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BLASTING CAP

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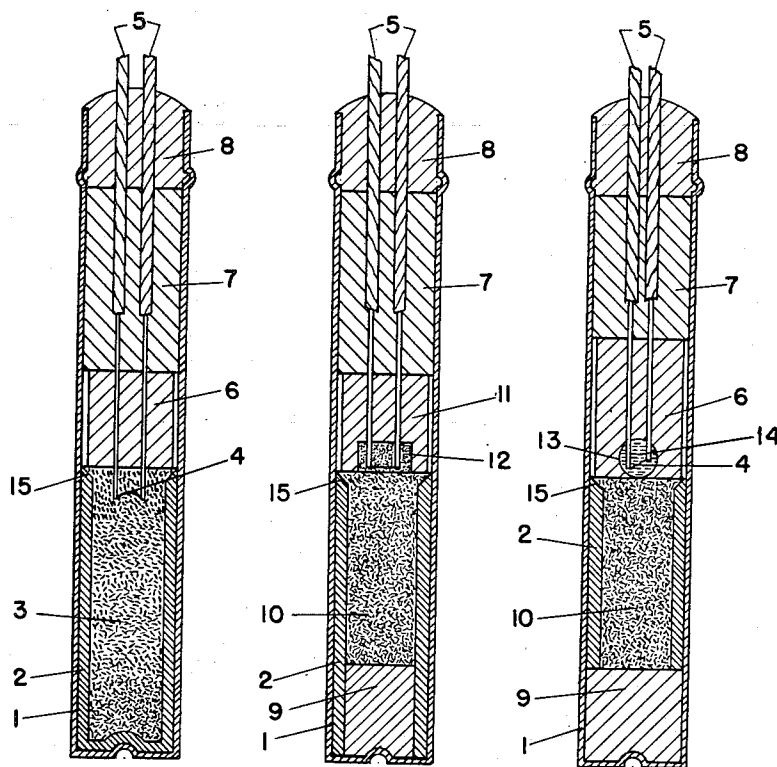


FIG-1

FIG-2

FIG-3

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## BLASTING CAP

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This invention relates to an improved electric blasting cap and more particularly to a blasting cap which is highly resistant to strong external heating. The cap of this invention is so designed as to prevent detonation even when the cap is placed in an open fire.

As is well known, electric blasting caps consist of a casing in which may be confined at the bottom a detonating charge, for example, tetryl, TNT, nitrostarch, or the like, and has superimposed upon this base a priming charge, for example, diazodinitrophenol, mercury fulminate, lead azide, or mixtures thereof with oxidizing agents such as potassium chlorate. If desired the entire charge may consist of a priming mixture. This priming charge is normally fired by a bridge wire assembly which may be either inserted directly into the priming charge or may be imbedded in an ignition charge, which will in turn fire the priming charge. The cap may also be fired by a cavity type plug, for example, a plug containing an easily ignited material that fires into the explosive compound or by a match head assembly. The cap shell is closed by a waterproof compound such as, for example, asphalt above the firing assembly and then is further closed by a sealing compound, for example, sulfur.

The electric blasting caps now known to the art are very sensitive to external heating and it is quite possible that these caps may be accidentally exposed to strong external heating. Thus, it will be apparent that during coal mining operations a misfired cap might remain in the coal and in time find its way into a stove or furnace. The blasting caps of present design would detonate under these conditions and cause extensive damage with the possible loss of life. Throughout industry, there are other places at which caps may be exposed to strong external heating and which may be the direct cause of serious damage. For example, if misfired caps from a rock quarry are introduced into a calcining furnace or if caps from an ore mine are introduced into a roasting furnace, the furnaces might be damaged upon explosion of the caps. Another possibility of damage occurring is in the extraction of naval stores material from stumps that have been removed by blasting or that have been broken into small pieces by blasting.

It is an object of this invention to produce an electric firing device which may be heated externally to a high temperature without causing detonation.

A further object of this invention is to manufacture a firing device that may be placed in a fire without danger of detonation. A still further object of this invention is to produce a safety cap which includes therein a protector unit which surrounds the explosive charge. A still further object of this invention is to provide a protector

unit for insertion into a firing device which will upon external heating of the firing device melt, decompose, or vaporize in a manner that desensitizes the explosive charge and prevents detonation of the device.

