

June 11, 1963

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3,093,072

SPIN-INDUCED DISPERSAL BOMB

Filed Jan. 30, 1957

6 Sheets-Sheet 1

FIG.1.

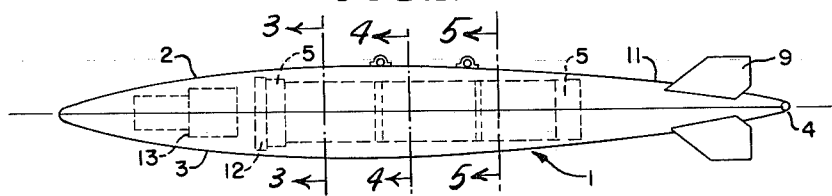
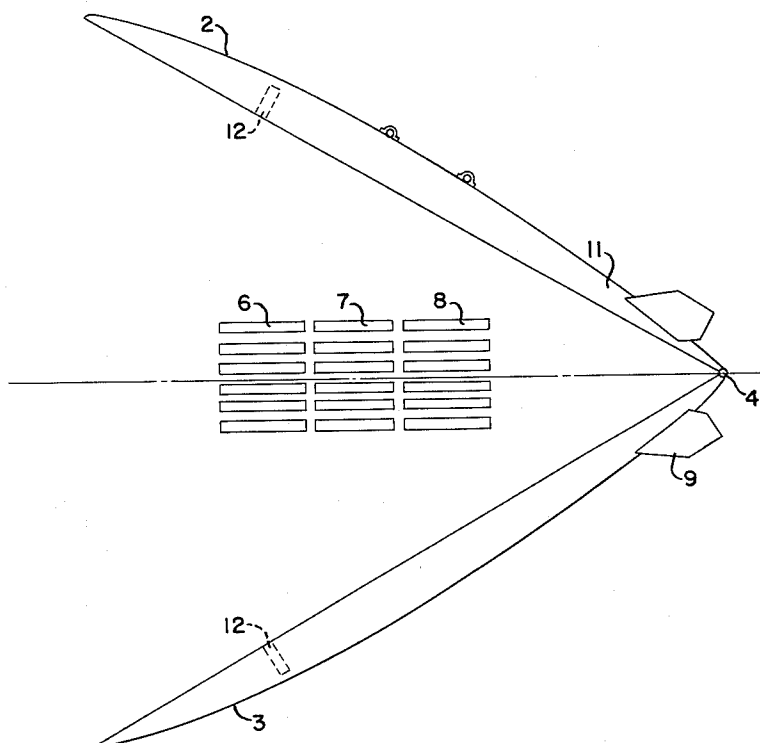


FIG.2.



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FIG.3.

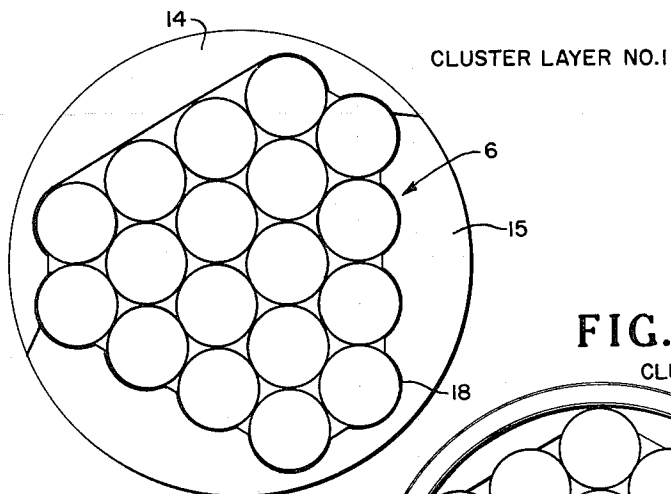


FIG.4.

