PCT WORLD INTELLECTUAL PROPERTY ORGANIZATION
International Bureau

INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(51) International Patent Classification 5 :		(11) International Publication Number: WO 93/12400
F42B 5/02, 5/067, 5/26 F42B 14/06, C06B 21/00	A1	(43) International Publication Date: 24 June 1993 (24.06.93)

(21) International Application Number: PCT/US92/10175

(22) International Filing Date: 23 November 1992 (23.11.92)

(30) Priority data:
803,806 9 December 1991 (09.12.91) US

(71) Applicant: OLIN CORPORATION [US/US]; 350 Knotter Drive, P.O. Box 586, Cheshire, CT 06410-0586 (US).

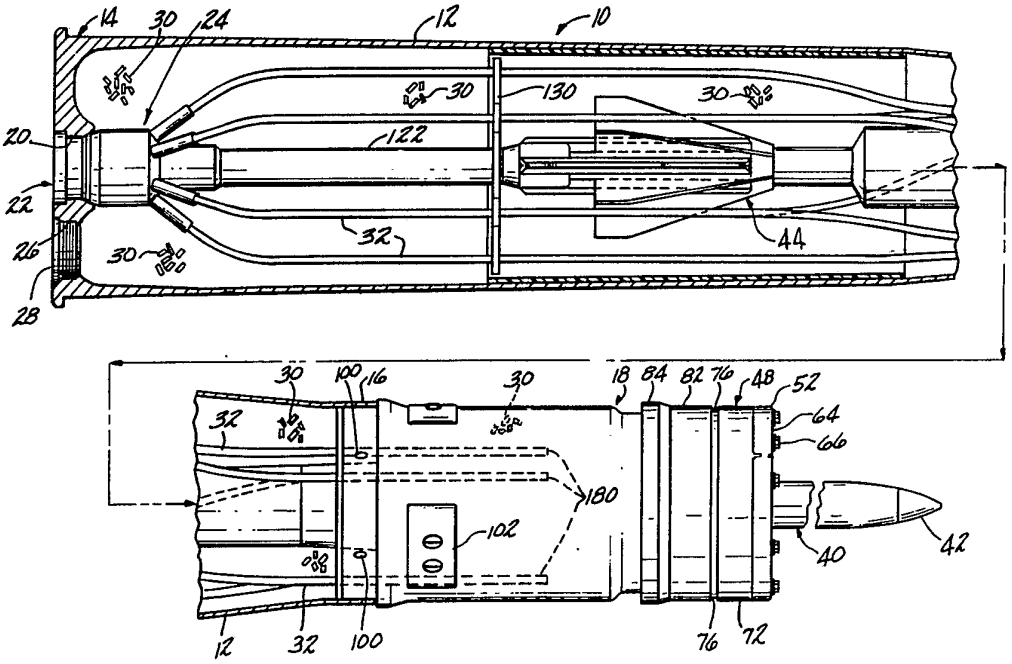
(72) Inventors: CAMPOLI, Ralph, F. ; 25 Alan Lane, Mine Hill, NJ 07801 (US). MCGOVERN, John, T. ; 1651 Robot Road, Lancaster, PA 17601 (US).

(74) Agents: BURDICK, Bruce, E. et al.; Olin Corporation, 350 Knotter Drive, P.O. Box 586, Cheshire, CT 06410-0586 (US).

(81) Designated States: AU, BB, BG, BR, CA, CS, FI, HU, JP, KP, KR, LK, MG, MN, MW, NO, PL, RO, RU, SD, European patent (AT, BE, CH, DE, DK, ES, FR, GB, GR, IE, IT, LU, MC, NL, SE), OAPI patent (BF, BJ, CF, CG, CI, CM, GA, GN, ML, MR, SN, TD, TG).

Published
With international search report.

(54) Title: EXTENDED CHARGE CARTRIDGE ASSEMBLY



(57) Abstract

A cartridge assembly which has a portion of the propellant charge (30) contained in an annular cavity (114) surrounding the projectile (40) is disclosed for propelling a subcaliber projectile (40) through a gun tube. The assembly includes a cartridge case having a multistrand ignition system (24) having a plurality of flexible combustible ignition strand (32) which extend through the propellant charge (30) in the case into the annular cavity (114) to simultaneously ignite the propellant charge (30) contained therein with the portion of the charge in the cartridge case.

FOR THE PURPOSES OF INFORMATION ONLY

Codes used to identify States party to the PCT on the front pages of pamphlets publishing international applications under the PCT.

AT	Austria
AU	Australia
BB	Barbados
BE	Belgium
BF	Burkina Faso
BG	Bulgaria
BJ	Benin
BR	Brazil
CA	Canada
CF	Central African Republic
CG	Congo
CH	Switzerland
CI	Côte d'Ivoire
CM	Cameroon
CS	Czechoslovakia
CZ	Czech Republic
DE	Germany
DK	Denmark
ES	Spain
FI	Finland
FR	France
GA	Gabon
GB	United Kingdom
GN	Guinea
GR	Greece
HU	Hungary
IE	Ireland
IT	Italy
JP	Japan
KP	Democratic People's Republic of Korea
KR	Republic of Korea
KZ	Kazakhstan
LI	Liechtenstein
LK	Sri Lanka
LU	Luxembourg
MC	Monaco
MG	Madagascar
ML	Mali
MN	Mongolia
MR	Mauritania
MW	Malawi
NL	Netherlands
NO	Norway
NZ	New Zealand
PL	Poland
PT	Portugal
RO	Romania
RU	Russian Federation
SD	Sudan
SE	Sweden
SK	Slovak Republic
SN	Senegal
SU	Soviet Union
TD	Chad
TG	Togo
UA	Ukraine
US	United States of America
VN	Viet Nam

EXTENDED CHARGE CARTRIDGE ASSEMBLY

This invention generally relates to large caliber ammunition and more particularly to armor penetrating, fin stabilized discarding sabot (APFSDS) projectile cartridges.

A large caliber APFSDS cartridge typically has a combustible case attached to a saboted long rod penetrator. The sabot has a front bore riding support or bourrelet and a rear bore riding support or bourrelet. The case is attached to the aft bourrelet on the sabot. The aft bourrelet is a solid cylindrical portion that forms a closure on the case mouth, thus retaining the propellant in the case. The front bourrelet is spaced from the case mouth and includes a scoop to catch onrushing air upon projectile exit from the gun tube. The scoop shaped front bourrelet permits onrushing air to separate the segments of the sabot from the fin stabilized long rod penetrator. The propelling gases push against the aft face of the aft bourrelet to push the projectile through the tube. When such a cartridge is inserted in the gun chamber, there is a toroidal void formed between the front and aft bourrelets and the inside surface of the gun tube. This void conventionally serves no useful function.

U.S. Patent No. 4,964,342, issued to Schleicher on October 23, 1990, discloses a sabot arrangement for an APFSDS projectile having front and aft bourrelets which has passages through the aft bourrelet. The passages through the aft bourrelet permit propelling gases to act

upon the rear face of the front bourrelet to pull the saboted projectile through the gun tube.

U.S. Patent No. 4,974,517, issued to Kraft et al on Dec. 4, 1990, discloses an APFSDS round with passages through the aft bourrelet connecting the space between the bourrelets with the propellant case. A combustible, or thin rupturable barrier separates the propellant in the case from the passage into the void between the bourrelets.

