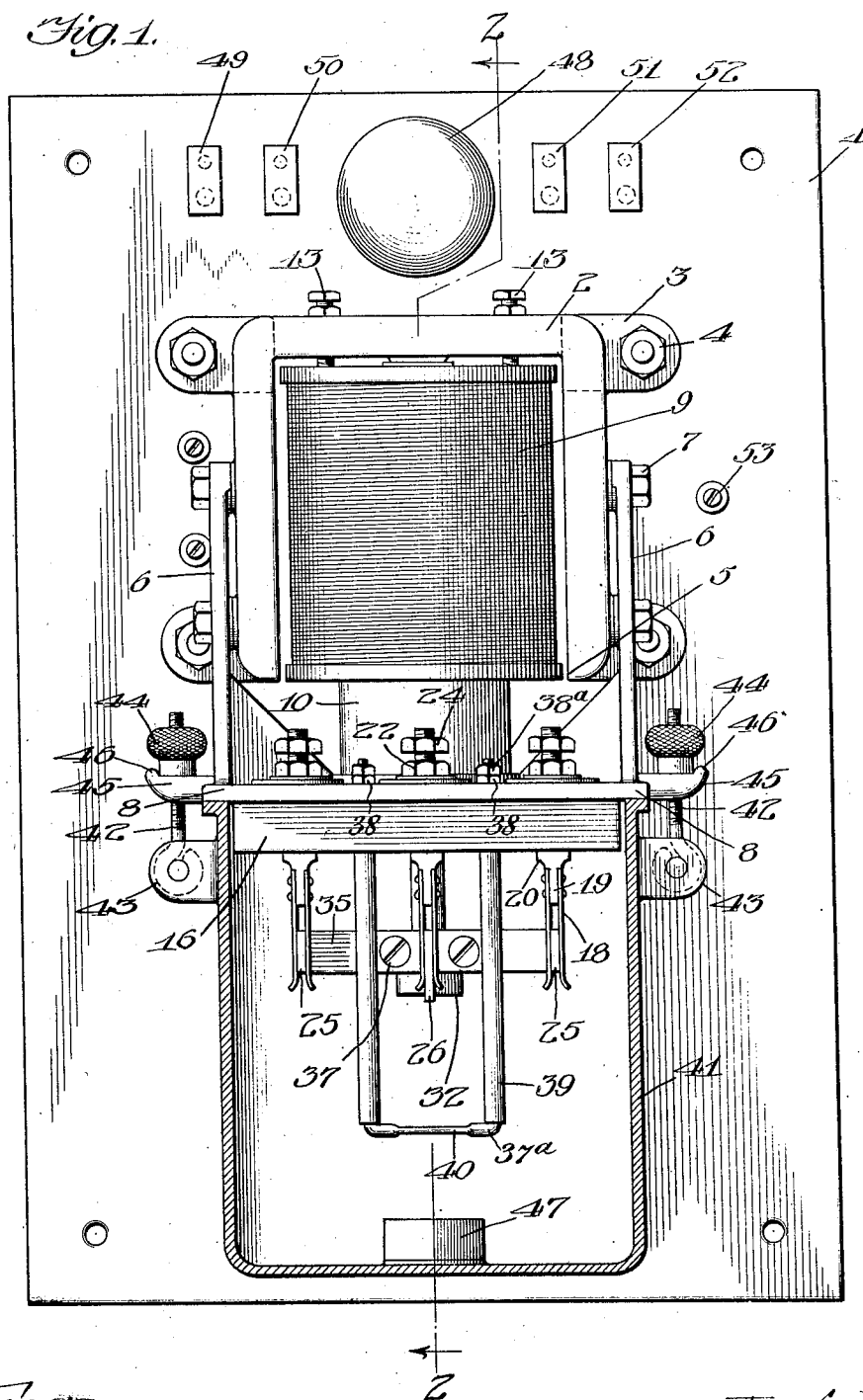


A. W. BERRESFORD.
SOLENOID SWITCH.
APPLICATION FILED JUNE 5, 1905.

935,733.

Patented Oct. 5, 1909.

