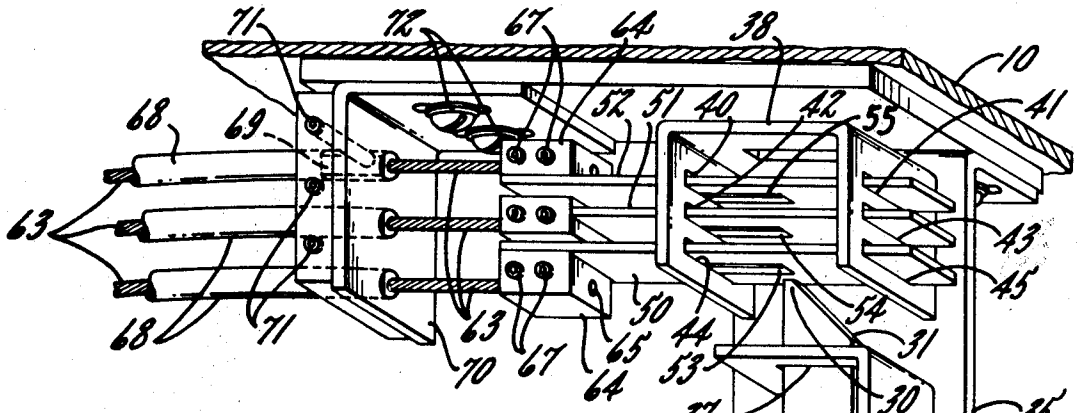
Oct. 13, 1970 G. J. MEYER 3,534,186

DOOR INTERLOCK SYSTEM FOR ELECTRICAL CONTROL CABINETS

Filed Aug. 6, 1969 3 Sheets-Sheet 1



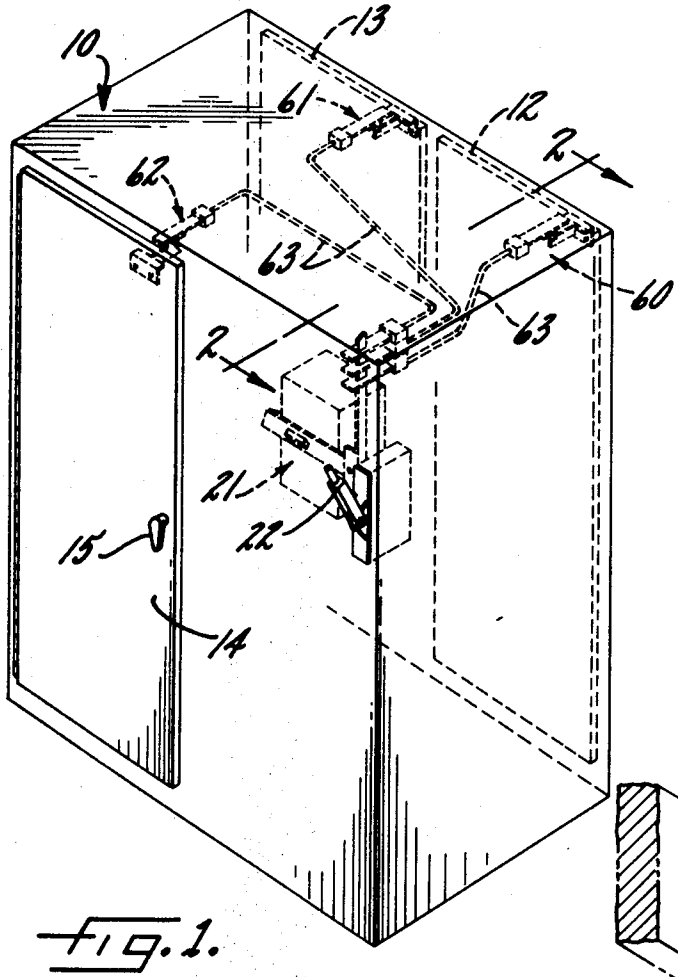


Fig. 1.

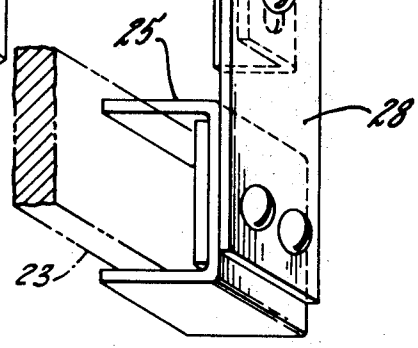


Fig. 5.

