Aug. 21, 1934. K. B. McEACHRON ET AL 1,971,194

ELECTRICAL BY-PASS

Filed May 26, 1933

Fig. 1.

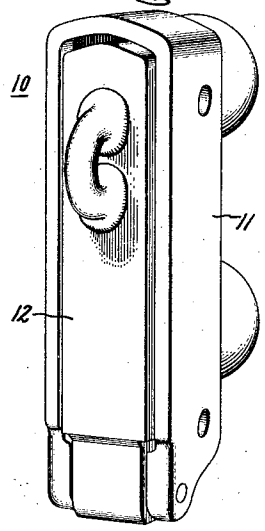


Fig. 2.

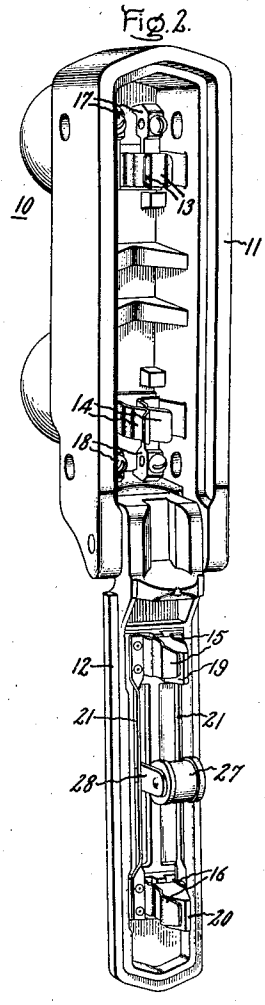


Fig. 3

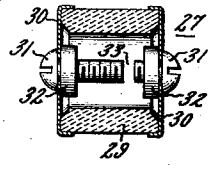


Fig. 4.

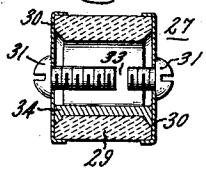
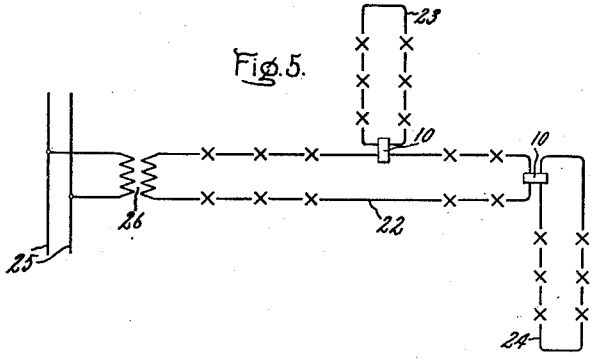


Fig. 5.



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Patented Aug. 21, 1934 1,971,194

UNITED STATES PATENT OFFICE

1,971,194

ELECTRICAL BY-PASS

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Application May 26, 1933, Serial No. 673,066

5 Claims. (Cl. 200—118)

Our invention relates to electrical by-passes. In an electrical circuit, trouble may develop in some part of the circuit or in some device connected in the circuit. A suitably connected by-pass may act automatically to short-circuit the defective part of the circuit or the defective device so that the remainder of the circuit may continue to operate without interruption. The general object of the invention is to provide an improved electrical by-pass which will automatically and effectively short-circuit a defective section of an electrical circuit or a defective device connected in the circuit but which will not respond to brief circuit disturbances such as may be caused by lightning. The invention is particularly applicable in connection with a constant current street lighting circuit but is of course not so limited.

The invention will be explained more in detail in the following description taken in connection with the accompanying drawing in which Fig. 1 is a perspective view of a cut-out box of the type commonly used in connection with constant current street lighting circuits; Fig. 2 is a perspective view of the cut-out box with the cover open and showing a by-pass constructed in accordance with the invention mounted in the box; Fig. 3 is a longitudinal sectional view of the by-pass in its normal condition; Fig. 4 is a similar sectional view of the by-pass in its short-circuited condition; and Fig. 5 is a diagrammatic view of a constant current street lighting circuit provided with cut-out boxes such as are shown in Figs. 1 and 2.

Like reference characters indicate similar parts in the different figures of the drawing.

