

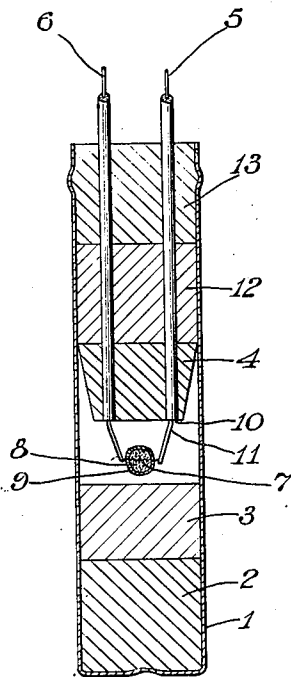
Jan. 2, 1940.

L. A. BURROWS ET AL

2,185,370

ELECTRIC INITIATOR

Filed April 14, 1937



Lawton A. Burrows
Walter E. Lawson

INVENTORS

BY

Wm. C. Wilson

ATTORNEY.

UNITED STATES PATENT OFFICE

2,185,370

ELECTRIC INITIATOR

Lawton A. Burrows, Wenonah, and Walter E. Lawson, Woodbury, N. J., assignors to E. I. du Pont de Nemours & Company, Wilmington, Del., a corporation of Delaware

Application April 14, 1937 Serial No. 136,743

12 Claims. (Cl. 102—10)

This invention relates to electric explosive initiators generally and more particularly to electric blasting caps possessing superior initiating features and of a design adapted to promote safety in handling and use.

Electric blasting caps consist essentially of a cylindrical metal shell containing a detonating base charge, an ignition composition, and an electric firing means in contact with, or embedded in, the ignition composition. The firing means commonly employed comprises an electrical conductor of high resistance joining the two leg wires of the firing circuit. When the current is applied to the firing circuit, this high resistance bridge wire is heated to incandescence, thereby firing the ignition composition, which in turn initiates the detonating base charge.

Electric blasting caps may be classified into three general types depending on certain structural characteristics of the firing means. One of these is known as the "bridge plug type" and contains a plug of insulating material, usually in the shape of a truncated cone, which holds the leg wires of the firing circuit in fixed relationship. The leg wires, extending somewhat beyond the base of the plug, are connected by a high resistance bridge wire which is surrounded by an ignition composition.

A second type of electric blasting cap is known as the "concave plug type." In this type the leg wires are also held in fixed spaced relationship by a conically shaped plug of insulating material. In this case, however, the smaller base of the plug is provided with a shallow concavity. The ends of the leg wires, and the bridge wire connecting the two, are arranged within this cavity, which serves to protect the bridge wire from rupture. The ignition composition employed for this type of blasting cap is usually applied in plastic condition and dries to form a hard cemented composition in this depression.

The third type of electric blasting cap is known as the "match-head type" and consists generally of a flat strip of insulating material, the two faces of which are covered with metal foil. A bridge wire passing around the end of the strip connects the two separated pieces of foil, which are soldered to the respective leg wires. A small pelleted mass is usually formed about the bridge wire to serve as ignition means.

The above three types are applicable to all uses where electric blasting caps are desired, for example in ordinary blasting operations and in cases where speed of functioning and absence of time lag are requisites. The so-called "fast" caps

are of particular importance, for example, in seismographic prospecting, where the need for accuracy in recording the exact time of detonation of the cap makes it essential that there be practically no time interval between the breaking of the bridge wire and the actual detonation of the cap compositions, in other words that there shall be no appreciable induction period. The copending case of Aughey, Burrows, and Lawson (Serial No. 47,385, filed October 30, 1935), has described various ignition compositions that are highly satisfactory for utilization in caps characterized by absence of time lag, for example lead styphnate, basic lead picrate, copper acetylide, silver azide, and the like. Such compounds, however, have shown themselves to be susceptible to the action of static electricity, and for this reason are hazardous for use under ordinary conditions. The above-mentioned application discloses methods of rendering caps containing such compounds entirely free from hazard from electro-static causes.

While employment of rapid ignition compounds has been made entirely practicable and free from hazard, there have been some undesirable features in the electric blasting caps containing such compounds from the point of view of lack of simplicity in construction. A marked advance has been made in the direction of providing an instantaneously functioning blasting cap free from susceptibility to static, but further advances have been indicated to be desirable.

