A kinetic energy rod warhead deployment system and method featuring jettison housings each including a plurality of lengthy individual projectiles therein and a navigable carrier for the jettison housings. The jettison housings are ejected in the vicinity of targets whereupon the individual projectiles are deployed in the trajectory path of each target.
FIG. 6

FIG. 7

FIG. 8
KINETIC ENERGY ROD WARHEAD DEPLOYMENT SYSTEM

RELATED APPLICATIONS

[0001] This application claims priority of Provisional Application Serial No. 60/406,828 filed Aug. 29, 2002.

FIELD OF THE INVENTION

[0002] This invention relates to improvements in kinetic energy rod warheads.

BACKGROUND OF THE INVENTION


[0004] “Hit-to-kill” vehicles are typically launched into a position proximate to a re-entry vehicle or other target via a missile such as the Patriot, Trident or MX missile. The kill vehicle is navigable and designed to strike the re-entry vehicle to render it inoperable. Countermeasures, however, can be used to avoid the “hit-to-kill” vehicle. Moreover, biological warfare bomblets and chemical warfare submunition payloads are carried by some threats and one or more of these bomblets or chemical submunition payloads can survive and cause heavy casualties even if the “hit-to-kill” vehicle accurately strikes the target.

[0005] Blast fragmentation type warheads are designed to be carried by existing missiles. Blast fragmentation type warheads, unlike “hit-to-kill” vehicles, are not navigable. Instead, when the missile carrier reaches a position close to an enemy missile or other target, a pre-made band of metal on the warhead is detonated and the pieces of metal are accelerated with high velocity and strike the target. The fragments, however, are not always effective at destroying the target and, again, biological bomblets and/or chemical submunition payloads survive and cause heavy casualties.


[0007] The two primary advantages of a kinetic energy rod warhead is that 1) it does not rely on precise navigation as is the case with “hit-to-kill” vehicles and 2) it provides better penetration then blast fragmentation type warheads.

[0008] To date, however, kinetic energy rod warheads have not been widely accepted nor have they yet been deployed or fully designed. The primary components associated with a theoretical kinetic energy rod warhead is a hull, a projectile core or bay in the hull including a number of individual lengthy cylindrical projectiles, and an explosive charge in the hull about the projectile bay with sympathetic explosive shields. When the explosive charge is detonated, the projectiles are deployed. See “Aligned Rod Lethality Enhanced Concept for Kill Vehicles,” R. Lloyd “Aligned Rod Lethality Enhancement Concept For Kill Vehicles” 10th AIAA/BMDD TECHNOLOGY CONE., July 23-26, Williamsburg, Virginia, 2001 incorporated herein by this reference.

[0009] SUMMARY OF THE INVENTION

[0010] It is therefore an object of this invention to provide a new kinetic energy rod warhead deployment system.

[0011] It is a further object of this invention to provide such a kinetic energy rod warhead deployment system which is capable of destroying multiple spaced apart target clusters but requiring only a single carrier missile.

[0012] It is a further object of this invention to provide such a kinetic energy rod warhead deployment system which is highly versatile.

[0013] The invention results from the realization that a more versatile kinetic energy rod warhead deployment system capable of destroying spaced apart target clusters but requiring only a single carrier missile is achieved by packaging projectiles in a number of housings jettisoned from the carrier missile and each placed in the vicinity of an individual target so that the projectiles, when deployed from each jettisoned housing, lie in the trajectory paths of all of the targets.

[0014] This invention features a kinetic energy rod warhead deployment system comprising at least one jettison housing including a plurality of individual projectiles therein and means for deploying said projectiles and a navigable carrier for the jettison housing including means for ejecting the jettison housing in the vicinity of a target whereby the means for deploying the projectiles is activated to deploy the individual projectiles in the trajectory path of the target.

[0015] In one example, the means for deploying the projectiles includes an explosive charge core surrounded by the projectiles. In another example, the means for deploying the projectiles includes an explosive charge within the jettison housing surrounding the projectiles. In still another embodiment, the means for deploying the projectiles includes explosive charge sections surrounding the projectiles.

