United States Patent [19]

Griffith

[11] **3,747,527**

[45] **July 24, 1973**

[54] **PROCESS AND PRODUCT**

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

[22] Filed: **July 7, 1971**

[21] Appl. No.: **160,435**

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

[51] **Int. Cl.** **F42b 1/04**

[58] **Field of Search** 102/24, 27

[56] **References Cited**

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Attorney—John W. Behringer, James N. Dresser et al.

[57] **ABSTRACT**

A booster for initiating relatively insensitive explosive compositions, and a process for manufacturing such boosters. In accordance with the process, a base is provided with at least one upstanding rod in the location at which an opening is desired in the booster for a fuse. A layer of relatively sensitive explosive material is placed around this rod, and an outer form having the cross-section desired of the finished booster is placed around the rod and explosive layer. A somewhat insensitive explosive material of high brisance is placed within the outer form and surrounding the relatively sensitive explosive material and allowed to harden to form the finished booster which thus comprises an outer layer of the somewhat insensitive explosive material and an inner layer of the more sensitive explosive material surrounding the fuse opening. A second rod can be provided to cause a second opening into the booster also contacting relatively sensitive explosive material. This second opening, for example, might accommodate a detonating cap. The layer of relatively sensitive explosive material can be provided in two or more lengths, if desired.

