March 5, 1968 M. A. COOK ET AL 3,371,606

EXPLOSIVE BOOSTER FOR RELATIVELY INSENSITIVE EXPLOSIVES

Filed July 18, 1966

Fig. 1

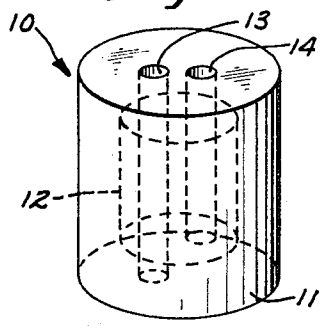


Fig. 2

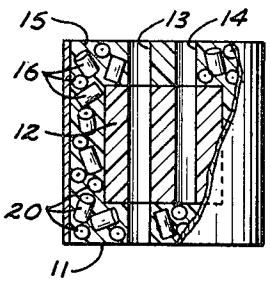


Fig. 3

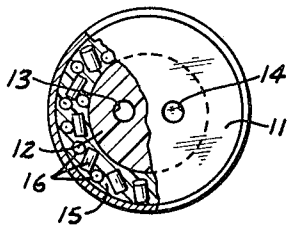


Fig. 5

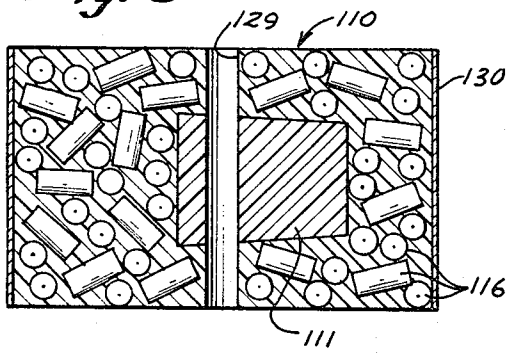


Fig. 6

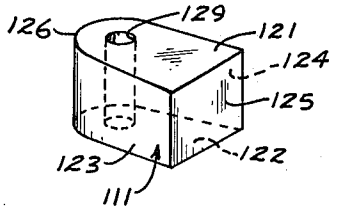


Fig. 4

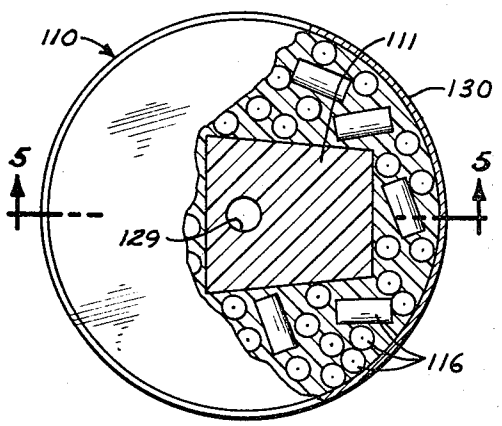
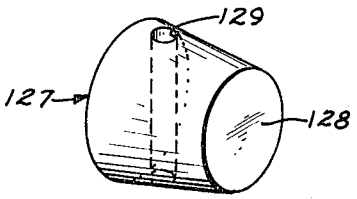


Fig. 7



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EXPLOSIVE BOOSTER FOR RELATIVELY INSENSITIVE EXPLOSIVES

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ABSTRACT OF THE DISCLOSURE

A powerful booster for use with highly insensitive explosives is made up by placing a small, consistently cap-sensitive core, of pentolite, pentaerythritol tetranitrate or equivalent, in the center of a suitable mold, packing grains of smokeless powder around the core, and pouring molten TNT or equivalent to cover the grains and thus to form a powerful cast composite sheath of cap-insensitive explosive having high brisance around the core. The grains expedite cooling and make a denser, cavity-free product. The sheath and core are provided with one or two openings so that a cap or detonating fuse may be inserted into the core. The mold may be cylindrical, frusto-conical, etc., for convenient production.

This invention relates to an improvement in an explosive booster for relatively insensitive explosives and more particularly relates to an improved explosive mixture wherein the presence of an additional component greatly reduces the cavity created by contraction during cooling of a cast explosive.