U.S. Patent No. 4,936,220, issued to Burns et al on June 26, 1990, discloses a saboted projectile having a scoop front bourrelet and a cylindrical rear bourrelet with a tubular sleeve between them made of a combustible material. Several plugged through bores through the aft bourrelet connect the toroidal cavity between the bourrelets with the rear face of the aft bourrelet. A portion of the propelling charge is contained within the toroidal cavity. This portion of the charge is sequentially ignited after ignition of the main charge by an igniter mounted in an unsealable blowout plug in the through bore or a delay charge/seal positioned in each of the through bores. The concept here is to sustain the pressure peak as the propelled projectile moves through the gun tube by providing a delayed ignition of an additional charge.

The cartridge in accordance with the invention has an additional propellant charge capacity without an additional cartridge volume. This extended capacity or propellant charge portion is contained within the toroidal space between the front and rear bourrelets of the saboted projectile and is ignited substantially simultaneously with the main charge. Simultaneous ignition is made possible with the use of a multistrand ignition assembly. The burn rate of the total

propellant charge can be optimized so as to improve projectile velocity beyond that which can presently be achieved with the conventional cartridges such as are described in the above patents.

The cartridge case is a conventional tubular case having a head end and an open end. A central bore through the head end supports a primer assembly and a separate threaded bore permits propellant loading. The case may be all metal or may be combustible with a metal head. The projectile assembly is affixed via rivits, threads, or other means to the open end of the case.

The saboted long rod penetrator projectile is an elongated cylindrical hard metal rod encircled by a sabot assembly which comprises two or more segments which grip and carry the penetrator during inbore acceleration. The sabot assembly has an outside diameter equal to the full bore of the gun tube in which the projectile is fired. The sabot assembly includes a full bore front bourrelet, an intermediate portion of less diameter, and a rear bourrelet spaced from the front bourrelet comprising a plurality of circumferentially spaced radial bore riding posts and a tubular case extension therebetween which defines a toroidal cavity beneath the extension between the bourrelets. This cavity contains a portion of the propellant charge. The remainder of the propellant charge is contained within the cartridge case.

The primer assembly in the cartridge of the present invention includes a multistrand igniter assembly and a primer head. The primer head is a threaded metal housing which contains a conventional priming element. The igniter assembly includes a unitary adapter body which holds the rear ends of a plurality of ignition strands in proximity to the discharge opening from the

primer head so as to receive the spark from ignition of the priming composition. The primer head and the adapter are threadably fastened together to join with the head of the cartridge case.

The igniter assembly comprises a single cylindrical body having a front threaded blind bore and a rear threaded blind bore and a plurality circumferentially spaced through bores which extend into the aft blind bore. Each through bore preferably has a central axis which intersects the longitudinal axis through the strand adapter in the aft blind bore. Each igniter strand is fed through a steel sleeve which is in turn inserted into the through bore so that the rear terminal end of the ignition strand communicates with the aft blind bore. The steel sleeve confines the rear end portion of the igniter strands during ignition to achieve the high order ignition propagation rate.

The plurality of ignition strands extend through the body of the case and through the propellant bed, along side the aft end of the long rod penetrator and extend through aft and front strand supports and into the cavity between the front and rear bourrelets. The rear ends of the ignition strands are confined so that a high order detonation rate is achieved within the strands. This detonation propagation rate is on the order of 3,000 to 6000 feet per second. As the cartridge case and extension is about 30 inches long, upon ignition the flame front propagates substantially instantaneously throughout the propellant bed in the case and the case extension between the front and aft bourrelets. Thus, the entire the propellant bed contained within the cartridge is ignited at the same time.

The sabot assembly in accordance with the present invention also includes a freely rotatable obturator

which has helical grooves in its outer surface adapted to engage to the corresponding rifling in a rifled gun tube. The obturator is designed to rotate about the sabot. This rotatable obturator is mounted on the front bourrelet in an appropriate circumferential channel.

The sabot assembly in accordance with the present invention also has removable arcuate bore riding shoes on the aft bourrelet. The aft bourrelet has a plurality of circumferentially spaced radially extending post portions, each receiving a bore riding shoe. Space between the post portions permits communication between the toroidal cavity between the bourrelets and the propellant charge in the cartridge case. The ignition strands in the primer assembly in accordance with the present invention extend through the spaces between the raised post portions into the cavity between the front and aft bourrelets so that the propellent contained therein can be ignited simultaneously with the main body of propellant in the case.

These and other features and advantages of the present invention will be come apparent from a reading of the following detailed description when taken in conjunction with the drawings and appended claims.

Figure 1 is a longitudinal side view, with portions sectioned, of the cartridge assembly of the invention.

Figure 2 is a partial sectional side view of the penetrator assembly in accordance with the invention.

Figure 3 is a side view of the saboted projectile assembly and case extension in accordance with the invention.

Figure 4 is a side view of the obturator in accordance with the present invention.

Figure 5 is a sectional view of the obturator shown in Figure 4.

Figure 6 is a side view of the case extension assembly in accordance with the present invention.

Figure 7 is a front view of the aft strand support.

Figure 8 is a front view of the front strand support.

Figure 9 is a side view of the front strand support shown in Figure 8.

Figure 10 is a side view of the primer assembly in accordance with the present invention.

Figure 11 is an enlarged sectional view of the strand adapter assembly in accordance with the present invention.

Figure 12 is a longitudinal sectional view of the primer head loading adapter assembly in accordance with the present invention.

A fully assembled cartridge 10 in accordance with the present invention is shown in a side view with partial sections broken away in Figure 1. Cartridge 10 basically includes a tubular case 12 having a closed head end 14 and an open mouth end 16. A projectile assembly 18 extends into and is secured to the case mouth 16. The head end 14 of the case 12 contains a central through bore 20 which is closed by a primer head loading adapter assembly 22 and a multistrand primer assembly 24. Head 14 also has a radially offset through bore 26 which is closed by a case plug 28. During assembly of the cartridge 10, a propellant 30 is loaded into the case 12 through the through bore 26. Installation of the case plug completes the assembly. The primer assembly includes a plurality of ignition strands 32 which extend through the case 12 and into the projectile assembly to provide substantially simultaneous ignition of the entire propellant bed as will be subsequently described.

Casing 12 may be an all metal body or may be a combustible case body having a metal head closing the head 14 of the cartridge 10. Casing 12 may be a straight cylindrical tube or may have the mouth end necked down to a smaller bore diameter as is shown in Figure 1. Primer head adapter assembly 22 and the multistrand primer assembly 24 are threaded together to sandwich the case head end 14 therebetween.

The projectile assembly 18 is shown partially and fully assembled in Figures 2 and 3 respectively. The projectile assembly 18 includes a long rod shaped penetrator 40 which has a pointed front tip 42 and a fin assembly 44 attached to the rear of the penetrator 40. The penetrator 40 has an externally threaded portion 46. The long rod penetrator 40 is preferably made of tungsten or other hard metal material, and the tip 42 comprises a plastic aerodynamic shroud.

Referring now to Figures 2 and 3, the threaded portion 46 of the penetrator 40 is encircled by a sabot assembly 48 which has three 120° sabot segments 50. Each sabot segment 50 has a front bourrelet portion 52, a rearwardly tapered central portion 54, an aft bourrelet 56, and a tapered rear portion 58. The segments 50 may be made of any desired material such as a composite plastic material or a light weight metal material such a aluminum. Each sabot segment 50 has two flat radial faces 60 which extend axially from front to rear. The segments 50 are joined with faces 60 abutting one another around the penetrator 40 to form full bore sabot 48.

