Sept. 19, 1950 W. R. WICKERHAM 2,523,170

PENDANT SWITCH FOR CRANE CONTROL

Filed May 24, 1949 3 Sheets-Sheet 1

Fig.1.

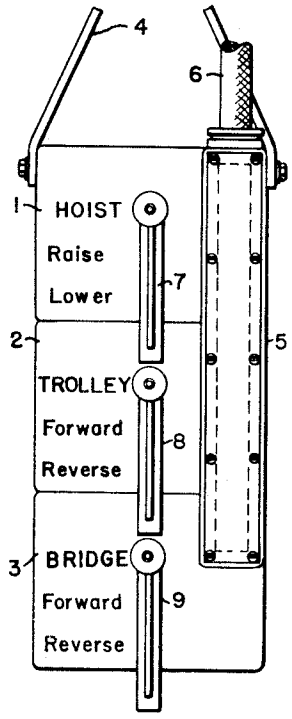


Fig.2.

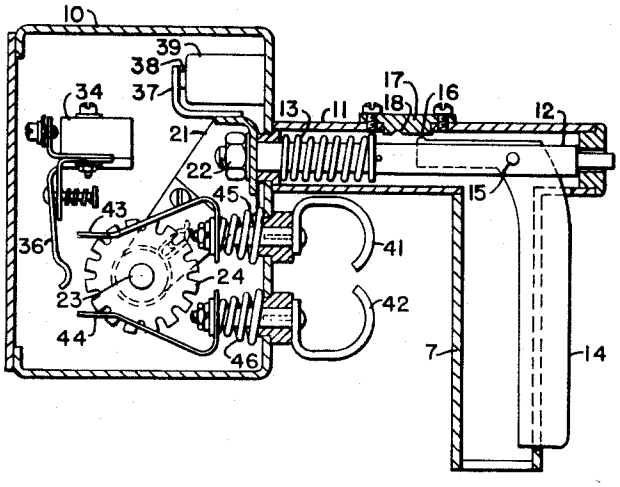
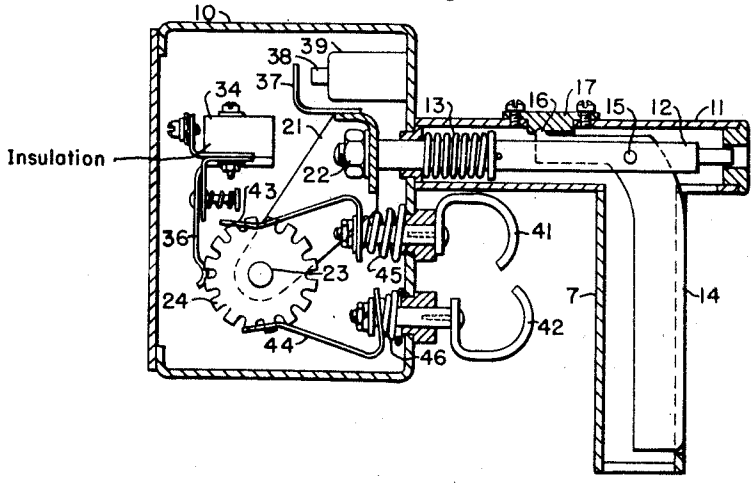


Fig.3.



WITNESSES:

N. F. Susan

Wm. C. Groome

INVENTOR

William R. Wickerham

BY C. M. Avery

ATTORNEY

Sept. 19, 1950 W. R. WICKERHAM 2,523,170

PENDANT SWITCH FOR CRANE CONTROL

Filed May 24, 1949 3 Sheets-Sheet 2

Fig.4.

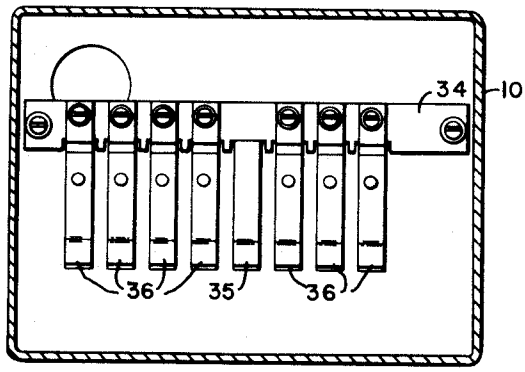


Fig.5.

