United States Patent [19]

Romney

[11] 3,831,522

[45] Aug. 27, 1974

[54] **EXPLOSIVE BOOSTER AND CONTAINER THEREFOR**

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

[51] **Int. Cl.** **F42b 3/10**

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

[56] **References Cited**

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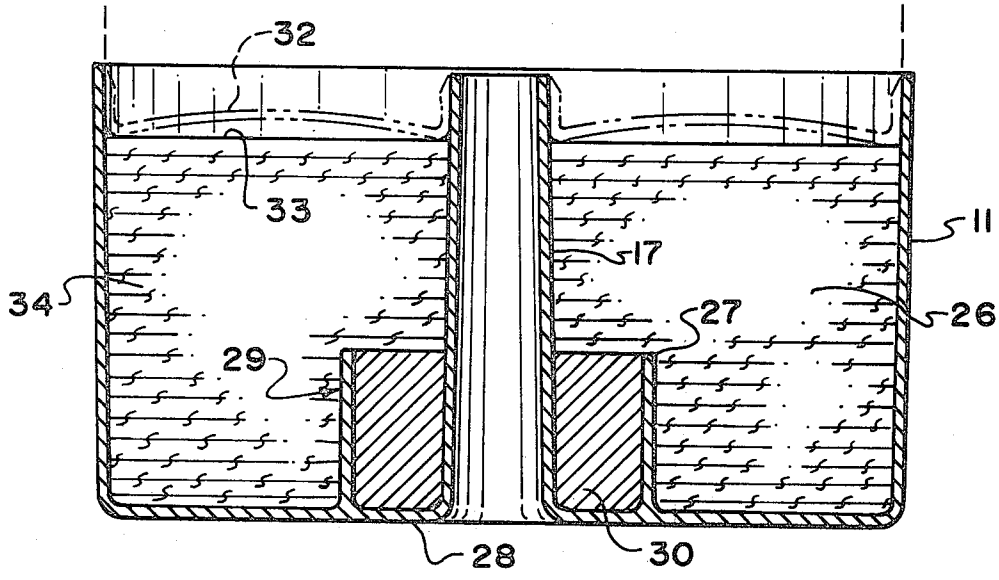
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Primary Examiner—Verlin R. Pendegrass

[57] **ABSTRACT**

A plastic shell or container casing for explosive charges, particularly small explosive charges of higher sensitivity, is injection molded in parts with sufficient precision that it can be assembled with liquid-tight joints without adhesives or heat-sealing. The casing or shell is formed with one or more integral tubes or recesses for receiving an initiator or primary detonator, such as a blasting cap or a detonating cord, or both. The separate parts of the container may be formed as a main receptacle and a closure, or as two half-casings or containers, or in other minor and major part combinations. The parts are designed with tight frictional connections but may include locking or semi-locking joints, to resist unauthorized tampering as well as to protect the contents against intrusion of water or other external liquids. Design features preferably include an inner structure or receptacle for holding a core of hyper-sensitive explosive, capable per se of detonation by a small initiator, to magnify the initiatory detonation and thus set off a surrounding charge of less sensitive material which could not be reliably detonated per se by the primary initiator.

