United States Patent [19]

Throner, Jr.

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[45] **June 25, 1974**

[54] **INDEPENDENT MULTIPLE HEAD FORWARD FIRING SYSTEM**

[75] Inventor: **Guy C. Throner, Jr.,** Saratoga, Calif.

[73] Assignee: **FMC Corporation,** San Jose, Calif.

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[52] **U.S. Cl.** **102/7.2,** 102/2, 102/4, 102/7.2

[51] **Int. Cl.** **F42b 25/16**

[58] **Field of Search** 89/1; 102/7.2, 70.2, 70.27, 102/67, 4

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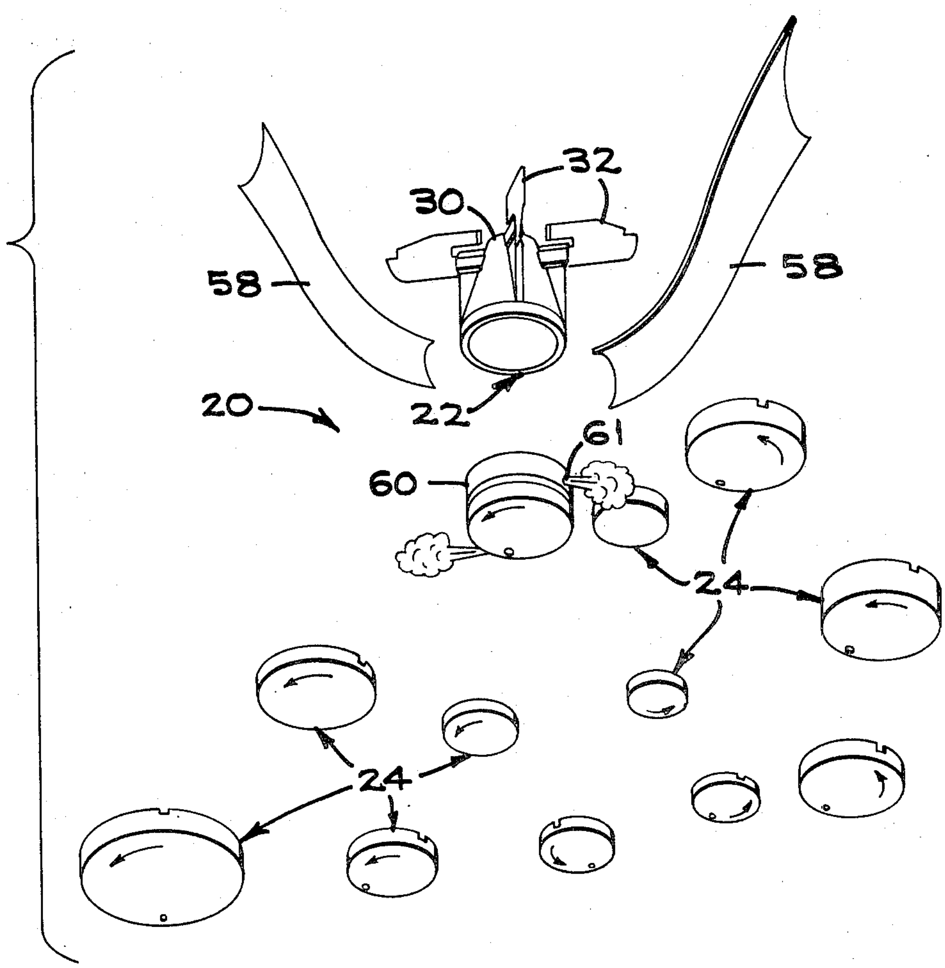
Primary Examiner—Samuel W. Engle
Attorney, Agent, or Firm—A. J. Moore; C. E. Tripp

[57] **ABSTRACT**

A missile carries a plurality of independent explosive heads which when fired direct fragments only in a forward direction. The missile releases all heads either in response to a timed delay from drop or launch or in response to movement of the missile to a predetermined position relative to the target. Upon release the explosive heads are rotated to swing each head away from the other heads while retaining orientation of each head so that firing of the dispersed heads will cause fragments to discharge forwardly toward the target without undue interference with the fragments from other heads.

