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Chupp et al.

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(54) **EXPANDING FIN ROCKET WITH FIN RESTRAINT**

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(22) Filed: **Apr. 9, 2024**

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F42B 10/16 (2006.01)

(52) **U.S. Cl.**
CPC ***F42B 10/16*** (2013.01)

(58) **Field of Classification Search**
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USPC 89/1.812
See application file for complete search history.

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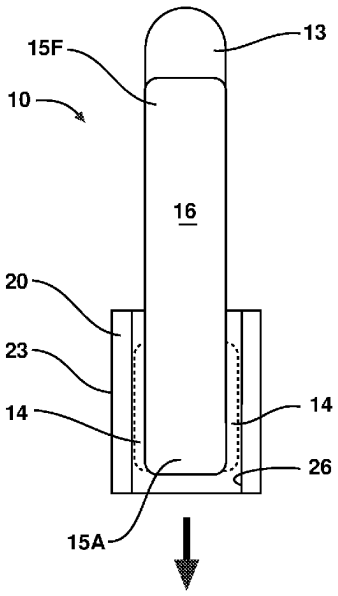
(74) *Attorney, Agent, or Firm* — AFMCLO/JAZ; Larry L. Huston

(57) **ABSTRACT**

An expanding fin aerial rocket in combination with a sleeve for restraining the fins prior to deployment. The rocket has an elongate body with a fore end for a warhead and an opposed aft end for motor and guidance fins. The guidance fins are hingedly attached to the rocket body at a proximal end and extend outwardly to a distal end. Fins may be collapsed during storage to conserve space and prevent damage. The springs are outwardly spring biased for flight upon deployment. The rocket has a durable removable sleeve, which fits over the fins during storage, to retract the sleeves into a collapsed position. The sleeve is removed for deployment, so the fins may radially expend to an extended position. The durable sleeve may then be reused for another rocket.

20 Claims, 11 Drawing Sheets



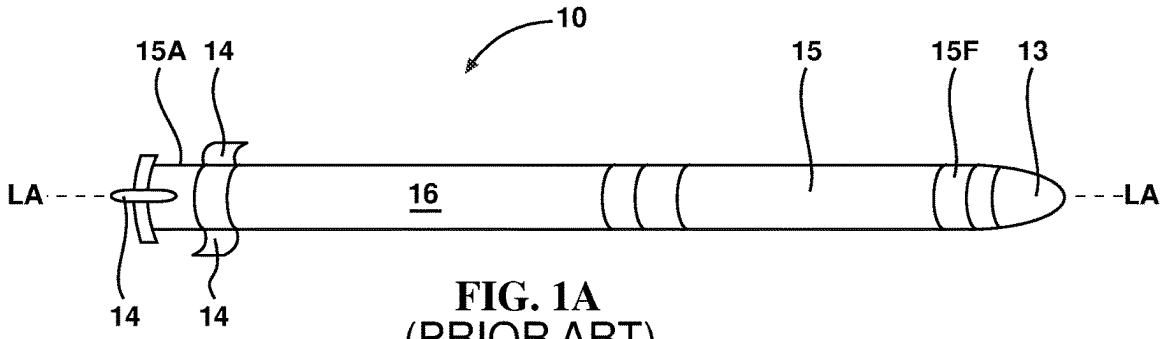


FIG. 1A
(PRIOR ART)

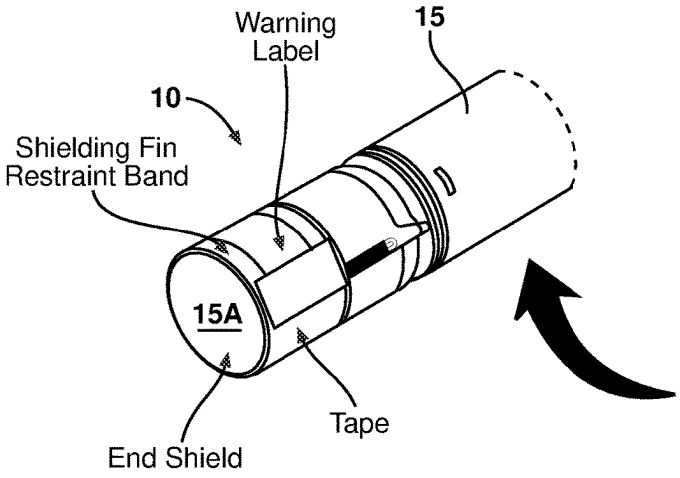


FIG. 1B2
(PRIOR ART)

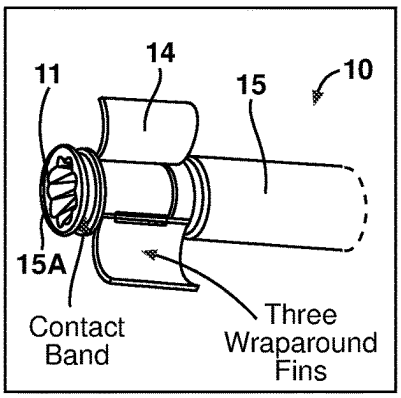


FIG. 1B1
(PRIOR ART)

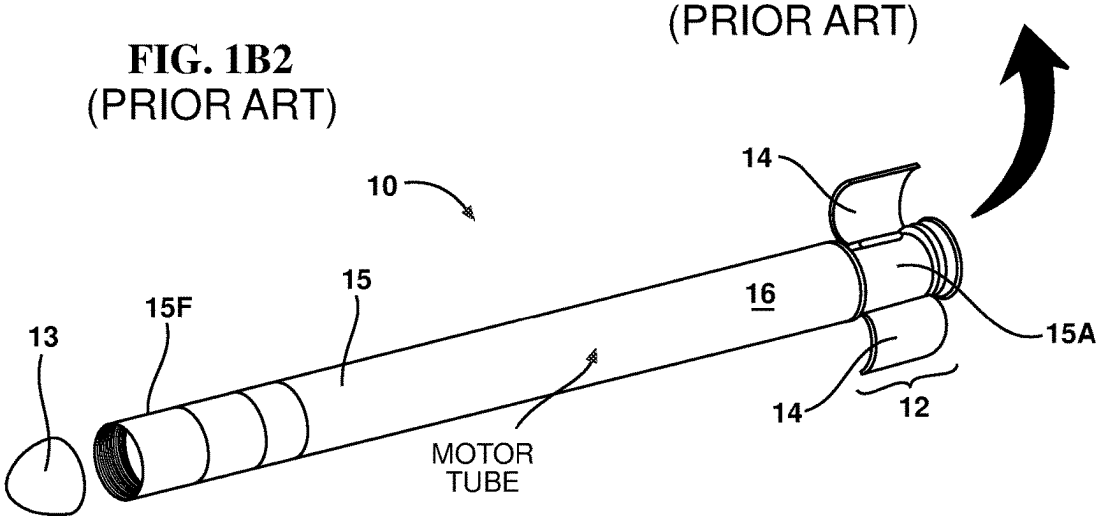


FIG. 1B
(PRIOR ART)

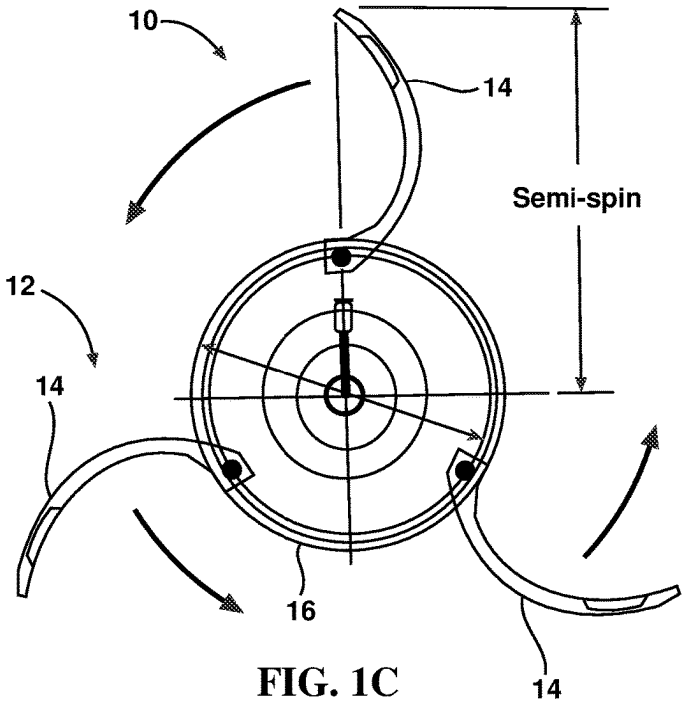


FIG. 1C
(PRIOR ART)

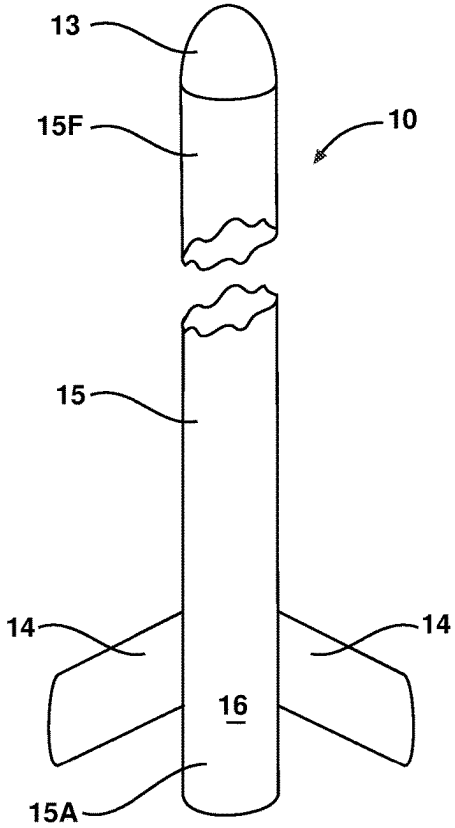


FIG. 1D
(PRIOR ART)

