

Dec. 26, 1950

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2,535,518

FUSE IGNITING AND CONNECTING MEANS

Filed Sept. 25, 1948

Fig. 1

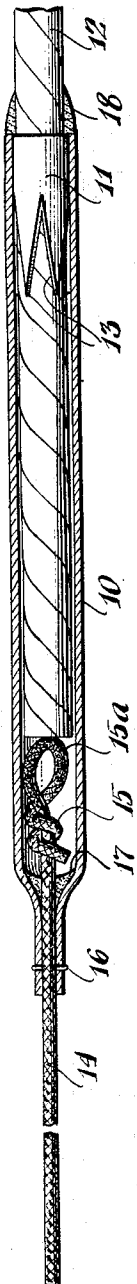


Fig. 2

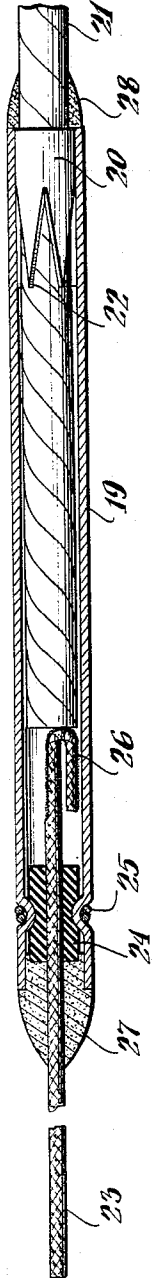
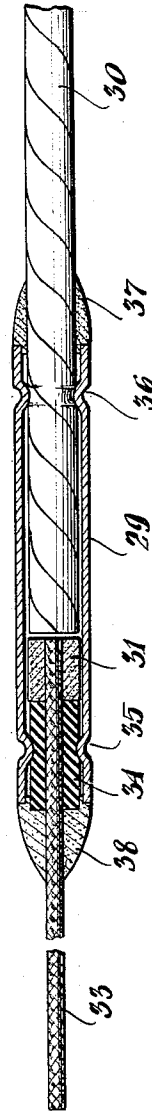


Fig. 3



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## UNITED STATES PATENT OFFICE

2,535,518.

## FUSE IGNITING AND CONNECTING MEANS

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Application September 25, 1948, Serial No. 51,254

4 Claims. (Cl. 102-27)

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This invention relates to a fuse igniting and connecting means, principally for use in blasting operations, but also usable for pyrotechnic devices, etc., which ignitively connects an ignition cord and a safety fuse or which connects other devices in which it is desired to convey fire from one type of igniting means to another with certainty under all conditions of use.

In commercial blasting operations it has been common for many years to use safety fuses. Examples of certain types of safety fuse are described in U. S. Patents Nos. 1,907,863 and 2,102,024, both to Pearsall. More recently, the so-called ignition cord of the types described in U. S. Patents Nos. 2,239,051 and 2,239,052, both to Pearsall and the present applicant jointly, has come into use for progressively igniting the safety fuses in correct rotation or a desired sequence.

Briefly, safety fuse consists of continuous lengths of a product similar in appearance to insulated wire, but containing a central powder core in place of the wire. The interior core of the fuse burns at a predetermined and uniform rate—relatively slow—under various conditions of use; and conveys fire to the explosive or explosive device. In contra-distinction, ignition cord, while produced in continuous lengths, is characterized by burning exteriorly at a uniform and relatively rapid rate; its structure consists of a central insulated wire having a powder coating which may or may not be further protected. Ignition cord is used only to ignite safety fuse or other types of igniting media.

In certain mining operations, it is important to set off a plurality of blasting charges in some regular or predetermined order or sequence. A method and means for doing this, using safety fuse and ignition cord, is described in the patent to Stoneking, No. 2,239,123. In the practice of this method it is necessary that ignition or flame be transmitted from an ignition cord as aforesaid to a safety fuse. Various arrangements have heretofore been proposed and in some cases tried out for effecting this purpose. One of the best of such prior arrangements has been to split an end portion of the safety fuse by a radial cut extending approximately to the center thereof and extending down the length of the fuse for about three-fourths an inch from the end. This cut is then opened to some extent and ignition cord placed in the opening. The two may then be bound together in any suitable manner as by wire, string, tape or the like. With this type of connection, the method outlined in the Stoneking patent may then be carried out as set forth in that patent. The slit joint is an effective firing joint, but is difficult to waterproof. Its preparation consumes an excessive amount of time. One advantage of the present invention is to provide easier, quicker and more waterproof connection means.