The object of the present invention is a new and improved electric blasting initiator which is free from susceptibility to electrostatic discharges. A further object is an electric blasting cap without an appreciable induction period and substantially free from susceptibility to static electricity. A still further object is an electric blasting cap of the character described, in which the means of ignition has been simplified and improved. Other objects will be apparent as the invention is described more fully hereinafter.

We have found that the foregoing objects are accomplished by the employment of an ignition means comprising a bead or mass of ignition material attached on the bridge wire of the bridge plug type of initiator, said bead being confined within a surface layer of hard, substantially non-flexible, pressure-resistant coating material. While such material may be of various compositions, it should be one that can be applied to fluid form and become hard, non-flexible, and pressure-resisting on standing. It may, for ex-

ample, be a solution or dispersion of a coating material in a volatile solvent of such nature that the latter may be subsequently volatilized. Preferably, however, we use as coating material one that can be applied in molten form and that will become solidified and hardened on cooling. It is desirable, therefore, that the material have a sharp melting point and sharp solidification point and that it possess a considerable degree of hardness and sufficient strength to offer satisfactory confinement to the explosive charge. This molten method of application is much more desirable than the solvent method first mentioned, for the reasons that it avoids the difficulty of removing the solvent, and likewise avoids the unsatisfactory nature of the coating, which exists as long as any solvent remains therein.

As an example of such a material we may use a resinous composition, for example a cumarone or cumarone-indene resin, a desirable one being of the latter composition and melting at around 150 to 160° C. Another example of a suitable resin is one of the chlorinated biphenyl type such as have been produced commercially under the trade name "Aroclors", preferably one melting between 100 and 150° C. We may also apply a coating of a hard wax, such as carnauba wax, or carnauba wax containing a filling material. Another effective type of coating from the point of view of confinement comprises a fusible metal, for example Wood's metal, having a melting point of about 90° C. Preferably, we employ as coating material a composition comprised largely of sulfur, and desirably sulfur to which various other materials have been added in small amounts for control of the consistency and strength. A composition containing about 95% sulfur is suitable, for example, with additions of such materials as graphite, pitch, chalk, siliceous materials, and the like.

The above coatings are applied to the bead in molten form. A casting method may, for example, be used, where the mold is so shaped that it can be withdrawn from the hardened bead. Preferably, we perform the coating operation by dipping the hard explosive bead into a bath of the molten coating material, withdrawing it, and allowing the bead to solidify and harden on cooling.

As ignition material we prefer to use lead styphnate or analogous compound that ignites substantially instantaneously, for example basic lead picrate, silver azide, the silver or mercury salt of chlorinated azodicarbonamidine, and the like. A suitable form for application to the bridge wire is a suspension of the ignition composition in a viscous solution of nitrocellulose in a suitable solvent. Using such a suspending solution, a bead is formed that smooths out satisfactorily about the bridge wire in the form of a small drop and sets quickly to a hardened mass. This bead is covered with a surface coating of a hard, confining, pressure-resistant material that is rigid when cold. Such a coating may be comprised desirably of the sulfur composition described heretofore, containing, for example, over 90 or 95% sulfur. The composition may be applied by maintaining it in molten form at around 150° C., for example, and dipping therein the bead of ignition composition, the important consideration being that the bead be completely covered. The presence of such a coating has the advantages of (1) protecting the friction-sensitive bead from any possible impact hazards resulting during the spacing of the bead in the cap, (2) protecting

the bead from electrostatic discharges, and (3) affording a substantially non-flexible, pressure-resisting coating that allows the practically instantaneous development of the full pressure of the ignition charge and thereby aids in the ignition process. The assumption is that the confinement of the coating is sufficient to cause detonation of the enclosed charge and that ignition of the secondary charge is brought about then by shock rather than by flash. Reduction or elimination of the time lag is thereby accomplished. Whereas compounds such as lead styphnate are so fast that, when used in quantity, they detonate substantially instantaneously, the amount present in the bead is so small as to deflagrate when unconfined. The confinement of the coatings described is sufficient to bring practically instantaneous detonation rather than deflagration. When such compounds as lead styphnate and the like are used in initiators of the "concave plug" type, elimination of time lag is attained without use of a confining coating because of the confinement afforded by the concavity and the juxtaposed charge.

