Sept. 20, 1960 W. MAXWELL 2,953,448

COMPOSITIONS FOR SAFETY HEATING ELEMENTS

Filed May 2, 1958

Fig.1.

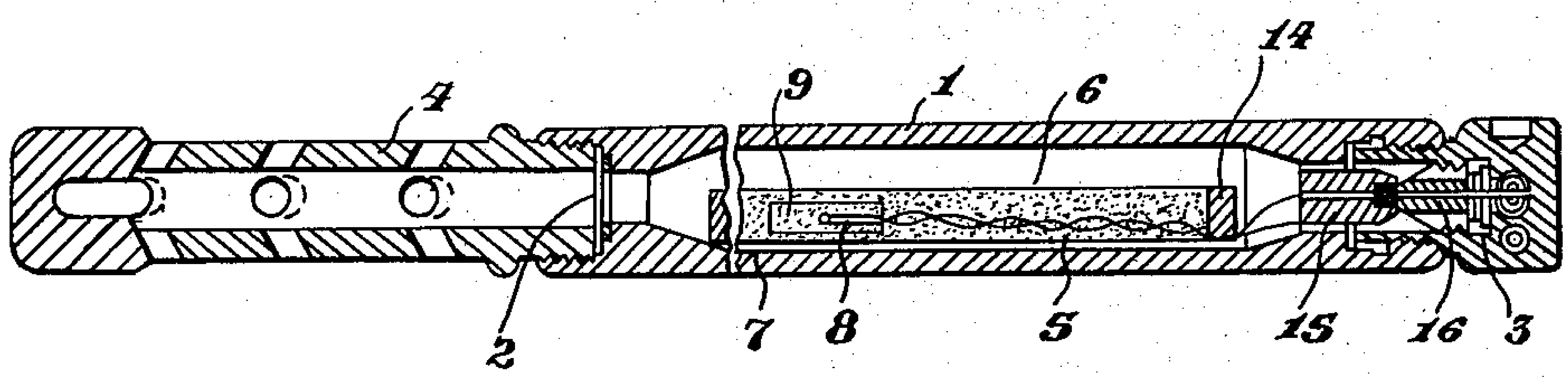
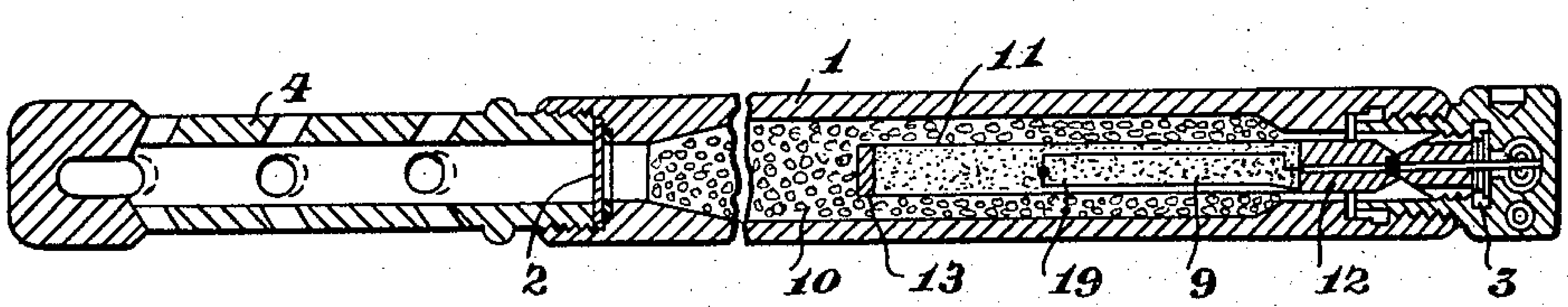


Fig.2.



