Dec. 28, 1937. H. E. NASH 2,103,432

ELECTRICAL FIRING DEVICE

Filed Aug. 27, 1935

FIG. 1

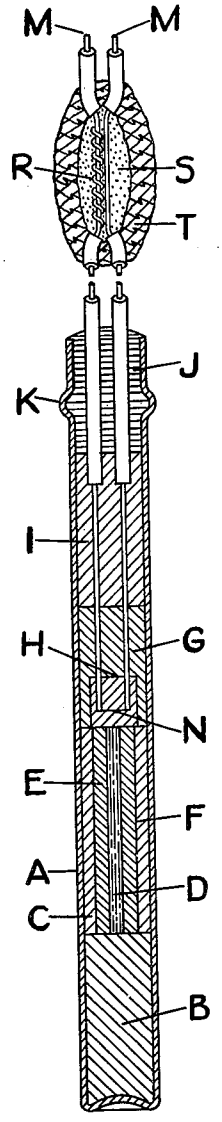


FIG. 2

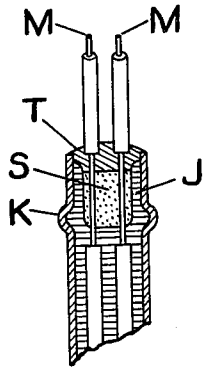


FIG. 3

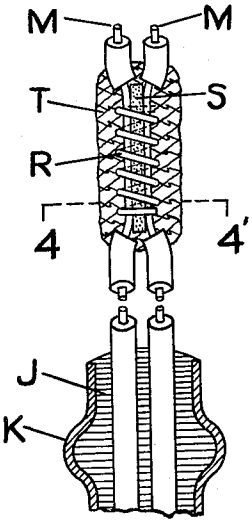
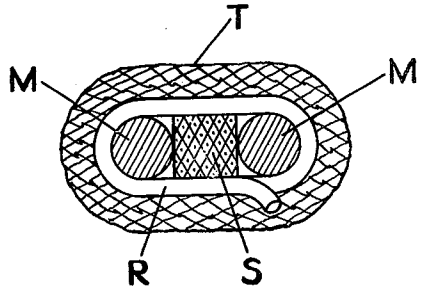


FIG. 4



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ELECTRICAL FIRING DEVICE

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7 Claims. (Cl. 102—10)

This invention relates to an improvement in blasting caps and igniters such as are used in firing commercial explosives, and more particularly relates to an improvement whereby the electrical delay blasting caps or igniters may be fired uniformly by the use of high-voltage power lines.

As is well known, delay electric blasting caps comprise a casing, a detonating charge, a slow-burning fuse composition (which may or may not evolve appreciable quantities of gas on combustion), a flash composition adapted, on heating by the bridge-wire, to ignite the slow-burning fuse, a bridge-wire of small diameter and high resistance adapted, on passage of electric current therethrough to become heated and ignite the flash composition surrounding it, lead wires extending into the blasting cap and fastened to said bridge-wire by soldering or welding, and a non-conducting plug holding the lead wires in position and forming a seal for the open end of the blasting cap, all as is more particularly described in United States Letters Patent No. 1,999,820, filed by me on March 22, 1932.

Usually, electric delay blasting caps or igniters are fired by a battery of suitable size, a blasting machine (which is essentially a hand-driven dynamo), by a 110 volt lighting circuit, or a 440 volt power circuit. Very frequently batteries or blasting machines of suitable size are not immediately available at the scene of operations, and resort is had to the convenient 440 volt power line for firing, even though such voltage be higher than necessary for the given operation. When electric delay blasting caps or igniters are connected in parallel for firing, the full voltage of the firing line is applied directly to the lead wires of each cap, and, when the bridge-wires in one or more delay caps of the series has melted, the metal vapor left from the bridge-wire forms a path for an arc caused by such high voltage.

