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(54) Countermeasure apparatus for deploying interceptor elements from a spin stabilized rocket

(57) There is provided a countermeasure defense system against hostile missiles directed against tanks and other military vehicles in battle zone that reduces the hazard to friendly military personnel in the zone that is produced at lower cost and whose mission is less complicated to implement by employing non-explosive intercepting ("NEI") elements **14** deployed by the spin stabilized rocket **10**. The NEI are carried in a payload section **17** and contained by a slidable sleeve assembly **16** which is retracted by a drive mechanism **21** after a predetermined time delay programmed into the trigger release assembly **46** at the time of launch. The drive mechanism includes a drive rod **26** that is releasably held by a release mechanism **46** that actuates the compressed coiled spring unit **30** that urges the sleeve assembly **16** to move forward with the sleeve member **22** exposing the contents of the payload section to the centrifugal force of the spin stabilized rocket propelling the NEI elements out from the rocket at constant angular velocity creating an intercepter cloud of elements.

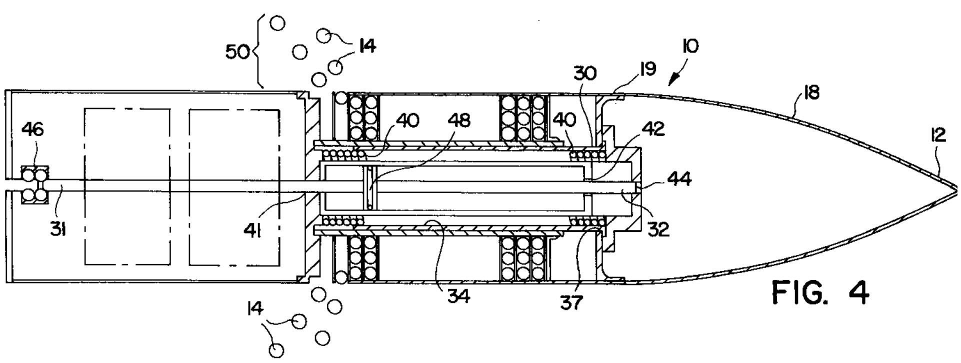

FIG. 4

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Description

BACKGROUND

This invention relates to countermeasures for killing a hostile missile and more particularly to the deployment of non-explosive intercepter elements ("NEI") deployed in the direct path of an incoming hostile missile from a spin stabilized rocket.

Battlefield engagements involving such weaponry as tanks, mobile artillery vehicles and other artillery pieces are vulnerable to attack by enemy armor-destroying guided missiles. Defensive countermeasures to neutralize or kill such incoming hostile attacks generally utilize explosive means for destroying the hostile missile and as a result pose a threat to friendly military personnel in the battle zone. Currently available countermeasure systems which involve guided missiles are costly and complicated to construct and, above all, the use of explosives as a countermeasure offer the potential of harming friendly military personnel. The use of countermeasures activated by proximity fuses are particularly hazardous to friendly military personnel. What is needed is an active defense system that itself is not explosive and yet will effectively intercept and kill an incoming guided missile using NEI which will at least lessen or decrease the hazard to friendly military personnel in the vicinity.

Known defensive systems, such as U.S. Patent No. 4,388,869 are deserving of comment. The teachings in this patent involve the use of non-explosive rods and pellets which are strewn in the orbital path of a satellite target moving in outer space. The targeted spacecraft is engaged and destroyed by the colliding and penetrating rods. The deficiency of such known systems is the ability to deploy the intercepters at precise time and in a controlled array such as a cloud of intercepters to effectively destroy the hostile missile. Other defense systems employ automatic guns that fire projectiles containing heavy metal shrapnel-like elements. A time delay fuse sets off an explosive charge that randomly sprays the shrapnel and subprojectiles against the hostile missile. Unlike the present invention the subprojectiles and shrapnel-like particles pose a hazard to friendly military personnel. Other known countermeasure techniques involve the use of guided missiles that are triggered by a contact fuse or otherwise guided by optical sensors to engage the incoming hostile missile. It has been found that the high probability of successfully defending against such hostile guided missiles is the creation of a cloud of NEI which are deployed directly in the trajectory path at a precise time and in a controlled pattern to assure collision and destruction.

