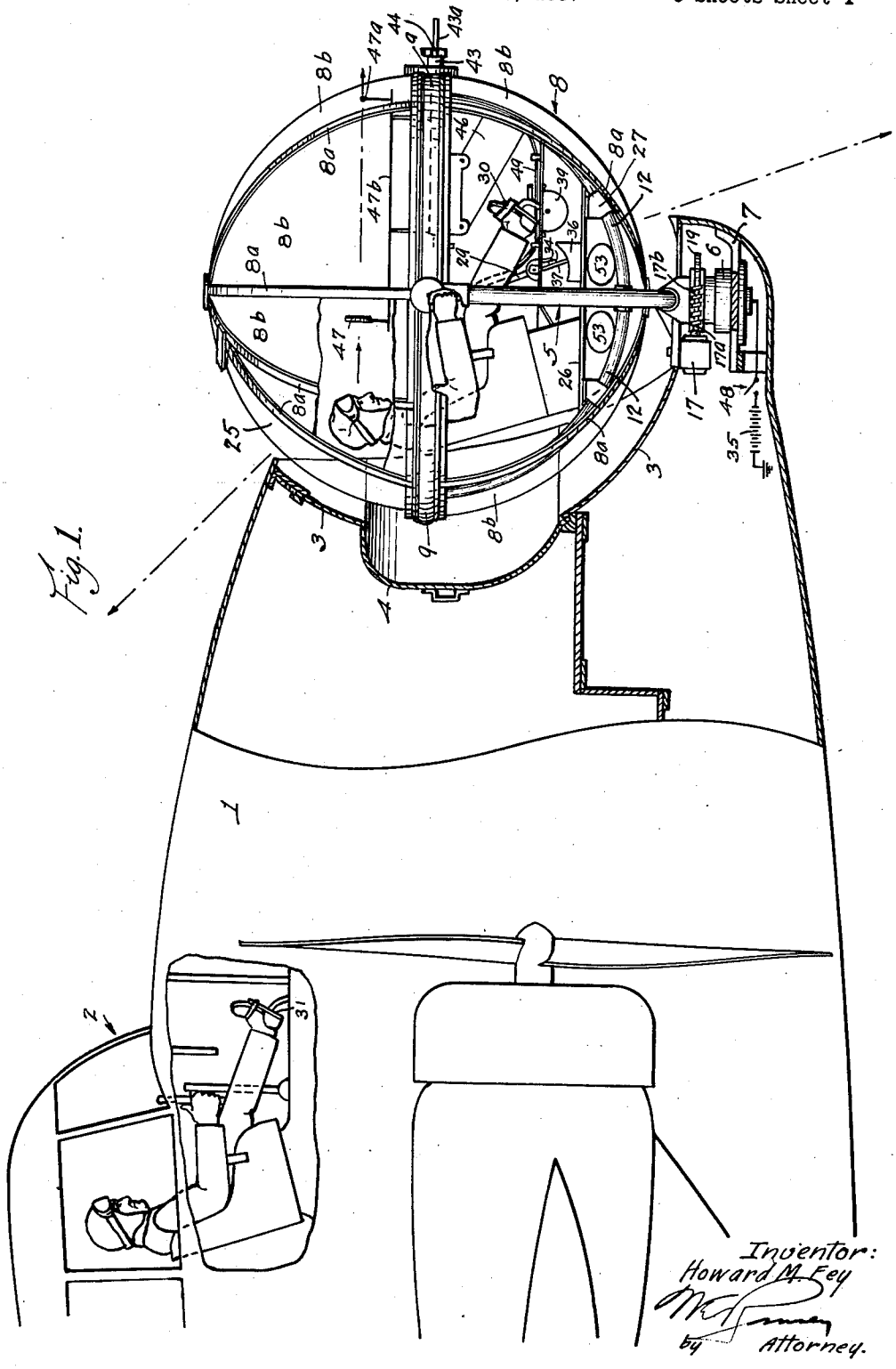
March 4, 1941. H. M. FEY 2,233,918

AIRPLANE MACHINE GUN MOUNT

Filed Dec. 29, 1937 3 Sheets-Sheet 1



March 4, 1941. H. M. FEY 2,233,918

