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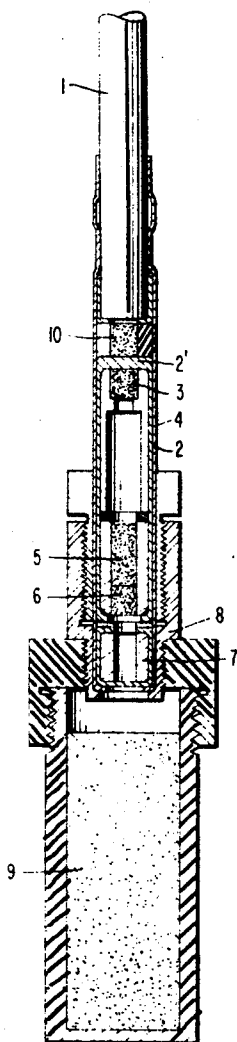
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[54] **RELAY CHARGE WITH A FUSE OF WEAKENED
 EXPLOSIVE POWER**
 10 Claims, 1 Drawing Fig.

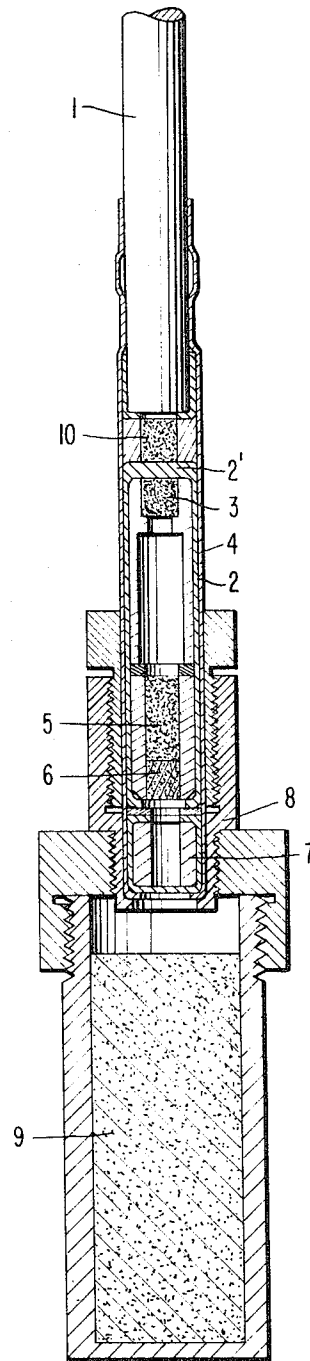
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—29, 70, 86.5; 149/37

ABSTRACT: A relay charge for use with fuses in the initiation of insensitive explosives which comprises two parts preferably detachably connected with each other; one of the two parts contains secondary explosives within a structurally rigid case, open at one end while the other part forms a delay element which is connected with the open end of the case and serves for the accommodation of the fuse and of the delay charge. The delay element includes a shock-sensitive primer composition, a delay charge and a base charge, appropriately encapsulated within a casing.



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RELAY CHARGE WITH A FUSE OF WEAKENED EXPLOSIVE POWER

The present invention relates to a relay or magazine charge, and more particularly to a relay or primer charge which can be used in vertical blast-holes.

For the purpose of igniting explosives which are difficult to set off or initiate, for example, such as "ammonium nitrate/Diesel oil," also referred to as "nitrocarbonitrates," from the maximum depth of a blast-hole, fuses are employed which are incapable by themselves of initiating or setting off the main charge, i.e., without the means of booster charges or priming cartridges. It is required of these booster charges that they can be initiated or set off by the fuse either instantaneously or with a delay. However, on the other hand, they cannot be excessively sensitive to shocks and impacts since they are installed at the deepest place of the blast-holes, which are vertical for the most part, and must be able to withstand, without being destroyed, the weight of the freely falling main charge placed or installed over the same. Consequently, demands have even been made occasionally that these charges not contain any initiating explosive. In any event, all sensitive parts are to be encapsulated in such a manner that no increase in danger is to be expected from this kind of blasting.

Accordingly, it is the aim of this invention to provide a relay charge by means of which the aforementioned requirements are fulfilled. According to the invention, the primer or relay charge essentially consists of the priming cartridge, properly speaking, which is constituted by a metallic container filled with explosives and of sufficient strength to withstand with certainty the pressure of the explosive column resting thereon, and of the delay part.

As the explosive filling for the priming cartridge there may be used conventional secondary explosives or explosive mixtures, such as cyclonite (RDX, hexogen) or pentaerythritol tetranitrate (PETN), dipentahexanitrate, nitromannite (mannitol hexanitrate), nitroglycerin, and nitroglycol explosives.

The delay part essentially consists of an external sleeve or casing, open on both sides, which encompasses a capsule having a strong-walled bottom in such a manner that an empty or hollow space is produced at one end this outer casing and that the end of the fuse can be introduced into this empty or hollow space and can be tightly clamped therein. The capsule with the strong-walled bottom contains, adjoining the bottom, a shock-sensitive primer or detonator composition, for example, in the form of a percussion cap, a small empty tube retaining this composition or percussion cap, a delay body or delay element, charged with a delay composition, a firing charge in this delay element, and finally a powder train charge. After completion of the charge, the capsule is sealed off in a watertight manner by means of a metallic or plastic foil, or by means of an impregnated paper foil.

