ELECTRONICALLY CONTROLLED AIMED BLAST WARHEAD

Inventors: Warren L. Gilbertson; Everett T. Shelton, Jr., both of Fredericksburg; Robert M. Southall, King George, all of Va.

Assignee: The United States of America as represented by the Secretary of the Navy

Filed: Feb. 28, 1968

Appl. No.: 710,706

U.S. Cl. 102/56, 102/22, 102/DIG. 2
Int. Cl. F42b 1/00, F42d 1/04
Field of Search 102/22–24, 56, 102/70.2

References Cited

UNITED STATES PATENTS

3,076,408 2/1963 Poulter et al. 102/23
3,136,251 6/1964 Witon 102/70.2 X
3,238,019 3/1966 Carli 102/DIG. 2
3,280,743 10/1966 Reuther 102/24
3,326,125 6/1967 Silvie et al. 102/23

Primary Examiner—Verlin R. Pendegrass
Attorney—G. J. Rubens, A. L. Branning, Thomas O. Watson and H. P. Ewell

ABSTRACT

An aimable warhead comprising a spherical core of high explosive, a buffer material enveloping this sphere, sheet explosive enveloping the buffer and an outer casing for the entire warhead. The buffer material is such that initiation of the outer layer of explosive at a single location does not immediately initiate the core explosive. However, the collision of detonation waves in the sheet explosive produces enough additional pressure at the line of collision to initiate the core at that line. The selection of a plurality of initiation points and of a sequence of initiation enables the explosive force of the core to be directed in a desired direction.

11 Claims, 4 Drawing Figures
ELECTRONICALLY CONTROLLED AIMED BLAST WARHEAD

GOVERNMENT INTEREST IN THE INVENTION

The invention described herein may be manufactured and used by or for the Government of the United States of America for governmental purposes without the payment of any royalties thereon or therefor.

BACKGROUND OF THE INVENTION

1. Field of the Invention

The invention relates to warheads which can direct the explosive force produced upon detonation in such a manner that more explosive force is produced in one direction than in others, and more particularly to warheads of the character described having particular utility in missiles designed to be used against aircraft.

2. Description of the Prior Art

Due to the high speed and maneuverability of modern aircraft, near misses by anti-aircraft missiles are common. In order that such misses not result in failure to destroy the aircraft, means have been devised whereby the missile can sense the presence of an aircraft and detonate the warhead of the missile when a certain proximity to the aircraft is achieved. However, a conventional warhead produces an isotropic blast pressure pattern and the sector in which the airplane lies in relation to the missile warhead receives only its proportionate share of such blast effects while the remainder of the blast effects are dissipated to produce no practical results. It is clear that if the blast effects could be concentrated toward the sector in which the airplane lies in relation to the missile, the effectiveness and therefore the kill probability, of the missile would be substantially increased.

The desirability of aimed blast warheads has been recognized in the past, and one attempt to produce the desired effect involves the physical repositioning of the warhead components in order to aim a concentrated blast effect at a target. This solution has not been entirely satisfactory since the repositioning maneuver required at least several milliseconds, a length of time unacceptable at high velocity warhead-target encounters. Another attempt to produce the desired effect involves the subjection of the warhead to an electric field so as to concentrate the electrons produced during deflagration of the warhead to one side of the warhead thereby creating an absorbing layer of gas and directing the main force of the explosion against the uncushioned side. This in turn causes fragmentation of one side of the warhead casing before the other and the exploding matter bursts out in that direction. A similar result has been achieved by weakening the casing of the warhead in the direction of the target or by exploding a detonator on the side of the warhead in order to weaken the container on that side. These latter means have a disadvantage in that it cannot always be determined in advance where the target will lie in relation to the warhead. The weakened portion of the warhead casing may direct the blast in a direction other than toward the target, thereby reducing the effectiveness of the missile. In the prior art electrically controlled aimed blast warhead, the gaseous cushioning layer fails to produce as positive an aiming of the blast as would be desirable. Further means which have been suggested to produce the desired aimed-blast effect are the use of irregularly shaped charges, the use of inert barriers interposed at selected locations within the explosive charge and the use of a plurality of different explosive compositions. These devices all have the disadvantage of lack of selectivity of blast direction in the event the target appears in a sector toward which the missile is not designed to blast.

