May 25, 1965 V. J. CUSHING ETAL 3,185,097

MISSILE STABILIZING MEANS

Original Filed Aug. 2, 1956 3 Sheets-Sheet 1

FIG.1.

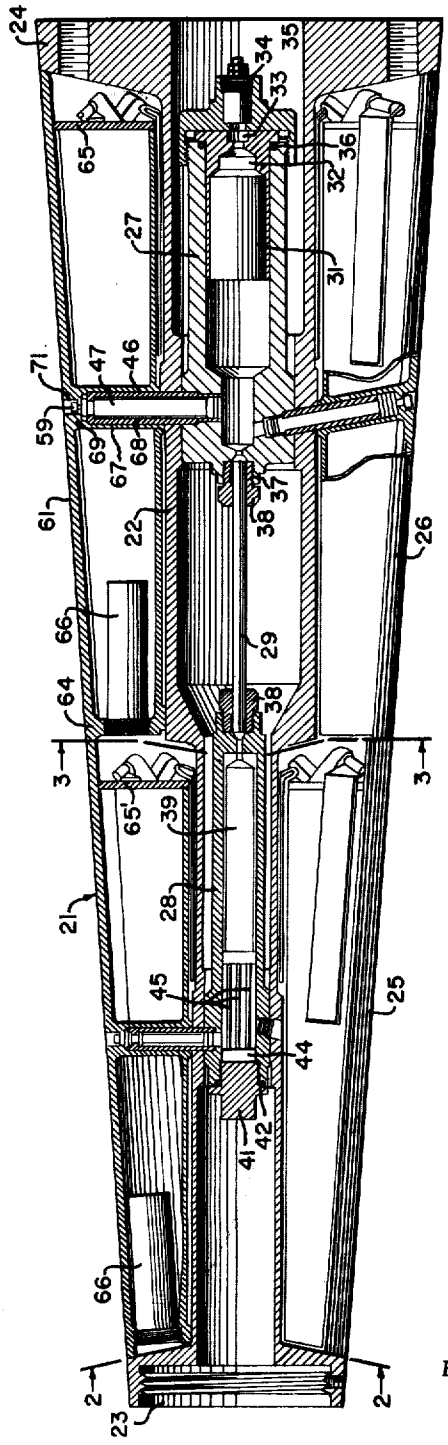
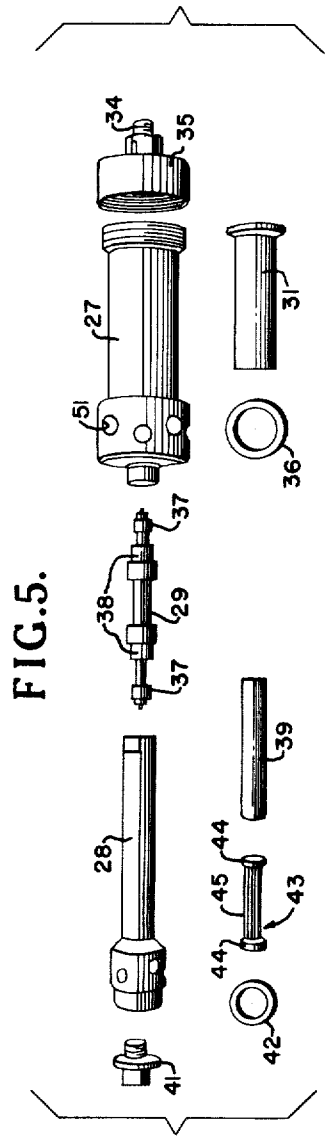


FIG.5.



INVENTORS.
V. J. CUSHING
W. A. BEAUDRY

BY Bacon & Warner
E. D. Hodges
ATTORNEYS.

May 25, 1965 V. J. CUSHING ETAL 3,185,097

MISSILE STABILIZING MEANS

Original Filed Aug. 2, 1956 3 Sheets-Sheet 2

FIG.4.

