June 14, 1955 G. P. GRAVENHORST 2,710,562

GUN MOUNTING ARRANGEMENT FOR AIRPLANES

Filed July 15, 1949 2 Sheets-Sheet 1

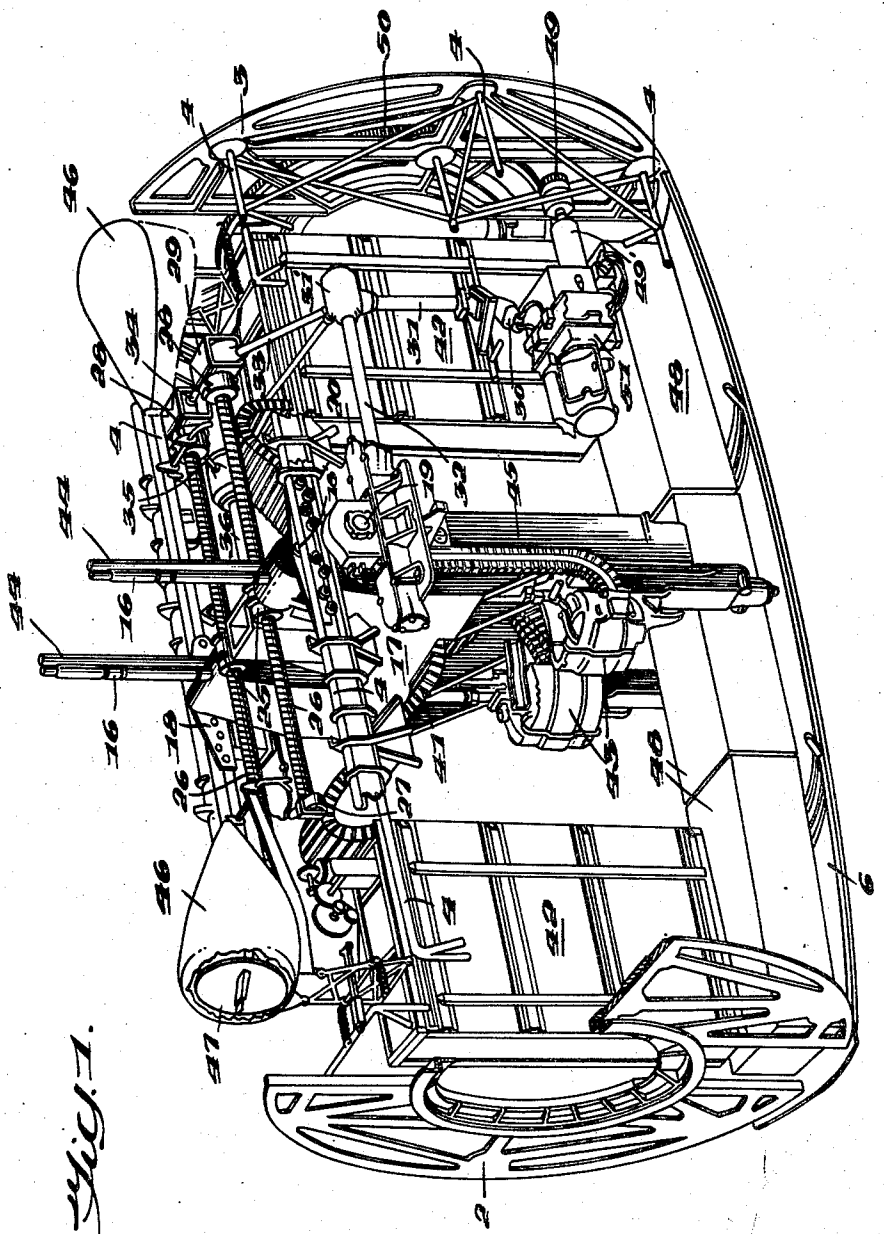


Fig. 1.

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Fig. 2.