It has been found that when using a high voltage power line there is a great tendency for the formation of an arc within the casing of the blasting cap or igniter, causing high pressures within the cap and consequent bursting of the cap shell before the slow-burning fuse has burned down to the detonating charge. Such bursting of the cap shell has the effect of destroying the cap shell, moving away from the detonating charge the burning fuse, or allowing the entrance of water into the delay, and causing failures to detonate, or misfires of the dynamite charge in the borehole.

Such arcing may occur along the path of the volatilized bridge-wire, after the bridge-wire has been melted by the heat of the current passing through it, or arcing may occur within the cap shell if the two lead wires are in too close proximity to one another. In either case the result is bursting of the cap shell and scattering of the cap elements by the internal pressure.

It should be noted that, ordinarily, most commercial dynamites are not detonated merely by a hot flame, but require a violent initiating shock, such as is imparted by the detonation of an initiating explosive, e. g. diazodinitrophenol, mercury fulminate, lead azide, etc. If the electric delay blasting cap or igniter bursts, as described above when an arc forms, there is seldom an ignition or detonation of the commercial dynamite in which the cap is embedded, but instead, the dynamite fails to detonate and a misfire is the result.

Now in accordance with my invention I provide a delay cap of such a character that arcing during high-voltage firing is avoided and consequent misfires of the dynamite charge prevented. This result I accomplish by providing a high-resistance electrical shunt path between the lead wires, either at the top of the cap or between the lead wires at some distance from the cap, in the latter case in such a manner that the high-resistance path may, for example, be buried in the tamping material used in tamping the borehole, and so protected against igniting dynamite, gas, or dust.

Having now indicated, in a general way, the nature and purpose of my invention, I shall proceed to a detailed description of a preferred embodiment thereof with reference to the accompanying drawing, in which

Figure 1 is a vertical section through an electrical delay blasting cap having an arc preventer embodying my invention, Figure 2 a fragmentary, similar, vertical section also embodying my invention, Figure 3 a fragmentary, similar, vertical section on enlarged scale embodying a further modification of my invention, and Figure 4 a plan in section 4—4 of the electric delay blasting cap represented in Figure 3.

With reference now to Figure 1 of the drawing, A indicates a casing, preferably of metal, as, for example, copper or aluminum. At the bottom of the casing is positioned a detonating charge, for example, of mercury fulminate, diazodinitrophenol, or the like, or comprising a base charge of tetryl or trinitrotoluene and a top charge of mercury fulminate or diazodinitrophenol. Above the detonating charge is positioned a slow-burning fuse C, consisting of a fuse pow-

der train D, comprising a mixture of, for example, 15% selenium and 85% barium peroxide, within a metal container E, about which there may be, if desired, a wrapping of cloth, tape, or other suitable material F. It will be understood that the length of the fuse C will be made such as to the desired delay in firing of the detonating charge B after ignition of the fuse.

Above the fuse, and for the purpose of igniting it, there is positioned a sulphur plug, for example, G, provided with a recess filled with an igniter charge H, desirably having the same characteristics as those of the fuse powder D, and, if desired, of a similar composition. Above the sulphur plug G is a waterproofing material I, of any desired composition, and the casing A is closed at the top by means of a sulphur plug J, which, when poured in, enters the crimp ring K and becomes keyed to the casing A.

Lead wires M, M extend into the casing A, through plug J, waterproofing composition I, plug G, and into igniter charge H. The ends of the lead wires M, M are connected by means of a bridge-wire N, as is usual in electric blasting caps, and the bridge-wire may, if desired, be coated with a readily-ignited composition, as, for example, diazodinitrophenol and potassium chlorate mixture, or the like, together with a binder, for example, nitrocellulcse, or the like, the binder being in sufficient quantity, however, insufficient to produce any substantial quantity of gas on burning.