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DOOR INTERLOCK SYSTEM FOR ELECTRICAL CONTROL CABINETS

Filed Aug. 6, 1969 3 Sheets-Sheet 2

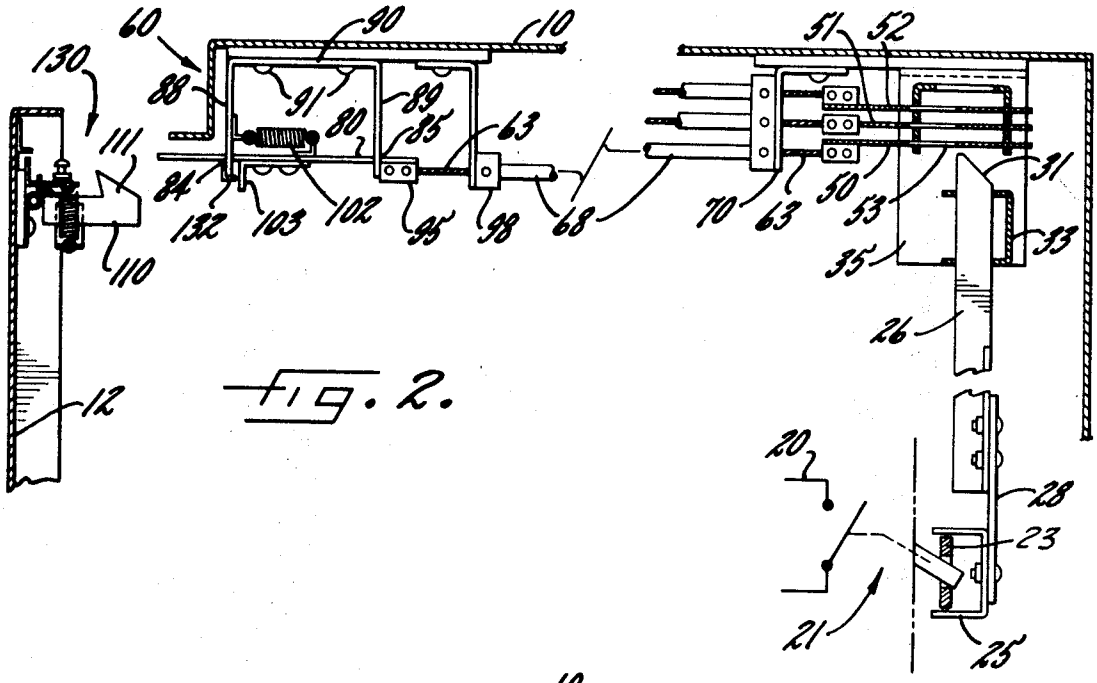


Fig. 2.

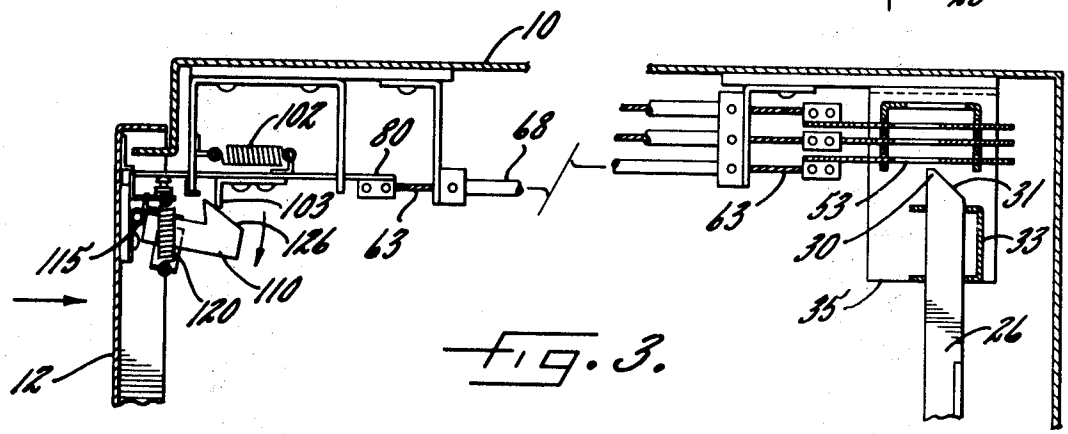


Fig. 3.