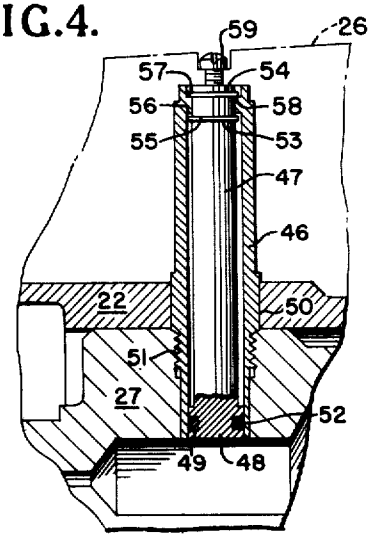


FIG.3.

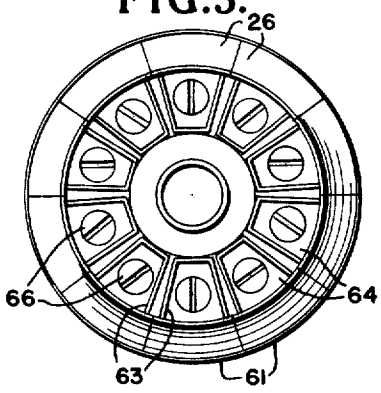


FIG.11.

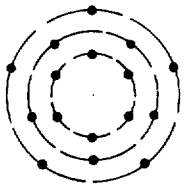


FIG.2.

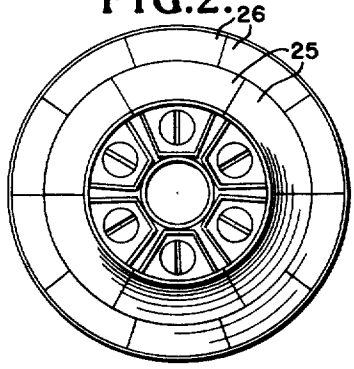
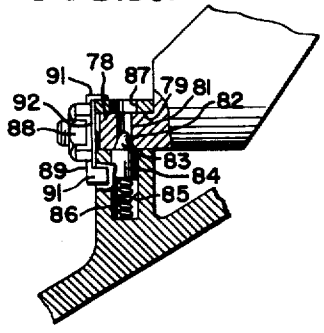


FIG.10.



INVENTORS
V. J. CUSHING
W. A. BEAUDRY

BY Baxter Warner & Hodges ATTORNEYS

May 25, 1965 V. J. CUSHING ETAL 3,185,097

MISSILE STABILIZING MEANS

Original Filed Aug. 2, 1956 3 Sheets-Sheet 3

FIG.6.

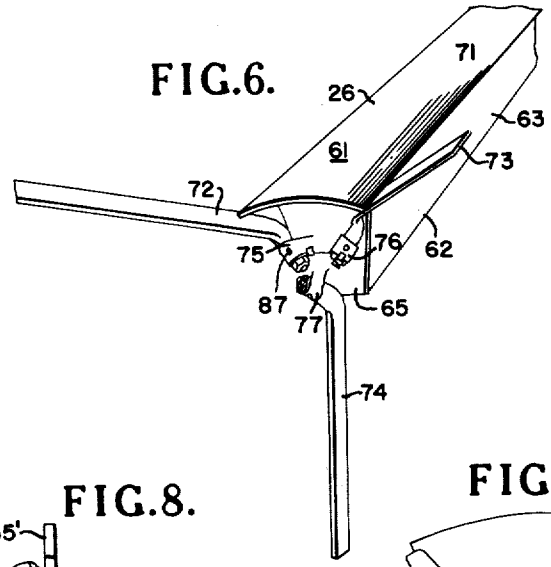


FIG.8.

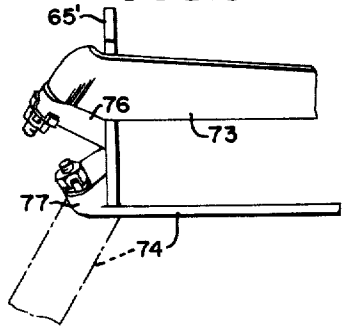


FIG.7.