9 Claims, 13 Drawing Figures

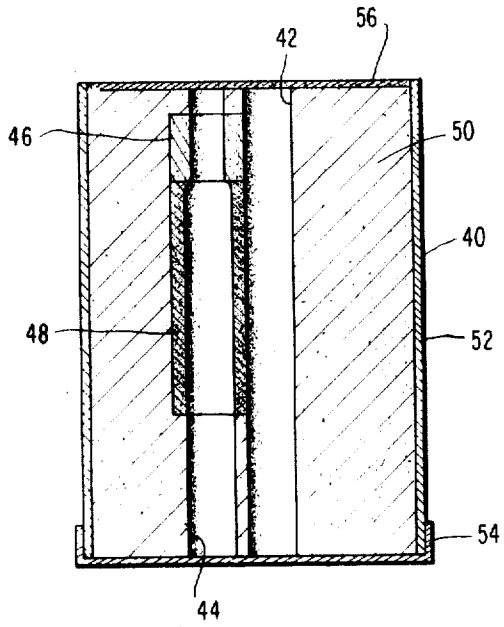


FIG. 1

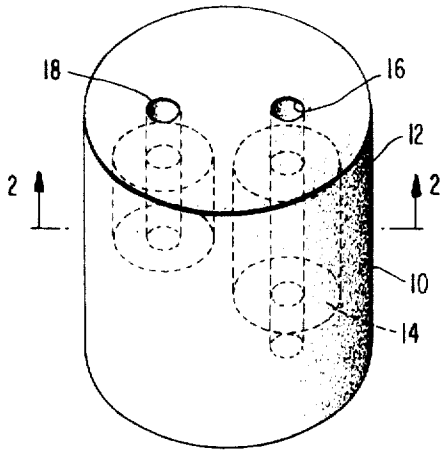


FIG. 2

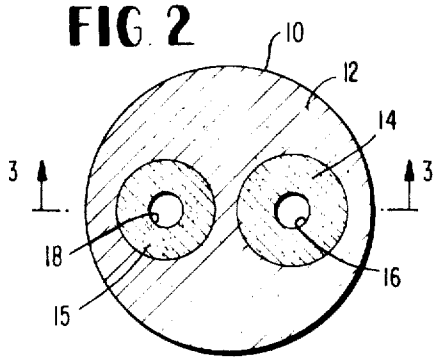


FIG. 4

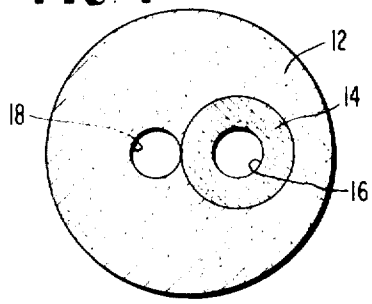


FIG. 3

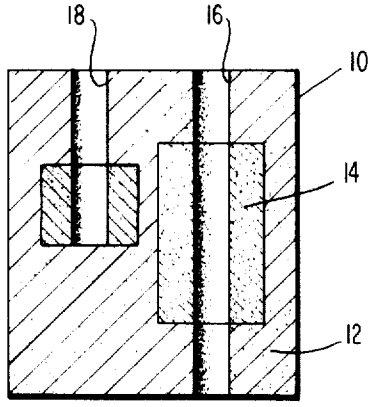


FIG. 5

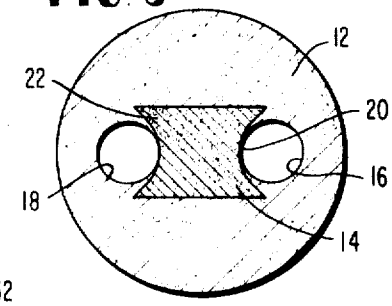


FIG. 9

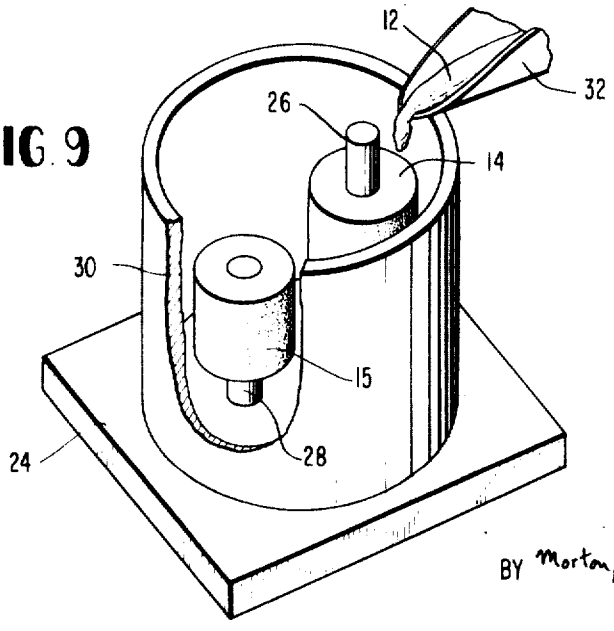
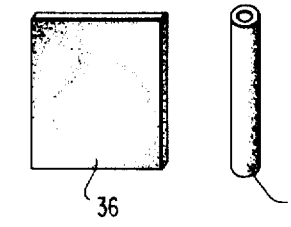


