

July 6, 1954

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2,683,201

SINGLE-ACTION SWITCH

Filed Dec. 23, 1952

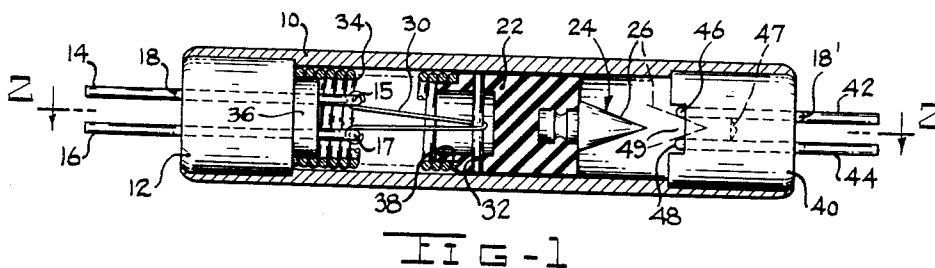


FIG-1

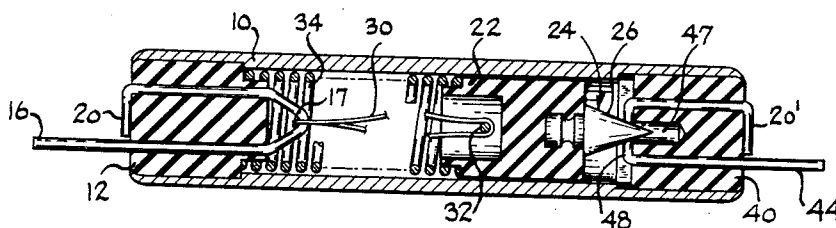


FIG-2

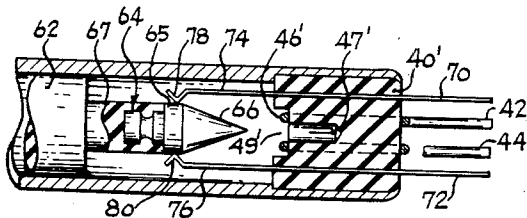


FIG-4

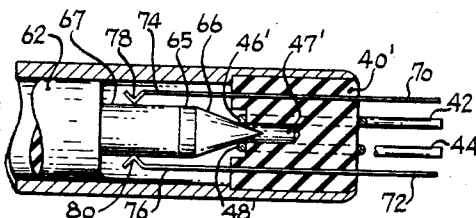


FIG-5

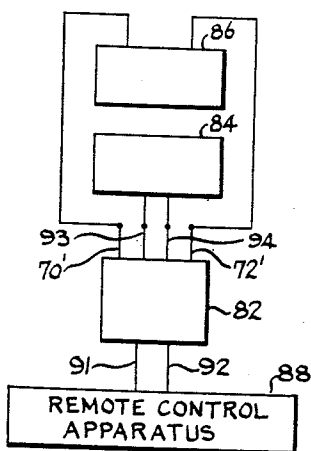


FIG-6

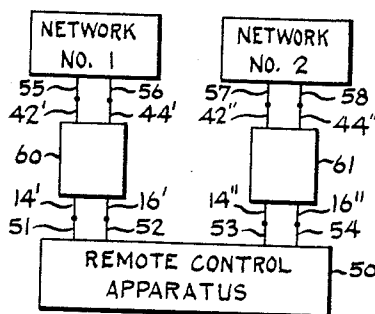


FIG-3

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2,683,201

SINGLE-ACTION SWITCH

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Application December 23, 1952, Serial No. 327,518

9 Claims. (Cl. 200—117)

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This invention relates to switching devices for opening or closing electrical circuits, and more particularly to a single-action switch or relay adapted to open or close a desired electrical circuit or circuits by remote control.

In many circuit applications, it is desired that specific circuits be made operative or inoperative from remote control points. In such circuit applications, it is of utmost importance that switching means operable from remote control points to condition specific circuits be extremely accurate and reliable, thereby to insure maximum effectiveness of control from a remote control station.

