May 16, 1944. R. N. LESNICK 2,349,101

GUN FIRE CONTROL

Filed April 7, 1941 3 Sheets-Sheet 1

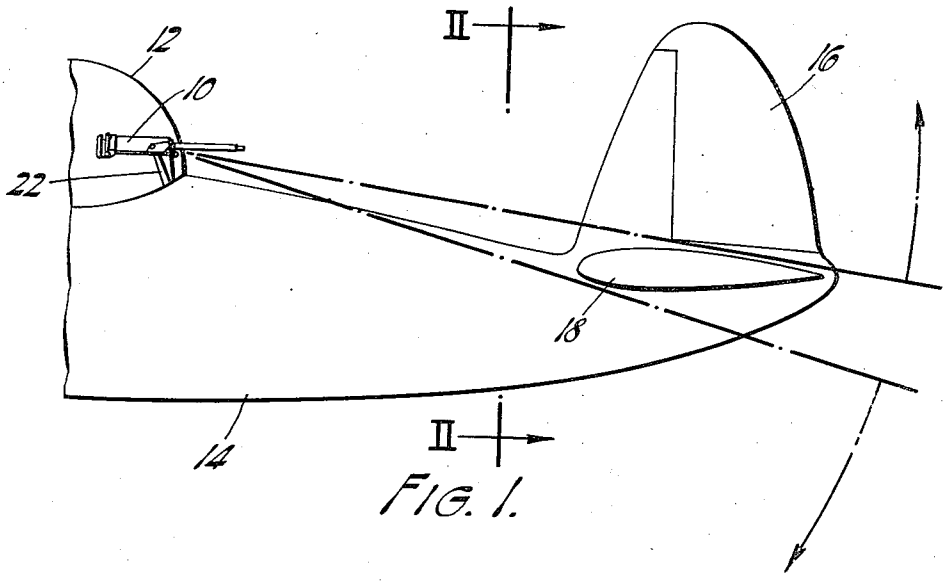


FIG. 1.

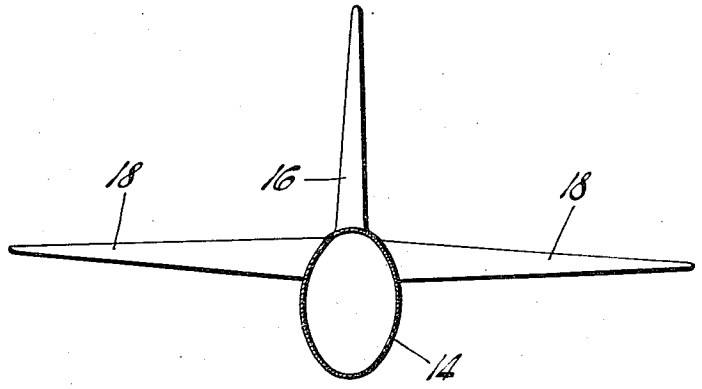


FIG. 2.