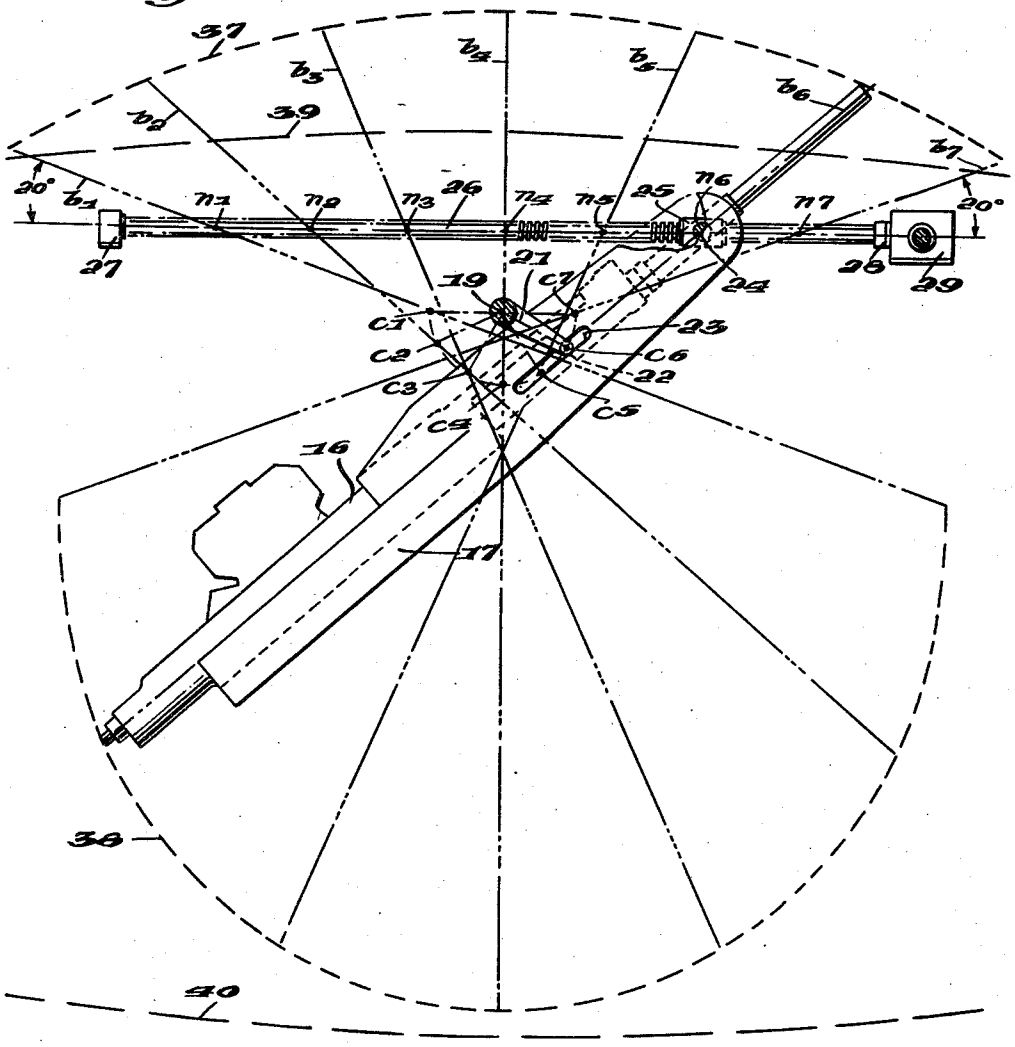


Fig. 3.

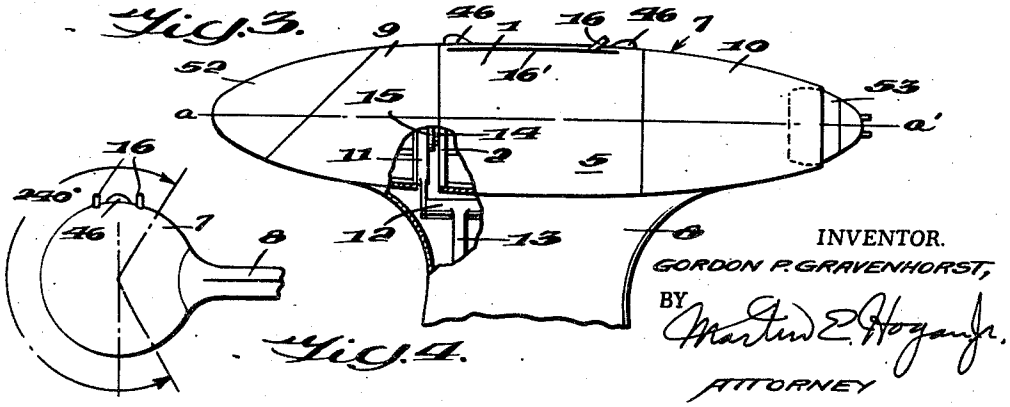


Fig. 4.