SUMMARY OF THE INVENTION

The present invention consists of means for electronically controlling the blast direction of a warhead by initiating the detonation of an explosive core or body along a line produced by the collision of separate explosive wave fronts in an initiating explosive. For instance, the explosive core can be covered by a buffering layer, for example, of thin sheet metal, which is in turn covered by a relatively thin layer of explosive. The latter explosive and buffering layer are sized so that initiation of the outer explosive layer at one point is insufficient to cause immediate detonation of the interior explosive core. However, if the outer explosive layer is detonated at more than one point, the meeting point of the detonation waves traveling through the outer explosive from the initiation point provides an additional pressure in collision to transmit sufficient pressures through the buffering layer to cause detonation in the core. This initiation of the core would start only at the point or line of collision of the detonation waves in the outer explosive layer. If the inner explosive core were in the shape of a sphere, a plurality of diametrically opposed initiators can be provided. Selection of the points and sequence of initiation of these detonators, which in turn initiate explosion of the outer explosive layer, can control the point of initiation of the detonation of the inner explosive core. It has been found that initiation of the inner explosive core on a minor circle of the sphere concentrates the blast effect in the portion of the sphere opposite the minor circle.

In operation, a target detecting device would sense the location of the target and cause initiation of the proper pair of electro-explosive detonators to direct a concentrated blast wave at the target.

An object of the present invention is to provide an aimable blast warhead.

Another object of the present invention is to provide an aimable blast warhead in which the direction of blast can be varied by means carried by the missile.

Yet another object of the present invention is to eliminate the time required to physically reposition or direct other aimable warheads. A further object of the present invention is to provide a relatively simple and inexpensive method of providing almost any desired number of aiming points in an aimed blast warhead.

Yet another object of the present invention is to provide means for initiating detonation of the explosive core of an aimed blast warhead on a continuous line rather than at a series of points. Such a line can be either a great circle or a minor circle of a sphere. This continuous line produces a desirable "drawstring" effect to increase blast effectiveness.

A yet further object of the present invention is to provide means, through adjustment of the delay between initiation of diametrically opposed detonators on a spherical warhead, to adjust the concentration of the blast pressures.
Other objects, advantages and novel features of the present invention will become apparent from the following detailed description of the invention when considered in conjunction with the accompanying drawing.

FIG. 1 is a perspective view of a missile including a warhead embodying the present invention;

FIG. 2 is a side elevation of a warhead embodying the present invention, with parts broken away to better show the construction of the interior of the warhead;

FIG. 3 is a diagramatic view showing the effect of the explosion of a single detonator; and

FIG. 4 is a diagramatic view showing the manner in which an inner explosive core can be detonated by initiation of two detonators.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

Referring now to the drawings, wherein like reference characters designate like parts throughout the several views, there is shown in FIG. 1 (which illustrates a preferred embodiment) a missile 11 provided with a warhead 12. The warhead, shown more particularly in FIG. 2, comprises an inner high explosive core 13 covered by an inert buffering material 14. In the preferred embodiment, the explosive core could be constructed of composition B explosive material, and the inert buffer could be a 0.062-inch thick sheet of aluminum. The inert buffer material is in turn covered with a thin layer of high explosive material 16. The warhead is provided with an exterior casing 17 which can be of conventional construction. A plurality of diametrically opposed electro-explosive initiators 18 are set in to the casing. In the preferred embodiment illustrated in FIG. 1, the electro-explosive initiators 18 are provided on the longitudinal, transverse, and vertical axes of the warhead with respect to the direction of movement of the missile 11. The layer of high explosive material 16 could, in the preferred embodiment illustrated, be a 0.075 inch layer of EL506 explosive. So-1 type electro-explosive initiators can be used to detonate the layer of high explosive material 16.

