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Description

This invention relates generally to ammunition and more particularly to a unitary charge module for separate ammunition used in large caliber artillery.

Large caliber gun ammunition (such as is used on naval ships) does not normally have a single, unitary cartridge but instead typically includes two separate components: (a) a projectile and (b) one or more separate bags or containers of propellant. The projectile and the propellant containers are sequentially loaded into the breech of the gun either by hand or automatically. The effective range of the projectile can be selected by the choice of how many bags or containers of propellant are loaded into the gun.

Early separate propellant charge containers were typically bags of either silk or cotton which had pockets to contain the ignition charge at one end. Typical designs of such containers are described in U.S. Patents 864,725; 1,329,503; 1,625,631; 2,405,104; and 3,771,460.

A more recent patent, U.S. Patent No. 4,282,813 discloses a unitary propellant charge formed in a cylindrical shape having a central bore along its axis for propagating a primer flash. The charge contains a priming charge at one end and has an outer coating of a heat shrinkable polyester film such as mylar. This unitary charge is not designed for use where multiple charges are employed.

Current propellant charge containers are made today so that they are interchangeable in terms of orientation. That is, they are axially symmetrical and radially symmetrical about the longitudinal axis so that several can be loaded and they can be loaded in the dark without danger of incorrect front to back orientation. Typical of such charge containers are those disclosed in U.S. Patents 4,702,167, 4,864,932, and 4,922,823.

U.S. Patents 4,702,167 and 4,864,932 also disclose a unitary propellant charge having a cylindrical shape with a central bore therethrough. However, in these patents, the charge, composed of black powder, surrounds a tubular igniter or a stack of self centering rings made of extruded porous nitrocellulose or an admixture of nitrocellulose and a known primer charge such as boron/potassium nitrate powder. The main charge of black powder is contained in an annular envelope which uses the igniter as the inner wall. This arrangement permits stacking without alignment problems and allows variation of the total propellant quantity by loading multiple charges in a gun.

U.S. Patent No. 4,922,823 discloses an igniter charge for a unitary propellant charge module such as is disclosed in the last described patents in which the igniter is made of a composite of an inner igniter tube and an outer support tube. Both tubes are made of extruded propellant powders and may be separately pressed in a mold to form the tubes. The igniter and support tubes are then adhesively bonded together. Alternatively the two tubes may be coextruded together. The igniter charge is then assembled into an annular main charge container.

One problem with such separate ammunition charge modules using conventional propellants such as black powder or nitrocellulose based extruded propellant formulations such as JA2 and M30 is the high sensitivity of these propellants to shock and their high flame temperatures. This combination results in a relatively high vulnerability of these propellants to the effects of shape charge attack. In addition, the high flame temperatures severely limits the potential rate of cannon fire and barrel life.

US-A-3 092 525 discloses a method for preparing a one-piece propellant powder charge wherein granular propellant powder grains are mixed with a plasticizer and pressed until the grains adhere together to form a consolidated body of individual grains. The charges show the burning characteristics of a loose powder. This document describes the preamble of claim 1.

It is therefore an object of the present invention to provide an improved unitary charge module of separate ammunition.

It is another object of the present invention to provide a unitary propellant charge module that has improved resistivity to shock impulses.

It is another object of the invention to provide an improved unitary propellant charge to extend barrel life of the gun in which the charge is fired.

It is another object of the invention to provide a unitary charge module of compacted spherical or spheroidal propellant grains.

It is another object of the invention to provide a unitary propellant charge having a center core igniter of compacted spherical or spheroidal propellant grains.

It is another object of the invention to provide a unitary propellant charge of compacted spherical or spheroidal propellant requiring no separate combustible case enclosing the charge.

These objects are achieved by the unitary propellant charge module claimed in claim 1. Particularly advantageous embodiments of the charge module of the present invention are subject matter of the dependent claims.

A solid compacted igniter charge having a tubular shape is disposed in the central bore. The igniter charge is an annular right circular cylinder also of compacted spherical or spheroidal propellant grains which lines the central bore through the charge module. However, in this case, each of the grains has an unrolled grain diameter of between about 0.51 mm to about 2.54 mm (20 to about 100 mils) in diameter and preferably between about 1.016 mm to about 1.778 mm (40 to about 70 mils) in diameter. A suitable spherical propellant for the igniter is BALL POWDER®

model No. WC 615, also available from Olin Corporation. However, the propellant actually used should be specifically tailored to the specific application on a case by case basis to optimize ignition. The igniter charge propagates the ignition flame front axially at a greater speed than the radial burn rate of the charge so that the entire charge burns symmetrically radially outwardly eliminating major pressure oscillations during ignition of the main propellant charge.

The above and other features and advantages of the invention will become more readily apparent from the following description it being understood that any feature described with reference to one embodiment of the invention can be used where possible with any other embodiment.