8 Claims, 16 Drawing Figures



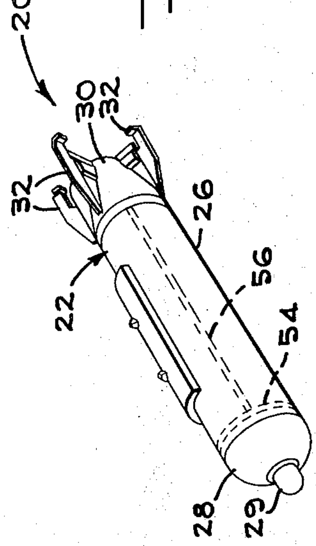


FIG_1

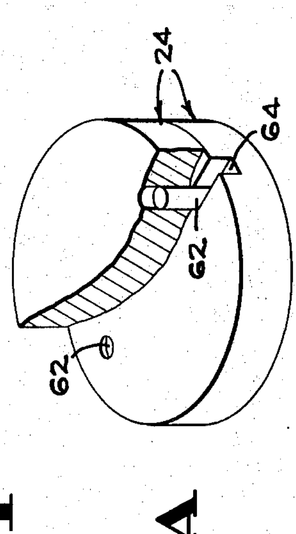


FIG_1A

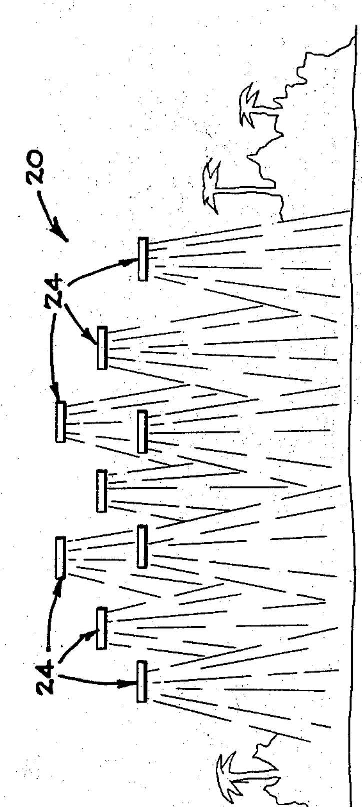


FIG_3

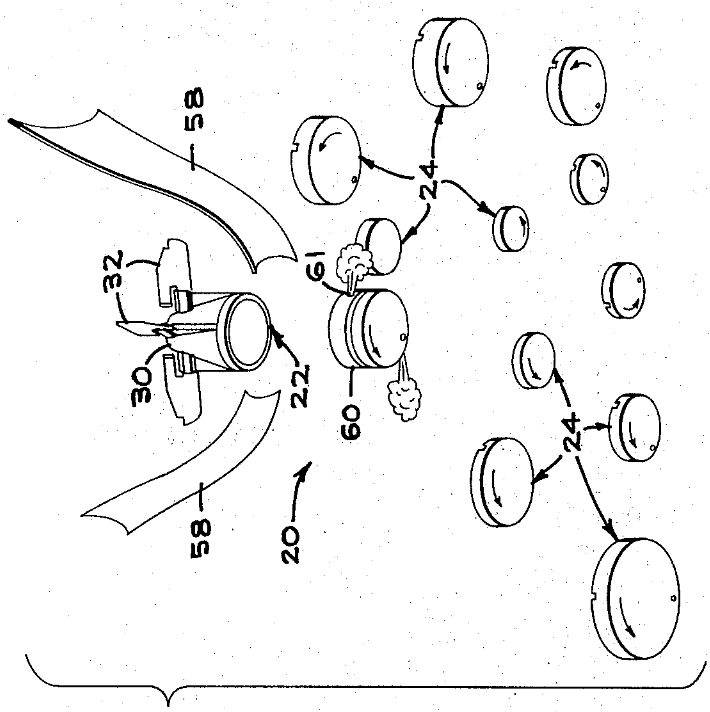


FIG_2

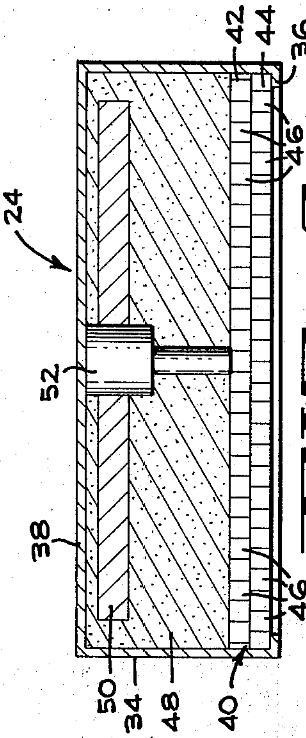


FIG_4

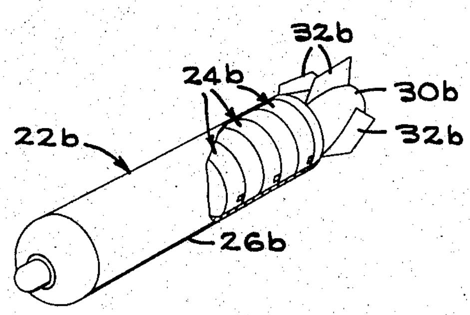


FIG_1B

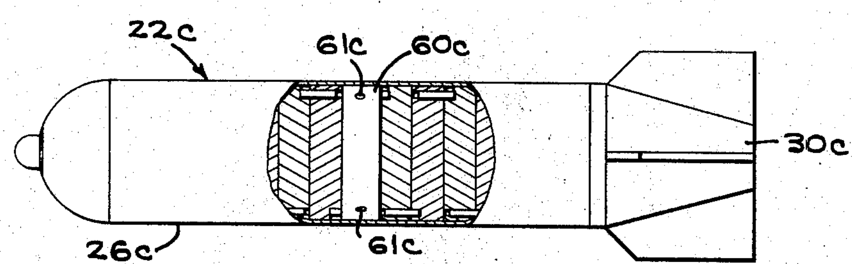


FIG_1C

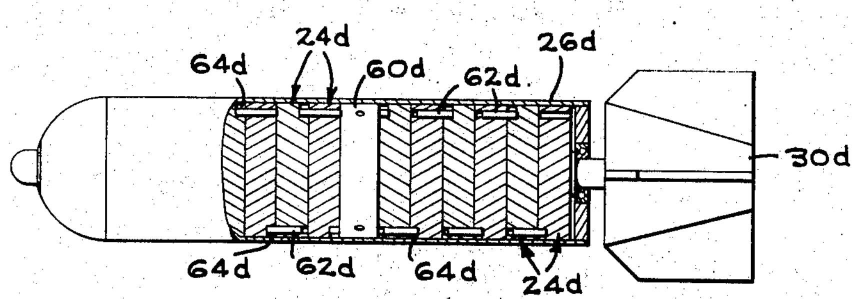
