Jan. 5, 1943. J. F. HABERLIN 2,307,582

GUN MOUNT

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Fig. 1

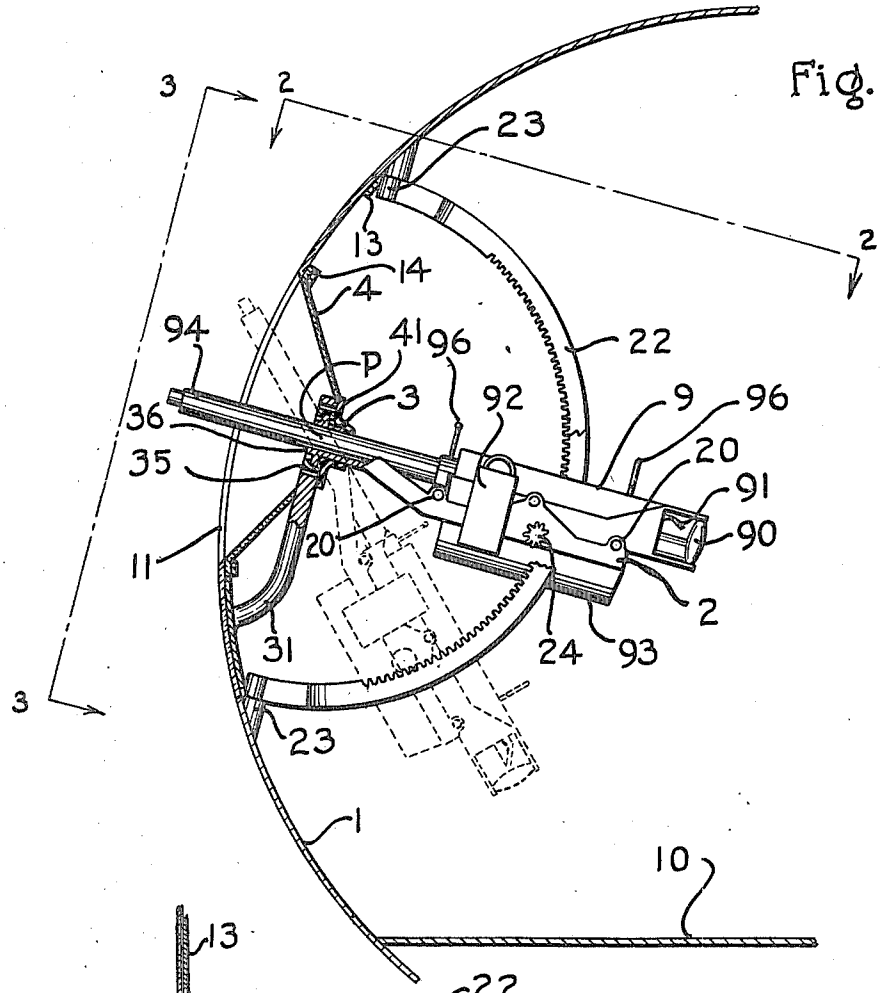
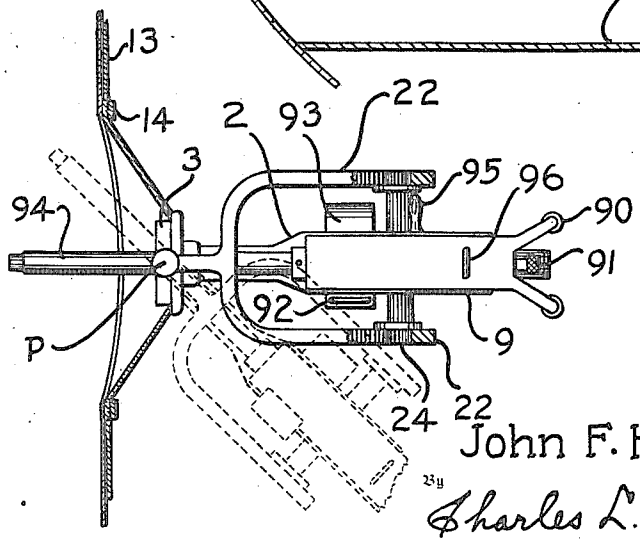


