Sept. 28, 1937. G. L. HILL 2,094,012

HIGH TENSION FUSE

Original Filed July 9, 1928 3 Sheets-Sheet 1

Fig. 1.

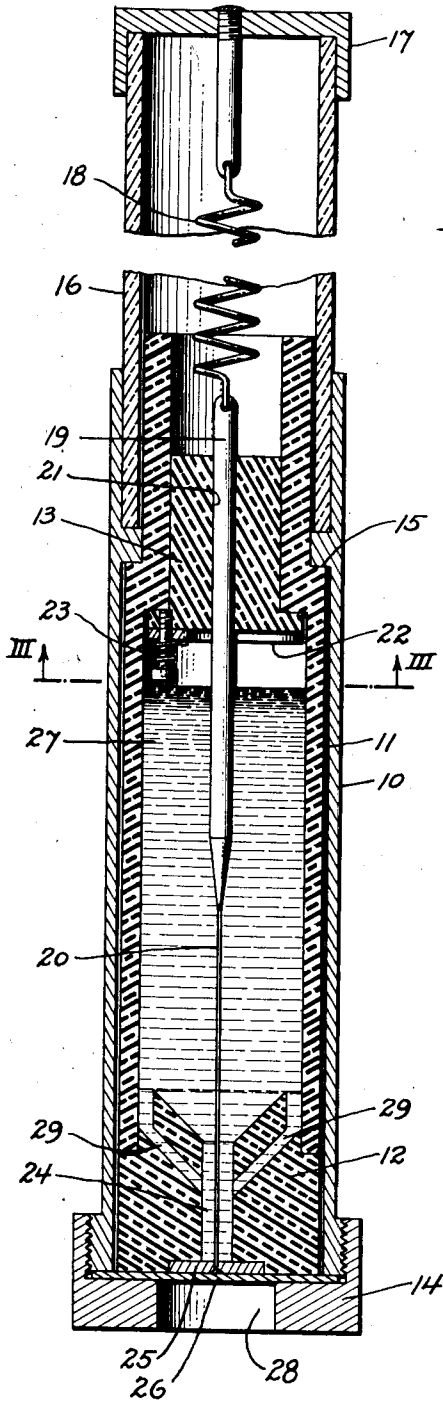


Fig. 3.

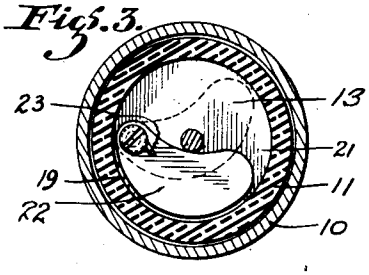
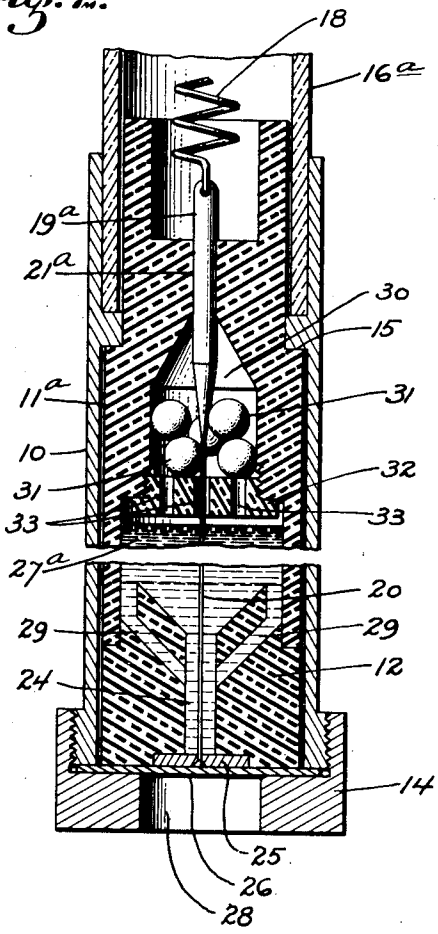


Fig. 2.



INVENTOR.
George Leslie Hill.
BY
Townsend, Lapture & Abbett
ATTORNEYS.

Sept. 28, 1937. G. L. HILL 2,094,012

HIGH TENSION FUSE

Original Filed July 9, 1928 3 Sheets-Sheet 2

Fig. 4.

