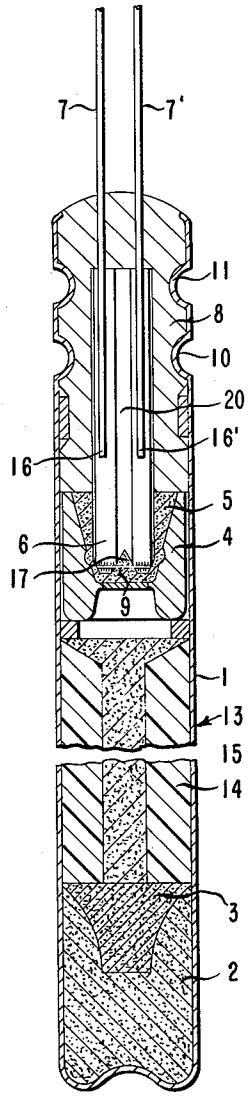
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ELECTRIC BLASTING CAP

Filed March 2, 1959 2 Sheets-Sheet 1

Fig. 1



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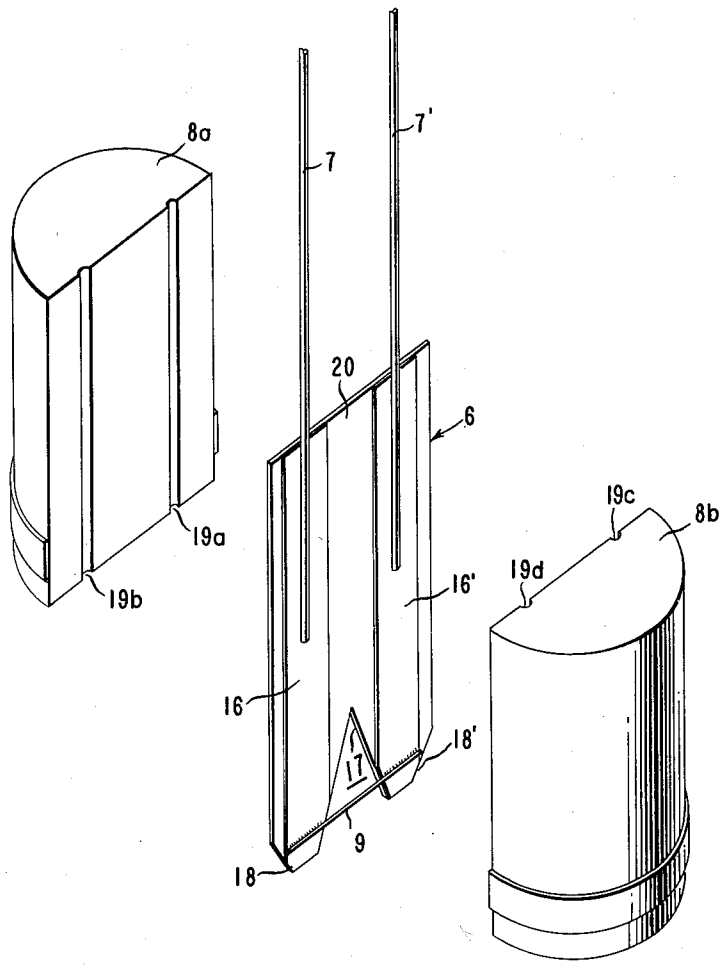
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Fig. 2



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2,999,460

ELECTRIC BLASTING CAP

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The present invention relates to a novel electric blasting cap having an improved ignition assembly. More particularly, the present invention relates to an improved ignition assembly for regular and delay electric blasting caps involving the use of a so-called "printed circuit" mechanism to mechanically support and electrically heat the bridgewire of an electric blasting cap.

The novel ignition assembly of the present invention may be advantageously employed in connection with both regular electric blasting caps and delay electric blasting caps, but for reasons which will be more particularly hereinafter described, the maximum advantages of the invention are obtained in connection with delay caps, and the invention will be especially discussed in this connection.

One of the biggest difficulties encountered in the use of ordinary delay electric blasting caps is the problem of "arcing." When an unduly high voltage is impressed across the cap, an electric arc may form and the bridgewire and the exposed portions of the conventional metallic leg wires which support the bridgewire may vaporize from the intense heat which is developed. The heat, and the vapors produced thereby, can develop such tremendous pressures within the cap that the wall of the cap cannot withstand the strain. When this occurs, a hole may be blown in the wall of the cap by the confined gases under pressure and this will either seriously interfere with the timing and functioning of the delay cap or, in some cases, may actually result in a complete failure of the cap to fire.

It is an object of the present invention to provide a novel delay electric blasting cap having an improved ignition assembly. It is a further object of the present invention to provide such a cap which will not sustain an electric arc when subjected to an unusually high electric voltage. It is a still further object of the present invention to provide a novel ignition assembly which will tend to function consistently in the proper manner to fire the cap regardless of the electrical voltage applied. It is a still further object of the present invention to provide a novel ignition system which may be used in connection with both delay electric blasting caps and regular electric blasting caps. It is a still further object of the present invention to provide a novel ignition assembly useful for both delay and regular electric blasting caps which is simple and economical to manufacture and easy to incorporate into the blasting cap by automatic assembling techniques. Other and additional objects of the invention will become apparent from a consideration of the ensuing specification and claims.