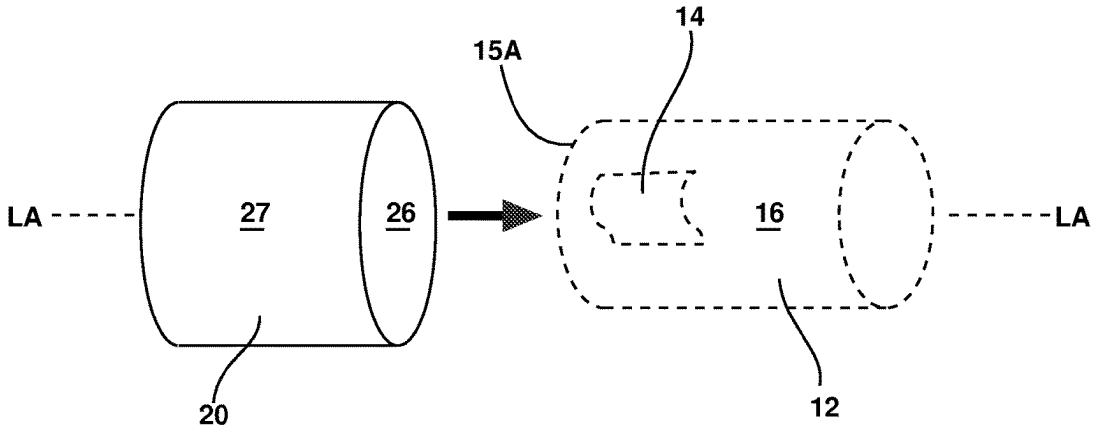


FIG. 2

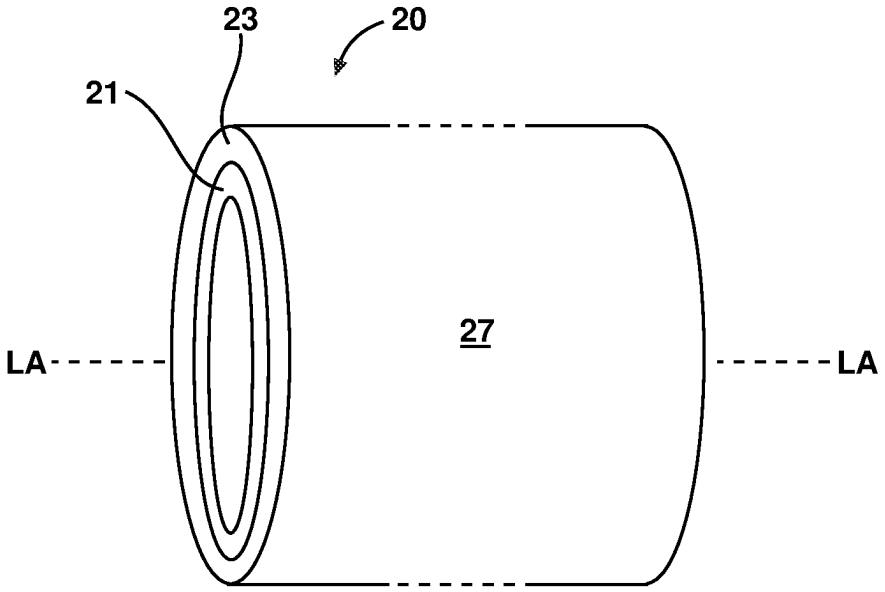


FIG. 3A

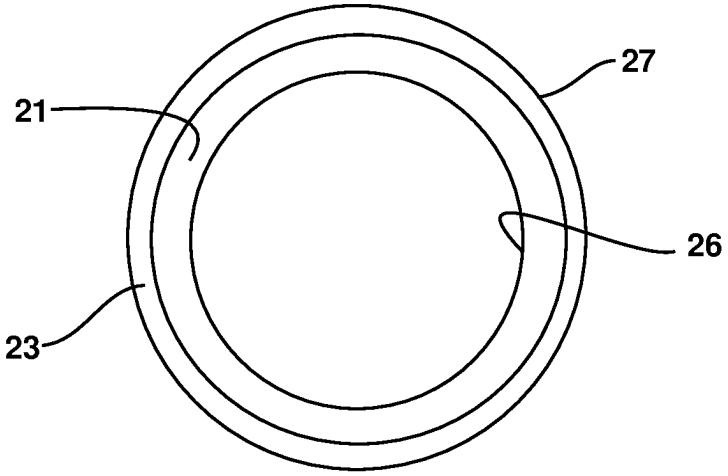


FIG. 3B

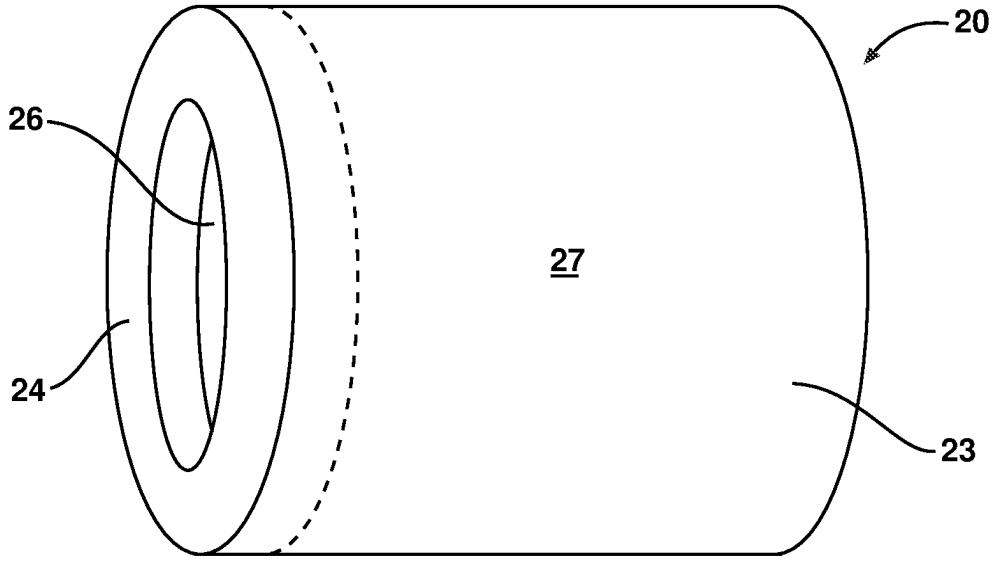


FIG. 4A

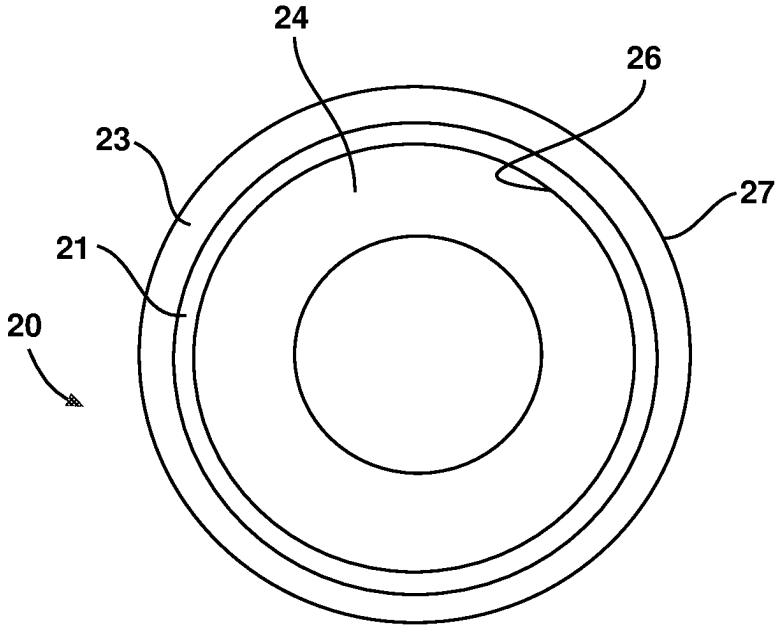


FIG. 4B