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United States Patent Office 2,953,448
Patented Sept. 20, 1960

2,953,448

COMPOSITIONS FOR SAFETY HEATING ELEMENTS

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Filed May 2, 1958, Ser. No. 732,662

Claims priority, application Great Britain Jan. 14, 1953

9 Claims. (Cl. 52—7)

The present invention relates to heating devices particularly suitable for use in blasting devices of the type comprising a pressure resisting container enclosing a blasting charge for use in dusty or fiery mines and of the kind capable of undergoing self-sustained flameless gas-producing thermal decomposition when locally heated, wherein the container is of tubular metal construction closed or fitted with a gas-tight closure at one end and at the other end fitted with a venting cap separated from the container by an expendable bursting disc adapted to yield at a predetermined pressure and wherein the container is fitted with electrical contacts to enable a heating device to be actuated. More particularly, my invention relates to a safety heating device for initiating thermal decomposition of a non-detonating safety blasting charge wherein an electric initiating element and a heating composition are enclosed in a container, said heating composition comprising guanidine nitrate, 25–45% by weight of a persulphate compound selected from the group consisting of sodium persulphate, potassium persulphate, and ammonium persulphate, and not more than 10% by weight cuprous chloride, and wherein the container is adapted to release the gas formed within it on initiation of the gas-generating reaction in said heating composition.

This application is a continuation-in-part of United States application Serial No. 614,932, now abandoned, which is a continuation-in-part of Serial No. 397,308, now abandoned.

In a charged blasting device of this nature the blasting effect is produced by the discharge of the gases into the borehole through ports in the venting cap when the pressure within the container has built up sufficiently to cause the bursting disc to yield and a passage has been opened up between the container and the venting cap. The time taken for the discharge of the gases from the container into the venting cap and through the ports into the borehole after the yielding of the bursting disc is sufficient to result in a comparatively gentle heaving blasting effect, such as is desirable for such purposes as the production of lump coal.

In blasting assemblies of this kind the charge commonly used comprises an equi-molecular mixture of sodium nitrite and ammonium chloride stabilized with an alkali such as magnesium oxide or sodium carbonate in amounts up to about 3% by weight which when locally heated decomposes in a non-detonating manner without flame in self-sustained fashion with the formation of sodium chloride, nitrogen and steam and under the rising pressure conditions experienced in the aforesaid blasting device this decomposition once initiated by the local heating device is greatly accelerated and almost immediately the gases are discharged without flame, with the result that blasting operations with a charge of this nature in a blasting device of the aforesaid kind are especially well suited for coal-mining in fiery or dusty mines.

In normal practice the decomposition of the charge is

initiated by using a small electric blackpowder fuse as the heating device. This practice has been possible because although a blackpowder fuse produces flame, the time taken for the decomposition of the stabilized mixture of sodium nitrite and ammonium chloride to build up a pressure sufficient to cause the bursting disc to yield is long enough for the fragments of the electric powder fuse to have burned out before the bursting disc yields. Although this type of blasting device using an electric blackpowder fuse as the heating device is widely used in fiery and dusty mines the nature of the heating device makes it necessary for loading to be carried out above ground. This causes some inconvenience, for example, considerable time is lost in taking the tubular containers above ground for recharging after every shot. The use of an electric blackpowder fuse as a heating device for blasting assemblies of the aforesaid nature also suffers from various other disadvantages.

It has now been found that the above noted disadvantages can be overcome by the use of a new heating composition together with an electric initiating element which, in combination, can be used, for example, in place of a blackpowder fuse to initiate the reaction of compositions capable of generating sufficient gas to sustain such reaction. The ability of this new heating composition to be initiated by an electric initiating element is a significant advantage and is achieved only by utilizing the heating composition disclosed including the specific proportion ranges set forth.

The heating composition contemplated for my novel safety heating device comprises guanidine nitrate, 25–45% by weight of a persulphate selected from the group consisting of sodium persulphate, potassium persulphate, and ammonium persulphate, and not more than 10% by weight cuprous chloride. It is preferred to add up to 1% by weight of petroleum jelly to this composition although not mandatory. Petroleum jelly is used in the composition as an anti-segregation agent. If desired, the heating composition of the invention may likewise contain up to about 1% by weight of an oxygen-negative organic fuel other than petroleum jelly, as, for example, castor oil or linseed oil.

