United States Patent

Friant et al.

[15] **3,687,076**

[45] **Aug. 29, 1972**

[54] **FIELD SENSITIZED EXPLOSIVE PACKAGE**

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[73] Assignee: **Explosives Corporation of America,** Issaguah, Wash.

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[21] Appl. No.: **100,012**

[52] **U.S. Cl.** **102/24**

[51] **Int. Cl.** **F42b 3/00**

[58] **Field of Search** 102/24, 28, 57

[56] **References Cited**

UNITED STATES PATENTS

1,298,500	3/1919	Hardel	102/57
2,509,710	5/1950	Van Loenen	102/6
3,371,605	3/1968	Eckels	102/24 HC
3,580,171	5/1971	Maes	102/28

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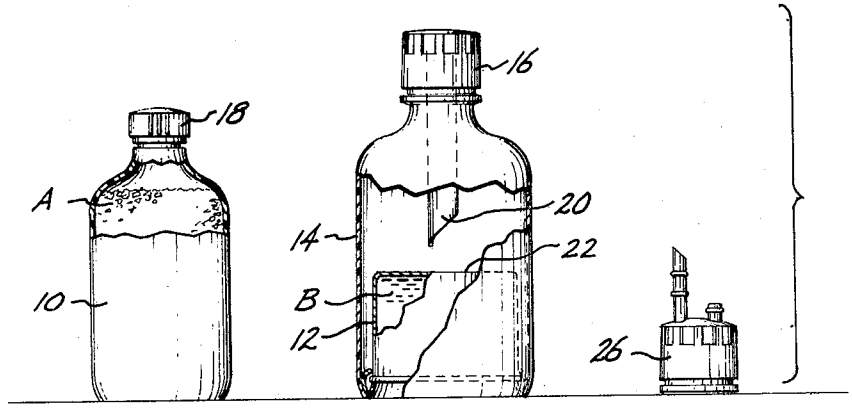
[57] **ABSTRACT**

An intrinsically non-explosive liquid constituent of an explosive composition is contained within a can. The can is located inside of a plastic bottle. In the field an intrinsically non-explosive solid constituent of the explosive composition is poured from a separate container into a space in the bottle above the cam. The user presses down on the capped top of the bottle to move a downwardly projecting cutter carried by an upper portion of the bottle downwardly and through the top of the can. Following cutting the bottle is turned upside down and/or shaken to cause a mixing of the two constituents of the explosive composition. The resulting explosive is a liquid which can be poured from the bottle and then detonated by a conventional detonator, or detonated while still in the bottle.

16 Claims, 15 Drawing Figures



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SHEET 1 OF 3

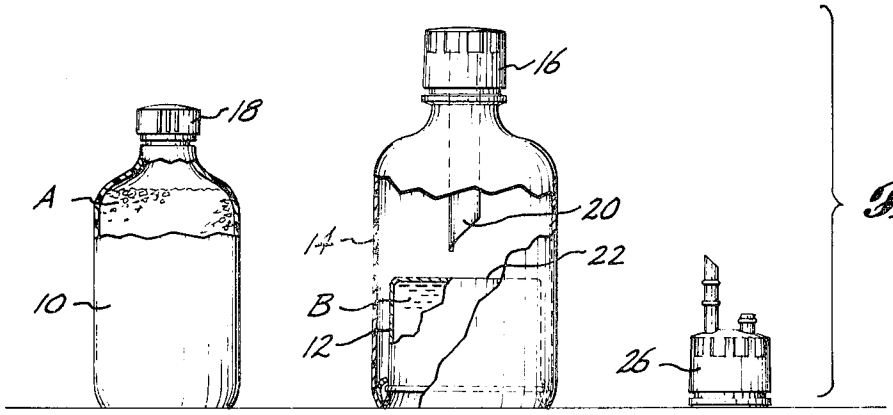


Fig. 1.