Figure 1 is a sectional view through a first embodiment of the unitary charge module in accordance with the present invention.

Figure 2 is a sectional view of the module shown in Figure 1 taken on the line 2-2.

Figure 3 is a side partial sectional view of an alternative embodiment of a center core igniter for use in the unitary charge module in accordance with the present invention.

Figure 4 is a side sectional view of a second embodiment of the unitary charge module in accordance with the present invention.

Figure 5 is a side sectional view of a third alternative embodiment of the unitary charge module in accordance with the invention.

"Spherical" and "spheroidal" as used herein also includes oblate spheroidal (i.e. with flattened ends like a partially inflated beach ball). As shown in Figures 1 and 2, a first embodiment of the unitary charge module 10 of the invention has a cylindrical annular main charge body 12 with a center core igniter 13 contained within a two piece combustible case 14 having a top member 16 and a bottom member 18 so shaped so that the top member slides into bottom member 18 to enclose the main charge body 12. The center core igniter 13 forms an inner wall lining a central bore 22 through the main charge 12.

The unitary charge module 10 in accordance with the invention is axially and radially symmetrical about its longitudinal axis A so that one or more of the modules may be inserted into the breech of a gun with either end first. This symmetry permits simple, fast handling procedures and eliminates the consequences of misorientation. This symmetry also simplifies multiple charge loading to vary the range of the projectile fired from the gun as well as increased firing rates and reduced barrel wear as will be subsequently described.

The main charge 12 is a compacted body of rolled or unrolled spherical or spheroidal propellant powder, preferably BALL POWDER® model No. WC950. The powder has an unrolled grain size of at least 2.54 mm (100 mils) in diameter and is preferably compacted after being softened on the grain surface by soaking the uncompacted grains in a solvent such as butyl acetate sufficient to make the surface of the grains tacky. The grains are then compacted to form the main charge body. The main charge 12 is thus a porous body made of interconnected spheroids of propellant. The interconnected grains may also be made by coating the propellant grains with a surface adhesive prior to compaction thus eliminating the need for a solvent.

The grains are preferably between about 3.05 mm and 4.06 mm (120 and 160 mils) in diameter. In particular, 3.81 mm (150 mil) grains are preferably compacted to form the unitary charge module intended to be used in the M199 cannon, a 155mm howitzer.

The use of large spherical or spheroidal or oblate spheroidal propellant is critical to the performance of the unitary charge module in accordance with the invention. Spheroidal propellants such as BALL POWDER® propellant result in much lower gun gas temperatures than comparable conventional propellants such as JA2 and M31A1E1. For example, M31A1E1 powder, presently used in the 155mm howitzer, has a flame temperature of about 2700° Kelvin. The BALL POWDER® propellant of the invention having a 3.81 mm (150 mil) grain size also has an average flame temperature of about 2700 Kelvin. However, the BALL POWDER® propellant has a burn rate deterrent outer layer. This deterrent layer results in much lower mean gun gas temperatures and lower chamber pressures. For example, the predicted mean gun gas temperature using compacted BALL POWDER® propellant is less than 2000 Kelvin. In contrast, M31A1E1 propellant use yields temperatures well in excess of 2000 Kelvin, peaking at about 2600 Kelvin. These lower temperatures and pressures resulting from the use of BALL POWDER® propellant compacted into the unitary charge module of the invention are expected to translate into significant improvements in barrel life and permissible rates of fire.

The top and bottom container members 16 and 18 are formed from conventional combustible case materials such as cellulose fibers impregnated with nitrocellulose and a resin binder. The members may be overlapping as shown in Figure 1 or may be butt joined. In the latter case they would by joined with a suitable combustible adhesive. These members provide moisture protection and abrasion protection during handling and field storage of the unitary charge module.

The center core igniter 13 is a tubular solid body 20 also formed of compressed spherical or spheroidal or oblate spheroidal propellant powder having an unrolled grain size of between about 0.51 mm (20 mils) to less than about 2.54 mm (100 mils) and more preferably between about 1.016 mm to about 1.778 mm (40 to about 70 mils). The tubular body 20 is thus a porous body made of interconnected spheroids of propellant. The propellant in the center core igniter 13

preferably is an undeterred spherical or spheroidal propellant so that the primer flash is propagated almost instantaneously along the igniter length. The tubular body 20 may be adhesively or frictionally fit within the bore 22 through the main charge 12. A central passage 23 through the center core igniter body 20 directs passage of the primer flame front (not shown) upon ignition. This passage may be clear or may be used to contain strands of ignition materials such as benite.

The solid igniter body 20 is formed in the same manner as the main charge body 12 by the addition of a solventless binder (adhesive) or a solvent such as butyl acetate to the uncompressed grains. In either case, the coated grains become tacky. They are then compressed to form the solid igniter body 20 and the excess solvent is removed.

