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[54] **RAM PRESSURE STANDOFF EXTENSION AND SAFE/ARM MECHANISM FOR SELF-ARMING MUNITIONS**

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[51] **Int. Cl.** **F42c 1/14**

[58] **Field of Search** 102/7.4, 81, 81.2, 70

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[57] **ABSTRACT**

A munition for flight through a fluid medium environment to a target having an extendible standoff member normally carried within the munition body for efficient packing density, an interior diaphragm responsive to the differential between fluid ram pressure and local low static pressure during flight to extend the standoff member forwardly of the munition body, and a detonator carried by the standoff member into an armed position wherein it is responsive to the impact of the standoff member with the target to detonate the munition at a predetermined standoff distance from the target.

7 Claims, 3 Drawing Figures

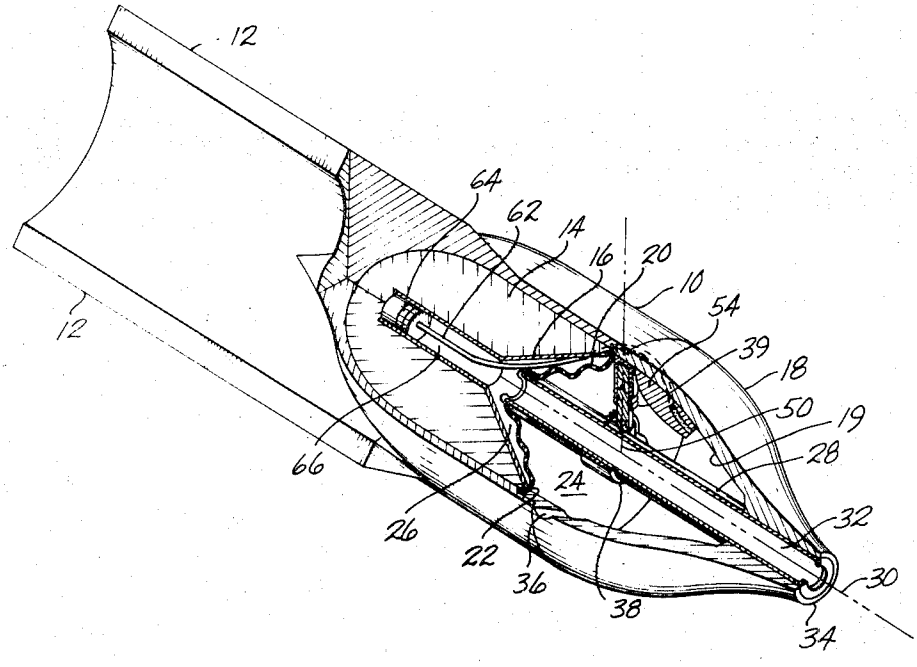


Fig. 1.