Fig. 2



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GUN MOUNT

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Fig. 3

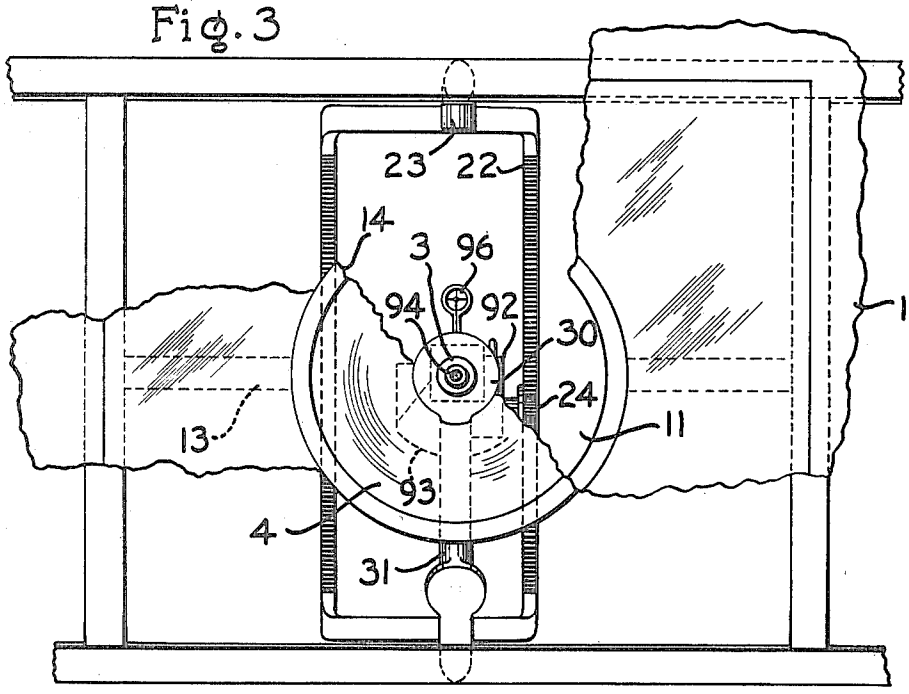


Fig. 9

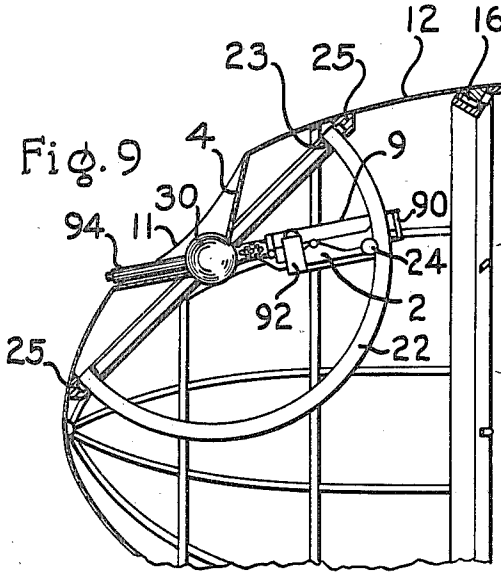
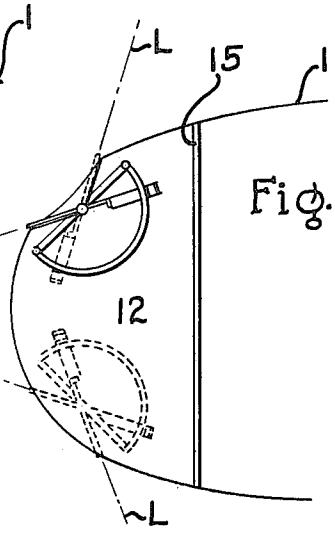


Fig. 10



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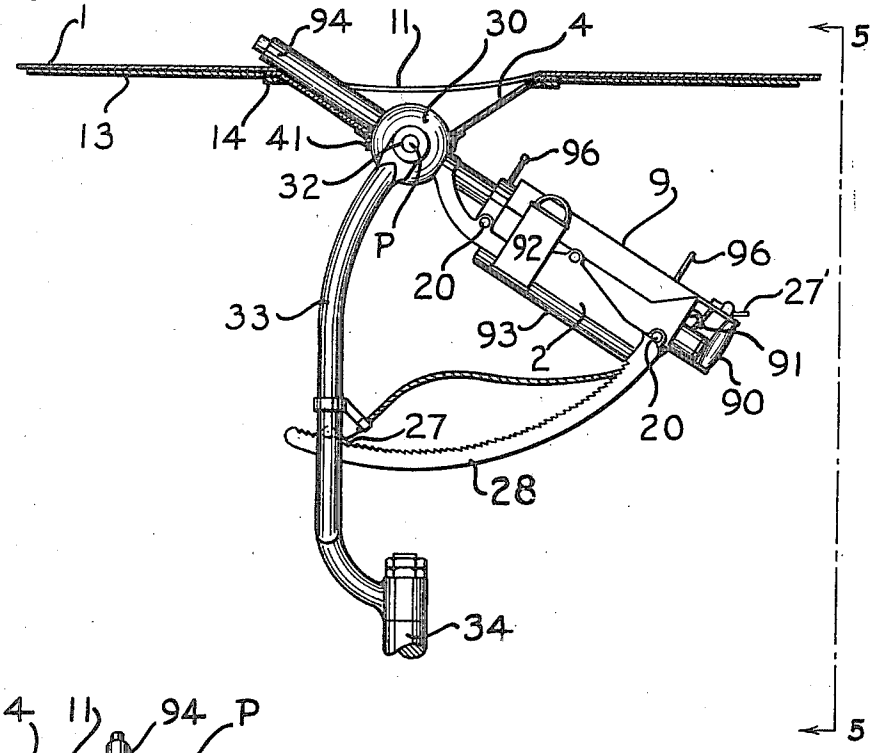
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GUN MOUNT