INVENTOR
ROBERT N. LESNICK
BY
Beau, Brooks, Buckley & Beau.
ATTORNEYS

May 16, 1944. R. N. LESNICK 2,349,101

GUN FIRE CONTROL

Filed April 7, 1941 3 Sheets-Sheet 2

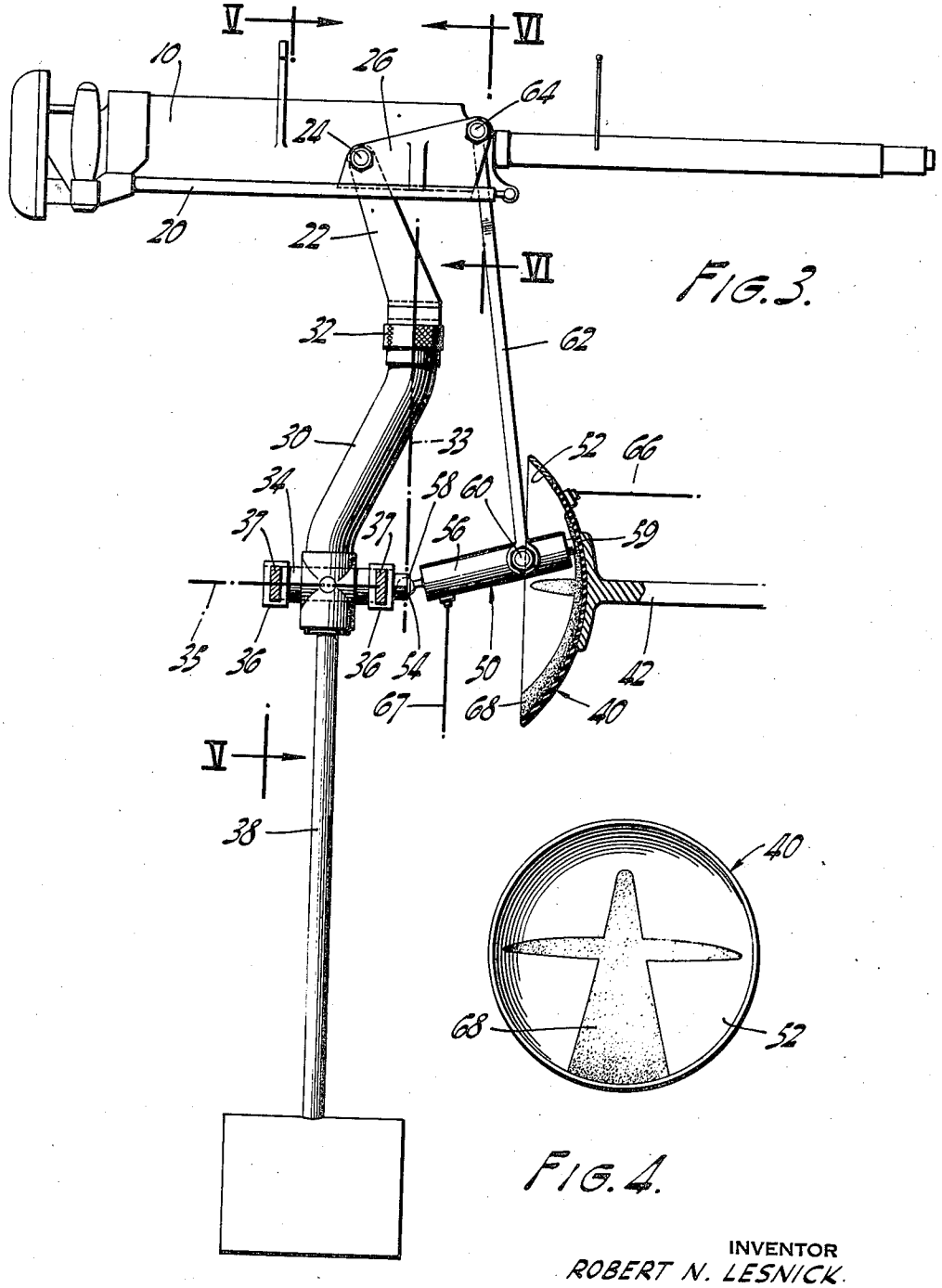


FIG. 3.

FIG. 4.

