

Feb. 19, 1952

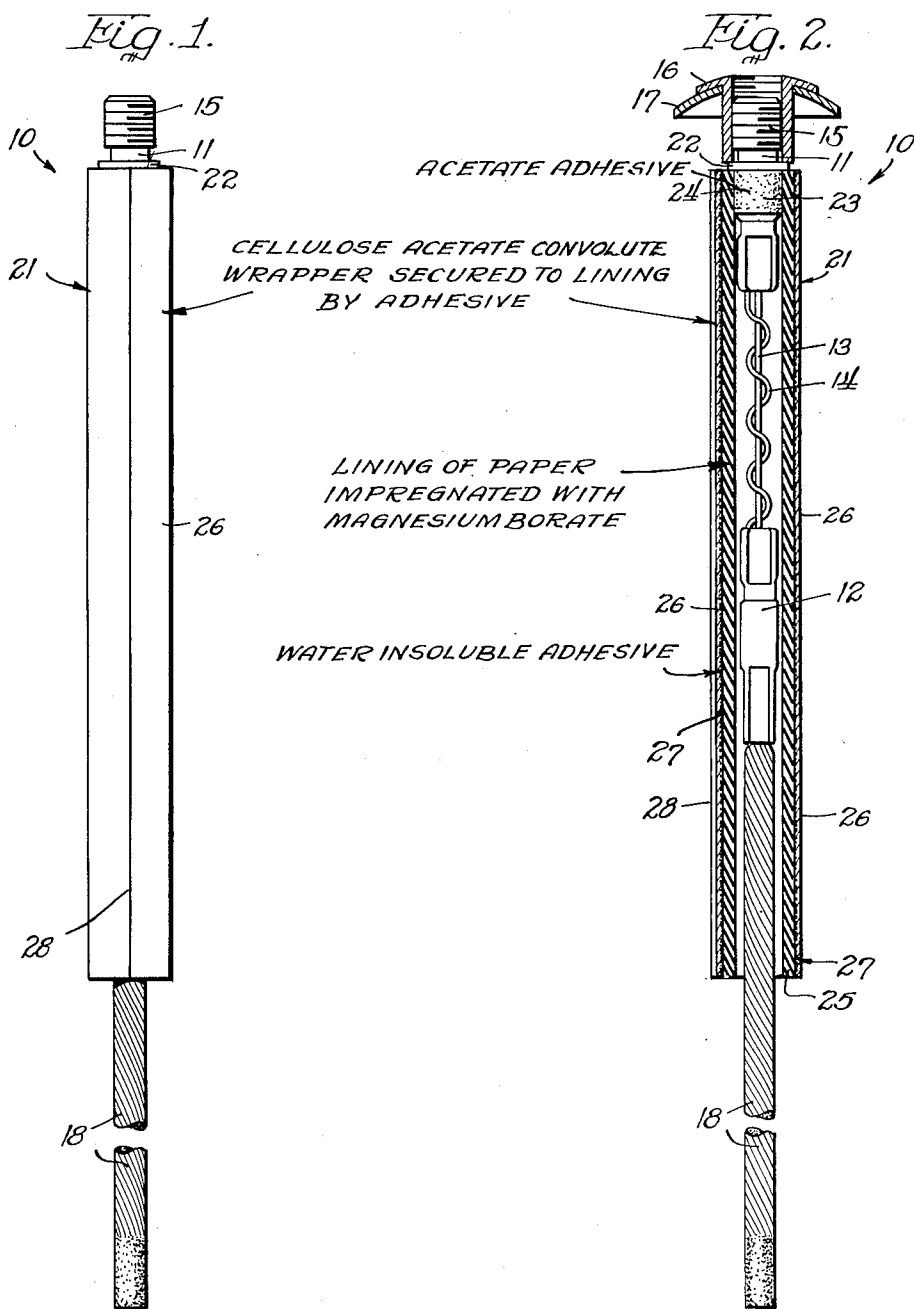
G. F. McMAHON

2,586,171

CIRCUIT INTERRUPTING MEANS

Filed May 1, 1947

2 SHEETS—SHEET 1



Inventor:
George F. McMahon

By *Brown, Jackson, Boettcher & Pierner*

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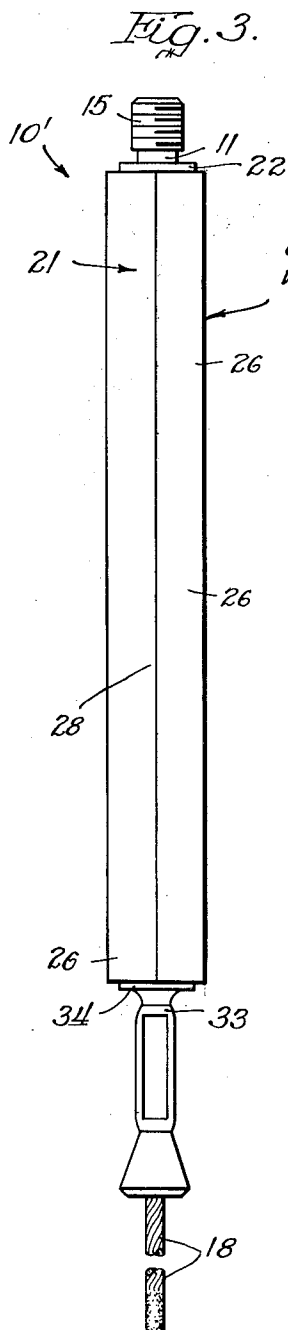