AIRPLANE MACHINE GUN MOUNT

Filed Dec. 29, 1937 3 Sheets-Sheet 2

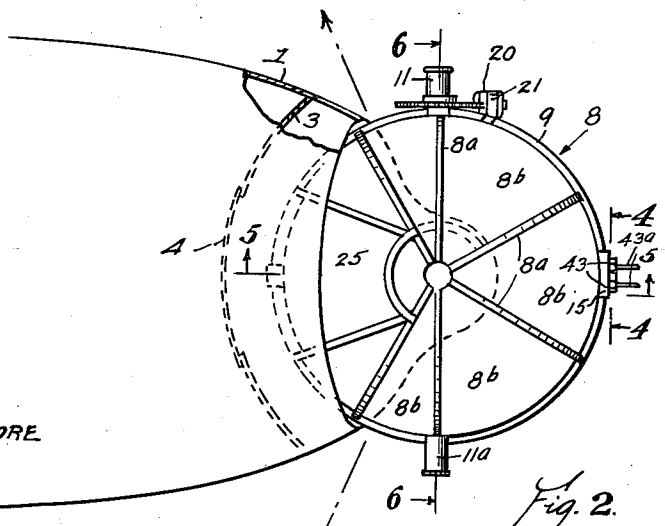


Fig. 2.

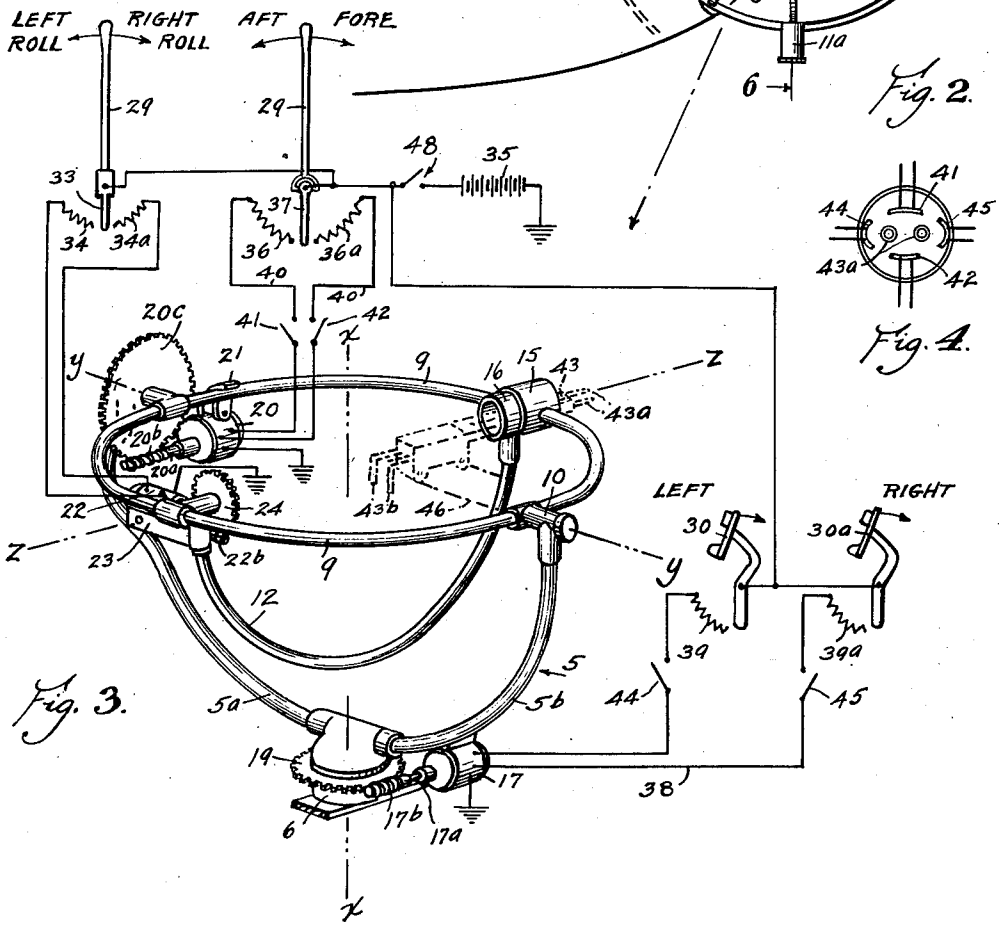


Fig. 3.

Fig. 4.

