Dec. 3, 1929. A. PENN 1,738,481

CLOSE RANGE DEVICE

Filed Nov. 25, 1925

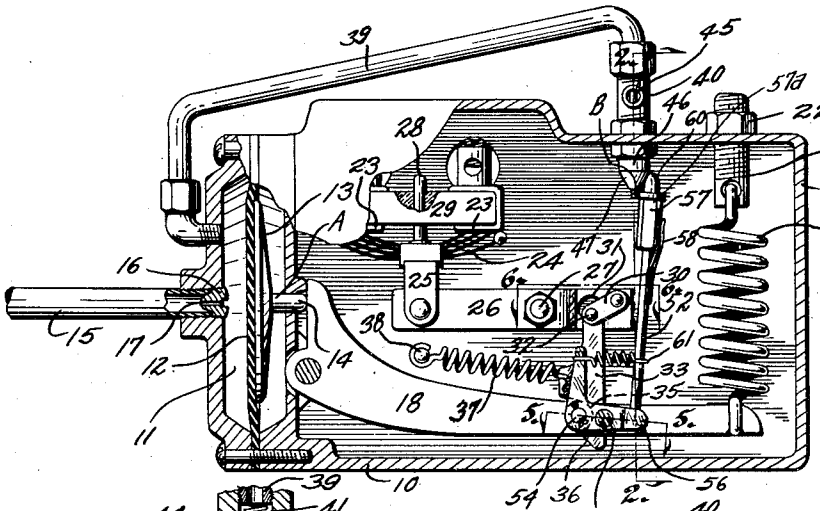


Fig. 1.

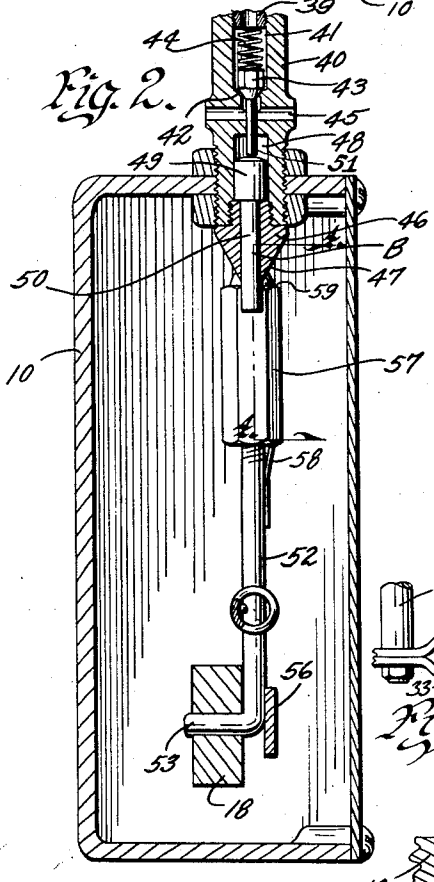


Fig. 2.

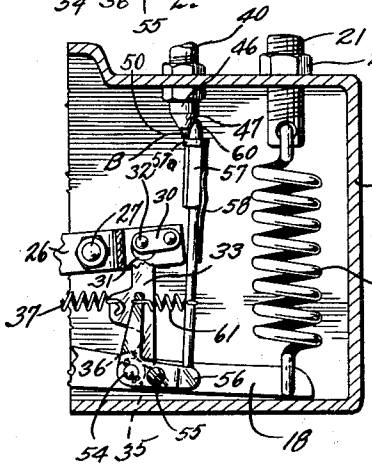


Fig. 3.

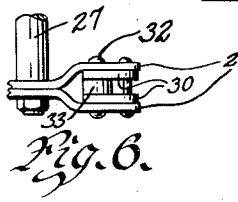


Fig. 6.

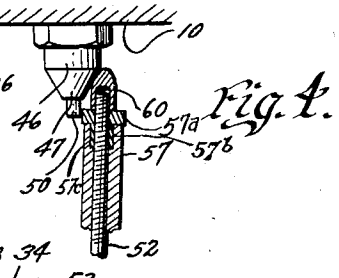


Fig. 4.

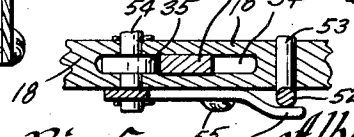


Fig. 5.

Witness

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UNITED STATES PATENT OFFICE

ALBERT PENN, OF DES MOINES, IOWA, ASSIGNOR TO PENN ELECTRIC SWITCH CO., OF DES MOINES, IOWA, A CORPORATION OF IOWA

CLOSE-RANGE DEVICE

Application filed November 25, 1925. Serial No. 71,500.