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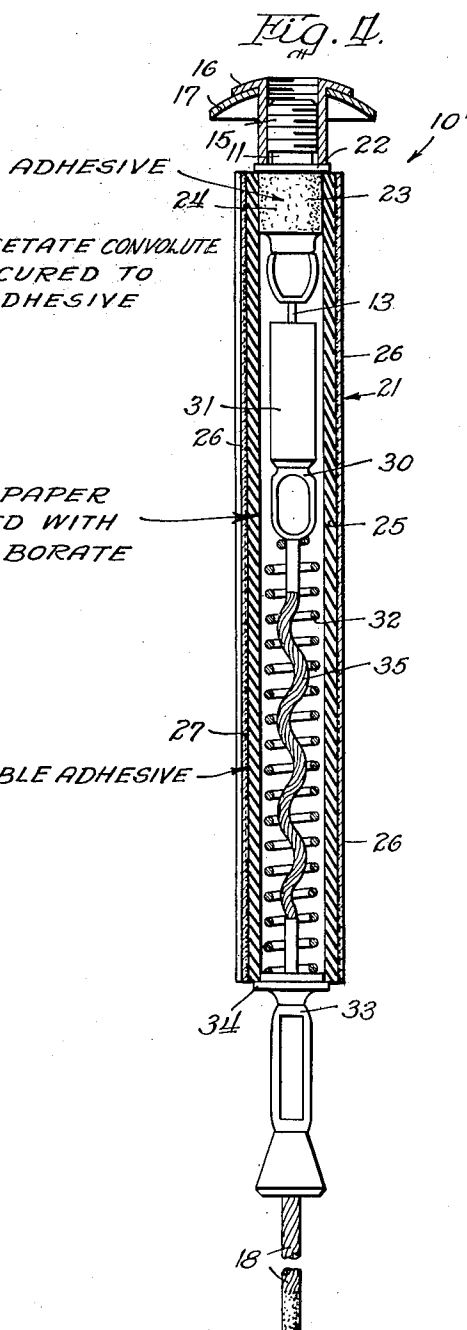
2 SHEETS—SHEET 2



CELLULOSE ACETATE CONVOLUTE
WRAPPER SECURED TO
LINING BY ADHESIVE

LINING OF PAPER
IMPREGNATED WITH
MAGNESIUM BORATE

WATER INSOLUBLE ADHESIVE



Inventor:
George F. McMahon
By Brown, Jackson, Boettcher & Diemer
Attys.

