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[54] **CONTROLLED DISPERSION MISSILE DISPENSER**
4 Claims, 7 Drawing Figs.

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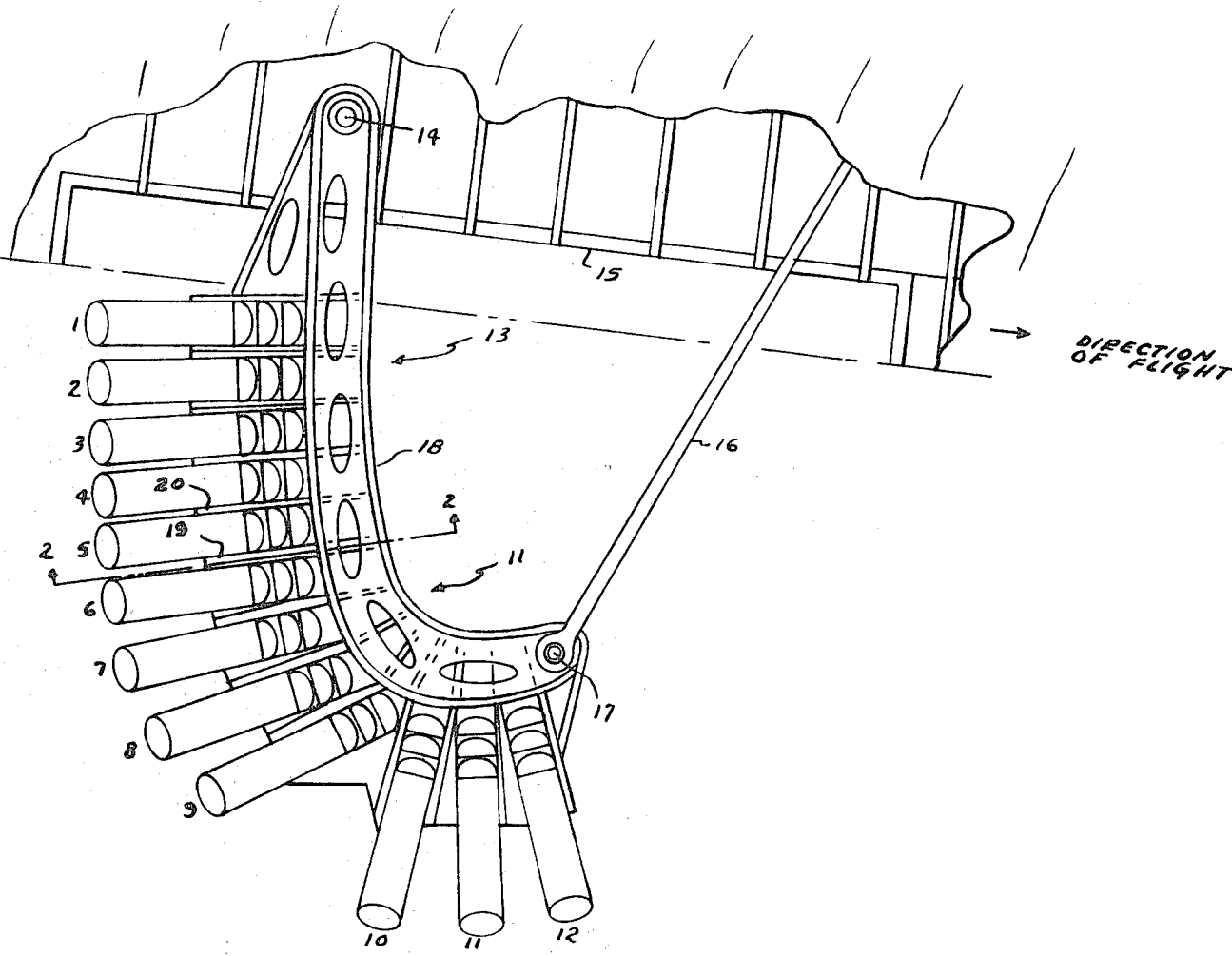
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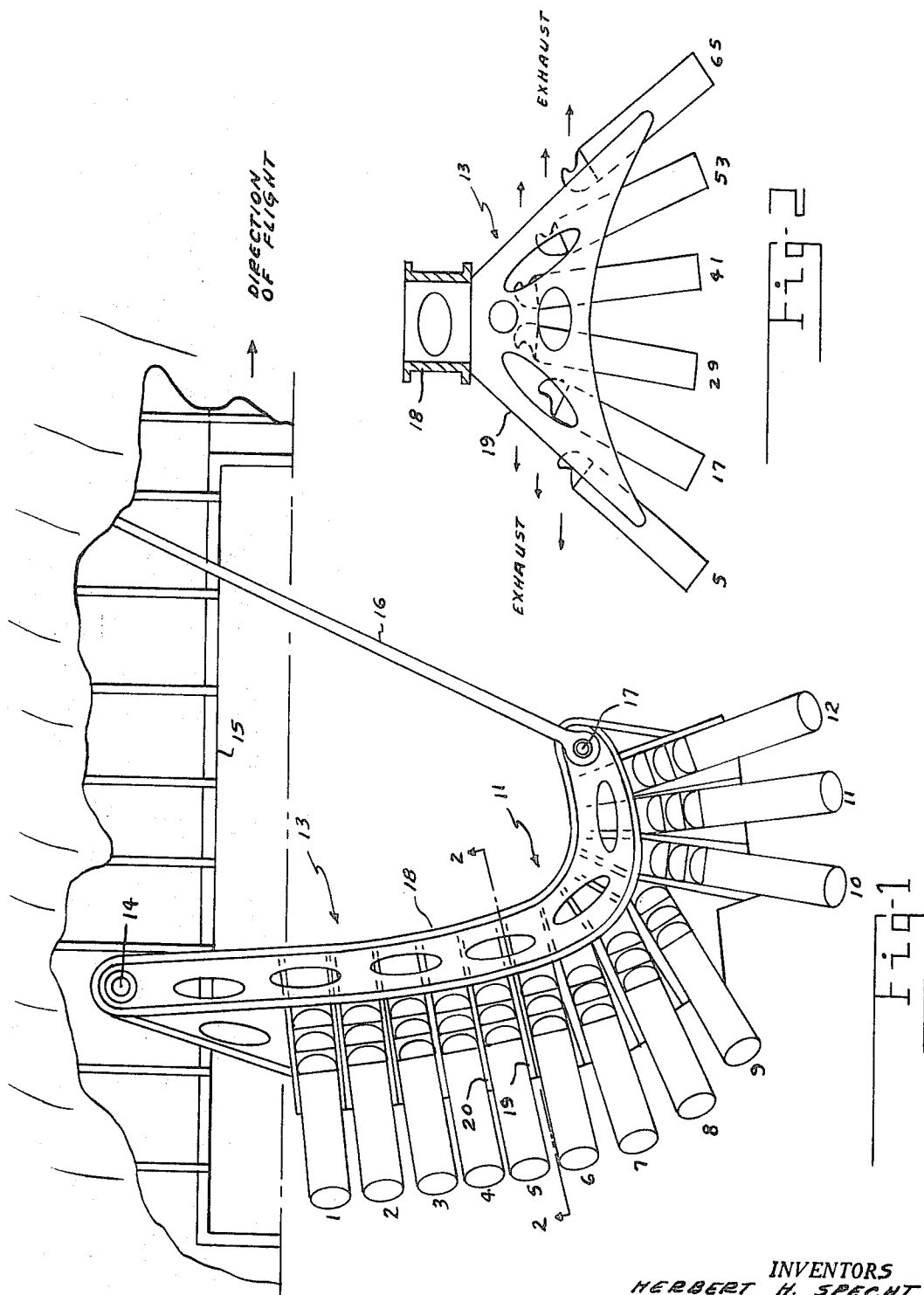
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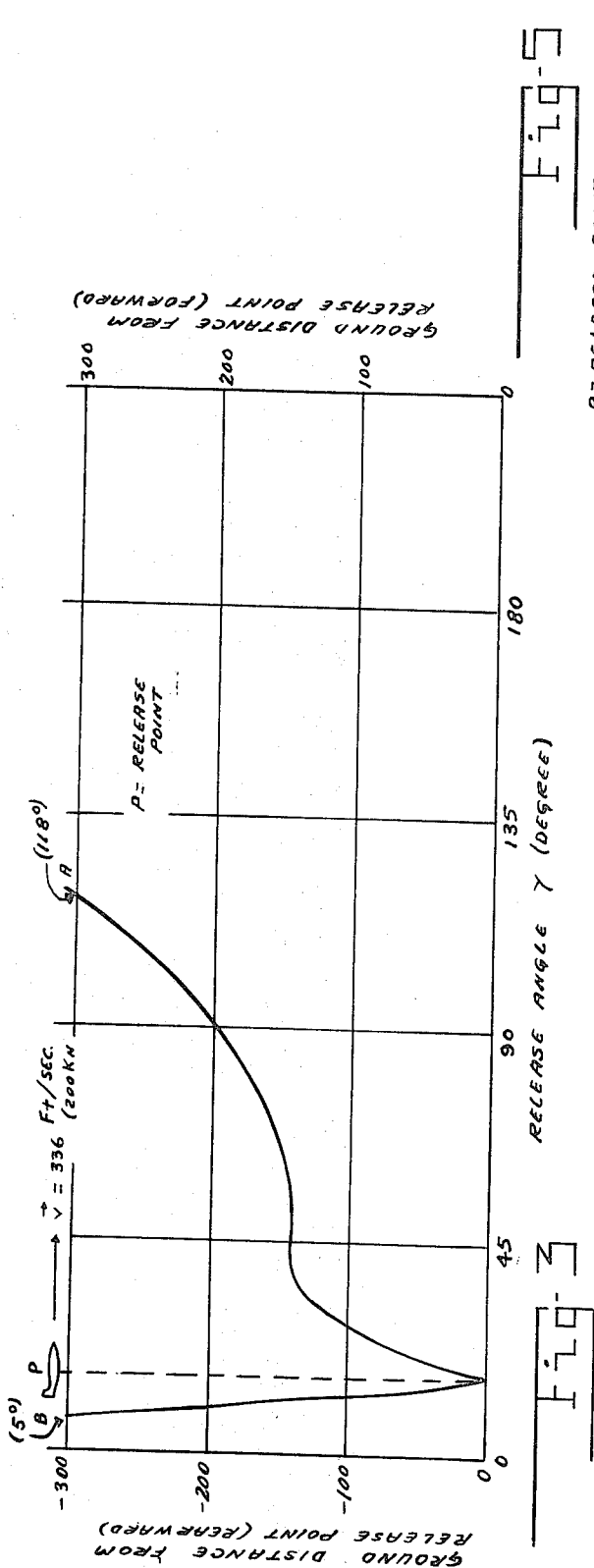
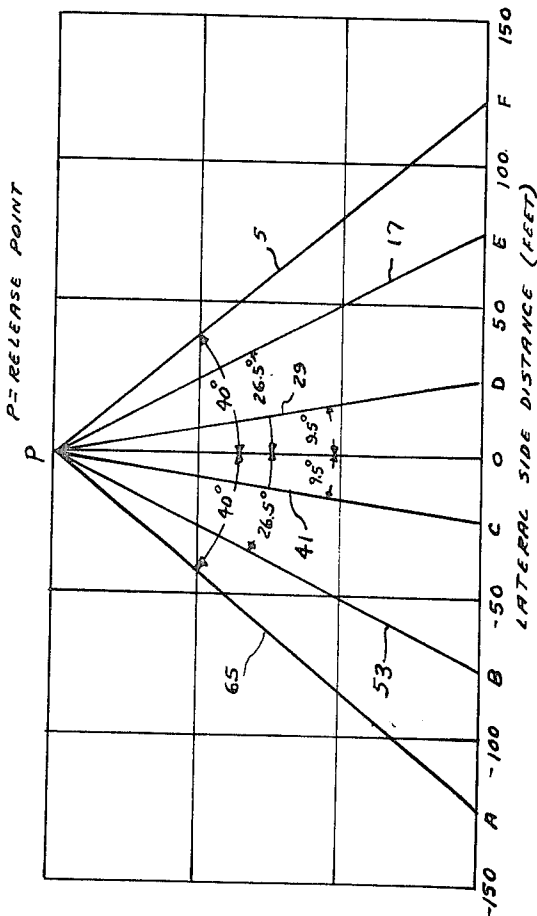
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ABSTRACT: A plurality of missile launch tubes are affixed to, and form an integral part of, a retractable bomb-rack which consists of a missile supporting frame member that is adapted to be pivotally supported for movement between a raised, retracted position within an aircraft bomb-bay compartment and a lower, firing position beneath the aircraft. The launch tubes are formed in depending relation in the bomb rack in a predetermined configuration which results in their respective axes being oriented out-of-parallel to each other and depressed below the horizontal, or longitudinal axis of the aircraft by precalculated starting angles of trajectory which increase in value when measured from rear-to-front along the axis of flight to thereby form a bombing pattern of a controlled lengthwise dispersion of maximum effect on target. The tubes are further arranged in several groups with each group formed into oppositely-disposed pairs of tubes and the axis of each tube in a particular group also oriented out-of-parallel by precalculated angles to the axis of any other tube in the same group in a lateral direction or, at right angles to, and on opposite sides of, the axis of flight. In this manner, the launch tubes of the present invention also provide a lateral dispersion to the overall bombing pattern that is inherently controlled to the most effective lateral coverage of the designated target area.