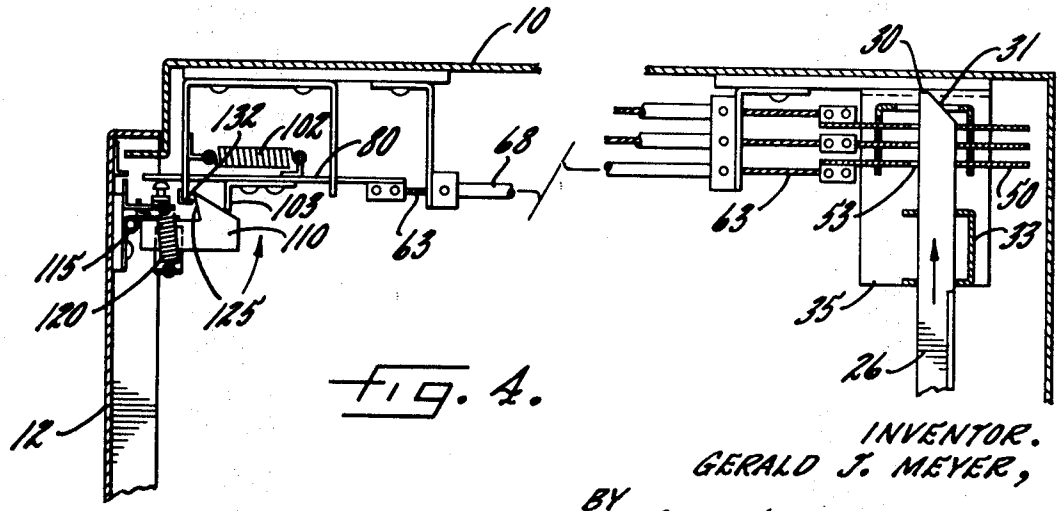


Fig. 4.

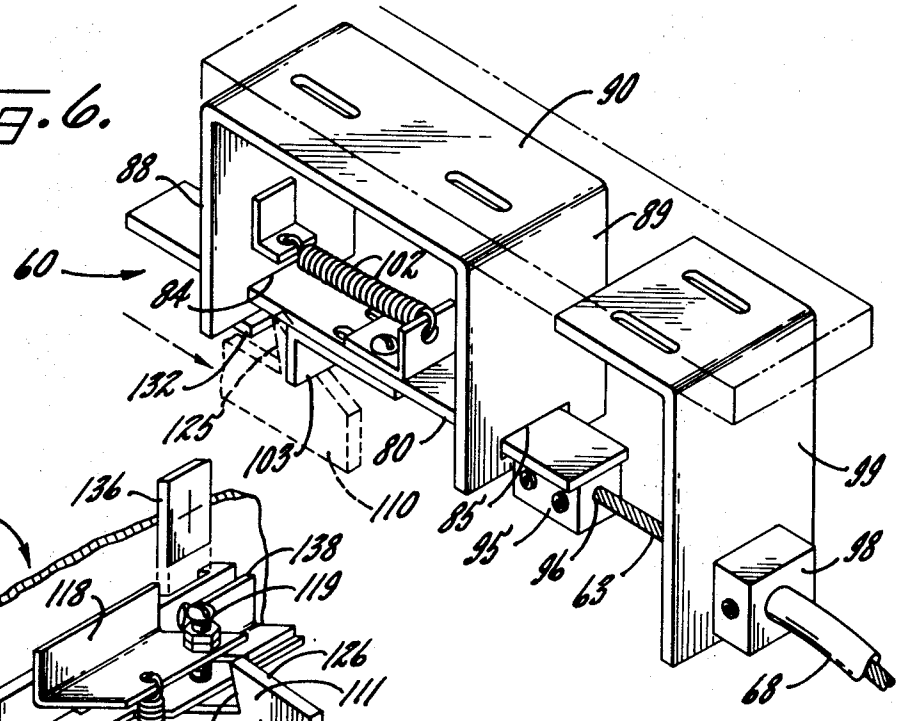
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DOOR INTERLOCK SYSTEM FOR ELECTRICAL CONTROL CABINETS

Filed Aug. 6, 1969 3 Sheets-Sheet 5

Fig. 6.