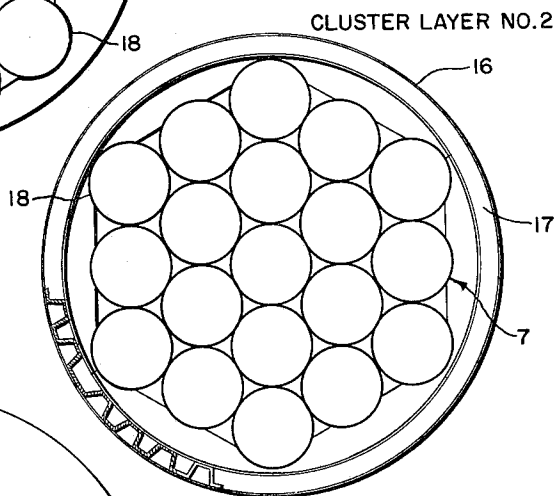
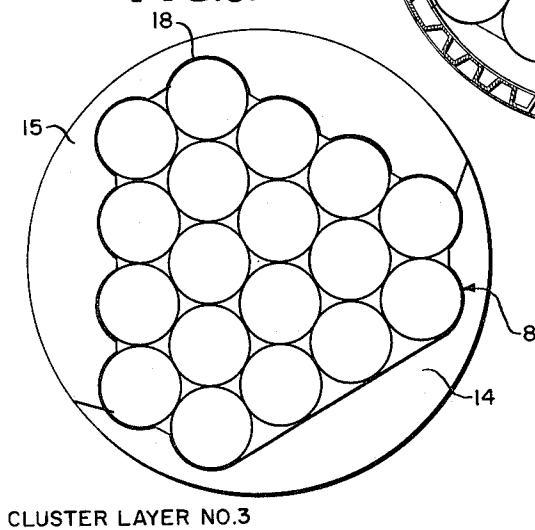


FIG.5.



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FIG. 6.

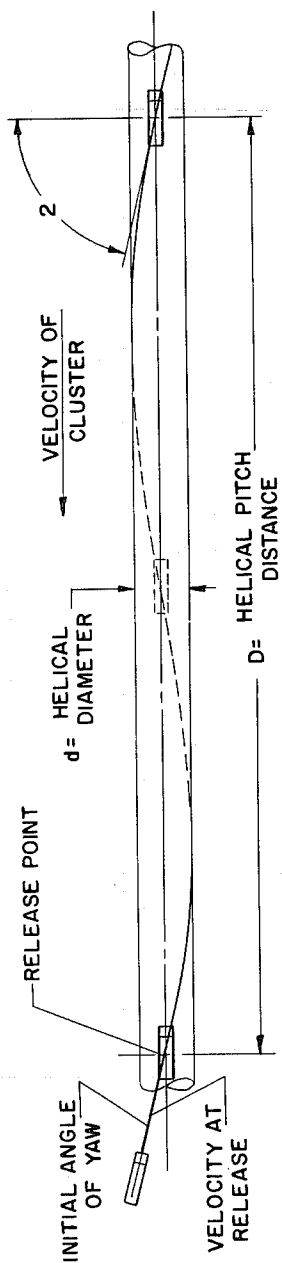


FIG. 7.

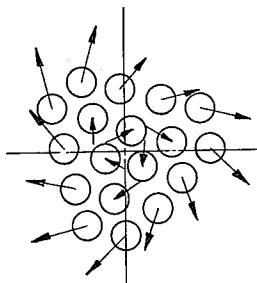
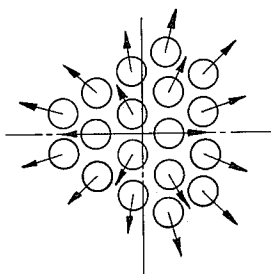


FIG. 8.