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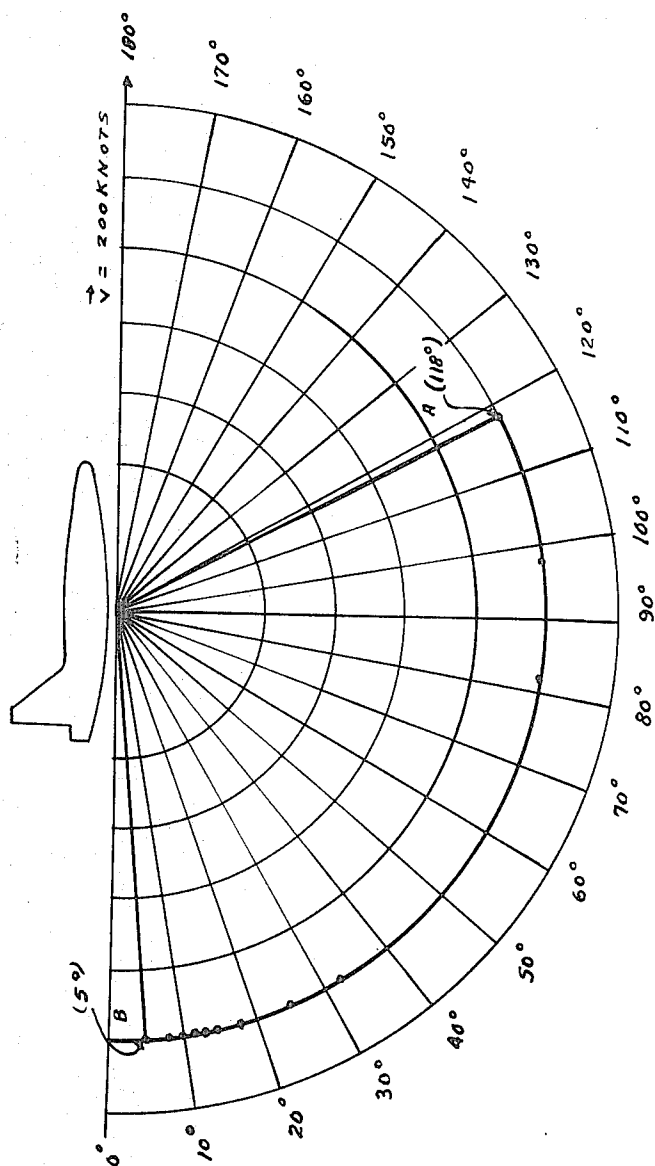