UNITED STATES PATENT OFFICE

2,586,171

CIRCUIT INTERRUPTING MEANS

George F. McMahon, Chicago, Ill., assignor to
S & C Electric Company, Chicago, Ill., a corporation of Delaware

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1 Claim. (Cl. 200—120)

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This invention relates, generally, to circuit interrupting devices and particularly to replaceable fuse links for fuse devices operating at distribution and transmission alternating voltages ranging upwardly from 2,300 volts to and including 44,000 volts and more particularly to the construction and composition of sleeves therefor.

In Patent Nos. 2,253,719, 2,253,720, and 2,328,825, assigned to the assignee of this application, fuse links are disclosed that are intended for use in fuse tubes of various types of fuse devices. In general, these fuse links comprise a pair of terminals that are interconnected by fusible means, such as a fusible element which comprises a strain wire and a coiled fuse wire or it may comprise simply a strain wire. Surrounding the fusible element and extending over the terminals is a sleeve of insulating material which has arc extinguishing properties.

In these patents, the sleeve is disclosed as being formed of rolled absorbent alpha cellulose paper impregnated with an arc extinguishing material, such as magnesium borate. The sleeve is disclosed as being formed only of this material and in this manner. It is also disclosed as being surrounded by an outer sheath of fiber.

Where the sleeve is formed solely of rolled paper tubing impregnated with magnesium borate, or other arc extinguishing material, it has been found that a great deal of care should be exercised in handling the fuse links or otherwise, since such a tube is relatively weak mechanically, it is likely to buckle or crack when subjected to stress. This is particularly true when a spring is incorporated in the fuse link for tensioning the fusible element and assisting in withdrawing the movable terminal when the fusible element blows.

Fuse links of the character with which the present application is concerned are intended for use in various makes and sizes of fuse tubes. In general, these fuse tubes have internal diameter, or bores of $\frac{3}{8}$, $\frac{7}{8}$, $\frac{1}{2}$, or $\frac{1}{4}$ of an inch, and there are some that have a diameter of $\frac{1}{8}$ of an inch. It is possible to make fuse links using only a rolled paper tube impregnated with an arc extinguishing material which will have an outside diameter that will permit the link to be inserted in fuse tubes having these diameters. Such a fuse link, however, is subject to the disadvantages enumerated hereinbefore. When the fiber sheath is provided around the paper sleeve impregnated with arc distinguishing material, the resulting outside diameter of the fuse link ordi-

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narly is too great to permit its being inserted in fuse tubes having these internal diameters. Thus, while the use of the fiber sheath would overcome the foregoing disadvantages, its use prevents the fuse link from being employed in fuse tubes having diameters ranging upwardly from $\frac{1}{8}$ of an inch.

It is important to understand the relationship that exists between the current interrupting range of the sleeve carried by the fuse link and the current interrupting ranges of fuse tubes of various bore sizes in which universal links are employed. The strength of the sleeve assembly determines the maximum current that can be interrupted by the sleeve itself. The link sleeve must possess the ability to interrupt currents up to values that can be handles efficiently by even the larger bore cutout tubes in which these links may be used. On the other hand, this ability must be attained in links of limited diameter capable of being used in the smallest bore employed in any commercial cutout, that is, in bores of minimum standard diameters of $\frac{1}{8}$ and $\frac{1}{4}$ of an inch in cutouts rated 50 amperes and 100 amperes, respectively. Fiber sleeves commonly employed have not been found to be capable of providing the desired coordination between the interrupting range of the fuse links and the larger bore cutouts in which such links are used, particularly in the higher voltage brackets. Failures have been experienced, particularly when primary fuses and cutouts are called on to interrupt low amperage, low power factor primary currents associated with secondary faults on relatively large transformers. The failures in such cases are due to the fact that the pressure generated in the link sleeve may exceed the strength of the fiber sleeve causing the sleeve to rupture at currents of intermediate magnitude which cannot be efficiently interrupted by cutout tubes of relatively large diameters, employed to attain higher ultimate interrupting capacities. Toughness, as a property of the reinforcing member of the impregnated sleeve, therefore is of importance.

