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[54] **INVERTED BOTTLE ARMING TECHNIQUE**

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[52] **U.S. Cl.** ..... **102/24 R**
[51] **Int. Cl.** **F42b 3/00**, F42d 5/00
[58] **Field of Search** 102/24

[56] **References Cited**

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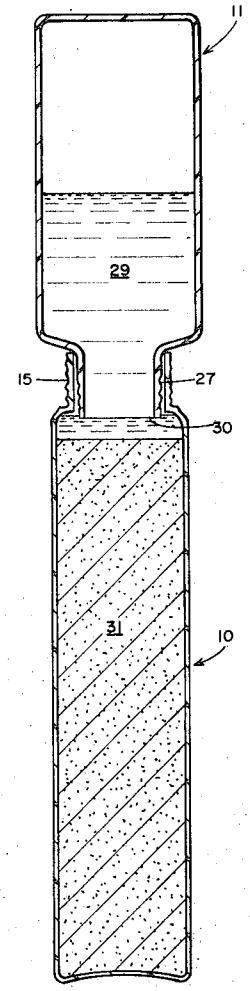
[57] **ABSTRACT**

A method of arming multiple component explosives and cooperable apparatus for carrying out the method are disclosed. A solid component containing mixing container is provided having a mouth designed to accept the spout of a cooperable liquid container and maintain the liquid container in an inverted discharge position in the mouth of the solid component container. The method includes regulating the rate of discharge from the liquid container into the mixing container by maintaining a flow retarding liquid seal at the point of discharge at the desired maximum liquid level within the solid mixing container.