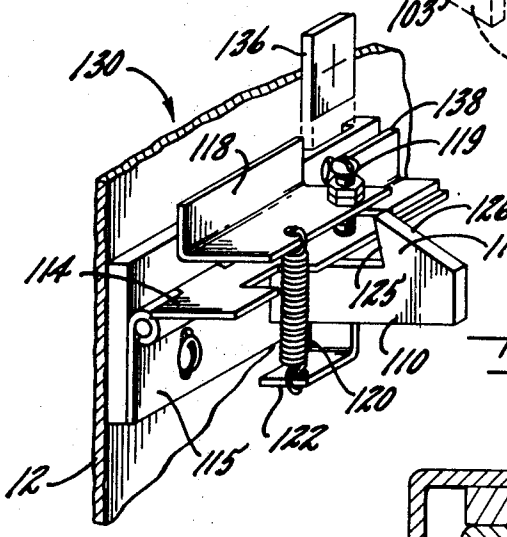


Fig. 7.

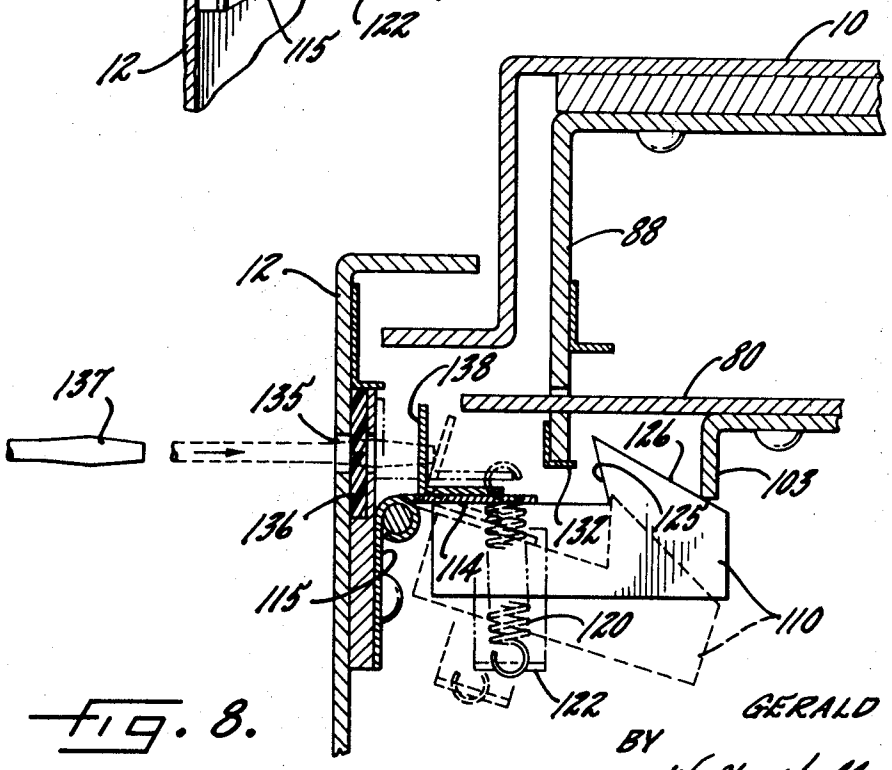


Fig. 8.

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DOOR INTERLOCK SYSTEM FOR ELECTRICAL CONTROL CABINETS

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U.S. Cl. 200—50 8 Claims

ABSTRACT OF THE DISCLOSURE

Disclosed is an interlock system for the access doors of an electrical control cabinet. The power to the cabinet is controlled by an externally actuable circuit breaker, which in turn is controlled by an actuator mechanism operatively coupled to each of the access doors of the cabinet. There is provided means for inhibiting the actuator mechanism and preventing the application of power to the cabinet when any of the access doors are open as well as means for securing the access doors in a closed position when power is applied to the cabinet, irrespective of the order in which the doors become closed. The interlock mechanism for each of the access doors may be selectively defeated to allow access to the contents of the cabinet while the power is still applied. When the door is again closed, it is automatically secured by the interlock system.

