July 13, 1937. S. L. HANDFORTH 2,086,548

ELECTRIC INITIATOR

Filed Oct. 30, 1935

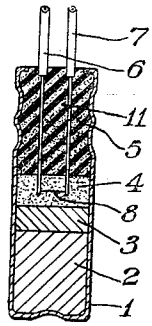

FIG. 1

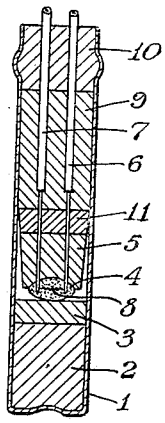

FIG. 2

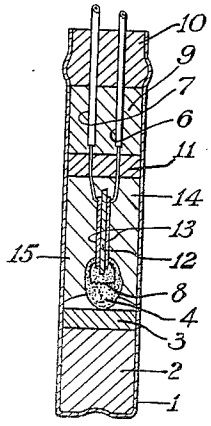

FIG 3

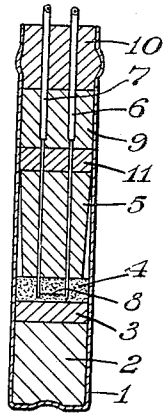

FIG. 4

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ELECTRIC INITIATOR

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Application October 30, 1935, Serial No. 47,388

11 Claims. (Cl. 102—10)

This invention relates to electric blasting initiators and in particular to a means of reducing the electrostatic susceptibility of such initiators.

As is well known, electric blasting caps consist essentially of a cylindrical metal shell containing a detonating base charge, an ignition composition, and an electrical firing means in contact with, or embedded in, the ignition composition. The firing means generally employed comprises an electric wire of high resistance between the two leg wires of the firing circuit. When the current is applied in the firing circuit, the high resistance or 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 as relatively "fast", or "slow", according to the time required for the cap to detonate after the firing current has been applied. The length of this lag is known to be dependent upon the nature of the particular ignition composition used, when the cap is fired at a given amperage. Thus, for example, caps are "fast" which contain an ignition charge comprising lead styphnate, lead picrate, basic lead picrate, silver azide, mercury or silver salts of chlorinated azodicarbonamidine, copper acetylide, or similar compounds.

It has been found that these rapid ignition compounds, and the electric blasting caps made therefrom, are dangerously susceptible to static electricity. In general, it appears to be true that the faster the cap, the more sensitive it is to electrostatic influences. The electrostatic trouble is so acute in such caps that they are generally regarded as too dangerous for manufacture, since electrostatic charges of low voltage, which are well within the range of that which may be accumulated by a man of ordinary electrical capacity, are capable of initiating these blasting caps. This imperfection is common to all the varied structural types known to the art, including the "bridge plug", the "concave plug", and the "match head" types. Inasmuch as these fast caps are very desirable for use in certain fields such as in seismographic work and elsewhere, it is important to eliminate such a danger which renders hazardous the manufacture and the use of such caps.

The object of my invention is to provide a means of overcoming this electrostatic susceptibility of electric blasting initiators. A further object is an electric blasting cap which is substantially safe from electrostatic discharge. Other objects will be apparent in the more complete description which follows.

I have found that these objects may be accomplished by providing the firing circuit of the electric blasting initiator with a discharging means which offers a low electrical resistance at high voltages, and which causes static electricity to pass harmlessly to the shell wall at a point outside the locus of the static susceptible ignition.

The same objects are accomplished in a different way in the co-pending application of Aughey, Burrows, and Lawson, Serial No. 47,385, filed October 30, 1935. The present invention, however, employs an entirely distinct and novel concept.

The anti-static means according to my invention comprises a material, the resistance of which is an inverse function of the voltage applied, for example, a material having a high resistance to a low voltage and a low resistance to a high voltage. Such a material will effectively ground the firing circuit against static discharge, but at the same time will not cause a short circuit at low voltages. Thus, the ideal material will exhibit a high resistance at a voltage of the order of magnitude to be used for intentionally firing the cap, yet will exhibit a low resistance to voltages caused by electrostatic discharges which would otherwise bring about premature firing.

I may employ, according to my invention, any material having the above mentioned properties, but the following are particularly suitable; zincite, carborundum, psilomelane, yellow crystalline iron pyrites, and metallic sulfides exhibiting variable resistance, such as stibnite, galena and the like.