13 Claims, 2 Drawing Figures



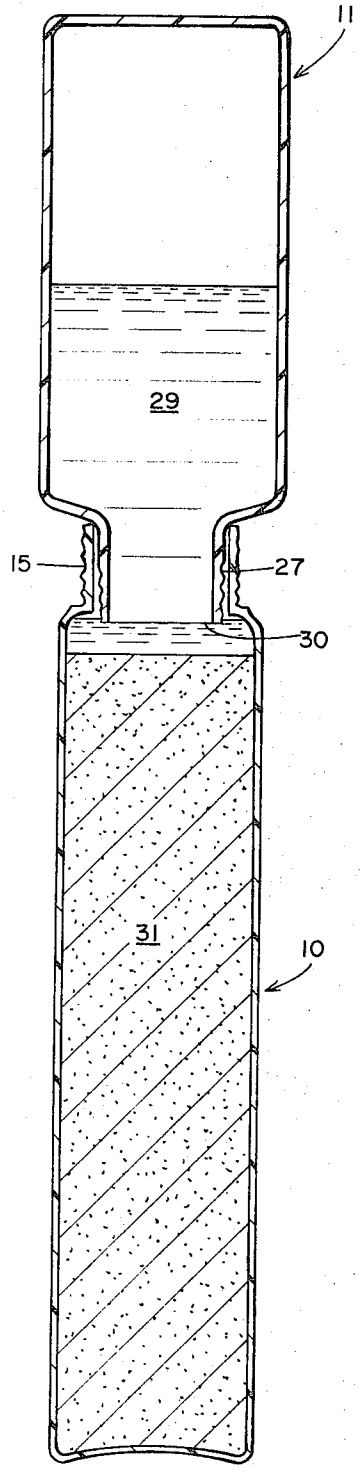


FIG. 2

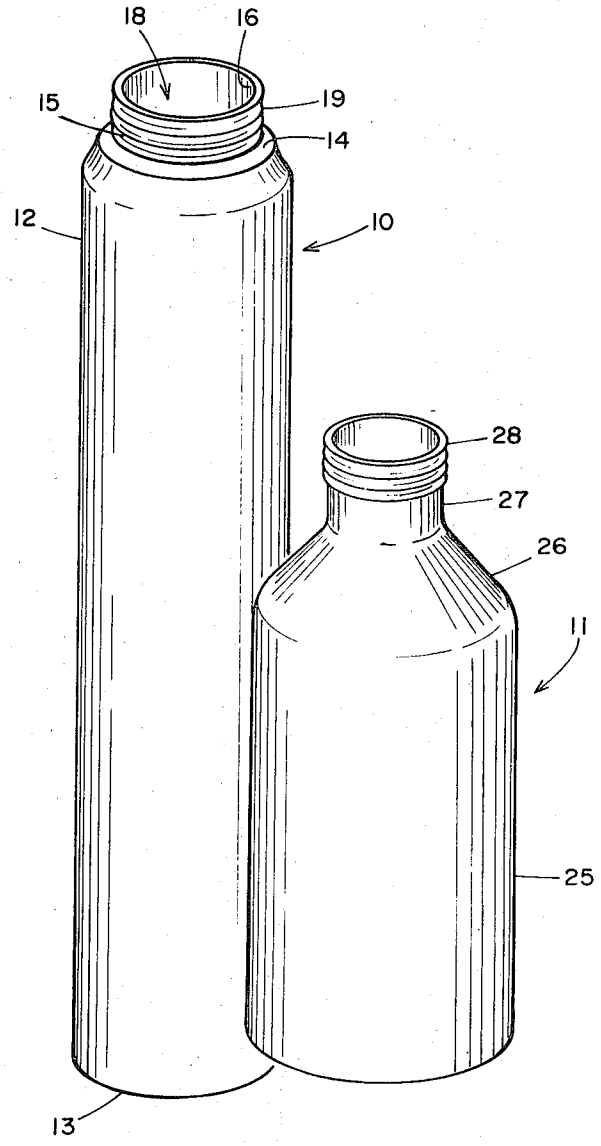


FIG. 1

INVERTED BOTTLE ARMING TECHNIQUE

The present invention relates to a system and method for activating various chemical compositions for intermixing at the site, and more particularly relates to a method of intermixing a liquid and a solid component, which separately are non-explosive, but when intermixed are rendered highly explosive. Cooperate containers for carrying out the method of the invention are also disclosed.

The explosive industry has for a long time been striving for a general purpose explosive which is detonatable by a small cap and which can be stored and transported with safety and convenience by conventional means. The traditional explosives such as TNT are reasonably inexpensive to manufacture and are detonatable by a small cap, for example a Number 6 explosive cap. However, the sensitivity of such a traditional explosive is also a drawback in that such an explosive must be shipped in commerce under the explosive regulations. The cost of special handling and transportation decreases the economic feasibility of use of such an explosive, and thus explosive users have looked to other compositions.

One way in which the explosive manufacturers have attempted to circumvent these problems is to ship the explosive as separate components which are mixed at the site of use. Each of the components of the explosive are by themselves insensitive and may be shipped in commerce by ordinary transportation facilities. Further, until mixed, the explosive components can be stored and handled with no special precautions required. Although some of these multiple component explosives have had the disadvantage that they are not sensitive to a conventional Number 6 blasting cap, and require a primary explosive, newer explosive compositions have been developed which are easily detonable without requiring a primary explosive. For example, the application of Gerald L. Hurst, Ser. No. 79,039 and now U.S. Pat. No. 3,718,512, entitled "EXPLOSIVE COMPOSITION METHODS FOR ACTIVATING AND DETONATING AN EXPLOSIVE, AND CONTAINER THEREFOR," co-pending herewith, discloses an effective cap sensitive explosive composition manufactured by combining appropriate portions of a non-cap sensitive organic liquid containing oxidizing groups with a porous substrate. The preferred liquid is nitromethane and the preferred substrate is a finely divided ionic nitrate powder. The method for detonating the two-component explosive mixture comprises adding to the porous solid a non-cap sensitive potentially detonatable liquid, and contacting the mixture with an explosive cap having a rating at least equal to a commercial Number 6 cap. The primary function of the solid component is to provide a porous base or substrate which will disburse the liquid component by a capillary action, thereby automatically providing an intimate mixture of finely divided liquid component and air.

Similarly, the application of Gerald L. Hurst, Ser. No. 79,096, and now U.S. Pat. No. 3,722,410 entitled "EXPLOSIVE COMPOSITION METHODS FOR ACTIVATING AND DETONATING EXPLOSIVES AND CONTAINER THEREFOR," discloses still another explosive composition which is a liquid-solid composition made effective through mixing at the site of use. The explosive composition is prepared at the site of use by combining appropriate portions of activated ammonium nitrate, a fuel and preferably a sensitizer. The preferred fuel is a liquid hydrocarbon derivative or a solid hydrocarbon derivative which is soluble in a sensitizer such as a nitromethane. It is to be understood that the method of the present invention is usable with various multiple component explosives which can be separately stored and mixed prior to the time of use, one of the components being in a liquid form. The compositions briefly described above and disclosed in the aforementioned co-pending patent applications are included only as general background as being typical of this general type of explosive.

