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R. W. GOFF

2,379,704

ELECTRIC SWITCH

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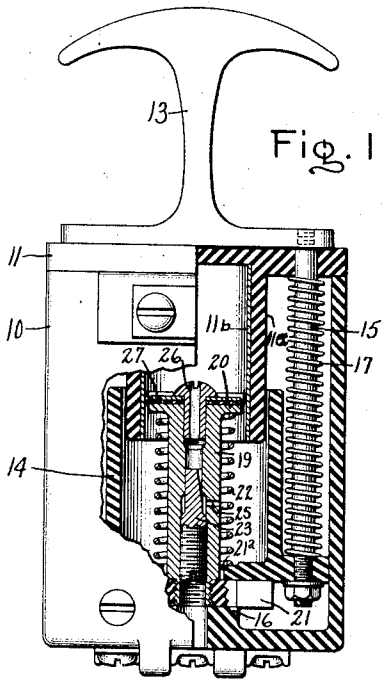


Fig. 1

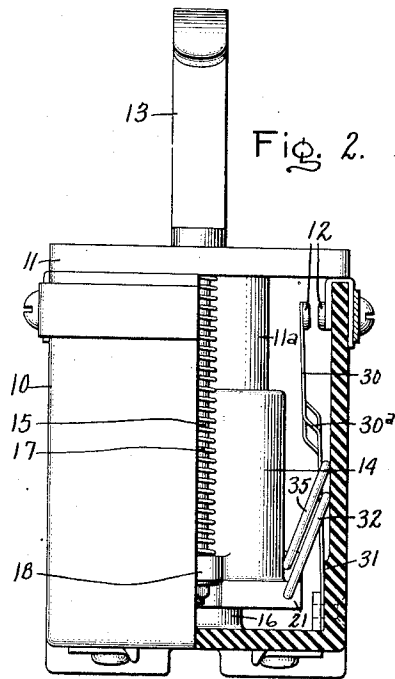


Fig. 2.

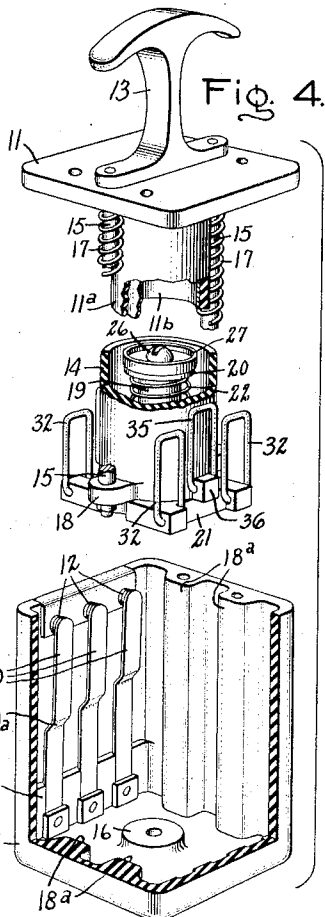


Fig. 4.

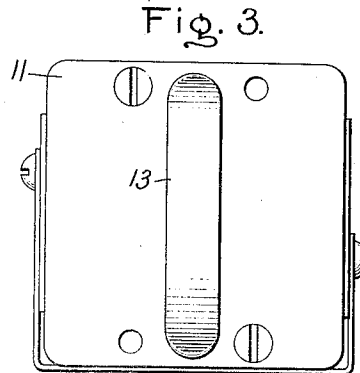


Fig. 3.

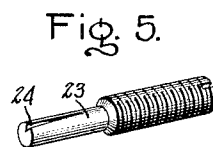


Fig. 5.

Inventor:
Robert W. Goff,
by *Harry E. Dunham*
His Attorney.

UNITED STATES PATENT OFFICE

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ELECTRIC SWITCH

Robert W. Goff, Schenectady, N. Y., assignor to
General Electric Company, a corporation of
New York

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7 Claims. (Cl. 200—34)

My invention relates to time element electric switches and more particularly to multicontact time delay control switches of the manually operable type.

