United States Patent

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[54] **MECHANICAL SWITCH INTERLOCK**
7 Claims, 4 Drawing Figs.

[52] **U.S. Cl.** **335/160,** 200/50
[51] **Int. Cl.** **H01h 9/20**
[50] **Field of Search** ..... 335/160, 161, 159; 200/50 (.3)

[56] **References Cited**

UNITED STATES PATENTS

3,240,889	3/1966	Lawrence	335/160
3,312,122	4/1967	Conner	335/160

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ABSTRACT: An interlock structure prevents inadvertent actuation of the second of a pair of relay switches after actuation of the first of the pair. Rods are moved into the nonactivated switch to block movement of its mechanism.

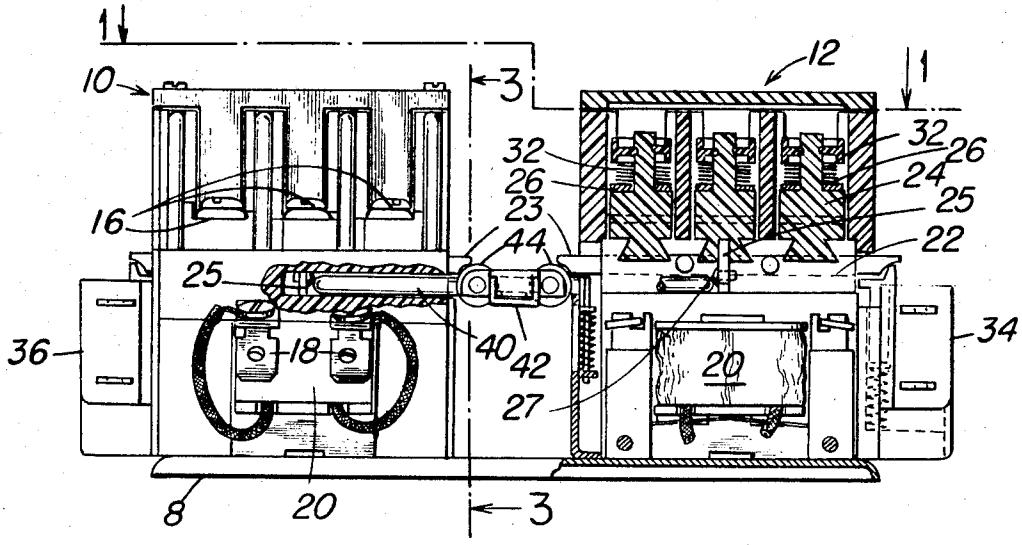


FIG. 1

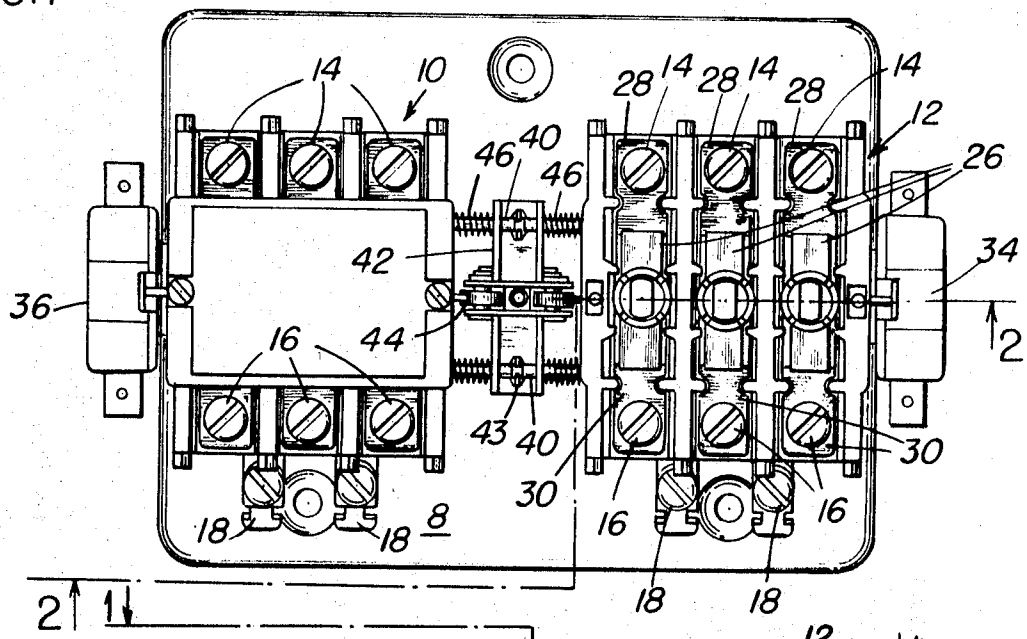


FIG. 2

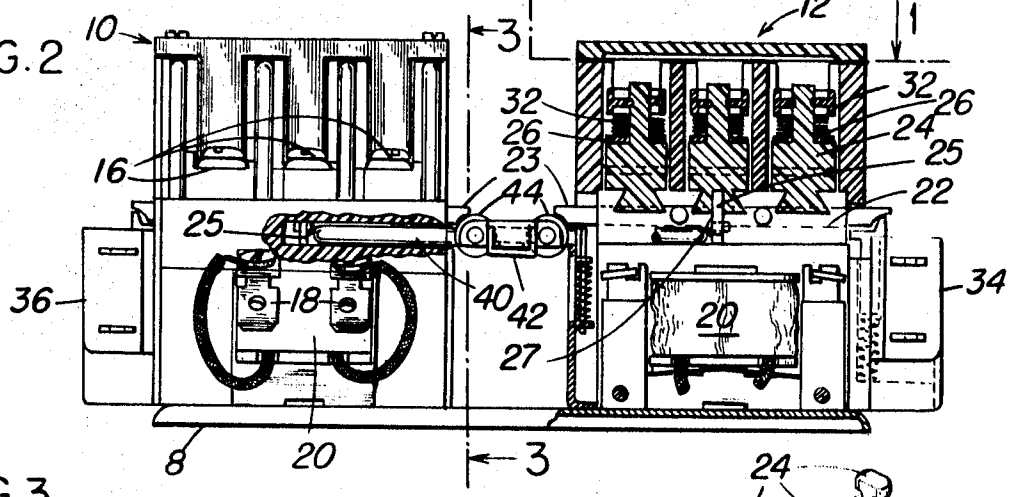


FIG. 3

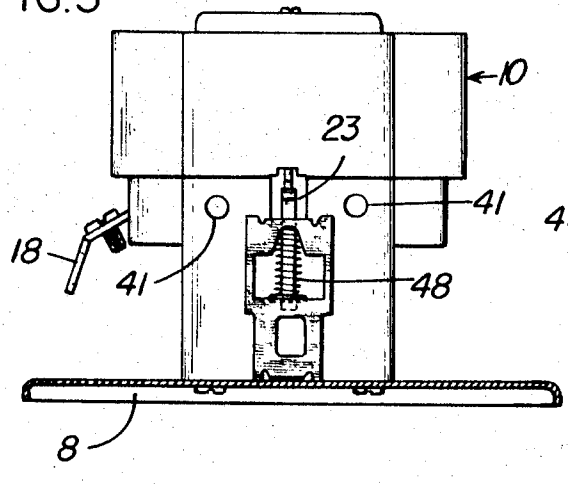
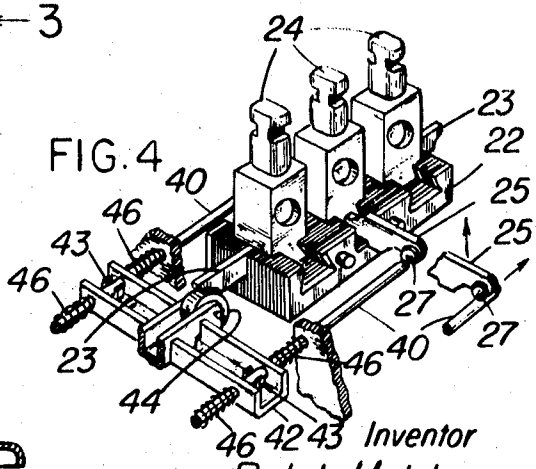


FIG. 4



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MECHANICAL SWITCH INTERLOCK

The present invention is concerned with prevention of inadvertent actuation of plural magnetically operated switches or relays. Such magnetically operated relay switches are widely used to control electrical power as the result of remote control pushbutton actuation. A typical application is the up and down control for an electric hoist. Pushing separate up and down pushbuttons causes actuation of motor control relay switches remote from the buttons which switches accomplish motor reversal. It is apparent that simultaneous pushing of both the up and down buttons is an expectable operator mistake, the consequences of which must be minimized. In the typical hoist control situation, such simultaneous button pushing can cause the forward and reverse windings of the motor to be simultaneously connected to the power line thereby causing a short or motor failure.

The present invention is directed to a novel mechanical interlock which allows the only one of a pair of pushbutton controlled magnetically actuated relay switches to function, the other being locked against actuation.

In the Drawings:

FIG. 1 is a plan view of the assembly of a pair of magnetically actuated relay switches provided with the novel interlock structure, the right-hand relay switch being a sectional view taken along the line 1–1 of FIG. 2;

FIG. 2 is an elevational view of the pair of relay switches of FIG. 1, the right-hand relay switch being a sectional view taken along the line 2–2 of FIG. 1, and a portion of the left-hand relay switch being broken away to show the interlock structure;

FIG. 3 is a view of the right-hand end of the left-hand relay switch assembly taken along line 3–3 of FIG. 2; and

FIG. 4 is a partial perspective view of the interlock structure.

