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Oakes

[11] **3,749,870**

[45] **July 31, 1973**

[54] **ELASTOMERIC COVER FOR A PENDANT SWITCH WITH AN UNTENSIONED INTERMEDIATE POSITION**

[75] Inventor: **Lloyd Oakes**, New Philadelphia, Ohio

[73] Assignee: **Joy Manufacturing Company**, Pittsburgh, Pa.

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[21] Appl. No.: **195,316**

[52] **U.S. Cl.** ..... **200/168 G**, 200/157

[51] **Int. Cl.** **H01h 13/06**

[58] **Field of Search** ..... 200/159 B, 168 G, 200/159 R, 153 LA, 5 C, 157

[56] **References Cited**

UNITED STATES PATENTS

2,870,273	1/1959	Merchant	200/153 LA X
3,086,090	4/1963	Carroll	200/168 G X
2,750,480	6/1956	Freeman	200/168 G
2,995,640	8/1961	Panerai et al.	200/168 G
3,592,980	7/1971	Alamprese	200/153 LA X

FOREIGN PATENTS OR APPLICATIONS

1,058,681	2/1967	Great Britain	200/168 G
610,415	12/1960	Canada	200/168 G

Primary Examiner—Robert K. Schaefer
Assistant Examiner—Robert A. Vanderhye
Attorney—E. Wallace Breisch

[57] **ABSTRACT**

A switch device having a plurality of compact multiple position push button switches housed in a common pendant station to control a plurality of circuits.