A co-pending application of Cook and Farnam, originally Ser. No. 766,698, filed Oct. 13, 1958, and later abandoned in view of a continuation-in-part of application Ser. No. 363,290, filed Apr. 28, 1964, now Patent No. 3,341,382, described the concept of using a cast or pressed explosive of high brisance and detonation pressure of 130 kilobars or greater, to initiate detonation in blasting agents or explosives of low sensitivity.

Insensitive explosives, such as those containing a high percentage of ammonium nitrate and containing explosive or non-explosive organic and inorganic sensitizers, have found wide application as blasting agents. Prilled ammonium nitrate, containing 94% ammonuim nitrate and 6% fuel oil, aqueous slurries of coarse TNT-ammonium nitrate, and aqueous slurries of a heat producing metal-ammonium nitrate, especially aluminum sensitized, are examples of such insensitive explosives. Such explosive compositions, generally, are not detonable by blasting caps; prior art methods for detonating them have included, for example, the use of heavy boosters such as those comprised of relatively large quantities of fine grain TNT primers, which are initiated or detonated by means of blasting caps or Primacord. Blasting methods, using such booster materials, have the disadvantage that these boosters are expensive. Furthermore, the dynamites, fine grained TNT and blasting caps which are used in such prior art methods are undesirably sensitive to heat and shock and are therefore hazardous.

In modern large diameter blasting operations, using high ammonium nitrate explosives, such as "prills and oil" or sensitized aqueous slurries or gels, Primacord fuse is normally the most desirable initiator. The high ammonium nitrate explosives, such as those mentioned above, are not dependably detonable by standard blasting caps or by the standard detonating fuses which contain a core of pentaerythritol tetranitrate, such as those commonly sold under the trade name Primacord, however, and they require a booster. For purposes of this invention, the terms "cap-sensitive" and "Primacord sensitive" are to be considered synonymous and they are to be understood as referring to compositions or materials which are sensitive enough to be reliably and consistently detonated by such caps or fuses. In some cases partial detonation may be obtained using only Primacord. Initiators usually preferred are those conventional Primacords which are widely available and which have a minimum content of PETN, having e.g., about 50 grains of PETN per foot. Of the prior art boosters that are operable, those that contain relatively large quantities of explosive boostering compositions are required for consistent results, to satisfactorily and completely detonate the ammonium nitrate explosive.

Boosters of the type described in U.S. Patents Nos. 3,037,452 and 3,037,453 to Cook et al., if made of cast TNT or Composition B, or a mixture, are satisfactory in most instances. However, they are sometimes defective and unreliable due to the formation of a cavity within the cast explosive. Such a cavity is commonly formed by contraction of the cast booster material which can occur upon cooling as the cast material is setting.

It is a principal object of the present invention to provide a booster for the highly insensitive types of explosives which is consistently detonable by an initiating Primacord of minimum standard PETN content. A more specific object is to make the boosters more reliable than prior art boosters of the same general type by preventing the formation of cavities such as are due to contraction of the high brisance cast material during manufacture of the booster.

A further object of the invention is to provide an improved booster which is relatively inexpensive to make and which utilizes a minimum of relatively expensive Primacord-sensitive materials.

Another object of the present invention is to provide an improved booster element which initiates on detonation impulse from a Primacord fuse or element, or equivalent, and for amplifying that detonative impulse. The booster of this invention is designed with an improved sheath explosive of high and adequate brisance and of relatively low initiation sensitivity.

These and other objects and advantages of the invention will be better understood after an explanation and description of specific and presently preferred embodiments of the invention which will next be explained.

This invention is predicated on the discovery that by casting a molten high brisance explosive component into a mold which has been previously filled or at least partly filled with granules of nitrocellulose or equivalent material, e.g. single, double, or triple base smokeless powder grains: (1) eliminates formation of a contraction cavity which otherwise frequently forms, (2) rapidly cools the molten explosive, thereby causing finer grain formation which insures greater sensitivity and reliability than with prior art booster, (3) distributes such individual contraction cavities as may be formed so that they are relatively very small. As a result, instead of being deleterious, the small cavities that are formed are actually found to be beneficial. They tend to increase the sensitivity of the high brisance material and they apparently increase the overall sensitivity of the booster. The holes or perforations commonly running through the grains of conventional smokeless powder apparently are beneficial cavities. They are found to increase the sensitivity of the booster, apparently because they produce products of overall lesser density as compared with prior art boosters of the same general type.

