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ELECTRIC FUSE

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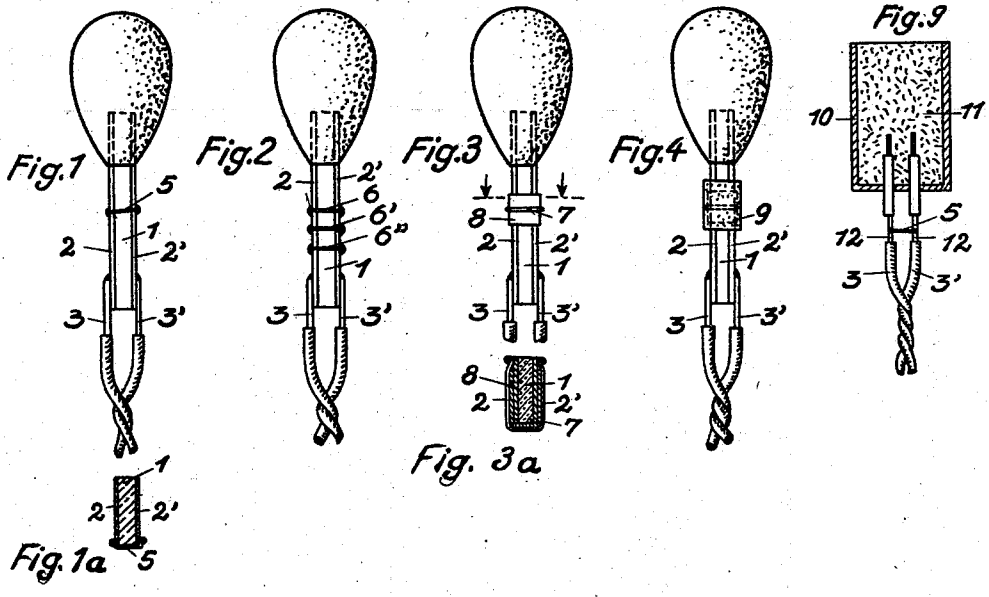

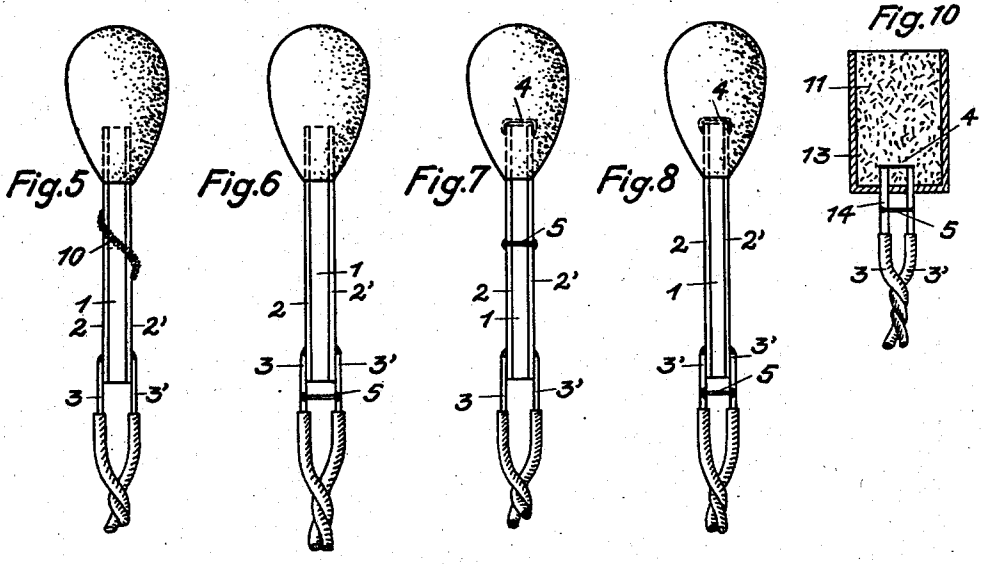

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ELECTRIC FUSE

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The invention relates to electric blasting fuses and has for its object to provide an improved blasting fuse which shall be reliable in operation, readily testable even when connected for being fired in series with a plurality of fuses, simple in construction and at the same time not liable to be actuated by stray currents, i. e. such fuses which for being ignited require higher potential and greater intensity of current than the potential and the intensity which may be supplied by stray currents even under the most unfavorable conditions.