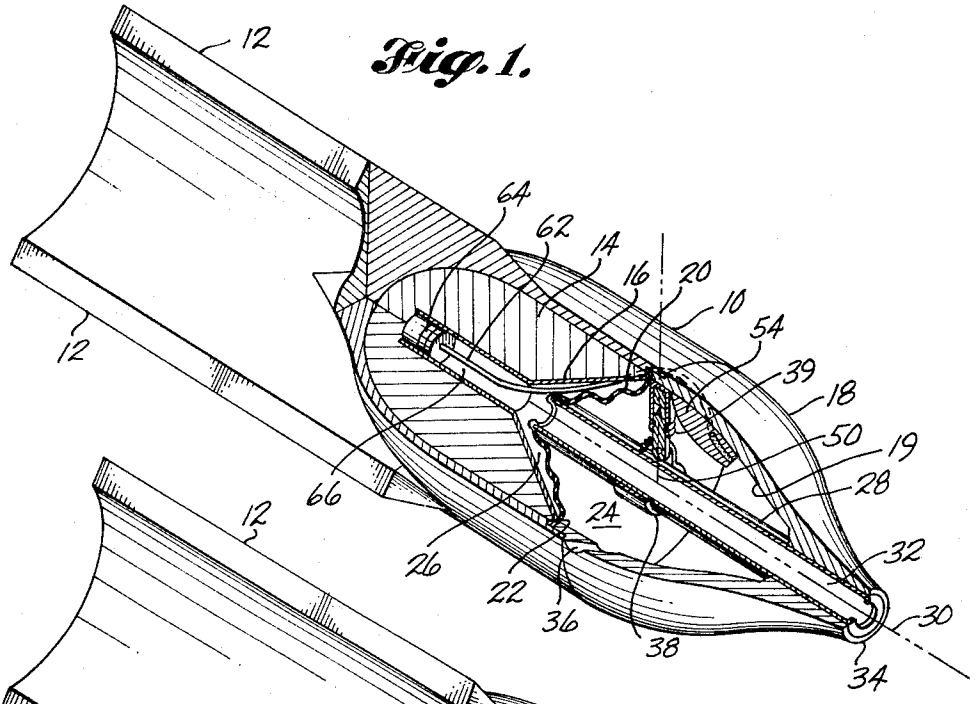
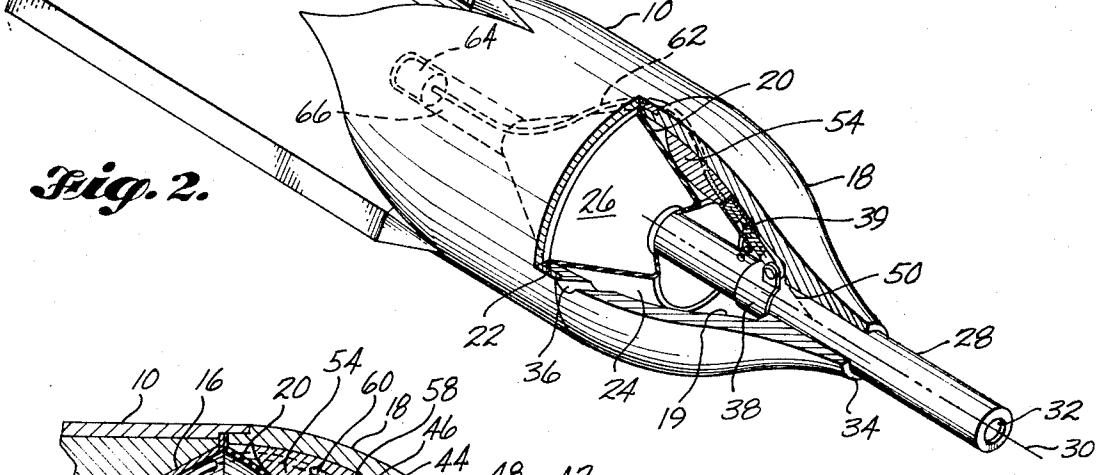


Fig. 2.



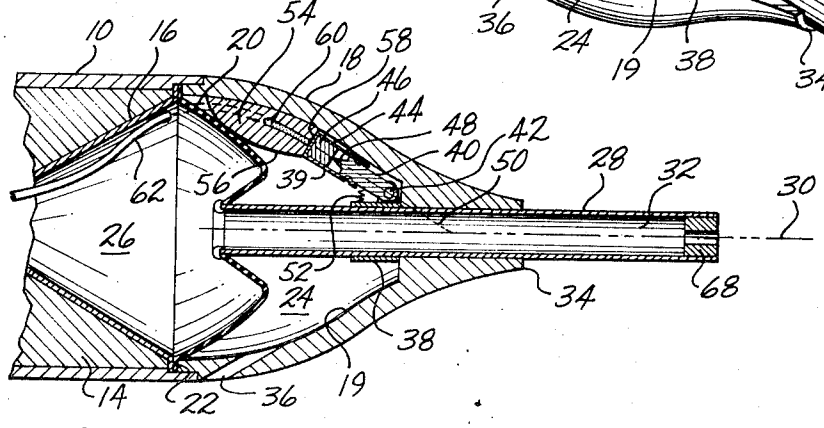


Fig. 3.