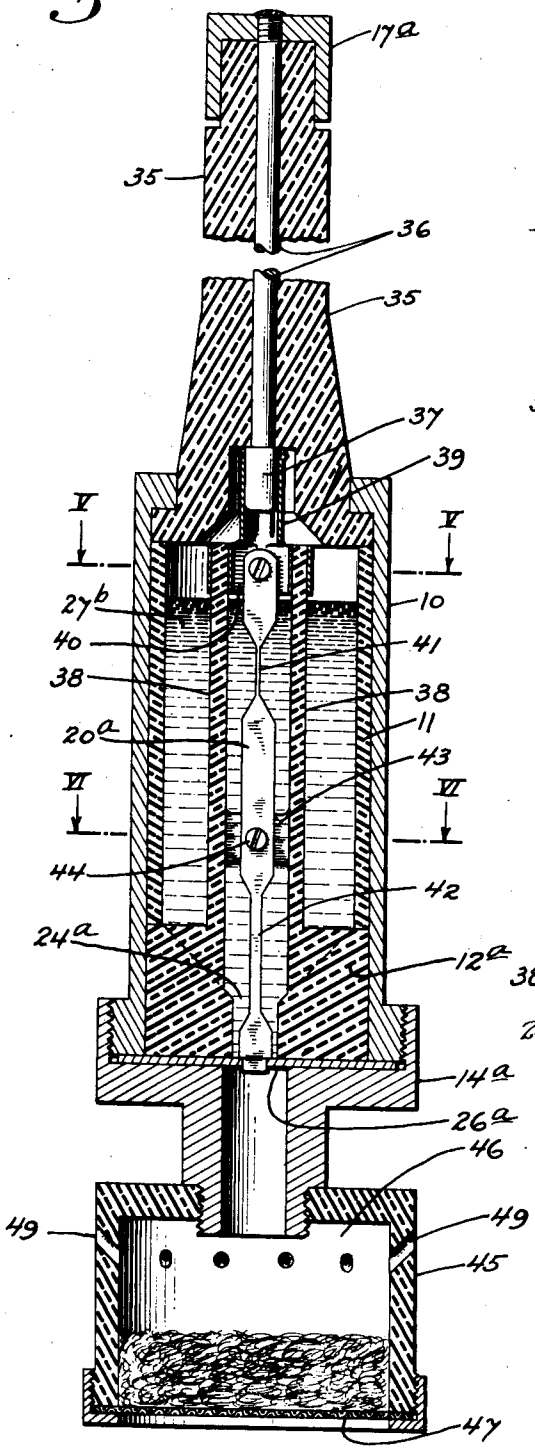


Fig. 5.

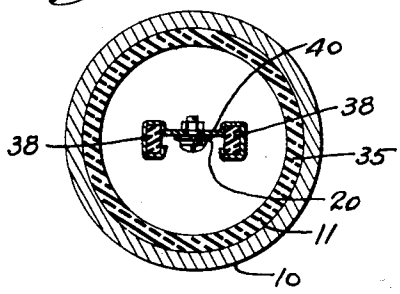
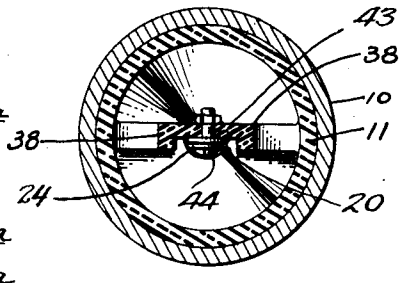


Fig. 6.



INVENTOR.
George Leslie Hill.
BY
Townsend, Lofton & Abbott
ATTORNEYS.

Sept. 28, 1937. G. L. HILL 2,094,012

HIGH TENSION FUSE

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Fig. 7.

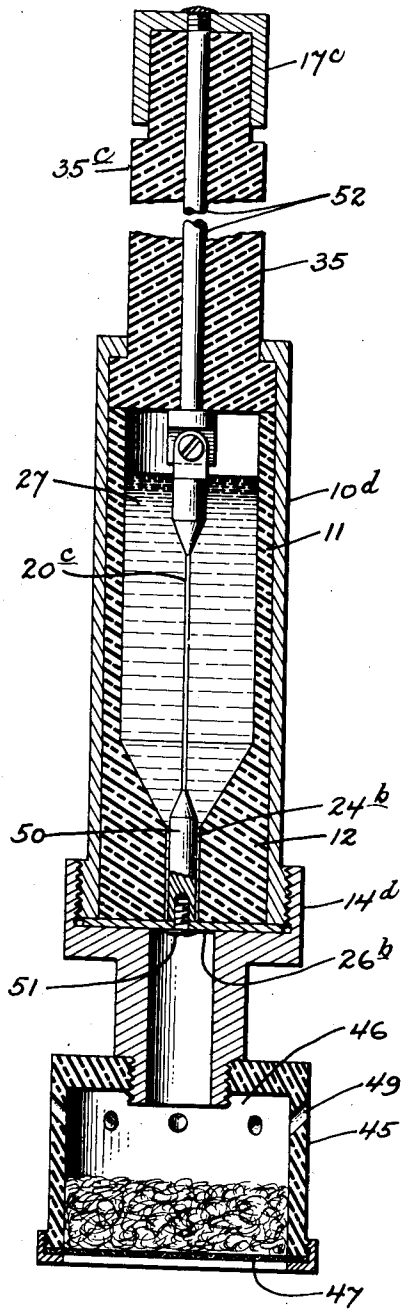


Fig. 9.

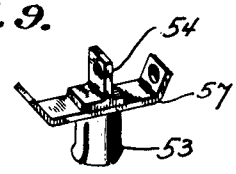
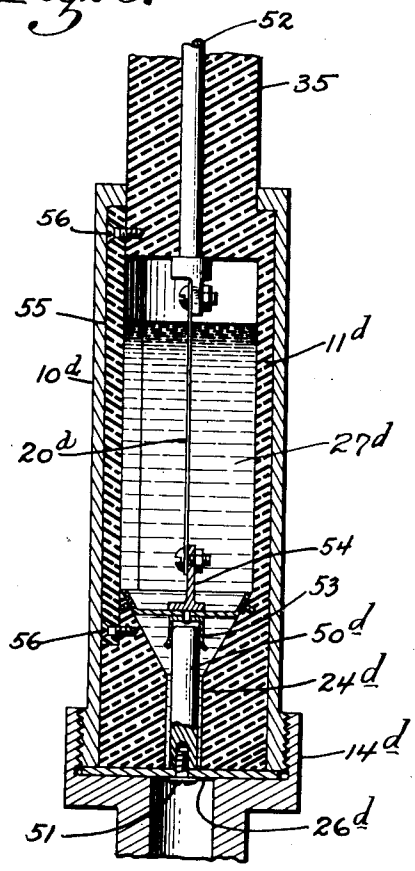


Fig. 8.



INVENTOR.
George Leslie Hill.
BY
Townsend Lofton & Hall
ATTORNEYS.

Patented Sept. 28, 1937 2,094,012

UNITED STATES PATENT OFFICE

2,094,012

HIGH TENSION FUSE

George Leslie Hill, Oakland, Calif.

Application July 9, 1928, Serial No. 291,214
Renewed September 19, 1934

56 Claims. (Cl. 200—120)

My present invention relates to high tension electric cut-outs and more particularly to fuses of the so-called expulsion type.

