Sept. 19, 1933. G. M. GIRDWOOD 1,927,397

ELECTRICAL FUSE

Filed Dec. 23, 1930 2 Sheets-Sheet 1

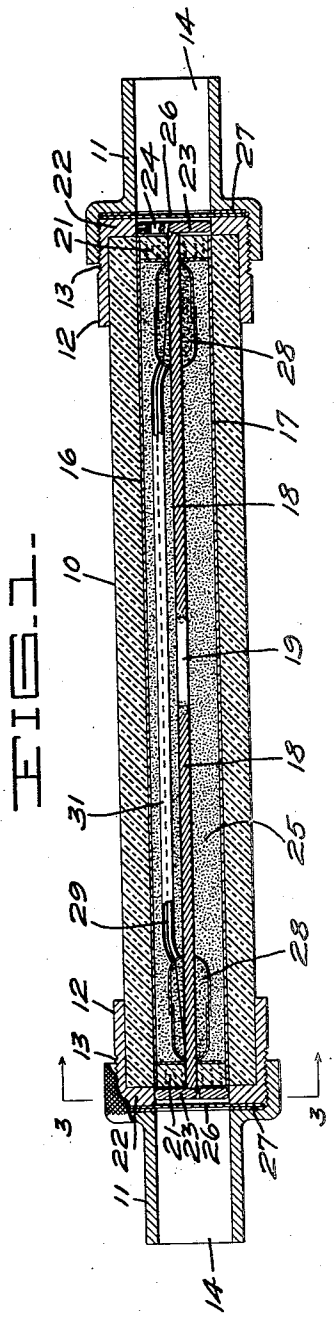


FIG. 1.

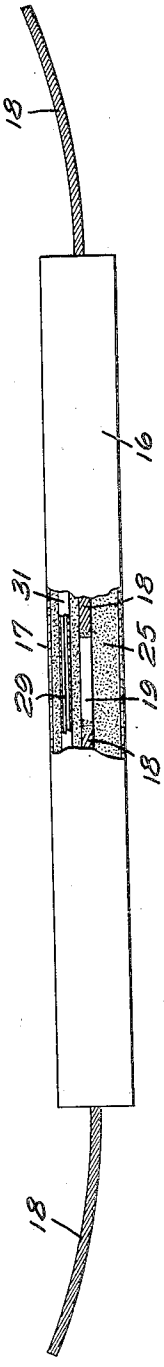


FIG. 2.

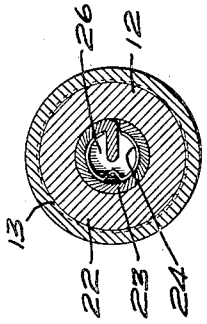


FIG. 3.

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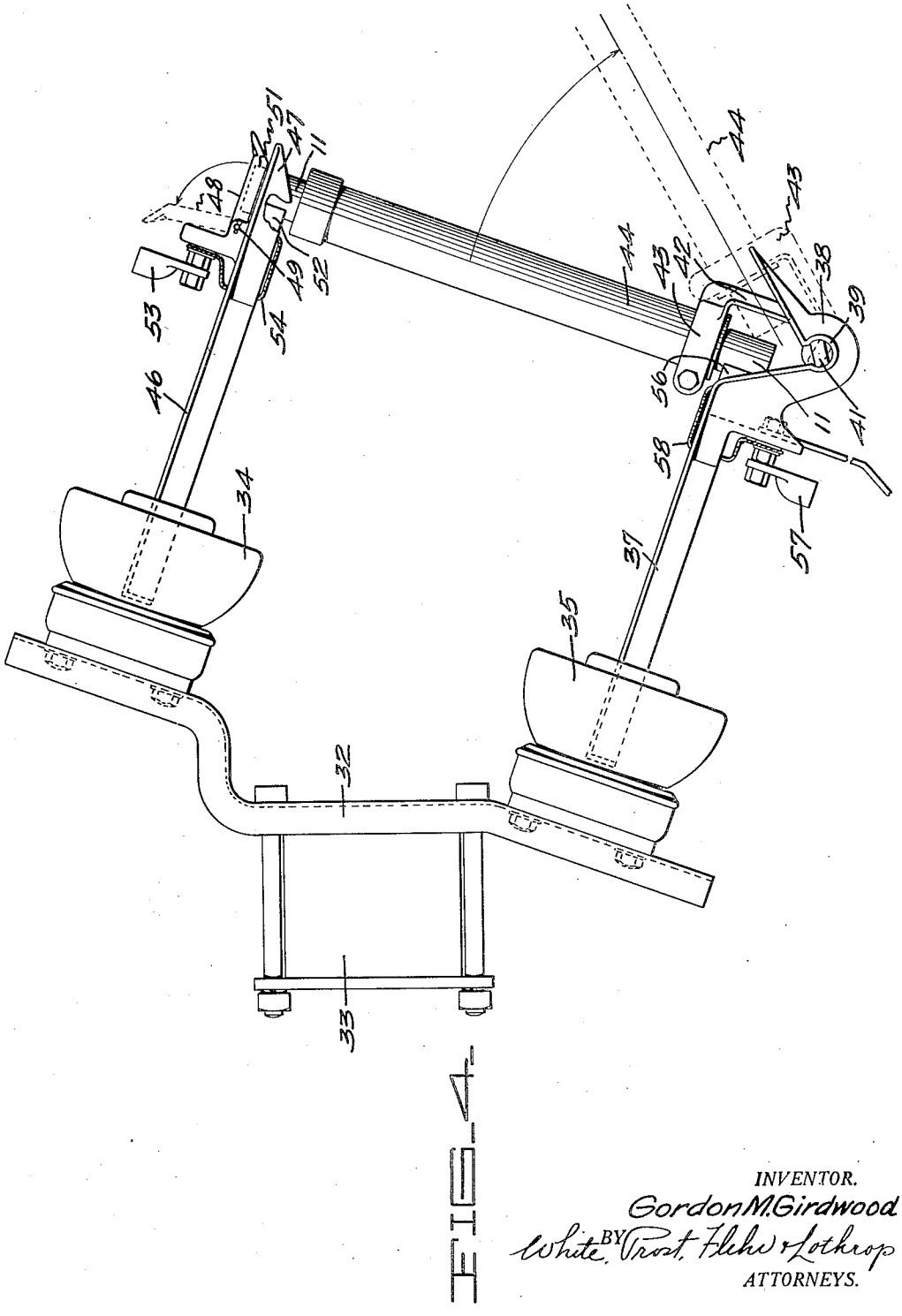


