Oct. 18, 1949. A. T. TIMERMAN 2,485,076

FUSE

Filed Sept. 3, 1946 3 Sheets-Sheet 1

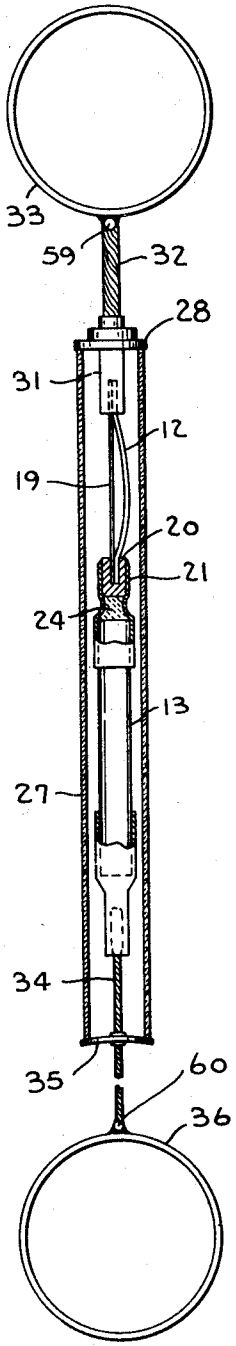

FIG. 3

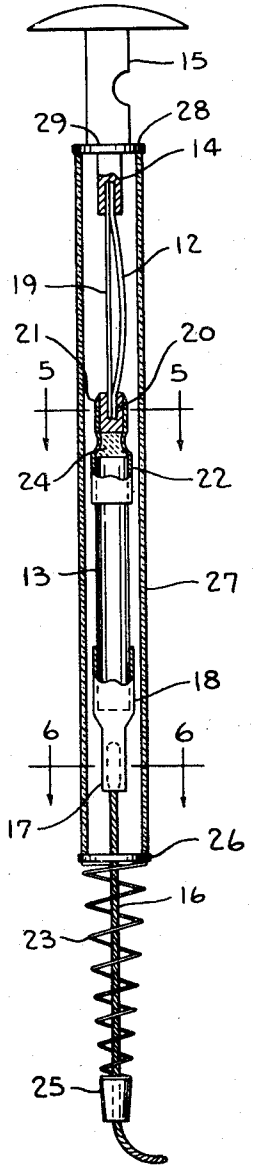

FIG. 1

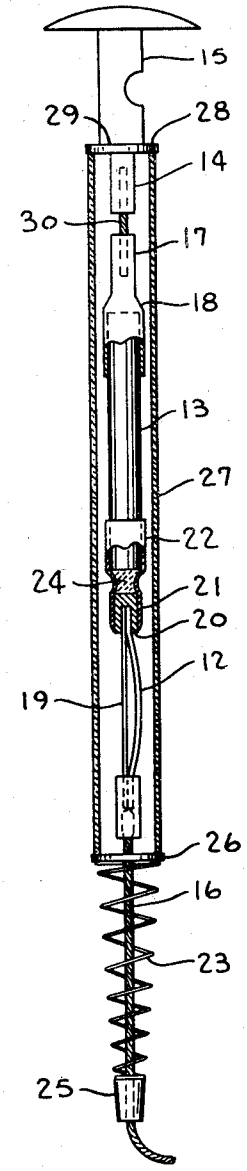

FIG. 2

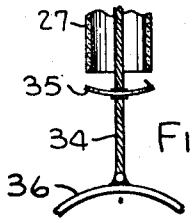

FIG. 4

INVENTOR.
Anthony T. Timerman

BY

Louis O. French
ATTORNEY

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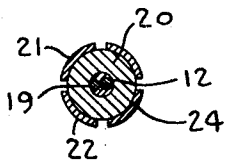

