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(54) Title: AN INTEGRATED AMMUNITION CARTRIDGE

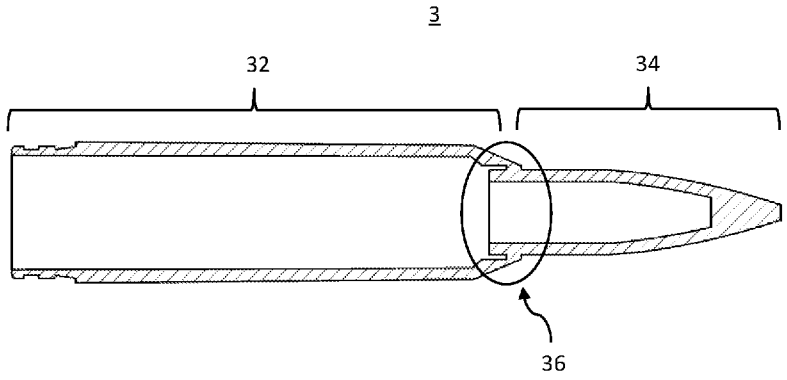


Figure 3

(57) **Abstract:** According to some embodiments of the present invention, an ammunition cartridge is provided herein. The ammunition cartridge may include a cartridge enclosure comprising a cartridge case portion and a jacket portion, wherein the jacket portion is configured to accommodate at least one projectile filling; and a base, connectable to the cartridge enclosure, wherein the base comprises an ignition device, wherein the cartridge enclosure comprises a section configured to control the detachment of at least some of the jacket portion from the cartridge case. According to some embodiments of the present invention, another ammunition cartridge is provided herein. The ammunition cartridge may include: a cartridge case portion; and a jacket portion, wherein the jacket portion is configured to accommodate at least one projectile filling, wherein the jacket portion is made of at least one of: polymer material, and composite material.

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AN INTEGRATED AMMUNITION CARTRIDGE

FIELD OF THE INVENTION

The present invention relates to ammunition cartridges. More particularly, the present invention relates to integrated ammunition cartridges.

BACKGROUND OF THE INVENTION

Figure 1 illustrates a conventional ammunition article according to the prior art. Conventional ammunition article typically includes four basic and separate components, that is: the projectile **14**, the cartridge case **10** holding projectile **14** therein, a primer **11**, and a propellant **12**, wherein a primer **11** provides the spark needed to ignite propellant **12** used to build a pressure and push projectile **14** down the barrel at predetermined velocities.

The cartridge components are manufactured in separate processes and then joined together and sealed with a sealing compound **18** for the purpose of meeting environmental and shelf-life requirements of ammunition.

The primary objective of the cartridge case **10** is to hold the projectile **14**, primer **11**, and propellant **12** therein until the gun is fired. Upon firing of the gun, the cartridge case **10** seals the chamber to prevent hot gases from escaping the chamber in a rearward direction. The empty cartridge case is extracted from the chamber once the gun is fired.

Cartridge case **10** is configured to hold projectile **14** by crimping or adherent connection **18** (between the case mouth and the bullet) to create a predetermined resistance, which is known in the industry and defined in the standards as bullet pull force. The bullet pull force is uninform due to tolerance differences between the two separated components (bullet and case) and due to crimping deviation and thus effect the ballistic performance of the cartridge.

Most of the current cartridge cases are formed from metals (brass, steel etc.) and some are made from polymeric or composite materials or based on them. The cartridge cases can have variety shapes and configurations, depending on the caliber of the ammunition.

The structure of the projectile usually includes a metal jacket (brass, or steel) and at least one core which integrated into it. The ballistics performance of the ammunition cartridges are significantly affected by the geometry of the projectile and by the type and number of the cores or projectile fillings integrated in it. For example, a different ballistic performance is required for different kind of ammunition: armor piercing, sniper ammunition or high stopping power and the like.

It should be noted that currently available manufacture process of the metal jackets is limiting the variety of possible geometries and shapes of the bullets.

SUMMARY OF THE INVENTION

In order to address the aforementioned challenges of the conventional ammunition cartridge, it is an object of some embodiments of the present invention to provide a structure of ammunition cartridge which may include an enclosure in which the case and the jacket portions form a single part. The ammunition structure in accordance with some embodiments of the present invention give rise to numerous advantages and may eliminate many potential failures of ammunition, for example, improper cartridge sealing, elimination of bullet pull-force deviation, flexibility in the bullet shape geometry, reduction of the manufacturing stages/cost and the like.