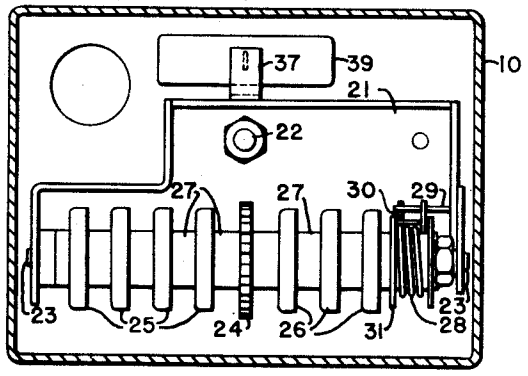
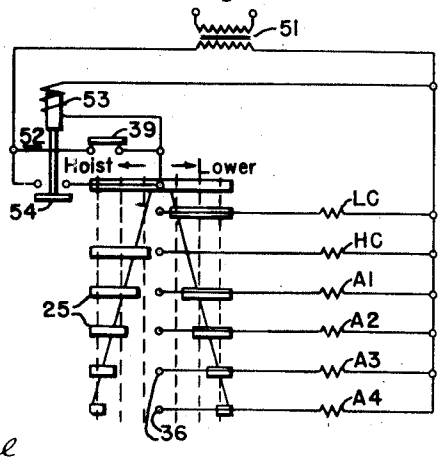


Fig.6.



WITNESSES:

H. F. Susan.

Wm. C. Groome

INVENTOR

William R. Wickerham.

BY C. M. Jung

ATTORNEY

Sept. 19, 1950 W. R. WICKERHAM 2,523,170

PENDANT SWITCH FOR CRANE CONTROL

Filed May 24, 1949 3 Sheets-Sheet 3

Fig.7.

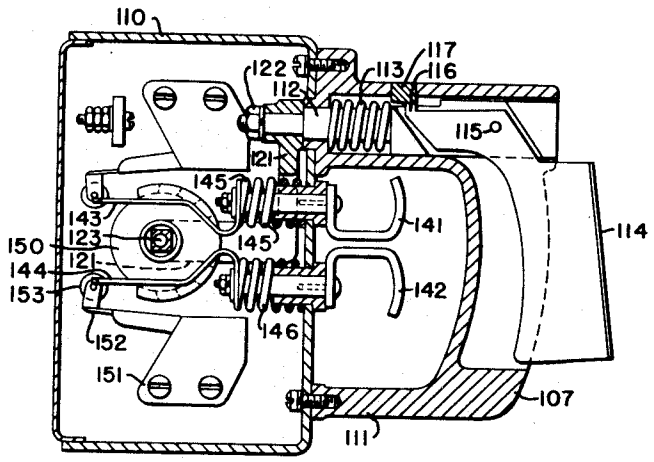


Fig.8.

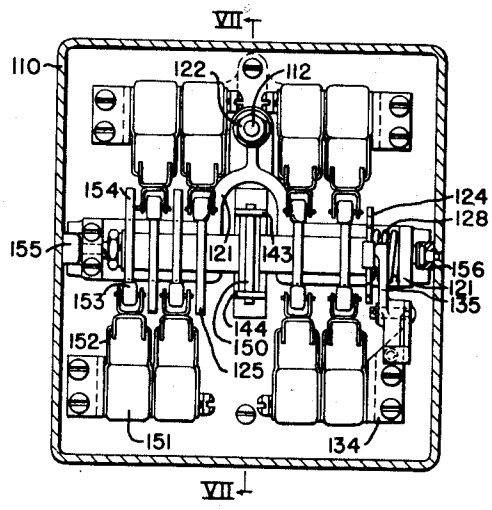
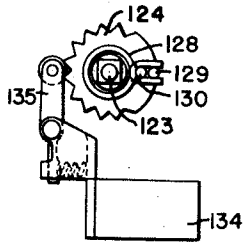


Fig.9.



WITNESSES:

N. F. Susan

Mrs. L. Groome

INVENTOR

William R. Wickerham.

BY C. M. Avery

ATTORNEY

Patented Sept. 19, 1950

2,523,170

UNITED STATES PATENT OFFICE

2,523,170

PENDANT SWITCH FOR CRANE CONTROL

William R. Wickerham, Buffalo, N. Y., assignor to Westinghouse Electric Corporation, East Pittsburgh, Pa., a corporation of Pennsylvania

Application May 24, 1949, Serial No. 95,023

12 Claims. (Cl. 200—157)

1

My invention relates to manually operable electric control or selector switches and in a more particular aspect, to pendant switches for controlling cranes and other hoists. Such pendant switches are suspended from the hoist or crane to permit operating the hoist, bridge and trolley motors from the floor and are designed as multi-point controllers to run the motors in different directions and at different speeds.