Thus, in accordance with this invention, a firing device has been designed and produced which will fail to detonate when subjected to strong external heating. The production of the new, improved, and novel firing device of this invention is accomplished by modifying the design and construction of the firing devices now being offered to the trade. Thus, a safety firing device has been produced by including within the firing devices now used in the art a protector unit which surrounds the explosive charge. The protector unit upon strong external heating desensitizes the explosive charge of the firing device and renders the device harmless.

There are three general designs used in the explosive firing devices now offered to the trade by the art, each of these may be altered by this invention in a manner which will prevent their detonation if they are heated externally. The different types of firing devices are described below.

The first and oldest design includes a firing device that contains a single explosive charge. This charge located in the base of a shell may include, for example, mercury fulminate, lead azide, diazodinitrophenol or the like either alone or in admixture with an oxygen carrying salt such, for example, as potassium chlorate, potassium nitrate, barium nitrate or the like. This device is normally fired with a high resistance bridge wire inserted into the explosive charge or by a cavity plug containing a bridge wire surrounded by an ignition material or by a match head consisting of a bridge wire covered by a button of copper acetylide. This type device was the original electric blasting cap and was used by the art exclusively, but the art now uses firing devices which have a base charge of less sensitive but more powerful explosive.

The firing devices including a base charge inserted into the bottom of the shell are now in very general use and comprise a base charge of, for example, tetryl, trinitrotoluene, picric acid, pentaerythritoltetranitrate, nitrolactose, nitromannite, nitrostarch or the like either alone or in admixture with any of the detonating compounds and oxygen carrying salts mentioned above as useful in the first described firing device. The firing devices which contain a base charge of insensitive explosive require a priming charge. This priming charge is superimposed upon the base charge and may be any of the substances described as useful in the first described firing device. The means of firing this device containing a base and priming charge are the same as those

used to fire the single charge cap, i. e., a bridge wire, a cavity type plug, or a match head device.

In order to provide a firing device which is more easily initiated than the above described two devices, the art has included in some devices an ignition compound which is imposed between the explosive charge and the firing assembly. This type ignition compound may be composed of various flame producing agents, oxygen carrying salts, binders, and carbonaceous materials. The firing devices having such an ignition compound are similar in explosive content to either the single charge or the base charge devices described hereinbefore but are easier to ignite.

Now in accordance with this invention, it has been found that any of the above type devices may be constructed in a manner which will cause these firing devices to be safe in that they will not detonate if subjected to strong external heating.

In general, the method and design of construction of electric firing devices, in particular electric blasting caps, to prevent their detonation when subjected to strong external heating comprises the inclusion of a protector unit within the cap shell. This protector unit surrounds the explosive charge in a manner which prevents the direct contact of the explosive charge with the cap shell and thereby insulates the detonating explosive charge from the cap shell and from close proximity to the source of heat. The units which may be used may prevent the entire charge from contacting the shell wall or may be designed to only prevent the contact of that part of the explosive charge which is sensitive to detonation by heat. The units which may be used are prepared from a compound or composition which will, upon strong external heating, desensitize the explosive within the shell by melting, vaporizing, or decomposing, and thus prevent detonation.

Having now indicated in a general way the nature and purpose of this invention, there follows a more detailed description of preferred embodiments thereof, with references to the accompanying drawing in which Figure 1 represents a cross-sectional view of an electric blasting cap containing a protector unit around the entire explosive charge and having a bridge wire firing assembly. Figure 2 represents a cross-sectional view of an electric blasting cap containing a protector unit around the priming and base charges but not across the base of the base charge and having a cavity type plug firing assembly. Figure 3 represents a cross-sectional view of an electric blasting cap containing a protector unit around the priming charge and having a match head firing assembly.

There follows a detailed description of the electric blasting cap, depicted in Figure 1, which contains a protector unit surrounding the entire explosive charge. The electric blasting cap of Figure 1 includes a metal casing 1 in the base of which is positioned a protector unit 2. The explosive charge 3 within the protector unit 2 is fired by a bridge wire 4 connected across a pair of leg wires 5 which extend beyond the electric blasting cap shell 1 to allow connection to a source of electric current. The leg wires 5 are held in position by a plug 6, a waterproofing compound 7, and a sealing compound 8. This upper section of the electric blasting cap which includes the firing assembly, waterproofing and seal is of the normal and well known design now used by the art. Thus, Figure 1 comprises a normal elec-

tric blasting cap but includes therein a protector unit 2 which is designed and positioned in a manner which prevents all contact between the explosive charge 3 and the metal shell 1.

