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[54] **IGNITOR FOR EXPLOSIVE CHARGE WITH MEANS FOR PREVENTING INADVERTENT IGNITION**
9 Claims, 3 Drawing Figs.

[52] **U.S. Cl.** **102/70,** 102/70.2, 102/71
[51] **Int. Cl.** **F42c 7/00,** F42c 11/00
[50] **Field of Search** 102/81, 70, 71, 72

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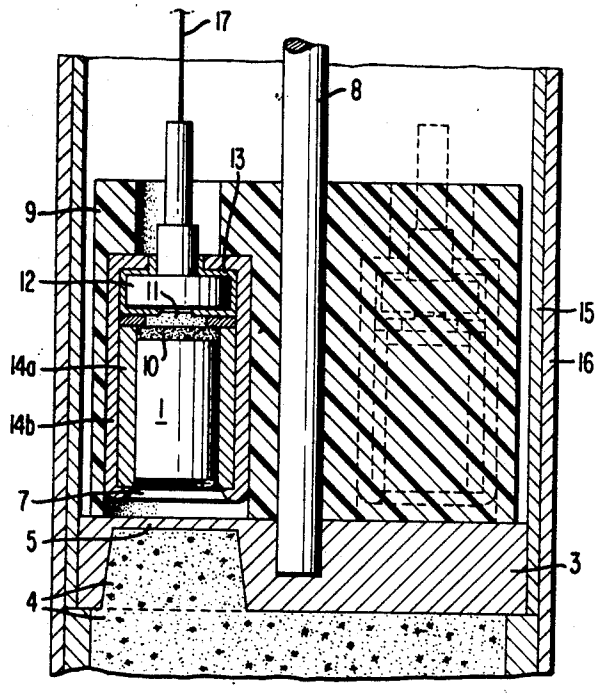
ABSTRACT: An ignitor adapted to be moved toward the explosive charge to be ignited simultaneously with firing, preferably by ignition of a propellant charge acting upon the detonator of the ignitor to move it as a piston within a tubular casing cylinder, with the casing housing the entire ignitor as a separable replaceable element. A delayed charge may be used to assure that the complete ignition of the detonator will occur at the end of its travel toward the explosive charge. Such an ignitor may be employed in combination with a conventional safety device wherein the ignitor is rotated between a safety position wherein it is separated from the explosive charge by a thick plate and a ready-fire position wherein it is separated from the explosive charge by a readily rupturable thin foil like element.



