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Griffith

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[54] **ENCLOSURE FOR EXPLOSIVE MATERIAL**

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[73] Assignee: **Commercial Solvents Corporation**, Terre Haute, Ind.

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

[51] **Int. Cl.** **F42b 3/08**

[58] **Field of Search** ..... 102/24 R, 24 HC

[56] **References Cited**

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Attorney, Agent, or Firm—Morton, Bernard, Brown, Roberts & Sutherland

[57] **ABSTRACT**

An enclosure for explosive material providing a safe, easily handled explosive booster or primer which can utilize liquid, slurry or solid explosive and which includes recesses to receive detonators. The explosive material is completely enclosed in a container, which illustratively might be an aluminum can including a sealed cover. A sleeve encircles the container. The sleeve and the container cooperate to form recesses for receiving detonators. One type of recess is open on only one end to retain a detonator such as a blasting cap. Another type of recess is open on two opposite ends to permit threading of a detonating cord on which the primer is suspended. The recesses might be formed by indentations in the container sidewall or by furrows in the sleeve. The sleeve can include explosive material to add to the explosive force of the detonator, thereby assuring actuation of the primer.

11 Claims, 10 Drawing Figures

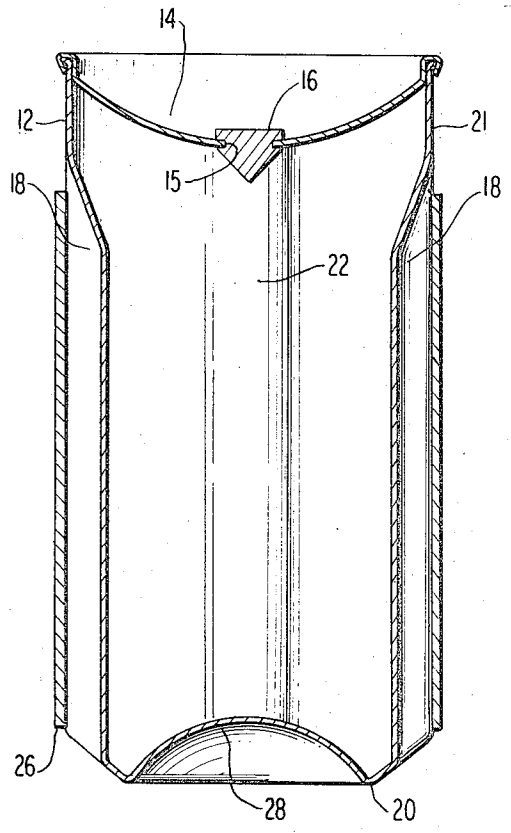


FIG.1

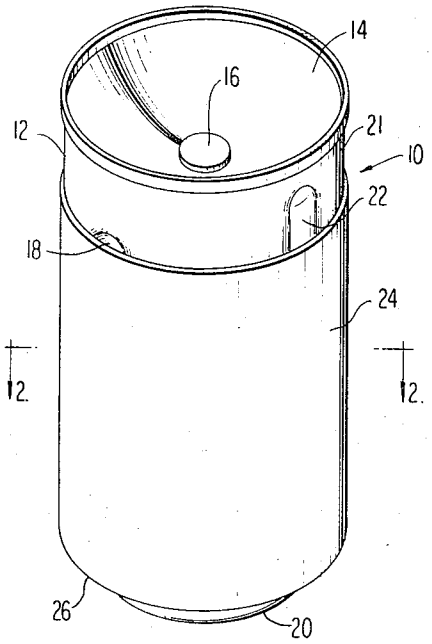


FIG.2

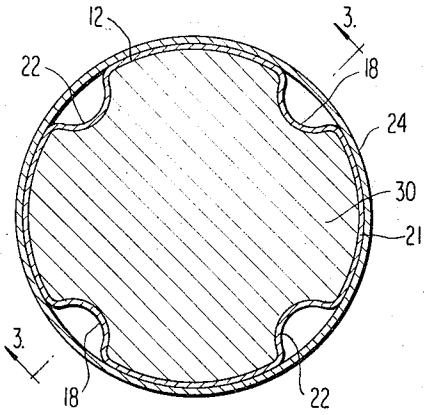
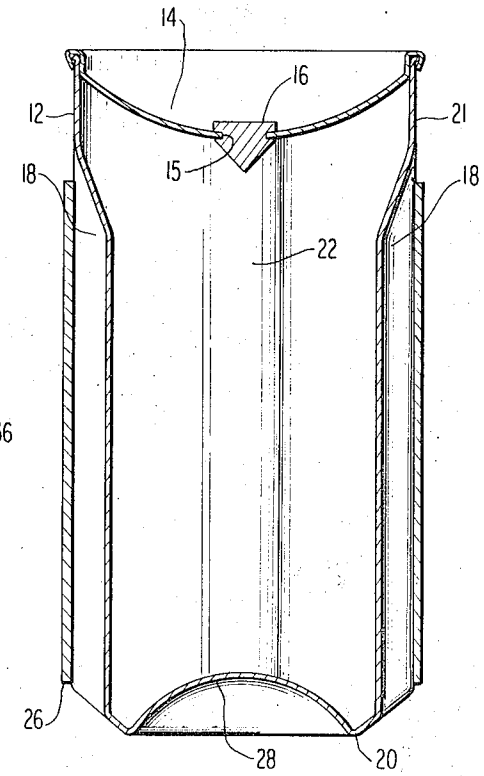


FIG.3



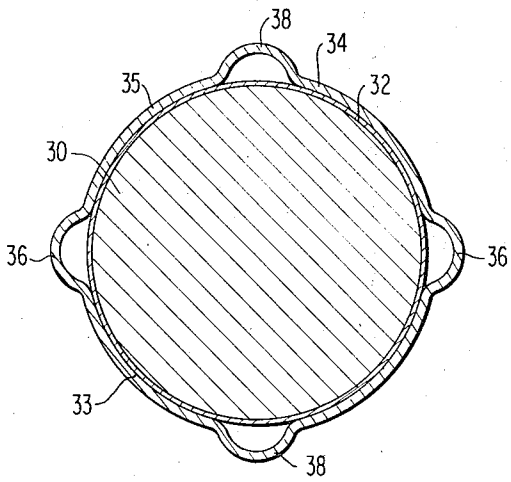


FIG.4

FIG. 5

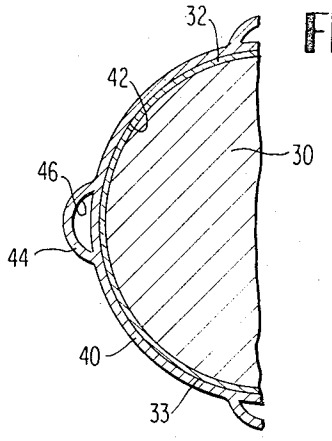


FIG. 6

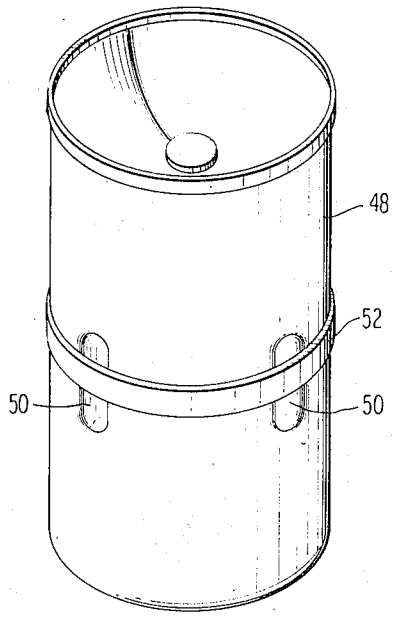


FIG. 7

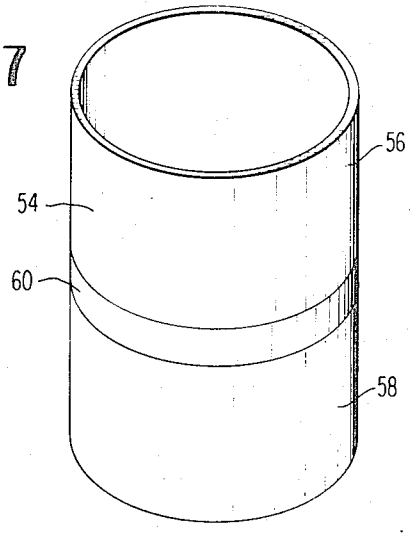
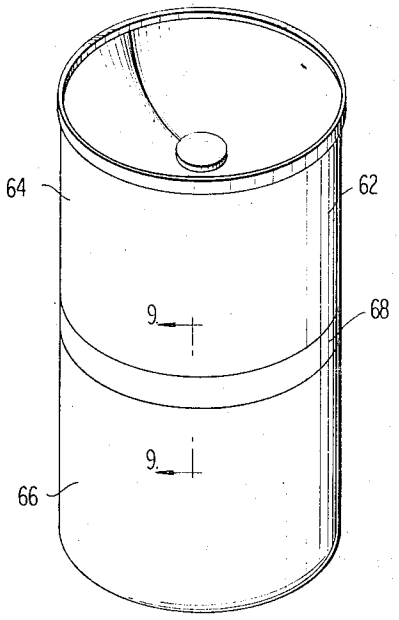