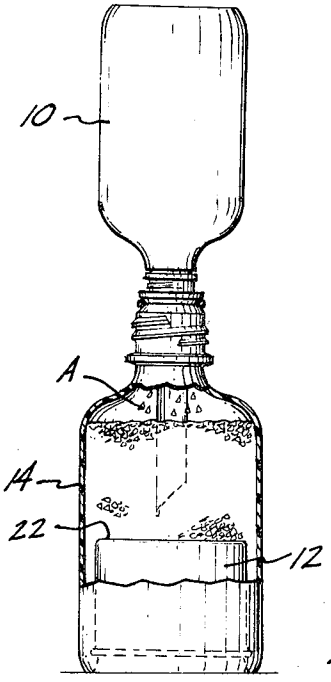
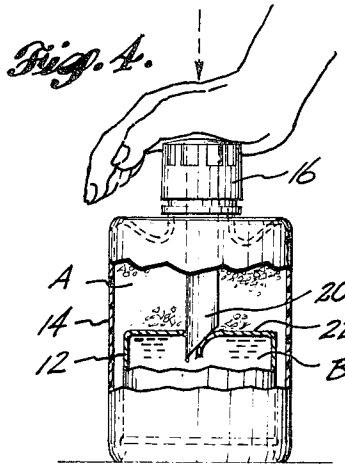


Fig. 2.



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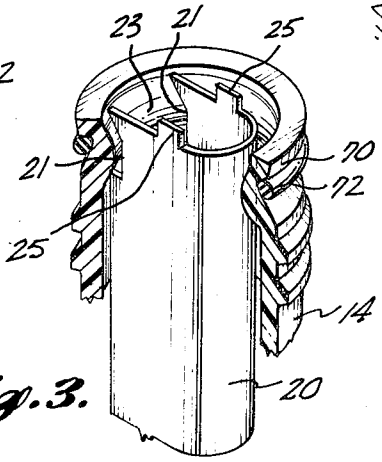

Fig. 3.

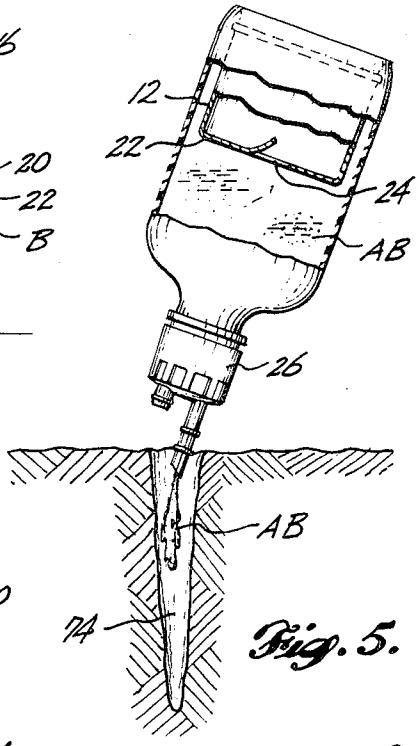

Fig. 5.

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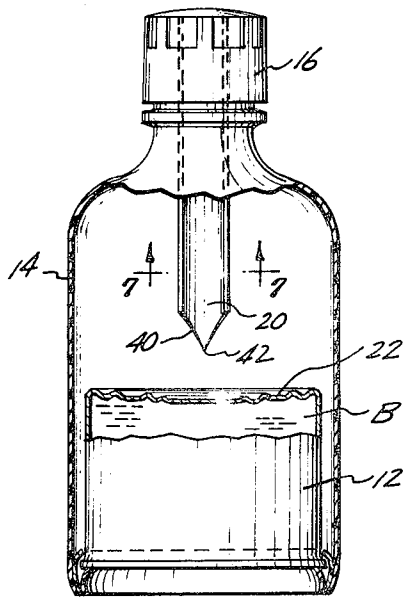

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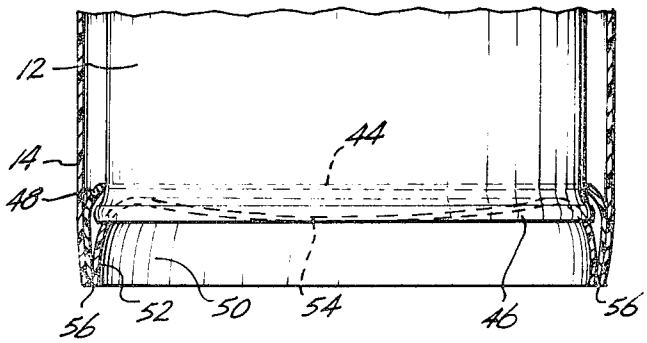


Fig. 8.

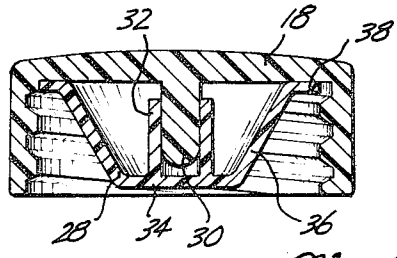


Fig. 9.