5 Claims, 16 Drawing Figures

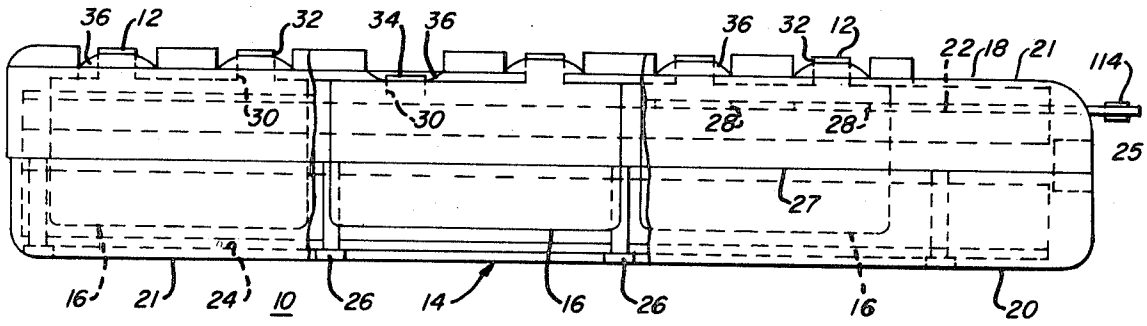


FIG. 1

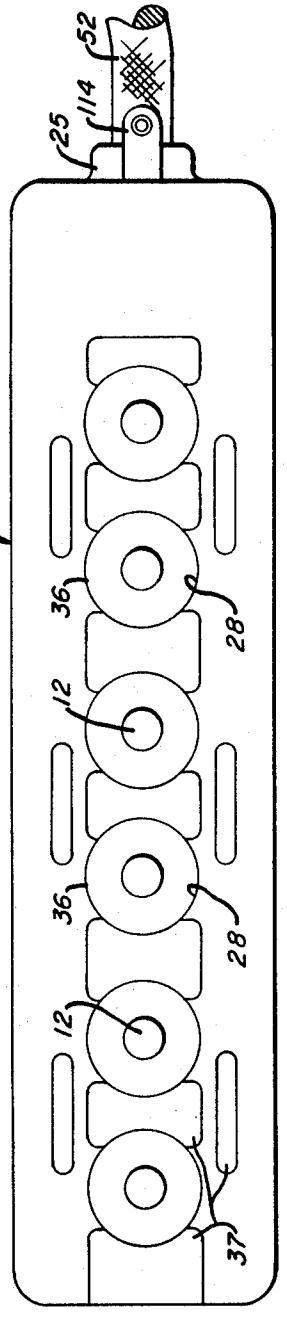


FIG. 3

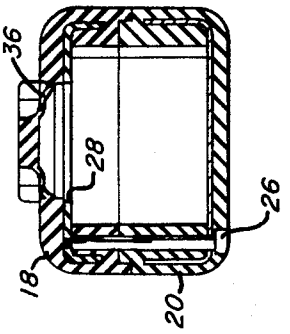


FIG. 2

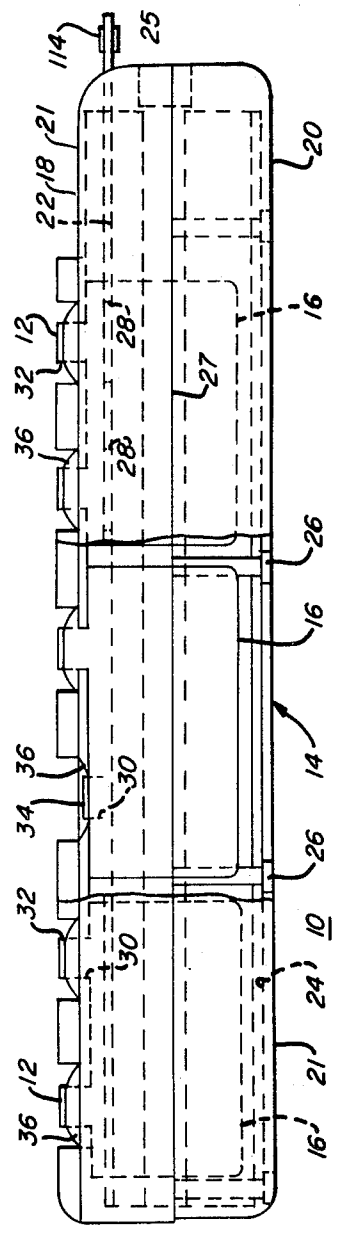


FIG. 8

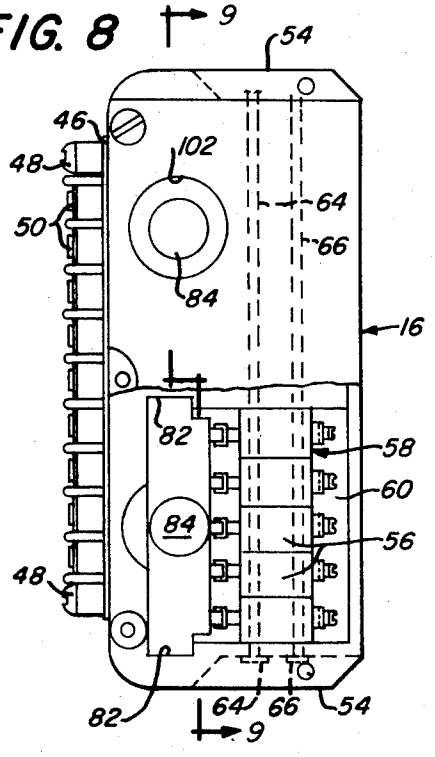


FIG. 9

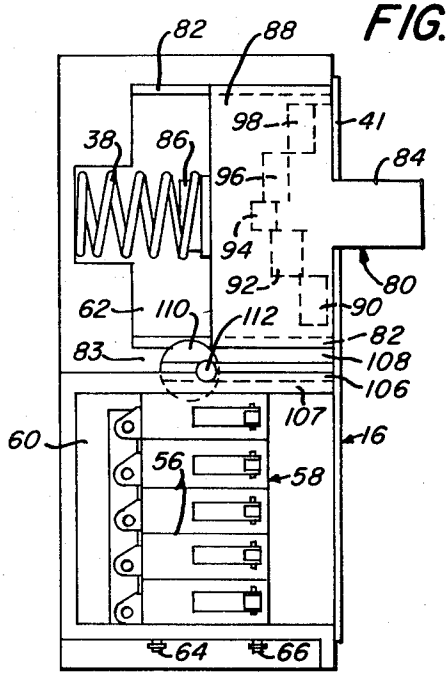


FIG. 16

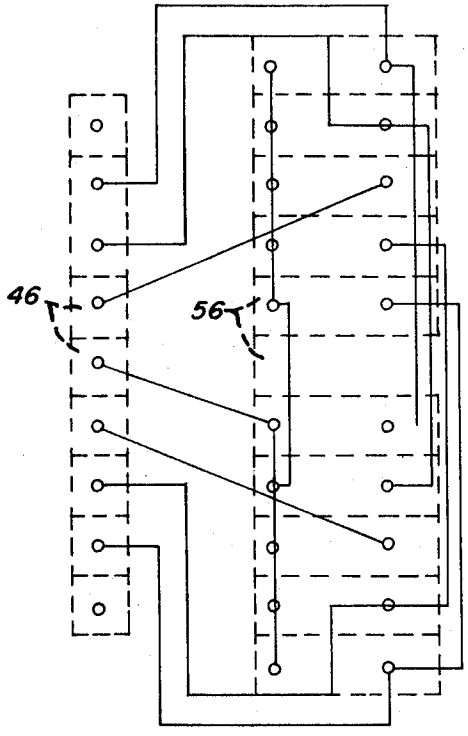


FIG. 5

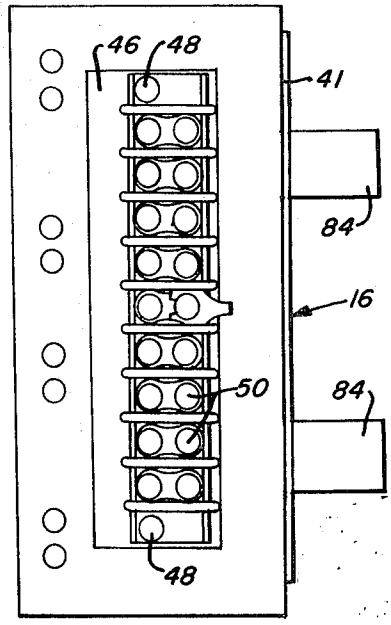


FIG. 11

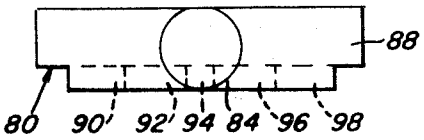


FIG. 12

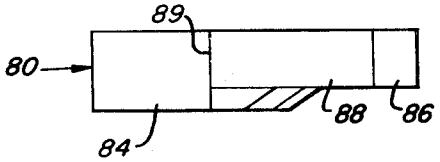


FIG. 6

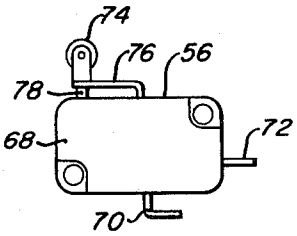


FIG. 7

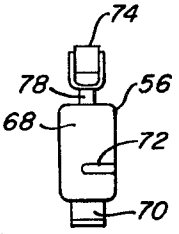


FIG. 10

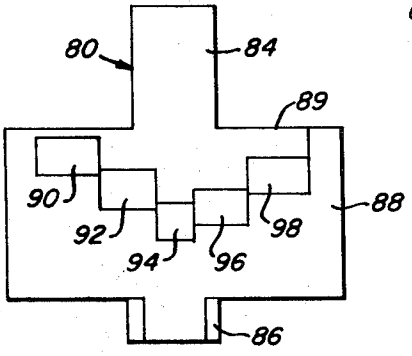


FIG. 15

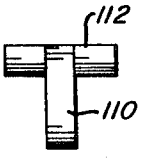


FIG. 14

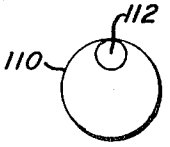


FIG. 13

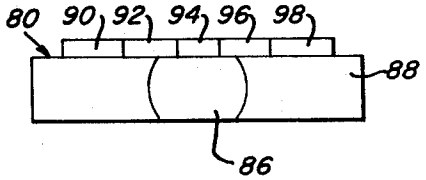
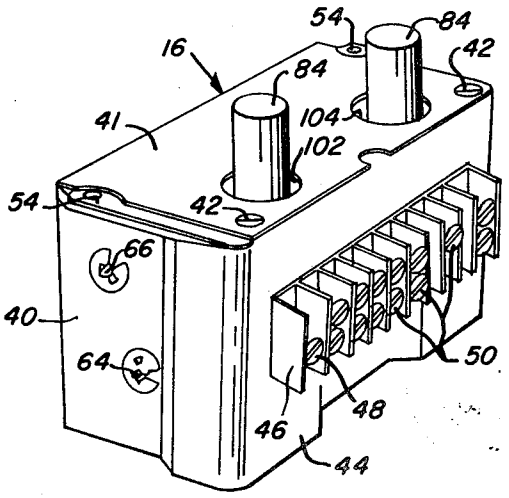


FIG. 4



ELASTOMERIC COVER FOR A PENDANT SWITCH WITH AN UNTENSIONED INTERMEDIATE POSITION

BACKGROUND OF INVENTION

In industrial applications such as controls for overhead electrical cranes and electrical hoists, it has been found desirous to have a single control station where switches may be housed to selectively control such equipment in movement to different positions and at different speeds. Various types of control panels or pendant control switch units have been utilized, all of which have been confronted with problems of space requirements necessitated by the use of a large number of switch devices to control a large number of desired control functions.