The container members 16 and 18 are not structurally required for the unitary charge module in accordance with the invention. The main charge 12 is a solid body which is self supporting. The compressed BALL POWDER® propellant of the main charge 12 retains its granular character however, and, upon ignition, deflagrates as a loose powder.

As shown in Figure 4, a second embodiment of the unitary charge module of the invention may simply comprise a main charge 12 containing a center core igniter 13 without the casing 14. In this alternative embodiment, abrasion and moisture protection may be provided by a thin coating 30 of mylar, lacquer, rubber, a polyurethane system, or other combustible material applied after the compressed body is formed and the excess solvent removed. The coating, if applied as a liquid, dries to form a protective film on the exterior of the main charge.

A similar protective coating 32 may be applied to the inside and or outside surface of the center core igniter 13 prior to its installation into the bore 22 in the main charge 12. This coating 32 may also include burn rate modifiers to tailor the overall burn rate to a specific gun's requirements.

An alternative embodiment of the center core igniter is illustrated in Figure 3. In this embodiment the igniter 24 includes a sleeve 26 of combustible case material around the tubular body 20 of the igniter. The sleeve has a plurality of apertures 28 along its length to direct the ignition flame into the main charge. A plurality of benite strands 29 are centrally disposed in the central bore 23 through the tubular body 20.

The tubular body 20 of both the center core igniters 13 and 24 and the main charge 12 are formed by the same general process. The rolled (oblate spheroidal) or unrolled (spherical or spheroidal) propellant grains are coated with a nitrocellulose solvent such as butyl acetate. Butyl acetate has been found to be the preferred solvent. However, other similar solvents may be used such as ethyl acetate or acetone.

The solvent diffuses into the surface of the grains. The grains can then be conditioned at a temperature of between about 1.67°C to 10.0°C (35° to 50° Fahrenheit) to prevent excessive solvent migration. The propellant grains are then reconditioned to about 21.1°C (70°F) and compressed in a mold to form the cylindrical shape of the main charge 12 or the center core igniter body 20. Finally, the excess solvent is then driven off.

A third embodiment of the unitary charge module in accordance with the invention is shown in Figure 5. The module 40 is a right circular cylindrical main charge body 42 made of compacted BALL POWDER® propellant. The body 42 has a central through bore 44 along its longitudinal axis. This through bore 44 has a constricted central portion 46 between two opposite end portions 48 and 50. The end portions 48 and 50 each have a greater radius than the central portion 46 to accomodate an igniter support tube 52 and an igniter ring 54 at the outer ends of the bore 44. The igniter support tubes 52 and the igniter rings 54 have outer diameters sized to snugly fit into the end portions 48 and 50 of the through bore 44 and have inner diameters preferably matching the diameter of the constricted central portion 46 of the main charge body 42.

The main charge body 42 is encased preferably by a moisture proof outer composite casing 56 made of combustible fibers. The central bore 44 is similarly lined with an inner channel casing 58. The casing 56 and liner 58 provide moisture and abrasion protection during module handling. The casing and liner may also be applied as a liquid or shrink-wrap coating and thus may be very thin and light weight.

The main charge is formed as above described in the previous embodiments and also preferably utilizes BALL POWDER® propellant grains having an unrolled grain size of about 3.81 mm (150 mils).

The igniter support tubes 52 are made of compacted BALL POWDER® propellant having a grain size between about 1.016 mm and 1.778 mm (40 and 70 mils) and are also formed as previously described. The igniter support tubes thus extend only partially along the through bore 44. This arrangement provides an alternative way to vary the ignition rate of the propellant in the main charge by varying the surface area of the main charge directly exposed to the ignition flame front. Thus the length of the ignition support tubes can be chosen so as to optimize the ignition geometry within the module.

The ignition rings 54 at each end of the central bore 44 are preferably formed of compressed fine grain undeterred spherical or spheroidal or oblate spheroidal propellant or black powder so as to couple the initial primer flash rapidly into the igniter support tube. This arrangement increases the module to module ignition sensitivity.

Claims

1. A unitary propellant charge module (10;40) for use in separate ammunition comprising a solid, porous, self-supporting charge body (12;42) of interconnected compacted spherical or spheroidal propellant grains,
characterized in that
each of said charge body grains has an unrolled propellant grain diameter of at least 2.54 mm (100 mils) and said charge body (12;42), upon ignition, burns symmetrically radially outward from a central axial bore (22;44) therethrough generating a mean gas temperature of less than 2000 K.

2. The module (10;40) according to claim 1
characterized in that
said charge body (12;42) has a right circular cylinder shape symmetrical about said central axial bore (22;44) therethrough.

3. The module (10;40) according to claim 1 or 2 further characterized by a solid compacted igniter charge (20,54) disposed in said bore (22;44)
characterized in that
said igniter charge is an annular right circular cylinder of compacted spherical or spheroidal propellant grains, each of said igniter charge grains having an unrolled grain diameter of between about 0.51 mm (20 mils) to less than 2.54 mm (100 mils).

