

[54] NON-SPARKING ELECTRICAL SWITCH

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[58] Field of Search **200/146, 146 A, 146 AA, 144 AP**

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[57] ABSTRACT

An electrical switch having contacts which make and break is provided with an inhibitor which inhibits sparking between the contacts. The switch has a movable contactor whose arms carry protruding contacts disposed to be brought against the fixed contacts of the switch. The inhibitor is mounted to move with the contactor and has resilient arms which diverge from the contactor arms when the switch is open. The inhibitor arms have apertures for receiving the protruding contacts of the contactor. The inhibitor's resistance is large relative to the resistance of the contactor. Closure of the switch causes the inhibitor arms to be first brought against the fixed contacts and then causes the divergence of the arms to decrease until the protruding contacts extend into the apertures and close upon the fixed contacts.

2 Claims, 3 Drawing Figures

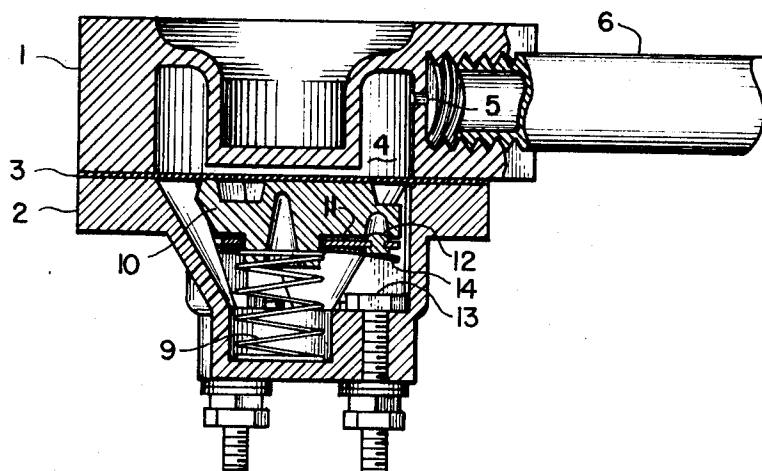


FIG. 1

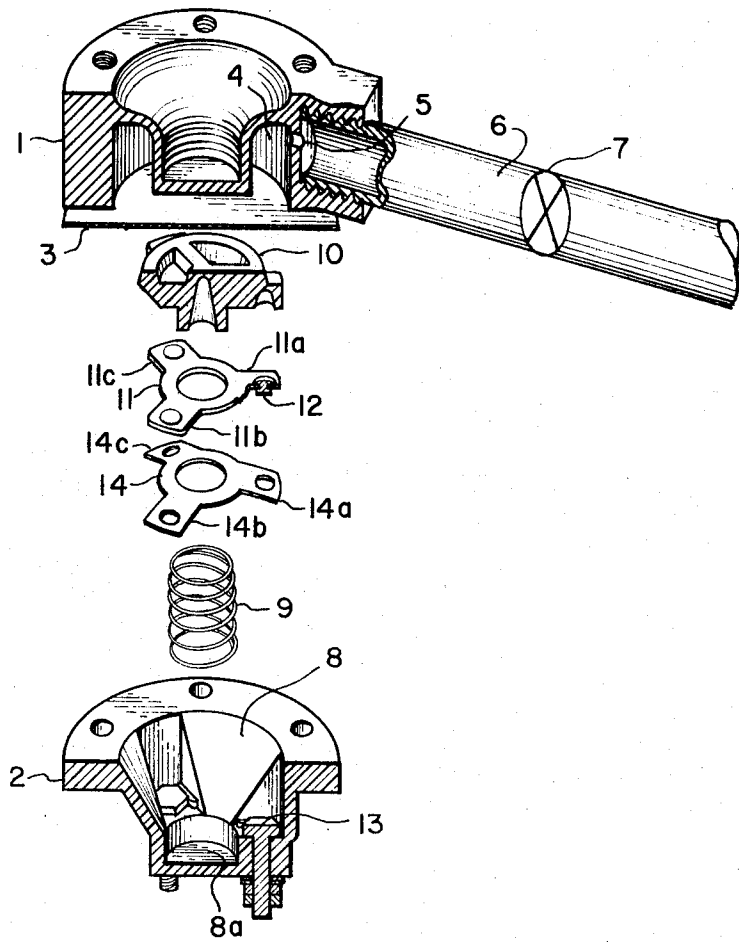
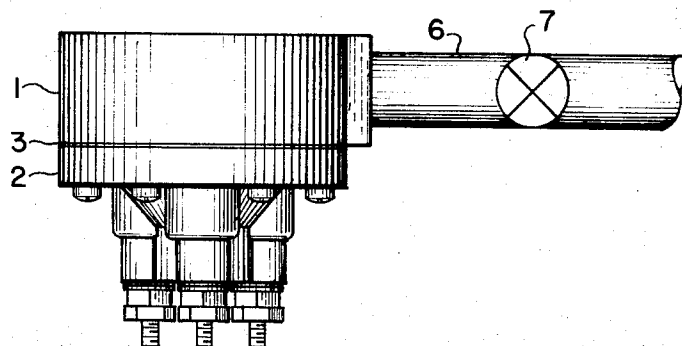
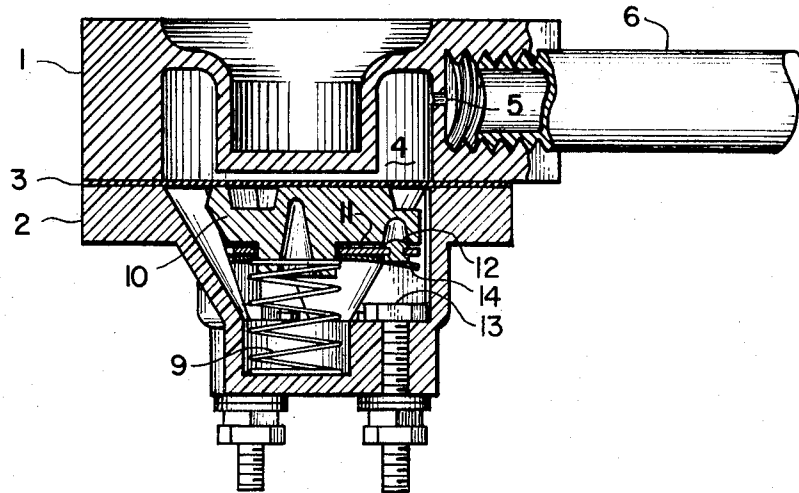


