Oct. 4, 1966 D. F. DALY 3,277,251

ENCLOSED SWITCH WITH COVER AND CONNECTOR INTERLOCK

Filed Oct. 17, 1963 2 Sheets-Sheet 1

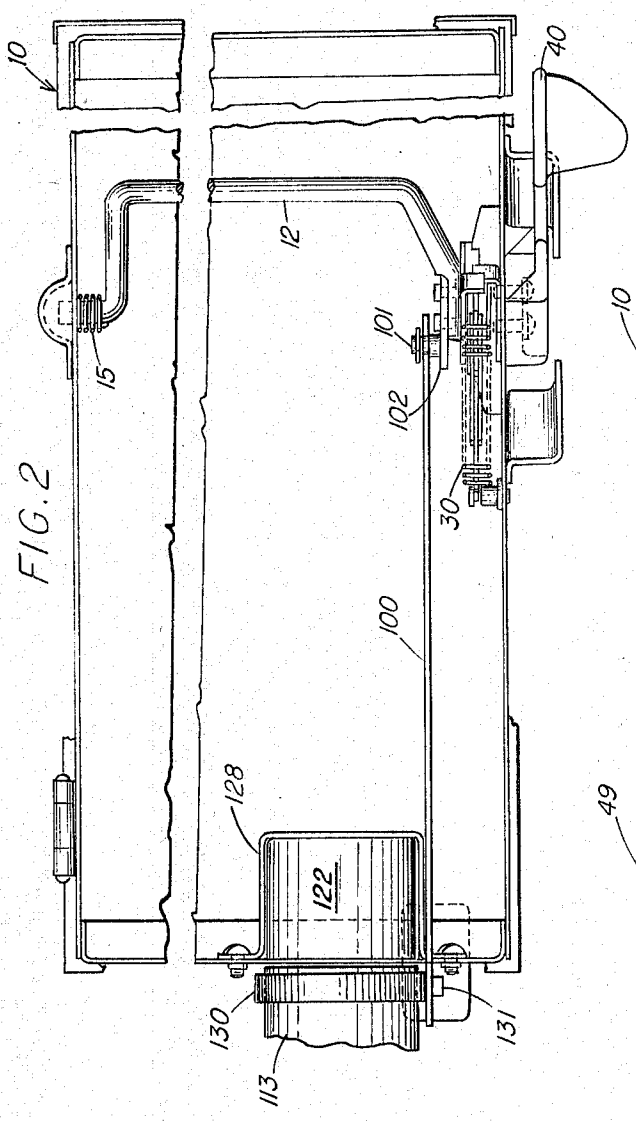


FIG. 2

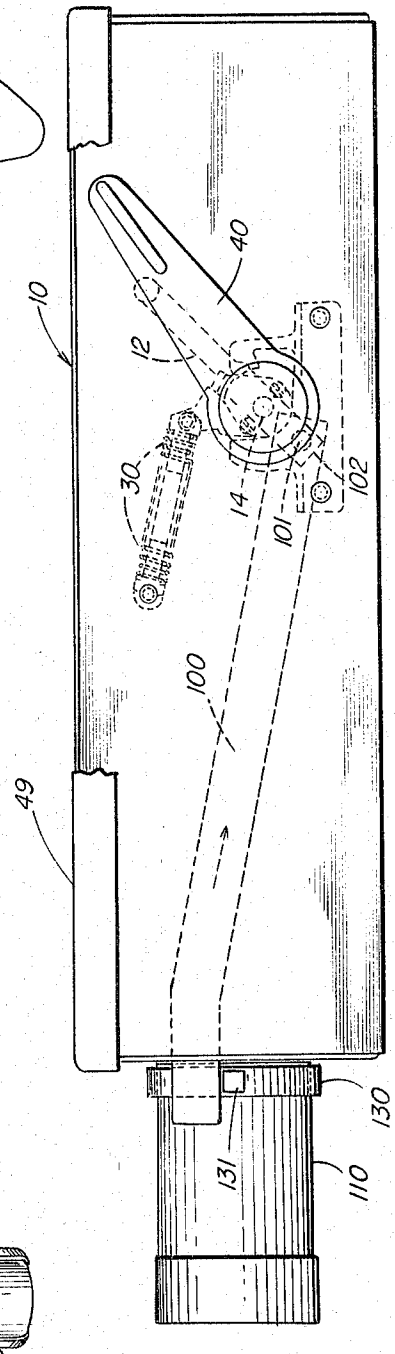


FIG. 1