8 Claims, 17 Drawing Figures



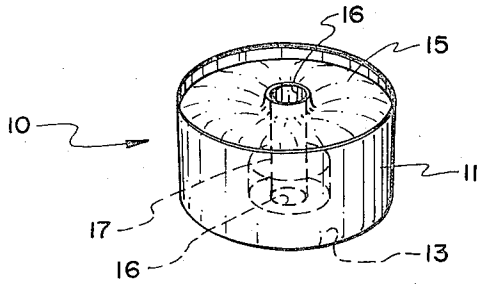


FIG. 1

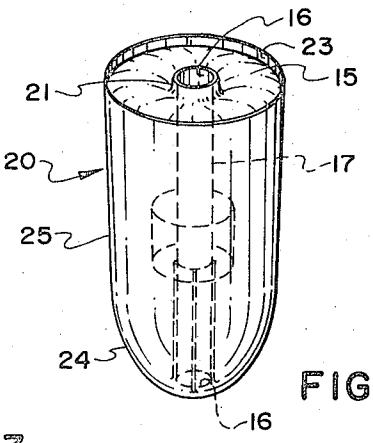


FIG. 2

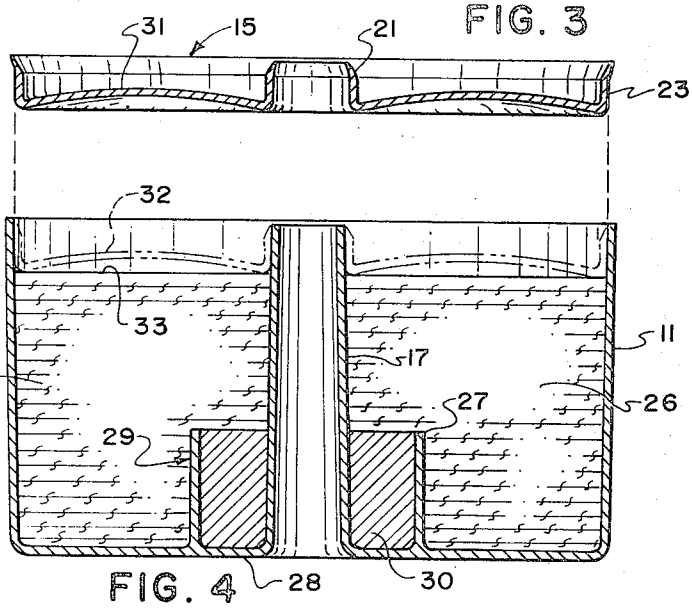


FIG. 3

FIG. 4

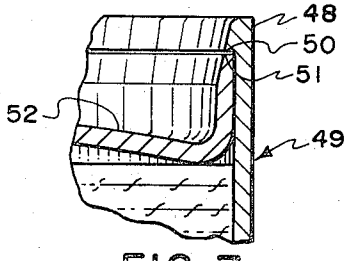


FIG. 7

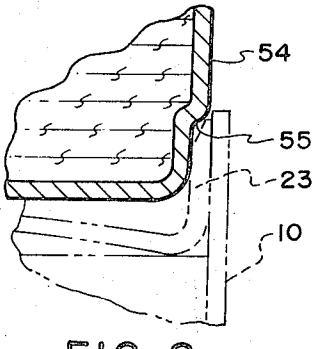


FIG. 8

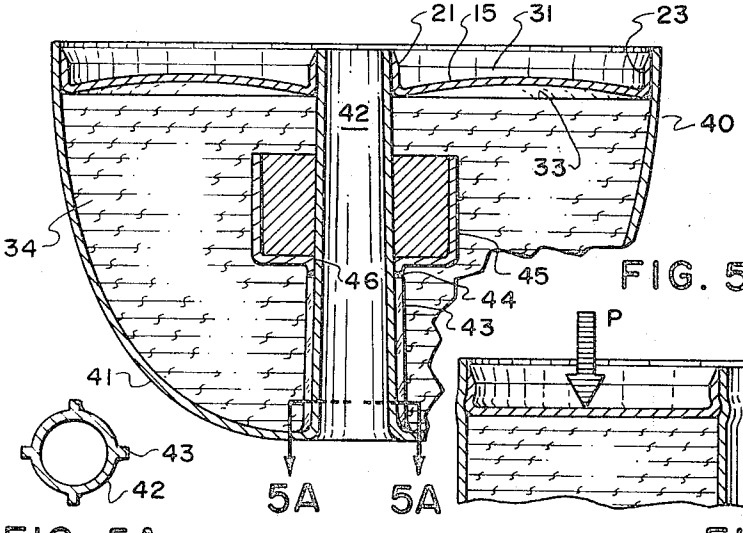


FIG. 5

FIG. 5A

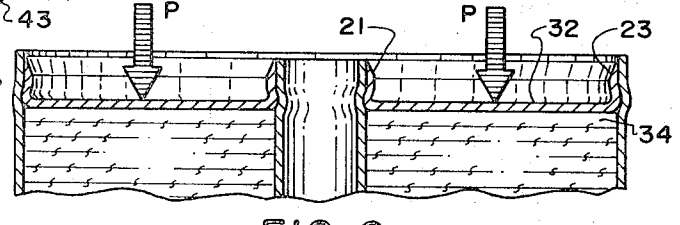


FIG. 6

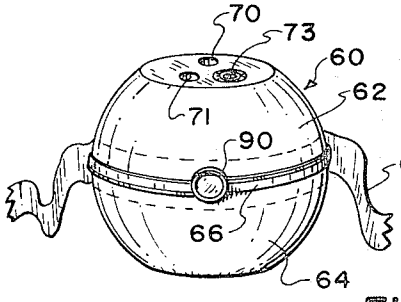


FIG. 9

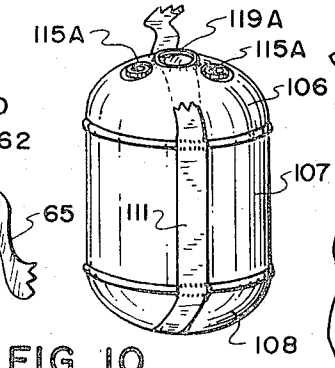


FIG. 10

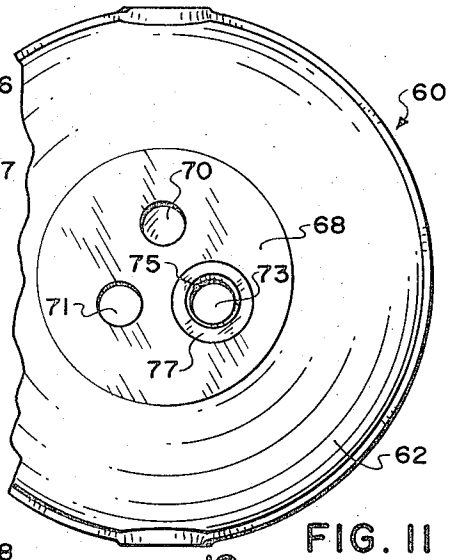


FIG. 11

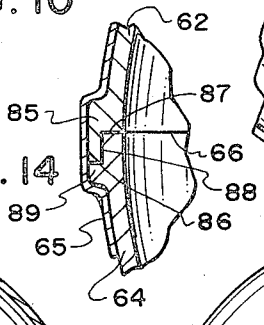


FIG. 14

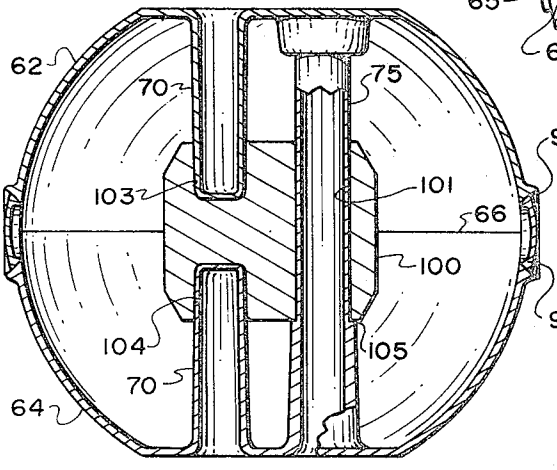


FIG. 12

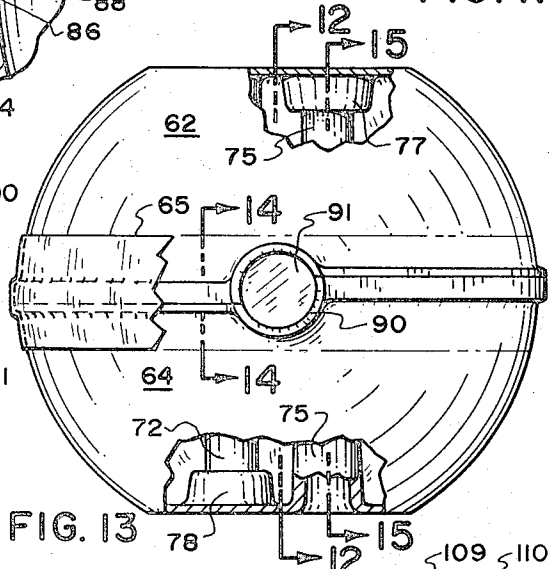


FIG. 13

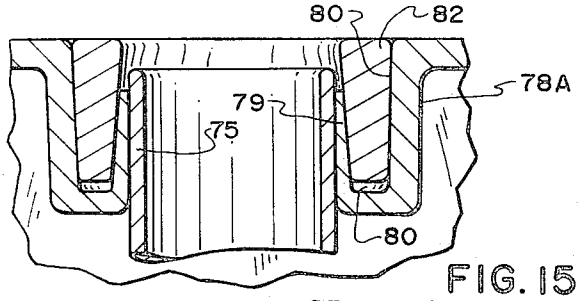
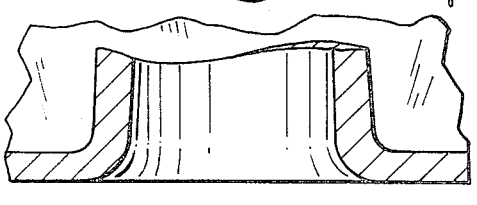


FIG. 15



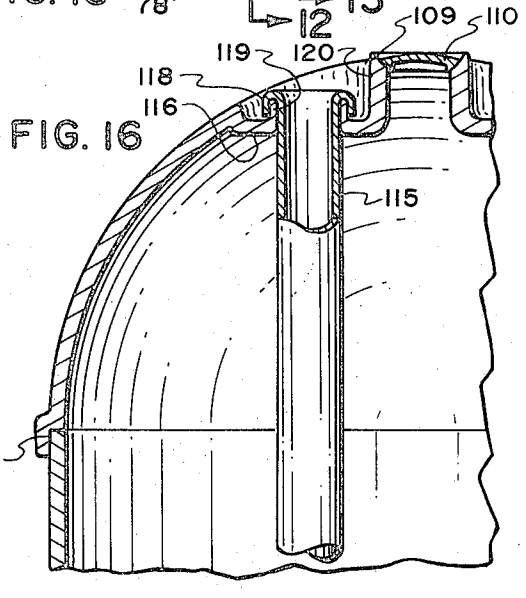


FIG. 16

EXPLOSIVE BOOSTER AND CONTAINER THEREFOR

BACKGROUND AND PRIOR ART

Some types of high explosives, used in large masses in mining, construction, and other operations where hard rock or earth work blasting is required, are sensitive enough that they can be detonated reliably by means of a small primary explosive charges, typically a blasting cap such as a fuseignited metal shell partly filled with mercury fulminate, lead azide, or a cordeau type fuse, or the like. Explosives of such high sensitivity are not favored for many applications. They are often inherently dangerous to ship or to handle. Less sensitive explosives are more difficult to set off, but not only are they safer, they are usually cheaper and often more powerful. TNT (trinitrotoluene) is favored for some types of blasting; it is less sensitive than some of the dynamites but is often difficult to detonate without some type of booster. A major problem is that TNT is more expensive than many other types of explosives. In recent years, blasting agents have appeared which are not only much less expensive than TNT or comparable agents, and safer to handle than the dynamites, particularly those based on nitroglycerine; these not only are cheaper, but they are often more powerful than either.

Among more recent and less expensive blasting agents, are "ANFO" (ammonium nitrate, of fertilizer grade, mixed with a fuel oil), and a variety of aqueous slurries or "gels," based usually on concentrated aqueous solutions of ammonium nitrate, or other inorganic salts which are similarly powerful oxidizers, plus suspended particulate fuel ingredients. These have largely replaced the older types of blasting agents, particularly in large scale blasting operations. In large open pit blasting operations, for example, it is not unusual to place a single charge nearly a foot in diameter and to depths of 50 to 100 feet or more in a single borehole, and to detonate a whole series of such charges and boreholes simultaneously. A major problem with such large charges is to accomplish full, reliable and complete detonation of all the charges at once Failure of even one or two charges in such a series can be disastrous, leaving a dangerous unfired charge in places where later heavy mechanical operations, such as loading with huge power shovels, etc., will be endangered.