The patent to Cook et al. No. 3,037,453, describes the term brisance, as applied to booster materials, and gives numerous examples of explosives of satisfactorily high brisance for use in boosters. According to the present invention, it has been found that boosters cast by the present method have good boostering action at low cost, being

particularly suitable for the initiation of low-sensitivity explosives such as those mentioned above. The aqueous slurries, in particular, are often very difficult to detonate, being sometimes a whole order of magnitude more insensitive even than prills and oil.

More specifically, according to the present invention, a booster is provided for detonating highly insensitive blasting charges, which booster comprises a compacted and relatively small core of cap-sensitive or Primacord-sensitive explosive material, surrounded by a compacted sheath, usually of somewhat larger mass, of Primacord insensitive explosive material, the latter having high detonation pressure characteristics. The booster has at least one perforation extending through the compacted sheath and into, adjacent, or otherwise in direct contact with the core. The core is thus adapted to receive a detonating fuse. It is often desirable to have two perforations, at least one of them extending entirely through the booster. A preferred embodiment is one in which the core is formed of Primacord sensitive material and is of a shape that is readily moldable, or castable, and easily removed from the mold, hence convenient to manufacture. As shown hereinafter, cast or pressed cores of 50/50 pentolite, or higher PETN pentolites, such as 60/40, or tetryl, PETN (pentaerythritol tetranitrate per se) are examples of suitable core materials, suitable for this purpose. An outer sheath of compact Primacord insensitive, but high brisance or high detonating pressure, material surrounds the core. A particularly preferred embodiment comprises a cast 60/40 pentolite inner core, cast around a short piece of duplex Primacord. Alternatively, it may be provided with one or two openings to receive Primacord and/or a cap. The outer surrounding body of high detonation pressure exposive, preferably a high brisance material, is exemplified by a TNT/smokeless powder sheath. The sheath preferably is made by pouring molten TNT into a mold containing smokeless powder granules arranged around the the more sensitive core material. The molten material, TNT, for example, fills the interstices between the grains of smokeless powder so that the sheath is solid, or substantially so, except for small openings in the smokeless powder granules. Composition B and/or other castable high-brisance materials may be used in lieu of TNT, or blended therewith, as set forth hereinafter.

The invention will be more fully understood by reference to the drawings and specific embodiments of the invention illustrated therein. In the drawings:

FIGURE 1 illustrates an elevational view of a preferred form of booster made in accordance with the invention.

FIGURE 2 is a view partly in cross section of another booster of generally similar construction.

FIGURE 3 is a top view, partly in cross section.

FIGURE 4 is a top view, with parts broken away to show a partial section, of another modification.

FIGURE 5 is a vertical cross-section of the booster of FIGURE 4, taken approximately on line 5—5 of said FIGURE 4.

FIGURES 6 and 7 are perspective views of two cores made according to the present invention.

Referring first to FIGURE 1, the booster as a whole is indicated at **10**. It comprises a compact core **12** of Primacord-sensitive material such as pentolite, surrounded by a sheath **11** of Primacord insensitive material. The latter is made up of a combination of a cast explosive of high detonation pressure type combined while molten with particles of a relatively large grain (or pelleted) material **16**. The grains or granules **16** are of material which will support or contribute to the explosive properties of the cast material. Single or double base smokeless powder, in granular form such as used in gun propellants, is preferred for the granular material. It is important that the granules or pelleted materials be of fairly large grain size and of composition which are either explosive themselves or of material which will contribute to the explosive properties of the cast medium which surrounds them. It is important also that the grained or pelleted material be one which will not materially degrade the brisance or detonation pressure of the cast explosive. The granules **16** as shown in FIGURE 2 are used in sufficient numbers to fill a substantial part of the space occupied by the sheath, e.g. at least 20% and preferably more, up to 50% or even more. A maximum usually will not exceed about 65% of the sheath volume. In the form illustrated in FIGURE 2, these grains fill roughly half of the bulk space of the sheath **11** and leave the other half for filling by the castable explosive. The latter is preferably TNT, Composition B, or mixtures thereof, but other materials of similar brisance or detonation pressure and sensitivity characteristics can be used. They should have detonation pressures of at least 1,500,000 p.s.i.g. and preferably of 2,000,000 p.s.i.g. or more. In the embodiments shown in FIGURES 1, 2 and 3, two holes, **13**, **14** extend through the sheath and into or through the core for receiving a suitable conventional initiator. As shown, hole or perforation **13** may pass entirely through the booster, so that it may receive a length of Primacord, looped by itself or carrying additional booster units. The hole or perforation **14** extends to the bottom of the core **12** only. A Primacord detonating fuse is normally used as initiator although a blasting cap may be used. A short piece of Primacord, or of a tube containing Primacord sensitive explosives such as RDX, PETN and the like, may be built into the core, as shown in U.S. Patent No. 3,037,453, for example, to increase reliability of detonation and to make it possible to use a cast or pressed core of minimum size, since core materials are expensive. However, use of a piece of Primacord or pentolite filled tube in the manner just described is not usually required.

