

Aug. 18, 1964

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3,145,275

ELECTRICAL SWITCH AND ACTUATOR APPARATUS

Filed March 30, 1962

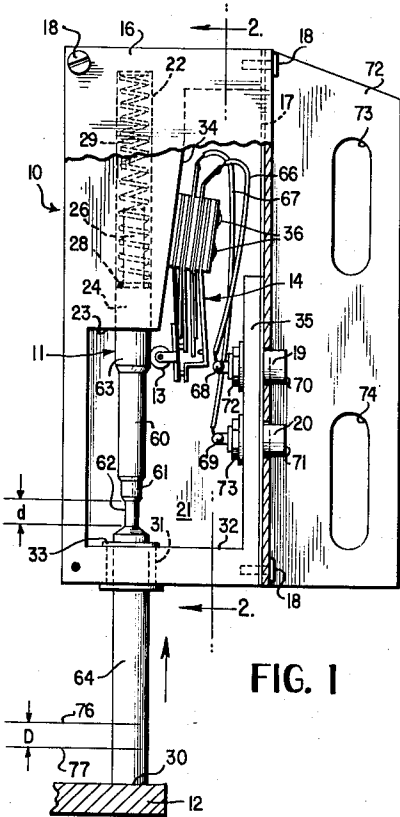


FIG. 1

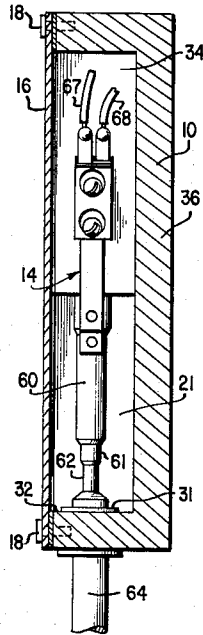


FIG. 2

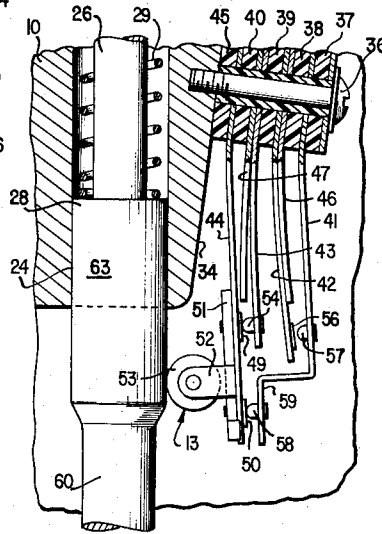


FIG. 3

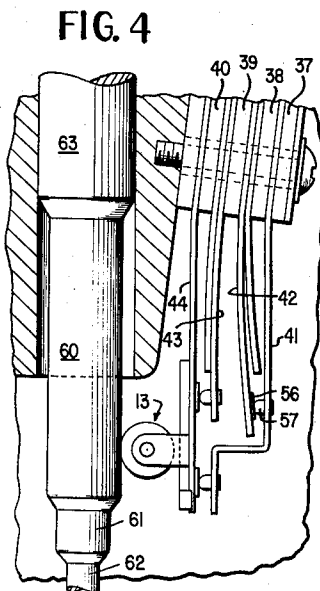


FIG. 4

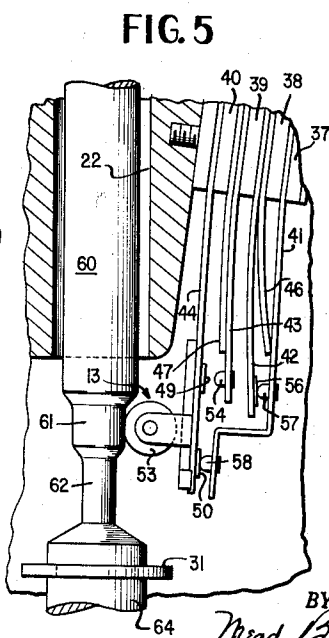


FIG. 5

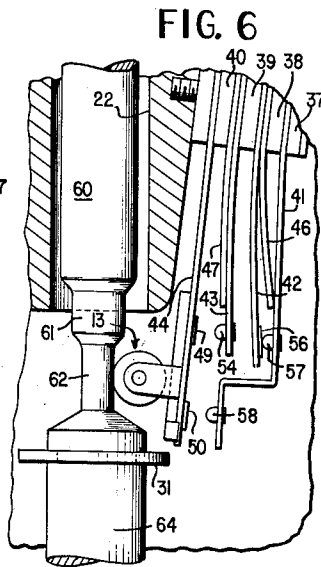


FIG. 6

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1

3,145,275

ELECTRICAL SWITCH AND ACTUATOR APPARATUS

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Filed Mar. 30, 1962, Ser. No. 183,822