While switches embodying my invention are suitable for many varied applications, they are particularly adapted for use in connection with remote control motor starting systems, such as crane control switches and the like. In remote crane motor control systems, such as floor control of traveling cranes and the like, it has heretofore been the practice to provide for each crane motor a plurality of motor starting contactors controlled by a plurality of time delay relays. These contactors and relays are carried on the trolley where space is limited. The time delay relays are in turn controlled by forward and reverse push buttons carried at the end of a pendant cable. Such an arrangement is both bulky and expensive, due to the large number of time delay relays incorporated in the control panel. Furthermore, it has been found in operation that the use of push buttons on the pendant cable permits accidental operation of the crane, as when the cable is allowed to swing freely and the push buttons are depressed by hitting against a stationary object.

In order to reduce the cost and improve the operation of floor controlled crane control systems, it is desirable to incorporate the time element of motor starting operation in the hand operated switch itself, and also to provide a pull type manual switch rather than a push button type.

Accordingly, it is a general object of my invention to provide a new and improved manually operable time delay control switch which shall be simple and reliable in operation and inexpensive to manufacture.

It is a more specific object of my invention to provide a time delay motor starting control switch of the manually operable type having a multiplicity of sequentially actuated contacts.

Briefly, my invention comprises an enclosing casing having side walls and at least one end wall formed to provide a re-entrant air cylinder. The movable switch member comprises a piston positioned within the cylinder and having an air bleeder valve to control the passage of air past the piston. The switch member is resiliently connected to a manually operable member biased in one direction and slidably mounted within the casing for movement against its bias by a handle arranged to be pulled outwardly from the casing. Because of the resili-

ent connection between the members and the action of the air piston, the switch member moves in delayed following relation with the manually operable member. Within the casing and along the side walls thereof there are mounted a plurality of cantilever spring contacts having offset portions variably spaced along the path of movement of the switch member. The contacts are controlled by means of camming members pivotally mounted upon the switch member and interposed between the cantilever springs and a wall of the casing.

My invention will be more fully understood and its objects and advantages further appreciated by referring now to the following detailed specification taken in conjunction with the accompanying drawing in which Figs. 1 and 2 are side elevations, partly in section, of an electric switch embodying my invention; Fig. 3 is an end view of the switch; Fig. 4 is an exploded perspective view of the same switch, partly in section; and Fig. 5 is a perspective view of the piston control valve.

Referring now to the drawing, and particularly to Figs. 1, 2 and 4, I have shown a multicontact time element electric switch comprising an enclosing casing 10 and removable cover 11, a plurality of pairs of cooperable switch contacts 12, and a reciprocal operating handle 13. Preferably, the enclosing casing 10 and cover 11 are formed of a suitable molded plastic insulating material. The removable end wall or cover 11 is formed to provide an inwardly extending or re-entrant cylinder 11a having a suitable metallic liner 11b.

Positioned within the enclosing casing 10 and in telescoping relation with the stationary cylinder 11a, I provide a movable cylinder 14 slidably mounted and rigidly attached to the operating handle 13 by a pair of studs 15. The sliding cylinder 14 and handle 13 are biased toward the bottom wall of the casing 10 and against an abutment 16 by a pair of helical compression springs 17 encircling the studs 15 and disposed between the casing cover 11 and a pair of outwardly extending bosses 18 formed integrally with the sliding cylinder 14. To align the movable cylinder 14 within the casing the bosses 18 are slidably positioned between pairs of longitudinal bosses 18a on opposite side walls of the casing 10.

Resiliently connected to the manually operable cylinder 14 for delayed following movement with respect thereto, I provide a movable switch member including a piston 20, a hollow piston

stem 19, and a flat plate 21 of insulating material.