The drawings illustrate the invention in the context of a hoist motor control switch in which a pair of magnetically actuated relay switches or relays **10** and **12** are mounted on a common baseplate **8**. One of the relay switches **10** and **12** is intended to control power to the clockwise windings of the motor and the other to control the counterclockwise windings. These motor windings are connected to one of a pair of terminal groups **14** and **16**, there being three terminals in each group for the three-phase motor control. The power is connected to the other terminal groups **14** and **16**.

A control station located remote from this assembly would have up and down pushbutton switches or the like which are connected to terminal groups **18** and wired so as to energize the respective solenoid coil **20** when one of the pushbutton switches is closed.

Energization of the solenoid coil **20** magnetically attracts an armature **22** downward against return springs **48**. Contact carriers **24** are associated with the armature **22**. Movable contact members **26** are carried by the carriers **24** such that downward movement of the armature **22** causes contacts **26** to contact the fixed contacts **28** and **30** associated with the terminal groups **14** and **16** to complete a circuit between terminal groups **14** and **16**. Movable contacts **26** are associated with the contact carriers with springs **32** to accommodate minor misalignment and to provide adequate contact pressure.

Auxiliary switches **34** and **36** are associated with the primary relay switches such that they also are actuated by the movement of the armatures. The auxiliary switches are used to perform other functions such as the control of indicator lights or warning devices. Auxiliary switches **34** and **36** contain return springs and can be substituted for return springs **48**.

The interlock structure comprises a pair of rods which are inserted in appropriate holes **41** in the housings of switches **10** and **12** and a channel member **42** which is affixed to the rods **40** by small clips **43** which snap into shallow grooves in the rods **40**. The channel member **42** is provided with a pair of rollers **44**. Horizontal movement of the channel member **42** causes the rods **40** to move axially. Springs **46** bias the interlock rod and channel assembly towards a neutral position in the center of the space between relay switches **10** and **12**.

Armature **22** includes a central longitudinal bar **23** which extends beyond the ends of the armature **22**. The ends of bar **23** are shaped to provide cam surfaces which contact the adjacent roller **44** of the interlock assembly. When the armature of one relay switch is attracted downwardly by virtue of energization of its solenoid coil **20**, the cam surface associated therewith causes the interlock structure to slide in a direction away from that relay switch. The cam surface of bar **23** cooperates with roller **44** to translate the vertical movement of the armature into horizontal movement of interlock rods **40**.

Armature **22** also includes a transverse member **25**, both ends of which protrude into the holes **41** in the relay switch housing in which interlock rods **40** slide. When one relay switch armature is activated, transverse member **25** is free to move downwardly because the rods **40** in the switch have been retracted by the cam action of bar **23** and roller **44**. A rounded button **27** and rounded ends on bars **40** provide low frictional resistance to relative movement of the transverse member **25** of the activated switch and the bars **40** and also provide an added horizontal force component to the proximal ends of the rods to insure retraction of the bars from the activated relay switch.

The distal rod ends within the nonactivated switch are urged under the transverse armature member **25** of that switch. FIG. **4** shows the relationship between the rod ends and the armature transverse member **25** in the activated relay switch. The partial detail view included in FIG. **4** shows the rod end after it has moved under the transverse armature member of the nonactivated relay switch. When the rods **40** have been moved under the transverse armature members **25** of the nonactivated relay switch, the armature of that switch cannot move downwardly. The nonactivated relay switch is mechanically blocked and cannot move.

Movement of the nonactivated relay switch is further prevented by the presence under the cam surface on the longitudinal bar **23** of that switch of the adjacent roller **44**. As can best be seen in FIG. **2**, the roller **44** adjacent the nonactivated relay switch is urged under the protruding end of the cam surface. Downward movement of the nonactivated armature is arrested by interference between its cam surface and the roller.

The following is a summary of the operation of the assembly. A remote control switch, such as a pushbutton, is closed to supply current to the coil of the relay switch **10** or **12** associated with that remote control switch. The energized coil magnetically attracts the armature **22** of activated relay switch downwardly. The cam surface of armature longitudinal member **23** engages the roller **44** adjacent to the activated relay switch resulting in a horizontal movement of that roller in a direction away from the activated relay switch. Roller **44** is associated with channel member **42** of the interlock structure and channel member **42** is fixed to rods **40** through clips **43** thereby transmitting the horizontal motion of the roller to the rods **40** to retract the rods **40** from the activated relay switch. The armature **22** of the activated relay switch is free to complete its downward movement to establish electrical connection between fixed contact groups **30** and fixed contact groups **28** through contacting movable contacts **26**. The circuit to the appropriate motor winding is completed. Horizontal movement of the interlock structure inserts the other ends of the rod into the nonactivated relay switch such that they pass under transverse member **25** of the nonactivated relay switch thereby preventing downward movement of the nonactivated armature. Simultaneously, the roller **44** adjacent to the nonactivated relay switch is moved to a position directly under the cam surface of longitudinal bar **23** of the nonactivated relay switch to further prevent actuation of that switch.