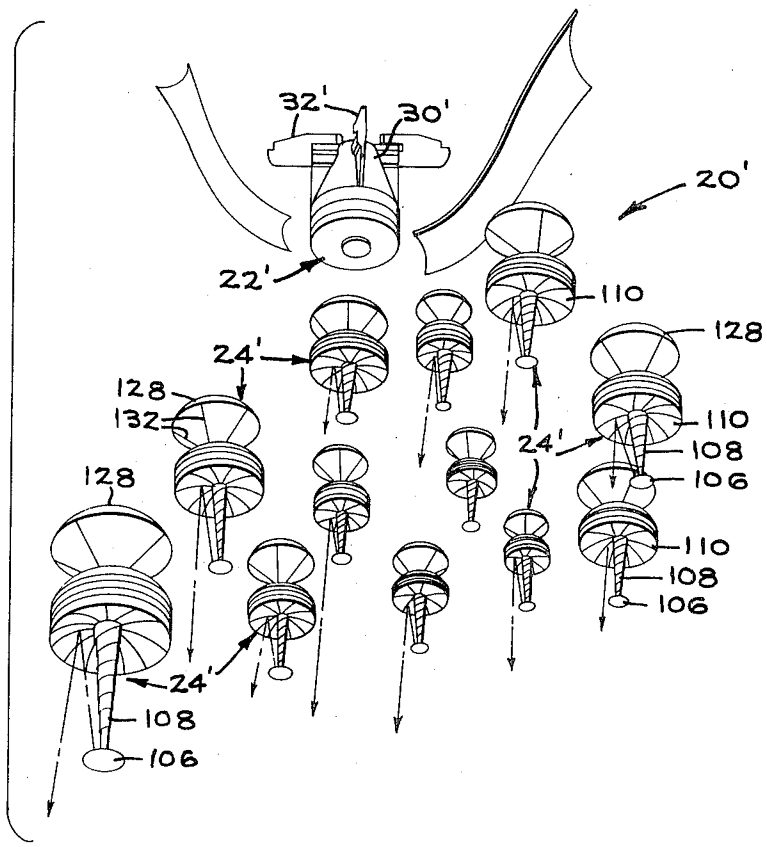


FIG_1D

FIG_5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30'
20'
22'
110
128
24'
128
132
110
24'
108
106
128
110
108
106
24'
108
106

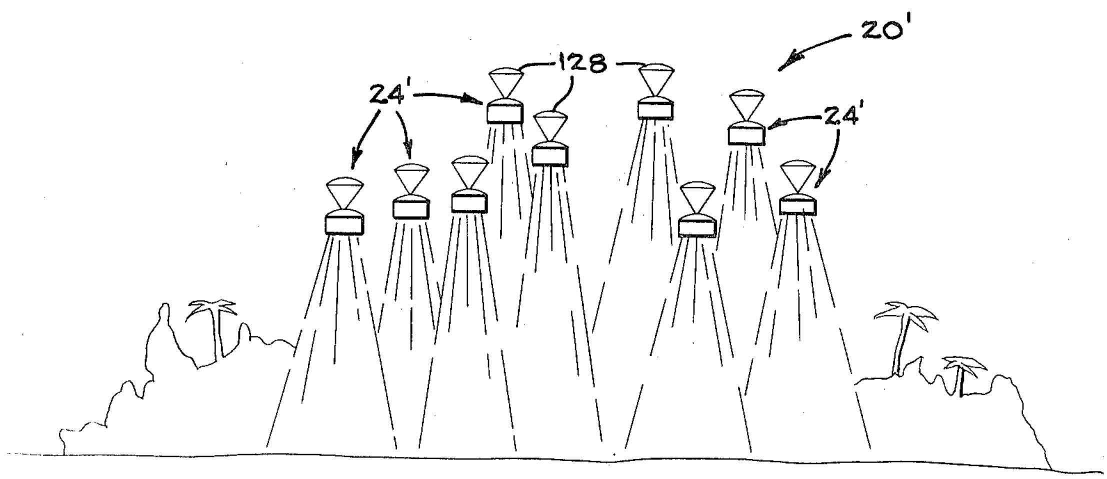
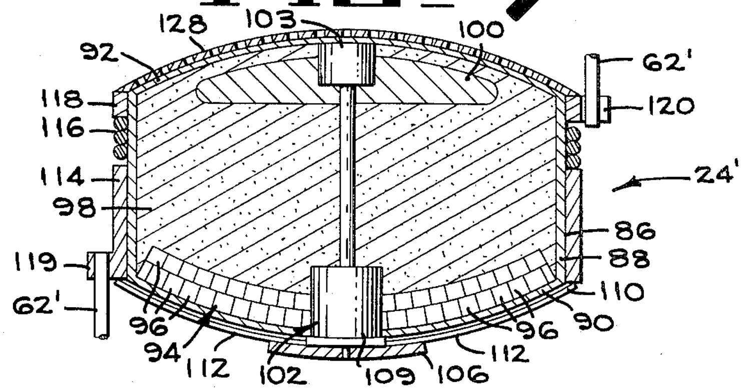

20'
128
24'
24'

FIG_6

FIG_7


128
103
100
92
62'
118
120
116
114
24'
98
86
88
119
110
62'
96
96
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112
102
109
106
112