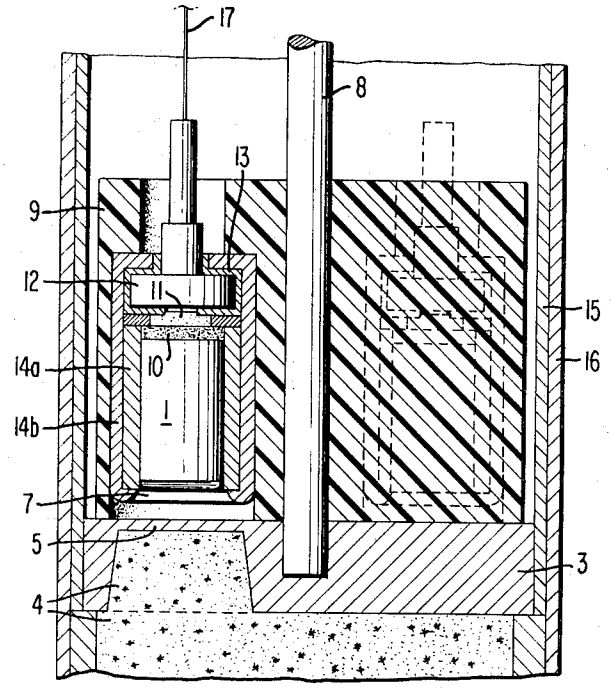


FIG. 1

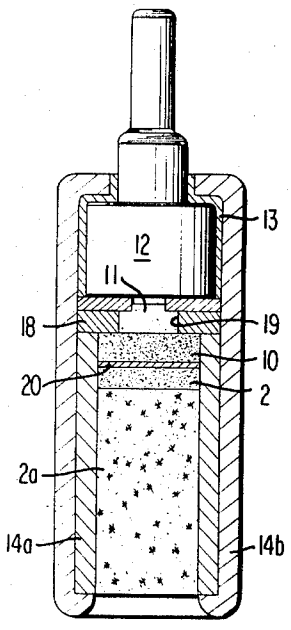


FIG. 2

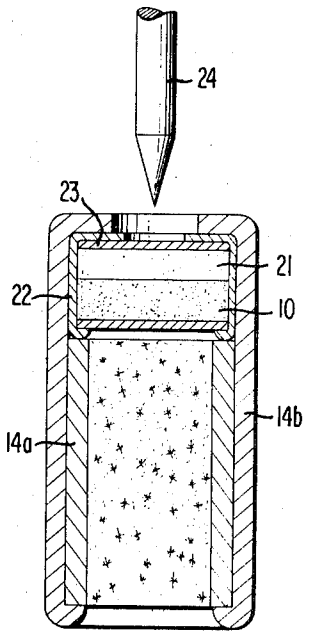


FIG. 3

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IGNITOR FOR EXPLOSIVE CHARGE WITH MEANS FOR PREVENTING INADVERTENT IGNITION

BACKGROUND OF THE INVENTION

For safety in transport and/or manipulation, a common requirement is that the explosive charge be spatially separated from the ignitor to prevent inadvertent ignition of the main explosive charge. In order to meet this requirement, particularly for military devices, the ignitor has been provided in a rotatable housing having a safe position wherein ignition is not transmitted to the explosive charge because of a separating relatively thick plate in the event of unintentional ignition, and a position wherein the ignitor is separated from the explosive charge by an easily rupturable foil or plate for sure transmission of the ignition from the ignitor to the explosive charge when desired. For this purpose, a relatively thick protective sheet or shield of metal is arranged between the explosive charge and the rotatable housing containing therein the ignitor, with the sheet of metal being provided with a weakened zone opposite the ready-fire position of the rotatable housing for easy penetration by the ignitor only at this position for ignition of the explosive charge.

With such an arrangement, the manufacture and construction has resulted in a relatively large spacing between the detonator of the ignitor and the explosive charge, which may produce misfiring. In order to eliminate the possibility of misfiring due to this spacing, the size of the detonator charge may be increased so that it will assure firing of the explosive charge even under the above-mentioned unfavorable conditions. However, there are many applications wherein there is not sufficient space to provide the above-mentioned additional detonator charge and the detonator charge that may be provided within the limited space will not assure the flawless firing of the explosive charge, because it will not be strong enough to overcome the spacing between the ignitor and explosive charge.

BRIEF SUMMARY OF THE INVENTION

It is an object of the present invention to overcome the above-mentioned disadvantages and additionally to provide an ignitor that will move close to the explosive charge to be detonated upon firing so the relatively small amount of detonator charge is required. The ignitor of the present invention may be triggered either electrically or mechanically and may be provided in addition to or in place of the rotatable ignitor support and separating sheet metal. The ignitor is provided with a detonator charge that is displaceable in the direction toward the explosive charge to overcome the spacing therebetween upon firing, which spacing might otherwise interfere with the proper transmission of ignition from the detonator to the explosive charge. Thereby, the spacing is maintained until the explosive charge is to be detonated, for a further safety feature. Only when the ignitor is purposely fired will the spacing be eliminated or substantially reduced to such an extent that the transmission of the ignition from the ignitor to the explosive charge is assured.

Various constructions are contemplated for effecting the displacement of the detonator charge accommodated in a support, particularly a known rotatable housing. It is particularly desirable to provide, in a further development of the invention, a propellant charge to displace the detonator charge, which propellant charge is provided before the detonator charge with respect to the direction of ignition within the ignitor. Upon firing, the propellant charge is first ignited by a primer to produce propellant gases for moving the detonator charge as a whole toward the main explosive charge. Particular advantages are obtained when a delayed action fuse or delayed action charge is provided between the propellant charge and the detonator charge, which may be designed so that complete ignition of the detonator charge will occur only when it is moved in the desired distance, so that the detonator charge will be ignited up to its end adjacent the explosive charge just at the moment at which the displacement of the detonator charge in the direction toward the explosive charge is at least almost terminated, and correspondingly the distance between the detonator charge and the explosive charge is completely or at least substantially eliminated.

