United States Patent

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[54] **PNEUMATIC TIME DELAY SWITCH WITH IMPROVED AUXILIARY MANUAL SWITCH ACTUATOR MEANS**
4 Claims, 4 Drawing Figs.

[52] **U.S. Cl.** **200/34,** 200/83
[51] **Int. Cl.** **H01h 7/03**
[50] **Field of Search** ..... 200/34, 83.9, 153.7, 153.8, 159 B; 188/94; 318/485

[56] **References Cited**
UNITED STATES PATENTS

2,543,090	2/1951	Ballou	200/34
2,996,155	8/1961	Priesemuth	200/34 X
3,178,524	4/1965	Frisk	200/34
3,209,094	9/1965	Bauer	200/83 (.9)
3,268,675	8/1966	Willcox	200/34

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ABSTRACT: An electrical switch includes a pneumatic time delay mechanism to provide a delay between release of the actuator and return of the contacts to their initial condition. A pivoted lever member associated with the actuator energizes the pneumatic mechanism and initiates the delay function upon release of the actuator.

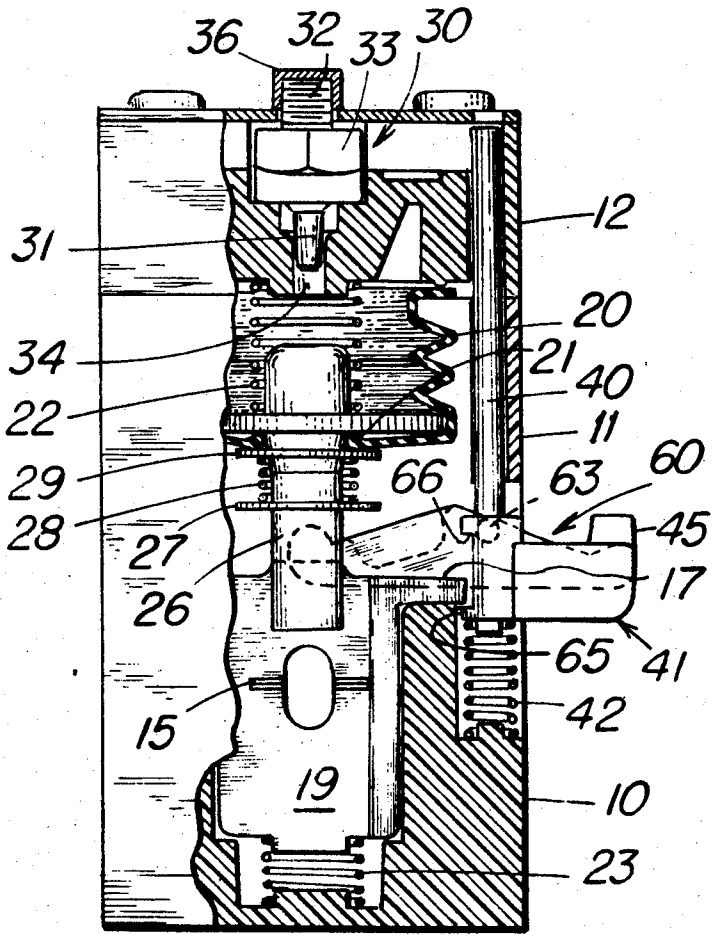


FIG. 1

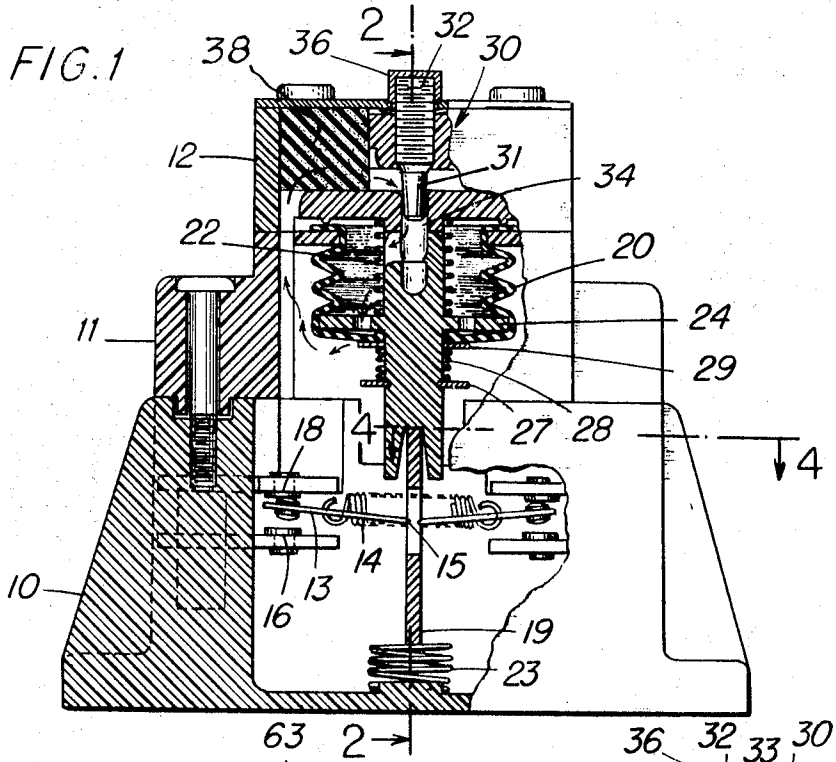


FIG. 2

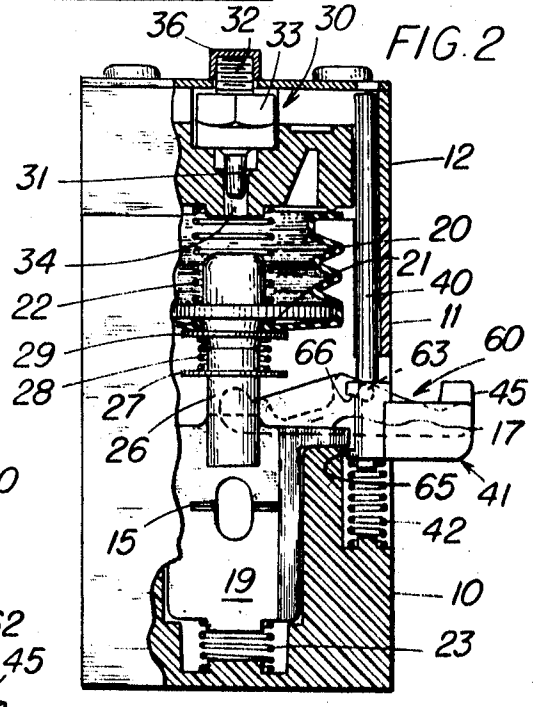


FIG. 4

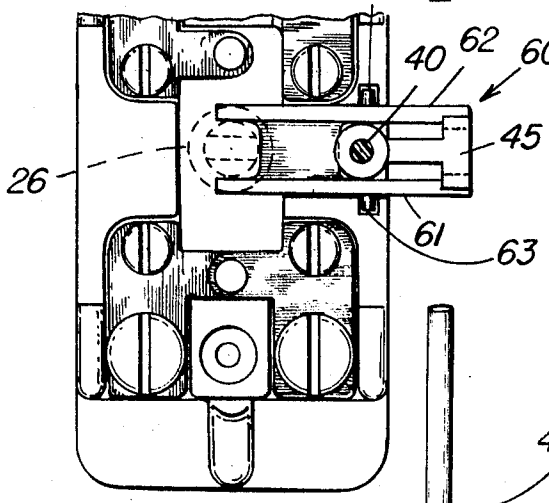
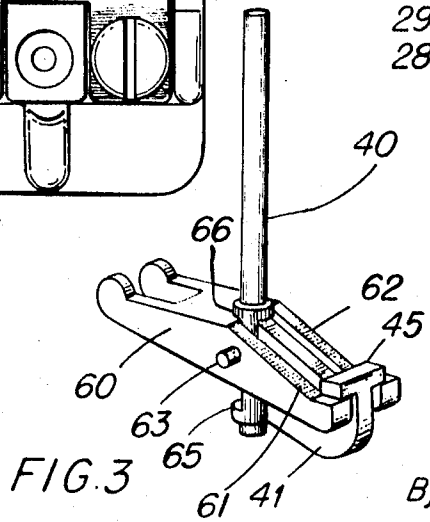


FIG. 3



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PNEUMATIC TIME DELAY SWITCH WITH IMPROVED AUXILIARY MANUAL SWITCH ACTUATOR MEANS

The present invention is concerned with a switch which pneumatically provides an adjustable delay between release of the actuator and movement of the contacts. The switch contacts can be arranged to make contact, break contact, or change to a second contact after the delay. The switch assembly is useful for motor starting where windings are connected in a time sequence. It also can be used to establish a minimum recycle time for such applications as refrigeration compressors.

