June 30, 1936. J. TAYLOR 2,046,194

BLASTING CHARGE

Filed Feb. 19, 1934

FIG. 1.

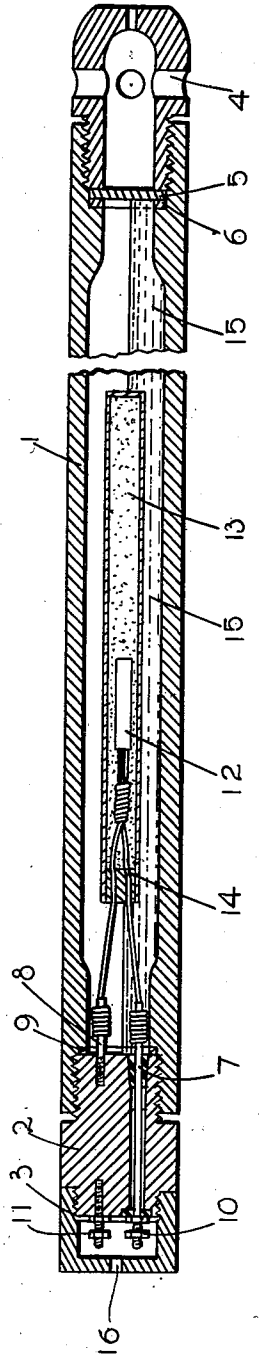
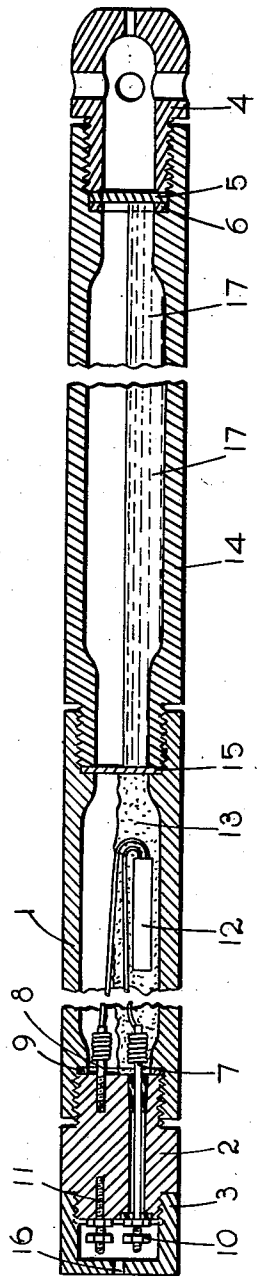


FIG. 2.



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Patented June 30, 1936 2,046,194

UNITED STATES PATENT OFFICE

2,046,194

BLASTING CHARGE

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Application February 19, 1934, Serial No. 712,051
In Great Britain December 15, 1933

10 Claims. (Cl. 102—7)

Explosives such as are used for blasting are characterized by their capacity to undergo rapid exothermic reaction when suitably ignited or initiated, so as to yield hot gases capable of exerting pressure and doing work.

In the case of most explosives the reaction occurs in a very short interval of time. In general the reactions which occur are highly exothermic and the gases resulting from the explosion are at high temperature, so that when explosives are used in fiery or dusty mines special measures such as the incorporation of cooling materials are necessary to minimize or eliminate the attendant danger.

Attempts have been made from time to time to utilize the property possessed by water of quenching flame and sparks in order to attain safety in the use of explosives. Thus expedients such as surrounding or partly surrounding the explosive with water or tamping it with water have been tried. Apart from considerable practical difficulties involved in such methods, their success has only been partial since it is difficult to ensure that intimate and adequate mixing of the products of the explosion with the water will occur before the latter is dispersed or blown away. Moreover the latent heat of water involves a diversion of a portion of the energy obtainable from the explosive.

The object of the present invention is to provide a method whereby exothermic reactions resulting in the production of adequate energy for the purpose of blasting are effected in the presence of water in such a manner that while maximum safety may be ensured the power resulting from the reaction is utilized in a really effective manner.

According to the present invention exothermic reactions of the kind which occur in the presence of water on the application of heat are utilized.

The exothermic reactions which I utilize are not of sufficient rapidity to result in explosion when they are carried out in the open, but according to my invention the reaction is caused to proceed within a rigid container capable of withstanding considerable pressure before venting occurs. A particularly suitable type of rigid container for the purpose of my invention is one provided with a venting system such as a bursting disc held in position by a screwed-in cap provided with a plurality of openings for the discharge of the gases after the disc has burst. Instead of a bursting disc held in position as above the venting member may take the form of a valve, in either case the container being provided with means to determine that venting shall take place at a considerable and predetermined pressure.

The source of heat provided within the container may take the form of an electric resistance heating element, or a composition capable of combustion when suitably ignited or initiated, an electric arc or a non-detonating explosive charge.

