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J. LOFGREN

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SAFETY SWITCH

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Fig. 1.

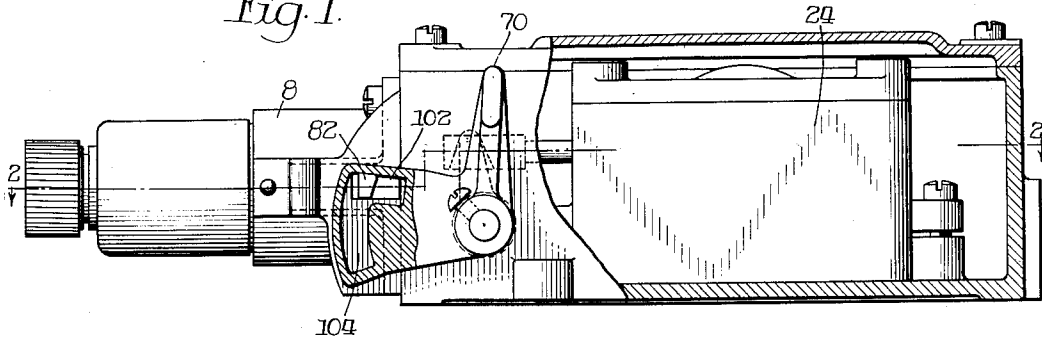


Fig. 2

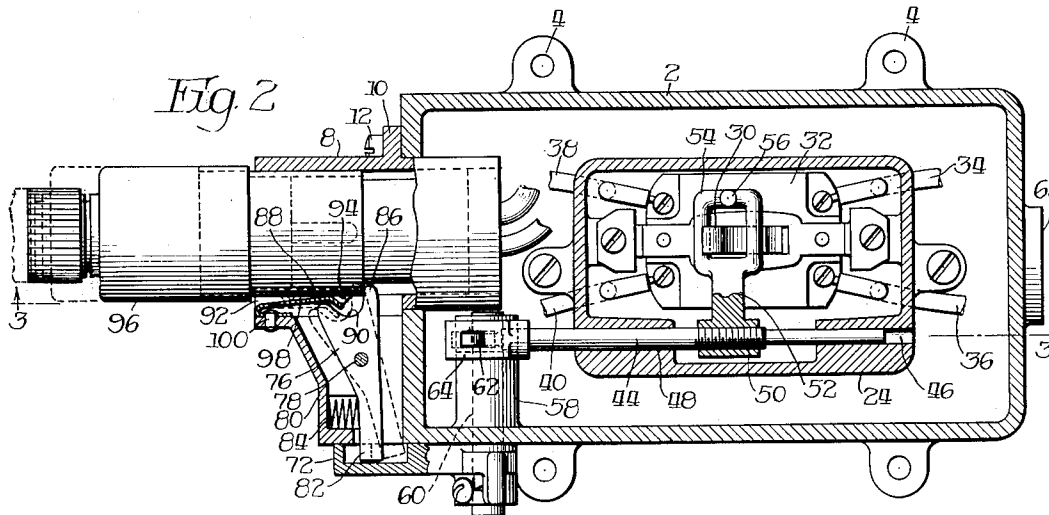


Fig. 3.

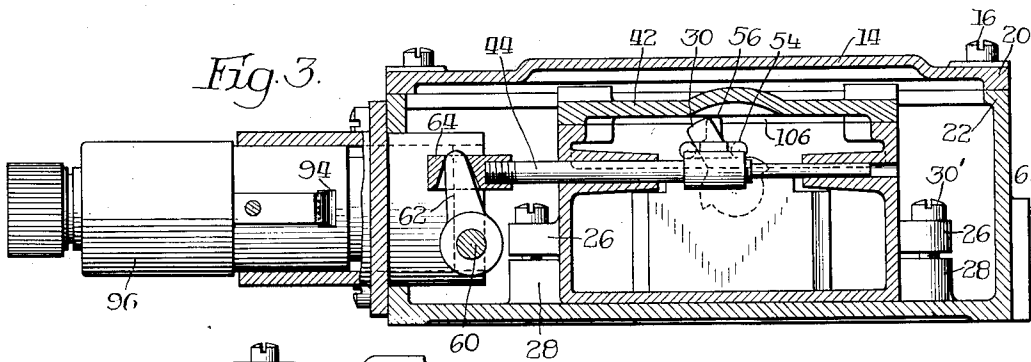
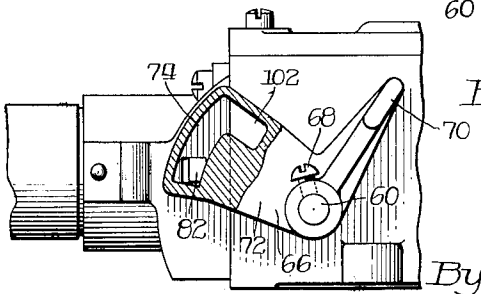