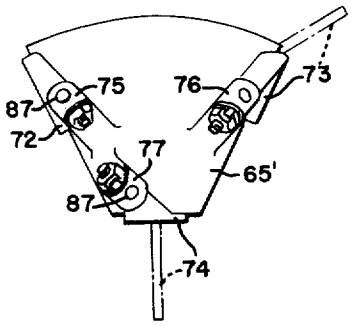
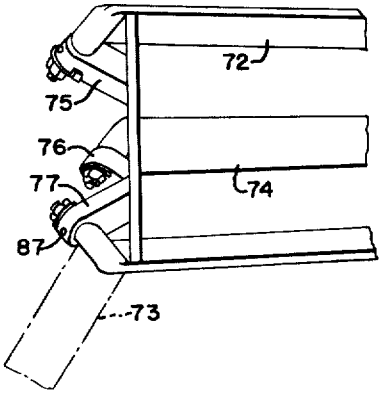


FIG.9.



INVENTORS.
V. J. CUSHING
W. A. BEAUDRY

BY Baxter Warner & Hodgson ATTORNEYS

United States Patent Office 3,185,097 Patented May 25, 1965

3,185,097

MISSILE STABILIZING MEANS

Vincent J. Cushing, Winnetka, and Walter A. Beaudry, Chicago, Ill., assignors, by mesne assignments, to the United States of America as represented by the Secretary of the Navy

Original application Aug. 2, 1956, Ser. No. 601,848. Divided and this application June 25, 1957, Ser. No. 673,997

2 Claims. (Cl. 102—50)

This is a division of application Serial No. 601,848, filed August 2, 1956.

The present invention relates to a dispersal type cluster warhead and more particularly to a dispersal type cluster warhead comprising a plurality of submissiles, each submissile containing an explosive charge and designed to penetrate a target even at acute angles of approach. The warhead of this invention may be incorporated in a guided missile, rocket, bomb, torpedo or other suitable ordnance items.

Various types of cluster warheads have been proposed including a type in which a carrier or parent missile has attached thereto or incorporated therein a small number of submissiles which are ejected from or dispersed relative to the parent missile upon approach of the missile within a predetermined distance of the target, in order that the target be struck by a number of missiles, thereby increasing the probability of destruction or "kill" of the target. Heretofore, most missiles have been circularly symmetrical and have had a conically shaped fuze attached at the front end thereof. When such a missile struck a target at other than normal incidence, the fuze was quite likely to be detached or "washed off" at impact, thus rendering the missile explosively ineffective and making it a dud. Also, folding fin designs on such missiles have required that the fins extend rearward in folded position, thereby occupying a great deal of valuable space.

The cluster warhead of the present invention comprises, in essence, a carrier missile and a considerable number of submissiles, each submissile containing its own explosive charge, which is in sufficient quantity to produce fatal damage to a target, the submissiles being dispersed when the missile comes within a predetermined distance of the target. More specifically, the submissiles are arranged in a plurality of banks and are of designs to form clusters whose external shape is that of the carrier missile ogive. These submissiles are stabilized by folding fins and have a novel shape to give the highest packaging density in the cluster while allowing for a sufficient quantity of explosive. Because of its unusual shape, it has been possible to provide each submissile with a fuze well, so that the fuze can be contained within the submissile and the fuze thus protected from "wash off" or detachment prior to detonation of the explosive in the submissile. The type of folding fin evolved for the cluster warhead of this invention is such that the fins fold forward and lie flush with the sides of the submissile when packaged in the warhead, thus greatly increasing the packaging density, yet when in open position, the three fins on each submissile form a perfectly symmetrical and conventional aerodynamic configuration whereby the plane of the fin surfaces of the three fins intersect in a common line for aerodynamic guidance of the submissile to the target.

One object of the present invention is the provision of a cluster warhead comprising banks of submissiles of novel design and having external surfaces that define the warhead ogive.