To insure that these large charges of such insensitive explosive agents will be detonated, reliably and completely, it has become customary to employ a rather large "booster" for each charge. Boosters of relatively small capacity have been used for many years, even for detonating the more sensitive explosives, such as dynamite. As early as 1880, Nobel obtained a U.S. Pat. No. 231,348, which describes a "primer" or booster for setting off larger blasting charges. This one was made up of a small central filling of sensitive dynamite or fulminate, detonable per se by a fuse, surrounded by a larger mass of granulated powder and formed into a block. U.S. Pat. No. 1,652,461 proposed to clamp lines of detonating cord between grooved blocks of cap sensitive material, such as tetryl or pressed crystals of TNT, more sensitive than cast TNT, to detonate massive blasting agents that were not cap sensitive. Further developments usually were of rather small boosters described in U.S. Pat. Nos. 2,424,374; 2,463,709; 2,558,163; 2,709,707; 2,775,200; 2,785,633; 2,913,982, and 2,944,485.

The advent of aqueous slurries, described by Dr. Cook in U.S. Pat. Nos. 2,930,685; Reissue 25,695; 3,453,158, and others, presented serious problems in achieving full and reliable detonation of large explosive charges. These materials are powerful, economical and efficient blasting agents but they are extremely hard to detonate with complete certainty. They are many times less sensitive than TNT and a failure to detonate a large mass of one of these can be disastrous. To accomplish detonation of these materials without employing very large booster masses of expensive and hazardous high explosives, the problem was solved in some degree by the development, by Cook and his associates, of the "Procore" (protected core) or two-stage booster. Examples are shown in U.S. Pat. Nos. 3,037,452; 3,037,453; 3,359,902, and 3,379,606. In principle, these boosters are a very important advance in the art. They employ a central charge, of small mass and of cap-sensitive explosive agent as a first stage which is surrounded by a charge of cast TNT or the like. The outer or second stage is not cap-sensitive but it can be surely and reliably detonated by the small protected inner core. The latter is reliably detonable by a standard initiator such as an electric blasting cap or a length of detonating core or cordeau cord, such as "Primacord." Detonating cord is widely used, in the form of a small diameter plastic tube or "cord" filled with a very sensitive high propagation-rate primary explosive.

In the two-stage or protected core booster, the first or inner stage is of explosive material which not only is cap sensitive but is also powerful enough, though quite small, to detonate with certainty and completely the surrounding body of non-cap sensitive material. Cast TNT has often been used as the second stage. The amount of TNT must be relatively large, as much as a pound or more in many cases, to make certain that a main charge of a slurry blasting agent will be fully and reliably detonated. Many explosives, which may appear to be set off on explosion of the booster, do not detonate fully and the blasting power of such an incomplete explosion is relatively useless. When TNT was available for use as second stage material in boosters, from surplus U.S. Government munition supplies, for example, it was quite cheap and the cost of making boosters of the protected core type was not unreasonable. In more recent times, however, surplus stock of TNT are not available in quantity. New production TNT is often not available. When it is available, TNT is much more expensive than the surplus material formerly used. A requirement has developed, therefore, for boosters to replace the TNT types. Obviously, it is desirable to retain as far as possible the low cost advantages of those types, along with their good reliability, relative safety for handling and shipping (because the impact safety of cast TNT is high), the more sensitive inner or first-stage component being quite well protected by being located within the less sensitive cast shell.

As shown in U.S. Pat. No. 3,037,452, a typical protected core construction for a booster may involve simply an inner charge of a cap sensitive pentolite or equivalent, completely surrounded by cast TNT, holes or perforations being provided into the inner core to accommodate the detonating cord or similar primer or

initiator. With this construction, there is no wrapper at all; in U.S. Pat. No. 3,037,453, a short length of paper tubing is used as a mold while molten TNT is poured around a core, serving later as an outer circumferential wrapper for the TNT outer casing.

With either of the constructions described above, the outer casing or body of insensitive explosive has no protectionn against water. When this outer body is cast TNT, such protection may not be needed, since cast TNT is not water soluble. However, when TNT has become too expensive or is not readily available, water-sensitive materials may necessarily be used and it becomes necessary to protect the whole booster, and particularly the outer body thereof by a moisture-proof or liquid-tight wrapper or container.

In making boosters of the types described in the patents just mentioned, manual methods largely have been used in the past. These involve manual placing of the small inner core, or manual forming of it, within a receptacle or container and holding it there, above the bottom of the container and out of contact with any side thereof, in order that the hot molten TNT can be poured around it for casting. See particularly, the method described in U.S. Pat. No. 3,037,453. The core, of course, should be as near the center of the booster mass as possible. An object of the present invention is to facilitate and make more convenient the production of boosters especially those of the two-stage or protected core type. The means by which openings have been provided for the necessary placing of cap, cord or equivalent primer next to the core have left much to be desired in the prior art; a further object of the present invention is to improve these. Also, the open ended tubular wrappers, which may be suitable for TNT boosters, are not suitable for enclosing boosters that include water-susceptible materials. With the necessary substitution of water-susceptible second-stage materials for explosives that are water resistant, it is of high importance to use a casing, wrapper, or container that is watertight. The seams, joints or other connections therein also must be watertight. Protection from damp weather may be essential when the booster body is water-susceptible. If the booster is to be used in aqueous slurry, which may be the most important use, it may be submersed in liquid slurry material, or in gel or semi-liquid material, to a considerable depth where substantial hydrostatic pressure tends to force water in. An object of the present invention is to design the container to resist water intrusion, even under pressure, and to keep the contents dry.