In order to comply with this last mentioned condition of safety against stray currents, the so-called "high tension fuses" were mostly employed up to now, i. e. electric fuses in which the current is led directly through the priming charge without an incandescent bridge, these fuses having been designed in such a manner that potentials of 10, 15 or 20 volts or even higher potentials were necessary to fire them. However, these fuses—when designed for operation at or above said potentials—have only small current consumption, for example, 5 to 10 milliamps., and it may happen in practice that stray currents exceeding these values may act upon the said fuses for long periods of time. Owing to this danger so-called "wire-bridge" igniters i. e. igniters in which the "priming" is fired by the heating effect of a wire through which a current is passed, have been resorted to, these igniters also being designed to be fired at comparatively high potentials and further requiring greater current strengths than do high tension fuses, for example, they may be designed to require currents of 100, 150, 200 or more milliamps. Such high resistance wire bridge fuses have, however, the great disadvantage that even when a powerful shot firing machine is employed, only a relatively small number of fuses can be fired simultaneously.

High tension fuses are free from this drawback; they have, however, the disadvantage that, although single fuses can be tested accurately (with sufficiently sensitive testing instruments) yet in practice it is impossible to test a plurality of fuses connected in series ready for being fired since, owing to the great differences likely to exist between the resistances of the various fuses in the circuit the obtaining of a correct total resistance is no guarantee that the wiring is correct and that all fuses of the set are included. Thus for practical purposes "check" measuring cannot be obtained.

The principal object of the present invention is to provide electrical fuses which are secure against both, comparatively high stray potentials and comparatively intense stray currents; larger numbers of which can be fired in series connection with certainty; and which can be adequately tested even after having been connected together in series. The essential feature of the invention resides in the provision exterior of the priming composition of a shunt conductor or conductors arranged to shunt or short circuit the ignition portion of the circuit. Preferably the said shunt is so designed that it will be fused or destroyed before it will allow sufficient current and potential to be applied to the ignition circuit proper to fire the priming.

When the shunt is destroyed, of course, a larger current sufficient to secure firing of the fuse will flow through the ignition portion of the circuit.

The shunt conductor employed can be of any desired form and many will suggest themselves to those skilled in the art. In the commonly employed "match-head" fuse in which the match-head is carried by an insulating strip having opposite sides coated with a conducting layer the shunt may conveniently comprise a thin wire if desired wound in a spiral passing round the edge of the insulating strip and connecting together the two coatings. In order to ensure that the shunt may not adversely affect any fusible or ignitable material in its neighbourhood by the heat it develops it may be covered with a lagging, for example, an asbestos winding. Again in cases where the shunt is arranged exterior of the fuse-head it is preferably arranged sufficiently near thereto to be included in the usually provided casing for the complete fuse so as to be protected from mechanical injury.

It will be seen that high tension fuses provided with shunts, in accordance with the present invention, give the advantages of both wire-bridge fuses and high tension fuses, for the shunts may readily be made so uniform that large numbers of in series connected fuses can be tested prior to ignition by means of ordinary resistance measuring apparatus (e. g. an ohmmeter) while the said shunts may be of such dimensions that they are only fused or burnt through with heavy currents for instance 1,000 to 1,200 milliamps. The higher resistance ignition circuit proper which is shunted by the shunt conductor provided in accordance with this invention requires, after the shunt has been burnt through, a potential of 10, 15, 20 or so volts (sufficiently high to be safe) and only a very low current strength (about 5–10 milliamps). Thus large series of such high tension igniters can be ignited with the customary blasting apparatus.

In wire bridge fuses manufactured according to the invention, owing to the fact that the bridge or ignition wire is in parallel with the shunt conductor, until the latter is burnt through the igniter may readily be designed to accommodate without being fired, currents of such magnitude as to be beyond the possibility of being by stray currents.