FIG. 4.

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UNITED STATES PATENT OFFICE

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ELECTRICAL FUSE

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Serial No. 504,310

9 Claims. (Cl. 200—127)

This invention relates generally to electrical fuses which are employed for protecting electrical circuits. In the particular form disclosed herein the invention is of particular value when used with high tension electrical distribution lines.

In electrical fuses which have been used in the past to protect high tension distribution lines, considerable difficulty has been experienced in securing rapid positive breaking of the circuit under all overload conditions. While such fuses have generally been effective under heavy overloads sufficient to burn the fuse link with explosive violence, they have not operated properly under slight overload conditions. Thus under slight overloads, fuses such as have been employed in the past frequently break down and form a leakage path for the high tension current. It is not uncommon under such conditions for fuses to catch fire, thus creating a fire hazard as well as failing to properly interrupt the circuit.

It is an object of the present invention to devise an electrical fuse which will function to secure quick and positive interruption of an electrical circuit under slight overload conditions, as well as under heavy overloads.

It is a further object of the invention to devise an electrical fuse which can be readily refilled for further use.

Further objects of the invention will appear from the following description in which the preferred embodiment of the invention has been set forth in detail in conjunction with the accompanying drawings. It is to be understood that the appended claims are to be accorded a range of equivalents consistent with the state of the prior art.

Referring to the drawings:

Figure 1 is a side elevational view in cross section illustrating a fuse incorporating principles of the present invention.

Fig. 2 is a side elevational view, partly in cross section, illustrating a refill for the fuse of Fig. 1.

Fig. 3 is a cross-sectional detail taken along the line 3—3 of Fig. 1.

Fig. 4 is a side elevational view illustrating suitable apparatus with which the fuse can be employed, to positively disconnect the fuse from its associated electrical circuit in case of an overload.

The invention can be outlined briefly as comprising a suitable mounting, such as a tube of insulating material, which serves to enclose a fuse link. In addition to the fuse link explosive charges or capsules are placed within the mounting and are arranged in a novel manner so as to be automatically ignited in case of an overload. Explosion of these capsules or charges serve to positively and quickly separate the ends of the conductor leads to which the fuse link is connected, and in case the fuse is mounted as shown in Fig. 4, the entire fuse is disconnected automatically from its associated electrical circuit.

Thus referring to Fig. 1 of the drawings, the fuse shown therein consists of a tube 10, which is preferably made of an insulating material such as a phenolic condensate product. This tube should have sufficient mechanical strength to adequately withstand the explosion pressures to which it is subjected. Terminal contact members 11 are mounted upon the ends of tube 10 for making convenient electrical connection with contacts of an associated electrical circuit.

To provide a suitable mounting for contact members 11, ferrules 12 are shown affixed to the ends of tube 10, and contact members 11 have a threaded connection 13 with these ferrules. For a purpose to be presently explained, contact members 11 are preferably provided with openings 14, these openings being alined with and of substantially the same diameter as the bore of tube 10. Positioned within tube 10 there is a refill assembly 16, which is shown in detail in Fig. 2.