Boosters of the type to which the present invention applies usually must have openings or pockets to receive a primer, whether cap or detonating cord, or both. The present invention is intended to facilitate the making and placing of such openings or tubular elements surrounding them, so that the primer will reliably set off the innver core. The invention is not necessarily limited to two-stage or protected core boosters; it may be applied to single stage types in some cases, at least, and it contemplates the use of an additional booster stage or stages where desired. However, the two-stage protected core booster is widely used and presently preferred. Most of the detailed description which follows applies to the latter.

BRIEF DESCRIPTION OF DRAWINGS

FIG. **1** is a perspective view, on a relatively small scale, of one form of booster casing or container, made according to the invention.

FIG. **2** is a similar view of another form.

FIG. **3** is a transverse sectional view through the lid or cover of a booster of the type shown in FIG. **2.**

FIG. **4** is a transverse sectional view through the body of a booster, such as is shown in FIG. **1.**

FIG. **5** is a transverse sectional view taken through the covered or sealed booster of the rounded bottom, similar to that of FIG. **2.**

FIG. **5A** is a small transverse section taken along line **5A—5A**, FIG. **5.**

FIG. **6** is a fragmentary view through the structure in the upper part of FIG. **5**, or FIG. **4**, showing the seal-enhancing effect of pressing a convex annular area of the lid or closure into flat position.

FIG. **7** is an enlarged detail, in section, showing a modification of wall and closure structure to insure locking of the cover in place.

FIG. **8** is a fragmentary view, in section, showing a modification of the bottom part of the side wall to facilitate stacking, nesting or packaging of the boosters.

FIG. **9** is a perspective view, on a small scale, of a modified form of booster casing.

FIG. **10** is a view similar to FIG. **9** of a related modification.

FIG. **11** is a top view, enlarged of the structure of FIG. **9.**

FIG. **12** is a vertical sectional view through the booster of FIG. **11**, taken on line **12—12** of FIGS. **11** and **13.**

FIG. **13** is a side view of the booster of FIGS. **11** and **12**, taken from the right of FIG. **12.**

FIG. **14** is a small cross-sectional and fragmentary view, taken substantially along line **14—14** of FIG. **13.**

FIG. **15** is an enlarged fragmentary and broken sectional view, taken substantially along line **15—15** of FIG. **13.**

FIG. **16** is an enlarged fragmentary sectional view of a modification.

DESCRIPTION OF PREFERRED EMBODIMENT

In form, the invention may be embodied in a container or casing of extrusion molded resin. The casing includes a major container compartment and a separately formed cover or closure, or it may be made up in two equal or substantially equal parts of half-casings which may be jointed together prior to filling. It also may be in the form of a major vessel or compartment, to which is joined another but smaller section, such as a closure or cap. The latter may form part of the final container, being a hemispherical portion, the parts being joined together prior to filling. Preferably, provision is made for locating and holding in position inside the receptacle, at or near its center of mass, a preformed or a castable core of cap sensitive explosive material. The latter will be surrounded as the container is filled (or filling is completed) by a less sensitive or cap-insensitive explosive mass. The latter, of course, must be susceptible to detonation by the detonation of the core, the latter usually being a much smaller mass.

In FIG. **1** there is shown a booster casing **10** of cylindrical or substantially cylindrical shape having a circumferential wall **11**, a more or less flat bottom **13**, and a closure or top **15.** The bottom **13** has a central opening **16** which joins with a vertically extending central

tube 17; the latter preferably may be integral with the bottom 13. In any case, the juncture between bottom 13 and tube 17 is liquid-tight and all wall components are liquid proof. The tube 17 extends through the top of the container and is secured in liquid tight relation to the top, leaving opening 16 all the way through the booster so that a detonating cord may be passed through it. The tube 17 fits securely inside an up-turned flange or collar 21 in the cover 15.

The cover has also an upturned peripheral rim 23 which fits neatly in and forms a liquid tight joint with the upper part of wall 11. The body 11, mentioned as being cylindrical instead may be slightly tapered or frusto-conical so that its bottom may be set within the top rim 23 of the next higher booster when they are packaged or stacked, to conserve space. In this case, of course, the central upturned flange 21 should also fit within the bottom part of tube 17, which may be slightly larger than passageway 16 above.

FIG. 2 shows a modified casing 20 which is much the same, in most respects, as that of FIG. 1, except that the bottom part 24 is of tapered or ogive shape to facilitate lowering of a booster into a borehole, which may have projection roughness that might interfere with free movement into the hole. The cover 15, the peripheral seal flange 23 and the central tube 17 and its holding collar 21 are much the same as in FIG. 1 except that tube 17 is shown longer and side wall 24, 25 is differently shaped and forms the bottom integrally.