According to some embodiments of the present invention, an ammunition cartridge is provided herein. The ammunition cartridge may include a cartridge enclosure comprising a cartridge case portion and a jacket portion, wherein the jacket portion is configured to accommodate at least one projectile filling, wherein the cartridge case portion is suitable for accommodating propellent powder; and a base, connectable to the cartridge enclosure, wherein the base is configured to accommodate an ignition device, wherein the base is a distinct element from the cartridge enclosure, wherein the cartridge enclosure comprises a section configured to control the detachment of at least some of the jacket portion from the cartridge.

According to some embodiments of the present invention, another ammunition cartridge is provided herein. The ammunition cartridge may include: a cartridge case portion suitable for accommodating propellent powder; and a jacket portion, wherein the jacket portion accommodates at least one projectile filling, wherein the jacket portion is made of at least one of: polymer material, and composite material.

BRIEF DESCRIPTION OF THE DRAWINGS

The subject matter regarded as the invention is particularly pointed out and distinctly claimed in the concluding portion of the specification. The invention, however, both as to organization and method of operation, together with objects, features, and advantages thereof, may best be understood by reference to the following detailed description when read with the accompanying drawings in which:

Figure 1 illustrates a conventional ammunition cartridge according to the prior art;

Figure 2 illustrates an assembled ammunition having a monolithic enclosure, a base, a projectile core and a propellant, according to some embodiments of the present invention;

Figure 3 illustrates a monolithic enclosure for an ammunition cartridge, having a case portion, a jacket portion, and a detachment area therebetween, according to some embodiments of the present invention;

Figure 4A illustrates a jacket portion which is partially open at the tail of the projectile core, being the side facing the base, according to some embodiments of the invention;

Figure 4B illustrates a jacket portion which is partially open at the head of the projection core, according to some embodiments of the invention;

Figure 4C illustrates a jacket portion which is partially open at the head and at the tail of the projectile filling, according to some embodiments of the invention;

Figures 5A-5D illustrate various jacket portions with detachment areas according to various embodiments of the present invention;

Figure 6A illustrates a projectile having a projectile filling and a standalone jacket in accordance with some embodiments of the present invention; and

Figure 6B illustrates the projectile of **figure 6A** attached to a jacket portion of an enclosure for ammunition cartridge according to some embodiments of the present invention.

It will be appreciated that, for simplicity and clarity of illustration, elements shown in the figures have not necessarily been drawn to scale. For example, the dimensions of some of the elements may be exaggerated relative to other elements for clarity. Further, where considered appropriate, reference numerals may be repeated among the figures to indicate corresponding or analogous elements.

DETAILED DESCRIPTION OF THE INVENTION

In the following detailed description, numerous specific details are set forth in order to provide a thorough understanding of the invention. However, it will be understood by those skilled in the art that the present invention may be practiced without these specific details. In other instances, well-known methods, procedures, and components, modules, units and/or circuits have not been described in detail so as not to obscure the invention. Some features or elements described with respect to one embodiment may be combined with features or elements described with respect to other embodiments. For the sake of clarity, discussion of same or similar features or elements may not be repeated.

Although embodiments of the invention are not limited in this regard, the terms “plurality” and “a plurality” as used herein may include, for example, “multiple” or “two or more”. The terms “plurality” or “a plurality” may be used throughout the specification to describe two or more components, devices, elements, units, parameters, or the like. The term set when used herein may include one or more items.

Unless explicitly stated, the method embodiments described herein are not constrained to a particular order or sequence. Additionally, some of the described method embodiments or

elements thereof can occur or be performed simultaneously, at the same point in time, or concurrently.

Prior to setting forth the detailed description of the invention, it may be helpful to provide definitions of certain terms which will be used hereinafter.

The term "ammunition cartridge" or simply "cartridge" as used herein relate to pre-assembled firearm ammunition article which packages together a projectile (bullet, shot, or slug), a propellant substance and an ignition device within a metallic, paper, or polymeric case that is precisely made to fit within the barrel chamber of a breechloading gun, for the practical purpose of convenient transportation and handling during shooting.

The term "cartridge case" is a portion of an article of ammunition which remains at the firearm and ejected therefrom after the projectile has been discharged from the cartridge upon combustion of the propellant.

The term "projectile" as used herein is defined as a portion that is detached from the cartridge upon combustion of the propellent and which is effectively fired out of the firearm's barrel.