4. The module (10;40) according to any one of claims 1 to 3
characterized by
a combustible casing (17;56) enclosing said body (12;42).

5. The module (10;40) according to claim 4
characterized in that
said casing (14) is a two piece container (16,18).

6. The module (10;40) according to any one of claims 1 - 5
characterized in that
the unrolled diameter of said charge body grains is between 3.05 and 4.06 mm (120 and 160 mils).

7. The module (10;40) according to any one of claims 3 - 6,
characterized in that
the unrolled diameter of said igniter charge grains is between about 1.016 and 1.778 mm (40 and 70 mils).

8. The module (10;40) according to any one of claims 3 - 7
characterized by
said igniter body (20) having an outer sleeve (26) made of combustible fiber material around said igniter body, said sleeve having a plurality of apertures (28) therethrough.

9. The module (10;40) according to any one of claims 3 - 8, further
characterized by
a plurality of igniter strands (29) disposed within said tubular igniter body (20).

10. The module (10;40) according to any one of claims 5 - 9
characterized in that
said casing container is a coating (30) applied to the exterior of said charge (12,42).

11. The module (10;40) according to claim 10
characterized in that
said coating (30) is a polyurethane system.

12. The module (10;40) according to any one of claims 3 - 11
characterized in that
said igniter body (20) has an exterior coating (32) of a moisture proofing material.

13. The module (10;40) according to any one of claims 3 - 12 further
characterized by
at least one igniter ring (54) axially disposed adjacent said igniter body within said bore.

14. The module (10;40) according to claim 13 further
characterized by
a pair of igniter rings (54) at opposite ends of said central bore (44).

15. The module (10;40) according to any one of claims 1 - 14
characterized in that
said bore (44) has a constricted middle portion(46) having a generally uniform diameter separating two larger diameter end portions (48,50), each of said end portions receiving and retaining a tubular igniter body (20) adjacent said middle portion (46) and an igniter ring (54) adjacent said igniter body.

16. The module (10;40) according to claim 15
characterized in that
said igniter ring (54) and said igniter body (20) each have an inner diameter approximately matching the diameter of said constricted middle portion (46).

Patentansprüche

1. Eine Einheit bildender Treibladungsmodul (10; 40) zur Verwendung in Einzelmunition, mit einem massiven, porösen, selbsttragenden Ladungskörper (12; 42) aus miteinander verbundenen, verdichteten kugelförmigen oder kugeligen Treibladungspartikeln,
dadurch gekennzeichnet,
daß jeder der Ladungskörperpartikel einen ungewalzten Treibladungspartikel-Durchmesser von wenigstens 2,54 mm (100 Mil) aufweist, und daß der Ladungskörper (12; 42) bei der Zündung von einer sich durch diesen hindurcherstreckenden, zentralen axialen Bohrung (22; 44) symmetrisch radial nach außen abbrennt und dabei eine mittlere Gastemperatur von weniger als 2000 K erzeugt.

2. Modul (10; 40) nach Anspruch 1,
dadurch gekennzeichnet,
daß der Ladungskörper (12; 42) eine gerade, kreisförmige Zylinderform aufweist, die symmetrisch um die sich durch diesen hindurcherstreckende, zentrale axiale Bohrung (22; 44) ist.

3. Modul (10; 40) nach Anspruch 1 oder 2,
weiterhin gekennzeichnet durch
eine massive, verdichtete Zünderladung (20; 54), die in der Bohrung (22; 44) angeordnet ist, sowie dadurch gekennzeichnet, daß es sich bei der Zünderladung um einen ringförmigen geraden kreisförmigen Zylinder aus verdichteten kugelförmigen oder kugeligen Treibladungspartikeln handelt, wobei jeder der Zünderladungspartikel einen ungewalzten Korndurchmesser von ca. 0,51 mm (20 Mil) bis weniger als 2,54 mm (100 Mil) aufweist.

4. Modul (10; 40) nach einem der Ansprüche 1 bis 3,
gekennzeichnet durch
eine brennbare Hülse (17; 56), die den Körper (12; 42) umschließt.

5. Modul (10; 40) nach Anspruch 4,
dadurch gekennzeichnet,
daß es sich bei der Hülse (14) um ein zweiteiliges Behältnis (16; 18) handelt.

6. Modul (10; 40) nach einem der Ansprüche 1 bis 5,
dadurch gekennzeichnet, daß der ungewalzte Durchmesser der Ladungskörperpartikel 3,05 bis 4,06 mm (120 bis 160 Mil) beträgt.

7. Modul (10; 40) nach einem der Ansprüche 3 bis 6,
dadurch gekennzeichnet,
daß der ungewalzte Durchmesser der Zünderladungspartikel ca. 1,016 bis 1,778 mm (40 bis 70 Mil) beträgt.