Electrical power supply and control cabinets are commonly provided with a manually operated circuit breaker by which electrical power may be releasably connected to the cabinet contents. Access doors to such cabinets are commonly interlocked with the circuit breaker so that under normal conditions the access doors cannot be opened with the circuit breaker closed, nor can the circuit breaker be closed if any door is open.

Prior interlock devices have had drawbacks or inadequacies. For example, one prior mechanical interlock system requires that the access doors to the control cabinet be opened and closed in sequential order to allow operation of the manually operated circuit breaker. Such a device made servicing of the control cumbersome and required additional time and patience on the part of the service personnel.

Electrical interlocks utilizing door actuated electrical switches have also been employed. This type of device is objectional because it requires a separate source of electrical power within the cabinet for supplying the switches, with the requirement that this separate source of power be independent of the main disconnect circuit breaker.

The present invention overcomes the disadvantages of the prior interlock systems and provides maximum protection for the operating personnel and for the contents of the cabinet.

It is an object of the present invention to provide a completely mechanical interlock system for a plurality of access doors in an electrical control cabinet utilizing mechanical components which are simple to manufacture and are easily asembled. It is a related object of the present invention to provide a mechanical interlock system which is applicable to a wide variety and configuration of control cabinets and doors.

A further object of the invention is the provision of a mechanical interlock system for use with control cabinets of the type having a manually actuated circuit breaker such that the breaker cannot be placed in its operative condition to apply power to the cabinet until all of the access doors to the cabinet are closed, but which

allows power to be thereafter supplied irrespective of the order in which the access doors were closed.

Still another object of the invention is to provide an interlock system which is foolproof in normal operation, but which contains a provision for selectively defeating the interlock for any door to permit servicing of the control with a minimum amount of risk while power is connected.

Still a further object of the invention is to provide an interlock system with means for selectively defeating the interlock for servicing through any door, while allowing the interlock for that door to be automatically reactivated after the door is again closed.

Other objects and advantages of the invention will become apparent upon reading the attached detailed description and upon reference to the drawings in which:

FIG. 1 is a perspective view, three-quarters from the top, of an electrical control cabinet with an interlock system constructed in accordance with the present invention.

FIGS. 2, 3 and 4 are vertical section views taken generally along the line 2—2 of FIG. 1 showing the interlock mechanism of the present invention in three different operative positions.

FIG. 5 is a perspective view of the actuator bar assembly and the associated cable operating structure.

FIG. 6 is a partial section view of the interlock mechanism identical to that shown at the left hand side of FIGS. 2, 3 and 4.

FIG. 7 is a perspective view of the latch mechanism of the present invention.

FIG. 8 is another view of the latch mechanism illustrating the interlock override feature.

While the invention has been described in connection with a preferred embodiment, we do not intend to limit the invention to the form set forth, but, on the contrary, we intend to cover such alternatives, modifications, and equivalents as may be included within the spirit and scope of the invention.

Turning then to FIG. 1, there is disclosed a control cabinet **10** of generally rectangular box-like construction. The cabinet is provided with access doors **12–14**. Each of these doors is supplied with a manually operated lock device indicated generally by a hand lever **15**. Cabinets of the type shown in FIG. 1 are commonly used for housing electrical controls and power supplies. They are particularly necessary for enclosing electrical apparatus which generates or is supplied by extremely high voltages or currents. Therefore, the power to cabinet **10** is supplied via a power input line **20** and is adapted to be applied to the various sections and elements of the cabinet by means of a circuit breaker indicated generally at **21**, as shown in FIGS. 1 and 2. A lever **22** projecting to the outside of the cabinet is provided for manually operating a control arm **23** of the circuit breaker to a lower position, in which case the power from the input line is disconnected, or to an upper position, in which the power is applied to the contents of the cabinet.