An object of my invention is to produce an improved form of high tension fuse which will readily interrupt the circuit upon the occurrence of an excessive overload or the like and efficiently extinguish any arc established during the operation.

Another object of my invention is to provide a fuse of the above type with arc extinguishing features which will operate positively and efficiently without danger to the fuse supporting structure.

A further object of my invention is to provide in a fuse of the above character, means whereby the arc when established by reason of interruption of the circuit by the fuse, will be drawn into a zone under the direct action of an arc extinguishing substance and be blown out thereby.

Another object of my invention is to provide in a fuse of the above type an arrangement whereby the arc extinguishing substance will not only function to extinguish any arc established but will also function to force the adjacent ends of the fuse apart to thereby draw out the arc during the extinguishing period.

A further object of my invention is to provide an arrangement whereby a tube of glass or other fragile material may be used as a portion of the fuse body without being subjected to internal pressures and fracture, as is the case with fuses of this type now on the market.

Another object of my invention is to provide in a fuse of the above character, means whereby any arc established by the fuse will be retained in a reinforced compartment in the presence of an arc extinguishing substance.

Other objects and advantages will be obvious to those skilled in the art and others will be hereinafter more specifically pointed out.

For the purpose of illustrating my invention, I have in the accompanying drawings illustrated several embodiments of my invention, but it should be understood that these drawings are to be taken as illustrating rather than limiting my invention.

In these drawings—

Figures 1 and 2 are sectional views of preferred embodiments of my invention,

Figure 3 is a plan view taken along line III—III of Figure 1, looking in the direction of arrows,

Figure 4 is a sectional view of a modified fuse embodying the features of my invention,

Figure 5 is a sectional view of the fuse shown in Figure 4 taken along line V—V of Figure 4, looking in the direction of arrows,

Figure 6 is a view similar to Figure 5 taken along line VI—VI of Figure 4,

Figures 7 and 8 show further modifications of my invention in section, Figure 8 being a fragmentary view, and

Figure 9 is a perspective view of a detail of the fuse shown in Figure 8.

In the drawings I show several distinct embodiments of my invention and for the purpose of explanation I shall discuss my invention separately in connection with each sheet of the drawings, it being understood that like numerals throughout the several views refer to like parts.

In the drawings, 10 designates a tubular metallic member which forms a reinforcing housing about what I shall term the expulsion chamber of my fuse. This expulsion chamber is formed in the fuse shown in Figure 1 by an insulating lining 11, an end member 12 at the bottom thereof and a partition 13 at the top thereof. The member 12 is provided with shoulders which engage the member 11 to form a seal therebetween. A cap or ferrule 14 is screw-threaded upon the tubular reinforcing member 10 and exerts pressure upon the members 11 and 12 in cooperation with an annular boss 15 carried by the member 10 which holds them tightly together. The member 11 is reduced in diameter at its upper end where it projects beyond the boss 15 and forms, in conjunction with a similar upward projection upon the member 10, a seat for a glass tube 16. Upon the other end of the tube 16 there is mounted a second ferrule or contact 17. Connected to the inside of the ferrule 17 I show a spring 18 which is adapted when elongated to operate within the glass tube 16 and separate the ends of the fuse when the latter is broken by an excessive current. The spring 18 is shown as secured to a member 19 which forms an enlargement upon the end of a fuse 20. The member 19 projects through a central opening 21 in the partition 13 and through which it will be drawn when the spring 18 collapses. Adjacent the opening 21 through which the member 19 projects I provide a baffle 22 which is biased by means of a spring 23 into a position where it will close the opening 21 when the member 19 is withdrawn through the partition 13. The lower end of the fuse 20 projects through a central opening 24 in the member 12 and is secured to a member 25 in intimate contact with a fragile disk 26. These parts may or may not be soldered

together, the only requirement being that they be in good electrical contact. The part **25** may also be eliminated where the fragile disk is sufficiently strong to withstand the tension occasioned by the spring **18** upon the fuse. The fragile disk **26** is of such diameter that it will be clamped between the member **10** and the ferrule or cap **14** and thus establish an electric circuit between the fuse and this ferrule.

The disk **26**, in addition to providing a circuit from the fuse **20** to the ferrule **14**, also provides a seal at this end of the fuse and thus functions to hold within the expulsion chamber a suitable arc extinguishing substance which I have designated in the drawings by the numeral **27**. The ferrule **14** is provided with a central opening **28** below the fragile disk **26** which is somewhat larger than the opening **24** in the member **12** and the member **25** so that when pressure is exerted upon the fragile diaphragm **26** by reason of pressures created within the expulsion chamber because of vaporization of the arc extinguishing substance **27**, it will rupture and permit the member **25** and the lower end of the fuse **20** to be blown outwardly and thus draw the arc down into the opening **24** and under the direct action of the arc extinguishing substance as it is discharged from the expulsion chamber.

The opening **24** in the member **12** is shown as provided with a widely tapering inlet and adjacent thereto and terminating midway the ends of the opening **24**, I show a plurality of other openings or conduits **29** which serve to direct the arc extinguishing substance in its discharge from the expulsion chamber against any arc which may be established and drawn into the opening **24**.

It should be pointed out here as one of the important points of my invention that the opening **24** in the member **12** forms what might be termed an orifice through which it will be seen that the arc when established must pass in order to maintain itself in connection with the opposite side of the circuit. This is because the ferrule **14** will form one terminal of the circuit and the member **19**, as long as it remains in the expulsion chamber, will form the other terminal, the arc under these conditions having to pass through the orifice **24**. As a result of the arrangement shown with the arc extinguishing substance within the expulsion chamber a condition is set up whereby the substance **27** in its discharge from the expulsion chamber will flow out through the orifice in direct opposition to the arc and interrupt and blow the arc out through the orifice in an efficient and effective manner.