FIGS. 3 and 4 show respectively and on larger scale the cover 15 and the main receptacle much as in FIG. 1. Provision is made inside the main receptacle 26 however for positioning or forming central core 30, the bottom wall 28 being formed with an upwardly projecting annular flange 27 which defines an annular cup 29. This cup 29 will be filled with a cap-sensitive explosive 30 centered around the tube 17. In FIG. 3, the central upturned flange or collar 21 and the peripheral rim 23 are both tapered and shaped to fit snugly against the tube 17 and the outer wall 11 respectively to form liquid tight joints. The annular area 31 of the lid 15 between these upturned portions 21 and 23 as shown at 32 is convex upwardly. The main container, when filled with the main body 34 of explosive to a level 33, is closed by inserting the lid between flanges 21 and 23 and pressing it down. Under normal conditions, the arched position 32 remains raised slightly above the upper level 33 of the less sensitive explosive mass 34. However, as shown in FIG. 6, when the booster is placed in a deep column of liquid or gel blasting agent, or even granular agents such as ammonium nitrate-fuel oil mixtures, the pressure from above tends to straighten the lid and exert greater sealing pressure on the joints at 21 and 23.

The provision for a core of more sensitive explosive at 30 makes a twostage booster. If desired, the cup 29 may be filled part way with the same relatively inert explosive as 34, before placing the core 30 in it. This will raise the core more nearly into the center of the main mass 34, making the booster as a whole somewhat more efficient.

FIG. 5 shows a modification essentially like that of FIGS. 3 and 4, except that the bottom portion 41 of the main wall 40 is curved and continuous, as in FIG. 2. Also, the central tube 42 for the detonating core is ribbed at 43 in its lower part, forming external ledges 44 on which a core 45, having a central opening 46 which fits around the upper part of tube 42, may rest. This provides an efficient and simple means for positioning a preformed core 45 which has a suitable centrally located opening 46 in the center of mass of the booster. The lid or cover 15 is similar to FIGS. 3, 4 and 6.

With respect to FIG. 7, the upper margin 48 of a side or circumferential wall 49, which in most respects is like the side wall 11 of FIG. 1 or FIG. 4, is formed with an inwardly projecting lip or ledge 50 under which the upper edge 51 of the cover rim 52 may be locked in place. This construction is a safety measure and gives some protection against unauthorized tampering, making it difficult or impossible to remove the cover and get at the contents without destroying the container. It emphasized that the plastic material of which the parts are all made is adaptable to injection molding so that the parts can be formed with excellent dimensional stability and fit together well, forming clean, tight joints which are liquid proof, even without adhesives. The latter may be used if desired. Normally they are not necessary.

FIG. 8 shows an alternative construction for the bottom of a booster in which the side wall 54 is offset inwardly at 55 to permit nesting within the rim 23 of FIGS. 3, 4, 5, 6 or 7, to permit nesting of one container within the top rim of the container below. This facilitates stacking and packaging and is an alternative to the tapered construction already described.

FIG. 9 shows a modification wherein a container 60 is made of two more or less hemispherically shaped half-casings or containers. Preferably, the container 60 of FIG. 9 is made of two identical half-sheels 62 and 64, as will be described in more detail below, but the two halves may be dissimilar if desired. FIG. 10 shows a modified booster wherein the length or depth is increased by placing between an upper part similar to part 62, FIG. 9, and a lower part which may have no central opening, a cylindrical side wall portion 107. With this arrangement, the capacity of the booster may be considerably increased. This will be referred to further, below. FIG. 11 is an enlarged top view and FIGS. 12 and 13 are sectional and right side views, respectively, of the container of FIG. 9, but shown on a larger scale. An adhesive tape 65 may be used to cover this joint 66 between these parts.

Looking down on the top of the container 60, as in FIG. 11, the more or less hemispherical top half 62 has a flattened area 68 in which three openings are shown. One of these, at 70, is a cup or pocket, adapted to receive a standard blasting cap, e.g., an electric cap. Opening 71 is the upper end of a tube 72 which is formed integrally with the upper half 62, see FIG. 13. Opening 73 is the upper end of a tube 75 (see FIG. 12) which is integral with the lower half or hemisphere. An inturned flange or collar 77 surrounds and receives the tube 75, forming a liquid tight seal therewith; see also FIG. 13. The lower end of tube 72 is similarly received in an inturned collar of flange 78, as shown at the bottom of FIG. 13. Thus, the upper and lower halves 62 and 64 are really identical and are interchangeable. This offers an advantage in assembling the parts since there are no dissimilar pieces to put together. As shown in larger scale, FIG. 15, the inturned flange 78A, similar otherwise to 78, may be formed with an upturned margin or cup 79 to form annular channel 80 in which there may be placed a wedging ring 82. After the inner

tube member **75** is fitted inside such a flange **79**, as shown at the top of FIG. **15**, the wedging ring **82** is forced into the channel **80** to hold the parts more tightly together and insure against entry of water or other liquid into the booster when under hydrostatic pressure. A similar construction will be used, in this case, at the bottom of the other tube. Both tubes **72** and **75** are open at both ends so that a detonating cord will pass through them.

