

July 11, 1933.

W. A. WULLE

1,917,567

SAFETY SWITCH

Filed Jan. 10, 1931

5 Sheets-Sheet 1

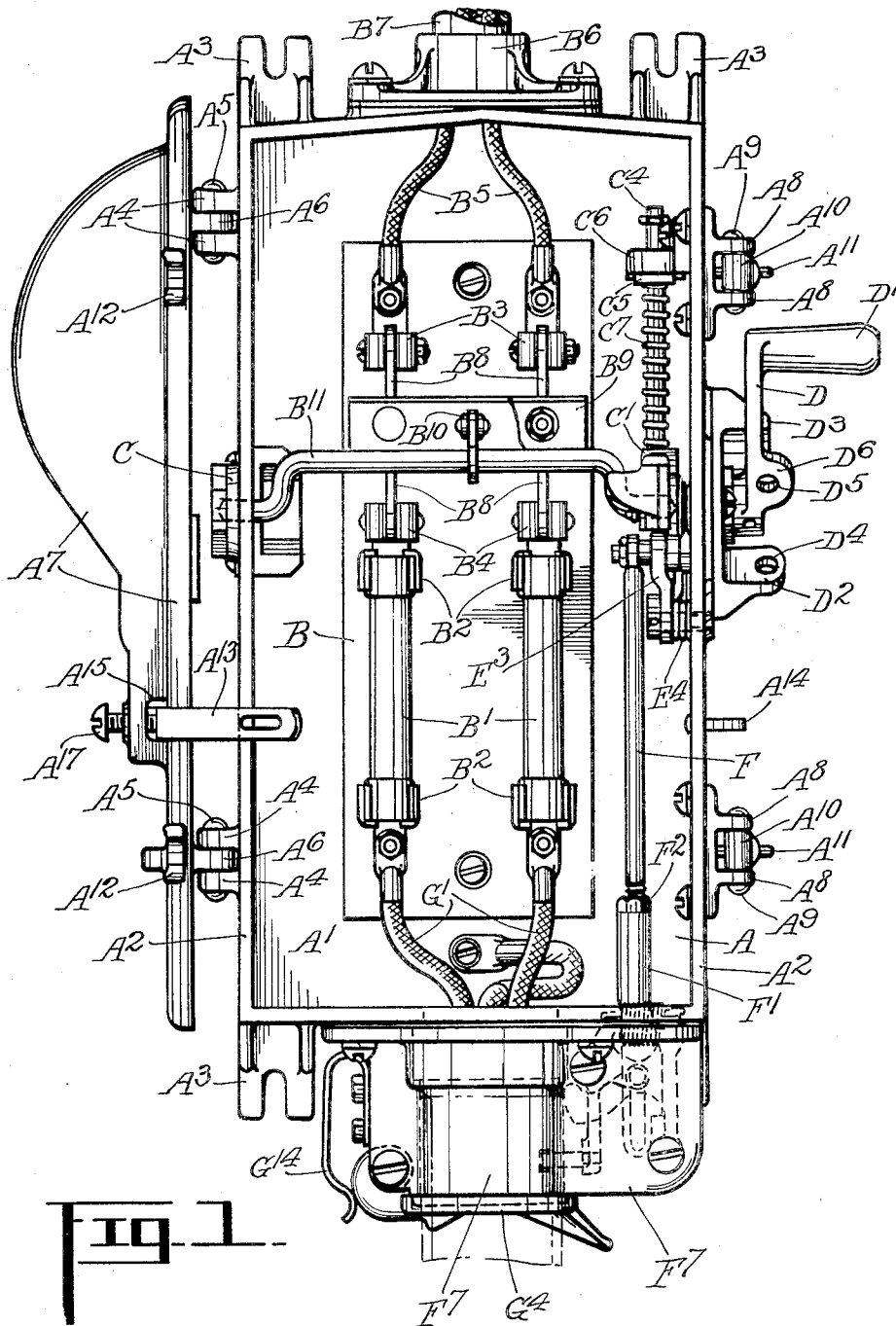


Fig. 1

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