FIG. 10

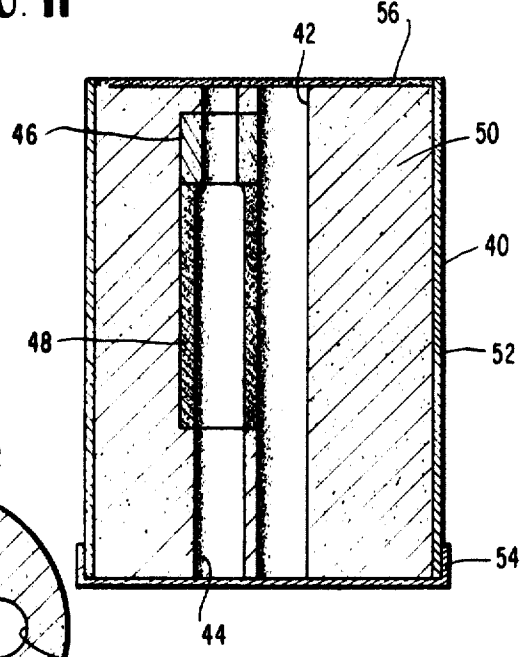


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FIG. 11



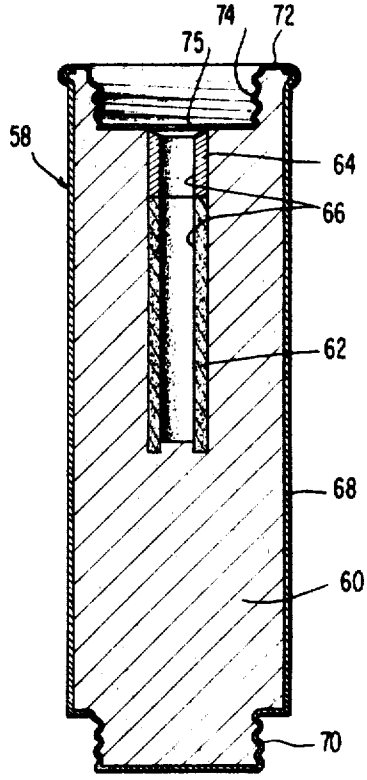


FIG. 13

FIG. 6

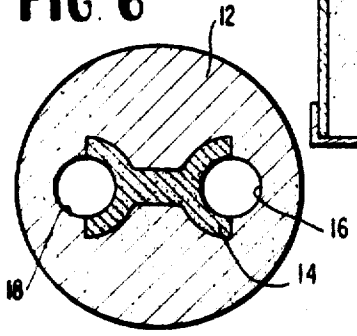


FIG. 7

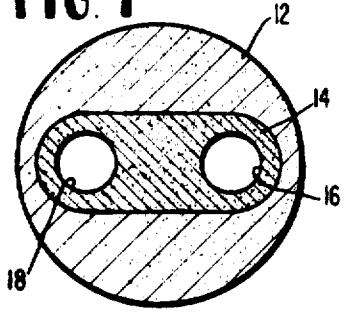
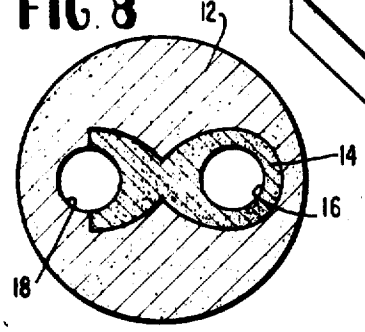


FIG. 8



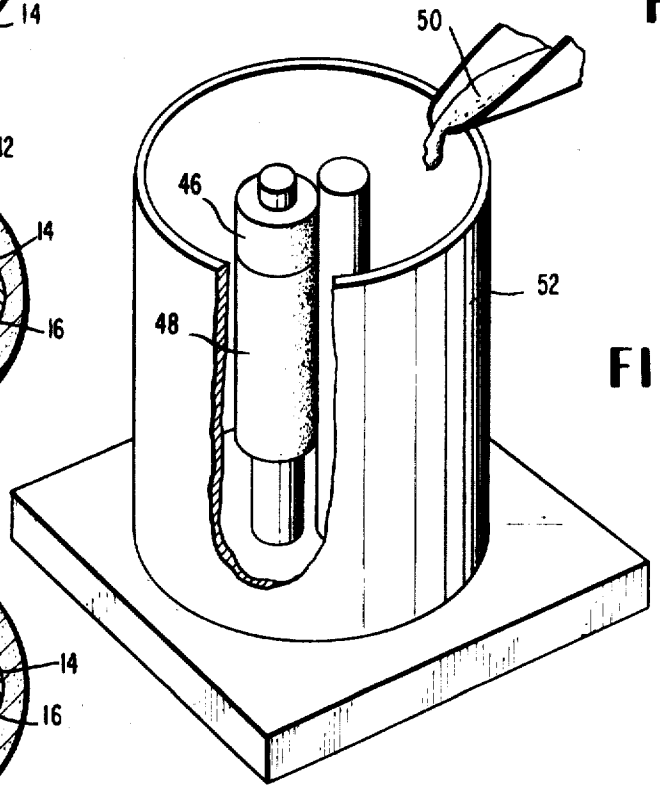


FIG. 12

PROCESS AND PRODUCT

The present invention pertains to a detonator for explosives. More particularly, the present invention pertains to a detonating booster for initiating relatively insensitive explosive compositions and to a process for manufacturing such boosters.

Insensitive explosives, such as those containing a high percentate of ammonium nitrate and nonexplosive organic sensitizers, are not generally detonatable by such conventional means as blasting caps and fuses. These insensitive explosives have been detonated in the past by the use of a primer such as dynamite or TNT which, in turn, is detonated by a blasting cap or a fuse of such material as pentaerythritol tetranitrate (PETN), commercially available as an elongated cord type fuse under the tradename Primacord. Not only are such primers expensive, but also dynamite, fine grained TNT and blasting caps are very sensitive to heat and shock, thus presenting a potential safety hazard. Use of a Primacord fuse is highly desirable because of the ease and safety with which it can be utilized. The most desirable boosters are thus materials which are reliably detonated by Primacord.

There have recently been developed boosters including an inner layer of Primacord sensitive material completely or partially surrounded by an outer layer of Primacord insensitive material of high brisance. These boosters initiate high ammonium nitrate explosives in a generally satisfactory manner; however, heretofore they have presented certain shortcomings, in particular difficulty of manufacture. Manufacture of one type of such booster requires two casting processes — a first to form the inner Primacord sensitive core, and a second to form the outer Primacord insensitive sheath. A second type of such booster has the inner Primacord sensitive material disposed in a multi-layer figure eight configuration. Placement of this within the sheath mold is a laborious and time-consuming task.