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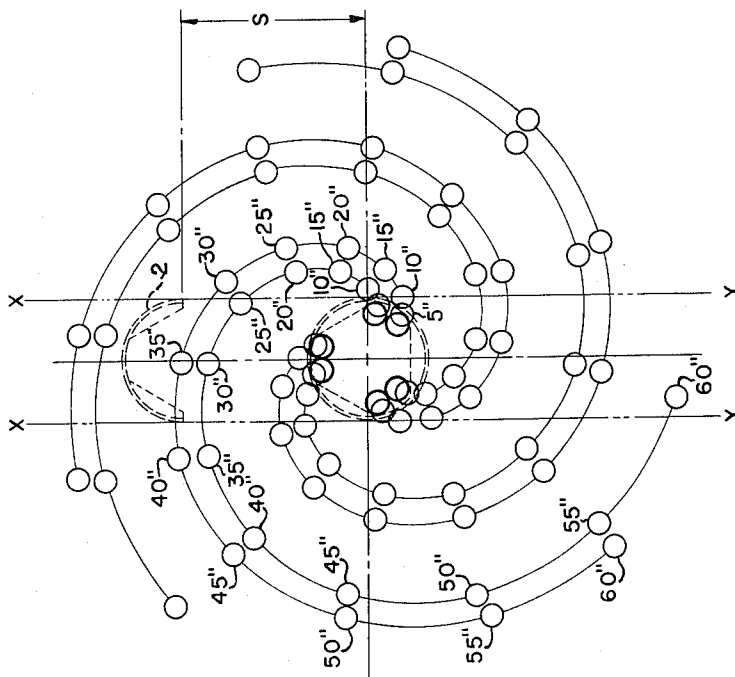


FIG. 9.

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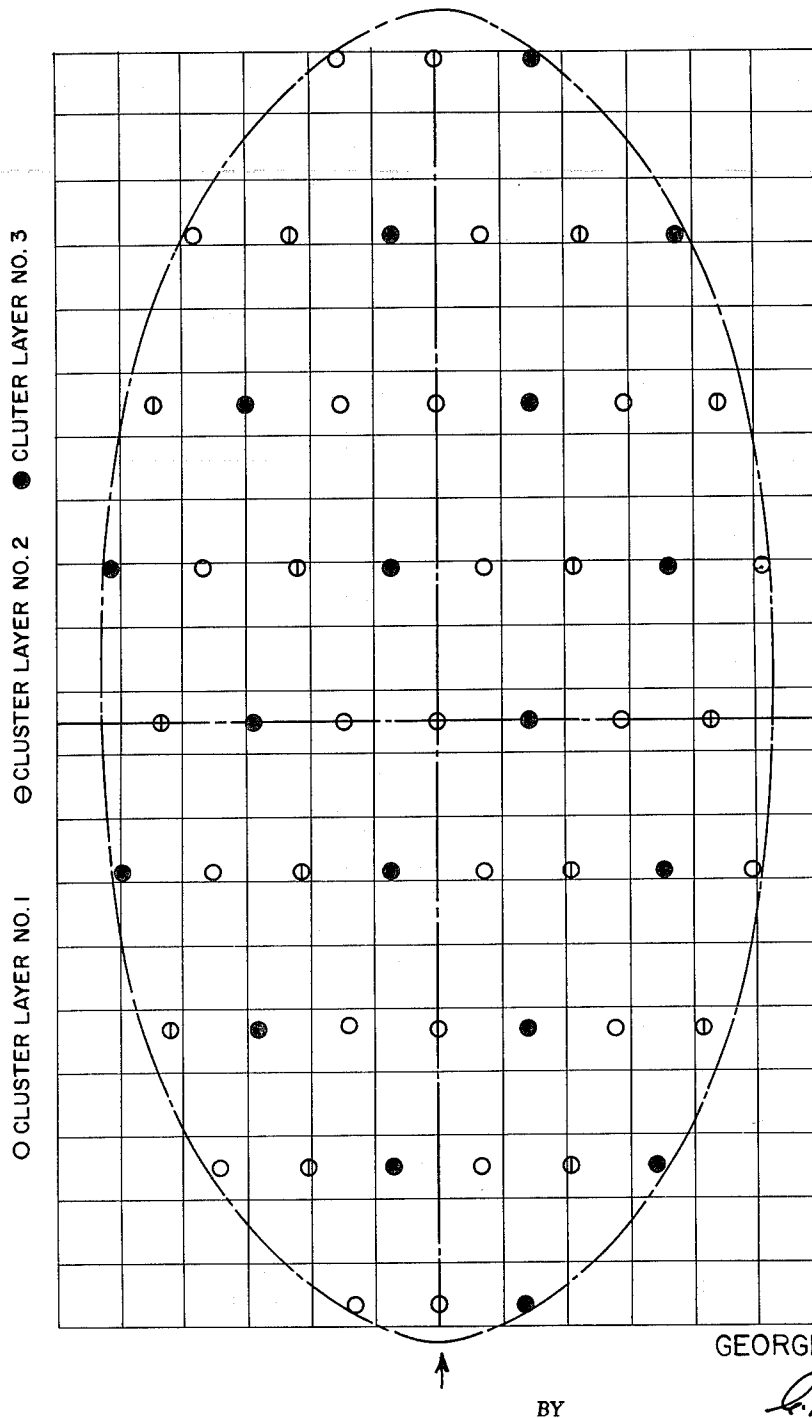


