

May 24, 1932.

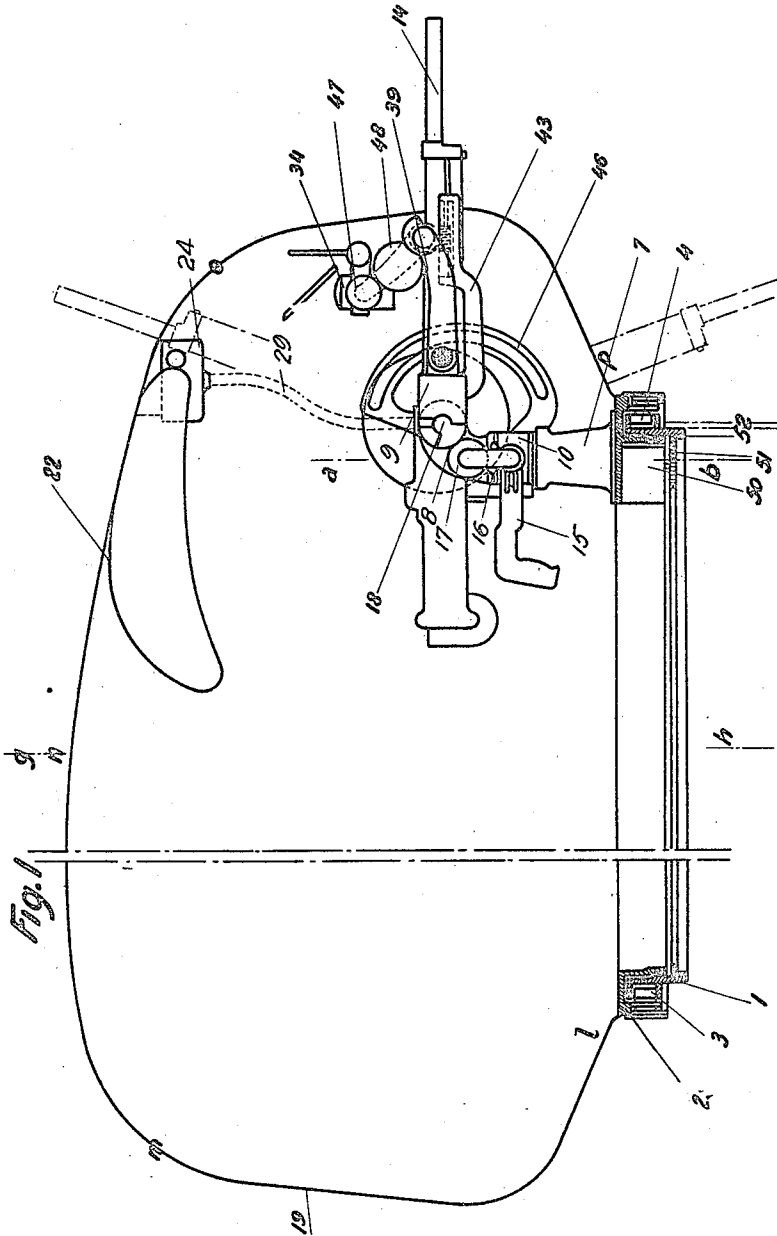
E. GRANAT

1,860,282

EQUILIBRATED TURRET FOR MACHINE GUNS ON BOARD AEROPLANES

Filed April 14, 1931

6 Sheets-Sheet 1



E. Granat
INVENTOR

By: *Mack & Co.*
ATTYS.

May 24, 1932.