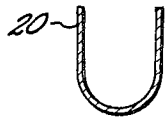
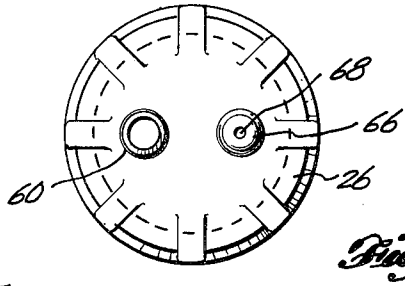


Fig. 7.

Fig. 10.



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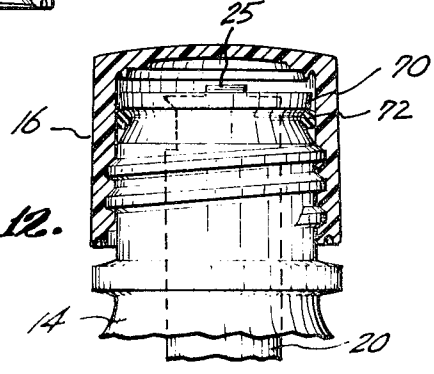

Fig. 12.

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Fig. 15.

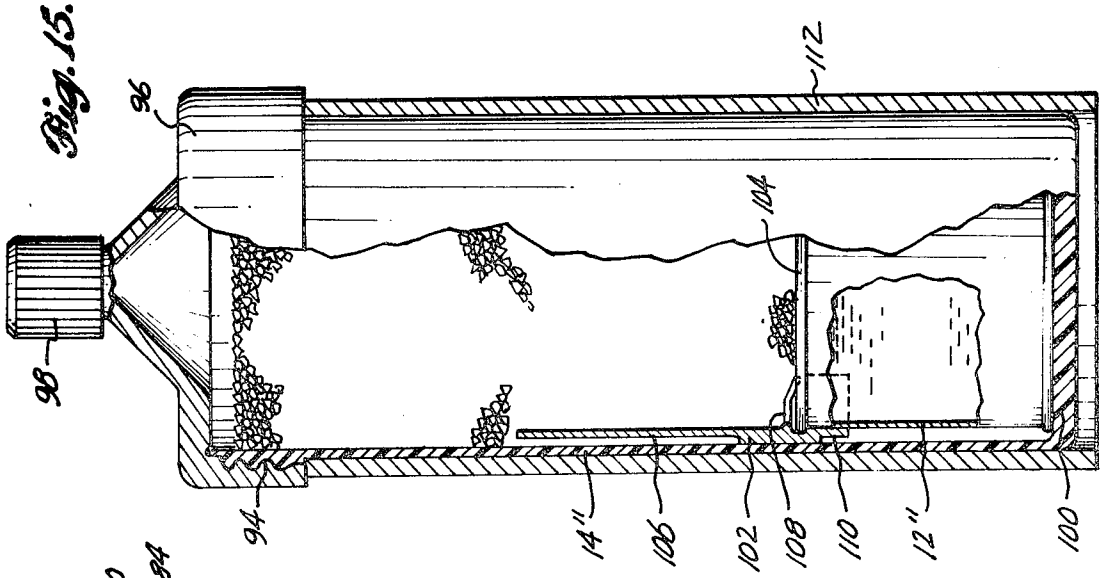


Fig. 14.

