April 25, 1933. G. B. MANGAN 1,905,236

EXPULSION FUSE

Filed Sept. 15, 1931

Fig. 1.

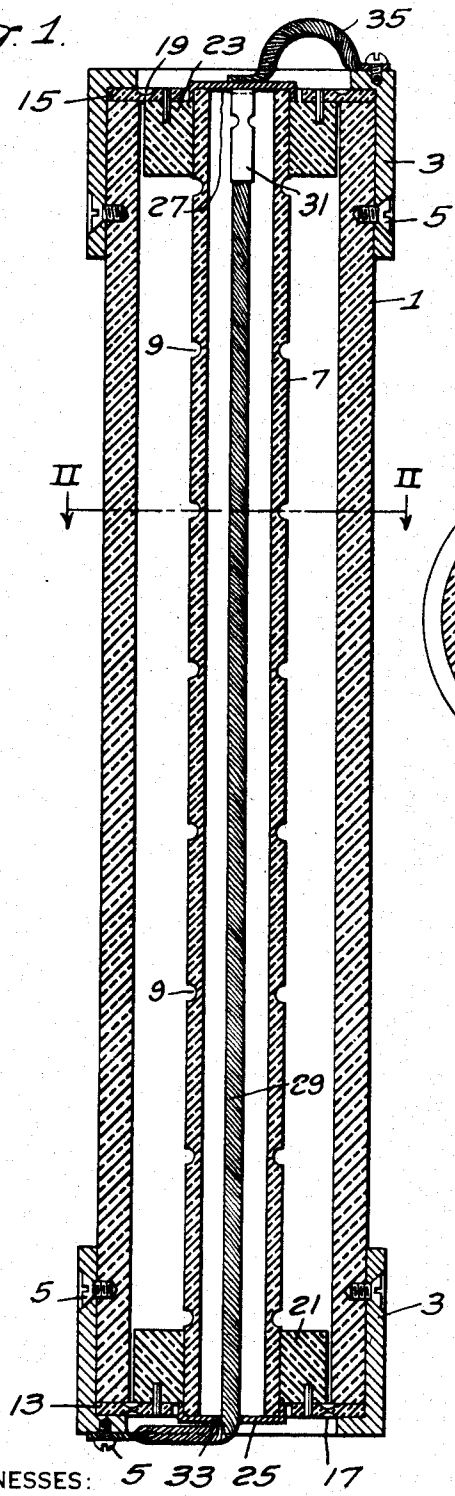


Fig. 2.

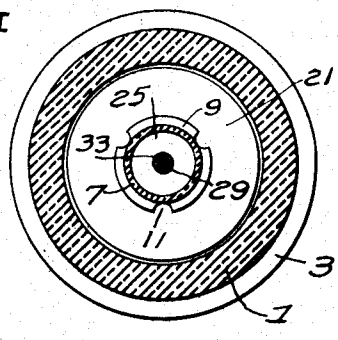
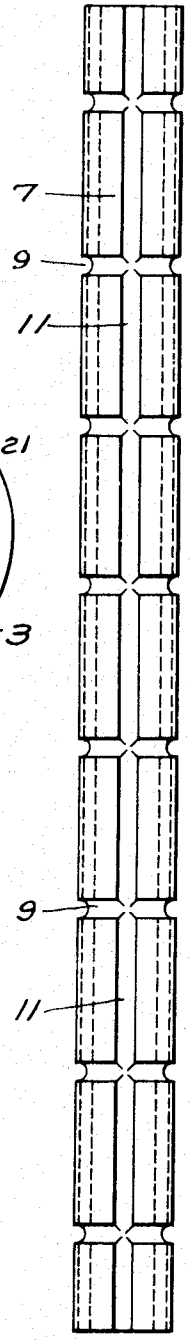


Fig. 3.



WITNESSES:

R. J. Fitzgerald

H. M. Cousseau

INVENTOR

George B. Mangan

BY

F. W. Lyle,

ATTORNEY

Patented Apr. 25, 1933

1,905,236

UNITED STATES PATENT OFFICE

GEORGE B. MANGAN, OF WASHINGTON, DISTRICT OF COLUMBIA, ASSIGNOR TO WESTINGHOUSE ELECTRIC & MANUFACTURING COMPANY, A CORPORATION OF PENNSYLVANIA

EXPULSION FUSE

Application filed September 15, 1931. Serial No. 562,842.

My invention relates to fuses, and particularly to fuses of the expulsion type wherein a fusible element in the form of a wire or strip is enclosed within an insulating container closed at both ends by means such as terminal members for the fuse. Such fuses are frequently employed to interrupt high tension circuits.

In order to confine an arc caused by ordinary overload currents in such a fuse to a small space, so that the pressure of the gases caused by the arc produce an expulsive action and thus assist in extinguishing it, and at the same time to provide sufficient space for the dissipation of the energy of the gases evolved when short-circuits occur, expulsion fuses are provided in which an inner container is disposed inside a large container of non-conducting material. Such an arrangement is adapted to partially confine the gases from an arc, produced by an ordinary overload to cause an expulsion of the gases to aid in extinguishing the arc quickly, while on short circuits the inner container is blown out of the outer container, thus giving a powerful expulsion action in the larger container for interrupting the short circuit arc.