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The reinforcing wire element within the ignition cord enables it to retain its position when the cord is wrapped around another object as, for example, another piece of ignition cord, or a supporting rock or post.

A primary object of the present invention is to provide connecting means for use between an ignition cord and a safety fuse, so as to insure the desired transfer of fire or ignition from the ignition cord to the safety fuse under all conditions reasonably met with in practice.

Another object of the present invention is to provide connecting means as aforesaid and particularly including a tubular member of suitable size for receiving the adjacent ends of the ignition cord and safety fuse, which will be operative under all conditions of moisture such as are often met with at a blasting site and which will be operative for the certain transmission of ignition from one to the other, notwithstanding such moisture conditions.

A further object of the present invention is to provide a connecting device and means which will serve to hold the ignition cord in place adjacent to each blast hole after the associated safety fuse has been ignited, so that the ignition cord cannot contact and accidentally ignite unburned ignition cord, causing possible interference with a desired order or sequence of blasting when a plurality of charges are to be ignited in desired rotation or sequence.

Other objects and advantages of the present invention will appear from the following description and appended claims, when considered in connection with the accompanying drawings, in which:

Figure 1 is a view principally in transverse vertical section of a connecting means and a safety fuse shown in elevation in their operative relation to one another, this being the preferred form in accordance with the present invention;

Fig. 2 is a similar view showing a modified form of the present invention; and

Fig. 3 is a similar view of another modified form thereof.

Referring first to the preferred form of the invention shown in Fig. 1, there is illustrated a substantially cylindrical tubular member 10, which may be of plastic, cellulosic or metallic material as may be desired. The tubular member 10 is initially formed substantially cylindrical with both ends open prior to the assembly of the connector. A metallic sleeve 11 may be suitably inserted and secured in one end of the tubular member 10, this sleeve 11 being provided for mechanically securing an end of a piece of safety fuse 12 within the tubular member 10. As shown, the inside diameter of the member 10 is just slightly larger than the outside diameter of the safety fuse 12, so that the latter may be freely inserted through the sleeve

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11 in assembling the connector to the end of a safety fuse. The sleeve 11 is provided with a plurality of inwardly directed prongs 13 as shown for engaging the safety fuse 12 and preventing its accidental withdrawal from the tubular member 10.

One end of a length of an igniting means, as for example a short piece of ignition cord 14, which has a substantially smaller outside diameter than the inside diameter of the member 10, is projected into the other end of the member 10 as shown and terminates in a mass 15 formed by gathering or twisting together portions of the ignition cord 14, so that the mass 15 as a whole has a substantially greater diameter than that of the cord 14. As shown one end of the ignition cord may be doubled back and wrapped around a portion adjacent to the end thereof, the mass 15 as a whole being located closely adjacent to and in igniting proximity with the end of the safety fuse 12. It is preferred that this end of the safety fuse be cut off substantially on a plane at right angles to the length of the safety fuse. This is sometimes termed square cut, as distinguished from an oblique cut. Some part or all of the mass 15 may, if desired, be coated with a suitable ignition compound 15a of an oxygen-sufficient character, such compounds or compositions being well known in the art. One such compound comprises a thermit type powder carried in a nitrocellulose binder. This composition insures an incandescent glow or flash at the place of transfer of ignition and makes certain the ignition of the safety fuse. At the same time the thermit does not form gases which might generate sufficient pressure to burst the tubular member 10.

The ignition cord 14 may be held in a predetermined position within the tubular member 10 by any suitable mechanical means. In the preferred form shown in Fig. 1 this comprises a wire staple 16 passed through the sides of the tubular member 10, so as to collapse and compress it around the cord 14, each prong of the staple 16 passing through two thicknesses of the tubular member 10 and being suitably crimped on the outside as is common in the art of wire stapling.