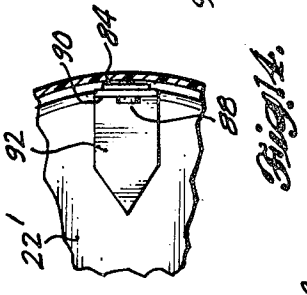
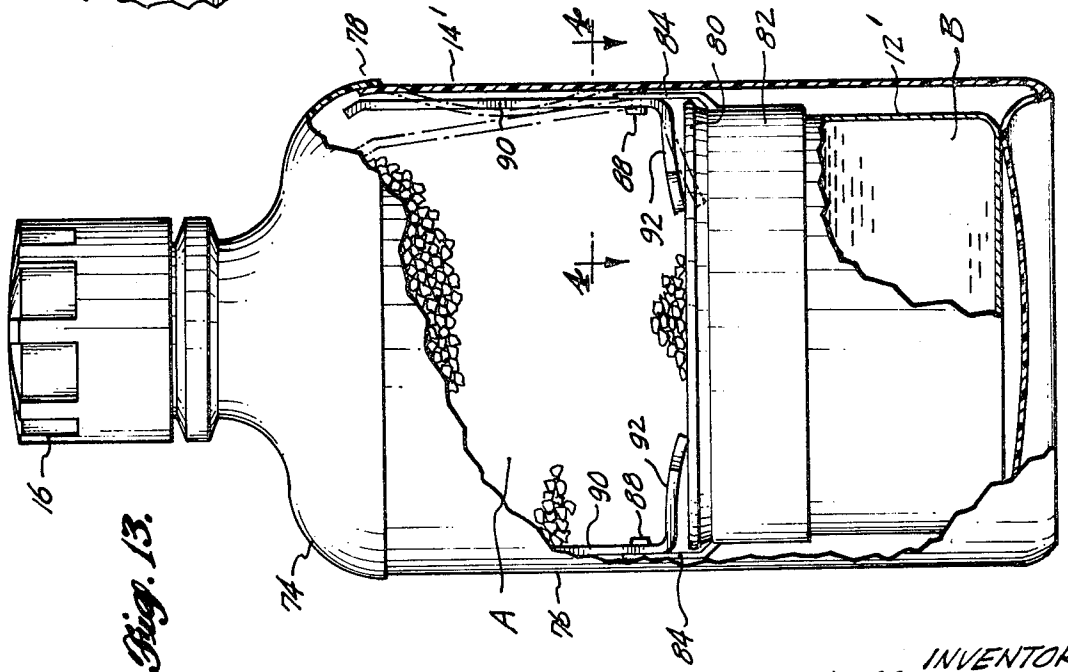


Fig. 13.



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FIELD SENSITIZED EXPLOSIVE PACKAGE

BACKGROUND OF THE INVENTION

1. Field of the Invention

This invention pertains to a field mix explosive package involving two constituents which are field mixed to form the explosive, and particularly to an improved form of field mix package.

2. Description of the Prior Art

It is known to formulate an explosive into two parts, each of which is by itself not an explosive, and then to mix the two parts together in the field shortly before use to form the explosive. The two parts are separately stored, transported and otherwise handled prior to their mixing. Since each part is itself not explosive in nature it does not require the special care in storage, transportation and handling that an explosive does.

U.S. Pat. No. 2,892,377, granted June 30, 1959 to Samuel H. Davidson discloses packaging discrete ammonium nitrate in a waterproof container having a soft elastic wall at one end thereof. The ammonium nitrate is not an explosive in and of itself, but is rendered explosive by the addition thereto of a liquid fuel. A hypodermic syringe is used to inject the liquid fuel through the elastic wall and into the ammonium nitrate.

U.S. Pat. No. 2,929,325, granted Mar. 22, 1960 to Idwal O. Lewis discloses packaging particulate ammonium nitrate in a first container and a particulate fuel in a second container which is telescopically joinable with the first container. A rubber membrane covers the open end of the inner container and serves to keep the two substances apart. In the field the two parts are telescopically moved together until a cutting blade carried by the closed end of the outer container pierces the membrane. The assembly is then shaken for the purpose of mixing the two parts of the explosive.

Field mixing of intrinsically non-explosive liquid and solid parts of a two-part explosive is also disclosed in U.S. Pat. No. 3,419,443, granted Dec. 31, 1968 to Michel E. Maes. The particular explosives disclosed by this patent are examples of two-part explosives usable in the field mix package of this invention.

SUMMARY OF THE INVENTION

The present invention relates to an improved field mix package for a two-part explosive. Broadly speaking, the field mix package of the present invention comprises a plastic bottle having a screw cap at its upper end. A metal can is housed within the lower portion of the bottle. A cutting tool or punch is located inside the bottle. Such tool extends downwardly from the neck of the bottle towards the top of the can and terminates in a cutting portion at its lower end. The side wall of the bottle is deep enough to hold the cutting portion of the punch out of contact with the top of the can. One of the non-explosive parts (e.g., liquid hydrazine) is housed within the can. The second part of the explosive (e.g., powered ammonium nitrate) is transported to the use site in a separate container (e.g., another plastic bottle). Shortly prior to use the cap of the field mix package is removed and the second part of the explosive is poured into the space in the bottle above the can. Then the bottle cap is replaced and a downward pressure is placed on the cap, causing the side walls of the bottle to buckle and the punch to move downwardly through the top of the can. Next the bottle is tipped and/or shaken to cause a thorough mixing of the two materials.