In Figure 3, the baffle **22** is shown as biased against the member **19** by the spring **23** and from this view it will be seen that when the member **19** is withdrawn from the hole **21** the baffle **22** will be immediately moved over to the position illustrated in this view of the drawings by dotted line, where it will completely close the opening **21** and thus prevent the exit of any arc extinguishing substance from the expulsion chamber into the glass tube **16**. This will insure against the fracture of the glass tube **16**, due to internal pressures and also prevent its discoloration by the carbonized arc extinguishing substance. It will also insure that the full pressure of the expanding substance **27** will be exerted against the diaphragm **26**.

The fuse partially illustrated in Figure 2 embodies all of the characteristics of the fuse illustrated in Figure 1 with the exception of the baffle **22**. In this fuse the lining member **11***a* is modified so as to completely close the top of the expulsion chamber except for the opening **21***a*. It is further provided with a chamber **30** in which is arranged a plurality of balls **31** of insulating material. In the drawing five such balls are shown. The balls **31** are held in the chamber **30** by means of a closure member **32** having provided a plurality of openings **33** which function to permit the arc extinguishing substance when under pressure to enter the chamber **30** so that when the circuit is interrupted, the pressure exerted from within the expulsion chamber will force the balls **31** upwardly where one of them will close the opening **21***a* as soon as the member **19***a* is withdrawn therefrom.

As a result of this construction, it will be seen that the pressures exerted by the arc extinguishing substance **27***a* will not only in this case serve to separate the fuse ends and extinguish the arc, but will also function to seal the opening **21***a* against the escape of any arc extinguishing substance into the glass tube **16***a*. The check valves **21** and **31** are primarily employed in conjunction with the glass tubes shown at **16** or **16***a* to prevent the gases generated during the blowing of the fuse from entering the tubes. These gases, when generated, are under a comparatively high pressure and might cause breakage of the glass tubes. In some instances where a tube, such as indicated at **16** or **16***a* are sufficiently strong the check valves may be omitted.

The refill or renewable cartridge composed of the members **11**, **12**, **13**, **20**, **21**, **25**, **26** and the substance **27** with which the cartridge is filled, see Fig. 1, and the members **11***a*, **12***a*, **20***a*, **21***a*, **25**, **26** and the substance **27***a*, see Fig. 2, when assembled forms a refill or renewable cartridge for insertion into the end member **10** of the fuse tube or housing **16** by the mere removal of the ferrule **14**. This is obviously more economical than renewing the whole device after it has operated from an overcurrent and has the advantage that refill units of various current ratings may be inserted into the main fuse tube **16** as desired.

Referring now to the modification illustrated on Sheet 2 of the drawings and identified as Figure 4, it will be seen that the glass tube portion **16** and the functions incidental to the spring **18** are omitted. This particular structure of the present fuse comprises an insulating body member **35** which carries the cap or ferrule **17***a*. Extending through the member **35** is a stud **36** upon the end of which is formed a suitable contact making head **37**. It will also be seen that the member **12***a* is modified so as to provide supporting means for the fuse within the expulsion chamber. This modification of the member **12***a* contemplates the provision of two upstanding and parallel supports **38** which extend substantially to the top of the expulsion chamber. At the upper ends of these supports **38** there is provided a metallic connector clip **39** adapted to slidably engage the contact head **37** upon the stud **36**. This connector clip **39** is provided with means for securing it to the ends of the supports **38** and has a web **40** therebetween to which the fuse **20***a* is attached. The fuse **20***a* in this particular embodiment is shown as having two reduced portions, one portion **41** at the upper end thereof which is adapted to fuse under an excessive current flow and a second portion **42** at a point adjacent the opening or orifice **24***a* which is adapted to break under the combined fusing

and the stretching action caused by the expansion of the arc extinguishing substance **27***b* within the expulsion chamber when the fusible portion **41** is fused and the diaphragm **26***a* ruptures. In order to provide for tension upon the fused portion **42** when the fusible portion **41** is fused, I provide a web **43** of insulating material between the members **38** and secure the fuse thereto by means of a screw **44**.

As an additional feature of invention I have shown in connection with this fuse a means for catching the molten metallic parts blown out of the fuse when it operates. This means comprises a suitable housing member **45** which is secured to the ferrule **14***a* by any suitable means and provides a chamber **46** in communication with the orifice **24***a*. The housing **45** is provided across its lower face with a closure means of metallic screen **47** and within the housing so formed and resting on the screen **47** I contemplate providing a quantity of metallic wool. This arrangement will insure against the escape of metallic particles from the fuse to the surrounding atmosphere and the metallic wool will also act to rapidly cool any gases and any other material which may escape therethrough. As an additional means of venting the chamber **46** there may also be provided suitable openings **49** at the upper part of the chamber. Obviously the housing member **45** is of any suitable material which will not be adversely affected by the molten metal from the fuse and at the same time will dissipate heat rapidly. Like the screen **47** the housing is preferably made of metal.

The operation of this embodiment of my invention is as follows: When the fuse is subjected to an excessive current, the fusible portion **41** of the fuse will burn away. This will create an explosion in the expulsion chamber, and as a result, the diaphragm **26***a* will be ruptured and thus impose upon the weakened portion **42** of the fuse a tension which will cause it to also break. The breaking of the portion **42** will, as will be evident, establish a second arc in the lower part of the expulsion chamber and within the zone of the orifice **24***a* where it will be readily blown out and extinguished as previously described in connection with the modifications illustrated in Figures 1 and 2.

After a fuse of this type has operated to open the circuit, the problem of re-fusing can be conveniently carried out by removing the ferrule **14***a* which will permit the withdrawal of the member **12***a* together with its fuse supporting members **38** so that the fuse together with a new diaphragm **26***a* may be conveniently mounted thereupon and reinserted in its operative position.