E. GRANAT

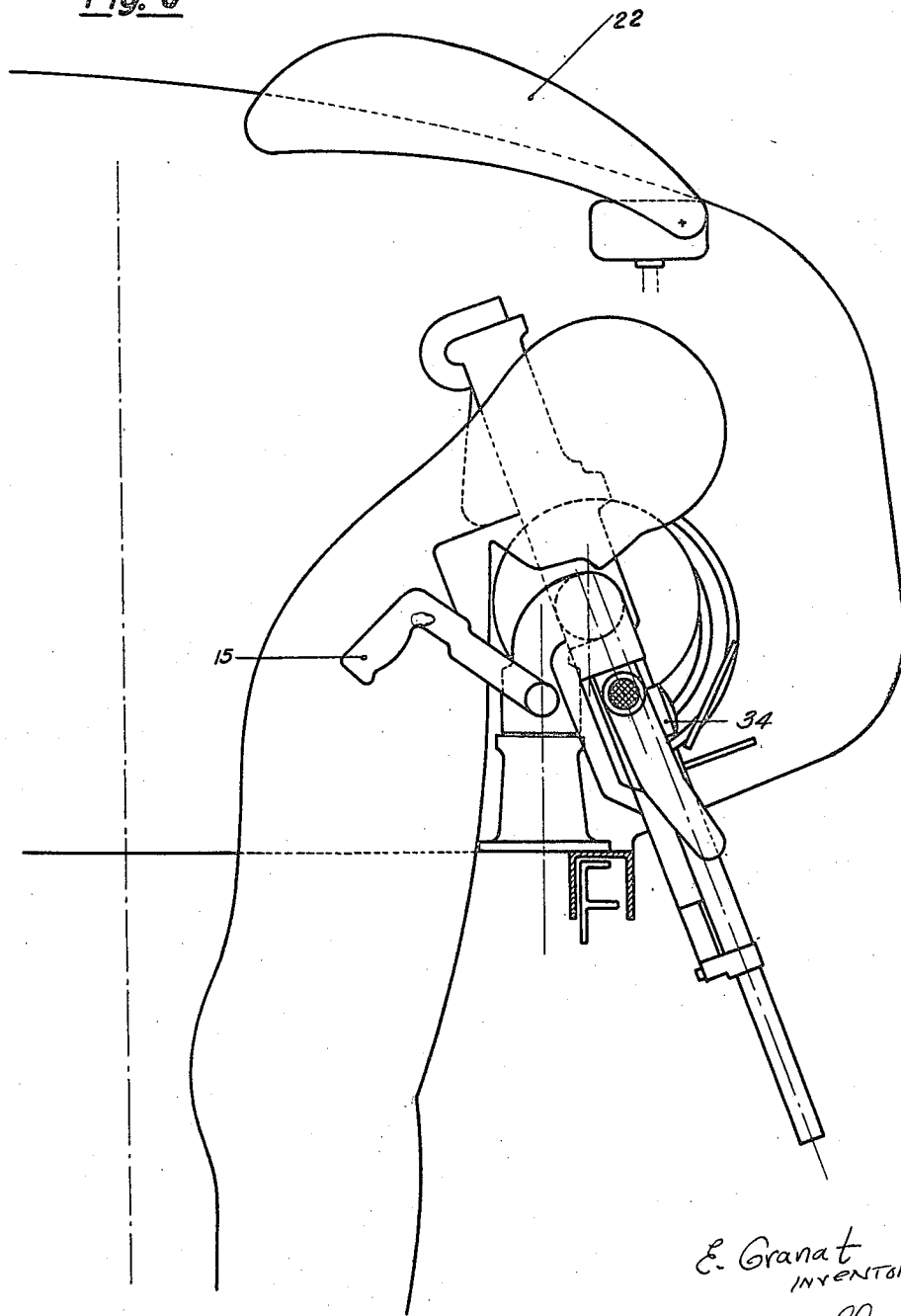
1,860,282

EQUILIBRATED TURRET FOR MACHINE GUNS ON BOARD AEROPLANES

Filed April 14, 1931

6 Sheets-Sheet 4

Fig. 6



E. Granat
INVENTOR

D-y. Mark & Co.
ATTYS.

May 24, 1932.