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AIRPLANE MACHINE GUN MOUNT

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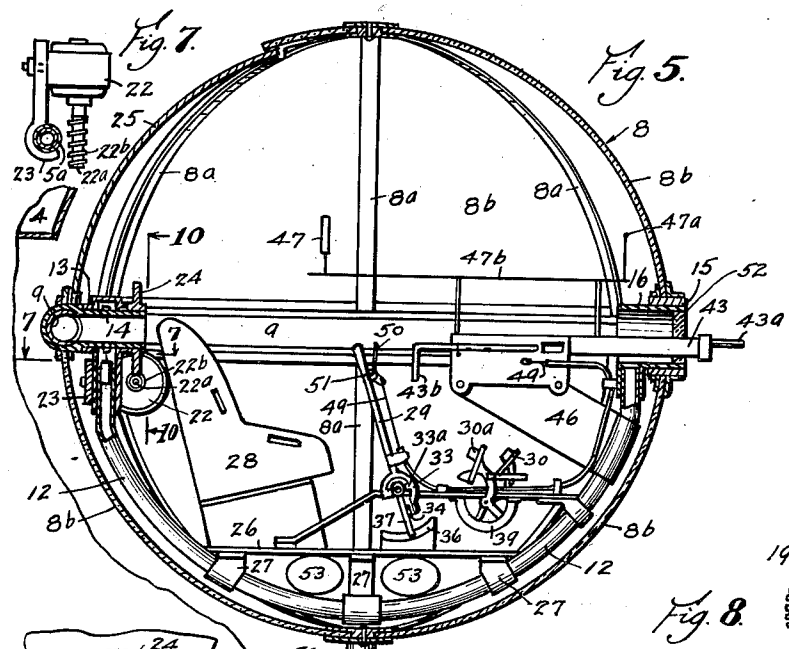

Fig. 7.

Fig. 5.

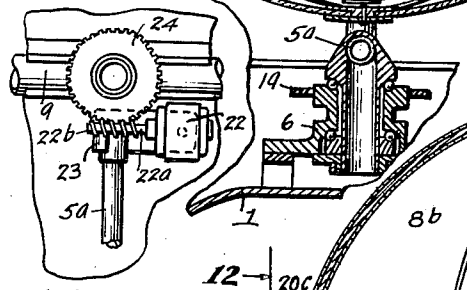

Fig. 10.

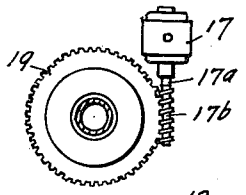

Fig. 8.

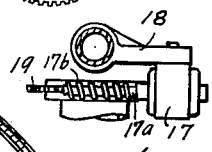

Fig. 9.

Fig. 6.

Fig. 11.

Fig. 12.

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UNITED STATES PATENT OFFICE

2,233,918

AIRPLANE MACHINE GUN MOUNT

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Application December 29, 1937, Serial No. 182,208

10 Claims. (Cl. 89—37.5)

My invention relates to gun mounts and controls therefor which are particularly adapted for aircraft. It is common practice at the present time to provide machine guns and light rifles upon aircraft, particularly of the bombing type, to protect said aircraft against enemy airplanes. It is essential that said guns be securely mounted so that they can be accurately aimed and so that their recoil can be readily absorbed, and it is necessary that controls be provided so that said guns may be easily and quickly moved to provide a relatively wide angle of fire.

The object of my invention is to provide a gunner's station adjacent which are controls and gunsights alined with the station so that a gunner seated thereon can direct one or more guns easily and quickly upon a target and can follow a moving target throughout a relatively wide range by control devices similar to those provided for controlling the course of an airplane.

The object is attained by providing an enclosed chamber in which substantial portions of the side walls, at least, are transparent. Said chamber is preferably spherical and is mounted upon articulated connections which permit said spherical chamber to be easily and quickly moved about two normal axes of rotation. That is, said chamber can be rotated about a vertical axis and about a horizontal axis. Within said chamber, said gunner's station is rotatable about an axis normal to the two aforesaid axes. Power driven means are selectively actuated from said gunner's station, and a gun or guns are alined with the gunner's station, either physically or indirectly by means of sights alined with said position. Thus, a gunner in said chamber and at said controls can direct said guns independently of the position of the airplane itself. I preferably provide controls which are similarly positioned and arranged with respect to the gunner's station and function in a similar manner to rotate said station as do the similar controls arranged adjacent the pilot's station for flying the aircraft. I do this because most machine gunners on aircraft are more or less familiar with the operation of flying controls, and the presence of said controls thus permits a gunner to "fly" a gun or "fly" gunsights in exactly the same manner as he would do if he were flying an airplane. These types of flying controls have generally been recognized as practical and efficient.