According to the present invention, release of an actuator frees a spring loaded bellows to expand at a rate determined by an adjustable air outlet flow control. The expanding bellows cause the switch contacts to change their position to accomplish the switching function. In the drawings:

FIG. 1 is an elevational view partially in section of a switch according to the present invention;

FIG. 2 is a sectional view taken along the line 2–2 of FIG. 1;

FIG. 3 is a perspective detail of the actuator and lever members; and

FIG. 4 is a sectional view taken along line 4–4 of FIG. 1.

Referring now to the drawings, particularly FIG. 1, the switch mechanism of the present invention is housed in a three part case comprising a lower portion 10, an intermediate portion 11, and an upper portion 12. The housing portions are assembled with screws. Lower portion 10 includes a pair of moving contact blade members 13 associated with a spring 14 which provides toggle action to bias the moving contact blade members 13 upwardly or downwardly against fixed contacts in a conventional manner. Fixed contact members 16 and 18 are affixed to the lower portion 10 such that the moving contact blade members can establish spring-biased contact with the fixed contacts. In the switch assembly illustrated in FIG. 1, the normal condition completes the circuit with fixed contacts 18. A vertically reciprocable blade carrier 19 having blade receiving grooves 15 is located between the pair of contact blade members 13 such that upward motion of the blade carrier 19 from the position illustrated in FIG. 1 will cause the contact blade members 13 to snap over to establish contact with fixed contacts 16. A spring 23 biases blade carrier 19 upwardly.

Intermediate housing portion 11 includes a bellows member 20 which is formed of elastomeric material. Within bellows 20 is an actuator spring 22 which acts downwardly against a disc member 24 affixed to or integral with a plunger. Spring 22 tends to urge the plunger downwardly to extend the bellows and to cause actuation of the switch contacts. Spring 22 has a spring rate great enough to overcome the bias of spring 23. Another spring 28 bears against an annular washer member 27 associated with the plunger 26. Spring 28 is arranged to bias a movable annular washer member 29 upwardly of the plunger 26 against the lower edge portion 21 of the bellows member 29 to urge the bellows edge 21 against the disc 24 to form therewith a check valve.

The upper housing portion 12 includes an air inlet plug valve member 30 having a tapered plug portion 31 and having a portion 32 in threaded association with an insert member 33 affixed in upper housing portion 12 to permit vertical position adjustment of the tapered portion 31. The vertical adjustability of plug valve member 30 permits a variable clearance between the tapered portion 31 and the bore 34 into which it fits. This clearance provides an air inlet orifice of variable dimension leading to the interior of the bellows member 20. A pad of filter material 38 such as polyurethane foam is included in the upper housing portion 12 and serves to clean the air before it enters the clearance space about the tapered portion 31 of valve member 30. Adjustment of plug valve 30 is accomplished by a screwdriver slot 35 in the protruding threaded portion 32. A cover 36 may be provided to discourage tampering with the adjustment and for protection.

As is best illustrated in FIG. 2, the switch mechanism is actuated by an actuator member 40 having a portion 41 which protrudes from an appropriate opening in the lower housing portion 10 to be engageable by an external device. Actuator member 40 is a rod vertically reciprocable within a vertical bore in the housing and is biased upwardly by a spring 42. As is best seen in FIG. 3, actuator portion 41 is located in a slot in a bifurcated lever member 60 which comprises a pair of similar lever members 61, 62 integrally joined. Actuator 40 includes a portion 45 transverse to portion 41. The transverse portion overlies the proximal ends of the lever pair so that downward force on the actuator will be transmitted to the proximal ends. Lever 60 is pivoted with respect to the housing by a trunnion 63. The distal ends form a yoke about a plunger 26 and are arranged to bear against annular washer 27 which is fixed to plunger 26. Downward motion of actuator 40 thus results in upward motion of plunger 26.

Operation of the device will now be described. The device is wired in series with a relay coil and physically associated with the relay such that the actuator 40 is depressed and held so by the relay until the relay is deenergized whereupon the delay function of the device prevents reenergizing of the relay coil until elapse of the delay interval. Downward movement of the actuator 40 causes ledge 66 of the actuator 40 to engage projection 17 of the contact blade carrier 19 to secure maintenance of the initial contact condition wherein contact with fixed contacts 18 prevails.

When actuator 40 moves downwardly against spring 42, transverse portion 45 bears against the proximal ends of lever member 60 causing it to pivot about trunnion 63. The distal ends of lever member 60 engage the fixed annular washer member 27 to cause upward movement of plunger 26 to collapse bellows 20 and to compress spring 22.