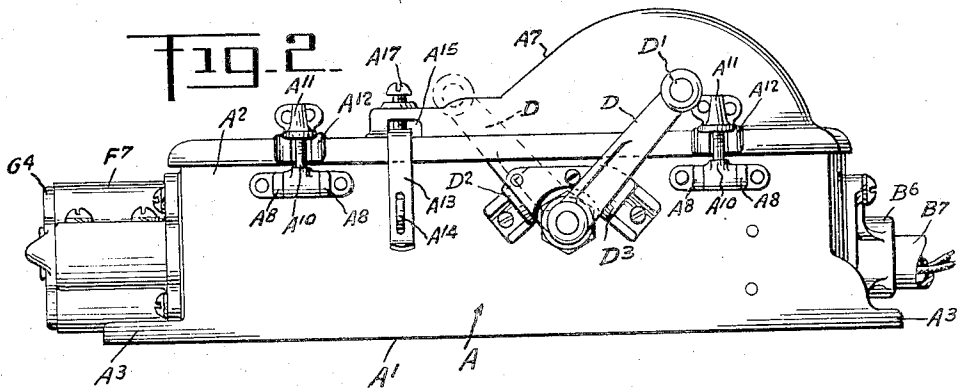
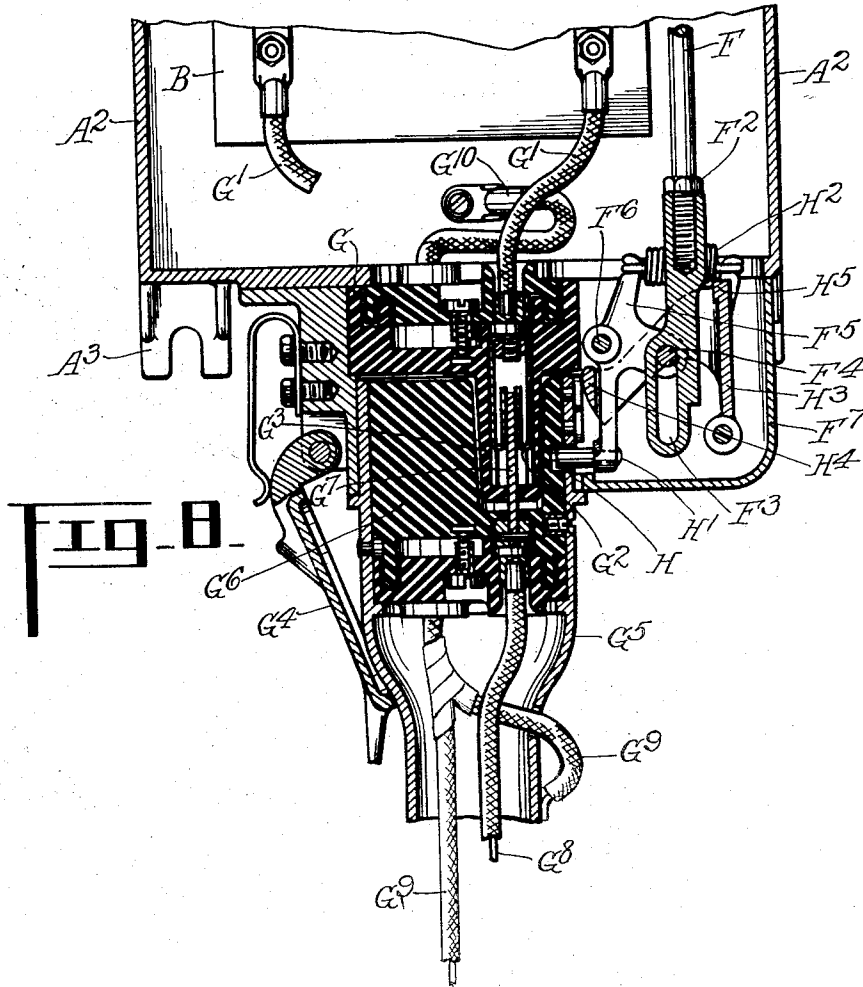
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SAFETY SWITCH