On Sheet 3 of the drawings I illustrate two additional modifications of my invention. The modification identified as Figure 7 differs from the previous modification in that the fuse element has a single reduced portion. This fuse is provided with the housing **45** and its metallic wool and screen outlet. At the point where the fuse extends through the orifice **24***b*, the fuse is provided with an enlarged cylindrical head **50** which substantially fills the orifice **24***b* and functions in much the same manner as would a piston when pressure is exerted from within the expulsion chamber by reason of a fusing of the fuse. This insures a more or less violent discharge of the arc extinguishing substance when the fuse breaks, which not only discharges the member **50**, but by reason of the delay in the complete opening of the orifice **24***b* a pressure is built up in the chamber so that any arc established within the orifice will be subjected to a rapid flow of arc extinguishing substance out of the expulsion chamber. The diaphragm **26***b* in this case is secured to the member **50** by means of a screw **51**. The upper end of the fuse **20***c* is secured in the usual manner to a stud **52** extending through the member **35***c* and connecting with the ferrule **17***c*. The modification illustrated in Figure 8 is constructed in substantially the same manner as the modification illustrated in Figure 7 with the exception that the plug member **50***d* in this case is made as a separate unit from the fuse and connects with a suitable clip **53** connected to a terminal member **54** upon which the fuse **20***d* is mounted. A fuse constructed in accordance with this embodiment of my invention possesses the characteristics of the modification illustrated in Figure 4 in that a second arc is established in the zone of the orifice **24***d* where it will come under the direct arc extinguishing action of the arc extinguishing substance **27***d*. When the fuse **20***d* interrupts the circuit, a pressure will be set up within the expulsion chamber and, as a result, the member **50***d* will be blown out through the orifice **24***d* and out of contact with the clip **53** so that a second arc will be established at this point. The member **50***d* in this case is also secured to the diaphragm **26***d* by means of a screw **51**.

In order to renew the fuses of these latter modifications, it is only necessary to remove the ferrule **14***d* and then by sliding the housing member **10***d* upwardly, the upper terminal or fuse support will be exposed so that a fuse can be readily applied.

In the modification illustrated in Figure 8, the expulsion chamber lining element **11***d* is shown as in one piece and having a closure member **55** in one side thereof so as to permit access to the interior for the purpose of renewing the fuse. This member **55** is secured in place by means of screws **56**.

In Figure 9 of the drawings I have shown in perspective a detail view of the clip **53** and fuse terminal **54**. As here shown, these members are supported on a bracket member **57** which is flared at the ends so as to fit within the conical portion of the aperture **24***d* where it is secured by any suitable means.

In the drawings, for the purpose of simplifying the same and to prevent confusion, I have shown the expulsion chamber as only partially filled with an arc extinguishing substance, but I desire to have it understood that I contemplate a complete filling of the fuse of any modification of my invention in some instances, and in this connection attention is directed particularly to the modifications illustrated in Figures 1 and 2, wherein the glass tube **16** forms a part of the fuse. When fuses of this type are used on high voltage circuits, it will be found desirable, if not necessary, to completely fill the fuse so that the glass tubular portion **16** will then also contain the arc extinguishing substance **27**. When the fuse is so filled with the substance **27**, it will be found necessary to cement the glass tube into the shell **10** so as to prevent leakage of the substance, it being understood that the cap **17** at the upper end thereof will be also similarly cemented. I desire also to point out the fact that when the fuse is completely filled with an arc extinguishing substance in this fashion it will operate with equal satisfaction in either the vertical or horizontal position or, in fact, at any particular angle and,

while I have shown the preferred form of my invention as now known to me, it is to be understood that various changes may be made in its construction without departing from the spirit of the invention as defined in the appended claims.

Having thus described my invention, what I claim and desire to secure by Letters Patent is—

1. In a fuse device of the expulsion type, the combination of a fuse supporting body having a closed compartment at one end thereof terminating in a discharge orifice of small area, said compartment adapted to contain an arc extinguishing substance, a fusible element located within said closed compartment and extending through said orifice, a fragile diaphragm forming a closure for said orifice and adapted to be ruptured by pressure exerted from within said compartment due to the fusing of the fusible element, and means whereby the corresponding end of the fuse together with said substance will be blown out through said orifice when said diaphragm is ruptured, whereby any arc established will be drawn out and extinguished by said substance in its discharge from said compartment.

2. In a fuse device of the expulsion type, a fuse supporting body member having a closed compartment at one end thereof adapted to contain an arc extinguishing substance, a fuse located within said compartment and submerged in said substance, a fragile diaphragm at one end of said compartment adapted to be ruptured by pressure exerted from within said compartment, a pressure resisting end member interposed between said compartment and said diaphragm and having a discharge orifice formed therein through which the fuse extends, and means whereby the corresponding end of the fuse will be pulled out through said orifice as said diaphragm is ruptured to draw the arc into said orifice where it is extinguished by the arc extinguishing substance in its discharge from said compartment.

3. In a fuse device of the expulsion type, a fuse supporting member having terminals at the ends thereof, a fuse extending between said terminals having a fusible portion located near one end thereof, a closed compartment formed within the fuse supporting member and adapted to contain an arc extinguishing substance and enclose the fusible portion of said fuse, said compartment terminating in a discharge orifice through which the fuse extends, a fragile diaphragm adapted to be ruptured by pressure exerted from within said compartment and permit the corresponding end of the fusible element to be pulled out of said orifice whereby any arc established within the compartment will be brought under the direct action of said arc extinguishing substance in its discharge from said compartment.

4. In a high tension fuse of the expulsion type, the combination of a relatively long body member of insulating material having a reinforced expulsion chamber at one end thereof adapted to contain an arc extinguishing substance, a dividing partition between said expulsion chamber and the remainder of said body member, a fuse supported within said body member projecting through an opening in said partition and having a fusible portion located within said expulsion chamber, means for withdrawing the end of said fuse from said expulsion chamber through said partition when the fusible portion is fused, and means for closing the opening through said partition whereby the escape of arc extinguishing substance from said expulsion chamber through the partition will be prevented.