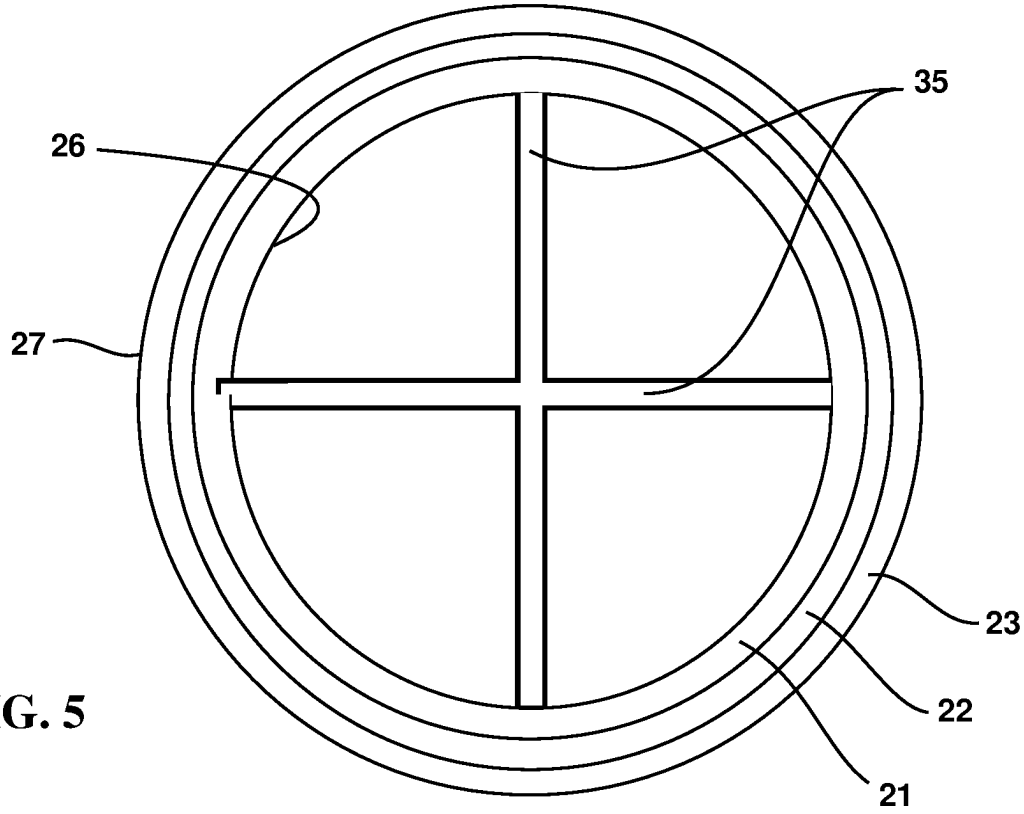


FIG. 5

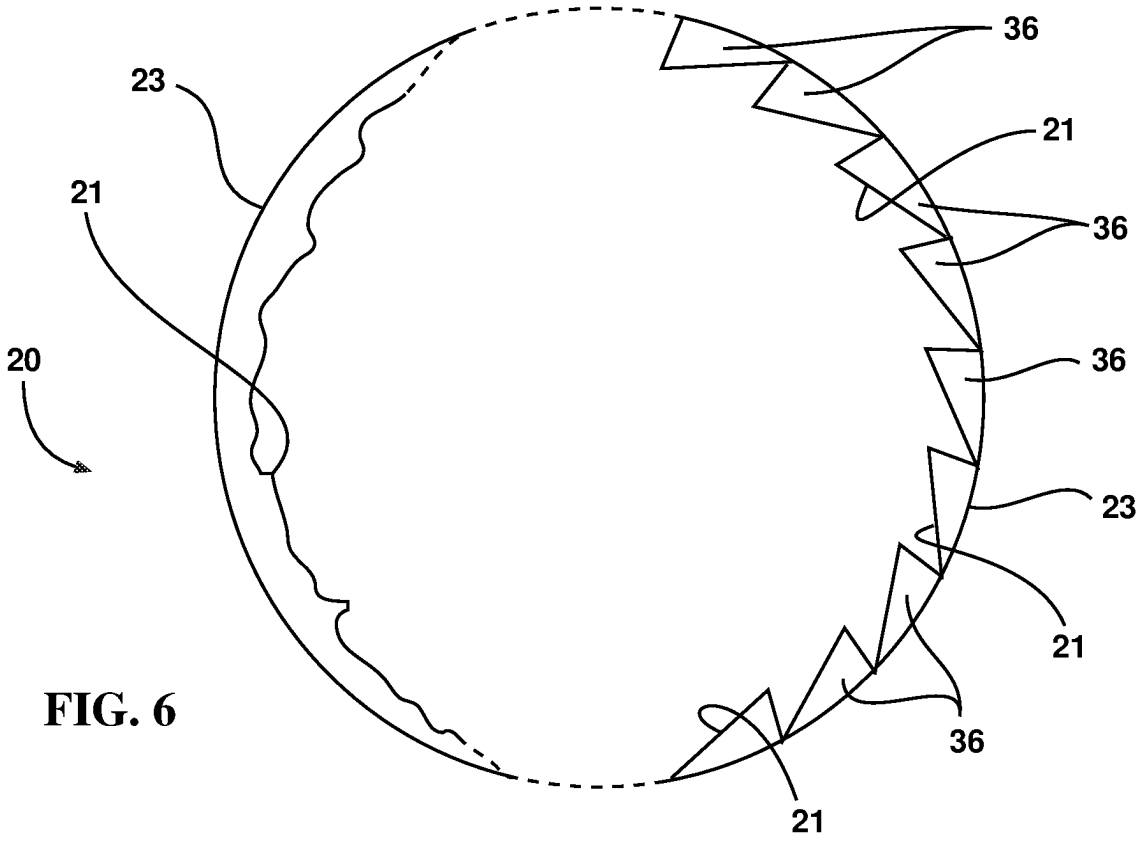


FIG. 6

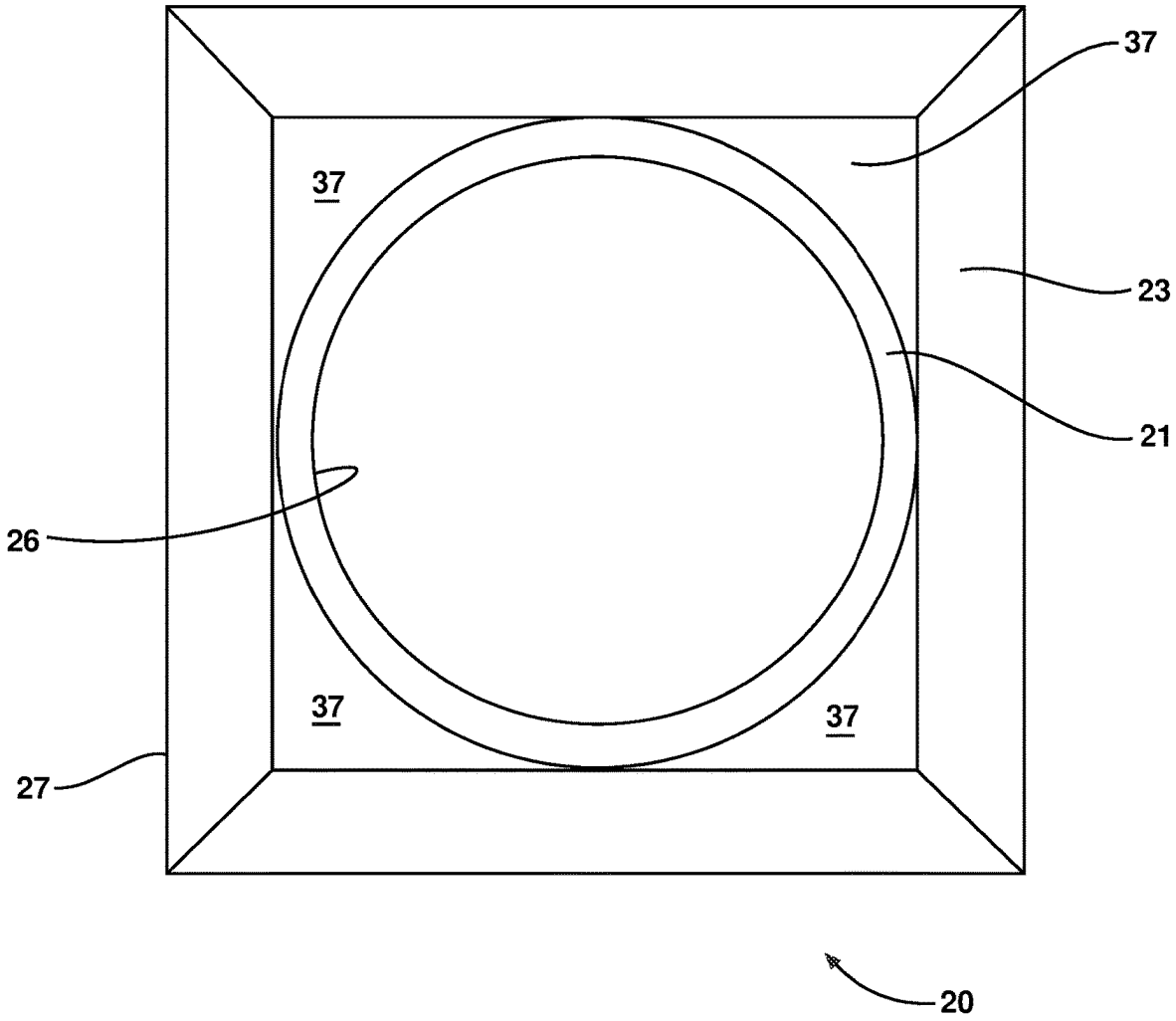


FIG. 7

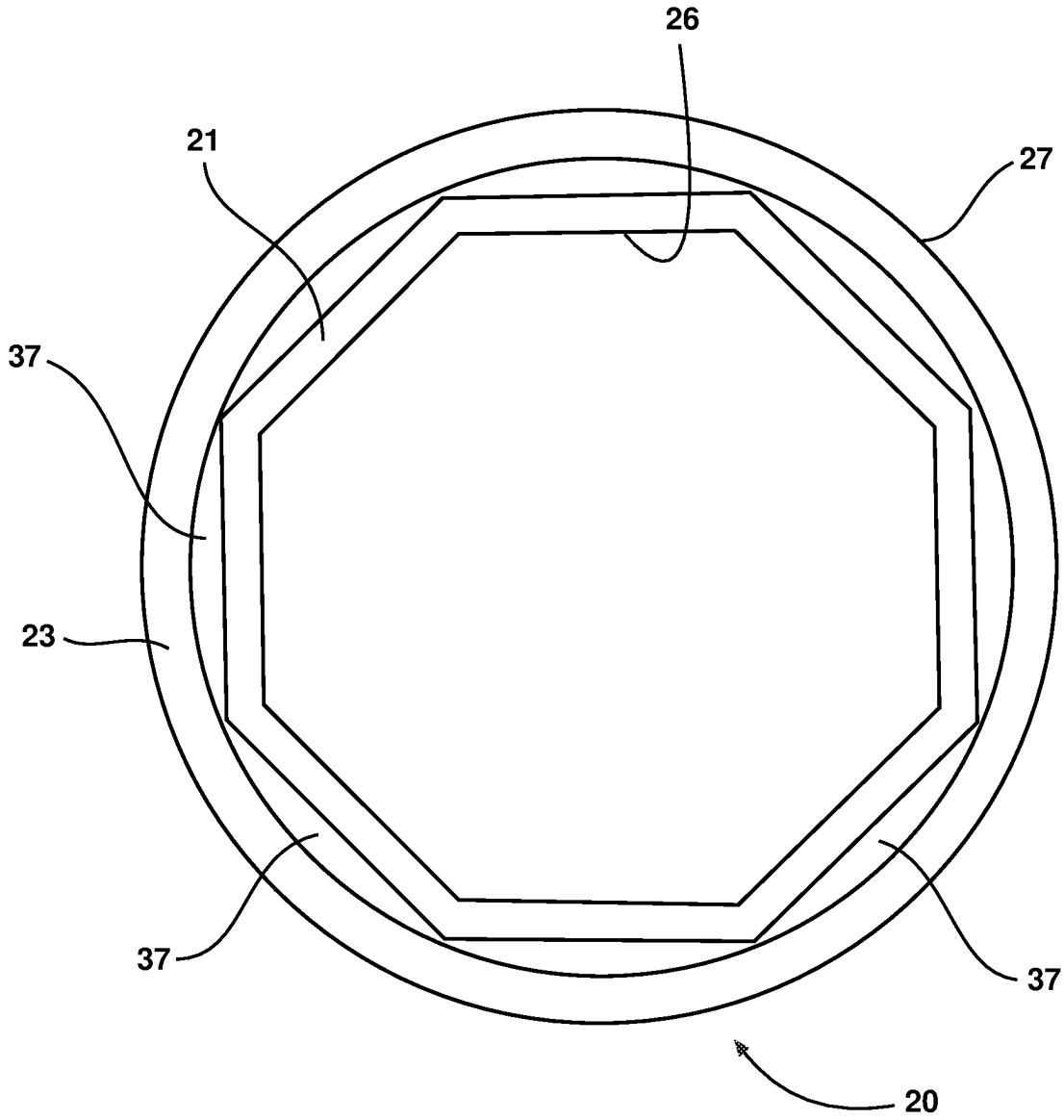


FIG. 8

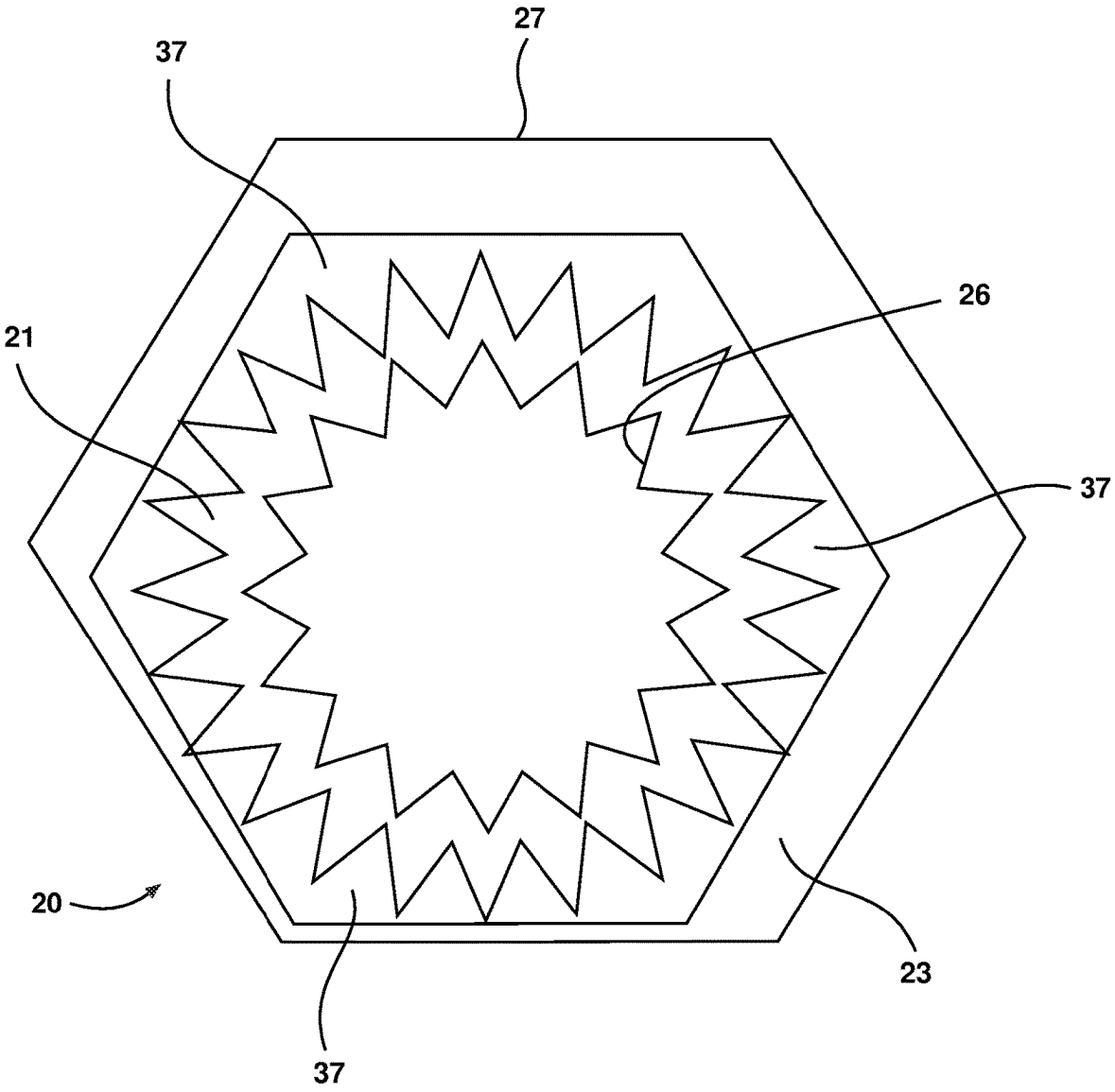


FIG. 9

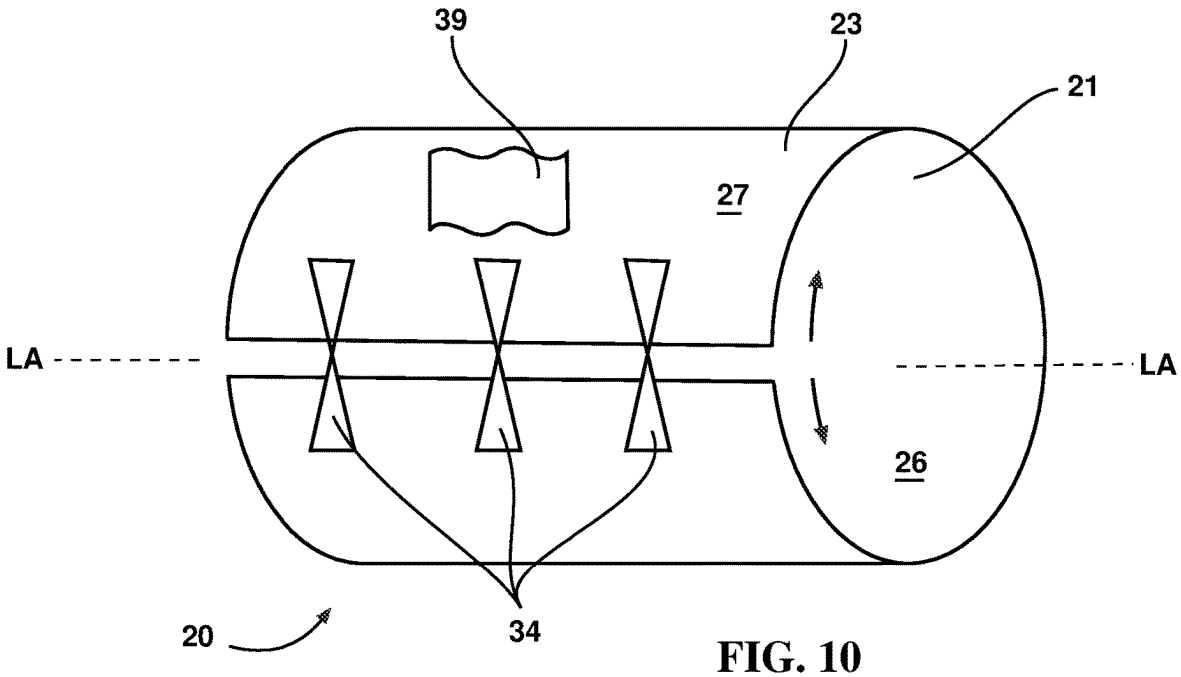