4 SHEETS—SHEET 1.



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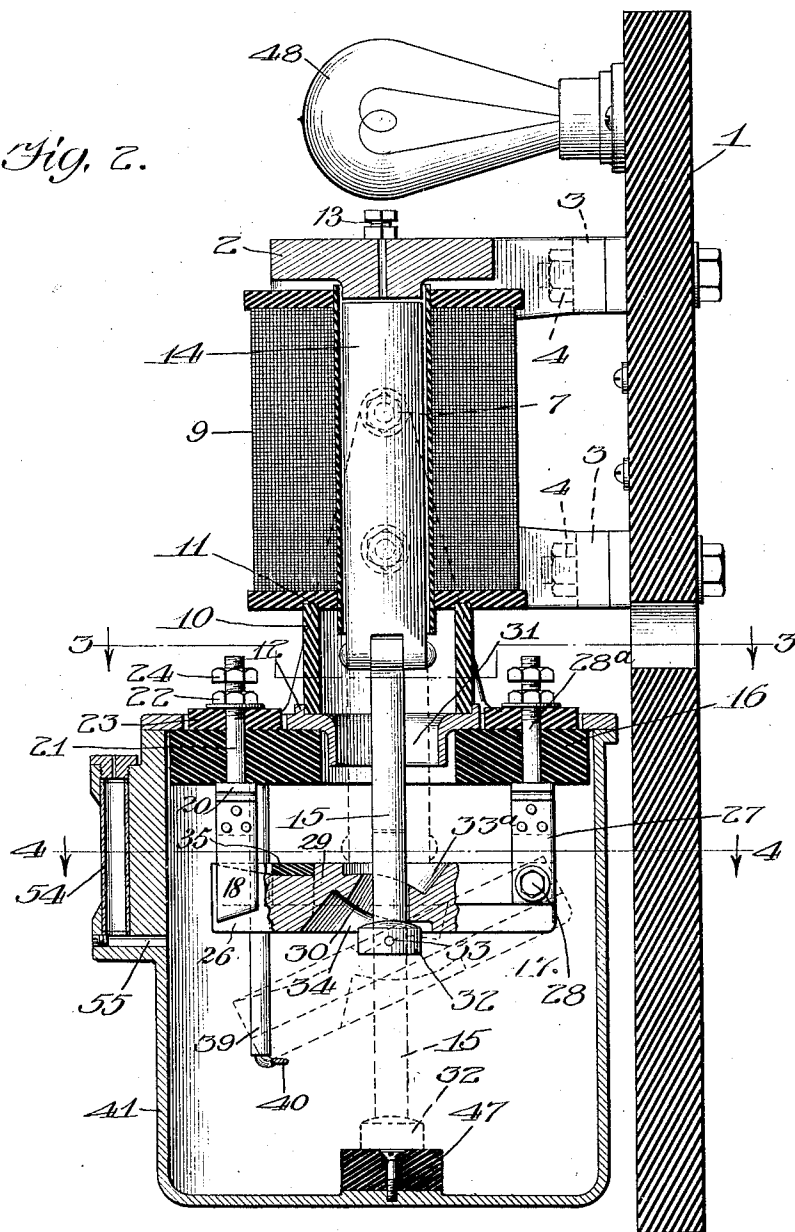
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4 SHEETS—SHEET 2.

Fig. 2.



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4 SHEETS—SHEET 3.

Fig. 3.