This invention also relates to specific details of the field mix bottle, and to an explosive kit which includes the mix bottle and some other components, each of which are hereinafter more specifically described in connection with the drawing directed to a preferred embodiment.

BRIEF DESCRIPTION OF THE DRAWING

FIG. 1 is a side elevational view, partially in section, of a three part typical embodiment of the field-mix explosive package of the present invention, comprising a combined field mixing bottle and transport container for a liquid part of the explosive, a transport bottle for a granular solid part of the explosive, and a pouring cap for the first bottle;

FIG. 2 is a side elevational view, partially in section, showing the contents of the granular solid bottle being poured into the mixing bottle;

FIG. 3 is a fragmentary isometric view partially in section showing the way the cutting tool is locked within the neck region of the field mixing bottle;

FIG. 4 is a side elevational view of the mixing bottle, showing a user depressing the cap of the bottle for the purpose of lowering the punch into piercing contact with the liquid constituent containing can within the mixing bottle;

FIG. 5 is a view of the mixing bottle with the pouring cap in place, showing the pouring cap being used for directing the liquid explosive contents of the mixing bottle into a crevice in the earth or some other material;

FIG. 6 is an enlarged scale side elevational view, partially in section, of the mixing bottle, said view being taken toward the concave side of the punch;

FIG. 7 is a cross-sectional view taken through the punch, substantially along line 7—7 of FIG. 6;

FIG. 8 is a fragmentary side elevational view on yet a larger scale, showing a preferred manner of securing the can within the mixing bottle;

FIG. 9 is an axial sectional view taken through a cap for the dry component bottle;

FIG. 10 is an axial section view through a pour spout cap for the mixing bottle;

FIG. 11 is a top plan view of the pour spout cap; and

FIG. 12 is an axial section view through the neck portion of the mixing bottle, showing an O-ring seal in place for sealing against leakage;

FIG. 13 is a view like FIG. 6 relating to a modified embodiment;

FIG. 14 is a fragmentary view along line 14—14 of FIG. 13; and

FIG. 15 is a view like FIGS. 6 and 13 of a further embodiment.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

Referring to FIG. 1, in the illustrated embodiment the first constituent A of the explosive AB is housed within a bottle 10. Explosive constituent B is stored in a can 12 which is housed in the lower portion of the field mixing bottle 14. The two constituents A and B are precisely preweighed and prepackaged in their respective containers 10, 12. Can 12 is preferably made from

an aluminum alloy which is not reactable with either constituent A or constituent B, or with mixture AB.

Constituent A is shipped in a separate box, apart from the mixing bottle 14. This is to prevent any accidental mixing of the two constituents A, B to form the explosives AB in the event of serious damage to the shipping containers. However, once the components have arrived at their destination it is perfectly safe, at the convenience of the user, to preload constituent A into the mix bottle 14, as shown in FIG. 2. This is done by removing the cap 16 from the mix bottle 14 and the cap 18 from bottle 10, then locating bottle 10 on bottle 14, and then pouring constituent A from bottle 10 into mixing bottle 14. This will not in any way cause mixing of the two constituents A, B to form the explosive AB because the constituent B is still hermetically sealed within the container 12.

The mixing bottle 14 may be carried as a non-explosive, even after it has been preloaded, since neither of the two constituents A, B are capable of detonation. Shortly, prior to use of the explosive, the constituents A, B are mixed according to the following procedure: The user supports the bottom of bottle 14 firmly and then exerts a downward pressure on the cap 16. This causes the walls of bottle 14 to buckle, permitting downward movement of punch 20 through the top wall 22 of container 12. After an opening 24 is formed in wall 22 the bottle 14 is shaken to cause mixing of the two constituents A, B. This shaking is in no way hazardous when the preferred explosive composition of the invention is used, because such explosive can only be initiated by a detonator.

By way of typical and therefore nonlimitive example, the cap 18 for bottle 10 may include a seal member of the insert type shown in FIG. 8 and designated 28 in that figure. The cap 18 is shown to include a center projection 30 which is telescopically received within a tubular center portion 32 of the member 28. The base of tubular member 32 is secured to a disc portion 34. Disc portion 34 is in turn secured to a frusto-conical portion 36 which envelopes the tubular member 32. An annular top flange 38 is secured to the frusto-conical portion 36. Flange 38 has an upper surface which rests against the inner surface of the top of the cap 18 and a lower surface which rests on the upper edge of the bottleneck.

As shown in FIG. 3, the upper end of punch 20 includes recessed portions 21 which snugly engage a rounded girth rib portion 23 of the bottle 14, for firmly securing the punch 20 to the bottle 14.

