

United States Patent

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[72] Inventor **Clarence B. Ziegler, Jr.**
3510 Balmars Court, Jackson, Mich.
49201

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3,472,977.

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Primary Examiner—Robert K. Schaefer
Assistant Examiner—William J. Smith
Attorney—Beaman and Beaman

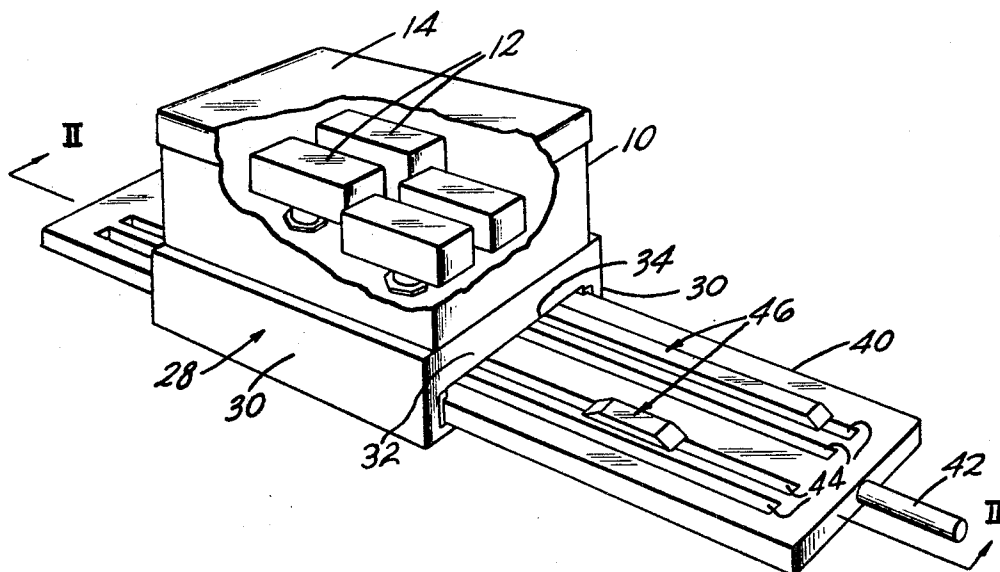
[54] MULTIPLE CAM LIMIT SWITCH ACTUATOR
5 Claims, 6 Drawing Figs.