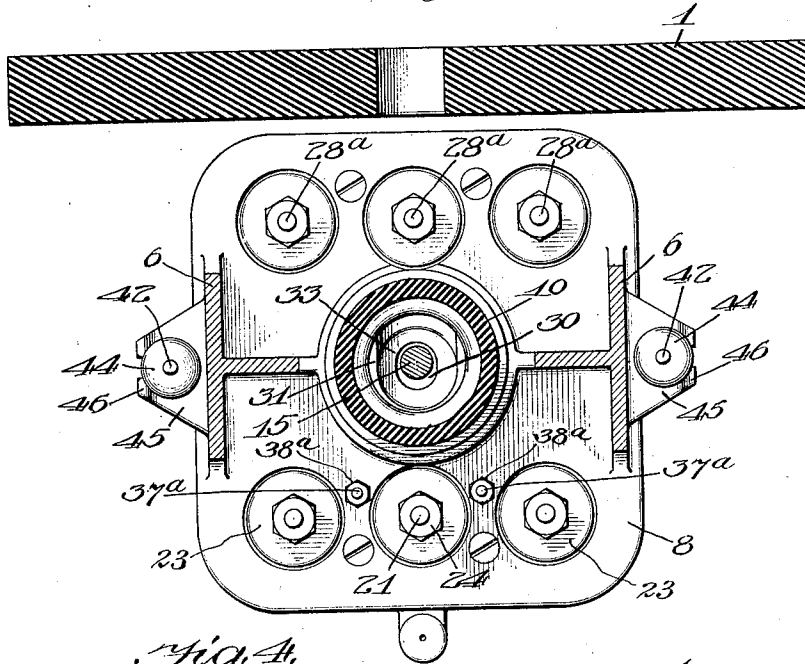
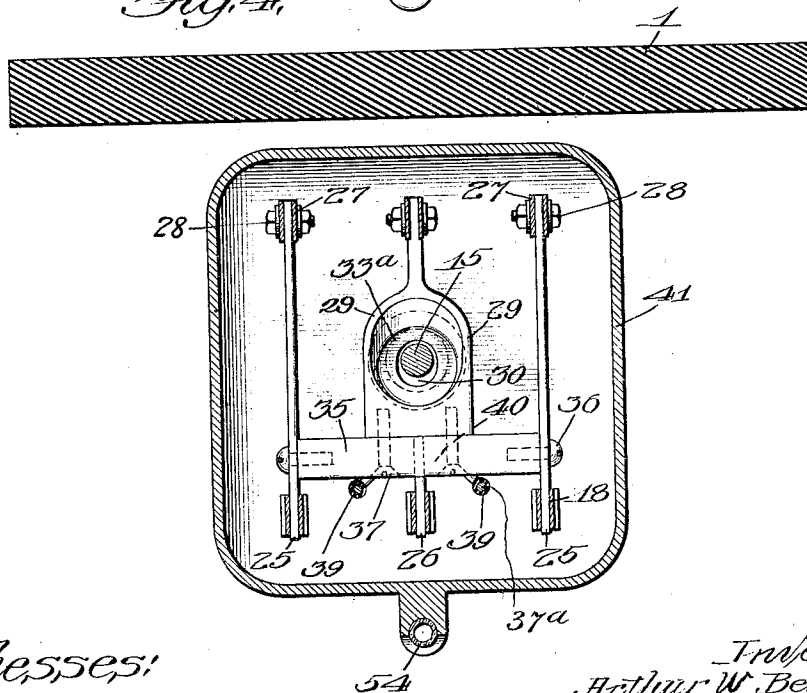


Fig. 4.



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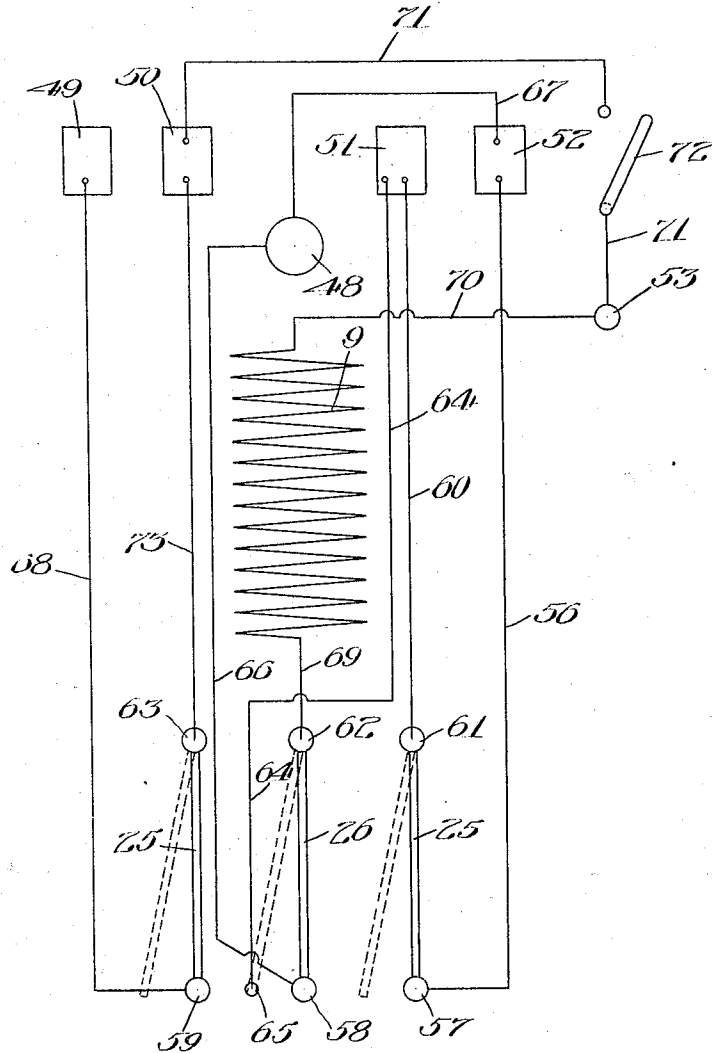
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4 SHEETS—SHEET 4.

