Oct. 25, 1960 F. LAZARI 2,957,415

SAFETY DEVICE FOR ELECTRIC PRIMERS FOR MINES, TO PROTECT AGAINST IGNITION BY STRAY ELECTRIC CURRENTS

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FIG. 1

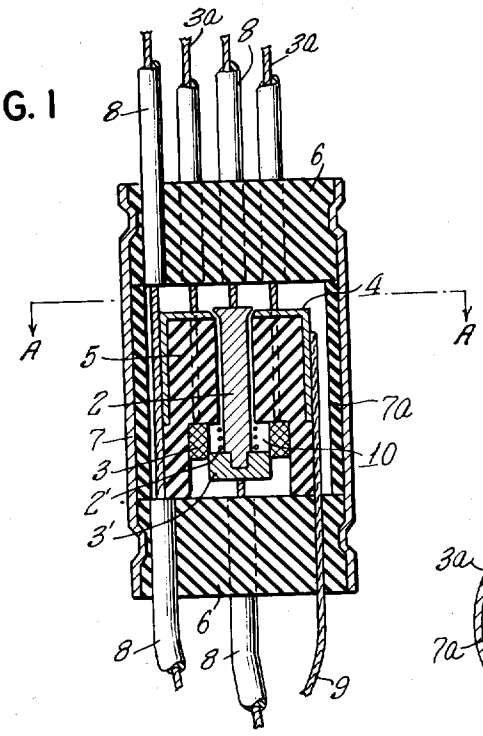


FIG. 2

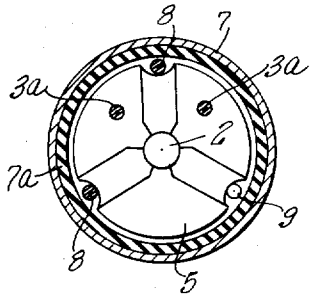
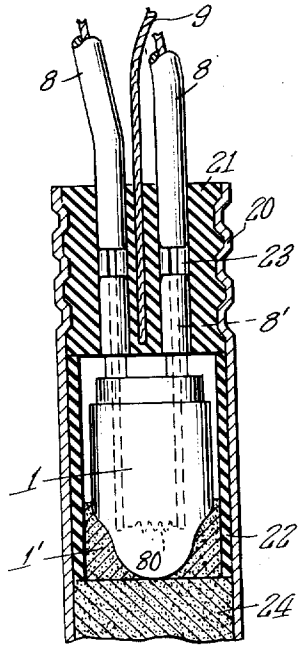