It should be stressed that the novel advantages of the safety heating device disclosed and the heating composition used therewith are dependent upon the make-up of the composition and the proportions of the various ingredients used. Thus, by my novel invention I have realized a heating composition as understood in the blasting art and particularly suitable for use to initiate the reaction of a blasting charge. This is achieved more easily and with safety from detonation of inflammable gas mixtures.

With the above in mind, the principal object of this invention is to provide a safety heating device for initiating thermal decomposition of a non-detonating safety blasting charge wherein an electric initiating element and a heating composition are enclosed in a container, said heating composition comprising guanidine nitrate, 25–45% by weight of a persulphate compound selected from the group consisting of sodium persulphate, potassium persulphate, and ammonium persulphate, and not more than 10% by weight cuprous chloride, and wherein the container is adapted to release the gas formed within it on initiation of the gas-generating reaction in said heating composition.

Another object of this invention is to provide a safety heating device as noted heretofore wherein the electric initiating element is a low tension electric fusehead and the cuprous chloride is included in the heating composition in amount of 6–10% by weight.

An additional object of this invention is to provide a safety heating device as noted heretofore wherein said electric initiating element is in the form of a wire of high electrical resistance adapted to be heated by an electric current either alone or in conjunction with a small amount of deflagrating composition and wherein the cuprous chloride of the heating composition is in amount of not more than 6% by weight.

Still another object of this invention is to provide a heating composition for use in a safety heating device comprising 45–66% by weight guanidine nitrate, 27–45% by weight of a persulphate compound selected from the group consisting of sodium persulphate and potassium persulphate, and not more than 10% by weight cuprous chloride.

An additional object of this invention is to provide a heating composition for use in a safety heating device comprising 20–70% by weight guanidine nitrate, 25–45% by weight ammonium persulphate, 0.5–10% by weight cuprous chloride, and not more than 35% by weight of a nitrate selected from the group consisting of ammonium nitrate, sodium nitrate, and potassium nitrate, the total amount of the nitrate compounds being from 55 to 75% by weight.

A further object of this invention is to provide a heating composition set forth heretofore and including not more than 1% by weight of petroleum jelly.

Still further objects and the entire scope of applicability of the present invention will become apparent from the detailed description given hereinafter. It should be understood, however, that the detailed description and specific examples, while indicating the preferred embodiments of the invention, are given by way of illustration only, since various changes and modifications within the spirit and scope of the invention will become apparent to those skilled in the art, from this detailed description.

Reference is made to the accompanying drawings wherein the same reference numbers refer to like parts.

Figure 1 illustrates a safety heating device including one embodiment of the invention, and showing the use of a low tension electric fusehead, and

Figure 2 illustrates a safety heating device including another embodiment of the invention, and showing the use of a wire of high electric resistance adapted to be heated by an electric current in conjunction with a small amount of deflagrating composition.

According to the present invention a safety heating device for initiating thermal decomposition of a non-detonating safety blasting charge of the kind wherein an electric initiating element and a heating composition are enclosed in a container is characterized in that the heating composition comprises guanidine nitrate, 25–45% by weight of a persulphate selected from the group consisting of sodium persulphate, potassium persulphate, and ammonium persulphate, and not greater than 10% by weight cuprous chloride. As noted heretofore, up to 1% by weight petroleum jelly can be used.

The electric initiating element may be in the form of a wire adapted to be heated by electric current either alone or in conjunction with a small amount of a deflagrating composition, for example, in the form of an electric fusehead. A low tension electric fusehead can sometimes be used, as will be noted hereinafter, depending upon the exact make-up of the heating composition and such low tension electric fusehead enables initiation of the blasting charge to be effected using an electric supply system which would not be adequate for initiation solely by a heated wire.

