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(21) International Application Number: PCT/US95/02325 (22) International Filing Date: 24 February 1995 (24.02.95) (71) Applicant: CLIPMATE CORP. [US/US]; 4000 N.W. 39th Street, Oklahoma City, OK 73112 (US). (72) Inventor: WALDOCK, Kevin, H.; 101-17 Bayview Street, Runaway Bay, QLD 4217 (AU). (74) Agents: GALLENSON, Mavis, S. et al.; Ladas & Parry, Suite 2100, 5670 Wilshire Boulevard, Los Angeles, CA 90036 (US).		(81) Designated States: AM, AT, AU, BB, BG, BR, BY, CA, CH, CN, CZ, DE, DK, EE, ES, FI, GB, GE, HU, JP, KE, KG, KP, KR, KZ, LK, LR, LT, LU, LV, MD, MG, MN, MW, MX, NL, NO, NZ, PL, PT, RO, RU, SD, SE, SG, SI, SK, TJ, TT, UA, UG, UZ, VN, ARIPO patent (KE, MW, SD, SZ, UG), European patent (AT, BE, CH, DE, DK, ES, FR, GB, GR, IE, IT, LU, MC, NL, PT, SE), OAPI patent (BF, BJ, CF, CG, CI, CM, GA, GN, ML, MR, NE, SN, TD, TG). Published <i>With international search report.</i>
(54) Title: ELECTRIC DETONATOR AND LEAD CONNECTOR ASSEMBLY (57) Abstract A detonator assembly wherein the electrical leads are attached to an electrical connector which maintains the ends of the leads in non-conductive, waterproof condition and which permits the leads to be spliced to another pair of electric leads without any splicing tools. The length of the electrical leads is selected to permit the assembly to be inserted in a booster charge so that the electrical connector is contained entirely within the throughbore in the booster charge. Packaging for such detonator assemblies includes at least one tray integrally formed of fire retardant material. The detonator assemblies fit snugly in parallel elongate recesses in the top of the tray so that when the tray is tipped or inverted the detonators will remain in position. The detonator assemblies are arranged in alternating fashion so that the detonator ends of adjacent assemblies are at opposite sides of the tray. Further, the recesses in each tray are spaced apart to maintain the detonators about one inch apart, and each tray is about one-inch thick so that detonators in adjacent stacked trays also are at least an inch apart.		

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ELECTRIC DETONATOR AND LEAD CONNECTOR ASSEMBLYField of the Invention

The present invention relates generally to detonation devices for explosives and in particular to electric detonation devices coupled with electrical lead connectors.

Summary of the Invention

The present invention is directed to a detonator assembly for use with a booster charge. The assembly includes an electrical detonator and two electrical leads of equal length. One end of each lead is connected to the electrical detonator, and the other end of each lead is connected to an electrical connector. The connector is characterized as capable of maintaining the ends of the two electrical leads in non-conductive condition. The length of the leads is selected so that when the detonator assembly and the booster charge are assembled, the electrical connector will be contained entirely within the throughbore of the booster charge.

The present invention further includes packaging for a plurality of detonator assemblies. The packaging includes at least one tray. The top of the tray defines a plurality of parallel elongate recesses, and each such recess is shaped to grippingly receive a single detonator assembly.

The present invention further comprises a packaging tray with a plurality of parallel elongate recesses containing the detonator assemblies in alternating fashion so that the detonator ends of adjacent assemblies are at opposite sides of the tray.

Still further, the present invention includes a packaging tray having a plurality of parallel elongate recesses containing the detonator assemblies and which are spaced apart to maintain the detonator portions of the detonator assemblies at least about one inch apart.

The present invention also contemplates packaging comprising a plurality of stacked trays. Each of the stacked trays has a plurality of parallel elongate recesses, each of which contains a detonator assembly and each of which is about one inch thick so that detonator assemblies in adjacent trays are maintained at least about one inch apart.

Finally, the present invention includes a method for assembling an electronic detonator and a booster charge. First, there is selected a booster charge having a body with a first end and a second end, a blind bore in one end for receiving an electronic detonator, and a throughbore spaced a distance from the blind bore and extending from the first end to the second end.

