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[54] DETONATOR AND IGNITER FOR EXPLOSIVES

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[51] **Int. Cl.** **F42c 19/08**

[58] **Field of Search** 102/27, 70, 70.2; 149/2, 38, 149/93, 96, 100

[56] **References Cited**

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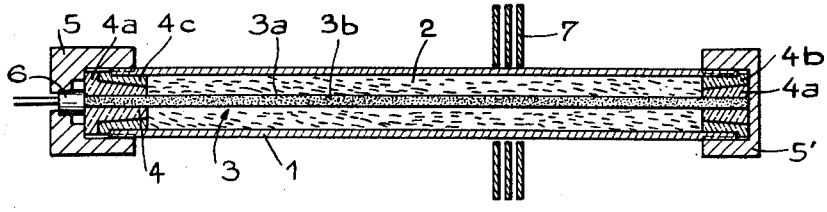
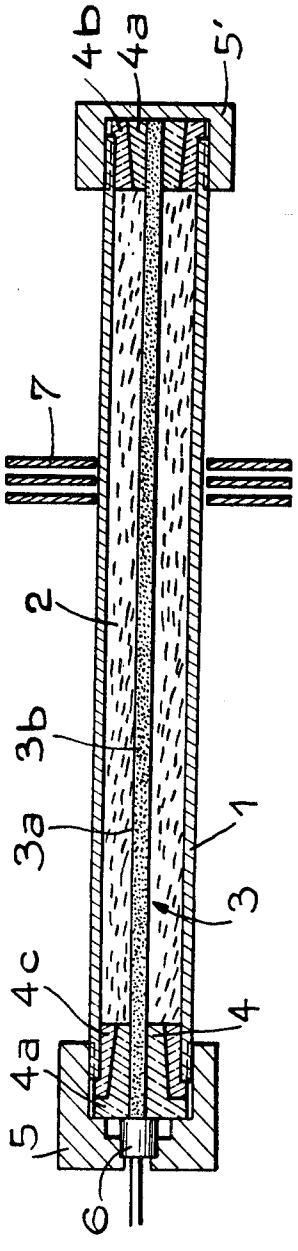
[57] **ABSTRACT**

A detonating fuse suitable for an igniter of propelling charges, which comprises a narrow metal sheath of lead or tin containing a mixture of a secondary explosive with a non-explosive ignition-booster. The invention also includes an igniter containing the detonating fuse.

2 Claims, 1 Drawing Figure




4b
4a
5'
7
2
3b
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4c
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DETONATOR AND IGNITER FOR EXPLOSIVES

This invention concerns detonating fuses for explosive charges, and igniters containing such fuses.

It is generally preferable, and often essential, to obtain a uniform and very rapid ignition of various propelling charges, especially in the case of charges in the form of grains of powder placed in a case and used in guns to fire shells. Conventionally in such cases, ignition is achieved by means of a priming tube which is placed at the center of the powder-containing case and which contains the igniting charge. The time taken to eject the projectile from the weapon is very short, and the entire propulsive powder charge in the case must be burnt up before the projectile leaves the weapon. The primer tube igniting charge must, therefore, fully ignite almost instantaneously if it is to fire the propulsive charge without delay.

Similar considerations apply to the propergol charges used to launch some rockets. These charges are required to burn rapidly (in a few tenths of a second) and, consequently, their thickness is small and their combustion surface, which it is required to fire initially, is usually very large. One example of such a charge is a large number of thin propergol discs threaded on a central tube containing the system for igniting them. All the discs must ignite simultaneously.

Similar considerations apply more generally to all double-base or composite propergol charges for which the requirement is substantially instantaneous ignition of the entire combustion surface in a manner which is satisfactorily reproducible in consecutive firings.

Conventional igniting systems take the form of tubes or receptacles which are filled with black powder or other pyrotechnic compositions. These igniting systems do not always function satisfactorily and often do not give reproducible results because of irregularities between individual igniters in the confining or heaping of the igniting composition, which is very often powdery, and because of local tampings which occur at firing and which tend to prevent all the parts of the igniter from operating simultaneously.