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Fig. 4



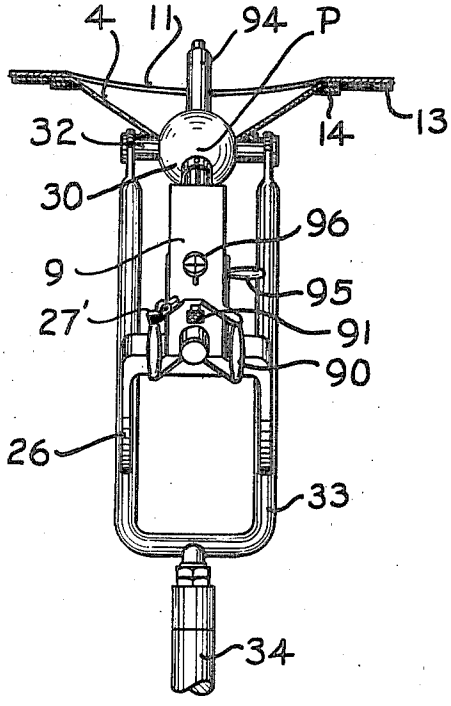


Fig. 5

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GUN MOUNT

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Fig. 6

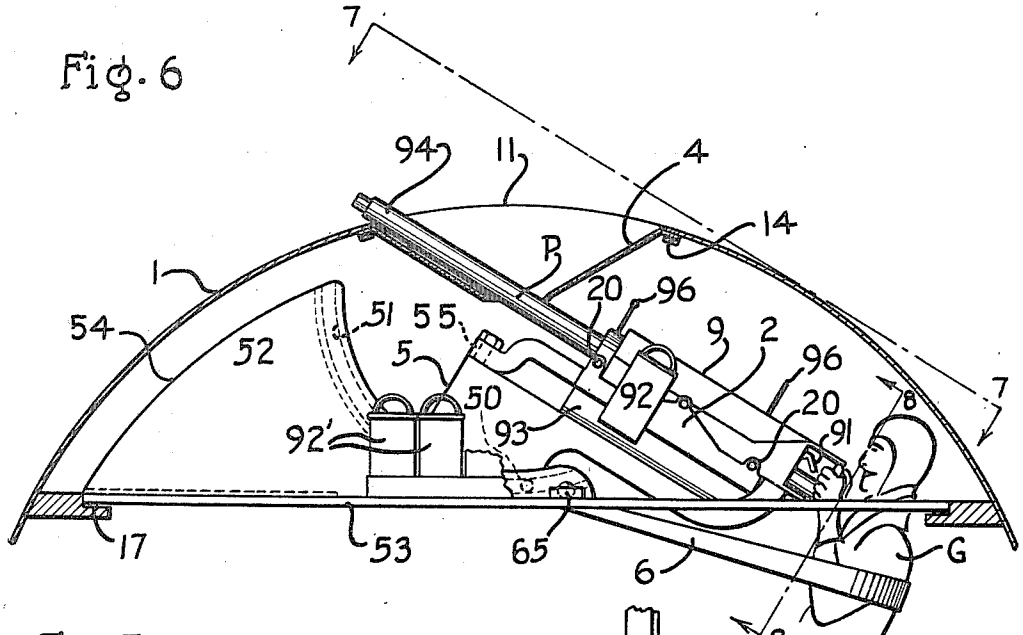
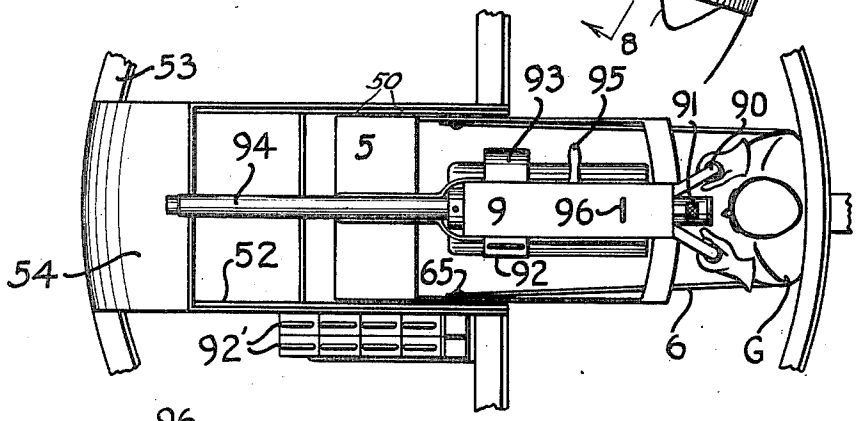


Fig. 7



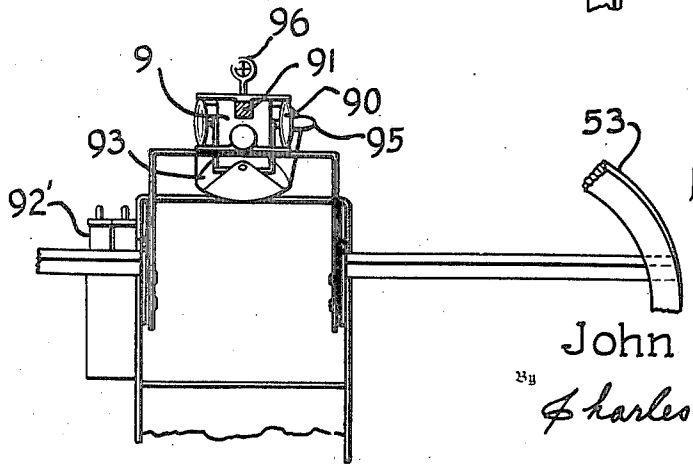


Fig. 8

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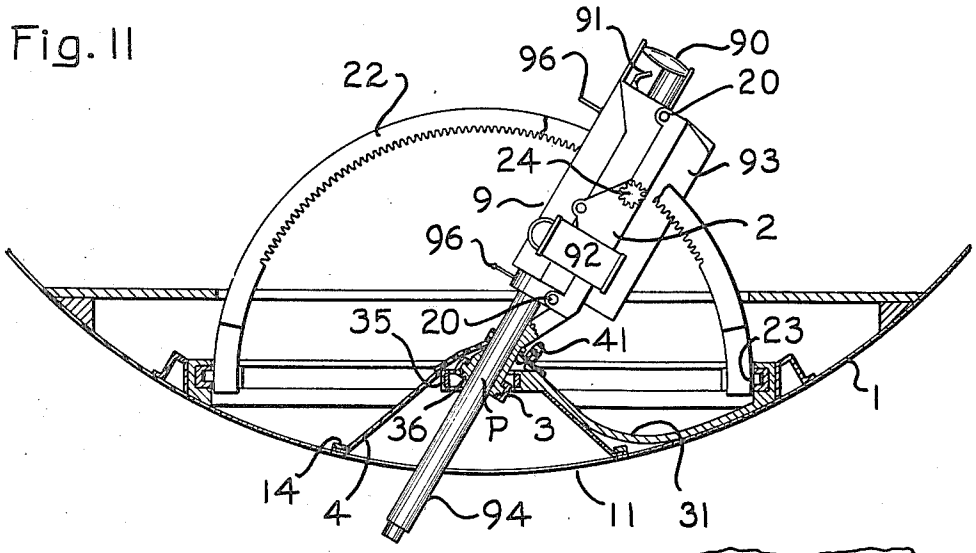
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GUN MOUNT