E. GRANAT

1,860,282

EQUILIBRATED TURRET FOR MACHINE GUNS ON BOARD AEROPLANES

Filed April 14, 1931

6 Sheets-Sheet 5

Fig. 4

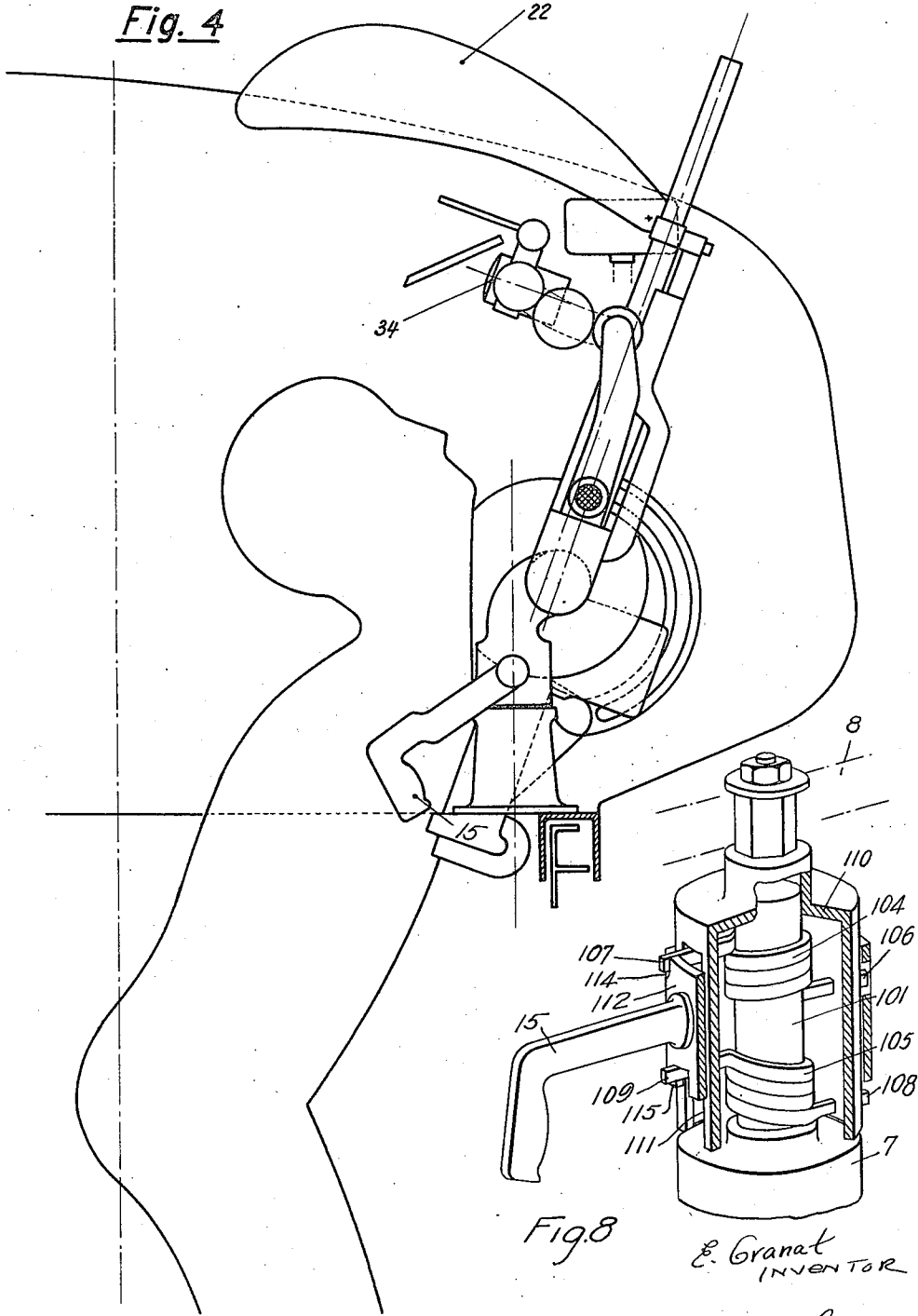


Fig. 8

E. Granat
INVENTOR

By: *Mentel & Co.*
ATTYS.

May 24, 1932.