FIG. 3



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FIG. 4

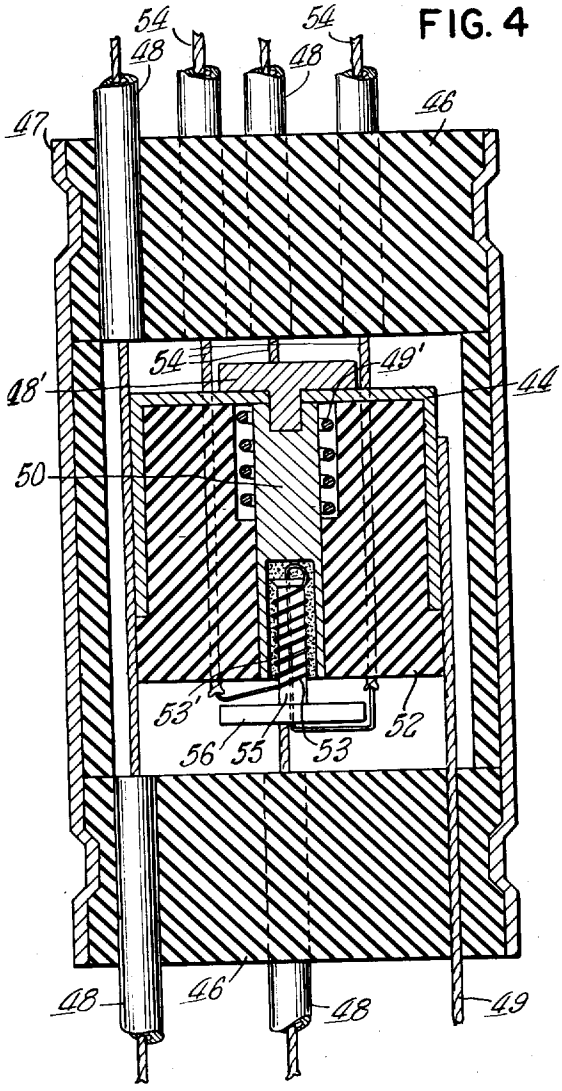
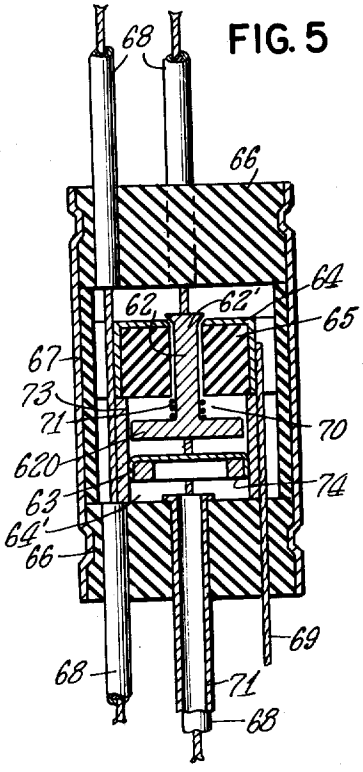


FIG. 5



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2,957,415

SAFETY DEVICE FOR ELECTRIC PRIMERS FOR MINES, TO PROTECT AGAINST IGNITION BY STRAY ELECTRIC CURRENTS

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3 Claims. (Cl. 102—28)

This invention relates to devices designed to electrically ignite, or fire simultaneously from a distance, one or more charges of explosive which are contained, for example, in mines placed in the earth. More particularly, it concerns safety apparatus employed in conjunction with the electric primers or igniters to prevent premature detonation by stray currents of electricity, in the earth, or in the general vicinity of the igniters.

Electric primers for the ignition of blast charges or mines, although offering important advantages over normal primers ignited by a gunpowder slow fuse, may sometimes be a source of danger. This is particularly the case in the preparation of a group of bursts, in that premature and untimely detonation may be caused by stray electric currents, or by other electric phenomena that may occasionally act upon the electric circuits of the primers. When the electric primer is designed to employ low-intensity currents for regular functioning, which is generally desired, it becomes susceptible to the action of such stray electric phenomena.

On the other hand, modern mining techniques, which require simultaneous blasting by a very high number of charges, also demand the use of electric primers whose ignition requires only moderate power. Otherwise the proper performance of electric firing would become too difficult to attain, and would lose most of its practical usefulness, because it would require high powered generators. This would require additional insulation in the firing circuits.

Various solutions have been proposed for the best possible protection of the electric primers from stray electric phenomena. The protection heretofore afforded leaves much to be desired, since it is often associated with an undesirable change in the functional characteristics of the electrical firing means, namely reduced sensitivity. This leads to an increase in the power demand of the usual firing means, and hence to the aforementioned difficulties.

It is an object of my invention to protect electric primers in general, and particularly those of the bridge type, from the above-mentioned occasional electric effects. These include extraneous currents, electrostatic charges, induction currents and, in general, all electric phenomena associated either with atmospheric electric discharges or discharges originating from nearby electric plants. This is accomplished without any modification of the usual, and desired, functional electric characteristics of the primers.

To this end, and in accordance with a preferred form of my invention, the electric primer or igniter is coupled with a safety device which short-circuits the two electric conductors leading to the electrical firing means, the short-circuit being located ahead of the firing means and being connected by a third conductor with the metal shell of the primer. In practice, the metal shell may be grounded.