INVENTOR
ROBERT N. LESNICK.
BY
Bean, Brooks, Buckley & Bean.
ATTORNEYS

May 16, 1944. R. N. LESNICK 2,349,101

GUN FIRE CONTROL

Filed April 7, 1941 3 Sheets-Sheet 3

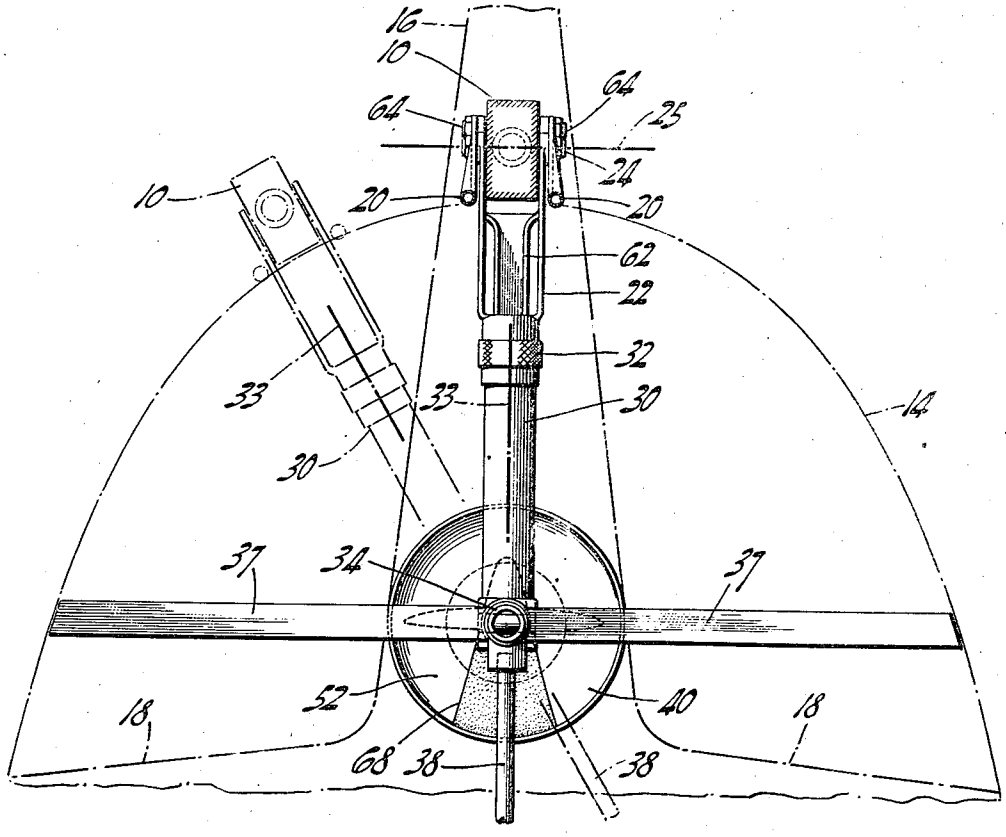


FIG. 5.

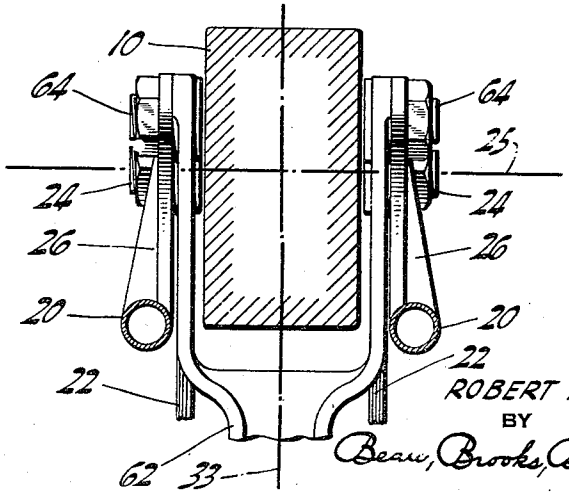


FIG. 6.

INVENTOR
ROBERT N. LESNICK
BY
Beau, Brooks, Buckley & Beau
ATTORNEYS

Patented May 16, 1944 2,349,101

UNITED STATES PATENT OFFICE

2,349,101

GUNFIRE CONTROL

Robert N. Lesnick, Brooklyn, N. Y., assignor to Brewster Aeronautical Corporation, Long Island City, N. Y.

Application April 7, 1941, Serial No. 387,245

8 Claims. (Cl. 89—37.5)

This invention relates to improvements in armament for aircraft, and more particularly to improvements concerned with control of the firing operation of machine guns mounted upon aircraft or the like.

The invention contemplates an improved method and means for controlling a machine gun mounted upon an airplane or other armed vehicle having structural elements thereof projecting into the normal range of the gun fire, whereby the gun fire is automatically interrupted whenever the gun is trained upon the vehicle projecting elements to prevent damage to the latter.

One of the objects of the invention is to provide an improved means for the purpose described which is simple and rugged and positive in action. Another object of the invention is to provide a device of the character described which is adapted to positively restrict the gun firing operation, as required, without interfering with free movement of the gun throughout the entire available range of training adjustment thereof. Other objects and advantages of the invention will appear from the specification hereinafter.