BRIEF DESCRIPTION OF THE DRAWING

Further objects, features and advantages of the present invention will become more clear from the following detailed description of the drawing, wherein:

FIG. 1 is a cross-sectional view through the center of an explosive device employing the ignitor arrangement of the present invention with a known type of rotatable safety housing, with portions broken away;

FIG. 2 is an axial cross-sectional view of an independently usable ignitor cartridge, according to FIG. 1, as a separable replaceable item; and

FIG. 3 is an axial cross-sectional view through another ignitor cartridge similar to that of FIG. 2.

DETAILED DESCRIPTION OF THE DRAWING

The explosive device shown in FIG. 1 employs an ignitor 1 separated from a main explosive charge 4 by a metal sheet or plate 3 having a weakened zone or area 5. Because of inherent construction problems or by design as an additional safety feature, a relatively large spacing 7 exists between the ignitor 1 and the plate 3. The ignitor 1 is contained within a housing 9 rotatable about the axis of shaft 8. Instead of being provided on the side of the plate 3 adjacent the detonator charge 1, the thin foillike covering of the weakened zone 5 could also be arranged on the side of the plate 3 adjacent the explosive charge; in the latter case, the depression of the plate 3 forming the weakened zone 5 would naturally not be filled with explosive and further increase the space 7.

The ignitor 1 is provided with a delayed-action charge, not shown in FIG. 1, in back of a propellant charge 10, which is in turn in back of a primer charge 11 to the rear of a pole piece 12, with respect to the direction of ignition. The pole piece 12 is partially surrounded with insulation 13 for the electric ignition of the primer charge 11. A tubular casing 14*b*, including a tubular insert sleeve 14*a*, houses the pole piece and all of the charges, and forms an independently separate ignitor cartridge that may be readily removed from and inserted into the rotatable housing 9. An electric line 17 is provided for transmitting a signal input to the pole piece 12. The other pole for the electric firing is a grounded pole and provided by means of the casing 14*a*, 14*b*, rotatable housing 9, plate 3, and the tubular main casing 15, 16. It is contemplated that individual ones of these components of the other pole may be constructed of an insulating material, rather than metal of the preferred embodiment, for example the rotatable housing 9 may be constructed of a synthetic material, particularly a synthetic plastic; in such a case, an additional electric line would be provided at the appropriate place.

As shown in FIG. 1, the ignitor 1, and thus the entire arrangement, is in the "live" or ready-fire position. If the ignitor is fired by means of a signal from the connecting line 17 in the illustrated position with a resulting ignition of the propellant charge 10, the detonator charge adjacent the propellant charge 10 will be displaced under the thus produced propellant gas pressure toward the plate 3 to decrease the spacing 7, that is the distance between the ignitor 1 and the plate 3, or even completely eliminate this spacing. After the ignition of the propellant charge 10, the delayed-action charge will be ignited to provide an appropriate delay in ignition of the detonator charge, which delayed-action charge is suitably dimensioned so that the complete ignition of the detonator charge will occur substantially simultaneously with the termination of the displacement of the detonator charge, that is when the latter comes into contact with the plate 3. With the complete or substantial elimination of the spacing 7, the energy of the detonator charge will definitely be sufficient to burst through the thin, foillike cover of the weakened zone 5 to ignite the ex-

plosive charge 4. Since the path of displacement of the detonator charge, that is the spacing 7, will generally only be a few millimeters, the delayed-action charge need only provide a delay of about 0.1 to 1 millisecond.

The housing 9 may be rotated about the axis of shaft 8 into the "safety" position wherein the ignitor would be in the position shown in dashed lines in FIG. 1. In this position, the ignitor would be separated from the explosive charge by the relatively thick part of the plate 3 so that an unintentional firing of the ignitor 1 would not ignite the explosive charge 4, because the thick part of the plate 3 could not be penetrated by the detonator charge and the weakened zone 5 is sufficiently far away that it would not be ruptured. It is also contemplated that the spacing 7 may be by itself sufficient to prevent unintentional ignition of the explosive charge 4 without the interposition of the plate 3 so that an explosive device could be provided with an explosive charge and an ignitor at a substantially great spacing therefrom.

As shown in FIG. 2, the ignitor pole piece 12 is provided with the insulation 13. A ring 18 is provided within its interior with the primer 11 on the explosive charge side 19 of the pole piece 12. The primer charge is followed by the propellant charge 10, which is covered with respect to the delayed-action charge 2 by a separating foil 20. The detonator charge 2*a* is provided immediately adjacent to the delayed-action charge 2. The pole piece 12 with its insulation 13 and the ring 18 are fixedly mounted in the outer casing portion b by means of the inner casing sleeve a and the illustrated flanges. The inner casing sleeve a contains the charges 10, 2, and 2*a*.Thus, a separate independent ignitor cartridge is provided.