The present invention is a booster for initiating relatively insensitive explosive compositions and comprising an outer layer of somewhat insensitive explosive material of high brisance and one or more inner layers of a more sensitive explosive material adjacent one or more openings adapted for receipt of a fuse or a blasting cap. Relatively insensitive explosive materials of high brisance suitable as the outer layer include TNT, pentolite, cyclonite (RDX), and composition B (RDX, TNT, and wax), and mixtures thereof. More sensitive explosive materials suitable for the inner layers include pentaerythritol tetranitrate (PETN) and finely-divided pentolite (PETN and TNT). In another aspect, the present invention pertains to a method of manufacturing such boosters. In accordance with this method, a layer of the more sensitive explosive material is placed in contact with one or more rods within a molding form, and the molding form is then filled with the somewhat insensitive booster material which is subsequently allowed to compact or harden. In one embodiment, the more sensitive explosive material is provided in a sheet material wrapped around the rods. In another embodiment, the more sensitive explosive material is provided as an extrusion which contacts only a portion of the surface of the rods and which is primarily surrounded by the less sensitive booster material. In a preferred embodiment, the more sensitive explosive material is provided as one or more hollow cylinders, and the rods are passed through the central openings thereof.

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 illustration of one embodiment of a booster in accordance with the present invention;

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

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

FIG. 4 is a view similar to FIG. 2 and depicting a modified embodiment of a booster in accordance with the present invention;

FIGS. 5 through 8 are views similar to FIG. 2 and depicting other modified embodiments of boosters in accordance with the present invention;

FIG. 9 is a view, partially broken, illustrating a preferred process for manufacturing a booster in accordance with the present invention;

FIG. 10 illustrates an alternative step in a process for manufacturing a booster in accordance with the present invention;

FIG. 11 is a vertical sectional view depicting a further embodiment of a booster in accordance with the present invention;

FIG. 12 is a view, partially broken, illustrating a process for manufacturing the booster of FIG. 11 in accordance with the present invention; and

FIG. 13 is a vertical sectional view depicting yet another embodiment of a booster in accordance with the present invention.

As depicted in FIGS. 1, 2, and 3, booster 10 includes an outer material 12 of a somewhat insensitive explosive of high brisance and surrounding a first inner material core 14 and a second inner material core 15, each of an explosive more sensitive than is material 12. Booster 10 is formed with a first longitudinal perforation or opening 16 passing completely through the booster, through both outer material 12 and inner material 14, to receive a fuse of, for example, Primacord, and a second longitudinal opening 18 passing from one outer surface of the booster a substantial distance into the booster, for example, two-thirds the length of the booster, to receive a blasting cap. In the embodiment depicted in FIGS. 1–3, inner material 14 is thus in the shape of an elongated cylinder having an axial opening therethrough to define opening 16 over a portion of the length of opening 16.

The inner more sensitive material 14 is thus adjacent opening 16 so that a fuse within opening 16 will contact the more sensitive material 14. Likewise, the inner more sensitive material 15 is adjacent opening 18 to permit intimate contact with a blasting cap. As depicted in FIG. 4 material 14 can be adjacent the edge of opening 18 if desired so that a blasting cap in opening 18 likewise contacts material 14, thereby eliminating inner material layer 15. Booster 10, by way of example, might have a diameter in the order of about 2-¼ inches and a length in the range of from about 2-½ inches to about 6 inches and preferably a length in the order of about 4-½ inches. These dimensions, of course, vary, depending upon the particular application

for which the booster is intended. The inner material **14** has a length of at least ½ inch aand preferably 2-½ inches and a diameter in the order of, for example, ½ inch. Inner material **14** can extend the entire length of booster **10**, if desired. Inner material **15** has a length in the order of 1 inch and a diameter in the order of ½ inch.