The manner in which the warhead can be utilized to produce an aimed blast effect will now be described. The buffering material 14 is of such a nature that activation of the outer explosive layer 16 by detonation of a single electro-explosive initiator 18 will not immediately cause detonation of the high explosive core 13. The inert buffering material attenuates the effect of the explosion of the layer of high explosive material 16 such that a single explosive front in the layer of high explosive material 16 will not cause detonation of the inner high explosive core 13. The buffering material 14, however, is thin enough that the higher shock produced by a collision of two or more explosive fronts in the layer of high explosive materials 16 will be enough to cause detonation of the inner high explosive core. When only a single electro-explosive initiator is detonated, such a collision would take place at a point diametrically opposed to the initiator. FIG. 3 shows a diatomic view of the warhead of the present invention in which only the upper initiator has been detonated. The arrows in that figure show the course of the explosive front in the layer of high explosive material 16. In the absence of detonation of the lower electro-explosive initiator, the explosive fronts produced by detonation of the upper initiator will collide at a point adjacent the lower initiator and produce a point initiation of detonation in the inner explosive core 13.

The desired collision of explosive fronts in the layer of high explosive material 16 can also, and preferably, be caused by either simultaneous or delayed initiation of diametrically opposed electro-explosive initiators. If, for example, the spherical warhead were described in terms of the earth, simultaneous detonation of electro-explosive initiators placed at the north and south poles would produce explosive fronts that would travel to produce a line of collision of these fronts at the equator. This would cause initiation of the explosive core 13 immediately under the line of collision entirely around this great circle. Since the detonation front in the inner high explosive core 13 will proceed as an expanding portion of a sphere from the point of detonation, the explosive force in the event of simultaneous detonation of the diametrically opposed initiators would be directed from the core at the north and south pole points.

If initiation of the electro-explosive initiator at the south pole were delayed for a certain period of time after initiation of the one at the north pole, the line of collision of the explosive fronts in the layer of high explosive material 16 could be made to occur at a location corresponding to some south latitude line. This in turn, through detonation of the core, would produce a greater blast pressure at the north pole than at the south. This situation is illustrated in FIG. 4, in which the upper electro-explosive initiator corresponds to the north pole and the lower electro-explosive initiator corresponds to the south pole. The initiation of the south pole has been delayed so that the line of collision, shown dotted in FIG. 4, between the explosive front detonated by the north pole and the explosive front detonated by the south pole is a minor circle corresponding to a circle of south latitude. Since the detonation of the inner explosive core will proceed on a spherical progression from the line of initiation, most of the explosive material in the inner core will be above the center of the explosion, thereby directing most of the explosive force toward the north pole and beyond in that direction. Conversely, a delay in the initiation of the north pole electro-explosive initiator would produce a line of collision at some latitude north and produce detonation of the core to produce a blast at the south pole greater than at the north. The "drowstring" effect of initiation at a line corresponding to a north or south latitude line produces a superior concentration of blast in a desired direction. At first thought, it might appear that detonation at the point directly opposite the direction in which the blast is desired would produce the maximum aimed blast in that direction. It has, however, been found that the drowstring effect of initiation of the outer activating layer loses its ability to concentrate the blast kill mechanism at small circles of latitude which vary with the parameters of the construction of the warhead. This eliminates the possibility of concentrating blast by initiation of only one point diametrically opposite the intended target.

The arrangement of the electro-explosive initiators shown in FIG. 1 permits aiming of the blast of the war-
head to the front, rear, left, right, up or down as shown in the Figure. This is accomplished by initiating the electro-explosive initiator closest to the direction in which the blast is desired to be aimed and by suitably delaying the detonation of the electro-explosive initiator diametrically opposed to the first initiator so as to produce a line of collision of the respective shock fronts in the outer high explosive material 16 that is closer to the last detonated initiator. Alternatively, the blast may be concentrated in two diametrically opposed directions by simultaneous initiation of diametrically opposed initiators.

This concept may, of course, be extended to include any desired number or pairs of initiators placed diametrically opposite each other on the surface of the exterior casing, thereby increasing the number of aiming points to equal the total number of initiators. Electronic adjustment of the delay between actuation of the initiators may be employed to adjust the concentration of the blast if this be desired. Initiation in proper sequence of more than one pair of initiators might also be employed to produce additional unique blast pressure patterns.