FIG. 10.

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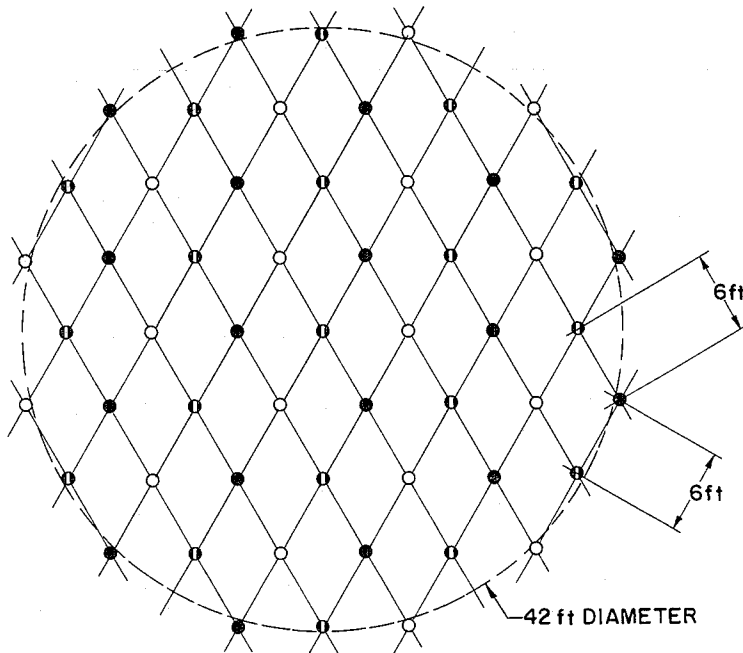
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FIG.11.

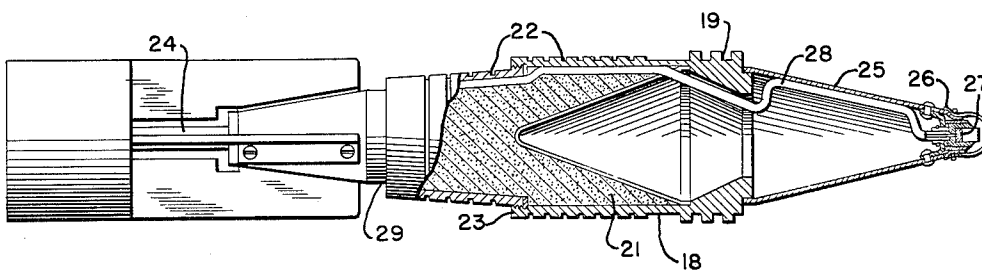


○ CLUSTER LAYER NO.1

◐ CLUSTER LAYER NO.2

● CLUSTER LAYER NO.3

FIG.12.



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SPIN-INDUCED DISPERSAL BOMB

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Filed Jan. 30, 1957, Ser. No. 637,338

1 Claim. (Cl. 102-7.2)

This invention relates to a method of and means for dispersal of a cluster of submissiles or bombs from a cluster bomb in a manner to secure a uniform density of distribution in a ground pattern, and to provide a desired control of ground pattern dimensions.

More particularly this invention relates to means for accomplishment of the foregoing desirable results by utilization of a particular prearrangement of the submissiles in the cluster bomb and the imparting of an initial tangential force thereto for lateral acceleration of the submissiles after release thereof and while they are undergoing a transition from the trajectory of the cluster bomb to their individual trajectories.