Referring to FIGS. 1, 3, 6 and 7, the punch or cutting tool 20 is shown to be generally U-shaped in cross section. The open side of punch 20 provides a large entrance into bottle 14 for the solid constituent being poured from bottle 10. Also, as a result of this shape, combined with the angle cut of the cutting edge 40, there is a progressive entry of the punch 20 into the top wall 22 of can 12. When the cap 16 is depressed a small hole is started by the point 42. Further downward movement of the cap causes the cutting edge portions on opposite sides of the point 42 to progressively slice into the top 22 until a generally semicircular cut matching the cross-sectional configuration of the punch 20 is formed. At the same time the flap cut in the top 22 is bent inwardly into the can 12, immediately opening a hole in the top 22. Since punch 20 is open along one side it does not act as a plug for the hole but rather readily permits the liquid to flow out from the hole into the space above the can 12.

Punch 20 is preferably cut from a flat piece of sheet metal and is then bent into the channel form shown in the drawing.

FIGS. 5 and 7 show the can 22 to be upside down within the bottle 14. In other words, its lid-closed end is directed downwardly. The top wall 22 is integrally formed with the side walls of the can 12. The open end of the can (i.e., the bottom end in the subject installation) is closed by a lid 44 which is connected to the rim portion of the can 12 in a conventional manner.

Bottle 14 may initially be a conventional plastic bottle which comes with an integral bottom wall. During the manufacture of the mixing bottle 14 this bottom is cut off. Then a retainer ring 48 having a radially inwardly curving upper lip portion is installed into the bottom portion of the bottle 14. The can 12 is inserted into the bottle 14 through the bottom opening. The lip on ring 48 engages the rim 46 on can 12 and holds the can 12 against complete movement into the bottle 14. Next a lower retainer and bottom member 50 is inserted into the bottom opening of the bottle 14, below the can 14. This member 50 includes an annular side wall 52 and a radial wall 54 which rests against the lid 44 of the can 14. The two retainer members 48, 50, both of which are constructed of the same plastic material as the bottle 14, are welded together and to the side wall of bottle 14 at location 56.

FIG. 3 shows the punch 20 having a pair of upwardly directed locating tabs or tines 25. These tines 25 are sized to snugly fit within the mouth of bottle 10 and serve to locate the mouths of the two bottles 10, 14 in substantial axial alignment during pouring of the solid material A from bottle 10 into bottle 14.

FIGS. 9 and 10 show a typical pour spout cap 26. It is shown to include a pair of openings in its top wall 58, one receiving a pouring spout 60 and the other receiving a breather tube 62, both of which are connected to and stem from a base member 64. Breather tube 62 is shown to include a top wall 66 in which a small breathing opening 68 is formed. The pouring spout-breathing tube assembly 60, 62, 64 is inserted into the cap from its open end. The base member 64 functions as a seal against unwanted leakage between the mixing bottle 14 and the cap 26.

As an example the solid constituent A may be a mixture of NH_4NO_3 and NH_4ClO_4 and the liquid constituent B may be a mixture of N_2H_4, NH_4NO_3 and H_2O. A typical formulation of this type of explosive is as follows:

Solid	-	NH_4NO_3	53.333 grams
		NH_4ClO_4	13.333 grams
Liquid	-	N_2H_4	26.685 grams
		NH_4NO_3	4.210 grams
		H_2O	3.333 grams
Total			100.894 grams

According to the invention, the side wall of container 14 is translucent. A powder type dye is added to the solid constituent A or to the interior of bottle 14 above the can 12. The dye material is of a type that will cause the mixture to turn a bright or deep color upon mixing. In this way a person can by sight determine if the can

12 has been punctured and the liquid B brought into mixing contact with the solid A.

Referring again to FIG. 3, the neck portion 70 of bottle 14 is provided with an O-ring seal 72 located about the girth of neck portion 70. This seal ring 70 is compressed by and is in tight sealing (against liquid leakage) contact with the inner surface of the cap 16 whether or not the cap is screwed on tight. Thus, a dependable liquid seal exists between the neck portion 70 and the cap 16 even if the cap 16 is only loosely secured to the neck portion 70.

Following mixing the resulting explosive mixture AB (which is a liquid) may be poured from the bottle 14 into or onto various objects or materials, depending upon the application. FIG. 5 shows the explosive AB being poured from the bottle 14 into a crevice 74 formed in the earth or some other material. Also, the explosive AB may be used directly within a container 14. For a discussion of various out-of-the-bottle uses of the explosive AB, reference is made to the aforementioned U.S. Pat. No. 3,419,443.