The term "enclosure" or "cartridge enclosure" is a portion of the ammunition cartridge which is attached to the base on one end and contains the propellant and is configured to discharge the projectile upon combustion of the propellant.

The terms "projectile core" or "projectile filling" or simply "filling" as used herein are defined as one or more portions or materials which fill the distal part of the enclosure opposite the base or the ignition device and forms a major part of the projectile, together with the jacket portion (see definition below). The projectile filling may include a projectile core possibly made of metal and can include several cores or materials including explosive or pyrotechnic substance such as the one used in a tracer.

The term "jacket portion" as used herein is a portion of the enclosure which accommodates the projectile filling and has a direct contact with the projectile filling. Upon combustion of the propellent, at least some of the jacket portion remains attached to the projectile filling and both projectile filling and detached jacket form together the projectile.

The term "case portion" as used herein is a portion of the enclosure which accommodates the propellant and has a direct contact with the cartridge base. Upon combustion of the propellent, at least some of the jacket portion is detached from the case portion.

According to some embodiments, apparatuses, systems are provided for an ammunition cartridge with a single enclosure to accommodate the projectile core and the propellant. The enclosure may be of a lightweight material such as a polymer, and connect to a base (e.g., metallic base or polymeric base). In order to detach the projectile - from the cartridge, a dedicated section may be positioned along the cartridge.

Figure 2 illustrates an integrated ammunition cartridge **2** having a case portion **20** and jacket portion **22** forming together the cartridge enclosure (element **3** in **Figure 3** below) according to some embodiments of the invention. Ammunition cartridge **2** may include a cartridge base **28** connectable to the case portion **20**, where the base **28** is configured to accommodate an ignition device/primer (not shown here) therein.

In some embodiments, the enclosure having case portion **20** and jacket portion **22** is made of at least one of: a polymer, a composite material, and a metal. The cartridge enclosure may be manufactured by at least one of: injection, mold injection, over-mold injection, extrusion, casting, plastic processing, metal forming, machining, and 3D printing.

In some embodiments, the cartridge enclosure may be manufactured of the same material in different conditions, for example: different cycle times and/or at different temperatures, such that different portions are connected together.

In some embodiments, cartridge case portion **20** is suitable for accommodating propellent powder and base **28** is a distinct element from the cartridge enclosure **3**. The suitability of cartridge case portion **20** is a structural feature and may require for example that when the powder is inserted during manufacturing, the cartridge case portion **20** is in a rigid form.

In some embodiments, various portions of the cartridge enclosure may be manufactured separately and connected afterwards, or at minimum, manufactured as rigid elements irrespective of the propellent.

Advantageously, having the enclosure as a standalone part allows filling it with one or more types of projectile and various types of propellent as needed, including propellent powder and/or explosive powder.

The cartridge enclosure may include case portion **20** which contains propellant **24** and a jacket portion **22** which contains a projectile filling **26**. Jacket portion **22** may be configured to accommodate at least one projectile core or filling **26** and the case portion **20** may be configured to accommodate the propellant **24**. Accordingly, the cartridge enclosure may accommodate the at least one projectile core **26** and also the propellant **24** within a monolithic enclosure.

Depending on the purpose and required performance of the ammunition cartridge **2**, for instance a sniper, armor piercing or increased stopping power capabilities, jacket portion **22** may accommodate one or many combination of the following projectile fillings: cores or pellets of different shape and material, explosive, incendiary, tracer and the like. In some embodiments the jacket portion **22** may accommodate a projectile filling as a full caliber projectile or a sub-caliber projectile, where jacket portion **22** may function as a sabot.

According to some embodiments, the cartridge enclosure may include a detachment section 27 configured to control the detachment of at least some of jacket portion 22 from the case portion

20. After detachment of jacket portion 22, the detached jacket portion 22 may remain attached to projectile filling or projectile core 26 forming together the projectile as it is shot towards the target. In some embodiments, detachment section 27 may include an area between the case portion 20 and the jacket portion 22, where this area may not be supported by the chamber of the corresponding firearm so as to allow detachment of at least some of the jacket portion 22 due to dedicated geometry of detachment section 27. In some embodiments, detachment section 27 may include a connecting area of different materials and/or transition area of various manufacturing methods.

For example, detachment section **27** may include a weakened portion (e.g., with a dedicated groove) such that during firing of the ammunition cartridge **2**, jacket portion **22** may be detached from the case portion **20** due to the forces applied on the weakened portion.