After the release of the cluster bomb from the launching aircraft a rotational acceleration is imparted to the cluster bomb by suitably inclined fins for aerodynamic drive thereof which continues during the free flight along the trajectory thereof. At the instant of substantially simultaneous release of the several clusters of submissiles carried in the cluster bomb and at a predetermined slant range from the ground, the latent energy of the individual masses of the submissiles effects a release of the previously restrained centrifugal forces due to rotation of the cluster bomb and propels the submissiles in a radial array of predetermined characteristics such that within the kill pattern on the ground there will be disposed one submissile in substantially every 10 ft. x 20 ft. area of the grid pattern thereof.

Prior cluster bombs have utilized a single cluster of symmetrical geometric cross section, while the instant method is directed to the utilization of a plurality of clusters, in the preferred case three, which are so disposed within the cluster bomb that the central cluster presents an equilateral geometric configuration which is symmetrical about the axis of the cluster bomb. This intermediate or central cluster is composed of nineteen submissiles arranged in a hexagonal pattern. The forward and aft clusters are symmetrically disposed about the longitudinal axis of the cluster bomb and comprise an inner group of six scatter bombs disposed in an equilateral triangle, with four additional scatter bombs disposed in adjacency to the three sides of the triangular group.

The forward and aft clusters are disposed in an equilateral triangular arrangement and present a mutually similar asymmetrical disposition about the longitudinal axis of the cluster bomb, as will hereinafter become more clearly apparent as the description proceeds.

It is therefore a feature of this invention to utilize a predetermined rate of aerodynamic rotation of the cluster bomb to facilitate the accomplishment of a predetermined dispersal distribution pattern without the necessity for elaborate mechanisms for launching the submissiles or scatter bombs.

One object of the instant invention resides in an improved method of bomb dispersal of a plurality of scatter bombs or submissiles from a cluster bomb and which provides for simplified fuzing of a cluster bomb utilizing a dispersal velocity which varies with forward velocity, and wherein the dispersal point along the cluster bomb trajectory is located at a substantially fixed slant range within reasonable tolerances, rather than at a fixed time from the target.

Another object resides in the use of an advantageous arrangement of three groups of clusters of differing pack-

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aging geometry within the cluster bomb to provide a homogeneous target dispersal array and high kill probability pattern on the ground target.

It is a further object to provide for the imparting of a mutually differing tangential velocity to each bomb contained in the several clusters immediately upon opening of the cluster bomb at the desired dispersal point along the trajectory thereof thereby to prevent mechanical interference between the individual bombs after dispersal.

In correlation with the immediately preceding object it is additionally an object to effect the impartation of said tangential velocity without appreciably altering the forward velocity of the collectively dispersed individual bombs as they move along their individual trajectories.

It is a further object to provide a packaging arrangement for a maximum number of scatter bombs wherein the relative orientation of the scatter bomb within the individual one of the plurality of clusters determines the magnitude of the tangential velocity imparted to each bomb when constraint of the cluster bomb structure is removed.

It is also an object to utilize the arrangement of the individual bombs as packed within the cluster to determine the ultimate pattern of the bombs on the ground.

Another object resides in the correlation of the positions of the three clusters of mutually different bomb orientations and packaging geometry with the rotational speed imparted to the cluster bomb after launching for obtaining a desired pattern arrangement on the ground.

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 wherein:

FIG. 1 is a generally diagrammatic showing of a cluster bomb and illustrates the longitudinal location of the three clusters thereof;

FIG. 2 is a diagrammatic illustration of one manner of release of the clusters by a hinged opening of the shell of the cluster bomb;

FIG. 3 is a cross sectional view taken along line 3-3 of FIG. 1 and showing the geometrical arrangement of the forward cluster;

FIG. 4 is a view in cross section taken along line 4-4 of FIG. 1 and illustrating the symmetrical equilateral arrangement of the intermediate cluster;

FIG. 5 is a view taken along line 5-5 of FIG. 1 to show the equiangular arrangement of the aft cluster with respect to the axis of the cluster bomb, and further showing the similarity and positional inversion to the pattern of the forward cluster;

FIG. 6 is a diagram showing the helical path of an individual bomb during movement with the cluster bomb and further illustrating the yaw effect which the bomb undergoes after release at cluster dispersal and prior to fin stabilization thereof.