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5 Sheets-Sheet 2



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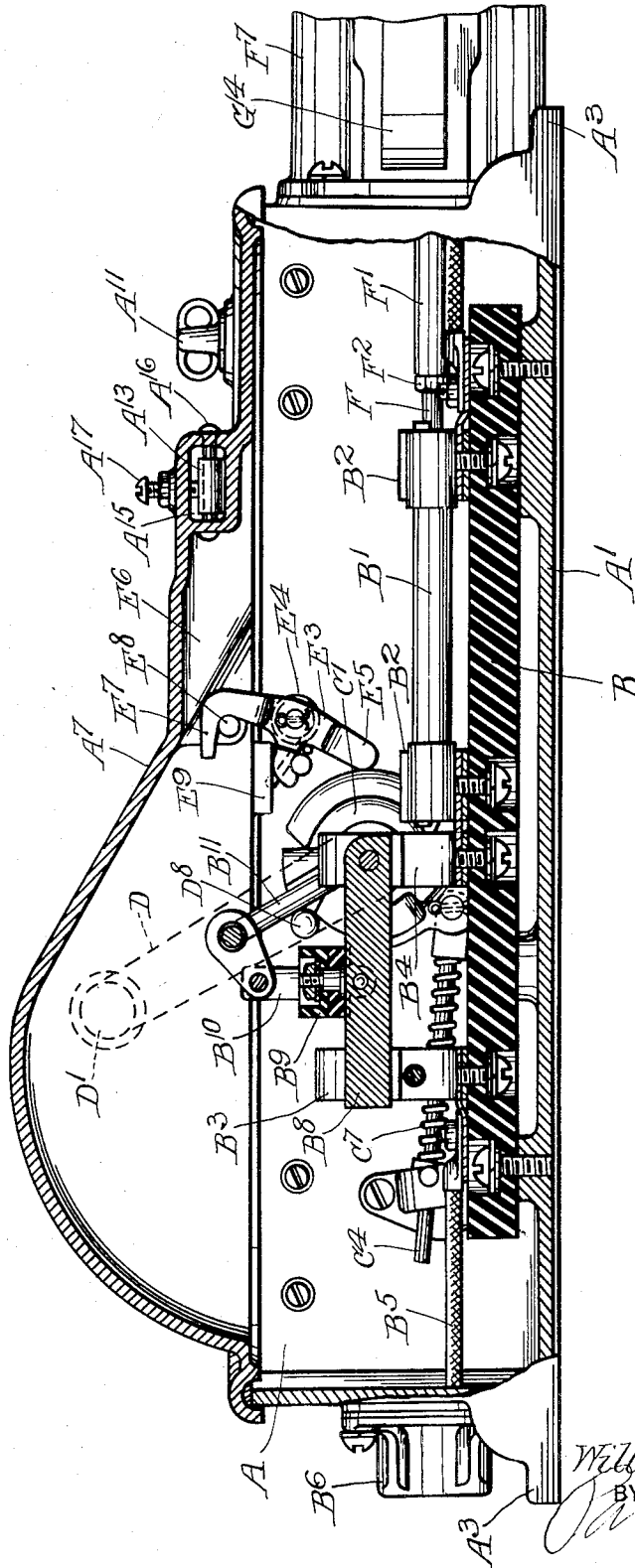
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SAFETY SWITCH

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5 Sheets-Sheet 3



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SAFETY SWITCH

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Fig. 4.

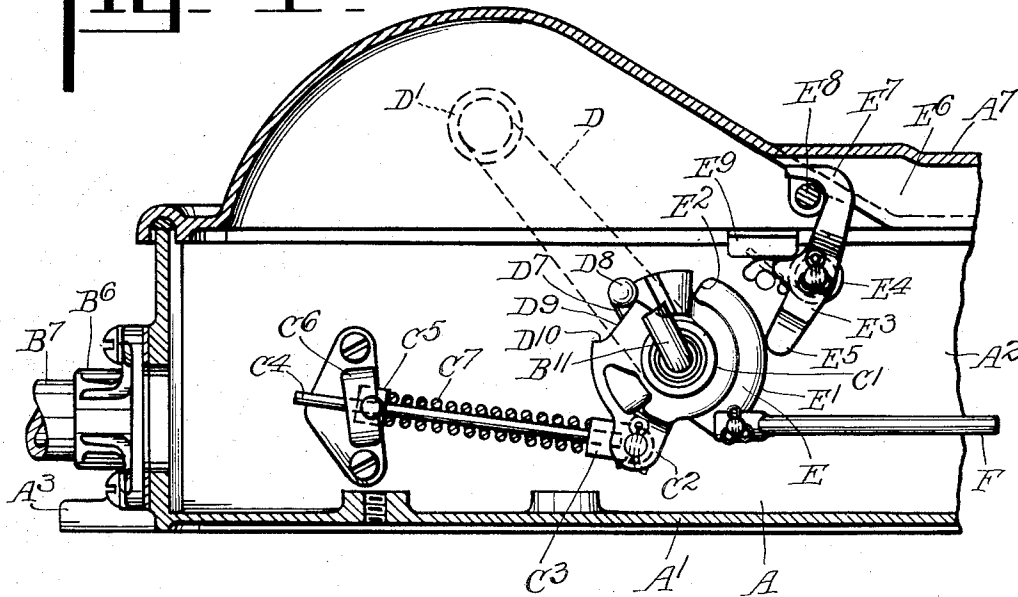
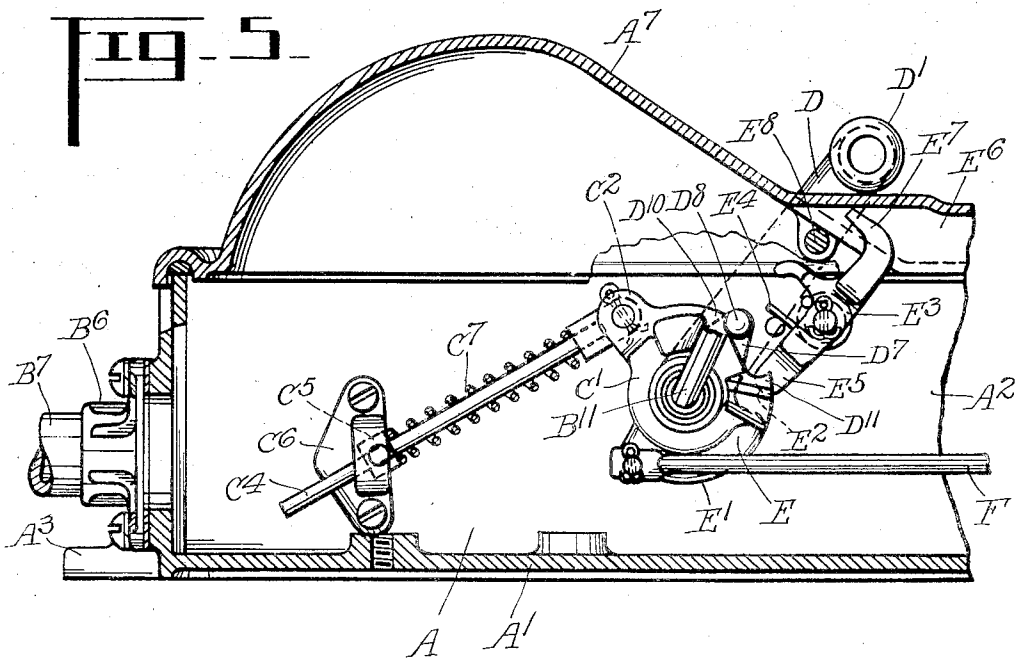


