Sept. 1, 1959 R. D. COWHERD 2,902,055

PNEUMATIC CONTROL

Filed June 5, 1957

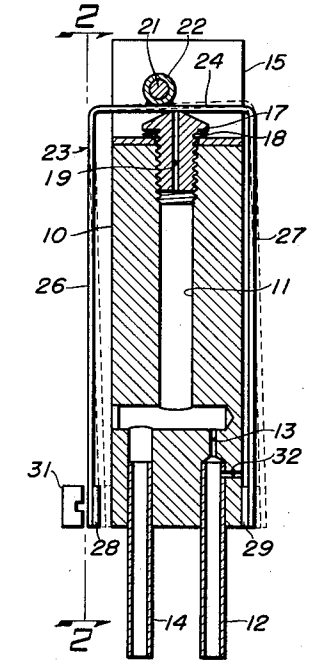



FIG. 1

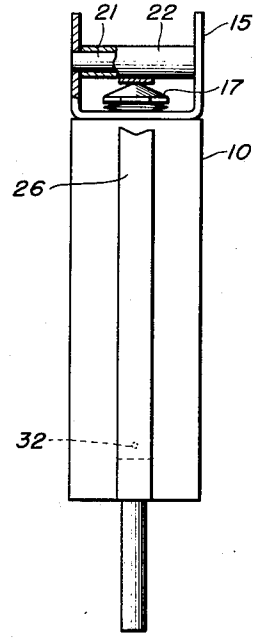



FIG. 2

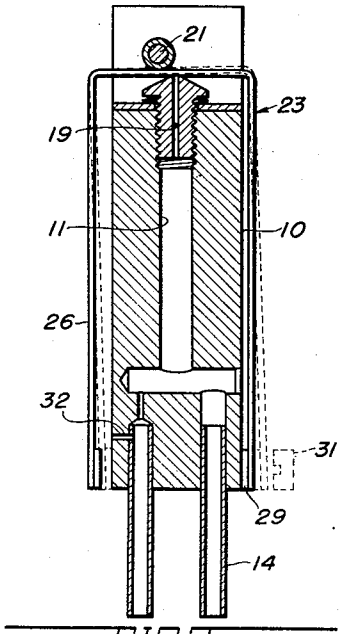



FIG. 3

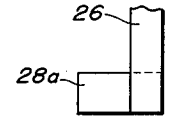



FIG. 4

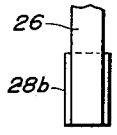



FIG. 5

INVENTOR.
ROBERT D. COWHERD
BY
Lockwood, Galt, Woodard & Smith
ATTORNEYS

United States Patent Office

2,902,055

Patented Sept. 1, 1959



2,902,055

# PNEUMATIC CONTROL

Robert D. Cowherd, West Terre Haute, Ind.

Application June 5, 1957, Serial No. 663,819

5 Claims. (Cl. 137—625.20)

This invention relates to pneumatic controls and particularly to a pneumatic control valve or air switch which may be magnetically actuated and is characterized by a construction which permits easy adaptation of the device for use as either a normally closed or normally open air switch.

In the field of instrumentation, and in particular in the fabrication of pneumatic control systems, both normally closed and normally open air switches are frequently used, both types of switches often being used in the same system. With these conditions in mind, the desirability of an air switch which can be easily modified to provide either normally closed or normally open operation is apparent. Further, since sensitive measuring or sensing devices normally have very little power or energy available for the actuation of their accompanying control devices, it is desirable that the controlling member be capable of being moved between its controlling positions with a minimum coupling force between the sensing element and the controller. Opposing this requirement is the necessity for providing a positive re-setting force for the controlling member so as to insure a clean, snap-acting operation of the air switch.

The present invention provides an air switch in which a U-shaped controlling member cooperates with a pressure nozzle to perform the switching function, and in which a re-setting orifice provides a force for positively re-setting the controlling member when the switch is de-actuated. The construction is characterized by the fact that by merely rotating the control body 180° with reference to the U-shaped controlling member, the air switch may be transformed from a normally open switch to a normally closed switch, or vice versa.

A further object of the present invention is to provide a magnetically actuated air switch of the type referred to above in which a permeable link, or flag, carried at the extremities of the U-shaped controlling member, may be readily varied either in horizontal or vertical dimension to thereby provide a flexibility in the operating differential of the apparatus.

A further object of the present invention is to provide an air switch of the type referred to above in which the controlling nozzle is adjustable with relation to the cooperating surface of the controlling member.

These and other objects will become apparent as the description proceeds with reference to the accompanying drawings in which:

Fig. 1 is a side sectional view of an air switch embodying the present invention.

Fig. 2 is a view of the air switch taken generally along the line 2—2 of Fig. 1.

Fig. 3 is a view similar to Fig. 1 but showing the control body rotated 180° to provide a normally closed switch.

Fig. 4 is a fragmentary, enlarged view of a modified form of a portion of the apparatus shown in Fig. 1.

Fig. 5 is an enlarged fragmentary view of a further modified form of a portion of the apparatus shown in Fig. 1.