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Fig. 11



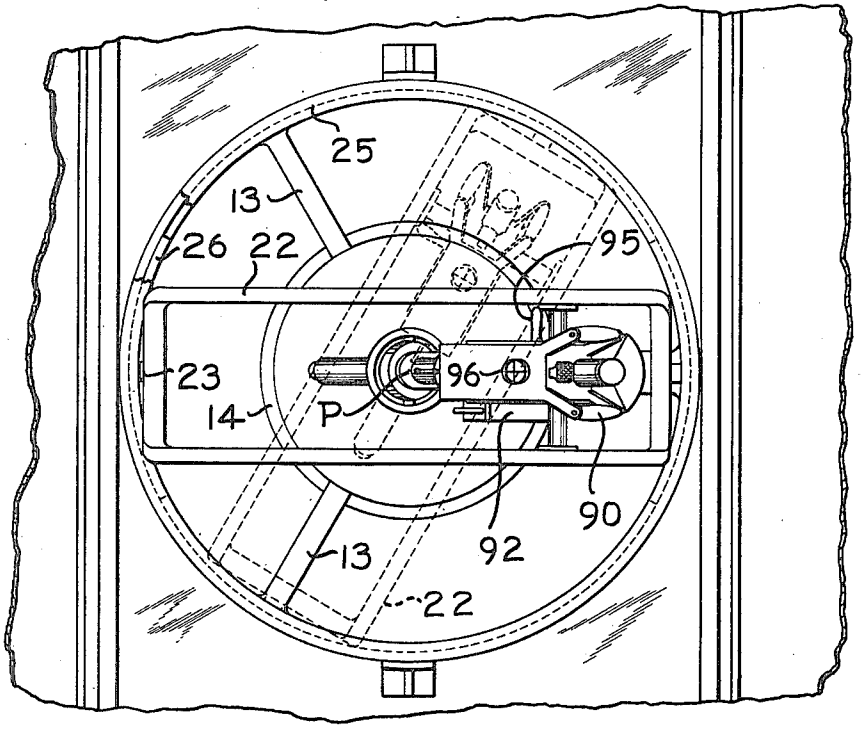


Fig. 12

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UNITED STATES PATENT OFFICE

2,307,582

GUN MOUNT

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Application April 3, 1939, Serial No. 265,622

10 Claims. (Cl. 89—37.5)

The present invention deals with gun mounts for aircraft. Such gun mounts as have been used widely, and considered as the most practical, heretofore, have been, for instance, of the types shown in the patent to Sanders No. 2,113,143, issued April 5, 1938, which illustrates principally nose mounted guns, and in the patent to Wells No. 2,044,036, issued June 16, 1936, which discloses side mounted guns.

Such prior gun mounts have been characterized by mounting the gun in such manner that it may swing in one plane, or tilt universally, about a center which—to give a proper angle or cone of fire to the gun—it was considered must be located approximately in the general surface defined by the skin of the immediately adjoining aircraft structure. Naturally, the skin must have an opening for protrusion of the gun; since the gun and its accessories are bulky adjacent its center of gravity, in the vicinity of which such center of tilting or rotation has been located, and since clearance must be had for swinging the gun, such openings had to be fairly large. They could not well be left wholly open to the air blast resulting from the relative wind created by the high speeds of such aircraft, and hence the guns, and their ammunition containers, case-and-link receivers, and mounts, have been surrounded (the gun in part at least) by a globular or blister-like shell, which of necessity had to protrude from the aircraft structure and into the relative air stream, and which had to be of circular cross-section normal to their axis of swing. Such protruding spheres or blisters, however well they might be faired in, still constituted a source of drag. To keep this drag to a minimum, the enclosures were kept as small in size as possible, yet the smaller were the enclosures, the greater was the extent of protrusion of the gun barrel. The protrusion of the gun's muzzle is in itself a serious matter (particularly with large caliber guns, such as .50 caliber), not only because of the drag thus created, but because of the loads thus imposed by wind action on the gun's handles, impeding easy and quick laying of the gun, its ready maneuverability in action, and greatly fatiguing the gunner. It appeared, however, that to make the protruding gun enclosure larger, in order to lessen the amount of projection of the gun barrel and to lessen the wind loads on the gun, merely increased the total drag caused by the protuberance, yet to lessen the size of the enclosure merely left the gun barrel the more greatly exposed to the wind, and hence even more difficult to handle, and only changed the source of drag from the enclosure to the gun itself, without materially, if at all, lessening the total amount.

In airplanes of a type where the last mile or two per hour added to the top speed may be the difference between successfully escaping after carrying out its mission or being shot down, anything which increases the drag is serious, and something to be eliminated if possible. Efforts have been made heretofore to eliminate such drag, for instance by mounting a shield upon the barrel of the gun, movable therewith with respect to an opening through which the gun's muzzle protrudes, as shown, for example, in patent to Anderson, No. 1,387,678, but this was still defective in that in all except one position of the gun there was likely to be lack of coincidence between the shield and the margin of the opening, so that a large unprotected opening was left in such other positions for entrance of the relative wind. Again, in the patent to Sanders, No. 2,105,055, issued January 11, 1938, it was attempted to remove the drag of side blisters, for instance, by retracting the same wholly within the aircraft structure and restoring the smooth continuity of the skin of the latter by a door, which was to be placed in the opening alternatively with the blister, but this was subject to the drawback that the gun was not available for use when needed, and it was not an easy task, under pressure and wind conditions, and under the stress of actual or impending combat, to place the gun again in condition for use, nor, indeed, to withdraw it and to restore the door to its place. Likewise, it was proposed in the Sanders application Serial No. 116,918, filed December 21, 1936, to maintain the smooth continuity of the skin of the aircraft structure, which had the opening in it for the protrusion of the gun, by making the gun shield or immediately surrounding section of the skin movable in part, relative to the adjacent fixed portion of the skin of the aircraft structure. While the latter arrangement approached a desirable solution, the gun's center of tilting was still substantially in the general surface of the skin, and it still left the gun, in all positions, protruding materially from the aircraft structure, with the result that the air pressure on the protruding muzzle of such a gun, especially when turned sidewise to the relative wind, produced such forces acting on the gun that it became extremely difficult for the gunner properly to control and manipulate his gun. Such pressures amount, in some instances, to over 100 pounds at the control handle. Obvi-

ously a gunner cannot perform his work properly and accurately if, while attempting to aim and fire the gun, in the small fraction of time permitted him by the maneuvers of his own plane and of the target, he must combat such forces applied to his gun by the wind stream.

All of such proposals were therefore defective in one way or another to reduce drag, and the forces applicable to the gun, to the desired minimum. They were all objectionable, too, in that each of these arrangements necessitated the leaving open of a slot at least, through which the gun barrel protrudes, which affords an entrance for the relative wind, and therefore which produces or tends to produce a draft of appreciable velocity, sufficient to disturb the gunner, through the gunner's compartment. Such were the disadvantages of this that it has been proposed, as in the Helwig Reissue Patent No. 20,771 of June 21, 1938, to provide a practically hermetically sealed compartment or bulkhead immediately to the rear of the gunner's compartment, whereby (it being considered impossible to prevent the entrance of the relative wind) to build up pressure within the gunner's compartment sufficiently to prevent the entrance of additional air, and thereby stopping the blast or movement of air through the gunner's compartment.