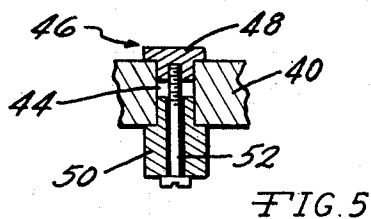
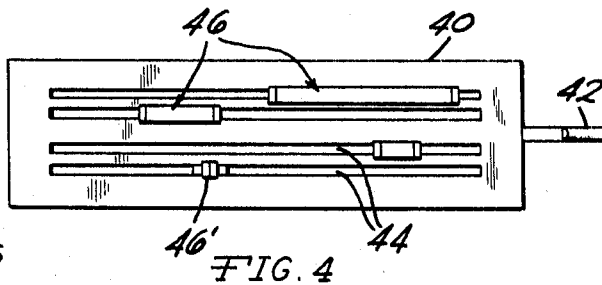
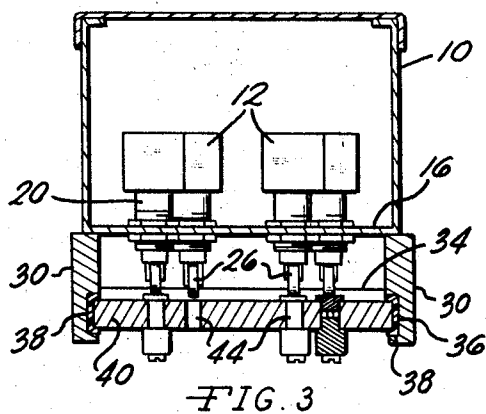
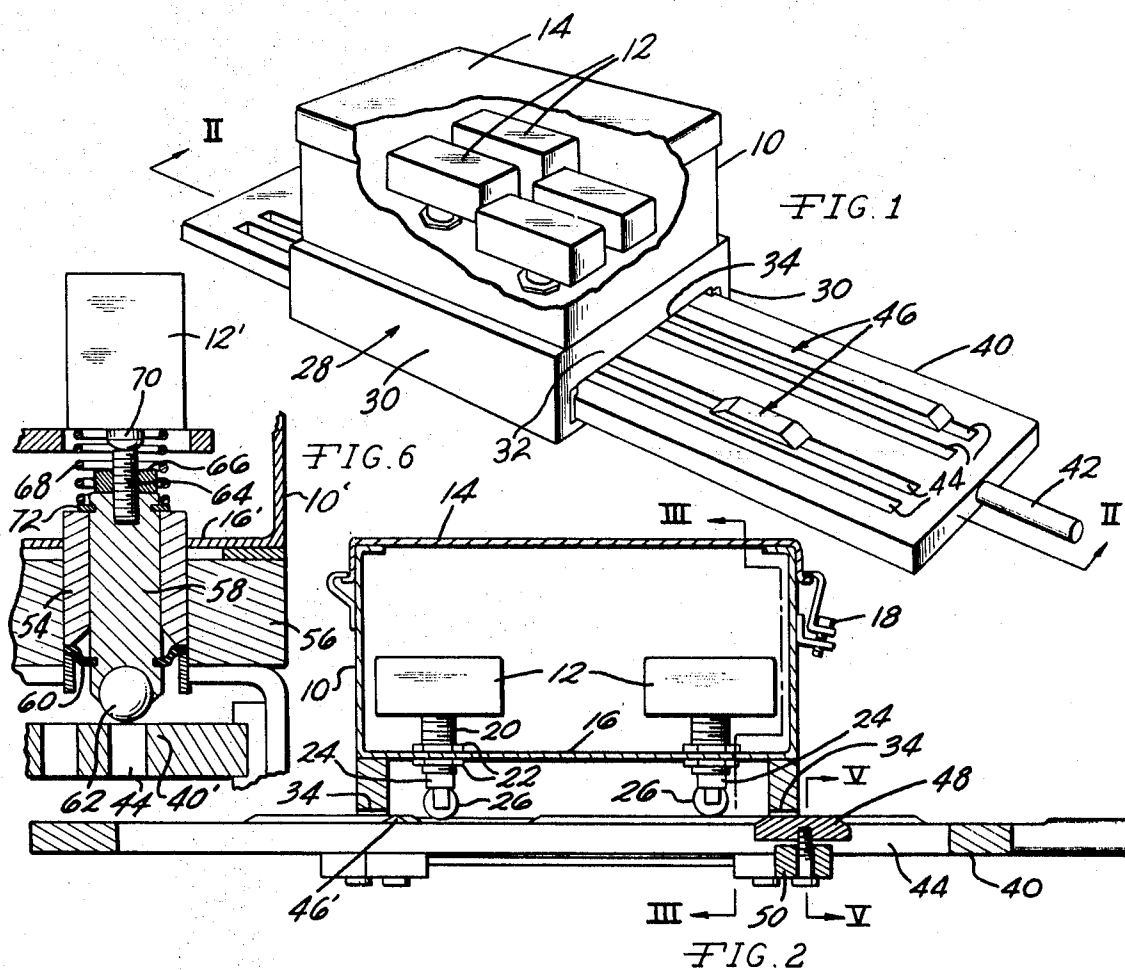
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153.12, 46, 47, 153.11, 153.13

ABSTRACT: An actuator for limit switches including a relatively flat cam slide plate upon which a plurality of cams are mounted for adjustment within tracks, the cam slide plate being slidably disposed relative to a plurality of switches, a switch being aligned with each cam track wherein the cams may be selectively positioned within the associated track to provide a desired sequence of switch operation upon movement of the cam slide.





INVENTOR
CLARENCE B. ZIEGLER, JR.

BY *Beaman & Beaman*

ATTORNEYS

MULTIPLE CAM LIMIT SWITCH ACTUATOR

CROSS REFERENCE TO RELATED APPLICATION

This application is a continuation-in-part of my copending U.S. application Ser. No. 674,595, filed Oct. 11, 1967, now U.S. Pat. No. 3,472,977.

BACKGROUND OF THE INVENTION

The invention pertains to the field of electric switch actuation wherein a plurality of switch actuators are mounted upon a commonly linearly movable slide member.