Such shortcircuiting of each primer eliminates the possibility of any potential difference occurring between the firing circuits and the metal shell of the primer, or between the two current supply conductors. Any such potential difference could cause premature ignition of the firing circuit and hence of the primer, due either to sparking or other discharges occurring in the primer between the interior parts on different potential, or by the Joule effect of stray current circulating through the firing circuit.

The safety device is built so that the short-circuit is disconnected, when desired, by remote control, after all drilled blast holes of the group to be ignited have been charged, and all circuits have been properly connected. The disconnection of shortcircuits can be controlled, immediately before the firing, from the same safe location at which the firing of the blast group is initiated. The disconnection by remote control of the short-circuit device can be carried out in various ways according to the present invention, for example by means of an electric current passing through a circuit independent of the one used for firing, or by pneumatic compression or by pressure release. The device can take various forms and employ different action mechanisms. Thus, the electric current may act either by Joule effect, including the effects of thermal expansion of elements suitable for such purpose, or by electromagnetic effect.

The different embodiments of the invention described hereinafter are intended merely as examples of the invention. The invention is not limited thereto.

Several preferred embodiments of the invention are illustrated in the drawing, in which:

Fig. 1 is a vertical section of a form of the short-circuiting safety device which employs an electromagnetically operated short-circuit breaking means, to normalize the igniter circuit;

Fig. 2 is a plan view in section on line A—A of Fig. 1;

Fig. 3 is a vertical section of the igniter cap or electric initiator or primer;

Fig. 4 is a vertical section of another form of the short-circuiting safety device in which a fusible or low-melting substance is melted by an electric resistance wire to release a short-circuit breaking means, whereby the igniter circuit is normalized;

Fig. 5 is a vertical section of a third form of safety device in which pneumatic means is employed to open the short circuit.

The structure of the electric initiator, primer or igniter cap may be of any conventional design. The electric conductors **8** of the firing circuit are connected at couplers **23** (Fig. 3) to connector wires **8'** which lead into a casing or package **1**. This casing contains the usual igniting bridge resistance wire **80** surrounded by an ignition composition (not shown). About the lower end of casing **1** is a priming charge **1'**, and below the latter is a pressed base charge **24**. The outer primer casing **20** is generally a bronze shell the upper part of which is sealed by a rubber or plastic seal **21**.

Electro-conductively connected to metal shell **20** is a conductor wire **9** the upper end of which passes through insulator sealing plug **6** in the lower end of the metal casing **7** of the safety device. Wire **9** is electro-conductively connected at its upper end to one of the three bent conducting strips **4**. These strips **4** are supported upon insulating material **5**. One of the functions of wire **9** is to grund a strip **4** through metal casing **20**. The two covered conductors **8** pass through lower and upper plugs **6**, each conductor **8** being electro-conductively connected to one of the remaining two strips **4**. The leads **3***a* are connected to energize the electromagnet **3**, which controls an armature **3'** fixed upon the lower end of a reciprocable, metallic electro-conductive piston **2**. This piston has a flared head which electro-conductively bridges the three strips **4** as shown in Fig. 2. At **7***a* is an insulating sleeve. Normally the piston **2** is held in its lowermost position by

compression spring 2', and thus serves to short-circuit the two conductors 8; that is, to connect them to each other and to connect them to casing 20, and to ground when the latter is placed in a bore hole.

Immediately before the firing, the electromagnet, which is in an electric circuit independent of the firing circuit, causes the movement of piston or core 2, and this movement, by disconnecting the pre-existing short-circuit, re-establishes the normal electric circuit for igniting the electric firing means.