In the drawings:

Fig. 1 is a fragmentary side elevation of an airplane having a flexibly mounted machine gun arranged to be fired generally toward the rear of the airplane;

Fig. 2 is a section taken substantially along line II—II of Fig. 1;

Fig. 3 is a side elevation of the machine gun of Fig. 1, showing portions of the gun mounting and gun fire interrupting mechanism of the invention;

Fig. 4 is a transverse elevation of a portion of the gun fire interrupter device of Fig. 3;

Fig. 5 is a section taken substantially along line V—V of Fig. 4, showing the machine gun in adjusted positions; and

Fig. 6 is a fragmentary section taken substantially along line VI—VI of Fig. 3.

The drawings illustrate the invention in connection with a machine gun 10 which is mounted within a cockpit enclosure 12 of an airplane fuselage 14. The airplane empennage vertical fin and rudder structures are indicated at 16, and the horizontal tail surfaces are indicated at 18.

The gun 10 is illustrated as being mounted at opposite sides thereof upon a pair of bearer tubes 20 by means of slide connections adjacent opposite ends of the bearer tubes in such manner that the gun 10 will be reciprocable longitudinally upon the bearer tubes for recoil shock absorbing purposes, in the presently customary manner. The bearer tubes 20 are pivotally mounted upon a gun mount trunnion yoke 22 by means of bolts 24 which engage opposite arm portions of the trunnion yoke 22 with corresponding brackets 26 extending rigidly upwardly from the bearer tubes 20 at opposite sides of the gun. Thus, the gun and bearer tube unit 20—20 is pivotally mounted upon the trunnion yoke 22 for rotation about a horizontal axis 25 extending transversely of the longitudinal axis of the gun 10, so that the gun 10 is free to be rocked about the axis 25 extending through the bolts 24—24 for elevational adjustments of the gun; while at all times the gun is free to reciprocate longitudinally relative to the bearer tubes 20 for recoil shock absorbing purposes.

The trunnion yoke 22 extends upwardly and in longitudinal continuation of a gun mounting column 30 and the yoke 22 is mounted upon the column 30 by means of a rotation connection device 32 so as to be rotatable relative thereto about a vertical axis 33. Thus, the gun 10 is arranged to be free to be rotated about the axis 33 for traverse or azimuth adjustments of the gun in accordance with aiming requirements. The post 30 is mounted to extend rigidly from a cradle shaft 34 which is supported by means of a pair of spaced stationary bearings 36 mounted upon corresponding stationary supporting elements 37 of the airplane structure, so that the shaft 34 is disposed with its longitudinal axis of rotation 35 substantially parallel to the thrust axis of the airplane. Thus, the gun support column 30 is pivotable about an axis extending longitudinally of the airplane, and the gun 10 is thereby adapted to be swung from its solid line central position of Fig. 5 to either side thereof as illustrated by broken lines in such manner as to be adapted to fire around the vertical tail surface structure 16 of the airplane. Preferably, a counterweight arm 38 is arranged to extend rigidly from the shaft 34 in diametrically opposed relation with respect to the column 30 so as to counterbalance the weight of the gun 10 when rotated to either side of its upright central position.

To forestall gunnery damage to the tail structure of the airplane through inadvertence of the gunner while attempting to shoot toward the rear and as close as possible to the tail structure thereof, a gun fire control device is provided in the form of a templet 40 which is stationarily fixed to a suitable fixed portion 42 of the airplane structure and is arranged to cooper-

ate with a tracer device indicated generally at 50 to cause the gun firing operation to be interrupted whenever the gun is aimed at the airplane structure. For this purpose the templet 40 is generally of spherical segmental form; having an inner concave surface 52 developed about a radius center indicated at 54 which lies in the extension of the axis of rotation of the cradle shaft 34. A tracer finger 56 is swivelly connected at one end to the cradle shaft 34 by means of a ball and socket joint connection device 58; the center of rotation of which coincides with the point 54. The tracer finger 56 carries at its opposite end a contact portion 59 which is round nosed and spring pressed into sliding contact with the templet surface 52. Intermediately of its ends the tracer finger 56 is pivotally suspended at opposite sides thereof by means of a bolt connection 60 to one end of a push-pull-torque link 62 which extends upwardly therefrom into yoked connection by means of bolts 64 with corresponding oppositely extending portions of the brackets 26. The bolt connections 24—64 are so relatively arranged that the distance between the axes of pivoting defined by the connections 24 and 64 is equal to the distance between the axes of the connections 58 and 60 of the tracer, and thus a parallelogram motion device is provided. The link 62 is so longitudinally dimensioned and the connections 64 are so vertically positioned that whenever the gun 10 is aimed in the region of the intersection of the median plane of the empennage group and the axis of rotation 35 the tracer contact portion 59 will be disposed on the line of the axis of rotation 35 of the cradle shaft 34. Hence, if the gun 10 is maintained in sighting relation upon the said region of intersection while being swung about the axis 35 of the cradle shaft 34 the tracer tube 56 will simply rotate about the line of the axis 35 of rotation of the cradle shaft 34 and thus the contact portion 59 will simply rotate against the center of the templet 40. However, any displacement of the line of the gun sighting away from the region of intersection referred to will cause the contact portion 59 to be similarly displaced relative to the center of the templet 40.