Fig-4

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CONTROLLED DISPERSION MISSILE DISPENSER

BACKGROUND OF THE INVENTION

This invention relates generally to the field of air-to-ground weapons systems technology and, in particular, to an improved airborne rocket-boosted bomb delivery device.

In providing close fire support to friendly ground troops, fighter-bomber type aircraft have employed various types of weapons and a variety of techniques. These techniques have included both conventional-type bombing, in which the bombs employed have been dropped on target from a vertically-oriented bomb-rack, and rocket type fire, in which relatively flat trajectory type fire has been used against selected targets. In this regard, the present invention was specifically designed to take advantage of the more accurate rocket-type fire in employing a plurality of relatively small type bombs or bomblets that incorporate the additional boost effect of rocket power to thereby more quickly bring fire in closer support of friendly ground forces.

To effect the delivery of such rocket-boosted bomblets, a variety of previously developed rocket launchers may be considered. The most generally accepted designs have included the use of one or more launcher racks, or tubes mounted in depending relation to the aircraft wing. The principal disadvantage of this technique is that the rocket can only be aimed by pointing the aircraft itself. Of course, if only one pass is to be made, the target must also be identified at a relatively great distance forward of, or away from, the aircraft to allow the pilot of the aircraft sufficient time to accurately aim on, and fire at, the target. Other devices have been designed, however, which are not strictly dependent on the attitude of the aircraft. For example, a turret arrangement containing a plurality of rockets whose fire could be adjusted in both azimuth and elevation has been shown as being constructed in the tail section of the aircraft. Also, the use of rocket launchers rotatably mounted in the aircraft wing tips and capable of firing both forward and to the rear of the aircraft has been proposed in at least one case.

Although the usual type of rocket fire, such as is given in the examples above, continues to offer advantage in placing effective and relatively accurate fire against a variety of both aerial and ground targets where flat trajectory fire is appropriate; nevertheless, the aerial delivery of a number of rocket propelled small bombs or bomblets on target is most desirable and of significant advantage in bringing rapid fire against massed personnel at much closer distances from friendly troops, as will become more apparent hereinafter from the following summary and detailed description of the present invention.

SUMMARY OF THE INVENTION

A principal object of the present invention, therefore, resides in the use of a new and improved bomb-launcher mechanism that specifically directs fire on target in an overall bombing pattern that is positively controlled to a more effective dispersion of the bombs delivered thereby both along the axis of flight and in lateral extent relative thereto.

A further object of the invention is to utilize a plurality of rocket-boosted, relatively small bombs or bomblets that are disposed in an improved configuration launcher device which is specifically adapted to direct fire against a ground target along initial or starting axes of trajectory that have been pre-calculated to form a bombing pattern of maximum destructive effect on a selected target.

A still further object of the invention is in the utilization of a novel bomb-dispensing device that assures the controlled and quicker delivery of a plurality of bombs or bomblets in a more accurate and tighter pattern that enables the more rapid attack of an enemy target that is in much closer proximity to friendly ground troops than would be the case with more conventional delivery techniques.

Other objects and advantages of the invention will become readily apparent from the following description, taken in connection with the accompanying drawings, in which:

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a somewhat schematic and partially broken away, side elevational view of the key missile dispenser or bomb dispensing mechanism of the present invention, illustrating the fully extended or firing position thereof.

FIG. 2 is a cross-sectional view, taken about on the line 2-2 of FIG. 1, showing further details of the launch-tube arrangement used with the missile dispenser of FIG. 1.