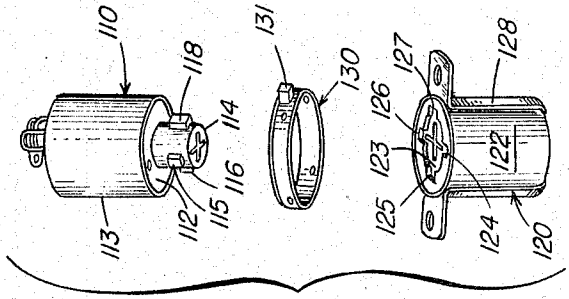


FIG. 3

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FIG. 4

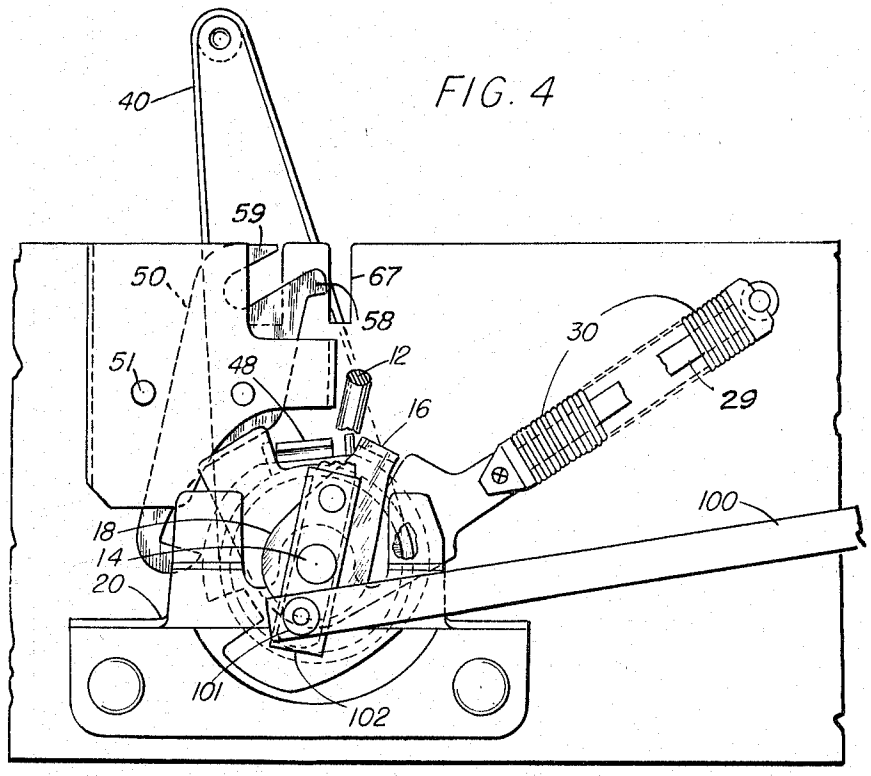


FIG. 5

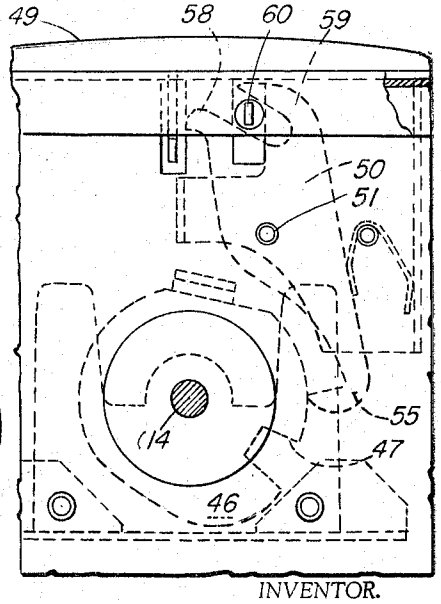
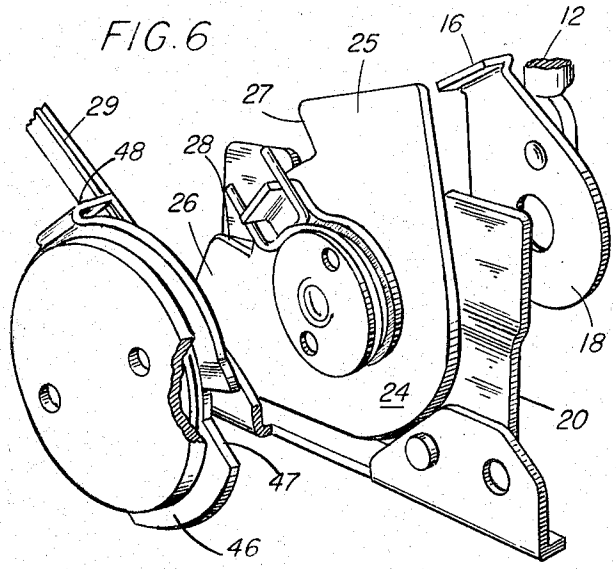