8. Modul (10; 40) nach einem der Ansprüche 3 bis 7,
dadurch gekennzeichnet,
daß der Zünderkörper (20) eine aus brennbarem Fasermaterial gebildete, äußere Hülse (26) um den Zünderkörper herum aufweist, wobei sich eine Vielzahl von Öffnungen (28) durch die Hülse hindurcherstreckt.

9. Modul (10; 40) nach einem der Ansprüche 3 bis 8,
weiterhin gekennzeichnet durch
eine Anzahl von Zündsträngen (29), die in dem rohrförmigen Zünderkörper (20) angeordnet sind.

10. Modul (10; 40) nach einem der Ansprüche 5 bis 9,
dadurch gekennzeichnet,
daß es sich bei dem Hülsenbehältnis um einen auf die Außenfläche der Ladung (12; 42) aufgebrachten Überzug (30) handelt.

11. Modul (10; 40) nach Anspruch 10,
dadurch gekennzeichnet,
daß es sich bei dem Überzug (30) um ein Polyurethansystem handelt.

12. Modul (10; 40) nach einem der Ansprüche 3 bis 11,
dadurch gekennzeichnet,
daß der Zünderkörper (20) einen äußeren Überzug (32) aus einem feuchtigkeitsfesten Material aufweist.

13. Modul (10; 40) nach einem der Ansprüche 3 bis 12,
weiterhin gekennzeichnet durch
wenigstens einen Zünderring (54), der dem Zünderkörper axial benachbart in der Bohrung angeordnet ist.

14. Modul (10; 40) nach Anspruch 13,
weiterhin gekennzeichnet
durch ein Paar Zünderringe (54) an einander gegenüberliegenden Enden der zentralen Bohrung (44).

15. Modul (10; 40) nach einem der Ansprüche 1 bis 14,
dadurch gekennzeichnet,
daß die Bohrung (44) einen verengten Mittelbereich (46) mit einem allgemein gleichmäßigen

Durchmesser aufweist, der zwei Endbereiche (48, 50) größeren Durchmessers voneinander trennt, wobei jeder der Endbereiche einen rohrförmigen Zünderkörper (20) angrenzend an den Mittelbereich (46) sowie einen Zünderring (54) angrenzend an den Zünderkörper aufnimmt und festhält.

16. Modul (10; 40) nach Anspruch 15, **dadurch gekennzeichnet,** daß der Zünderring (54) und der Zünderkörper (20) jeweils einen Innendurchmesser aufweisen, der in etwa an den Durchmesser des verengten Mittelbereichs (46) angepaßt ist.

Revendications

1. Module unitaire (10 ; 40) de charge de matière propulsive destiné à être utilisé dans des munitions séparées comprenant un corps plein et poreux d'une charge cohérente (12 ; 42), formé de grains de matière propulsive sphériques ou sphéroïdaux tassés et interconnectés, caractérisé en ce que chacun des grains du corps de la charge a un diamètre de grain non roulé d'au moins 2,54 mm (100 mil) et le corps de la charge (12 ; 42) , après allumage, brûle symétriquement en direction radiale vers l'extérieur depuis un trou axial central (22 ; 44) qui le traverse en donnant une température moyenne du gaz inférieure à 2 000 K.

2. Module (10 ; 40) selon la revendication 1, caractérisé en ce que le corps de la charge (12, 42) a une forme de cylindre de section droite circulaire symétrique autour du trou axial central (22 ; 44) qui le traverse.

3. Module (10 ; 40) selon la revendication 1 ou 2, caractérisé en outre par une charge solide et tassée (20, 54) d'allumeur disposée dans le trou (22 ; 44), caractérisé en ce que la charge d'allumeur est un cylindre annulaire de section droite circulaire formé de grains sphériques ou sphéroïdaux tassés de matière propulsive, chacun des grains de la charge d'allumeur ayant un diamètre de grain non roulé compris entre environ 0,51 mm (20 mil) et moins de 2,54 mm (100 mil).

4. Module (10 ; 40) selon l'une quelconque des revendications 1 à 3, caractérisé par une douille combustible (17 ; 56) entourant le corps (12 ; 42).

5. Module (10 ; 40) selon la revendication 4, caractérisé en ce que la douille (14) est formée d'un récipient en deux parties (16, 18).

6. Module (10 ; 40) selon l'une des revendications 1 à 5, caractérisé en ce que le diamètre des grains du corps de la charge, à l'état non roulé, est compris entre 3,05 et 4,06 mm (120 à 160 mil).

7. Module (10 ; 40) selon l'une quelconque des revendications 3 à 6, caractérisé en ce que le diamètre des grains non roulés de la charge d'allumeur est compris entre environ 1,016 et 1,778 mm (40 à 70 mil).