Over and above all these factors it is becoming increasingly apparent that airplanes mounting flexible guns must be prepared for combat at upper altitudes, up to, for instance, 25,000 to 30,000 feet. At these altitudes the rarification of the atmosphere is such that human beings cannot operate effectively without either oxygen helmets, which restrict their freedom of action and agility, or the maintenance of elevated pressure within the cabins or compartments wherein such human beings are contained. Accordingly it is desirable to provide means whereby the gunner compartments of such aircraft may be supercharged, but with each compartment of the type referred to above, either because of the provision of apertures, of slits, or because of the necessary movement of the gun shield relative to the skin of the aircraft structure, or both, it was rendered difficult, if not impossible, to effect a pressure-tight seal about the gum, and yet to afford the gun sufficient flexibility of movement to accomplish proper protection of the aircraft. An improvement in the ability to seal the cabin might be produced by the employment of a mount of the general type shown in the patent to D'Eyncourt et. al., No. 1,488,746, issued April 1, 1924, but here again the center of swing is substantially in the surface of the skin, through which the gun protrudes, which is not objectionable in a relatively slowly moving tank or armored car, such as the D'Eyncourt mount is intended for, but it would permit so large a part of the muzzle of the gun to protrude through the aircraft skin, were it to be used in an aircraft gun mount, that it would still be subject to the objection pointed out above, namely, the creation of large forces by air resistance acting upon the protruding muzzle of the gun.

The problem is, therefore, twofold—to provide a mounting which will permit the muzzle of the gun to protrude by the least amount practicable, if at all, outside of the general surface of the skin in any position of the gun, and to provide such a mount which can be at need sealed adequately against interchange of pressure between the exterior and the interior, whether that exchange of pressure results from the pressure of the relative wind tending to enter or the interior supercharged pressure tending to escape. It is to the solution of such problems that my present invention is directed.

It is therefore one of the principal objects of my invention to provide a gun mount especially designed for aircraft use, which is so designed and constructed that the muzzle of the gun need project but little, if at all, outside the general surface of the skin of the aircraft structure, and by a type of mounting which will permit the sealing of the mounting, and the complete closure about the gun, without affecting the flexibility and handling characteristics of the latter, yet sufficiently to prevent interchange of pressure between the exterior and the interior.

It is furthermore an object to provide such a mount as that described in general terms above, which may be incorporated in a nose mount, or in a side mount (and, of course, in a tail mount), and which in either position will reduce drag to the minimum, to the point where, practically speaking, it cannot be observed that there is any difference with the gun so mounted or without any such gun and mount.

It is a further object to provide such a gun mount which may be incorporated in a nose turret of the general type disclosed in the Sanders Patent No. 2,113,143.

It is a further object to provide such a gun mount which may be directed laterally at the side of the fuselage or other skin of the aircraft structure, which may be directed through the bottom or through the top of such a skin, the skin lying generally parallel to the relative wind.

It is a further object to provide such a gun mount which shall be simple and rugged in construction and readily handled by the gunner, without distraction from his duties having to do with the training, aiming, firing and ammunition supply for his gun.

Further, with relation to a special type of gun mount intended for firing through the top of an aircraft structure, it is a particular object to provide means whereby the gunner, by the use of his body and of harness connecting him with the gun support, may readily accomplish movement of the gun support and gun by his body, which will provide an ammunition supply readily available at all times and in all positions of the gun and gunner, and in general which is peculiarly adapted to a top installation.

With these and other objects in mind, as will appear hereafter, my invention comprises the novel gun mount and the novel combination thereof with the aircraft structure, all as disclosed in the accompanying drawings, described in this specification, and as will be more particularly defined by the claims which terminate the same.

In the accompanying drawings I have shown the principles of my invention embodied in various representative forms, it being understood that these showings are largely illustrative rather than restrictive, and that various changes may be made in the form, proportion, relative arrangement, and relationship of the parts, relative to each other and to the aircraft structure.

Figure 1 is a transverse section through an aircraft structure, illustrating a gun mounted generally for firing either to the side or to the front, and illustrating in simple form the principles of my invention.

Figure 2 is generally a plan view of the installation of Figure 1, taken from the viewpoint of

the line 2—2 of Figure 1, and Figure 3 is generally a side elevation of the installation of Figure 1, taken from the viewpoint of the line 3—3 of Figure 1.

Figure 4 is an elevation of a gun that may be considered a top mounted gun, illustrating a modification of the mount, and Figure 5 is an elevation of the same taken from the viewpoint indicated by the line 5—5 of Figure 4.

Figure 6 is a transverse section through the aircraft structure, illustrating in elevation a top firing gun, in further modified and presently preferred form, and Figures 7 and 8 are respectively a plan view and breech end elevation of the same, taken substantially from the respective viewpoints illustrated by the lines 7—7 and 8—8 of Figure 6.

Figure 9 is an axial section through the nose portion of a turret mount, illustrating the association of such a gun mount with such a turret rotatable along the longitudinal axis of the fuselage or the like, and Figure 10 is a diagram illustrating the extent of protection afforded by such a combined mount.

Figure 11 is a section, transversely of the fuselage, illustrating the principles of my invention incorporated in a bottom mount, and Figure 12 is a top plan view of the same.

The arrangement shown in Figures 1, 2 and 3 includes a gun, generally indicated by the numeral 9, handled and aimed by hand grips 90 and fired, for instance, by a trigger 91. Ammunition is supplied from a removable container 92, or in any other suitable fashion. The center of gravity of the gun is located in the vicinity of the ammunition container. Spent cases and links are received within a chute and receiver 93. A cocking handle 95 is usually found on the right side of the gun. Such a gun is commonly used and the details of its construction are known to those skilled in the art pertaining thereto.

The aircraft structure illustrated may be taken as the side wall or skin of the fuselage, this skin being illustrated at 1, and structural parts being in the main omitted, since these may be any that are found suitable. In general the skin will be curved, as shown in Figure 1, and of slight thickness. There will normally be a floor or platform 10 for the support of the gunner while operating the gun 9. The skin of this aircraft structure is provided with an opening 11 through which the muzzle of the barrel 94 of the gun protrudes or through which it fires. The skin surrounding this opening may be of transparent material, the better to enable the gunner to pick up a target before it comes into the field of fire of his gun, but this per se is not part of my invention. The opening 11 is normally generally circular, but it may depart from true circular shape, whether by reason of structural limitations or because it is preferred to afford the gun a greater angle of swing in one direction than in another.