FIG. 6



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ENCLOSED SWITCH WITH COVER AND CONNECTOR INTERLOCK

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13 Claims. (Cl. 200—50)

This invention relates to enclosed electric switches in which the cover of the enclosure is interlocked with the switch and cannot be opened when the switch is in closed-circuit position. More particularly, the invention relates to the provision in such switches of detachable connectors which cannot be separated or connected while the switch is in closed-circuit position.

By error or mistake, plug-in connectors frequently are disconnected from receptacles which are located in the electric switch boxes. This occurs even though the connectors be of the locking type which requires rotation or release of a locking arrangement in order to permit the connector parts to separate. When separation takes place while the power is on, or when connection is made while a heavy load remains on the load side, arcing occurs resulting in a hazard to the hand of the operator. On occasion severe arcing will cause burns and possibly electrically shock the operator. At high voltages, for example around 600 volts, the operator would be lucky if he did not suffer more serious injury or death.

Therefore, one object of this invention is to provide an improved interlocking arrangement between a connector plug, its socket and a control switch mechanism which prevents the plug from being withdrawn while the switch is closed, but which allows the connector parts to be separated when the switch is in open-circuit position.

A still further object is to provide, in interlocking connector and switch combinations having the foregoing characteristics, means for preventing connection of the connector parts while the switch is closed.

Another object is to provide an interlocking arrangement as aforesaid, applicable to an enclosed switch and to a connector of the locking type, i.e., to a connector wherein the connector parts cannot be separated without first rotating or otherwise moving one with respect to the other to release their locking engagement.

A related object of the invention, when it is applied to the rotate-to-release type of connector, is to provide interlocking means which prevents rotation of the connector part when the switch is closed; and a further related object is to provide such interlocking means when one connector part is within the enclosure.

Another object of the invention is to provide an improved interlocking connector and enclosed switch combination wherein the cover of the switch enclosure can only be opened when the switch is in open-circuit position and in which a separable connector is associated with the enclosure and switch in such manner that the connector parts can only be separated when the switch is in open circuit position. An associated object is to provide such interlocking means when one connector part is within the enclosure.

Another object is to provide interlocking means in a combination as in the immediately foregoing object in which the connector parts are of the rotary locking type and rotation is prevented while the switch is in the closed-circuit position so as to prevent connection and separation of the connector parts under such condition or when the cover cannot be opened.

Other objects and advantages of the invention will occur to those skilled in the art as the invention is described in connection with the accompanying drawings.

In the drawings:

FIG. 1 is a side elevation view of an interlocking connector and enclosed switch combination embodying the invention.

FIG. 2 is a plan view of the device of FIG. 1 with the cover open.

FIG. 3 is an exploded perspective view of the connector parts as used in FIGS. 1 and 2.

FIG. 4 is an interior side elevation view of the switch operating mechanism and parts of the cover locking and connector locking mechanism.

FIG. 5 is an exterior side elevation view similar to FIG. 4, but with the cover closed, but unlocked.

FIG. 6 is an exploded perspective view of part of the operating mechanism of FIG. 4.

Referring to the drawings, the invention is shown in connection with an enclosed switch having mechanism to lock the cover closed when the switch is closed as fully described in the application of Daniel F. Daly and Joseph M. O'Malley, Serial No. 286,443, assigned to the same assignee as this application, to which application reference may be had for full structural details and operation of that portion of the novel combination of the present invention.

The enclosure may be a rectangular metal box **10** on the walls of which the operating mechanism is mounted. The switch contacts may be of any suitable type, such as for example pivoted knife-blade contacts. For simplicity, however, the switch contacts have been omitted from the drawings.