The inner surface portion 52 of the templet 40 is illustrated as being formed of electrical conductive material and is electrically connected to a conductor 66 forming a portion of the circuit which controls the firing operation of the gun 10. The contact portion 59 is also formed of electrical conductive material and is electrically connected to another conductor 67 which forms another portion of the gun fire control circuit, so that whenever the tracer portion 59 contacts a conductive portion of the templet surface 52 the electrical circuit to the gun trigger control solenoid is closed, providing the gunner's control device is in firing condition. As illustrated in Fig. 4, the templet surface 52 is provided with a mask of electrically insulating substance as at 68, and the mask 68 is so shaped as to resemble generally the silhouette of the airplane empennage structure as viewed from the gunner's cockpit. Thus, whenever the tracer portion 59 rides over the mask 68 the electrical circuit to the gun control solenoid is automatically broken, and consequently whenever the gun 10 is aimed at the tail structure of the airplane the gun is automatically prevented from firing even though the gunner may inadvertently have the gun fire control switch in operative position.

It will be understood that the mask 68 will be so formed and proportioned as to provide any desired factor of safety with respect to clearances between the line of gun fire and the airplane tail structure, and that the mask 68 will include vertically and laterally projecting portions corresponding to the silhouette of the empennage structural elements of the airplane as viewed from directly behind the gun from any position thereof which is made possible by the flexible mounting arrangement mechanism upon which the gun is mounted. It will also be understood that the electrically conductive characteristics of the mask 68 and the remaining portion of the templet surface 52 may be reversed, if desired, and that any other suitable form of tracer action responsive control mechanism may be employed in lieu of the electrical circuit referred to, and that the tracer device will in any event be arranged to be operative to interrupt the gun firing operation whenever the gun is sighted toward the airplane empennage or wing or other projecting structure to be protected.

It is also contemplated that in lieu of the single gun mount as illustrated and described hereinabove in connection with the gun fire control device of the invention, any desired form of plural gun unit may be employed in connection with the invention. For example, a twin gun unit comprising a pair of parallel guns may be mounted upon the column 30 to be carried thereby as in the manner of the single gun 10 of the drawings, and in such case a pair of corresponding tracer elements similar to the tracer device 56—59 will be suitably mounted upon corresponding swivel connection devices so as to extend in substantially parallel relation and to cooperate with the templet 40 to individually control the fire of the corresponding guns, as in the manner previously described hereinabove.

Although only one form of the invention has been shown and described in detail, it will be apparent to those skilled in the art that the invention is not so limited but that various changes may be made therein without departing from the spirit of the invention or the scope of the appended claims.

What is claimed is:

1. An aircraft, a gun adjustably mounted thereon for aiming purposes, said aircraft having a positionally fixed structure facing said gun under certain conditions of gun aim adjustment, said gun being mounted upon a shaft extending substantially toward said fixed structure, said shaft being rotatable about its longitudinal axis and said gun being pivotally mounted relative to said shaft about an axis intersecting said shaft longitudinal axis and about another axis disposed transversely of said second mentioned axis, a tracer finger swivelly connected at one end to an end portion of said shaft and extending therefrom toward said fixed structure, a templet fixed upon said aircraft and having an inner surface portion of spherical form engaging the free end of said finger in abutting relation and centered upon the position of intersection of said shaft longitudinal axis and said second mentioned axis, link means connecting at one of its ends with said gun at a position spaced from the axes of said pivotal mountings and connecting at the other of its ends with said finger at a position spaced from said swivel connection so as to cause said finger to move relative to said templet in accord with movements of said gun relative to

the direction of said fixed structure, said templet being provided with complementing electrically conducting and electrically insulative surface portions contoured to correspond to the outline of said fixed structure as viewed from the position of said gun and adapted to register with said finger to provide in cooperation therewith electrical circuit make and break means arranged to control the firing of said gun.