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GUN MOUNTING ARRANGEMENT FOR AIRPLANES

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11 Claims. (Cl. 89—37.5)

This invention relates to an arrangement for mounting guns on aircraft, particularly aircraft of high-speed performance characteristics.

As airplanes have been improved and their speed of flight has approached the speed of sound, the problem of providing adequate gun fire coverage has reached serious proportions. To adequately protect an airplane, there must be provision for substantially spherical fire coverage about the airplane. Yet the number of guns and associated equipment must be held to a minimum to avoid unnecessary weight. It is, therefore, desirable to provide gun fire coverage by means of a relatively few gun turrets, each providing for a wide field of fire. Such turrets normally are arranged to rotate about a given axis and to provide for the guns thereof to be swingable about an axis generally perpendicular to the turret axis. It is usual to mount the guns within the turret so that they project through suitable slots in the outer wall thereof, the gun mounting being a pivotal connection between the gun and the turret structure. In order to keep the volume of space traversed by the guns in the turret at a minimum, the guns have normally been pivoted adjacent their mid portion. Where a wide angle of fire is desired, the gun pivot would be located closely adjacent the wall of the turret and, as a result, nearly one half of the gun would project outwardly into the air stream. Such an arrangement results both in undue drag, tending to slow down the airplane and, possibly more serious, in deflection of the gun barrel due to the air loads thereon so that the actual line of fire differs from the calculated line of fire.

To minimize the projection into the air stream, the guns might be pivoted closely adjacent their muzzle ends but in this case, particularly where wide angle fire coverage is involved, the space required within the turret to permit such wide angle traversing would be prohibitively large.

It is an object of this invention to provide a mounting for guns within a turret wherein the guns may be traversed through a relatively wide angle and yet wherein both the projection of the guns beyond the wall of the turret and the space required therefor within the turret will be minimized.

It is a further object to provide a barrel-type turret of relatively short over-all length, said turret being mounted for rotation about its longitudinal axis and carrying therein a gun or guns angularly traversible over a wide angle in a plane generally parallel to said axis and with but relatively slight projection of the guns beyond the wall of the turret.

Another object is to provide a mounting for such guns within the turret wherein said guns are bodily moved lengthwise of said turret at the same time that they are angularly traversed.

It is a further object to provide a gun mount wherein the gun is mounted adjacent its muzzle end for substantially straight line movement and wherein an intermediate portion of the gun is mounted for simultaneous

movement along an arcuate path in the same general direction.

A still further object is to provide in conjunction with a barrel-type turret and gun mount of the above-mentioned type, a generally conical streamlined housing arranged coaxially therewith, said housing including a nose-type gun turret having a generally conical sector of fire, whereby the fields of fire coverage of the two turrets overlap to provide more than hemispherical coverage.

Other and further objects will appear from the following description and claims when considered in view of the accompanying drawings.

In the drawings:

Figure 1 is a fragmentary perspective view of the barrel turret, broken away to better show the manner in which the guns are mounted within said turret.

Figure 2 is a diagrammatic view showing the relative positions of the parts as the gun is angularly traversed relative to said turret.

Figure 3 is a fragmentary plan view of a wing-tip-mounted armament unit incorporating the barrel turret and gun mount of this invention.

Figure 4 is an end view of the armament unit.

In the drawings is shown a barrel-type turret **1** formed of two disc-like end members **2**, **3** connected together by suitable tubular frame members **4** (most of which have been broken away in Figure 1). The turret includes a generally cylindrical outer wall **5**, one portion of which is formed as a removable access door **6** (see Figure 1).

As shown in Figure 2, the turret **1** is incorporated in a wing-tip armament unit generally indicated at **7**, carried at the outer end of the wing **8** of an airplane.

This armament unit includes two generally conical housings **9** and **10** rigidly carried by supporting discs **11**, in turn carried by a tubular member **12** rigid with the wing spars **13**. The turret **1** includes circular bearing portions **14** carried by the end discs **2**, **3** and rotatably mounted within bearing members **15** rigidly carried by discs **11**, whereby the turret is rotatable about the longitudinal axis *a*—*a'*. As indicated in Figure 4, the turret is rotatable about said axis through an angle of substantially 240°. A pair of guns **16** is mounted for angular traversing relative to the turret **1** in a plane parallel to the axis *a*—*a'*, the muzzle ends of said guns protruding through suitable slots **16'** formed in the outer wall **5** as shown in Figure 3.