FIG. 2



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FIG. 3



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NON-SPARKING ELECTRICAL SWITCH

FIELD OF THE INVENTION

This invention relates in general to an electrical switch and more particularly pertains to an improved switch in which the tendency to pit the contact surfaces and the tendency to transfer metal from one contact to its opposite contact are minimized.

In electrical switches of the type having contacts which come together to "make" and which separate to "break," there is a tendency for the switches to spark as the contacts make and break. Further, where the switch is connected in circuit with a D.C. voltage source, the D.C. voltage tends to cause metal to be transferred from one contact to its opposite contact. It is known that where the circuit controlled by the switch contains appreciable inductance, upon opening of the switch contacts, the inductance causes a large voltage to appear across the gap of the contacts and results in an arc or a "spark." The heat generated in the spark has a deleterious effect upon the contacts and, in time, erodes the contacts to the extent that the efficiency of the switch is materially impaired.

To promote the efficient flow of electricity between the contacts of the switch and to reduce heating caused by resistance between the contacts, it is customary in some electrical switches to coat the contact surfaces with silver. As is well known, silver is an excellent conductor of electricity. However, silver is a relatively soft metal and where sparking between the contacts occur, the contacts tend to become rough and pitted through vaporization and abrasion of the metal coating or because some of the silver is transferred from one contact to the other.

The invention relates to an electrical switch constructed to insert resistance into the circuit at the beginning of the "make" operation to prevent a surge of current when the contacts close. When the switch is fully closed, the resistance drops to a very low value so as to offer but slight impedance to the flow of current. As a corollary, in the "break" operation, the switch reinserts resistance into the circuit to prevent a large voltage from building up and causing an arc across the opening contacts.

The invention, both as to its arrangement and mode of operation, can be better understood from the following exposition when considered in conjunction with the accompanying drawings in which

FIG. 1 is an exploded view showing the components of a preferred embodiment of the invention;

FIG. 2 depicts the appearance of the preferred embodiment in assembled form; and

FIG. 3 is a cross-section of preferred embodiment showing the relationship of the parts in the assembled device.

THE EXPOSITION

In the preferred embodiment of the invention shown in FIGS. 1, 2, and 3, the switch casing is constituted by an upper housing 1 separated from a lower housing 2 by a flexible diaphragm 3. An air chamber 4 in the upper housing has an inlet part 5 to which an air conduit is connected. A valve 7 in the conduit is arranged to permit the chamber to be pressurized and to permit the pressure in the chamber to be relieved. Below the diaphragm a second chamber 8 is provided in the lower housing 2. The second chamber 8 has a well 8a in which a helical spring 9 sits. The upper end of the spring encircles a post on a dielectric member 10. Also disposed on that post is a contactor 11 having three resilient arms 11a, 11b, and 11c symmetrically arranged around a circle. Each arm carries a downwardly protruding contact 12 which is preferably of silver or is silver plated. The contactor, itself, is made of beryllium-copper and each arm has a sufficiently large cross section to carry the maximum current for which the switch is designed while providing some flexure when the contacts close upon the contacts 13 fixed in the lower housing.