The front bourrelet 52 of the sabot 48 has a scoop shaped front face 62. An annular metal bourrelet ring 64 having a U-shaped cross section is fastened via bolts 66 to the outer periphery of the scoop shaped front face

62 of the sabot segments 50 to hold the front bourrelet portions 52 together. The aft end of the sabot segments 50 are held together by a retaining band 68 which is pressed over the rear end of the segments placed around the penetrator 40. An aft seal sleeve 70 preferably formed of rubber or RTV is formed as by molding in place over the tapered rear portion 58 of the sabot 48 after the retaining band 68 is installed. This seal primarily protects the rear of the sabot 48 from the heat of the combustion gases during the ballistic cycle.

The front bourrelet 52 of the sabot 48 has a cylindrical outer bore riding portion 72 adjacent the bourrelet ring 62. Bourrelet 52 also has an annular U shaped channel 74 and a rearwardly extending flange 75 behind the bore riding portion 72. A seal band 76 preferably made of polypropylene and which preferably has an L shaped cross section is installed within the channel 74. The band 76 is preferably heated and stretched to snap fit over an outwardly projecting annular retaining ridge 78 between the flange 75 and the channel 74 into the channel 74. The band 76 then cools and shrinks in place. This band provides a low friction support for an annular obturator 80 as is shown in Figures 3, 4 and 5.

The obturator 80, shown in a side view in FIgure 4, is installed over the seal band 76 in the channel 74 in a similar manner. The obturator 80 is preferably made of Zytel 101 nylon and has a cross section as shown in Figure 5. Obturator 80 has a body portion 82 with a generally rectangular cross section and an outwardly flared annular flexible sealing portion 84. The flexible sealing portion 84 has a series of helical grooves 86 which complement and engage corresponding lands in the rifled gun tube of the cannon in which the

cartridge of the invention is loaded. The body portion 82 slidably rotates on the seal band 76 in the annular channel 74 to permit the helical grooves 86 to engage with the corresponding lands in the rifled gun tube. During the ballistic ignition and acceleration phase, the obturator spins to maintain the projectile/bore seal without imparting significant spin to the projectile itself. The grooves 86 are omitted from the obturator if the cartridge of the invention is designed for use in a smooth bore gun such as the 120 mm cannon.

Referring again to Figure 2, each sabot segment 50 has an axially extending C shaped groove 88 in the radial face 60 extending from the annular channel 74 rearward adjacent the outer surface of the sabot segment 50 to the rear of the tapered rear portion 58. When the segments 50 are joined, these grooves 88 match to form a passage extending from the channel 74 to the rear portion 58. This passage is filled with a sealant material such as JRTV during assembly of the sabot segments on the penetrator 40 in order to completely seal the sabot projectile assembly along each of the joints between the segments 50.

Referring now to Figures 1 through 3, the projectile assembly 18 includes the penetrator 40, the sabot assembly 48, and an outer case extension assembly 90. The outer case extension assembly 90 includes a case extension 92 which is a combustible sleeve that fits over the aft bourrelet 56. The front end of the case extension 92 fits under the flexible sealing portion 84 of the obturator 80 and over the annular ledge 75 so as to butt up against the ridge 78. A tubular combustible case extension support 94 is adhesively fastened to the inside of case extension 92. The case extension support 94 is a combustible sleeve which has a plurality of

circumferentially spaced holes 96 in an after skirt portion 98 for fastening the skirt portion 98 to the mouth 16 of the cartridge case 12 with expansion rivets 100.

The case extension support 94 and case extension 92 are secured to the sabot segments 50 via three sabot shoes 102 which are bolted onto the aft bourrelet 56 of each sabot segment 50. The sabot shoes 102 each have a curved, rectangular, outer bore riding surface portion 104 having a surface curvature corresponding to the land to land diameter of the gun bore. The sabot shoe 102 further has a keyed base portion 106 which fits into a correspondingly notched outwardly extending portion or post 108 of the aft bourrelet 56.

Each sabot shoe base portion 106 also fits, as shown in Figure 6, through a corresponding rectangular cutout 110 in the case extension support 94. The outer surface portion 104 of the sabot shoe 102 correspondingly fits within a cutout 112 in the case extension 92. The sabot shoes 102 firmly lock the case extension support 94 and case extension 92 firmly in place on the sabot 48.

Referring again to FIgure 3, assembled, the projectile assembly 18 defines a toroidal cavity 114 that is open, via the space between the sabot shoes 102 and the post portions 108 of the aft bourrelet 56, to the interior of the projectile casing 12. The cavity 114 is bounded by the inside surface of the combustible case extension assembly 90, the front bourrelet 52, the central portion 54, and the aft bourrelet 56. Accordingly, propellant 30, loaded into the case 12 through the loading bore 26, also enters into and fills the toroidal cavity 114 during loading. Thus the toroidal cavity 114 formed by the case extension assembly 90 surrounding the sabot 48 operably extends

the length of the propellant containing case, and its volume, up to the aft face of the front bourrelet 52.

Adhesively glued to the rear annular face of the case extension support 94 is a front ignition strand support 116. The front ignition strand support 116 is shown separately in front and side views in Figures 8 and 9 respectively. The front ignition strand support 116 is a flat annular body of combustible material such as nitrocellulose having three radially widened portions 118 extending inward and symmetrically spaced around the perimeter of the body 116. Each of the widened portions 118 has a pair of holes 119 therethrough. These holes are sized to receive and support individual ignition strands as will be subsequently described. The front strand support 116 is positioned against and glued to the aft face of the case extension support 94 so that the widened portions are between the shoes 102 and thus directly in line into the toroidal cavity 114.

The multistrand primer assembly 24 is shown assembled in the cartridge 10 in Figure 1 and separated from case 12 in Figure 10. Primer assembly 24 includes a generally cylindrical metal strand adapter assembly 120 to which is connected a plurality of ITLX ignition strands 32, preferably six, each spaced 60° from one another about a central axis A. The ignition strands 32 are plastic tubes containing a fast burning ITLX ignition cord structure which is preferably commercially available from Atlas Powder Company. The strands 32 are described in detail in U.S. Patent No. 4,917,017, issued to Donald R. Beltz on April 17, 1990.

A cylindrical fin support shaft 122 has one end threadably connected to the strand adapter assembly 120 and the other end threadably connected to a fin support finger assembly 124. Fin support finger assembly 124

has preferably 3 axially extending fingers 126 which slidably extend between the fins of the fin assembly 44 attached to the rear end of the penetrator 40. The fin support shaft and fin support finger assembly 124 are designed to permit movement of the penetrator 40 of the projectile assembly 18 only in an axial direction out of the projectile case 12 and thus provide lateral support to the aft end of the projectile assembly 18.

An aft strand support 130 made of a combustible casing material such as felted nitrocellulose, is slidably fastened to the fin support shaft 122 and holds a mid-portion of the igniter strands 32 in a spaced relation about the central axis A.

In the embodiment shown in Figures 1 and 10, only 1 support 130 is shown. Depending on the case length, more may be placed on the fin support shaft 122. The aft strand support 130 is a flat body having six radially extending legs 132 extending symmetrically from a disk shaped entrance portion 134 having a central through bore 136. Each leg 132 terminates in a hole 138 through which the ignition strand 32 passes. The aft strand support 130 is thus a flat spider shaped support which maintains the ignition strands 32 in a circumferentially and radially spaced position during assembly, storage, loading, and use of the cartridge 10 in accordance with the present invention.