Above plug J the lead wires M, M have the insulation removed therefrom for a distance, and around one of the lead wires at its bare portion is wrapped, for example, a graphite-impregnated thread or cord R. The other lead wire, at its bare portion, is then brought into close proximity to the lead wire which has been wrapped with graphite-impregnated thread, and the two lead wires, at their bare portion, are separated from one another merely by the graphite-impregnated thread. While maintained in such position a fused material, for example, sulphur, is poured around such positioned lead wires and allowed to solidify to a mass S, to maintain the lead wires and graphited thread in the position shown. The mass S may, if desired, be further protected by casting or molding thereabout a protecting sleeve T, for example, of pitch or the like.

By way of specifically illustrating the practical embodiment of my invention where other means are provided to form the arc-preventing electrical shunt, reference is made to the accompanying drawing, Figure 2, which shows a fragmentary cross section of an electrical blasting cap, M, M the lead wires, passing through plug J, retained in the cap shell by crimp groove K, said lead wires M, M passing also through, for example, a high-resistance, graphite composition or finely divided lead peroxide, S, which forms the high-resistance, arc-preventing electrical shunt, and said composition S, for example, is retained in the position shown by a plug T, for example, of poured pitch.

For further illustration of the practical carrying out of my invention, reference is made to the drawing, Figure 3, which illustrates, on an enlarged scale, a fragmentary cross section through an electric delay blasting cap embodying my arc-preventing shunt in a still further modification, where M, M represents the lead wires, J the sulphur plug, retained in the shell by groove K, S a strip of, for example, graphite impregnated, thick paper or pasteboard, R a non-conducting, flexible wrapping material, for example, string or cord, adapted to hold the bare parts of lead wires M, M in close contact with the high-resistance strip S, and T represents a protective composition, for example, pitch or tape.

Reference is also made to the drawing, Figure 4, which depicts a plan of the shunt of Figure 3 at the cross section 4—4'.

My invention is also applicable to electric delay blasting caps which contain, as the fuse or delay element, compositions which burn with development of gases of combustion, for example, black powder trains, which electric delay blasting caps are provided with a vent for the escape of such gases of combustion. In such electric delay blasting caps, although there is a small vent for the escape of the gases of combustion of the fuse train, said opening is incapable of venting the large quantity of extremely hot gas caused by an arc within the cap caused by the application to the lead wires of high voltages, with the result that, under such conditions, the electric delay blasting cap bursts from the high internal pressure, and misfires result.

My invention is also applicable to electric igniters, which are used for firing fuse and black powder charges of explosives. Such electric igniters contain no detonating charge and are open or easily ruptured at the bottom of the shell, so that the flash from the burning of the last portion of the delay fuse element can strike directly the charge of black powder in the cut end of a common fuse or the black powder in the borehole, and ignite the same. It should be noted that, when using igniters for firing common fuse, an arc within the igniter shell, caused by a high voltage firing source, will burst the igniter, scatter the same, and cause misfires of the fuse. When using igniters for firing charges of black powder in a borehole, an arc within the shell of the igniter will burst the shell of the igniter, scatter the elements of the igniter, and cause ignition of the charge of black powder in the borehole before the fuse train delay element has had a chance to burn, thus causing premature explosion of the charge of black powder in the borehole. All these disadvantages are avoided by the use of my arc preventing shunt.

In the operation of my improved electric blasting caps, when connected in series, and the lead wires connected to a source of high voltage, at the instant when the bridge-wire heats and fuses an arc would tend to form across the metal vapor where the bridge-wire had been an instant before. Such a path through the metal vapor has, however, a relatively high resistance, so that the electric current chooses instead a path through the outside shunt S, as represented in the drawing. This shunt, while passing such current, becomes highly heated, but since the shunt is external to the delay blasting cap, no pressures internal to the blasting cap can develop and burst the cap. As has been stated, high temperatures do not detonate most commercial dynamites as at present manufactured, and, in the use of dynamites more sensitive to heat than these, or in the use of black powder explosive, resort is had to the modification of the shunt shown in Figures 1 or 3, since it is then possible to place the shunt in the tamping of the borehole, instead of within the explosive blasting charge, in which position it cannot come into contact with any explosive.