In connection with the foregoing, the quantity of cuprous chloride in the heating composition can be up to 6% by weight, if the electric initiating element is in the form of a wire of high electric resistance with or without deflagrating composition. Only if a low tension electric fusehead is used have I found it normally necessary to include cuprous chloride in an amount of more than 6% and up to 10% by weight. Both modifications of the invention are contemplated by me. However, the latter modification is preferred when the safety heating

device is to be fired in gassy mines. Under such circumstances, a low tension electric fusehead is preferred because initiation thereof can be effected by an electric supply system of the kind approved for firing in gassy mines, which gives a current of only short duration. Of course, such a current would be inadequate to heat a wire of high electric resistance to the temperature required to effect initiation of the aforesaid heating compositions.

It can be appreciated that a reduction of the quantity of cuprous chloride in the heating composition is advantageous in order to enhance the heating characteristics thereof. Accordingly, where it is permissible to use a high electrical resistance type of initiating element, as for example, in other than gaseous atmospheres, this modification would be preferred.

It should be noted that potassium persulphate, sodium persulphate, or ammonium persulphate, can be used in the heating composition and display similar consistently satisfactory results. The ultimate choice primarily depends upon the availability of the respective compounds. The addition of the persulphate compound gives a heating composition that is cooler, more sensitive and, therefore, more easily initiated. The end result is a heating composition which is particularly adaptable to use with blasting charges of the type described, which is safe for use in mixtures of inflammable gases, and which is non-explosive.

A preferred heating composition using potassium persulphate, petroleum jelly and a low tension electric fusehead comprises 60% by weight guanidine nitrate, 31.5% by weight potassium persulphate, 8% by weight cuprous chloride and 0.5% by weight petroleum jelly. It is noted that the percentage of cuprous chloride, of necessity, is between 6 and 10% in view of the use of a low tension electric fusehead in the safety heating device.

A preferred composition using potassium persulphate, petroleum jelly and a wire of high electrical resistance, alone or in conjunction with a small amount of deflagrating composition comprises 62% by weight guanidine nitrate, 34% by weight potassium persulphate, 3% by weight cuprous chloride and 1% by weight petroleum jelly. The use of high resistance wire as the electric initiating element permits decrease of the amount of cuprous chloride to under 6%.

A preferred composition using sodium persulphate, petroleum jelly, and a high electrical resistance wire comprises 62% by weight guanidine nitrate, 34% by weight sodium persulphate, 3% by weight cuprous chloride and 1% by weight petroleum jelly. As previously set forth, in all of the preferred heating compositions, up to 1% by weight of an oxygen-negative organic fuel other than petroleum jelly, such as, for example, castor oil or linseed oil, can be used. Such additives enhance the stability of the heating composition over substantial periods of time, and, accordingly, can be utilized depending upon the specific circumstances under which the safety heating device is being used.

The use of ammonium persulphate can also contemplate the inclusion of up to 35% by weight ammonium, sodium, or potassium nitrate in the heating composition. In this event, the amount of guanidine nitrate can be from 20% to 70% by weight with the total amount of the nitrate compounds being from 55% to 70% by weight.

In the absence of these other nitrate compounds, the guanidine nitrate is present in the heating composition in amounts of from 45–66% by weight.

It should be stressed that the foregoing discussion regarding the necessity for more than 6% cuprous chloride when using a low tension electric fusehead is not applicable in the case where other nitrate compounds are added to the heating composition.

A preferred composition using ammonium persulphate, and an additional nitrate compound, with a low tension electric fusehead comprises 27.0% by weight guanidine nitrate, 40% by weight ammonium persulphate, 2.5% by weight cuprous chloride, and 30.5% sodium nitrate.

It should be emphasized that the heating compositions of the invention do not cause ignition of a methane/air mixture containing 9% by volume of methane when their decomposition is initiated therein. Thus, heating devices comprising a charge of these compositions are eminently suitable for underground loading in blasting devices of the aforesaid type.