The strand adapter assembly 120 is shown in Figure 10 and in an enlarged view, in Figure 11. The strand adapter assembly 120 comprises a generally cylindrical metal body 140 having a front threaded blind bore 142 which receives the rear end of the fin support shaft 122 and threaded blind bore 144 through the aft end of the strand adapter body 140. Six radially symmetrical through bores 146 extend through the strand adapter body

140 between the blind bores and into the aft blind bore 144. The blind bores 146 are preferably equally spaced circumferentially about the axis A and preferably extend into the threaded blind bore 144 at an angle so that the axis bore intersect axis A at a common point.

A strand adapter lock 148 is frictionally press fit into each bore 146. Each adaptor lock 148 is at least approximately 1½ inches long. The aft end 150 of each ignition strand 32 is pushed through the strand adapter lock 148. The ends 150 extend slightly beyond the inner ends of the strand adapter locks 148 and communicate with the aft blind bore 144.

The primer head loading adapter assembly 22 is threaded into the threaded blind bore 144 to fasten the primer assembly 24 to the case head 14 as shown in Figure 1. As shown in Figure 12, the primer head loading adapter assembly 22 comprises a metal threaded plug primer head 160 which has an ignition element assembly 162 mounted therein and insulated therefrom. The ignition element assembly 162 includes an ignition charge and may contain a bridge wire that ignites an ignition charge 164 of black powder when electrical current is passed through the wire. The flame from the ignited charge 164 passes through a conical cavity in a plug 166 which is threaded into the primer head 160.

Cartridge 10 in accordance with the present invention requires a different assembly procedure than is currently utilized in most ammunition. In most conventional ammunition construction, the primer assembly is loaded into the case, propellant is added, and finally the projectile assembly is inserted into and fastened to the case mouth. Alternatively, where a combustible cartridge case is utilized, the combustible case may be fastened to the rear of the projectile

assembly and inverted. Loose propellant or propellant sticks are then inserted around the fin assembly on the projectile within the case. The case stub tube or head is then snap fit, adhesively bonded, or threaded onto the combustible cartridge case. Finally, a primer is threaded into the case base or head to complete the assembly.

In contrast, the cartridge 10 according to the present invention requires assembly of the entire cartridge assembly first and then finally, loading of the propellant. Assembly of the cartridge of the present invention proceeds generally as follows. The three sabot segments 50 are position around the threaded portion 46 of the long rod penetrator 40. The retaining band 68 is then pressed onto the rear tapered portion 58 of the sabot 48. The bourrelet ring 62 is then bolted via bolts 64 to the front bourrelet 52. RTV is then force fed through the passage formed by grooves 88, and the aft seal sleeve 70 is molded in place on the tapered rear portion 58.

The seal band 76, preferably made of polypropylene, is heated and then stretched over ridge 78 and into annular channel 74 on the front bourrelet 52 and allowed to cool. The obturator 80 is then similarly heated and then snapped over and onto the seal band 76 in the annular channel 74 and allowed to cool.

Next, the case extension support 94 and case extension 92 are adhesively bonded together and the assembly 90 slid over the rear end of the sabot 50 so that the front end of the case extension 92 fits under the lip 84 of the obturator 80 onto ledge 75 so as to abut ridge 78. The front strand support 116 is then adhesively bonded to the rear skirt portion 98 of the case extension support 94.

Finally, fin assembly 44 is then threadably installed on the rear end of penetrator 40 and the sabot shoes 102 are threadably installed onto the outer post portions 108 of the aft bourrelet 56 to complete the assembly of the case and projectile assembly 18 as shown in Figure 3.

The primer assembly 24 is assembled separately. The fin support finger assembly 124 is threaded onto the front end of the fin support shaft 122 and aft strand support 132 is then slid on to the fin support shaft 122 threading the fin support shaft 122 is then threaded into the blind bore 142 of the strand adapter 140. The six strand adapter locks 148 are then pressed into bores 146 and the rear ends of the igniter strands 32 are pressed through the strand adapter locks 148 so that the ends 150 communicate into the threaded blind bore 144 of the strand adapter 140. Alternately, the ends 150 of the strands 32 may be inserted into the adapter locks 148 first and then installed in the bores 146. The forward ends of the igniter strands 32 are each fed through hole 138 in the arm 134 on the aft support 132. This completes the assembly of the primer assembly 24.

The primer assembly 24 is then slidably mounted onto the projectile assembly 18 by sliding the fin support fingers 126 between the fins 128 as shown in Figure 1. The front ends 180 of the ignition strands 32 are then each fed through the corresponding holes 119 in the front ignition strand support 116 so as to extend well within the cavity 114. An O-ring 168 is then installed in the O-ring groove 170 on the strand adapter assembly and the case 12 is slid over the primer assembly 24 and onto the aft end of the projectile assembly 18. The case 12 is then rotated so that the holes in the case mouth 16 correspond to the holes 96 in the skirt portion

98 of the case extension support 94 are aligned. Expansion rivets 100 are then installed to secure the case 12 to the projectile assembly 118. The primer head adapter assembly 22 is then threaded into the threaded blind bore 144 in the strand adapter 140 to fasten the primer assembly 24 to the case head 14.

Finally, the charge of granular propellant 30 is loaded through the bore 26 in the head 14 and the case plug 28 is installed to complete assembly of the cartridge 10.

It is to be understood that the above described embodiments of the invention are illustrative only. Modifications throughout may occur to those skilled in the art. Accordingly, it is intended that the invention is not to be limited to the embodiments disclosed herein but is defined by the scope and fair meaning of the appended claims.

WHAT IS CLAIMED IS:

1. A sabot (48) for an elongated subcaliber projectile (40) having a plurality of arcuate segments (50), each segment characterized by:

an arcuate scoop shaped front bourrelet (52);

an aft bourrelet (56) spaced axially from said front bourrelet (52); and

a rearwardly tapered intermediate portion (54) between said bourrelets; and

a rearwardly tapered aft portion (58) extending behind said aft bourrelet;

said aft bourrelet having a single post (108) extending radially outward and terminating in an arcuate bore riding shoe (102).

2. In a cartridge assembly (10) for propelling a projectile assembly (18) from a tubular cartridge case (12) including a primer head (120) and containing a propellant charge (30) through a gun tube, said projectile assembly (18) characterized by:

a subcaliber elongated rod shaped penetrator (40);

a segmented sabot (48) encircling and gripping a portion (46) of said penetrator, said sabot having a generally annular front bourrelet (52) adapted to provide a pressure barrier between said penetrator (40) and the gun tube and an aft bourrelet (56) spaced rearwardly from said front bourrelet (52) having a plurality of circumferentially spaced post (108) and shoe (102) portions providing spaced lateral support to the portion (46) of the penetrator (40); and

a combustible tubular case extension (90) over said sabot segments (50) between said bourrelets (52, 56) forming an annular cavity (114) thereunder open to the interior of said tubular cartridge case (12) between said post portions (108) of said aft bourrelet (56), said cavity containing a portion of said propellant charge (30).

3. The assembly according to claim 2 characterized in that comprising a plurality of flexible combustible ignition strands (32) extending from said primer head (120) through said case (12) and said charge (30) into said cavity (114) between said bourrelets and into said portion of said charge.