5. In a high tension fuse of the expulsion type, the combination of a relatively long body member of insulating material having a metallically reinforced expulsion chamber at one end thereof adapted to contain an arc extinguishing substance, a dividing partition between said expulsion chamber and the remainder of said body member, a fuse supported within said body member projecting through said partition and having a fusible portion located within said expulsion chamber, means for withdrawing the end of said fuse from said compartment through said partition when the fusible portion is fused, and means for closing the opening through said partition whereby the escape of arc extinguishing substance from said expulsion chamber through the partition will be prevented.

6. In a high tension fuse of the expulsion type, the combination of a relatively long body member of insulating material having a reinforced expulsion chamber at one end thereof adapted to contain an arc extinguishing substance, a fusible conductor mounted within said expulsion chamber adapted to be fused by a predetermined current, a fragile diaphragm adapted to be connected to one of the terminals of the fuse element and be ruptured by pressure exerted from within said expulsion chamber, and means for connecting said diaphragm with said fuse adapted to be blown out of connection therewith when said diaphragm is ruptured to thereby draw any arc established under the direct action of said arc extinguishing substance in its discharge from said compartment.

7. In a fuse device of the expulsion type, the combination of a fuse supporting body having a closed compartment adapted to contain an arc extinguishing substance, said compartment terminating in a discharge orifice, a fusible element located within said closed compartment with said arc extinguishing substance and extending through said orifice, a fragile diaphragm forming a closure for said orifice and adapted to be ruptured by pressure exerted from within said compartment due to the fusing of the fusible element, and means whereby the corresponding end of the fuse together with at least a portion of said arc extinguishing substance will be blown out of said compartment and through said orifice, when said diaphragm is ruptured, whereby any arc established will be drawn out and extinguished by said substance in its discharge from said compartment.

8. In a fuse device of the expulsion type, a fuse supporting member having terminals at the ends thereof, a fuse extending between said terminals having a fusible portion, a closed compartment adapted to contain an arc extinguishing substance and enclose the fusible portion of said fuse, a fragile diaphragm at one end of said compartment adapted to be ruptured by pressure exerted from within said compartment to permit the corresponding end of the fuse element to be blown out of said compartment, and a plurality of radially arranged diverging conduits through which said arc extinguishing substance may exit to discharge said substance in a diverging manner upon any arc established when said fuse is blown out of said compartment, whereby any arc established will be brought under the direct action of said arc extinguishing substance in its discharge from said compartment.

9. In a fuse device, a fusible element, and

means operable by pressure generated by fusion of said element to cause a stream of arc extinguishing substance to play upon an arc caused by said fusion, at an angle to cause extinction of said arc.

10. In a fuse device, a hollow member forming a chamber, a fusible element and an arc extinguishing substance within said chamber, means operable by pressure generated by fusion of said element to expel automatically one end of said fusible element from said chamber and to direct a stream of said arc extinguishing substance onto an arc formed by said fusion, as the arc is drawn out by movement of said one end of said fusible element, said stream being directed thereupon and in a direction to cause a rapid extinction of said arc.

11. In a fuse device, a fusible element, a closed compartment adapted to contain an arc extinguishing substance, and means operable by pressure generated by fusion of said element to force the arc extinguishing substance into the arc stream at an angle and aid in the extinction of said arc.

12. In a fuse device, a fusible element, and means operable by pressure generated by fusion of said element to cause a stream of arc extinguishing substance to play at an angle upon an arc caused by the fusion of said element thereby aiding in the extinction of said arc.

13. In a fuse device of the character described having a compartment formed therein and a discharge orifice in communication therewith, a fuse in the compartment, an arc extinguishing substance in the compartment, and angularly disposed passages formed in the device connected with the discharge orifice at one end and with the compartment at the other end whereby when the fuse blows an arc extinguishing substance is directed under pressure at an angle into the discharge orifice.

14. In a fuse device of the character described having a compartment formed therein and a discharge orifice in communication therewith, a fuse in the compartment, an arc extinguishing substance in the compartment, and passages formed in the device parallel to the compartment and connected at their upper ends with the compartment, said passages being angularly disposed at their lower ends and communicating with the discharge orifice whereby when the fuse blows the arc extinguishing substance is directed under pressure and at an angle into the discharge orifice.

15. In a fuse device of the character described having a compartment formed therein, a member in the compartment consisting of insulating material, said member having a compartment formed therein terminating in a discharge orifice, a fuse within the compartment, an arc extinguishing substance in the compartment, and a passage formed in the member and parallel to the chamber, said passage being in communication with the compartment at its upper end and the lower end of the passage being angular and adapted to direct the arc extinguishing substance to a point to play upon an arc caused by the blowing of the fuse.

16. A fuse device of the character described having a compartment formed therein adapted to contain a member constricted of insulating material, said member having a compartment formed therein terminating in a discharge orifice and said member having a passage formed therein and offset with relation to the discharge orifice, said passage being connected with the discharge orifice on an angle.

17. In a high tension fuse of the expulsion type, the combination of a relatively long body member of insulating material having an expulsion chamber at one end thereof adapted to contain an arc extinguishing substance, a dividing partition between said expulsion chamber and the remainder of said body member, a fuse supported within said body member projecting through an opening in said partition and having a fusible portion located within said expulsion chamber, means for withdrawing the end of said fuse from said compartment through said partition when the fusible portion is fused, and a valve for closing the opening through said partition whereby the escape of the arc extinguishing substance from said expulsion chamber through the partition will be prevented.

18. In a high tension fuse of the expulsion type, the combination of a relatively long body member of insulating material having an expulsion chamber at one end thereof adapted to contain an arc extinguishing substance, a dividing partition between said expulsion chamber and the remainder of said body member, a fuse supported within said body member projecting through an opening in said partition and having a fusible portion located within said expulsion chamber, means for withdrawing the end of said fuse from said compartment through said partition when the fusible portion is fused, and a ball check valve adjacent the opening in said partition, said valve adapted to automatically close when pressure is generated and thereby prevent escape of the arc extinguishing medium and gases from the expulsion chamber through the partition.