Fig. 5.



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SAFETY SWITCH

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5 Sheets-Sheet 5

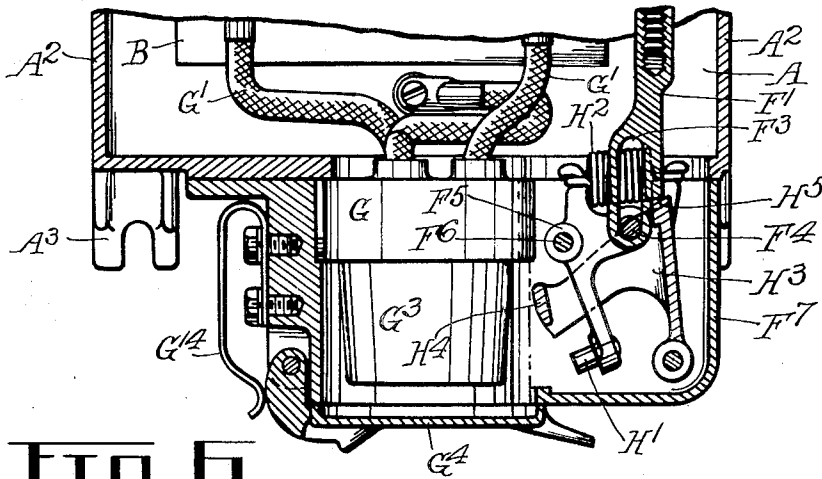


Fig. 6.