[0016] Typically, the carrier is a missile and there are a plurality of jettison housings carried by the missile and selectively ejectable from the missile.

[0017] The means for ejecting the jettison housing may include spinning the carrier to impart a velocity to the housing, an explosive charge about the jettison housing, or a propulsion subsystem associated with the jettison housing.

[0018] The method of destroying a number of spaced targets of this invention features navigating a carrier missile proximate the target, ejecting housings each containing a plurality of projectiles into the trajectory path of each target, and deploying the projectiles of each jettison housing to destroy each target.

BRIEF DESCRIPTION OF THE DRAWINGS

[0019] Other objects, features and advantages will occur to those skilled in the art from the following description of a preferred embodiment and the accompanying drawings, in which:
FIG. 1 is a schematic view showing the typical deployment of a "hit-to-kill" vehicle in accordance with the prior art;

FIG. 2 is a schematic view showing the typical deployment of a prior art blast fragmentation type warhead;

FIG. 3 is a schematic view showing the deployment of a theoretical kinetic energy rod warhead system;

FIG. 4 is a schematic view showing the deployment of a kinetic energy rod warhead as a replacement for a blast fragmentation type warhead in accordance with the subject invention;

FIGS. 5A–5C are schematic views showing the ejection of a single jettison housing from a missile and the deployment of a plurality of projectiles in accordance with the system and method of the subject invention;

FIG. 6 is a schematic cross-sectional view showing the primary components associated with one type of jettison housing in accordance with the subject invention;

FIG. 7 is a schematic cross-sectional view showing the primary components associated with another embodiment of a jettison housing in accordance with the subject invention;

FIG. 8 is a schematic cross-sectional view showing the primary components with still another embodiment of a jettison housing in accordance with the subject invention;

FIG. 9 is a schematic view showing a carrier missile with a number of jettison housings in accordance with the subject invention;

FIG. 10 is a schematic view showing the ejection of a number of jettison housings from a single missile and the deployment of the projectiles of each jettison housing to destroy object clusters deployed far apart in space in accordance with the system and method of this invention;

FIG. 11 is a schematic view showing how, in one embodiment, the housings are jettisoned from the carrier;

FIG. 12 is a schematic view showing an explosive charge for jettisoning the housings from the carrier; and

FIG. 13 is a schematic view showing a propulsion subsystem for jettison of the housings from the carrier.

DISCLOSURE OF THE PREFERRED EMBODIMENT

As discussed in the Background section above, “hit-to-kill” vehicles are typically launched into a position proximate a re-entry vehicle 10, FIG. 1 or other target via a missile 12. “Hit-to-kill” vehicle 14 is navigable and designed to strike re-entry vehicle 10 to render it inoperable. Countermeasures, however, can be used to avoid the kill vehicle. Vector 16 shows kill vehicle 14 missing re-entry vehicle 10. Moreover, nuclear, biological and chemical submunition payloads 18 are carried by some threats and one or more of these bomblets or chemical submunition payloads 18 can survive, as shown at 20, and cause heavy casualties even if kill vehicle 14 does accurately strike target 10.

Turning to FIG. 2, blast fragmentation type warhead 32 is designed to be carried by missile 30. When the missile reaches a position close to an enemy re-entry vehicle (RV), missile, or other target 36, a pre-made band of metal or fragments on the warhead is detonated and the pieces of metal 34 strike target 36. The fragments, however, are not always effective at destroying the submunition target and, again, biological bomblets and/or chemical submunition payloads can survive and cause heavy casualties.


In general, a kinetic energy rod warhead, in accordance with this invention, can be added to kill vehicle (interceptor) 14, FIG. 3 to deploy lengthy cylindrical projectiles 40 directed at re-entry vehicle 10 or another target. In addition, the prior art blast fragmentation type warhead shown in FIG. 2 can be replaced with or supplemented with a kinetic energy rod warhead 50, FIG. 4 to deploy projectiles 40 at target 36.