In Fig. 4 the safety device comprises a metal casing 47 sealed at its upper and lower ends by means of insulator plugs 46 through which pass the covered leads 48. The latter serve the same purpose as leads 8 of Fig. 1. Within the casing 47 each of the conductors 48 is connected to a bent metal strip 44 of which there are three, all disposed like strips 4 of Figs. 1 and 2. The strips are supported on or embedded in insulating material 52. A conductor 49, which serves the same purpose as conductor 9 of Fig. 1, is connected to the third strip 44 and to the primer casing 20. Ordinarily the three strips are electrically connected to each other by the central bridging disc or metal flange 48' fixed upon the upper end of reciprocable piston 50. The latter is under upward pressure of compression spring 49'. Piston 50 ordinarily cannot move upwardly because it is immovably held in its lowermost position by a dielectric mass 53' melting at 50°–200° C., such as sulfur. When a current is passed through leads 54 and embedded wire 53, which is coiled about an upright arm 55 formed upon stationary member 56, the sulfur melts, resulting in the release of the piston 50. This breaks the short-circuit between the two conductors 48, the connection of the later to the wire 49 also being broken.

Immediately before the burst, an electric current of suitable intensity is passed through the electric resistance 53 which is inserted into a circuit that is independent of the firing circuit whereby the dielectric mass is melted by the electrothermal effect. This allows the spring 49' to push the piston, which cuts off the pre-existing short-circuit and thus re-establishes the normal electric circuit preparatory to the ignition of the electrical firing means.

In the form shown in Fig. 5, ordinarily the upper flange 62' of metal piston 62 electro-conductively bridges the three bent metal strips 64, being pressed downwardly by compression spring 71 bearing against the lower surface of insulating material or block 65. When air pressure is applied through pipe 71 and chamber 64' to the lower surface of flexible diaphragm 63, the gas pressure below flange 620 of piston 62 is increased, causing the upward movement of the piston. If necessary a gas vent to atmosphere can be provided for the chamber 70 above the flange 62'. The apparatus can also be operated by applying suction, by disposing flange 62' below the ends of the contact strips 64, or by reversing the positions of the flanges 62' and 620. The other elements of Fig. 5 are like those of the previous figures. The metal housing 67 is sealed at its ends by insulating rubber plugs 66 through which the leads 68 pass. The pneumatic chamber is provided by, and formed by, an inner sleeve 73 of insulating material, which supports ring 74. The latter carries diaphragm 63. The metal strips 64 are supported upon insulating block 65.

Immediately before the burst, a suitable air pressure of vacuum is applied which causes displacement of the pistons whereby the pre-existing short-circuit is cut off. This re-establishes the normal electric circuit for the ignition of the electrical firing means.

I claim:

1. An electric blasting initiator comprising igniter apparatus including electric circuit means to initiate a blast, the said electric circuit means having two conductors connected thereto and adapted to be connected to an electric current source and to carry current to and from the igniter apparatus, a separate safety device comprising electro-conductive means normally connecting the two conductors to short circuit them ahead of the igniter electric circuit means, and remotely controllable means independent of the blast initiating circuit to disconnect the electro-conductive means at the will of the operator, to remove the short-circuit preparatory to initiating the blast, the independent means comprising an electromagnetic coil, the position of the electro-conductive means being controlled by the electromagnetic coil, said electro-conductive means normally grounding the two conductors when the igniter apparatus is grounded.

2. An electric blasting initiator comprising igniter apparatus including an electro-conductive outer shell and electric circuit means to initiate a blast, said electric circuit means having two conductor leads connected thereto adapted to be connected to an electric current source and to carry current to and from the igniter apparatus from a distance, a separate safety device comprising electro-conductive circuit means normally connecting the two conductors to short circuit them and normally connecting them to the said outer shell, and remotely controllable means to open circuit the electro-conductive circuit means at the will of the operator, to remove the short-circuit preparatory to initiating the blast, the means to open circuit comprising an electromagnetic coil operatively positioned to control a movable part of said electro-conductive circuit means, said electro-conductive means normally grounding the two conductors when the igniter apparatus is grounded.

3. The apparatus described in claim 2, the electro-conductive circuit means of the safety device comprising two conductive elements each connected to one of the two conductor leads, and further comprising a third conductive element connected to the outer shell of the igniter, and further comprising a moveable piston having at least a part thereof normally in position to electrically connect the three conductive elements, the electromagnetic coil controlling the position of the piston.

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