THE INTERLOCKING MECHANISM FOR THE COVER AND SWITCH

Briefly, the mechanism as described in said prior application Serial No. 286,443 includes a cover **49** hinged to the box body at one edge with a catch bar **60** extending inwardly from a flange on the box cover in position to enter a slot **67** in the edge of the box body when the cover closes.

When the switch contacts are disengaged or open, the box cover may be closed. In so doing, the catch **60** engages an inclined surface on the back of a finger **58** on the latch **50** which is mounted pivotally on a pin **51** in the side of the box. This engagement causes pivoting of the latch **50** counter clockwise to the position of FIG. 5. In such condition the nose **55** on latch **50** has moved out of a notch **47** in a disc-shaped locking-and-actuating member **46** which is secured by screws to the switch handle **40** so as to move as a unit therewith.

Thus, when the cover is closed, the handle is freed or unlocked for movement from open to closed-switch position.

When the switch is closed (or when it is in a transient position between open and closed as shown in FIG. 5), the nose **55** of the latch **50** abuts the periphery of the locking-actuating member **46** and is thus held in the FIG. 5 position. In such condition its hook portion **59** overlies the catch bar **60** of the cover and prevents the cover from being opened. The cover can thus only be opened when the switch is open, at which time the handle has moved the locking member to a position (not shown in these drawings) where notch **47** will receive the nose **55**. This unlocks the cover by moving the hook **59** out of the path of the cover's catch bar **60** and simultaneously locks the handle from movement to close the switch contacts.

Movement of the switch contacts is accomplished (as described fully in said application Serial No. 286,443) by the oscillation of a U-shaped bail **12** pivotally mounted at one end which is out-turned and extends through one wall of the box, with a coiled compression spring **15** around said end to press the bail axially and to hold

it in engagement with the handle-operated actuating mechanism on the opposite wall of the box (see FIG. 2). The bail is pivoted at this end on the end of a stud shaft **14** which in turn is supported in a bearing bracket **20** affixed to the wall of the box.

The movement of the bail is initiated by a peripheral transversely-bent lug **48** on an actuating member **46**. This lug is engageable with one or the other of radial surfaces **27**, **28** on wings **25** and **26** respectively of a drive plate **24** so as to turn that drive plate until the opposite radial surface engages an inturned peripheral lug **16** on an actuating arm **18** riveted or otherwise secured to one end of the bail **12**. The engagement of the drive plate **24** with the actuating arm **18** causes the bail to turn so as to positively start movement of the switch contacts toward the opposite position.

This movement is continued with a snap action by over center spring **30** on a holder **29**, as described in said prior application Serial No. 286,443.

INTERLOCKING MECHANISM FOR CONNECTOR AND SWITCH

In order to tap off at the box **10** current from the circuit controlled by the herein described switch, an electric attachment plug receptacle, designated generally by numeral **120**, is affixed within the box preferably in a corner at one end. This receptacle may be of any well known type which is adapted to receive an attachment plug, designated generally by numeral **110**, which is turnable relative to the receptacle to lock and hold the plug and receptacle together until the plug is purposely pulled to disconnect them. For the purpose of illustration, the invention is shown in connection with a plug and receptacle, as shown in the expired U.S. Patent No. 2,102,625.

The plug comprises a cylindrical insulating body **112** encased in a metal protective cylindrical shell **113**. Extending axially from the end of the insulating body and integral therewith is a cylindrical insulating post **114** of lesser diameter than the body **112**.

Circumferentially spaced around the periphery of the post **114** and extending radially outward are four electrical contacts, of which **115**, **116** and **118** are visible. To compel observance of polarity, contact **118** is made larger than the rest. The contacts may be connected in any known fashion to conductor wires entering the opposite end of the plug body, for example as described in said Patent No. 2,102,625.

The receptacle **120** likewise comprises a cylindrical insulating body **122** which is supported by a U-shaped stamped sheet metal strap or bracket **128** secured by screwbolts to the box wall with the surface of the receptacle body extending through an aperture in the box wall and flush therewith. The receptacle body has a cylindrical cavity **123** in one end adapted to receive a plug post **114**.

Extending lengthwise of the body **122** and radially outward from cavity **123** are channels **124**, **125**, **126** and **127**. Channel **127** is larger than the others and is designed to receive plug contact **118**. This arrangement with contacts and channels makes it possible for the plug post **114** to be inserted in the receptacle when oriented only one way, namely with contact **118** aligned with channel **127**.