Another object is the provision of submissiles of such shape and design to give optimum packaging density in the cluster warhead and at the same time allow for a sufficient quantity of explosive in the submissile.

Still another object is to provide a fin assembly for each of the submissiles wherein the fins fold forwardly and lie flush with the sides of the submissile when the same is packaged in the cluster warhead.

A still further object is the provision of means for pivotally mounting three fins on each of the submissiles, which fins in the folded positions thereof lie flush with the sides of the submissile, yet when in open position, the three fins form a symmetrical conventional aerodynamic configuration.

An additional object is to provide detent means for locking each of the fins in the open position thereof.

Another object of the invention is the provision of rotation axes for the fins such that the setback forces acting on the fins at the time of submissile ejection serve to unfold the fins and rotate them to the open positions thereof.

A further object is to provide means for slowing or retarding the speed of such rotation, as the fins are rotated to their open or unfolded positions.

Other objects and many of the attendant advantages of this invention will be readily appreciated as the same becomes better understood by reference to the following detailed description when considered in connection with the accompanying drawings in which like reference numerals designate like parts throughout the figures thereof and wherein:

FIG. 1 is a sectional plan view of the cluster warhead of this invention, with parts broken away;

FIG. 2 is a cross sectional view of the cluster warhead, taken generally along line 2—2 of FIG. 1 and looking in the direction of the arrows;

FIG. 3 is a cross sectional view of the cluster warhead, taken generally along line 3—3 of FIG. 1 and looking in the direction of the arrows;

FIG. 4 is a detail view of one the piston assemblies of the dispersal gun;

FIG. 5 is an exploded view of the dispersal gun, with the piston assemblies thereof omitted;

FIG. 6 is a perspective view of one of the submissiles of the cluster warhead of this invention, with the three fins of the submissile being shown in the open or unfolded position thereof;

FIG. 7 is a rear elevational view of one of the fin assemblies with the fins thereof in the forward or folded position, the dotted lines serving to illustrate the open positions of two of the fins;

FIG. 8 is a side elevational view of the fin assembly, the fins being fragmentarily shown and the dotted lines illustrating the unfolded position of one of the fins;

FIG. 9 is a plan view of the fin assembly, the fins being in fragmentary form and the dotted lines illustrating the unfolded position of one of the fins;

FIG. 10 is a detail sectional view of the means mounting one of the fins for rotation, showing the means for slowing or retarding such rotation as the fin approaches its open position and the detent means for locking the fin in the open position; and

FIG. 11 schematically illustrates the theoretical dispersion pattern of the submissiles.

Referring now to the drawings, wherein like reference characters designate like or corresponding parts throughout the several views, there is shown in FIG. 1, which illustrates a preferred embodiment, a cluster warhead generally designated by reference numeral 21. More specifically, the cluster warhead comprises a central tubular support 22, which extends the length of the warhead, the support being provided at one end with a threaded portion 23, into which a suitable nose may be threaded, and has a base portion 24 adapted to be attached to appro-

priate propulsion means. Clustered about the tubular support **22** are a forward bank of submissiles or sprites **25** and a rear bank of submissiles or sprites **26**, the submissles or sprites being secured to the support by means hereinafter described in greater detail.

Disposed within the support **22** is a dispersal gun comprising a rear or aft gas chamber **27** and a forward or fore gas chamber **28**, the chambers being interconnected by a high pressure channel or igniter tube **29**. The aft gas chamber **27** is energized through to the medium of a propellant cartridge **31** which is ignited by a powder charge **32**, the powder charge in turn being set off by an electric primer **33**, in response to an impulse transmitted through a suitable safety and arming mechainsm **34**. Mechanism **34** is housed in a cap **35** which is threadedly connected to one end of the gas chamber **27**, a ring seal or gasket **36** being provided to make the connection gas tight. Igniter tube **29** is connected in gas tight relation to the other end of gas chamber **27** by suitable means, for example, a high pressure connector comprising a sleeve **37** threaded on the end portion of tube **29** and a cup-shaped member **38** surrounding the sleeve **37** and tube **29**, said member being threadedly connected to gas chamber **27**.