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RAM PRESSURE STANDOFF EXTENSION AND SAFE/ARM MECHANISM FOR SELF-ARMING MUNITIONS

BACKGROUND OF THE INVENTION

This invention relates to munitions designed for flight through a fluid environment to a target and more particularly to means for arming such munitions in response to a flight environment forcing function and for detonating the munition at a predetermined standoff distance from the target.

It has long been known that the armor penetration capability of a munition can be increased by appropriately shaping the munition charge geometry and by detonating the munition at a predetermined distance, known as the standoff distance, from the charge to the armor surface. For conventionally shaped charge geometries, maximum armor penetration is achieved with a standoff distance of approximately three to four charge diameters. Detonation of the charge at the predetermined standoff distance has been provided in the prior art by affixing to the nose of the munition an elongated standoff member which impacts the target prior to the munition proper, and triggers the detonation of the explosive charge upon the impact of the standoff member with the target. However, providing a standoff member of sufficient length to detonate the munition at an optimum standoff distance seriously compromises the packing density capability of the munition, resulting in handling problems prior to launch and seriously limiting the number of munitions that can be carried in a weapons delivery system. With the development of submunitions designed to be clustered in the warhead of a missile or other similar weapons delivery system, the packing density of the particular submunition design becomes a critical factor for effective weapon deployment. Thus the weapons designer has been required to make a compromise between optimum standoff distance and maximum packing density with the normal compromise generally being for increased packing density and reducing standoff distance to approximately to one charge diameter.

In addition to the penalty of low packing density, prior art standoff members have posed problems in prelaunch handling of the munition. Since the munition must be sensitive to detonation by impact force applied to the standoff member, the extension of this member beyond the normal envelope of the munition has resulted in increased exposure of the munition to accidental detonation. Thus it is desirable to provide an arming sequence that is responsive to a forcing function obtained only in the in-flight environment and to provide a safe condition wherein the explosive train is discontinuous so the accidental detonation of the initiator or detonator will not result in detonation of the principal explosive charge.

When a munition is designed for multiple packing or clustering in a warhead, problems of standoff member damage and premature detonation have been encountered due to collisions between the submunitions during the initial dispersal sequence. Thus it is desirable to not only provide an arming sequence responsive to the in-flight environmental conditions, but means must be provided to protect the standoff member and delay the arming sequence for an interval subsequent to warhead opening to prevent disarming of the submunition and to insure against premature detonation.

SUMMARY OF THE INVENTION

It is an object of this invention to provide means for detonating a munition at an optimum predetermined standoff distance from a target without compromising packing density of the munition.

It is another object of this invention to provide means for arming a munition designed for flight through a fluid environment to a target, said means being responsive to a forcing function obtained only in the in-flight environment.

It is yet another object of this invention to provide a munition having minimum length for increased packing density and an out-of-line explosive train for increased safety during prelaunch handling and which is responsive to post launch in-flight environment for arming and standoff extension.

It is a further object of this invention to provide a submunition capable of delayed in-flight standoff extension and arming for preventing premature detonation due to collisions between submunitions during initial dispersal sequence.

These and other objects of the invention are provided by incorporating within a munition designed for flight through a fluid medium environment to a target, an extendible standoff member that is carried within the body of the munition prior to launch and which, in response to the flight environment, extends forwardly of the munition body to a predetermined optimum standoff distance. Forward movement of the standoff member is provided by a rearwardly extending conical yieldable diaphragm attached to the standoff member and defining a pair of chambers within the munition body; one of said chambers being in communication with the fluid ram pressure at the nose of the munition, and the other chamber being in communication with the fluid static pressure at a point remote from the nose of the munition. The differential fluid pressure applied to the diaphragm deforms the conical diaphragm to a forwardly extending position extending the standoff member forwardly beyond the nose of the munition. Detonator means, carried by the standoff member, are simultaneously moved from a safe position, out of line with the explosive train with its impact actuation axis normal to the longitudinal axis of the standoff member, to an armed position, in operative relationship with the munitions explosive charge with the impact actuation axis inclined to and having a substantial component parallel with the longitudinal axis of the standoff member. Upon impact of the standoff member with the target, impact forces are transmitted to the detonator causing detonation of the munition's charge at the predetermined optimum standoff distance from the target.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is an isometric view, partly in section and with portions broken away, of a munition incorporating the features of the invention in the safe condition with the standoff member withdrawn.