FIGS. **5**, **6**, **7**, and **8** depict modified embodiments of boosters in accordance with the present invention having elongated cores of inner material **14** of various shapes. In the embodiment of FIG. **5**, the inner material **14** is provided with a first curved edge **20** defining a portion of the circumferential surface of opening **16** and thus adjacent opening **16** and a second curved edge **22** defining a portion of the circumferential surface of opening **18** and thus adjacent opening **18**. This shape of material **14** can be readily formed as an extrusion. The embodiment of FIG. **6**, has the inner material **14** defining approximately one-half of the circumferential surface of opening **16** and approximately one-half of the circumferential surface of opening **18**. In the embodiment of FIG. **7**, inner material **14** completely encircles openings **16** and **18**, defining the entire circumferential surface thereof over the length of inner material **14**. The embodiment depicted in FIG. **8** has the entire circumferential surface of opening **16** and approximately one-half the circumferential surface of opening **18** defined by inner material **14**. While FIGS. **2–8** depict several embodiments of the present invention, numerous others could be made within the scope of the invention.

FIG. **9** depicts a preferred process of manufacturing the embodiment of booster **10** which is depicted in FIGS. **1**, **2**, and **3**. Base **24** is provided with a pair of upwardly extending rods **26** and **28** in the locations at which openings **16** and **18** are to be provided. Preferably, rods **26** and **28** have a slight taper over their lengths. A layer of more sensitive explosive material **14** is affixed about rod **26**, and a layer of more sensitive material **15** is affixed about rod **28** in the desired location. These layers **14** and **15** can be affixed to rods **26** and **28** in any of several manners. In a preferred process, hollow cylinders of the more sensitive explosive material are positioned over rods **26** and **28**. Preferably, these hollow cylinders have inner diameters such that the cylinders **14** and **15** position themselves on tapered rods **26** and **28** at the desired locations, keeping in mind that the finished booster is inverted during the manufacturing process of FIG. **9**, relative to the finished booster depicted in FIGS. **1–3**. Alternatively, if material **14** is to extend the length of booster **10**, then the cylinder of material **14** can rest upon base **24**. FIG. **10** illustrates an alternative step in the manufacturing process in which a section of more sensitive explosive material **34** is cut from a flexible sheet of such material, wrapped about a hollow cylindrical sleeve **36** of, for example, paper, and affixed thereto by an adhesive. The resulting compacted cylindrical layer of the more sensitive explosive material is then placed on rod **26** or on rod **28**, as desired. Alternatively, sleeve **36** can be placed on rod **26** or on rod **28** before the section of more sensitive explosive material **34** is wrapped about and affixed to the sleeve.

After material **14** aand material **15** are affixed on rods **26** and **28**, a mold form **30** of metal or cardboard aand having a cross-section of that desired for the finished booster is positioned around rods **26** and **28** and material **14** and **15**, as depicted in FIG. **6**, and non-compacted, e.g. molten, explosive material **12** is poured into the mold form from a spout **32**. After the material **12** has compacted or hardened, booster **10** is removed from base **24**. If form **30** is cardboard or paper, then it need not be removed from the finished booster.

In a preferred implementation of the manufacturing process depicted in FIG. **9**, pin **26** has a length in the order of 4-¾ inches and tapers from a diameter in the order of 0.295 inches near the top of the pin to a diameter in the order of 0.312 inches at the base of the pin; pin **28** has a length in the order of three inches, a diameter at its top in the order of 0.305 inches and a diameter at its base in the order of 0.312 inches. The material **14** is applied in the form of a hollow cylindrical sleeve or tube of PETN placed over rod **26** and having a length in the order of 2-¼ inches, an inside diameter in the order of 0.308 inches, and an outside diameter in the order of 0.480 inches. The material **15** is applied in the form of a hollow cylindrical sleeve or tube of PETN placed over rod **28** and having a length in the order of one inch, an inside diameter in the order of 0.307 inches, and an outside diameter in the order of 0.480 inches. A relatively sensitive explosive made up of PETN and an elastomeric binder and suitable for use as material **14** and as material **15** is commercially available in both sheet form and hollow cylindrical sleeve form from E. I. duPont de Nemours & Co., under the trademark Detasheet, and can likewise be obtained in extruded shapes from that source.

FIG. **11** depicts an alternate embodiment of explosive booster **40** in accordance with the present invention. Longitudinal openings **42** and **44** pass completely through the booster. Opening **44** is surrounded over a first short portion of its length by a first core **46** and over a second short portion of its length, preferably contiguous with the first short portion, by a second core **48**. Cores **46** and **48** and longitudinal openings **42** and **44** are surrounded by an outer layer **50** of a somewhat insensitive explosive of high brisance. Cores **46** and **48** are of an explosive more sensitive than outer layer **50**. Opening **42**, which contacts cores **46** and **48**, is adapted to receive a fuse of, for example, Primacord. The interior of core **48** forms a capwell for blasting caps, while the smaller diameter interior of core **46** provides close contact with small diameter, low core-load detonating cords, should that be desired.