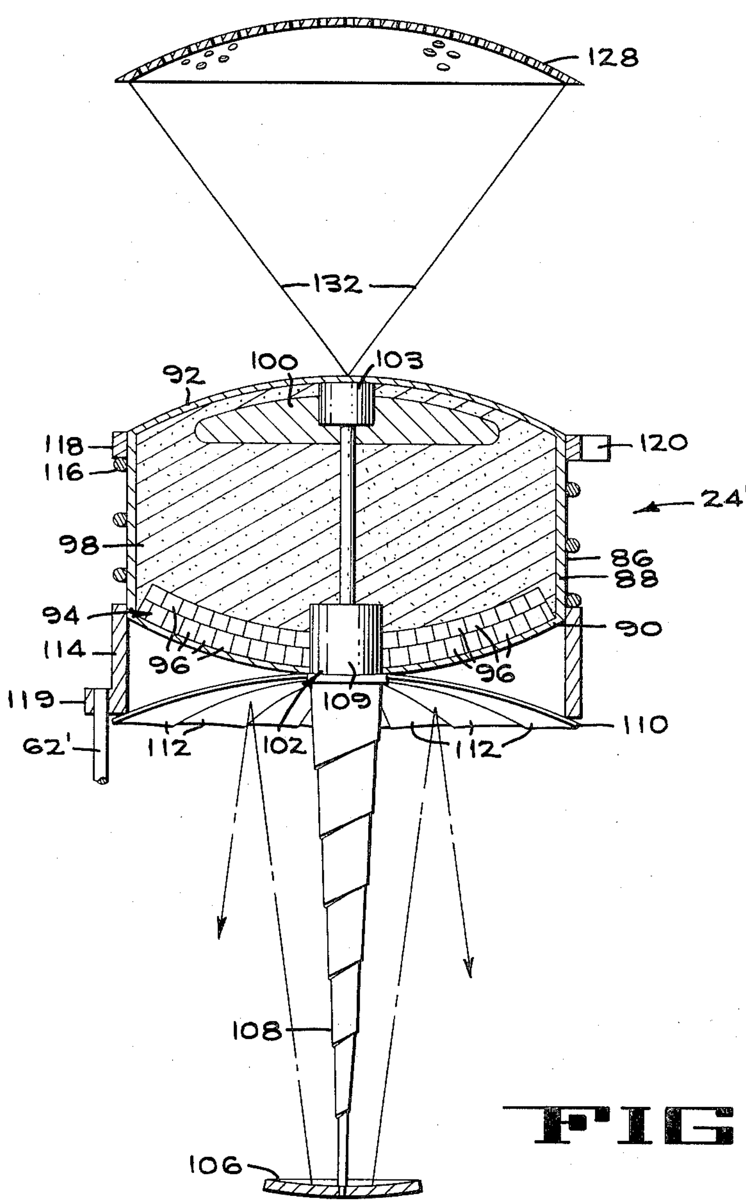
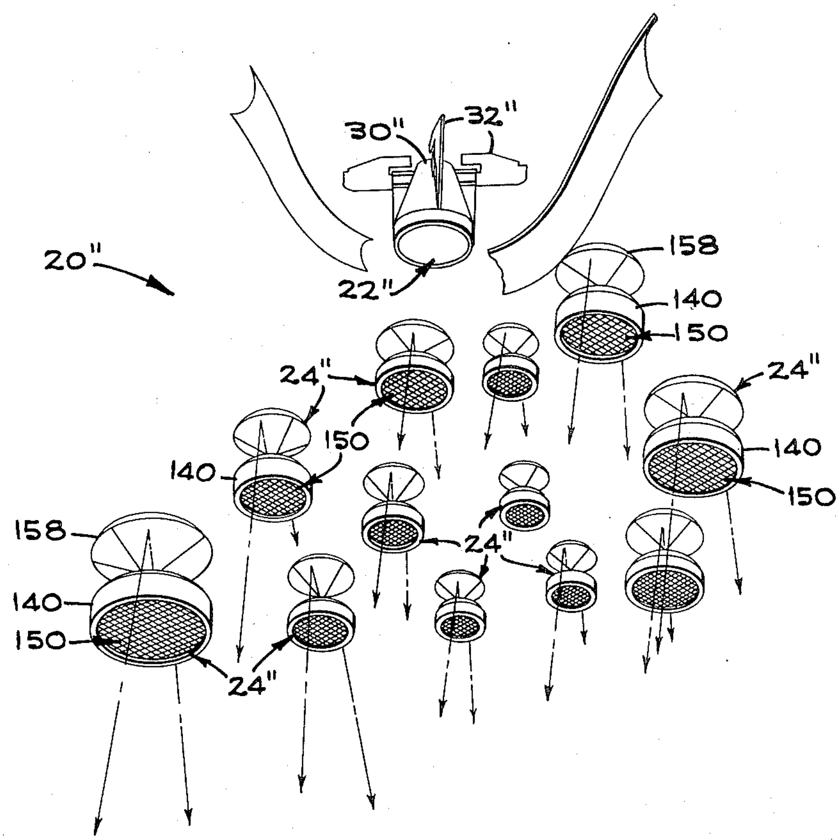

128
132
92
100
103
118
120
116
24'
98
86
88
94
90
114
96
96
109
119
110
62'
112
102
112
108
106

FIG_8

FIG_9


30''
32''
20''
22''
158
140
150
24''
24''
150
140
150
140
158
24''
140
150
24''

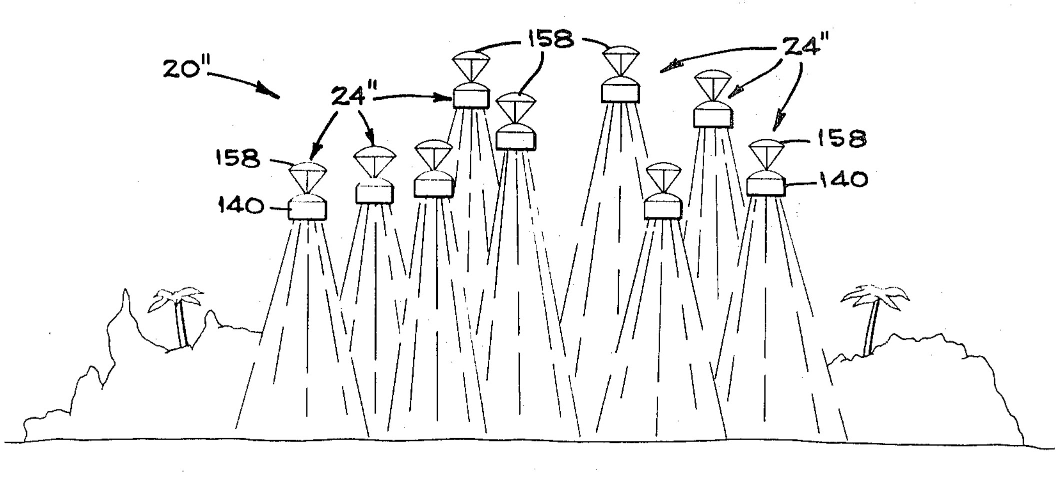
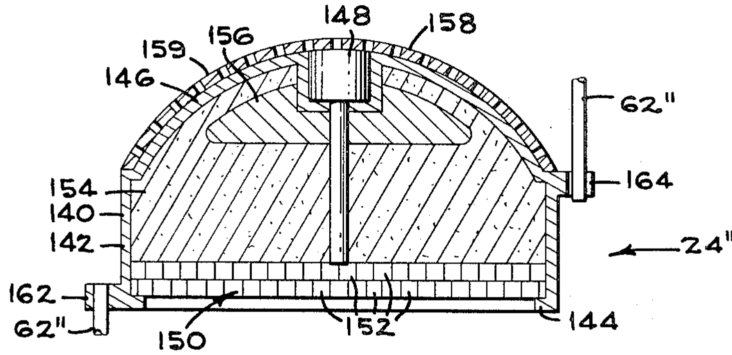