Fig. 5.



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UNITED STATES PATENT OFFICE,

ARTHUR W. BERRESFORD, OF MILWAUKEE, WISCONSIN, ASSIGNOR TO THE CUTLER-HAMMER MFG. CO., OF MILWAUKEE, WISCONSIN, A CORPORATION OF WISCONSIN.

SOLENOID-SWITCH.

935,733.

Specification of Letters Patent,

Patented Oct. 5, 1909.

Application filed June 5, 1905. Serial No. 263,873.

To all whom it may concern:

Be it known that I, ARTHUR W. BERRESFORD, a citizen of the United States, residing at Milwaukee, in the county of Milwaukee and State of Wisconsin, have invented new and useful Improvements in Solenoid-Switches, of which the following is a full, clear, concise, and exact description, reference being had to the accompanying drawing, forming a part of this specification.

My invention relates to improvements in solenoid switches and more particularly to switches used on alternating current circuits, my object being to provide a switch in which the switch contacts will operate in oil to prevent arcing, and to provide a switch of this character which shall be simple in construction and durable in use.

Other objects of my invention will appear in the accompanying specification and claims.

I have illustrated my invention in the accompanying drawings, in which,

Figure 1 is a front elevation thereof, the oil casing being shown in section; Fig. 2 is a sectional view of my device, taken on the line 2—2 of Fig. 1; Fig. 3 is a sectional view of my device taken on the line 3—3 of Fig. 2; Fig. 4 is a sectional view of my device taken on the line 4—4 of Fig. 2; and, Fig. 5 is a diagrammatic view of the circuit arrangements of the various parts of my switch.

In the preferred embodiment of my invention, upon a suitable base 1, which is preferably made of insulating material, usually in the form of a slate or marble slab, is mounted an iron shroud 2, which is provided with legs or feet 3, through which bolts 4 are adapted to pass, to secure the same against the insulating base. This shroud is preferably open at its lower end, whereby an air gap 5 is provided. Secured beneath the iron shroud by means of upwardly extending arms 6, 6, which are bolted to the sides of the shroud by the bolts 7, is a supporting plate 8.

The plate and arms are preferably formed of one piece of material, and are made of non-magnetic material, as, for instance, brass, and the plate forms a support for the various binding posts and parts of the switch. This plate also supports in position within the iron shroud the solenoid winding 9. The winding is of the usual form and is supported at its lower end upon the plate

8 through the medium of a fiber or other insulating tube 10, which extends between the bottom of the solenoid and the plate. A suitable annular groove 11 is provided in the bottom of the solenoid winding, into which is adapted to project the fiber tube 10, and an annular ring 12 is formed upon the plate 8, which fits around the insulating tube 10, whereby the tube is prevented from lateral displacement. Set screws 13 are provided at the top of the iron shroud 2 and extend through the same and bear upon the upper part of the solenoid winding 9 to hold the same rigidly in position. The solenoid winding is provided with the usual core or plunger 14, which at its lower end has connected thereto an extension rod 15, the purpose of which will appear more fully hereinafter.

Mounted upon the underside of the plate 8 is a wooden plate 16, which may be held in position in any desired manner, as by screws passing through the same and screwing into the plate 8, and mounted upon the underside of this wooden plate or base are the various switch contacts of the switch. Mounted beneath the wooden base 16 are three contacts of a knife switch 17. These contacts consist each of two plates 18, suitably secured upon either side of a support 19, which is provided with shoulders 20 bearing against the underside of the insulating base. The support has an upwardly extending bolt 21, which passes through the wooden base 16 and the plate 8, and is secured in position by a nut 22 screwed upon the upper end thereof. Suitable fiber disks 23 surround the bolts 21 and fit within openings in the plate 8, whereby the bolt is properly insulated from the plate 8. The bolts for each of the contacts also form binding posts, a second nut 24 being screwed thereon for suitably holding in position the circuit wires. The knife switch consists of three blades, two outer blades 25 and an inner blade 26. These blades are pivoted at their rear ends between the supports 27, by bolts or other pivots 28. These supports are of the same general construction as the contact blades and the upwardly extending bolts 28 thereof form binding posts at the rear of the plate 8, to which suitable circuit wires may be connected. The central knife blade is of peculiar construction and has an enlarged portion 29 at its center, through