4 Claims. (Cl. 200—61.41)

This invention relates to electrical switches and actuating apparatus and, more particularly, to an electrical switch and actuating apparatus for controlling the operation of a machine having a repeating cycle of operations.

It is an object of this invention to provide an electrical switch and actuator having a plurality of switch elements which are actuated during the normal cycling operation of a machine in a set sequence with some of said switches being actuated at different times and for different periods of time during the cycling of the machine.

Another object of this invention is to provide an electrical switch which is adaptable to several different modes of operation without any structural changes thereto.

Another object of this invention is to provide a timing switch for controlling the operation of a machine having a fixed cycle of operations.

The invention features an actuator member movable along a guided path in timed relation with the operation of the machine. The actuator member has formed thereon a plurality of levels each level corresponding to a selected portion of the cycle of the operation of the machine with some of the levels being of greater extent than the others. A spring biased switch follower member, controlled by the actuator member opens and/or closes spring biased contact elements according to the position of the actuator member. The contact elements are limited in the extent of their movement so that while some of the contact elements may follow the movement of the follower in every respect, some of the contact elements only follow the movement of the follower member a limited extent so that certain of the switch elements may be opened and/or closed while certain of the other switch elements may be closed and/or opened.

A further feature of the invention includes means for shifting the initial position of the follower member with respect to the actuating member so that at least one of said switch elements is closed during all movements of said actuator member.

These and other objects, advantages and features of the invention will become more apparent from the following description taken in conjunction with the accompanying drawings wherein:

FIG. 1 is an elevational view of a structure incorporating the invention with a portion of the dust cover removed;

FIG. 2 is a cross-sectional elevational view taken on lines 2—2 of FIG. 1; and

FIGS. 3—6 are enlarged views of the top portion of the actuator member and the follower member and associated contacts at the different positions of actuation thereof.

Referring to FIG. 1, a switch and actuator assembly incorporating the invention comprises a cast metal frame member 10 having a plunger actuator 11 reciprocally guided in the frame 10 and actuated by a movable part on the machine 12. Spring biased follower member 13 actuated by plunger actuator 11 couples to contact elements 14 the position of the machine part 12 through the plunger actuator 11. Certain of the contact elements 14 are coupled by conductors to terminals 19 and 20 which lead to a control circuit which may control the operation of the machine which includes part 12. An

2

L-shaped dust cover 16 having a sealing gasket 17 is secured to the frame 10 by screws 18.

Frame 10 has formed therein a chamber 21 for housing switch structure 14, actuator 11 and follower member 13. A bore 22 formed in wall 23 of chamber 21 receives an end of plunger 11 for guiding the movement thereof. The end 24 of plunger 11 has a projection 26 of reduced cross-section to form a shoulder 28 on which spring 29 in the bore 22 acts to plunger 11 in a downward direction so as to maintain constant abutment of the lower end 30 of plunger 11 with machine part 12. The lower end of plunger 11 is guided by a bush member 31 in wall 32 of chamber 21. A stop washer 33 frictionally secured in a groove in the plunger 11 limits the downward movement of the plunger 11.

The switch structure 13 is mounted on the sloping wall 34 of chamber 21 by machine screws 36. A portion of the outside wall of chamber 21 is removed as at 36 to allow access to screws 36.