While the assembly may assume any desired shape, it is preferred to use the cylindrical form, as shown in FIGS. 1, 2 and 3 in the drawings, for economy of material and for ease of manufacture. The booster may be manufactured by first making the core **12**, e.g. by casting or pressing it in a suitable mold, and then positioning the core **12** in a mold, filling or at least partly filling the mold around the core with large grain material **16** (or pelleted material) such as smokeless powder or granules of TNT, Composition B, and the like, and then casting a molten explosive around the core **12** and into the interstices between the large grain material **16**. This should be done in such a way as to insure that all the grains or pellets will be wet by the molten matrix material **15**. The holes **13** and **14** are designed to receive the Primacord or cap detonator. They may be produced by forming, e.g. casting or pressing the core **12** around pins which are preset in a mold in positions corresponding to the holes. It is preferred also to utilize pins to position the core in a mold, forming the sheath around the core, as shown in U.S. Patent 3,037,453, and then later removing the pins after the sheath is cast, to form the holes in the sheath in alignment with those in the core. In using the booster, a Primacord fuse, such as 50-grain PETN per foot fuse, is commonly threaded through one or more of the holes **13** which pass entirely through the booster. This fuse or cord is then knotted to prevent the removal of the booster from the fuse. The booster may then be inserted in a priming cartridge of ammonium nitrate explosive for association with a main charge or it may be lowered by itself into the borehole, e.g. by suspending it on the Primacord line, to an appropriate position in the borehole. This may be done before or after placing the main charge, or it may be in a middle part of the main charge. When the main charge is of slurry, the booster may be placed in the borehole first, being suspended to the desired level, or lowered to the bottom, as desired. The charge is then put in place, preferably and simply by pouring the loose or slurry explosive material into the hole around the booster.

The Primacord fuse, when used, usually is initiated electrically, as is well known in the art. Inasmuch as stand-

ard fuse caps and electric blasting caps are usually of about the same diameter as detonating Primacord, such caps may also be used to initiate the booster. It is desirable, in any case, that the booster which is intended for use of fuse caps and electric blasting caps be designed to receive and hold these caps in a safe manner. By having the core itself entirely surrounded by the sheath, these boosters are relatively safe to handle, even after they have been fused.

As examples of the superior action of the booster of the invention, boosters such as those illustrated in FIGURES 1 to 3 were prepared in the manner described above, utilizing in some cases a core which was cast of 10 grams of 50/50 pentolite and a sheath containing about 156 grams of 6"/47 SPCG smokeless powder and 169 grams of TNT, the latter being molten and then cast around the smokeless powder. The cores used in the particular booster of FIG. 2 were generally about 1 inch in diameter and about 0.6 inch long. See FIG. 2. The overall size of the sheath in this case was about 3 inches in diameter and about 2 inches long. One hole **13** was about ¼" in diameter for receiving a standard size Primacord fuse and the other hole **14** was slightly larger, about 19/64" diameter, for alternatively receiving either an electric blasting cap or a Primacord fuse of the conventional larger size, as desired.