Referring initially to Figs. 1 and 2, there is shown at 10 a control body having therein a central, T-shaped pressure chamber 11. The pressure chamber is connected to an inlet tube 12 through a restricted orifice 13, and, at a point spaced laterally from the orifice 13 has unrestricted communication with an outlet tube 14. At its upper end the control body carries a bracket 15 having upwardly extending legs. The bracket is fixedly held in relation to the control body by means of a nozzle member 17 which is threaded through the base of the bracket and into the control body. A spring washer 18 is interposed between the underside of the nozzle head and the bracket. A nozzle passage 19 extends centrally through the nozzle member and communicates with the pressure chamber 11. Displaced laterally somewhat from the axis of the nozzle passage the bracket 15 carries a stationary pin 21 upon which is journaled for rotation a sleeve 22. The sleeve 22 carries rigidly secured thereto a U-shaped controlling member 23, having a horizontal portion 24 and depending legs 26 and 27. Controlling member 23 is thus adapted to be pivotally moved about the pin 21. Members or plates 28 and 29 are carried at the ends of the legs 26 and 27, respectively, the plates being preferably formed of high permeability material in contrast to the controlling member 23 which is preferably formed of a non-permeable material such as brass. A controlling magnet 31 is shown schematically and is conventionally adapted to be moved toward and away from the leg 26 by a conventional sensing device operated in response to a change in the condition which is to determine the operation of an external pneumatic component attached to the lead-off tube 14 as is well known in the art. A re-setting orifice 32 extends through one side of the control body communicating with the interior of the tube 12, the kinetic energy of the air issuing from the re-setting orifice acting upon the leg 27 to oppose the force exerted by the magnet 31.

The operation of the pressure switch will now be described with reference to Fig. 1. The inlet tube 12 may be assumed to be connected to a suitable source of pneumatic control pressure which may be of the order of 25 lbs. per square inch. The lead-off or outlet tube 14 may be assumed to communicate with an external pneumatic component, the operation of which is to be controlled. In Fig. 1 the air switch is shown in its actuated position, that is, the magnet 31 has been positioned closely adjacent the permeable member 28 and the attractive force exerted thereon has moved the controlling member 23 from its broken line position to its solid line position, thereby closing the nozzle passage 19. This movement has been opposed by the kinetic energy of the air issuing from the re-setting orifice 32 and by the pressure exerted against the member 23 at the nozzle 17. When the external sensing device (not shown) moves the magnet away from influencing relation to the permeable member 28, the force exerted on the leg 27 at the re-setting orifice will snap the controlling member 23 into its broken line position of Fig. 1, thereby uncovering the orifice passage 19. Since the capacity of the passage 19 is considerably greater than the capacity of the orifice 13, with the passage 19 uncovered the pressure within the chamber 11 will immediately decrease, lowering the pressure in the tube 14 and thereby de-actuating the remote pneumatic component connected to the tube 14. When the magnet 31 is again moved into attracting relation with the permeable member 28, the controlling member 23 will again be pivotally moved clockwise, closing the passage 19, thereby causing the pressure in chamber 11 to increase and again actuate the remote pneumatic component connected to the tube 14. The spring washer 18 permits adjustment

of the nozzle 17 with reference to the under side of the cooperating horizontal portion of the controlling member 23, to permit calibration of the air switch and to assure that the passage 19 is properly closed off when the air switch is in actuated position.

From the description of operation set out above, it will be evident that, because of the slight leftward positioning of pivot pin 21 in relation to the mouth of nozzle passage 19, the resultant of the weights of the legs 26 and 27 will act to close the nozzle passage. This force will be opposed by the force provided by the jet effect on leg 27 of the orifice 32 and the pressure at the mouth of passage 19. The orifice 32 is so sized with relation to the pressure in chamber 11 that this re-setting force total is always larger than the force exerted by the resultant moment provided by the weight of the legs 26 and 27 about pin 21, so that, when de-actuated, the member 23 will be moved to open the passage 19. This net force tending to open the passage 19 must, of course, be overcome by the magnetic actuator 31 to shift the air switch to closed position.

In Fig. 3 there is disclosed an air switch having the same components as the air switch referred to with reference to Fig. 1 but modified so as to provide a normally closed device. This modification is performed by rotating the control body 10 through an angle of 180° from its position of Fig. 1, so that the re-setting orifice 32 is positioned adjacent the leg 26 of the controlling member. Under these conditions the air issuing from the orifice 32 acts against the leg 26 and the permeable member 29 becomes the actuating means which is attracted by the magnet 31. As viewed in Fig. 3, the air switch is shown in de-actuated position with the controlling member 23 having been re-set by the force exerted thereon at orifice 32, aided by the resultant moment of the weight of member 23 about pin 21. Under these conditions the passage 19 is closed and the external pneumatic component connected to the tube 14 is pressurized. When the magnet 31 is brought into proximity with the permeable member 29, as indicated in broken lines in Fig. 3, the attractive force exerted on the member 29 will move the controlling member 23 into its broken line position. Passage 19 will thereupon be uncovered, permitting the pressure within the chamber 11 to rapidly decrease, thereby depressurizing the external pneumatic component. When the magnet 31 is displaced from attracting relation to the permeable member 29, the force exerted at the re-setting orifice 32 upon the leg 26 will again re-set the controlling member into its solid line position of Fig. 1, thereby again pressurizing the external pneumatic component connected to the tube 14.