The other end of igniter tube **29** is similarly connected to the rear end of the forward or fore gas chamber **28**, this end of the igniter tube terminating at the base of a propellant cartridge **39** contained in the gas chamber **28**. The forward end of gas chamber **28** is closed off and sealed by a plug **41** threadedly connected thereto and a ring seal or gasket **42**. To insure that the base of cartridge **39** is related in proper proximity to the associated end of igniter tube **29**, there is provided a spacer member, generally designated **43**, disposed between the cartridge and plug **41**. Spacer member **43** comprises a pair of spaced apart rings **44**, interconnected by a plurality of elongated members, such as rods **45**, or the line, see FIG. 5. One of the rings **44** is adapted to be placed in abutting relation to the forward end of cartridge **39** and the other ring **44** in abutting relation to plug **41**, rods **45** being of such length that, when plug **41** is completely screwed in, the base of cartridge **39** is properly related to the associated end of igniter tube **29**.

It will be noted the high pressure gas channel or igniter tube **29** is of relatively small cross sectional area, the size of the opening necessary in the tube being such as to permit the high pressure gases generated in the gas chamber **27**, by burning of the propellant therein, to spurt through the igniter tube and ignite the propellant in the forward gas chamber **28**. However, the igniter tube so constricts the gas flow that there is no appreciable transfer of energy between the gas chambers through the tube; if the transfer of energy were appreciable, violent and destructive pressure oscillations could result. With the system described ignition of the propellant charge **31** in the aft gas chamber **27** is sufficient to initiate firing the dispersal gun, and it is therefore necessary to have only one safety and arming mechanism **34**.

Turning now to FIGS. 1 and 4, it will be noted that each gas chamber has associated therewith piston assemblies, a typical piston assembly being shown in FIG. 4 and comprising a cylinder **46** and a piston **47**, the piston having an enlarged portion **48** which is provided with a circumferential groove **49** therein. The cylinder **46** is threaded, as at **51** to the housing of the gas chamber and communicates with the interior thereof; the cylinder passing through a suitable opening **50** in tubular support **22**. In the circumferential groove **49** there is disposed an O-ring seal **52** for the purpose of preventing the leakage of gas pressure past the enlarged portion **48** of the piston.

The free end of the reduced portion of piston **47** is provided with a pair of spaced apart circumferential grooves **53** and **54**. In the innermost of said last mentioned grooves, that designated by numeral **53**, is a shear ring **55**, said ring being adapted to engage a shoulder **56**

inside the cylinder **46**, and in the other of said grooves, designated by numeral **54**, is a retaining ring **57** which engages an external shoulder **58** on the cylinder. Threaded into the end portion of piston **47** is a frangible attachment screw **59**, such screw serving to attach and hold in place a submissile, in a manner which will later be apparent.

From an inspection of FIG. 1, it should be noted that some of the piston assemblies are arranged with the longitudinal axis thereof radially disposed with respect to the longitudinal axis of the warhead and perpendicular or normal thereto, while other piston assemblies are radially disposed and at an angle to the longitudinal axis of the warhead. This is true of the piston assemblies associated with both the rear and the fore gun gas chambers of the dispersal gun. Half of the piston assemblies associated with each gas chamber are canted as indicated and are arranged in alternation with the other piston assemblies that are perpendicularly disposed, the reason for the canting being to avoid mutual interference between adjacent piston assemblies at the inner ends thereof and in order to maximize the strokes of the pistons within the limitations of the overall size of the warhead. It is also to be be noted that the enlarged portions of the several piston assemblies have different dimensions and the dimensions are such that when related to the gas pressures generated in the gas chambers, the piston assemblies are moved outwardly by gas pressure to impart to the submissiles desired ejection velocities.