Fig. 4.



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UNITED STATES PATENT OFFICE

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SAFETY SWITCH

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14 Claims. (Cl. 200—50)

My invention relates to a safety switch adapted peculiarly for use in places where there may be combustible gases or explosive vapors or combustible dust in the atmosphere immediately surrounding the switch.

The switch in general comprises an explosion-proof casing containing the switch mechanism proper, an external handle for drawing the switch on or off, a socket electrically connected to the internal switch mechanism, and a detachable connector plug adapted to fit in the socket to make connections forming a source of current to the switch mechanism.

The primary object of my invention is to simplify certain features of the switch mechanism shown in my prior Patent No. 1,347,534, issued July 20th, 1920.

Among the further objects of my invention is to provide an explosion-proof switch of the general character shown in my prior patent, but wherein provision is made for making the switch mechanism even more explosion-proof.

Yet another object of my invention resides in cheapening and simplifying the switch, and particularly the operating connections from the exterior operating handle to the interior switch lever, and in simplifying and cheapening the connections from the exterior operating handle to the shiftable interlock between the switch-throwing mechanism, and means for locking the plug within or outside of its socket.

Still another object of my invention resides in providing a more positive operation of the interior switch lever from the exterior operating handle.

Yet another object of my invention resides in the provision of a practical ground connection between the detachable plug and the casing.

These and other objects of my invention will be apparent from a perusal of the following specification when taken in connection with the accompanying drawing, wherein:

Figure 1 is a side view, partly in section, of my improved switch;

Figure 2 is a top view on line 2—2 of Figure 1;

Figure 3 is a sectional view on line 3—3 of Figure 2; and

Figure 4 is a view of the exterior operating handle with the connection to the interlocking lever, said parts being cut away to show the construction.

Referring now to the drawing in detail, in the illustrated form of my invention there is a box 2 which is intended to be mounted in fixed position by means of suitable lugs 4. This box at one end has an opening 6 which is threaded on the interior bore thereof to receive the usual pipe conduit through which the electrical conductors pass. At its opposite end this box 2 is provided with a socket 8, which may be either integrally

formed therewith or connected thereto by means of a flange 10 and suitable screws 12. The junction between the socket 8 and the box 2 is preferably gas-tight. In addition, the box 2 is provided with a cover 14 secured to the box in any suitable or convenient manner as by means of suitable screws 16, or other suitable means. The junction of the cover and the box 2 is made by relatively wide flanges 20 on the cover and 22 on the box. These flanges extend around the entire surface of the box top and cover so as to provide a relatively wide joint to prevent the propagation of flame in case of an internal explosion.

The switch mechanism which is adapted to be actuated is contained within an explosion proof inner casing or box 24, which inner box is provided with projecting lugs 26 adapted to be attached to upstanding lugs 28 formed on the inner bottom wall of the outer box 2. Screws 30 provide this detachable connection. This inner switch box contains any type of single, double pole or even triple pole switch.

The switch mechanism, save for the fact that it embodies a shiftable control or switch lever 30, forms no part of my present invention. It is shown of conventional type, including the insulation 32 and the conductor terminals 34, 36, 38 and 40 passing through suitably formed apertures in the two extreme ends of the box. These apertures are sealed by any type of sealing composition. In addition, the box is provided with a cover 42 held in place as by screws, or other suitable means, and in such manner that gas cannot pass through the junction of the cover and the box. The switch lever 30 is adapted to be oscillated about a horizontally arranged pivot.