It is common practice to utilize electric switches, or hydraulic or air valves, to operate the many types of machines utilizing a plurality of motors, slides and mechanical movements. For instance, in the machine tool art, the cross-slides, work supporting tables, toolheads, and other movable components of the machine are often controlled with respect to degree of movement, rapid and slow traverse, and reversing sequences by electric limit switches which are engaged by dogs or other cams mounted upon the moving components of the machine. In the past, it has been the practice to mount the switch upon the machine at the most desirable location, and it has also been necessary to mount the switch actuating element upon the movable component in such a location as to engage the switch at the desired time and sequence of operation. In that the more complicated machines require a considerable number of electric switches, or hydraulic or air valves, this type of control often results in the machine becoming "cluttered" due to the presence of a number of control elements located at various positions on the machine, and the electric conductors, pipelines or other interconnection means detracts from the appearance of the machine, and more seriously, produces a number of potential maintenance problems due to the interconnection conductors being susceptible to damage or fatigue due to vibration.

A number of switch controlled devices have been proposed wherein the control of switches under the influence of movable machine components can be centrally located, and reference is made to U.S. Pat. Nos. 2,968,710 and 3,192,350.

While the prior art devices meet some of the requirements of machines and mechanical systems utilizing such control devices, the high degree of versatility that is often required is not capable of being met by the present switch actuating equipment, and it is often necessary to use a plurality of the prior art devices to obtain the type of control desired.

Another of the problems with the prior art devices is the sensitivity of the devices to malfunctioning because of the entrance of dirt or foreign matter into the close tolerances of the operating components, and it is one of the objects of the invention to provide a switch control device which is relatively free of such maintenance problems.

SUMMARY OF THE INVENTION

In the practice of the invention a plurality of switches, which may be either electric switches, or hydraulic or air valves, are mounted within a housing, and each switch has associated therewith an actuator which extends from the housing, such as through a bottom wall. Directly associated with the switch housing adjacent the bottom wall is a bracket for slidably receiving a cam slide.

The cam slide is preferably of a relatively flat platelike construction having a plurality of parallel cam receiving tracks defined therein. The tracks are parallel to the direction of cam slide movement during operation, and a switch actuator is aligned with each cam track.

At least one cam is associated with each cam track whereby upon the cam of a track becoming disposed directly below the switch actuator aligned with its track, the cam will actuate the switch actuator and close the switch to perform the desired control function. The cam may be of a configuration to only momentarily close the associated switch. However, by using a cam of considerable length, the associated switch can be maintained closed for a considerable portion of the movement

of the cam slide. Also, it is possible to use a plurality of cams in a given track for sequential operation of the same switch during movement of the cam slide in a given direction.

One of the features of the invention is the use of a bridge member mounted upon the cam slide bracket which is located from the bracket a distance no greater than the permissible operating range of movement of the switches which are being actuated. Thus, the switches are protected against a machine operator placing a cam upon the cam slide which would produce a greater degree of switch movement than the switch is capable of accommodating. This is an important feature of the invention in that it is common for unskilled operators to attempt to modify limit switch control systems by using cams which are not of the proper size and often damage the limit switches controlled by the cams.

In that the cam slide may be of a significant width, a number of switches may be mounted within the switch housing, and it is possible to produce a sequential operation of switches very closely related to each other, or even produce simultaneous operation, and this type of actuation is difficult to accomplish with many of the prior art devices.

The switch actuation apparatus of the invention permits a very versatile control to be produced merely by changing or relocating cams, and by using a switch actuator having a large number of cam tracks and switches a machine may be programmed for complete automatic operation without requiring the use of more complicated apparatus.

BRIEF DESCRIPTION OF THE DRAWING

The aforementioned objects of the invention will be apparent from the following description and accompanying drawings wherein:

FIG. 1 is a perspective view, partly in section, illustrating a switch actuator in accord with the invention,

FIG. 2 is an elevational, sectional view of the actuator of FIG. 1 taken along Section II-II thereof, illustrating a cam passing under the actuator bridge,

FIG. 3 is an elevational, sectional view taken along Section III-III of FIG. 2,

FIG. 4 is a top, plan view of the cam slide plate, per se,

FIG. 5 is an enlarged, detail, elevational view of a cam as taken along Section V-V of FIG. 2, and

FIG. 6 is an enlarged, detail, sectional, diametrical, elevational view of a modification of switch actuator and plunger which may be used in accord with the invention.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

The switch actuator device of the invention may be used to operate electric switches, or hydraulic or air switches or valves. It will be appreciated by those skilled in the art that the substitution of one type of switch or valve for the other may be readily accomplished, and in the described embodiment, electric switches are used in that the widest range of applications are present with electric switches.