The explosive charge used in the cap of Figure 1 is shown to be a single charge and may include any of the detonating explosives alone or in admixture with an oxygen carrying salt in accordance with the hereinbefore described commercial cap having a single explosive charge. I have found that when caps of this single charge type are used, it is necessary to entirely prevent the explosive charge from contacting the shell. With complete prevention of contact obtained, there is produced an electric blasting cap which will not detonate upon strong external heating.

The electric blasting cap shown in Figure 2 differs from the cap of Figure 1 in that the explosive charge includes a base charge 9 and a priming charge 10 instead of a single explosive charge as shown in Figure 1. When electric blasting caps contain a base charge this charge is usually a high explosive which is not a detonating compound. This type compound does not require as much protection as the detonating compounds and, therefore, in Figure 2 the protector unit 2 does not extend across the base of the shell. This protector unit 2 in Figure 2 is entirely adequate to desensitize the entire explosive charge. In order to show the possible variation in firing assemblies that may be included in this invention, the cap of Figure 2 contains a cavity type plug firing assembly. This assembly consists of a plug 11 having a bridge wire 4 connected to leg wires 5 which is surrounded by an ignition compound 12. The ignition compound 12 may be, for example, lead trinitroresorcinate or admixture of flame producing agents, carbonaceous material, oxygen carrying salts and binders. The remaining design of the cap is similar to the cap of Figure 1.

The electric blasting cap shown in Figure 3 differs from the two above described caps in that the protector unit 2 surrounds only the priming charge 10. The explosive charge in this cap consists of a base charge 11 and is of a type explosive which will not detonate upon strong external heating, therefore requiring no protection. The protector unit 2 surrounding the priming charge 10 adequately desensitizes the entire explosive charge upon heating. In order to show another means of firing the cap, Figure 3 includes a match head firing assembly. This type assembly 13 comprises a bridge wire 4 attached to two leg wires 5 and surrounded by a button of ignition material 14 usually copper acetylide.

A preferable but not essential feature in protector unit design is the bevel edge 15 shown in each figure. This beveled edge 15 aids materially in preventing contact between the explosive charge and the cap shell as it directs the explosive into the cavity provided for it and prevents grains of explosive lodging upon the edge of the protector unit and in contact with the cap shell.

In each of the above described blasting caps an ignition charge may be inserted over the priming charge to aid in initiating the detonation. In the event that such an ignition charge is used, it should be understood that the protector unit may be extended to surround this ignition charge.

In the foregoing description, it will be understood that the various designs of protector units, the different explosive charges, and the different types of firing devices may be combined with each other in the most desirable and suitable manner

to effect positive protection from strong external heating and to produce the most efficient and safe electric blasting cap.

The preparation of the protector units described hereinbefore may be accomplished in several manners. Thus, I have found that the units of this invention may be extruded, molded, punched, cast or otherwise shaped in a suitable manner depending entirely upon the type protector unit being fabricated and upon the physical properties of the compound or composition being used to form the protector unit. I have also found that with some of the compounds suitable for use in my invention, the unit may be formed in the shell by introducing molten material and spinning the shell.

The protector units in accordance with this invention are prepared from a compound or composition which will, upon strong external heating, desensitize the explosive charge with which it is used. Thus, it is necessary to coordinate the protector unit's design and composition with the explosive charge of the cap in which it is to be used. I have found that materials which are suitable for use as protector units are, for example, trinitrotoluene, dinitrotoluene, retene, phenanthrene, p-nitrodiphenyl, diphenyl, naphthalene, and mixtures of opalwax (hydrogenated castor oil compound), and various resinous compositions such as the alkyd resins or modified alkyd resins, for example, of the maleic anhydride-terpene-polyhydric alcohol reaction products type. The alkyd resins alone or mixtures thereof with various solid waxes, and other organic compounds have also been found to exert a desensitizing effect on detonating explosives. The materials which I have found suitable all have a melting point between about 60° C. and about 150° C. and when heated, desensitize the detonating explosive before it is initiated.