The container is preferably made of any convenient non-deflagrating, non-smoulderable material such as for example sheet metal, certain synthetic resins such as polychloracrylates and fireproofed cardboard but may also be made of combustible materials provided that the combustion thereof cannot be initiated by the heating composition. The container may also have a lightly sealed portion adapted to be unsealed by a slight rise in pressure which in itself would not be sufficient to rupture the bursting disc of the blasting device or assembly. In a preferred form of the heating device of the invention the container consists of a fireproofed cardboard cylinder sealed at one end with a wooden plug through which pass two wires leading to a low tension electric fusehead and sealed at the other end by a cork which blows out on the generation of slight pressure after initiation.

The safety heating devices of the invention may be used in blasting assemblies of the aforesaid kind in which the main charge comprises any composition capable of flameless exothermic gas-producing reaction when locally heated, such as are commonly used, but are more advantageous for use with main charge compositions which require a super-atmospheric pressure for their reaction to be initiated. Suitable main charges include ammonium chloride-sodium nitrite mixtures, ammonium nitrate compositions as for example, compositions based on ammonium nitrate and magnesium nitrate hexahydrate or aluminum nitrate nonahydrate and compositions based on ammonium nitrate and calcium formate.

The amount of the compositions of the invention used in safety heating devices for blasting devices or assemblies of the aforesaid kind may vary from 1 gram upwards but is preferably from 5–120 grams. The time lag between initiation and bursting of the disc of the blasting device or assembly will, of course, vary according to the amount used. Thus, in a blasting assembly fitted with a mild steel bursting disc 7/64 inch thick and containing a main charge consisting of 380 grams of an equi-molecular mixture of ammonium chloride and sodium nitrite and 1.5% by weight magnesium oxide with a heating device containing a heating charge consisting of 60.0% by weight guanidine nitrate, 31.5% by weight potassium persulphate, 8.0% by weight cuprous chloride and 0.5% by weight petroleum jelly and an electric initiating element consisting of a low tension electric fusehead for a heating charge weighing 1, 5, 10, 20, and 40 grams, the time lag is 32, 10, 5, 2, and 1 second respectively. The weight of heating composition used is preferably not less than 5 grams since it is considered undesirable to have a time lag greater than 10 seconds.

In a blasting assembly fitted with a mild steel bursting disc 7/64 inch thick and using a main charge constisting of 380 grams of equi-molecular mixture of ammonium chloride and sodium nitrite and 1.5% by weight magnesium oxide with a heating charge comprising 62% by weight guanidine nitrate, 34% by weight sodium persulphate, 3% by weight cuprous chloride and 1% by weight petroleum jelly, and an electric initiating element consisting of a high electric resistance wire, bursting of the disc occurred 28, 12, 6, 2, and 1 second after initiation when the weight of heating charge was 1, 5, 10, 20, 40, and 120 grams, respectively.

In a blasting assembly fitted with a mild steel bursting disc 7/64 inch thick and using a main charge consisting of 380 grams of an equi-molecular mixture of ammonium chloride and sodium nitrite and 1.5% by weight magnesium oxide with a heater charge comprising 35% by weight ammonium persulphate, 60.5% by weight guanidine nitrate, 1% by weight potassium nitrate, 2.5% by weight cuprous chloride, 0.5% by weight castor oil and 0.5% by weight china clay, bursting of the disc occurred 35, 30, 15, 9, 3 and 2 seconds after initiation when the weight of the heater charge was 1, 5, 10, 20, 40, and 120 grams, respectively.

The safety heating elements of the invention may also be used for non-detonating blasting charges of the kind capable of undergoing self-sustained flameless gas-producing thermal decomposition which are used for blasting in boreholes in other devices than of the kind described hereinbefore.

