May 9, 1933. D. E. PEARSALL 1,907,863

SAFETY FUSE

Filed Aug. 5, 1931

Fig. 1.

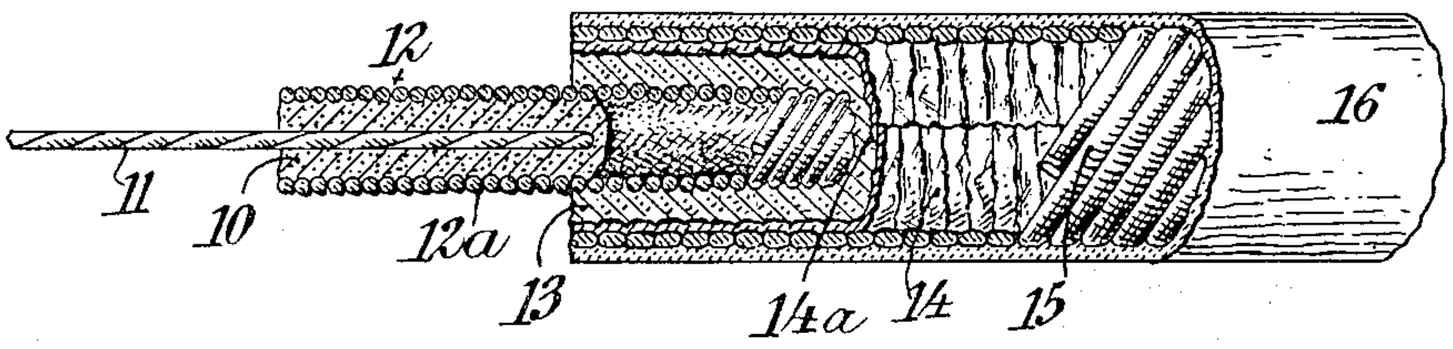
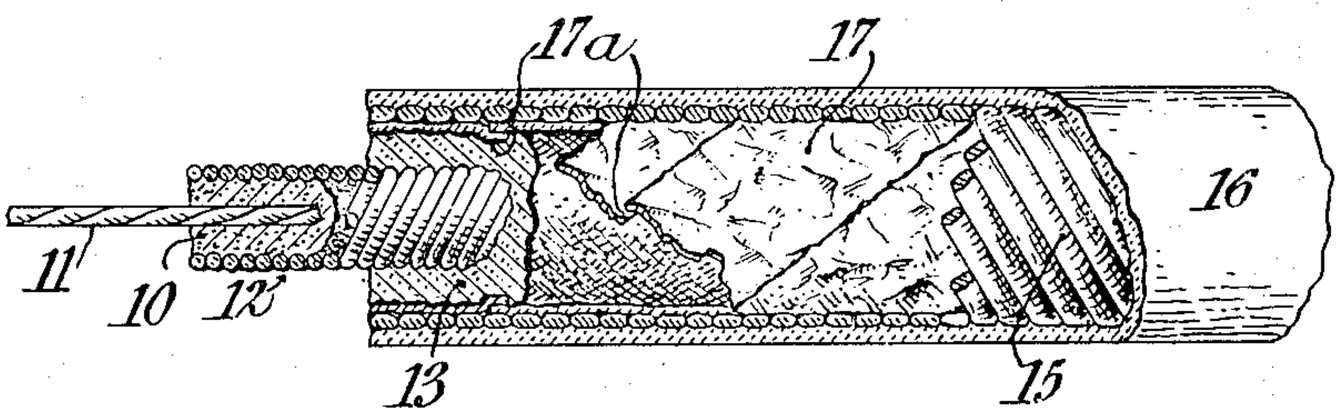


Fig. 2.



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Patented May 9, 1933 1,907,863

UNITED STATES PATENT OFFICE

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SAFETY FUSE

Application filed August 5, 1931. Serial No. 555,233.

The present invention relates to safety fuse for use in blasting and aims to provide certain improvements therein. More particularly it relates to blasting fuse which has a paper envelope extending longitudinally thereof and enclosing the powder core as a part of its structure, and aims to increase the waterproofness of such fuse and also the degree of uniformity of its burning speed.