Air within bellows 20 is compressed as the bellows is collapsed. The resulting superatmospheric pressure deflects bellows edge 21 downwardly against spring-biased washer 29. Deflection of edge 21 creates a passage for the compressed air to escape between plunger 26 and the surrounding bellows edge 21. Edge 21, washer 29, spring 28, and the surface of plunger 26 cooperate to form a check valve which relieves superatmospheric pressure with the bellows during collapse but seals against ingress of air when the bellows interior is subatmospheric during extension.

Release of the actuator initiates the delay function. Spring 42 moves actuator 40 upwardly. Ledge 66 no longer holds blade carrier down. Spring 23 urges blade carrier upwardly causing contact blades 13 to pass through a horizontal position. In so doing, blade spring 14 is stretched. Spring 14 provides an overcentering toggle action which causes the blades 13 to snap downwardly against fixed contacts 16 accomplishing the contact transfer to fixed contacts 16.

Simultaneous with actuator release, lever member 60 is released thereby freeing the collapsed bellows so that they may expand. The check valve constituted by bellows edge 21, annular washer 29, and spring 28 closes during extension of the bellows due to the subatmospheric pressure in the bellows. The rate at which the bellows extends is regulated by the rate at which air is permitted to enter the bellows through the adjustable orifice whose dimensions are determined by the adjustment of inlet air valve 30. Air traversing the clearance between tapered plug portion 31 and bore 34 enters bellows 20 relieving the subatmospheric pressure at a rate determined by the setting of air inlet valve 30.

Downward expansion of bellows 20 under the urging of spring 22 moves plunger 26 against blade carrier 19 to effect return of the contacts to their initial condition.

The time between release of the collapsed bellows and snapping of the moving contact blades back to their initial position is the delay time. It is apparent that this time can be set to that desired by adjustment of the valve 30. Switch devices made in accordance with the present invention have delay capabilities of up to about 5 minutes.

From the above it is apparent that the switch transfers contacts immediately upon release of the actuator and will maintain the contacts in the transferred position until elapse of the preset delay time after release of the actuator. When used in the coil circuit of a motor relay, the motor cannot be restarted until elapse of the delay time.

Because switch devices are frequently employed in unclean environments, applicant provides filter means **38** which may be polyurethane foam pads to clean the air prior to its passage through the adjustable inlet valve orifice. To further promote cleanliness, the air used in the pneumatic system recirculates within the system. This permits hermetic enclosure of the moving parts of the switch if desired. Where hermetic sealing is not necessary, recirculation of air obviates the need to introduce unclear external air to the interior of the device. The path of air circulation is illustrated in FIG. **1** by arrows. Air travels past adjustable plug valve **30** into the bellows interior. Upon release of the actuator, air exits from the bellows by passing through an aperture in disc **24** and then passing between edge **21** and plunger **26**. The air is drawn from the interior of the housing through a passage and through filter **38** while the bellows are extending.

The above-described device provides a pneumatic time delay switch having a repeatable time delay of great accuracy. The delay is adjustable over a wide range of times. By recirculating and filtering the air used by the pneumatic system, the device is insensitive to the cleanliness of its environment. The arrangement of the moving contact blades provides rapid and positive contact establishment and maintains adequate contact pressure with the resulting benefits and reduced arcing, contact sticking, and insensitivity to shock and vibration.

I claim:

1. An adjustable delay time electrical switch having first and second positions, electrical contacts movable between the first position and the second position, fixed contact means engageable by said movable contacts in at least one of said positions, a movable actuator for holding said movable contacts in the first position when actuated, biasing means for moving the movable contacts to the second position upon release of the actuator, and a pneumatic time delay device for effecting return of the movable contacts to the first position upon elapse of a delay time after release of the actuator, said time delay device comprising a bellows arranged to be collapsed when the actuator is actuated and spring biased to extend upon actuator release, said bellows being associated with the movable contacts by means of a reciprocable plunger member which effects the return of the movable contacts from the second to the first position upon extension, an adjustable air orifice to admit air to the interior of the bellows during their extension, the rate of air admission being determinative of the delay time, and a check valve for exhausting the air from the bellows during their collapse during actuation.

2. The switch of claim **1** wherein the actuator is reciprocable and is spring biased against the direction of actuating force and wherein the bellows is collapsed during actuation by means of a pivoted lever member engageable at its proximal end with said actuator and at its distal end with said reciprocable plunger.

3. The switch of claim **2** wherein the distal end of said lever member is bifurcated so as to encompass said plunger.

4. The switch of claim **3** wherein the proximal end of said lever is bifurcated, a portion of said actuator is interposed between the bifurcated proximal end portions and said interposed actuator portion is surmounted by a transverse actuator portion such that actuating force on the actuator is transmitted to the bifurcated proximal end portions of the lever.