Two key advantages of kinetic energy rod warheads as theorized is that 1) they do not rely on precise navigation as is the case with “hit-to-kill” vehicles and 2) they provide better penetration then blast fragmentation type warheads.

The idea behind the subject invention is to deploy projectiles in the trajectory path of a target from a jettison housing or housings ejected from a carrier such that the projectiles are placed in the trajectory path of a target or targets as shown in FIGS. 5A–5C. Thus, the deployment system of this invention features navigable carrier 50 such as a missile including jettison housing 52 and means for ejecting jettison housing 52 in the vicinity of target 54 to be destroyed as shown in FIG. 5B. Jettison housing 52 includes a plurality of projectiles 56, FIG. 5C wherein which are deployed in the trajectory path P of target 54 as shown.

In one embodiment, jettison housing 52a, FIG. 6 includes hull 60 and therein explosive charge core 62 surrounded by projectiles 56. Upon detonation of explosive charge 62, hull 60 fragments and projectiles 56 are deployed as shown in FIG. 5C. In another embodiment, jettison housing 52b, FIG. 7 includes hull 70 encasing explosive charge 72 surrounding projectile core 74. Upon detonation of explosive charge 72, hull 70 breaks up and projectile core 74 is deployed as shown in FIG. 5C.

In still another embodiment, jettison housing 52c, FIG. 8 includes explosive charge sections 80a–80c surrounding projectiles 82 and separated by detonation cord 84. In this way, the projectiles can all be deployed in one primary direction by detonating, for example, the detonation cord between explosive charge sections 80b and 80c, and between 80a and 80c, and between 80d and 80e to deploy explosive charge sections 80b and 80c. Then, explosive charge sections 80a and 80d are detonated to deploy projectiles 82 in the general direction of vector 86.

Thus, the means for deploying the projectiles in accordance with this invention can vary depending on the
specific design and purpose of the jettison housing and in accordance with the state of the art. See also U.S. patent application Ser. Nos. 10/301,420, 09/938,022 and 09/938,022, incorporated herein by this reference. These patent applications describe other types of deployment systems. See also the application filed on an even date herewith entitled “Kinetic Energy Rod Warhead with Imploding Charge for Isotropic Firing of the Penetrators” by the same inventor.

[0042] It is preferred that the missile carrier include a number of jettison housings as shown in FIG. 9 which can be selectively ejected each to be placed in the vicinity of a number of potential and actual targets as shown in FIG. 10. Thus, jettison housing 52 is ejected in the vicinity of decoy cluster 54a, FIG. 10, jettison housing 52" is ejected in the vicinity of actual target 54b (e.g., a re-entry vehicle), jettison housing 52" is ejected in the vicinity of decoy cluster 54c, and jettison housing 52iv is ejected in the vicinity of decoy cluster 54d.

[0043] The projectiles or rods of each jettison housing, once deployed, are now in the trajectory path of each target 54a-54d and will destroy each target.

[0044] The means for ejecting each jettison housing can vary depending on the design criteria. At least three different jettison technologies could be used to deploy the warhead housing. A predictor fuse can be used to determine which object is a threat. The guidance system of the missile is able to compute a range and angle of the objects relative to the missile system. Based on this data, a time-to-go is computed. The jettison housing is deployed to the space and initiated ahead of the incoming objects. This creates a cloud of projectiles that kill all the enemy objects.

[0045] One ejection concept is to deploy the housings by spinning the missile. This generates an angular rotation of all the housings. The fuse determines which housing to deploy relative to the position of all the object clouds. The spinning energy is converted to linear energy and velocity by releasing the housing while it is spinning. The spinning housing is released and is still spinning as it approaches it intercept point. The projectiles are then released with a linear shaped charge that cuts a retaining band or they are explosively deployed. If rods are used, they are perfectly aligned after angular deployment because the housing contains a high angular velocity. The rods are deployed with perfect spacing as shown in FIG. 11 where v is the deployment velocity and w is the angular velocity.