4. A cartridge assembly (10) for propelling a projectile assembly (18) through a gun tube, said assembly characterized by:

a tubular case (12) having a primer (22) in one end and having an opposite open end (16), said projectile assembly (10) extending into and out of said case (12) through said open end (16);

said projectile assembly (18) including a subcaliber elongated penetrator (40) and a sabot (48) encircling and gripping said penetrator (40), said sabot (48) having a front bourrelet (52) outside of said case providing a pressure barrier between said penetrator and said gun tube and an aft bourrelet (56) spaced rearwardly from said front bourrelet providing circumferentially spaced lateral support to a portion (46) of said penetrator, and a tubular combustible case extension (90) having one end attached to said open end of said case, said case extension extending beyond said case between said bourrelets to form a toroidal cavity (114) therebetween about said sabot;

a propellant charge (30) in said case and in said toroidal cavity (114); and

an ignition assembly (24) supported within said case extending from said primer (22) through said propellant charge (30) and into said toroidal cavity (114) so as to ignite said propellant (30) in said toroidal cavity substantially concurrently with said propellant in said case.

5. The assembly according to claim 4 characterized in that said toroidal cavity (114) is open through said aft bourrelet (56) into said case.

6. The assembly according to claim 5 characterized in that said aft bourrelet (56) further comprises at least three outwardly projecting and circumferentially spaced post portions (108) each having an arcuate bore riding sabot shoe (102) mounted thereto.

7. The assembly according to claim 4 characterized in that said case extension (90) has a tubular rear portion (98) fastened to said open end (16) of said case (12) and to said aft bourrelet (56) of said sabot (48) to secure said projectile assembly (40) to said case (12).

8. The assembly according to claim 7 characterized in that said case extension (90) has a tubular front end portion (92) engaging said front bourrelet (52).

9. The assembly according to claim 8 characterized in that said assembly further comprises an annular obturator (80) rotatably mounted on said front bourrelet.

10. The assembly according to claim 9 characterized in that said obturator (80) has a rearwardly flared annular lip (84) having spaced grooves (86) in an outer surface thereof for engaging rifling in said gun tube.

11. The assembly according to claim 9 characterized in that said obturator (80) is mounted on a plastic seal band (76) having an L shaped cross section disposed in an annular channel (74) in an outer surface (72) of said front bourrelet (52).

12. The assembly according to claim 11 characterized in that wherein said front end portion (92) of said case extension (90) overlaps an annular flange (75) on said front bourrelet (52) and abuts against a raised annular rib (78) between said flange and said channel (74).

13. The assembly according to claim 8 characterized in that said rear portion (98) of said case extension (90) is a tubular support sleeve of combustible material slidably disposed in and bonded to said tubular case extension (90).

14. The assembly according to claim 4 characterized in that said ignition assembly (24) comprises:

a cylindrical igniter strand adapter body (120) having an open end (144) adapted to mate and engage with said said primer (22), an internal ignition chamber (166) adapted to communicate with an ignition charge (164) in said primer, a plurality of through bores (146) extending through said adapter (120) into said chamber (166), and a tubular metal sleeve (148) pressed into each of said bores;

said plurality of flexible ignition strands (32) each having one end frictionally clamped by and extending through one of said tubular sleeves (148) so as to communicate into said ignition chamber (166), each of said sleeves (150) confining a rear portion of said strand at said end in order to generate a high order propagation rate upon ignition.

15. The assembly according to claim 14 characterized in that said toroidal cavity (114) is open through said aft bourrelet (56) into said case.

16. The assembly according to claim 15 characterized in that said aft bourrelet (56) further comprises at least three outwardly projecting and circumferentially spaced post portions (108) each having an arcuate bore riding sabot shoe (102) mounted thereto.

17. The assembly according to claim 14 characterized in that said case extension (90) has a tubular rear portion (98) fastened to said open end (16) of said case (12) and to said aft bourrelet (56) of said sabot (48) to secure said projectile assembly (40) to said case (12).

18. The assembly according to claim 17 characterized in that said case extension (90) has a tubular front end portion (92) engaging said front bourrelet (52).

19. The assembly according to claim 18 characterized in that said assembly further comprises an annular obturator (80) rotatably mounted on said front bourrelet (52).

20. The assembly according to claim 19 characterized in that said obturator (80) has a rearwardly flared annular lip (84) having spaced grooves (86) in an outer surface thereof for engaging rifling in a gun tube.

21. The assembly according to claim 19 characterized in that said obturator is mounted on a plastic seal band (76) having an L shaped cross section disposed in an annular channel (74) in an outer surface (72) of said front bourrelet (52).

22. The assembly according to claim 21 characterized in that said front end portion (92) of said case extension (90) overlaps an annular flange (75) on said front bourrelet (52) and abuts against a raised annular rib (78) between said flange (75) and said channel (74).

23. The assembly according to claim 18 characterized in that said rear portion (98) of said case extension (90) is a tubular support sleeve of combustible material slidably disposed in and bonded to said tubular case extension (90).

24. A cannon cartridge propellant ignition assembly (120) for connecting to a primer head (22) in a cartridge case (12), said head containing an ignition device (162) and an ignition charge (164) therein, said assembly characterized by:

a solid igniter strand adapter body (140) having an open end (144) adapted to mate and engage with said said primer head (22), an internal ignition chamber (166) adapted to communicate with said ignition charge (164), a plurality of through bores (146) extending through said adapter body (140) into said chamber (150);

a tubular metal sleeve (148) pressed into each of said bores (146); and

a plurality of flexible ignition strands (32) each having one end (150) frictionally clamped by and extending through one of said tubular sleeves (148) so as to communicate into said ignition chamber (166), each of said sleeves (148) confining a portion of each of said strands (32) at said end (150) in order to generate a high order propagation rate upon ignition.

25. A method of cannon cartridge assembly characterized by the steps of:

a) providing a projectile assembly (18) having an elongated penetrator (40) surrounded by a segmented sabot (48) having a front bourrelet (52) and an aft bourrelet (56);

b) mounting an igniter assembly (24) on the rear of said penetrator, a portion of said assembly (24) extending between said bourrelets;

c) installing a tubular case extension (90) over said rear bourrelet (56) and onto said front bourrelet (52) so as to form an annular cavity (114) thereunder;

d) sliding a tubular cartridge case (12), having an open front end (16) and a closed rear end (14) with first (20) and second (26) apertures through said rear end of said tubular case, over the aft bourrelet (56) of said penetrator (40) so that said front bourrelet (52) fits onto said case extension (90);

e) inserting a primer head (22) through the first aperture (20) through the rear end (14) of said tubular case (12) so as to engage said igniter assembly (24) and fasten said igniter assembly (24), said case (12), and said primer head (22) together;

f) loading a propellant charge (30) into said case and said annular cavity through said second aperture (26); and

g) installing a plug (28) into said second aperture (26) to complete assembly of and close said cartridge.

26. The method according to claim 25 characterized in that said step of installing further comprises of mounting a plurality of bore riding shoes (102) on said aft bourrelet (56) so as to fasten said case extension (90) to said sabot (48).