Mixing of explosive components of the general type described above has been achieved in a number of ways. Generally, the particulate or solid component is stored in containers which are adapted to receive the liquid component and are then mixed ready for use. The introduction of liquid into the solid component container may be by simple pouring. The individual solid component containing containers are filled with the liquid individually from a larger liquid container by means of a funnel or by directly pouring into the solid containers. For example, co-pending application Ser. No. 79,093 discloses a laminated foil solid component container which is adapted to be torn open to receive the liquid component. When the liquid has been absorbed, the torn end of the solid component package is rolled or folded tightly to reseal the package. A Number 6 or larger detonating cap is placed firmly against the solid component package for detonation.

Other more sophisticated means of introducing the liquid component into the solid component have been suggested in the prior art. Pressure filling apparatus to speed the operation have been tried. Use of a needle and syringe type filling device to inject the liquid into the solid component container is also known. These methods are not entirely satisfactory as special filling equipment and special closures to permit insertion of the filling devices are required, making fabrication of the containers considerably more expensive.

The simple pouring method, while effective and requiring no specialized equipment, has the disadvantage of being extremely inefficient. The vessels containing the solid or particulate material are filled one at a time and a workman cannot proceed to the next container until the prior one has been completely filled. Often, the rate of absorption of liquid into the solid is considerably low, for example, it may take as long as 20 minutes to fill a single relatively small container. This means that when a multiplicity of containers are being readied as explosive devices, the better part of a day may be required in preparing the charges. This is particularly disadvantageous in the mining, petroleum, and construction industries where time is particularly important. Idle crew time can cost an operator a great deal of money. Thus, the present invention fulfills the need to provide an apparatus and method to efficiently and expediently arm liquid-solid explosives at the use site.

The present invention briefly includes charging the solid component in a container having an opening adapted to receive the neck or the spout of a cooperable liquid container. The liquid container is adapted having a spout that can be received in the opening of the solid component container, securing the liquid component container in an inverted position. The spout is of sufficient length so that when the liquid con-

taining bottle is inverted, the spout extends a short distance into the solid container. The liquid discharge is automatically regulated and flows out of the inverted liquid containing bottle at the rate at which it is absorbed in the solid without overflowing or spilling from the container. The flow rate is regulated by demand analagous to the principle on which bottled water coolers operate with flow occuring only when the liquid level recedes below the discharge orifice at the spout.

The system and method of the present invention will be better understood from the following specification in conjunction with the accompanying drawings, in which:

FIG. 1 illustrates the cooperable liquid and solid component containers, and

FIG. 2 illustrates in section, the liquid container positioned in an inverted position within the mouth of the solid component container.

In accordance with the present invention, the explosive composition of the present invention includes a liquid component which can be stored and transported conveniently in the bottle of the present invention to its site of use. The liquid component of the explosive will generally be a non-cap sensitive liquid capable of being freely shipped in normal commerce which is activated at a use site by mixing with the appropriate solid component of the explosive composition.

The explosive solid composition similarly can be stored and transported conveniently in its container to the site of use. As set forth in the introduction of this specification, the solid and liquid components may be chosen from a range of compositions. The present invention is also adapted for use with chemical compositions other than explosives which are stored separately and then intermixed to render them active ready for use.

In FIG. 1, the numeral **10** generally designates the solid component container and the numeral **11** designates the liquid component container. The solid component container **10** is shown as having a generally tubular body member **12** having bottom **13** and top **14**, terminating in an annular neck **15** which defines a mouth or opening **16** communicating with the interior **18** of the container. Neck **15** is threaded at **19** to reseal-ably receive a conventional closure or cap, not shown. Alternately, other types of closures such as a snap plug adapted to be pressed into the opening **16** in an interference type of fit could be used. The container can be fabricated from a wide range of material, but preferably would be made of a suitable plastic compatible with its contents by an appropriate molding process. An explosive cartridge of this general type is shown in copending application Ser. No. 245,719, filed Apr. 20, 1972, entitled "EXPLOSIVE STICK WITH SIDE DETONATION." It will be understood that the solid container can be of various shapes and configurations and be cooperable with the liquid container of the invention.