The explosive AB is initiated by any standard commercial detonator, e.g., a number 8 strength detonator. Either electric or fuse types are satisfactory. If the explosive AB is used within the container 14, the detonator should be immersed at least half way into the explosive AB to ensure initiation.

FIGS. 13–15 relate to modified embodiments of the invention.

Referring to FIG. 13, the field mixing bottle 14', made from polyethylene plastic or any other suitable similar material, is shown by way of example to include an upper portion 74 and a lower portion 76 which are welded together at 78. Before the two parts 74, 76 are welded together an arming assembly is inserted into the lower part 76. It includes a can 12' which is completely sealed and contains the liquid component. By way of example, the can may be manufactured to include integral side and bottom wall portions and a top which is secured to the upper edge of the side wall by a bead in accordance with conventional can lid applying procedures.

A cylindrical sleeve 82 is shown surrounding the can 12' immediately below the bead 80. Sleeve 82 carries a pair of diametrically opposed upstanding ears 84. An intermediate portion of a punch member 86 is secured to each ear 84, such as by a rivet 88. The punch member 86 includes an upstanding handle portion 90 and a lower punch portion 92 which is constructed very much like a conventional beer can opener. This can be easily seen in FIG. 14 wherein the punch portion 92 is shown to have a pointed end portion which initially rests upon the top 22' of the can 12'.

Preparatory to use the solid component A is poured into the bottl 14' and the cap 16 is applied. Then the user exerts a lateral squeezing force on the bottle 14' in the vicinity of the cutter handles 90. This squeezing action swings the cutter portion 92 downwardly and causes the pointed end to pierce the top 22' of the can 12'. The bottle 14' is then turned upside down and/or shaken to cause a mixing of the liquid component B with the solid component A.

FIG. 15 shows the plastic mix bottle 14'' having a threaded upper portion 94. A top section 96 is threaded onto this threaded portion 94. Top section 96 includes a nozzle like outlet normally closed by a cap 98. In this embodiment the can 12'' is shown merely resting on the bottom 100 of bottle 14''. At diametrically opposed positions a cutter tool 102 is located on the rim portion 104 of the can 12''. As in the embodiment shown by FIGS. 13 and 14, this tool 102 includes an upstanding handle portion 106 and a can cutting or piercing portion 108 extending generally at right angles thereto. It also includes a mounting portion 110 which locates the tool 102 relative to the upper beaded edge portion of the can 12''. In operation, this embodiment is used in the same fashion as the embodiment of FIGS. 13 and 14.

FIG. 15 shows the bottle 14'' surrounded by a rigid packing sleeve 112. In this particular embodiment the packing sleeve is shown to extend only up to where the upper section 96 is joined to the bottle 14''. This same type of rigid packing sleeve may be provided for the other embodiments, but made to extend upwardly to or even about the level of the cap. The purpose of the packing sleeve 114 is to prevent unwanted crushing or buckling of the plastic side wall of the field mixing bottle. The use of such a packing sleeve in combination with the mixing bottles is considered to be a part of the present invention.

What is claimed is:

1. A field-mix explosive package, comprising:

inner wall means forming a chamber for an intrinsically non-explosive first constituent of an explosive composition;

outer wall means surrounding said inner wall means and extending above said inner wall means to form a container which includes a space therein above the chamber for receiving an intrinsically non-explosive second constituent of the explosive composition, said outer wall means terminating above said chamber in an access opening for said container; and

a closure for said access opening;

a punch projecting downwardly from the region of the access opening, having a lower end portion that is normally supported above said chamber,

said outer wall means being readily bendable by a downward push on said closure, so that such a downward push can be used to move the lower end of the punch through said inner wall means, permitting mixing of the two constituents within the confines of the outer wall means to form the explosive composition.

2. The field-mix explosive package of claim 1, wherein the chamber formed by said inner wall means is a rigid can, and said can includes a lower rim bead and said package includes means connecting said rim bead to said outer wall means.

3. The field-mix explosive package of claim 1, wherein said punch is an elongated member having a lower end portion cut for progressive entry into the said first wall means upon movement towards said first wall means.

4. The field-mix package of claim 3, wherein said punch has a curved cutting edge which starts from a generally pointed leading end and curves both laterally and axially away from said leading end, on both sides thereof.