In blasting fuse of the character set forth, the desired uniformity in the burning speed is not always obtained due to the structure provided by the combination of the paper envelope, the countering threads thereabout and the outside clay-glue mixture coating, in view of which the gases of combustion are prevented from escaping readily through the walls of the fuse and have a tendency to vent through the end of the fuse instead of freely through the sides. Moreover, such fuse is relatively stiff and inflexible, and, if bent sharply, produces a rupture or fracture in either or both the paper envelope and the outside coating, which not only lowers the waterproofness of the fuse but also adversely affects its regularity in burning owing to the irregularity in venting caused by such ruptures. The clay-glue mixture coating is not waterproof and gradually disintegrates when the fuse is soaked in water. Gutta percha and rubber coverings have also been used on fuse, but said coverings are dark in color, are subject to oxidation and deterioration, are costly and require intricate equipment for application and handling. Asphalt and tar compounds have also been used for outside coverings, but these are black and not readily visible in dark mines, and besides they give off much noxious smoke when burning, which is objectionable in underground work.

According to my present invention I overcome the deficiencies in safety fuse of the type described by improving the character of the paper envelope and also that of the outside coating. The improvement in the paper envelope resides in using a paper which is creped, crimped or crinkled to such a degree that it will stretch without rupturing when the fuse is sharply bent. The improvement in the outer covering resides in the use therefor of a light colored wax or wax mixture which is tough and flexible and has a relatively high melting point. The manner in which these improvements overcome the above-described deficiencies will be apparent from the detailed description of the invention which follows, when considered in conjunction with the accompanying drawing, wherein

Figure 1 is a side elevation of a section of safety fuse embodying my invention, parts thereof being broken away to show the structure thereof.

Fig. 2 is a similar view to Fig. 1, showing a slight modification of the invention.

Referring to the drawing let the reference character 10 indicate a powder core which surrounds a central longitudinal strand or strands 11, the powder core in turn being surrounded by a casing 12 which is provided by spinning one or more layers of strands 12*a* around the powder core. The powder core 10 and casing 12 may be considered as the fuse core. Surrounding the casing 12 or fuse core are one or more plastic coatings of waterproof material 13, such as asphaltum, gutta percha and the like, which serves to prevent moisture gaining access to the powder core. Enclosing the coating 13 is an envelope of material 14, such as paper or the like, which is held in contact with the coating 13 by countering strands 15 which are wound around the paper under sufficient tension to transfer through the medium of the paper a pressure to the underlying plastic coatings 13 causing these coatings to become amalgamated and embedded in the strands 12*a* forming the casing 12. Surrounding the countering strands 15

is an outer casing or covering 16. The safety fuse thus far described is substantially that in commercial use today and its construction and method of formation are described in detail in United States Patent No. 1,023,142, dated April 16, 1912.

My present invention resides in the particular character of the envelope or casing 14 and the outer covering 16, through the medium of which elements I provide safety fuse which is flexible, waterproof, and burns with a more uniform speed.

According to my present invention, instead of the envelope 14 being formed of ordinary paper tape enveloping the waterproof coatings 13 and powder core 10, I employ a paper tape which is formed of creped, crimped or crinkled paper having a degree of stretch when formed into a cylindrical envelope of from ten per cent. to fifty per cent. of its normal length. In Fig. 1, I show the envelope 14 as being formed of creped paper with the creping extending perpendicular to the fuse axis, the creped paper being applied to the fuse in the form of a longitudinal tape wherein the creping extends at right angles to the length of the tape, which latter is wrapped around the fuse with its edges in overlapping relation, as indicated at 14*a*, in a manner quite similar to that shown in the patent aforementioned. It is desirable that the creping of the paper be fine and close as possible so as to possess the desired degree of stretch and waterproofness. I have found that a creping which gives below ten per cent. stretch does not possess the desired amount of flexibility and ease in handling, while in a paper which permits a stretch above fifty per cent. I have found that the paper does not fit tight enough to the fuse to give the desired degree of waterproofness or to permit of its efficient working on machines adapted for the application of such paper to fuse.