The boosters described above have been found particularly and consistently satisfactory to booster blasting charges consisting of 94/6 ammonium nitrate/fuel oil mixtures, blasting gels or slurries of 64/21/15 ammonium nitrate/coarse TNT/water mixtures, and aluminum/ammonium nitrate/water slurries of the general types described in U.S. Reissue Patent No. 25,695 to Cook and Farnam, when initiated by a 50-grain (per foot) Primacord. An equivalent booster in power, consisting wholly of 50/50 pentolite, which is also suitable for consistent detonation of these explosives, was found to weigh 165 grams, requiring 87.5 grams of PETN. Another booster of the general type shown in U.S. Patent No. 3,037,452 and consisting of a 50/50 pentolite core and a TNT sheath was found to require 30 grams of 50/50 pentolite or 15 grams of the relatively more expensive PETN. In contrast to this, the particular boosters described above, made according to present invention, contained only 5 grams of this expensive ingredient.

The above dimensions for a cylindrical booster made, according to the present invention, have been found also to be about optimum for general use with slurries in large boreholes when using a cast 60/40 pentolite core and a heterogeneous sheath composition consisting of about a 47/53 by weight mixture of smokeless powder grains and cast TNT. The core, in boosters of this size, should contain about 5 to 20 grams, preferably 10 to 15 grams, of the pentolite or equivalent cap sensitive material. The core size may be in the range of about 1 to 2 inches in diameter when it is cylindrical in shape (but not exceeding about 0.5 times the sheath diameter), with a length between ½ and 1½ inches. With Composition B, RDX, or EDNA, for example, in the sheath, the core may be even smaller than 5 grams in weight, down to 2 or 3. The sheath itself may range in outer dimensions from about 2 or 2½ to about 5 inches in diameter and from about 2 to 5 inches in length, depending on the main charge. Such sheaths have been found very suitable for cores having the above described dimensions. That is to say, for economy coupled with reliable performances, the core size is substantially fixed at a practical minimum, consistent with reliable detonation of the sheath material, and the sheath mass should be at least 4 or 5 times and preferably up to 10 or more times, the core mass. The sheath may be even larger than this if desired. For economic reasons it is preferred to minimize the cost of the booster by optimizing both the masses of core and sheath material. Hence costs of both core and sheath materials must be considered. In round numbers, the sheath will generally have a mass of between about 4 and 20 times that of the core. The core contains only about 2 to 30, or possibly up to 40 grams of the more sensitive explosives such as pentolite, but generally will be about 3 to 15 grams.

Protected core boosters of the general type of this invention and those disclosed in U.S. Patents Nos. 3,037,452 and 3,037,453 comprise the relatively small and relatively sensitive explosive inner core, protected by a larger but less sensitive outer explosive sheath. Boosters of this type are currently manufactured under the registered trademark "Procore," Registration No. 714,039. The sheath material to be employed is restricted generally to those compositions which have a pre-determined impact or friction sensitivity. Ordinary cast TNT is generally somewhat too insensitive for use as the sheath. This sheath is made preferably of material that is no more sensitive than the commercial explosive, Composition B, and will generally be somewhat less sensitive. The combination of granular smokeless powder and cast TNT provides a sheath which is somewhat less sensitive than Composition B and yet is sufficiently more sensitive than simple cast TNT to allow a decided economic advantage. It requires use of much less core material, proportionately, than a