FIG. 7 is a velocity diagram showing the directions of the dispersal of the individual bombs of the cluster of FIGS. 3 and 5 after dispersal, and as viewed from a stationary frame of reference;

FIG. 8 is a velocity diagram showing the directions of the individual bombs of the clusters of FIGS. 3 and 5 after dispersal for an assumed rotating frame of reference, i.e. the observer is rotating with the cluster bomb and with the line of vision directed along the axis of the cluster bomb;

FIG. 9 is a diagrammatic illustration showing the time function relationship between the two halves of the cluster bomb shell immediately following cluster release, as well as the paths of the critical bombs of the intermediate cluster as they are centrifugally accelerated after dispersal;

FIG. 10 is a diagrammatic illustration for a ground bomb pattern after dispersal at a 500 foot slant range, with a velocity of 1000 ft. per second and at an angle of 30° with the ground;

FIG. 11 is a diagrammatic illustration of the bomb pattern cross section prior to striking the ground; and

FIG. 12 is an elevation view with parts broken away and in section of a scatter bomb for use with the instant invention.

Referring now to FIG. 1, a cluster bomb assembly of the instant invention is indicated at 1. This assembly 1 comprises a pair of half shell shaped casing members 2 and 3 which are preferably hingedly connected at 4 and suitably latched together by structure disposed at 5.

The three clusters carried by the cluster bomb are indicated by the numerals 6, 7 and 8 in FIG. 2. Suitably canted or inclined fins 9 are mounted on the tail portion 11 of the cluster bomb. These fins function to impart a rotary motion to the cluster bomb after launching and provide for acceleration to a rotational speed of approximately 900 r.p.m. at the dispersal point along the trajectory and preferably at a slant range from the ground target of 500 feet.

The specific details of the shell portion per se of the cluster bomb structure forms no part of the instant invention. The latch structure at 5 for maintaining the cluster bomb closed and explosively operated piston structure at 12 for releasing the cluster may be of the character disclosed in the copending application of George L. Pigman, Serial No. 597,831, filed July 13, 1956, now Patent No. 2,970,542, dated February 7, 1961, for Bomb Release Device or alternately the release may be accomplished by a Primacord type of dispersal structure as disclosed in the copending application of Fred Brown, Serial No. 597,313 filed July 11, 1956, now Patent No. 3,016,011, dated January 9, 1962, for Cluster Opening Methods.

The former type of the two dispersal arrangements is shown herein for purposes of illustration and for a better understanding of the invention.

When the dispersal point along the cluster bomb trajectory is reached after launching from an aircraft, an explosively driven piston in the structure indicated at 12 is fired by the fuzing apparatus of the cluster bomb generally located at 13 and the cluster bomb opens up as shown in FIG. 2.

A fuzing arrangement which would satisfy the necessary requirements for fixing the cluster dispersal distance with suitable tolerance may be a proximity fuze of the type described in an article entitled "Generator-Powered Proximity Fuze" by R. D. Huntoon and B. J. Miller appearing in the December 1945 issue of "Electronics" magazine.

A preferred fuzing arrangement may be of the radio linked missile character disclosed in the copending application of George L. Pigman and Donald E. Richardson, Serial No. 672,101 filed July 15, 1957, for a Pilot Projectile (Radio Linked).

The release of the three clusters 6, 7 and 8 present a number of serious problems since the entire body is revolving at a rate of approximately 900 r.p.m. at the moment of cluster dispersal.