The lower end wall of the slidable cylinder 14 is apertured at 21a slidably to accommodate the piston stem 19. The plate 21 is positioned below the cylinder 14 and is rigidly connected, as by a screw thread, to the piston stem 19. A helical compression spring 22 encircling the stem 19 is disposed between the piston 20 and the lower end wall of the sliding cylinder 14 thereby resiliently to connect the switch member to the sliding cylinder 14 with the flat plate 21 normally held against the bottom wall of the cylinder 14 and the piston stem 19 positioned centrally within the cylinder 14 to hold the piston 20 in the cylinder 13.

The hollow piston stem 19 is provided internally with a variable air or fluid control valve 23. Referring particularly to Figs. 1 and 5, it will be observed that the valve 23 is cylindrical and provided at one end with a threaded portion of enlarged diameter by means of which the valve is variably positioned internally of the hollow piston stem 19. At its other end the valve 23 is provided with a longitudinal groove 24 increasing in depth and width as it approaches the end of the valve. The groove 24 cooperates with the internal surface of the hollow stem 19 to provide a variable air vent between the interior and exterior of the cylinder 13. This air bleeding passage is completed by a radial hole 25 in the piston stem 19 and a hollow screw 26 used to hold in place a packing ring 27 carried by the piston head 20.

Referring now particularly to Figs. 2 and 4, it will be noted that each pair of cooperating switch contacts 12 includes a movable contact mounted upon the free end of a cantilever contact spring 30. The cantilever springs 30 are attached at one end to a side wall of the casing 10 and extend in substantially parallel spaced relation to the side wall for nearly the full length of the casing. Preferably, as shown at Fig. 2, the springs 30 are mounted upon a small boss 31 formed upon the casing wall in order to provide between the springs and the casing wall sufficient space for a camming member without producing excessive bending of the spring strip. It will be noted from Figs. 2 and 4 that each cantilever spring strip 30 is offset away from the side wall of the casing 10, as at 30a. The offset portions 30a are variably spaced from the fixed ends of the contact springs. These offset portions 30a cooperate with camming members in the form of substantially rectangular stirrups 32 and 35 pivotally attached to the flat plate 21 and to the movable cylinder 14, respectively. The stirrups 32 and 35 may be wire loops, and each has one rod-like end interposed between the casing wall and the associated spring 30. Since the flat plate 21 and the piston 20 are rigidly connected and constitute a movable switch member, it will be evident that the camming stirrups 32 follow the movement of the piston 20.

While it is possible to provide any convenient number of contact springs positioned around the internal walls of the casing 10 in any desired manner, I have shown a preferred embodiment of my invention in which each of the two opposite side walls of the casing 10 between the walls having the bosses 18a is provided with three parallel cantilever contact springs 30. Of these three springs, the two outer springs are arranged for cooperation with the camming stirrups 32 mounted upon the plate 21. To illustrate that at least one instantaneous contact member may be provided in conjunction with a plurality of time ele-

ment contacts, I have shown, particularly at Figs. 2 and 4, the contact camming stirrup 35 positioned for cooperation with the central contact spring of each group of three springs and pivotally mounted upon a projecting boss 36 on the sliding cylinder 14. Thus, the stirrup 35 is moved directly by the operating handle 13, while the stirrups 32 are moved by the delayed movable switch member.

In operation, the switch contacts 12 are controlled, and more particularly are sequentially closed, by withdrawing the handle 13 from its normal biased position in engagement with the casing cover 11. The handle may be withdrawn quickly or slowly, and may be stopped at any intermediate point between its extreme limits of travel. The extent to which the handle 13 is withdrawn determines extent of movement of the switch member, and hence the number of switch contacts closed.