The arrangement just described provides two tubes extending entirely through the booster, each of proper diameter to receive snugly a detonating cord, so that the cord, if desired, can be passed down through one tube and back up through the other. This is useful when it is desired to use the detonating cord as a suspending rope or string to lower the booster into place in a deep borehole, e.g., before the slurry is poured into place. Obviously, a plurality or series of such boosters may be carried on a single line and lowered into place for simultaneous detonation. Detonation, of course, will be initiated only after the main explosive body, slurry or other, has been filled into the borehole around the boosters. For most operations, a single booster in a deep borehole is sufficient, although in some cases more than one may be used.

The circumferential or side seam **66** by which the two half booster cases **62** and **64** of FIGS. **9** to **14** are secured together, is also formed so that each half-casing has an internal rabbet half way around and an external rabbet the other half way. See FIGS. **13** and **14**, particularly. The latter Figure shows a cross-section, enlarged, of the seam or joint, taken at line **14—14** of FIG. **13**. This seam or joint consists of an internally rabbetted edge portion **85**, rebated at **86** to provide an internal ledge **87** or half booster **62** matched with an external rabbet **88** formed in the edge **89** of the other half booster **64**. The joint just described extends only half way around the circumference of the booster, each end terminating at a flanged opening **90**, FIG. **13**, adapted to receive a closure plug **91**. The other half circumference, at the right of FIG. **13**, is reversed as compared with the half-seam shown in FIG. **14**, the external rabbet being in the half-casing above the joint and the internal rabbet in the half below. This construction is required in order that the upper and lower half shells **62** and **64** may be identical in every respect, as previously mentioned.

FIG. **12** also shows an internal core or cap-sensitive element **100** assembled in the casing so as to be located substantially in the center of mass of the booster. This core **100** is precast, or otherwise preformed, with two openings **101** extending all the way through, to accommodate the tubes **72** and **75** (only the latter is seen in FIG. **12**) which are identical in diameter, tube **72** extending down from the top half-shell **62** and the other tube **75** extending upwardly from the lower half-shell **64**. The core **100** has also an upper cup or opening **103** to receive the cap-cup **70** which hangs down from the upper half-hsell or casing **62** and a lower cup or opening **104** projecting upwardly to receive the similar cup **70** which projects upwardly from the bottom half shell or half-casing **64**. A shoulder or rib **105** may be formed on tubes **72** and **75** to further support core **100**.

After the upper and lower half-casings **62** and **64** are assembled, with the core **100** in place on the tubes **72**, **75** and on cups **70** as just described, the booster is ready to be filled with its main non-cap sensitive charge. This charge is poured in or extruded in through one of the openings **90**. The opposite opening may be left unplugged to permit air to escape, if desired, or it may be closed if air can escape around the filler device, depending upon the type of the latter. A filling nozzle which is highly satisfactory for the purpose is shown in U.S. Pat. No. 3,078,068, issued to the present inventor. It has a self-closing valve and may have either (or both) a convex or male type nozzle or a concave or female type nozzle extremity, the former being particularly suited for the present application. See FIG. **3** of said patent. For use with such a nozzle, the filler openings **90**, are made of hollow spherically surfaced seat section. These are shown in FIG. **12**; a further example is shown in FIG. **16**, which shows a modification. The filler opening seat **109** at the top, FIG. **16**, is shown of spherical cross section, being closed with a plug **110** of complementary shape. The openings **90** of FIGS. **9** and **13** may be of similar shape. However, if desired, other types of filling devices may be used, as will be obvious.

Referring further to FIG. **10** and to FIG. **16**, it was mentioned above that, if desired, the top portion, see **106**, of the booster casing of FIG. **10** may be of the same type as the top half **62** of FIGS. **9**, **11**, **12** and **13**. However, for some purposes, it may be desirable to make this part somewhat different and to make the tubes **72** or **75** of FIGS. **12** and **13**, or **115A**, FIG. **10**, of a different material than the main body of the casing. For one reason, the moldable plastic material of which the booster casing is made is more compressible than metal and is not ideal for transmitting the sharp shock of detonation from the initiator (cap or detonating cord) through to the booster explosive. In FIG. **12**, for example, the plastic wall (of polyethylene, polypropylene, or polyvinyl chloride or other vinyl polymer, etc.) may act somewhat to cushion or soften the shock and this may result in failure to detonate. A thin metal tube is a better transmitter for the shock. Hence, in FIG. **16**, a thin walled metal tube **115** may be inserted to extend through the top and bottom walls **116** and **117**, respectively, of the booster casing and to receive detonating cord (not shown). Similarly, in FIG. **10**, a filler opening may be made in the top, as indicated at **119A**, while two tubes **115A** are placed in the container and extend from top to bottom, being open at both ends, to receive the detonating cord which will be used to detonate the booster. In FIG. **10**, tubes **115A** extend through bottom part **108**.

The metal tubes **115** or **115A** may be made of brass, aluminum, or other suitable metal, preferably rust-resistant. Aluminum tubing of light gauge is very satisfactory. As shown in FIG. **16**, they may be secured in place by spoinning or curling down each end, as **118**, of the tube to overlie and grip an out-turned or up-turned flange **119** surrounding the tube opening **120**. A similar construction is used at the bottom, not shown. In this way, the metal tubes **115**, of FIG. **16**, or **115A**, of FIG. **10**, will serve as tension elements to hold the upper and lower parts of the booster casing in assembled relation, these being joined in a suitable joint such as the rabbetted joint **125** of FIG. **16**, or the joint **85**, **89**, of FIGS. **13** and **14**, as previously described. In this case, then, the tubes would serve as tension members to hold the upper and lower parts, **62** and **64** of FIG. **13**, for example, more securely together. However, the parts in the Figures just described also can be held

quite securely by making them fit together with precision, which is possible by good modern injection molding practices.