However, overload currents vary, and in accordance with my invention an inner container is provided which confines the gases of arcs resulting from currents of less than a certain value so that a maximum expulsive action will be attained, while for larger currents, and in particular for short-circuit currents, the inner container is ruptured. By this expedient fuses of the sizes now effective for interrupting currents between certain limiting values may be safely utilized for covering a much wider range of current values, thus rendering it unnecessary to keep large stocks of fuses of different sizes, and ensuring efficient operation of a given fuse, both on extremely small, and on extremely large overloads.

In accordance with the above-described principles, it is an object of my invention to dissipate the energy of gases caused by an arc in a fuse in one step or in two or more progressive steps, depending upon the value of the current causing the arc.

It is another object of the invention to increase the space from which the gases generated by an arc in a fuse are expelled in one or more progressive steps, depending upon the magnitude of the current causing the arc.

A further object of my invention is to provide an expulsion fuse on which a given outer casing is adapted for use with fusible refills having a relatively large number of different capacities, thus reducing the number of different sizes of fuse casings required to be maintained in stock.

A further object of my invention is to provide an expulsion fuse wherein the fuse is provided with an insulating inner container which surrounds the fusible element and is designed to remain intact and withstand interior gas pressures generated by the arc within the tube under predetermined low current or moderate overload conditions, but which fractures under severe short-circuit currents, thereby facilitating interruption of the circuit under the last named condition.

A further object of the invention is to provide an expulsion fuse in which the mechanical strengths of the various parts increase in a predetermined order, so that throughout a wide range of current values it is insured that a gas pressure will be produced of sufficient magnitude within the fuse during the process of interruption to cause the certain extinction of arcs within the fuse.

Other objects and advantages of my invention will become apparent from the following description and drawing, wherein:

Figure 1 is a cross-sectional view of an expulsion fuse taken on its longitudinal axis and constructed in accordance with an embodiment of my invention;

Fig. 2 is a longitudinal sectional view of the expulsion fuse taken on line II—II of Fig. 1; and

Fig. 3 is an elevational view of the inner tube preferably utilized in the embodiment of my invention shown in Fig. 1.

In order to carry out the objects of my invention, an expulsion fuse is provided which essentially comprises an insulating

outer container provided with terminal members and closed ends which support an inner container also provided with caps or seals on its ends and in which a fusible element is contained. The mechanical strength of the closed ends, seals and inner container are so arranged that the gas pressures created by arcs of different current values, blow off or rupture one or another of the parts of the fuse in dependence upon the value of the current causing the arc. The gas pressure is, therefore, fixed at such a value as to cause maximum expulsion effect of the gases in extinguishing the arc, and the energy of the arc discharge is dissipated in progressive steps.

Referring specifically to the drawing for a detailed description of my invention, the fuse comprises a heavy insulating container 1 preferably of fiber, which is provided with terminal members 3 fastened to the container 1 by means of screws 5. An inner container 7 of insulating material provided with weakened radial sections 9 and longitudinal sections 11 is disposed within the outer container 1 and is held in place by washers 13 and 15 and gaskets 21 and 23 at each end of the container 1. The washers 13 and 15 are provided with weakened sections 17 and 19 at various points, the lower washer 13 being the weakest for a purpose hereinafter explained.

The washers 13 and 15 are disposed under the terminal members 3 and the fuse is refilled by detaching the terminal members 3 from the container 1 by means of screws 5 and placing another refill in the outer tube 1, and refastening the terminal members 3.

The inner container is provided with seals or caps 25 and 27 on the ends thereof. A flexible conductor 29 provided with a fusible element 31 is attached to one of the terminal members 3 of the main container 1 and is inserted through and engages frictionally with an aperture 33 in the lower cap 25 of the inner container 7. The fusible element 31 is fastened to the inside of the cap 27 on the inner container 7. A second flexible conductor 35 connects the upper cap 27 of the inner container 7 to a terminal 3 on the outer container 1, thus completing an electrical circuit between the terminals 3.

In order to cause a maximum expulsive action of gases for a given current in the arc and to dissipate the excess energy of the gases without permitting injury to the outer container 1 on short-circuit conditions, the various parts of the fuse vary in mechanical strength in a predetermined order. The degree of overload current controls the pressure of the gases set up in the inner container 7, and it is desirable to attain a maximum expulsive action on small overloads, as well as on large overload currents, and yet to release gas pressure under short-circuit conditions as quickly as possible and in a sufficient number of steps to dissipate substantially all of the energy of the gases before the inner walls of the container 1 are injured.

The mechanical strengths of the various elements of the fuse are, therefore, so proportioned as to rupture or break in a predetermined order so that the gases may escape from predetermined areas, depending upon the current causing the arc. In the preferred embodiment of my invention, the fastening of lower cap 25 on the inner container 7 is the weakest mechanically, and is blown off when the fusible element 31 melts under small overload currents. When the cap 25 is blown off, it pulls the flexible conductor 29 partly out of the inner container 7, thus stretching the arc in an atmosphere of high pressure gases whereby the arc is quickly extinguished.