SUMMARY OF INVENTION

According to the present invention, there is provided a new and improved pendant switch unit having a novel casing for housing a plurality of multiple position switches to be manually adjusted such that each switch controls a separate control function with a multiple choice of speeds by use of a single new and novel economical space-saving push-button device.

Other provisions of this invention will be more apparent when studied in conjunction with the following detailed description and accompanying drawings wherein:

FIG. 1 is a plan view of the novel pendant switch casing;

FIG. 2 is a side elevational view of the pendant switch casing partly in section;

FIG. 3 is an end elevational sectional view of the switch casing;

FIG. 4 is a perspective view of a switch unit;

FIG. 5 is front elevational view of a switch unit;

FIGS. 6 and 7 are respectively side and bottom elevational views of an internal switch;

FIG. 8 is a top elevational view partly in section of the switch unit;

FIG. 9 is a front sectional view of FIG. 8 taken along the line 9—9;

FIG. 10 is a plan view of a switch actuator;

FIGS. 11, 12 and 13 are respectively top, end and bottom elevational views of the switch actuator of FIG. 10;

FIGS. 14 and 15 are respectively side and end elevational views of a switch interlock;

FIG. 16 is a proposed schematic of the wiring circuit of a switch unit.

Referring to FIG. 1 there is shown a pendant switch device 10 having a plurality of push button switches 12 housed within a casing 14 in a linear manner. The switches 12 are arranged in pairs as switch units 16 as can be seen in FIG. 2, each unit 16 controlling a specific operation while the individual switches 12 of each unit 16 control the speed and direction of the specific operations as explained hereinafter.

The casing 14 as seen in FIGS. 1, 2, 3 is formed of two elongated channel shaped halves 18 and 20 of metal such as steel. Although the casing 14 is usually utilized in a vertical position, for purposes of description, it is shown herein in FIGS. 1, 2 and 3 in a horizontal position wherein one half is referred to as the upper half 18 while the other half is referred to as the lower half 20. With the exception of the inside upper surface

22 of the upper half 18 and the inside bottom surface 24 of the lower half 20, the casing 14 is completely encased in a cover 21 of an elastomeric molded material such as neoprene so as to have the entire outside of said casing 14 electrically non-conductive. The ends of the channel halves are closed in with the neoprene to give the casing an insulated rectangular shape with a cable entry opening 25 in one end. The dimensions of the casing 14 are predetermined to house a predetermined number of switch units 16, shown herein in FIGS. 1 and 2 as three units providing six push buttons. Although shown as a six button combination, any desired number of buttons may be provided.