2. An aircraft having a positionally fixed structure portion, a shaft mounted upon said aircraft to extend substantially toward said fixed structure portion and to be rotatable about its longitudinal axis, a gun mount post carried by said shaft to extend therefrom in a transverse direction and to be rotatable about an axis substantially intersecting the longitudinal axis of rotation of said shaft, a gun mounted upon said gun mount post so as to be pivotable relative thereto about an axis extending in a direction transverse to the direction of the axis of rotation of said gun mount post relative to said shaft, a tracer finger swivelly connected at one end to an end portion of said shaft and extending therefrom toward said fixed structure portion, a templet fixed upon said aircraft and having an inner surface portion of spherical form engaging the free end of said finger in abutting relation and centered upon the position of intersection of said shaft longitudinal axis and said second mentioned axis, link means connecting at one of its ends with said gun at a position spaced from the axes of said pivotal mountings and connecting at the other of its ends with said finger at a position spaced from said swivel connection so as to cause said finger to move relative to said templet in accord with movements of said gun relative to the direction of said fixed structure portion, said templet being provided with complementing electrically conductive and electrically insulative surface portions contoured to correspond to the outline of said fixed structure portion as viewed from the position of said gun and adapted to register with said finger to provide in cooperation therewith electrical circuit make and break means arranged to control the firing of said gun.

3. An aircraft having a positionally fixed structure portion, a shaft mounted upon said aircraft to extend substantially toward said fixed structure portion and to be rotatable about its longitudinal axis, a gun mount post carried by said shaft to extend therefrom in a transverse direction and to be rotatable about an axis substantially intersecting the longitudinal axis of rotation of said shaft, a gun mounted upon said gun mount post so as to be pivotable relative thereto about an axis extending in a direction transverse to the direction of the axis of rotation of said gun mount post relative to said shaft, a tracer finger swivelly connected at one end to an end portion of said shaft and extending therefrom toward said fixed structure portion, a templet fixed to engage the free end of said finger in abutting relation, link means connecting at one end with said gun at a position spaced from the axes of said gun and gun mount post pivotal mountings and connecting at the other end with said finger at a position spaced from said swivel connection so as to cause said finger to move relative to said templet in accord with movements of said gun relative to the direction of said fixed structure portion, said templet being provided with complementing electrically conductive and electrically insulative surface portions contoured to correspond to the outline of said fixed structure portion as viewed from the position of said gun and adapted to register with said finger to provide in cooperation therewith electrical circuit make and break means arranged to control the firing of said gun.

4. An aircraft having a positionally fixed structure portion, a shaft mounted upon said aircraft to extend substantially toward said fixed structure portion and to be rotatable about its longitudinal axis, a gun mount post carried by said shaft to extend therefrom in a transverse direction and to be rotatable about an axis substantially intersecting the longitudinal axis of rotation of said shaft, a gun mounted upon said gun mount post so as to be pivotable relative thereto about an axis extending in a direction transverse to the direction of the axis of rotation of said gun mount post relative to said shaft, a tracer finger swivelly connected at one end to an end portion of said shaft and extending therefrom toward said fixed structure portion, a templet fixed to engage the free end of said finger in abutting relation, link means connecting at one end with said gun at a position spaced from the axes of said gun and gun mount post pivotal mountings and connecting at the other end with said finger at a position spaced from said swivel connection so as to cause said finger to move relative to said templet in accord with movements of said gun relative to the direction of said fixed structure portion, said templet being provided with tracer finger contact surface portions contoured to correspond to the outline of said fixed structure portion as viewed from the position of said gun and adapted to register with said finger to provide in cooperation therewith actuating means arranged to control the firing of said gun.