5. The field-mix package of claim 1, wherein said outer wall means forms a relatively small diameter tubular neck in the region of the access opening, and said punch includes an upper end portion including means for securing it to said neck portion.

6. The field-mix package of claim 5, wherein said punch also includes upwardly extending means for engaging the opening of another container, and serving to locate the opening of such other container in substantial axial alignment with said access opening.

7. The field-mix explosive package of claim 5, wherein the chamber formed by said inner wall means is a rigid can, and said can includes a lower rim bead and said package includes means connecting said rim bead to said outer wall means.

8. The field-mix explosive package of claim 5, wherein said punch is an elongated member having a lower end portion cut for progressive entry into the said first wall means upon movement towards said first wall means.

9. The field-mix package of claim 8, wherein said punch has a curved cutting edge which starts from a generally pointed leading end and curves both laterally and axially away from said leading end, on both sides thereof.

10. The field-mix explosive package of claim 1, wherein the outer wall means is made from a light transmitting plastic material and a dye material is present in the mixing space, causing the two constituents to assume a color upon mixing, whereby the user can tell when mixing has occurred by viewing the color through said outer wall means.

11. The field-mix package of claim 1, wherein said inner wall means is initially a hermetically sealed can having a rim bead at its lower end, said outer wall means surrounds the can and said bead, and includes a first retainer ring having a lip defining and opening large enough to receive the can but not pass the rim bead, and a second retainer member which underlies the can and holds it within the outer wall means, and wherein the two retainer members are firmly secured to the outer wall means.

12. A method of handling and mixing an explosive prior to its use, comprising:

locating an intrinsically non-explosive first constituent of an explosive composition within a sealed first container;

positioning said first container inside of a larger second container such that a mixing space exists in said second container above said first container;

anchoring a cutting tool to an upper portion of said second container, which cutting tool is of a type having a cutting edge at its lower end and is of such a length that the cutting edge is normally spaced above the first container;

transporting said first constituent in said first and second container assembly;

transporting an intrinsically non-explosive second constituent of the explosive composition in a third container;

preparatory to use, pouring said second constituent from said third container into the space in the second container above the first container;

closing said second container;

forcing the top of said second container downwardly to move the cutting edge of said cutting tool through said first container; and

repositioning said second container as necessary to cause a mixing of the first and second constituents.

13. A field-mix explosive package, comprising:

inner wall means forming a chamber for an intrinsically non-explosive first constituent of an explosive composition;

outer wall means surrounding said inner wall means and extending above said inner wall means to form a container which includes a space therein above the chamber for receiving an intrinsically non-explosive second constituent of the explosive composition, said outer wall means terminating above said chamber in an access opening for said container;

a closure for said access opening;

punch means including an elongated handle extending upwardly from said container along the inside portion of said outer wall means in its extent above the container, and a punch portion connected to the lower end of said handle and extending over a portion of the container;

said outer wall means being readily bendable by a lateral squeezing action thereon in the vicinity of said handle, so that such a squeezing action can be used to move the handle of the punch means laterally inwardly, causing a downward swinging movement of the punch portion through the container, providing an opening in the container and permitting mixing of the two constituents within the confines of the outer wall means to form the explosive composition.

14. The field-mix explosive package of claim 13, wherein the chamber formed by said inner wall means is a rigid can, and said can includes an upper closure, and said punch portion is a pointed member which prior to use extends over the upper closure of the can, and said punch portion is rigidly connected to the lower end portion of the handle so that swinging movement of the handle will cause a swinging movement of the punch portion.

15. A field-mix explosive package, comprising:

inner wall means forming a chamber for an intrinsically non-explosive first constituent of an explosive composition;

outer wall means surrounding said inner wall means and extending above said inner wall means to form a container which includes a space therein above the chamber for receiving an intrinsically non-explosive second constituent of the explosive composition, said outer wall means terminating above said chamber in an access opening for said container;

a closure for said access opening;

punch means within the confines of the outer wall means and positioned in close proximity to said container, said punch means functioning upon a collapsing force applied to some portion of the outer wall means to pierce through a portion of the container, so that the constituent within said container can be released therefrom within the confines of the outer wall means to mix with the other constituent to form the explosive composition.

16. The field-mix explosive package of claim 15, in combination with a relatively rigid packing sleeve which surrounds at least that portion of the outer wall means which is forced inwardly to move the punch means through a portion of the container, said packing sleeve serving to preventing unwanted inner movement of said outer wall means.

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