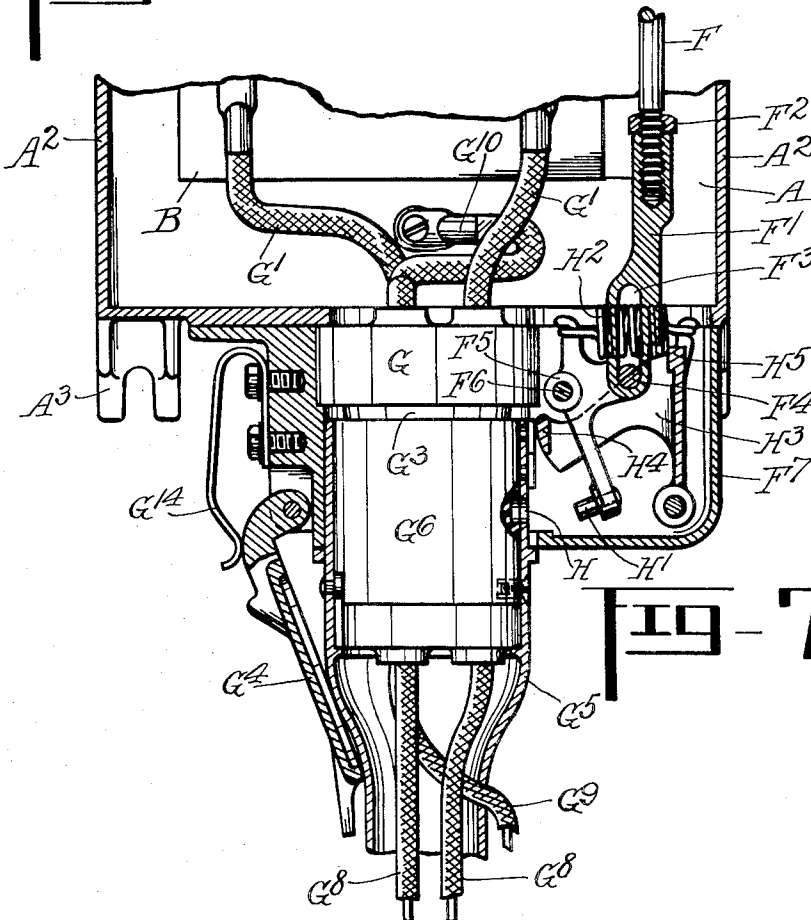


Fig. 7.

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UNITED STATES PATENT OFFICE

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SAFETY SWITCH

Application filed January 10, 1931. Serial No. 507,812.

My invention relates to improvements in safety electrical switches and has for one object to provide a combined switch and terminal plug with housing wherein the terminal plug cannot be inserted unless the switch is open and wherein the plug cannot be withdrawn when the switch is closed and further to provide a cover for the switch box which unless specially manipulated for the purpose of adjustment and the like protects the switch and the switch operator by making it normally impossible to open the cover when the switch is closed and to close the switch when the cover is open. Other objects of my invention will appear from time to time in the specification.

My invention is illustrated more or less diagrammatically in the accompanying drawings, wherein—

Figure 1 is a plan view showing the cover open with the switch for the purposes of illustration closed;

Figure 2 is a side elevation showing the cover closed;

Figure 3 is a longitudinal section;

Figure 4 is a detailed fragmental longitudinal section showing the switch in the closed position;

Figure 5 is a similar detail showing the switch in the open position;

Figure 6 is a fragmental section through the terminal plug socket and associated parts in the position assumed when the plug is not present;

Figure 7 is a similar view showing the plug in position the switch being open;

Figure 8 is a similar view with the plug itself in section the switch being closed.

A is a switch box. It has a bottom A¹ and side walls A² integral therewith. Ears A³ are provided whereby the box may be mounted on any suitable support. Lugs A⁴ support hinge pins A⁵ and lugs A⁶ on the cover A⁷. Locking lugs A⁸ support pivot pins A⁹ and thumb screw locking links A¹⁰ upon which are threaded thumb screws A¹¹ to engage lugs A¹² to seat the cover on the box. A¹³ is a spring hasp on the cover adapted to engage an eye A¹⁴ so that the box may for additional security be padlocked in the closed position. The spring hasp A¹⁴ is loosely socketed in the pocket A¹⁵ being associated with a pivot pin A¹⁶ and an adjustable screw A¹⁷ which may be positioned to control the tension of the spring hasp.

B is an insulating switch panel mounted in the bottom of the box A¹. This switch panel carries fuses B¹ in spring clips B². B³ B⁴ are flexible spring fingers mounted on the switch block B each finger B⁴ being electrically connected to one of the spring clips B², each finger B³ being in electric relation with a conductor B⁵ which passes out of the box through the gap B⁶ and conduit B⁷. B⁸ B⁹ are switch blades, each blade being pivoted at one end on the spring fingers B⁴ adapted to be forced between the spring fingers B³ by means of an insulating block B⁹ which carries the two blades B⁸ and a link pivoted on a yoke B¹⁰ on the block at one end and on the switch crank bar B¹¹ at the other end.

The switch crank bar B¹¹ is mounted at one end in the bearing sleeve C in the wall of the housing and at the other end is rigidly mounted in the snap cam C¹. This snap cam has an ear C² upon which is pivoted a socket C³ carrying a spring pin or plunger C⁴. The pin C⁴ slides in the trunnioned block C⁵ oscillatably mounted in a bracket C⁶ on the wall of the housing. C⁷ is a spring encircling the pin compressed between the sleeve C³ and the block C⁵ so that when the parts are in the position shown in Figure 4 with the switch closed the spring tends to keep the switch closed. When the parts are in the position shown in Figure 5 with the switch open the spring tends to keep the switch open, the two positions being at opposed sides of the center line of movement from open to closed position or vice versa.