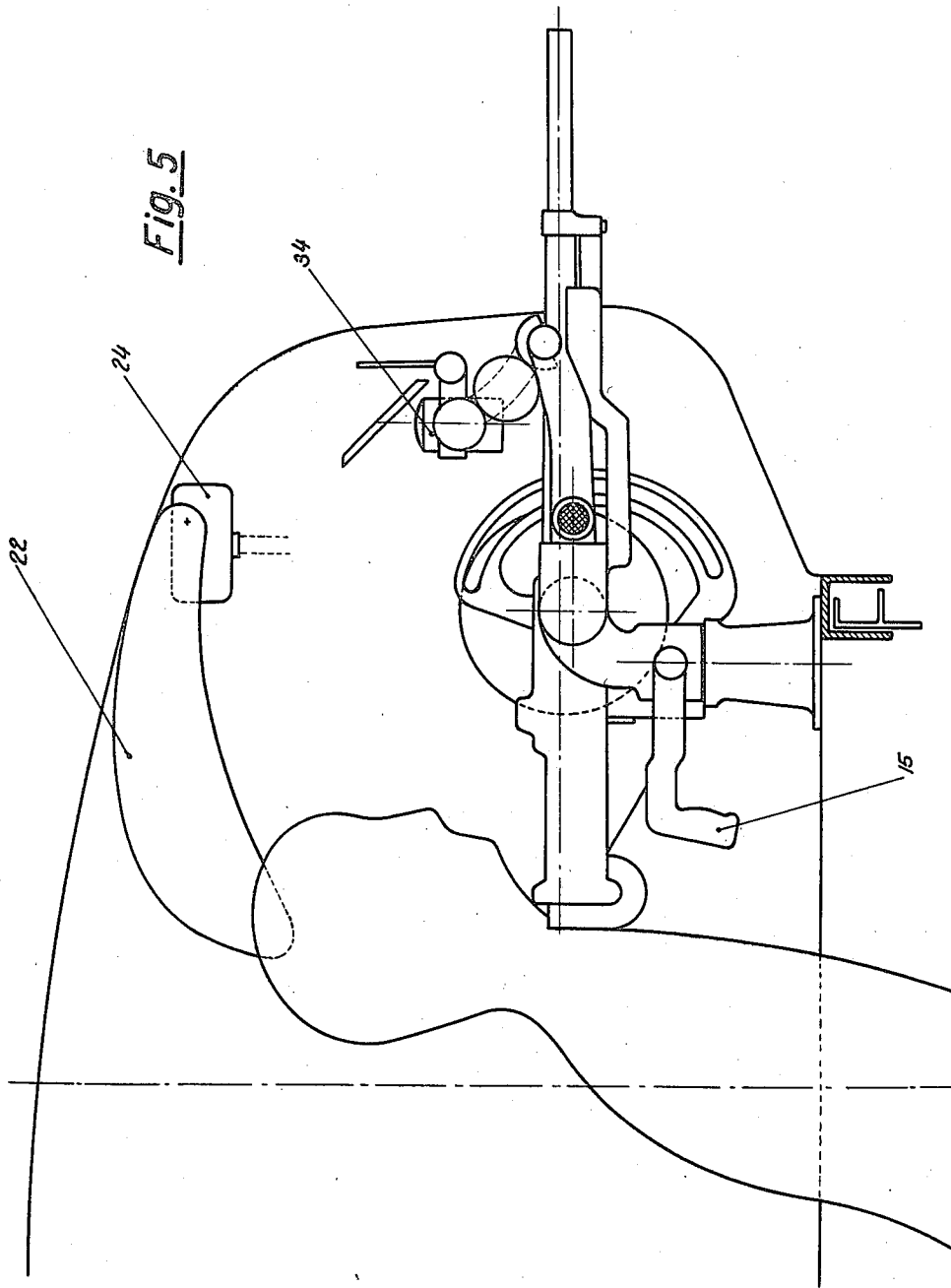
E. GRANAT

1,860,282

EQUILIBRATED TURRET FOR MACHINE GUNS ON BOARD AEROPLANES

Filed April 14, 1931

6 Sheets-Sheet 6



E. Granat
INVENTOR

BY *Mark H. ...*
ATTORNEY

UNITED STATES PATENT OFFICE

ELIE GRANAT, OF PARIS, FRANCE, ASSIGNOR OF ONE-HALF TO COMPAGNIE DES FORGES ET ACIERIES DE LA MARINE ET D'HOMECOURT, OF PARIS, FRANCE, A FRENCH COMPANY

EQUILIBRATED TURRET FOR MACHINE GUNS ON BOARD AEROPLANES

Application filed April 14, 1931, Serial No. 530,043, and in France May 3, 1930.

My invention relates to a turret carrying twin machine guns on board aeroplanes. The turret may rotate integrally for making a first approximate laying; this laying is then finished by moving the machine guns over a special carriage which allows their rotation through a sufficient angle round three axes with a view to aiming as to azimuth and sight and to inclining the plane of the two machine guns for firing along the frame. This carriage supports the reactions due to the firing which dispenses the gunner with the setting of the gun to the shoulder. The turret is covered by a dome of transparent material protecting the gunner against the wind while allowing him to see all round him; it is designed so as to automatically equilibrate the turret whatever the position of the guns may be whereby the gunner may make it rotate easily without having to overcome any resistance caused by the wind.