19. In a fuse device a renewable cartridge for insertion in a supporting housing, said cartridge containing a fusible element, and means operable by pressure generated by fusion of said element to cause a stream of arc extinguishing substance to play at an angle on an arc in said cartridge.

20. In a fuse device, a tube having metal end ferrules, one ferrule adapted to permit insertion of a renewable cartridge, a fragile member closing one end of said cartridge, a conducting plunger extending through the opposite end of said cartridge and connected to a fuse element in the cartridge, and tension means connected with the plunger.

21. In a fuse device, a tube having metal end ferrules, one ferrule being removable to permit insertion of a renewable cartridge, a fragile member closing one end of said cartridge, a conducting plunger extending through the opposite end of said cartridge and connected to a fuse element in the cartridge, tension means connected with the plunger, and an arc extinguishing substance in the cartridge.

22. In a fuse device an insulating tube having metal end terminals, a renewable fuse cartridge containing a fusible element, said cartridge adapted to be inserted in said insulating tube, and means operable by pressure generated by fusion of said element to cause a fragile end of the renewable cartridge to be blown outward and thereby relieve said cartridge of excess pressure.

23. In a fuse device, the combination of a fuse supporting body having a closed compartment formed therein with a discharge orifice at one end thereof, a fusible element and an arc extinguishing substance in said compartment, and a fragile diaphragm closing the compartment at the orifice

end and adapted to be ruptured by pressure from within said compartment.

24. In a fuse device, a renewable fuse cartridge consisting of an insulating body, said insulating body having a fusible element mounted therein, a discharge orifice formed at one end of the insulating member and a passage at one side of the discharge orifice, a fragile member forming a closure for the discharge orifice and the passage, a head member on the opposite end of the insulating member and having a passage formed therein for the reception of a plunger, and means connecting the plunger with a fusible element.

25. In a fuse device an insulating tube having metal ferrules at each end, said tube adapted to receive an insulated member having a chamber formed therein, a fuse element and an arc extinguishing substance in said chamber, said member being shaped to project the arc extinguishing substance into the arc stream at an acute angle with relation to the axis of the arc during blowing of the fuse element.

26. In a fuse device an insulating tube having metal ferrules at each end, said tube adapted to receive an insulated member having a chamber formed therein, a fuse element and an arc extinguishing substance in said chamber, said member being shaped to project the arc extinguishing substance into the arc stream at an angle with relation to the axis of the arc during blowing of the fuse element.

27. In a fuse device, a fusible element, and means operable by pressure generated by fusing of said element to cause a stream of arc extinguishing substance to play upon an arc caused by said fusion, at an acute angle to cause extinction of said arc.

28. In a fuse device, a fusible element, a closed compartment adapted to contain an arc extinguishing substance, and means operable by pressure generated by fusion of said element to force an arc extinguishing substance into the arc stream at an acute angle to aid in the extinction of said arc.

29. In a fuse device, a fusible element, and means operable by pressure generated by fusion of said element to cause a stream of arc extinguishing substance to play at an acute angle upon an arc caused by fusion of said element, thereby aiding in the extinction of said arc.

30. In a fuse device of the character described having a compartment formed therein and a discharge orifice in communication therewith, a fuse in the compartment, an arc extinguishing substance in the compartment, a passage formed in the device and connected with the discharge orifice at one end and with the compartment at the other end, whereby when the fuse blows an arc extinguishing substance is directed under pressure on an acute angle into the discharge orifice.

31. In a fuse device, a renewable fuse cartridge consisting of an insulating body, said insulating body having a fusible element mounted therein, a discharge opening formed at one end of the insulating member and a passage at one side of the discharge opening, a fragile member forming a closure for the discharge opening and said passage, a head member on the opposite end of the insulating member and having a passage formed therein for the reception of a plunger, and means connecting the plunger with a fusible element.

32. In a fuse device a tube having metal end terminals, one terminal adapted to permit insertion of a renewable cartridge, said cartridge comprising an insulating tube, one end of said tube being closed, a conducting plunger extending through the closure and connected to a fuse element, said insulating tube having a discharge opening formed in the other end, and a member in said tube having a central passage containing the fuse element and connected with the discharge opening.

33. In a fuse device a tube having metal end terminals, one terminal adapted to permit insertion of a renewable cartridge, said cartridge comprising an insulating tube, one end of said tube being closed, a conducting plunger extending through the closure and connected to a fuse element, said insulating tube having a discharge opening formed in the other end, a member in said tube having a central passage containing the fuse element and connected with the discharge opening, and another passage formed in said member and offset with respect to the central passage but communicating therewith.

34. In a fuse device, an expulsion tube, a fuse element within the tube, a housing having a chamber forming a continuation of the tube, said chamber acting as a receptacle for expelled parts from the fuse device, and a sealing member interposed between the fuse element and the chamber.

35. In a fuse device, an expulsion tube, a fuse element within the tube, a housing having a chamber forming a continuation of the tube, said chamber acting as a receptacle for expelled hot gases and parts of the fuse device, a sealing member interposed between the fuse element and said chamber, and means in the chamber for rapidly cooling the gases.

36. In a fuse device, an expulsion tube, a fuse element within the tube, a housing having a chamber forming a continuation of the tube, said chamber acting as a receptacle for expelled parts from the fuse device and an expellable sealing member interposed between the fuse element and said chamber.

37. In a high tension fuse device an expulsion tube, a fuse element in the tube, a housing having a chamber forming a continuation of said tube, said chamber acting as a receptacle for hot gases and expelled parts from the fuse device, and venting means in the housing for allowing the escape of gases at an angle with relation to the longitudinal axis of the tube.