The foregoing objects are achieved by replacing at least the bottom terminal portion of the conventional metallic leg wires in an electric blasting cap with a "printed circuit" component which will convey an electric current from the lead wires to the bridgewire in order to heat the latter and initiate the ignition composition. Characteristically, the "printed circuit" component will consist of an electrically non-conductive strip having a

pair of separate, generally parallel metallic film sections applied to its face. Between the metallic film sections, the plastic strip is notched on its lower end to provide a gap across which the bridgewire is stretched.

The invention will be better understood from a consideration of the attached drawings in which a preferred embodiment of the invention is illustrated. In the drawings, FIGURE 1 represents a cross-sectional view of a delay electric blasting cap provided with the novel ignition assembly of the present invention. FIGURE 2 is an exploded view of the "printed circuit" component of the ignition assembly and the two halves of the rubber plug between which it is supported.

In FIGURE 1, **1** represents an outer metal shell which houses the components of the blasting cap, **2** is a base load, as for example PETN, and **3** represents a primer load, which may be lead azide or any other suitable composition that is commonly used for priming purposes in electric blasting caps. In the blasting cap depicted in FIGURE 1, there is provided atop the priming charge **3** a delay train **13**, which consists of a carrier **14**, for example lead or plastic tubing, and a delay charge **15**, such as an 85/15 barium oxide-selenium mixture or a 2/98 boron/red lead mixture. A plastic capsule **4**, such as polyethylene or the like, is positioned within the shell above the delay train **13**. The capsule contains a conventional ignition composition **5**, such as the 2/98 boron/red lead mixture, or the like. A pair of leg wires **7**, **7'** extend through an elastomeric plug **8** which may be formed in two mating sections **8***a* and **8***b*, as shown in FIGURE 2. The plug **8** is secured in position within shell **1** by circumferential crimps **10** and **11**. The leg wires **7**, **7'** terminate at their lower ends within the confines of the plug **8**. Sandwiched between the portions **8***a* and **8***b* of plug **8** is a "printed circuit" component which extends on its bottom end out and down from the plug a short distance. The "printed circuit" component consists of a suitable non-conducting film **20** such as glass, mica, oriented polyethylene terephthalate film of the type available commercially as "Mylar" polyester film, polytetrafluoroethylene or other plastic film, or the like. On the surface of the non-conducting film there is provided a pair of separate and distinct, generally parallel ribbons of current-conducting coating **16**, **16'**, such as a copper coating or other suitable metal, extending at least a substantial distance along the length of the strip. A notch **17** is provided at the base of the film between the two coated segments **16**, **16'**, and the film may also be chamfered, as at **18**, **18'**, to facilitate its ultimate insertion into the plastic capsule **4** containing the ignition composition. The leg wires **7**, **7'** are positioned within the plug **8** by means of the various grooves **19***a*, **19***b*, **19***c*, and **19***d* to lie directly adjacent to and in physical contact with the metallic ribbons **16**, **16'**. When pressed into assembled relation, a firm electrical contact is established between leg wires **7**, **7'** and metallic ribbons **16**, **16'**. At the base of the non-conducting film, a bridgewire **9** is positioned across the notch **17** and affixed to both of the prongs which form the notch in firm electrical contact with the base of the metallic ribbons **16**, **16'**.

In assembled relation, as shown in FIGURE 1, the end of "printed circuit" component supporting the bridgewire protrudes from the base of the plug **8** and is submerged in or otherwise is placed in initiating proximity to the ignition composition **5** contained within the capsule **4**. When an electric current is impressed across the cap, it

will be carried to the bridgewire 9 by means of the leg wires 7, 7' and metallic ribbons 16, 16' to heat the wire and initiate the ignition composition 5. The cap will then fire in the conventional way. However, should an exceptionally high voltage be applied to the cap, the tendency of an electric arc to develop and to sustain itself in a manner affecting the performance of the cap, as outlined above, is materially reduced. The exposed components of the ignition assembly contain an insufficient amount of metallic material to vaporize, ionize, and sustain an arc for any extended period. Then too, the very thin metallic ribbons of the "printed circuit" will often act as a fuse by melting away if the current becomes too high and will interrupt further current flow. The plastic support itself, of course, is not conductive and is preferably made of a substance such as an oriented polyethylene terephthalate film which does not carbonize and support current flow.

The electrically-resistant heating means may be either a bridgewire as indicated at 9 in the attached drawing, or a portion of metallic ribbon, similar to the ribbons 16, 16' or any other suitable electrically-resistant heating means.