TABLE I

Test No.	CORE			Sheath				Results [1]
	Type Explosive	Size		Size, In. Dia.xIn. Length	Composition			
		Grams	In. Dia.xIn. Length		Smokeless Powder		Filling Material	
					Type	Percent		
1	Tetryl	28	1⅜x⅞	3x4	M-15, 90 mm	48	TNT	14D, OF
2	do	28	1⅜x⅞	3x4	M-15, 90 mm	47	Comp. B	10D, OF
3	do	28	1⅜x⅞	3x2	M-6, 57 mm	48	TNT	5D, OF
4	Primacord, 50 gn./ft	6	x24 [2]	3x2	M-6, 57 mm	48	TNT	2L, IF
5	do	13	x48 [2]	3x2	M-6, 57 mm	48	TNT	1D, OF
6	do	16	x60 [2]	3x2	M-6, 57 mm	48	TNT	5D OF
7	Primacord, 400 gn./ft	3.3	x1½	3x2		0	TNT	OD IF
8	do	13	x6	3x2		0	TNT	5D OF
9	PETN	4	2-0.32x1½	3x2		0	TNT	3L
10	60/40 Pentolite	18	1 3/16x1 3/16	3x2		0	TNT	8D, OF
11	do	10	1 3/16x½	3x2		0	TNT	4D OF
12	50/50 Pentolite	15	1 3/16x1 1/16	3x2		0	TNT	2D OF
13	60/40 Pentolite	7	1 3/16x5/16	3x2		0	TNT	OD, 4L
14	do	[3] 15	1 3/16x1 1/16	3x4	SPCG, 6"/47	48	TNT	10D OF
15	do	[3] 15	1 3/16x1 1/16	3x4	M-6, 57 mm	48	TNT	11D OF
16	do	7	1 3/16x5/16	3x2	SPCG, 6"/47	48	TNT	5D OF
17	do	7	1 3/16x5/16	3x2	M-6, 57 mm	48	TNT	5D OF

[1] D—Detonation with power to initiate low-sensitivity blasting agents as shown by perforation of a 1" thick steel plate.
L—Low order only—only small dent in plate.
F—Failure to detonate.
[2] Wound in figure 8 around holes.
[3] With 2" length of duplex Primacord adjacent to 1 hole.

sheath made entirely of cast TNT. Smokeless powder is often available as Government surplus stock at comparably very low price. When this is the case it makes possible a decided saving in the cost of the sheath material.

As examples of the composition and practice of the invention, a number of boosters of right cylindrical shape having a diameter of about 3" and an axial length of about 2" were prepared. These were detonated on 1" thick steel plates, using 50-grain per foot Primacord as initiator. Boosters which cut a hole approximately equal in diameter to the booster size, through a 1" thick steel plate, generally will reliably detonate the least sensitive of the practically useful high ammonium nitrate slurries and gels mentioned above. As a rule, somewhat less power than this may be adequate.

Various types of smokeless powder may be used, including single base, double base and triple base powders. Also, various core materials can be used. As shown in the above table, the pentolite cores in combination with TNT-smokeless powder sheaths, performed best in the smaller sizes.

Though TNT has been set forth above as an example of the material that may be cast around the grains, e.g. of smokeless powder which produce an interstitial volume of about 50%, it is not intended that the invention be restricted to the use of TNT. Examples of other castable explosives of high brisance which may be used are blends of TNT with other materials, e.g. Tetrytol (Tetryl/TNT), Cyclotol (RDX/TNT), Composition B (RDX/TNT/Wax), Ednatol (EDNA/TNT), Amatols (Ammonium Nitrate/TNT), Sodatols (Sodium Nitrate/TNT), Baratols (Barium Nitrate/TNT), Tritonal (Aluminum/TNT), and other heat producing metals besides aluminum, mixed in TNT, and the like.

Referring now to FIGS. 4 and 5, a modified booster **110** is shown which in overall shape is a right circular cylinder. It can, of course, be of polygonal shape, but the cylinder is preferred. The core **111** is not cylindrical in this case but is of a generally frusto-conical or frusto-pyramidal shape, that is, it tapers somewhat. The advantage of this form is that the core can be more readily pressed or molded and removed from the mold. The core shown in FIGS. 4 and 5 is of essentially the shape shown in perspective in FIG. 6, having at least two more or less trapezoidal sides, surfaces **121, 122** (shown as top and bottom). In this case only one hole or perforation is shown in the core, although more can be made if desired. The surfaces **121** and **122** may be in parallel planes, but their planes preferably converge somewhat so that all four peripheral sides, **121, 122, 123** and **124**, considering the surface **125** as the base, are somewhat trapezoidal. The end **126** opposite the base is shown as being arcuate in shape (part-cylinder surface) which is preferred, but it could be made planar or multiplanar if desired. Hole **129** may be single, as shown, or double.