In operation, an electrical impulse is received from a suitable influence device carried by the ordnance item incorporating the warhead of this invention and actuates the electric primer **33** at a predetermined interval of time away from the target, say for example, one quarter of a second. The primer, through the powder train **32**, ignites cartridge **31** which burns and causes a rapid rise in gas pressure, thus energizing the aft gas chamber **27**, an accompanying energizing of the forward gas chamber **28** resulting from hot gases the spurting through tube **29** and igniting cartridge **39**. The rapid rise in gas pressure ruptures shear ring **55** of each of the piston assemblies and allows the piston to travel through its ejection stroke. During this stroke, the sumbissile is accelerated relative to the tubular support **22** until the enlarged portion **48** of the piston strikes the internal shoulder **56** with such force that the frangible attachment screw **59** ruptures, freeing the submissile and allowing it to continue with its acquired ejection velocity. The ejection force passes through the center of gravity of the submissile so that no undesirable overturning moments are imparted to the submissile; also, the force which ruptures the screw passes substantially through the center of gravity of the submissile so that no undesirable overturning moments are imparted to the submissile during this detachment process.

It has been previously stated that the submissiles are so designed and shaped that the external surfaces thereof, when clustered in the warhead, define the ogive of the warhead and, from viewing FIGS. 1, 2 and 3, it will be appreciated that the submissiles or sprites are generally segmental in cross-section. In addition, of course, each of the submissiles or sprites is elongated and comprises an external or skin member **61**, bottom wall **62** and side walls **63**, the member **61** conforming in shape to the particular segment of the warhead that the submissile forms.

For a better understanding of the configuration of the submissile, reference may be had to FIG. 6, wherein is illustrated, in perspective, one of the submissiles or sprites **26** of the aft bank or cluster of submissiles. While the configuration of the submissile or sprite **25** will be generally similar to that of sprite **26**, there will, of course, be differences in dimensions due to the dimensional characteristics of that portion of the warhead of which the sprite **25** forms a part; better understood by reference to FIGS. 2 and 3.

Sprite **26** is closed off at its ends by a front plate **64**

and a rear plate 65, front plate 64 being suitable bored to receive and support a suitable fuze 66 within the submissile. Interconnecting skin member 61 and bottom wall 62 is a tubular portion 67 formed with a large bore portion 68 and a reduced bore portion 69, the reduced bore portion receiving attachment screw 59 and being countersunk, as at 71, to locate the head of the screw inwardly of the skin member 61.

While the description has referred only to the structural features of submissile or sprite 26, it is to be understood, of course, each submissile or sprite 25 is provided with features that are substantially the same, differing only in dimensional characteristics.

The space in each of the submissiles, not occupied by the fuze and the tubular portion, is utilized to house the explosive charge of the submissile, approximately 1.4 pounds of high explosive; the tubular portion of each submissile being so located that the longitudinal axis of the tubular portion passes through the center of gravity of the submissile so that the hereinbefore mentioned ejection and attachment screw rupturing forces pass, or substantially pass through said center of gavity. The center of gravity is that when the submissile has been charged with explosive and fuzed, and has been provided with fins folded forwardly, which fins will now be described.

For the purpose of aerodynamically directing each of the submissiles toward the target, there is provided on the trailing end thereof a fin assembly, comprising three fins 72, 73 and 74, mounted on the rear plate of the submissile by means of projections or mounting standards 75, 76 and 77, respectively secured to the plate or formed integrally therewith. Each of the fins is mounted for rotation in its respective standard, the standards being so disposed and the axes of rotation so chosen, that in the open positions of the fins as illustrated in FIG. 6, the fins form a symmetrical and conventional aerodynamic configuration, whereby the planes of the fin surfaces intersect in a common line; yet the fins are adapted to fold forward and lie flush with the bottom and side walls of the submissile.