FIG. 10

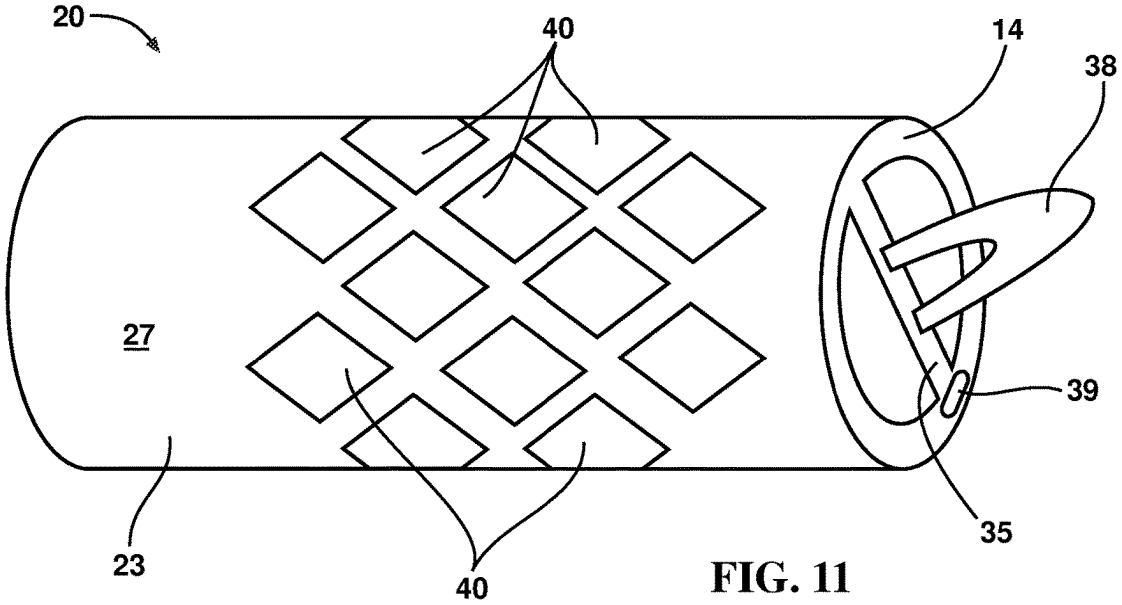


FIG. 11

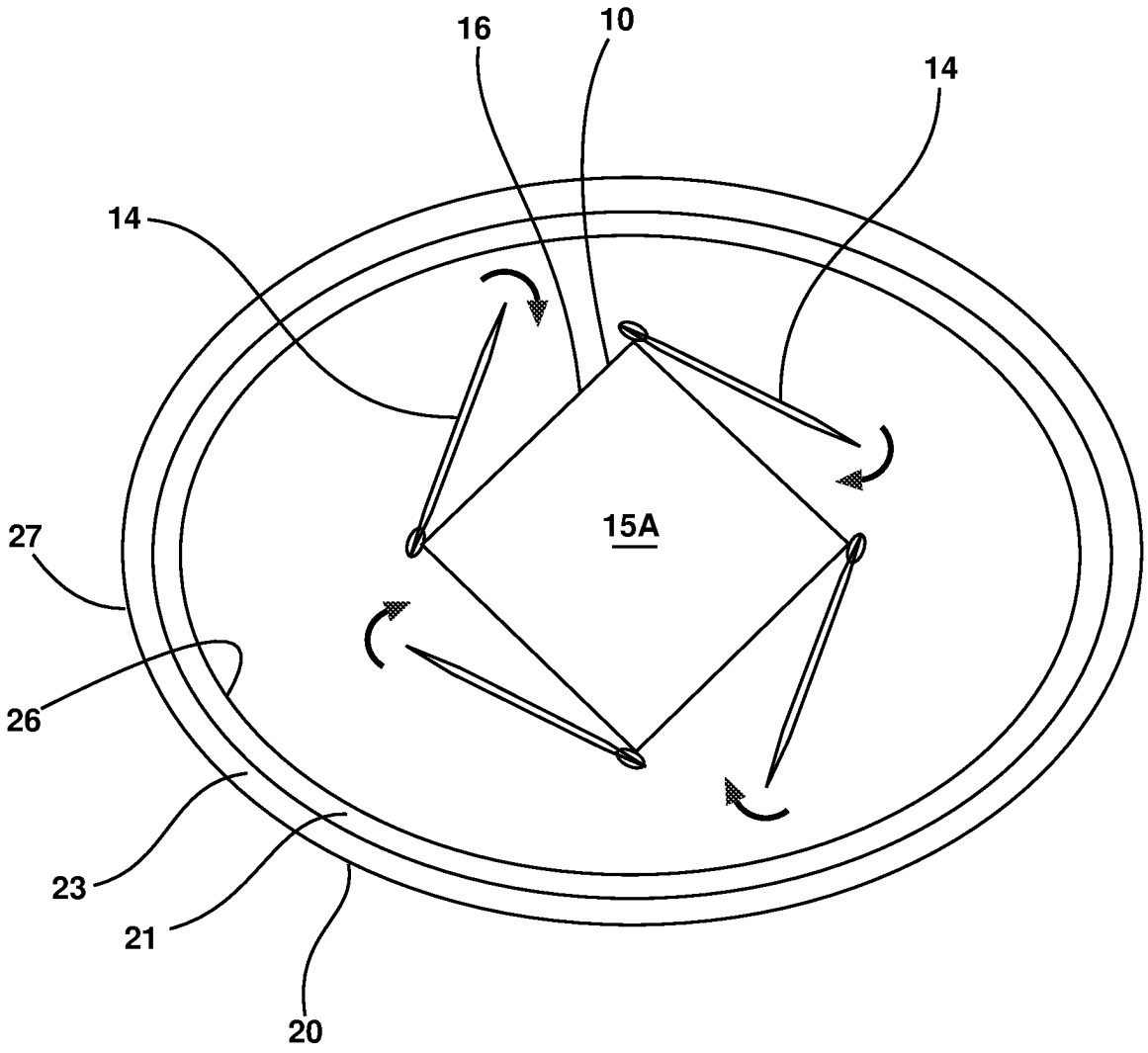


FIG. 12

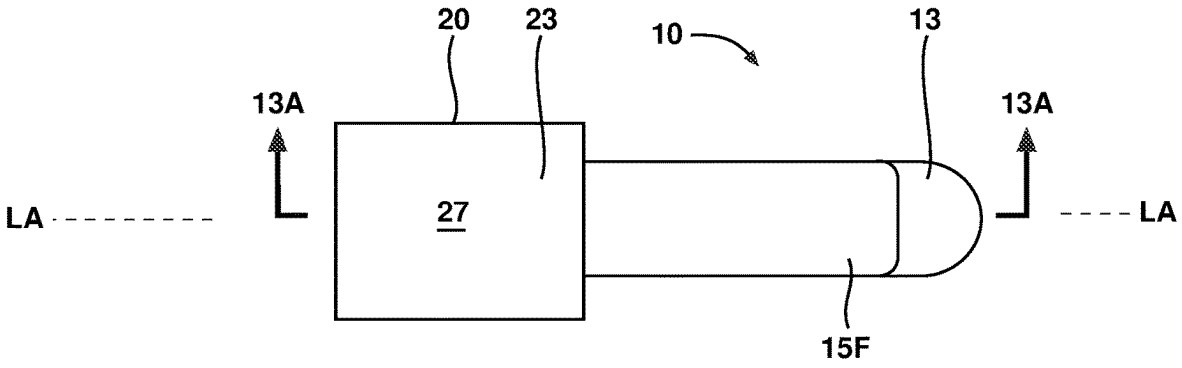


FIG. 13A

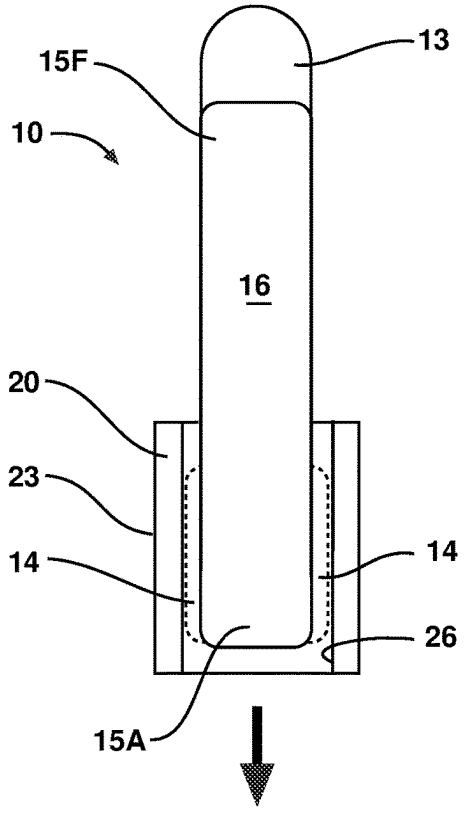


FIG. 13B

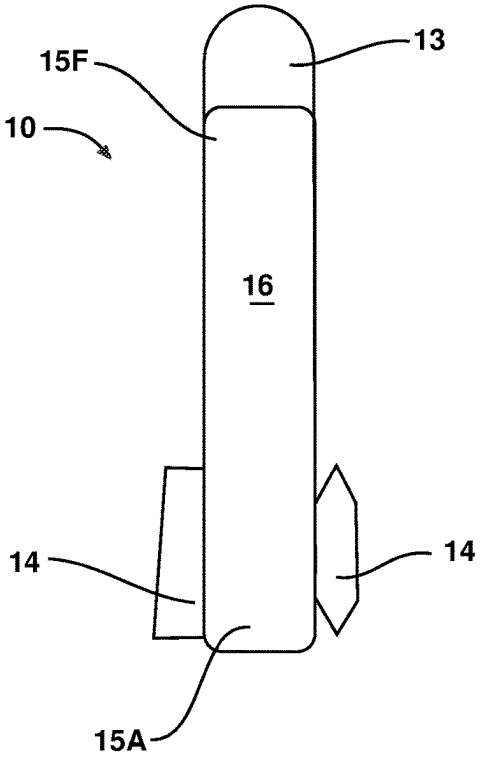


FIG. 13C

EXPANDING FIN ROCKET WITH FIN RESTRAINT

STATEMENT OF GOVERNMENT INTEREST

The invention described and claimed herein may be manufactured, licensed and used by and for the Government of the United States of America for all government purposes without the payment of any royalty.