We have now found that if a special detonating fuse is placed at the center of the igniter, substantially simultaneous and reproducible firing of the charges or compositions contained in the igniter, and hence a very rapid ignition of the propulsive charge to be fired, can be achieved.

According to the invention, we provide a detonating fuse suitable for an igniter of propelling charges, which comprises a narrow metal sheath of lead or tin containing a mixture of a secondary explosive with a non-explosive ignition-booster.

The invention also includes an igniter which comprises a metal or combustible or destructible tube containing a pyrotechnic igniting composition, and a detonating fuse of the invention, the fuse being disposed on the tube axis with one end in contact with a primer.

In the igniters of this invention, the tube is either a perforate metal sleeve or a combustible or destructible tube containing the required pyrotechnic igniting composition. The detonating fuse, which is disposed on the tube axis, comprises a metal sheath, for instance, of lead or tin, which is of reduced diameter — as a rule, of the order of from 1 to 3 mm — containing a special explosive composition consisting of a mixture of secondary explosive with a non-explosive ignition-booster. One end of the detonating fuse on the tube axis is in contact with a detonating primer for initiating the start of firing.

The explosive composition of the detonating fuse is preferably mainly a mixture of a secondary explosive, for example Hexogen (trimethylene trinitramine), Octogen or Penthrite (pentaerythritol tetranitrate), with a non-explosive ignition-booster such as a mineral charge of calcium silicide ($CaSi_2$) a metallic sulphide inter alia an antimony or iron sulphide, or a metal powder inter alia aluminum or magnesium, and forms, when the fuse operates, hot particles which boost the firing of the igniting charge.

The weight proportion of ingredients in the mixture is preferably from one-third to two-thirds of secondary explosive to two-thirds to one-third of non-explosive ignition-booster.

The pyrotechnic igniting composition can, for example, be either black powder or an intimate mixture of an oxidizing agent and a combustible metal, both in finely divided form, provided that the composition does not readily detonate on its own. Preferably a composition called "porous B powder" is used on a base of nitrocellulose having a nitrogen level of from 12.6 to 13.6 percent and containing from 0.5 to 3 percent of diphenylamine or ethyl Centralite (a symmetrical diphenyldiethyl urea, also known as Carbamite) as stabilizer and from 0 to 30 percent of metal powder (aluminum or magnesium) as additive improving the igniting power, this composition being made porous by the addition during manufacture of at least 20 percent by weight of saltpeter (relative to the composition), the saltpeter being removed subsequently by leaching.

In order that the invention may be better understood, one form of igniter of the invention will now be described, by way of example only, with reference to the accompanying drawing which shows the igniter in sectional elevation.

Referring to the drawing, the igniter comprises a perforate or combustible or destructible metal tube **1** containing a pyrotechnic igniting "porous B" composition **2**. Disposed on the axis of tube **1** is a detonating fuse **3** of the invention comprising a narrow lead sheath **3***a* (for example, outer diameter 2 mm, inner diameter 1 mm) containing an explosive composition **3***b* formed of a mixture of equal parts of Penthrite and calcium silicide. Fuse **3** is borne at each end by a centering system **4** comprising a split cone **4***a* which has a clamping action on the fuse **3**, and a flanged ring **4***b* which contacts the tube **1**. Tube **1** is screwthreaded at its ends and closed by cap nuts **5**, **5'**. Nut **5** has an inner bearing flange adapted to retain fuse **3** in contact with a primer **6**.

This igniter can be used, for instance, to ignite a propergol charge in the form of thin discs **7** threaded on tube **1**.

Despite the power of the igniter, its destructive effects are very limited and if the igniter has a reasonably thick metal wall, this will not be damaged. If the igniter is fully combustible or destructible, the blast effect of the whole (detonating fuse plus igniting charge) is small enough not to damage the powder grains or blocks of propergol which it is required to ignite.