The dispositions of the standards, and the axes of rotation of the fins, may be better understood by reference to FIGS. 7, 8 and 9, in which the fins are shown associated with a rear plate 65' of a submissile 25; the folded forward positions of the fins being shown in full lines and the dotted lines showing the open positions of some of the fins. Viewing FIG. 7, it should be apparent that in the unfolded or open positions of the fins, the planes of the fin surfaces are disposed in planes angularly related and approximately 120 degrees from each other, the planes meeting generally in a line of intersection.

Further, it will be appreciated if possible to select rotation axes such that the setback forces acting upon the fins at the time of submissile ejection are adequate to move the fins to the unfolded or open positions thereof, thus obviating the need for additional means, such as springs, or the like, for unfolding the fins.

For locking the fins in the unfolded or open position, each fin is provided with a detent mechanism. On each fin, at one end thereof, is a shaft 78, the shaft being journalled for rotation in a bore 79 in one of the projections or standards 75, 76 or 77, as the case may be. The shaft 78 is provided with a bore 81, the bore having a flared opening 82. The flared opening is adapted to receive the tapered portion 83 of a detent element 84, the detent element being mounted for movement is a bore or well 85 formed in the associated standard and urged or biased to locking position by a spring 86 reacting against the detent element and the bottom of the well. A port or opening 87 is provided in the standard, in alignment with well 85, in order that a thin rod may be passed through said opening and bore 81 for forcing the detent element out of locking position.

It has been found that during rotation of the fins to open position, the speed of rotation attained was often so great that the detent mechanism was adversely affected and the fins would not lock properly. Various ways of slowing or retarding the speed of rotation were attempted and the preferred manner of doing so will now be described. The outer or free end portion of the shaft 78 is threaded so as to receive a nut 88 thereon, the nut being held against movement relative to the standard or projection by means of a retainer member 89, the retainer-member being provided with tangs 91 some of which are bent to engage the sides of the standard and the others being bent in the other direction to engage the nut. Disposed between the nut and the standard, on one side of the retainer member or the other, as desired, is a washer 92 of suitable material; for example, aluminum, or the like. With the nut retained against movement relative to the standard, rotation of the shaft, due to movement of the fins to open position, will have the effect of drawing the nut tighter to the standard, thereby exerting a pressure upon the washer, which pressure deforms the washer and may be sufficient to cause extrusion of the material of which the washer is made. This deformation of the washer absorbs some of the energy of rotation and the speed of rotation is accordingly slowed or retarded as the fin moves to open position, the detent mechanism then functioning to lock the fin in the open position. It will be understood, of course, for the desired effect just described to obtain, the threads on the shaft of certain ones of the fins will be right hand due to the direction of rotation of such fins, whereas the threads on the shaft of other fins will be left hand because of the direction of such fins will be opposite to the direction of rotation of the first named fins.

The desired pattern at the target consists of five, five, and six submissiles, equally spaced around the peripheries of three substantially concentric, generally circular boundaries of radii of approximately 40 feet, approximately 29 feet, and approximately 18 feet, respectively. Since the dispersal time has been set at a quarter of a second away from the target, the required dispersal or ejection velocities are approximately 160, 116, and 72 feet per second, respectively. It is to be understood, of course, that the remainder of the warhead and the nose attached to it, as well as the propulsion means, constitute the center submissile in the desired pattern. The ejection velocity of approximately 72 feet per second for the 6 missiles in the forward bank or cluster is determined by the piston size of the piston assemblies of the forward gas chamber and the gas pressure generated therein. The aft gas chamber has 10 submissiles and 10 piston assemblies associated therewith and every other piston has a diameter such as to give a suitable accelerating impulse to five submissiles to achieve 160 feet per second ejection velocity; the piston assemblies of the remaining five submissiles have a piston diameter such as to cause an ejection of velocity of 116 feet per second. These various ejection velocities substantially produce the theoretical desired pattern schematically shown in FIG. 11.