In accordance with the present invention, there is provided a single-action switching or relay device for remote control purposes which is highly accurate and reliable. One embodiment of the switching device of this invention comprises first and second pairs of conductors having spaced terminals extending into a housing. The terminals of the first pair of conductors are directly connected by a fuse wire. The fuse wire is mechanically coupled to a movable conductive element that is located between both pairs of terminals and provided with mechanical biasing means for movement toward the terminals of the second pair of conductors. The fuse wire holds the conductive element in spaced relation with respect to the terminals of the second pair of conductors. Sufficient current is passed through the fuse wire connecting the first pair of conductors to weaken the wire and cause it to break under the force of the biasing means, thereby to release the conductive element for movement toward and into contact with the terminals of the second pair of conductors to provide a direct connection therebetween. By virtue of the mechanical motion of the conductive element, a highly reliable switching device is provided that is suitable for connection between remote control apparatus, which may be coupled to the first pair of conductors to supply current for weakening the fuse wire, and an open-circuit network coupled to the second pair of conductors, whereby such network may be rendered operative upon the fuse wire being broken and a direct connection provided between the second pair of conductors.

It is, therefore, an object of this invention to provide a simple switching device for effecting reliable control of the operating conditions of one or more electrical circuits by remote control.

It is another object of this invention to provide

a single-action switching device in which a single movable element of conductive material is biased for movement in only one direction to contact a pair of conductors and establish a direct connection therebetween, in which a fuse wire mechanically coupled to such movable element restrains the element against movement, and in which the movable element is released for movement upon the fuse wire being broken to contact both of the conductors.

It is a further object of this invention to provide a highly reliable single-action switch for electrical circuits which provides a minimum number of component parts of simple design providing a highly accurate operating mechanism for controlling the operating condition of at least one electrical circuit.

This invention, both as to its organization and method of operation, together with further objects and advantages thereof, will be better understood from the following description considered in connection with the accompanying drawing, and its scope is pointed out in the appended claims. In the drawing:

Fig. 1 is a perspective view of a single-action switch employing a movable conductive element adapted for movement at a predetermined instant to contact a pair of spaced conductor terminals and establish a direct connection therebetween, in accordance with this invention;

Fig. 2 is a cross-sectional view taken along line 2—2 of Fig. 1;

Fig. 3 is a block diagram illustrating the remote control of electrical circuits by single-action switches of the type shown in Fig. 1, also in accordance with this invention;

Figs. 4 and 5 are cross-sectional views of a single-action switch of the type shown in Fig. 1, illustrating a preferred modification thereof for simultaneously closing one circuit and opening another circuit, further in accordance with this invention; and

Fig. 6 is a block diagram illustrating the remote control of a pair of circuits by means of the single-action switch shown in Figs. 4 and 5.

Referring to the drawing, in which like reference characters are used to indicate like parts throughout, and more particularly to Figs. 1 and 2, a suitable supporting structure, such as a housing 10, is provided for the switching device of this invention. The housing 10 may be of cylindrical construction as shown and may, for example, be provided with a thick disk-shaped element or short, solid cylindrical end closing member 12 disposed at one end of housing 10.

Preferably, end member 12 is composed of insulating material. Extending through end member 12 into the interior of housing 10 is a pair of spaced conductors 14, 16 having respective interiorly extending lengths 15, 17 supported in spaced relationship. Additional support for maintaining the interiorly extending end lengths 15, 17 of conductors 14 and 16 in spaced relation may be provided in any suitable manner. This may, as shown, be accomplished by bending the conductors 14, 16 in the interior of housing 10 and returning their free ends 18, 20 through end member 12 and crimping them so as to be flush against the external surface of end member 12. The intermediate bent portions of the interiorly extending end lengths 15, 17 of conductors 14 and 16 provide terminals for the conductors 14, 16.

Located within housing 10 is a movable element, such as a cylindrical insulating member or plunger 22 which fixedly supports, or has centrally embedded therein, a metallic or conductive element or contact 24. A conical terminating portion 26 of contact 24 projects from the end of insulating plunger 22 remote from end member 12. In accordance with this invention, a fuse element provides a direct connection between conductors 14, 16 within housing 10 and forms a mechanical linkage between conductors 14, 16 and contact 24. Such fuse element preferably is a short fuse wire 30 having its ends connected to respective terminals 15, 17 of conductors 14, 16 and being mechanically coupled intermediate its ends to a portion of plunger 22. For example, plunger 22 may be provided with a post 32 at the end thereof adjacent end member 12, and the fuse wire 30 extends between conductor terminals 15 and 17 and about the post 32.