FIG. 5

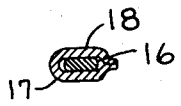

FIG. 6

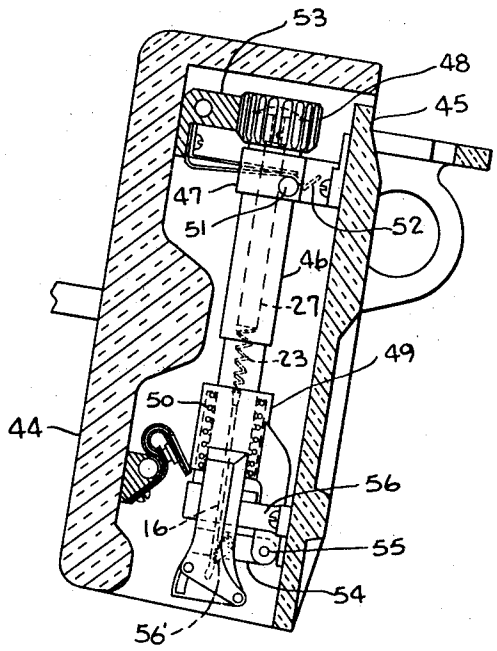

FIG. 8

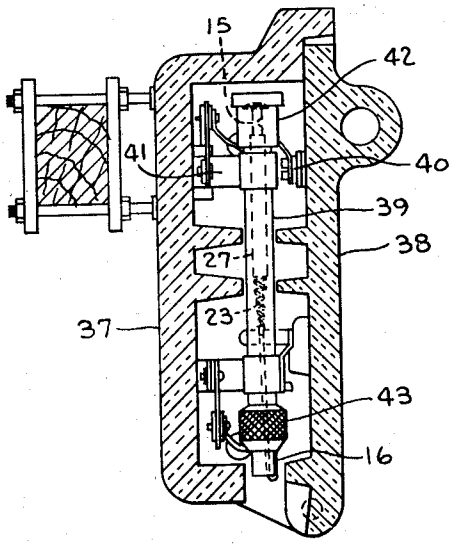

FIG. 7

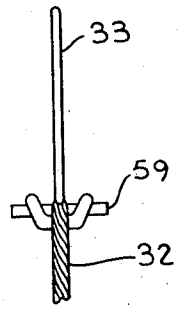

FIG. 10

INVENTOR.
Anthony T. Timerman
BY
Louis O. French
ATTORNEY

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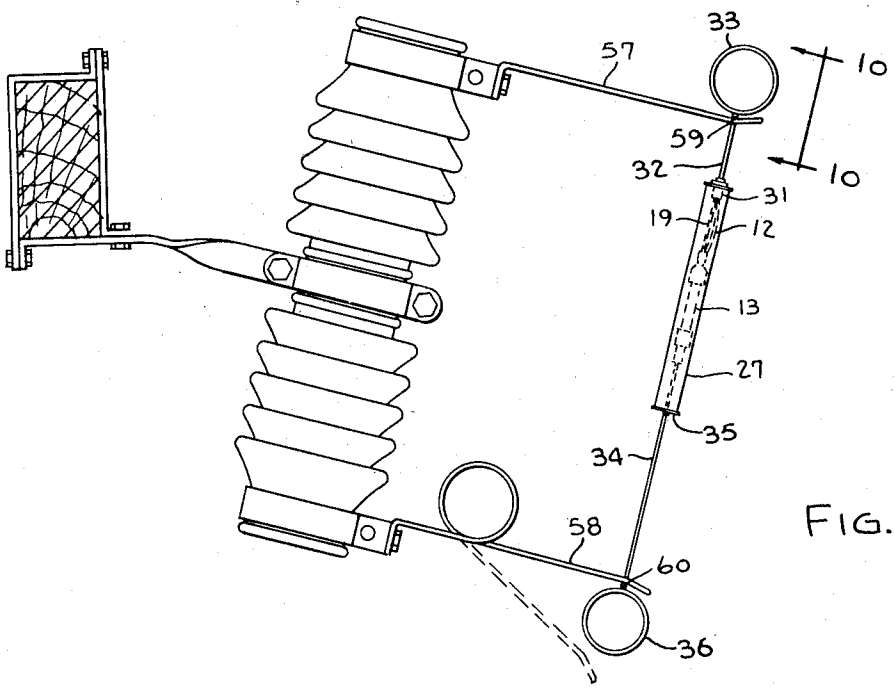