My invention is specifically illustrated by the attached drawings in which Figure 1 shows a blasting device of the aforementioned kind in which the heating composition **9** is initiated by a low tension electric fusehead **8** and is contained in a paper container, the whole being contained within the main charge which is itself prepackaged in a waxed paper wrapper. Figure 2 illustrates a similar blasting device in which the main charge is packed loosely around the heating composition which is contained in a fireproofed cardboard cylinder and which is positioned by means of the wooden plug **12** which seals one end thereof. A high electrical resistance wire **19** with deflagrating composition thereon comprises the electric initiating element.

With specific reference to Figure 1, a pressure resisting steel container **1** is of 680 cc. capacity of 1¼ inch internal diameter and is provided with a mild steel disc **2** of 7/64 inch thickness adapted to burst at 12 tons per square inch, a firing head **3** and a discharge head **4**, both of which are of high tensile steel. The pulverulent composition **5** consists of a charge of 170 grams of a mixture of 49.2% by weight magnesium nitrate hexahydrate, 38.8% by weight ammonium nitrate, and 12% by weight woodflour enclosed in a waxed paper wrapper **6** weighing 20 grams and of ⅞ inch external diameter. The loading densisty throughout the tube is 0.25. The electrically actuable heating device embedded in the composition **5** consists of a paper container **7** weighing 2 grams and containing a low tension electric fusehead **8** and a 20 gram charge **9** of a heating composition consisting of 60% by weight guanidine nitrate, 31.5% by weight potassium persulphate, 8% by weight cuprous chloride and 0.5% by weight petroleum jelly.

It can be appreciated that, in Figure 1, element **14** is a cork plug for sealing the container **6**, element **15** is a wooden plug for positioning the electric terminal of the leading wires, and element **16** is an insulant to insulate one of the electrodes from the main body of the firing head. The aforementioned low tension electric fusehead **8** consists of a pole-piece structure comprising two metal foils separated by an insulant and having one end of each connected by a resistance bridge wire which has been coated with a composition comprising lead mono-nitro-resorcinate and potassium chlorate in a nitrocellulose dope and finally given a number of coats of nitrocellulose to render it waterproof.

Turning to Figure 2, the pressure resisting steel container **1** contains 320 grams of loose charge **10** consisting of an equi-molecular mixture of sodium nitrite and ammonium chloride stabilized with 3% of magnesium oxide.

The electrically actuable heating device comprises a fireproofed cardboard cylinder **11** which weighs 4 grams and which is sealed at one end by a wooden plug **12** through which pass the wires leading to a wire **19** of a high electrical resistance adapted to be heated by an electric current in conjunction with a small amount of deflagrating composition, and which is sealed at the other end by a cork **13** which blows out on the generation of a slight pressure after initiation of the 20 grams of heating composition charge **9**. Said heating composition comprises 62% by weight guanidine nitrate, 34% by weight potassium persulphate, 3% by weight cuprous chloride and 1% by weight petroleum jelly.

Other modifications of the invention are more specifically illustrated by the following examples.

Example 1

A blasting device of the kind described and having a mild steel bursting disc of thickness 7/64 inch is charged with a main charge consisting of 140 grams of a mixture of 49.0% by weight ammonium nitrate, 34.0% by weight magnesium nitrate hexahydrate and 17.0% by weight woodflour and with a heating device comprising 40 grams of a mixture of 64% by weight guanidine nitrate, 33.0% potassium persulphate, 2.5% by weight cuprous chloride and 0.5% by weight petroleum jelly enclosed in a fireproofed cardboard container with an electric heating element as illustrated in Figure 2. The time lag between initiation and bursting of the disc is 5 seconds.

Example 2

The procedure is as in Example 1 except that the composition in the heating device consists of a mixture of 65.0% by weight guanidine nitrate, 34.5% by weight potassium persulphate and 0.5% by weight petroleum jelly. The time lag is 35 seconds.

Example 3

The procedure is as in Example 1 except that the composition in the blasting device consists of a mixture of 62.0% by weight guanidine nitrate, 31.5% by weight potassium persulphate, 6.0% by weight cuprous chloride and 0.5% by weight castor oil. The time lag is 3 seconds.