This result is obtained inter alia by the use of a secondary explosive instead of a primary explosive in the detonating fuse, and by making the diameter of the explosive charge of the fuse of the order of from 1 to a few millimeters.

The igniting power of the detonating fuse results from an addition, to the secondary explosive forming it, of a non-explosive ignition-booster. Manufacture of a fuse containing such a mixture is not hazardous. Despite the presence of this non-explosive product and the narrowness of the fuse, the fuse transmits the detonation satisfactorily at speeds which are, as a rule, between 2,000 and 6,000 meters/sec. and which are, therefore, high in relation to the speed in which ignition is propagated from a conventional fuse in conventional igniters.

The presence of the non-explosive product does not make it difficult to fire the detonating fuse. For instance, a fuse in a lead sheath having an outer diameter of 2 mm and an inner diameter of 1 mm and containing a mixture of equal parts of Penthrite and calcium silicide is fired in unconfined conditions (in open atmosphere) by the detonation of 0.40 g of lead azoimide (as primer), thus igniting 7 g of "porous B powder". In the confinement condition within the igniter, the fuse is fired by detonation of a charge of 0.030 g of lead azoimide. Of course, these charges vary with the nature of the fuse.

The firing of the detonating fuse and the propagation of detonation are produced satisfactorily at temperatures of the order of −30° C. However, tin fuse sheaths are unsuitable for use at the latter temperature. A conventional igniting primer does not ignite the porous B composition very rapidly even if the composition has a high porosity, but this disadvantage disappears when a detonating fuse according to the invention is used, this providing substantially instantaneous ignition of the composition provided that the porosity thereof is appropriate (more than 20 percent of saltpeter introduced during manu-

facture and then removed by leaching) and that the igniter tube retains it long enough near the fuse. It, therefore, has the advantage of very rapidly firing the propelling powder or propergol.

As a comparison, experiments in a manometric bomb showed that an igniter tube identical to the one described but having a conventional detonating fuse instead of a detonating fuse according to the invention burned for times varying from 30 to 70 millisec. when the tube was charged with black powder and for times varying from 60 to 100 millisec. when the tube was charged with porous B powder. However, when the conventional fuse was replaced by a fuse of the invention, the combustion occurred in times varying from 3 to 5 millisec. in the case of both black powder and porous B powder. The total combustion times are, therefore, much shorter and have much less spread than those prior known.

Ultra-rapid cine-camera tests showed that the ignition was propagated from one end of the tube to the other in from 12 to 30 millisec. in the case of ignition by a conventional fuse, and in a time not resolvable by normal ultra-rapid cinematography, such time being lower than 0.3 millisec., in the case of ignition by the explosive fuse according to this invention.

What we claim is:

1. An igniter for propelling charges, which comprises a metal or combustible or destructible tube containing a pyrotechnic igniting composition, and a detonating fuse disposed on the tube axis, one end of the detonating fuse being in contact with a primer, said detonating fuse comprising a narrow sheath of lead or tin containing a mixture of a secondary explosive with a non-explosive ignition-booster, said secondary explosive being a member selected from the group consisting of trimethylene trinitramine, pentaerythritol tetranitrate, and cyclotetramethylene-tetranitramine, said ignition-booster being a member selected from the group consisting of calcium silicide, antimony sulphide and iron sulphide, aluminum and magnesium powder, the proportion of ingredients by weight in said mixture being between one-third and two-thirds of secondary explosive to between two-thirds and one-third of ignition-booster, the pyrotechnic igniting composition comprising a nitrocellulose base having a nitrogen level of from 12.6 to 13.6 percent, containing from 0.5 to 3 percent of a stabilizer which is a member selected from the group consisting of diphenylamine and a symmetrical diphenyl-diethyl urea and from 0 to 30 percent of a finely divided metal, the composition being made porous by an addition during manufacture of at least 20 percent of saltpeter which is subsequently removed by leaching.

2. An igniter according to claim 1, wherein said mixture consists of equal parts by weight of pentaerythritol tetranitrate and calcium silicide.

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