According to the present invention, means are provided for mechanically coupling the access doors **12, 13** and **14** with the hand lever operated circuit breaker **21**. To this end, the actuator mechanism for the circuit breaker **21** includes the lever **22**, breaker control arm **23**, a horizontal bracket **25** movable in a vertical path under the control of the lever **22** via control arm **23**, and an actuator bar **26** connected to the horizontal bracket **25** via an extension plate **28**. The upper end of the bar **26** is formed with a blunted stop surface **30** and an angled camming surface **31**. The extension plate **28** connecting the bar **26** to the bracket **25** is slideably connected to the actuator bar **26** to provide for initial adjustment of the vertical position of the bar **26**. A

U-shaped extension **33** of a bracket **35** is formed with slots **36** and **37** (FIG. 5) to support the upper end of the bar **26** for vertical translation. The bracket **35** is permanently secured to the top of the cabinet **10**. A second U-shaped extension **38** of the bracket **35** has downwardly extending legs which are formed with horizontally aligned slots **40–45** disposed in a vertical array directly above the bar **26**. Pairs of these slots are disposed for slideably supporting stop bars **50**, **51** and **52**, as shown in FIG. 5. Each of these stop bars **50–52** is associated with a selected one of the access doors **12–14** in a manner hereinafter described.

In accordance with one aspect of the present invention, there is provided means for preventing the placement of the circuit breaker into the operative state when any of the access doors **12–14** are open. In furtherance of this objective, the stop bars **50–52** are provided with slots **53**, **54** and **55** respectively, which lie in a vertical plane common to the movement of the bar **26**. These stop bars **50–52** can be positioned horizontally to block the upward movement of the bar **26** (FIG. 2) or to allow each upward movement when the slots **53–55** are at least partially aligned with the bar **26** (FIGS. 3 and 4). Permanently secured to the top of the cabinet **10** adjacent to each door opening is a door interlock assembly, indicated generally at **60**, **61** and **62** of FIG. 1. Each of these assemblies **60–62** is mechanically coupled to the stop bars **50–52** respectively via a push-pull type cable **63**. Referring to FIG. 5, it is seen that each of the stop bars **50–52** is provided with a cable connector block **64** with a hole **65** therein adapted to receive one end of the cable **63**, with set screws **67** serving to lock the cable to the block **64**. The cable **63** operates within a tube **68** which is attached at one end in a bore **69** formed in a bracket **70** attached to the upper surface of the cabinet **10**. Set screws **71** serve to secure the tube **68** to the bracket **70**. An elongated slot **72** in the bracket base provides for initial adjustment of the tube relative to the blocks **64**.

Each of the door interlock assemblies **60–62** for the doors **12–14** are identical; therefore, a description of one, given below, will suffice for the others also.

For the purpose of sensing the closed condition of its associated access door, the door interlock assembly **60** includes a door operating bar **80** disposed perpendicular to the door when the door is closed. As shown in FIGS. 2, 4 and 6, the bar **80** is supported for movement in a pair of parallel slots **84**, **85** in the legs **88**, **89** of a U-shaped bracket **90**. The bracket **90** is secured to the top of the cabinet **10** by screws **91**. The bar **80** is connected to the end of the cable **63** which is opposite the stop bar **50** described above. A block **95** formed on the inner end of the bar **80** has a hole **96** adapted to receive and secure the cable **63**. The cable tube **68** is attached at its door end to a support block **98** which forms part of a bracket **99** secured to the top of the cabinet **10**. A tension spring **102**, having its opposite ends secured to the bar **80** and leg **88**, serves to bias the bar **80**, cable **63** and stop bar **50** to the left or blocked position of the interlock. An adjustable stop **103** secured to the bar **80** serves to establish the normally blocked position for the assembled members associated therewith.

FIGS. 2, 3 and 4 illustrate the three basic positions of the interlock mechanism for doors **12**, **13** and **14**. Referring to FIG. 2, the door **12** is shown in its open position relative to the cabinet **10**. In this position of the door, the spring **102** is free to bias the operating bar **80**, cable **63** and stop bar **50** to their left-most position as established by the stop **103**. The slot **53** of the stop bar **50** is located to the left of the actuator bar **26** so that entry thereof is positively precluded, the bar **26** being blocked from upward vertical movement. Consequently, the breaker **21** is prevented from being placed in the operative condition, and the cabinet is held in the "power-off" state.

Upon closing of the door **12**, as shown in FIG. 3, the operating bar **80** is forced to the right a short distance. Stop bar **50**, by reason of its direct connection with the bar **80** through cable **63**, is likewise moved to the right a corresponding amount. Closing of the doors **13** and **14** will serve to place their respective door interlock mechanisms **61**, **62** and their associated stop bars **51**, **52** in the same relative position just described. In other words, all three stop bars **50**, **51**, **52** are disposed so that the blunted point of the actuator bar **26** is aligned for entry into the slots **53**, **54** and **55**. Power may now be applied to the cabinet.