FIG. 3 is a graph illustrating a plot of the distance forward and rearward of the bomb release point, at which a bomblet of the type used with the present invention would strike the surface of the ground when launched at various release angles from an aircraft traveling at 200 knots.

FIG. 4 is a second graph showing in schematic form the overall orientation of the entire launch tube assembly used with the missile dispenser of FIG. 1 and illustrating the tube axes of each tube group in the inventive arrangement oriented at the increasing angles, relative to the horizontal, or longitudinal axis of the aircraft, that is required to ensure the laydown of the desired bombing pattern along the axis of flight.

FIG. 5 is a third graph illustrating the additional angles, relative to, and transversely of the axis of flight, at which the launch tubes of the present invention are required to be oriented in order to ensure that the lateral dispersion in the overall bombing pattern is correct for the maximum effect on target.

FIG. 6 represents an overall plan view of the basic missile that is adaptable to be mounted in each launch tube of the missile dispenser of FIG. 1;

FIG. 7 is another plan view, partly in section and broken away of the basic missile of FIG. 7, illustrating additional construction details particularly of the combustion chamber wall sections utilized therein.

DESCRIPTION OF THE PREFERRED EMBODIMENT

The improved missile dispenser of the present invention is illustrated in FIG. 1 of the drawing as consisting of a retractable bomb-rack, indicated generally at 13, as including basically a main missile-supporting frame member 18, and a plurality of missile launch-type tubes, such as those indicated by the reference numerals 1-12, inclusive, that may be integrally formed within said supporting frame member 18 during the manufacture thereof. The latter member 18 is pivoted at its upper end, as at 14, to the airframe 15 of an aircraft whose direction of flight is indicated at the arrow in FIG. 1. A bomb-rack actuating member at 16 is shown pivoted to the lower end of the frame member 18, as by means of the pivot at 17. With use of such an actuating member, as 16, which may be hydraulically operated by any appropriately designed means not shown, the missile dispenser or bomb-rack 13 may be pivoted about the pivot 14, either to a raised, retracted position within the aircraft bomb-bay compartment when not in use, or lowered to its bomb release or firing position in depending relation to and beneath the aircraft when ready for use.

Although the inventive launch tubes are arranged in the missile dispenser 13 in what has the appearance of a honeycomb configuration, the axis of each launch tube is oriented out-of-parallel to that of any other tube in the entire assembly by a precalculated value designed to form an overall bombing pattern of controlled dispersion and, therefore, of increased effectiveness on target. This is accomplished by selecting the particular size bomb desired, determining its area of lethal effect, and then choosing the total number of such bombs required for a selected target area, and precalculating the most efficient distribution or dispersion required for most efficiently and effectively covering the target area. After precalculating the starting angle of trajectory required of each launch tube for achieving the precalculated bombing pattern of the greatest effectiveness, each of the aforesaid launch tubes, such as those indicated at 1-12, inclusive, in FIG. 1, are oriented when formed in the supporting frame member 18 during the manufacture thereof with their tube axes respec-

tively disposed at the aforesaid precalculated angles, as will be discussed hereinafter in more detail.

In the view of FIG. 2, which constitutes a representative example of the entire launch tube assembly, it is clearly seen that each of the previously-noted launch tubes 1—12 actually constitute but one tube in a group of six tubes, and accordingly, there are in the preferred embodiment twelve groups of six tubes each, for a total of 72 launch tubes. Thus, tube No. 5 is in a tube group that includes tubes no. 17, 29, 41, 53 and 65. Note, also, that the exhaust of three of the tubes is reversed from the exhaust of the other three tubes in each group in order to equalize the forces resulting from the exhaust gases occurring during the firing of the present missile-bomblets during the launching operation. Although the preferred embodiment is shown as incorporating a total of 72 launch tubes, a lesser or greater number of tubes could obviously be used without departing from the true spirit or scope of the invention.

The missile-supporting frame member 18, which may be fabricated in an arcuate configuration, such as that shown in FIG. 1, to specifically accommodate the out-of-parallel orientation of the launch tubes of the present invention, may also incorporate some means of facilitating the formation of the said tubes into the previously described separate tube groups. For this purpose, the member 18 may be manufactured with a plurality of spacer or divider elements extending in depending relation therefrom, as for example that indicated by the reference numerals 19 and 20 in the view of FIG. 1. An additional, more detailed view of one of said elements is shown at 19 in FIG. 2. With the use of such spacer or divider elements, as at 19, 20, a plurality of tube compartments, in this case there are twelve, may thereby be formed with each of the previously described twelve groups of six tubes being disposed in a corresponding compartment. Of course, where the curvature of the present missile dispenser 13 requires it, as in the area of tubes number 9 and 10, for example, the supporting frame member 18 may be further fabricated with any appropriately designed additional supporting structure that will provide the necessary support for the launch tubes, the specific nature of which being, however, unimportant to the present invention and is, therefore, neither shown nor described in detail.