FIELD OF THE INVENTION

The present invention is related to expandable fin aerial rockets having expanding fin retaining sleeves and more particularly to such rockets having durable expanding fin retaining sleeves.

BACKGROUND OF THE INVENTION

Unguided air-launched rockets 70 mm diameter were originally developed in the late 1940s by the Naval Ordnance Test Station at China Lake, CA. as an air-to-air weapon to be used by interceptors against heavy bombers. Later modifications provided for air-to-ground use. The original model was the MK 4, which was spin-stabilized and featured four flip-out fins around the nozzle, commonly referred to as a folding fin aerial rocket (FFAR). Fitted with a six pound HE warhead, this rocket was widely used in the 1950s by USAF interceptors as the Mighty Mouse air-to-air rocket. These rockets used as supplements and/or replacements for guns in both air-to-air and air-to-ground applications. Millions of these rockets have been built, and the latest versions are still widely used by all U.S. armed services and several friendly foreign nations.

The current 70 mm rockets are known as Hydra 70 rockets and use the MK 66 rocket motor. The Hydra 70 is a high-explosive (HE), fin-stabilized, un-guided rocket used primarily in the air-to-ground role with various available warheads. The Hydra 70 was developed by the U.S. Army as a replacement of the MK 4 and MK 40 for both fixed-wing aircraft and helicopters.

The three fins are of the wrap-around type, and fit around the circumference of the rocket nozzle. Therefore the MK 66 is sometimes called a WAFAR (Wrap-Around Fin Aerial Rocket) instead of an FFAR. Both the FFAR and WAFAR and described herein as Expanding Fin Aerial Rockets (EFAR).

The MK-66 rocket is part of the Hydra-70 family of rockets made by General Dynamics. This rocket system contains three components: the MK66 MOD 4 rocket motor, one of nine available warheads, and the associated point-detonating, or remote-set fuze(s). The Hydra 70 rocket is 2.75" diameter, 41.7" long without a warhead, weighs 23 to 27 pounds and uses one of three available motors. Average thrush ranges from 1335 lbs. to 1415 lbs. with a 148 ft/sec launch velocity and 60-70 g launch acceleration, rising to 95-100 g at final velocity. The effective range is 500 M to 8000 M with a launch spin rate of 10 rps and a final spin rate of 35 fps. The Hydra 70 fires from the existing seven and 19-tube launchers and can be mounted on most rotary and fixed-wing aircraft. Hydra-70 rockets are fired from the LAU-61 19-tube, M261 19-tube, LAU-68 7-tube and LAU-131/A 7-tube rocket launchers, collectively referred to herein as weapons. The Navy uses the 19 round LAU-61C/A and the seven round LAU-68 D/A rocket launchers. These reusable launchers have an external thermal coating that greatly prolongs cook-off protection time. Full production of these launchers began in June 1985.

The rocket system can be installed on most rotary and fixed-wing aircraft, such as the AH-64 Apache, AH-1Z Viper, AH-1 Cobra, OH-58 Kiowa, UH-60 Black Hawk, P-3 Orion, MH-6 Little Bird, A-10 Thunderbolt II, AV-8B Harrier II, UH-1 Iroquois, F-4 Phantom II, F-16 Fighting Falcon, F/A-18 Hornet, OV-10 Bronco, A-4 Skyhawk and A-6 Intruder. General Dynamics has made more than four million air-launched Hydra 70 rockets since 1996 and the four-millionth Hydra-70 rocket was delivered to the US Army in May 2011.

The Hydra 70 rocket has three aft wraparound fins which fit around the circumference of the rocket body. The fins are spring biased to open upon firing. But these fins must be restrained from opening when the rocket is in storage, transport, not in the launcher or otherwise weaponed. If the fins are opened during storage, the rocket requires more storage space and the fins are subject to damage. Even damage to one fin requires the rocket to be taken out of service and subsequently transported off-site for repair.

Currently the wraparound fins are restrained with single-use adhesive tape during storage. But adhesive tape has a limited lifespan. More particularly, adhesive tape loses efficacy when subjected to heat or humidity. Unfortunately common conditions in austere environments often expose the adhesive tape to heat and/or humidity, causing the tape to lose its efficacy and allowing the fins to spring open. Several tapes have been tried, but none have proven efficacious.

Furthermore, if the tape prematurely releases, the fins open under the spring force exposing a contact band of the rocket motor. The rocket motor is classified as subject to Hazards of Electro-Magnetic Radiation and Electrostatic Discharge unsafe. A spark to the contact band could cause premature ignition of the motor, creating a safety hazard.

Furthermore, even if the tape properly restrains the fins, the tape takes time to apply to and unwind from the rocket. Care is required during winding of the fins to ensure all fins are in proper position, debris from the environment does not block the adhesive and cutting of the tape to length does not scratch sensitive components. Care is also required during tape removal to prevent damage to the rocket, often requiring undue time and potentially delaying operability.

Furthermore, even under the best conditions the tape is single use. The tape has to be replenished leading to ongoing expenses, old tape discarded and new tape ordered as part of the supply regiment—all leading to administrative burdens.

Literally millions of the Hydra 70 rockets were used in Vietnam. Hydra 70 rockets were also deployed in Operation Just Cause and as Desert Storm. Media report the Hydra 70 rockets have been sent to Ukraine for the war against Russia. Despite the millions of EFAR rockets having been used from the 1940's through present day, the problems with restraining expanding fins have persisted for decades. Clearly a new approach is needed.

There is a need for a retaining sleeve which is durable, i.e. not discarded after a single use and which can be restored, if necessary, and cleaned for future use. There is a need for such a sleeve which can be quickly and easily installed to ensure the fins are in proper position and likewise quickly and easily removed for combat readiness. There is a need for a retaining sleeve which can be installed and removed with one hand. There is a need for a retaining sleeve which is not affected by heat, humidity or other climate conditions.

SUMMARY OF THE INVENTION

In one embodiment the invention comprises an elongate, powerable, expanding fin aerial rocket. The rocket com-

prises: a body having a fore end for containing a warhead and an aft end opposed thereto, the aft end having at least one autonomously radially expandable fin joined thereto, the at least one fin being biased to expand outwardly from a collapsed position juxtaposed with the body to an extended position outward of the body; and a sleeve removably installed over the at least one fin in the collapsed position, the sleeve restraining the at least one fin in the collapsed position and being removable to allow the at least one fin to expand outwardly from the body, the sleeve having an inner surface oriented towards the body and outer surface opposed thereto, the inner surface of the sleeve being conductive whereby a charge occurring proximate the at least one fin is grounded to prevent ignition of a motor at the aft end of the rocket.

In another embodiment the invention comprises a longitudinally elongate, powered, expanding fin aerial rocket. The rocket comprises: a body having a fore end for containing a warhead and an aft end opposed thereto, the aft end having a plurality of circumferentially spaced, radially expandable fins joined thereto, the plural fins being outwardly spring biased; and a hollow sleeve removably installed over each of the plural fins in a collapsed position, the sleeve restraining the plural fins in the collapsed position and being removable to allow the at least one fin to expanding outwardly from the body, the sleeve having an electrically conductive inner surface oriented towards the body and outer surface opposed thereto, the inner surface of the sleeve being conductive whereby a charge occurring proximate the aft end is grounded to prevent ignition of a motor at the aft end of the rocket.

In another embodiment the invention comprises a method of handling an expanding fin aerial rocket. The method comprises the steps of:

a. providing at a storage location a first longitudinally elongate, powered, expanding fin aerial rocket, the rocket having a body having a fore end for containing a warhead and an aft end opposed thereto, the aft end having a plurality of circumferentially spaced, radially expandable fins joined thereto, the plural fins being outwardly spring biased from a collapsed position proximate the body to a radially extended position and a complementary hollow sleeve having an electrically conductive inner surface oriented towards the body and outer surface opposed thereto, the inner surface of the sleeve being conductive whereby a charge occurring proximate the aft end of the rocket is grounded to prevent ignition of a motor at the aft end of the rocket;
b. removably installing the sleeve over each of the plural fins in the collapsed position, the sleeve restraining the plural fins in the collapsed position and being removable therefrom without damage to the fins;
c. transporting the rocket to a deployment location;
d. removing the sleeve from the plural fins; and
e. loading the rocket onto a weapon without undue delay.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. **1**A is a perspective view of an expanding fin aerial rocket according to the prior art.