Accordingly, among the objects of this invention are: To reinforce an arc extinguishing sleeve capable of extinguishing arcs of magnitude likely to develop stress sufficient to burst the same so as to prevent such destruction and permit the sleeve to interrupt the arc current which it is capable of doing; to provide for reinforcing an insulating and arc extinguishing sleeve for a fuse link that is formed of rolled paper impregnated with an arc extinguishing material so that

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it can withstand handling and stress incident to assembly and operations in a cutout and yet will have an external diameter that will permit the link in final form to be inserted in fuse tubes having internal diameters ranging upwardly from $\frac{1}{8}$ of an inch; to provide on the lining of a fuse link formed of rolled alpha cellulose paper impregnated with an arc extinguishing material a reinforcing wrapper the thickness of which is substantially less than the wall thickness of the lining; to provide such a fuse link wherein the wall thickness is approximately eight to twelve times the thickness of the wrapper; to employ a moisture resistant tape for the wrapper and to apply it to the lining in a convolutely wound fashion; to secure the wrapper to the lining by adhesive means; to employ magnesium borate as the arc extinguishing material and a tape formed of cellulose acetate; to employ water insoluble adhesive means for securing the wrapper to the lining; and to secure the sleeve to one of the terminals by adhesive means.

Other objects of this invention will, in part, be obvious and in part appear hereinafter.

This invention is disclosed in the embodiments thereof shown in the accompanying drawings, and it comprises the features of construction, combination of elements, various materials and arrangement of parts which will be exemplified in the constructions and compositions set forth hereinafter, and the scope of the application of which will be indicated in the appended claim.

For a more complete understanding of the nature and scope of this invention, reference may be had to the following detailed description, taken together with the accompanying drawings, in which:

Figure 1 is a view, in side elevation and at a double scale, of a fuse link in which the present invention is incorporated;

Figure 2 is a longitudinal sectional view of the fuse link shown in Figure 1, certain parts being shown in elevation with the removable button head assembly means shown in section;

Figure 3 is a view, in side elevation and at double scale, of a spring type of fuse link in which the present invention is incorporated; and

Figure 4 is a longitudinal sectional view of the fuse link shown in Figure 3, certain parts being shown in elevation and the replaceable button head being shown in section.

Referring now particularly to Figures 1 and 2 of the drawings, it will be observed that the reference character 10 designates, generally, a fuse link of the non-spring type that is provided with a sleeve which is formed and constructed in accordance with this invention. The fuse link 10 includes terminals 11 and 12 which are interconnected by fusible means comprising a strain wire 13 and a fusible element or wire 14. The strain wire 13 may be formed of nickel chromium alloy and the fusible element or wire 14 may be formed of silver, tin or other metal or metal alloys. The upper end 15 of the terminal 11 may be threaded for receiving a removable button head 16 with which a washer 17 cooperates to adapt the fuse link 10 for mounting in various types of fuse tubes, and to facilitate connection to one terminal thereof. A stranded flexible conductor 18 extends from the other terminal 12 and is of sufficient length to extend out of the fuse tube for connection to a second line terminal.

Surrounding the fusible means comprising the strain wire 13 and fusible element or wire 14 and

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extending over the terminals 11 and 12 is an insulating sleeve, indicated generally at 21, which is constructed in accordance with this invention. The sleeve 21 abuts a radial flange 22 of terminal 11 and is secured to a cylindrical intermediate portion 23 thereof by a suitable adhesive 24, such as an acetate adhesive. As shown in the patents referred to hereinbefore, the sleeve 21 may be secured to the terminal 11 by other means. However, it is preferred to secure it thereto by adhesive means, as described, to reduce the expense involved in manufacturing and assembling the fuse links.