Further in accordance with this invention, there is provided resilient means for mechanically biasing plunger 22, and hence contact element 24, for movement in one direction through the housing 10. Preferably, such resilient means is provided by spring loading or biasing the plunger 22, as by a helical spring 34 compressed between end member 12 and plunger 22. Consequently, spring 34, as compressed, provides potential energy which tends to bias plunger 22 for movement axially through housing 10 away from end member 12; simultaneously, fuse wire 30, by means of its mechanical linkage with plunger 22, restrains the plunger 22 against any movement. The mechanical strength of fuse wire 30 is sufficiently greater than the biasing force of spring 34 to maintain spring 34 in its compressed condition and to prevent plunger 22 from being forced to move in an axial direction.

In order to insure that spring 34 will at all times be positioned for biasing plunger 22 in the manner above described, opposed portions of end member 12 and of plunger 22 preferably have reduced cylindrical sections 36, 38, respectively, adapted to receive one or more end turns of spring 34. Furthermore, the end turns of spring 34 may rest along the outer periphery of the reduced cylindrical sections 36, 38 in the manner illustrated in Figs. 1 and 2.

Spaced a short distance along the axis of housing 10 beyond the point of the spring-biased conical portion 26 (as shown in Fig. 1) of contact 24 is another end closing member 40 which is disposed within housing 10 opposite end member 12 and which with end member 12 provides a supporting structure for the switching device of this invention. A pair of spaced conductors 42

and 44 extend through end member 40 into housing 10 in substantially the same manner as conductors 14, 16 extend through end member 12, with respective interiorly extending end lengths 46, 48 having intermediate portions providing terminals and having their ends 18', 20' returned through end member 40 and crimped against the outer surface thereof as shown particularly in Fig. 2. However, the intermediate portions of conductors 42, 44 which provide respective terminals 46 and 48 therefor, preferably rest flush against the inner surface of end member 40.

It is the purpose of this invention to provide means for establishing direct electrical contact between terminals 46 and 48 through contact element 24 by passing sufficient current through fuse wire 30 to cause the wire to weaken and break under the pressure of spring 34. The potential energy of spring 34 will thus be released to force the conical portion 26 of contact 24 into engagement with the terminals 46, 48.

In order to achieve secure, firm contact of conical portion 26 with terminals 46 and 48, and to prevent possible damage to the point of the conical portion 26, a central opening 47 is provided in disk 40 which extends at least a short distance therethrough from the inner surface thereof, and between terminals 46 and 48. Furthermore, opposed portions of terminals 46 and 48 are conically tapered toward opening 47 to provide contact surfaces which will accurately register with the surface of the conical portion 26 of contact 24. In this manner, movement of the plunger 22 axially along housing 10 by the action of spring 34 will result in firm, intimate contact of the conical portion 26 of contact element 24 with terminals 46 and 48.

Terminals 46, 48 preferably rest in a recess 49 (see particularly Fig. 1) in the inner surface of end member 40, whereby, upon the conical portion 26 of contact 24 striking terminals 46, 48 (Fig. 2), the walls of the recess 49 will provide lateral support for terminals 46, 48 and prevent either terminals 46, 48 being forced laterally out of contact with the conical portion 26 of contact 24 upon being struck thereby.

The utilization of the above-described switch will now be explained with reference to Fig. 3 along with Figs. 1 and 2. Fig. 3 illustrates remote control apparatus 50, by means of which it is desired to selectively operate one or more electrical circuits, for example, electrical networks No. 1 and No. 2, as shown. Remote control apparatus 50 is provided with two pairs of output conductors 51, 52 and 53, 54, and electrical networks No. 1 and No. 2 are provided with respective pairs of conductors 55, 56 and 57, 58, of which the individual conductors must be directly connected to establish operation thereof.

Two switching devices 60 and 61 of the type above described provide means for establishing direct connections between individual ones of each pair of conductors 55, 56 and 57, 58. The switching devices 60, 61 have respective pairs of fuse-wire-connected conductors 14', 15' and 14'', 16'' corresponding to the pair of conductors 14, 16 of the device shown in Fig. 1. Conductors 14', 16' are connected, respectively, to output conductors 51, 52 of remote control apparatus 50, and conductors 14'', 16'' are connected, respectively, to output conductors 53, 54 of remote control apparatus 50. Similarly, switching devices 60 and 61 are provided with respective pairs of conductors 42', 44' and 42'', 44'' corresponding to the pair of conductors 42 and 44 of Fig. 1. Con-

ductors 42', 44' are connected, respectively, to conductors 55, 56 of network No. 1, and conductors 42'', 44'' are connected, respectively, to conductors 55, 56 of network No. 2.