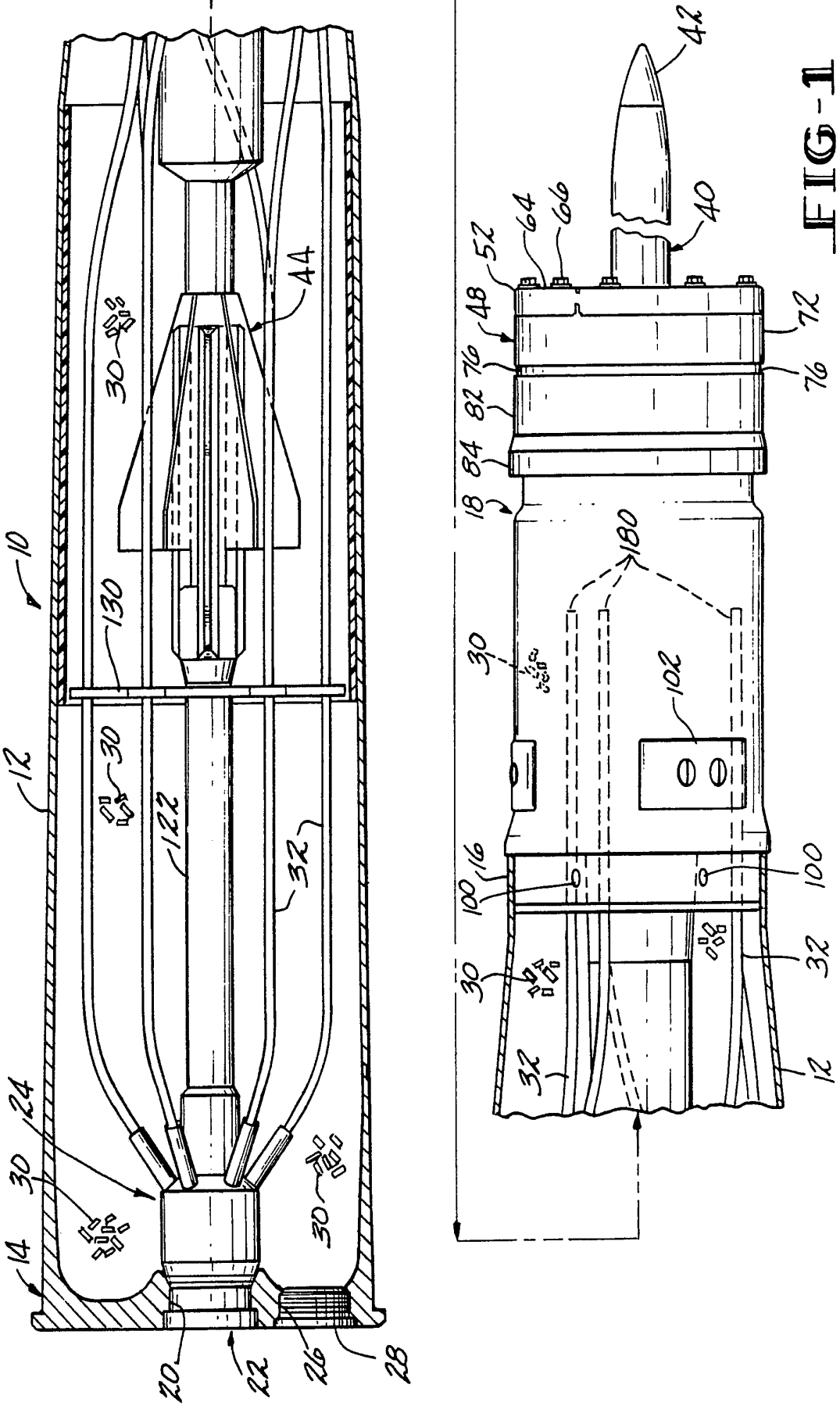

42
40
64
66
52
48
72
76
76
82
84
18
180
30
102
16
100
100
32
12
10
44
130
122
124
14
20
22
26
28