The fastening of the cap 27 at the upper end of the inner container 7 is next in order of mechanical strength, and on higher overload currents which melt the fusible element 31 and create an arc, both the upper and lower caps 25 and 27 on the inner container 7 are blown off, resulting in the escape of gases from both ends of the container. The flexible conductor 29 is pulled at least partly out of the container 7, thus stretching the arc in an atmosphere of high pressure gases whereby the arc is quickly extinguished. The flexible conductor 35 connecting the terminal member 3 on the outer container 1 and the cap 27 on the inner tube 7 allows the cap 27 to be blown off.

The inner tube 7 weakened at the grooves 9 and 11 is the next in order of mechanical strength. The weakened sections 17 of the lower washer 13 and then the weakened sections 19 of the upper washer 15 follow in order of mechanical strength, and the outer container 1 is the strongest.

On very high currents, such as short-circuit currents, the gases will be released quickly enough to substantially extinguish the arc. The upper and lower caps 27 and 25 respectively on the inner container 7 will be first blown off when the fusible element 31 is melted, the conductor 29 will be pulled out of the container 7, thus stretching the arc and assisting in extinguishing it. The inner tube 7 then is ruptured at the weakened sections 9 and 11, and the lower and upper washers 15 and 13 and gaskets 23 and 21 respectively blow out, thus giving the full effectiveness of the openings at both ends of the main container, and since most of the energy of the gases is dissipated, the outer container 1 is not injured. Since the lower washer 13 is slightly less in mechanical strength than the upper washer 15, it blows out first, thus allowing the broken inner container 7 to be ejected from the bottom of the fuse.

From the foregoing description, it will be

readily seen that I have provided a fuse which has a wide range of interrupting capacities and which interrupts currents in from one to more than one progressive steps, depending on the arc current. It will also be apparent that I have provided a fuse which will extinguish the arc and dissipate most of the energy of gases produced within the fuse by short-circuits before the main outer container of the fuse is injured, thus allowing the outer container to be used repeatedly with new refills. It will also be seen that the gases set up by different overload currents in each instance are confined at the high pressures which are most effective in assisting arc extinction and that these gases also provide the necessary force for separating the ends of the members between which the arc is established, whereby the arc is quickly stretched and extinguished by the expulsive action of the high pressure gases.

Although I have shown and described a specific embodiment of my invention, it is understood that modifications and changes may be made by those skilled in the art without departing from the spirit and scope of the appended claims.

I claim as my invention:

1. The combination with an expulsion fuse having an insulating outer casing and a fuse element therein adapted to rupture under a predetermined current value, of an insulating inner container having closed ends, the fastening of one of the ends being weaker than that of the other end, said inner container being provided with weakened side-wall portions stronger than the fastening of said ends, said inner container being held in said outer casing by fastenings which are stronger than said weakened portions of said inner container.

2. In a circuit interrupter, means responsive to current conditions for causing an arc, means for confining the gases caused by said arc comprising a pair of containers closed at both ends, one of which is placed within the other, and weakened means for so holding said inner container, said inner container and holding means being proportioned so that one end of said inner container blows off on arcs of predetermined current values, and both ends of said inner container blow off on arcs of higher predetermined current values, and said container and said holding means rupture on arcs of still higher predetermined current values.

3. A double container expulsion fuse comprising a pair of tubular members, one of which is positioned within the other, an upper and lower seal on said inner member, said inner member being provided with weakened wall portions, an upper and lower means for closing said outer member and holding said inner member in place, the mechanical strength of the various elements of said fuse varying from the weakest to strongest in the progressive order of the lower seal on said inner member, the upper seal of said inner member, said weakened wall-portions on said inner member, the lower seal on said outer member, the upper seal on said outer member, and said outer member.

4. A double end expulsion fuse comprising a fusible element, a pair of tubular members, one of which is positioned within the others, an upper and lower seal on said inner member, and an upper and lower means for closing said outer member, and means for expelling gases set up by an arc generated by the melting of said fusible element through openings, the area of which varies in more than two steps in accordance with the current causing said arc.

5. In a circuit interrupter, a fusible element responsive to current conditions for causing an arc, means for confining the gases caused by said arc, comprising a pair of containers closed on both ends, one of which is placed inside the other, means for holding said inner container therein, said outer container being provided with terminals adapted for connection with a source of electrical energy, a flexible conductor attached to said fusible conductor and extending through and engaging with one of said closures on said inner container and extending to one of said terminal members, said fusible conductor being also connected with a second closure on the inner tube, and a second flexible conductor connecting said second closure to the other terminal members.

6. A double container expulsion fuse comprising a pair of tubular members, one of which is positioned within the other, end closing means on said inner member, and on said outer member, the mechanical strength of said closing means and inner and outer members being varied in a predetermined order.

In testimony whereof, I have hereunto subscribed my name this 4th day of September 1931.

GEORGE B. MANGAN.