As noted hereinbefore, the starting angles of trajectory for the bomblet arrangement to be used with the present invention may be computed and applied to the respective launch tubes. In fact, variations in the distance, both forward and rearward of the bomb release point, at which the dispensed bomblet would strike the surface of the ground, against changes in the bomb release angles have been computed and plotted in the graph of FIG. 3 for the present invention. Thus, from the latter FIG., which is for an aircraft traveling at a speed of 200 knots, it is seen that, for a pattern of 600 feet along the axis of flight, which is included in the overall bombing pattern of 600 feet by 300 feet that has been chosen for the present example, a release angle of about 118° (Note point "A") is required for a bomb strike on the ground surface at a distance of approximately 300 feet forward of the bomb release point "P". This 118° angle represents the angular value at which the tube group containing tube no. 12 would be oriented or depressed below the horizontal, or in other words, measured in the counterclockwise direction as viewed in FIG. 1, for example. As another example, for a bomb strike on the ground of about 300 feet to the rear of the bomb release point, an angle of approximately 5° is selected (Note the point "B" on the graph of FIG. 3) and this would be the angular value at which the tube group containing Tube No. 1 would be oriented or depressed below the horizontal. The remaining tube groups between Nos. 1 and 12 would be correspondingly oriented at the various angles required and selected from the FIG. 3 graph to evenly distribute or disperse the bomb pattern over the entire 600 foot distance. The entire pattern is shown in schematic form in the self explanatory view of FIG. 4 for the sake of clarity and for use as a guide in correctly orienting the entire tube assembly.

In addition to being oriented at various angles along the axis of flight to thereby control the dispersion in the lengthwise direction of 600 feet in the overall bombing pattern, each tube of the present launch tube arrangement is also oriented in a specific and unique manner to ensure a controlled dispersion of the bombing pattern in a lateral direction, which in this case, has been preselected to be 150 feet on each side of the axis of flight for a total of 300 feet. Thus, as seen in FIG. 5, the various angles required for orienting the six tubes of each tube group have been precalculated for the desired lateral bombing pattern of 300 feet and plotted in graphical form. As seen further in FIG. 2, which is typical of all other tube groups, each group consists of six launch tubes arranged in oppositely-disposed pairs to the right and left, respectively, of the axis of flight. The actual lateral angle for the two outermost, oppositely-disposed pairs, such as to achieve a bombing strike at the approximate 150 foot mark on each side of the axis of flight may be selected from FIG. 5 as being equal to the angle OPF or APO which are both equal to each other and which is indicated as being equal to an angle of 40° . The middle pair of launch tubes, such as tubes No. 17 and 53 in FIG. 2 would all be oriented at the angle designated as OPE or BPO in FIG. 5, or in other words, 26.5° . The final innermost pair of tubes, for example Tubes No. 29 and 41 (Note FIGS. 2 and 5) are shown oriented at the angle OPD or CPO which is equal to 9.5° . Thus, with the launch tubes of each tube group respectively oriented at the lateral angles indicated above, as well as at the previously described starting angles of trajectory, the bombing pattern dispensed by the missile dispenser 13 of the present invention would be specifically and positively controlled to both an axial and lateral dispersion of an overall extent of 600 feet by 300 feet and of maximum effect on the selected target.

Although the inventive missile dispenser 13 has been described above with respect to a configuration of 72 missile-bomblet launching tubes whose angles of orientation have been precalculated for a specific bombing pattern of 600 feet by 300 feet, and for an aircraft traveling at a speed of 200 knots and an altitude of 150 feet, it is obvious that other bomblet configurations and tube orientation angles could be required for different aircraft types, speed, altitude and changes in the desired bombing pattern and size. Other variables that could require the tubes to be oriented at different angles could include the tactics and military application to be utilized. In any event, the actual number of bomblets to be used, their specific arrangement in the missile dispenser 13, and the specific angles at which each launch tube would be oriented could obviously be changed or modified in accordance with the particular application without departing from the true spirit or scope of the invention. Moreover, although the preferred embodiment contemplates the simultaneous launch of all bomblets at different angles, the tubes could be fixed at equal angles to the flight axis and, therefore, oriented parallel to each other, and the missile could then be launched in a proper time sequence relative to the aircraft ground speed to obtain the desired dispersion. However, with the latter configuration, the time for a complete laydown of the bombing pattern would be 34 seconds for a 200 knot aircraft speed, whereas, with the unique launch tube arrangement of the present invention, the laydown of the pattern is completed in a maximum of 1.4 seconds. This time difference of about 32.5 seconds would naturally weigh heavily against the aircraft's survivability against anti-aircraft and small arms fire, and therefore, the present inventive launch device offers clear and significant advantage particularly in jungle type terrain.