FIG. 9

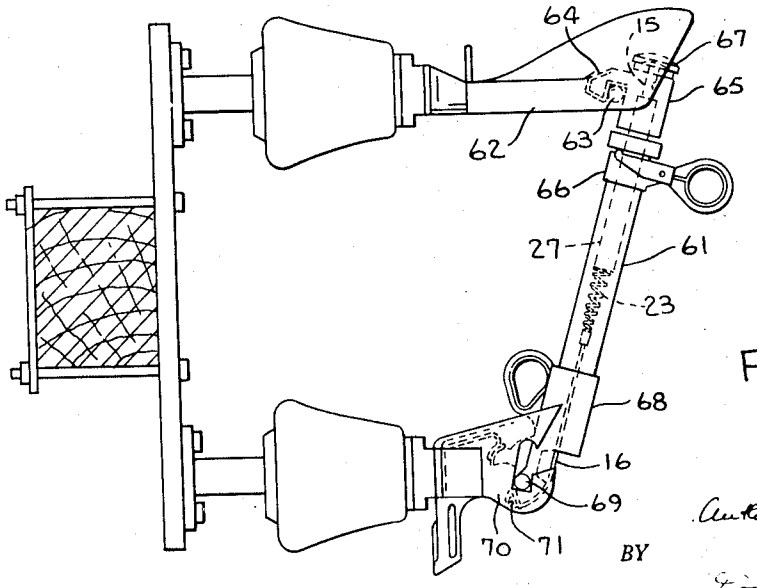

FIG. 11

INVENTOR.
Anthony T. Timerman
Louis O. French
ATTORNEY

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UNITED STATES PATENT OFFICE

2,485,076

FUSE

Anthony T. Timerman, Milwaukee, Wis.

Application September 3, 1946, Serial No. 694,647

1 Claim. (Cl. 200—123)

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This invention relates to electrical fuses.

While the fuse hereinafter described is especially applicable to circuits of 2300 volts and up and relatively low current amperage or fractional amperages, it will also serve in protecting electrical equipment in the low voltage and high amperage field, and we, therefore, do not wish to limit our invention to any particular use or capacity.

The general object of this invention is to provide a fuse which will have characteristics which will permit it to protect the apparatus, such as a transformer or other electrical device, from overheating, short circuit currents, etc., in the apparatus itself, as well as surge currents, magnetizing currents, or switching transients that may occur in the current supply system for such apparatus. In order that a fuse may carry out this multiple phase of protection the object of this invention is to provide a fuse that has a dual curve, either of which can be adjusted or predetermined independently of the other without limitation, but both of which act as a unit to produce an opening of the circuit under conditions met with in practice. Thus the fuse of this invention may have a time current characteristic of lower current value and shorter time than the safe loading curve of the device it protects and at the same time also operate to protect the device against high current surges in the supply line, or conversely protect the supply line from harmful surges due to failures originating within the apparatus protected by the fuse. Where fuses melt on low currents, they must, to be successful, have strong mechanical means to separate their arcing terminals in order to extinguish the arcs resulting from high voltages, and the fuse elements themselves must, therefore, be strong enough to resist separation by these separating means except when required. An object of our invention is to provide a fuse having low ampere melting characteristics and yet strong enough to withstand the forces of the separating means.

More particularly, according to this invention, the heat required to operate the fuse on low currents is furnished by a resistor or heater whose tensile strength under any conditions met with, either electrical or mechanical, is greater than any forces that may be imposed upon it by the separating devices, said resistor preferably being a molded composition material such as carbon, carborundum, or powdered metal bonded together which of themselves are not intended to rupture when in use but to act as a heating

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means under certain conditions to loosen a thermally responsive anchoring means for a fuse element which may rupture under high load current conditions.

It is also to be noted that the resistor heater herein forming a part of this invention has sufficient thermal capacity to withstand high surge currents and a large percentage of lightning surges as well as all switching transients, and therefore, requires no means for by-passing the currents and thereby subject the electrical equipment which it is protecting to these high surges.

The invention further consists in the several features hereinafter set forth and more particularly defined by the claim at the conclusion hereof.

In the drawings:

Fig. 1 is a vertical sectional view through a fuse embodying the invention;

Fig. 2 is a view similar to Fig. 1 showing certain modifications;

Fig. 3 is a view similar to Fig. 2 showing modifications thereof;

Fig. 4 is a detailed view of parts shown in Fig. 3 in an open circuit condition;

Fig. 5 is a detailed horizontal sectional view taken on the line 5—5 of Fig. 1;

Fig. 6 is a detailed horizontal sectional view taken on the line 6—6 of Fig. 1;

Fig. 7 is an elevation view of a fuse link embodying the invention mounted in a known form of box without special loading features;

Fig. 8 is an elevation view of a fuse link embodying the invention mounted in a fuse box of the drop out type;

Fig. 9 is an elevation view of the fuse link shown in Fig. 3 as used on an open spring arm type of mounting:

Fig. 10 is a detailed side elevation view looking in the direction of the arrows 10—10.

Fig. 11 is an elevation view of a fuse link embodying the invention associated with an open drop out type of mounting.

Referring to the drawings, one fuse link in general includes line connectors or terminal members, a fusible link 12, a relatively rigid heater member 13, and a fusible connection between the link 12 and 13.

Referring to Fig. 1, the fuse link 12 and a strain link 19 are fixedly secured at one end to the shank 14 of a button type terminal member 15 by which the fuse may be electrically connected to one of the terminals of fuse mountings shown in Figs. 7, 8 and 11. The specific means

of connection is the same as that used in connection with the other terminal and shown in Fig. 6. The other terminal includes a cable or conductor 16 which is connected to the deformed or U-shaped end 17 of a tube or socket member 18. As shown in Fig. 6, the cable 16 is held clamped between parts of said end 17 which may also be spot welded together.