In the case where an explosive charge or heater mixture is used for promoting the reaction it may be contained in a waterproof case in the container in such a way that the liquid partly or completely surrounds it, or it may be contained in a separate rigid container attached to or screwed into the reaction container and separated therefrom by means of a suitable temporary closure member.

When the source of heat chosen is an explosive or heater composition, the quantity used is so chosen that the pressure it generates by itself is insufficient to cause venting. In this manner it is ensured that the hot products from the explosive or heater charge are mixed with the water before venting occurs so that there is no danger of the liquid being shot out like a projectile before reaction occurs.

Moreover, by suitable choice of the nature and quantities of the heating charge and of the components of the exothermic reaction mixture or substance it is possible to ensure that the final temperature of the products vented is insufficient to produce ignition in even the most dangerous mixtures of methane and air.

The invention is thus capable of providing a safe method of blasting in fiery or dusty mines. Depending upon the nature of the substance or mixture used for producing the exothermic reaction, it may be introduced along with the water in the form of a solution, a paste, a suspension, or the like liquid mass, and it will be understood that the substances which may be chosen for producing the exothermic reaction are very numerous. Thus there may be used a solution of ammonium nitrite in water, or a solution containing a mixture of sodium nitrite and ammonium chloride, again a solution of ammonium nitrate may be used, or a mixed solution of urea and sodium nitrite, or mixtures of hydrogen peroxide and organic liquids such as alcohol. The above examples are particularly favourable since the reactions give rise not only to heat but to the evolution of gases.

Figs. 1 and 2 are longitudinal sectional views of two forms of the device suitable for carrying out my invention. The following is a description of Figure 1.

Into one threaded end of a shouldered strong steel container (1) there is screwed a firing head (2) separated from the container (1) by a sealing washer (9) of fibre or other suitable material such that a seal which is gas tight even at high pressures is ensured. The firing head (2) is provided with electrodes (7) and (8) of which one (8) is in metallic connection with the firing head (2), while the other (7) is insulated from the firing head. The mounting of the insulated electrode (7) is such as to allow no gas leakage at pressures up to about 25 tons per sq. in. Terminals (10) and (11) are provided for the electrodes, which are used in initiating the cartridge electrically. A protective steel cap (3) having an aperture (16) for the leads to the terminals from the cable of the exploder or other suitable source of electrical energy is screwed on the firing head (2). The heater charge (13) comprises a charge of blackpowder contained in a waterproof cylinder and contains a 5 grain powder fuse or other igniter (12). It is closed by a waterproof plug (14) through which the suitably insulated lead wires of the powder fuse pass to the electrodes (7) and (8). The charge (15) of exothermic liquid medium is poured into the steel cylinder (1) through the end of the tube remote from the firing head (2), and only partially fills the cylinder. On the shoulder of the container remote from the firing head (2) there is placed a fibre or like sealing washer (6), the steel bursting disc (5) adapted to be ruptured at a predetermined pressure being held in position between the said washer and the hollow screwed-in cap (4), which is pierced with suitable channels for the venting of the gases and the direction and distribution of the blast. In blasting, the assembly is placed in the borehole with the cap (4) as far in as possible, and the device may if desired be tamped. It is then fired electrically.

In Figure 2 the parts (1) to (11) and (16) have precisely the same significance as in the description of Figure 1. An electric powder fuse or other igniter is connected by its wire leads to the electrodes (7) and (8), and the heater charge (13)—for example one of blackpowder—is introduced into the cylinder (1) as shown, and need not be wrapped. On the shoulder of the container remote from the firing head (2) there is placed a fibre or like waterproof disc (15) designed to withstand only very low pressures, and held in position by the screwed-in end of a second shouldered steel cylinder (14) into which the charge (17) of the exothermic liquid medium is introduced. The fibre or like cylinder washer (6), the steel bursting disc (5) and the hollow screwed-in cap (4) are positioned at the shouldered end of the container (14) as in Figure 1. The charge (13) of powder is insufficient in amount to cause the rupture of the disc (5) when the charge (17) of liquid is replaced by an equal volume of water.

In both Figures 1 and 2 for convenience the device has been shown in the upright position, but it will be understood that the charge (15) in Figure 1 and the charges (13) and (17) in Figure 2 would only assume the positions shown if the devices were horizontal. In practice, the device can be used in any position.

The following examples further illustrate my invention:—

Example 1

A rigid container of 600 c. c. capacity venting at a pressure of 12 tons per sq. in. was utilized. A suitable means for firing a heater cartridge was provided, the cartridge used yielding 57,000 calories, and consisting of an 80:20 mixture of potassium perchlorate and a phenolic resin. Tests having shown that in presence of 200 c. c. water the explosion of an equal charge of the same explosive failed to cause venting, there were used as exothermic material a mixture of 50 c. c. water and 150 c. c. saturated ammonium nitrate solution. The total liquid in the container was thus 200 c. c.