It is desirable to design such selector switches so that they can be held and operated with one hand only, thus permitting the operator to use his other hand, for instance, for directing a hoist load. The known switches of this type have one or two grips and several spring-biased pull handles underneath each grip so that the handles can be pulled by the fingers of the same hand that holds the grip. The handles control several multi-position contacts so that the motor controlled thereby operates on one or the other of its speed steps depending upon how far the spring-biased handle is pulled out of its "off" position. The switch is further equipped with a separately operable emergency contact for instantaneously cutting off and restoring power to the controlled motor, and with a separately controllable reset contact for restoring the switch to its off condition after the occurrence of an automatic interruption due to overload or low voltage.

It is an object of my invention to devise a manual selector switch for one-hand operation which provides an absolute point by point control for both running directions of the controlled motor rather than a control by feel or skill of the operator as required for the proper manipulation of the known multi-position pull handles.

Another object of my invention is to devise a one-hand selector switch which, by the inherent functioning of its multi-point control mechanism, provides for an instant circuit interruption from any previously existing speed adjustment, thus obviating the necessity of adding a separately operable emergency contact and permitting a safer and more speedy interruption of power in emergencies.

Still another object of my invention, also relating to one-hand selector switches, is to make the switch automatically resetting, thus eliminating the necessity of performing a separate resetting manipulation after the occurrence of overload or voltage failure.

It is among other objects of my invention to provide a pendant one-hand switch whose operation requires less effort or trigger pull than

2

known switches of this kind; to devise a pendant one-hand switch which is applicable for various control circuits and systems, including magnetic controls, regardless of intricacies of circuit design; and to provide a pendant crane control switch for two or three motors (hoist motor, trolley motor and/or bridge motors) which may be manipulated either with one hand for operating any one of the motors or with both hands for simultaneously operating two of the motors.

While the novel means, by which the invention achieves these and the more specific objects apparent from the following, are particularly set forth in the annexed claims, these means are more fully described and explained hereinafter with reference to the drawings, in which:

Figure 1 shows a triple pendant switch according to the invention for controlling the hoist, trolley and bridge motors of a crane;

Figs. 2 and 3 show cross sections of one of the switch units in two different operating conditions respectively;

Figs. 4, 5 and 6 show the contact finger and pawl assembly and the contact drum assembly respectively of the same switch unit;

Fig. 6 shows an example of a control circuit and drum development applicable with the same switch unit; and

Figs. 7, 8 and 9 represent another embodiment of a switch according to the invention in a sectional view, rear view and detail illustration respectively; the sectional view of Fig. 7 being taken along the plane denoted by line VII—VII in Fig. 8.

Referring to the multiple switch unit shown in Fig. 1 of the drawings, it is assumed that this unit serves for operating a bridge crane. The unit is composed of three individual switches 1, 2, 3, which are joined together and are suspended by means of a bracket 4. A cable duct or channel member 5 interconnects the three switches and has an outlet for a cable 6 that contains all electric leads connected to the unit. Each switch has a handle 7, 8 or 9. One of these handles is to be seized and held by the operator of the crane, depending upon whether he wants to operate the hoist motor, the trolley motor, or the bridge motor.

Each of the three switch units is designed in accordance with Figs. 2 through 5. As apparent from Figs. 2 and 3, the individual switch unit has a casing 10, which has a projecting portion 11 that is integral with the handle 7. A slide pin 12 is displaceable in the housing portion 11 and is biased by a spring 13 toward the normal position illustrated in Fig. 2. A switch member 14 is

pivoted to the displaceable part 12 by a pivot pin 15 and has a nose 16 in sliding engagement with a surface of a guide block 17 which is firmly secured to the housing portion 11 and has a notch at 18. The member 14, under the bias of spring 13, normally projects through a slot of handle 7 as is apparent from Fig. 2. When the handle 7 is grasped and held by the operator, the member 14 is pushed into the handle so that the slide pin 12 slides toward the left in opposition to the biasing force of spring 13 until it reaches the position shown in Fig. 3. In this position the nose 16 of member 14 engages the notch 18 of the guide block 17 so that much less manual force is required to hold the slider 11 in the position of Fig. 3 than is necessary to move the slider into that position. When the handle is released by the operator, the spring 13 causes the nose 16 to be disengaged from the notch 18 so that slider 12 and member 14 move back to the position shown in Fig. 2.