D is the control lever. It has a handle D¹. It is rotatably mounted in the wall of the switch box and its movement is limited by the lugs D² D³. The lug D² is apertured as at D⁴ in register with an aperture D⁵ in the lug D⁶ on the handle so that the switch may be locked in the open position by padlock or the like. The crank arm B¹¹ is rigidly mounted in the member C¹ which member is rotatably mounted on the crank extension where it projects inwardly through the wall of the housing. D⁷ is a driving lug rigidly connected to the crank D and having a tooth D⁸ overlying the member C¹ which member is reduced in diameter as at D⁹, the reduced portion terminating in driving abutments D¹⁰ D¹¹ so that the cam member C¹ may have a limited movement with relation to the lever D. This arrangement

permits one or other of the driving abutments D¹⁰ D¹¹ to be engaged by the member D⁷ as the lever D is rotated to compress the spring C⁷ until the member C² is in line with the pin C⁴. Further movement permits the spring C⁷ to snap the cam member C¹ ahead to give the characteristic sudden opening or closing of the switch.

Mounted for rotation with lever D is the locking cam E. This locking cam E has a cylindrical locking face E¹ terminating in a release pocket E². E³ is a lock lever pivoted on the inside of the housing and associated with a spring E⁴ tending to rotate that lever in a clockwise direction as shown in Figures 4 and 5. This lever has a cam engaging tail E⁵ which tail may engage the locking face E¹ of the cam E when the switch lever is in the closed position or which when the switch lever is in the open position as shown Figure 5 drops into the pocket E² to lock the switch lever or arm in the open position. The cover A⁷ has a pocket E⁶ in which the lever E³ may operate and this lever terminates in a latch hook E⁷ to overlie the latch pin E⁸ in the cover. In the position shown in Figure 4 then when the switch is closed, the latch is locked and the cover cannot be opened. In the position shown in Figure 5, the latch is open and the cover can be closed or opened. It will be noted that the cover is never in the position shown in Figure 5 without the latch being thrown into substantially the position shown in Figure 4. This is done by the lug E⁹ on the edge of the cover engaging the hook E⁷ which engagement results in causing the latch to move in counter-clockwise direction into hooking engagement with the pin E⁸ to lock the cover and at the same time causing the latch tail E⁵ to move out of engagement with the pocket E² and permit the cam E to rotate. For purposes of illustration in Figure 5, the cover is shown in place but it will be noted that the lug E⁹ is removed to permit the latch hook E⁷ to come up as the lock lever E³ is moved in clockwise direction about its pivot.

The above arrangement takes care of the situation where it is necessary to have the cover locked in place before the switch is closed. Of course, the operator may manipulate this latch by hand so as to free the cam E and permit the switch to be closed as may be done by the electrician when he is testing circuits but ordinarily this movement takes place and the switch can be closed only when the cover is down and after the cover is down and the switch is closed, the cover cannot be opened by anyone without first opening the switch.

Pivoted to the cam member E¹ is a connecting rod F which is caused to reciprocate by the rotation of the switch handle. This connecting rod F extends to the end of the housing where it terminates in a yoke F¹

which is threaded onto the connecting rod and provided with a lock nut F². This yoke F¹ is provided with a longitudinal slot F³ engaging a pin F⁴ on one of the arms of the three arm lever F⁵ which lever is pivoted on the pin F⁶ in the socket housing F⁷. As will hereinafter appear a connection is established between the hand operated switch and the terminal socket through the medium of this connecting rod whereby locking means are controlled to prevent the insertion of a plug in the terminal socket when the switch is closed and to prevent the withdrawal of the plug if a plug is there unless the switch is open. In other words, there is a combined safety interlock to make it impossible to insert or withdraw a terminal plug unless the circuit is open.

The socket housing F⁷ is attached to the end of the main housing or box A and contains an insulated terminal base G. Conductors G¹ G¹ lead from the fuses B¹ B¹ to spring terminal fingers G² in the boss G³ which extend forwardly from this insulated socket G on one side thereof and eccentric to the same. G⁴ is a cover pivoted on the housing F⁷ adapted to close the opening in register with the base G and provided with a spring G¹⁴ to cause such closing when the plug is not present. The housing F⁷ is generally circular adjacent the base G but has a relatively flat extension at one side as shown in Figure 2 to enclose the interlock mechanism. G⁵ is a terminal plug. It contains an insulating block G⁶ having a socket as indicated to enclose the projection G³. In this socket are two terminal blades G⁷ adapted to engage the spring terminal jaws G². Since this socket and the member G³ are not circular and are disposed eccentrically to the plug and base, engagement can take place only when they are in line and the two members are held against angular movement and compelled to be in a predetermined angular relation before they are engaged. Conductors G⁸ terminate in the spring fingers G⁷ to provide electric connection through the wires G⁸, fingers or jaws G⁷, fingers G², wires G¹ to the two poles of the knife blade of the knife switch.