FIG. 2 is an isometric view, partly in section and with portions broken away, of a munition incorporating the features of this invention in the armed condition with the standoff member extended.

FIG. 3 is a longitudinal cross sectional view of the forward portion of the munition of FIG. 2 showing

details of the detonator and standoff extension apparatus.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

Referring now to the drawings which illustrate a shaped charge munition designed for flight through the atmosphere to a target that incorporates the standoff extension and safe/arm features of the invention, there is shown a housing **10** having fins **12** for aerodynamic stability and containing a shaped explosive charge **14** with a shaped charge liner **16**. While the standoff extension features of this invention provide particular benefits when applied to shaped charge munitions and will be described herein that context, it is to be understood that the features of this invention can be applied to other than shaped charge munitions. Similarly, the application of this invention is not limited to munitions designed for aerodynamic flight to a target, but may also be applied to munitions designed for flight through environments other than the atmosphere, such as torpedoes and other underwater munitions.

Housing **10** has a nose cone **18** which is generally hollow and forming an interior nose cavity defined by the interior surface **19** of nose cone **18** and the shaped charge liner **16**. A differential pressure sensitive means, such as a conically shaped deformable diaphragm **20** is positioned within said nose cavity with the outer peripheral edge **22** of the diaphragm sealed to the interior wall surface **19** of nose cone **18** forming two separate pressure chambers within said nose cavity: a fore or low pressure chamber **24** defined by diaphragm **20** and interior wall surfaces **19** of nose cone **18**; and an aft or high pressure chamber **26** defined by diaphragm **20** and shaped charge liner **16**. Attached to the central apex of conical diaphragm **20** and sealed thereto is elongated standoff means **28** which may conveniently be a hollow tubular member having longitudinal axis **30** and an interior bore **32** communicating with aft chamber **26**. Standoff means **28** extends forwardly of diaphragm **20** through fore chamber **24** and is slidably fitted to an aperture in forward nose portion **34** of nose cone **18**. It is normally desirable that standoff means **28** be fitted to nose cone **18** such that its longitudinal axis **30** is coincident with the longitudinal axis of the munition in order to provide aerodynamic stability and to insure that the forward end of standoff means **28** will be presented to the free stream total pressure field during flight of the munition. A bore or aperture **36** is provided in the shoulder of nose cone **18** at a point remote from forward nose portion **34** to vent fore chamber **24** to a low fluid pressure region on the order of free stream static pressure during the flight of the munition through a fluid medium environment.

Collar **38** fixedly attached to standoff means **28** within chamber **24** has pivotally attached thereto a detonator means **39** having a first end comprising a piston **40** pivotally connected to collar **38** by pin **42**; and a second end comprising a cylindrical sleeve **44** containing a detonating charge **46**. As is more clearly shown in FIG. **3**, sleeve **44** is crimped about an annular groove in piston **40** and the end of piston **40** opposite to that pinned to collar **42** is formed into a firing pin **48** placed adjacent to detonating charge **46**. Impact or accelerating force applied to detonator means **39** along impact actuation axis **50**, which is generally the symmetrical axis of detonator means **39** and extends through pin **42**, will cause firing pin **48** to penetrate and detonate detonator charge **46**.