FIG. 8



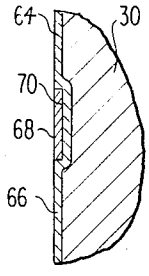


FIG. 9A

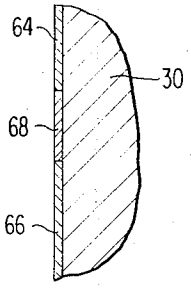


FIG. 9B

ENCLOSURE FOR EXPLOSIVE MATERIAL

The present invention pertains to an enclosure for explosive material. More particularly, present invention pertains to an explosive primer including an explosive material in a container such as an aluminum can and a sleeve fitting around the can and cooperating with the can to form recesses adapted to receive a blasting cap or detonating cord for actuating the explosive primer.

Explosive primers or boosters are frequently utilized in the detonation of explosive material. Insensitive explosives, such as those containing a high percentage of ammonium nitrate and nonexplosive organic sensitizers, are not generally detonatable by such conventional means as blasting caps, detonating cords and fuses. These insensitive explosives, therefore, are generally detonated by utilizing an explosive primer or booster which is more sensitive and is, therefore, detonated by the blasting cap or detonating cord. The explosive primer or booster might include material such as dynamite or TNT. Other boosters include an outer layer of a relatively insensitive explosive material of high brisance such as pentolite, cyclonite (RDX) and composition B (RDX, TNT and wax) and an inner layer of more sensitive explosive material such as pentaerythritol tetranitrate (PETN), and finely divided pentolite (PETN and TNT). Liquid explosive materials such as nitromethane-containing products are also usable, and in many instances, are preferable.

Solid explosive boosters are frequently manufactured by casting the explosive material in the desired configuration. In the casting process suitable recesses can be cast into the explosive material to receive a blasting cap or detonating cord. Liquid explosive, on the other hand, cannot be cast and so requires a container which is adapted to readily receive a blasting cap or detonating cord while providing secure storage of the liquid explosive. No such container has been available heretofore.

The present invention is an enclosure for holding explosive material to provide an explosive primer or booster. The present invention is adapted for use with either a liquid, a slurry or a solid explosive material. Since the present invention provides the finished explosive booster in a completely closed container, the explosive booster can be safely handled without fear of spillage or accidental detonation. In accordance with the present invention a container such as a can of a size to hold the desired quantity of explosive material is provided with a sleeve to fit over the container. The container and the sleeve cooperate to provide one or more recesses for receiving a detonator such as a blasting cap or a detonating cord. In one embodiment of the present invention the recesses are provided by indentations in the surface of the container. In another embodiment of the invention the recesses are provided by forming furrows in the sleeve which fits over a smooth-walled container. Because the container is entirely enclosed, the explosive material can be safely handled, with the recesses permitting rapid installation of a detonator.

These and other aspects and advantages of the present invention are more apparent in the following detailed description and claims, particularly when considered in conjunction with the accompanying drawings in which like parts bear like reference numerals. In the drawings:

FIG. 1 is a perspective view of an explosive booster in accordance with the present invention;

FIG. 2 is a sectional view taken along line 2—2 of FIG. 1;

FIG. 3 is a sectional view taken along line 3—3 of FIG. 2;

FIG. 4 is a sectional view of a modified embodiment of an explosive booster in accordance with the present invention;

FIG. 5 is a fragmantary sectional view of another modified embodiment of an explosive booster in accordance with the present invention;

FIGS. 6, 7 and 8 are perspective views of additional embodiments of explosive boosters in accordance with the present invention; and

FIGS. 9A and 9B are fragmentary sectional views of alternative embodiments of the explosive booster of FIG. 8 and are each taken along line 9—9 of FIG. 8.