With use of the present missile dispenser as at 13, with its launch tubes oriented at precalculated angles to laydown a more efficient and rapidly dispensed bombing pattern, there is not only the increased survivability gained by virtue of the much quicker bombing laydown time (1.4 seconds as compared with 34 seconds) as noted hereinabove, but, in addition thereto, very close support missions may be flown with the aircraft flying at an altitude as low as 150 feet and providing tactical support of friendly troops on targets as close as 150 feet

away. The close nature of the support available from use of the present invention and the significant gain in survivability resulting therefrom is particularly emphasized when comparison is made with the use of a single 750 pound general purpose bomb. With the latter bomb, the attacking aircraft must maintain an altitude of at least 1300 feet to safely escape the lethal envelope of its own bomb, or alternatively, the bomb must be retarded, if lower altitudes are to be used. Moreover, such a 750 pound bomb must not be employed any closer than 2000 feet to friendly troops, and if it is employed in retarded manner to achieve the required 1300 foot safety distance for the aircraft, a free-fall time of about 9 seconds is the result if the aircraft is at a 150 feet altitude. Thus, the enemy has this 9 seconds to organize his anti-aircraft and other defensive measures. Furthermore, should it be elected to fly at the higher altitude of 1300 feet, instead of retarding the bomb, the aircraft would obviously be exposed to the enemy by a larger angle of view and therefore a longer observation period. Moreover, use of the 750 pound general purpose bomb at a 150 feet altitude would require an overfly of the enemy position before the bomb would approach the target because of the retardation effect and, finally, if delivered at a 200 knot aircraft speed and at 1300 feet altitude, the 750 pound bomb would travel about 3000 feet in the direction of aircraft flight before hitting the ground, and at 100 feet altitude, about 900 feet. The foregoing distances are applicable to flat, open terrain; however, in a jungle type classic air support role, these distances are too large for positive detection and identification of the enemy position. Therefore, it is likely that the aircraft must make two or more passes over the enemy.

The missile dispenser 13 of the present invention provides a much higher degree of survivability than is the case with the use of the 750 pound general purpose bomb having the inherent disadvantages listed above, by providing a low level flight capability at a reasonable observation or action aircraft speed of, for example, 200 knots, and with a nearly instant weapon delivering capability after positive enemy detection normally with only one overpass required. This increased survivability inherent in the use of the present invention is particularly enhanced by the builtin target coverage of 600 feet by 300 feet provided with use of the 72 bomblet configuration of the inventive missile dispenser 13 and with the inherent capability of releasing all or any desired portion of the total bomb load while the aircraft is in the center of the target area and at only a 150 feet altitude. Thus, the aforesaid missile dispenser 13 has greatly increased flexibility in quickly permitting the selection either of the entire target area to be bombed, or of certain sectors thereof, extending up to 300 feet either forward and/or backward of the bomb release point, and laterally dispersed up to 150 feet to each side of the axis of flight.

FIG. 6 illustrates one type of missile-bomblet that is adaptable to be contained within each of the 72 launch tubes of the present missile dispenser 13. Said missile-bomblet is indicated generally at 21 as including a rocket booster propulsion unit section 22, a bomblet section 23 and a tail section 24 carrying a total of four fins, two of which are indicated at 25 and 26. Rocket booster propulsion unit section 22 may contain a propellant adapted to produce a constant thrust of one second duration to thereby ensure the powered thrust of each bomblet along a constant initial or starting angle of trajectory. With this rocket propelled initial launch, the plurality of bomblets contained in the missile dispenser 13 will reach the ground surface so fast that it would appear, in terms of equivalent "free-fall" time, as if the aircraft were flying only 5 feet above the ground, instead of its actual 150 feet altitude. In one embodiment, the missile-bomblet 21 is actually designed with an overall length of 13.677 inches, a diameter of 2.5 inches, and an overall weight of 6 pounds, including 3 pounds for the combined weight of rocket-booster/propulsion unit section 22, bomblet section 23 and tail section 24, and 3 pounds for the weight of the propellant itself.

In the partially broken-away and sectional view of FIG. 7, the combustion chamber used with the rocket-booster/propulsion unit section 22 of the missile-bomblet 21 of FIG. 6 is indicated generally at 27 and includes a total of three exhaust nozzles, one of which is indicated at 28. Combustion chamber 27 also includes a forward bulkhead at 29, and an aft bulkhead at 30. To resist a predetermined internal combustion chamber pressure of 500 p.s.i.a. with a safety factor of two for a total 1000 p.s.i.a. pressure, the required thickness of the combustion chamber wall, as indicated by the reference numeral 31, for a high temperature alloy steel has been determined to be 0.0104 inch.

The foregoing missile-bomblet 21 may incorporate a conventional explosive warhead which has a lethally effective diameter of 50 feet, and therefore, with a total controlled dispersion bombing pattern of 72 bomblets being dispensed by the present missile dispenser 13, a target area of approximately 600 feet by 300 feet may be covered with the most efficient bombing effect. Since each bomblet weighs 6 pounds, the entire assembly of 72 missile-bomblets would weigh about 432 pounds and with an estimated weight for the inventive missile dispenser itself of about 118 pounds, this compares favorably with more conventional bomb racks used for a single bomb of equal weight (about 500 pounds).