The terminal plug G⁵ is apertured as at H. One arm of the three way lever F⁵ carries a latch pin H¹. When the plug is inserted, the aperture H is in such position that the latch pin H¹ may enter it and prevent withdrawal of the plug. This entrance takes place only when the connecting rod F is thrust forward from the position shown in Figure 7 to the position shown in Figure 8. When this occurs, the spring H² contracts, throwing the lock pin into engagement with the hole H in the switch plug G⁵ and holding it in position to lock the plug in place. When the switch is opened the connecting rod F is moved away from the lever F⁵ into the position shown in Figures 6 and 7 rotating the lever

F⁵ in a counter clockwise direction, exerting a tension on the spring H² and disengaging the latch pin and the plug. Under these circumstances the plug may be withdrawn.

5 H³ is a yoke pivoted in the housing F⁷. It supports one end of the spring H², the other end being supported by one of the arms of the three way lever F⁵. This yoke has an engagement pad or part H⁴ which extends down into the path of the terminal plug. When the plug is withdrawn, this yoke under the influence of the spring H² is held in an inclined position as shown in Figure 6. When the plug is inserted it engages this pad and rotates the yoke in a clockwise direction as shown in Figure 7. This rotation causes the cam H⁵ on the yoke to move out of line with the end of the yoke F¹. It will be noted that in Figure 6 the cam is engaged by the yoke and the connecting rod F can not be moved forward, thus the switch is held against operation by this yoke and cam engagement until the plug has been inserted to disengage this lock. Of course, the operator might reach in by lifting up the cover of the plug housing and push the yoke to one side with his finger or some instrument, if it were necessary to be able to operate the switch. But under ordinary circumstances this insures that the switch is locked in the open position and cannot be closed until a plug has been inserted and after the plug has been inserted the switch may be operated but if closed locks the plug against withdrawal.

35 The wires G⁸ G¹⁰ are safety wires. G¹⁰ extends from a binding post on the housing to a terminal socket just like the socket for the wire G¹. The wire G⁹ connects to a socket in the plug just like the sockets for the wires G⁸. When the plug is inserted a circuit is closed between the wires G⁹ G¹⁰. The wire G⁹ is grounded as indicated on the handle G⁵. It also extends down through the conduit parallel with the wire G⁸ and is grounded on the machine or apparatus controlled or furnished with power from the box, the idea being that this ground wire breaks both the switch box, the plug handle and the machine or apparatus supplied with current by the extension cord in the event of short circuit.

50 It sometimes happens that a motor mounted on a wheeled truck will have a short, in which case the operator standing on a steel floor touching the motor will get a shock. This safety wire protects all the apparatus against this and if there is a short, there will be a return circuit of lower resistance than the body of the operator and he will be safe.

I claim:

60 1. A switch mechanism including in combination, a housing, a movable switch member in said housing, a cover for said housing, a crank for actuating said switch member, a cam disc immovably fastened to said crank, 65 said disc having a gap in its cam surface, a

tooth lying within said gap and movable within said gap relatively to said disc, an operating lever carrying said tooth for initiating movement of said disc, a spring connected to said disc for completing movement thereof with snap action, a rod pivoted to said disc and carrying said spring, a bearing for said rod with respect to which said rod is movable, said rod, spring and disc constituting a toggle mechanism for moving said crank to actuate said switch after the initial movement thereof by said lever and cam disc.

2. A plug lock for a switch mechanism including in combination, a bell crank, a stud thereon, the switch mechanism having a plug receiving socket, a plug insertable in said socket, said plug and socket having registering apertures for receiving said stud, a movable switch member, means for moving said switch member to closed position, means operable by said last-mentioned means for actuating said bell crank to move said stud into said registering apertures of the socket and plug, a yoke having a part lying in the path of the plug and having an abutment normally positioned to prevent movement of said bell crank by said last mentioned means to engage said stud with the socket aperture in the absence of the plug, the application of the plug to said socket engaging said yoke part and moving said abutment out of abutting relation with respect to the bell crank, the normal position of the yoke abutment with respect to the bell crank actuating means preventing the closing of the switch member when the plug is absent.