In assembling the parts, a short length of ignition cord as 14 is secured in the tubular member 10 as shown in Fig. 1 and suitably mechanically secured in position as shown. If desired, this ignition cord may be further sealed in the end of the tubular member 10 by the use of a water-proofing composition, usually a wax-like material, a few drops of which may be introduced as shown at 17 prior to or at about the time of the insertion of the staple 16, so as to seal this end of the member 10 against the ingress of moisture. The assembly may then be transmitted to the point of use in this condition, the short length of the ignition cord 14 projecting as shown in the drawings serving to connect the assembly to some other length of ignition cord which may be assembled in accordance with the teaching of the Stoneking patent aforesaid at the point of use.

The safety fuse after being suitably square cut as aforesaid may then be introduced into the right hand end, as seen in the drawings, of the member 10 as far as it will go, i. e. to a point such that the inner square cut end is closely adjacent to the mass 15.

In addition to the mechanical means shown at 11-13 for holding the safety fuse 12 in the tubular member 10, it is usually desired that means

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be provided for preventing the ingress of moisture into the tubular member 10 between it and the safety fuse 12. For this purpose, an annular body of a suitable water-proofing compound, usually of a wax-like nature, may be provided at the joint between these members as shown in Fig. 1 at 18. The compositions shown at 17 and 18 thus constitute a sealing means for preventing ingress of moisture into the place where ignition is to be transferred as aforesaid.

In the form of the invention shown in Fig. 2, there is provided a tubular member 19, similar to the member 10, and provided with a metal sleeve member 20, similar to the member 11, for receiving one end of a piece of safety fuse 21, suitable prongs or projections 22 being provided on the member 20, corresponding structurally and functionally to the prongs 13 above described.

One difference between the forms of Figs. 1 and 2 is in the manner of holding the ignition cord, here shown at 23, in place in the tubular member 19. A further difference resides in the manner of providing for the transmission of ignition from the inner end of the ignition cord 23 to the end of the safety fuse 21, which is also preferably square cut as shown in the drawings.

In this instance there is provided surrounding the ignition cord 23, at a zone spaced from the end thereof, an annular plug 24 formed of a suitable material such as rubber, which has an outside diameter sufficiently small to be readily insertable within the tubular member 19 as shown. Thereafter the tubular member 19 may be crimped or otherwise suitably held around this plug 24. In the event that the tubular member is made of metal, this crimping may be done by a suitable crimping tool operating upon the metal itself in a manner well known in the art. If, on the other hand, the member 19 be of paper or some cellulosic material, it is usually desirable to use a binding wire as shown at 25, the wire being wound in a suitable number of turns and being twisted together in a usual manner, so as to form a groove in the tubular member 19, as shown, and to bind the tubular member tightly around the plug member 24.

In this instance the transfer of ignition is provided by forming a suitable loop or U-bend 26 of the ignition cord and cutting an outer portion thereof away, or slashing it for about one-half inch to expose an amount of the oxygen-sufficient burning composition with which the ignition cord is provided, so as to provide an incandescent glow or flash upon the lighting of the ignition cord and the transmission of combustion to the inside point thereof shown as the loop 26. This will be sufficient to ignite the burning composition centrally of the safety fuse 21, the end of which is located adjacent thereto as hereinabove described in connection with Fig. 1.

Suitable sealing means may be provided, using a wax-like water-proofing composition as shown at 27 and 28 for sealing the joints between the tubular member 19 and the ignition cord 23 and safety fuse 21 respectively, all substantially as described above in connection with the Fig. 1 form of the invention.

Turning now to the form of the invention shown in Fig. 3, there is illustrated a tubular member 29 corresponding functionally to the tubular members 10 and 19 hereinabove described. In this case, however, the tubular member 29 is preferably of metal or some relatively rigid material, which may retain any shape imparted to it and which can act by suitable deformation

so as mechanically to grip onto parts therewithin. As shown, there is projected into the right hand end of the member 29 a square cut end of a piece of safety fuse 30. Closely adjacent to the square cut end of the fuse 30 within the tubular member 29, is an insert 31 consisting at least in part of oxygen-sufficient combustible material, which may be preformed as shown into a substantially cylindrical annulus. As shown, a piece of ignition cord 33 has its end portion extending centrally through the insert 31 to a point closely adjacent to the end of the fuse 30. Surrounding the ignition cord 33 outwardly from the insert 31 is a suitable annular plug 34, which may be of rubber or some other suitable material and which serves the same function as the plug 24 described above in connection with the Fig. 2 form of the invention. The tubular member 29 may be mechanically crimped about the plug 34 and to the safety fuse 30, each by one or more annular crimping zones shown as grooves 35 and 36 respectively, so as mechanically to hold the ignition cord and the safety fuse in the desired relative position as shown in the drawing. Suitable sealing means may be provided as shown at 37 and 38, each preferably comprising a wax-like sealing composition for protecting the joint between the tubular member 29 and the safety fuse and ignition cord respectively to prevent ingress of moisture into the ignition zone shown as the chamber 31.