With the controlled dispersion distribution of a plurality of relatively small bomblets by the missile dispenser 13 of the present invention, more efficient and effective coverage can be made on a target area than is possible with a single large bomb, such as the previously-noted 750 pound general purpose bomb. The latter bomb has a lethal area of about 50,000 square feet in flat open terrain. On the other hand, each of the missile-bomblets 21 adapted to be dispensed by the missile dispenser 13 covers a lethal area of about 600 square feet in flat, open terrain. Thus, with 72 missile-bomblets being dispersed, an overall lethal area of about 42,300 square feet would be covered, at a total weight of 432 pounds. Therefore, the 72 missile-bomblet arrangement of the present invention would achieve a lethal area coverage of about 100 square feet per pound, whereas, the single 750 pound bomb would cover a lethal area of only about 67 square feet per pound. Moreover, an equal weight (750 pounds) of bomblets would actually give a total lethal area of about 75,000 square feet.

The above comparison shows that the present missile dispenser, distributing a plurality of relatively small bombs or bomblets on target, has obvious advantage and is more effective than is the single, large general purpose type 750 pound bomb in open flat terrain. This advantage is even further emphasized under the real condition of typical forest type terrain, such as jungle and tropical rain forests, where the lethal area normally is severely degraded by the extensive cover and fragmentation shielding afforded the target personnel. In this regard, it can be easily shown that, since the lethality of a warhead is determined principally by the density of its lethal fragments, it follows that by distributing multiple burst points (and therefore high density of lethal fragments) over a given target area, as is accomplished with maximum effect by the missile dispenser 13 of the present invention, there is a greatly reduced shielding effect and the effectiveness of the bombing is not nearly as degraded as it would be for a single ground burst point by the large type bomb.

While a preferred embodiment of the present invention has been shown and described for purposes of exemplification, it is apparent that many modifications and changes may be made, such as constructing the inventive launch tubes in the unique configuration taught in FIG. 1, either entirely within the aircraft fuselage or wings, or partly distributed over the fuselage and wings, without departing from the true spirit or scope of the invention defined hereinafter in the accompanying claims.

Thus, a new and unique missile dispenser has been developed by the present invention that incorporates a controlled-pattern bombing dispersion, enables a quicker response and relatively low speed attack from low altitude,

and facilitates the immediate laydown of a more effective bombing pattern even on targets located directly below the aircraft.

We claim:

1. In an air-to-ground weapons system; a missile-housing and launching device adapted to contain a plurality of missiles therein and mountable in firing position to an aircraft; said device having a main, supporting frame member formed into a predetermined arcuate configuration for thereby incorporating therein a plurality of missile launch tubes at increasing angles of depression below the horizontal and measured from the longitudinal axis of the aircraft, each of said plurality of missiles being thereby adapted to be positioned within a respective launch tube for launching at different starting angles of trajectory increasing in value from rear-to-front by precalculated amounts in a direction along the axis of flight and directly corresponding to the respective angles of depression precalculated for ensuring the collective laydown of a bombing pattern of a controlled-dispersion configuration and extent along the axis of flight predetermined for maximum effect on a selected mass target; first means incorporated in said main, supporting frame member for forming said plurality of missiles into a series of separate and related missile groups, each of said missile groups comprising an equal number of missiles collectively oriented at the same precalculated angle of depression below the horizontal and simultaneously oriented in corresponding pairs disposed on opposite sides of the longitudinal axis of the aircraft, and being displaced at limited angles of divergency therebetween precalculated for ensuring the most effective coverage on the selected mass target in a direction transverse-

ly and on opposite sides of the axis of flight; and second means carried by the aircraft for mounting said missile-housing and launching device in correct firing position.

2. In an air-to-ground weapons system as in claim 1, wherein said first-named means comprises a plurality of missile launch tube-carriers extending in depending relation to said main, supporting frame member and each disposed at said increasing angles of depression from the horizontal to thereby orient the respective missile groups mounted therein at the said predetermined angle relative to the longitudinal axis of the aircraft corresponding to that precalculated for maximum effect on the selected mass target.

3. In an air-to-ground weapons system as in claim 2, wherein said plurality of missile launch tube-carriers consist of a series of divider elements each angularly disposed relative to the horizontal at a precalculated angle and supporting a corresponding missile group in firing position therewithin.

4. In an air-to-ground weapons system as in claim 3, wherein each of said divider elements further incorporates an integrally-formed, upper arcuate surface cojoined and cooperatively associated with said main, supporting frame member and disposed in transverse relation to the direction of aircraft flight to thereby further ensure the disposition of the missile groups formed therewithin into the number of oppositely-disposed pairs respectively oriented along lines of fire disposed on opposite sides of the longitudinal axis of the aircraft and being consistent with, and precalculated for, maximum bombing effect on the selected mass target.

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