Referring then to FIG. 4, it is seen that the actuator bar **26** has been moved to its uppermost position by operation of the circuit breaker lever **22** to its "power-on" position. During its upward movement, the cam surface **31** of the actuator bar **26** serves to force the stop bars **50**, **51**, **52** to the right so that the right hand edge of the actuator bar **26** is engaged with the right end of the slots **53**, **54** and **55** against the bias of the spring **102** of each door interlock mechanism.

In accordance with another aspect of the present invention, provision is made for securing the access doors in the closed position when the circuit breaker is in the operative state causing power to be applied to the cabinet. To this end, latching means are provided including a releasable catch affixed to each of the access doors and holding brackets affixed to the cabinet and disposed for retaining the releaseable catch to secure the doors in the closed position. As shown in FIGS. 2, 3, 4 and 7 a catch **110** with a hook **111** on one end projects perpendicularly from the door **12**. It is pivotally supported at the other end by one leg **114** of a hinge **115** fastened to the door. A bracket **118** fixed to the door carries an adjusting screw **119** for setting the closed or latched position of the catch **110**. A spring **120** is secured between the bracket **118** and an extension arm **122** of the catch **110**, serving to urge the catch to its latched position. The catch **110** is formed with a latching edge or surface **125** which is slightly angled to form the hook **111**. The outer end of the catch **110** is formed with an angled camming surface **126**, the purpose of which will be hereinafter described.

The catch assembly indicated generally at **130**, is operatively associated with the door interlock assembly **60**, which has been partially described above. For the purpose of cooperating with the releaseable catch **110** of the door **12**, the outer leg **88** of the bracket **90** is provided with an L shaped member **132** which serves as a latching edge over which the surface **125** of the catch **110** is adapted to latch. Furthermore, the stop **103** which has been described above in connection with the breaker inhibit function, serves a second purpose in that it constitutes a surface by which the catch hook **111** is cammed away from possible latching contact with the L-shaped member **132** as the door is initially closed (FIG. 3). When the stop **103** is moved to the right as a result of the actuator bar **26** assuming its uppermost position, the bracket leg **88** with its member **132** forms a holding bracket behind which the hook **111** of the catch **110** may be secured (FIG. 4).

FIGS. 2, 3 and 4 show the latching mechanism in its three basic positions. As the door **12** is closed, the stop **103** moves to the right a short distance; however, due to contact of the stop **103** with the camming surface **126** of the catch **110**, the catch **110** is rotated against the force of the spring **120** away from engagement with the holding bracket **88**, **132**. Only after the breaker lever **22** is moved to its "power-on" position and the actuator bar **26** has been shifted upward does the stop **103** move far enough to the right to allow the catch **110** to be positioned behind the holding bracket. In this latter position, as shown in FIG. 4, the interlock system is fully engaged to secure the doors. When the circuit breaker **21** is again placed in the inoperative state and the actuator bar **26** has moved to its lower position, the tension spring

102 will pull the stop 103 to the left, camming the catch 110 to the position shown in FIG. 3 to allow normal opening and closing of the door 12.

As another feature of the present invention, the interlock mechanism described above is provided with means for selectively disabling the interlock on any of the doors while the circuit breaker 21 is in its operative state. This is desirable to allow service personnel entrance through the access doors without disconnecting power from the cabinet. In keeping with this objective, the doors 12, 13 and 14 are provided with separate and independent interlock defeating means. Referring to FIG. 8, an opening 135 is provided in each of the doors. This opening is sealed by a piece of sheet rubber 136 cemented to the inside of the door. In the area of the opening or hole the rubber is provided with cross slit through which a pointed tool such as a screwdriver 137 may be inserted. The catch 110 is provided with a side extension 138 which extends horizontally in overlapping alignment with the opening 135. By inserting a pointed tool through the opening hole in the door the catch 110 can be urged out of engagement with the member 132 by rotating on the hinge 115. While holding the catch in this position, the serviceman may open the door without interfering with the interlock mechanism on any of the other doors or with the application of power to the cabinet. Subsequent closing of the door causes the catch to relatch behind the member 132 so that the interlock is automatically reactivated to prevent unauthorized opening of the door.