During storage or while contained within a warhead or other weapons delivery system, and at all times prior to launch through the atmosphere or other fluid medium to a target, the munition embodying the apparatus of this invention is in the configuration as shown in FIG. **1**, wherein standoff means **28** is in a first position contained essentially entirely within nose cone **18** and does not extend forwardly beyond forward nose portion **34** of nose cone **18**. Diaphragm **20** is in its relaxed position with the apex thereof, to which is attached standoff means **28**, extending rearwardly toward shaped charge liner **16** and impact actuation axis **50** of detonator means **39** is essentially normal to longitudinal axis **30** of standoff means **28** in a safe or unarmed position. This orientation of impact actuation axis **50** and longitudinal axis **30** is maintained by compression springs bias means **52** which may be either a metallic compression spring or a resilient nonmetallic compression member. In this condition the overall length of the munition is at a minimum enabling increased packing density to be obtained in a warhead or other weapons delivery system. In addition, any impact force accidentally applied to forward nose portion **34** of nose cone **18** will not be transferred to detonator means **39** and cause the detonation thereof because of the perpendicular orientation of impact actuation axis **50** and standoff longitudinal axis **30**; and even if detonator means **39** should be accidentally detonated, since it is not in operative relationship with shaped explosive charge **14** and is shielded therefrom by diaphragm **20** and shaped charge liner **16**, a detonation of the shaped charge would not result.

Upon warhead opening or other launch of the munition from its delivery system into the atmosphere or other fluid medium environment for flight to a target, fins **12** stabilize the flight path of the munition and forward nose portion **34** of nose cone **18** experiences the ram fluid pressure. During the flight of the munition to the target, the fluid ram pressure is conducted to aft chamber **26** through interior bore **32** of standoff means **28** while simultaneously fore chamber **24** is vented to a low static pressure region remote from forward nose portion **34** causing a buildup of pressure in the aft side of diaphragm **20** and a drop in pressure in the fore side of diaphragm **20**. This results in a differential pressure applied across diaphragm **20** producing a resultant pressure acting on the aft side of diaphragm **20** deforming it in a forward direction, as shown in FIG. **2**, to move standoff means **28** to a second position wherein standoff means **28** extends forwardly beyond forward nose portion **34** of nose cone **18**.

As standoff means **28** moves forwardly to the second position during flight, it carries detonator means **39** along with it into operative relationship with shaped explosive charge **14** in a manner to be now described. Positioned on interior surface **19** of nose cone **18** is camming means **54** having a first surface **56** engaging sleeve **44** of the second end of detonator means **39** during movement of standoff means **28** from the first to the second position. During this engagement of detonator means **39** with first surface **56** of camming means **54**,

the bias of spring bias means 52 is overcome and detonator means 39 is pivotally urged about pin 42 from the safe position, wherein its impact actuation axis 50 is normal to standoff means axis 30, to an inclined armed position, wherein impact actuation axis 50 has a substantial component parallel to longitudinal axis 30, as is shown more clearly in FIG. 3. As sleeve 44 of the second end of detonator means 39 travels along first surface 56 of camming means 54 and reaches the forward end thereof, spring bias means 52 urges detonator means 39 upwardly, as shown in FIG. 3, locking the second end of detonator means 39 into abutting relationship with second surface 58 of camming means 54. Mild detonating cord 62 connected to booster charge 64 in a well or bore 66 within shaped explosive charge 14 has an end 60 contained within a bore in camming means 54 and presented to second surface 58 thereof. In this manner, forward movement of standoff means 28 from the first position to the second position by the differential pressure applied to diaphragm 20 during flight of the munition to a target, moves detonator means 39 from a safe or unarmed position, wherein its impact actuation axis 50 is essentially normal to standoff means axis 30, to an armed position, wherein detonator charge 46 is locked into operative relationship with shaped explosive charge 14 and wherein impact actuation axis 50 has a substantial component parallel to longitudinal axis 30. Upon impact with the target, a component of the impact force received by standoff means 28 is transferred through pin 42 and piston 40, causing firing pin 48 to penetrate detonator charge 46 producing a detonation thereof. This explosive energy is then transferred by mild detonator cord 62 to booster charge 64 which detonates explosive charge 14 in a very short interval subsequent to the impact of standoff means 28 with the target.