A further property and limitation which must be considered to determine whether a material is a preferred compound for use as a protector unit is its action during storage of the electric blasting caps. The material must not desensitize the explosive charge during the storage period in which the temperature may vary from -40° F. to 130° F. I have found that it is necessary to use compounds and compositions which have a melting point above about 60° C. and which will not decompose or vaporize sufficiently at 55° C. to desensitize the explosive charge in the blasting cap.

Thus, the compounds which I may use as protector units, although numerous, may be described as organic compounds having a melting point between about 60° C. and about 150° C. and which, upon heating, melt, fuse, or decompose in a manner which desensitizes the detonating explosives used such as, for example, mercury fulminate, lead azide, or diazodinitrophenol. In addition to these limitations, the compound should be capable of being formed into a substantially cylindrical unit that will have sufficient strength to maintain its shape during processing. The protector units may be manufactured from individual compounds or from admixtures of the various compounds.

In order to aid in the manufacture of the protector tubes of my invention, I have found that it is often desirable to add reinforcing, fillers or binders to the material going into the protector units to produce a unit of the required strength. The reinforcing materials which I may use are wire strands, gauze or the like. The fillers which

I have found suitable are, for example, chalk, talc, diatomaceous earth, and similar substances. The binders which I have found suitable are, for example, resins, glue, gelatin, sodium silicate, and similar substances.

The electric blasting caps described hereinbefore that contain a protector unit have been tested to determine their resistance to detonation upon strong external heating in the following manner.

A cast iron crucible containing molten Wood's metal and equipped with a thermocouple and a shield was set up in a manner which allowed the insertion therein of electric blasting caps. The caps were immersed in the molten metal which was kept at a definite temperature usually 189° C. and the length of time required for detonation or decomposition observed and recorded. In all tests conducted comparisons have been made to the behavior of various standard electric blasting caps. The results of the various tests made are given in the following tables and these tests show that the use of the protector units of this invention will transform a commercial cap that detonates upon external heating into a safety cap which will decompose quietly upon external heating.

In Table I is shown the performance of a cap with a protector unit around the entire explosive charge such as is depicted in Figure 1. The performance of a similar cap without the protector unit is given for comparison.

TABLE I  
RESULTS OF TEST AT 189° C.

| Cap A                                                                    | With TNT protector unit                                   | Without protector unit                              |
|--------------------------------------------------------------------------|-----------------------------------------------------------|-----------------------------------------------------|
| Explosive charge: 0.60 g. diazo/chlorate 75/25. Ignition by bridge wire. | Five caps decomposed after 24, 25, 26, 27 and 27 seconds. | Five caps detonated after 4, 4, 4, 5 and 5 seconds. |

<sup>1</sup> In table I and subsequent tables the following terms have been used for the sake of brevity: "Diazo" for diazodinitrophenol; "chlorate" for potassium chlorate; "fulminate" for mercury fulminate; "PETN" for pentaerythritol tetranitrate.

In Table II is shown the performance of caps having various explosive charge; and with a protector unit around the priming charge thereof such as is depicted in Figure 3. The performance of similar caps without the protector unit is given for comparison.

TABLE II  
RESULTS OF TEST AT 189° C.

| Cap A                                                                                                                            | With TNT protector unit                                    | Without protector unit                                 |
|----------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------|--------------------------------------------------------|
| Base charge: 0.28 g. PETN 2,500 lbs./sq. in. Priming charge: 0.28 g. diazo/chlorate 75/25. Ignition by a bridge wire.            | Five caps decomposed after 15, 18, 18, 19 and 21 seconds.  | Five caps detonated after 4, 5, 11, 13 and 14 seconds. |
| Cap B<br>Base charge: 0.28 g. PETN 2,500 lbs./sq. in. Priming charge: 0.40 g. fulminate/chlorate 80/20. Ignition by bridge wire. | Five caps decomposed after 50, 53, 55, 56, and 58 seconds. |                                                        |
| Cap C<br>Base charge: 0.30 g. tetryl 4,000 lbs./sq. in. Priming charge: 0.18 g. lead azide. Ignition by cavity plug.             | Five caps decomposed after 63, 63, 69, 72 and 74 seconds.  |                                                        |

In Table III results which indicate that ignition by means of a match head or cavity type plug are comparable to ignition by means of the bridge wire of Tables I and II are given