In pursuit airplanes one or more guns are arranged in fixed relation with sights leading forwardly from the pilot's position. Thus, a pursuit pilot merely has to aim his plane at a target and fire said gun when it is thus aimed. Thus, a machine gunner in my invention can virtually "fly the sights" in such a gunner's station, and he will be relieved of the responsibility of flying the plane. Said gunner's station is preferably spaced from the pilot's station, and the pilot is charged only with the responsibility of flying said plane while the gunner flys the gunsights with similar controls which cause the chamber and its connected guns to elevate or depress the guns, rotate them about their bores or swing them transversely towards the right or left.

I preferably arrange said controls so that they make and break electrical contacts and actuate variable rheostats so that as said operating controls are moved out of their normal position, they progressively increase the speed of movement of the driving means for said gunner's station. That is, a minor deflection of said operating controls will produce relatively slow speed, while greater deflection will produce increased speed. This permits the coarse adjustments of the gunsights, and the guns for which said sights are provided, to be made by major deflections of said controls, while fine sights and minor adjustments may be made by minor deflections of said operating controls.

One of the important advantages of my invention, therefore, is that a gunner can direct his attention wholly to the aiming and firing of his gun and not be concerned with the position of the plane upon which the gun is mounted. By my invention he can quickly and accurately arrange his position and swing his gun thru a wide range of fire without considering the plane's position. The pilot would not thus be concerned with the necessity of giving a gunner "good shots," and the gunner would probably make corrections for the plane's changes in position subconsciously or mechanically as a flyer compensates for rough air. A gun turret or chamber of this character also permits larger, heavier or more numerous guns to be carried and aimed because of the solidity of the gun mount and the ease and flexibility of operation of the controls.

Further details of my invention, the mode of operation thereof, and the operating advantages thereof are hereinafter described in greater detail with reference to the accompanying drawings, in which:

Fig. 1 is an elevation of the forward end of an airplane with portions shown broken away to disclose operating details of the gunner's station

and its relative position with respect to the pilot's station;

Fig. 2 is a fragmentary plan view, looking down on the forward end of said airplane and upon said rotatable gunner's compartment;

Fig. 3 is a more or less schematic view of the structural details of said compartment and the power means for rotating said member, with the electrical diagram shown connected therewith;

Fig. 4 is a fragmentary sectional view taken on the line 4—4 in Fig. 2, illustrating the manner in which limit switches may be placed about the gun barrels to prevent said gunner's compartment from being swung around to such a degree that bullets could be directed against the airplane upon which it is mounted;

Fig. 5 is a cross-sectional view taken on the line 5—5 in Fig. 2, and shows the details of the gunner's compartment, and the controls arranged therein;

Fig. 6 is a transverse view thru said compartment taken on the line 6—6 in Fig. 2, which is looking forwardly; and

Figs. 7 to 12, inclusive, are diagrammatic illustrations of the manner in which the power driven means are secured to the structural members of said gunner's compartment, certain section lines being indicated upon the other figures to indicate from where the detail views were taken.

My invention is particularly adapted to be used upon bombers and large sized aircraft, and preferably is arranged in the forward or nose end of the fuselage 1 thereof. I feel that my invention is more advantageous at this point because here a gunner is facing forwardly and is given a wide uninterrupted view, both forwardly, laterally and vertically. It is possible, however, to arrange said gunner's compartment at the rear end of said fuselage, top, bottom or sides thereof. It also could be arranged upon the wing structure thereof or upon the motor nacelles.

In the drawings, said compartment is shown as being mounted upon the nose of said fuselage, forward of and slightly below the pilot's station 2. It can be reached by a walk or passageway extending thru the fuselage, but separated from the interior of said fuselage by a bulkhead 3 thru which access can be had, thru a door 4. Said compartment is supported by a vertically extending yoke member 5 which constitutes the base therefor. The arrangement of the structural members is clearly shown in Fig. 3. Said yoke member is journalled in a vertically extending bearing 6, mounted upon a bracket 7 secured to the fuselage of the aircraft. Said yoke is bifurcated and the two arms 5*a*—5*b* thereof extend upwardly and lie outside of the spherical chamber 8. Said spherical chamber is carried by an annular member 9. Said member is pivotally mounted on trunnions 10, radially and oppositely disposed, which are journalled in bearings 11—11*a*, carried by the uppermost portions of the arms 5*a*—5*b* of the yoke member.

A dependent cradle member 12, lying inside of the chamber 8, is supported by the annular member 9. A trunnion 13 extends inwardly from the annular member 9, and upon said trunnion an encircling bearing 14, carried by one end of the cradle, has a a journalled bearing. Diametrically opposite the trunnion 13 is a relatively large bearing 15, seated in and forming a part of the annular member 9. In said bearing is a hollow trunnion 16, carried by the opposite end of the cradle member 12.