38. In a high tension fuse device an expulsion tube, a fuse element in the tube, a housing having a chamber forming a continuation of said tube, said chamber acting as a receptacle for hot gases and expelled parts from the fuse device, venting means in the housing for allowing the escape of gases at an angle with relation to the longitudinal axis of the tube, and means for rapidly cooling the gases.

39. In a high tension fuse device an expulsion tube, a fuse element and an arc extinguishing substance in the tube, a housing having a chamber forming a continuation of said tube, said chamber acting as a receptacle for hot gases and expelled parts from the fuse device, and venting means for allowing the escape of gases from the housing at an angle with relation to the longitudinal axis of the tube and housing.

40. In a fuse device, an expulsion tube, a member constructed of insulating material disposed within the tube, said member having a chamber formed therein terminating in a discharge passage, a fuse element and an arc extinguishing

substance in the chamber, said arc extinguishing substance being expelled through the discharge passage during blowing of the fuse and a second passage formed in said member and offset with relation to the discharge passage and adapted to direct a portion of the arc extinguishing medium into said discharge passage.

41. In a fuse device, an expulsion tube, a renewable fuse cartridge insertable in said tube, said cartridge having a chamber formed therein terminating in a discharge passage, a fuse element and an arc extinguishing substance in the cartridge, said arc extinguishing medium being expelled through the discharge passage of the cartridge during blowing of the fuse, and a second passage formed in the cartridge and offset with relation to the discharge passage and adapted to direct a portion of the arc extinguishing medium into said discharge passage.

42. In a fuse device, an expulsion tube, a fuse element within the tube, an arc extinguishing substance within the tube, a housing having a chamber forming a continuation of the tube, said chamber acting as a receptacle for expelled parts from the fuse device, and a sealing member interposed between the fuse element and the chamber.

43. In a fuse device, an expulsion tube, a fuse element within the tube, an arc extinguishing substance within the tube, a housing having a chamber forming a continuation of the tube, said chamber acting as a receptacle for expelled hot gases and parts of the fuse device, a sealing member interposed between the fuse element and said chamber, and means in the chamber for rapidly cooling the gases.

44. In a fuse device, an expulsion tube, a fuse element within the tube, an arc extinguishing substance within the tube, a housing having a chamber forming a continuation of the tube, said chamber acting as a receptacle for expelled parts from the fuse device and an expellable sealing member interposed between the fuse element and said chamber.

45. In a high tension fuse device, an expulsion tube, a fusible element in the tube, an arc extinguishing substance in the tube, and a housing having a chamber forming a continuation of said tube, said chamber acting as a receptacle for expelled hot gases and parts from the fuse device.

46. In a high tension fuse device, an expulsion tube, a fusible element in the tube, an arc extinguishing substance in the tube, a housing having a chamber forming a continuation of said tube, said chamber acting as a receptacle for expelled hot gases and parts from the fuse device, and means in the chamber for rapidly cooling the gases.

47. In a high tension fuse device, an expulsion tube, a fusible element in the tube, an arc extinguishing substance in the tube, a housing having a chamber forming a continuation of said tube, said chamber acting as a receptacle for expelled hot gases and parts from the fuse device, and metallic means in the chamber for rapidly cooling the gases.

48. In a high tension fuse device, an expulsion tube, a fusible element in the tube, an arc extinguishing substance in the tube, a housing having a chamber forming a continuation of said tube, said chamber acting as a receptacle for expelled hot gases and parts from the fuse device, means in the chamber for rapidly cooling the gases, and means for allowing escape of the cooled gases.

49. In a fuse device of the expulsion type, a housing, an expulsion tube of insulating material adapted to be inserted in said housing, a fuse within the expulsion tube, said tube having an enlarged chamber which forms a continuation of said tube and said enlarged chamber having means mounted therein adapted to act as a receptacle for expelled parts, means in the enlarged chamber for cooling hot expelled gases, and means for allowing an escape of the cooled gases.

50. In a fuse device of the expulsion type, the combination with an expulsion member constructed of insulating material and having a passage formed therein of a fuse element within said passage, an enlarged chamber forming a continuation of the passage, and means in said chamber to prevent the escape of expelled particles but allowing the escape of gases.

51. In a fuse device of the expulsion type, the combination with an expulsion member constructed of insulating material and having a passage formed therein, of a fuse element within said passage, an enlarged chamber forming a continuation of the passage, means in said chamber to prevent the escape of expelled particles but allowing the escape of gases, and means in the chamber for rapidly cooling the gases entering the chamber during the blowing of the fuse.

52. In a fuse device of the expulsion type, a housing, an expulsion tube of insulating material adapted to be inserted in said housing, a fuse within the expulsion tube, said tube having an enlarged chamber which forms a continuation of said tube and said enlarged chamber having means mounted therein adapted to act as a receptacle for expelled particles, and means in said chamber for allowing escape of gases during the blowing of the fuse.

53. The combination with a fuse device of the character described of a receptacle connected with the expulsion end of the fuse device, and means in the receptacle for rapidly cooling the gases generated during blowing of the fuse and to prevent excessive pressure from being formed in the fuse device.

54. In a high tension fuse device, an expulsion tube, a fusible element within the tube, a terminal member on the expulsion end of the tube, and a receptacle connected with the terminal member, said receptacle being adapted to act as a receiver for expelled parts from the expulsion tube.

55. In combination with a fuse of the expulsion type, said fuse having an aperture through which any arc created is expelled, a receptacle in communication with said aperture and in alignment therewith, and means in said receptacle adapted to prevent the escape of flaming or molten particles from the fuse, said means permitting escape of gases generated during blowing of the fuse.

56. In combination with a fuse of the expulsion type, said fuse having an aperture through which any arc created is expelled, a receptacle in communication with said aperture and in alignment therewith, said receptacle having a screened escape passage adapted to prevent the escape of flaming or molten material from the fuse to the surrounding atmosphere by permitting the escape of gases generated during blowing of the fuse.

GEORGE LESLIE HILL.