[0046] The housings could also be deployed with an explosive. An explosive arc 80, FIG. 12 is placed around the housing 52 and given the correct time-to-go, the housing is explosively launched from the missile. The same fuse logic would be employed as the spinning concept, except a small explosive charge would be used for deployment. The explosive charge would be designed thin enough with a proper buffer to protect the housing from damage during initial deployment. Polyurethane foam buffer 82 is used to help protect the housing 52 from explosive damage.

[0047] Another ejection concept is a propulsion system 90, FIG. 13 for each housing (e.g., a thruster). Each housing would contain a small propulsion system that would accelerate the housing to its correct point in space. Once it has reached this point, then the rods are deployed with a small center core of explosives as shown in FIG. 6.

[0048] The projectiles or rods within the jettison housings may be lengthy cylinders or may have special shapes as disclosed in U.S. patent application Ser. No. 10/162,498 filed Jun. 4, 2002 and incorporated herein by this reference.

[0049] The advantages of such a system wherein the projectiles are housed in housings jettisoned from a carrier missile include the ability to destroy multiple target clusters spaced apart in space with only one carrier missile. Thus, the method of this invention features navigating carrier missile 50, FIG. 10 proximate the targets, ejecting a housing containing a plurality of projectiles into the trajectory path of each target as shown in FIG. 10, and deploying the projectiles of each jettison housing to destroy each target.

[0050] Although specific features of the invention are shown in some drawings and not in others, this is for convenience only as each feature may be combined with any or all of the other features in accordance with the invention. The words “including”, “comprising”, “having”, and “with” as used herein are to be interpreted broadly and comprehensively and are not limited to any physical interconnection. Moreover, any embodiments disclosed in the subject application are not to be taken as the only possible embodiments.

[0051] Other embodiments will occur to those skilled in the art and are within the following claims:

What is claimed is:

1. A kinetic energy rod warhead deployment system comprising:

at least one jettison housing including a plurality of lengthy individual projectiles therein and means for deploying said projectiles; and

a navigable carrier for the jettison housing including means for ejecting the jettison housing in the vicinity of a target whereupon the means for deploying the projectiles is activated to deploy the individual projectiles in the trajectory path of the target.

2. The kinetic energy rod warhead deployment system of claim 1 in which the means for deploying the projectiles includes an explosive charge core surrounded by the projectiles.

3. The kinetic energy rod warhead deployment system of claim 1 in which the means for deploying the projectiles includes an explosive charge within the jettison housing surrounding the projectiles.

4. The kinetic energy rod warhead deployment system of claim 1 in which the means for deploying the projectiles includes explosive charge sections surrounding the projectiles.

5. The kinetic energy rod warhead deployment system of claim 1 in which the carrier is a missile.

6. The kinetic energy rod warhead deployment system of claim 1 in which the means for ejecting the jettison housing includes spinning the carrier to impart a velocity to the housing.

7. The kinetic energy rod warhead deployment system of claim 1 in which the means for ejecting the jettison housing included an explosive change about the jettison housing.

8. The kinetic energy rod warhead of claim 1 in which the means for ejecting the jettison housing includes a propulsion subsystem associated with the jettison housing.
9. The kinetic energy rod warhead deployment system of claim 1 in which there are a plurality of jettison housings carried by the carrier and each selectively ejectable from the carrier.

10. A method of destroying a number of spaced targets, the method comprising:

navigating a carrier missile proximate the target;
ejecting housings containing a plurality of projectiles into the trajectory path of each target; and
deploying the projectiles of each jettison housing to destroy each target.

11. A kinetic energy rod warhead deployment system comprising:

at least one jettison housing including a plurality of lengthy individual projectiles therein and means for deploying said projectiles; and

a navigable carrier for the jettison housing for ejecting the jettison housing in the vicinity of a target whereupon the means for deploying the projectiles is activated to deploy the individual projectiles in the trajectory path of the target.

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