A detonator assembly also is selected. The detonator assembly comprises an electronic detonator having a first end and a second end, an electrical connector having a first end and a second end, and a pair of electrical leads connecting the first end of the detonator and the first end of the connector, the leads having a length slightly greater than the distance between the blind bore and the throughbore in the booster charge.

A length of leg wire is selected. The leg wire comprises a pair of electrical leads and has a first end and a second end.

The first end of the selected length of leg wire is threaded through the throughbore in the body of the booster charge so that the first end of the selected length of leg wire extends a distance out of the throughbore from the first end of the body of the booster charge. Then, the first end of the selected length of leg wire is connected to the second end of the electrical connector of the detonator assembly. Then, the detonator is inserted, second end first, into the blind bore in the first end of the booster charge, and the leg wire is pulled tautly through the throughbore.

Brief Description of the Drawings

Figure 1 is a perspective view of a detonator assembly in accordance with the present invention.

Figure 2 is a side elevational view illustrating the use of a detonator assembly in a booster charge.

Figure 3 is a perspective view of packaging for the detonator assemblies of the present invention comprising
5 a plurality of stacked trays.

Figure 4 is a cross-sectional view taken along line 4-4 in Figure 3.

Detailed Description of the Preferred Embodiments

Electric and electronic detonators typically
10 comprise a small charge of explosive contained in a metal casing. The detonators are equipped with lengths of twin electrical leads referred to as "leg wire." Detonators are commercially available with leg wires of assorted lengths, such as 16 feet, 24 feet, 50 feet, and so forth. Detonators
15 are also manufactured with different delay periods, such as 24 milliseconds, 50 milliseconds, and so forth. Given the specific leg wire length and delay periods of conventional detonator products, detailed planning and the purchase of the correct number of specific detonator products is
20 required for maximum efficiency.

To utilize a detonator which has the desired delay period but which has an inadequate length of leg wire, an additional length of leg wire may be attached by splicing it to the ends of the leg wire on the detonator. Industry
25 standards presently require that the ends of the leg wires on detonators be shunted by stripping the insulation jacket for a few inches, twisting the bare conductive core portions of the leads together, and covering the stripped portions of the wire with a non-conductive protective sleeve. This is
30 done to reduce the likelihood that a stray electrical charge will activate the detonator. To splice on additional leg wire, the ends of the extra leg wire are stripped and connected to the stripped ends of the leg wire from the detonator by twisting the ends together or using a crimping
35 tool. While effective, this splicing procedure is time consuming and inconvenient at the blast site.

The present invention provides a detonator assembly comprising a conventional detonator with a relatively short length of leg wire attached. The free ends of the leg wire are attached to an electrical connector which substitutes for the shunt. This electrical connector maintains the ends in waterproof, nonconductive condition and allows the leg wire to be spliced with additional leg wire without the use of stripping or crimping tools.

The detonator assembly of this invention is designed to be used with a conventional booster charge. To this end, the leg wire is relatively short so that when the assembly is emplaced in the booster, the electrical connector will be contained within the throughbore of the booster. This protects the connector from damage while the booster charge is being lowered into the blast hole.

Also, it will be appreciated that the detonator assembly of this invention will in most instances reduce the cost of materials for a blast job. This is because the price of conventional detonators includes the cost of the leg wire at a price substantially higher than the cost of leg wire when bought in bulk. Furthermore, the detonator assembly of this invention permits the operator to purchase detonators simply by delay periods, rather than the delay period and the leg wire length. This simplifies the planning and execution of a blast job, as all detonators with equal delay periods are interchangeable.

Due to the short leg wire lengths, the detonator assemblies can be packaged in multiples. By employing the packaging of this invention, multiple detonators can be safely shipped and stored. The packaging, which includes multiple trays, maintains all detonators in a package at least one inch apart. Also, in accordance with the present invention, the detonator ends of the assemblies are arranged in alternating fashion so that the detonators of adjacent assemblies are at opposite ends of the package. Thus, in the event of an accidental detonation, the burst from the exploding detonator will be aimed away from the other detonators in the package. These and other advantages of the

present invention will be apparent from the following description of the preferred embodiments.