The mechanism for throwing the switch lever 30 has been greatly simplified in my present invention. In the form illustrated, it comprises a slidable rod 44 which slidably fits through a bore 46 and a bore 48 formed in one side of the inner casing 24. A central portion of this rod 44 is threaded as at 50 to receive a yoke 52, which extends over and straddles the upstanding switch lever 30 as at 54. The yoke 54 is provided with an upstanding projection 56 adapted to slide along the under side of the wall 106 of the cover 42. Just above the control lever 30 the cover is bulged upwardly as at 60 in order to permit of its arcuate movement at this point, but since the upstanding lug 56 on the yoke 54 contacts with the bottom of the cover, the yoke is prevented from rising above and slipping off the upstanding switch member 30.

Means is provided for operating the sliding rod 44 from a point outside the outer casing 2. In the present instance, the inner wall of the casing 2 is provided with an inwardly projecting, horizontally disposed sleeve 58 having a central bore to receive a shaft 60, which is rigidly fastened there-

to at its inner end, and a lever 62. The inner end of this lever enters a recessed block 64, fastened to one end of the control rod 44. The outer end of the shaft 60 is provided with a quadrant 66 rigidly connected thereto as by a set screw 68 or other suitable means such as a key or pin through hub and shaft could be used. Rigid with this quadrant is one form of an operating handle 70, the other end of the quadrant is a sector-shaped portion 72, the inner wall of which is cut away in a somewhat L-shaped formation, as at 74.

In order to provide an interlock between the mechanism for operating the switch 30 from the handle 70, I have provided a locking lever 76 pivoted as at 78 to an extension 80 of the casing 8. The end 82 of this lever projects into the recess 74 of the quadrant 72, and a coiled spring 84 is arranged normally to press the end 82 of this lever inwardly, so that when the short leg of the L-shaped recess is opposite the end 82 of this lever, if other conditions permit, the spring 84 will force such end to the shorter recess. The opposite end of the lever 76 is of yoke-shaped formation, providing two spaced-apart fingers 86 and 88 and an intermediate groove 90. The socket 8 of the casing is provided with a lateral angularly shaped bore 92 somewhat in the form of a guideway to slidingly receive a locking lug 94 on the side of the plug. This is provided so that the plug can be slidingly inserted into the socket in only one position. This locking lug 94 is a member which is adapted to cooperate with the locking lever 76 to form an interlock between the switch-operating mechanism and the plug, so as to make it impossible for the operator to insert or withdraw the plug unless the switch is open, and thus avoid arcing of the electrical contacts and the consequent danger of explosion.

In order to provide a ground connection between the plug 96 and the casing 2, I have provided the casing with a spring 98 attached to the casing as at 100, and the inner end of this spring extends inwardly and is adapted to lie in the groove 90 in the interlocking lever 76, so that when the plug is inserted in the socket 8, the lug 94 will pass or scrape along the smooth surface of the copper contact strip 98 to form a firm and constantly bright ground connection.

It will be noted that the two fingers 86 and 88 and the groove 90 of the interlocking lever 76 are arranged so that as the plug 96 is inserted, its inner end will contact against the finger 86 of the lever 76. In the operation of my device, with the switch in open position and the control handle 70 as shown in Figure 1, the plug 96 is inserted in the socket 8, the lug 94 passing into the offset guideway 92. Upon pushing the plug into the socket, the inner end of the plug will push against the finger 86 of the control lever until the plug is in innermost position. In this inward movement of the plug, due to the fact that the inner end of the plug has contacted with the finger 86, the end 82 of the interlocking lever 76 has been swung about its pivot 78 so that this end is thrown slightly forwardly away from the shorter leg 102 of the cut-out 74. In other words, it will be somewhat in the position shown in Figure 1.

