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H. E. ELLSWORTH

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SAFETY FUSE

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Fig. 4.

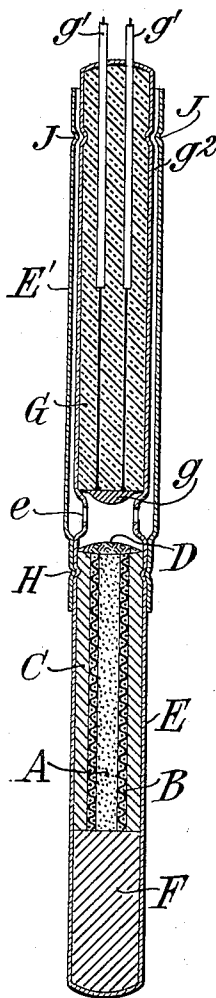


Fig. 1.

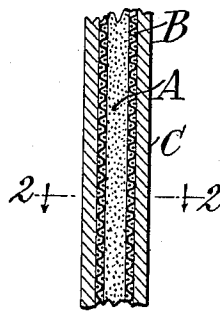


Fig. 3.

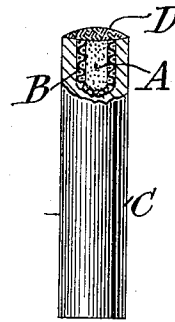


Fig. 2.



INVENTOR

Henry E. Ellsworth

By Attorneys,

Draser, Myers-Manley

UNITED STATES PATENT OFFICE

HENRY E. ELLSWORTH, OF SIMSBURY, CONNECTICUT, ASSIGNOR TO THE ENSIGN-BICKFORD CO., OF SIMSBURY, CONNECTICUT, A CORPORATION OF CONNECTICUT

SAFETY FUSE

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The present invention relates to safety fuse, to products made from or embodying such fuse and to the manner of using the same.

5 An object of the invention is to provide a new and improved type of weatherproof safety fuse. A further object is to provide safety fuse which may be readily primed with a composition to assist in the easy ignition of the fuse. A still further object is to provide a very slow burning fuse of uniform burning rate. A still further object is to employ such fuse cut into short lengths as delay elements for use in electric blasting caps, which delay elements may be primed at one end if desired.

According to the present invention I accomplish the foregoing and other objects by providing safety fuse consisting of a core of inflammable material enclosed within a fibrous or cellular covering, and the resulting fuse enclosed within a covering of impervious material. Preferably the inflammable material is a slow burning powder; the fibrous covering, a textile which is woven or wrapped around the powder core; the covering of impervious material, a metal such as lead, tin, aluminum or the like, which is closely fitted over the textile material to reduce to a minimum or entirely eliminate air spaces between the outside of the textile covering and the inside of the metallic covering. This fuse can be used in the conventional manner or it may be cut into short lengths and primed with an easily ignitable compound to provide delay elements for electric blasting caps.

The invention will be better understood from the detailed description which follows and the accompanying drawings, wherein

40 Figure 1 is a longitudinal, diametrical section through a portion of safety fuse embodying the present invention.

Fig. 2 is a transverse section of the safety fuse taken substantially along the plane of the line 2—2 of Fig. 1.

50 Fig. 3 is an elevation partly broken away of an application of the safety fuse of the present invention to form what is termed a delay element.

Fig. 4 is a longitudinal, diametrical section of an electric blasting cap which embodies a delay element shown in Fig. 3.

Referring first to Figs. 1 and 2 of the drawings, the safety fuse consists of a core A of slow burning powder which is enclosed in a wrapping or covering B of textile fabric preferably formed of jute and cotton yarns. The elements A and B in assembled relation constitute what is recognized in the arts as safety fuse, and the composition of the powder A and the character of the covering B may be varied, as desired. Snugly engaging around the covering B is a tube C of impervious material which is of a relatively non-combustible character, and one that is capable of having its outer diameter accurately sized for a purpose which will presently be made apparent. Preferably this outer tube is formed of lead, but it will be understood that it may be formed of other ductile metals or any other substance which may be found to have the requisite characteristics.

75 The safety fuse A, B, C may be fabricated or manufactured in any manner which is found practicable, it being a desirable quality of the fuse that the coating C closely engage the covering B so that air spaces between said B and C will be reduced to a minimum or entirely eliminated. It is also desirable that the covering B be formed of a textile which has a cellular structure so that air may be occluded within said cells or between the fibers of the textile material, so that as the powder core burns, the air cells will provide a cooling and insulating effect which will prevent the melting of the outer coating C, which melting might result in obstructing the propagation of the burning.

80 In the production of the safety fuse A, B, C, a powder core A of a suitably slow and uniform burning powder is spun into the covering B, after which it is drawn into the lead tubing C, which tubing is then drawn down to snugly engage around the covering B. An alternative method is to extrude lead piping or other extrudable metal over the previously formed safety

fuse A, B, by a process similar to that used in making resin-core solder, lead covered cables and the like.