Turning now to the drawings in general and to Figure 1 in particular, there is shown therein a detonator assembly constructed in accordance with the present invention and designated generally by the reference numeral 10. The detonator assembly comprises an electronic detonator 12. Conventional detonators are suitable for use in this invention. The detonator 12 has a first end 14 and a second end 16.

The assembly 10 further comprises a pair of electrical leads 18 which are of about equal length and which have first ends 20 and second ends 22. The first ends 20 are connected to the first end 14 of the detonator 12. The leads 18 preferably are conventional electronic wires, which comprise a conductive core and an insulating jacket.

The assembly 10 still further comprises an electrical connector 24 having a first end 26 and a second end 28. The first end 26 of the connector 24 is connected to the second ends 22 of the two electrical leads 18. The electrical connector 24 is characterized as capable of maintaining the second ends 22 of the two electrical leads 18 in non-conductive and also preferably waterproof condition. The connector 24 also preferably permits a waterproof, high tensile strength splicing of the two electrical leads 18 with another pair of similar electrical leads without the use of splicing tools.

A preferred electrical connector for this purpose is marketed under the name ClipMate™ by ClipMate Corporation (Oklahoma City, OK). This electrical connector is described in detail in U.S. Patent No. 4,952,167, issued August 28, 1990, and the content of this patent is incorporated herein by reference.

With reference now to Figure 2, the use of the detonator assembly 10 now will be described. A conventional booster charge 30 is generally cylindrical in shape. A first blind bore 32 extends from the first end 34 a distance into the booster 30. A second throughbore 36 extends from the

first end 34 through the length of the booster 30 to the opposite or second end 38.

In accordance with the method of the present invention, a length of conventional leg wire 40 is selected.

5 The leg wire 40 comprises a pair of electrical leads and has a first end 42 and a second end 44. The leg wire 40 is threaded through the throughbore 36 so that the first end 42 of the leg wire 40 extends a distance out of the throughbore 36 at the first end 34 of the booster charge 30.

10 Next, the first end 42 of the leg wire 40 is connected to the second end 26 of the connector 24 of the assembly 10 in the manner taught in U.S. Patent No. 4,952,167. The detonator 12 of the assembly 10 then is inserted into the blind bore 32, and the leg wire 40 is
15 pulled taut through the throughbore 36 so that the connector 24 is protected inside the throughbore. Thus assembled, the booster 30 can be dropped down into the blast hole (not shown) or otherwise positioned in a known manner so as to detonate the primary charge.

20 Now it will be appreciated that the electrical connector 24 should be sized to fit easily inside the throughbore 36 in booster charge 30. Further, it now will be understood that the length of the twin leads 18 in the assembly 10 between the connector 24 and the detonator 12
25 should be long enough to traverse comfortably the distance between the bores 32 and 36 on the first end 34 of the booster charge 30.

It is also preferable, however, that the length of the leads 18 be shorter than the sum of the distance between
30 the bores 32 and 36 and the length of the throughbore 36. In this way, when the assembly 10 is threaded through the booster 30, the connector 24 will be positioned well inside the booster. This will protect the connector 24 from damage as the booster 30 is lowered into the blast hole. To this
35 end, the leads 18 preferably are from about one-half inch to about 12 inches long, more preferably from about one inch to about three inches long, and most preferably about two inches long.

It is also desirable to provide a groove 46 in the first end 34 of the booster 30 which extends from the mouth of the blind bore 32 to the mouth of the throughbore 36. When the leg wire 40 is pulled tautly through the
5 throughbore 36 to position the detonator inside the throughbore, the middle portion of the twin electrical leads 18 will nest in the groove 46. This stabilizes the assembled booster 30 and protects the leads 18 from injury as the booster is lowered into a blast hole or other location.

10 Attention now is directed to Figure 3 for a description of a preferred packaging for detonator assemblies in accordance with the present invention. The packaging, designated generally by the reference numeral 50, comprises at least one tray 52, and more preferably a
15 plurality of such trays. The tray 52 may be integrally formed of some lightweight, fireproof material such as styrofoam.