The booster **40** can be enclosed by a canister **52** with a bottom lid **54** and a top wax seal **56**, if desired. By way of illustration, a satisfactory explosive booster in accordance with this embodiment of tthe present invention can be made with outer material **50** being, for example composition B, and having a length in the order of 3-½ inches and a diameter in the order of 2-½ inches, with first core **46** being a piece of duPont Detaflex No. 72P-050 having a length in the order of 178 **inch, an outside diameter in the order of ½ inch, and an inside diameter in the order of** 7/32nds inch, and with second core **48** being a piece of duPont Detaflex No. 72P-175 having a length in the order of 1-¾ inches, an outside diameter in the order of ½ inch and an inside diameter in the order of 5/16ths inch. The booster of FIG. **11** can readily be manufactured by the process described above as depicted in FIG. **12**.

FIG. **13** depicts an explosive booster in accordance with the present invention and suitable for use as a

primer or booster in a train of seismic explosive cans, for example, within a bore hole during land seismic work as described in U.S. Pat. No. 3,097,601, issued July 16, 1963 to George L. Griffith and George A. Lyte. Booster **58** includes an outer material sheath **60** of a somewhat insensitive explosive material of high brisance and surrounding an inner material core **62** of an explosive more sensitive than is material **60.** Spacer **64** can be provided above core **62** if desired. Capwell **66** extends through spacer **64** and into core **62** and is adpated to receive an explosive device such as a blasting cap to initiate booster **58.** Booster **58** is enclosed by casing **68** which includes a threaded lower extension **70.** The upper surface of booster **58** is closed by lid **72** which includes threaded recess **74** and a capwell opening **75.** Threaded extension **70** and threaded recess **74** permit booster **58** to be included in a train of seismic explosive cans, as set out in U.S. Pat. No. 3,897,601. Booster **58** might have a diameter in the order of 2 inches and a length in the order of 6 inches, with core **62** having an outside diameter in the order of ½ inch, an internal diameter in the order of 5/16ths inch, and a length in the order of 2-¼ inches and being formed of duPont Detaflex No. 72P-225.

Although the present invention has been described with reference to preferred embodiments, numerous modifications and alterations could be made and still the result would come within the scope of this invention.

What is claimed is:

1. An explosive booster for initiating relatively insensitive explosives comprising

a cylindrical sheath of somewhat insensitive explosive material of high brisance having a perforation extending longitudinally thereinto and adapted to receive an explosive device; and

a cylindrical core of more sensitive explosive material encircled by the sheath and encircling the perforation over at least a portion of the length thereof, said cylindrical core having a longitudinal axis substantially parallel with the longitudinal axis of the sheath, said cylindrical core including a first core portion of a first internal diameter and a second core portion of a second internal diameter.

2. An explosive booster as claimed in claim **1** in which the cylindrical core is pentaerythritol tetranitrate.

3. An explosive booster as claimed in claim **2** in which the cylindrical sheath is TNT.

4. An explosive booster as claimed in claim **2** in which the cylindrical sheath is pentolite.

5. An explosive booster as claimed in claim **2** in which the cylindrical sheath is composition B.

6. An explosive booster as claimed in claim **1** in which the cylindrical sheath has a second perforation extending longitudinally thereinto.

7. An explosive booster as claimed in claim **1** in which the cylindrical core includes a second surface defining at least a portion of the circumference of the second perforation over at least a portion of the length thereof.

8. An explosive booster as claimed in claim **1** in which the first core portion has a length in the order of ½ inch, an outside diameter in the order of ½ inch, and an inside diameter in the order of 7/32nds inch, the second core portion has a length in the order of 1-¾ inches, an outside diameter in the order of ½ inch and an inside diameter in the order of 5/16ths inch, and the cylindrical sheath has a length in the order of 3-½ inches and a diameter in the order of 2-½ inches.

9. An explosive booster as claimed in claim **1** in which the cylindrical sheath is enclosed within a casing having a threaded lower portion and an upper cap with a threaded internal recess.

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