The invention is more particularly described in the following description and illustrated in the accompanying schematic drawing of which Figs. 1 to 6 show high tension fuses and Figs. 7 and 8 wire bridge fuses of the match-head type; Figs. 9 and 10 wire bridge fuses of the loose primer type in accordance with the invention.

In the Figures 1–8 reference number 1 represents a strip of non-conducting material, 2 and 2′ represent conducting coatings on opposite sides thereof, 3 and 3′ insulated fuse wires (fuse legs) leading to said coatings and in the case of Figs. 7 and 8, 4 represents the incandescent wire bridge. All these parts are as commonly employed and will be obvious from the figures.

Referring now more particularly to Fig. 1 a shunt wire 5 passes over the narrow side of the strip 1 and is soldered at its ends to the coatings, 2, 2′ as will be clear from a consideration of the sectional plan view shown in Fig. 1*a*.

The arrangement shown in Fig. 2, differs from that shown in Figs. 1 and 1*a* only in that the shunt is formed of several (in the drawing three) parallel wires, 6, 6′ and 6″.

In Fig. 3, a shunt wire 7 is soldered to the edge of the coating 2, passes around said coating, around the narrow side of the strip 1 and around the coating 2′ and is soldered to the edge of the coating 2′ opposite the first fixing position. It is insulated from the coatings 2 and 2′ except at the points of attachment by means of an insulating plate 8 as will be seen from the sectional plan shown in Fig. 3*a*.

Fig. 4 shows a modification of that shown in Fig. 3 differing therefrom only in that an asbestos winding or covering 9 is provided so that combustible materials which may be employed in the fuse are not liable to be ignited by the heat developed in the shunt wire.

In Fig. 5 the shunt is in the form of a fine spiral wire 10 connecting the coatings 2, 2′.

In Fig. 6, the shunt 5 is arranged under the match-head between the fuse wires (fuse legs) 3 and 3′ which are bared of insulation for a short distance for this purpose as shown.

The fuse with incandescent wire bridge shown in Fig. 7, corresponds in construction to the high tension fuse in Fig. 1, while the incandescent wire bridge fuse shown in Fig. 8, corresponds in construction to the high tension fuse in Fig. 6. It is therefore not deemed necessary further to describe Figs. 7 and 8.

The present invention does not relate to match head fuses only but as well to blasting fuses with a loose primer as shown in Figs. 9 and 10, Fig. 9 showing a high tension fuse, Fig. 10 showing an incandescent wire bridge fuse.

Referring to Fig. 9, 10 is a case made of cardboard or any suitable material, 11 is the loose priming mass. The fuse legs 3, 3′ go through the bottom of the case directly into the loose priming mass.

Outside of the case near the bottom of it the insulation is taken off from the fuse legs as shown at 12, and the shunt 5 is soldered across the fuse wires.

Referring to Fig. 10, the case 13 is made of insulating material as cardboard. The end 14 of the fuse legs 3, 3′ are bared of insulation, and inside of the case they are connected by the incandescent wire 4. Outside of the case the shunt 5 is soldered across the uninsulated ends of the fuse legs.

In the claims which follow the term "ignition circuit" designates the circuit by which ignition is effected i. e. the circuit includng an incandescent bridge in the case of a wire bridge fuse and that including the conductors and the priming or equivalent in the case of a high tension fuse.

I claim:

1. An electric fuse comprising in combination a priming charge, an ignition circuit for said priming charge and fusible shunt means connected across said ignition circuit exterior to said charge, said shunt means having such dimensions that said ignition circuit cannot fire said charge until said shunt means are destroyed.

2. An electric fuse comprising in combination an insulating strip, conductive coatings on opposite sides of said strip, connect-

ing means for said conductive coatings, a priming charge upon said strip, extending from one of said conducting coatings to the other and fusible shunt means connecting said conductive coatings exterior to said priming charge.

3. An electric fuse comprising in combination an ignition circuit including a bridge glow wire, a priming charge surrounding said glow wire and fusible shunt means connected across said ignition circuit exterior to said charge.