By this construction, the yoke or base member 5 is adapted for rotation about a vertical axis *x*—*x* as viewed in Fig. 3. The cradle is rotatable about a horizontal axis *z*—*z* extending longitudinally of the fuselage as viewed in the figures, and the annular member is rotatable about a horizontal axis *y*—*y* extending transversely of said fuselage. Thus, each of the axes extends normal to both of the others. Thus, the cradle can be moved about any of the three axes, and power devices, hereinafter described, are adapted to produce such rotation. It is to be noted that each of the members 5, 9 and 12, are hollow. These are made hollow as to accommodate the electrical conduits from the control devices, which are arranged within the chamber, to the driving mechanisms which are or might be spaced some distance therefrom.

The yoke or base member 5 is rotated about the axis *x*—*x* by an electrical motor 17. The base of said motor is fixed to a bracket 18, welded or otherwise secured to the yoke or base member 5. The motor shaft 17*a* carries a worm 17*b* thereon. Said worm is adapted to mesh with a worm gear 19 fixed to the fuselage of the aircraft. Thus, rotation of the motor, and therewith the worm 17*b*, causes the motor, its shaft and worm, to rotate about said worm gear 19, and to carry therewith the yoke or base member 5. Said electric motor is preferably reversible, as are all of the motors hereinafter described, and thus rotation of said motor 17 in one direction causes the yoke to rotate about the axis *x*—*x*, while opposite rotation of the motor, produces opposite rotation of said yoke or base member 5.

Electric motor 20 is fixed by a bracket 21 to the annular member 9. Said electric motor carries a worm 20*a* upon its operating shaft 20*b*. Said worm is fixed to the trunnions 10 of annular member 9, and thus rotation of the electric motor and the worm carried by its shaft causes the motor and the worm assembly to rotate relatively about the worm gear 20*c* attached to bearing 11 carried by yoke 5 to rotate the annular member 9 about the axis *y*—*y*.

Electric motor 22 is arranged to rotate the cradle member 12. Said motor is secured by a bracket 23 to the cradle member 12. Said motor 22 carries an operating shaft 22*a*, having a worm 22*b* fixed thereto. Said worm meshes with and engages a worm gear 24 secured to the trunnion 13, forming a part of the annular member 9. Thus, the rotation of said electric motor 22 causes the motor, its shaft and worm, to rotate relatively about the axis *z*—*z*, and to carry therewith the cradle member 12 and the mechanism carried thereby, which will hereinafter be described. It is to be noted that the electric motor 20 lies inside of the arm 5*a*, and said arm must thus be bent slightly, as is shown in Fig. 6, to accommodate the movement of said motor about the axis *y*—*y*, as said motor and the parts connected therewith rotate about the worm gear 20*c*.

The spherical chamber 8 is carried by the annular member 9, as has been heretofore stated, and the chamber is built about a framework of structural members 8*a* which join at the top and bottom, as is shown in Figs. 2 and 6. Said members carry panes of transparent material, such for example as shatterproof glass, 8*b*. Thus, the container completely encloses the gunner's compartment, and the panes of shatterproof glass provide good visibility thru the side walls of said chamber. Access is had to the interior of said spherical chamber by a sliding door 25, lying in the upper half of the chamber, as is shown in

Fig. 1. When the chamber is rotated so that said door alines with the door 4 thru the bulkhead 3, both of said doors can be opened, and a gunner can climb from the interior of the fuselage into the spherical chamber, or vice versa.

Within said chamber, the cradle member 12 depends from central bearings which extend radially thru the annular member 9. Carried by said cradle member is a platform 26, supported by divergent brackets 27, which are welded or otherwise secured to the cradle and to said platform to define a unitary structure. A gunner's seat 28 is carried by the platform, and arranged directly forward of said seat is a stick control 29. Forward of said stick control and lying at opposite sides thereof are pedal controls 30 and 30*a*, corresponding to the rudder pedal controls 31 in the pilot's station.

With respect to said controls, their physical location, structure and relative resulting movement, they are similar to the controls in said pilot's station 2. That is, movement of said stick control toward said gunner will cause the spherical chamber to rotate about the axis *y*—*y* in a counterclockwise direction, as viewed in Fig. 1. That is, pulling said stick back, will cause the spherical chamber to "nose up," and pushing it forward will cause it to rotate downwardly or "dive," using said terms relatively. Moving said stick left and right will produce rotation of the cradle member about the axis *z*—*z*. Moving said stick towards the left will cause the cradle to "roll" left, as with the left wing down in an airplane, while moving the stick towards the right will cause the cradle to "roll" right. The depressing of foot pedals 30 causes the spherical chamber to swing left and right about said axis *x*—*x*. Depression of the left pedal will cause the chamber to rotate towards the gunner's left, and depression of the right pedal will cause said chamber to rotate about said axis *x*—*x* towards the right.