which extends an opening 30. The plate 8 is provided with a central opening 31, immediately beneath the core or plunger of the solenoid, through which is adapted to pass the rod 15 connected to the core or plunger. This rod passes through the opening 30 in the center blade of the knife switch and has at its outer end a button 32, which is secured upon the end of the rod in any desired manner, as by a pin 33, passing there-through and through the rod. The enlarged portion 29 of the center blade of the switch is provided with a seat or depression 33^a upon its upper side and a corresponding seat or depression 34 on its underside, in which the core or plunger and the button 32 are adapted to fit. The bottoms of these seats are inclined, as shown, so that when the button strikes the center blade when the core or plunger is attracted by its winding and when the core or plunger strikes the center blade when it is permitted to drop, the blow will be square and not at an angle. The forward ends of the blades of the knife switch are suitably connected by a fiber cross-brace 35, which extends between the two outer blades 25, being secured thereto by bolts 36 and which is slotted to accommodate the forward portion of the center blade and is secured to the enlarged portion of the center blade by screws 37. By this arrangement a rigid framework is made of the knife blades and danger of the same becoming laterally displaced is obviated.

Extending downwardly from the plate 8 is a contact support for the knife switch when it is in its lowermost position. This support is preferably formed of a U-shaped brass rod 37^a, the two legs of which pass through the wooden sub-base and the plate 8, and are secured in position at their upper ends by nuts 38. Jam-nuts 38^a, also screwed upon the ends of the support, prevent the dislodging of the set screws 38 and also form means for securing circuit wires thereto, if desired. The legs of the rod are surrounded by suitable insulating material in order that the same may be insulated from the plate 8, this insulating medium being preferably in the form of fiber tubes 39, which extend up to and flush with the top of the plate 8 and down to the cross-arm 40 thereof. This cross-arm, however, is left exposed in order that the center blade 26 may make contact therewith when the switch is opened.

A suitable inclosing casing 41 is adapted to surround the switch parts and is held in position at its upper end against the plate 8, thereby effectually inclosing all the parts. The casing is held in position by rods 42, which are pivoted between the outwardly extending lugs 43, arranged on either side of the casing and which are provided with thumb-nuts 44, which rest upon outwardly extending lugs 45, formed upon the arms 6

of the plate 8. These lugs are bifurcated to receive the rods 42 and have upturned flanges 46 which effectually prevent the thumb-nuts 44 from slipping out of position after they have been screwed tight. In the bottom of the casing 41, immediately beneath the plunger, is an insulating block 47, upon which the bottom of the extension rod 15 is adapted to rest when the switch is open, thereby supporting the plunger and relieving the center blade of the switch from the strain thereupon, which would otherwise occur.

Mounted upon the upper portion of the base and above the solenoid, is a lamp 48, the purpose of which will appear more fully hereinafter. Binding posts 49, 50, 51, 52 and 53 are also mounted upon the base 1, which are suitably connected in such a manner that when the switch is closed the circuit will be closed and which also serve to connect the solenoid winding 9 in circuit.

The air gap 5 is so proportioned that when the plunger or core is in its lowermost position, the passage of current through the coil will not be substantially effected. That is, the variable air gap in the magnetic circuit formed by the plunger or core 14, and the fixed air gap 5 are so proportioned that when the plunger or core is down, the self-induction of the magnet is sufficiently small to permit the passage of current to actuate the plunger. As the variable air gap, however, decreases, the fixed air gap 5 becomes relatively more important and when the plunger is in its raised position, the air gap 5 is practically the only air gap in the magnetic circuit and prevents the self-induction of the coil from becoming so high as to prevent the passage of sufficient current to maintain the core in its raised position. By thus so proportioning the fixed air gap 5 with respect to the variable air gap formed by the plunger or core when the plunger is at its lowest position, the self-induction of the coil will be only sufficient to prevent current from passing through the coil which will be so great as to heat the same, but the self-induction will not be great enough to prevent the passage of sufficient current to raise the core.