In the case of the embodiment of FIG. **10**, the upper and lower end parts **106** and **108** of the casing may be alike or dissimilar, depending on whether it is desirable to have a plugged opening at one end or at both. Cylindrical wall part **107** is held between top and bottom members **106** and **108**. For convenience of manufacture, it may be desirable to have the top and bottom ends of identical structure, for the same reasons that the two halves **62** and **64**, FIGS. **9**, **12** and **13**, are made in this way. A length of tape **111**, FIG. **10**, helps hold sections **106**, **107** and **108** together.

While the casings or containers of FIGS. **9** to **16**, and the bottom parts of those of FIGS. **2** and **5**, have been illustrated as being of rounded or generally hemispherical shape, it will be understood that they may be made flat, rounded, cylindrical, frusto-conical, or of any other reasonable shape desired, without departing from the spirit of the invention or losing its advantages. For efficiency, obviously, the booster casing should hold a good volume of explosive for its overall size, to conserve packaging material and to minimize shipping space requirements. Preferably, the boosters are made so as to locate and hold a sensitive inner core at or near the center of mass, while also providing access to this core of initiator such as an electric blasting cap or detonating cord through a cup or tube which is either very thin-walled or is otherwise so formed as to facilitate transmission of the detonating shock to the core from the initiator. A larger shock thus is transmitted from the core to the main body of less sensitive explosive and on with further boosting through the booster container wall, into the main charge to be set off. Since the initiator shock is so much smaller, a critical point in transmission may be through the wall or tube which surrounds the cap or cord primary initiator. Transmission of the major booster shock through the outer booster wall is not ordinarily a problem. While use of a core is preferred, the invention in its broader aspects does not require such use.

In general, it is intended that the booster components, which are made separately, for convenience of injection molding, shall fit well enough and tightly enough that the casing will be liquid tight and preferably without use of adhesive. However, it is not intended to exclude the use of adhesive as an additional insurance against leakage but this ordinarily will not be required. As indicated in connection with FIG. **7**, interlocking seam or joint elements may be provided for giving further protection against separation of the booster container parts in handling and shipping. These or equivalent means may be provided or formed on other matching or interlocking parts, such as the seam or joint **66** of FIG. **14**, the connection of the tubes and flanges of FIGS. **13** and **15**, the securing in place of a closure plug as in FIG. **16**, and at any other place where such interlocking is desirable or appropriate.

The advantages of the invention may be realized in other forms and it is intended by the claims which follow, to cover all such modifications as would be obvious, or as would occur to those skilled in the art, as they contemplate this disclosure, as broadly as the state of the prior art properly permits.

What is claimed is:

1. A casing or shell for an explosive booster comprising, in combination, a precision molded resinous peripheral outer wall, a molded resinous bottom wall secured to said peripheral wall, a molded resinous top wall also secured to the peripheral wall by a friction joint fitted with such accuracy as to exclude liquid passage through the joint, at least one continuous tubular element formed to provide a conduit passing through both said top wall and said bottom wall, said tubular element also being connected with said top and bottom walls to assist in holding them in assembled relationship, said tubular element being sized to receive in its conduit a standard primary detonator or initiator, a core-positioning means associated with said tubular element for locating and holding a core of cap-sensitive explosive material in the general center of mass of the casing and in position spaced from both the top and bottom walls thereof so as to be surrounded by filling material when the casing is filled for use as a booster, and a liquid-tight joint between the respective ends of the tubular element and the top and bottom walls of the casing.

2. A booster casing according to claim **1** in which the bottom wall of said casing is molded integrally with the side wall and in which the top or cover wall is formed separately and is secured to the side wall by a circumferential friction joint.

3. A booster casing according to claim **1** in which the core-locating element is an annular structure integral with the bottom wall of the casing and projecting upwardly therefrom.

4. A booster casing according to claim **1** in which the core-locating element is an integral projecting part of a said conduit.

5. A booster casing according to claim **1** in which the casing is formed in two similar and peripherally matching half-casings, with means for interlocking the half-casings together around their matching pripheries and which includes other tension means for locking said two half-casings together and comprising at least one of said conduits.

6. A booster casing according to claim **1** in which a top or cover member comprising said top wall is connected peripherally in a friction fitted liquid-tight joint to a lower member and in which at least one conduit for the initiator or detonator cord is comprised of metal and extends from the said top wall through the bottom wall, and means on said conduit for locking the bottom wall with respect to the top wall and comprising a liquid-tight joint between said conduit member and said wall.

7. A booster casing according to claim **1** in which two identical upper and lower half-casing members are secured together in a circumferential seam or joint of rebate cross-section, one half of said joint being internal and the other peripheral half being external with respect to one of said members, and in which one conduit for said initiator or detonator is integral with each half-casing and has its free end frictionally engaged with said other half-casing to form a liquid-tight connection and to assist in holding the two half-casings together.

8. A booster casing according to claim **7** which includes elements projecting from each of the half-casings toward the other for locating and holding in place a booster core, a cap-sensitive core held by said projecting elements, and a filler of explosive booster material surrounding said core which filler is detonable by said core but is not reliably detonable by a standard cap or detonating cord.

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