The tray 52 preferably is rectangular and has a top 54 in which a plurality of parallel elongate recesses
20 are formed. One of the recesses is designated by the reference numeral 56. The length of the recess 56 is about the same as the length of one detonator assembly 10. The depth of the recess 56 is about the same as the width of the connector 24 of the assembly, so that the assembly will not
25 protrude above the top 54 of the tray 52. The width of the recess 56 is sized to grippingly engage the sides of the connector 24 of the detonator assembly 10. In this way, if the tray 52 is tipped over, the detonator assemblies 10 will not spill out of the tray 52.

30 The recesses 56 are spaced about one-half inch apart and the detonator assemblies are positioned therein in alternating fashion. Thus, the detonator 12 of adjacent assemblies 10 will be at opposites sides of the tray 52, and the detonator of alternate assemblies 10 will be at least
35 one inch apart.

As shown in Figures 3 and 4, the package 50 includes a plurality of trays 52 stacked one upon another. Each tray 52 has a thickness of at least about one inch.

Accordingly, when the trays 52 are stacked together, detonator assemblies in adjacent trays are at least one inch apart. As seen in Figure 4, the trays 52 are loaded so that the detonator assemblies 10 at the ends of adjacent trays are arranged in alternating fashion so that the detonator ends are at opposite sides of the trays.

In the preferred practice of the present invention, each tray 52 has about 25 recesses. To simplify the illustration, however, the tray 52 is shown in the drawings as having only ten recesses. Similarly, although in the preferred commercial practice of the invention, about 10 trays will be combined in a single package, a stack of only 4 trays is depicted in the drawings. The package preferably is enclosed in a transparent covering commonly known as "shrink wrap."

Changes may be made in the combination and arrangement of the various parts, elements, steps and procedures described herein without departing from the spirit and scope of the invention as defined in the following claims.

Claims

1. A detonator assembly for use with a booster charge having a first end and a second end, a blind bore in the first end, and a throughbore a distance from the blind bore and extending from the first end to the second end, the
5 detonator assembly comprising:

an electrical detonator receivable in the blind bore;

two electrical leads of equal length, each one of
10 the two electrical leads having a first end and a second end, the first end of each one of the two electrical leads being connected to the electrical detonator; and an electrical connector connected to the second ends of the two electrical leads and characterized as capable of maintaining
15 the second ends of the two electrical leads in non-conductive condition with one another;

wherein the length of the two electrical leads is greater than the distance between the blind bore and the throughbore in the first end of the booster charge and
20 wherein the length of the leads is less than the sum of the distance between the blind bore and the throughbore and the length of the throughbore so that when the booster charge and the detonator are assembled, the electrical connector is contained entirely within the throughbore of the booster
25 charge.

2. The assembly of claim 1 wherein the length of the two electrical leads is between about one-half inch to about 12 inches.

3. The assembly of claim 2 wherein the length of
30 the two electrical leads is between about one inch and about three inches .

4. The assembly of claim 3 wherein the length of the two electrical leads is two inches.

5. The assembly of claim 1 wherein the electrical connector is further characterized as maintaining the ends of the electrical leads in waterproof condition.

6. The assembly of claim 1 wherein the electrical
5 connector further comprises:

means for providing a high tensile strength splicing of the two electrical leads of the assembly and another pair of electrical leads without using splicing tools.

10 7. A package of detonator assemblies comprising:
a plurality of detonator assemblies, each such assembly comprising:

an electrical detonator comprising generally a first end of the assembly;

15 two electrical leads of equal length, each having a first end and a second end, the first end of each lead being connected to the electrical detonator; and

an electrical connector connected to the second ends of the two electrical leads and characterized as
20 capable of maintaining the second ends of the two electrical leads in non-conductive condition, and wherein the electrical connector comprises generally the second end of the assembly;

at least one tray having a top; and

25 wherein the top of the tray defines a plurality of parallel elongate recesses, each such recess being shaped to grippingly receive a single detonator assembly.

8. The package of detonator assemblies of claim 7 wherein the electrical connector is further characterized as
30 maintaining the ends of the electrical leads in waterproof condition.