The liquid container **11** is also of a general cylindrical shape having a body **25** which converges at shoulder section **26** to spout section **27**. Spout **27** is of a diameter slightly less than the opening at mouth **16** of container **10**. The diameter of the body portion **25** is greater than the opening at the mouth section **16** so that the container **11** may be inverted with the spout **27** depending into opening **16** and with shoulder **26** engaging the edges of mouth **16** of container **10**. The spout **27** is also of sufficient length to depend in container **10** a short distance below the interior of the upper surface **14**. In this way, container **11** may be simply inverted and placed in the mouth **16** of the container **10** without other support. The relatively close fit between the spout **27** and the mouth **16** will serve to secure the inverted bottle **11** in an upright position. If desired, threads **28** may be provided on the spout **27** on the bottle **11** to accept a standard screw cap type closure. The bottle **11** may be of any suitable material which is impervious to the liquid explosive component it is adapted to contain. For example, it may be glass, metal, or, in some cases, plastic.

Typically, the solid component containers **10** would be packed with the solid component at the manufacturing site and shipped in cartons to the job site. As mentioned above, because the solid component is cap insensitive, no special precautions in shipping and storage are necessary. Similarly, the liquid component container **11** would also be filled with its liquid at the manufacturing site and shipped to the job site for mixing with the contents of container **10**. The solid and liquid containers are normally paired so that the correct relative quantities for manufacturing the explosive are contained in each container. When it is desired to utilize the explosives, the contents of container **11** would be poured into and absorbed into the contents of container **10**. Generally, no shaking or physical mixing is required. As many containers or charges as required would be armed at the time of use. Thus, no armed explosives would have to be stored, eliminating a possible source of danger.

FIG. 2 better illustrates the method of the present invention, showing the controlled discharge of liquid into the solid container **10**. To arm an explosive, the workman would remove the closure of the solid component container **10**.

Similarly, the workman would take a bottle containing the liquid component from its case and remove the closure from the spout **27**. The container **10** of course has been sized to permit acceptance of the required amount of liquid to arm the explosive. Similarly, the container **11** is of a preselected volume in relation to the amount of solid explosive. A workman would then simply grasp the bottle **11** and place it in an inverted position with spout **27** in the opening or mouth **16** of the container **10**. The liquid **29** within the bottle **11** is free to flow into the solid **31** within the container **10** and be absorbed therein. As is typical of many explosive mixtures, the rate of absorption is rather slow and often requires 20 minutes or more for the liquid to be absorbed into the entire depth of the solid container. Normal pouring techniques would require the workman to pour a small quantity of fluid into the container **10** and then wait until it is absorbed and repeat the procedure. However, with the present invention, it will be seen that the spout **27** depends and discharges at an elevation within the interior **18** of container **10**, and that when inverted the liquid lever **30** in the container **10** will rise to slightly immerse the end of the spout **27**. The liquid lever **30** will never be permitted to rise any higher than this and overflow container **10**, as the discharge is regulated in a manner similar to conventional bottled water coolers. As the liquid is absorbed and lever **30** lowers, more liquid will be permitted to flow out of bottle **11** into container **10** until the lower end

of the spout **27** is again immersed and the vacuum in the bottom portion of the container **10** prevents additional liquid from flowing from the bottle. Thus, the rate of flow from bottle **11** into the container **10** is automatically regulated in relation to the demand as determined by the rate of absorption of the liquid into the solid material. The bottle can be placed in the inverted position and left unattended until it is completely empty without fear of overflowing or spillage. When the bottle **11** is empty, the workman can simply remove it and replace cap **21** on container **10.** The container **10** now contains an explosive mixture and is ready for resealing by placing a closure on the container. No physical mixing is required. The arming of the explosive charge in container **10** is completed by attaching a conventional detonator such as a cap or detonator cord to the container.

The particular advantage of this automatic arming system is that the workman can proceed to arm the required number of containers **10** in one continuous operation without the necessity of waiting until one container is completely armed before proceeding to fill the next. The operation of removing the caps from the liquid and solid containers and placing the liquid container in a position in the mouth of the solid container takes only a few seconds. Thus, it is conceivable that a large number of charges could be armed for use with the workman proceeding with the arming operation while the prior inverted containers **11** are draining into their respective solid containers. It would be possible for the workman to arm as many as a hundred containers in a short period of time. Previously, arming this many explosives would have required many hours of time as each would have to be completely filled before the workman could proceed to arm the next device.

In summary, the present invention provides a cooperable container system and novel method of arming multiple component explosive devices at the use site which greatly expedites their handling. The method is simple and assures that no spillage or overflowing of the liquid component will occur. The rate of flow of liquid from the liquid container is dependent upon the rate of absorption into the solid and automatically responds to the demand rate.