Example 4

The procedure is as in Example 1 except that the composition in the heating device consists of a mixture of 64.0% by weight guanidine nitrate, 34.0% by weight potassium persulphate, 1.5% by weight cuprous chloride and 0.5% by weight petroleum jelly. The time lag is 10 seconds.

Example 5

The procedure is as in Example 2 except that the main charge consists of a mixture of 63.0% by weight ammonium nitrate, 34.0% by weight calcium formate and 3.0% by weight woodflour. The time lag is 5 seconds.

Example 6

The procedure is as in Example 5 except that the composition in the heating device is that used in Example 2. The time lag is 35 seconds.

Example 7

A blasting device of the kind described and having a mild steel bursting disc of thickness 7/64 inch is charged with a main charge consisting of 140 grams of a mixture of 49.0% by weight ammonium nitrate, 34.0% by weight magnesium nitrate hexahydrate and 17.0% by weight woodflour and with a heating device comprising 40 grams of a mixture of 61.0% by weight guanidine nitrate, 32.5% sodium persulphate, 6.0% by weight cuprous chloride and 0.5% by weight castor oil enclosed in a fireproofed cardboard container with an electric heating element as illustrated in Figure 2. The time lag between initiation and bursting of the disc is 3 seconds.

Example 8

The procedure is as in Example 7 except that the composition in the heating device consists of a mixture of 62.0% by weight guanidine nitrate and 34.0% by weight sodium persulphate, 3.0% by weight cuprous chloride and 1.0% by weight castor oil. The time lag is 7 seconds.

Example 9

The procedure is as in Example 7 except that the composition in the heating device consists of a mixture of 63.0% by weight guanidine nitrate, 34.5% by weight sodium persulphate, 2.0% by weight cuprous chloride and 0.5% by weight castor oil. The time lag is 10 seconds.

Example 10

The procedure is as in Example 7 except that the composition in the heating device consists of a mixture of 64.5% by weight guanidine nitrate, 34.0% by weight sodium persulphate, 1.0% by weight cuprous chloride and 0.5% by weight castor oil. The time lag is 13 seconds.

Example 11

The procedure is the same as in Example 7 except that the composition in the heating device consists of a mixture of 65.0% by weight guanidine nitrate, 34.0% by weight sodium persulphate and 0.5% by weight castor oil. The time lag is 21 seconds.

Example 12

The procedure is as in Example 7 except that the composition in the heating device consists of a mixture of 60.0% by weight guanidine nitrate, 31.5% by weight sodium persulphate, 8.0% by weight cuprous chloride and 0.5% by weight petroleum jelly and that the electric initiating element is a low tension electric fusehead as illustrated in Figure 1. The time lag is 4 seconds.

Example 13

The procedure is as in Example 7 except that the composition in the heating device consists of a mixture of 59.0% by weight guanidine nitrate, 30.5% by weight sodium persulphate, 10.0% by weight cuprous chloride and 0.5% by weight petroleum jelly and that the electric initiating element is a low tension electric fusehead as illustrated in Figure 1. The time lag is 4 seconds.

Example 14

A blasting device of the kind described and having a mild steel bursting disc of thickness 7/64 inch is charged with a main charge consisting of 320 grams of a loose charge of an equi-molecular mixture of sodium nitrite and ammonium chloride stabilized with 3% of magnesium oxide and with a heating device comprising 20 grams of a mixture of 30.5% by weight sodium nitrate, 40.0% by weight ammonium persulphate, 27.0% by weight guanidine nitrate, and 2.5% by weight cuprous chloride enclosed in a fireproofed cardboard container with a low tension electric fusehead as illustrated in Figure 1. The time lag between initiation and bursting of the disc is about 5 seconds.