3. A switch mechanism including in combination, a housing, a plug receiving socket forming a part of said housing, a plug insertable in said socket, said socket and plug having registering apertures, a switch mechanism within said housing, a plug locking mechanism including a stud, means for actuating said switch mechanism, means operable by said last-mentioned means for actuating the plug locking mechanism to move the stud into said apertures when said switch mechanism is actuated to close the switch, a yoke having a part lying in the path of said plug and having an abutment engageable against the plug locking mechanism for preventing actuation of the switch mechanism and plug locking mechanism in the absence of the plug, the insertion of a plug in said socket engaging said yoke part and moving said abutment away from the plug locking mechanism, actuation of the switch mechanism then being effective to close the switch and lock the plug by engagement of said stud with the registering apertures in the plug and socket.

4. A switch mechanism including in combination, a housing, a plug receiving socket as a part of said housing, a switch mechanism within said housing, means for actuating said

switch mechanism, said socket having an opening therein, a bell crank disposed adjacent said socket and having a stud thereon for entering said opening, connections between said switch actuating mechanism and said bell crank for moving said stud into said opening when said switch actuating mechanism is moved in a direction to close the switch, and an abutment engageable against the bell crank actuating mechanism for preventing movement thereof in the absence of a plug, the abutment serving to prevent actuation of the switch closing mechanism when in abutting relation with respect to the bell crank actuating mechanism.

5. An electric switch apparatus including in combination, a housing, a throw switch within said housing, a socket carried by said housing, a plug insertable in said socket, a cover for said housing, means for operating said switch, means actuated by the closing of the cover for locking the cover in closed position, said last-mentioned means being maintained in locking engagement with the cover by engagement of said switch actuating means therewith, means for locking a plug in said socket, said locking means being operable by the switch actuating means, and an abutment for preventing actuation of the switch actuating means to move the switch in closed position and the plug locking means to locking position in the absence of a plug.

6. In a device of the class described, in combination, a casing having switch mechanism therein, said switch mechanism including a member movable to open and close the switch, a plug socket on said casing having an aperture in its wall, a bell crank carrying a projection for entering said aperture under certain conditions, means for moving said movable switch member to closed position, connections between said last-mentioned means and said bell crank for moving said projection into the socket aperture when said movable switch member is moved in a direction to close the switch, and a stop member having a part lying in the socket in the path of the plug and engaging said bell crank for preventing movement of it and the movable switch member to switch closing relation in the absence of a plug in said socket, the insertion of a plug in said socket engaging said stop member part and moving said stop member out of stopping engagement with the bell crank and its connected parts.

7. A switch mechanism including a housing, a removable cover for said housing, said switch mechanism including a movable member for closing and opening circuit relation through said switch mechanism, a socket carried by said housing, a plug insertable in said

socket, means for actuating said movable switch member, a pawl pivoted inside said housing for hooking engagement with the cover, said pawl and cover having cooperating parts for moving said pawl into hooking engagement with the cover as the cover is closed, means carried by the switch actuating means for maintaining said pawl and cover in hooked engagement as long as said movable switch member is in closed position, said socket and plug having registering apertures, a bell crank carrying a projection for entering said registering apertures, connections between said bell crank and said switch operating mechanism for moving said projection into the apertures in said socket and plug as said switch member is moved to closed position, a yoke having a part lying in the path of said plug, said yoke being effective to prevent closing of the switch mechanism in the absence of a plug, the insertion of a plug engaging said part to move said yoke out of position otherwise preventing actuation of the switch closing mechanism.

8. A switch mechanism including a housing, a removable cover for said housing, said switch mechanism including a movable member for closing and opening circuit relation through said switch mechanism, a socket carried by said housing, a plug insertable in said socket, means for actuating said movable switch member, a pawl pivoted inside said housing for hooking engagement with the cover, said pawl and cover having cooperating parts for moving said pawl into hooking engagement with the cover as the cover is closed, means carried by the switch actuating means for maintaining said pawl and cover in hooked engagement as long as said movable switch member is in closed position, said socket and plug having registering apertures, a bell crank carrying a projection for entering said registering apertures, connections between said bell crank and said switch operating mechanism for moving said projection into the apertures in said socket and plug as said switch member is moved to closed position, and a stop member having a part lying in the path of movement of the plug in its application to said socket, said stop in the absence of a plug engaging the connections between the switch actuating means and the bell crank for preventing movement of said parts to close said switch and lock the cover, said stop being moved from engagement with said parts by a plug when the latter is inserted in said socket.

Signed at Chicago, county of Cook and State of Illinois, this 8th day of January 1931.

WILLIAM A. WULLE.