SUMMARY

In accordance with the teachings of the present invention an airborne apparatus is provided that is directed along an interception path for dispensing a plurality of non-explosive intercepter ("NEI") elements in a predetermined configuration to generate a continuous cloud which is directly in the path of the oncoming hostile missile. The apparatus is in the form of a spin stabilized rocket having a longitudinal axis, a rearward end, a lead end, a nose cone body, and a payload section intermediate said nose cone and the rearward end, said payload being disposed circumferentially about the longitudinal axis of the rocket. The payload is comprised of a supply of NEI elements which are propelled from the payload section at a constant tangential velocity in response to the centrifugal force produced by the spin rate of the spin stabilized rocket in flight. Release means is provided in the form of a slidably driven sleeve assembly that covers the payload section during flight and releasing the NEI elements when the sleeve assembly is retracted from the rearward end to the lead end exposing the payload section free of containment. Dispersing the NEI elements forms an intercepter cloud. The cloud is precisely deployed directly in the trajectory path to stop the hostile missile.

In one preferred embodiment, the intercepters may be contained in a series of tube structures arranged radially about the longitudinal axis propelling the NEI elements in a particular formation by the centrifugal force of the spin stabilized rocket which generates a particularly shaped intercepter cloud.

In another preferred embodiment the NEI elements are randomly placed in the payload section so that deployment at the precise time forms a controlled cloud of air borne elements in the intercepting path of hostile missile.

DRAWINGS

These and other features, aspects and advantages of the present invention will become better understood from the following description, appended claims, and accompanying drawings where:

Figure 1 is a longitudinal cross-section of the defending countermeasure rocket showing the containment of the NEI elements in the payload section;
Figure 2 is a cross-section taken through 2-2 of Fig. 1 showing the payload section and containment of the NEI elements;
Figure 3 is a cross-section view of the payload section with the NEI elements randomly loaded in the compartment taken through 3-3 of Fig. 5;
Figure 4 is a longitudinal cross-section of the defending countermeasure rocket showing the slidable sleeve assembly driven in the direction of flight partially uncovering the stowed NEI elements propelling the initial formation of the intercepter cloud; and
Figure 5 is a longitudinal cross-section of the

defending countermeasure rocket showing the sleeve assembly enclosing the randomly disposed NEI elements within the payload section.

DESCRIPTION

This invention is directed to a defensive countermeasure apparatus identified generally with the numeral **10** that can be used to protect weaponry such as tanks and other mobile vehicles such as artillery pieces to be defended against guided missiles. Such countermeasure apparatus desirably should intercept the incoming missile in a manner that presents a minimal hazard to friendly military personnel in the battle zone. The use of explosive countermeasures against hostile missiles that depend on a contact fuse or proximity fuse to explode the defending apparatus in the vicinity of the incoming missile poses a recognized hazard to friendly military personnel operating in the targeted battle zone. Hence, the defense system of this invention employs NEI elements which at least will reduce that hazard.

The construction and operation of the countermeasure apparatus is much less costly to produce because of the unique mechanical arrangement employed to deploy the NEI at the predetermined instant it encounters the incoming hostile missile. The tracking system is rather uncomplicated for the reason it avoids the heat tracking sensors, proximity fuses or other sophisticated techniques. It relies on a radar tracking system.

The defense system of this invention, as shown in Fig. 1, is a spin stabilized rocket **10** spinning at 11,000 RPM having a rearward end **11** and a lead end **12** which is adapted to carry a deployable supply of NEI elements **14**. Analogous elements in the various figures are denoted by the same reference numerals. The apparatus **10** is a 102 mm diameter rocket equipped with a solid propellent motor (not shown) having a slidable sleeve assembly **16**, a payload section **17**, a nose cone body **18** and a drive mechanism identified generally with the numeral **20**. The payload section **17** is defined by a movable wall **19** and rear fixed wall **22**. The NEI elements **14** are loaded in the payload section **17** and are contained therein until the slidable sleeve assembly **16** is retracted uncovering the NEI elements **14** which are then propelled out from the payload section at a constant angular velocity in response to the centrifugal force generated by the spin rate of the rocket.