In order to accomplish such a dispersal without mechanical interference the cluster bomb skin or shell elements 2 and 3, and the cluster retaining bulkhead elements 14, 15, 16 and 17, FIGS. 3, 4 and 5 must be removed at the same moment, for at this instant the small scatter bombs 18 in each cluster layer start moving in a tangential outward direction as shown in FIG. 8. Moreover, it is important that there be no occurrence of interference between the scatter bombs and the cluster body at this time. It is thus deemed apparent that the scatter bombs cannot be restrained in either a lateral or fore and aft direction by any fixed structural member which is not removed at the time of dispersal. The individual scatter bombs 18 may advantageously be mutually restrained

in a fore and aft direction by means of mutually interengaging threads at 19, FIG. 12, which are provided about a portion of the periphery of the scatter bombs. The details of this interengaging thread structure is shown and described with greater particularity in the copending application of Fred Brown and H. J. Thomiszer, Serial No. 622,511 filed November 15, 1956, on Interlocking Screw Threads.

The provision of these interengaging threads facilitates longitudinal movement of individual bombs for purposes of making positioning adjustments thereto without altering the position of the rest of the bombs within the cluster. Likewise this structure obviates the necessity for structure in the cluster bomb to restrain the interiorly disposed bombs of the cluster. In utilizing this advantageous arrangement the separable cluster retaining structure comprising the bulkhead members at 14, 15, 16 and 17 of FIGS. 3, 4 and 5, need only engage the outermost scatter bombs of each cluster.

Referring now more particularly to FIGS. 3, 4 and 5 the arrangements of the individual scatter bombs 18 in the three clusters 6, 7 and 8 are shown to comprise somewhat similar groupings of eighteen scatter bombs in the forward and aft clusters 6 and 8 while the centrally disposed cluster comprises 19 scatter bombs. The clusters 6 and 8 are restrained in the cluster bomb by a pair of non-symmetrically shaped bulkheads 14, 15 while the cluster 7 is restrained by a pair of bulkheads 16 and 17 which are of symmetrical configuration.

The fifty-five scatter bombs are each capable of penetrating seven inches of armor by virtue of the shaped charge provided at 21 in the nose thereof FIG. 12. Additionally, they are capable of producing effective anti-personnel fragmentation after impact by means of serrations at 22 in the body portion 23 adjacent the aforementioned screw threads at 19.

The scatter bombs may advantageously be armed a predetermined period after dispersal by any suitable arrangement such, for example, as an air screw-driven arrangement disposed at the tail portion 24 thereof for moving an explosive train into an aligned relation with respect to a detonator and booster charge arrangement, not shown. This movement is from an armed position providing physical separation between these firing train elements. This structure is not shown since it forms no part of the instant invention.

A suitable nose cover 25 of conical configuration is disposed ahead of the shaped charge cone at 21 to provide increased aerodynamic stability and to provide a mounting at the nose portion thereof for a contact type fuze 26 of the variety disclosed in the copending application of C. F. Brown et al., Serial No. 260,295 filed December 6, 1951 now Patent No. 2,892,411, dated June 30, 1959 wherein the crushing of the nose on impact causes a firing potential to be generated by the barium titanate transducer 27 disposed therein and which is connected by means of leads 28 to the detonator, not shown, but disposed in the afterbody portion 29 of the scatter bomb.

The advantageous dispersal pattern provided by the instant cluster arrangements provides a pattern according to the cross sectional view of FIG. 11. The scatter bombs assume such a pattern a brief period after dispersal, and after the individual bombs overcome the initial yaw occurring with dispersal and which is produced as shown in FIG. 6. They follow such a pattern along their mutually associated trajectories until they strike the ground.

Obviously, the ground striking pattern for the scatter bombs is largely governed by the release angle of the cluster bomb from the carrying aircraft; i.e., a circular strike pattern will result from a vertical approach, or dive, and as the angle of approach relative to the vertical increases the strike pattern will assume an elliptical configuration. FIG. 10 shows an elliptical ground pattern for a cluster bomb moving at an angle in the order of 60° with the vertical to the earth's surface at the point of dis-

persal initiated by the fuzing apparatus 13, and in an approach direction indicated by the arrow. For the instant arrangement of the individual scatter bombs in the three clusters, a scatter bomb will strike within approximately every ten foot by twenty foot rectangle of the grid pattern within the elliptical boundary, as shown.

A brief discussion of the action of the individual scatter bombs in the cluster at the instant of dispersal is herewith presented in order to present a clarification of the physical principles involved.