The cut-out box 10 shown in Figs. 1 and 2 includes a base portion 11 and a hinged cover 12. Two pairs of springs 13 and 14 are mounted in the base 11 and two pairs of springs 15 and 16 are mounted on the cover 12. When the cover is open as shown in Fig. 2, the springs 13 are pressed together and their terminals 17 short-circuited and the springs 14 are likewise pressed together and their terminals 18 short-circuited. The springs 15 are held apart and normally insulated from each other by a wedge 19 of insulating material such as porcelain and a similar wedge 20 between the springs 16 normally insulates them from each other. Each spring 15 is connected by a conductive strip 21 with one of the springs 16. The cut-out box 10 may be used as indicated in Fig. 5 where it is shown diagrammatically in connection with a constant current street lighting system including a main lamp circuit 22 and two branch lamp circuits 23 and 24. A source of current 25 is connected through a constant current transformer 26 to the main lamp circuit 22 to which each of the branch circuits 23 and 24 is connected through a cut-out box 10. The terminals of each branch circuit are connected to the terminals 17 of the springs 13 of their cut-out box and are thus short-circuited by these springs when the cover 12 of the cut-out box is open as shown in Fig. 2. The main lamp circuit is broken at each cut-out box and connected to the terminals 18 of the springs 14 so that the break is also short-circuited by the springs 14 when the cover 12 is open. Thus, with the covers 12 of the cut-out boxes open, the main lamp circuit 22 is completed through the springs 14 and is in condition to be operated but the branch circuits 23 and 24 are disconnected and insulated from the main circuit so that repairs or other work may be done on them without interrupting operation of the main circuit. Now, if the cover 12 of a cut-out box is closed, the springs 15 with their insulating wedge 19 will be forced between the springs 14, and the springs 16 with their insulating wedge 20 will be forced between the springs 13. The branch circuit is thus connected through the conductive strips 21 in series with the main circuit and both operate together as a single series circuit.

A by-pass 27 constructed in accordance with the present invention is removably held between two conductive clips 28 secured to the two strips 21 as shown in Fig. 2. This by-pass 27 includes a cylinder 29 of resistance material with two conductive metal end caps 30, each provided with an electrode 31. These electrodes are shown in the form of metal screws with their heads drawn against the outer surfaces of the caps 30 by internal washers 32. The electrodes extend into the cylinder 29, their inner ends being spaced apart to provide a gap 33 in parallel with the cylinder 29. The heads of the electrodes 31 form external knobs or terminals to form contact with the clips 28 and to hold the by-pass in position between these clips.

When used as indicated in Fig. 5, the voltage impressed at any time on a branch lighting circuit is impressed on the electrodes 31 and thus across the resistance cylinder 29 and the gap 33 of its by-pass. The resistance cylinder 29 is therefore formed of material having such high resistance under normal voltage conditions that the current through it will be negligible. This resistance material, however, has a

negative resistance-ampere characteristic so that, if the voltage becomes abnormally high at any time, the current through the resistance will increase greatly and substantially raise the temperature of the cylinder and its electrodes. A resistance material which is suitable for this purpose is disclosed in the K. B. McEachron Patent No. 1,822,742, issued September 8, 1931.

If trouble develops in one of the branch lamp circuits 23 and 24 so that there is an open circuit, the constant current transformer will automatically raise the voltage applied to the system and thus also the voltage across the by-pass connected across the branch circuit. This will raise the temperature of the resistance cylinder 29 by causing a large increase in current through it. As least one of the internal washers 32 is formed of metal which is solid under normal operating temperatures but which will be easily melted by heat from the adjacent cylinder 29 under abnormally high voltage conditions. The cylinder 29 is mounted horizontally so that when one or both of the fusible washers is melted, the molten metal will run into the lower part of the cylinder and form a short circuit 34 between the two electrodes 31 as indicated in Fig. 4, thus restroing the main circuit 22 so that it may continue to operate without waiting for repairs on the defective branch circuit. The internal gap 33 will break down and permit a discharge in case a transient voltage across the electrodes so high as to endanger the cylinder 29.

Abnormally high voltages such as may be caused by lightning sometimes appear in a circuit and these may be of very brief duration. One advantage of the by-pass which has been described is that an appreciable time is required to produce sufficient heat to melt the fusible washers 32 and, in the case of such brief disturbances, sufficient protection is afforded by the gap 33 and the reduced resistance of the cylinder 29. Both the main and branch circuits may then continue to operate and no replacement or repair of the by-pass will be necessary.

The invention has been explained by describing a particular form and application thereof but it will be apparent that changes may be made without departing from the spirit of the invention and the scope of the appended claims.

What we claim as new and desire to secure by Letters Patent of the United States, is,—

1. A by-pass including a resistance element, a metal member adjacent said resistance element and having a low melting point, and a spark gap connected in parallel with said resistance element, said by-pass being formed to retain said metal member when melted in position to short circuit said resistance element.

2. A by-pass including a resistance element having a negative resistance-ampere characteristic, a metal member adjacent said resistance element and having a low melting point, and a spark gap connected in parallel with said resistance element, said by-pass being formed to retain said metal member when melted in position to short circuit said resistance element.

3. A by-pass including a cylindrical resistance element, a metal cap on each end of said element, an electrode mounted on each cap, said electrodes being spaced within said cylindrical element to form a spark gap in parallel therewith, and a metal member within said resistance element having a low melting point.

4. A by-pass including a cylindrical resistance element having a negative resistance-ampere characteristic, a metal cap on each end of said element, a metal electrode mounted on each cap, and a metal member having a low melting point mounted on at least one of said electrodes within said resistance element, said electrodes being spaced within said resistance element to form a spark gap in parallel therewith.

5. A by-pass including a cylindrical resistance element, a metal cap on each end of said element, a threaded electrode extending through each cap, said electrodes being spaced within said resistance element to form a spark gap in parallel therewith, and a metal washer threaded onto at least one of said electrodes and having a low melting point.

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