When the circuit through the winding 9 of the solenoid is open, the plunger is at its lowermost position, as shown in dotted lines, in Fig. 2. Assuming that current has been permitted to pass through the windings, the same will become energized and attract the plunger, which rises, and, in so doing, will raise the rod 15, which will cause the button 32 to strike the center switch-arm 26 and deliver a hammer blow to the switch, closing the same. When the windings are deenergized, the core will be permitted to drop, and it will be seen that, as the core drops considerable distance before it strikes the center

switch-arm 26, a hammer blow which will open the switch will be effected.

The casing 41, in practice, is adapted to be filled with oil, up to and above the knife switch, whereby all the parts are surrounded by oil and arcing and destruction of the parts is reduced. In order that the oil level may be readily ascertained, an indicating glass 54 is secured upon the outer side of the casing and communicates by the passage 55 with the inside of the oil casing.

In Fig. 5 I have illustrated diagrammatically the circuit connection for my switch. The binding posts 49 and 52 are adapted to be connected with the circuit wires leading to the part to be controlled by the switch and the binding posts 50 and 51 are adapted to be connected to the supply wires. Binding post 52 is connected by conductor 56 with the contact 57, of the knife switch, which has been previously described. Binding post 51 is connected by conductor 60 with the terminal 61 of one of the knife switch blades 25. A conductor 64 connects the binding post 51 also with the end contact 65 of the support 40. The contact 58 is connected by conductor 66 with one terminal of the lamp 48, the opposite terminal of said lamp being connected by conductor 67 with binding post 52. The contact 59 of the switch is connected by conductor 68 with the binding post 49. One terminal of the solenoid winding is connected by conductor 69 with the terminal 62 of the switch and the opposite terminal of said winding is connected by conductor 70 with the binding post 53, the binding post 53 being adapted to be connected by conductor 71 with binding post 50 and a suitable controlling switch 72 being interposed in the conductor 71.

In operation, assuming that the solenoid switch is opened and the switch 72 is opened, and that it is desired to operate the solenoid switch; by closing the switch 72, current will flow from binding post 51 by conductor 64 to the contact 65, across the center blade 26 of the knife switch to terminal 62, thence by conductor 69, through the solenoid winding 9, by conductor 70 to binding post 53, and by conductor 71 to binding post 50, which is connected to the opposite main of the supply circuit. Current is thus admitted to the solenoid winding, which energizes its core, raising the same and causing the button 32 to strike the center blade 26 of the knife switch, and raise the switch, closing the same. This closes the circuit from main 51 by conductor 60, to terminal 61, across the switch to contact 57, thence by conductor 56, to the binding post 52, which is connected with one side of the apparatus to be controlled. Current will then flow through the apparatus and back to the binding post 49, thence by conductor 68 to contact 59, across the knife switch to terminal 63 and thence

by conductor 73 to binding post 50. The closing of the knife switch causes the center blade thereof to break contact with the cross-arm 40 and thereby open the original circuit through the winding and close a second circuit therethrough with the lamp resistance 48 in circuit. This circuit may be traced from binding post 52 by conductor 67, through the lamp resistance 48 by conductor 66 to contact 58 of the knife switch, across the knife switch to terminal 62, thence by conductor 69 through the solenoid winding 9, by conductor 70 to binding post 53, and thence by conductor 71, to the binding post 50, thereby closing the circuit through the solenoid winding, across the line with the lamp 48 in circuit. The insertion of the lamp 48 in circuit reduces the current permitted to pass through the winding.

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

1. In a solenoid switch, the combination with a winding, of a knife switch arranged below said winding, a plunger cooperating with said winding, said plunger being slidably connected with said knife switch and having means thereon for limiting its sliding movement relative to said knife switch whereby a hammer blow is delivered to the switch in the opening and closing of the same, a casing surrounding the parts of said switch, whereby the parts of the same may be suitably inclosed in oil, and a cover for said casing, said cover having an opening through which the plunger works, the stationary members of the switch being secured to said cover.