However when the angle of sight of the machine guns varies, the guns pass more or less out of the dome and consequently the effort exerted on them by the wind varies; this is a cause of lack of equilibrium which is corrected by means of small fins adapted to project more or less out of the dome so as to be acted upon over a more or less great surface by the wind, these fins being controlled by the displacement of the machine guns as to sight.

Lastly it is necessary for the gunner to be able to aim without having to take any uncomfortable positions to obtain this result; the sight glass is mounted therefor on a support carried by two arms which according to the angle of sight of the guns are more or less spaced apart from the machine-guns; this arrangement is such that the optic axis of the sight-glass remains always parallel to the axis of the machine gun with reference to which it takes therefore a movement of simple translation without any rotation. The sight glass is moreover displaced with reference to its support through the agency of suitable correcting devices.

The following description and appended drawings show by way of example a form of execution of the invention.

Figs. 1, 2 and 3 are front, side and plan views of the whole turret.

Figs. 4, 5 and 6 show the positions of the gunner, of the support of the sight glass and of the small equilibrating fins for different angles of sight of the machine guns.

Fig. 7 shows the mechanism carrying the sight glass.

Fig. 8 shows one of the clutches through which the machine gun is secured to its carriage and which is adapted to absorb the reactions of firing.

To the aeroplane is secured a circular support 1 serving as a race for the movable circular part 2 provided with carrier rollers such as 3 and 4 running over the races of the support 1; the movable circular part is centered round the vertical axis gh of the assembly through the rollers 5 rolling over a cylindrical part 6 of the support 1. The stationary circular part 1 carries moreover an annular toothwork 52.

On the platform is mounted the carriage 7 of the two twin machine guns; this carriage carries the pivot 8 allowing the laying in azimuth round the axis ab (Fig. 1). This pivot is connected with the carriage 7 through the non-reversible braking clutch of the type disclosed in my French Patent No. 706,287. I have shown this clutch in detail in Fig. 8. It comprises a stationary spindle 101 integral with the support 7 and with reference to which the pivot 8 may be held stationary in any desired angular position. Two springs 104 and 105 wound in opposite direction have their ends 106 and 107, 108 and 109 bent so as to be parallel to a meridian plane. The inner diameter of the springs 104 and 105 is smaller than that of the spindle 101 round which they are secured; consequently a predetermined initial pressure is exerted by these springs on the stationary spindle 101. A casing 110 coaxial with the spindle 101 and rotating freely round it carries the pivot 8 to be held fast and is connected with the stationary spindle 101 through the agency of the springs 104 and 105. To this purpose the ends 106 and 108 of these springs 104 and 105 are assembled without play with the casing 110 while the

opposite ends 107 and 109 pass through an opening 111 in the casing the breadth of which is sufficient to allow the free movement of these ends 107 and 109 in one direction or the other. A collar 112 coaxial with the casing 110 and rotating freely over it may bear through its projections 114 and 115 against the inner side of the ends 107 and 109 of the springs while it leaves the outer sides thereof free. The control handle 15 is radially secured to the collar 112. It will be noticed that the collar 112 has no permanent connection with the springs 104 and 105 and consequently with the controlled pivot 8 and thus the handle 15 is submitted to no other force beyond those which are exerted purposely on it and therefore the reactions of the gun carried by the pivot 8 have no influence on it. If it is desired to move the pivot 8 and the gun, an effort in the direction of the movement to be produced is exerted on the handle 15 rotating with the collar 112; the projection 114 on the collar 112 will transmit to the end 107 of the spring 104, the effort exerted on the handle. The motion thus imparted will have as an effect to slightly unwind the spring 104. This will consequently release the pressure exerted on the stationary axis and bring the end 107 of the spring 104 against the wall of the opening 111 through which the latter passes through the casing 110; the movement of the handle produces then the simultaneous rotation of the spring 104, of the casing 110 and of the pivot 8 carried by it, at the same time as that of the spring 105 which the casing 110 drives through its end 108 and causes to rotate in the direction unwinding it, which relaxes the pressure exerted by it on the stationary spindle 101.

When the effort exerted on the handle ceases, the springs 104 and 105 owing to their initial tension tighten over the stationary spindle and lock again the casing 110 and the pivot 8 integral therewith against motion. This support 8 carries in its turn a strap 9 allowing the laying as to sight round the axis $c d$ (Figs. 2 and 3): this strap is connected with the support 8 through a non-reversible clutch 11 of the same type as the precedent; it carries a shaft 12 to the ends of which are secured the machine guns 13 and 14.