It will be apparent that in this position it will register with the longer leg 104 of the cut-out 74 so that if it now be desired to move the handle 70 of the exterior operating lever by shifting it clockwise, the switch lever 30 is not only thrown to closed position, but also, due to the moving of the longer leg 104 of the cut-out 74 across the end 82

of the interlocking lever 76, the interlocking lever has been locked against further pivotal movement. Hence the lug 94 on the side of the plug will be securely locked between the two fingers 86 and 88 of the interlocking lever 76, and therefore it will be impossible to withdraw the plug from its socket, but the switch-operating lever 70 can be operated freely to throw the switch to on and off position. In other words, with the lever 70 thrown to on position when the switch is closed, it is not possible to withdraw the plug until this lever 70 is thrown to a position wherein the switch is open. At this point the end 82 of the interlocking lever will again register with the shorter leg 102, so that the plug can be withdrawn from its socket.

It will also be seen that when the plug 96 is withdrawn from socket 8 of the casing, the coiled spring 84 will force the end 82 of the interlocking lever 76 up into the shorter leg 102 and with the interlocking lever 76 in this position it can be readily seen that the handle 70 is positively locked. This prevents the switch from being operated or moved to its on position until the plug 96 is again inserted in the socket 8, and which forces the end 82 of the interlocking lever 76 down far enough to allow it to enter the shorter leg 102 when the lever 70 is moved forward.

This is an important advantage, since the construction prevents accidental or intentional switch closing movement of the operating handle when the plug is removed. If the switch should be closed when the plug is removed, some innocent person might proceed to insert the plug without knowing that the plug engaging electrical contacts were alive, and the resulting electric arc which would be created at the instant the plug engages the contacts, might create hazardous conditions, particularly if the contacts should be surrounded by an explosive atmosphere.

It will be apparent from the foregoing that I have provided a switch of extreme simplicity, of relatively low cost of manufacture, and with practically no possibility of mechanically getting out of order. At the same time, it is as nearly explosion-proof as possible, since the arcing portion of the switch is enclosed in a substantially hermetically sealed outer casing. The only apertures in the inner casing are the bores 46 and 48 through which the rod 44 slides, and this slide fit can be made sufficiently close to prevent the passage of any gas therethrough. The only opening in the outer box is that between the sleeve 58 and the shaft 60, and this oscillatable shaft fitting can be made so relatively close as to prevent the possibility of any gas passing therethrough. The covers of the two boxes can be made practically hermetically sealed. The interlocking feature between the inner switch mechanism and the insertable plug is located wholly outside of the box, and is operable from the switch quadrant 72, which eliminates any possibility of the entrance of gas, and provides ready access to this mechanism for repairs and inspection. The switch mechanism is simple in construction and operation, and is in constant, direct, and positive actuating connection between the handle 70 and the switch lever 30.

It must be apparent that any type of switch may be used within the inner box 24, and that the yoke connection 54 may be suitably modified to accommodate whichever type of switch-operating lever is used in lieu of the lever 30, and it

will be understood that numerous changes may be made in the form, construction and arrangement of the several parts without departing from the spirit or scope of my invention or sacrificing any of its attendant advantages, the form herein described being a preferred embodiment for the purpose of illustrating the several novel features of my invention.

Having thus described my invention, what I claim as new and desire to secure by Letters Patent is:

1. A switch of the character described, comprising switch mechanism having a shiftable switch member, a substantially explosion-proof casing enclosing the switch mechanism and the member, operating connections for said member passing through the wall of the casing, a second casing wholly enclosing the inner casing, said second casing including a socket and a connection for electrical conduits, and a shiftable control handle mounted on the exterior of said second casing and having a controlled member passing through the wall of said second casing, and connections from said controlled member passing through the walls of said second casing to the switch-operating mechanism passing through the wall of the inner casing, a plug adapted to be inserted in the socket, said plug having an interlocking element, and a shiftable associated locking element mounted on the said second casing and adapted to make locking and unlocking contact with the lug on said plug, and connections from said shiftable locking element to the shiftable control handle on said second casing, said connections being constructed and arranged whereby to prevent the withdrawal of said plug when said shiftable handle is moved to throw the switch to closed position and permitting free withdrawal of said plug when the switch is thrown to open position.

2. In a device of the class described, the combination of a casing provided with a socket, a switch mounted in said casing, and provided with a movable element, a handle mounted on the outside of the casing, said handle being provided with a rigidly connected arm, said arm being provided with a locking means having angularly disposed portions, a lever pivotally mounted on the outside of said casing between the laterally disposed arm of the handle and the socket, the inner end of said lever having a portion adapted to interlock with a lug on a plug adapted to be inserted in the socket, whereby to be shifted upon the movement of said plug, the opposite end of said lever being constructed and arranged to cooperate with the locking means, and spring means adapted to normally urge said pivoted lever in a predetermined direction.