5. An aircraft having a positionally fixed structure portion, a shaft mounted upon said aircraft to extend substantially toward said fixed structure portion and to be rotatable about its longitudinal axis, a gun mount post carried by said shaft to extend therefrom in a transverse direction and to be rotatable about an axis substantially intersecting the longitudinal axis of rotation of said shaft, a gun mounted upon said gun mount post so as to be pivotable relative thereto about an axis extending in a direction transverse to the direction of the axis of rotation of said gun mount post relative to said shaft, a tracer finger swivelly connected at one end to an end portion of said shaft and extending therefrom toward said fixed structure portion, a templet fixed upon said aircraft and having an inner surface portion of spherical form engaging the free end of said finger in abutting relation and centered upon the position of intersection of said shaft longitudinal axis and said second mentioned axis, link means connecting at one of its ends with said gun at a position spaced from the axes of said pivotal mountings and connecting at the other of its ends with said finger at a position spaced from said swivel connection so as to cause said finger to move relative to said templet in accord with movements of said gun relative to the direction of said fixed structure portion, said templet being provided with tracer finger contact surface portions contoured to correspond to the outline of said fixed structure portion as viewed from the position of said gun and adapted to register with said finger to provide in cooperation therewith actuating means arranged to control the firing of said gun.

6. An aircraft, a gun adjustably mounted thereon, said aircraft having a fixed structure

portion facing said gun under certain conditions of gun adjustment, said gun being mounted upon a shaft extending substantially toward said fixed structure portion, said shaft being rotatable about its longitudinal axis and said gun being pivotally mounted relative to said shaft about an axis intersecting said shaft longitudinal axis and about another axis disposed transversely of said second mentioned axis, a tracer finger swivelly connected at one end to an end portion of said shaft and extending therefrom toward said fixed structure portion, a templet fixed upon said aircraft and having an inner surface portion of spherical form engaging the free end of said finger in abutting relation and centered upon the position of intersection of said shaft longitudinal axis and said second mentioned axis, link means connecting at one of its ends with said gun at a position spaced from the axes of said pivotal mountings and connecting at the other of its ends with said finger at a position spaced from said swivel connection so as to cause said finger to move relative to said templet in accord with movements of said gun relative to the direction of said fixed structure portion, said templet being provided with tracer finger contact surface portions contoured to correspond to the outline of said fixed structure portion as viewed from the position of said gun and adapted to register with said finger to provide in cooperation therewith actuating means arranged to control the firing of said gun.

7. In combination, a support, a gun mount post connected to extend from said support while being pivotable relative to said support about two intersecting axes, a gun mounted upon said post to be pivotable relative thereto about an axis extending in a direction transversely of one of said pivoting axes of said gun mount post, a gun fire control templet of spherically curved form fixed to said support so as to be centered substantially upon the intersection of said axes of pivoting of said gun mount post relative to said support, a gun fire control tracer mounted upon an arm extending into swivel connection with said support at substantially the position of intersection of said axes of pivoting of said gun mount post relative to said support, said tracer being disposed to slidably abut said templet for actuation thereby to control firing operations of said gun, and means operable by aiming movements of said gun to displace said tracer relative to said templet in direct relation to the aiming movements of said gun.

8. In combination, a support, a gun mount post connected to extend from said support while being pivotable relative to said support about two intersecting axes, a gun mounted upon said post to be pivotable relative thereto about an axis extending in a direction transversely of one of said pivoting axes of said gun mount post, a gun fire control templet of spherically curved form fixed to said support so as to be centered substantially upon the intersection of said axes of pivoting of said gun mount post relative to said support, a gun fire control tracer mounted upon an arm extending into swivel connection with said support at substantially the position of intersection of said axes of pivoting of said gun mount post relative to said support, said tracer being disposed to slidably abut said templet for actuation thereby to control firing operations of said gun, and means operable by aiming movements of said gun to swing said tracer so as to displace the abutting end portion thereof relative to said templet in direct relation to the aiming movements of said gun, said gun support including structural portions extending into the range of fire of said gun, and said templet including a silhouette pattern portion corresponding substantially to the silhouette of said extending structural portions as viewed from the position of said gun and adapted to cooperate with said tracer when in registry therewith to interrupt the fire of said gun.

ROBERT N. LESNICK.