After plug post **114** is inserted fully into the receptacle **120**, it may be rotated in order to lock the plug and receptacle together to prevent the plug from withdrawing without first being reversely rotated. The structural details of the inside of the receptacle **120** which prevent withdrawal of the plug **110** before it has been reversely rotated are well known and may be, for example, as described in said United States Patent No. 2,102,625.

In order to prevent connection of the plug **110** with receptacle **120** when the switch is closed or withdrawal of the plug from the receptacle when the switch is closed, a locking link **100** is provided which extends from the switch operating mechanism longitudinally near one side wall of the box to and through the end wall of the box adjacent the receptacle. By the means and structure about to be described this locking link is movable into two positions by the switch operating mechanism so that in one position it will interfere with or prevent the rotation of the plug **110** which is necessary on the one hand for withdrawal of the plug (if the plug is already inserted) or, on the other hand, for insertion of the plug (if the plug and receptacle were not connected). In the other position, both insertion and withdrawal are permitted.

The link is movable in response to movements of the contact-moving bail **12** by a loose connection at one end to a pivot pin **101** projecting inwardly of the box from a crank arm **102**. This crank arm may be integral with or a separate part secured to and rotating with the bail, but the axis of the pin is offset from the axis of rotation of the bail and so located as to cause substantially rectilinear longitudinal movement of the link **100** as the bail operates. Such movement of the link **100** causes its opposite end to project to a greater or lesser extent from the end of the box.

In switch-closed position the end will be projected furthest. To prevent, under such condition, connection of the plug to the receptacle, an adapter ring **130** having a radially projecting interlocking lug **131** thereon, may be fixedly attached to the plug **110**. The ring preferably is of interior diameter to slidably fit over the shell **113** of the plug (if the plug has a shell) or over the plug body **112** (if no shell is used).

The ring may be secured firmly and rigidly to the shell or body by set screws or otherwise, in such position that its locking lug **131** will abut the outer end of the locking link **100** if an effort is made to insert the plug post **114** (when properly oriented) into the receptacle cavity **123** while the switch is closed and the locking link is fully projected outwardly. Such abutment of the lug **131** with the extended end of the locking link **100** prevents interconnection of the plug and receptacle.

When the link **100** is retracted by movement of the switch into open-circuit position, the end of the link **100** will no longer interfere with insertion of the plug **110** into the receptacle **120**. When the plug is inserted and rotated to lock it in the receptacle and the switch is operated to closed circuit position, the adapter ring lug **131** will lie along side the then-projecting end of the locking link **100**. In such condition, the plug can not be reversely rotated preparatory to withdrawal from the receptacle because the lug strikes against the link and interferes with this essential preparatory rotation.

It should also be noted that the movement of locking link **100** is independent of intermediate movements of the handle **40**. The locking link **100** does not move until one of the drive plate wings **25**, **26** engage and move the lug **16**. As the lug **16** moves, however, the over center spring **30** snaps the bail **12** and locking link **100** into its proper position independently of any further movement of the handle **40**. Thus, locking link **100** remains stationary and maintains a position independent of the movement of the handle **40** under normal conditions until the over center spring action becomes effective. This also ensures that the plug **110** cannot be withdrawn from or connected to the receptacle **120** when the switch contacts are being moved between their fully open and closed positions under abnormal conditions, as when the over center spring should break and the wing **25** or **26** has to move the lug **16** and bail.

From the foregoing it will be observed that the plug can not be interconnected with the receptacle while the switch is closed nor can the plug be removed from the receptacle while the switch is closed, nor can the cover of the box be opened to gain access to the receptacle or switch connections or parts while the switch is closed.

These desirable objectives are achieved while using available switch and connector structures, many of which are in common and constant use. Hence, where interlocking connector plugs of the turn-to-lock type are already in use, they can be adapted to use with the switch and receptacle portion of the present invention by merely adding an adapter ring of the form described and illustrated herein.

Although the adapter ring and lug have particular advantages of their own, the lug may be formed integral with the shell or welded thereon during manufacture of the shell, if desired.

Many modifications will occur to those skilled in the art within the scope of the invention. Therefore, the invention is not limited to the specific embodiments described and illustrated.