What I claim is:

1. An electric delay firing device for firing ex-

plosives including a bridgewire, lead wires connected to the bridgewire and adapted for connection into an electric circuit, said lead wires having uninsulated portions along a portion of the length of said lead wires, and a shunt having an electrical resistance in excess of that of the bridgewire and sufficiently low so that on fusing of the bridgewire by an electric current the formation of an arc will be prevented by passage of the current through the shunt.

2. An electric delay firing device for firing explosives including a shell, a fuse within the shell, a bridgewire and a flash composition about the bridgewire adapted to ignite the fuse, lead wire connected to the bridgewire and extending without the shell, said lead wires having uninsulated portions along a portion of the length of said lead wires, and a shunt having an electrical resistance in excess of that of the bridgewire and sufficiently low so that on fusing of the bridgewire by an electric current the formation of an arc will be prevented by passage of the current through the shunt.

3. An electric delay firing device for firing explosives including a metal shell, a fuse within the shell, a bridgewire, and a flash composition about said bridgewire adapted to ignite said fuse, lead wires connected to said bridgewire and extending through the open end of said metal shell and having uninsulated portions along a portion of the length of said lead wires, an insulating plug within said metal shell adapted to hold said lead wires in position spaced from one another and from the metal shell, and a shunt having an electrical resistance in excess of that of the bridgewire and sufficiently low so that on fusing of the bridgewire by an electric current the formation of an arc will be prevented by passage of the current through the shunt.

4. An electric delay blasting cap for firing explosives including a metal shell, a detonating explosive within said shell, a fuse within said shell adapted to detonate said explosive, a bridgewire and flash composition about said bridgewire adapted to ignite said fuse, lead wires connected to said bridgewire and extending through the open end of said metal shell and having uninsulated portions along a portion of the length of said lead wires, an insulating plug within said metal shell adapted to hold said lead wires in position spaced from one another and from the metal shell, and a shunt having an electrical resistance in excess of that of the bridgewire and sufficiently low so that on fusing of the bridgewire by an electric current the formation of an arc will be prevented by passage of the current through the shunt.

5. An electric delay firing device for firing explosives including a metal shell, a fuse within said shell, a bridgewire and flash composition about said bridgewire adapted to ignite said fuse, lead wires connected to said bridgewire and extending through the open end of said metal shell and having uninsulated portions along a portion of the length of said lead wires, an insulating plug within said metal shell adapted to hold said lead wires in position spaced from one another and from the metal shell, and a graphite shunt having a resistance in excess of that of the bridgewire and sufficiently low so that on fusing of the bridgewire by an electric current the formation of an arc will be prevented by passage of the current through the shunt.

6. An electric delay firing device for firing explosives including a metal shell, a fuse within said shell, a bridgewire and flash composition about said bridgewire adapted to ignite said fuse, lead wires connected to said bridgewire and extending through the open end of said metal shell and having uninsulated portions along a portion of the length of said lead wires outside the shell, an insulating plug within said metal shell adapted to hold said lead wires in position spaced from one another and from the metal shell, and a shunt having a resistance in excess of that of the bridgewire and sufficiently low so that on fusing of the bridgewire by an electric current the formation of an arc will be prevented by passage of the current through the shunt.

7. An electric delay blasting cap for firing explosives including a metal shell, a non-detonating explosive within said shell, a fuse within said shell adapted to fire said explosive, a bridgewire and flash composition about said bridgewire adapted to ignite said fuse, lead wires connected to said bridgewire and extending through the open end of said metal shell and having uninsulated portions along a portion of the length of said lead wires, an insulating plug within said metal shell adapted to hold said lead wires in position spaced from one another and from the metal shell, and a shunt having a resistance in excess of that of the bridgewire and sufficiently low so that on fusing of the bridgewire by an electric current the formation of an arc will be prevented by passage of the current through the shunt.

HENRY E. NASH.