Guns **16** are suitably mounted in a gun cradle **17** which is pivotally carried at **18'** by the spaced carriages **18**, which constitute supporting elements for the guns adapted to move in a straight line along guide tracks formed by certain of the tubular frame members **4**, the path of such movement being parallel to the plane in which the guns traverse. Suitable rollers are provided on the carriages for mounting the carriages for movement along said tracks with a minimum of friction. Mounted within suitable bearing housings **20**, rigidly carried by the turret frame, is a pair of crank shafts **19** having outwardly extending crank arms or levers **21**. These levers carry at their outer ends rollers **22** which ride in suitable slots **23** formed in the outer face of the gun cradle as clearly shown in Figure 2. Rollers **22** thus serve as additional supporting elements for the guns, each being movable along a curved path also lying in a plane parallel to the plane of traverse of the guns. Pivotally connected to the gun cradle at **24**, coaxial with pivots **18'**, is a pair of nuts **25** threadedly carried by spaced feed screws **26** extending generally longitudinally of the turret closely adjacent the outer wall thereof and supported at opposite ends by bearing members **27** and **28** rigidly carried by the turret frame members, bearings **28** forming portions of gear housings **29**. Feed screws **26** and crank shafts **19**

are adapted to be simultaneously actuated by a rotary hydraulic motor 30. This motor is connected, as by shafting 31—36 and by suitable gearing (not shown) within the housings 20 and 29, to swing the crank arms 21 and to rotate the feed screws 26. The gear ratios are such that the said screws will traverse the nuts along the entire effective length thereof while the crank shafts 19 rotate through substantially 180°.

Figure 2 shows the positions of the gun axis (b_1 to b_7) corresponding to various positions of the nut (n_1 to n_7) and of the roller 22 (c_1 to c_7). It will be noted that in traversing from one extreme position to the other, the tip of the gun barrel moves along the dash line path 37 while the breech end thereof moves along the dash line path 38. The adjacent portions of the turret wall are indicated in dash lines at 39, 40. It will be noted that the gun is angularly traversed through substantially 140° and thus provides for gun fire coverage to within approximately 20° of the axis of the turret. Yet at no point in the traverse does the gun barrel protrude objectionably far beyond the outer wall of the turret, thus minimizing both the adverse drag effect and the tendency of the gun barrels to be deflected by the air load.

Returning to Figure 1, suitable flexible ammunition chutes 41 are provided, leading from ammunition boxes 42, which are located adjacent the ends of the turret and between the paths traversed by the breech ends of the guns, and extending to suitable feeders 43 carried on the guns. Empty ammunition cases are adapted to be discharged through suitable chutes 44 by means of ejection mechanism 45. Where automatic radar-controlled gun tracking is employed, a pair of partially retractable radomes 46 may be provided projecting from the outer wall 5 between the slots 16'. These radomes will house scanning mechanism indicated generally at 47 used in conjunction with conventional radar mechanism housed within the units 48 rigidly mounted on the access door 6.

For rotating the turret about its longitudinal axis, a pinion 49 is provided, driven by a rotary hydraulic motor 49', and engaging a fixed ring gear 50 carried by one of the supporting discs 11. Motors 30 and 49' are adapted to be selectively actuated either individually or collectively, the rate and direction of rotation being governed by an electrically controlled hydraulic transmission unit 51, which, in turn, would be controlled in conventional fashion by suitable manual or automatic gun directing apparatus (not shown).

As shown in Figure 3, the tip portion of housing 9 is formed as a radome and suitable search radar equipment (not shown) may be housed within this member. The housing 10 has its tip portion formed as a conventional ball-type turret 53, arranged to provide for generally conical fire coverage about the axis a—a', the apex angle of said cone being substantially 60°. The field of fire coverage of this turret is arranged to slightly overlap that of the main barrel turret so that the two turrets together will give complete fire coverage over more than a hemispherical sector of space about the airplane.