Alternatively, the core may be frustoconical in shape, as in FIG. 7, and either or both ends, **127, 128** shown as planar, can be made hemispherical if desired. In other respects the boosters of FIGS. 4 and 5 are made up much as those of FIGS. 1, 2 and 3. The core is held in place about the center of the peripheral band **130**, of cardboard or the like, while the large grained particles **116** are piled around it in such manner that the molten binder of TNT or the like will run between them and fill all the voids between the grains. Some small perforations in the grains, especially when they are of smokeless powder, may not be entirely filled, but this usually will not affect the booster adversely and in some cases is actually beneficial.

The TNT or other binder is poured in to fill the peripheral band **130**, to flow under and around the core **111**, and around and between all the granules **116**. As it cools and solidifies it may shrink and crack slightly, but it will not have large cavities as often occurs when a whole block is cast of TNT, RDX, Composition B, and the other materials mentioned above.

The boosters of this invention which are presently preferred normally will have one or two holes to receive an initiator, cap or fuse type. Preferably they will include as core a small mass of PETN and/or at least a short length of Primacord adjacent at least one and preferably both of such holes. More than two holes may be used. A desirable and simple arrangement for the latter purpose is a short length of duplex Primacord arranged alongside, doubly or triply folded along, wrapped around or otherwise placed adjacent at least one of the holes, preferably adjacent to both. Though smokeless powder has been used as a desirable example of the large grain material, which is preferred to eliminate large contraction cavities occurring when the cast material cools, and to increase sensitivity of the sheath, it is not intended to restrict the invention to smokeless powders for such grain material. Other grains or pellets of explosive material, or energy contributing material, which leave 40 to 60 percent void space to be filled with the cast TNT or equivalent, and which do not materially reduce the detonation pressure of the resulting explosive mixture, may be used in the sheath. While explosives having detonating pressures above 1,300,000 p.s.i. and higher, are most desirable, those having pressures moderately below this value are useable and may often be desirable, even though larger mass is required, depending upon economic considerations.

It will be understood that the terms "Primacord" and "Primacord sensitive" as used herein means detonating cord of equivalent characteristics and is not limited to any particular trade product. It will be understood, too, that the core may consist largely or entirely of a cordlike detonating material folded or wound on itself or around or alongside the initiator hole, being of sufficient mass to detonate the sheath.

It will be understood that numerous variations may be made in shape, size and relative proportions, as well as in specific compositions used for the core and the sheath, respectively. In particular, the shape of the core may vary greatly, as long as its center of mass or gravity is located within reasonably close proximtiy to the center of gravity of the sheath. It is intended by the claims which follow to cover the above and such other variations and modifications as will readily occur to those skilled in the art, as far as the prior art properly permits.

What is claimed is:

1. A booster for relatively insensitive explosives such as high ammonium nitrate blasting agents and the like, which comprises, in combination, a small inner core of a cap sensitive material and a much larger heterogeneous outer sheath comprising a cast cap insensitive explosive material of high brisance, said outer sheath also including 20 to 65 percent of its weight of large, discrete explosive grains of size and quantity sufficient to cool rapidly the insensitive material and thereby inhibit formation of cavities and promote fine grain structure.

2. A booster according to claim **1** wherein the core contains not more than one-fourth as much material as the sheath.

3. A booster according to claim **1** wherein the core includes a small quantity of PETN in addition to a cap-sensitive explosive selected from the class which consists of cast and pressed 50/50 and higher Pentolites, PETN, and Tetryl.

4. A booster according to claim **1** wherein the core includes PETN in quantity of not more than about 10% of the total booster mass.

5. A booster according to claim **1** wherein the core includes a hole to receive an initiator and at least a short length of detonating cord fuse in the core and near enough said hole to be reliably detonated by said initiator.

6. A booster according to claim **1** wherein the core includes a hole to receive a detonator and wherein the core comprises a length of detonating cord of sufficient mass per se to detonate the sheath arranged in proximity to said hole.

7. A booster according to claim 1 wherein the grains consist essentially of smokeless powder.

8. A booster according to claim 1 wherein the core comprises PETN and the sheath is made up of cast TNT and perforate grains of smokeless powder embedded therein.

9. A booster according to claim 1 which comprises a core of cast pentolite of at least 50/50 PETN content, and a sheath comprising TNT cast about discrete propellant grains of smokeless powder of at least 57 mm. grain size and constituting proportions of 20 to 65 percent of the weight of the sheath.

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