While the optimum standoff distance yielding maximum armor penetration for a shaped charge munition depends upon many design factors, including charge cone angle, liner material and the type of explosive, there is generally an increase in armor penetration with increased standoff distance up to a certain point for all types of shaped charge munitions. In the case of a munition employing a charge cone angle of 60°, maximum armor penetration is obtained at a standoff distance of approximately three to four charge diameters. In order to obtain acceptable packing densities, munitions employing conventional fixed geometry standoff means are limited to standoff distances of approximately one charge diameter thus compromising the armor penetration capability of the munition. By employing the apparatus of this invention, standoff means 28 may be readily sized to provide standoff distances on the order of 1 ½ – 3 charge diameters thus providing increased armor penetration capability without compromising the packing density of the munition. Increased length of standoff means 28 yielding standoff distances in the order of 4 charge diameters may also be employed subject to the flight stability characteristics of the specific munition design and its intended application.

Differential pressure sensitive means of configurations other than diaphragm 20, such as a bellows, may be employed in the practice of this invention. However, diaphragm 20 is considerably less complicated than a bellows arrangement and provides increased economy of manufacture and reliability of operation. In addition, diaphragm 20 has the capability of long excursions in response to the fluid ram and static pressure differential making possible standoff distances of up to three charge diameters without sacrificing packing density. In certain applications, when such large standoff distances are not required and the increased complexity so warrants, a bellows arrangement may be used to replace diaphragm 20. Diaphragm 20 is preferably made of a deformable material such as nylon, Mylar, or other types of plastic films or membranes. Diaphragm 20 must possess sufficient yieldability to deform from the stored position, as shown in FIG. 1, to the inverted position, as shown in FIG. 2, in order to move standoff means 28 from the first to the second position. Diaphragm 20 should also be sufficiently inert to retain its yieldability over long durations of storage and, in this regard, vacuum formed nylon materials have been found to be particularly suitable.

While the apparatus of this invention has been described as applied to a munition, it is also particularly suitable as applied to a plurality of submunitions, packed into a warhead or other weapons delivery system. In this application, it is generally desirable to delay the application of the full differential pressure to diaphragm 20 for a duration subsequent to the initial submunition dispersal sequence to prevent damage of standoff means 28 or premature detonation of the submunition due to collisions between the submunitions. This operational delay can be achieved by metering the high fluid ram pressure flow through an orifice restricting interior bore 32 of standoff means 28. In FIGS. 1 and 2, such metering is provided by rolling over the forward end of tubular standoff means 28 to form an orifice of a diameter less than interior bore 32. Increased flexibility in providing various operational delays may be obtained by the alternate configuration shown in FIG. 3, wherein a separate orifice defining plug 68 is inserted into interior bore 32 and fixed therein prior to launch of the munitions.

What is provided, then, by this invention is an improved means for arming a munition during flight to a target responsive to a forcing function obtained only in the flight environment and for detonating the munition at optimum preselected standoff distances from the target. These advantages are obtained without sacrificing packing density capability of the munition and out-of-line safety of the explosive train is maintained to prevent accidental detonation prior to in-flight arming. The features of this invention may be applied to a plurality of submunitions clustered in a warhead, or the like, wherein delayed in-flight arming and standoff extension can be provided to prevent premature detonation of the submunition during the initial dispersal sequence due to collisions between the submunitions. Various modifications of the features of this invention may be resorted to by those skilled in the art without departing from the spirit and scope of the invention as hereinafter defined by the appended claims.

We claim:

1. In a munition for flight through a fluid medium environment to a target, improved means for arming the munition and for detonating the munition at a predetermined standoff distance from the target comprising:

a. a housing for containing an explosive charge and having a forward nose portion;

b. elongated standoff means longitudinally mounted in the nose portion of said housing and adapted for movement from a first position, wherein said standoff means is withdrawn into said housing, to a second position, wherein said standoff means extends forwardly beyond the nose portion of said housing;

c. differential pressure sensitive means connected to said standoff means within said housing and responsive to the pressure differential between the fluid ram pressure at the forward nose portion and the fluid static pressure at a low pressure region remote from the forward nose portion, said differential pressure sensitive means including a deformable diaphragm means defining fore and aft chambers within said housing, and further including means for venting said fore chamber to the static fluid pressure at a low pressure region remote from the forward nose portion of said housing and means for applying the fluid ram pressure to the aft chamber whereby the differential fluid pressure between the fore and aft chambers during flight of the munition to the target deforms said diaphragm means to move said standoff means from the first to the second positions, and

d. detonator means connected to said standoff means for movement thereby into operative relationship with the explosive charge as said standoff means moves from the first to the second positions, said detonating means adapted for detonation of the explosive charge upon impact of said standoff means with the target when in the second position.