**TABLE III**  
**RESULTS OF TEST AT 189° C.**  
**With TNT protector unit**

| Cap A                                                                                         | Ignition by match head                                 | Ignition by cavity plug                                   |
|-----------------------------------------------------------------------------------------------|--------------------------------------------------------|-----------------------------------------------------------|
| Base charge: 0.28 g. PETN 2,500 lbs./sq. in.<br>Priming charge: 0.28 g. diazo/chlorate 75/25. | Five caps decomposed after 18, 18, 19, and 21 seconds. | Five caps decomposed after 19, 25, 25, 25 and 26 seconds. |

In Table IV is shown the performance of a cap with a protector unit around the ignition and priming charge. The performance of a similar cap without the protector unit is given for comparison.

**TABLE IV**  
**RESULTS OF TEST AT 189° C.**

| Cap A                                                                                                                                                                                                                            | With TNT protector unit                                   | Without protector unit                                   |
|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------|----------------------------------------------------------|
| Base charge: 0.30 g. tetryl 4,000 lbs./sq. in.<br>Priming charge: 0.18 g. lead azide 2,000 lbs./sq. in.<br>Ignition charge: 0.13 g. ground smokeless powder/lead sulfocyanate/chlorate 40/40/20.<br>Ignition with a bridge wire. | Five caps decomposed after 73, 83, 84, 90 and 94 seconds. | Five caps detonated after 55, 72, 69, 73 and 76 seconds. |

In Table V a series of tests which show the performance of five commercial caps are given. These tests establish that commercial caps will not stand the high external heat that the caps of my invention will resist.

**TABLE V**

| Composition of cap tested                                                                                                                                                                          | Results of test at 189° C.                               |
|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------|
| <b>Cap A</b><br>Base charge—0.35 g. tetryl/diazo 75/25.<br>Priming charge—0.45 g. diazo/chlorate 75/25.<br>Ignition by bridge wire.                                                                | Five caps detonated after 5, 15, 16, 19 and 20 seconds.  |
| <b>Cap B</b><br>Base charge—0.23 g. tetryl.<br>Priming charge—0.54 g. fulminate/chlorate.<br>Ignition by a match-head.                                                                             | Five caps detonated after 16, 23, 27, 28 and 29 seconds. |
| <b>Cap C</b><br>Base charge—0.30 g. tetryl.<br>Priming charge—0.21 g. lead azide.<br>Ignition with a cavity plug.                                                                                  | Five caps detonated after 51, 57, 58, 62 and 70 seconds. |
| <b>Cap D</b><br>Base charge—0.33 g. fulminate/chlorate 80/20.<br>Priming charge—0.67 g. fulminate/chlorate 80/20.<br>Ignition by bridge wire.                                                      | Five caps detonated after 28, 30, 31, 34 and 39 seconds. |
| <b>Cap E</b><br>Base charge—0.26 g. tetryl.<br>Priming charge—0.19 g. lead azide.<br>Ignition charge—0.17 g. smokeless powder/lead sulfocyanate/chlorate 40/40/20.<br>Ignition with a bridge wire. | Five caps detonated after 53, 59, 60, 70 and 77 seconds. |

In Table VI the performance of caps that contain protective units manufactured from various suitable materials in accordance with this invention are given.

**TABLE VI**

| Cap composition                                                                                                                                                                                                                | Results of test at 189° C.                                |
|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------|
| <b>5</b><br><b>Cap A</b><br>Base charge—0.28 g. PETN 2,500 lbs./sq. in.<br>Priming charge—0.28 g. diazo/chlorate 75/25.<br>Ignition with a bridge wire.<br>Protective unit of p-nitrodiphenyl around the priming charge.       | Five caps decomposed after 18, 18, 20, 20 and 21 seconds. |
| <b>10</b><br><b>Cap B</b><br>Base charge—0.28 g. PETN 2,500 lbs./sq. in.<br>Priming charge—0.28 g. diazo/chlorate 75/25.<br>Ignition with a bridge wire.<br>Protective unit of opalwax/petrex 90/10 around the priming charge. | Five caps decomposed after 20, 22, 24, 24 and 25 seconds. |
| <b>15</b>                                                                                                                                                                                                                      |                                                           |

<sup>1</sup> The petrex used comprises an admixture of rosin modified terephthalic anhydride resin, carnauba wax, mineral oil, and ethyl cellulose.