In Fig. 2, I have shown the paper envelope as formed by spirally winding a tape 17 around the coating 13, the tape 17 being formed of crinkled paper which will give to the enclosing envelope formed thereby the desired degree of stretch or extensibility. In this connection it is important that the degree or extent of overlapping of the tape in its spiral winding of the fuse, as indicated at 17*a*, should be sufficient to permit of the necessary stretch without breaking the overlap joints so as to affect the waterproofness of the envelope. Instead of the crinkled paper tape 17 disclosed in Fig. 2, I may use a creped paper tape, in which case it will be apparent to one skilled in the art that the creping will be such as to extend transverse to the length of the tape so that when spirally wound around the fuse the creping will extend transverse to the longitudinal axis of the fuse and preferably perpendicular thereto.

To permit of a fuse formed with an extensible envelope, such as 14 or 17, to have as a concomitant thereof a high degree of waterproofness, it is essential that the outer coating 16 be both waterproof and relatively flexible. I have found that this can be accomplished by forming the outer covering 16 of a wax or wax mixture which is tough and flexible over the wide temperature range, say from 32° to 130° F., normally encountered in the use of such fuse, and which softens materially and preferably melts to a limp liquid when the fuse is burned to permit the escape of the smoke and gases of combustion. It is also desirable that this wax or wax mixture be light colored so as to be readily visible in a dark mine, and one which will be non-sticky and will not stain white paper when heated to temperatures as high as 130° F. I have found that the refined petrolatum stock waxes, such as are known to the trade as "Cerowax" and "Superlawax," admirably fulfill these conditions. This outer coating of wax not only fulfills the requirements for rendering the fuse containing the paper envelope flexible and waterproof, but also adds to the moisture-proofness of the fuse and makes possible a waterproof seal between the fuse and the detonator, and thus renders less necessary the use of detonator sealing compounds, as is now current practice.

Safety fuse of the character described will be highly flexible due to the character of the paper envelope and outer covering. It will be waterproof to a far greater degree than fuse heretofore made because of its freedom from fracture or rupture of the paper envelope and outer covering when the fuse is bent in handling in the field, and it will have a more uniform burning speed due to the fact that, as the fuse burns, the outer wax coating will melt freely, thereby permitting the gases of combustion to vent more uniformly through the wall of the fuse. The fuse as thus described will be no more costly to manufacture than conventional safety fuse, but will possess distinct advantages over the latter.

While I have shown and described certain preferred embodiments of my invention, I do not wish to be limited to the details of construction set forth nor to any specific manner of manufacture for the fuse, since the same may be varied without departing from the spirit of the invention.

What I claim is:

1. A safety fuse comprising a fuse core, an extensible paper envelope surrounding the fuse core, the extensibility of the paper being from approximately 10% to 50% of its original length.

2. A safety fuse comprising a fuse core

and a crinkled single paper envelope extending longitudinally of the fuse core.

3. A safety fuse comprising a fuse core and an extensible paper envelope consisting of a crinkled paper tape applied longitudinally of the fuse core.

4. A safety fuse comprising a fuse core and an extensible paper envelope consisting of a creped paper tape applied longitudinally of the fuse core, the direction of creping being transverse to the fuse axis.

5. A safety fuse comprising a fuse core and an extensible paper envelope consisting of a creped paper tape capable of from approximately 10% to 50% stretch applied longitudinally of the fuse core, the direction of creping being transverse to the fuse axis.

6. A safety fuse having an outer coating of wax which is tough and flexible over a wide temperature range.

7. A safety fuse having an outer coating of wax which is tough and flexible over the temperature range from 32° to 130° F.

8. A safety fuse having an outer coating of a light colored wax which has a sufficiently high melting point to remain firm and not stain white paper when heated to a temperature of approximately 130° F.

9. A safety fuse comprising a fuse core, an extensible paper envelope capable of from approximately 10% to 50% stretch extending longitudinally of the fuse core and an outer coating of a light colored wax which is tough and flexible over a wide temperature range.

In witness whereof, I have hereunto signed my name.

DAVID E. PEARSALL.