The manner of placement of the NEI elements within the payload section **17** provides advantages to the effectiveness of the apparatus. In one preferred embodiment (Figs. 3 and 5) the NEI elements are charged randomly into the payload section **17**. This is a less costly approach and upon deployment provides a randomly dispersed intercepter cloud. In another preferred embodiment (Fig. 2) the NEI elements are of a particular shape such as spheres or elongated rods and loaded into a series of rows of tubular structures extending radially about the longitudinal axis of the rocket. The advantage of the second preferred embodiment is the special configuration of the intercepter cloud generated by the controlled rate at which the NEI elements are propelled as well as the uniform weight distribution of the load in the rocket assuring more accurate control of its flight pattern. Both embodiments provide good kill success by the respective intercepter clouds.

As shown in Figs. 1 and 2 the NEI elements **14** are loaded into a series of rows of radially extending tubes **23** or cylinders forming an array of columns of NEI elements about the longitudinal axis **25** of the rocket. In the alternative preferred embodiment of the NEI elements is to randomly shown in Fig. 3, the NEI elements are randomly charged into the payload section **17**. In both embodiments as the sleeve assembly **16** is driven in the direction of flight, portions of the loaded NEI elements are freed from containment forming an intercepter cloud of either a randomly deployed elements and in the other embodiment in particular configuration.

Referring again to Fig. 1 there is shown a drive mechanism **20** which at the appropriate time is actuated causing the slidable sleeve assembly **16** to move in a direction from the rearward end **11** to the lead end **12** of the spin stabilized rocket **10.** The slidable sleeve assembly **16** comprises a sleeve member **21** which is integrally affixed to and moves with the nose cone body **18**. The support wall **19** has an annular opening **30** which is closed with a cup-shaped bracket **28**. The drive mechanism **20** includes a drive cylinder **24** centrally mounted within the payload section **17**, generally along the center longitudinal axis **25**, and containing a drive rod **26**. The drive rod **26** extends along the longitudinal axis **25** having one end **31** releasably supported in the rearward end **11** of the rocket and its forward end **32** affixed to the bracket **28**. The bracket **28** also receives the forward end **29** of the drive cylinder **24**. The support wall **19** extends transversely across the inside diameter of the rocket meeting the sleeve member **21** at the juncture **27** where it comes with the nose cone body **18**.

The sleeve member **21**, the shell of the nose cone body **18** and the wall **19** are welded at the juncture **27** or otherwise integrated so that the assembly **16** moves as a unitary assembly.

A slide support casing **34** concentrically surrounds the drive cylinder **24**. The casing **34** is diametrically larger than the drive cylinder **24** forming an annular space **36** therebetween. The slide support casing extends rearwardly through the payload section, its front end **37** fixed to the support wall **19**, and the back end being unattached. With the slide support casing **34** affixed to the front support wall **19** it will slide toward the lead end **12** as the support wall is moved forward. In the space **36** formed between the slide support casing **34** and the drive cylinder **24** there is coiled about the drive cylinder, under compression, a spring unit **40** disposed between the bracket **28** and the rear fixed support wall

22 of the payload section. In the circumstance a driving force greater than what is provided by a coiled spring the driving mechanism may be equipped with an initiator type squib.

Referring to Figs. 4 and 5, running through center of the rocket **10** along the longitudinal axis **25** is the drive rod **26** releasably secured at the rearward end **11** and extending into and through the drive cylinder **24** through the opening **41** and terminating at the other end of the drive cylinder **24** through opening **42** and secured to the bracket **28** within a notch **44**. The back end of the drive rod **26** is releasably supported in the rearward end **11** of the rocket **10** and is locked in position by a trigger assembly **46** that releases the drive rod **26** in response to a predetermined signal generated by a time delay mechanism built into the trigger assembly.

As shown in Fig. 3 and 5, the NEI elements **14** are randomly loaded in the payload section **17**. In contrast to the type of NEI cloud formation **50** that occurs when deploying the elements in Fig. 4, the randomly loaded elements **14** in Fig. 5 will form a continuous cloud of randomly dispersed elements **14**. Deployment occurs in the same manner as described in connection with Fig. 4 except that the NEI elements are propelled out from the payload section in random fashion thereby forming a continuous intercepter cloud. The dimensions of the cloud are similar to that described in connection with Fig. 4.