In the normally closed type of device described above, the resultant moment about pin 21 exerted by the weight of member 23 will tend to close the passage 19. With the air switch de-actuated, orifice 32 must be so sized with relation to the pressure in the chamber 11 that the force exerted by its jet effect on leg 26 together with the force exerted by the weight of member 23 will be sufficient to re-set the switch against the force exerted on the member 23 by the pressure existing at the mouth of the nozzle passage 19. This net force tending to close the passage 19 will, of course, be the force which must be overcome by the magnetic actuator 31 to open the switch.

Referring now to Fig. 4 there is disclosed a modified form of permeable member 28 which is indicated at 28*a*. In this form, the permeable member 28*a* is elongated horizontally and is adapted to cooperate with an actuating magnet, such as magnet 31 in Fig. 1, which is moved laterally with respect to the air switch housing. From a comparison of Figs. 1 and 4, it will be apparent that the actuating magnet will hold the leg 26 in attracted position during the interval in which the magnet moves laterally along the face of the permeable member 28*a*. Thus, lengthening or shortening the lateral extension of the member 28*a* provides a convenient means for fixing the magnitude of the positional displacement of the magnet required to actuate and de-actuate the air switch.

A further modified form of the permeable member 28 is shown at 28*b* in Fig. 5. Here the member 28*b* is elongated vertically and is adapted to cooperate with a controlling magnet, such as magnet 31 of Fig. 1, which, in its controlling movement, moves vertically along the leg 26. From the previous discussion in regard to Fig. 4 it will be evident that the magnitude of the vertical motion of the controlling magnet required to actuate and de-actuate the air switch; in other words the operating differential thereof, may be conveniently varied by proper sizing of the vertical dimension of the member 28*b*.

From the foregoing it will be apparent that the present invention provides an air switch which may be readily modified into either a normally open or a normally closed air switch, and in which a re-setting orifice is provided to positively re-set the switch when it is de-actuated.

Modifications of the present invention may occur to those skilled in the art, however, the scope of the invention is to be limited only by the appended claims.

I claim:

1. A pneumatic control comprising an elongated body having an inlet and an outlet communicating with a pressure chamber within the body, means providing a control orifice at one endface of the body, said orifice providing communication between the pressure chamber and atmosphere, magnetically actuated closure means for said orifice comprising a U-shaped controlling member having a central portion overlying said orifice for cooperation therewith, pivotal mounting means for the controlling member carried by said body adjacent said orifice, the legs of said controlling member being coextensive with said body on opposite sides thereof, means for magnetically coupling one of said legs to an external magnetic operator comprising a permeable armature member carried by said one of said legs at its free extremity, and a re-set orifice communicating with said body inlet and extending through a sidewall of said housing adjacent the other of said legs, said reset orifice being thereby adapted to provide a re-setting force against said other leg for opposing said external magnetic operator.

2. An assembly as claimed in claim 1 in which the armature member cooperates with a vertically movable magnetic operator and extends over a part of the length of said one leg to thereby increase the operating differential of the control an amount depending on the magnitude of said extending part.

3. An assembly as claimed in claim 1 in which the armature member cooperates with a horizontally movable magnetic operator and extends a distance laterally beyond the longitudinal axis of said one leg to thereby increase the operating differential of the control an amount depending on the magnitude of said extending distance.

4. A pneumatic control comprising an elongated body having an inlet and an outlet communicating with a pressure chamber within the body, a control orifice at one endface of the body communicating with the pressure chamber, magnetically actuated closure means for said orifice comprising a U-shaped controlling member having a central portion overlying said orifice for cooperation therewith, pivotal mounting means for the controlling member adjacent said control orifice, the legs of said controlling member being substantially co-extensive with said body, means for magnetically coupling one of said legs to an external magnetic operator, a reset orifice communicating with said body inlet and extending through a sidewall of said housing adjacent the other one of said legs, said reset orifice being thereby adapted to provide a re-setting force against said other leg for opposing said external magnetic operator.

5. A pneumatic control comprising an elongated body

having an inlet and an outlet communicating with a pressure chamber within the body, a control orifice at one endface of the body communicating with the pressure chamber, magnetically actuated closure means for said reset orifice comprising a U-shaped controlling member having a central portion overlying said orifice for cooperation therewith, pivotal mounting means for the controlling member adjacent said orifice, the legs of said controlling member being co-extensive with said body, means for magnetically coupling one of said legs to an



external magnetic operator comprising a permeable armature member carried by said one of said legs, a re-set orifice communicating with said body inlet and extending through a sidewall of said housing adjacent the other of said legs, said orifice being thereby adapted to provide a re-setting force against said other leg for opposing said external magnetic operator.

No references cited.