A bracket structure 21 is firmly secured to slider 12 by means of a fastening screw 22 (Figs. 2, 3, 5). A shaft 23 for a revolvable contact assembly is journalled in the bracket structure. The revolvable assembly comprises a ratchet wheel 24, a number of contact carrying discs 25, and intermediate insulating spacers 27 (Fig. 5). A return spring 28 is mounted on the revolvable assembly and has its two ends abutting against pins 29 and 30. Pin 29 is attached to the bracket structure 21. Pin 30 is attached to a disc 31 which is rigidly secured to the assembly. The spring 28 tends to hold the assembly in a given position of rest ("off" position) but permits the assembly to be revolved in either direction in opposition to the spring force.

Mounted in the housing 10 is an insulating bar 34 which carries a spring-biased detent 35 (Fig. 4) for engagement with the ratchet wheel 24 and also a number of elastic contact fingers 36 (Figs. 2, 3, 4) for engagement with the respective segments of the discs 25.

Attached to the bracket structure 21 is an arm 37 for engagement with the push button 38 of a switch 39 which is mounted in the housing 10. The push button 38 is depressed, and the switch 39 opened when the unit is in the condition of rest illustrated in Fig. 2, and the button 38 is released and the switch 39 closed when the handle 7 is held by the operator and the slider 12 in the position shown in Fig. 3.

Mounted on the housing 10 are two triggers 41 and 42. These triggers are located underneath the handle 7 so that they can be operated by two fingers of the hand holding the handle 7. Attached to the triggers and located within the housing are respective ratchet pawls 43, 44 and appertaining biasing springs 45, 46 which tend to hold the triggers and pawls in the position shown in Fig. 2.

When the unit is in condition of rest according to Fig. 2, the revolvable assembly is removed from the detent 35 and the contact fingers 36, and the position of the ratchet pawls 43 and 44 relative to the ratchet wheel 24 is such that the pawls cannot engage the ratchet wheel. Consequently, the revolvable assembly is now only subject to the biasing force of the return spring 28 and is kept in its "off" position.

When the handle 7 is held by the operator so that slider 12 and member 14 are in the position of Fig. 3, the revolvable assembly is moved into its operative position in which the detent 35 engages the ratchet wheel 24 and the contact fingers 36 are in position to engage the contact segments of disc 25. Now, when one of the two triggers is pulled out of the housing, the corresponding pawl engages the ratchet wheel 24 and moves it one angular step in one or the other direction depending upon which of the two triggers is pulled. For instance, when trigger 42 is pulled (Fig. 3), pawl 44 engages the ratchet wheel 24 and turns the assembly counterclockwise one step. When the trigger 42 is thereafter released, the ratchet wheel 24 and the whole assembly are retained by the detent 35 so that the pawl 44, biased by spring 46, slides back into its normal position. When the same trigger 42 is pulled a second time, the revolvable assembly moves another step and so forth. In this manner, the motor controlled by the switch unit can be adjusted to run at any of the available speeds in the direction by which of the two triggers is pulled. In order to adjust the revolvable assembly to a lower speed, it is merely necessary to pull the other trigger, for instance trigger 41; and each actuation of the trigger will turn the assembly back one step, i. e., to the next lower speed.

In order to further elucidate this performance, one of the many suitable examples of control circuits will be described with reference to Fig. 6 in which the switch 39 represents the switch denoted by the same numerals in Figs. 2, 3 and 5, and the contact segments 25 denote those appertaining to the disc members 25 in Fig. 5. The contact fingers 36 according to Fig. 4 are schematically represented by terminals 36 in Fig. 6.

The control system is energized through a transformer 51 and is equipped with a low voltage relay 52 whose coil and contact are denoted by 53 and 54, respectively. The selector switch according to Figs. 2 through 5 is shown schematically in developed form. The contactors appertaining to the system are represented in Fig. 6 only by the respective control coils. Coils LC and HC appertain to a lowering contactor and hoist contactor, respectively. These contactors determine the polarity of connection and hence the running direction of the motor to be controlled. Coils A1, A2, A3 and A4 are those of accelerating contactors whose energization determines the speed of the motor. Relay systems for hoist, trolley and bridge motors operable with a control circuit according to Fig. 6 are well known in many modifications and are not shown in the drawings because they do not form part of the invention proper.