The object of my invention is to provide a close range device for actuating a mechanical element such for instance as a switch.

I have illustrated my invention as applied to an electric switch, but it might be applied to other uses.

It is particularly the purpose of my invention to provide a close range device of the type in which is employed a diaphragm subject to pressure and actuating a lever and to provide means whereby the movement of the lever serves to relieve the pressure on the diaphragm as for instance by opening a valve.

It is especially my purpose to provide such a device having parts so constructed and arranged as to provide an adjustable and close range between the minimum and maximum pressures at which the device is operative.

With these and other objects in view, my invention consists in the construction, arrangement and combination of the various parts of my close range device, whereby the objects contemplated are attained, as hereinafter more fully set forth, pointed out in my claims, and illustrated in the accompanying drawings, in which:

Figure 1 shows a detail, sectional view of a close range device embodying and illustrating my invention.

Figure 2 is a detail, sectional view taken on the line 2—2 of Figure 1.

Figure 3 is a sectional view illustrating in detail part of the close range device structure.

Figure 4 is an enlarged, detail view of part of the mechanism shown in Figure 3.

Figure 5 is a detail, sectional view taken on the line 5—5 of Figure 1; and

Figure 6 is a detail, sectional view taken on the line 6—6 of Figure 1.

In the accompanying drawings, I have shown my device supported largely in a casing indicated generally by the reference character 10.

The casing has at one end a diaphragm chamber 11 in which is mounted a diaphragm 12 having a head 13 from which a pin 14 projects through an opening in the wall of the diaphragm chamber.

A pipe 15 communicates with the diaphragm chamber on the opposite side of the diaphragm from the head 13.

A choker 16 is provided, which may comprise a plug having a reduced opening 17 for restricting the flow of fluid into the diaphragm chamber from the pipe 15.

The pipe 15 may be connected with any source of pressure.

Pivotally mounted in the casing 10 is a lever 18, having one arm arranged adjacent to the pin 14 and arranged to coact therewith. Connected with the other arm of the lever 18 is a coil spring 20, which is connected with a screw bolt 21 projecting through the top wall of the casing 10 and provided with an adjusting nut 22.

In the application of my invention as here shown, the diaphragm 12 is subject to pressure from the pipe 15 on one side and to pressure from the spring 20 on the other side.

I have shown in the present device a switch structure comprising the fixed contact members 23 and the movable spring contact members 24 supported from the insulating block or the like 25.

The block 25 is pivoted to another lever 26. The lever 26 is pivoted on the casing as at 27 and projects in both directions from its pivot. A guide pin 28 extends from the block 25 through the insulation block 29, to keep the movable and stationary contact elements in proper relative positions.

Pivotally secured to forked arms of the lever 26 on the opposite side of the pivot 27 from the block 25 are links 30. The arms of the lever 26 have therein registering holes 31. A pin 32 of much smaller diameter than

the holes 31 extends through the links 30 and the holes 31 and is pivoted to another arm 33.

The lever 18 has a slot 34 through which the lower part of the arm 33 extends. Mounted in the slot 34 is a roller 35.

The arm 33 is provided with a V-shaped point 36 illustrated in dotted lines in Figure 3 adapted to coact with the roller 35.

A spring 37 connected with the arm 33 and post 38 on the casing wall tends to hold the V-shaped portion 36 of the arm 33 in engagement with the roller 35.

The operation of the switch structure above described may be briefly set forth as follows: As the pressure in the pipe 15 and in the diaphragm chamber increases, the diaphragm 12 is flexed to the right for actuating the lever 18 for moving its right-hand end downwardly past the point 36.

The spring 37 tends to move the arm 33 upwardly due to the arrangement and positions of the links 30 and the angle of pull of the spring 37. The action of the links 30 is as in the Patent No. 1,520,258, issued December 23, 1924 to Ralph Penn and Albert Penn.

When tripping position is reached, the action of the arm 33 in conjunction with the links 30 rocks the lever 26 on its pivot 27 with a snap action for moving the contacts 24 away from the contacts 23.

When the pressure in the pipe 15 is reduced the spring 20 raises the right-hand end of the lever 18 until the roller 35 again clears the point 36 whereupon the tension of the spring 37 will cause the upper, inclined face of the point 36 to travel downwardly adjacent to the roller 35 for closing the switch.

The natural differential of pressure between the high and low at which the device as heretofore described operate, or in other words, the range of the device is too great for certain purposes. It is therefore the purpose of the structure now to be described to cooperate with the quick action mechanism already set forth, to reduce this differential or range and to make it adjustable.