The following comparative data are set forth illustrating the advantages of the safety heating device and heating compositions utilized therewith of the present invention, over means previously utilized in the art with particular emphasis on the blackpowder fuse devices presently in use.

A number of composite charges were made up in fireproofed paper containers of length 22 inch and 1 3/16 inches in diameter. The main charge in each case consisted of 140 grams of a composition consisting of 49% by weight ammonium nitrate, 34% by weight magnesium nitrate hexahydrate and 17% by weight woodflour. The heating elements used consisted of a 40 gram charge of a composition consisting of 60.0% by weight guanidine nitrate, 31.5% by weight potassium persulphate, 8.0% by weight cuprous chloride and 0.5% by weight mineral jelly, Composition A, or 61.5% by weight guanidine nitrate, 35.0% by weight ammonium persulphate, 2.5% by weight cuprous chloride, 0.5% by weight china clay and 0.5% by weight castor oil, Composition B, in conjunction with an electric initiator of the kind described in United States Patent No. 2,127,603 in some cases while in others the heating element consisted of an electric blackpowder fuse of varying weight. These charges are initiated while being freely suspended in an atmosphere consisting of 9% by volume of methane in air in order to determine whether accidental initiation of such a charge in a gassy mine could cause ignition of the inflammable gas mixtures present. The results obtained are given in the table below. It should, of course, be noted that in this test the reaction of the main charge was not initiated because of the initiation of the heating element taking place at atmospheric pressure.

Heating Element	Result
40 g. of Composition A	10 shots, no ignitions.
40 g. of Composition B	10 shots, no ignitions.
20 g. Electric Blackpowder fuse	Ignited.
10 g. Electric Blackpowder fuse	Do.
5 g. Electric Blackpowder fuse	Do.

The novel principles of this invention are broader than the specific embodiments recited above and rather than unduly extend this disclosure by attempting to list all the numerous modifications which have been conceived and reduced to practice during the course of this development, these novel features are covered in the following claims.

I claim:

1. A heating composition for use in a safety heating device consisting essentially of guanidine nitrate, 25–45% by weight of a persulphate compound selected from the group consisting of sodium persulphate, potassium persulphate, and ammonium persulphate, and not more than 10% by weight cuprous chloride.

2. A heating composition as claimed in claim 1 including up to 1% by weight petroleum jelly.

3. A heating composition as claimed in claim 2 including up to about 1% by weight of an oxygen-negative organic fuel selected from the group consisting of castor oil and linseed oil.

4. A heating composition as claimed in claim 1 wherein said guanidine nitrate is in amount of from 45–66% by weight.

5. A heating composition as claimed in claim 1 wherein said guanidine nitrate is in amount of from 20–70% by weight, said persulphate compound is ammonium persulphate, and wherein said heating composition includes not more than 35% by weight of a nitrate selected from the group consisting of ammonium nitrate, sodium nitrate, and potassium nitrate, the total amount of the nitrate compounds being from 55–70% by weight.

6. A heating composition as claimed in claim 1 wherein said guanidine nitrate is in amount of 60% by weight, said persulphate is potassium persulphate in amount of 31.5% by weight, said cuprous chloride is in amount of 8% by weight and including 0.5% by weight petroleum jelly.

7. A heating composition as claimed in claim 1 wherein said guanidine nitrate is in amount of 62% by weight, said persulphate is potassium persulphate in amount of 34% by weight, said cuprous chloride is in amount of 3% by weight and including 1.0% by weight petroleum jelly.

8. A heating composition as claimed in claim 1 wherein said guanidine nitrate is in amount of 62% by weight, said persulphate is sodium persulphate in amount of 34% by weight, said cuprous chloride is in amount of 3% by weight and including 1.0% by weight petroleum jelly.

9. A heating composition as claimed in claim 1 wherein said quanidine nitrate is in amount of 27% by weight, said persulphate is ammonium persulphate in amount of 40% by weight, said cuprous chloride is in amount of 2.5% by weight and including 30.5% by weight sodium nitrate.

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