The electrical connections are diagrammatically illustrated with relation to the members and driving connections in Fig. 3. The stick control 29 is shown twice in said diagram; the left-hand view thereof is shown as looking forwardly at it, to illustrate the manner in which it is moved from left to right, while the stick control shown at the right is arranged to illustrate its movement fore and aft. Considering it first in connection with its lateral motion, it is to be noted that a downwardly projecting finger 33 extends in alinement with said stick and is adapted to move onto and have electrical connection with two spaced rheostats 34 or 34*a*. Engagement of the finger 33 with rheostat 34 will produce rotation of the cradle in one direction, and engagement with the rheostat 34*a* will produce opposite rotation. It is to be noted that said rheostats, while initially engaged by the finger, interpose the greatest resistance to the flow of electrical energy from the battery or other source of power 35. It is to be noted that a battery is diagrammatically illustrated, but it is common practice to provide high voltage generators on aircraft, and said generators are driven by the engines of said airplane, but a diagram of a battery is used to illustrate any source of power. Thus, when said finger first engages the rheostat only a relatively small amount of power is transmitted to the motors, all of which are of the variable speed type. Thus, said motors rotate relatively slowly to produce a correspondingly small angular movement of the member driven. Greater deflection of the stick or of the rudder controls, which operate similarly, produces a greater overlap upon the rheostats, and correspondingly cut out a greater amount of the resistance. This permits a greater flow of electrical energy to the motor affected, with a correspondingly greater speed of rotation of said motor and corresponding increase in angular movement of the member driven thereby. Movement of said stick control 29 towards the left will cause the finger 33 to ride progressively over the rheostat 34*a*, as it is displaced from vertical which is normal, and movement to the right will cause a corresponding movement over and engagement with the rheostat 34, and the actuation of the motor 22 for the cradle 12 thru electrical connections 38.

The movement of the stick control 29 forward and aft, as shown in the right-hand picture of said stick control, will cause corresponding movement and override over the rheostats 36—36*a*, which the finger 37 engages. It is to be understood that the finger 37 is separate from the finger 33, as is illustrated in Fig. 5, and is engaged by two inwardly projecting lugs 33*a* upon said finger 33, which engage the finger 37 to actuate it. The rheostats 36—36*a* are in the electrical connections 40 for the motor 20, which is adapted to rock the annular member 9 about the axis of rotation *y*—*y*. The pedal controls 30—30*a* engage rheostats 39—39*a* for the base motor 17, which rotates the base member or yoke 5 about the axis of rotation *x*—*x*.

Limit switches 41—42 are arranged in electrical connections 40 to limit the degree to which the spherical chamber 8 can be rotated about the horizontal axis *y*—*y*, considered when the plane is flying upright. In Fig. 1, broken lines indicate the range of fire of the two guns 43 which are arranged alongside each other and extend thru the walls of said spherical chamber, and indicate correspondingly the degree to which said spherical chamber 8 can be rotated about said horizontal axis *y*—*y*. Said limit switches 41 and 42 are arranged above and below, respectively, the muzzles 43*a* of said guns, as is shown in Fig. 4. Limit switches 44 and 45 are shown in the electrical connections 38 for the base motor 17, and said limit switches lie to the left and to the right of said muzzles, respectively, as is indicated in Fig. 4. The angular movement of said guns, and correspondingly, the angular movement of said spherical chamber, is indicated in dotted lines in Figs. 1 and 2. It is thus apparent that the said spherical chamber can rotate slightly greater than 180° vertically, and approximately 230° laterally, to produce a correspondingly wide angle of fire from said guns.

The guns 43 are carried by a gun mounting 46, fixed to the cradle member 12 in front of the gunner's seat 28. A rear sight 47 and a front or bead sight 47*a* are arranged directly in front of the gunner, while seated. Said sights are carried by a beam 47*b* in the usual manner, and are adjustable thereon to be arranged conveniently for said gunner. Said arrangement of the gun and of the said sights is intended to correspond substantially to the arrangement of machine guns in a pursuit plane, and the relation of said sights to the gunner's position corresponds to the position of said guns with respect to a pursuit pilot, when seated. The position of the controls likewise is similar to those adjacent the pilot's station. In my invention, however, the gunner, although operating said

controls, is not concerned with the position of the plane, but merely "flys the sights," but said controls operate similarly to the operating controls of a pursuit plane.