When assembled as shown in FIG. 2, the switch units are secured to the inside surface 22 of the upper half 18 by suitable means such as screws (not shown) and the top and bottom halves 18 and 20 are securely bolted together by means such as bolts 26 to bind the outer edges 27 of the casing in a water-tight fashion with suitable overlapping surfaces (not shown). A plurality of openings 28 in the metallic portion of the inside upper surfaces 22 permit the push button stems 30 of the switch units 16 to extend therethrough a distance of half of its hereinafter described operating travel such that the stems 30 can be selectively positioned from a fully extended non-operating or unactuated position as shown in FIG. 2 at 32, through a series of operating positions representing different operating speeds explained hereinafter, to a full operating position shown at 34 in FIG. 2

Flexible neoprene button diaphragms 36 (FIGS. 1, 2 and 3) are integrally molded to the neoprene cover 21 across the openings 28 in the upper half 18 of the casing 14 with a solid mold to prevent water, dust or dirt from entering the inside of the assembled casing 14 and fouling the switch units 16 therein. The molding application of these button diaphragms 36 is unique in that the natural positions of the diaphragms 36 are initially formed in the same plane as the surface of the upper half 18 of the casing 14 in a manner such that when the switch units 16 are in position within the assembled casing 14, the button stems 30 engage the center area of the diaphragm 36 and cause it to be distended outwardly from the casing 14 to an unactuated non-operating position, a distance of half the operating travel of the button stem 30. A spring 38 (within the switch unit 16 described hereinafter) tends to maintain the button stem 30 and the button diaphragm 36 in this outward extending non-operating position. As seen at 32 in FIG. 2 during operation of the switch units 16 (explained hereinafter) the button diaphragm 36 and the engaged button stem 30 are manually pushed towards the inside of casing 14 through a series of switch operating positions (hereinafter described) towards the inside of casing 14 to a position at 34. The movement of the diaphragm 36 passes from an outwardly distending state at 32 through its described natural position halfway through the button stem operating travel and then continues on to be distended inwardly the remaining half of operating travel to a full operating position of the button stem 30 at 34. Release of manual pressure on the diaphragm 36 permits the spring 38 to return the button stem 30 and engaged diaphragm 36 to be returned back through the operating travel distance to the outwardly extended non-operating position at 32. This novel arangement of the diaphragm 36 permits a wide range of operating travel of the diaphragm 36

without putting any severe internal stress thereon and thereby lengthens the operating life of the diaphragm **36**. A plurality of protective bumpers **37** are suitably located surrounding the openings **28** to prevent damaging of the button stem **30**.

The end view of FIG. **3** illustrates one shape of the diaphragms **36** as located in the openings **28** of the upper half **18**.

The switch unit **16** as shown in FIG. **4** consists of a non-conductive container **40** made of a sturdy material such as a phenolic resin, with a cover **41** made of metal such as aluminum and secured across the top of the switch container **40** by screws **42**. As viewed in FIGS. **4** and **5** the front side **44** of each switch unit **16** has a terminal strip **46** secured thereto by screws **48**. Terminal strips **46** include a plurality of terminal screws **50** each of which may be connected by suitable wiring to precision switches within the container **40**, back to selected terminal screws **50**, and thence via selected wiring (not shown) making up a multiple connector cable **52** (FIG. **1**) leading from the pendant casing **14** to the equipments desired to be controlled as further described hereinafter. A plurality of mounting brackets **54** are formed in the top (FIG. **4**) of the container to provide means for securing the switch units **16** to the inside upper half **22** of the casing **14** when the pendant switch device is assembled.

Housed within the container **40** of each switch unit **16** is a plurality of precision switches **56** (FIGS. **6** and **7**) arranged in two sets **58** (only one of which is shown in FIGS. **8** and **9**) in separate compartments **60** and **62** of the container **40**. The switch sets **58** include a plurality of switches **56** arranged side by side in each of the compartments **60** and **62** as shown in FIGS. **8** and **9** wherein the set **58** is comprised of five individual switches maintained in position by a pair of retaining rods **64** and **66** shown in FIG. **8** with the relative position of the ends thereof shown in FIG. **4**. Although five switches are shown and described herein, it should be noted that a lesser number of switches may be utilized with appropriate spacing means as necessary for specific control requirements.