It will be apparent to those of ordinary skill in the art upon reading the present disclosure to make various changes in the method and the herein disclosed invention. It is the intent, however, that the concepts disclosed herein be limited only by the appended claims.

I claim:

1. A cooperable container system for separate storage of an explosive comprised of a liquid and a particulate component to facilitate absorption of the liquid into the particulate component to arm the explosive comprising:

a first container adapted to contain said particulate component having an opening adapted to receive removable closure means and selected to accept the addition of a predetermined volume of liquid to its contents, and

a second container adapted to contain a liquid and having spout means extending therefrom, said spout adapted to be received within the opening of said first container in an inverted position with respect to the first container while permitting air to escape from the opening of the fluid container whereby the maximum level of liquid in the first container will be limited to a predetermined maximum below the opening of the first container.

2. A cooperable container system for separate storage of an explosive comprised of a liquid and particulate component to facilitate absorption of the liquid into the particulate component to arm the explosive comprising:

a first container means having an opening adapted to receive removable closure means,

a second container adapted to contain a preselected volume of liquid and having spout means associated therewith, said spout adapted to be received within the opening of said first container in an inverted position and having discharge means therein whereby said spout depends a predetermined distance into said first container in said inverted position to establish a liquid seal at the discharge opening to regulate the flow from said second container to said first in responsive to the rate of absorption, and

cooperative means on each of the first and second containers for supporting said second container in said inverted position.

3. A method of arming an explosive having at least a first particulate component in a first container having an opening and a second liquid component in a second container, said method comprising:

placing said second container in an inverted position relative to said first container whereby said second container discharges into said first container,

regulating the discharge from said second container in response to the level of liquid in said first container by positioning said second container with the discharge means depending into said first container to discharge at the maximum predetermined liquid level whereby a predetermined increase in the liquid level will seal the discharge means, thereby terminating the flow from said second container until said liquid level recedes below said discharge means,

removing said second container from said first container and closing said first container, and

attaching detonator means to said first container.

4. The method of claim **3** wherein said second container is sized to contain a quantity of liquid component necessary to arm said first container and said first container is selected to accept the addition of liquid component to its contents.

5. The method of claim **3** wherein a multiplicity of explosive charges are armed sequentially each being left substantially unattached until said second container fully drains into said first container.

6. A cooperable container system for separate storage of explosive components to facilitate mixing comprising:

a liquid container containing a preselected volume of liquid and having an openable spout means extending from the upper end, said liquid container being sealed except for the open spout,

a particulate container containing a particulate explosive component and having a top opening adapted to receive the spout of the liquid container when the liquid container is inverted, and being further adapted to support the liquid container with the lower end of the spout spaced below the top opening of the particulate container, the partic-

ulate container being vented to atmosphere when the spout of the liquid container is positioned in the top opening such that liquid will rise only to a limited level below the opening in the particulate container as a result of atmospheric pressure acting on the liquid.

7. The system of claim **6** wherein said liquid container includes shoulder means adapted to be engaged by the periphery of the opening in said particulate container.

8. The system of claim **6** wherein said liquid container is sized to contain the correct relative volume of liquid component, and said particulate container is sized to contain the correct relative volume of said first component and to accept the addition of the volume of said second container to the particulate component.

9. The system of claim **6** wherein each of said containers is provided with a removable closure.

10. The system of claim **9** wherein the closures comprise insertable plugs.

11. The system of claim **9** wherein the closures comprise threaded caps adapted to resealably engage the containers.

12. A method of arming an explosive having at least a liquid and particulate component comprising:

charging said particulate material in a first container having an opening, said container being selected to receive a predetermined amount of liquid in addition to its particulate contents,

storing said liquid component in a second container having discharge means associated therewith,

arming said explosive by placing said second container in an inverted position with the discharge means depending into the opening in said first container while venting the first container to atemosphere such that the discharge from the second container will be automatically regulated in response to the rate of demand into the particulate component by atmospheric pressure to maintain the liquid below a predetermined level in said first container.

13. The method of claim **12** wherein said liquid level is maintained by positioning said second bottle with the discharge means depending into said container to discharge at the maximum liquid level whereby a predetermined increase in the liquid will seal the discharge means terminating flow from said second container until said liquid level recedes below said discharge means.

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