A main control switch **48** is provided for the entire electrical control connections for said compartment, and said switch can be arranged either inside or out of the spherical chamber, but I deem it preferable that it be arranged outside of the chamber so that when the gunner has climbed out of said chamber, the electrical connections can be fully disconnected to render the operating devices ineffectual. I have shown the guns **43** as machine guns, and show the operating handles **43***b* thereof arranged facing and adjacent the gunner's seat **28**. Thus, if either or both of said guns should jam, said handles can be pulled to clear the guns. Inasmuch as it is necessary only to operate the stick control with one hand, it leaves the other hand free to clear said guns by pulling said operating handles which are arranged immediately in front of the gunner, and thus convenient thereto. Said guns can be fired by a control cable **49** for each gun, which can be pulled by a gripping toggle **50** for each gun, arranged adjacent the top of the stick control **29**. Two of said toggle grips are shown in Fig. 6, and if but one gun is to be fired, one of said gripping toggles can be swung downwardly about its pivot **51** so as to be out of operation.

The guns extend thru the bore of trunnion **16** which is of relatively large diameter. Inasmuch as said trunnion is a part of and fixed to the cradle member **12**, said trunnion moves therewith. Thus, the bore of said trunnion, except that part occupied by the barrels of a machine gun, can be closed by a relatively thick transparent window **52**. This closes off the bore of said trunnion and permits the chamber to be wholly enclosed.

It is desirable that the chamber in which the gunner is seated be made relatively airtight so that the air streaming past the exterior of said spherical chamber will not flow into said chamber. It is not necessary that it be completely airtight because it is common practice for airplane pilots, and other men engaged aboard aircraft, to have an auxiliary oxygen supply for use at high altitudes. Towards this end, I provide one or more tanks of oxygen **53** which may be carried beneath the platform **26**, but upon the cradle member so as to move therewith, and provide oxygen breathing apparatus which can supply oxygen from said tanks to the machine gunner while seated in said spherical chamber. Thus, slight leaks in the walls of said chamber are inconsequential, and as a matter of fact, are desirable to permit the expelled air to leak out of said chamber and fresh air to be supplied therefor. It is intended, however, that the door member **25** of the spherical chamber fit relatively tightly upon its guides so that to all intents and purposes the chamber is sealed when said door is slid back in place.

When I use the terms horizontal, vertical, lateral and longitudinal, I use these terms with regard to the original positions of the parts as they are arranged as shown in Fig. 1. I appreciate that said spherical chamber rotates about the two axes noted; and sometimes the axis *x*—*x*, which I refer to as the vertical axis, might be arranged horizontally, as when the airplane carrying said gun mount is lying on one side. A corresponding change would thus be made in the other axes. The axis *z*—*z* could be arranged laterally instead of longitudinally, as when the guns are shooting sidewise, and thus said positions are only descriptive of the arrangement of the parts when they are positioned as shown in Fig. 1.

I appreciate that if the supply of electrical energy should be interrupted for any reason while the gunner is in said spherical compartment, that the worm and worm gear connections between the driving parts would prevent the door **25** for the compartment being moved into alinement with the door **4** for the bulkhead. I have not shown clutches or other disengaging devices for permitting said spherical compartment to swing free upon its axes to permit the gunner to leave or enter the compartment, because said devices would readily suggest themselves to persons skilled in the art, and play no part in my invention.

When I use the term "gunner's station" I refer to the structure defining the place occupied by a gunner while aiming and firing the guns. This might be a seat as shown or it might be a structure defining a location where said gunner might stand, kneel, or recline. Therefore, the term "gunner's station" defines the place regularly occupied by the gunner while performing his regular duty of aiming and firing a gun. Likewise the pilot's station is the place, seat or otherwise about which the airplane controls are located for guiding the flight of said airplane. This station is normally arranged in a cockpit or cabin.

I claim:

1. In an airplane having a gunner's station mounted for rotation in said airplane, a gun and a mount therefor alined and rotatable with and fixed to said gunner's station and means for selectively rotating said station, gun and mount together and to a like degree in said airplane about any of three axes of rotation each axis being arranged normal to the other two axes.

2. In an airplane having a gunner's station mounted for rotation in said airplane, a gun and a mount therefor alined and rotatable with and fixed to said gunner's station, means for selectively rotating said station, gun and mount together and to a like degree in said airplane about any of three axes of rotation each axis being arranged normal to the other two axes, and operating controls for said means operatively arranged adjacent said station, and operable therefrom.