3. In a device of the class described, the combination of a casing having a receptacle and having a switch handle shiftable mounted on its exterior, said switch handle having a laterally disposed quadrant provided with a locking groove, one portion of which extends peripherally of the quadrant, and the other portion of which extends substantially at right angles thereto, a switch mounted within the casing and having a shiftable control element, operative connections from the operating handle to the control element of the switch, whereby, upon movement of the handle, said switch element will be shifted, and an interlocking lever mounted on the exterior of said casing, said lever being pivoted intermediate its ends and having its innermost end provided with spaced-apart fingers and an intermediate groove, the opposite end of said lever projecting into the

locking groove of the quadrant, and a plug for said receptacle, said plug having a locking lug adapted, when the plug is in inserted position, to lie between the fingers of the interlocking lever with the innermost end of the plug pressing against one of said fingers.

4. In a device of the class described, a switch, a casing for said switch, including a socket, a plug for the socket, said plug having a locking lug, a switch mechanism within the casing, including a shiftable member, an operating handle mounted on the exterior of said casing and being operatively connected therefrom through the wall of the casing to the switch mechanism, and interlocking mechanism mounted on the exterior of said casing, including a pivoted lever operatively associated with the operating handle, and with a lug on the plug, said casing having a resilient ground-contacting member in the path of movement of the lug on the plug, whereby, when the plug is inserted, ground contact will be made between said plug and the casing.

5. A switch mechanism comprising a casing enclosing a switch, said casing having a socket provided with a lateral guideway, a plug having a lug adapted to slide into said guideway to permit the insertion of the plug into the socket, there being a resilient metal contact mounted in the inner wall of said guideway and extending inwardly into the path of movement of said lug on the plug to provide a ground contact.

6. A switch mechanism comprising a casing enclosing a switch, said casing having a socket provided with a lateral guideway, a plug having a lug adapted to slide into said guideway to permit the insertion of the plug into the socket, there being a resilient metal contact mounted in the inner wall of said guideway and extending inwardly into the path of movement of said lug on the plug to provide a ground contact, there being a control handle mounted on the exterior of said casing connecting to the switch mechanism within the casing, and an interlocking lever mounted on the exterior of said casing and connected to said control handle, one end of said interlocking lever being operatively associated with the plug and with the lug on the plug, and with the resilient ground contact.

7. A switch mechanism of the character described comprising a casing having at one end a connection for an electrical conduit, said casing at the other end having an opening, a socket member having a cylindrical sleeve passing into said opening, said socket member including a flange and fastening means passing through said flange, and through the end of the casing, to hold the socket member in position on said casing, said socket member having a lateral extension at the end of the casing provided with a hollow portion, a lever pivoted in said hollow portion transversely to the bore of the socket member, and an operating handle mounted on the exterior wall of said casing, said operating lever having a lateral offset arm provided with an interlocking groove adapted to receive the outer end of said pivoted lever, a switch mounted in said casing and provided with an actuatable arm, and operating connections from said handle on the exterior of said casing through the wall of said casing and to the actuating arm of the switch, and a plug adapted to be inserted in said socket, said plug having a locking lug adapted to be operatively associated with the inner end of said pivoted lever.

8. An explosion-proof switch comprising an

outer casing having a socket adapted to receive a plug and having a control member mounted on the outer side thereof with an operating shaft passing through said casing, and a substantially explosion-proof box rigidly mounted within said casing, said box having a switch therein including an actuatable member and connections passing through the wall of said inner box to the inner end of the actuating mechanism that is mounted on the exterior wall of the outer box.

9. A switch of the character described, comprising a casing having an internal sleeve formed therein, a shaft passing through said sleeve, the inner end of the shaft carrying a lever, a recessed block operatively associated with said lever, a switch box mounted within the first-mentioned casing, a switch in said box, said switch box having registering internally disposed sleeves, a rod slidable through said sleeves, one end of said rod passing outside of said switch box and connected to the recessed block, and a yoke mounted on said sliding rod within said switch box, said yoke overlying a shiftable switch member whereby, on sliding movement of said rod, said switch member will be shifted.