The braking clutches 10—11 are actuated through the handle 15. The laying as to sight is moreover controlled by this handle through the agency of the pinions 16—17—18 which are moreover adapted to give both guns an angular displacement double that of the handle 15 and in the same direction.

It is apparent that the laying as to sight and azimuth, the latter inside the limits allowed by the arrangement of the carriage, are provided through the single handle 15; for the more considerable displacements as to

azimuth, the gunner makes the whole of the carriage and dome carried by the rotary plate 2 rotate over the race 1.

This operation is very easily performed. In normal period the rotary plate 2 is held in position through any braking device controlled by the levers 20 and 21. It is sufficient for releasing the brake that the gunner moves slightly so as to bear with his body against one of these levers; he will then drive easily the whole of the turret without it being necessary for him to remove his hand off the control handle 15 carrying the firing triggers.

If it is necessary to fire very near the aeroplane frame, it may be of interest to render the plane containing the two machine guns substantially parallel to the plane of the planks of the keelson; to this end the shaft 12 may rotate round the axis $e f$ of a crank pin carried by the strap 9 (Fig. 3) which allows a superelevation of one gun with reference to the other. For all the other positions of the guns the shaft 12 is automatically bolted on the crank pin ef . It is thus apparent that the arrangement formed by the two twin machine guns may rotate round the three rectangular axes ab , cd , ef and may consequently take all possible positions between certain limits. On the other hand, the carriage receives the reactions caused by the firing; the gunner does not need to press the gun against the shoulder; all his work is limited to directing the machine guns on to the target which he does by acting on the handle 15 and if required on the turret while he brings the image of the target on the crossing of the hair-cross in a collimator or sight glass the manner of mounting which will be described hereinafter.

The dome 19 of the turret is of transparent material preferably an artificial mouldable product mounted in a metal frame; it is possible moreover to provide a certain independence of the dome with reference to the plate 2 whereby the apertures through which the machine guns pass may be made narrower.

The turret is symmetrical with reference to a plane passing through its axis gh and through that of the carriage; under these conditions the effort of the wind is equilibrated when the turret fires along the axis of the aeroplane.

On the other hand, the shape of the dome is determined in a manner such that when the firing is made perpendicularly to the axis of the aeroplane the part $lmnh$ of the dome (Fig. 1) disposed to one side of the axis gh is submitted by the wind to the same stresses as the half-dome $n o p h$ and the part of the guns passing out of the latter; under these conditions, the effort of the wind is equilibrated for the two extreme positions of the turret (firing parallel or perpendicular to the axis of the aeroplane) and experience shows

that for the intermediary positions the lack of equilibrium is small enough to be completely neglected.

5 However, according to the angle of sight under which the firing is effected, the part of the guns passing out of the dome is more or less considerable and consequently offers the wind a more or less considerable surface. This would have as a consequence a lack of
10 equilibrium of the turret for the guns in an elevated position in case the dome were designed to provide equilibrium with horizontal machine guns. To remove this drawback, the dome carries two small similar fins 21 and 23 similarly placed with reference to its plane of symmetry and projecting more or less out of the turret according to the angle of sight of the machine-guns. It is thus possible to restore equilibrium, the increase of the effort of the wind on the guns projecting more out of the dome being compensated by a reduction of its effort on the small fins which pass inside the dome by a suitable amount.

25 To obtain the control of the small fins 21, 22 through the angle of sight of the machine guns, each of these small fins, fin 21 for instance, is controlled by a cam 23 carried by a mechanism 24, the elevational movement of
30 the guns being transmitted to this mechanism through the pinions 25 and 26 contained in the casing 28 and by the yielding connection 29. The movement of the cam is transmitted through the pinions 31 and 32 to
35 the axis 33 carrying the fin 21.

It is important for a proper control of the firing that the firer may always aim comfortably without having to take uncomfortable positions; for this it is necessary to remove the collimator or sight glass more or less away from the guns according to the angle of sight of the latter.

45 Figs. 4, 5 and 6 show the position of the gunner aiming upwardly, horizontally and downwardly.

Inspection of these figures shows the collimator 34 is very near the guns when the gunner aims downwardly (Fig. 6), that it is on the contrary very far from them when he aims upwardly and that it occupies an intermediary position when he aims horizontally.