The sleeve 21 comprises a lining 25 that is formed by rolling a sheet of alpha cellulose paper to form a tube and impregnating the rolled paper thus formed with an arc extinguishing material, such as magnesium borate as described in detail in Patent No. 2,253,719. As pointed out hereinbefore, while such a sleeve by itself, is satisfactory from an electrical and operating standpoint it may be damaged during handling. Also it may possess sufficient bursting strength for small diameter fuse tubes and not have sufficient strength to resist bursting in larger diameter fuse tubes at current values below that at which the fuse tube itself is adapted to extinguish the arc quickly and efficiently. Accordingly, it is desired that it be reinforced to increase its operating range and efficiency. However, the means used for reinforcing the lining 25 must be such as to maintain or not impair the electrical characteristics of the sleeve and at the same time be of such thickness that the fuse link can be inserted in a fuse tube having an internal diameter of $\frac{3}{8}$ of an inch or less, as will appear hereinafter.

In order to reinforce the lining 25, a wrapper 26 in the form of a tape is convolutely wrapped around the lining 25. Preferably the wrapper 26 is formed of moisture resistant material, such as cellulose acetate, and it is secured to the lining 25 by an adhesive 27 which preferably is water insoluble. Such a water insoluble adhesive may be formed from rubber latex, synthetic rubbers and other resins, plasticizers, pigments and fillers. The wrapper 26 may have printed or otherwise placed thereon information as to characteristics, rating, etc. of the fuse link 10.

The cellulose acetate convolute wrapper 26 may be in the form of a tape and has the adhesive 27 on one side thereof to facilitate adherence to the outer surface of the lining 25. The outer terminal edge portion of the convolute wrapper 26 is indicated at 28. The material used for the wrapper 26 should be heat resisting under normal high temperature operating conditions of the order of 150° C.

The sleeve 21 for the usual sizes of fuse links has a length of $3\frac{1}{8}$ inches. The sleeve 21 may be formed initially in this length or it may be formed in lengths of 24 inches or more and then the longer sleeves may be cut to the desired short lengths as required.

For the non-spring type of link shown in Figures 1 and 2, the lining 25 may be formed of rolled absorbent alpha cellulose paper, the initial thickness of which is 0.0045 inch. The rolled paper tube may be repeatedly dipped in a crystalloidal solution of magnesium borate for a number of times, depending upon the amount of magnesium borate that is desired as described in Patent No. 2,253,719. Because of the absorbent property of the paper which is required to include a sufficient quantity of inorganic arc extinguishing material, a relatively fragile tube is provided that can be

reinforced to advantage by a tough outer shell. The liner 25 may be formed so that its internal diameter is 0.234 inch and its outside diameter is 0.312 inch. This provides a wall thickness of 0.039 inch. The cellulose acetate convolute wrapper 26 preferably has a thickness of about 0.004 inch, which is less than one-ninth of the wall thickness of the lining 25. This provides a maximum outside diameter of the sleeve 21 over the terminal edge 28 of 0.333 inch. Thus, ample clearance is provided between the outer surface of the sleeve 21 and the inner surface of a fuse tube having an internal diameter of $\frac{3}{8}$ of an inch or more.

When the fuse link 10 is to be inserted in a fuse tube having an internal diameter of $\frac{3}{8}$ of an inch, it is necessary to modify the foregoing dimensions slightly and to reduce the diameter of the cylindrical portion 23 of the terminal 11. For this purpose the diameter of the cylindrical portion 23 is reduced to 0.200 inch and the internal diameter of the lining 25 is made to conform to this dimension. The lining 25 is formed so as to have an outside diameter of 0.275 inch. When the cellulose acetate wrapper 26 is convolutely wound on a lining of such dimensions, a sleeve having an outside diameter of 0.295 inch is provided. This readily fits into a fuse tube having an internal diameter of $\frac{3}{8}$ of an inch.