Remote control apparatus 50 may be adapted for automatically generating currents at predetermined instants to be passed through the respective pairs of output conductors 51, 52 and 53, 54 to weaken the fuse-wire connections in the respective switching devices for the purpose previously described. Upon such currents being passed through the fuse wire, direct connections for the respective pairs of conductors 42', 44' and 42'', 44'' are established to effect operation of the networks No. 1 and No. 2 associated therewith.

Referring now to Figs. 4 and 5, there are shown modifications of the insulating plunger 22, contact 24, end member 40, and terminals 46, 48 of Fig. 1 for simultaneously effecting the closing of one circuit and the opening of another. A movable insulating plunger 62 corresponds to insulating plunger 22 of Fig. 1 and supports a conductive contact element 64 corresponding to contact element 24 of Fig. 1. A projection of contact 64 is provided with a short, cylindrical section 65 which terminates in a conical portion 66. The conical portion 66 of contact 64 has precisely the same function as the conical portion 25 shown in Fig. 1. The short cylindrical section 65 of contact 64 projects from a reduced cylindrical section 67 of plunger 62, and the outer diameters of both cylindrical sections 65, 67 are substantially equal.

Extending through an end member 49', and through a recess 49' that is relatively wide compared to recess 49 of end member 49 of Fig. 1, is a pair of conductors 70, 72 which extend interiorly into housing 10 and terminate in spring wires 74, 76. Spring wires 74, 76 are provided with respective contact terminals 78, 80 which preferably are hook-shaped as shown. Terminals 46', 48' of conductors 42, 44, corresponding to terminals 46, 48 of Fig. 1, are flattened against the inner surface of recess 49' about an inner opening 47' and tapered inwardly toward opening 47' for matching registry with conical portion 66.

In the restrained position of insulating plunger 62, terminals 78, 80 are adapted to rest against the outer peripheral surface of the cylindrical section 65 of conductive element 64, as shown in Figs. 4 and 5. Thus, it can be seen that this arrangement initially provides a direct connection for one pair of conductors 70, 72 prior to operation of plunger 62 in the manner previously described.

Fig. 5 shows the effect of axial movement of insulating plunger 62 in the manner of plunger 22 of Fig. 1. Upon such axial movements of plunger 62, the conical portion 66 functions in the same manner as the conical portion 26 of Fig. 1 to establish electrical contact with terminals 78, 80 of conductors 70 and 72 slide onto the reduced cylindrical section 67 of insulating member 62, thereby breaking electrical contact between conductors 70 and 72.

Fig. 6 shows the use of a switching device 82 of the type illustrated in Figs. 4 and 5 adapted for reversing the operating conditions of a pair of electrical networks 84, 86, where it may be desired to have one network 84 initially nonconducting and the other network 86 initially conducting, by means of a selective remote control apparatus 75

88. Remote control apparatus 88 is coupled to a pair of fuse-wire-connected conductors 91, 92 corresponding to conductors 14, 16 of Fig. 1. One network 84 is coupled to a pair of conductors 93, 94 corresponding to conductors 42, 44 of Figs. 1, 4 and 5, and the other network is coupled to a pair of conductors 70', 72' corresponding to conductors 70 and 72 of Figs. 4 and 5. Upon a current generated by remote control apparatus 88 to weaken the fuse-wire connection between conductors 91, 92 in the manner previously described in connection with conductors 14, 16 of Fig. 1, contact between conductors 93, 94 is established and contact between conductors 78', 72' is broken in the manner above described with reference to respective pairs of conductors 42, 44 and 70, 72 of Figs. 4 and 5. Consequently, operation of the initially conducting network 86 is interrupted while operation of the initially nonconducting network 84 is established.

From the foregoing explanation, it is clear that there has been described a novel single-action switch having a movable contact mechanically biased for movement in one direction to make and/or break contact between a pair of conductors and provided with a fuse element for restraining such contact against movement in the one direction except upon the application of current to such fuse element to cause it to weaken and permit the mechanical biasing force to operate.