8. Module (10 ; 40) selon l'une quelconque des revendications 3 à 7, caractérisé en ce que le corps d'allumeur (20) possède un manchon externe (26) formé d'un matériau de fibres combustibles placé autour du corps d'allumeur, le manchon ayant plusieurs orifices (28) qui le traversent.

9. Module (10 ; 40) selon l'une quelconque des revendications 3 à 8, caractérisé en outre par plusieurs brins (29) d'allumeur placés à l'intérieur du corps tubulaire d'allumeur (20).

10. Module (10 ; 40) selon l'une quelconque des revendications 5 à 9, caractérisé en ce que le récipient de la douille est un revêtement (30) appliqué à l'extérieur de la charge (12, 42).

11. Module (10 ; 40) selon la revendication 10, caractérisé en ce que le revêtement (30) appartient au système des polyuréthannes.

12. Module (10 ; 40) selon l'une quelconque des revendications 3 à 11, caractérisé en ce que le corps d'allumeur (20) a un revêtement externe (32) d'un matériau de protection contre l'humidité.

13. Module (10 ; 40) selon l'une quelconque des revendications 3 à 12, caractérisé en outre par au moins un anneau (54) d'allumeur disposé axialement près du corps d'allumeur dans le trou.

14. Module (10 ; 40) selon la revendication 13, caractérisé en outre par une paire d'anneaux (54) d'allumeur placés aux extrémités opposées du trou central (44).

15. Module (10 ; 40) selon l'une quelconque des revendications 1 à 14, caractérisé en ce que le trou (44) a une partie médiane rétrécie (46) de diamètre uniforme de façon générale, séparant deux parties d'extrémité (48, 50) de plus grand diamètre, chacune des parties d'extrémité logeant et retenant un corps tubulaire d'allumeur (20) adjacent à la partie médiane (46) et un anneau d'allumeur (54) adjacent au corps d'allumeur.

16. Module (10 ; 40) selon la revendication 15, caractérisé en ce que l'anneau d'allumeur (54) et le corps d'allumeur (20) ont chacun un diamètre interne correspondant approximativement au diamètre de la partie médiane rétrécie (46).