Situated below the contactor 11 on the post of dielectric member 10 is a resilient member 14 having three arms ar-

ranged in the same manner as the arms of contactor 11. The function of member 14 is to insert resistance in the circuit to inhibit a surge of current from flowing when the switch "makes" and to inhibit arcing when the switch "breaks." The inhibitor member 14 is preferably fabricated of stainless steel so that its electrical resistance is in the order of 5 to 10 times as great as the electrical resistance of the contactor 11. The arms 14a, 14b, 14c of the inhibitor member are resilient and are downwardly bent. By exerting pressure upon the central ring of the inhibitor member, the arms can be straightened until the entire inhibitor member is flat. Each of the arms 14a, 14b, 14c of the inhibitor member 14 has an aperture through which the contact 12 can pass to close upon the fixed contact 13 in the lower housing. Each fixed contact, as best shown in FIG. 1, is situated in a depression having steep sides which guide the arms of the contactor 11 and the inhibitor 14. Thus when the chamber 4 is pressurized by passing air pressure through valve 7, the diaphragm presses down upon the dielectric member and causes that member to move down against the force exerted by spring 9. The downward displacement causes the arms to ride down in the depressions of the lower housing. Initially, the arms of inhibitor member 14 sit upon the fixed contacts 13 and the current flow is through the arms of that member. Further downward movement of the dielectric member 10 causes the contacts 12 to protrude through the apertures in the arms 14a, 14b, and 14c and sit upon the fixed contacts 13. The current flow is then principally through the arms of the contactor 11.

Upon relieving the pressure in chamber 4, spring 9 causes dielectric member 10, contactor 11, and inhibitor 14, to move upwardly, as viewed in the drawings. The initial upward movement causes the contacts 12 to withdraw through the apertures in the arms 14a, 14b, 14c while those arms still rest upon the fixed contacts 13. By that action the current is caused to flow through the arms 14a, 14b, 14c which offer greater resistance than the path through contacts 12. Therefore contacts 12 break without arcing because a path, albeit of higher resistance, is still available for current flow. Further upward movement of the movable assembly causes arms 14a, 14b, and 14c to lift off the fixed contacts 13. When those arms "break," an arc may form in the gap but the stainless steel is better able to withstand the sparking than the silver contacts 12. Further because of the resistance inserted in the circuit prior to complete breaking, the voltage that can be created across the gap is greatly diminished.

As can be best seen in FIG. 3, the fixed contacts 13 extend through the lower housing 2 to provide posts to which external electrical connections can be made. The fixed contacts have broad flat surfaces to promote good electrical contact with the arms of the inhibitor. The tips of the inhibitor arms slide along the surfaces of the fixed contacts when the inhibitor is "making" or "breaking." Thus the surface area of contact changes gradually and a corresponding change in resistance occurs.

While a preferred form of the invention has been illustrated, it is apparent that alterations which do not depart from the essence of the invention are obvious. For example, the switch can be constructed to have any number of fixed contacts and the contactor and inhibitor can be provided with a corresponding number of arms. The switch need not be pneumatically actuated but can be mechanically or electrically actuated. The inhibitor can be made of any material that has the requisite resistance and resilience. In view of the different forms that the invention can take, it is not intended that the invention be limited to the embodiment here illustrated and described. Rather, it is intended that the invention be delimited by the appended claims and include those switches which do not depart in any material respect from the essential features of the invention.

What is claimed is:

1. In a switch of the type having a housing, electrical contacts fixed in position in the housing,

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means external to the housing providing electrical connections to the fixed contacts,
a movable contactor in the housing, the contactor having arms provided with protruding contacts, and
switch closure means for moving the contactor toward the fixed contacts in the housing to cause the protruding contacts to close upon the fixed contacts,
the improvement for reducing arcing between the movable protruding contacts and the fixed contacts, the improvement residing in
an inhibitor having a higher resistance than the contactor, the inhibitor being mounted in the housing to move with the contactor, the inhibitor having arms in register with the arms of the contactor, the inhibitor arms diverging from the contactor arms when the switch is open, each inhibitor arm having an aperture into which the movable

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contact of the adjacent divergent arm can extend, and closure of the switch causing the inhibitor arms to be first brought against the fixed contacts and then causing the divergence of the arms to decrease until the movable contacts extend into the apertures and close upon the fixed contacts.
2. The improved switch according to claim 1, further comprising
a movable dielectric member,
the inhibitor and contactor having central abutting portions mounted to move with the dielectric member,
resilient means arranged to oppose movement of the dielectric member toward the fixed contacts, and
the switch closure means being arranged to move the dielectric member against the opposition of the resilient means.

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