The socket member 18 is firmly clamped to one end of the heater member 13. The other end of the heater member and the fuse link 12 associated with the usual strain link 19 are operatively connected together by anchoring the one end of the strain link 19 and the fuse 12 in a conductor block or round plug 20 mounted to fit within the reduced slotted end 21 of a metal tube 22 whose lower end forms a socket for the upper end of the heater member 13. It will be noted from the drawings, Figs. 1 to 3 and 5, that there is a direct electrical contact connection between the slotted end 21 of the tube 22 and the plug 20 so that current may flow freely between the fuse 12 and the heater member 13. The connection between the tube 21 and the block 20 however is of itself not sufficient to hold the fuse 12 connected with the tube under the action of a force tending to separate the parts between the terminals previously described through the action of a spring 23, and in order then to operatively connect the fuse link 12 with the heater member 13 under normal operating conditions the space within the tube 22 and bounded by the upper end of the heater member 13 and the block 20 is filled with a relatively low melting point fusible alloy or solder 24, the connections of the other elements being made while the solder is in a heated condition, and in its normally cold congealed condition the solder serves as an anchor for a connector forming a part of the link structure. When, however, under circuit conditions that may be imposed in the use of the device the temperature of the heater 13 is raised to the softening point of the alloy 24, then under the action of the spring 23 the fuse element 12 will be released from the tube 22 and the circuit broken. Also if circuit conditions are such as to rupture the fuse 12, the circuit will be broken. For imposing the tension of the spring 23 on the fuse elements above described one end of the spring bears against a plug 25 associated with the terminal cable 16, while its other end bears against a cap 26 of insulating material associated with the lower end of tube 27 of insulating material whose upper end is provided with a cap 28 of insulating material against which the shouldered end 29 of the button terminal member 15 bears, the tube 27 thus forming an enclosure for the fuse members and a spacer for the terminals.

The structure shown in Fig. 2 is identical with that of Fig. 1 except that the position of the fuse 12 relative to the terminals has been reversed, that is, the fuse 12 is shown operatively connected to the cable 16 instead of to the button 15 and the socket member 18 is shown connected by a short cable section 30 with the deformed end of the button type terminal member 15. The other parts are similar to those described in connection with Fig. 1 and are similarly numeralled, and the action of the device is the same, the spring 23 acting under critical load conditions to separate the terminal connections when either the fuse 12 blows or the solder 24 melts.

The fuse construction shown in Fig. 3 is similar to that in Fig. 1, and similar references are applied thereto except that in this construction the upper terminal member 31 is connected to a cable 32 secured to a ring member 33, and the terminal cable 34 corresponding to the cable 16 extends through and is secured to a thin flexible metal diaphragm 35 abutting the lower open end of the tube 27 and acting as a spring to tension or load the fuse connections between the terminals, the extended end of the cable 34 being connected to a ring member 36. With the type of fuse shown in Fig. 3 separation of the contacts is further effected through an exterior spring loading between the terminals by an exterior mounting spring, as shown in Fig. 9, and on separation through a break in the circuit either by the rupture of the fuse 12 or melting of the solder 24 in the construction shown in Fig. 3 the terminal member 34 and its diaphragm 35 move to the open position shown in Fig. 4.

In each of the constructions the heater member 13 is a relatively rigid member, that is, its tensile strength under any conditions met with in the use of the fuse, either electrical or mechanical, is greater than any forces that may be imposed upon it by the separating device, said resistor preferably being a molded composition material or monolithic structure such as carbon, carborundum, or powdered metal bonded together which of themselves are not intended to rupture when in use but to act as a heating means under certain conditions to loosen or melt the thermally responsive anchoring means or solder 24, and thus cause a separation of the fuse parts. The fuse link 12 may be of any standard or approved form of link which has its rating determined to protect the apparatus in connection with which the fuse is used against high current surges, magnetizing currents, or switching transients that may occur in the current supply system for the apparatus. In general the resistance of the resistor heater 13 is such as to melt the fusible member 24 following the so-called safe loading curve for the transformer or other apparatus to be protected so as to prevent overheating thereof, the heating effect being rated below the so-called safe loading curve so as to adequately protect the apparatus. In this connection by coating part of the surface of the resistor 13 with copper any desired resistance heater rating may be obtained for the resistor.