Prior to dispersal, each individual scatter bomb in the cluster is following a helical path as a result of the forward velocity of the cluster combined with the rotary motion thereof. These relationships are shown graphically in FIG. 6. The maximum diameter of the helix corresponds to the diameter of the outermost circle of bombs in the cluster. The pitch distance D of the helix, in feet, is given by the expression

$$D = \frac{2\pi}{\omega} v$$

wherein ω is the angular velocity of the cluster in radians per second and v is the forward velocity of the cluster in feet per second. The particular value of the magnitude of ω/v is determined by the angular setting and diameter of the inclined fins 9 of the cluster bomb. The pitch angle γ of the helix or the angle between the helix and a plane perpendicular to the forward axis of the cluster is given by

$$\tan \gamma = d \frac{2}{\left(\frac{\omega}{v}\right)}$$

The values of γ are all less than 90 degrees, and the minimum value of γ which is for the outermost circle of bombs is 87 degrees, 21 minutes for a value of ω/v chosen for a 500 foot cluster dispersal distance.

The center of gravity of each individual bomb in the cluster, therefore, has a motion which is predominately forward at the instant of release, but which actually has a slight angle relative to the forward axis of the cluster. After release of the cluster, the center of gravity of each bomb tends to move the same direction and at the same velocity as it was moving at the instant of release, and it will continue to move in this direction unless some positive force is exerted to direct it from this path. If it be assumed that the scatter bomb enters a nonturbulent air stream at the instant of release, and if the bomb is stable, it will tend to align itself with the direction in which the center of gravity thereof is traveling and continue to move in that direction. The angle of yaw of the bomb as it enters the air stream at the instant of release from the cluster is 90 degrees $-\gamma$, which has a maximum value for the conditions previously assumed of 2 degrees, 39 minutes.

If the bombs of the cluster are viewed along the axis of the cluster at the instant of release by an observer moving forward with the cluster but in a non-rotating frame of reference, the bombs will appear to move outward along paths which are tangential to the rotation circles thereof, as shown in FIG. 7. As each scatter bomb moves further outward it actually curves into a spiral path relative to the rotating reference frame, FIG.

7. It yaws through a small angle as shown in FIG. 6 prior to the assumption of a stable altitude of flight.

The movements of the individual scatter bombs 18 of the cluster 8 which is the most critical as to the possibility of mechanical interference between the half shell 2 of the cluster bomb and the outermost scatter bombs is shown diagrammatically in FIG. 9. The distance S indicates movement of the half shell 2 along the X paths in 35 milliseconds after dispersal, which is the critical distance before the scatter bombs have moved forward a sufficient distance to avoid interference from the half shell 2. The paths YY indicate the path of the lower half shell 3.

The positions of the outermost scatter bomb are indicated in milliseconds and are indicated by reference designations of 5" to 60".

It is thus deemed apparent that an improved cluster dispersal arrangement has been provided by the novel arrangement of the individual scatter bombs in the three clusters.

Obviously many modifications and variations of the present invention are possible in the light of the above teachings. It is therefore to be understood that within the scope of the appended claim 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:

Apparatus for providing a uniform ground pattern of scatter bomb hits from an aircraft launched cluster bomb which comprises in combination, a cluster bomb, three clusters of scatter bombs disposed therein, each of the first and third of which are comprised of an inner group of six scatter bombs disposed in an equilateral triangle with four additional scatter bombs disposed in adjacency to each of three sides of each triangular group, and the intermediate or central cluster comprises nineteen scatter bombs arranged in a hexagonal pattern, means for providing aerodynamically accelerated rotation of said cluster bomb after release from an aircraft, means for initiating dispersal of said clusters at a predetermined point along the trajectory thereof corresponding to a desired slant range from the ground, releasable retaining means individual to each of said clusters for maintaining the scatter bombs disposed in each of said clusters in geometric patterns of mutually differing orientations, and for instantaneously releasing all of the clusters at said dispersal point, and means including canted fins on each of said scatter bombs for providing accelerated rotation thereto, thereby to impart directional stability during flight along the individual trajectories of the scatter bombs, whereby the uniform pattern distributed at release of the scatter bombs is substantially maintained until all of the scatter bombs strike the target.

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