As can be seen from Figure 2, the axis of shafts 19 lies between the straight-line path along which the nuts and carriages travel and the arcuate path traversed by the roller 22. The relationships are such that a substantially constant ratio obtains between the rate of longitudinal movement of the nut and the rate of angular traversing of the gun about pivot 24. Therefore, for a given speed of operation of the drive motor 30, the gun will be angularly traversed at a substantially constant rate regardless of its position at any particular time. By displacing the mid-portion of the gun laterally (as a result of the motion of roller 22) at the same time that the upper portion of the gun is being moved along its straight-line path, the longitudinal extent of the area traversed by the breech end of the gun is minimized, while still retaining the relatively small projection of the muzzle of the gun beyond the wall of the turret. As a result, the over-all length of the turret can be made much smaller than would otherwise be the case, a particularly desirable result where, as in the present case, it is desired to incorporate such a turret in a wing-tip armament unit.

While the traversing mount has been specifically described in conjunction with the mounting of a gun within a turret, it is obvious that a similar mounting could be provided wherever it is desired both to limit the projection of the gun beyond its protective wall and to minimize the volume of clear space required behind the wall to permit such traversing. Similarly, other means than the nut and feed screw could be provided for traversing the gun pivot along its straight line path, and other changes and modifications could be made without departing from the spirit and scope of the appended claims.

I claim as my invention:

1. A gun mount comprising a main support, a first supporting element, means mounting said supporting element on said main support for movement along a straight line path relative thereto, a second supporting element, means mounting said second supporting element on said main support for movement along an arcuate path relative thereto, said arcuate path lying in a plane substantially parallel to said straight line path, the center of curvature of said arcuate path lying between said paths, a gun pivotally carried by said supporting elements at points spaced axially along said gun, and means for simultaneously moving said supporting elements in corresponding directions along said paths whereby to angularly traverse said gun relative to said main support.

2. A gun mount for angularly traversing a gun in a plane, comprising a main support, a first supporting element carried by said main support for movement relative thereto along a straight line path substantially parallel to said plane, a second supporting element carried by said main support for movement relative thereto along an arcuate path lying in a plane substantially parallel to said first plane, a fixed pivotal connection between said first supporting element and said gun adjacent the muzzle end of said gun, a second pivotal connection between said second supporting element and said gun adjacent the central portion of said gun and movable axially of said gun, and means for simultaneously moving said supporting elements along said paths to angularly traverse said gun.

3. A gun mount comprising a main support including a wall, a supporting element, means mounting said supporting element on said main support for movement along a path extending generally parallel to said wall and closely adjacent to one side thereof, a gun pivoted to said element adjacent the muzzle end of said gun for angular movement in a plane parallel to said path, said wall being provided with a slot generally parallel with said path and the muzzle of said gun projecting through said slot, and means connected to said gun and to said element for angularly traversing said gun about said pivot and for simultaneously moving said element along said path to bodily shift said gun in the same general direction, whereby to minimize both the projection of said gun beyond said wall and the overall extent, parallel to said path, of the area traversed by that portion of the gun to said one side of said wall.

4. A gun mount comprising a main support, a gun, a supporting element carried by said main support for movement along a straight line path relative thereto and pivotally supporting said gun adjacent the muzzle end thereof, means for moving said element in a selective direction and at a predetermined rate along said path, and means carried by the support for movement in a plane parallel to said path and connected to the gun adjacent the middle portion thereof and operatively interconnected with said moving means to bodily move said middle portion in the corresponding direction but at a slower rate whereby to angularly traverse said gun.

5. A gun mount, comprising a main support, a supporting element carried by said main support for movement along a straight line path relative thereto, a gun, pivot means pivotally supporting said gun from said element for angular movement relative to said element in a plane parallel to said path, means for moving said element along said path at a predetermined rate, and means operatively connected to said moving means for simultaneously angularly traversing said gun about said pivot means at an angular rate having a substantially constant ratio to said first-mentioned rate throughout the range of movement of said gun.

6. A gun mount, comprising a main support, a supporting element carried by said main support for movement along a straight line path relative thereto, a gun, pivot means pivotally supporting said gun from said element for angular movement relative to said element in a plane parallel to said path, means for moving said element along said path at a predetermined rate, and means movably supporting said gun from said main support for bodily shifting relative thereto in a plane parallel to said first-mentioned plane and supporting said gun at a point spaced axially of the gun from said pivot and being operatively connected to said moving means for simultaneously angularly traversing said gun about said pivot means at an angular rate having a substantially constant ratio to said first-mentioned rate throughout the range of movement of said gun.