In the above examples it is to be noted that the protector units vary in length. Thus, the units in accordance with this invention may be prepared in lengths which adequately cover or surround the explosive charge to be protected. The various electric blasting caps on the market vary in size from a diameter of .22 inch to, in special cases, .45 inch, therefore, the protector units of this invention must be prepared so that they fit tightly within the shell. The length of the protector units is also subject to change as the height of the explosive charge to be protected may vary from about 1/8 inch to two or three inches. It is to be understood that I contemplate fabricating protector units which will suitably fit the individual electric blasting caps manufactured by the art and thereby prevent the contact of the explosive charge to be protected and the cap shell. While the length and diameter of the protector units are varied to fit the cap shell and explosive charge, the thickness of the units remains fairly constant as I have found that a unit which is about .04 inch in thickness gives sufficient protection regardless of the length or diameter. The thickness of the unit may, if desired, be varied from .01 to .10 inch but the thin units are extremely difficult to prepare with the proper strength and in some cases fail to fully prevent detonation while the thick units so decrease the volume of explosive that the cap shell must be made extra large which is more expensive and has no redeeming features to offset the added expense.

The units have been described above as being cylindrical but I have found that it is possible to vary the design of a protective unit so that a lesser amount of explosive material can be used without impairing the cap's performance. For example, in a cap containing a PETN base charge and a diazo/chlorate priming charge surrounded by a protective unit, it is possible by tapering the inside of the cavity within the unit, to reduce the amount of priming charge necessary for detonation of the base charge. In a cap of this type containing a unit the inside diameter of which being tapered from 0.215 inch for the top end to 0.100 inch for the bottom end, the priming charge was reduced about 25%.

A further advantage of the caps of this invention is their resistance to impact. It has been found that the protector unit while inserted to prevent detonation from heat also will aid in preventing the caps from detonating upon sudden impact. Tests on these properties of the caps of my invention are given in comparison to commercial caps in the following table:

TABLE VII  
COMPARISON OF EFFECT OF IMPACT

| Height of 10-lb. hammer fall | 3" steel plate over entire cap          |                                   | 1/4" steel bar over priming charge      |                                   |
|------------------------------|-----------------------------------------|-----------------------------------|-----------------------------------------|-----------------------------------|
|                              | PETN base TNT cylinder cap <sup>1</sup> | Commercial E. B. cap <sup>2</sup> | PETN base TNT cylinder cap <sup>1</sup> | Commercial E. B. cap <sup>2</sup> |
| Inches                       |                                         |                                   |                                         |                                   |
| 76.5                         | 1S, 4F                                  | 2S, 3F                            | 3S, 2F                                  |                                   |
| 70.5                         | 5F                                      | 1S, 4F                            | 3S, 2F                                  |                                   |
| 64.5                         |                                         | 5F                                | 2S, 3F                                  |                                   |
| 58.5                         |                                         |                                   | 2S, 3F                                  |                                   |
| 52.5                         |                                         |                                   | 1S, 4F                                  |                                   |
| 46.5                         |                                         |                                   | 1S, 4F                                  |                                   |
| 40.5                         |                                         |                                   | 1S, 4F                                  |                                   |
| 34.5                         |                                         |                                   | 2S, 3F                                  |                                   |
| 28.5                         |                                         |                                   | 1S, 4F                                  |                                   |
| 22.5                         |                                         |                                   | 5F                                      | 5S                                |
| 16.5                         |                                         |                                   |                                         | 1S, 4F                            |
| 10.5                         |                                         |                                   |                                         | 5F                                |

<sup>1</sup> See Table II—cap A with protector unit.

<sup>2</sup> See Table II—cap A without protector unit.

S—indicates shot.

F—indicates failure.

The use of protector units in accordance with this invention provides an electric blasting cap which will not detonate if placed in a position that causes it to be affected by strong external heating, for example, in a furnace or a stove. The advantages of such a cap will be at once apparent to those skilled in the art. These types of caps are of especial usefulness in coal mines where often misfired caps find their way to a stove or furnace and cause serious damage.

It will be understood that the details and examples hereinbefore set forth are illustrative only, and that the invention as broadly described and claimed is in no way limited thereby.