In a further example, for the weakened portion, detachment section **27** may include a dedicated material having weak structure compared to the cartridge enclosure materials.

Figure 3 illustrates a cartridge enclosure **3** according to some embodiments of the invention. cartridge enclosure **3** includes a case portion **32** and a jacker portion **34** attached to each other as monolithic integral part via a detachment section **36**.

Figures 4A-4C illustrate various types of jacket portions varying in the way they embrace the projectile filling therein.

Figure 4A illustrates a partial view of cartridge enclosure **40A** defining a chamber **44A** for propellant and a jacket portion **42A** which is partially open at the tail of projectile filling **46A**, according to some embodiments of the invention. **Figure 4B** illustrates a partial view of cartridge enclosure **40B** defining a chamber **44B** for propellant and a jacket portion **42B** which is partially open at the head of projectile filling **46B**, according to some embodiments of the invention. **Figure 4C** illustrates a partial view of a cartridge enclosure **40C** defining a chamber **44C** for propellant and a jacket portion **42C** which is partially open at the tail and at the head of projectile filling **46C**, according to some embodiments of the invention.

According to some embodiments, in a case where the projectile core **46B** is configured to form a sabotted sub-caliber projectile, the partially open ammunition enclosure **40B** may receive a sabotted projectile core, at the partially open jacket **42B**. The partially open jacket portion **42B** may be configured to operate as a sabot after detachment from the cartridge enclosure **40B** when the projectile core **46B** is configured to detach from the partially open jacket **42B** such that only the projectile core **46B** is at impact with the target. It is noted that enclosure **40C** can also operate in a similar manner forming a sabotted projectile.

Figures 5A-5D illustrate various types of projectile fillings. **Figure 5A** illustrates cartridge enclosure **50A** with jacket portion **52A** encapsulating several projectile fillings (projectile cores)

54A, **56A**, and **57A** and detachment section **58A**. the jacket is open at the tail of projectile filling **56A**. **Figure 5B** illustrates cartridge enclosure **50B** with jacket portion **52B** encapsulating several projectile fillings (projectile cores) **54B**, **56B**, and detachment section **58B**. The jacket portion is open at the head of projectile filling **56B**. Projectile filling **54B** can include tracer composition.

Figure 5C illustrates cartridge enclosure **50C** with jacket portion **52C** encapsulating projectile filling **56C** and detachment section **58C**. The jacket portion is open at the tail of projectile filling **56C**. By the aforementioned structure, a full or a sub caliber projectile can be inserted and used by the cartridge as a projectile filling. **Figure 5D** illustrates cartridge enclosure **50D** with jacket portion **52D** encapsulating projectile filling **56D** and detachment section **58D**. The jacket portion is open at the head of projectile filling **56D**. By the aforementioned structure, a full or a sub caliber projectile can be inserted and used by the cartridge as a filling.

According to some embodiments. the cartridge case portion is suitable for accommodating propellent powder as explained above and the jacket portion form together an enclosure which comprises a section configured to control the detachment of at least some of the jacket portion from the cartridge portion.

According to some embodiments of the present invention, the projectile filling may be full caliber - same caliber/diameter as the firearm from which it is fired - or it can be in a sub caliber - caliber/diameter smaller than firearm. It is also noted that detachment section **58A-58D** may be positioned on any portion along the cartridge enclosure **50A-50D**.

Figure 6A illustrates a projectile **6** having a projectile filling **66** and a standalone jacket **64** in accordance with some embodiments of the present invention. Projectile **6** may include a standalone projectile jacket, i.e., not part of enclosure **62** shown in **Figure 6B**. Projectile jacket **64** is configured to accommodate at least one projectile filling **66**. Standalone projectile jacket **64** is made of at least one of: polymer material, and composite material.

Figure 6B illustrates the projectile of **figure 6A** assembled and embraced by a jacket portion of an enclosure **62** for ammunition cartridge according to any of the embodiments of the present invention described above.

While certain features of the invention have been illustrated and described herein, many modifications, substitutions, changes, and equivalents may occur to those skilled in the art. It is, therefore, to be understood that the appended claims are intended to cover all such modifications and changes as fall within the invention.

Various embodiments have been presented. Each of these embodiments may, of course, include features from other embodiments presented, and embodiments not specifically described may include various features described herein.