While our invention is particularly applicable when fast, static-susceptible compounds are used as bead ignition materials, it gives decreased induction periods also when compounds are used of a slower order of ignition, for example, mercury fulminate.

We preferably impart additional protection by so constructing the firing mechanism that any electrostatic charge will be discharged outside the locus of the ignition composition. While various means for this result may be adopted, we find a simple and effective method to comprise bending the two leg wires in toward one another shortly beyond the point where they leave the bridge plug. By this expedient the wires are closer to the shell wall near the plug than they are at the locus of the bridge wire and the bead surrounding said bridge wire. Consequently, any static charge will tend to discharge at the point where said leg wires are closest to the metal shell wall, thereby protecting the sensitive ignition composition.

By way of more exact illustration, the attached drawing shows a vertical elevation of an electric blasting cap, according to our invention. This is done by way of illustration only, and is not to be regarded as a limitation in any way to the scope of the invention, since many variations will be readily apparent.

In the drawing, 1 represents the shell wall of a suitable metal, 2 a base charge of tetryl, and 3 a top charge of lead azide. The bridge plug 4 holds in spaced position the leg wires 5 and 6, while above the bridge plug are the water-proofing composition 12, and a sulfur seal 13. The leg wires are connected at their termination, below the bridge plug, by a high resistance bridge wire 7 which is surrounded by the bead 8, having an inflexible pressure-resistant coating 9. A feature that adds to the protection against electrostatic effects may be illustrated on leg wire 5 which leaves the bridge plug at 10. At 11 this wire is distinctly bent in toward the center of the cap shell and away from the shell wall. In case of discharges of static electricity, therefore, such discharge will take place to the shell wall from the portion 10 to 11, this section being sufficiently outside the locus of the bead of sensitive ignition material as to afford complete protection for the cap. It will be seen that the same protection is likewise provided by wire 6. Only 75

when the firing current is applied to the leg wires will bead 7 be ignited, which will cause instantaneous detonation of the other cap charges.

From the foregoing description, it will be apparent that one feature of our invention is the discharging portion of the firing circuit, with respect to possibly accumulated charges of static electricity. In the example, there is the double medium for discharge, by reason of the two wires, and a construction such as is shown there is our preferred form. It will be understood, however, that other means for facilitating discharge may be included if desired, for example attachments to, or distortions of, one or both wires bringing them closer to the shell wall, or even the grounding of one of the wires to the metal wall. The bead of ignition material will preferably be positioned close to the layer of the charge to be ignited.

The following table is illustrative of the advantages obtained by our invention, where the induction period for bead type ignition caps is shown as measured by the cathode ray oscillograph. Examples are given of coated and uncoated beads, in which lead styphnate is used as an example of a very fast compound and mercury fulminate as illustrating one of the detonating compounds in ordinary commercial use.

Bead	Coating	Induction period
Lead styphnate.....	None.....	0.00004 sec.
Do.....	Sulfur composition.....	Immeasurably small.
Do.....	Cumaron-indenoresin.....	Not > 0.00002 sec.
Do.....	Chlorinated biphenyl resin.....	Not > 0.00002 sec.
Do.....	Carnauba wax.....	Not > 0.00002 sec.
Do.....	Wood's metal.....	< 0.00002 sec.
Mercury fulminate—potassium chlorate: 90-10 compositions.	None.....	0.0010 sec.
Do.....	Sulfur composition.....	0.0005 sec.

The foregoing results indicate the value of a firm, non-flexible, pressure-resisting coating of the type described, in decreasing the induction period in electric blasting caps employing the bead of ignition.

The advantages of our invention will be apparent, therefore, since an improved electric blasting initiator has been disclosed having increased safety properties and of a simplified form of construction for an initiator embodying such features. While the invention has been described particularly in relation to electric blasting caps, which contain detonating explosives and are adapted to the initiation of high explosives of the dynamite type, it is equally applicable to the so-called electric squibs, which are adapted for use in igniting deflagrating explosives such as black powder.