50 To achieve this result, the collimator 34 is mounted on a support shown in detail in Fig. 7; this support comprises two arms 35 and 36 secured to a shaft 37 carrying a pinion 38. The shaft 37 is supported by the arms 39 and 41 rigid with the axis 12 of the machine
30 guns.

The pinion 38 meshes with a cylindrical rack 42 adapted to move in a frame 43. The rack is integral with an arm 44 the end of which carries a pin 45 engaging a suitably-shaped groove 46 provided in a stationary

plate 40 carried by the carriage 8. The frame 43 is rigid with the strap 9.

The working is easy to understand. If the angle of sight of the machine guns varies, the angle of the frame 43 with the horizontal varies; in this movement the arm 44 guided
70 by the pin 45 moves along its own direction; the rack 42 moves also and makes the pinion 38 rotate and therewith the arms 35 and 36, moving thus the collimator more or less away
75 from the guns.

In order that the direction of the optic axis of the collimator may remain, the corrections not being taken into account, parallel to the line of sight of the machine guns, the support of the collimator 34 may rotate between
80 the arms 35 and 36; it is carried by a shaft secured to a toothed wheel 47 meshing with a wheel 48 carried by an arm 35, said wheel 48 meshing itself with a wheel 49 stationary
85 with reference to the arm 39, the wheels 47 and 49 being of the same diameter. It is apparent that in this case the collimator is submitted with reference to the machine guns to an actual movement of translation and that a shaft considered as invariably bound to it and parallel at one moment to the axis of the machine guns, will retain at any moment this parallelism. The circular shape of the rack allows the superelevation of the guns, the parallelism of the axes being maintained whatever the inclination of the plane of the machine guns round the axis *ef* may be.

An automatic firing corrector 50 records on one hand the inclination of the guns as to sight, which is transmitted to it through a yielding connection, on the other hand the azimuth angle of laying of the guns. This latter displacement is transmitted to it through a set of gears actuated by the supporting pivot and by the pinion 51 moving inside the stationary circular part 52. It transmits to the collimator through yielding connections, an inclination as to sight and azimuth such that the optic axis of aiming is parallel to the resultant of the component speeds of the aeroplane and bullet.

What I claim is:

1. A machine gun system chiefly for use on aeroplanes comprising a circular rotary platform, a set of parallel machine guns, a carriage therefor, a pivot perpendicular to the platform, a non-reversible braked clutch connecting the pivot with the carriage, a second pivot normally parallel to the platform, a second nonreversible braked clutch connecting the two pivots, and means wherethrough the guns are secured to the second pivot.

2. In a system as claimed in claim 1 the combination of a sight glass, a support therefor, two connecting links pivotally carrying the support, a third pivot parallel to the second pivot and integral therewith for the free end of said links, a cylindrical rack adapted to move round the second pivot, a plate se-
130

5 cured to the second pivot and provided with a suitably shaped slot controlling the longitudinal position of the rack with reference to the second pivot, means whereby the rack controls the angular position of the connecting links round the third pivot and a gear work keeping the support of the sight glass parallel to its original position during the angular movement of the connecting links.

10 3. In a system as claimed in claim 1 the combination of a sight glass, a support therefor, two connecting links pivotally carrying the support, a third pivot parallel to the second pivot and integral therewith for the free end of said links, a cylindrical rack adapted to move round the second pivot, a plate secured to the second pivot and provided with a suitably shaped slot controlling the longitudinal position of the rack with reference to the second pivot, means whereby the rack controls the angular position of the connecting links round the third pivot, a gear work keeping the support of the sight glass parallel to its original position during the angular movement of the connecting links, a fire corrector, means for transmitting thereto the azimuth and elevation of the guns and means whereby said corrector deflects the sight glass through an angle such that the optic axis thereof is parallel to the resultant of the speeds of the aircraft and bullet.

25 4. In a system as claimed in claim 1 the combination of a dome of transparent material covering the platform, symmetrical with reference to the vertical plane of symmetry of the set of guns and to a plane perpendicular thereto and provided with apertures for the passage of the chase of the guns, a series of fins pivotally secured to the dome at points symmetrical with reference to the vertical plane of symmetry of the guns and adapted to project to a varying extent out of the dome according to their angular position, a cam controlling the angular position of the pivoting fins and a gearwork controlled by the elevational movement of the guns and controlling the cam.

In testimony whereof I affix my signature.

30 ELIE GRANAT.

35

40

45

50