FIG. **1**B is a partially exploded perspective view of a wraparound fin aerial rocket according to the prior art, having three fins in an open position.

FIG. **1**B**1** is an enlarged view of the fins and nozzle assembly of the aerial rocket of FIG. **1**B according to the prior art.

FIG. **1**B**2** is an enlarged view of the fins of FIG. **1**B**1** in a collapsed position according to the prior art.

FIG. **1**C is a rear profile view of the rocket of FIG. **1**B according to the prior art and having wraparound fins in an extended position.

FIG. **1**D is a side elevational view of an indeterminate length expanding fin aerial rocket according to the prior art.

FIG. **2** is a schematic perspective view of a sleeve according to the present invention engaging a fragmentary rocket shown in phantom having a single, retracted fin in the collapsed position.

FIG. **3**A is a perspective view of an indeterminate length sleeve according to the present invention.

FIG. **3**B is an end view of a sleeve according to the present invention.

FIG. **4**A is a perspective view of an alternative embodiment of a sleeve according to the present invention.

FIG. **4**B is an end view of the sleeve of FIG. **4**A.

FIG. **5** is an end view of an alternative embodiment of a three ring sleeve having struts.

FIG. **6** is a split end view of an alternative embodiment of an indeterminate circumference sleeve having pleats and/or flaccid material for the inner ring.

FIG. **7** is an end view of an alternative embodiment of a sleeve having a polygonal outer ring.

FIG. **8** is an end view of an alternative embodiment of a sleeve having a polygonal inner ring.

FIG. **9** is an end view of an eccentric alternative embodiment of a sleeve having a polygonal inner ring and polygonal outer ring.

FIG. **10** is a perspective view of an alternative embodiment of a sleeve having latches and indicia.

FIG. **11** is a perspective view of an alternative embodiment of a perforate sleeve having a mesh construction and an end cap with a lip, strut and handle.

FIG. **12** is an end view of a four wraparound fin, polygonal body rocket having an elastic sleeve therearound.

FIG. **13**A is a rocket according to the present invention having the sleeve installed on the aft end.

FIG. **13**B is a sectional view taken along lines **13**A-**13**A of FIG. **13**A, with the fins shown in phantom.

FIG. **13**C is a vertical profile view of the asymmetrical rocket of FIG. **13**A having the sleeve removed.

DETAILED DESCRIPTION OF THE INVENTION

Referring to FIG. **1**A, FIG. **1**B, FIG. **1**B**1** and FIG. **1**B**2** a rocket **10** according to the present invention is elongate in a longitudinal direction defined by longitudinal axis LA. The rocket **10** has a body **15** with an exterior surface **16** and may be axi-symmetrical about longitudinal axis LA. The rocket **10** has a fore end **15**F for optionally holding a removable warhead **13** and an aft end **15**A longitudinally opposed thereto. The rocket **10** has a motor **11** at the aft end **15**A and typically comprising one or more slanted nozzles. At least one outwardly biased fin **14** extends juxtaposed with the aft end **15**A of the body **15** extends outwardly from the exterior surface **16**. The aft end **15**A of the rocket **10** has a fin **14** and nozzle assembly **12** providing for propulsion and trajectory.

Referring to FIG. **1**C, the fins **14** extend from a proximal end and may be hingedly joined thereat to the body **15** of the rocket **10**. The fins **14** extend to a distal end remote from the respective proximal end. The fins **14** may be plural and substantially circumscribed the body **15** in a first, collapsed position in which the fins **14** are retracted and proximate the exterior surface **16**. The fins **14** may be circumferentially

conforming wraparound fins **14** retracting in the direction of the arrows to the collapsed position.

Referring to FIG. **1**D, the rocket **10** may have one or more folding fins **14** which extend in the direction of the arrows to, a second, open position. Such fins **14** articulate in the longitudinal direction and may be hingedly attacked to the exterior of the body **15** at the proximal end of the fins. The rocket **10** forms no part of the claimed invention, except as specifically claimed herein in combination with a sleeve.

Referring to FIG. **2**, a sleeve **20** according to the present invention is longitudinally elongate and preferably axi-symmetric about longitudinal axis LA. The sleeve **20** has longitudinally opposed ends which may be open and perpendicular to longitudinal axis LA. The sleeve **20** telescopingly fits over the aft end **15**A of the rocket **10** in the axial direction as inserted in the direction of the arrow. The sleeve **20** may have a light friction fit, as imparted by the outward spring bias of the fins. The sleeve **20** is preferably concentric to both the body **15** and to the longitudinal axis LA when installed on the rocket **10**.

The rocket **10** may be stored in a first location for protection from weather, sabotage, etc. The sleeve **20** is installed on the rocket **10** in the first location. The rocket **10** is later transported to a second location for deployment and loading onto one of the aforementioned weapons. A rocket **10** may be moved individually or moved in a plurality of rockets **10** to be deployed on a common weapon or different weapons. The sleeve **20** is removed form each rocket **10** at the second location.

Referring to FIG. **3**A and FIG. **3**B, the sleeve **20** may be generally cylindrical and have a round cross section. The sleeve **20** preferably comprises an inner ring **21** and an outer ring **23** joined in face to face relationship. The inner ring **21** has an inner surface **26** which faces towards longitudinal axis LA and contacts the fins **14** in the collapsed position. The inner surface **26** is preferably smooth and continuous, to minimize obstructions, rugosities or other snags when telescopingly installing or removing the sleeve. The inner ring **21** may be electrically conductive to ground any spark which occurs while installed on the rocket **10**. The inner surface **26** may comprise any electrically conductive material, such as aluminum foil, printed metal, steel linings, etc.

The outer ring **23** may comprise any material having sufficient hoop strength to resist the combined spring bias of all of the fins. The outer ring **23** may be metallic or is preferably polymeric. The inner ring **21** and outer ring **23** may be adhesively joined, joined by spin welding, etc. Preferably the inner ring **21** and the outer ring **23** are not axially rotatable relative to the other, although the entire sleeve **20** may be axially rotatable relative to the exterior surface **16** of the body **15** of the rocket **10**. In one non-limiting embodiment, the sleeve **20** may be an open cylinder which is 4 inches long with a 2.9" ID. The longitudinal length of the sleeve **20** may be less than, equal to or preferably slightly greater than the axial length of the fins, so that the fins **14** are protected by the sleeve **20** when installed on the rocket **10**. The sleeve **20** may be rigid, not plastically deforming during ordinary use and storage. A rigid sleeve **20** provides the benefit, not found in the prior art, that such sleeve **20** can readily be installed and removed with one hand. Furthermore, the rigid sleeve **20** of the present invention can ambidextrously be installed or removed using either hand.

Referring to FIG. **4**A and FIG. **4**B, in one nonlimiting embodiment the sleeve **20** may have a lip **24** at one end thereof. The lip **24** may preferably circumscribe the circumference of the sleeve, or be intermittent. The lip **24** prevents the sleeve **20** from being longitudinally telescoped too far onto the body **15** and ensures the sleeve **20** will be in the right position to hold the fins **14** in collapsed position.

Referring to FIG. **5**, the sleeve **20** may have a third, intermediate ring **22** between and joined to both the inner ring **21** and the outer ring **23**. The intermediate ring **22** may be configured to provide hoop strength while the outer ring **23** may provide protection against foreign object damage. The intermediate ring **22** may be continuous and match the respective walls of the circumjacent inner ring **21** and circumjacent outer ring **23**. Alternatively, the intermediate ring **22** may be discontinuous to conserve material.

With continuing reference to FIG. **5**, one end of the sleeve **20** may have one or more struts **35** thereacross four being shown in a nonlimiting embodiment. The struts **35** form chords and intercept the longitudinal axis LA. While cross struts **35** are shown, one of skill will recognize the invention is not so limited and may comprise a simple diametrical strut, a triskelion, etc. The struts **35** perform a function similar to the aforementioned lip **24**, but provide the benefit of increasing both crush strength and hoop tension strength proximate that end.

Referring to the left side of FIG. **6**, the inner ring **21** may comprise flaccid material. This arrangement provides the benefit of widening the material selection for the inner ring **21** and particularly providing a material for the inner ring **21** which may cushion the fins **14** to prevent damage during storage and transport. Such an inner ring **21** can accommodate deviations from concentricity in the aft end **15**A of the rocket **10**.

Referring to the right side of FIG. **6**, the inner ring **21** may comprise pleats **36**. The pleats **36** provide for accumulation of the otherwise flaccid material into a repeating pattern and thereby reducing snagging during installation and removal. The pleats **36** likewise provide for cushioning against the fins **14**. Such an inner ring **21** can accommodate deviations from concentricity in the aft end **15**A of the rocket **10**.

Referring to FIG. **7**, the outer ring **23** may be polygonal. By polygonal it is meant that the respective inner ring **21** or outer ring **23** forms a regular or irregular polygon having vertices. This embodiment provides the benefit that the sleeve **20** prevents rolling of the rocket **10** during storage. This embodiment provides the further benefit that pockets **37** are formed between the inner ring **21** and the outer ring **23**. The pockets **37** can be open ended or closed ends. The pockets **37** may be used for temporary storage of items related to storage and deployment of the rocket **10**, padded throughout with foam for cushioning or simply left empty.

Referring to FIG. **8**, the inner ring **21** may be polygonal, and pockets **37** formed between the inner ring **21** and the outer ring **23** as discussed relative to the preceding embodiment. The polygonal inner ring **21** provides opposed flat surfaces as may be helpful for folding wing rockets **10** or any rocket **10** having even numbers of opposed outwardly biased fins.