2. In a solenoid switch, the combination with a winding, of a plunger operated thereby, striking heads carried by said plunger, a support, a plurality of switch contacts carried by said support, a plurality of blades pivotally mounted upon said support and adapted to cooperate with said contacts, and means for loosely connecting one of said blades with said plunger between said striking heads, whereby the latter will deliver a hammer blow to the blades in opening or closing the switch.

3. In a solenoid switch, the combination with a winding, of a plunger operated thereby, a support below said winding, a plurality of switch-contacts depending from said support, a plurality of switch-blades pivotally depending from said support and adapted to cooperate with said contacts, means for connecting said blades together, means for connecting one of said blades with the plunger, whereby the switch is opened by the downward movement of said plunger and closed by the upward movement thereof, and an inclosing casing depending from said support whereby the switch may be operated in oil.

4. In a solenoid switch, in combination, a winding, an iron shroud surrounding said winding, a plunger arranged to be drawn upward by said winding, striking heads carried by said plunger, a support carried by said shroud, switch contacts carried by said support, switch blades carried by said support, and means for loosely connecting one of said switch blades with said plunger between said striking heads whereby said plunger would open said switch by its downward movement and close said switch by its upward movement and deliver a hammer blow to the blades in opening or closing the switch.

5. In a solenoid switch, the combination with a winding, of a plunger operated thereby, a support, a knife switch contact carried by said support, a switch arm pivotally mounted upon said support and cooperating with said contact, said arm having an opening therein, a rod passing through said opening and connecting at one end with the plunger, and having a button at its other end, whereby a hammer blow will be delivered to the switch arm when the same is opened and closed, and an inclosing casing surrounding the various parts of the switch, whereby the same may be operated in oil, said switch being adapted to be opened by the downward movement of said plunger and closed by the upward movement thereof.

6. In a solenoid switch, the combination with a winding, of a plunger operated thereby, a support, a plurality of switch contacts carried by said support, a plurality of switch arms pivotally mounted upon said support, means for connecting said arms together, one of said arms having an opening therethrough, a rod passing through said opening and connected at one end with the plunger and having at its other end a button, whereby a hammer blow would be delivered to said switch arm when the solenoid is operated to open or close the switch, and an inclosing casing surrounding the various parts of the switch, whereby the same may be operated in oil, said switch being adapted to be opened by the downward movement of said plunger and closed by the upward movement thereof.

7. In a solenoid switch, the combination with a winding, of a plunger operated thereby, a support, a plurality of switch contacts carried upon the underside of said support, and having portions thereof projecting through said support and forming binding posts, a plurality of downwardly extending supports carrying pivotally mounted switch

blades adapted to cooperate with said contacts, said downwardly extending supports being adapted to pass through the support and having formed at their upper ends binding posts, and means for connecting said switch blades with said plunger, whereby said plunger will strike a hammer blow in either opening or closing the switch.

8. In a solenoid switch, the combination with a winding, of a plunger operated thereby, a support, a plurality of switch contacts carried upon the underside of said support, and having portions thereof projecting through said support and forming binding posts, a plurality of downwardly extending supports carrying pivotally mounted switch blades adapted to cooperate with said contacts, said downwardly extending supports being adapted to pass through the support, and having formed at their upper ends binding posts, means for connecting said switch blades with said plunger whereby said plunger will deliver a hammer blow in either opening or closing the switch, and an inclosing cover or casing surrounding the various parts of the switch, whereby the same may be operated in oil.

9. In a switch, the combination of a receptacle for oil, a cover for said receptacle, a switch arranged upon the lower side of said cover, a solenoid disposed above the receptacle, and a plunger for said solenoid, said cover having an opening therethrough, said plunger being adapted, when released from the solenoid, to fall through said opening and to strike the movable part of the switch and open the same by impact.

10. In a switch, the combination of a receptacle for oil, a cover for said receptacle, a switch arranged upon the lower side of said cover, a solenoid disposed above the receptacle, and a plunger for said solenoid, said cover having an opening therethrough, said plunger being adapted, when released from the solenoid, to fall through said opening and to strike the movable part of the switch and open the same by impact, and means carried by the plunger for engagement with the movable part of the switch upon upward movement of said plunger, whereby the switch may be closed by energizing the solenoid.

In witness whereof, I have hereunto subscribed my name in the presence of two witnesses.

ARTHUR W. BERRESFORD.

Witnesses:

H. H. CUTLER,
F. R. BACON.