9. The package of detonator assemblies of claim 7 wherein the electrical connector is further characterized as providing a high tensile strength splicing of the two

electrical leads of the assembly and another pair of similar electrical leads without the use of splicing tools.

10. The package of claim 7 wherein the plurality of detonator assemblies are arranged in alternating fashion
5 so the first end of any one detonator assembly is not adjacent the first end of any other detonator assembly.

11. The package of claim 10 wherein the recesses in the tray are spaced about one-half inch apart so that the first ends of alternate detonator assemblies are about one
10 inch apart.

12. The package of claim 11 comprising a plurality of trays, wherein the trays are stacked, wherein each of the trays is about one inch thick so that detonator assemblies in adjacent trays are at least about one inch apart.

13. The package of claim 11 wherein the trays are
15 integrally formed of fire retardant material.

14. The package of claim 7 wherein the tray is integrally formed of fire retardant material.

15. A package of detonator assemblies comprising:
20 a plurality of detonator assemblies, each such assembly comprising: an electrical detonator comprising generally a first end of the assembly;

two electrical leads of equal length, each having a first end and a second end, the first end of each lead
25 being connected to the electrical detonator; and

an electrical connector connected to the second ends of the two electrical leads and characterized as capable of maintaining the second ends of the two electrical leads in non-conductive condition, and wherein the
30 electrical connector comprises generally the second end of the assembly;

at least one tray having a top; and

wherein the top of the tray defines a plurality of parallel elongate recesses; and

wherein a detonator assembly is contained within each recess and wherein recesses are spaced apart to
5 maintain the first ends of detonator assemblies at least about one inch apart.

16. The package of detonator assemblies of claim 15 wherein the electrical connector is further characterized as maintaining the ends of the electrical leads in
10 waterproof condition.

17. The package of detonator assemblies of claim 15 wherein the electrical connector is further characterized as providing a high tensile strength splicing of the two electrical leads of the assembly and another pair of similar
15 electrical leads without the use of splicing tools.

18. The package of claim 15 wherein the recesses are spaced about one-half inch apart and the detonator assemblies are arranged in alternating fashion so that the first ends of adjacent detonator assemblies are at opposites
20 sides of the tray and so that the first ends of alternate assemblies are at least about one inch apart.

19. The package of claim 18 wherein the package includes a plurality of trays, each of which is about one inch thick so that detonator assemblies in adjacent trays
25 are at least about one inch apart.

20. The package of claim 19 wherein the trays are integrally formed of fire retardant material.

21. The package of claim 15 wherein the trays are integrally formed of fire retardant material.

22. The package of claim 15 wherein each recess in the tray is shaped to grippingly engage the first end of the detonator assembly contained therein.

23. A package of detonator assemblies comprising:
5 a plurality of detonator assemblies, each such assembly comprising: an electrical detonator comprising generally a first end of the assembly;
two electrical leads of equal length, each having a first end and a second end, the first end of each lead
10 being connected to the electrical detonator; and
an electrical connector connected to the second ends of the two electrical leads and characterized as capable of maintaining the second ends of the two electrical leads in non-conductive condition, and wherein the
15 electrical connector comprises generally the second end of the assembly;
at least one tray having a top; and
wherein the top of the tray defines a plurality of parallel elongate recesses; and
20 wherein a detonator assembly is contained within each recess and the detonator assemblies are arranged in alternating fashion so that the first ends of adjacent detonator assemblies are at opposite sides of the tray.

24. The package of detonator assemblies of claim
25 23 wherein the electrical connector is further characterized as maintaining the ends of the electrical leads in waterproof condition.

25. The package of detonator assemblies of claim
23 wherein the electrical connector is further characterized
30 as providing a high tensile strength splicing of the two electrical leads of the assembly and another pair of similar electrical leads without the use of splicing tools.

26. The package of claim 23 wherein the package comprises a plurality of trays, each tray being about one

inch thick so that detonator assemblies in adjacent trays are maintained at least about one inch apart.

27. The package of claim 26 wherein the trays are formed of fire retardant material.

5 28. The package of claim 23 wherein the tray is formed of fire retardant material.