When the switch unit is in its normal position according to Fig. 2, the control circuit is interrupted at contact 39 and contact 54, the revolvable assembly is in the "off" position shown in Fig. 6, and the contact fingers 36 are not in engageable position relative to the contact segments. When the handle of the switch unit is grasped and held by the operator, switch 39 closes. As a result, relay 52 is energized and closes its self-holding contact 54. As explained previously, the contact fingers 36 are now engageable with the contact segments 25, but since the movable contact asembly is in its "off" position, none of the contactor coils are energized. If now one of the triggers 41 and 42 is pulled, the assembly moves one step either in the lowering or hoisting direction and causes the motor to run at the lowest speed in the selected direction. A second actuation of the same trigger moves the contact assembly to its second step and causes the motor to run at higher speed, and so forth.

When the handle of the switch unit is released by the operator, the contact assembly snaps back to the position illustrated in Fig. 2. Consequently, regardless of the previous position of the revolvable assembly the control circuits to all contactors are immediately interrupted due to the separation of the revolvable assembly from the contact fingers. Thus the switch unit performs also the function of an interrupting contactor and makes the provision of a separate contactor for this purpose unnecessary. The circuit remains deenergized until the switch unit is again grasped by the operator.

It will be recognized from the foregoing that a switch unit according to the invention affords a positive step by step operation which does not require special skill or feel from the operator for selecting and maintaining a desired motor speed.

It will also be apparent that the unit does not require the actuation of a separate emergency switch or contact because it operates inherently as such an emergency device due to the immediate separation of the revolvable contact assembly from the stationary contacts. This not only simplifies and improves the design in comparison with the switches heretofore available, but also secures a higher speed and increased safety of operation because the mere release of the switch by the operator's hand is rapidly effective to deenergize the control circuit.

The unit also does away with the resetting switch or mechanism because, when the handle is released by the operator, the revolvable contact assembly is automatically returned to its "off" position.

As apparent from Fig. 1, a switch according to the invention lends itself readily to being combined with others to a multiple switch apparatus for the control of a plurality of motors. Switches according to the invention are applicable for practically all variations of control circuits customary for motor control, and they can, of course, also be used for purposes other than controlling motors. Aside from its use or design as a pendant switch for crane control, the invention is also applicable for switches that are stationarily mounted or structurally integrated with electric apparatus to be controlled, such as electric drills and other portable electric equipment.

The embodiment represented in Figs. 7, 8 and 9, although designed differently from the above-described switch unit, performs substantially the same functions and is composed of similar elements. Those elements of the switch shown in Figs. 7 to 9 that are denoted by numerals between **107** and **144** correspond in functional respects substantially to the elements denoted by the respective numerals **7** through **44** in Figs. 1 to 5. Consequently the foregoing description of the embodiment shown in Figs. 1 through 5 is in substance also applicable to the embodiment of Figs. 7 to 9. It should be noted, however, that while the ratchet wheel **24** (Figs. 2, 3, 5) of the first-described embodiment cooperates with a detent **35** as well as with ratchet pawls **43** and **44**, the corresponding ratchet gear **124** of the second embodiment cooperates only with a detent **135** and has a separate ratchet gear **150** for cooperation with ratchet pawls **143** and **144**. The detent **135** in the embodiment of Figs. 7 to 9 is pivoted on a structure **134** which consists of a metal bracket and is mounted on the housing **110** of the switch at one side of the cam shaft **123**. In further contrast to the embodiment of

Figs. 1 through 5, the switch unit according to Figs. 7 to 9 is equipped with individually enclosed contact or switch units such as the one denoted by **151**. Each of the eight illustrated individual switch units has an actuating member such as the one denoted by **152**, equipped with a roller **153** for engagement by the appertaining cam disc **154** of a cam shaft **123**. The bracket structure **121** which is displaceable by the spring biased pin **112** and carries a cam shaft **123** is equipped with guide surfaces that extend vertically with respect to the plane of illustration in Fig. 8 and are engaged by a roller **155** or **156**. The rollers **155** and **156** (Fig. 8) are mounted on the housing **110** and provide a secure guidance of the displaceable bracket structure **121** and the revolvable assembly journalled thereon as this bracket structure is being moved from the rest position (Fig. 7) into operative relation to the actuating pawls and switch units.