As best seen in FIG. 3, the switch elements 14 are mounted in a sandwich-type arrangement with individual blocks of insulation separating the conducting elements of the switch. Thus, insulating blocks 37, 38, 39 and 40 insulate spring contact carriers 41, 42, 43 and 44, respectively, from each other. Each insulation block 37—40 and each spring contact carriers 41, 42 and 43 as well as relatively rigid members 46 and 47 have aligned holes therein which holes have a diameter considerably larger than the diameter of screw 36. Tubular insulating insert 48 having an outside diameter equal to the diameter of the aligned holes in each of the insulating blocks and the contact carrier strips is force fitted therein so that insulating blocks, 37, 38, 39 and 40, contact carriers 41, 42 and 43, and stiffening members 46 and 47 are frictionally retained in assembly. Contact and follower carrier member 44 is spaced from wall 34 by a conducting metallic insert so that there is a conductive path between the element 44 and the frame member 10. In this arrangement, element 44 may be referred to as a round contact carrier. A pair of rivet-type contact buttons 49 and 50 secure roller yoke plate 51 to the free end of carrier member 44. A pair of yoke arms 52 (only one shown) turned down from each side of yoke plate 51 support roller follower member 53 which may be of nylon or Teflon construction.

Associated with contact carrier 43 and an electrical contact therewith is a stop bar or member 47 which limits the inward travel of contact carrier 43 so that the contact button 54 carried at the end of contact carrier 43 for cooperation with contact button 49 does not follow the movement of follower member 13 during all of its course of movement but is limited to a selected portion thereof. Likewise, stop member 46, sandwiched between insulating blocks 38 and 39 with contact carrier 42 limits the outward movement of contact carrier 42 and, the inward movement of contact carrier 4.

Contact carrier 42 has a single contact 56 carried on the end thereof while contact carrier 41 has two contact buttons 57 and 58. Contact button 57 makes electrical contact, according to the position of actuator member 11, with contact element 56, while contact button 58 is carried on an offset portion 59 of carrier member 41 to cooperate with contact button 50 on carrier 44. It will be appreciated that the various contact elements mentioned above are opened and closed from time to time for varying periods of time. This is accomplished through the actuating plunger 11. Actuator plunger 11 is shown as having a series of sections of reduced cross-sectional area, 60, 61 and 62, while the upper and lower ends, 24 and 64, respectively, have the same diameter. When the follower roller 53 is riding on portion 24 of actuator 11 contact button 54 makes electrical contact with contact

3

button 49 and, at the same time, contact button 58 makes electrical contact with contact rivet 50 so that both contact carriers 41 and 43 are electrically connected to the frame 10 through contact carrier 44 and plate 45. It will be noted however that member 46 prevents contact carrier 42 from moving in an outward direction so that there is an open circuit between contact button 57 and contact element 56.

When follower roller 53 is riding on portion 60 of actuator member 11, electrical contact is made between contact buttons 54, 57 and 58 with contact members 49, 56 and 50, respectively. Thus, the outer contact carrier members 41, 42, and 43 are connected to ground through their respective contact buttons and contact carrier 44.

As shown in FIG. 5, when follower roller 53 is riding on portion 61 of actuator 11, stop member 47 prevents the inward travel of contact button 54 with the follower member so that there is no electrical connection between contact carrier 43 and the frame 10 of the switch.

In FIG. 6, follower roller 53 is shown riding on portion 62 of actuator plunger 11. In this condition, only contact button 57 makes electrical contact with contact element 56. However, since only contact carriers 42 and 43 are connected through connections to terminals 19 and 20, respectively, to the control circuit which is conditioned by the switch, this connection is of no effect. It will be noted that bar member 46 in conjunction with spring contact carrier 42 prevents the inward travel of contact button 58 so that this contact button does not follow the movement of contact element 50 as carrier element 44 moves with the follower mechanism 13.

As noted earlier, contact carrier 44 is electrically connected to the frame 10 through metal bar 45. Thus, unless one of contact buttons 54 or 58 is in electrical contact with contact members 49 and 50 so that contact carriers 41 and 43 are effectively removed from the ground connection through carrier 44. Wires 66 and 67 connect contact carriers 42 and 43 to terminals 68 and 69, respectively, of output jacks 19 and 20, respectively. The outer members 70 and 71 of terminals 19 and 20 make electrical connection with the frame 10 and are secured thereto by lock nuts 72 and 73, respectively.

When used with the circuit shown in application Serial No. 182,549, filed March 26, 1962, of Harold A. MacIntosh, the switch and actuator described herein is a conditioning and control device, which, in conjunction with a detector switch (not shown), controls the cycle of operation of a machine having a repeating cycle of operation on failure of completion of a cycle of the machine. For example, the detector switch referred to above may be actuated by the passage of a work product either into or out of the machine. If such actuation of the detector switch occurs during the period of time which follower member 13 is riding on portion 60 of actuator member 11, and during the time period when contact buttons 54, 57 and 58 are in electrical contact with contact members 49, 56 and 50, respectively (as shown in FIG. 4), the circuit controlled by the switching elements 14 is conditioned for a subsequent operation of the machine with which part 14 is associated.