As shown in FIGS. **6** and **7**, the switches **56** are well known precision micro-switch mechanisms (not shown) contained in compact non-conducting housing **68** with external switch terminals **70** and **72** and an engaging roller **74** mounted on a movable arm **76** to pivotally position responsive to push button action explained hereinafter, to move a contactor **78** inwardly against an internal spring action and operate the usual internal switch mechanism selectively to a circuit closed or open position.

A push button actuator **80** is slidably positioned in an elongated guide cavity **82** formed in the walls and a dividing section **83** of the container **40**. The positioning of push button actuator **80** is shown in FIGS. **8** and **9** wherein the bottom portion of FIG. **8** with the cover **41** cut away illustrates the position of the push button actuator **80** with respect to the guide cavity **82** and one set **58** of precision switches **56**, while the top portion of FIG. **9** illustrates the relative position of the push button actuator **80** with respect to the spring **38**, and the cavity **82** in the switch compartment **62**.

The push button actuator **80** (FIGS. **10, 11, 12, 13**) is made of non-conductive plastic material having a button stem **30**, a guide **86** and an intermediate cam portion **88**. The cam portion **88** consists of a plurality of inclined camming surfaces **90, 92, 94, 96, 98** arranged side by side with each cam surface beginning its angle of inclination at a different distance below the top **89** of the cam portion **88**. The cam surfaces **90-98** are located on each of the cam portions **88** which are slidable in the cavity **82** within each switch compartment **60, 62** adjacent to the roller **74** of a set of switches **56** to engage each roller **74** of a switch set to effect closing of each switch mechanism thereof in a pre-selected sequence as the actuator **80** is manually moved into the cavity **82** and in a reverse sequence of opening as a spring **38** moves the actuator **80** outward of the cavity **82** when manual pressure is released as described further hereinafter. One sequence of the effectiveness of the cam surfaces is shown in the FIG. **10**, however various pre-selected locations of the cam surfaces below the top **89** can be prearranged in the forming of the actuators as desired. Each of the actuators **80** is maintained in position within the switch compartments against the forces of springs **38** by the cover **41**, with the button stems **84** projecting through openings **102** and **104** therethrough.

An elongated slot **106** is provided in the divider **83** (FIG. **9**) between the two switch compartments **60** and **62**, with elongated guide slots **107** and **108** extending perpendicular therefrom opening into each of the said switch compartments **60** and **62**. A disc shaped switch interlock **110** (FIGS. **14, 15**) having a suspension pin **112** extending perpendicular therethrough and eccentrically located near the periphery of the disc, is positioned with the pin **112** riding in the slot **106**. The sides of the disc interlock **110** extend through the guide slots **107** and **108** into the switch compartments **60** and **62** on either side of the divider **83**. If either one of the actuators **80** are manually moved inwardly, the cam portion **88** thereof will engage the extended side of the disc interlock **110** in the respective switch compartment to thereby pivot the interlock **110** about the suspension pin **112** into the opposite switch chamber to thereby permit the moving actuator **80** to pass by the interlock to permit the cam surfaces **90-98** to engage their respective rollers **74** to operate the switch set in that particular switch compartment. The pivotal movement of the interlock **110** into the opposite switch compartment will prevent the adjoining actuator **80** (operative therein) from being manually moved inward against the disc and thereby providing an interlock operation whereby only one actuator **80** may be moved inwardly at any one time.

An example of the type of circuitry that may be controlled by this device is shown in FIG. **16** utilizing six internal circuits with lead wires omitted. Normal lead wires extend from the various switch units **16** to form a cable **52** (FIG. **1**) which extends from the switch casing **14** to units to be controlled. A hanger **114** is provided on casing **14** to conveniently locate the casing as desired.