In the further embodiment of the ignitor charge according to FIG. 3, corresponding numerals refer to corresponding parts with respect to the embodiment of FIGS. 1, 2. However, instead of the electric detonation of the primer charge 11 by the pole piece 12 with its insulation 13, there is provided a percussion primer charge 21. The percussion primer charge 21 is disposed with the propellant charge 10 within a cup 22 that is covered on opposite faces by foils 23, or the like; the cup 22 is fixedly mounted and held in the outer casing tube 14*b* by the inner casing tube 14*a* with the outer casing tube 14*b* having opposed inwardly extending annular flanges substantially the same as those shown in FIG. 2. A firing pin 24 is partially shown for striking and detonating the percussion primer charge 21 after piercing the adjacent foil 23.

Two embodiments of the invention have been specifically described for purposes of illustration; additional embodiments, variations and modifications are contemplated within the spirit and scope of the invention.

We claim:

1. An explosive device, comprising: a main explosive charge; ignitor means for igniting said main explosive charge; housing means retaining said ignitor means in a free spacing with respect to said main explosive charge; said ignitor means having a detonator charge ignited upon actuation to directly fire said main explosive charge; power means responsive to said actuation for displacing at least said ignited detonator charge as a body toward said main explosive charge to effect firing thereof upon contact therewith.

2. The device of claim 1, wherein said power means is constituted by at least one of said housing means and said ignitor means constituting a cylinder containing said detonator charge as a piston therein forming an expansion chamber on the opposite side of said detonator charge from said main explosive charge, and a propellant powder charge ignitable to produce propellant gases within said expansion chamber pushing the piston detonator charge relative to the cylinder toward said main explosive charge.

3. The device of claim 2, wherein said ignitor means includes a delayed action charge providing the sole ignition of said detonator charge and being ignited solely by said propellant powder charge for delaying the complete detonation of said detonator charge until said detonator charge as a body has moved substantially the entire distance of said spacing.

4. The device of claim 3, wherein said ignitor means includes a substantially tubular casing securely enclosing in aligned order said detonator charge, said delayed action charge, said propellant powder charge, and a primer for igniting said propellant charge as a complete dimensionally stable replaceable item; said tubular casing of said ignitor means constituting said cylinder.

5. The device of claim 4, including safety means for preventing inadvertent ignition, including said spacing between said ignitor means and said main explosive charge and a separator plate between said ignitor means and said main explosive charge provided with a relatively thick portion preventing transmission of detonation from said ignitor means to said main explosive charge and a relatively thin portion dimensions readily rupturable by said ignitor means to readily allow detonation of said main explosive charge by said ignitor means; means for moving said ignitor means relative to said separator plate from a safety position with said relatively thick portion between said ignition means and said main explosive charge, and a ready-fire position with said relatively thin portion between said ignitor means and said explosive charge.

6. The device of claim 1, including a separator plate between said ignitor means and said main explosive charge provided with a relatively thick portion preventing transmission of detonation from said ignitor means to said main explosive charge and a relatively thin portion dimensions readily rupturable by said ignitor means to readily allow detonation of said main explosive charge by said ignitor means; means for moving said ignitor means relative to said separator plate from a safety position with said relatively thick portion between said ignition means and said main explosive charge, and a ready-fire position with said relatively thin portion between said ignitor means and said explosive charge.

7. The device of claim 1, including means for delaying the complete ignition of said detonator charge until said detonator charge has moved toward said main explosive charge a distance substantially corresponding to said spacing.

8. A safety ignitor comprising, a main explosive charge; a generally tubular casing having an axial direction of ignition transmission; primer means, propellant powder means and detonator charge means, ignited upon actuation thereof and aligned in the direction of ignition transmission within said tubular casing; said detonator charge and said casing providing piston and cylinder means forming an expansion chamber containing said propellant charge for driving said ignited detonator charge as a body in the direction of ignition relative to said casing toward said main explosive charge upon ignition of said propellant charge producing propellant gases acting upon the piston.

9. The device of claim 8, including a delayed action charge means between said propellant charge and said detonator charge for delaying complete ignition of said detonator charge until said detonator charge has moved as a body a predetermined substantial distance relative to said casing.