The delay element and the relay or primer charge, properly speaking, are connected with each other, at the latest shortly before use, with the aid of appropriate, conventional means, for instance, by means of a threaded part or an adapter with a bayonet-type connection.

Accordingly, it is an object of the present invention to provide a primer and relay charge of the type described above which avoids by simple means the aforementioned shortcomings and drawbacks encountered in the prior art.

Another object of the present invention resides in a primer and relay charge which increases the safety of operation, especially when used in vertical blast-holes.

A further object of the present invention resides in a relay charge of the type described above which is able to withstand the explosive charge, properly speaking, that rests on the same, and at the same time minimizes the danger of excessive sensitivity to shocks and impacts.

These and further objects, features and advantages of the present invention will become more obvious from the following description, when taken in conjunction with the accompanying drawing, which shows, for purposes of illustration only, one embodiment in accordance with the present invention, and wherein:

The single FIGURE is an axial cross-sectional view through one embodiment of a relay charge in accordance with the present invention.

Referring now to the single FIGURE of the drawing, the starting detonation of the fuse 1 of any known, conventional construction acts through the reinforced bottom 2' of the internal capsule 2, on the shock-sensitive primer charge 3; the latter produces a flame which ignites the delay charge 5 across the empty tube 4. The delay charge 5 burns up and ignites the firing charge 6 which, depending on the flame sensitivity of the powder charge, may be made of an especially strongly flame-spraying firing charge. The firing charge 6 ignites the base charge 7, and owing to the secure connection 8 of the delay element with the relay charge 9, the latter is detonated.

Depending upon the explosive force of the fuse, it may be necessary to provide on the bottom of the internal capsule 2, an additional booster charge 10, for example, in the form of a primer or percussion cap, which is directed toward the end of the fuse 1 and which increases a possibly inadequate percussion of the fuse.

The shock-sensitive primer charge 3 and/or 10 may consist of a conventional mixture of potassium chlorate and of an explosive from the class of the solid nitric acid esters, such as penthrite (PETN, pentaerythritol tetranitrate), nitromannite, or nitrostarch (starch nitrate), or also of any desired, known primer cap composition.

The delay charge 5 may consist, depending on the desired period of delay, of conventional thermite (Thermit®) mixtures, e.g., minimum/silicon; minium/boron; potassium permanganate/antimony, and the like. Depending upon the type of delay charge 5 and of the composition of the base charge 7, it may be necessary to employ a firing charge 6 for the ignition of a compressible base powder charge, for example, of a mixture of minium/silicon, nitrocellulose or black powder, which firing charge 6 is made of a flame-spraying thermite composition, such as, for example, zirconium/minium.

Suitable charges 9 for the primer cartridge, properly speaking, are explosives which are more sensitive with respect to initiation than tetryl, i.e., cyclonite, penthrite, and other solid nitric acid esters, but also plastic mixtures on the basis of nitroglycerin or nitroglycol.

While I have shown and described only one embodiment in accordance with the present invention, it is understood that the same is not limited thereto but is susceptible of numerous changes and modifications as known to a person skilled in the art, and I therefore do not wish to be limited to the details as shown and described herein.

I claim:

1. A relay charge for delayed blasting operations initiated by means of a fuse for detonating explosives from the bottom of a blast hole comprising a unilaterally closed structurally rigid case filled with a secondary explosive and delay means including a delay charge detachably connected between said rigid case and said fuse, said delay means being provided as an open cylindrical casing including a capsule having one end open and the other end closed by a thickened bottom wall, a shock-sensitive primer cap positioned on the inner bottom wall of said capsule, said delay charge being spaced from said primer cap to form a delay space therebetween, a flame-producing composition in contact with said delay charge at the open end of said capsule, and a base charge positioned adjacent said flame-producing composition at the other end of said casing detachably connected to said rigid case and spaced from said secondary explosive, the other end of said casing including a bayonet-type connection for receiving and holding said fuse.

2. A relay charge according to claim 1, wherein said delay means is connected to said rigid case by a threaded connection.

3. A relay charge according to claim 1, wherein said secondary explosive is penthrite.

4. A relay charge according to claim 1, wherein a booster charge is located outside said closed end of said capsule in said

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casing adjacent said fuse, said booster charge being provided in the form of a primer cap.

5. A relay charge according to claim 1, wherein said secondary explosive is a material selected from the group essentially consisting of cyclonite, penthrate and solid nitric acid esters.

6. A relay charge according to claim 1, wherein said flame-producing composition is provided in the form of a flame-spraying thermite composition.

7. A relay charge according to claim 1, wherein said powder charge consists of a mixture of materials selected from the

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group essentially consisting of minium, silicon, and nitrocellulose.

8. A relay charge according to claim 7, wherein said flame-producing charge consists of a mixture of materials selected from the group consisting of zirconium and minium.

9. A relay charge according to claim 8, wherein the delay charge consists of a mixture of minium and silicon.

10. A relay charge according to claim 9, wherein said secondary explosive is penthrate.

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