The gun is supported generally centrally of the opening 11, and for swinging about a point which preferably lies within the axis of the barrel 94, and preferably also within an axis extended through the center of and normal to the opening 11, but this point about which the gun swings should in all cases be spaced appreciably inwardly from the plane defined by the margin of the opening 11, or from the general surface of the skin surrounding the aperture. Preferably the gun is swingable universally about such a point, which is indicated at P. This point is preferably somewhat outwardly of the center of gravity of the gun, that is, between the gun's center of gravity and its muzzle, so that the major portion, if not all of the gun, is located inside the aircraft structure or the skin 1 from the margin of the opening 11.

Means are provided, preferably disposed wholly within the aircraft structure, for supporting the gun for swinging about the point P, and such means may take any one of a variety of forms. As shown in Figures 1, 2 and 3, the gun is mounted upon a mount 2, having the points of engagement 20, which mount is preferably also connected to a small universal joint 3, through which the gun barrel 94 extends, and which is located to enclose the point P at its center. The universal joint may be a pair of gimbal rings, or a ball within a socket. In Figures 1, 2 and 3, and in Figures 11 and 12, the joint is shown as a pair of gimbal rings 35 and 36. The gun mount 2 extends forwardly, and in this instance is integral with the inner ring 36. The outer ring 35 is pivotally supported from a bracket 31, which is fixed to the aircraft structure. In Figures 4 and 5, and in Figures 9 and 10, the joint is illustrated as a ball 30, formed on a forward extension of the gun mount 2. This ball might be received in an actual supporting socket, or may be in effect supported in or surrounded by a socket.

The inner end of the mount 2 is suitably supported as by a sector or spaced sectors 22, the center of which is the point P, and which sectors are swingable transversely of the gun, but still about an axis which includes the point P, defining a plane always intersecting the plane of the cone apex aperture, by pivot mountings at 23, which are supported from the aircraft structure. Since the breech end of the gun must be positively supported in some fashion, the sectors 22 may be toothed, as shown best in Figures 1 and 11, and a pinion 24 upon the gun mount 2, suitably controlled by means not shown, meshes with the teeth of the sectors 22 and locks the gun in any position to which it is adjusted angularly along the sectors 22. By such means the gun may be elevated or depressed by moving it (in Figure 1) down or up along the sectors 22. In similar fashion it may be traversed by swinging it together with the sectors 22, about the axis defined by the pivot means 23, which, as indicated above, are in alignment with the point P, and therefore swinging movement of the sectors is not affected by the ball and socket mount at 3.

In Figures 11 and 12, which show a bottom or belly gun, the gun's supporting means must include means whereby the gun will not be inverted as it is swung between opposite limits, for inversion of the gun might cause cases to clear improperly, and the gun to become jammed. Accordingly, the transverse pivots 23 are carried in circular segmental shoes 26, guided in a circular track 25 concentric with and parallel to the opening 11, and in a plane including the point P. The track 25 is supported from the aircraft structure. This arrangement permits rotation of the gun bodily about the point P, as is indicated in dash lines in Figure 12, and the gun is always upright.

By spacing the point P inwardly a material distance from the general surface of the skin 1 which surrounds the opening 11, the muzzle 94 is withdrawn into the opening. This reduces somewhat the angle or cone of fire, but by making the opening 11 relatively large in diameter, as compared to the extent of inward withdrawal of the point P, this effect can be lessened, and

a satisfactory cone of fire may still be had. The cone will probably, in most designs, be limited as much by contact of the breech end of the gun with the internal concave surface of the skin, and with other structure, or by lack of space for the gunner's head and body in line behind the gun and its sights 96, as by contact of the muzzle with the periphery of the opening 11. While the influence of such internal space restrictions is increased by lengthwise withdrawal of the gun's center of gravity inwardly, relative to the tilting point P, the lessened extent of the barrel which is exposed to wind loading justifies this. The gun's muzzle is, or may be, so far withdrawn that it does not in some positions (see the dash line position of Figures 1 and 2), or may not in any position, project into the wind stream appreciably, or even at all. By so much is the drag reduced, by the withdrawal inwardly of the gun.

Such arrangements in themselves are of material advantage, even though the opening 11 be not closed in any respect, since the gun is thereby withdrawn to an appreciable extent within and protected from the relative wind by the general surface of the skin of the aircraft surface. However, the protection against air blasts may be increased, and the air blast substantially excluded completely, by providing closure means such as the conical element 4 which extends from the margin of the opening 11 inwardly substantially to the universal joint 3, or to where it would be, if used. This conical closure element 4, which has the margin of the opening 11 as its base, and the apex of which is approximately the point P, is clear of the protruding muzzle of the gun in all positions of the latter, and therefore offers no resistance whatever to the movement of the gun, and being of transparent material, as is preferred, it offers no impediment to the proper sighting of the gun by means of the sights 96. The closure means 4 may be so supported, as by the ring 14 and the spacers 13 (see Figures 3 and 11), that it is sufficiently rigidly held in place, and it may be made tight all about its margin, and about the aperture at its apex, to the end that entrance of wind caused by the air blast or escape of internal pressure may be prevented.

The arrangement has been described as a side mount or as a bottom mount, with the general surface of the aircraft skin surrounding the opening 11 lying in the direction of or parallel to the relative wind, but the construction might equally well be employed in a forwardly directed mount or nose mount. It has been shown as incorporated in a nose mount in Figures 9 and 10. Here the gun and its mount are supported, not directly from the main fuselage 1, but from a shell 12. The fuselage 1 is terminated or truncated at its forward end about a plane which is normal to its longitudinal axis, the terminus of the fuselage being indicated at 15 in Figure 10, and the generally ogival shape of the fuselage is restored, and the forwardly directed aperture in the fuselage left by the truncation at 15 is closed, by the turret 12, which is rotatable about a track 16, the axis whereof corresponds to the longitudinal axis of the fuselage. The opening 11 in the shell 12 is placed between its base and its dome, and since the shell is rotatable, in accordance with the principles disclosed in the Sanders Patent No. 2,113,143, the gun, being universally movable in any position, covers in excess of a complete hemisphere of fire, as is indicated by the dot-dash lines L in Figure 10.