Referring now particularly to Figures 3 and 4 of the drawing, it will be noted that the reference character 10' designates, generally, a fuse link of the spring type, such as that shown and described in Patent No. 2,361,638, assigned to the assignee of this application. Insofar as the same elements are employed in the fuse link 10' that are employed in the fuse link 10, as shown in Figures 1 and 2 and described hereinbefore, the same reference characters will be applied in Figures 3 and 4. In lieu of the terminal 12, shown in Figure 2, a terminal 30 is provided to which the strain wire 13 is secured. The terminal 30 has an integrally formed metal shield 31 which extends over the strain element 13 for the purposes described in said Patent No. 2,361,638. A coil tension spring 32 is strained between the terminal 30 and an anchor terminal 33 which has a flange 34 that abuts the lower end of the sleeve 21. The anchor terminal 33 is secured to the flexible conductor 18 in such position that the upper end 35 thereof between the terminal 30 and the anchor terminal 33 is slack. The purpose of this is to require that sufficient tension be applied to the flexible conductor 18 to lift the flange 34 off of the lower end of the sleeve 21 before any stress is applied to the fusible element 13, in addition to that already supplied by the coil tension spring 32.

Since the spring 32 may be arranged to apply a tension of about 10 pounds to the fusible element 13, it is desirable that the lining 25 be slightly thicker for use in this application than was required for the non-spring link 10 shown in Figures 1 and 2. Accordingly, while the internal diameter of the lining 25 is the same as before, i. e., 0.234 inch, its external diameter is 0.340 inch. However, the same thickness of cellulose acetate convolute wrapper 26 is employed as before with the result that the outside diameter of the sleeve 21 is about 0.367 inch. This provides sufficient clearance for the fuse link 10' to enter a fuse tube having an internal diameter of $\frac{3}{8}$ of an inch. For use with fuse tubes having bores of $\frac{3}{8}$ of an inch diameter, the internal diameter of the lining

25 is 0.200 inch and its external diameter is 0.300 inch. The same thickness of wrapper 26 is used as before.

In making the fuse links disclosed herein the sleeve 21 is formed in its entirety and then is assembled with the other parts making up the link. The wrapper 26 is applied to the lining 25 at room temperature, no heat being required to cause it to adhere thereto. If heat were required to cause the wrapper 26 to adhere to the lining 25, as for example a high temperature baking operation, the lining 25 might be injured. This is avoided by employing for the adhesive 27, a material which can be used at room temperature.

The use of the improved arc extinguishing sleeve disclosed herein is not limited to universal fuse links for insertions in fuse tubes of various makes and bore diameters. For example, it may be used to provide the sleeves for open type fuse links such as shown in Patent No. 2,324,044.

While certain dimensions have been specified herein and certain materials have been mentioned, it will be understood that these are for illustrative purposes only and that the scope of the invention is to be determined only as set forth in the following claim, these dimensions and materials having been mentioned for illustrative purposes only.

What is claimed as new is:

A replaceable fuse link comprising, in combination, a pair of terminals interconnected by fusible means, and an insulating sleeve surrounding said fusible means and extending over said terminals; said sleeve having a lining of arc extinguishing material characterized by being relatively weak mechanically and likely to buckle when subjected to longitudinal stress and to crack or break in handling, and likely to burst when employed in fuse tubes before the magnitude of the arc current capable of being extinguished thereby is high enough to be quickly and efficiently extinguished by the fuse tube, and a cellulose acetate wrapper convolutely wound on said lining and secured thereto by adhesive means, said wrapper having a thickness substantially less than the wall thickness of said lining and characterized by being relatively tough and strong mechanically and capable of reinforcing said mechanically weak lining to withstand longitudinal stress and protecting said lining in handling and resisting bursting stress up to the limit of the arc interrupting ability of said lining.

GEORGE F. McMAHON.

REFERENCES CITED

The following references are of record in the file of this patent:

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Number	Name	Date
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2,279,630	McMahon	Apr. 14, 1942
2,304,250	Fox	Dec. 8, 1942
2,325,416	McMahon	July 27, 1943
2,325,935	Benton	Aug. 3, 1943
2,328,825	McMahon	Sept. 7, 1943

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Number	Country	Date
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399,896	Great Britain	Oct. 19, 1933