What is claimed is:

1. A switching device comprising, in combination, first and second pairs of conductors, each having spaced terminals, first and second insulating members in spaced relation said first and second pairs of conductors being supported respectively by said first and second insulating members, the spaced terminals of said first and second pairs of conductors being located between said first and second insulating members, a length of fuse element providing a direct connection between the terminals of said first pair of conductors, a movable conductive element interposed between the pairs of terminals, resilient means mechanically coupled between said movable element and said first insulating member to bias said movable element toward the terminals of said second pair of conductors, said fuse element being mechanically coupled intermediate its ends to said movable element to restrain movement thereof toward the terminals of said second pair of conductors, and said resilient means being operable to break said fuse element upon current being passed through said first pair of conductors to weaken said fuse element, whereby said resilient means forces said movable element into contact with the terminals of said second pair of conductors.

2. The switching device defined in claim 1, including a third pair of conductors, said third pair of conductors having spaced terminals disposed between said first and second insulating members, the terminals of said third pair of conductors being slidably engaged by said movable conductive element in the restrained position thereof, and said movable element, upon said resilient means forcing said movable element into contact with the terminals of said second pair of conductors, being adapted to move out of contact with the terminals of said third pair of conductors.

3. A switch for electrical circuits comprising, in combination, a housing having two opposed insulating members; first and second pairs of

conductors having spaced terminal portions extending into said housing through respective ones of said members; a fuse wire providing a direct connection between the terminal portions of said first pair of conductors; a movable conductive element disposed between said pairs of terminal portions; spring means disposed between said movable element and the supporting insulating member for said first pair of conductors, to urge said movable element toward the terminal portions of said second pair of conductors; and said fuse wire being mechanically coupled intermediate its ends to said movable element and adapted to restrain said movable element against movement by said spring means, said spring means being effective to break said fuse wire upon a current being passed through said first pair of conductors to weaken said fuse wire, thereby to free said spring means to force said movable element into contact with the terminal portions of said second pair of conductors.

4. The switch defined in claim 3, including a third pair of conductors, said third pair of conductors extending into said housing and having spaced terminal portions in releasable engagement with said movable element in the position of restraint of said movable element, and in which said movable element disengages the terminal portions of said third pair of conductors upon said movable element being forced into contact with the terminal portions of said second pair of conductors.

5. A switching device for electrical circuits comprising, in combination, a cylindrical housing, first and second insulating end closing members disposed in the opposite ends of said housing, a first pair of conductors having spaced terminals extending into said housing through said first end closing member, a second pair of conductors having spaced terminals extending into said housing through said second end closing member, a movable conductive element within said housing disposed between the pairs of terminals, resilient means mechanically coupled between said conductive element and said first end closing member to bias said conductive element toward said second end closing member, a fuse wire connection between the terminals of said first pair of conductors, said fuse wire connection also being mechanically coupled intermediate its ends to said conductive element to restrain said conductive element against movement by said resilient means, and the terminals of said second pair of conductors being positioned within said housing so as to be contacted upon movement of said conductive element toward said second end closing member, whereby weakening of said fuse wire connection by current passed through said first pair of conductors causes said resilient member to break said fuse wire and force said conductive element into contact with the terminals of said second pair of conductors.

6. The switching device defined in claim 5, in which a movable insulating member fixedly supports said conductive element, said resilient means is in engagement with said insulating member and said first end closing member, and in which said fuse wire connection engages a portion of said insulating member.

7. The switching device defined in claim 6, in which said first end closing member and said insulating member are provided with adjacent projecting portions of equal diameter and in which said resilient means comprises a helical spring having at least one turn at its opposite ends supported, respectively, on the outer peripheries of said projecting portions.

8. The switching device defined in claim 6, in which said conductive element has a conical portion projecting from said insulating member, in which said second end closing member is provided at its inner surface with a central opening adapted to receive the point of the conical portion of said conductive element, in which each of said second pair of conductors has a terminal portion oppositely disposed with respect to the axis of said opening and in registry with the inner surface of said second end closing member, said oppositely disposed terminal portions being conically tapered, and in which the conical portion of said conductive element upon being moved by said resilient means registers with said oppositely disposed, conically tapered terminal portions of said second pair of conductors, and the point of said conical portion enters said opening, whereby firm contact providing a direct connection between said second pair of conductors is achieved and damage to the point of said conical portion is prevented.

9. The switching device defined in claim 8 in which said conductive element has a cylindrical portion disposed between said conical portion and said insulating member, in which a third pair of conductors extend through said second end closing member having terminal portions in contact with said cylindrical portion in the restrained position of said conductive element, whereby a direct connection between the terminal portions of said third pair of conductors is provided, and said cylindrical portion, upon said conductive element being released for movement into contact with the terminal portions of said second pair of conductors, being moved until the conductive connection therethrough is broken.

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