Referring to FIG. **9**, in another embodiment, both the inner ring **21** and outer ring **23** may be polymeric and form the aforementioned pockets **37** therebetween. The inner ring **21** and the outer ring **23** in this embodiment, or any of the embodiments described herein, may be eccentric relative to the longitudinal axis. This arrangement provides the benefit that plural rockets **10** with sleeves **20** installed thereon may be conveniently stacked and disposed as irregular storage space allows in austere environments.

Referring to FIG. **10**, in another embodiment the sleeve **20** may be longitudinally split. The sleeve **20** may be opened in the direction of the arrows for installation onto and

removal from the rocket **10**. The sleeve **20** may be circumferentially closed about the aft end **15**A of the rocket **10** and the outwardly biased fins **14** by latches **34**. Suitable latches **34** include buckles, hook and loop fasteners, straps which circumscribe the sleeve, etc. If desired, the sleeve **20** may have a hinge, not shown, diametrically opposite the longitudinal split. This embodiment provides the benefit that if there is insufficient space to longitudinally telescope the sleeve **20** onto and off of the rocket **10**, the sleeve **20** may instead be installed and removed in the radial direction.

With continuing reference to FIG. **10**, the sleeve **20** may have one or more indicia **39**. The indicia **39** may be disposed on the outer surface **27** of the sleeve **20** and provide instructions for use, inventory data, etc.

Referring to FIG. **11**, if desired, the sleeve **20** may have a mesh configuration with perforations **40** through the inner ring **21**, the outer ring **23** or both. The perforations **40** provide for material conservation, while the continuous mesh retains the necessary hoop strength. The sleeve **20** may have a handle **38** to provide for ergonomics when installing and removing the sleeve. This embodiment provides the benefits of weight reduction and temperature equalization through the sleeve, reducing elevated temperatures therein.

Referring to FIG. **12**, if desired the sleeve **20** may be radially elastic. The sleeve **20** may be stretched open for installation and removal. Upon installation the sleeve **20** elastically contracts, restraining the sleeve **20** about the fins **14** in the collapsed position. This arrangement provides the benefit that a single sleeve **20** may be used for multiple rocket **10** configurations.

Referring to FIG. **13**A and FIG. **13**B, in use the sleeve **20** is inserted over the rocket **10** retracting and holding the fins **14** in the collapsed position. The rocket **10** with the installed sleeve **20** therein may be disposed at a first, storage location. The sleeve **20** may be longitudinally removed in the direction of the arrow.

Referring to FIG. **13**C, the rocket **10** may be transported to a second, deployment location, where the sleeve **20** is removed. Upon removal of the sleeve, the fins **14** extend outwardly for guidance during flight. Advantageously, the sleeve **20** and rocket **10** combination of the claimed invention is feasible for rockets **10** having identical fins **14** or fins **14** of different geometries, as shown. The find may be folding, wraparound or a combination thereof.

Upon removal the durable sleeve **20** is cleaned and inspected as necessary. The sleeve **20** is transported to the original storage location or to a different storage location. The sleeve **20** is then reused as needed on another rocket **10**.

All values disclosed herein are not strictly limited to the exact numerical values recited. Unless otherwise specified, each such dimension is intended to mean both the recited value and a functionally equivalent range surrounding that value. For example, a dimension disclosed as "40 mm" is intended to mean "about 40 mm." The term "or" as used herein is to be interpreted as an inclusive or meaning any one or any combination. Therefore, "A, B or C" means "any of the following: A; B; C; A and B; A and C; B and C; A, B and C." Every document cited herein, including any cross referenced or related patent or application, is hereby incorporated herein by reference in its entirety unless expressly excluded or otherwise limited. The citation of any document or commercially available component is not an admission that such document or component is prior art with respect to any invention disclosed or claimed herein or that alone, or in any combination with any other document or component, teaches, suggests or discloses any such invention. Further, to the extent that any meaning or definition of a term in this document conflicts with any meaning or definition of the same term in a document incorporated by reference, the meaning or definition assigned to that term in this document shall govern according to Phillips v. AWH Corp., 415 F.3d 1303 (Fed. Cir. 2005). All limits shown herein as defining a range may be used with any other limit defining a range of that same parameter. That is the upper limit of one range may be used with the lower limit of another range for the same parameter, and vice versa. As used herein, when two components are joined or connected the components may be interchangeably contiguously joined together or connected with an intervening element therebetween. A component joined to the distal end of another component may be juxtaposed with or joined at the distal end thereof. While particular embodiments of the present invention have been illustrated and described, it would be obvious to those skilled in the art that various other changes and modifications can be made without departing from the spirit and scope of the invention and that various embodiments described herein may be used in any combination or combinations. It is therefore intended the appended claims cover all such changes and modifications that are within the scope of this invention.

What is claimed is:

1. An elongate, powerable, expanding fin aerial rocket comprising:

a body having a fore end for containing a warhead and an aft end opposed thereto, the aft end having at least one autonomously radially expandable fin joined thereto, the at least one fin being biased to expand outwardly from a collapsed position juxtaposed with the body to an extended position outward of the body; and

a sleeve removably installed over the at least one fin in the collapsed position, the sleeve restraining the at least one fin in the collapsed position and being removable to allow the at least one fin to expand outwardly from the body, the sleeve having an inner surface oriented towards the body and outer surface opposed thereto, the inner surface of the sleeve being conductive whereby a charge occurring proximate the at least one fin is grounded to prevent ignition of a motor at the aft end of the rocket.

2. A rocket according to claim **1** wherein the sleeve is rigid.

3. A rocket according to claim **2** wherein the sleeve has an inner layer comprising a conductive metal film and a polymeric outer layer in contacting relationship with the inner layer.

4. A rocket according to claim **3** wherein the conductive metal film comprises aluminum foil and is joined to the outer layer.

5. A rocket according to claim **4** wherein the sleeve is generally cylindrical.

6. A longitudinally elongate, powered, expanding fin aerial rocket comprising:

a body having a fore end for containing a warhead and an aft end opposed thereto, the aft end having a plurality of circumferentially spaced, radially expandable fins joined thereto, the plural fins being outwardly spring biased; and

a hollow sleeve removably installed over each of the plural fins in a collapsed position, the sleeve restraining the plural fins in the collapsed position and being removable to allow the at least one fin to expanding outwardly from the body, the sleeve having an electrically conductive inner surface oriented towards the body and outer surface opposed thereto, the inner

surface of the sleeve being conductive whereby a charge occurring proximate the aft end is grounded to prevent ignition of a motor at the aft end of the rocket.

7. A rocket according to claim **6** wherein the hollow sleeve comprises a conductive inner layer and a rigid nonconductive outer layer joined thereto in face to face relationship.

8. A rocket according to claim **7** wherein the hollow sleeve has a friction fit when installed on the aft end of the body and over the fins.

9. A rocket according to claim **8** wherein the hollow sleeve is longitudinally removable from the aft end of the rocket.

10. A rocket according to claim **8** wherein the hollow sleeve is longitudinally split and circumferentially closes around the aft end of the rocket with at least one latch.

11. A rocket according to claim **8** wherein the hollow sleeve has two opposed open ends and further comprising an end cap on one open end, the end cap limiting longitudinal engagement of the sleeve on the aft end of the rocket.

12. A rocket according to claim **11** wherein the end cap comprises a circumferential lip, the lip having a hole therethrough.

13. A rocket according to claim **9** wherein the outer layer of the sleeve is perforate with first and second opposed open ends and a continuous mesh therebetween.

14. A rocket according to claim **13** wherein the inner layer and outer layer of the sleeve are perforate, the sleeve having perforations therethrough.

15. A rocket according to claim **9** having three wrap-around fins and a rigid sleeve which engages the fins when installed on the aft end of the rocket without touching the body of the rocket.

16. A method of handling an expanding fin aerial rocket, the method comprising the steps of:

a. providing at a storage location a first longitudinally elongate, powered, expanding fin aerial rocket, the rocket having a body having a fore end for containing a warhead and an aft end opposed thereto, the aft end having a plurality of circumferentially spaced, radially expandable fins joined thereto, the plural fins being outwardly spring biased from a collapsed position proximate the body to a radially extended position and a complementary hollow sleeve having an electrically conductive inner surface oriented towards the body and outer surface opposed thereto, the inner surface of the sleeve being conductive whereby a charge occurring proximate the aft end of the rocket is grounded to prevent ignition of a motor at the aft end of the rocket;

b. removably installing the sleeve over each of the plural fins in the collapsed position, the sleeve restraining the plural fins in the collapsed position and being removable therefrom without damage to the fins;

c. transporting the rocket to a deployment location;

d. removing the sleeve from the plural fins; and

e. loading the rocket onto a weapon without undue delay.

17. A method according to claim **16** further comprising the step of saving the sleeve for future use on a second rocket, the second rocket having an aft end substantially identical to the aft end of the first rocket.

18. A method according to claim **17** further comprising the step of providing a first plurality of identical rockets and an identical first plurality of complementary sleeves and removably installing each sleeve of the plurality of sleeves on a rocket complementary thereto at the storage location.

19. A method according to claim **18** further comprising the step of transporting a second plurality of rockets having complementary sleeves installed thereon to the deployment location, removing each of the sleeves therefrom and loading each of the rockets of the second plurality of rockets onto a weapon.

20. A method according to claim **19** wherein each rocket of the second plurality of rockets is loaded onto the same weapon.

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