10. A switch of the character described, comprising a casing having an internal sleeve, a shaft passing through said sleeve, the inner end of the shaft carrying a lever, a recessed member operatively associated with said lever, a switch box mounted within the first-mentioned casing, a switch in said box, said switch box having registering internally disposed sleeves, a rod slidable through said sleeves, one end of said rod passing outside of said switch box and connected to the recessed member, and a yoke mounted on said sliding rod within said switch box, said yoke overlying a shiftable switch member whereby, on sliding movement of said rod, said switch member will be moved, said yoke having an upstanding finger sliding along a wall of said switch box, whereby to prevent the upward movement of said yoke beyond a predetermined point upon movement thereof.

11. In a switch of the character described, the combination of a switch box carrying a switch mechanism, said box having openings there-through, a switch mechanism mounted in said box and having electrical conductors passing through said openings, said openings being hermetically sealed by a sealing medium, a rod slidable through one of the side walls of said box, the inner portion of said rod being operatively connected to a slidable member switch, a second casing enclosing the first mentioned switch box, said casing having an inwardly projecting sleeve, a shaft passing through said sleeve, and provided at its inner end with a lever having an articulated connection with said sliding rod, the outer end of said shaft having an operating handle whereby to cause the operation of said switch on the outside of both of said switch boxes, said outer switch box having a socket provided with switch terminals passing into the inner portion of said box and connecting with the terminals of the conductors that pass through the inner box, and a plug carrying connecting terminals adapted to make contact with the terminals in the socket.

12. The combination of an exterior casing having an opening at its end, a socket member having a flange attached by suitable fastening means

to said casing, and said socket member having a lateral extension fitting the end wall of said casing, said extension having a transversely extending plate-like member lying adjacent that side of the wall of the casing adjacent to the end wall, said extension being hollow, and said socket member having a lateral guideway leading into said hollow portion, a plug having a locking lug adapted to be inserted in said socket with the locking lug passing into the guideway, a lever pivoted in the hollow extension, said lever having a forked end constructed and arranged to receive the locking lug on the plug between its furcations, the outer end of the lever extending beyond the plate-like projection, said plate-like projection being slotted to permit oscillation of such end of the lever, a spring interposed between said lever and the adjacent wall of the extension, and an operating handle mounted on the second mentioned wall of the casing and provided with a quadrant having a locking groove, a portion of which extends substantially concentrically with the axis of oscillation of the quadrant, and a second portion extending substantially at right angles to the first-mentioned groove portion, whereby said grooved portions will permit the oscillation of the end of said lever at certain positions of the quadrant, and a switch mechanism mounted within the casing, including an oscillatable member, and operative connections from said member to the arm on the outside of said casing.

13. A switch mechanism comprising a casing, a switch mounted in said casing and having a switch arm oscillatable about a horizontal axis, said oscillatable switch arm extending upwardly, a cover for said casing, said cover having a portion to permit the oscillation of said arm, and having the adjacent walls of said cover lying within the arc of movement of the upstanding switch element, a yoke straddling the oscillatable switch arm, said yoke having an upstanding finger adapted to contact with and slide along the under surface of the cover during the oscillation of the yoke, whereby to keep said yoke and switch arm in operative connection, and means passing through the switch casing for oscillating said yoke, and a second casing enclosing the first casing, an operating handle mounted on the outside of the second casing, with a connection passing through the wall of the second casing to the switch-operating mechanism within said casing, said outer casing having a socket and a plug adapted to be inserted in said socket, said plug carrying a lug and an interlock associated with said switch-operating handle on the outside of the casing, and with the lug on the plug.

14. In a device of the class described, a switch, a receptacle, a plug for the receptacle, a box enclosing the switch, a handle outside of the box connected to the switch for closing it, said handle having a laterally and rigidly extending portion provided with a substantially L-shaped guide, a lever having one end normally moving in said guide and having its other end provided with means located in the path of the movement of the plug, there being operatively associated means on said lever and on said plug providing an interlock.

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