Although I may introduce the variably resistant material into the cap in any manner suitable to permit the function described, I prefer to incorporate the necessary amount in a plug or layer surrounding the leg wires and contacting the shell. By this means, currents of low voltages will pass through the bridge wire and ignite the caps, whereas currents of high voltage will be by-passed to the shell wall and thereby be effectively grounded.

In order to describe my invention more clearly, I shall refer to the accompanying drawing, representing preferred embodiments thereof. It is to be understood, however, that this is done solely by way of example, and is not to be regarded as a limitation upon the scope of my invention.

Figures 1 to 4 represent vertical sectional views taken in the plane of the electrodes of various types of electric blasting caps embodying my invention.

Figure 1 represents a vertical section of an

electric blasting cap provided with a base charge 2 of tetryl, a priming charge 3 of lead azide, and an ignition composition 4 comprising lead styphnate. The base and primer charges are pressed into the headed and beaded shell 1 of suitable electrically conducting material such as a metal; for example, copper, aluminum, or the like. The bridge wire 8 is surrounded by, or embedded in, the ignition composition 4. The leg wires 6 and 7 are held in fixed space-relationship by the plug 5 which engages the shell wall in water-impervious relation by means of the crimps. This rubber plug 5 comprises soft rubber in which is incorporated 86 per cent by weight of galena crystals 11 ground fine enough to pass a 100-mesh screen. The plug exhibits a low resistance to high-voltage electrostatic charges which might otherwise arc from the firing circuits 6, 7 and 8 to the shell 1 in the vicinity of the ignition composition 4, and instead allows such charges to pass along the particles of galena on a path of least resistance within the plug from the leg wires 6, 7 to the shell, at a safe distance from the ignition composition. To a low voltage such as those used in intentionally firing the cap, this plug exhibits a high resistance, preventing a short circuit in the firing circuit between the leg wires. This renders unnecessary the insulation of the leg wires from each other, as would be necessary in the use of a plug which was a conductor at all voltages.

Referring now to Figure 2, the base charge 2 consists of tetryl, the priming charge 3 of lead azide, and the ignition composition 4 comprises basic lead picrate gelatinized with nitrostarch. This is "cemented" around the bridge wire 8 in the concave plug 5. The upper part of the plug comprises the anti-static means. This consists of a one-quarter inch layer of a composition containing about 24 per cent galena made from 150-meshed galena crystals 11 in molten sulfur. The resistance of this means is an inverse function of the voltage applied. The cap is closed with waterproof layer 9 and sulfur seal 10.

Figure 3 shows the "match head" type of electric blasting cap in which the firing circuit comprises a flat strip of insulating material 12, the two faces of which are covered with metallic foil 13. A bridge wire 8, passing around the end of the strip, connects the two pieces of foil which are soldered to the respective leg wires 6 and 7. The bridge wire is dipped in an ignition composition 4, of silver azide gelatinized with nitrostarch. This "match head" is held in position within the paper cylinder 15 by means of the sulfur composition 14. The cap has a pressed base charge 2 comprising 40 per cent trinitrotoluene and 60 per cent picric acid and a priming charge 3 of lead azide. The cap contains an anti-static means consisting of a layer of 100-meshed yellow crystals of iron pyrites 11 three-eights of an inch in depth, surrounding the bare leg wires 7 and 8, which permits dangerous electrostatic charges on the firing circuit to find a path of least resistance to the shell, at a safe distance from the match head 4. The cap is sealed with water-proof layer 9 and sulfur layer 10.

Figure 4 illustrates an electric blasting cap comprising a metal shell 1, a pressed base charge 2 of tetryl, a priming charge 3, an ignition composition 4 of the mercury salt of chlorinated azodicarbonamidine, a bridge plug 5 surrounding the leg wires 6 and 7, connected by a bridge wire 8, an anti-static means 11, a water-proof layer 9, and sulfur seal 10. The electrostatic control means 11 comprises a layer of 80-meshed carborundum crystals engaging the leg wires and the shell wall in electrically conducting relation with respect to static electricity. This furnishes a safe path for static electricity, well removed from the locus of the ignition composition.