As more fully explained in the aforementioned application of Harold A. MacIntosh, Serial No. 182,549, there are two general types of clutch mechanisms in use with repeating machines, for example clutch presses and the like. As noted in that patent application, the first type of clutch mechanism is a so-called "dog-type clutch" which relies on interference and clearance of the clutch dogs for engagement and disengagement of the clutch. In this type of clutch mechanism, the clutch is effective to stop the ram stroke at the uppermost or top position. The condition of the switch of this invention corresponding to the top of the up stroke of the machine part 12 is shown in FIG. 6 wherein contact carrier members 42 and 43 are ungrounded. Specifically, contact button 58 is effectively disengaged from contact button 50 so that

4

terminal 69 of jack 20 is likewise ungrounded. Thus, contact button 58 and contact element 50 function as a limit switch for controlling the movement of machine part 12.

The second type of clutch mechanism referred to in the aforementioned MacIntosh application is a so-called "air clutch" in which the machine with which the clutch is associated may be stopped in any position throughout its cycle so that the limit switch formed by contact button 58 and contact element 50 is not needed in this application. As shown in FIG. 1, the frame 10 has a projecting mounting flange 72 with bolting slots 73 and 74. A pair of indicia marks 76 and 77 on the lower end of 64 of actuator plunger 11 are spaced on a distance d apart which is substantially equal to the length of reduced section 62 of actuator rod 11. Part 12 of the machine to which frame 10 is to be secured is moved to the topmost position of the stroke so that the switch elements are in the condition shown in FIG. 6 and both indicia lines 76 and 77 are visible below bushing 33. Then, the bolts passing through slots 73 and 74, respectively, may be loosened so that the frame 10 may be lowered to where only indicia mark 76 is visible below bush 33. In this condition the electrical connection between contact button 58 and contact element 50 is never broken so that the clutch mechanism (air clutch) may be actuated during any time during the cycle of the operation of the machine.

It will be appreciated that the metal contact bar 45 between contact carrier 44 and the frame 10 may be replaced with an insulating bar so that instead of grounding the terminals 68 and 69, these terminals may be connected to other circuit means.

While I have shown and described but one embodiment of my invention, it will be appreciated that numerous modifications and changes may be made thereto without departing from the scope of the invention. Accordingly it is desired to comprehend such modifications within this invention as may fall within the scope of the appended claims.

What I claim is:

1. A switch structure comprising a frame member having the guide bore therein,
 - an actuator plunger reciprocable in said bore,
 - and a spring member in said bore biasing said plunger outwardly therefrom,
 a plurality of stepped surfaces, more than two, formed on said plunger,
 - a plurality of resilient contact carriers mounted in a sandwich structure with intervening insulating inserts between the contact carriers, said sandwich structure being mounted on said frame member,
 - a follower member formed on one of said resilient contact carriers and in constant engagement with said plunger and moved thereby by the engagement of said follower with a different one of said stepped surfaces,
 means between selected ones of said contact carriers intermediate the end ones for limiting the movement of said intermediate contact carriers relative to the movement of the other of said contact carriers, said means being effective to limit the movement of at least one of said contact carriers in one direction and at least another of said contact carriers in an opposite direction, said stepped surfaces being of a different extent along the longitudinal dimension of said plunger,
 and electrical contacts on said contact carriers.
2. The switch defined in claim 1 wherein said plurality of resilient contact carriers mounted in a sandwich structure includes a first contact carrier secured to and adjacent said frame, said follower means coupling the movement of said actuator to said first contact carrier,
 - a plurality of said second contact carriers,
 - and means biasing said contact carriers such that the

5

movement of said first contact carrier effects movement of said second contact carriers.

3. The switch defined in claim 2 wherein said means between intermediate ones of said contact elements for limiting the actuation thereof is effective during selected periods only of movement of said actuator plunger.

4. A switch as defined in claim 1 wherein said frame member is shiftable relative to said plunger member so that at least some of said contact elements are not operative during reciprocating movement of said actuator plunger.

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