The just-mentioned features and the operation of the device of Figs. 7 to 9 will be more fully understood from the following:

When the device is at rest according to Fig. 7, the revolvable assembly is out of operative engagement with the ratchet pawls and also removed from the actuating rollers **153** of the individual switch unit. The revolvable assembly is now only subjected to the biasing force of the return spring **128** and hence is kept in the "off" position. When the handle **107** is grasped by the operator so that the member **114** is forced toward the switch housing, the slide pin **112** (Fig. 7) moves toward the left in opposition to the bias of spring **113**, and the nose **116** of member **114** slides along the guide block **117** until it snaps behind the block and thus secures the slide pin **112** in the proper operating position. As the slide pin **112** moves from the illustrated position (Fig. 7) toward the left, the bracket structure **121** is taken along. The cam shaft **123** journalled on the bracket structure **121** also moves toward the left into its operative position in which the pawls **143** and **144** become capable of moving the ratchet gear **150** in one or the other direction, and in which the cam members **154** are capable of actuating the rollers **153** of the individual switch units.

When thereafter the operator actuates one of the two triggers **141**, **142**, the revolvable cam assembly turns stepwise in the same manner as described in the foregoing with reference to the embodiment of Figs. 1 to 5, i. e., one of the ratchets **143** and **144** rotates the cam assembly stepwise in the direction determined by the selection of the actuated trigger. In this manner the cam members are caused to actuate the individual switch units in the sequence and combination required for the desired switching operations.

It will be obvious to those skilled in the art that as regards structural and electrical features of my invention, the design may be altered and modified in various respects without departing from the essence of the invention and within the features set forth in the claims annexed hereto.

I claim as my invention:

1. A switch, comprising a housing having a handle, a spring-biased control member normally projecting out of said handle to be depressed when said handle is grasped, a spring-biased trigger projecting out of said housing to be operable by the hand holding said handle, a selective contact device disposed in said housing, a

stepping drive coupling said device with said trigger and being connected with said control member to operatively connect said device with said trigger only when said member is depressed, said device having a return spring for returning said device to a given position when said member is released.

2. A switch, comprising a housing having a handle, a spring-biased control member normally projecting out of said handle to be depressed when said handle is grasped, a contact controlled by said member to close an electric circuit only when said member is depressed, a spring-biased trigger projecting out of said housing to be operable by the hand holding said handle, a selective contact device disposed in said housing and electrically connected with said contact for controlling said circuit, a stepping drive coupling said device with said trigger and being connected with said control member to operatively connect said device with said trigger only when said member is depressed, said device having a return spring for returning said device to a given position when said member is released.

3. A switch, comprising a housing having a handle portion, a part displaceably mounted in said housing and being movable between two positions, a spring biasing said part toward one of said positions, electric switch means disposed in said housing and connected with said part to be controlled by movement of said part between said positions, a member pivoted to said part and normally projecting out of said handle portion under the bias of said spring so that said member is depressed and moves said part to said other position when said handle portion is grasped, said housing having a guide engaging said member for preventing its pivotal movement relative to said part during movement of said part, one of said guides and member having a recess and the other a projection engageable with each other in said other position of said part thus forming a catch for reducing the effort needed to hold said part in said other position while permitting said spring to return said part to said one position when said member is released.

4. In a switch according to claim 3, said electric switch means comprising a selective contact device having two contact assemblies movable relative to each other into and out of mutual engagement, one of said assemblies being revolvable, said device being connected with said part so that said assemblies are in engagement only when said part is in said other position, a trigger mounted on said housing near said handle, and a stepping drive connecting said trigger with said revolvable assembly for revolving the latter when said trigger is actuated.

5. In a switch according to claim 4, said electric switch means comprising a normally open contact electrically series-connected with said contact device and mechanically connected with said part to be closed only when said part is in said other position.

6. An electric control switch, comprising a housing having a handle, two triggers mounted on said housing, said triggers being individually reciprocable relative to said housing and having respective parts disposed on the outside of said housing adjacent to said handle to be individually operable by the hand holding the handle, said triggers having respective spring means individually biasing said triggers toward respective rest positions relative to said housing, a selective contact device disposed in said housing and having a contact member revolvable in two opposing directions and a reversible stepping drive for controlling said contact member, said contact member having a given off position and having a plurality of sequential positions of revolution away from said off position in each of said two directions, and said drive having two actuating members connected with said contact member to revolve said contact member one step for each reciprocation of each trigger and in one of said directions depending upon which trigger is actuated.