In order to fully utilize the improved capabilities of the warhead of the present invention, a target detecting device, of which many are developed and available, would be provided to sense the location of the target and cause initiation of the proper pair of electro-explosive devices to direct a concentrated blast wave at the target. A more complex target detecting device to accurately sense direction and distance might also adjust the delay between actuation of initiators to provide for maximum effectiveness at the target according to its distance from the warhead.

Referring to FIG. 1, such a target detecting device could be comprised of a proximity device 19, a time delay relay 21 and a sector selector 22. U.S. Pat. No. 3,136,251 to Witow discloses a suitable proximity device and sector selector. The sector selector of Witow could be used to transmit electrical impulses to the initiators of the present invention instead of transmitting electrical charges to the various sectors of the warhead as shown in the patent. In order to provide for the desired delay in initiation of the diametrically opposed initiators, a time delay relay 21 is provided.

The operation of the target detecting device is as follows. The proximity device senses the location of the target in relation to the missile and through line 24 transmits this information to the motor of the sector selector as disclosed in the Witow patent. When a desired proximity is reached, an initiating signal is provided through line 26. Branch line 27 transmits the initiating impulse to the initiator which is to be detonated first and time delay relay 21 transmits the signal to the initiator which is to be detonated with a delay. Any suitable conventional target detecting device can be modified in an obvious manner so as to control the initiation of the explosion of the present invention. The target detecting device per se is not part of the present invention but the utilization of such devices enables the present invention to be utilized to the full advantage.

It is, of course, obvious that the invention can be utilized for other purposes than missile warheads. For instance, armor-piercing projectiles, depth charges, artillery shells and the like could incorporate the principles of the present invention.

What is claimed is:
1. An explosive device comprising a spherical explosive body; a buffer layer on the body; an explosive layer on the buffer layer; a plurality of initiators for detonating the explosive layer; and means for delaying the detonation of one of the initiators relative to another.
2. The device of claim 1 in which the initiators are arranged so as to provide at least one pair of diametrically opposed initiators.
3. The device of claim 2 further comprising an outer casing over the explosive layer.
4. An explosive device comprising an explosive body; a buffer layer on the body; an explosive layer on the buffer layer, said buffer layer being sized to prevent a single explosive front in the explosive layer from detonating the explosive body; and means for initiating the detonation of the explosive layer.
5. The device of claim 4 wherein the means for initiating the detonation of the explosive layer comprises separate means for detonating the explosive layer at a plurality of points.
6. The device of claim 5 further comprising means for delaying the detonation of one of the separate means in relation to another.
7. An explosive device comprising a spherical explosive core; and means for initiating detonation of the core at a continuous line on its surface which lies on the intersection of a flat plane with the surface of the sphere.
8. The device of claim 7 in which the flat plane is perpendicular to a line drawn through the center of the sphere, whereby initiation of detonation takes place on a great or minor circle of the sphere.
9. An explosive device comprising a spherical explosive body; a buffer layer on the body; an explosive layer on the buffer layer; and a plurality of initiators for detonating the explosive layer, said initiators being arranged so as to provide at least one pair of diametrically opposed initiators.
10. A method for aiming the blast effects of an explosive device comprising an explosive body, a buffer layer on the body and an explosive layer on the buffer layer and in which the buffer layer is sized to prevent a single explosive front in the explosive layer from detonating the explosive body, comprising detonating the explosive layer near one end of the device; and subsequently detonating the explosive layer near the other end of the device; whereby the explosive fronts from the respective detonations will meet at a point nearer the subsequent detonation than to the initial detonation.
11. A method for aiming the blast effect of an explosive device comprising a spherical explosive body, a buffer layer on the body, an explosive layer on the buffer layer and a plurality of diametrically opposed initiators for detonating the explosive layer, comprising
detonating a first initiator; and
subsequently detonating a second initiator diametrically opposed to the first initiator.

* * * * *