In the embodiment of the invention depicted in the attached drawing, the "printed circuit" component of the ignition assembly is shown as terminating within the confines of the plug member 8 and the conducting ribbons 16, 16' are in electrical contact with a pair of conventional leg wires 7, 7' entering the plug from the top. Though this represents one preferred embodiment of the invention, blasting caps in which the "printed circuit" component extends up and out of the plug 8 for some distance (even for direct connection to the power source) are within the scope of the invention. Under such circumstances, the exposed metallic ribbons 16, 16' exterior of the plug 8 would have to be covered, for example, by a separate non-conducting film or coating applied to the surface of film 20 which carries the ribbons 16, 16'. For instance, that portion of the ribbons 16, 16' above the point of contact of the ribbons with the bridgewire 9, or at least that portion of the ribbons which extends up from the plug member 8 and out of the shell, may be positioned between a pair of laminated films which encase the ribbons. The critical feature of the invention is the presence of the "printed circuit" component within the confines of the blasting cap as part of the ignition assembly, and the precise mode by which this component is electrically connected to the source of power is not too significant.

The "printed circuit" component 6 of the present invention may be prepared by any suitable technique which is commonly used today in the manufacture of "printed circuits" for a variety of electrical machines and appliances. For example, the metallic ribbons may be applied to the plastic support by vapor deposition of the metal onto one entire side of the plastic in a vacuum chamber in the well-known way. The surplus metal may be removed by chemical or mechanical means to leave two separate and distinct strips which serve as two individual conductive ribbons. Alternatively, the plastic may be masked prior to vapor deposition of the metal ribbons such that the latter deposit on the desired areas only. The bridgewire may then be affixed at both ends across the notch 17 to the conductive metal ribbons 16, 16' by any suitable technique. The bridgewire may be soldered into position by a spray soldering technique, or it may be mechanically embedded into the plastic and then connected electrically to the copper strip by further deposition of metal after suitably masking the remainder of the circuit with a soluble masking material which may thereafter be removed with a suitable solvent. Any of the known procedures for preparing "printed circuit" components may be used for the preparation of element 6, and the precise technique employed in any instance forms no part of the present invention.

The novel ignition assembly of the present invention may be advantageously used in connection with either delay electric blasting caps or regular electric blasting caps. Since the arcing problem is particularly serious with delay caps, the invention may find its greatest utility in that connection. However, the invention is definitely applicable to regular blasting caps too, and the latter are contemplated as falling within the scope of the invention.

The nature and implications of the present invention have been described in the foregoing specification and illustrated in the attached drawings. However, the depiction of the invention in the specification and drawings is intended as illustrative only. It will be readily apparent to those skilled in the art that many variations may be made in the embodiments described, their method of manufacture, and their mode of assembly. It is intended, therefore, to be limited only by the following claims.

We claim:

1. An electric blasting cap comprising a shell containing a detonation composition and an ignition composition in initiating proximity thereto, a plug member formed in two one-piece mating sections above said ignition composition, a single, thin non-conducting film supported between the mating sections of the plug and projecting out and down therefrom, a notch in the lower end of said film which protrudes out from the bottom of the plug, a pair of separate and distinct conducting ribbons affixed along the surface of said film, each ribbon terminating at one end along one side of said notch, a bridgewire in initiating proximity to the ignition composition stretching across the mouth of the notch and secured at either end in electrical contact with one of the two separate conducting ribbons, each of said ribbons also being in electrical contact with one of a pair of leg wires entering the cap at the end remote from the detonating composition and mounted between the mating sections of the plug member.

2. In an electric blasting cap having a shell containing a detonation composition and an ignition composition in initiating proximity thereto, an improved ignition assembly at least partially embedded in said ignition composition comprising a single thin non-conducting film having a notch at its lower end, a pair of separate and distinct conducting ribbons affixed along the surface of said film, each ribbon terminating at one side of said notch, an electrical-resistant heating means in initiating proximity to the ignition composition stretching across the mouth of the notch and secured at either end in electrical contact with one of the two separate conducting ribbons, and means for connecting said conducting ribbons to a source of electrical power.

3. In an electric delay blasting cap having a shell containing a detonation composition and an ignition composition separated by a delay train mechanism, an improved ignition assembly at least partially embedded in said ignition composition comprising a single, thin, non-conducting film having a notch at its lower end, a pair of separate and distinct conducting ribbons affixed along the surface of said film, each ribbon terminating at one end along one side of said notch, an electrical-resistant heating means, in initiating proximity to the ignition composition stretching across the mouth of the notch and secured at either end in electrical contact with one of the two separate conducting ribbons, and means for connecting said conducting ribbons to a source of electrical power.

4. An electric blasting cap comprising a shell containing a detonation composition and an ignition composition in initiating proximity thereto, a plug member formed in two one-piece mating sections above said ignition composition, a single, thin non-conducting film supported between the mating sections of the plug and projecting out and down therefrom, a notch in the lower end of said film which protrudes out from the bottom of the plug,

a pair of separate and distinct conducting ribbons affixed along the surface of said film, each ribbon terminating at one end along one side of said notch, a bridgewire in initiating proximity to the ignition composition stretching across the mouth of the notch and secured at either end in electrical contact with one of the two separate conducting ribbons, and means for connecting said conducting ribbons to a source of electrical power.

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