FIGS. 1, 2 and 3 depict a preferred embodiment of explosive booster 10 in accordance with the present invention. Booster 10 includes a container 12 having its side surface and bottom surface formed in one piece, for example by an extrusion process. Container 12 is enclosed by cover 14 which is preferably concave and which is sealed to the container. Preferably, cover 14 includes in substantially its center an opening 15 with a cap 16 inserted therein to provide a liquid-tight seal. Cap 16, therefore, provides a safety valve, and so if, for example, container 12 is hit by a projectile or is in a fire, causing pressure within the container to increase, cap 16 pops off to prevent explosion. A plurality of indentations are formed in the side surface of container 12. Thus, for example, indentations 18 are provided on opposite sides of the container and extend longitudinally from the junction of lower end 20 and container sidewall 21 to a point part way up container 12, for example a point in the order of three-fourths the height of container 12. Likewise, indentations 22 are formed in the side surface of container 12 on opposite sides of the container and at approximately 90° from indentations 18. Indentations 22 extend from the junction of lower end 20 and sidewall 21 to a point very near top 14 and thus further up sidewall 21 than do indentations 18.

Sleeve 24 fits snugly but slidingly about container 12. Preferably sidewall 21 is slightly tapered so that sleeve 24 slides onto container 12 from lower end 20 until the lower edge 26 of sleeve 24 is adjacent lower end 20. In this position sleeve 24 covers indentations 18 over substantially their entire length, while indentations 22 extend slightly above sleeve 24.

Preferably, a concave indentation 28 is provided in the lower end 20 of container 12. The concave surfaces of cover 14 and lower end 20 give a shaped charged effect to the explosion which results upon detonation of explosive primer 10, as do indentations 18 and 22.

Container 12 is filled with an explosive material 30 which can be a liquid, such as nitromethane, or a slurry or a solid. RDX, for example, can be heated to a liquid state, poured into container 12, and cooled to solidify to provide an explosive booster of this solid explosive material. FIG. 3 illustrates the interior of container 12 without the explosive material 30 in place.

Preferably, container 12 is a seamless metal can formed of aluminum, for example by an extrusion process, with the result that on detonation of explosive booster 10 the aluminum oxidizes at an extremely high

temperature, reacting with the explosive atmosphere to create additional heat and explosive velocity. Sleeve **24** might be formed of a fiber material such as cardboard or of a plastic material. With an explosve booster of this type in accordance with the present invention, explosive velocities in the order of Mach **30** might be achieved.

When it is desired to ignite an explosive charge with explosive primer or booster **10**, the booster is detonated with a detonating device such as a blasting cap or a detonating cord. To achieve this, the booster can be inverted from the position depicted in FIG. **1** and blasting caps inserted into recesses **18**. Since recesses **18** do not extend beyond sleeve **24**, the blasting caps do not fall out. The blasting cap lead wires extend from the recesses **18** to permit actuation of the blasting caps. Alternatively, a detonating cord of, for example, PETN can be threaded through each recess **22** so that sleeve **24** retains explosive primer **10** at the desired location on the detonating cord. By this means several explosive boosters **10** can be positioned on a single detonating cord which is threaded through a recess **22** of each booster.

If explosive booster **10** is filled with a liquid explosive material, either the liquid can be placed into container **12** before top **14** is installed, or top **14** can be installed first and the liquid explosive material introduced through opening **15** in the center of top **14** with opening **15** subsequently closed by cap **16**. If the liquid is a normally solid explosive which has been heated to the liquid state, it can be cooled to return it to the solid state before inserting cap **16**.

FIG. **4** depicts a modified embodiment of an explosive booster in accordance with the present invention. Explosive material **30** is provided within container **32** which has a smootn sidewall **33**. The sidewall **35** of sleeve **34** is provided with furrows **36** and **38** which cooperate with sidewall **33** of container **32** to form receptacles for the detonator. Thus furrows **36** and **38** are formed integrally in sleeve sidewall **35**. Furrows **36** might extend from the bottom of sleeve **34** to a point just below the top of the sleeve to receive a blasting cap, while furrows **38** can extend the entire length of the sleeve to permit threading of the booster onto a detonating cord.

