased deflection thereof, resistance means between the actuated member and the floating member for restraining substantial displacement of the floating member relative to the actuated member such as would permit deflection of the secondary loading means while the primary loading means is being deflected during the initial period of movement of the actuated member, and means for releasing said resistance means after a pre-determined degree of deflection of said primary loading means.

2. Means for controlling the movement of an actuated member, according to claim 1, wherein the primary and secondary loading means comprise, compression springs of different strengths acting on opposite sides of the floating member, one of said springs bearing against the actuated member while the other bears against said stationary base.

3. Means for controlling the movement of an actuated member, according to claim 1, wherein the chambers on opposite sides of the floating member are filled with liquid and the resistance means for restraining the deflection of the secondary spring comprises a liquid buffer provided by said liquid in the secondary chamber and the floating member which is provided with a spring seated valve, and means for opening said valve to release the liquid pressure from the secondary chamber when the primary spring has been deflected to a predetermined extent.

4. Means for controlling the movement of an actuated member, according to claim 1, wherein the primary and secondary chambers are filled with liquid and the resistance means comprises a liquid buffer provided by liquid in said secondary chamber and the floating member, normally closed valve means on the floating member, and a pin projecting from said stationary member adapted to unseat said valve as the floating member moves relative to the stationary member, the arrangement being such that during continued movement of the actuated member, the floating member hovers in a position in which the extent of loading of the primary spring is maintained substantially constant.

5. Means for controlling the movement of a sliding valve with respect to a radially disposed valve orifice, comprising, a body having a guiding bore, a stationary base in the bore, a tubular extension for said sliding valve slidable in said bore, said tubular extension being formed with two external surfaces of different diameter, one of said surfaces closely fitting the bore and the other being spaced therefrom, the space defined by the guiding bore, extension, and said base being filled with liquid, port means in the wall of the tubular member at the junction of said external surfaces of different diameter, a floating bushing slidable within the tubular extension and having a central passage, a primary spring confined between the stationary base and one side of the floating member, a secondary spring of weaker strength than the primary spring confined between the floating member and the actuated member, a normally closed spring pressed valve within the central passage of the floating member, a pin extending from the stationary base in the path of movement of said valve on the floating member and adapted to unseat said valve to release pressure of liquid trapped in the resistance chamber which houses a secondary spring.

6. Means for controlling the movement of a sliding valve with respect to a radially disposed valve orifice, comprising, a body having a guiding bore, a tubular extension for said sliding valve slidable in said bore, said extension having a portion of its exterior in close sliding relation to the bore and also having its remaining portion of less diameter than the bore and provided with lateral ports at the junction of said latter portion with said first mentioned portion, a floating member having a central passage and also having a peripheral recess connected by an oblique duct with the central passage, a stationary base within the bore, the space defined by the guiding bore, extension, and said base being filled with liquid, a primary spring confined between the stationary base and one side of the floating member, a secondary spring of less strength than the primary spring confined between the other side of the floating member and said sliding valve, a spring pressed valve normally closing the central passage of the floating member, and a pin projecting from said stationary member and adapted to engage and unseat said valve when the primary spring is deflected sufficiently by the floating member to bring the valve of said floating member into engagement with the pin, thereby releasing liquid trapped at the side of the floating member at which the secondary spring is located.

7. Means for controlling the movement of an actuated member, according to claim 1, wherein the resistance means for restraining deflection of the secondary spring comprises, a mechanical spacing element normally located in the secondary chamber and held between the actuated member and the floating member, and means for mechanically displacing said spacing element relative to the floating member when the primary spring has been deflected to a predetermined extent.

8. Means for controlling the movement of an actuated member, according to claim 1, wherein the floating member has a central passage and moves substantially in unison with the actuated member during deflection of the primary spring and the said resistance means is in the form of a mechanical spacing element located in the secondary chamber, said element consisting of a base flange and a tubular portion whose axis is oblique to the axis of the flange, the mouth of said tubular portion being internally tapered to provide a cam face, the flange of said spacing element normally engaging the actuated member and the opposite end having the cam face normally engaging the floating member to resist deflection of the secondary spring, and a pin projecting from said stationary member and passing through the central passage of the floating member to engage the cam face of the spacing element and rock said element so that the said tubular portion can move into the said central passage of the floating member.

9. Means for controlling the movement of a sliding valve with respect to a valve orifice, comprising, a body having a guiding bore, a tubular extension for said member slidable in said bore, a stationary base in the bore at a point beyond the limit of movement of the sleeve therein, a floating member having a central passage and slidable within the tubular extension, a primary spring confined between the stationary base and one side of the floating member, a secondary

spring weaker than the primary spring located at the other side of the floating member, a spacing element including a base flange and a tubular sleeve whose axis is oblique to the axis of the flange and having an internal cam face, said flange having one face abutting the sliding valve and the other face forming a bearing for the base of the secondary spring, and said spacing element, when the sliding valve is in closing relation to its orifice, rigidly spacing the floating member from the sliding valve whereby upon initial movement of the sliding valve, the spacing element will initially move the floating member to compress the primary spring while the secondary spring remains incompressed, and means on the stationary base for engaging the cam surface of the sleeve of the resistance member to rock the same on its base flange and cause said sleeve to disengage the floating member and telescope within the central passage thereof, whereby, continued movement of the sliding valve and the primary spring will tend to collapse the secondary spring.

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