In the foregoing detailed description of our invention it is apparent that many variations in composition and procedure may be made without departing from the spirit or scope thereof. We wish to be limited, therefore, only by the following patent claims:

We claim:

1. An electric blasting initiator comprising a loaded shell, a plug disposed in said shell, a pair of leg wires extending into said shell through said plug with their ends disposed below said plug, an electric filament disposed between the ends of said leg wires electrically connecting said ends, a coated bead of ignition material spaced from the said plug and suspended on said filament, the coating on said bead comprising a

hard, substantially non-flexible pressure-resistant material of a hard, solidified melt completely coating said bead of ignition material, said coating material being characterized by a sharp solidification point above normal temperatures.

2. An electric blasting initiator comprising a loaded shell, a plug disposed in said shell, a pair of leg wires extending into said shell through said plug with their ends disposed below said plug, an electric filament disposed between the ends of said leg wires electrically connecting said ends, a coated bead of ignition material disposed about said filament, the coating on said bead comprising a hard, substantially non-flexible pressure-resistant layer of a hard, solidified melt completely surrounding said bead of ignition material, said coated bead being spaced from the plug and from the sides of the shell, said coating material being characterized by a sharp solidification point above normal temperatures.

3. An electric blasting initiator comprising a loaded shell, a bridge plug disposed within said shell, bridge posts extending through and below the base of said bridge plug, a bridge wire disposed between said bridge posts below said bridge plug, a coated bead of ignition material disposed about said bridge wire and spaced from the plug and shell wall, said coating comprising a hard, substantially non-flexible pressure-resistant layer of solidified sulfurous composition.

4. The electric blasting initiator of claim 3 wherein the bead of ignition material comprises lead styphnate.

5. The electric blasting initiator of claim 3 wherein the bead of ignition material comprises mercury fulminate.

6. The electric blasting initiator of claim 2 wherein the coating material comprises a resinous material.

7. The electric blasting initiator of claim 2 wherein the coating material comprises a readily fusible metal fused about said bead to form said hard, substantially non-flexible pressure-resistant coating.

8. The electric blasting initiator of claim 3 wherein the sulfurous composition comprises approximately 95% sulfur.

9. An electric blasting initiator comprising a charged metal shell and a firing circuit, said circuit comprising a bridge plug, leg wires passing through said bridge plug in dielectric relation with each other, a bridge wire connecting said leg wires, and a bead of ignition material surrounding said bridge wire, said bead being confined within a hard surface layer of substantially non-flexible, pressure-resistant material, said leg wires being bent in toward one another below the region of their emergence from said bridge plug, and outside the locus of said bead of ignition material, permitting the harmless discharge of static electricity.

10. An electric blasting initiator comprising a charged metal shell and a firing circuit, said circuit comprising a bridge plug, leg wires passing through said bridge plug in dielectric relation with each other, a bridge wire connecting said leg wires, and a bead of ignition material comprising lead styphnate surrounding said bridge wire, said bead being confined within a hard surface layer of substantially non-flexible, pressure-resistant material, said leg wires being bent in toward one another below the region of their emergence from said bridge plug, and outside the locus of said bead of ignition material, permitting the harmless discharge of static electricity.

11. An electric blasting initiator comprising a charged metal shell and a firing circuit, said circuit comprising a bridge plug, leg wires passing through said bridge plug in dielectric relation with each other, a bridge wire connecting said leg wires, and a bead of ignition material comprising basic lead picrate surrounding said bridge wire, said bead being confined within a hard surface layer of substantially non-flexible, pressure-resistant material, said leg wires being bent in toward one another below the region of their emergence from said bridge plug, and outside the locus of said bead of ignition material, permitting the harmless discharge of static electricity.
12. An electric blasting initiator comprising a charged metal shell and a firing circuit, said cir-

cuit comprising a bridge plug, leg wires passing through said bridge plug in dielectric relation with each other, a bridge wire connecting said leg wires, and a bead of ignition material comprising silver azide surrounding said bridge wire, said bead being confined within a hard surface layer of substantially non-flexible, pressure-resistant material, said leg wires being bent in toward one another below the region of their emergence from said bridge plug, and outside the locus of said bead of ignition material, permitting the harmless discharge of static electricity.

LAWTON A. BURROWS.
WALTER E. LAWSON.