FIG-1

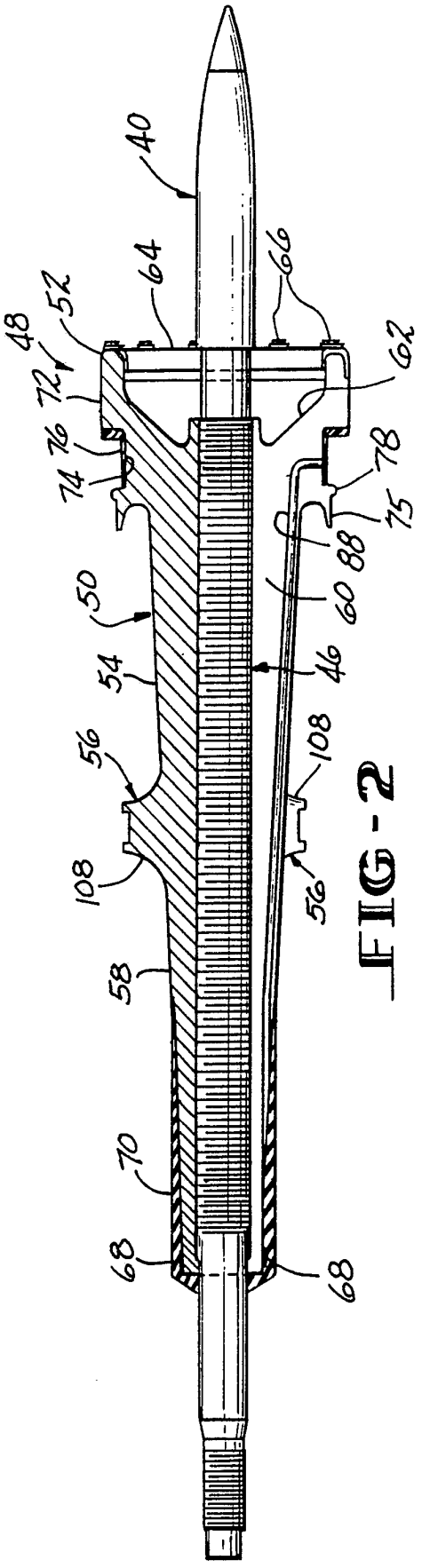

40
64
66
52
48
72
62
76
74
78
75
88
60
50
54
46
56
108
108
56
58
70
68
68

FIG - 2

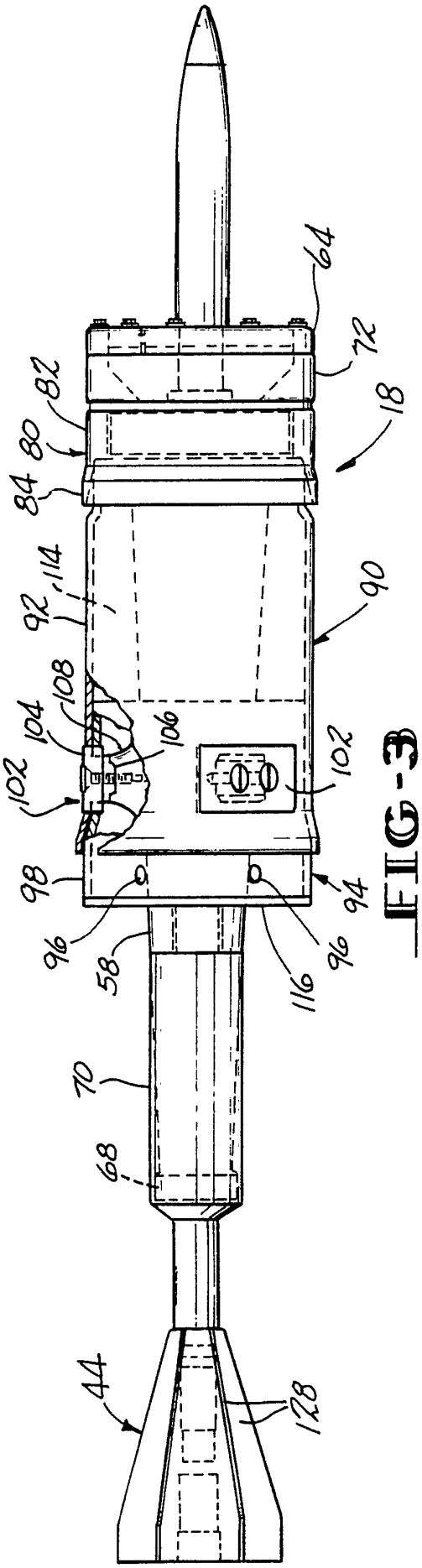

64
72
82
80
18
84
92
114
90
108
104
106
102
102
98
94
96
96
58
116
70
68
44
128

FIG - 3

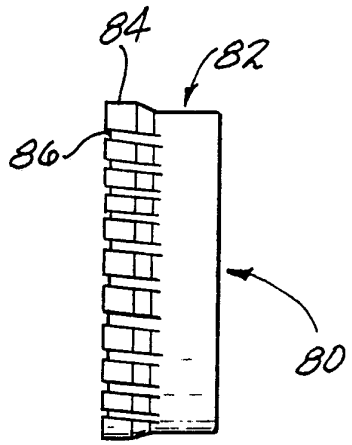


FIG-4

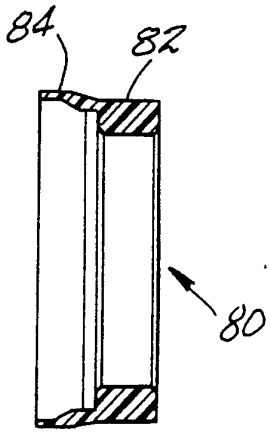


FIG-5

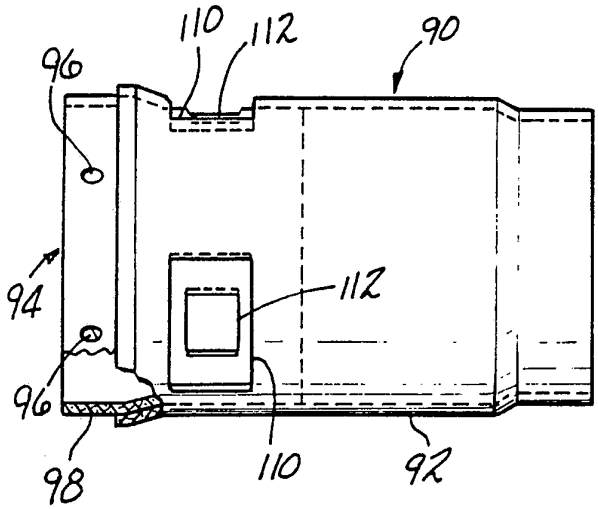


FIG-6

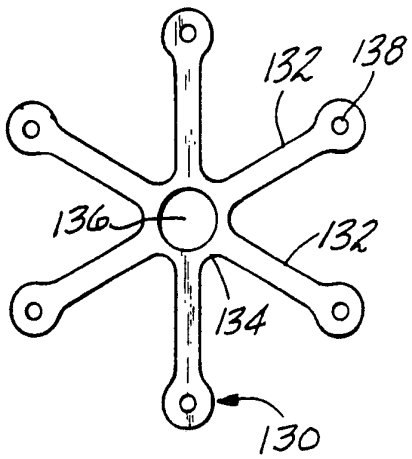


FIG-7

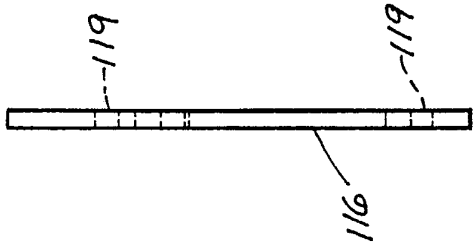


FIG-9

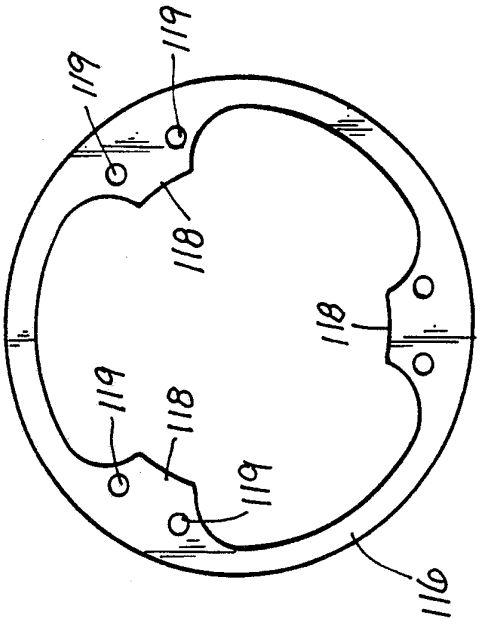


FIG-8

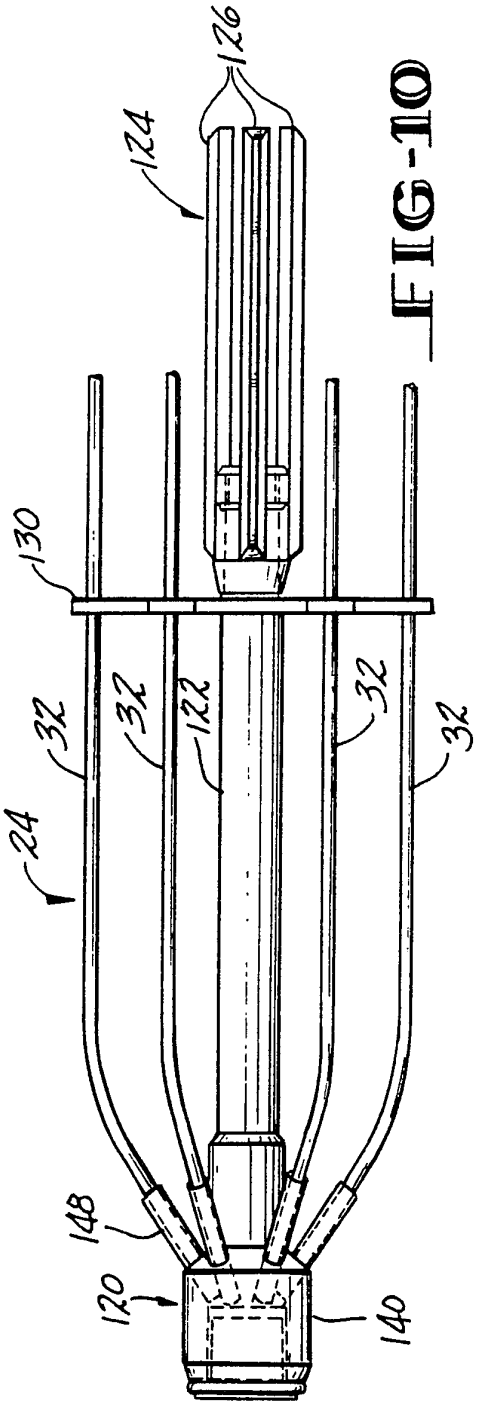


FIG-10

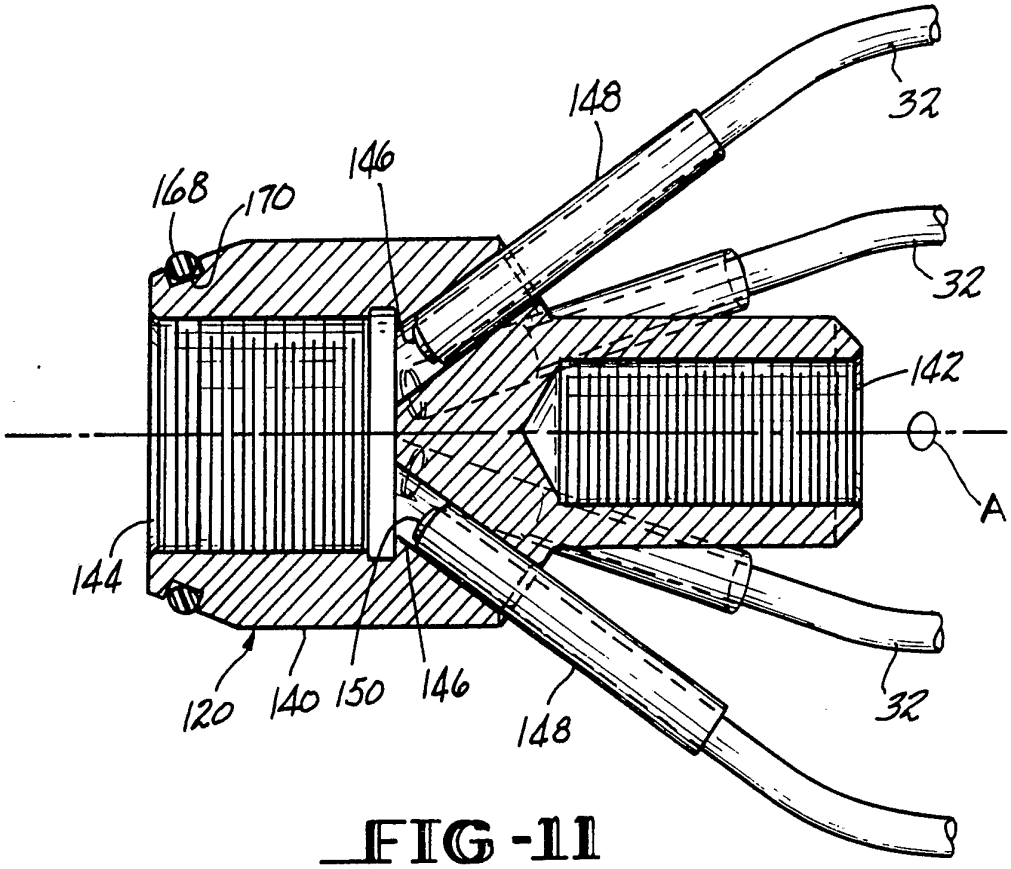

148
32
146
168
170
32
142
A
144
120
140
150
146
148
32

FIG -11

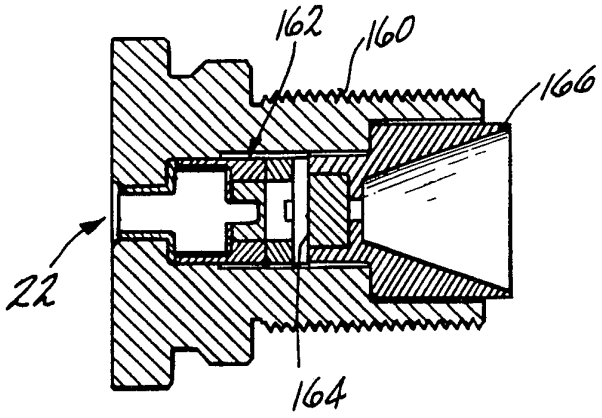

162
160
166
22
164

FIG -12

INTERNATIONAL SEARCH REPORT

International application No.
PCT/US92/10175

A. CLASSIFICATION OF SUBJECT MATTER

IPC(5) :F42B 5/02,5/067,5/26,14/06;C06B 21/00
US CL :102/439,470,521;86/1.1
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)

U.S. : 86/1.1 102/430,439,467,470,520-523,275.1,275.4-275.8

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 practicable, 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.
X	US,A, 4,444,114 (Bisping et al) 24 April 1984 (See col. 2, line 51 Col. 4, line).	1
X,&	US,A, 4,542,696 (Bisping et al) 24 September 1985 (See col. 2, line 59; col. 4, line 14).	1
A	US,A, 4,917,017 (Beltz) 17 April 1990.	2-26
A	US,A, 4,936,220 (Burns et al.) 26 June 1990.	2-23
A	US,A, 4,964,342 (Schleicher) 23 October 1990.	1
A	US,A, 4,974,517 (Kroft et al.) 04 December 1990.	1

[X] Further documents are listed in the continuation of Box C. [ ] See patent family annex.

*	Special categories of cited documents:	"T"	later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention
"A"	document defining the general state of the art which is not considered to be part of particular relevance	"X"	document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone
"E"	earlier document published on or after the international filing date	"Y"	document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art
"L"	document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)	"&"	document member of the same patent family
"O"	document referring to an oral disclosure, use, exhibition or other means		
"P"	document published prior to the international filing date but later than the priority date claimed		

Date of the actual completion of the international search	Date of mailing of the international search report
11 MARCH 1993	26 MAR 1993

Name and mailing address of the ISA/US	Authorized officer
Commissioner of Patents and Trademarks Box PCT Washington, D.C. 20231	For DAVID H. BROWN Agatha Nguyen AGATHA NGUYEN INTERNATIONAL DIVISION