A pipe 39 communicates with the diphragm chamber 11 on the side thereof subject to pressure from the pipe 15. The pipe 39 connects with a valve casing 40 in which is a passage 41 provided with a valve seat 42.

A valve 43 is arranged to coact with the valve seat 42 and is normally held closed by a spring 44 and fluid pressure.

The passage 41 connects with an outlet passage 45 beyond the seat 42.

The valve casing in the form of the invention here shown is mounted in the top of the casing 10.

Mounted in the lower end of the valve casing is a plug 46 having a tapered lower end 47. The lower part of the valve casing has a recess 48 receiving the head 49 of a plunger 50, which projects downwardly through the plug 46 and projects below it, as shown in Figure 2.

For practical purposes, the plunger 49 and stem 50 form an extension of the valve stem 51, which slidably projects into the recess 48.

By pressing the stem 50 upwardly, the valve 43 is unseated.

A rod 52 has at its lower end a right-angled extension 53 mounted in the lever 18 as shown in Figure 2.

Fixed to the lever 18 by being mounted on the spindle 54 of the roller 35 and also by means of a screw 55 is an angle 56, one end of which overlies the lower end of the rod 52 for holding the extension 53 against accidental removal.

Screwed onto the upper end of the rod 52 is a sleeve 57, which is thus adjustable on the rod.

The sleeve 57 has flat sides and is held against accidental rotation by a spring clip 58. A hardened collar 57^a has an extension 57^b pressed into a recess 57^c in the upper end of the sleeve 57. On the upper end of the rod 52 is a steel nose 60. The collar 57^a stands adjacent to the stem 50.

When the right-hand end of the lever 18 is in its lowermost position, the collar 57^a stands just below the stem 50, as shown in Figure 3.

When the pressure on the diaphragm is reduced and the spring 20 moves the lever 18 upwardly, the collar 57^a engages the stem 50 and unseats the valve 43.

It will be noted that in the device here shown, a relatively slow movement of the diaphragm permits a greater movement of the longer end of the lever 18 for actuating the control mechanism shown here in the form of a trip mechanism and switch contacts.

In a device of this kind where no close range mechanism is employed, it occurs that when the pressure in the receiver 9 is reduced until the spring 20 begins to overcome the action of the fluid pressure on the diaphragm a considerable range of variation is required between the pressure at the commencement of the operation of the spring 20 and the pressure in the receiver at the time when the lever 18 is moved a sufficient distance to actuate the trip mechanism.

Where the close range device is employed, it is apparent that the valve will be opened with very little movement of the lever 18 when the parts are properly adjusted, thereby reducing the actual diaphragm pressure to the point where the lever will be permitted to actuate the trip mechanism for closing the switch without anywhere nearly so great a change in the pressure in the receiver as would have been necessary if the close range device had not been used.

In order that pressure in the diaphragm

chamber may not be maintained by incoming fluid from the pipe 15, the choker 16 is provided so that fluid can not come into the chamber 11 from the pipe 15 as fast as it can escape through the pipe 39 and the valve.

The spring 61 is connected with one arm of the angle 56 and with the rod 52 for yieldingly holding the sleeve 57 in position for coacting with the stem 50.

The plug 46 is provided with a beveled portion 47 and the nose 60 on the rod 52 is beveled in order that when the right-hand end of the lever 18 commences its upward stroke and thus causes the collar 57a to engage the stem 50 to unseat the valve 43, the further upward movement of the rod 52 causes the beveled faces 47 and 60 to engage each other and swing the sleeve 57 and rod 52 to one side against the pressure of the spring 61 until the hardened collar 57a clears the stem 50. Thereupon the valve closes, preventing further escape of fluid from the diaphragm chamber. The valve is thus opened for a very short length of time. The valve is unseated due to the pressure through the pipe 15 whereupon the lever 18 is actuated through the diaphragm 12 and that in turn operates the rod 52.

The closing of this valve is, of course, accomplished by the spring 44 and fluid pressure immediately after the collar 57a clears the stem 50. Thereupon fluid will pass from the pipe 15 and source of supply with which it is connected through the choker 16 into the diaphragm chamber and the diaphragm will again be subjected to the receiver pressure.

If then, for example, the electrical switch shown herein for illustration is used for closing a circuit through a motor for operating a compressor for supplying the receiver with compressed fluid, such as air, the motor will operate until the pressure in the receiver is great enough to cause the switch to trip to open position for stopping the motor and compressor. Then when the pressure in the receiver is reduced, the cycle of operations is repeated.