While certain features of the present invention are applicable to fuses not adapted to be refilled for further use, the use of a refill has certain economic advantages and is considered a novel feature. The assembly as shown in Fig. 2 consists of a tube 17 preferably made of insulating material, which when the refill assembly is positioned as shown in Fig. 1, tube 17 forms a liner for the outer tube 10. Extending into each end of tube 17, there is an electrical conductor lead 18, which is preferably made flexible. The inner ends of conductor leads 18 are connected to a suitable fuse link 19. The use of fuse links of this character is well known in the art and their proportioning and the materials employed for the same need not be described in detail. It is sufficient to point out that this link will fuse at a predetermined current value. Conductor leads 18 extend thru closures 21, which are fitted into the ends of tube 17, and which are made of some suitable material such as cork.

It is apparent that the assembly of Fig. 2 can be slipped into tube 10 thru one of the contact members 11, to assume the normal operating position shown in Fig. 1. As suitable means for forming electrical connection between leads 18 and the contact members 11, I have shown the ends of these leads coiled within the end portions

22 of metal ferrules 12. These coiled lead portions, which have been indicated at 23, can then be expanded to make good electrical contact with the adjacent metal walls of ferrule portions 22, by means of the split expansible discs 24. It is frequently desirable to seal the tube against entrance of moisture, and for this purpose there is shown a sealing disc 26, made of suitable material such as lead, and which is clamped between contact members 11 and their associated ferrules 12. Gaskets 27 can be inserted between the discs 26 and the adjacent surfaces of contact members 11. The entire space within tube 17 is preferably packed with a suitable filler 25 of divided insulating material, such as crushed marble.

If the fuse as described above were employed for protecting an electrical circuit, without the provision of additional means such as will be presently explained, under slight overload conditions the fuse link 19 would not blow with explosive violence, but would tend to permit an arc to form between the inner ends of conductor leads 18. The heat of this arc might also break down the insulation of tube 10, to form a direct leakage path between the contact members 11. In order to provide means to prevent such action under slight overload conditions, I provide a plurality of charges or capsules 28 of explosive material, such as gunpowder, which are located within tubes 10 and 17 but remote from the fuse link 19. The preferred location for these charges or capsules is to have at least one charge adjacent each end of tubes 10 and 17. Furthermore the charges can either be positioned beside leads 18, or surrounding these leads as shown in Fig. 1. In order to automatically ignite the charges 28, I provide a resistance element in the form of a resistance wire 29, this wire being extended thru and in contact with the explosive material of charges 28, and having its ends connected to the leads 18 so as to be in shunt with the fuse link 19. I also preferably enclose that portion of wire 29 extending between the charges 28, with a tube or sheath 31 of insulating material which loosely fits over the wire. A suitable sheath or tube of this character is commonly known as insulating "spaghetti".

In operating the fuse described above, assuming that an electrical circuit is connected to the contact members 11, in the event of a slight overload sufficient to melt fuse link 19, a relatively heavy current is bypassed thru resistance wire 29, so that this wire is heated sufficiently to ignite the explosion charges 28. In the event that wire 29 fuses within the tube or sheath 31, jets of incandescent material are ejected from the ends of this tube to ignite charges 28. The explosion caused by igniting these charges immediately blows out the closures 21 thru openings 14 in contact members 11, and these closures carry with them the lead conductors 18. Thus any arcing tending to occur between the inner ends of leads 18 is immediately broken when the leads are jerked apart. In all observed instances it has been found that both the explosive charges have been ignited to blow out both the end closures 21. However in the event that only one charge is ignited, the filler 25 will withstand the pressure of this explosion so that the closure 21 adjacent this charge will be expelled to withdraw its associated lead 18.

The apparatus shown in Fig. 4 is particularly adapted for use with the fuse described above, and makes possible automatic cutout of the fuse when the fuse blows. This apparatus consists of a suitable bracket 32 adapted to be clamped to a member 33 of a supporting structure, and serving in turn as a support for a pair of insulators 34 and 35. An arm 37 is mounted upon and extends from insulator 35, and is provided at its outer end with a bifurcated portion 38. Bifurcated portion 38 is formed to provide a journal 39 for a pivot pin 41. Member 42 is carried by pivot pin 41, and secured to this member 42 there is a clamp 43 adapted to be detachably secured to one end of the fuse 44. Mounted upon and extending from the other insulator 34, there is an arm 46 having an outer bifurcated portion 47. When in normal position the upper end of fuse 44 extends between the branches of bifurcated portion 47. Immediately above portion 47 there is a latch 48, which is pivotally connected to arm 46 by means of pivot pin 49. The lower face of latch 48 is provided with a pocket or recess 51 which receives the upper end of contact member 11 of the fuse, when the latch is in normal position. A spring pressed contact 52 is carried between the branches of bifurcated portion 47, so as to normally engage and make good electrical contact with the upper contact member 11 of the fuse. This contact member is shown connected to a bus conductor 53, by means of jumper 54. The lower contact member 11 of the fuse is likewise adapted to make electrical contact with a spring pressed contact 56, carried by arm 37. This contact 56 is connected to bus conductor 57 by means of flexible jumper 58. Normally contact 52 urges the upper end of fuse 44 outwardly, but the fuse is retained in operating position by latch 48. In case of an overload which will cause an explosion within the fuse as has been previously described, the force of the explosion blowing outwardly thru the upper contact member 11, lifts latch 48, and thus permits the fuse to swing downwardly in the position shown in dotted lines in this figure. Thus in the event of an overload the fuse is positively and automatically cut out from its associated electrical circuit.