Example 2

The device and the source of heat were as in Example 1. The exothermic mixture consisted of a mixture of 200 c. c. saturated ammonium nitrate solution and 50 c. c. saturated ammonium carbonate solution, the total liquid being 250 c. c.

Example 3

The device and source of heat were as in Example 1. The exothermic mixture consisted of 300 c. c. saturated sodium nitrite solution in which had been dissolved as much ammonium chloride as it could take up.

Example 4

The container was of 330 c. c. capacity having a bursting disc venting at 12 tons per sq. in. A waterproofed heating cartridge containing 33 gm. blackpowder with a 5 grain powder fuse as igniter was introduced into the container. The exothermic aqueous mixture was made by dissolving in 130 c. c. saturated ammonium nitrate solution as much sodium nitrite and as much urea as it would hold in solution.

In carrying out the blast the charged device is inserted in the borehole so as to vent at back.

My invention is capable of many variations which will be obvious to those skilled in the art, and all such variations are intended to be covered in the appended claims although not necessarily specifically described herein.

I claim:

1. A blasting device comprising a pressure-rupturable vessel and a charge of an aqueous solution of an ammonium salt capable of undergoing exothermic decomposition, said charge being confined within said pressure-rupturable vessel, and means for initiating the decomposition of said ammonium salt.

2. A blasting device comprising a pressure-resisting shell and a charge of an aqueous medium containing a gas-generating material which is capable of undergoing exothermic decomposition, said charge being confined within said pressure-resisting shell, said shell having a release member adapted to permit the escape of the gases at a predetermined and considerable pressure, and means for initiating the decomposition of said gas-generating material.

3. A blasting device comprising a pressure-resisting shell and a charge of an aqueous solution of a gas-generating material which is not in itself an explosive when unconfined, but which is capable of undergoing exothermic decomposition, said charge being confined within said pressure-resisting shell, which shell has a release member adapted to permit the escape of the gases at a predetermined and considerable pressure, and means for initiating the decomposition of said gas-generating material.

4. A blasting device comprising a pressure-resisting shell and a charge of an aqueous solution of a gas-generating material which is capable of undergoing exothermic decomposition, said charge being confined within said pressure-resisting shell, said shell having a release member

adapted to permit the escape of the gases at a predetermined and considerable pressure, a heater composition in amount insufficient in itself to bring about the escape of the gases by said release member but sufficient to initiate the exothermic decomposition of said gas-generating material, and means for igniting said heater composition.

5. A blasting device as set forth in claim 4, in which the heater composition is located in a waterproofed case in the vessel, said case being in contact with the liquid medium.

6. A blasting device as set forth in claim 4, in which the heater composition is located in a rigid container and is separated from the liquid medium by a temporary closure member.

7. A blasting device as set forth in claim 3, comprising a charge of an aqueous solution of which at least one substance is itself capable of undergoing exothermic decomposition.

8. A blasting device as set forth in claim 4, wherein the aqueous liquid medium consists of a solution containing an alkali nitrite and a substance selected from the group consisting of urea and ammonium salts.

9. A blasting device comprising a pressure-resisting cylindrical shell having plugs at both ends, one of said plugs co-operating with a pressure-rupturable disc to seal the one end of the cylinder until the internal pressure rises to a predetermined value, and being adapted to release the gases into the borehole in which the device is placed and the other of said plugs being adapted to seal the other end of the cylinder and to convey current to a pair of electrical leads; a heating cartridge located within the said cylinder, said cartridge containing an igniter adapted to be fired electrically and having electrical leads connected to the last-mentioned plug; and a charge of aqueous liquid medium located within the said cylinder and containing a gas-generating material which is adapted to give rise to an exothermic reaction accompanied by the evolution of gas when initiated by the said heating cartridge.

10. A blasting device comprising a pressure-resisting cylinder shell having plugs at both ends, one of said plugs co-operating with a pressure-rupturable disc to seal the one end of the cylinder until the internal pressure rises to a predetermined value and being adapted to release the gases into the borehole in which the device is placed, and the other of said plugs being adapted to seal the other end of the cylinder and to convey current to a pair of electrical leads, said shell being divided into two compartments by means of a disc adapted to rupture at a comparatively low pressure; a heating composition located within the compartment next to the last-mentioned plug; a fuse having electrical leads connected to the said last-mentioned plug, said fuse being in effective contact with said heating composition; and a charge of aqueous liquid medium within the compartment adjacent to the first-mentioned plug and containing a gas-generating material which is adapted to give rise to an exothermic reaction accompanied by the evolution of gas when initiated by the said heating composition.

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