Facsimile No. NOT APPLICABLE	Telephone No. (703) 308-0506

Form PCT/ISA/210 (second sheet)(July 1992)*

INTERNATIONAL SEARCH REPORT

International application No.
PCT/US92/10175

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, H940 (Roller) 06 August 1991.	2-26
A,P	US,A, 5,129,324 (Campoli) 14 July 1992.	2-26
A,P,&	US,A, 5,155,295 (Campoli) 13 October 1992.	2-26

INTERNATIONAL SEARCH REPORT

International application No.
PCT/US92/10175

Box I Observations where certain claims were found unsearchable (Continuation of item 1 of first sheet)

This international report has not been established in respect of certain claims under Article 17(2)(a) for the following reasons:

1. ☐ Claims Nos.:
because they relate to subject matter not required to be searched by this Authority, namely:

2. ☐ Claims Nos.:
because they relate to parts of the international application that do not comply with the prescribed requirements to such an extent that no meaningful international search can be carried out, specifically:

3. ☐ Claims Nos.:
because they are dependent claims and are not drafted in accordance with the second and third sentences of Rule 6.4(a).

Box II Observations where unity of invention is lacking (Continuation of item 2 of first sheet)

This International Searching Authority found multiple inventions in this international application, as follows:
(Form PCT/ISA/206 Previously Mailed.)

Group I, claim 1, drawn to a sabot for a subcaliber projectile, classified in class 102, subclass 521.

Group II, claims 2-23, 25&26 drawn to a cartridge assembly and method of making including projectile structure, classified in Class 102, subclass 439.

Group III, claim 24, drawn to a propellant ignition assembly breech end structure, classified in Class 102, subclass 469.

1. ☒ As all required additional search fees were timely paid by the applicant, this international search report covers all searchable claims.

2. ☐ As all searchable claims could be searched without effort justifying an additional fee, this Authority did not invite payment of any additional fee.

3. ☐ As only some of the required additional search fees were timely paid by the applicant, this international search report covers only those claims for which fees were paid, specifically claims Nos.:

4. ☐ No required additional search fees were timely paid by the applicant. Consequently, this international search report is restricted to the invention first mentioned in the claims; it is covered by claims Nos.:

Remark on Protest

☐ The additional search fees were accompanied by the applicant's protest.

☐ No protest accompanied the payment of additional search fees.