I claim:

1. In an electrical fuse, a tubular member, conductor leads extending into the ends of said member, a fuse link connecting the inner ends of said leads, a filler of divided insulating material disposed within said member, means for connecting said leads and serving as closures for the ends of said member, and means for quickly withdrawing said leads from the tube in the event of an overload, said means comprising a plurality of charges of explosive material disposed within said member, a charge being located adjacent each closure, and means for simultaneously igniting said charges.

2. In an electrical fuse, a tubular member, conductor leads extending into the ends of said member, a fuse link connecting the inner ends of said leads, a filler of divided insulating material disposed within said member, means connected to said leads and serving as closures for the ends of said member, and means for quickly withdrawing the leads from said tubular member in the event of an overload, said means comprising a plurality of charges of explosive material disposed within said member, a charge being located adjacent each closure, and a resistance element forming a shunt path across said fuse link and serving as means to ignite said charges.

3. In an electrical fuse, a tubular member, conductor leads extending into said member from the ends thereof, a fuse link connecting the inner ends of said leads, a filler of divided insulating

material packed within said member, and means for quickly withdrawing said leads from said tubular member in the event of an overload, said means including a charge of explosive material disposed within said tubular member remote from said fuse link.

4. In an electrical fuse, a tubular member, conductor leads extending into said member from the ends thereof, a fuse link connecting the inner ends of said leads, a filler of divided insulating material packed within said member, and means for quickly withdrawing said leads from said member in the event of an overload, said means including a plurality of charges of explosive material disposed within said member adjacent both ends thereof and remote from said fuse link, and electrical means for automatically igniting said charges in the event of an overload.

5. In an electrical fuse, an outer tube, conductor leads extending into said tube from the ends thereof, closure members for the ends of said tube connected to said leads, a fuse link connecting the inner ends of said leads, a filler of divided insulating material packed within the tube about said link and the adjacent portions of said leads, a plurality of charges of explosive material disposed within the tube remote from said link, a charge being located adjacent each end of the tube, a resistance conductor in contact with said charges and connected in shunt with said link, and a second tube disposed about that portion of the resistance conductor extending between said charges, said last mentioned tube serving to direct the heat from said resistance conductor toward said explosive charges.

6. In an electrical fuse apparatus, a fuse tube, contact members mounted upon the ends of said tube, a fuse link disposed within the tube and connected to said contact members, explosive charges located in the end portions of said tube, means for effecting automatic ignition of said charges in the event of an overload, means for supporting said tube with its contacts connected with an electrical circuit, and means responsive to explosion of said charges for automatically disconnecting said contact members from said circuit.

7. In a fuse, a tube, contact members mounted upon the ends of said tubes, and a fuse refill assembly slidably insertable within said tube thru one end thereof, said assembly comprising a liner tube insertable within said first tube, conductor leads extending into said liner tube, a fuse link connecting the inner ends of said conductor, explosible charges disposed within the ends of the liner tube, a resistance element connected in shunt with said link and in contact with said charges, and a filler of divided insulating material packed within said liner tube.

8. In an electrical fuse, a tubular member, a conductor lead extending into one end of said member, a fuse link disposed within said member and having one end thereof connected to the inner end of said lead, means for making electrical connection to the other end of said fuse link, and means for quickly withdrawing said lead from said tubular member in the event of an overload, said means including a charge of explosive material disposed within said tubular member remote from said fuse link, and a resistance conductor connected in shunt with the fuse link for igniting said explosive material.

9. In an electrical fuse, a tubular member, a conductor lead extending into said member, a fuse link having one end thereof connected to the inner end of said lead, said link being disposed within said tubular member, means for making electrical connection with the other end of said fuse link, and means for quickly withdrawing said lead from said tubular member in the event of an overload, said means including a charge of explosive material disposed within said tubular member remote from the fuse link, a resistance conductor connected in shunt to the link and having one end thereof terminating adjacent said charge, and an insulating sheath surrounding said resistance conductor and likewise having one end thereof terminating adjacent said charge.

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