From the above description, it will be recognized that there has been brought to the art an all-mechanical interlock system for electrical control cabinets which is simple and foolproof, but which offers all of the features normally desirable in interlock systems for control cabinet.

I claim as my invention:

1. In an interlock system for a plurality of access doors in a control cabinet, the combination comprising,
- a power input line having an externally controlled circut breaker associated therewith.
- an actuator mechanism for placing said circuit breaker in an operative state or an inoperative state to respectively connect or disconnect the power for said cabinet,
- mechanical sensing means responsive to the open condition of any of said access doors to inhibit said actuator mechanism and thereby prevent placement of said circuit breaker into the operative state, and
- latching means coupled to said mechanical sensing means for responding to the operative condition of said circuit breaker to secure said access doors and prevent opening thereof when said circuit breaker is in the operative state, said latching means being actuable to secure said doors after all of said doors are closed, irrespective of the order in which said doors become closed.

2. In an interlock system for a plurality of doors in a control cabinet, the combination according to claim 1 further including interlock defeating means associated with each access door for allowing selective opening of said doors without disconnecting power to the cabinet.

3. In an interlock system for a plurality of access doors in a control cabinet, the combination comprising,
- a power input line having an externally controlled circuit breaker associated therewith,
- an actuator mechanism for placing said circuit breaker in an operative state or an inoperative state to respectively connect or disconnect the power for said cabinet,
- mechanical sensing means including a plurality of stop bars, one for each of said access doors, and cables connected to each of said stop bars, each cable being responsive to the open condition of its associated door to position its associated stop bar for inhibiting said actuator mechanism, thereby preventing placement of said circuit breaker into its operative state, and
- latching means responsive to the operative condition of said circuit breaker to secure said access doors and prevent opening thereof while the power for said cabinet is connected.

4. In an interlock system for a plurality of access doors in a control cabinet, the combination comprising:
- a power input line having an externally controlled circuit breaker associated therewith,
- an actuator mechanism for placing said circuit breaker in an operative state or an inoperative state to respectively connect or disconnect the power for said cabinet.
- mechanical sensing means responsive to the open condition of any of said access doors to prevent placement of said circuit breaker into the operative state, and
- latching means for each door including a releasable catch affixed to the door, a holding bracket affixed to the cabinet and disposed for retaining said releasable catch to secure said door in its closed position, and means responsive to the inoperative condition of said circuit breaker for placing said releasable catch in the release position, preventing retention of said catch by said bracket and freeing the door for movement.

5. In an interlock system for a plurality of access doors in a control cabinet, the combination comprising,
- a power input line having an externally controlled circuit breaker associated therewith,
- an actuator mechanism for placing said circuit breaker in an operative state or an inoperative state to resepctively connect or disconnect the power for said cabinet,
- mechanical sensing means including a plurality of stop bars, one for each access door, and cables connected to each of said stop bars, each cable being responsive to the open condition of its associated door to position its associated stop bar for inhibiting said actuator mechanism, thereby preventing placement of said circuit breaker into its operative state while any of said doors are open, and
- latching means for each door including a releasable catch affixed to the door, a holding bracket affixed to the cabinet and disposed for retaining said releasable catch to secure said door in its closed position, and means responsive to the inoperative condition of said circuit breaker for placing said releasable catch in the released position, preventing retention of said catch by said brackets and freeing the door for movement.

6. In an interlock system for a plurality or doors in a control cabinet, the combination according to claim 4, further including interlock defeating means associated with each door including an opening in each door and an extension on said releasable catch disposed for engagement by an instrument inserted through said opening, whereby the releasable catch may be externally urged to its released position to allow opening of the selected door while the power to the cabinet remains connected.

7. The combination according to claim 6 in which said selected door, when again closed, will be automatically relatched by said releasable catch and again interlocked with said circuit breaker.

8. An interlock system for electrical control cabinet access doors, comprising an input line circuit breaker;
- first means for placing said circuit breaker into an operative state;
- second means responsive to the open position of any of said access doors to prevent placement of said circuit breaker into the operative state;
- third means which, after access doors have been closed and said circuit breaker placed in its operative state,

is operative to secure said doors in their closed position;

and interlock defeating means associated with each of said doors and operative to allow disengagement of said door securing means for any selected access door to allow opening of said selected access door while said circuit breaker remains in the operative state and while the nonselected doors remain secured.

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