158
20''
24''
24''
158
140
158
140

FIG_10

FIG_11


148
158
159
156
146
62"
164
154
140
142
24"
162
62"
150
152
144

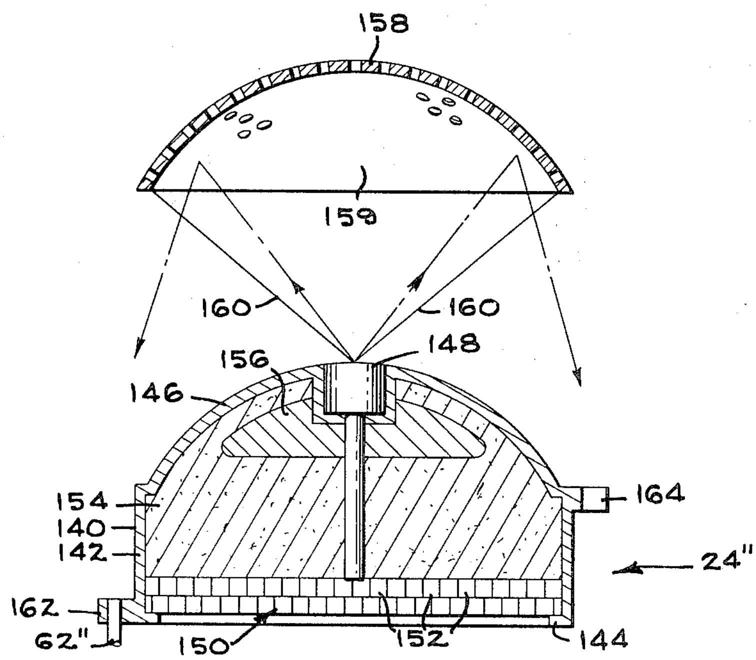

158
159
160
160
148
156
146
154
140
142
164
24"
162
62"
150
152
144

FIG_12

INDEPENDENT MULTIPLE HEAD FORWARD FIRING SYSTEM

CROSS REFERENCE TO RELATED APPLICATIONS

The independent multiple head forward firing system of the present invention is related to an application Ser. No. 281,878 by James F. Cullinane et al filed on even date herewith and assigned to the assignee of the present invention.

BACKGROUND OF THE INVENTION

1. Field of the Invention

This invention pertains to anti-personnel and anti-material weapons and more particularly relates to a forward firing explosive head, and a missile that carries a plurality of independent forward firing explosive heads and means for dispersing the heads.

2. Description of the Prior Art

Fragmentary anti-personnel and anti-material explosive heads are known which when exploded propel fragments at high velocity against the target. However, the known fragmentation heads of this type not only propel fragments at the target but also propel other fragments away from the target. U.S. Pat. No. 3,500,714 which issued to Cullinane on Mar. 17, 1970 and is assigned to the assignee of the present invention discloses a system for spinning explosive heads which is similar to that used in certain embodiments of the present invention.

SUMMARY OF THE INVENTION

The multiple head forward firing system of the present invention provides a fragmentary explosive head which when fired propels the fragments only in a forward direction toward the target. A plurality of these heads are preferably carried by a missile, such as an aerial bomb, projectile, or guided missile; and the missile releases each head either after a predetermined interval from launching or when in range of the target for tangential separation from each other while retaining their aimed orientation so that the fragments of one head will not interfere with fragments fired from other ones of the heads, and so that a wide target area will be contacted by the fragments of these several heads.

It is, therefore, one object of the present invention to provide an explosive head having a fragmentary wall only on the forward end of the head for directional control of the fragment upon firing of the head.

Another object is to provide a relatively light explosive head by providing a fragmentation wall only on the forward end of the head.

Another object is to provide a missile having a plurality of forward firing heads therein with the heads retaining their directional orientation and with each head being swung radially outward from the missile when in the proximity of the target and prior to firing the heads.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a perspective of a missile containing a plurality of forward firing heads therein, the missile being illustrated as an aerial bomb substantially as it would appear when on the bomb racks of an aircraft.

FIG. 1A is a diagrammatic perspective with parts in section illustrating the manner in which the forward firing heads are stacked together.

FIG. 1B is a diagrammatic perspective of a missile illustrating first means for rotating the missile for dispersing the explosive heads, certain parts being cut away.

FIG. 1C is a diagrammatic side elevation illustrating second means for rotating the missile, certain parts being cut away.

FIG. 1D is a side elevation similar to FIG. 1C illustrating third means for rotating the missile, certain parts being cut away.

FIG. 2 is a diagrammatic perspective illustrating the missile after a fuze has ignited cutting charges which have separated the nose cone from the body of the missile and has longitudinally severed the missile body into three sections, the plurality of forward firing heads being shown as they appear after being spun out of the open missile body.