Using known conventional radar sensing systems the incoming hostile missile is detected. The radar sensor provides the incoming velocity and range of the hostile missile which enables the calculation of the aiming and time point of actuating the time delay of the defense rocket of the instant invention.

The drive mechanism **20** is set to force the nose cone **18** and the sleeve member **21** to advance in the direction of the lead end **12** of the rocket by the biasing force of the coiled spring unit **40** biased against the ends of the cup-shaped bracket **28** which covers the annular opening **30** of the movable front payload wall **19**. Within the drive cylinder **24** and affixed to the drive rod **26** is a dash pot **48** which serves to control the rate of movement of the drive rod **26** within the cylinder **24** that uncovers the payload section **17**. It will be appreciated that the size and geometry of the continuous intercepter cloud of NEI can be controlled by the rate at which the sleeve member **21** unsheathes the payload section **17** centrifugally forcing out the NEI elements **14** in controlled cloud patterns. Rapid release in a short period of time of all of the NEI elements would create a rather condensed intercepter cloud and the slower the rate at which they are propelled out of the payload section **17** the more dispersed would be the continuous intercepter cloud.

Turning now to Fig. 4 there is shown the condition of the rocket **10** with the trigger assembly **46** having been actuated releasing the drive rod **26** thereby setting the sleeve assembly **16** in motion towards the lead end **12** of the rocket **10** exposing the initial arrays of NEI elements. The elements **14** are deployed by the centrifugal force of the spin stabilized rocket. Laboratory tests have demonstrated that the system will create a continuous cloud **50** of spherical intercepters. It will be appreciated the NEI elements may be spherically shaped such as, for example, ball bearings of 5/16 inches in diameter or steel rods 1/4 to 3/4 inches long and 5/16 inches in diameter, dispersed in the trajectory path of the incoming hostile missile. In terms of time, for example, deployment takes place within the range of 256 to 512 milliseconds after launch. It will be appreciated that the trigger assembly can be adjusted to vary the time over a wide range when the NEI are to be deployed after launch. The trigger assembly **46** is a time delay fuse that can be preset at launch or controlled by a radio link.

In the event the initial array of NEI elements fail to engage the target the subsequent elements in the remaining cloud will likely strike the missile. Within fractions of a second after deployment the entire cloud will have spent its discharge energy from the rocket and begin to fall harmlessly to the earth. In most instances a single intercepter element striking the incoming missile could cause a kill. It will be appreciated that the only explosive elements occurring in the engagement would be that of the hostile missile kill thereby reducing and possibly minimizing the hazard to friendly military personnel on the ground beneath the engagement.

In the event that the countermeasure missile completely misses its target it will ultimately fall to earth but poses no hazard since it contains no unexploded or undetonated cargo. This invention avoids the circumstance of the countermeasure missile being armed with explosives such that the expiration of the time delay could, by itself, cause an explosion in mid-air and pose a hazard. The use of heavy metals or shrapnel-like elements that are deployed by an explosive force pose a hazard to friendly military personnel.

Although the present invention has been described in considerable detail with reference to certain preferred versions thereof, other versions are possible. Therefore, the scope of the appended claims should not be limited to the description of the preferred versions contained herein.

Claims

1. A countermeasure spin stabilized defense rocket carrying non-explosive intercepter (NEI) elements for intercepting and destroying an incoming hostile missile comprising:

    control means for directing the rocket along an intercepting path after launch;
    means for deploying the NEI elements at a predetermined time after launch; said means comprising a payload section containing a supply of said NEI elements;

means for containment of said NEI elements during flight;

drive means for operating the containment means to deploy the NEI elements; and

time control means for activating the containment drive means, whereby the NEI elements are deployed in a controlled manner along the intercepting path forming a cloud of elements having a predetermined diameter by the centrifugal force of the spin stabilized rocket.

2. The invention as claimed in claim 1 wherein the NEI elements are spherical in shape, or

wherein the NEI elements are elongated rods, or

wherein the NEI elements are irregular in shape.

3. The invention as claimed in claim 1 wherein the deployment of the NEI elements are propelled outward from the payload section at a constant tangential velocity forming a continuous cloud of said elements in the intercepting path of the incoming hostile missile.