In Fig. 3 there is illustrated what I term a delay element for electric blasting caps, said delay element being formed of a suitable length of safety fuse, as illustrated in Fig. 1, which piece of fuse, after being cut to the desired length, and accurately sized to suitable diameter it is primed at one end, as shown at D, with an easily ignitable compound. The priming compound may be of any desired or preferred composition, and I have found as a suitable composition for this purpose a paste formed by dissolving celluloid in acetone and mixing therewith ordinary black meal powder in the proportion of twenty parts by weight of powder to one part of celluloid. A delay element such as above described should have the following specifications:

1. It must burn very slowly and accurately—in fact, more slowly and with greater accuracy than any safety fuse hitherto made for general use.

2. It must have a uniform and accurate diameter.

3. It must have a rigid body which can be pressed into a copper shell, producing a very close fit, so that the flash from the igniter cannot pass between the fuse element and the copper tube and produce a premature ignition. The importance of this feature will be appreciated when one considers that the shortest elements are only about one-quarter inch long and the igniter produces a very hot and sudden flash.

4. It must be easily ignited.

5. It must burn without emission of side sparks or hot gases.

6. The metal tube must not rupture or melt during burning.

7. It should be cheap and easy to manufacture.

The delay element as shown in Fig. 3, and having the characteristics specified in the preceding paragraph is used in an electric blasting cap in the manner illustrated in Fig. 4, wherein the blasting cap consists of a tube shell E formed of brass, copper or aluminum within which the delay element is fitted between a detonating compound F in the bottom of the shell and an ignition head G fitted into the outer end of the cap. The priming composition D of the delay element is spaced from the electric ignition head *g* of the ignition head, and the shell between said elements is formed with openings *e* which provide vents for the gases formed in the burning of the fuse. For igniting the composition *g* of the ignition head, a pair of electric conductors *g'* joined by a platinum bridge extend through insulating material *g''* of the ignition head. For protecting the ignition head *g* and the prim-

ing composition D of the electric blasting cap, and at the same time permitting the venting of the formed gases from said cap, the upper half of the shell E is protected by a supplemental shell E' through the medium of spinning or crimping said shells together, as shown at H and indenting as shown at J.

From the foregoing detailed description it will be apparent that I have devised a novel type of safety fuse which may be used in a conventional manner and which is particularly useful in the preparation of delay elements for electric blasting caps. These delay elements can be cheaply and accurately made, and provide an efficient means of increasing the efficiency of the electric blasting caps of the type wherein delayed or properly timed explosions can be electrically set off.

While I have shown and described what I consider a preferred embodiment of my invention and the manner in which the same may be used, I do not wish to be limited to the specific construction or composition of elements described, since these may be varied within the scope of one skilled in the art without departing from the spirit of my invention.

What I claim is:

1. A fuse element consisting of a core of slow burning powder, cellular material enclosing the powder and a covering of a relatively non-combustible rigid impervious material snugly engaging over the cellular material, said impervious material having an accurately sized uniform external diameter.

2. A fuse element consisting of a core of safety fuse enclosed within a ductile tube which is drawn down snugly against the outer surface of the safety fuse to reduce to a minimum air spaces between the fuse and the inner wall of the tube, said ductile tube having an accurately sized external diameter.

3. The method of forming a fuse element comprising enclosing safety fuse within an imperforate relatively non-combustible, rigid, impervious material, causing said material to snugly engage over said safety fuse and accurately and uniformly sizing the outer diameter of the enclosing material.

4. The method of forming a fuse element comprising enclosing safety fuse within an imperforate ductile metal tube and then reducing the diameter of the metal tube to fit snugly over the safety fuse.

5. For use in blasting caps or the like, a delay element comprising a length of safety fuse enclosed throughout its length in a casing of relatively non-combustible, rigid, impervious material, the outer diameter of which is accurately sized, one end of the fuse being primed with an easily ignitable compound.

6. For use in blasting caps or the like, a delay element comprising a length of safety fuse enclosed throughout its length in a ductile metal tube having a uniform external diameter, the fuse at one end of the tube being primed with an easily ignitable compound.

7. The method of forming delay elements for blasting caps or the like, comprising forming in long lengths, a fuse element having a core of inflammable material, a coating of fibrous material enclosing the inflammable material and an outer coating of impervious relatively non-combustible rigid material, cutting said fuse element into desired lengths and priming one end of each length so obtained with an easily ignitable compound.

8. The method of forming delay elements for blasting caps or the like, comprising forming in long lengths, a fuse element having a core of slow burning powder, a coating of textile material enclosing the powder and a metal covering snugly engaging over the textile material, cutting said fuse element into desired lengths and priming one end of said lengths of fuse element with an easily ignitable compound.

9. For use in an electric blasting cap comprising a shell having an ignition head at the top and a detonating compound at the bottom, a delay element for positioning between said ignition head and said detonating compound, said delay element comprising a short length of safety fuse snugly enclosed within a metal jacket which is adapted to closely fit the interior of the shell, said delay element being primed at one end with a compound adapted to be ignited by the ignition head of the blasting cap.

10. A delay element comprising a core of inflammable material enclosed within a ductile metal tube, and means between the inflammable material and the tube for preventing the melting or rupturing of the tube during the burning of the inflammable material.

11. The method of forming delay elements for blasting caps and the like, comprising forming in long lengths a fuse element having a core of inflammable material enclosed within a ductile metal tube, and means between the inflammable material and the tube for preventing melting or rupturing of the tube during the burning of the inflammable material and cutting said fuse element into desired lengths.

In witness whereof, I have hereunto signed my name.

HENRY E. ELLSWORTH.