The operation of the warhead of this invention should be apparent from the foregoing description and only a brief summary thereof will be recited. After incorporation of the warhead in a suitable ordnance item having appropriate propulsion means and influence devices, the warhead is propelled toward the target and at a predetermined time from the target, an impulse is delivered through the electric primer 33, burning of the propellant in gas chamber 27 is initiated and gases are generated which develop high pressures and high temperatures. The gases generated in gas chamber 27 spurt through igniter tube 29 and ignite the propellant in gas chamber 28, thereby generating gases therein. The gases generated in the gas chambers 27 and 28 exert pressure upon the pistons of the piston assemblies associated therewith, and when the pressure exerted on the pistons becomes sufficiently great, the shear rings holding the pistons are ruptured and the pistons move outwardly, each carrying with it the associated submissile. At the end of the stroke of

each piston, the enlarged portion thereof strikes the internal shoulder of its respective cylinder and the ejection forces are sufficient to rupture the frangible attachment screw securing the submissile to its piston, thereby releasing the submissile with an acquired ejection velocity dependent upon the dimensions of the piston and the pressure of the gases exerting pressure on the piston. The particular ejection velocity acquired by the submissile causes the submissile to assume its place in the submissile pattern. During movement of the submissile to its place in the submissile pattern, the fins unfold and rotate to open position, the metal washer associated with each of the fins serving to absorb some of the energy the speed of rotation of the fin, thereby slowing or retarding the rotation of the fin so the detent mechanism thereof functions to lock the fin in open position for aerodynamically guiding the submissile so it may maintain its proper place in the submissile pattern.

From the foregong description, it is evident there has been provided a cluster warhead comprised of a considerable number of submissiles, the external surfaces of the submissiles defining the external shape of the warhead, and means have been provided for ejecting the submissiles and for aerodynamically guiding the same so that the submissiles will strike a target in a desired submissiles pattern.

Obviously many modifications and variations of the present invention are possible in light of the above teaching. It is therefore to be understood that the invention may be practiced otherwise than as specifically described.

What is claimed as new and desired to be secured by Letters Patent of the United States is:

1. In a missile comprising a body having a fin on the rear end thereof movable between a forwardly folded position and a rear unfolded position, means rotatably mounting said fin, said means comprising a standard on the rear of the body, said standard having a bore therein, a shaft on said fin journalled for rotation in said bore, said shaft having a threaded portion outside said bore, a nut threaded on said threaded portion, retaining means engaging said nut and said standard to hold the nut stationary with respect to the standard, and a washer of deformable material disposed between the nut and the standard, movement of the fin from folded to unfolded position rotating said shaft to draw the nut tighter to the standard and thereby deform the washer, deformation of the washer absorbing some of the energy of rotation to retard movement of the fin to the unfolded position thereof.

2. A missile comprising a body having a pair of converging flat side walls interconnected by a flat bottom wall, pivots mounted on the rear of said body and disposed with a pivot adjacent each of said walls respectively, each pivot having an axis of rotation disposed at an angle to the plan of its respective wall, a plurality of planar fins, each of said fins being mounted for rotation on each of said pivots respectively, each fin being moveable about the axis of rotation of its pivot from a forwardly folded position in which the fin lies in close face-adjacency with the respective wall to an unfolded operative position, said fins being moveable in response to aerodynamic forces, means connected to each pivot for retarding rotation of the fin mounted thereon as the fin approaches its operative position, said last-named means comprising a threaded portion rotatable with the respective fin, a nut threaded on said portion and secured to a part fixed on said body, a deformable member disposed between said nut and said part, rotation of said portion serving to draw the nut tighter to the part for deforming said member, deformation of the member absorbing some of the energy of rotation and thereby retarding the rotation of the respective fin.

References Cited by the Examiner

UNITED STATES PATENTS

1,296,403	3/19	Kindle	102—50
1,879,840	9/32	Brandt	102—50
2,430,896	11/47	Uhl	102—50
2,784,669	3/57	Apotheloz	102—50
2,793,591	5/57	Jasse	102—50
2,801,587	8/57	Gould	102—50

SAMUEL FEINBERG, *Primary Examiner.*

ARTHUR M. HORTON, SAMUEL BOYD, *Examiners.*