FIG. 3 is a diagrammatic perspective illustrating the wide firing pattern of the plurality of forward firing heads as the heads approach the targets, the firing elevation being illustrated in greatly foreshortened scale.

FIG. 4 is an enlarged diagrammatic central section taken through one of the explosive heads.

FIG. 5 is a diagrammatic perspective similar to FIG. 2 but illustrating a plurality of forward firing heads of a second embodiment of the invention immediately after they have been released from the missile, each head being fired by a proximity fuze.

FIG. 6 is a diagrammatic perspective illustrating the firing pattern of the heads of FIG. 5.

FIG. 7 is an enlarged diagrammatic central section taken through one of the forward firing heads of FIG. 5 when the head is in its compact position.

FIG. 8 is a section similar to FIG. 7 but illustrating the parts in an expanded position.

FIG. 9 is a diagrammatic perspective similar to FIG. 2 but illustrating a plurality of forward firing heads of a third embodiment of the invention.

FIG. 10 is a diagrammatic perspective illustrating the firing pattern of the heads of FIG. 9.

FIG. 11 is an enlarged diagrammatic central section taken through one of the forward firing heads of FIG. 9 when the head is in its compact position.

FIG. 12 is a section similar to FIG. 11 but illustrating the parts in their expanded positions.

DESCRIPTION OF THE PREFERRED EMBODIMENT

The forward firing system **20** (FIGS. **1–4**) of the first embodiment of the invention is illustrated as a missile in the form of an aerial bomb **22** having a plurality of independent forward firing heads **24** therein. It will be understood, however, that other types of missiles, such as mortar shells, rockets, or anti-aircraft shells may be used to transport or launch the forward firing heads toward their targets.

In the illustrated first embodiment of the invention, the missile or bomb **22** (FIG. 1) comprises a thin walled tubular body **26**, a nose cone **28** on one end of the body with a time fuze or proximity fuze **29** therein, and a tail assembly **30** on the other end with direction controlling fins **32** pivotally mounted thereon all as is well known in the art.

The forward firing heads **24** are in the shape of circular discs each having a cylindrical wall **34** (FIG. 4) of plastic or thin metal with a lower flange **36** and a rear flat wall **38.** A lower or forward fragmentation wall **40** made up of one or more layers **42** and **44** of metal fragments **46** such as steel, is supported by the lower flange **36.** A fragmenting plate may be substituted for the precut fragmentation wall **40** if desired. The fragments **46** are normally interconnected with sufficient strength to define the wall **40** but separate into individual fragments **46** upon firing of an explosive charge **48.** The explosive charge **48** is illustrated as including a wave shaper **50,** and is fired by a fuze **52** such as a time delay sub-missile fuze.

The plurality of heads **24** are concentrically stacked in the tubular body **26** in abutting contact with each other as illustrated in FIG. **1B, 1C** and **1D,** and with the fragmentation wall **40** of each head facing the nose cone **28** (FIG. **1**). The fuze **29** is provided in order to open the body **26** at a predetermined time from launch or at the desired distance from the target. If the fuze is a proximity fuze, it may be adjusted to fire when the missile is at any one of a plurality of predetermined distances from the target. The fuze **29** (FIG. **1**) is connected to an annular cutting charge **54** on the internal surface of the body adjacent the nose cone **28,** and is also connected to three linear cutting charges **56** (only one being illustrated in FIG. **1**) placed at even intervals on the inner or outer surface of the body **26** and extending longitudinally thereof for substantially the full length of the body. Activation of the fuze **29** fires the cutting charges **54** and **56** thus severing the nose cone **28** from the body **26** and longitudinally cutting the body into three pieces **58** (only two being shown in FIG. **2**). The wind resistance immediately strips the nose cone from the missile and peels the three body strips **58** therefrom as indicated in FIG. **2** leaving the stack of forward firing heads **24** exposed for substantial tangential dispersal.

In order to disperse the several forward firing heads **24,** and retain orientation of each head with its fragmentation wall **40** directed toward the target, each missile is first spun as a unit thus imparting rotation to each forward firing head about its longitudinal axis prior to activation of the cutting charges **54** and **56.**

FIGS. **1B, 1C** and **1D** illustrate three separate ways of rotating at least the load carrying portions of the missiles about their longitudinal axes. In FIG. **1B,** the tail assembly **30*b*** is rigid with the body **26*b*** of the missile **22*b*** and has its fins **32*b*** angled relative to the missiles longitudinal axis thus causing air resistance to spin the entire missile. In FIG. **1C,** the tail assembly **30*c*** is rigid with the body **26*c*** of the missile **22*c*** is spun by a rotating motor **60*c*** which is illustrated as a rocket propelled device having several substantially tangential rocket motors **61*c*** which communicate with openings (not shown) in the missile body **26*c*** thus rotating the entire missile when activated. FIG. **1D** illustrates a missile spinning system that is similar to the missile **22*c*** except that the tail assembly **30*d*** is journaled on the body **26*d*** and accordingly does not spin with the body when the motor **60*d*** is activated.

As best illustrated in FIGS. **1A** and **1D,** the forward firing heads **24,24*d*** in the missile are interconnected to each other and to the head rotating motor **60,60*d*** by pins **62,62*d*.** The heads **24,24*d*** are releasably connected to the next adjacent head or to the motor **60,60*d*** by one of the pins **62,62*d*,** (FIG. **1A**). Each pin **62,62*d*** is secured to one of the heads **24,24*d*** (or the motor **60**) adjacent its periphery and is slidably received in a radial edge slot **64,64*d*** in the adjacent wall of the next adjacent head in a manner similar to that disclosed in the aforementioned Cullinane patent. Thus, the motor **60,60*d*** causes all of the heads to rotate as a unit with the end head or heads of the stack of heads being the first to be spun from the stack of heads. The remaining plurality of heads will each progressively peel off the ends of the stack of heads and will be tangentially dispersed as indicated in FIG. **2.** The gyroscopic affect of each spinning head will maintain orientation of the head with the fragmentation wall **40** facing the target.