4. The invention as claimed in claim 1 wherein the NEI elements are stored in the payload section in a series of tubes extending radially about the longitudinal axis wherein the NEI elements are propelled outward from the payload section forming a predetermined configured continuous cloud in the intercepting path of the incoming missile; and/or

wherein the containment means comprises a retractable sleeve assembly enclosing the payload section, said sleeve assembly being slidably mounted in the direction of the lead end of the rocket being driven by the drive means actuated in response to the time control means, and

wherein the drive means preferably comprises a slidable drive rod releasably held by a release mechanism and a coiled spring maintained under compression for driving the containment means in the direction of the lead end of the rocket in response to the actuation of the release mechanism, and

wherein the drive rod preferably is slidably received in a fixed drive cylinder equipped with means for controlling the rate of movement of the drive rod, and/or

wherein the time control means is a time delay device preset at the time the rocket is launched; and/or

wherein the rocket is propelled by solid propellent.

5. A countermeasure defense spin stabilized rocket adapted to intercept a hostile incoming missile employing non-explosive intercepter (NEI) elements that are propelled by the centrifugal force of the spinning rocket and having a rearward end and a nose cone, said rocket comprising:

a payload section charged with a supply of NEI elements to be deployed in the direct trajectory path of the incoming missile;

a slidable sleeve assembly comprising a shroud that circumferentially envelops the rocket closing the payload section during flight whereby containing the NEI elements and is operable to an open position exposing the payload section;

drive mechanism that retracts the sleeve assembly at a predetermined time after launch including a drive rod guide that advances the sleeve assembly at a controlled rate to its retracted position; said drive rod being releasably latched by a latch mechanism; and

a time delay control for unlatching the drive rod after launch urging the sleeve assembly to its open position whereby the NEI elements are propelled from the payload section at a constant tangential velocity generating a controlled continuous cloud of NEI elements in the trajectory path of the incoming hostile missile.

6. The invention as claimed in claim 5 where the NEI elements are spherically shaped, and/or

wherein the drive means is a compressed coiled spring urging the sleeve assembly to its open position, and/or

wherein the continuous cloud has a diameter in the range of 4-6 ft, and/or

wherein the continuous cloud is formed of a predetermined pattern of NEI elements, and/or

wherein the time delay control is preset at launch and unlatches the drive rod a predetermined time after launch, and/or

wherein the time delay control is actuated from a remote location just prior to interception of the hostile missile occurs, and/or

wherein the drive means is an initiator type squib, and/or

wherein the NEI elements are disposed in a series of radially extending tubes within the payload section generating a predetermined continuous cloud upon ejection from the rocket, and/or

wherein the circumferential shroud that encloses the payload section is integral with the nose cone being moved when the nose cone is driven, and/or

wherein the drive means includes a drive cylinder fixedly mounted within the payload section and concentrically mounted within a casing, the latter being attached to and movable with the nose cone, thereby forming an annular space between the drive cylinder and the casing, said drive rod extending through the drive cylinder with its lead end attached to the nose cone, and/or

wherein the biased spring is disposed under compression in the annular space between the drive cylinder and the casing urging the nose cone to advance thereby retracting the sleeve assembly, and/or

wherein the time delay control is associated with the release mechanism for the drive rod.

7. The invention as claimed in claim 6 wherein the continuous cloud is in the form of an annular ring.

8. The invention as claimed in claim 6 wherein the drive cylinder is equipped with a constant velocity dash pot controlling the rate at which the drive rod is propelled by the biased spring.