CLAIMS

1. An ammunition cartridge comprising:

   a cartridge enclosure comprising a cartridge case portion and a jacket portion, wherein the jacket portion is configured to accommodate at least one projectile filling, wherein the cartridge case portion is suitable for accommodating propellent powder; and

   a base, connectable to the cartridge enclosure, wherein the base is configured to accommodate an ignition device, wherein the base is a distinct element from the cartridge enclosure,

   wherein the cartridge enclosure comprises a section configured to control the detachment of at least some of the jacket portion from the cartridge enclosure.

2. The ammunition cartridge of claim 1, wherein the jacket portion of the cartridge enclosure is open at a side of the projectile filling facing the base.

3. The ammunition cartridge of claim 1, wherein the jacket portion of the cartridge enclosure is open at a side of the projectile filling opposite the base.

4. The ammunition cartridge of claim 1, wherein the jacket portion of the cartridge enclosure is open at both sides of the projectile filling.

5. The ammunition cartridge of any preceding claim, wherein the jacket portion accommodates the at least one projectile filling.

6. The ammunition cartridge of any preceding claim, wherein the jacket portion is configured to accommodate at least two projectile fillings.

7. The ammunition cartridge of any preceding claim, wherein the jacket portion is configured to accommodate a projectile filling as a full caliber or a sub caliber projectile.

8. The ammunition cartridge of any preceding claim, wherein the cartridge enclosure comprises at least one of: a polymer, a composite material, and a metal.

9. The ammunition cartridge of any preceding claim, wherein the cartridge enclosure is manufactured by at least one of: injection, mold injection, over-mold injection, extrusion, casting, plastic processing, metal forming, machining, and 3D printing.

10. The ammunition cartridge of any preceding claim, wherein the section comprises a groove.

11. The ammunition cartridge of any preceding claim, wherein the section comprises a connecting area of different materials or transition area of various manufacturing conditions.

12. The ammunition cartridge of any preceding claim, wherein the section comprises a dedicated material having weak structure compared to the cartridge enclosure materials.

13. An ammunition cartridge comprising:

a cartridge case portion suitable for accommodating propellent powder; and

a jacket portion, wherein the jacket portion is configured to accommodate at least one projectile filling,

wherein the jacket portion is made of at least one of: polymer material, and composite material.

14. The ammunition cartridge according to claim 13, wherein the cartridge case portion and the jacket portion form together an enclosure which comprises a section configured to control the detachment of at least some of the jacket portion from the cartridge portion.

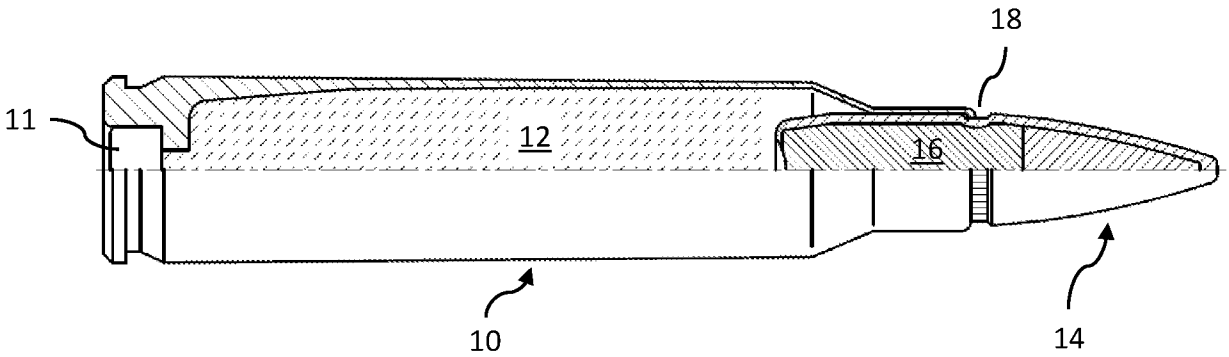


Figure 1
(Prior Art)