The advantages of my invention are very important to the art. It provides a simple, permanent, easily manufactured, and effective means for substantially completely eliminating the hazards involved in the use of ignition compounds which are susceptible to static electricity. In this way, the invention permits the safe use of many ignition compounds which were heretofore regarded as dangerous for commercial application, and the safe manufacture and use of very rapid electric blasting caps.

While my invention is particularly useful for "fast" electric blasting initiators having an ignition composition comprising lead styphnate, lead picrate, basic lead picrate, silver azide, or mercury, or silver salts of chlorinated azodicarbonamidine, and other "fast" ignition compounds such as copper acetylide and the like, it is applicable to electric blasting initiators generally, regardless of the ignition composition employed. Thus, it may be employed with electric squibs, electric detonators, or delay electric detonators. Again, the invention is equally applicable to the concave plug type, the bridge plug type, and the match head type of electric blasting initiator. Furthermore, it may be employed in any blasting initiator regardless of the base charge, priming charge, or ignition composition employed, since all electric initiators are to some extent susceptible to static electricity.

In the foregoing embodiments of my invention, it is apparent that many variations in detail may be made without departing from the spirit or the scope of my invention. Thus, it is possible to change the base charge, the priming charge, or the ignition charge, or to change the structural details in any of the examples given without circumventing the scope of this invention. Other changes in detail and other mechanical or electrical equivalents of the means shown will be apparent to those skilled in the art. I therefore intend to be limited only in accordance with the following patent claims.

I claim:

1. An electric blasting initiator, the firing circuit of which is provided with a discharging means having a resistance variable in accordance with the voltage applied whereby the susceptibility of the initiator to static electricity is substantially reduced.

2. An electric blasting initiator, the firing circuit of which is provided with a discharging means, the resistance of which is an inverse function of the voltage applied thereto, whereby the susceptibility of said initiator to static electricity is substantially reduced.

3. An electric blasting initiator including a plug comprising a material of variable resistance, displaying a high resistance to low voltages and a low resistance to high voltages, whereby the susceptibility of the initiator to static electricity is substantially reduced.

4. An electric blasting cap comprising a firing circuit and an ignition composition which is susceptible to static electricity, said firing circuit being provided with a means having a resistance variable in accordance with the voltage applied, whereby the susceptibility of the cap to static electricity is substantially reduced.

5. An electric blasting initiator substantially free from susceptibility to static electricity, said initiator containing a material of variable resistance, such that it displays a high resistance to low voltages and a low resistance to high voltages, said material serving to maintain the firing circuit of the initiator in electrically-conducting relation with the shell wall at a point outside the locus of the ignition composition.

6. An electric blasting cap containing lead styphnate as an ingredient of its ignition composition, and containing a layer of galena crystals, said layer of crystals serving to connect the leg wires of the firing circuit with the shell wall at a point outside the locus of the ignition composition.

7. An electric blasting cap containing lead styphnate as an ingredient of its ignition composition and containing also a material of variable resistance, such that it displays a high resistance to low voltages and a low resistance to high voltages, said material engaging the firing circuit and the shell wall in electrically-conducting relation at a point outside the locus of the ignition composition.

8. An electric blasting cap containing an electrostatic susceptible ignition composition and a resilient plug of a material of variable resistance, such that it displays a high resistance to low voltages and a low resistance to high voltages, said plug engaging the shell wall at a point outside the locus of said ignition composition, whereby the electrostatic susceptibility is substantially reduced.

9. An electric blasting cap containing an ignition composition which is susceptible to static electricity and a bridge plug comprising sulfur and a material of variable resistance, such that the plug displays a high resistance to low voltages and a low resistance to high voltages, said plug of variable resistance being maintained in electrically-conducting relation with the shell wall at a point outside the locus of said ignition composition.

10. An electric blasting cap containing an ignition composition which is susceptible to static electricity and a bridge plug containing carborundum, said plug being maintained in electrically conducting relation with the shell wall at a point outside the locus of the ignition composition.

11. An electric blasting cap containing an ignition composition which is susceptible to static electricity and galena crystals, said galena crystals surrounding the leg wires and extending to the shell wall to effect an electrically-conducting relation between said leg wires and said shell wall at a point outside the locus of said ignition composition.

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