It will thus be seen that I have here provided a mechanism for operating a movable member, such for instance as the lever 26. This lever in the present illustration operates a switch, but is equally adaptable for mechanically operating a valve or valves or other devices.

In the present device, the lever 18 is actuated in one direction by pressure from the pipe 15 and in the other direction by the spring 20.

When the pressure in the pipe 15 is lowered until it is overcome by the spring 20 enough to bring the actuation of the snap action or quick action mechanism, it will be seen that I have provided means for quickly relieving or reducing the pressure on the diaphragm, so that for a short instant of time, it does not offer substantial resistance to the action of the spring 20.

If it be assumed for purposes of illustration that the natural range of the device were twenty pounds, then by providing the close range device and quickly relieving the diaphragm chamber pressure, it has been found in actual practice that this range can be reduced to about two pounds.

It will be noted that the range under which the device operates may be varied by varying the distance of the rod 52 from the pivot of the lever 18 during manufacture.

It will also be noted that I have provided a ready adjustment for the close range device by making the sleeve 57 adjustable on the rod 52, so that the valve 43 may be opened at different points in the travel of the lever 18, depending upon the adjustment of the sleeve 57.

The advantages of a close range device will be largely obvious from the statement of the operation of the mechanism.

In many instances, it is desirable that the range be close and that the pressure within a receiver be maintained within very close limits.

It is very desirable for example in the control of heating plants that use compressed air to operate steam valves to keep that pressure within a matter of two or three pounds. Therefore it is important that the receiver pressure be kept within very close limits. This desirable result can be accomplished with my close range device.

It will be noted that this close range mechanism operates as herein set forth without in anyway affecting the tension which is imposed upon the contact points for holding them together when the switch is closed.

This is important where the device is used in connection with an electrical switch.

While I have illustrated my close range device as connected with a switch, it will be understood that it can be used for a great variety of purposes as I have illustrated in my co-pending application on a Pneumatic control apparatus, Serial No. 77,483, filed December 24, 1925. For purposes of illustration here, I have shown the device connected with a quick acting switch.

It is, however, my purpose to cover by my claims any modified forms of structure or use of mechanical equivalents, and uses for other purposes, which may come within the spirit of my invention and the scope of said claims.

I claim as my invention:

1. In a device of the class described, a diaphragm chamber, a diaphragm therein, a pipe for supplying pressure to the diaphragm chamber, a lever arranged to be actuated in one direction by the diaphragm, means for actuating the lever in the other direction, a

second pipe communicating with the diaphragm chamber, a valve in said second pipe normally closed to prevent the loss of pressure from the diaphragm chamber, and means operatively connected with the lever for opening said valve during the stroke of the lever in one direction adapted to be moved to inoperative position by the completing portion of such stroke, said second pipe and valve being adapted to permit the discharge of air from the diaphragm chamber faster than the first pipe supplies air thereto.

2. In a device of the class described, a diaphragm chamber, a diaphragm therein, a pipe for supplying pressure to the diaphragm chamber, a lever arranged to be actuated in one direction by the diaphragm, means for actuating the lever in the other direction, a second pipe communicating with the diaphragm chamber, a valve in said second pipe normally closed to prevent loss of pressure from the diaphragm chamber, and means operatively connected with the lever for opening said valve, adapted to become inoperative before the full lever stroke is completed, for then allowing the valve to close for preventing continual loss of air from the diaphragm chamber.

3. In a device of the class described, a diaphragm chamber, a diaphragm therein, a pipe for supplying pressure to the diaphragm chamber, a lever arranged to be actuated in one direction by the diaphragm, means for actuating the lever in the other direction, a second pipe communicating with the diaphragm chamber, a valve in said second pipe normally closed to prevent loss of pressure from the diaphragm chamber, an operative mechanism, means including a roller, a member with bevelled faces and means for holding said member under tension against the roller, for operating said mechanism from the lever, and means operatively connected with the lever for opening said valve, adapted to become inoperative after the roller has moved from one bevelled face to the other for allowing the valve to close for preventing loss of pressure thereafter from the diaphragm chamber.

4. In a device of the class described, a diaphragm chamber, a diaphragm therein, a pipe for supplying pressure to the diaphragm chamber, a lever arranged to be actuated in one direction by the diaphragm, means for actuating the lever in the other direction, a second pipe communicating with the diaphragm chamber, a valve in said second pipe normally closed to prevent the loss of pressure from the diaphragm chamber, an operative mechanism, means including a roller, a member with bevelled faces and means for holding said member under tension against the roller, for operating said mechanism from the lever, and means operatively connected with the lever for opening said valve, adapted to become inoperative after the roller has moved from one bevelled face to the other for allowing the valve to close for preventing loss of pressure thereafter from the diaphragm chamber, said means being adjustable for varying the range of the device.