29. A method for assembling an electronic detonator and a booster charge comprising the steps of:
selecting a booster charge having a body with a
10 first end and a second end, a blind bore in one end for receiving an electronic detonator, and a throughbore spaced a distance from the blind bore and extending from the first end to the second end;

selecting a detonator assembly comprising an
15 electronic detonator having a first end and a second end, an electrical connector having a first end and a second end, and a pair of electrical leads connecting the first end of the detonator and the first end of the connector, the leads having a length slightly greater than the distance between
20 the blind bore and the throughbore in the booster charge;

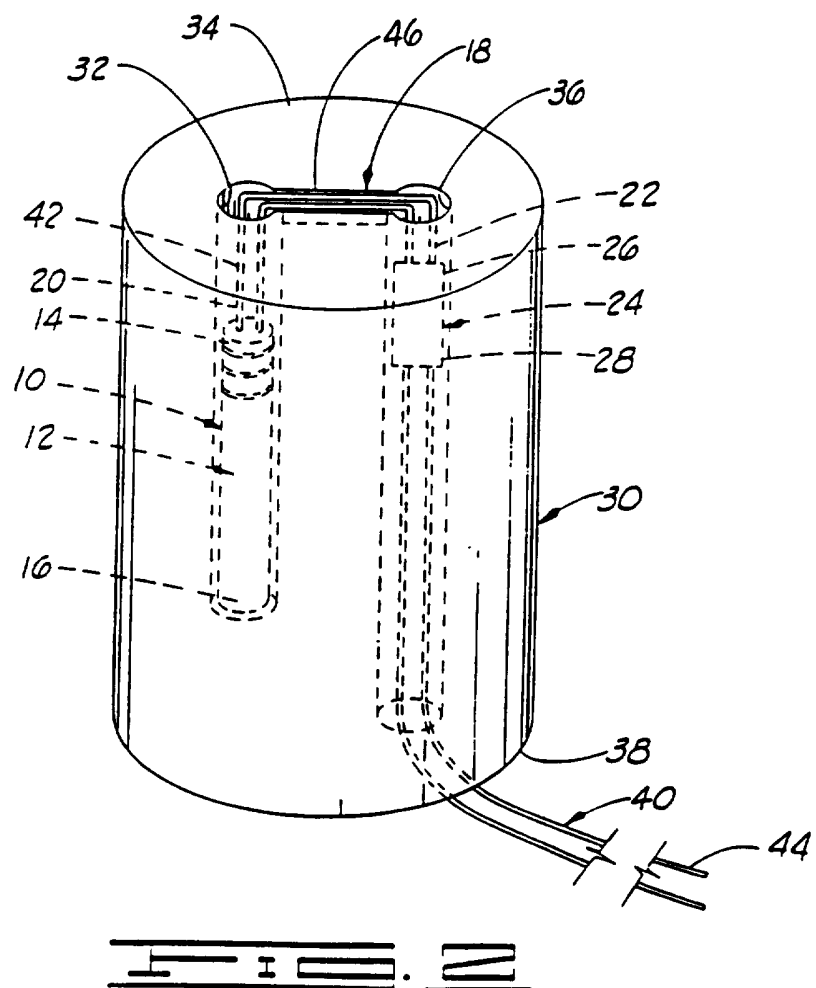
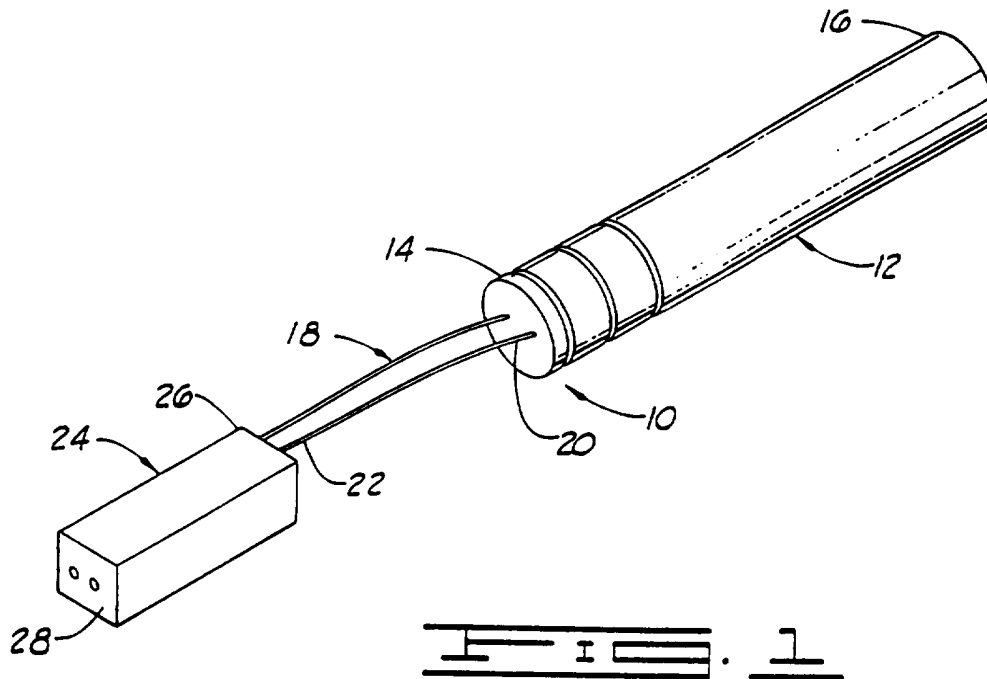
selecting a length of leg wire comprising a pair of electrical leads and having a first end and a second end;
threading the selected length of leg wire through
the throughbore in the body of the booster charge so that
25 the first end of the selected length of leg wire extends out of the throughbore at the first end of body of the booster charge;