7. A gun mount for an airplane wing tip, comprising a turret having a generally cylindrical outer wall, means supporting said turret from said wing tip for rotation about the longitudinal axis of said turret, a gun having a muzzle end and a breech end, supporting means movably mounted within the turret and operatively connected to said gun adjacent the muzzle end thereof for moving said end of the gun in a plane extending generally longitudinally of said turret, said outer wall being provided with a longitudinally extending slot and said muzzle end of the gun projecting outwardly through said slot, and means movably carried by and within said turret for movement in a plane parallel to said first-mentioned plane and supporting the gun adjacent the central portion thereof and being operatively connected to said first-mentioned supporting means for simultaneously causing lateral bodily displacement of said central portion in the same general direction as, but at a slower rate than, said muzzle end, whereby to angularly traverse and simultaneously bodily shift said gun relative to said turret to minimize both the projection of the gun outside of the turret and the over-all extent, lengthwise of the turret, of the area traversed within said turret by the breech end of said gun as said gun is angularly traversed.

8. A gun mount comprising a main support, a gun, means movably carried by said support and operatively connected to said gun adjacent the muzzle end thereof for moving said end of the gun laterally in a given direction, and means movably carried by the support for supporting the gun adjacent the central portion thereof and being operatively connected to said first means for simultaneously causing bodily lateral movement of said central portion in the same general direction but at a slower rate, whereby to angularly traverse said gun.

9. A gun mount comprising a turret having a generally cylindrical wall, means supporting said turret for rotation about its longitudinal axis, a feed screw mounted within said turret adjacent the outer wall thereof and extending generally parallel to said longitudinal axis, a nut movable along said feed screw, a gun assembly including a gun pivoted to said nut adjacent the muzzle end of said gun, a crank lever swingably mounted in said turret for movement in a plane parallel to said axis, a sliding pivotal connection between the free end of said crank lever and an intermediate portion of said gun assembly and means for simultaneously rotating said feed screw and swinging said lever to angularly traverse said gun assembly in a plane parallel to the axis of said turret.

10. A gun mount for providing gun fire coverage over a large angular section of a sphere, comprising a main support, a turret rotatably carried by said support and having a generally cylindrical wall, said turret being rotatable through substantially 240° about the longitudinal axis thereof, a gun having an over-all length slightly greater than the diameter of the turret, pivot means movably carried within said turret adjacent the wall thereof for movement along a path extending generally parallel to said axis and pivotally carrying said gun adjacent the muzzle end thereof for angular movement in a plane parallel to said axis, said wall being slotted and the muzzle end of said gun extending outwardly therethrough with the remainder of said gun being completely housed within said turret, and means connected to said pivot means and to said gun for angularly traversing said gun about said pivot through an angle of substantially 140° and for simultaneously bodily moving said pivot means and said gun lengthwise of said turret whereby to minimize both the projection of said gun outside of the turret and the overall extent, lengthwise of the turret, of the area traversed by that portion of the gun within said turret.

11. A gun mount for providing gun fire coverage over a large angular sector of a sphere, comprising a main support, a turret rotatably carried by said support and having a generally cylindrical wall, said turret being rotatable through substantially 240° about the longitudinal axis thereof, a gun having an over-all length slightly greater than the diameter of the turret, pivot means movably carried within said turret adjacent the wall for bodily movement in a plane parallel to said axis and pivotally carrying said gun adjacent the muzzle end thereof for angular movement in a plane parallel to said axis, said wall being slotted and the muzzle end of said gun extending outwardly therethrough with the remainder of said gun being completely housed within said turret, means connected to said pivot means and to said gun for angularly traversing said gun about said pivot through an angle of substantially 140° and for simultaneously bodily moving said pivot means and said gun lengthwise of said turret whereby to minimize both the projection of said gun outside of the turret and the over-all extent, lengthwise of the turret, of the area traversed by that portion of the gun within said turret, a generally conical streamlined housing carried by said main support adjacent one end of said turret and substantially coaxial therewith, and a second gun turret forming the tip portion of said housing and mounted therein for limited swinging about perpendicularly related axes whereby to provide gun-fire coverage throughout a conical sector of space lying about the longitudinal axis of said first turret and overlapping the sector covered by the gun of said first turret.

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