4. An electric fuse comprising in combination a priming charge, an ignition circuit including a bridge wire embedded in said priming charge and shunt means destructible by electric current connected across said ignition circuit exterior to said priming charge, said shunt means having such dimensions that said bridge glow wire cannot fire said charge until said shunt means are destroyed.

5. An electric fuse comprising in combination an insulating strip, conductive coatings on opposite sides of said strip, connection means for said conductive coatings, a bridge glow wire connected between said coatings, a priming charge surrounding said wire and fusible shunt means connected between said connecting means across said conducting coatings and said bridge glow wire.

6. An electric fuse comprising in combination an insulating strip, conductive coatings on opposite sides of said strip, connection means for said conductive coatings, a bridge glow wire connected between said coatings, a priming charge surrounding said wire and fusible shunt means connected between said connecting means across said conducting coatings and said bridge glow wire, said shunt means having such dimensions that said glow wire cannot fire said charge until said shunt means is fused by the firing current.

7. An electric fuse comprising in combination a priming charge an ignition circuit for said priming charge, and a shunt wire of fusible material connected across said ignition circuit exterior to said charge said shunt wire having such dimensions that said ignition circuit cannot fire said charge until said shunt wire is burnt out by the firing current.

8. An electric fuse comprising in combination an insulating strip, conductive coatings on opposite sides of said strip, connection wires for said conductive coatings, a priming charge upon said strip extending from one of the coatings to the other and fusible shunt means connected across said coatings.

9. An electric fuse comprising in combination an insulating strip, conductive coatings on opposite sides of said strip, connection wires for said conductive coatings, a priming charge upon said strip and shunt means, of material destructible by electric current connected between said coatings, said shunt means having such dimensions that said charge cannot be fired until said shunt means are destroyed.

10. An electric fuse comprising in combination a priming charge an ignition circuit including a bridge glow wire embedded in said priming charge and fusible shunt wire connected across said ignition circuit exterior to said priming charge, said shunt wire having such dimensions that it is fused before said bridge glow wire has reached firing temperature.

11. An electric fuse comprising in combination an insulating strip, conductive coatings on opposite sides of said strip, connection means for said conductive coatings, a priming charge upon said strip, fusible shunt means connected in parallel with an ignition circuit including said coatings and heat insulating means for said shunt means.

12. An electric fuse comprising in combination an insulating strip, conductive coatings on opposite sides of said strip, connection means for said conductive coatings, a priming charge upon said strip, liable to be destroyed by electric current, shunt means connected in parallel with an ignition circuit including said coatings, said shunt means having such dimensions that said ignition circuit cannot fire said charge until said shunt means are destroyed by the shot firing current and heat insulating means for said shunt means.

13. An electric fuse comprising in combination a priming charge, an ignition circuit in operative connection with said priming charge, leading-in wires connected to the ends of said ignition circuit, and fusible shunt means connected across said leading-in wires for inclusion in the usual fuse shell but sufficiently spaced from the charge to prevent heat of fusion of the shunt from igniting the charge.

14. An electric fuse comprising in combination a metal casing, a loose priming charge in said casing; insulated leading-in wires leading through said casing into said priming charge; fusible shunt means connected across said leading-in wires exterior to said casing.

15. An electric fuse comprising in combination a casing made from insulating material; a loose priming charge in said casing, insulated leading-in wires having bared ends, these bared ends leading through the casing into said priming charge; fusible shunt means connected across said bared ends of said leading-in wires exterior to said casing.

16. In an electric fuse, an ignition charge, an ignition spark gap, a fusible short circuit means for the ignition spark gap close to the charge and so dimensioned that the charge will not be fired until short circuit has been fused, the distance between the charge and fusible short circuit being sufficient to pre-

vent the heat of fusion from firing the charge.

17. In an electric fuse the provision of an auxiliary shunt connection for the poles of the fuse, the said shunt connection fusing at a certain strength of current.

18. In an electric fuse the provision of an auxiliary shunt connection for the poles of the fuse, the said shunt connection fusing at a certain pressure.

In testimony whereof I affix my signature.

JULIUS SCHÜRMANN.