Thus, the relay switch associated with the remote control switch first closed is allowed to be activated but the switch associated with another remote control switch is prevented from actuation.

Release of the remote control switch deenergizes the coil allowing the activated armature to return to the upward position by virtue of return springs **48** or the like. The biasing springs **46** retract the interlock structure from the nonactivated relay switch and cause the interlock to assume a neutral position in which either one of the switches can be selected for activation.

A further safety feature of this arrangement comes into force when the solenoid of the second of the relay switches is energized in error. The armature **22** of that second switch is prevented from effecting actuation by virtue of the interference between the transverse member **25** and the interlock rods **40**. However, magnetic attraction of the armature toward the erroneously energized solenoid will develop frictional force on rods **40** sufficient to overcome the neutral bias springs **46**. Thus, the interlock rods are held in locking position in the second relay switch such that they will not retreat when the first relay switch is deenergized. The second switch must also be deenergized before the interlock rods can return to a neutral position. This feature prevents sudden and unexpected direction reversal when the first pressed remote control pushbutton is released.

Although the invention has been described in the context of solenoid actuated remotely controlled switches, it is apparent that the advantages of the interlock structure accrue to directly actuated switches whose movable contacts are actuated by manual pushbuttons, pneumatic or hydraulic actuators, or motion derived from machinery associated with the switches. It is further apparent that the invention is applicable to sets of plural switches and is not limited in application only to pairs of switches.

I claim:

1. A mechanical interlock which permits actuation of only one of either of a pair of switches, said switches each including a movable member associated with the movable contacts of the switch, the movable members each having a cam surface extending longitudinally of the movable members to the exterior of the switches intermediate the pair, at least one element longitudinally slidable with respect to the switches and located so as to interfere with movement of the movable member when the element is advanced toward one of the switches to thereby block actuating motion of that movable member, said element having affixed thereto a cam surface follower such that actuating motion of one of the switches of the pair will cause the cam surface of that switch to engage the cam surface follower and advance the element into interference with the movable member of the other switch.

2. In the combination of a pair of remotely actuated switches and a mechanical interlock which permits actuation of only one of either of the switches of the pair, said switches being spaced from each other, said switches each including an armature associated with the moving contacts of the switch and an actuation mechanism which moves the armature to actuate the switch when the actuation mechanism is energized, the improvement which comprises a cam surface affixed to each armature and extending into the space between the pair, a transverse member affixed to each armature, an axially slidable rod extending between the switches and located such that when axially advanced toward one of the switches of the pair said rod will interfere with the transverse member of that switch to prevent actuating movement of that armature, and a cam surface follower associated with said rod such that actuation of one switch will cause its cam surface to drive said cam surface follower and associated rod toward the other switch to cause the rod to interfere with the transverse armature member of said other switch.

3. The combination of claim **2** wherein there are a pair of axially slidable rods which act in concert.

4. The combination of claim **3** wherein the cam surface follower is attached to both rods of the pair and is provided with rollers for contact with the cam surfaces of the switch armatures.

5. The combination of claim **2** wherein the length of the slidable rod is less then the distance between the transverse members of the pair of armatures.

6. A mechanical interlock which permits actuation of only one of either of a pair of solenoid actuated switches, said switches each including a movable armature associated with the movable contacts of the switch, a member centrally affixed to and transverse of the armature, at least one rod axially slidable with respect to the switches and located so as to interfere with the transverse member to prevent movement of one of the armatures when the rod is advanced toward that one of the switches to thereby block actuating motion of that armature, said rod being associated with the armatures such that actuating motion of the armature of one of the switches of the pair will axially advance the rod into interference with the transverse member of the other switch.

7. A mechanical interlock mechanism for a set of at least two switches which mechanism prevents actuation of one of said switches after actuation of another of said switches, said switches each including a movable member associated with the movable contacts of the switch, the movable members each having a cam surface extending longitudinally of the movable members to the exterior of the switches intermediate the switches, at least one element longitudinally slidable with respect to the switches and located so as to interfere with movement of the movable member when the longitudinally slidable element is advanced away from the first actuated switch to thereby block actuating motion of the movable member of the switch whose actuation is thereby prevented, said longitudinally slidable element having affixed thereto a cam surface follower such that actuating motion of the first actuated switch of the set will cause the cam surface of that switch to engage the cam surface follower and advance the longitudinally slidable element into interference with the movable member of the switch whose actuation is to be prevented.