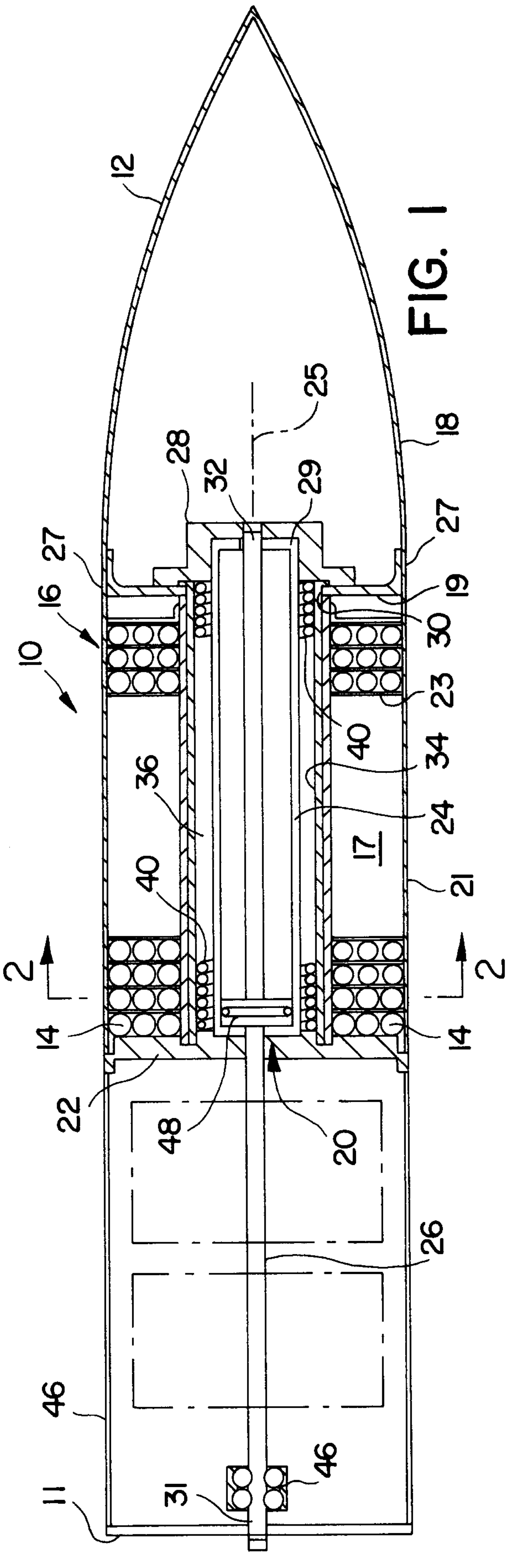

FIG. 1

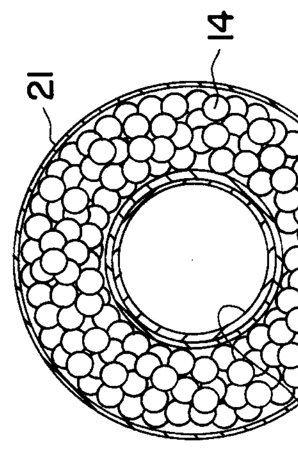

FIG. 3

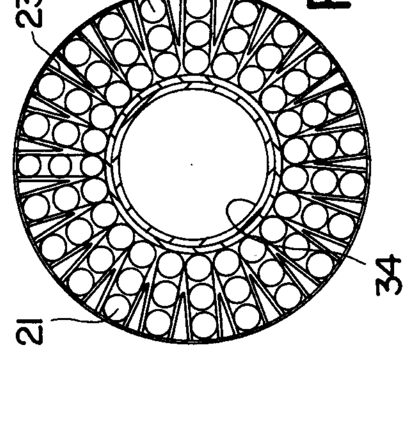

FIG. 2

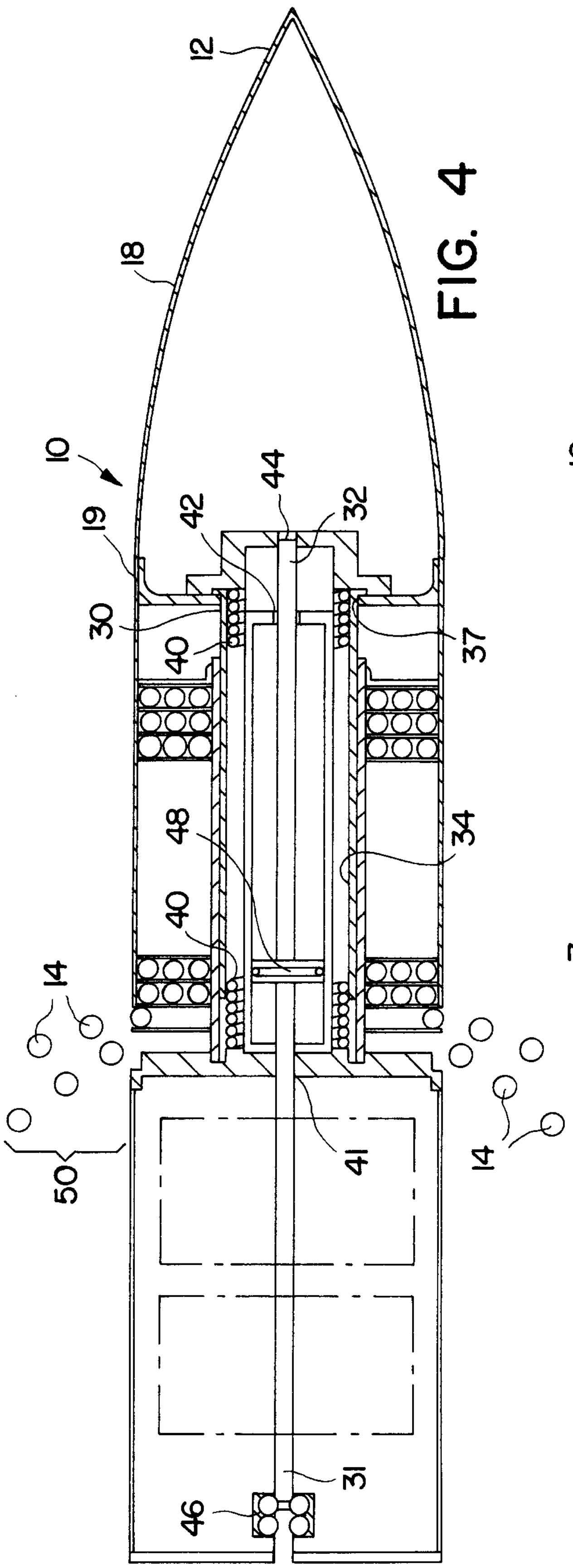