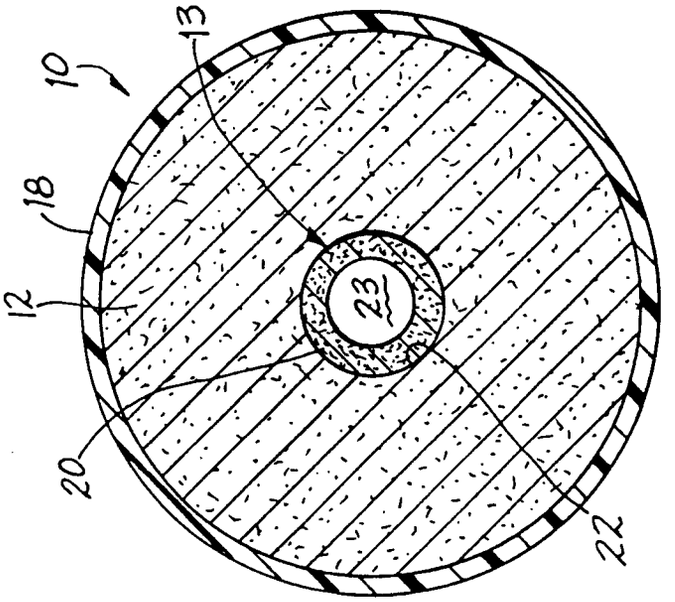


FIG-2

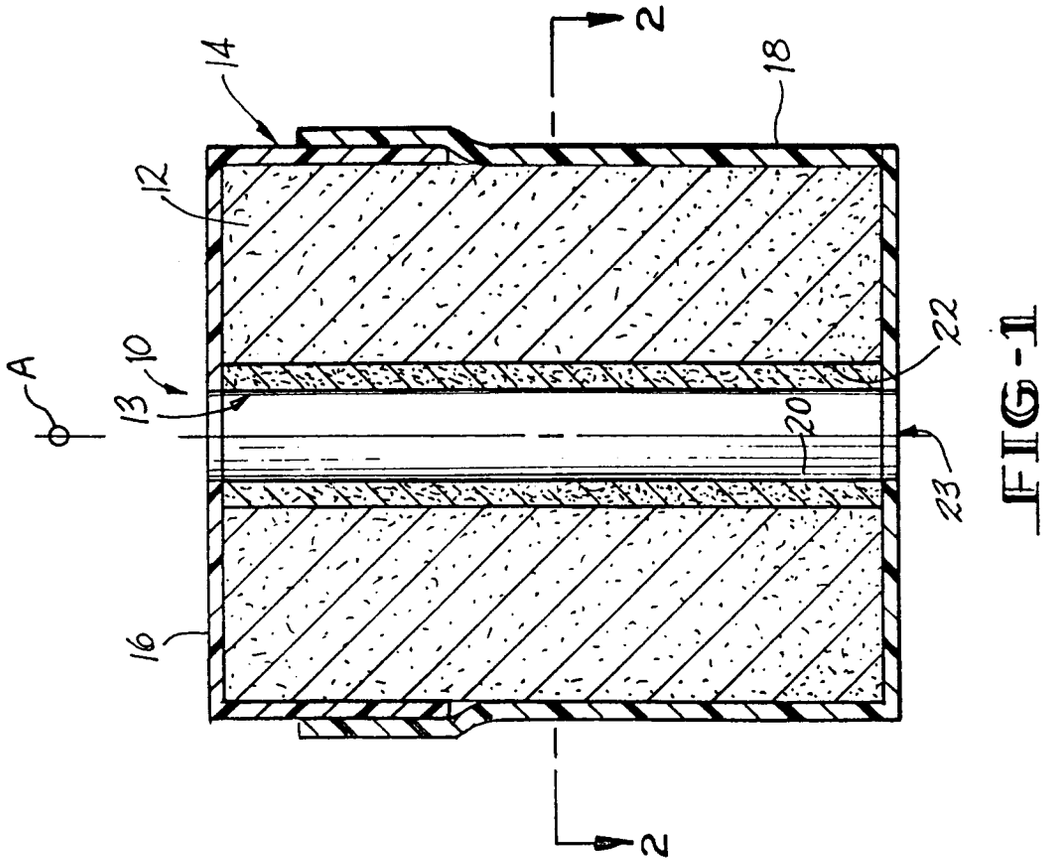


FIG-1

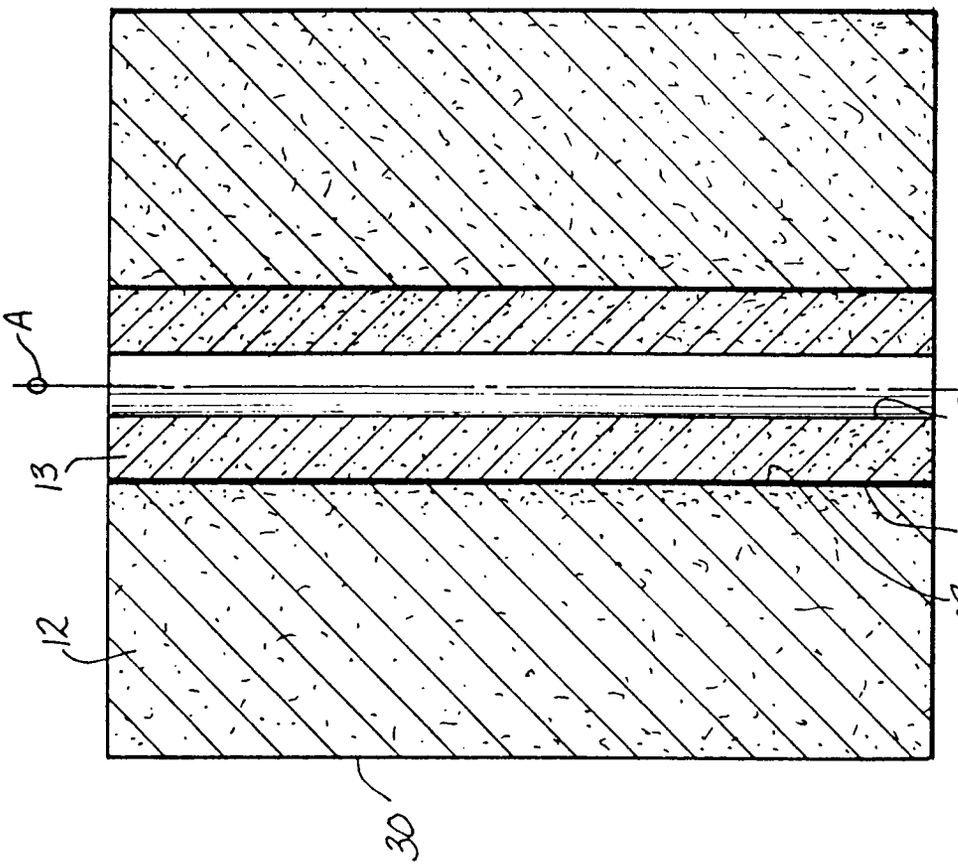