Let it be assumed for the purpose of illustration that the handle 13 is withdrawn rapidly and to the limit of its outward movement. By such action, the slidable outer cylinder 14 is immediately drawn upward into telescoping relation with the stationary cylinder 11a against the bias of the compression springs 17. The piston 20 and plate 21, however, do not move upward as rapidly as does the slidable cylinder 14, due to the entrapment of air between the piston 20 and the upper end of the cylinder 11b. Accordingly, the piston 20 is initially moved upwardly only far enough to compress the air in the cylinder 11b sufficiently to balance the force of the spring 22. The remainder of the upward movement of the handle 13 compresses the spring 22 thereby to bias the piston 20 upwardly. If the handle 13 is now held in its uppermost or retracted position, the piston 20 gradually moves into the cylinder 11b under the action of the spring 22 as the entrapped air escapes through the hollow bolt 26, the valve 23, and the air vent 25. The speed of this upward movement is controlled by the size of the opening through the valve aperture 24. The size of this opening may be controlled by turning the threaded portions of the needle valve farther into or farther out of the piston stem 19. As the piston 20 moves upwardly at a predetermined speed controlled by the air valve, it carries with it the flat plate 21 and the camming stirrups 32. As the camming stirrups 32 move upwardly, they sequentially come into juxtaposition with the offset portions 30a of the cantilever contact springs 30. As each camming stirrup 32 comes under the associated offset spring portion 30a, the contact carried by that spring closes.

It will be noted that, while the stirrups 32 are moved upwardly at a slow predetermined speed by the piston 20 and spring 22, the stirrup 35, being attached directly to the slidable outer cylinder 14, is moved upward instantaneously along with the operating handle 13.

While it will be understood that my invention does not necessarily include an instantaneous contact actuated by the operating handle, this arrangement has been chosen by way of illustration because of its suitability to the kind of motor starting apparatus to which reference has previously been made. In this connection it will be evident to those skilled in the art that the central instantaneous contacts 12 on opposite sides of the enclosing casing may be used as line switches instantaneously to connect a motor to a source of supply when the operating handle 13 is withdrawn. The remaining spring contacts

controlled by the piston 20 may then be arranged for sequential closure as the flat plate 21 moves upwardly and connected gradually to short-circuit a starting resistor in series circuit relation with the motor. In a typical application to traveling crane motor control, the usual three crane motors may each be provided with a forward and reverse motor starting control switch of the type described above. These six switches may be mounted one above the other, or in any other desired manner, in a block carried at the end of a pendant cable. With switches of this type, there is no danger that any of the crane motors will be inadvertently started by swinging of the control cable and the switch box against an object. Collision of the switch handle 13 with an object cannot start the motors, since motor starting requires withdrawal rather than depression of the operating handle 13. Furthermore, it will be noted that the time delay necessary for reducing the resistance of the motor circuits is incorporated in the manually operable cable switch itself, so that no time delay relays need be included on the motor contactor panel carried on the trolley. Many other applications of the invention will occur to those skilled in the art.

While I have described only a single preferred embodiment of my invention by way of illustration, many modifications will occur to those skilled in the art, and I therefore wish to have it understood that I intend in the appended claims to cover all such modifications as fall within the true spirit and scope of my invention.

What I claim as new and desire to secure by Letters Patent of the United States is:

1. A manually operable electric switch comprising a base, a cylinder fixedly attached to said base, a movable switch member including a piston slidably positioned in said cylinder, a manually operable member slidably mounted upon said base and resiliently connected to said switch member, means for biasing said manually operable member in one direction, a plurality of cantilever spring contacts mounted upon said base, and camming means interposed between said contacts and said base and connected to said switch member to control said contacts in accordance with movement of said piston.

2. A manually operable electric motor starting switch comprising an enclosing casing, a cylinder fixedly attached to and extending into said casing, a movable switch member including a piston slidably mounted in said cylinder, a manually operable member slidably positioned in said casing and resiliently connected to said switch member, means for biasing said manually operable member in one direction, a plurality of cantilever spring contacts mounted upon an interior wall of said casing, camming means interposed between at least one of said contacts and said wall and connected to said manually operable member, and additional camming means interposed between the other of said contacts and said wall and connected to said switch member to control said other contacts in accordance with movement of said piston.