As seen in FIG. **2**, the switch units **16** are secured side by side to the inside surface **22** of the upper half of the casing **14** by the screws mounted in the brackets **54** on the switch container **40**. According to the control circuit requirements, the switch units are selectively wired from incoming and return wires (not shown) in the cable **52** (FIG. **1**) to the selected terminal screws **50** on the selected terminal strips **46** (FIG. **4**) for the desired switch **56**. An example of the internal wiring is shown in FIG. **16** wherein the terminal strip **46** and switches

56 are shown in part as a simplified dotted block form. The selection of the specific switch circuit is made in accordance with the specific control requirements such that each actuator **80** operates a single control operation with each control operation have specific degrees of control, such as different degrees of speed of motor operation, which are controlled in predetermined steps by selective operation of each switch **56** of each switch set **58** associated with the actuator **80** being utilized. An example being one switch unit **16** having the shown two push button actuators wherein the interlock **110** (previously described) prevents both from being actuated at the same time, however, one actuator may be moved inwardly different degrees to select different motor speeds in one direction while the second actuator of the same unit may be moved inwardly different degrees to select different speeds of the same motor but in the opposite direction.

In describing the operation of the actuators **80** with respect to the switch sets **58** it should be noted, that as viewed in FIG. **9** an actuator **80** is associated and operates with the shown switch set **58** although for purposes of description is not shown. Similarly, a switch set **58** operates and is associated with the shown actuator **80** although for simplicity of description is not shown therewith.

In operation, as an actuator **80** is manually moved inwardly within the switch compartments **60** or **62**, the cam portion **88** slides within the guiding cavity **82** to an engaging position where the cam surface furthermost from the top **89** of the cam portion **88**, engages a cam roller **74**. As viewed in FIGS. **8, 9** and **10** the cam surface **94** is the first surface to engage a roller **74** and therefore is the first of the switches **56** of that particular switch set **58** to operatively closed by action of the roller **74** on the contactor **78**. Viewing the drawings it can be seen that the cam surfaces **94, 96, 92, 98** and **90** engage the associated rollers **74** and move the contactors **78** in that sequence such that the associated switches **56** will be operatively closed in that order as the actuator **80** is manually moved upwardly by pressing on the button stem **30** thereof. Releasing the button stem **30** permits the associated spring **38** to return through the reverse sequence of opening the switches associated with the cam surfaces **90, 98, 92, 96** and **94** in that order. The spring **38** returns the button stem **30** to its non-operating position **32** to bias the button diaphragm **36** to its outwardly extended position. It can thus be seen that by selective wiring of the switches, a forward and reverse sequence of control operation can be effected for a single unit such as a crane motor with the speeds thereof being sequentially increased as the actuator **80** is pushed inwardly, and the motor speeds being sequentially decreased as the actuator **80** is released and returned to its non-operating position by the spring **38.**

The spacing and locating of the respective cam surfaces can be varied as desired to effect different sequences of different controls to meet any needs. The pair of actuators **80** in each switch unit **16** should normally control the same motor at sequential speeds forward for one actuator and sequentially in reverse speeds for the second actuator. The plurality of switch units **16** in one casing **14** provides for a single compact remote control station for a plurality of motors performing separate functions.

Since numerous changes may be made in the above-described construction and different embodiments of the invention may be made by addition, elimination or relocation of switch units, switch chambers and cam surfaces without departing from the spirit and scope thereof, it is intended that all matter contained in the foregoing description as shown in the accompanying drawings shall be interpreted as illustrative and not in a limiting sense.

What is claimed is:

1. An electrical switch comprising, in combination: an insulated housing; at least one switch means located within said housing; said switch means having actuating means substantially lineraly movable in opposite directions and biased in one of said directions; said housing having integral deformable elastomeric web means overlying said actuating means and flexible in at least said opposite directions; said actuating means being normally biased in said one direction and in said normally biased position engaging and biasing said web in said one direction into a tensioned state from an untensioned state thereof; and upon movement of said actuating means a predetermined distance in a direction opposite said one direction said web means passes from the tensioned state thereof at least to said untensioned state.

2. The combination set forth in claim **1** further characterized in that said switch means includes a plurality of contactor devices axially aligned in a common plane.

3. An electrical switch as specified in claim **1** wherein upon movement of said actuating means said predetermined distance said web means passes from the tensioned state thereof through said untensioned state and into an oppositely tensioned state.

4. An electrical switch as specified in claim **3** wherein said untensioned state is at a distance substantially equidistant from the extreme tensioned and oppositely tensioned stae of said web means.

5. An electrical switch as specified in claim **1** wherein said actuating means engages said web means at a central location of said web means.

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