While there is herein shown and described several forms of the present invention, including the preferred form shown in Fig. 1, I do not wish to be limited to the forms herein particularly shown and specifically described, but rather intend that the invention shall include all reasonable equivalents thereof which will occur to those skilled in the art from the present disclosure.

#### I claim:

1. A water-resistant connecting device for ignitively joining a safety fuse to a line of ignition cord usable in the sequential firing of explosives, comprising a tubular member of a size freely to receive an end of said safety fuse, a piece of deformable ignition cord arranged to be connectible to the line of ignition cord and having one end portion projected into said tubular member to a predetermined point therein, an oxygen-sufficient combustible composition disposed about an end portion of said ignition cord adjacent to said point, means for mechanically securing said piece of ignition cord in said tubular member, and means for mechanically securing an end of a piece of safety fuse, which may be projected into said tubular member, in ignitive proximity to said piece of ignition cord at said point for preventing accidental withdrawal of the safety fuse from said tubular member once it has been inserted thereinto.

2. A water-resistant connecting device for ignitively joining an ignition cord and a safety fuse usable for igniting a charge of blasting explosive, comprising a tubular member for receiving an end portion of said ignition cord and an end portion of said safety fuse in igniting proximity to one another, means associated with said tubular member for gripping a portion of a piece of safety fuse projected thereinto to hold said safety fuse against accidental displacement therefrom, a length of ignition cord having one end portion projecting into the other end of said tubular member and having a part of this end portion within said tubular member gathered into a mass of greater diameter than that of said ignition

cord, said mass being located at a predetermined point within said tubular member, an oxygen-sufficient combustible composition disposed on at least a part of said mass, a wire fastening means for mechanically securing said ignition cord in the end of said tubular member through which it projects, and means for sealing the end of said tubular member to said ignition cord when it is in its position as aforesaid to prevent ingress of moisture into said tubular member around said ignition cord.

3. As an article of manufacture, a water-resistant connecting device for ignitively joining a safety fuse to a line of ignition cord, usable in the sequential firing of explosives, comprising a tubular member of a size freely to receive an end of a piece of safety fuse, a piece of ignition cord having a central core of deformable metallic wire arranged for connection to the line of ignition cord and having one end portion projected into said tubular member to a predetermined point therein, means for mechanically securing said piece of ignition cord in said tubular member, and means for mechanically securing an end of a piece of safety fuse which may be projected into said tubular member in the use of the device in ignitive proximity at said point to the end portion of the piece of ignition cord secured therein, for preventing accidental withdrawal of said safety fuse from said tubular member once it has been inserted thereinto, whereby in the use of said connecting device, in ignitively joining a safety fuse to a line of ignition cord in the sequential firing of explosives, the connection between said piece of ignition cord including the wire core thereof will serve to prevent physical dislocation of the lighted piece of ignition cord aforesaid, so as to prevent the uncontrolled igniting of other combustible fuse means, including other points on said line of ignition cord, whereby to prevent the firing of a plurality of charges of explosive out of a desired sequence.

4. As an article of manufacture, a water-resistant connecting device in accordance with claim 2, wherein said length of ignition cord includes a core of deformable metallic wire extending continuously throughout said length of ignition cord, whereby in the use of the connecting device in ignitively joining a safety fuse to a line of ignition cord in the sequential firing of explosives, the connection between said length of ignition cord including the wire core thereof will serve to prevent the physical dislocation of the lighted length of ignition cord aforesaid, so as to prevent the uncontrolled igniting of other combustible fuse means, including other points on the line of ignition cord, whereby to prevent the firing of a plurality of charges of explosive out of a desired sequence.

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