5. In a device of the class described, a diaphragm chamber, a diaphragm therein, a pipe for supplying pressure to the diaphragm chamber, a lever arranged to be actuated in one direction by the diaphragm, means for actuating the lever in the other direction, a second pipe communicating with the diaphragm chamber, a valve in said second pipe normally closed to prevent the loss of pressure from the diaphragm chamber, an operative mechanism, means including a roller, a member with bevelled faces and means for holding said member under tension against the roller, for operating said mechanism from the lever, and means operatively connected with the lever for opening said valve, adapted to become inoperative after the roller has moved from one bevelled face to the other for allowing the valve to close for preventing loss of pressure thereafter from the diaphragm chamber, said means being adjustable for varying the range of the device, said means being adjustable for regulating the period in the lever movement when the valve is operated for thus varying the range of the device.

6. In a device of the class described, a diaphragm chamber, a diaphragm therein, a pipe for supplying pressure to the diaphragm chamber, a lever arranged to be actuated in one direction by the diaphragm, means for actuating the lever in the other direction, a second pipe communicating with the diaphragm chamber, a valve in said second pipe normally closed to prevent the loss of pressure from the diaphragm chamber, an operative mechanism, means including a roller, a member with beveled faces and means for holding said member under tension against the roller for operating the mechanism from the lever, and means operatively connected with the lever for opening said valve adapted to become inoperative after the roller has moved from one beveled face to the other for allowing the valve to close for preventing loss of pressure thereafter from the diaphragm chamber, said means being adjustable for varying the range of the device, said means being adjustable for regulating the period in the lever movement when the valve is operated for thus varying the range of the device, said last means comprising a stem device for actuating said valve mounted in a cone-shaped member and projecting therefrom, a rod pivoted to said lever and an adjustable member mounted on said rod having a cone-shaped portion and a shoulder.

7. In a device of the class described, a movable element, a lever operatively con-

nected with said element, a diaphragm chamber, a diaphragm therein subject on one side to variable fluid pressure, said lever being mounted for movement by the diaphragm in its fluid pressure-subjected actuation, means for actuating the lever reversely, a pipe leading from the chamber on the pressure subject side of the diaphragm and having a valve casing, a normally seated valve in said casing having a projecting stem, a rod operatively connected with said lever, a longitudinally adjustable part on said rod for engaging said stem.

8. In a device of the class described, a movable element, a lever operatively connected with said element, a diaphragm chamber, a diaphragm therein subject on one side to variable fluid pressure, said lever being mounted for movement by the diaphragm in its fluid pressure-subjected actuation, means for actuating the lever reversely, a pipe leading from the chamber on the pressure subject side of the diaphragm having a valve casing, a normally seated valve in said casing having a projecting stem, a rod operatively connected with said lever, an adjustable part on said rod for engaging said stem, and cooperating members on said casing and rod for causing the movement of the rod to inoperative position at the end of its stem engaging stroke.

9. In combination with a controller a device of the class described, comprising continuous pressure means, a normally closed valve through the port of which fluid may flow from the pressure means and means operated by the controller for momentarily opening said valve during each cycle of operation of the controller.

10. In combination with a controller a device of the class described, comprising continuous pressure means, a normally closed valve through the port of which fluid may flow from the pressure means and means operated by a controller for momentarily opening said valve and operable from the controller when the pressure reaches a predetermined amount.

11. In combination with a controller a device of the class described, comprising continuous pressure means, a normally closed valve through the port of which fluid may flow from the pressure means and means for momentarily opening said valve governed by said controller, said controller being actuated from said pressure means.

12. In a fluid controller, pressure means, a switch mechanism for making and breaking an electric circuit, operable when the pressure of said pressure means reaches a predetermined amount, a normally closed valve through the port of which fluid from the pressure means may flow and means for momentarily opening said valve with each cycle of operation of the controller for bleeding fluid from said pressure means.

13. In a fluid controller, pressure means, a switch mechanism for making and breaking an electric circuit, a normally closed valve through the port of which fluid may flow from the pressure means and means for momentarily opening said valve with each cycle of operation of said switch mechanism for bleeding fluid from said pressure means.

Des Moines, Iowa, November 16, 1925.

ALBERT PENN.