FIG. **5** depicts a slightly modified embodiment of sleeve for use in conjunction with a smooth-walled container such as container **32**. The explosive material **30** is within smooth-walled container **32** surrounded by sleeve **40**. Sleeve **40** includes a sidewall **42** having a smooth inner surface. Furrows **44** extend outwardly from sleeve sidewall **42** to form recesses **46** for the blasting caps or detonating cords.

Rather than being made of a nonexplosive material such as cardboard or nonexplosive plastic, the sleeves **24, 34** or **40** could be made of an explosive material such as a sheet explosive, one of which is available from E. I. duPont de Nemours & Co., Inc., under the trademark Detasheet. If an explosive plastic of that type is to be used, then it need not encompass the entire length of can **12**. FIG. **6**, for example, depicts a container **48**, having recesses **50** extending only over a short portion of the length thereof for receipt of a detonator, and a short sleeve or band **52** of explosive plastic such as Detasheet wrapped about the container at the recess **50**. Sleeve **52**, therefore, serves to hold the detonator, either a blasting cap or a detonating cord, within the recess **50**. FIG. **7** depicts a sleeve **54** including upper portion **56** and lower portion **58** of, for example, a fiber or a nonexplosive plastic and joined by center rib **60** of an explosive material such as Detasheet. Sleeve **54** can be utilized with container **12** having recesses **18** and **22** as depicted in FIG. **1**. The explosive material such as sleeve **52** or rib **60** provides additional explosive force directed into the container, thereby ensuring detonation of the explosive material within the container. FIG. **8** depicts a container **62** having an upper portion **64** and a lower portion **66** each of a nonexplosive material such as aluminum and joined by an explosive rib **68**. As seen in FIG. **9A**, explosive rib **68** can fit within a notch **70** of the sleeve so that upper portion **64**, lower portion **66** and notch **70** are a single piece. Alternatively, as depicted in FIG. **9B**, upper portion **64** and lower portion **66** can be separate pieces connected by explosive rib **68**. The container **62** of FIG. **8** can be utilized with a sleeve such as sleeve **34** of FIG. **4** or sleeve **40** of FIG. **5**, having furrows.

It is thus seen that in accordance with the present invention there is provided a container for explosive material which permits sure, safe handling of liquid, slurry or solid explosive, while providing means for the ready insertion of a detonator. While the preceding has set forth several embodiments of containers in accordance with the present invention, numerous modifications and rearrangements could be made, and still the result would be within the scope of the invention.

What is claimed is:

1. An enclosure for explosive material comprising:

a cylindrical container including an enclosed lower end having a concave outer surface, a sidewall sealingly secured to said lower end and having a plurality of elongated recesses therein substantially equally spaced angularly about the sidewall, and a cover having a concave outer surface and adapted to be sealingly secured to said sidewall to form an enclosed, sealed container, and

a sleeve adapted to fit over said lower end onto said sidewall,

said sleeve and said sidewall recesses cooperating to receive at least one detonator;

said lower end concave outer surface, said cover concave outer surface and said recesses providing a shaped charge effect upon explosion of explosive material within the container.

2. An enclosure as claimed in claim **1** in which at least one of said plurality of elongated recesses extends longitudinally on said enclosure from the junction of said lower end and said sidewall.

3. An enclosure as claimed in claim **2** in which at least one of said plurality of elongated recesses extends longitudinally on said enclosure the entire length of said sleeve.

4. An enclosure as claimed in claim **3** in which at least one of said plurality of elongated recesses extends longitudinally on said enclosure only part of the length of said sleeve.

5. An enclosure as claimed in claim **1** in which said container is an aluminum can.

6. An enclosure as claimed in claim **1** in which said sleeve is a fiber sleeve.

7. An enclosure as claimed in claim **6** in which said fiber sleeve is cardboard.

8. An enclosure as claimed in claim **1** in which said sleeve is a plastic sleeve.

9. An enclosure as claimed in claim 8 in which said sleeve includes an explosive plastic.

10. An enclosure as claimed in claim 1 in which said sleeve comprises a band of explosive plastic wrapped about the container and over the recesses.

11. An enclosure as claimed in claim 1 in which the sleeve includes at substantially the longitudinal center thereof a circular rib of an explosive material.

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