What I claim and desire to protect by Letters Patent is:

1. A firing device insensitive to detonation by the external application of heat which comprises a casing containing a firing assembly and an explosive charge, an organic compound having a melting point between about 60° C. and about 150° C. surrounding and maintaining the said explosive charge at least .01 inch from said casing, the said organic compound adapted to desensitize said explosive charge when the organic compound is heated to at least its melting point upon external application of heat to said device.

2. In combination with a firing device insensitive to detonation by the external application of heat and comprising a casing containing a firing assembly and an explosive charge, a compound having a melting point between about 60° C. and about 150° C. interposed between and maintaining said casing and said explosive charge separated by a distance of between about .01 inch and 0.10 inch, the said compound being adapted to desensitize said explosive when the compound is heated to at least its melting point upon external application of heat to said device.

3. A firing device insensitive to detonation by the external application of heat which comprises a casing containing a firing assembly and an explosive charge comprising a heat sensitive detonating explosive, and an organic compound having a melting point between about 60° C. and about 150° C. interposed between the said casing and said detonating explosive and having a thickness of between about 0.01 inch and 0.10 inch, the said organic compound being adapted to desensitize said explosive charge when the organic compound is heated to at least its melting point

upon external application of heat to said device.

4. A firing device insensitive to detonation by the external application of heat which comprises a casing containing a firing assembly and an explosive charge sensitive to detonation by external application of heat and a cylinder of trinitrotoluene surrounding said explosive charge, said cylinder so disposed as to desensitize said explosive charge when the trinitrotoluene is heated to at least its melting point upon the external application of heat.

5. A firing device insensitive to detonation by the external application of heat which comprises a casing containing a firing assembly and an explosive charge sensitive to detonation by external application of heat and a cylinder of p-nitrodiphenyl surrounding said explosive charge, said cylinder so disposed as to desensitize said explosive charge when the p-nitrodiphenyl is heated to at least its melting point upon the external application of heat.

6. An electric firing device comprising a metal casing and a detonating explosive positioned therein, which includes interposed between said detonating explosive and said casing an organic compound having a melting point between 60° C. and 150° C., and being capable of desensitizing the said detonating explosive when said organic compound is heated to approximately its melting point, the said organic compound interposed between said casing and said detonating explosive comprising a layer at least .01 inch thick, whereby the said organic compound causes desensitization of the said detonating explosive upon external application of heat to said casing.

7. An electric firing device insensitive to detonation by external heating comprising a closed end metal casing, a detonating explosive charge therein, a firing assembly in igniting contact with said detonating charge and an organic compound interposed between said casing and said detonating charge, and separating said detonating charge from said casing by at least .01 inch, the said organic compound having a fusing point between about 60° C. and about 150° C., and being characterized by an ability to desensitize said detonating charge upon being raised to approximately its fusing point by application of heat to the external portion of the said casing.

8. An electric firing device insensitive to detonation by external heating comprising a closed end metal casing, a detonating explosive charge therein, a firing assembly in igniting contact with said detonating charge and an aromatic compound interposed between said casing and said detonating charge, and separating said detonating charge from said casing by at least .01 inch, the said aromatic compound having a fusing point between about 60° C. and about 150° C. and being characterized by an ability to desensitize said detonating charge upon being raised to approximately its fusing point by application of heat to the external portion of the said casing.

9. An electric firing device insensitive to detonation by external heating comprising a closed end metal casing, a detonating explosive charge therein, a firing assembly in igniting contact with said detonating charge and a resinous compound interposed between said casing and said detonating charge, and separating said detonating charge from said casing by at least .01 inch, the said resinous compound having a fusing point between about 60° C. and about 150° C. and being characterized by an ability to desensitize said detonating charge upon being raised to approximately its

fusing point by application of heat to the external portion of the said casing.

10. An electric firing device insensitive to detonation by external heating comprising a closed end metal casing, a detonating explosive charge therein, a firing assembly in igniting contact with said detonating charge and an alkyd resinous compound interposed between said casing and said detonating charge, and separating said deto-

nating charge from said casing by at least .01 inch, the said alkyd resinous compound having a fusing point between about 60° C. and about 150° C. and being characterized by an ability to desensitize said detonating charge upon being raised to approximately its fusing point by application of heat to the external portion of the said casing.

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