What is claimed is:

1. In combination, an interlocking connector and switch, a box enclosing said switch and having an openable cover, an operating handle outside the box, switch contacts fixedly mounted in said box, movable contacts and operating mechanism for said movable contacts in the box, said handle actuating said operating mechanism for moving the switch between open and closed positions, means on said cover and operating mechanism locking said cover closed when said switch is closed and preventing operation of the switch when the cover is open, a locking member, said operating mechanism moving said locking member as the operating mechanism moves between open and closed switch positions, a connector member having contacts and fixedly mounted on said box, a second connector member having contacts connectable with the contacts of said first connector member, and means to interlock said connector members by relative rotation thereof after they are connected to prevent disconnection thereof prior to reverse rotation, and means on said second member engaged by said locking member to prevent rotation of said second member when said switch is closed.

2. An interlocking connector and switch combination as claimed in claim **1**, wherein said locking member is within said box and has an end extendible outwardly thereof in the path of said means-on-said-second member, said end preventing relative rotation and separation of said first and second members in closed-switch position.

3. An interlocking plug and switch as claimed in claim **1** in which the means-on-said-second member is a radial extension and in which said locking member is within the box and has an end extendible outwardly therefrom to be engaged by said extension in closed-switch position to prevent relative rotation of the said first and second members.

4. An interlocking plug and switch as claimed in claim **1** wherein said means-on-the-second member comprises a ring member having a radial extension, and means to secure said ring member detachably on said second member.

5. An interlocking connector and switch combination according to claim **1**, wherein the operating mechanism moves the locking member and the switch contacts together from one position to the other independently of the handle after the handle has moved a predetermined amount, whereby the locking of the connector is independent of intermediate handle movement.

6. In combination, an interlocking connector and switch, a box enclosing said switch and having an openable cover, an operating handle outside the box, switch contacts fixedly mounted in said box, movable contacts and operating mechanism for said movable contacts in the box operated by said handle for moving the switch between open and closed positions, means on said cover and operating mechanism locking said cover closed when said switch is closed and preventing operation of the switch when the cover is open, a locking member, said operating mechanism moving said locking member as the operating mechanism moves between open and closed switch positions, a connector member having contacts and fixedly mounted on said box, a second connector member having contacts connectable with the contacts of said first connector member, and means on said second member engaged by said locking member preventing interconnection of said first and second members when said switch is closed.

7. An interlocking connector and switch according to claim **6** wherein the means on said second member is a lug which extends radially from said second member, and in which the locking member is within the box and has an end extendible outwardly therefrom to engage said lug and prevent interconnection of said first and second members in switch-closed position.

8. In combination, an interlocking connector and switch, a box enclosing said switch and having an openable cover, an operating handle outside the box, switch contacts fixedly mounted in said box, movable contacts and operating mechanism for said movable contacts in the box, said handle actuating said operating mechanism for moving the switch between open and closed positions, a connector member having contacts and fixedly mounted on said box, a second connector member having contacts connectable with and separable from the contacts of said first connector member, means to interlock said connector members by relative rotation thereof after they are connected to prevent disconnection thereof prior to reverse rotation, and means actuated by said contact-operating mechanism and engageable by said second member to prevent rotation and separation of said connector members when the switch is closed.

9. In combination, an interlocking connector and switch, a box enclosing said switch and having an openable cover, an operating handle outside the box, switch contacts fixedly mounted in said box, movable contacts and operating mechanism for said movable contacts in the box, said handle actuating said operating mechanism for moving the switch between open and closed positions, a connector member having contacts and mounted on said box, a second connector member having contacts connectable with the contacts of said first connector member, means to interlock said connector members by relative rotation thereof after they are connected to prevent disconnection thereof prior to reverse rotation, and locking means, said contact-operating mechanism actuating said locking means to prevent in switch-closed position the interconnecting of said connector members, and also in said position preventing relative rotation of said connector members and separation thereof.

10. The combination as claimed in claim **8** in which the means on said second member is a radial extension and in which said locking member is within the box and has an end extendible outwardly therefrom to be engaged by said extension in closed-switch position to prevent relative rotation and separation of the said first and second members.

11. The combination as claimed in claim **8** in which the means on the second member comprises a ring member having a radial extension, and means to secure said ring member detachably on said second member.

12. The combination as claimed in claim **8** wherein the operating mechanism moves the locking member and the switch contacts together from one position to the other independently of the handle after the handle has moved a predetermined amount, whereby the locking of the connector is independent of intermediate handle movement.

13. The combination as claimed in claim **9** wherein the operating mechanism moves the locking member and the switch contacts together from one position to the other independently of the handle after the handle has moved a predetermined amount, whereby the locking of the connector is independent of intermediate handle movement.

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