In this instance the gun and its mount are carried upon the shell 12, rather than upon the fuselage 1. The gunner's support is in the fuselage 1, rather than in the shell 12, and since it is preferable to insure proper feeding and clearance of the gun that the gun be kept always upright, the trunnions 23 which support the sectors 22 are mounted in a tilted ring mount or track 25, as described in conjunction with Figures 11 and 12, whereby the sectors 22 may be rotated about the axis of this ring mount 25, as the shell 12 is rotated about the track 16, thereby, in all rotated positions of the shell, maintaining the gun 9 upright.

In this instance the opening 11 faces to the front, and unless a closure means were provided the air would enter this large opening, and would either create pressure within the gunner's compartment, if that were closed to the rear, or would create an air blast sweeping through the interior of the fuselage. By providing the closure 4, however, the air enters the opening, but in such small quantities that its only effect is to build up something of a blanket of compressed air within the cone 4, after which the pressure becomes static. The blanket of compressed air within the cone serves to deflect other air and to restore the smooth streamline or ogival shape of the nose of the fuselage, with the result that there is no measurable decrease in the speed of the aircraft because of the provision of the opening 11. To all intents and purposes the airplane flies with undiminished speed, as though there were no opening, and as though the surface were instead fully streamlined and continuous where the opening 11 is disposed.

The same effect has been observed with relation to the side apertures, such as shown in Figures 1, 2, and 3. While these do not face to the front, and therefore do not serve quite to the same extent as scoops to catch the relative wind, they are open, and might serve to permit entrance of air, or might be conceived of as causing eddy currents that would create drag as the relative air enters the openings and departs therefrom, but it has been found that substantially the same smoothing-out effect takes place; that is to say, the air pressure builds up within the conical closure member 4, and then no appreciable change of pressure takes place. Instead a blanket of compressed air within the conical member 4 serves to restore the smooth streamline continuity of the skin, which thereupon acts as though there were no opening.

A top mount is illustrated in Figures 4 and 5, the gun supporting mechanism being slightly modified. Here the ball 30 is tiltable upon trunnions 32 upon a standard or upright yoke 33, which is supported at the upper end of a vertical post 34, supported from the floor, for rotation about a vertical axis, which axis is arranged to intersect the point P. A quadrant 28 depends below the gun mount 2, and moves through or relative to the yoke 33. It is provided with ratchet teeth, and a ratchet dog 27 is provided on the yoke 33, which engages with the teeth on the quadrant 28 to support the gun mount in any tilted position desired. This dog 27 may be released by suitable means, preferably by means located adjacent the control handles 90, as for instance the thumb piece 27' connected to the dog by a Bowden wire or like distant control mechanism.

In this instance the opening 11 is in the top of the skin of the fuselage 1, and the gun is completely rotatable through 360° about a vertical

axis including the point P, and defined by the post 34, about which the gunner may walk. The gun is likewise tiltable in any rotated position by movement of the quadrant 28 relative to the dog 27 or to the yoke 33, so that by a combination of such tilting movement and rotary movement the gun is universally swingable about the point P, and its angle of movement is limited only by the contact of the muzzle 94 with the margin of the opening 11, or by contact of the control handles 90 or the interference with the gunner in some swung position, due to the transverse curvature of the fuselage. However, by locating the point P well inward from the skin of the fuselage such interference is minimized. The gun has coverage through an appreciable angle or cone of fire.

For sealing about the universal joint 3, in any form, the aperture at the apex of the conical closure 4 may be provided with wiper means, or with a flexible diaphragm, as indicated at 41 in Figures 1, 4, and 11, and by these means or equivalent means internal or cabin pressure may be maintained, or external pressures may be kept out. It is feasible to seal such small openings pressure-tightly, whereas larger openings may not be so well or so readily sealed.

A preferred form of top mount is illustrated in Figures 6, 7, and 8. The gun mount 2 is supported in this instance from a carriage 5 which, by means of rollers 50 or equivalent means, moving in a track 51, which is supported from the aircraft structure, may tilt, with the gun, about an axis which is perpendicular to the gun's barrel, represented by the point P, which axis is the center of the part-circular track 51. The track 51 is mounted for rotation about an upright axis upon a structure 52 which forms part of a substantially horizontal ring 53 of considerable diameter, approximately the entire width of the aircraft structure at the plane where it is located, which ring is rotatably mounted upon a support 17 to rotate in a plane which is spaced inwardly from and substantially parallel to the general plane defined by the margin of the opening 11. The ring 53 rotates therefore about an axis which is coaxial with the opening 11 and its conical closure 4, and which therefore includes the point P. In order to give the gunner some local traversing of the gun, without the necessity of rotating the ring 53, the gun mount 2 is pivoted at 55 upon the carriage 5. The axis of this pivot 55 includes the point P, but is normal to the axis of the circular track 51.

The natural tendency of the weight of the gun 9 and its mount 2 and carriage 5 is to tilt the gun so that its muzzle points generally upwardly, the carriage guide rollers 50 riding upward along the track 51. However, a harness 6 may be provided, in the nature of a strap, which may encircle the shoulders of the gunner as he stands aiming his gun, and this strap may be connected at its forward end either to the ring 53, to assist in accomplishing rotation of the ring, or preferably to the carriage 5, as indicated at 65, whereby, by leaning backward, the gunner may draw the carriage 5 back down the guide 51, and counteract the tendency mentioned above for the carriage to run along the guide until the gun points upwardly.

The ring 53 may be conveniently formed to support a plurality of ammunition containers, indicated at 92', where they are always within reach of the gunner, regardless of the rotated position of the gun and ring 53. The advantage of carrying them upon the ring is that regardless of the rotated position of the gun they are always in a familiar position with relation to the gun, and if they were carried upon a non-rotative or fixed part of the aircraft structure it would be necessary to rotate the ring back to a position where they could be reached, if during the course of action it had been rotated to some other position. By mounting them upon the ring 53 they are always located in a familiar and known position, and can be obtained and put in place with a minimum of difficulty. The ring 53 may be provided, too, with a shield 54 of armor or the like to protect the extra ammunition supply and the gunner.