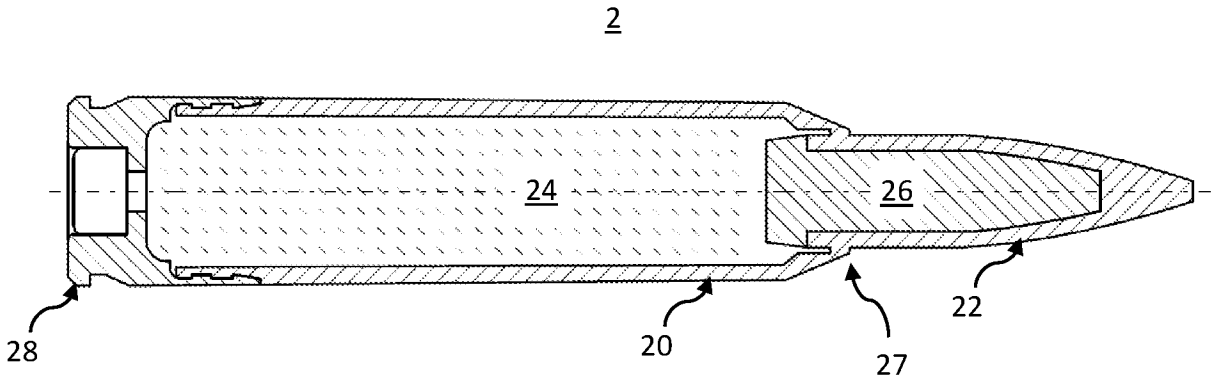


Figure 2

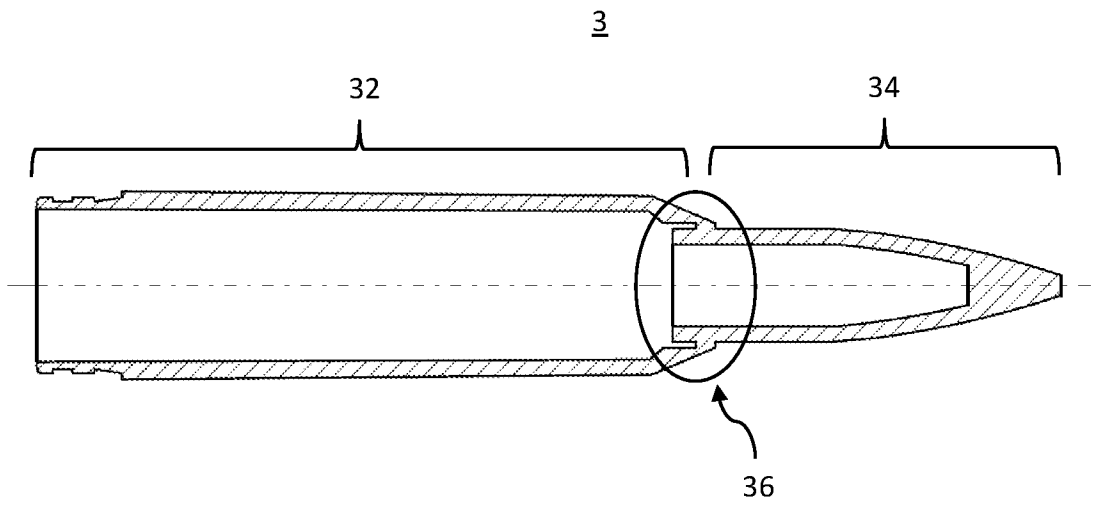


Figure 3

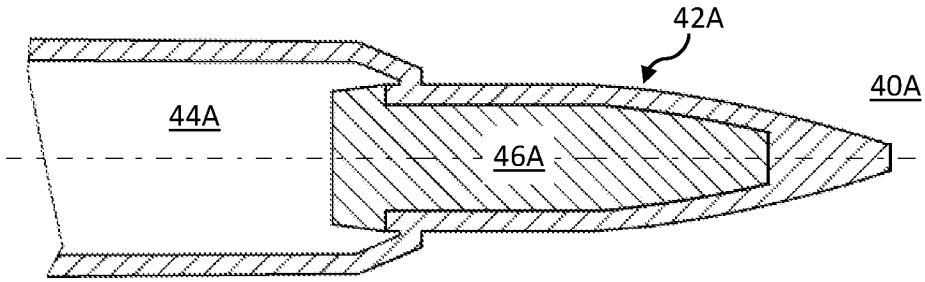


Figure 4A

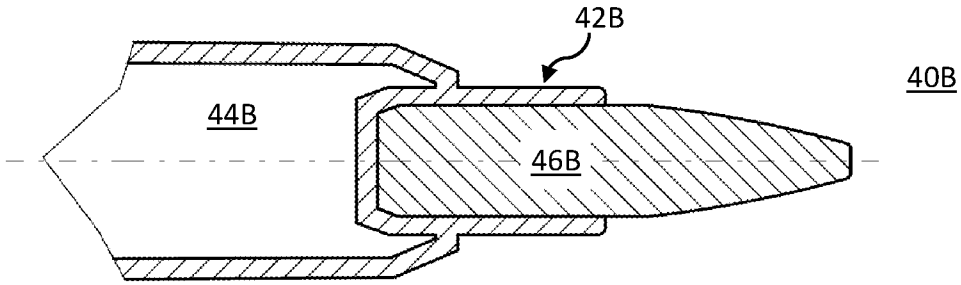


Figure 4B

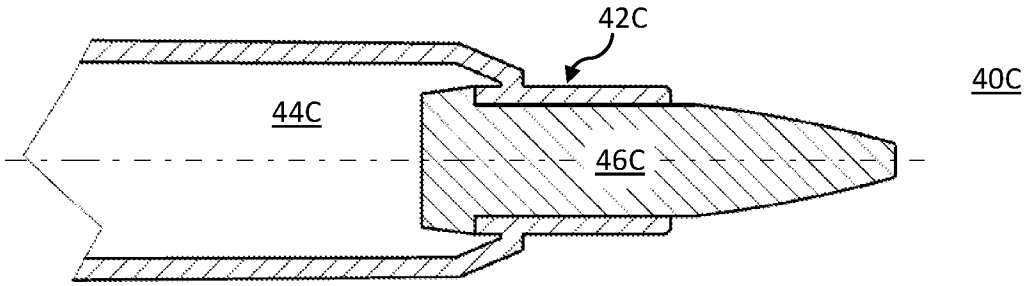


Figure 4C

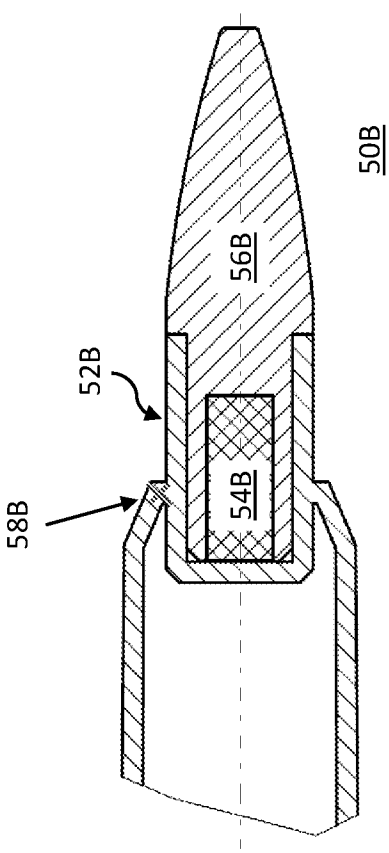


Figure 5B

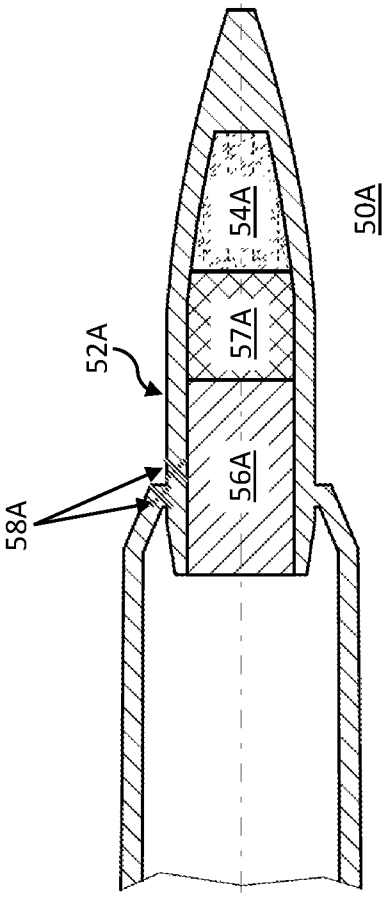


Figure 5A

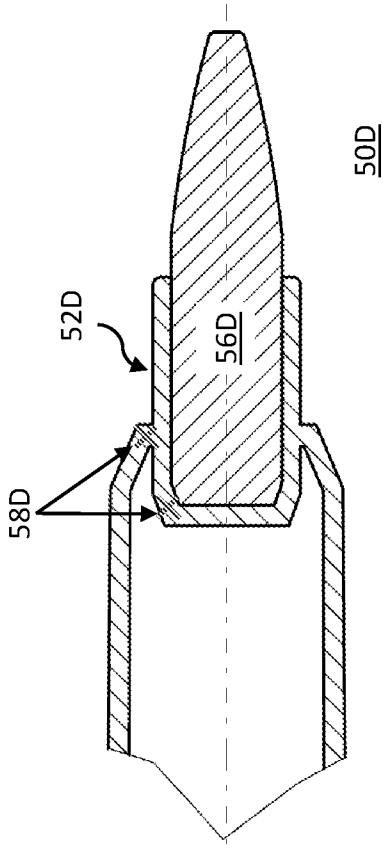


Figure 5D

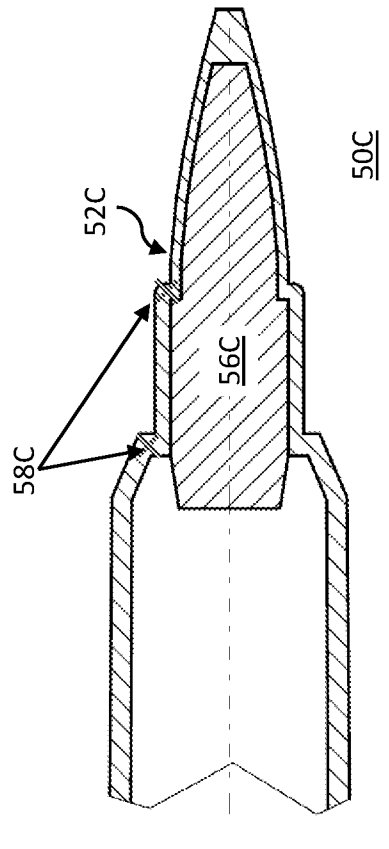


Figure 5C

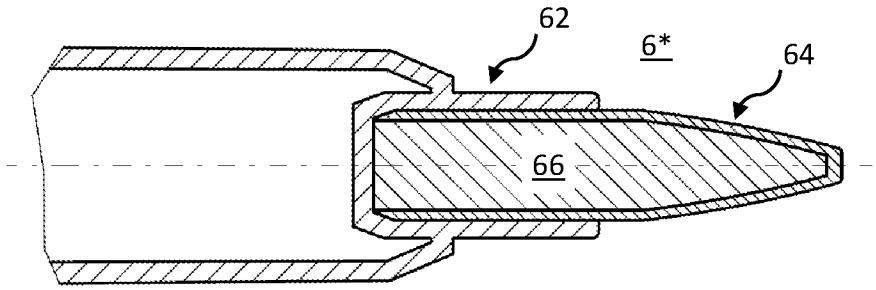


Figure 6B

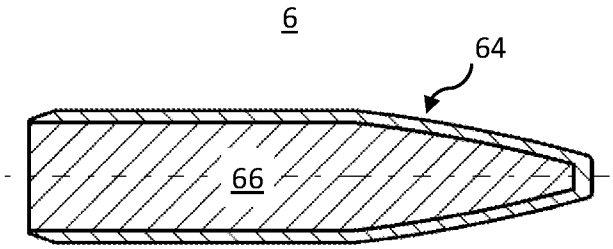


Figure 6A

INTERNATIONAL SEARCH REPORT

International application No.
PCT/IL2023/050483

A. CLASSIFICATION OF SUBJECT MATTER

F42B 12/72(2023.01)i; ***F42B 12/24***(2023.01)i; ***F42B 12/74***(2023.01)i
CPC:F42B 12/72; F42B 12/24; F42B 12/745; F42B 12/74

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)

F42B 12/72; F42B 12/24; F42B 12/74
CPC:F42B 12/72; F42B 12/24; F42B 12/745; F42B 12/74

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)

Databases consulted: Esp@cenet, Google Patents, Orbit, Similari (AI-based)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
	US 3935816 A (Lawrence E. Boquette, Jr.) 03 February 1976 (1976-02-03)	
A	Entire Document	1-12
X		13,14

☐ Further documents are listed in the continuation of Box C.

☑ See patent family annex.

* Special categories of cited documents:
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"P" document published prior to the international filing date but later than the priority date claimed
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Date of the actual completion of the international search	Date of mailing of the international search report
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INTERNATIONAL SEARCH REPORT
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Patent document cited in search report	Publication date (day/month/year)	Patent family member(s)	Publication date (day/month/year)
US 3935816 A	03 February 1976	US 3935816 A	03 February 1976