connecting the second end of the electrical connector of the detonator assembly to the first end of the
30 selected length of leg wire;

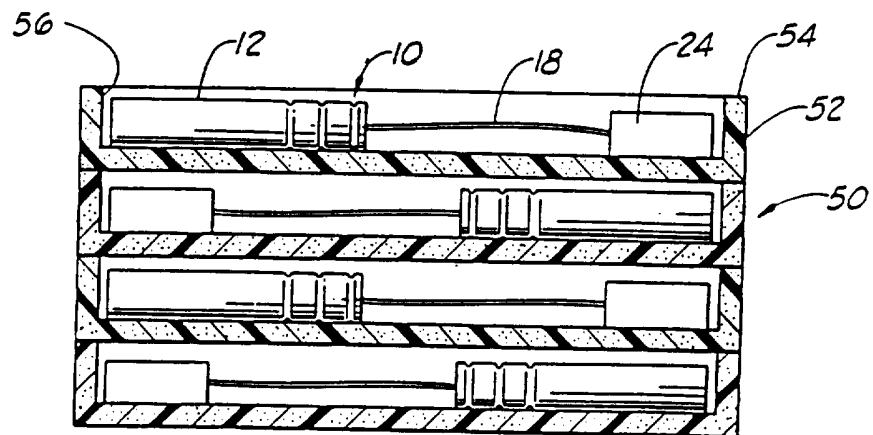
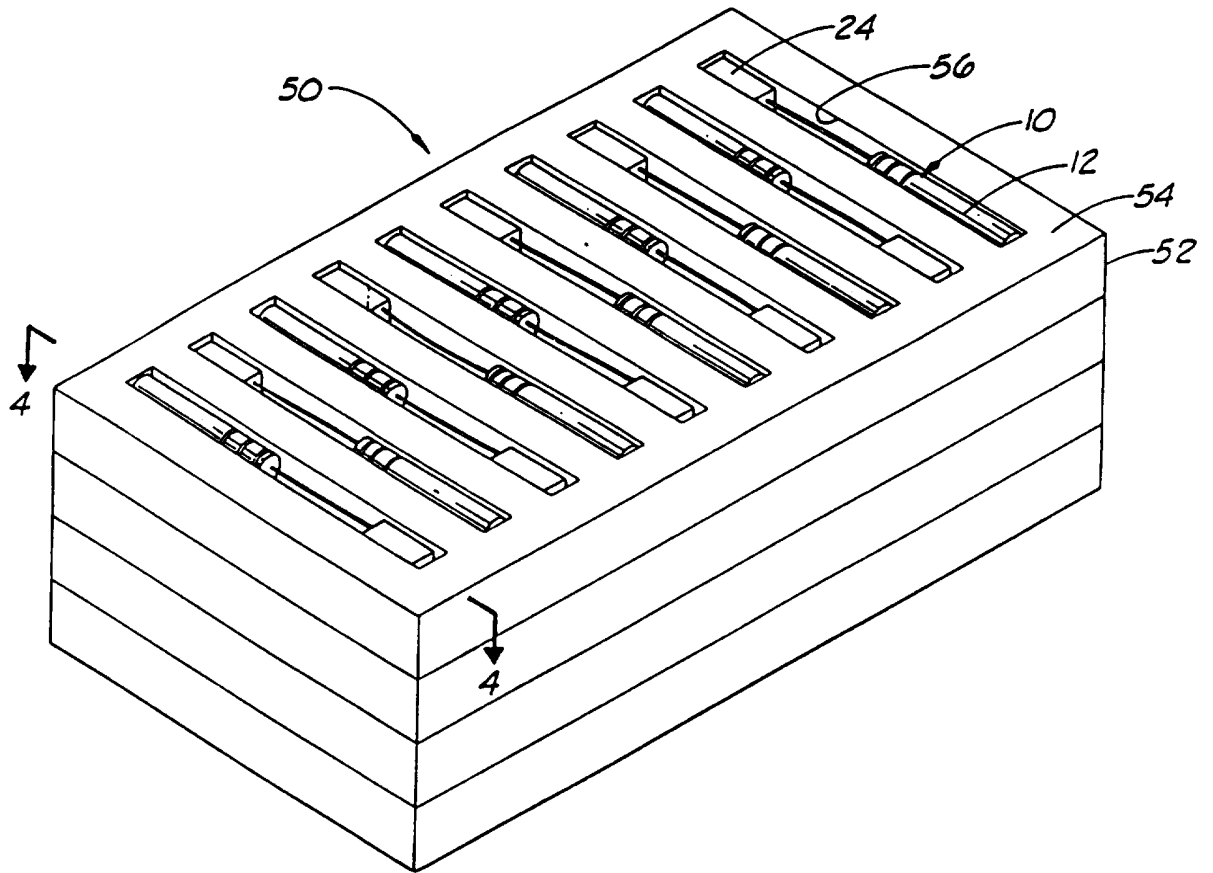
inserting the detonator, second end first, into the blind bore in the first end of the booster charge; and

pulling the leg wire tautly through the throughbore.

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INTERNATIONAL SEARCH REPORT

 Intern: J Application No
 PCT/US 95/02325

 A. CLASSIFICATION OF SUBJECT MATTER
 IPC 6 F42B3/26 F42B39/30

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

IPC 6 F42B

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	US,A,4 425 849 (JORGENSEN) 17 January 1984 see column 4, line 38 - line 48; figures 1,4 ---	1
A	US,A,4 637 312 (ADAMS) 20 January 1987 see column 7, line 16 - column 8, line 19; figure 7 ---	1
A	GB,A,735 407 (I.C.I) 17 August 1955 see page 2, line 116 - line 129; figures 1,3 ---	1
A	US,A,3 931 763 (BLUHM) 13 January 1976 see figures 4,6 ---	1
A	US,A,2 993 441 (GRIFFITH) 25 July 1961 see the whole document ---	1
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☒ Further documents are listed in the continuation of box C.

☒ Patent family members are listed in annex.

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Date of the actual completion of the international search

10 October 1995

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Name and mailing address of the ISA

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C.(Continuation) DOCUMENTS CONSIDERED TO BE RELEVANT

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	US,A,4 952 167 (HERTELENDY) 28 August 1990 cited in the application see abstract; figures 1,2; examples ---	1
A	US,A,4 817 787 (OWEN) 4 April 1989 see figures ---	7,15
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INTERNATIONAL SEARCH REPORT

Information on patent family members

Intern: J Application No

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