2. The apparatus as claimed in claim 1 wherein said standoff means comprises a hollow tube in fluid pressure communication with the aft chamber for applying the fluid ram pressure to said diaphragm means during flight to the target.

3. The apparatus as claimed in claim 2 further including orifice defining means positioned within said hollow tube standoff means for delaying the application of the fluid ram pressure to said diaphragm means during flight to the target.

4. In a munition for flight through a fluid medium environment to a target, improved means for arming the munition in response to the flight environment and for detonating the munition at a predetermined standoff distance from the target comprising:

a. a housing for containing an explosive charge and having a forward nose portion;

b. elongated standoff means having a longitudinal axis and slidably mounted in the forward nose portion of said housing, said standoff means longitudinally movable from a first position, contained essentially entirely within said housing for storage of the munition, to a second position, extending substantially beyond the forward nose portion of said housing, for impact with the target prior to such impact of the forward nose portion;

c. detonator means having an impact actuation axis, a first end containing a detonating charge, and a second end pivotally connected to said standoff means;

d. spring bias means engaging said detonating means for biasing said detonating means to a safe position wherein the impact actuation axis is essentially normal to said standoff means longitudinal axis when said standoff means is in the first position;

e. camming means contained within said housing and having a first surface engaging said detonating means for overcoming the bias of said spring bias means and pivotally urging said detonating means to an inclined armed position wherein the impact actuation axis has a substantial component parallel to said standoff means longitudinal axis as said standoff means is moved from the first to the second positions; said camming means further having a second surface receiving in abutting relationship the first end of said detonating means when said detonating means is in the armed position wherein the second surface presents a detonating cord explosive train, connected to the explosive charge, in operative relationship with the detonating charge; and

f. differential pressure sensitive means connected to said standoff means within said housing responsive to the pressure differential between the fluid ram pressure at the forward nose portion and the fluid static pressure at a low pressure region remote from the forward nose portion during flight of the munition to the target to move said standoff means from the first position to the second position.

5. In a munition for flight through a fluid medium environment to a target, improved means for arming the munition in response to the flight environment and for detonating the munition at a predetermined standoff distance from the target comprising:

a. a housing for carrying an explosive charge;

b. said housing having a forward nose portion;

c. elongated standoff means slidably mounted in said forward nose portion for movement from a first position within said nose portion to a second position extending substantially beyond said forward nose portion;

d. differential pressure sensitive means connected to said standoff means within said housing responsive to differential pressure;

e. said differential pressure sensitive means including a deformable diaphragm defining fore and aft chambers within said housing, and means for venting said fore chamber to static fluid pressure at a low pressure region remote from said forward nose portion and means for applying said fluid ram pressure to said aft chamber whereby the differential of fluid pressure between said fore and aft chambers during flight of munition to the target deforms said diaphragm for moving said standoff means from said first to said second position, and

f. detonator means having an impact actuation axis, a first end containing a detonator charge and a second end connected to said standoff means for movement of said detonator means from an unarmed to an armed position in response to movement of said standoff means first position to said standoff means second position respectively, so that said impact actuation axis of said detonator means moves for a substantial component parallel to said standoff means longitudinal axis in said

second extended position and whereby said first end detonator charge moves into cooperating relationship with means interconnecting said detonating charge with said explosive charge carried in said housing, thereby arming said munition.

6. The munition as claimed in claim 5 wherein said standoff means comprises a hollow tube in fluid pressure communication with the aft chamber for applying the fluid ram pressure to said diaphragm means during flight to the target.

7. The munition as claimed in claim 6 further including orifice defining means positioned within said hollow tube standoff means for delaying the application of the fluid ram pressure to said diaphragm means during flight to the target.

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