What I claim as my invention is:

1. An aircraft structure having an approximately circular opening in its skin, a ring substantially coaxial with the opening, means supporting said ring within the aircraft structure for rotation in a plane spaced inwardly from and substantially parallel to the opening, a carriage, means supporting said carriage on the ring for rotation therewith and for guiding thereupon for tilting relative to the common axis of the ring and opening about a point lying in such axis but intermediate the planes of the ring and opening, a gun mount to support a gun for firing through the opening and supported from said carriage for universal movement of the gun about such point as a center, by combined rotary movement of the ring and tilting movement of the carriage, and closure means closely embracing the gun's barrel adjacent such point, and diverging outwardly thence to the margin of the opening.

2. An aircraft structure having an approximately circular opening in its skin, a ring substantially coaxial with the opening, means supporting said ring within the aircraft structure for rotation in a plane spaced inwardly from and substantially parallel to the opening, a carriage, means supporting said carriage on the ring for rotation therewith and for guiding thereupon for tilting relative to the common axis of the ring and opening about a point lying in such axis but intermediate the planes of the ring and opening, a gun mount to support a gun for firing through the opening and supported from said carriage for universal movement of the gun about such point as a center, by combined rotary movement of the ring and tilting movement of the carriage, means interposed between the carriage and gun mount for limited traversing of the gun about such point without rotation of the ring, and closure means closely embracing the gun's barrel adjacent such point, and diverging outwardly thence to the margin of the opening.

3. An aircraft structure having an approximately circular opening in its skin, a ring substantially coaxial with the opening, means supporting said ring within the aircraft structure for rotation in a plane spaced inwardly from and substantially parallel to the opening, a carriage, means supporting said carriage upon the ring for rotation therewith and for guiding thereupon for tilting relative to the common axis of the ring and opening about a point lying in such axis but intermediate the planes of the ring and opening, a gun mount to support a gun for firing through the opening and supported from said carriage for universal movement of the gun about such point as a center, by combined rotary movement of the ring and tilting movement of the carriage, closure means closely embracing the gun's barrel adjacent such point, and diverging outwardly thence to the margin of the opening,

and means carried by said ring to support ammunition containers within convenient reach of the gunner, regardless of the rotated position of the gun.

4. An aircraft structure having an approximately circular opening in its skin, a ring substantially coaxial with the opening, means supporting said ring within the aircraft structure for rotation in a plane spaced inwardly from and substantially parallel to the opening, a carriage, means supporting said carriage upon the ring for rotation therewith and for guiding thereupon for tilting relative to the common axis of the ring and opening about a point lying in such axis but intermediate the planes of the ring and opening, a gun mount to support a gun for firing through the opening and supported from said carriage for universal movement of the gun about such point as a center, by combined rotary movement of the ring and tilting movement of the carriage, closure means closely embracing the gun's barrel adjacent such point, and diverging outwardly thence to the margin of the opening, a harness connected to said carriage, and engageable by a gunner when he is in firing position, to assist in shifting the gun to new positions.

5. In an aircraft structure having an aperture for reception of a gun barrel, defining substantially a plane and of a size to embrace closely such barrel, an arcuate track defining a plane always intersecting the plane of such aperture, and having its center of curvature substantially in the plane of such aperture, a gun mount supported for movement along said track for swinging a gun with its barrel received in such aperture about the center of curvature of said track, and means supporting and guiding said track for rotation about an axis substantially perpendicular to the plane of such aperture.

6. In an aircraft structure having an approximately circular opening in its skin, a ring substantially coaxial with the opening, means supporting said ring within the aircraft structure in a plane spaced inwardly from and substantially parallel to the opening, a carriage, means supporting said carriage on said ring for rotation therewith about the common axis of the ring and opening, and guiding thereupon for tilting relative to such axis about a point lying therein, a gun mount to support a gun for firing through the opening, means supporting said gun mount from said carriage for universal movement of the gun about such point as a center, by combined rotary and tilting movement of the carriage, and closure means closely embracing the gun's barrel adjacent said point, and diverging outwardly thence to the margin of the opening.

7. In an aircraft structure having a substantially circular opening in its skin, a closure for such opening indented inwardly from the surrounding surface of the aircraft structure, conforming to the surface of a truncated right circular cone, and terminating in an aperture defining a plane substantially parallel to such circular skin opening, a ring substantially coaxial with the skin opening and conical closure, means supporting said ring within the aircraft structure in a plane spaced inwardly from and substantially parallel to the opening, a gun mount to support a gun for firing through such aperture, a carriage, means supporting said carriage on said ring for rotation about the common axis of the ring, closure, and opening, and for guiding thereupon for tilting relative to such axis, and means supporting said gun mount on said carriage for universal movement of a gun carried thereby substantially about the point of intersection of such common axis with the plane of closure truncation as a center, which point is spaced from the adjacent conical surface of said closure a distance equal to at least half the maximum thickness of the gun portion intersected by such plane of truncation.

8. An aircraft structure having an approximately circular opening in its skin, an indented conical closure closing such opening and apertured at its apex, a gun mount to support a gun projecting through the aperture, and means entirely independent of said closure and disposed inwardly thereof, to support the gun mount directly from the aircraft structure for rotation about the axis of the conical closure, and for tilting about an axis normal to the conical closure axis.

9. An aircraft structure having an approximately circular opening in its skin, an indented conical closure closing such opening and apertured at its smaller end, a gun mount to support a gun projecting through the aperture, and means entirely independent of said closure and disposed inwardly thereof, to support the gun mount directly from the aircraft structure for rotation about the axis of the conical closure, for tilting about an axis normal to the conical closure axis, and further for limited tilting about an axis normal to the second axis.

10. An aircraft structure having an approximately circular opening in its skin, a gun mount to support a gun for firing through the opening, closure means snugly embracing the gun's barrel and diverging outwardly to the margin of the opening, and means entirely independent of said closure and disposed inwardly thereof, to support the gun mount directly from the aircraft structure for rotation about the axis through the center of the opening, and for universal swinging about a point lying substantially in such axis and between such opening and said supporting means.

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