7. A pendant switch for hoist control, comprising a housing having a handle, two spring-biased triggers disposed on the outside of said housing adjacent to said handle to be individually operable by the hand holding the handle, a selective contact device disposed in said housing and having a revolvable contact member, a reversible ratchet mechanism having a ratchet gear on said contact member and having two pawls engageable with said gear and connected with said respective triggers for stepwise revolving said contact member in opposite directions depending upon which trigger is actuated.

8. A pendant switch for crane control, comprising a housing having a handle, a spring-biased control member normally projecting out of said handle to be depressed when said handle is grasped, a spring-biased trigger disposed on the outside of said housing near said handle to be operable by the hand holding the handle, a selective contact device disposed in said housing and having a revolvable contact member, a return spring connected with said contact member for biasing said contact member toward a given position, a ratchet gear for revolving said contact member, a detent for arresting said gear member, a pawl member connected with said trigger for stepwise revolving said contact member, said gear and said detent being movable relative to each other into and out of mutually engageable position under control by said control member so as to release said contact member for return by said spring when said handle is released.

9. A pendant switch for crane control, comprising a housing having a handle, a spring-biased control member normally projecting out of said handle to be depressed when said handle is grasped, a spring-biased trigger disposed on the outside of said housing underneath said handle, a selective contact device having two contact assemblies of which one is revolvable, said assemblies being movable relative to each other between mutually engaged and disengaged positions and controlled by said control member to move to said disengaged position when said handle is released, and a stepping drive connected with said trigger for stepwise revolving said revolvable assembly when said trigger is actuated.

10. A pendant switch for crane control, comprising a housing having a handle, a spring-biased control member normally projecting out of said handle to be depressed when said handle is grasped, a spring-biased trigger disposed on the outside of said housing correlated with said handle, a bracket structure movable in said housing and connected with said control member to be displaced when said control member is depressed, a selective contact device having two contact assemblies of which one is revolvable, one of said assemblies being mounted on said bracket

to be placed into engageable position with said other assembly only when said control member is depressed, and a ratchet drive disposed between said revolvable assembly and said trigger for stepwise revolving said latter assembly when said trigger is actuated.

11. A pendant switch for crane control, comprising a housing having a handle, a spring-biased control member normally projecting out of said handle to be depressed when said handle is grasped, a spring-biased trigger disposed on the outside of said housing correlated with said handle, a bracket structure movable in said housing and connected with said control member to be displaced when said control member is depressed, a selective contact device disposed in said housing and having a movable contact assembly and stationary contact assembly, said stationary assembly being firmly secured to said housing, said movable assembly being revolvably mounted on said bracket structure so as to engage said stationary assembly only when said control member is depressed, a ratchet mechanism having a ratchet gear mounted on said movable assembly and having a drive pawl connected with said trigger and engageable with said gear, said trigger is actuated while said control member is depressed, and a return spring connected with said movable assembly for biasing it toward a given position of revolution.

12. A pendant switch for crane control, comprising a housing having a handle, a spring-biased control member normally projecting out

of said handle to be depressed when said handle is grasped, two spring-biased triggers projecting out of said housing near said handle, a selective contact device disposed in said housing and having a movable contact assembly and stationary contact assembly, said stationary contact assembly being firmly secured to said housing, said movable assembly being revolvably mounted on said bracket structure so as to engage said stationary assembly only when said control member is depressed, a reversible stepping drive having a ratchet gear mounted on said movable assembly and having two opposingly acting drive pawls connected with said respective triggers and a detent stationarily mounted in said housing so that said triggers and detent are engageable with said gear only when said control member is depressed, and a return spring connected with said movable assembly for biasing it toward a given position of revolution.

WILLIAM R. WICKERHAM.

REFERENCES CITED

The following references are of record in the file of this patent:

UNITED STATES PATENTS

Number	Name	Date
1,572,509	Schneider	Feb. 9, 1926
1,598,639	Briggs	Sept. 7, 1926
1,741,406	Decker	Dec. 31, 1929
2,442,164	Ferris	May 25, 1948