In operation of the first embodiment of the invention, an aerial bomb or missile **22** loaded with a stack of forward firing heads **24** therein is dropped from an aircraft. The fuze **29** is activated in response to the bomb reaching a predetermined elevation above the target; or alternately, in response to a predetermined interval of time elasping from the time of drop, depends upon what type of fuze is being used. The activation of the fuze **29** preferably occurs when the bomb is within between about 5,000 to 200 feet from the target area. If the bomb is of the type illustrated in FIGS. **1C** or **1D,** activation of the fuze **29** first fires the motor **60*c*, 60*d*** for a period of about 1/10 to 2 seconds thereby spinning the missile. After a delay of about 1/100 to 2 seconds, a delayed signal from the fuze ignites the cutting charges **54** and **56** allowing air resistance to peel the nose cone **28** and body strips **58** from the stack of forward firing heads **24.** The rotating heads **24** then disperse outwardly as indicated in FIG. **2** before the time delay sub-missile fuzes **52** (FIG. **4**) fire their respective heads **24.** The fuses **52** fire after a preset delay after dispersion of about 1/100 to 10 seconds. The fired explosives **48** and **50** in each head breaks the fragmentation wall **40** into a plurality of separate fragments **46.** Subsequently all of the fragments **46** are thus propelled in a generally conical pattern toward the target as illustrated in FIG. **3.**

Although the size of the missile is not controlling, an effective missile size may be within the range of about 4 to 60 inches in diameter, and an effective fragment size may be about 10–1,000 grains.

The forward firing system **20'** of the second embodiment of the invention illustrated in FIGS. **5–8** is fired, and the heads **24'** are dispensed in a manner substantially the same as that of the first embodiment of the invention. The system **20'** differs only in the particular type and shape of forward firing head **24'** being used. Accordingly, only the heads **24'** will be described in detail and parts which are similar to those described in the first embodiment of the invention will be assigned the same numerals followed by a prime (').

When the heads **24'** are stacked in the bomb **22'** they are in their compacted positions as illustrated in FIG. **7,** and after the heads **24'** have been rotated and dispersed from the bomb they expand to the position illustrated in FIGS. **5** and **8.** A jet motor or angled vanes **32'** in the tail assembly **30'** may be used to spin the head as in the first embodiment of the invention and serve to disperse the several forward firing heads as diagrammatically illustrated in FIGS. **5** and **6.**

Each forward firing head **24'** comprises a relatively thin plastic or metal, generally disc shaped shell **86**

(FIGS. 7 and 8). The shell **86** includes a cylindrical side wall **88** having an outwardly bowed concave lower wall **90** and an outwardly bowed concave upper wall **92.** A concave fragmentation wall **94** made up of fragments **96** within the shell **86** bears against the lower wall and has an explosive charge **98** and a wave shaper **100** thereabove. It is to be understood that the wave shaper is optional. A proximity fuze **102** which includes a primary reflector or antenna **106**, a booster **103**, and a wave generator is provided for each head **24'**. The reflector or antenna **106** is mounted on the free end of an expandible helical leaf spring **108** (FIG. 8) which fits within a housing **109** secured in a small cavity in the lower wall **90** when compacted as illustrated in FIG. 7. The antenna **106** is projected outwardly a substantial distance from the forward wall **90** as illustrated in FIG. 8 in response to the next forward head **24'** moving away from the wall **90.** The leaf spring **108** may be of the type disclosed in U.S. Pat. No. 3,587,658 which issued to Charles M. Giltner on June 28, 1971.

As indicated in FIG. 8, the antenna or reflector **106** directs electrical wave signals against a multi-leafed parabolic secondary reflector **110** for reflection to the target area. The reflector **110** thereafter collects waves reflected off the target and target area, and focuses all such return signals at the apex of the concave reflector or antenna until the set distance is ascertained by the fuze which then detonates the explosive **98.**

The secondary reflector **110** is composed of a plurality of resilient pie shaped leafs **112** having their inner ends secured to the outer periphery of the housing **109** and having their outer ends engaging a ring **114** slidably received on the outer periphery of the side wall **88** of the shell **86.** A helical spring **116** is disposed between the slidable ring **114** and a stationary ring **118** that is rigidly secured to the cylindrical side wall **88.** As indicated in FIG. 7, each pin **62'** of the spinning mechanism is secured to a hub **119** on the ring **114** of one head **24'** and is slidably received in an edge slot **120** in the stationary ring **118** of the next adjacent head **24'**. When the pins **62'** have been removed from their associated slots **120** by swinging the heads **24'** in the stack away from their stacked position as previously described, the reflector **106** and the secondary reflector **110** of the next above head **24'** are free to extend under the influence of the helical leaf spring **108** and the helical spring **116**, respectively.

Since the gyroscopic affect imparted to each head **24'** as it is rotated and swung from the stack of heads may not be sufficient to compensate for the affect of air resistance acting upon the elongated head when in the expanded position indicated in FIG. 8, a retarding device **128** is provided. The drag or retarding device is attached to the center of the upper wall **92** by a swivel mounted plurality of flexible lines **132** such as wires or cords.

The operation of the second embodiment of the invention is substantially the same as that of the first embodiment except that firing of each forward firing head **24'** is controlled by the proximity fuze **102.** The booster **103** of the fuze **102** fires when sufficiently radiated wave signal energy which energy was previously generated by the wave generator of the fuze and sent to the target, is collected from the target area and reflected back to the firing system by the reflector **110.** The retarding device **128** serves to maintain the heads **24'** aimed at the target. As indicated in FIG. 6, when the heads are fired, the fragmentation wall **94** breaks into its individual fragments **96** which first destroys the parts of the head **24'** therebelow and then covers the target area with a conical pattern of fragments moving toward the target at very high speeds. It will also be noted that all fragments are directed toward the target as opposed to having some of the fragments being wasted by being directed outwardly to the sides or in a direction away from the target.