FIG-4

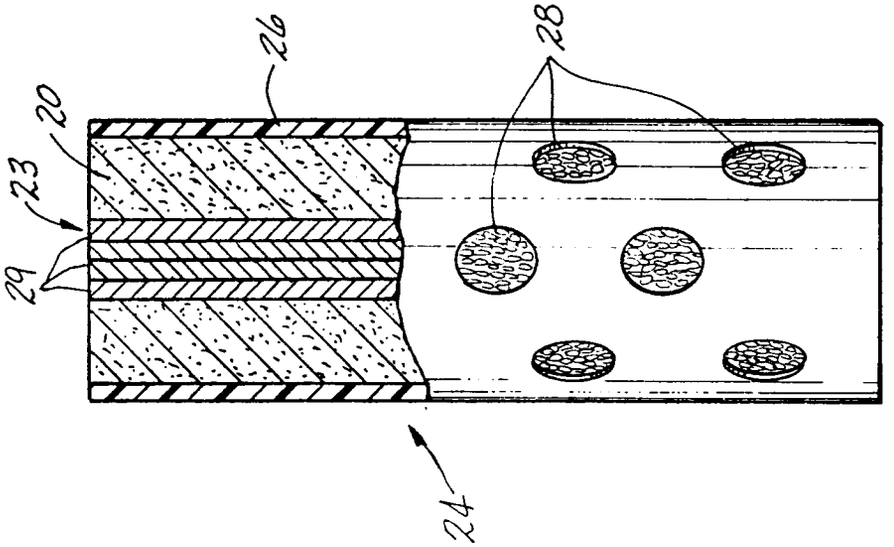


FIG-3

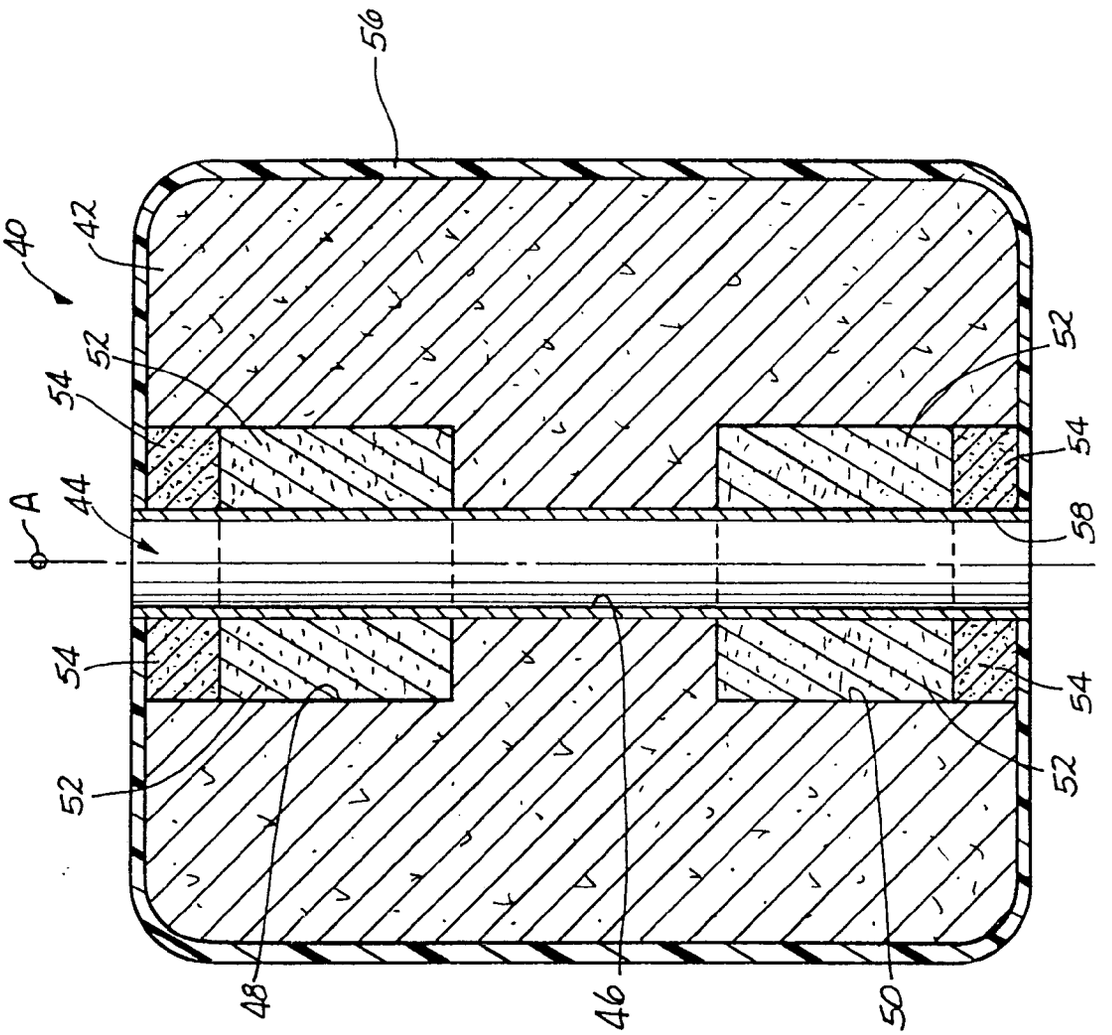


FIG-5