With reference to the drawings, a switch housing 10 is employed to house a plurality of switches 12. The housing 10 may be of steel or other material and preferably includes a removable cover 14 which may be removed for providing access to the switches and the wiring associated therewith. Electrical conductors, not shown, are associated with the switches and extend through a suitable opening, not shown, defined in the switch housing at the location most convenient for the particular installation. The switch housing 10 includes a lower or bottom wall 16, and the removable cover may be maintained in position by a clamping element 18.

In FIGS. 1 through 3 an electric switch 12 is illustrated which may be of the well known "micro" type, and the switch is mounted on a threaded actuator stem 20 which extends through a circular hole defined in the housing bottom wall 16. Nuts 22 mounted upon opposite sides of the bottom wall on each stem maintain the associated switch and actuator stem in the desired vertical position. The switch actuators 20 include

plungers 24, FIGS. 2 and 3, movably mounted within the threaded stem, and the upper end of the plungers engages operating mechanism within the associated switch for opening and closing the switch contacts. The lower end of the plunger may be provided with rollers 26 for engagement with the cams, as will be later described.

A cam slide bracket 28 is affixed to the housing 10 adjacent the bottom wall. In the disclosed embodiment the bracket includes a pair of downwardly extending spaced parallel members 30 which are interconnected adjacent their ends by bridge elements 32 which include a downwardly facing edge 34. The brackets 30 include recesses 36 in which nylon bearings 38 are mounted, and the cam slide plate 40 is slidably received within the bearings 38.

The cam slide 40 is preferably of a generally flat platelike configuration having a rectangular periphery as will be appreciated from FIG. 4. A connecting stud 42 is defined upon one end of the slide for connecting the slide to the movable member of the equipment which is to be controlled.

The cam slide 40 includes a plurality of cam tracks 44 which are in the form of slots. The slide may include eight or 10 slots, or more if desired, and for purpose of illustration a four-track slide is shown. The slots 44 are parallel to each other, and parallel to the direction of sliding movement of the cam slide within the bearings 38. A slot is defined in the slide for each limit switch 12 within the housing 10, and the slots are each aligned with an actuator plunger of the switches as will be appreciated from FIG. 3. It is to be noted that the limit switches within the housing 10 are staggered with respect to each other so as to permit alignment with the cam track slots 44. One of the features of the invention lies in the fact that the disclosed construction of the cam slide 40 permits the slots 44 to be of a length substantially equal to that of the entire slide, and in this manner control can be produced throughout substantially the entire operating movement of the slide.

The cams 46 are mounted upon the cam slide, and include members 48 and 50, FIG. 5. The upper member 48 of the cam constitutes that member which is disposed upon the side of the slide toward the switch actuators and switch housing. The members 48 and 50 are of a T-configuration whereby the members are partially received within the slots, and partially engage the upper or lower side of the cam slide, respectively. The screw 52 interconnects the members 48 and 50 and by tightening or loosening the screw the cams 46 may be positioned as desired within their associated slot.

As will be appreciated from FIG. 4, the cam members 46 may take several configurations. A momentary type of contact cam is shown at 46' where the member 48 is formed with an inverted V-configuration, and this type of cam will only produce a momentary closing of its associated switch. The remaining cams 46 illustrated are of various lengths with respect to the length of the slide 40, and will therefore produce a duration of switch closing proportional to their length, and the rate of movement of the cam slide.

In operation, cams 46 of the desired length are placed upon the cam slide within the appropriate track slots 44 and affixed thereto by the lower members 50 and the screws 52. Of course, the length of the cams will depend upon the function they are to control, and the cams will be positioned upon their respective slides in an order to accurately provide the control desired at the proper position of cam slide movement as determined by the member to which the cam slide is affixed, not shown. If desired, one or more of the switches can be used to lock other switches, in or out of the circuit, and by using an actuator having several tracks, eight for instance, it is possible to provide a rather complex programming system for machinery using a switch control system.

Should it be desired that hydraulic oil or air valves be controlled rather than electric switches, the electric switches are replaced by valve mechanisms having plungers which associate with the cams 46 in a manner which will be apparent to one skilled in the art.