3. A manually operable electric switch comprising a base, a cylinder fixedly attached to said base, a movable switch member including a piston slidably positioned in said cylinder, a fluid flow control valve arranged to control the passage of air past said piston, a manually operable member slidably mounted upon said base and resiliently connected to said switch member, means for biasing said manually operable member in one

direction, said manually operable member being movable against its bias to bias said piston for movement in said cylinder at a speed controlled by said valve, a plurality of cantilever spring contacts mounted upon said base in substantially parallel spaced relation with one surface thereof, and camming means interposed between said spring contacts and said one surface and connected to said switch member sequentially to control said contacts in accordance with movement of said piston.

4. A manually operable electric switch comprising an enclosing casing having side and end walls, said casing including a reentrant cylinder formed upon one of said end walls, a movable switch member including a piston slidably positioned in said cylinder, a fluid flow control valve arranged to control the passage of air past said piston, a manually operable member including a handle member resiliently connected to said switch member, means for biasing said manually operable member in one direction, a plurality of cantilever spring contacts mounted upon said side walls and extending in substantially parallel spaced relation thereto, and common means including a plurality of rods interposed between said spring contacts and said side walls and pivotally connected to said switch member for sequentially controlling said contacts in accordance with movement of said piston.

5. A manually operable electric switch comprising an enclosing casing having side and end walls, said casing including a reentrant cylinder formed upon one of said end walls, a second cylinder slidably mounted within said casing in external telescoping relation with said reentrant cylinder, a manually operable handle rigidly connected to said second cylinder, means for biasing said second cylinder in one direction, a movable switch member including a piston slidably positioned in said reentrant cylinder and resiliently connected to said second cylinder, a fluid control valve arranged to control the passage of air past said piston, a plurality of cantilever spring contacts mounted upon said side walls and extending in substantially parallel spaced relation thereto, and camming means including a plurality of rods interposed between said spring contacts and said side walls and pivotally connected to said switch member for sequentially controlling said contacts in accordance with movement of said piston.

6. A manually operable electric switch comprising an enclosing casing having a substantially flat inner wall, a plurality of pairs of cooperating switch contacts in said casing, a manually operable member slidably mounted in said casing for movement in substantially parallel spaced relation to said wall, a movable switch member, time element means connecting said switch member to said manually operable member in delayed following relation, a plurality of cantilever contact springs mounted upon said wall and extending in substantially parallel spaced relation thereto to control said contacts, and camming means interposed between each of said springs and said wall and pivotally mounted upon said switch member for actuating said contacts.

7. A manually operable electric switch comprising an enclosing casing having a substantially flat inner wall, a plurality of pair of cooperating switch contacts in said casing, a manually operable member slidably mounted in said casing

for movement in substantially parallel spaced relation to said wall, a movable switch member, time element means connecting said switch member to said manually operable member in delayed following relation, a plurality of offset cantilever contact springs mounted upon said wall and extending in substantially parallel spaced relation thereto to control said contacts, and a plural-

ity of substantially rectangular stirrups each having one end pivotally mounted upon said switch member and the opposite end interposed between said wall and one of said contact springs for camming cooperation with the offset portions of said contact springs to control said contacts.

ROBERT W. GOFF.

CERTIFICATE OF CORRECTION.

Patent No. 2,379,704.

July 3, 1945.

ROBERT W. GOFF.

It is hereby certified that error appears in the printed specification of the above numbered patent requiring correction as follows: Page 1, second column, line 6, for "cantilever" read --cantilever--; page 3, first column, line 51, for "attached" read --attached--; line 63, for "sid" read --said--; and second column, line 25, for "common" read --camming--; line 73, for "pair" read --pairs--; and that the said Letters Patent should be read with this correction therein that the same may conform to the record of the case in the Patent Office.

Signed and sealed this 2nd day of October, A. D. 1945.

Leslie Frazer

(Seal)

First Assistant Commissioner of Patents.