3. In an airplane having a gunner's station mounted for rotation in said airplane, a gun and a mount therefor alined and rotatable with and fixed to said gunner's station, means for selectively rotating said station, gun and mount together and to a like degree in said airplane about any of three axes of rotation each axis being arranged normal to the other two axes, and operating controls for said means operatively arranged adjacent said station, operable therefrom and carried thereby.

4. In aircraft, a gunner's compartment formed by a transparent spherical wall element, a bifurcated base member therefor, rotatably mounted in said aircraft, an annular member pivotally mounted between the bifurcations of said base member upon an axis normal to the axis of rotation of said base member, said annular mem-

ber carrying said transparent wall element, and a member carrying a gunner's seat and a gun mounted in alined relation thereto, said latter member being housed within said wall element and being journalled in said annular member upon an axis normal to the axes of rotation of said other two members.

5. In aircraft, a gunner's compartment formed by a transparent spherical wall element, a bifurcated base member therefor, rotatably mounted in said aircraft, an annular member pivotally mounted between the bifurcations of said base member upon an axis normal to the axis of rotation of said base member, said annular member carrying said transparent wall element, and a member carrying a gunner's seat and a gun mounted in alined relation thereto, said latter member being housed within said wall element and being journalled in said annular member upon an axis normal to the axes of rotation of said other two members, said gun being directed outwardly from said compartment thru the journal connection of said last mentioned member and the annular member.

6. In aircraft, a gunner's compartment formed by a transparent spherical wall element, a bifurcated base member therefor, rotatably mounted in said aircraft, an annular member pivotally mounted between the bifurcations of said base member upon an axis normal to the axis of rotation of said base member, said annular member carrying said transparent wall element, a member carrying a gunner's seat and a gun mounted in alined relation thereto, said latter member being housed within said wall element and being journalled in said annular member upon an axis normal to the axes of rotation of said other two members, power driven means for producing relative rotation of said members, and selective controls for energizing said means, said controls being carried by said last mentioned member.

7. In aircraft, a gunner's compartment formed by a transparent spherical wall element, a bifurcated base member therefor, rotatably mounted in said aircraft, an annular member pivotally mounted between the bifurcations of said base member upon an axis normal to the axis of rotation of said base member, said annular member carrying said transparent wall element, a dependent cradle member carrying a gunner's seat and a gun mounted in alined relation thereto, said latter member being housed within said wall element and being journalled in said annular member upon an axis normal to the axes of rotation of said other two members.

8. In aircraft, a gunner's compartment formed by a transparent spherical wall element arranged in the forward portion of the fuselage of said aircraft, a bifurcated base member therefor, rotatably mounted in said aircraft, an annular member pivotally mounted between the bifurcations of said base member upon an axis normal to the axis of rotation of said base member, said annular member carrying said transparent wall element, and a member carrying a gunner's seat and a gun mounted in alined relation thereto, said latter member being housed within said wall element and being journalled in said annular member upon an axis normal to the axes of rotation of said other two members.

9. In aircraft, a gunner's compartment formed by a transparent spherical wall element, a bifurcated base member therefor, rotatably mounted in said aircraft, an annular member pivotally mounted between the bifurcations of said base member upon an axis normal to the axis of rotation of said base member, said annular member carrying said transparent wall element, a dependent cradle member carrying a gunner's seat and a gun mounted in alined relation thereto, said latter member being housed within said wall element and being journalled in said annular member upon an axis normal to the axes of rotation of said other two members, said gun being directed outwardly from said compartment thru the journal connection of said last mentioned member and the annular member, power driven means for producing relative rotation of said members, and selective controls for energizing said means, said controls being carried by said last mentioned member.

10. In aircraft, a gunner's compartment formed by a transparent spherical wall element, a bifurcated base member therefor, rotatably mounted in said aircraft, an annular member pivotally mounted between the bifurcations of said base member upon an axis normal to the axis of rotation of said base member, said annular member carrying said transparent wall element, a dependent cradle member carrying a gunner's seat and a gun mounted in alined relation thereto, said latter member being housed within said wall element and being journalled in said annular member upon an axis normal to the axes of rotation of said other two members, said gun being directed outwardly from said compartment thru the journal connection of said last mentioned member and the annular member, power driven means for producing relative rotation of said members, and selective controls for energizing said means, said controls being carried by said last mentioned member, said control devices being operable to regulate the speed of operation of said means, and said control devices being proportioned and arranged to effect progressively greater speed of operation of said means as said control devices are moved from normal.

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