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FIG. 4

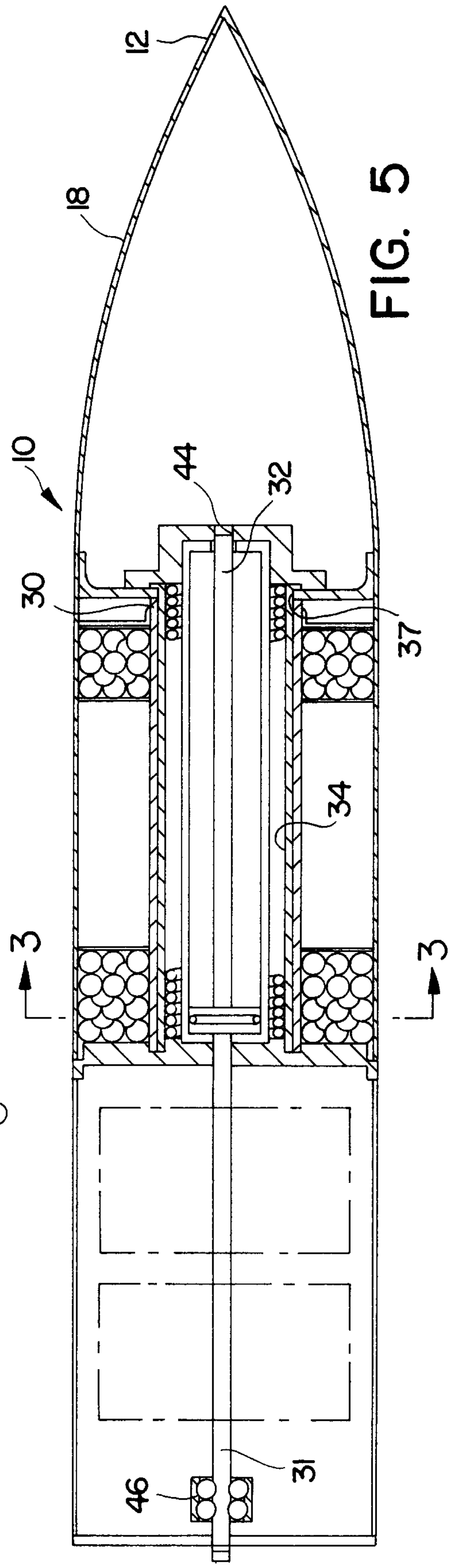
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FIG. 5