From the above it will be noted that with the fusing arrangement above described the fuse has a dual curve, either one of which can be adjusted or predetermined independently of the other without limitation, but both of which act as a unit to produce an opening of the circuit under conditions met with in practice. Thus the fuse of this invention may have a time current characteristic of lower current value and shorter time than the safe loading curve of the device it protects and at the same time also operate to protect the device against high current surges in the supply line. The fact that portions of this fuse may melt on lower current values does not prevent an efficient separation of the fuse elements since even with low current melting, the resistor 13 of this invention is not the fusible member but will adequately serve as a strong mechanical connection resisting the load imposed by the separating means except when required.

In Fig. 7 we have shown the fuse structure of the form shown in Fig. 1 mounted in a porcelain box 37 having a hinged cover 38, the cover carrying a tube 39 in which our fuse is mounted and provided with terminals 40 cooperating with line

connecting spring terminals 41 mounted within the box, the tube 39 having a metal ferrule with a seat for the button head 15 which is clamped thereto by a threaded cap member 42. The conductor 16 extends through the lower open end of the tube 39, and the end thereof is brought under the annular knurled nut 43 and clamped against the surface of the lower ferrule. In this construction the loaded spring 23 provides the force necessary to separate the terminals under the conditions heretofore described.

In Fig. 8 we have shown the fuse structure of the form shown in Fig. 1 mounted in a porcelain box 44 having a front cover 45 which carries a tube 46 in which our fuse is mounted. The tube 46 has an upper ferrule 47 with a threaded cap 48 for clamping upon an annular seat the button head 15 shown in Figs. 1 and 2. The tube 46 is slidably mounted in a fitting 49 and movable downwardly under the action of a spring 50 to disengage a pin 51 on the ferrule 47 from the latch spring 52 that connects with the upper stationary terminal 53. The lower end of the tube 46 engages a link 54 pivotally connected at 55 to the fitting 49. A bracket 56 and the ferrule 47 are both carried by the cover and mount the fuse thereon. A cam shaped jaw 56' grips the lower end of the flexible conductor 16 against a jaw on the link 54, and the tension of this member serves to hold the cover 45 in a closed position. The spring 50 tends to thrust the tube 46 down against the link 54, and this reaction is taken up by the tension in the flexible head 16 and thence through the other parts of the fuse link structure. Upon rupture of the fuse 12 or melting of the solder 24 the tube 46 drops down as the link 54 is no longer sustained by tension of the fuse elements, the pin 51 is unlatched from the latch spring 52 and the cover 45 drops open.

In Fig. 9 we have shown the fuse structure of the form shown in Fig. 3 mounted between a terminal carrying forked arm 57 and a terminal carrying forked end spring arm 58, the pin portions 59 and 60 secured to the rings 33 and 36 acting in conjunction with the forks to hold the fuse in operative position, the spring arm supplying the main loading force tending to separate the terminals if the fuse 12 or solder 24 gives way.

In Fig. 11 we have shown a drop out fuse mounting in which fuses of the form shown in Figs. 1 and 2 are mounted in a tube 61. A fixed terminal member 62 includes a spring mounted pin 63 engaged by a hook 64 formed on the movable sleeve 65 of an upper ferrule 66. A compression spring (not shown) between the sleeve 65 and the ferrule 66 tends to disengage the hook 64. The fuse assembly of Figs. 1 and 2 when connected acts to resist the compression spring above referred to. The sleeve 65 has a threaded cap 67 for clamping the button head 15 of the fuse element. The lower end of the tube 61 is mounted in a ferrule 68 provided with trunnions 69 mounted in a forked trunnion bracket 70. The conductor 16 is carried down through the ferrule 68 and connected under a binding post 71. When either one of the fuse elements gives way, the spring between the sleeve 65 and the ferrule 66 moves the sleeve 65 upwardly permitting the hook 64 to move out of engagement with the pin 63 and allowing the spring contacts which bear upon the sleeve 65 and gravity to swing the tube 61 in a clockwise direction about the trunnions 69.

I desire it to be understood that this invention is not to be limited to any particular form or arrangement of parts except in so far as such limitations are included in the claim.

What I claim as my invention is:

In a fuse device, the combination with a pair of terminals tensioned relative to each other, of a connection between said terminals comprising a fuse link adapted to rupture under high current surges, a heater element having a tensile strength greater than any tensioning load that may be placed upon it, and means connecting said fusible link with said heater including a conductor plug in which one end of said link is anchored, a metal tube directly electrically connecting said plug and one end of said heater element, the connection between said tube and plug being insufficient to hold the tube mechanically connected with said plug under the tension force of said terminals, and a fusible composition for anchoring said tube to said plug against said tension force.

ANTHONY T. TIMERMAN.

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