The distance that the bridge edge 34 is spaced above the adjacent "upper" cam slide surface is no greater than the maximum permissible operating movement of the switch plungers 24. Thus, should an operator place a cam upon the cam slide which extends upwardly from the cam slide surface a greater distance than is permissible, this cam will engage the bridge edge 34 prior to engaging a limit switch. Such an engagement of the cam with the bridge 32 will produce a binding action which will immediately be apparent to the operator and the fact that the cam is of an improper size will be immediately apparent, and the situation may be remedied. This feature is considered of significance in that it is a common problem with switch controlled devices that, in setting the machine up, the operator permits a cam to operate the switch through a greater degree of movement than that for which it was designed, often resulting in damage to the switch, and usually requiring that the switch be discarded.

The point at which the switches close relative to their engagement by the aligned cam 46 is usually determined by locating the cam member on the slide. However, it will be appreciated that the vertical adjustment of the switch threaded stems 20 will also affect the point of switch actuation relative to slide movement.

FIG. 6 illustrates a variation of stem and plunger assembly wherein the switch actuator art prevents any fluid or dust from passing from the area adjacent the cam slide into the switch housing. In the embodiment of FIG. 6 a bronze bearing 54 is inserted in the member 56 affixed to the bottom wall of the housing 10', and a plunger 58 is reciprocally mounted within the bearing. A neoprene diaphragm 60 of an annular configuration produces a sealing relationship between the bearing and the plunger 58, and the lower end of the plunger includes a hardened steel ball 62 for engagement with the aligned cam member 46.

At the upper end of the plunger 58 a small threaded pin 64 is located thereon in a threaded hole and fixed by locknut 66, and a spring 68 is employed between the switch 12' and plunger to bias the plunger downwardly away from the switch control 70 extending from the underside of the switch 12'. Stop ring 72 limits the downward axial movement of the plunger. In this manner if sudden axial forces or motion is imposed upon the plunger 58 by the cam engaging the ball 62 the spring 68 will prevent "over travel" of the plunger due to inertial forces and the spring thereby serves to protect the switch 12'.

It will be appreciated that the switch actuator of the invention provides an economical means for automatically programming equipment by the use of switches, without necessitating sophisticated electronic and computer devices. The apparatus of the invention is most versatile in use, and standard switch actuator units can be quickly adapted to use with many various types of applications.

It is appreciated various modifications will be apparent to those skilled in the art without departing from the spirit and scope thereof, and it is intended that the invention be defined only by the language of the following claims:

I claim:

1. A linear switch actuator comprising, in combination, a limit switch housing having a bottom wall, a plurality of limit switches mounted within said housing, a switch actuator connected to each of said switches and extending through said bottom wall, a cam slide track mounted on said housing adjacent said bottom wall, an elongated flat cam slide plate mounted in said track for linear slidable movement relative to said switch housing and said switch actuators having a length greater than the length of said switch housing in the direction of said slidable movement, a plurality of cam tracks defined in said slide extending substantially the length thereof and parallel to the direction of movement thereof, a cam track being aligned with each switch actuator, a cam mounted within each of said tracks, said cams actuating the switch actuator aligned with its associated cam track upon the movement of said slide to engage a cam with its aligned actuator, and means defined

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on said slide for connecting said cam slide to a movable member.

2. A linear switch actuator as in claim 1 wherein said cam slide track includes a bridge member disposed between said cam slide and said switch housing and extending over said cam slide, said cams passing under bridge during operation of said slide, the distance between said bridge and cam slide in the direction of switch actuator movement being no greater than the maximum operating range of movement of said switch actuator and switches whereby said bridge protects said switches against excessive movement due to oversize cams being affixed to said cam slide.

3. A linear switch actuator as in claim 1 wherein said switch actuators each include a plunger slidably mounted in said actuator movable within given limits in the operative direction of

movement, and a spring biasing each of said plungers away from the associated switch whereby said springs prevent over travel of said plungers toward said switches due to inertia forces.

4. In a linear switch actuator as in claim 3 wherein said plungers each include a first end disposed toward said cam slide, a semispherical recess defined in said first end and a ball rotatably received within said recess and engageable by the aligned cam.

5. In a linear switch actuator as in claim 1 wherein said cam slide track includes first and second oppositely disposed ends, said track ends being open wherein said cam slide may extend beyond said ends during operation.

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