The forward firing system **20''** of the third embodiment of the invention is illustrated in FIGS. 9–12. The system **20''** differs from the first and second embodiments only in that the forward firing heads **24''** differ somewhat from the previously described heads. Accordingly, only the heads **24''** will be described in detail and parts which are similar to those described in the first embodiment of the invention will be assigned the same numerals followed by a double prime ('').

As indicated in FIGS. 11 and 12, each forward firing head **24''** includes a shell **140** having a cylindrical side wall **142** with a flange **144** on its lower end and with a concave upper wall **146** provided with a cavity for receiving a proximity fuze **148** which includes a detonator and a wave generator. A fragmentation wall **150** made up of a plurality of interconnected fragments **152** closes the lower end of the shell **140** and has an explosive charge **154** and a wave shaper **156** thereabove. It is to be understood that the wave shaper is optional. A combination reflector and retarding device **158** is shaped as a perforated dish **159** and is connected to the center of the proximity fuze **148** by swiveled and flexible connectors **160** as cables or the like.

As in the first embodiment of the invention, when the plurality of forward firing heads **24''** are stacked in the bomb **22''**, they are interconnected by pins **62''** which are secured to ears **162** in the forward firing heads **24'** and project into radial edge slots **164** in the next adjacent head. The bomb **22''** may be rotated about its longitudinal axis either by a rocket motor or by angled fins **32''** on the tail assembly **30''** as in the other two forms of the invention.

In operation of the third embodiment of the invention, after the stack of forward firing heads have been spun they are released from their missile **22''** (FIG. 9). The heads then swing outwardly from the stack of heads and eventually assume the positions illustrated in FIG. 9 with the combined retarding devices and reflectors **158** in their extended positions. Each head **24** then moves toward the target until the signals from the wave generator that was previously reflected to the target area by the dished reflector **159** are reflected back to the fuze mechanism **148** by the target and reflector **159.** At the set altitude the proximity fuze **148** initiates the explosive train. The explosive charge **154** projects the fragmentation wall **150** onto the target area at high speed in conical patterns as indicated in FIG. 10.

From the foregoing description it is apparent that the forward firing heads of the present invention are stacked in the missile and the missile is spun about its longitudinal axis either by angled tail fins or a rocket motor to induce spin. The heads are released from the missile in response to the firing of a first time delay or proximity fuze in the nose cone of the missile. The rotated heads then independently disperse over a relatively wide area and gyroscopically retain their directional control with their fragmentation walls directed toward the target. The explosive charge in each head is then fired either in response to a time delay fuze or in response to an adjustable proximity fuze as in the other embodiments of the invention. A retarding device is provided on certain of the heads to retain orientation of the heads and to provide for more effective control of the firing of the heads. Since only one wall of each forward firing head is a fragmentation wall, and since that wall is directed toward the target, all fragments are propelled against the target area upon explosion of the head and are not wasted by flying away from the target in other directions.

Although the best mode contemplated for carrying out the present invention has been herein shown and described, it will be apparent that modification and variation may be made without departing from what is regarded to be the subject matter of the invention.

I claim:

1. A forward firing system comprising a missile movable in a forward direction toward a target area and including a tubular body; a plurality of explosive heads in the form of discs positioned in said body defining a stack of heads having a longitudinal axis; each head including an explosive charge, a fragmentation wall disposed only on the forward end of said explosive charge, and a thin walled housing enclosing the remaining portion of the head; means for rotating the stack of heads; means for simultaneously releasing all heads in said stack of heads from said body in response to the movement of the missile into range of the target area; connecting means for releasably interconnecting said heads in said stack and being responsive to rotation of said stack and to the release of said stack from said body for dispensing said heads from said stack and from each other in a plurality of different directions while retaining directional orientation of said heads relative to said target area; and means for thereafter detonating the explosive charge in each of said heads prior to the heads reaching the target area.

2. A forward firing system according to claim **1** wherein said detonating means is a proximity fuze.

3. A forward firing system according to claim **2** wherein each of said heads carries a signal wave generator and a signal reflector, and means mounting at least a portion of said reflector for movement from a compact stacked position against one end surface of said head to an extended reflecting position spaced from said one end of said head.

4. A forward firing system according to claim **3** wherein said one end is the forward end of said head, and additionally comprising forward expansible reflector supporting means movable between a compact position encompassed within said associated head when said head is in said stack, and an extended position forwardly of said forward end of the head after the head has been swung away from said stack.

5. A forward firing system according to claim **3** wherein said one end is the rear end of said head and wherein said reflector is a concave dish which contacts and conforms to the shape of the rear wall of said head when the head is in said stack, and which is spaced rearwardly of said rear wall in an operative reflecting position when the head is released from said stack, and extendible connecting means for connecting said reflector to said head when in its operative reflecting position.

6. A forward firing head according to claim **3** wherein said tubular body is a cylindrical housing having an axis of generation and wherein said signal reflector includes a plurality of resiliently stressed pie shaped leaves having their inner ends connected to the forward end of said housing about said axis of generation and having their outer ends free to move forwardly away from said forward end, and means engaging the free ends of said pie shaped leaves for bowing said leaves by moving the outer ends of said leaves forwardly away from said fragmentation wall in position to define a parabolic reflector for sending and collecting signals reflected back from the target area.

7. A forward firing head according to claim **6** and additionally comprising forwardly extendible resilient means movable between a compact position encompassed by said housing and an extended position projecting forwardly of said housing, said antenna being mounted on the projectable end of said extendible resilient means.

8. A forward firing head according to claim **1** wherein said fragmentation wall is a planar wall.

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