Jan. 16, 1940. S. G. GREEN 2,186,969

MACHINE GUN STRUCTURE

Filed June 29, 1938 3 Sheets-Sheet 1

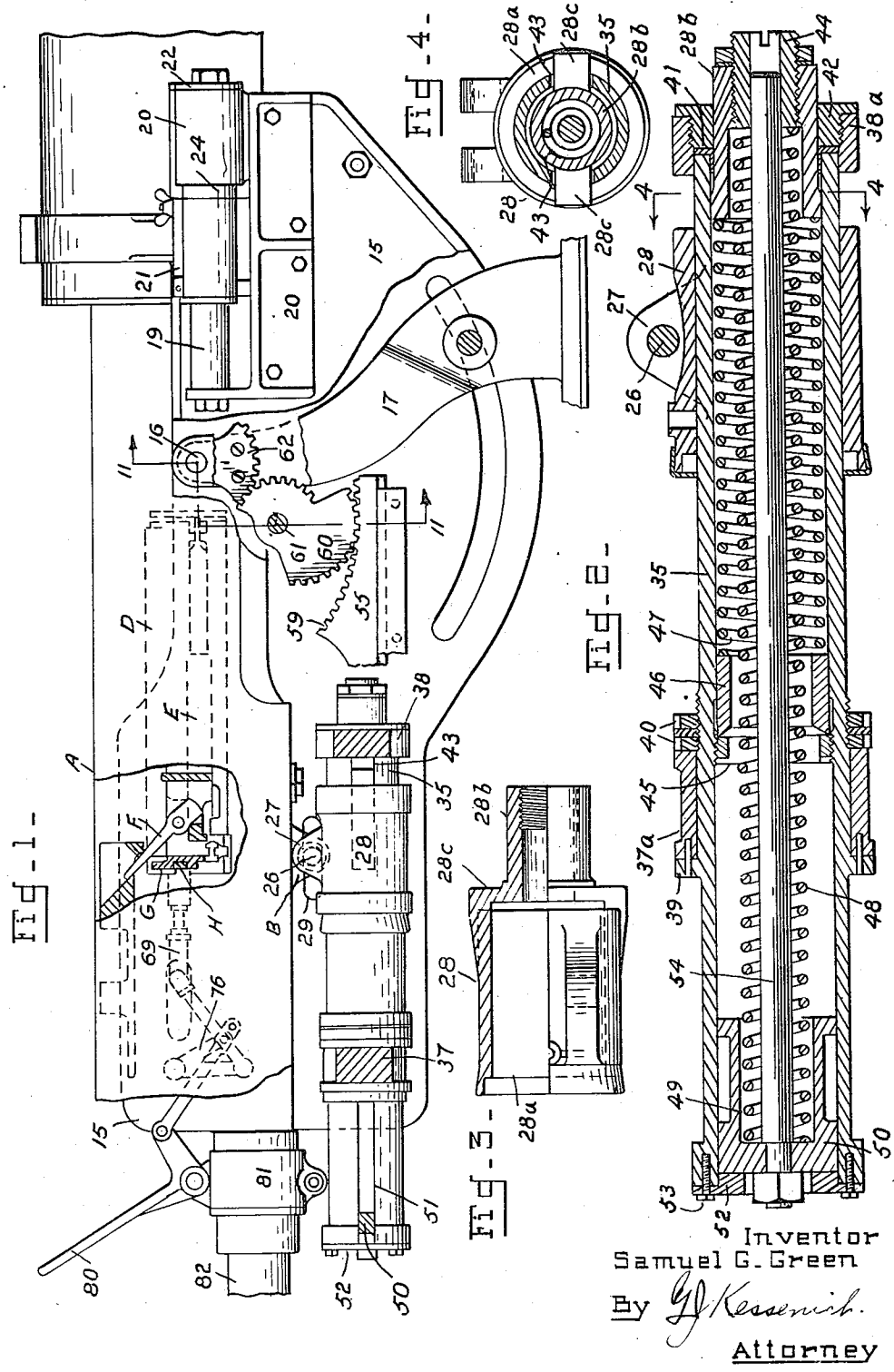


Fig. 1.

Fig. 2.

Fig. 3.

Fig. 4.

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MACHINE GUN STRUCTURE

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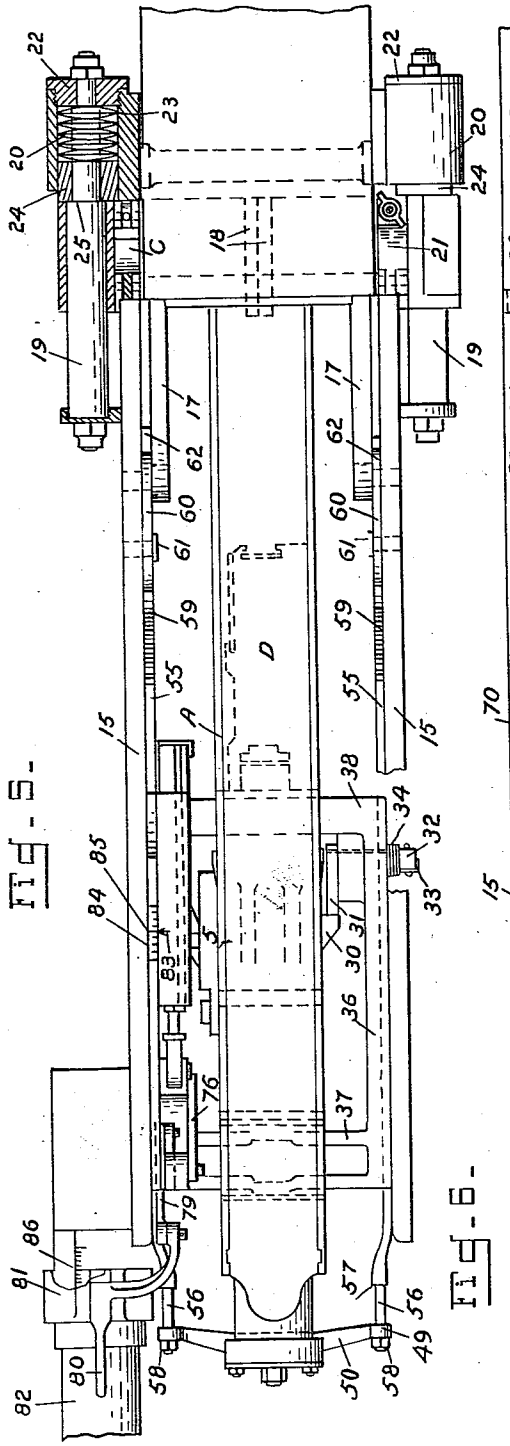


Fig. 5.

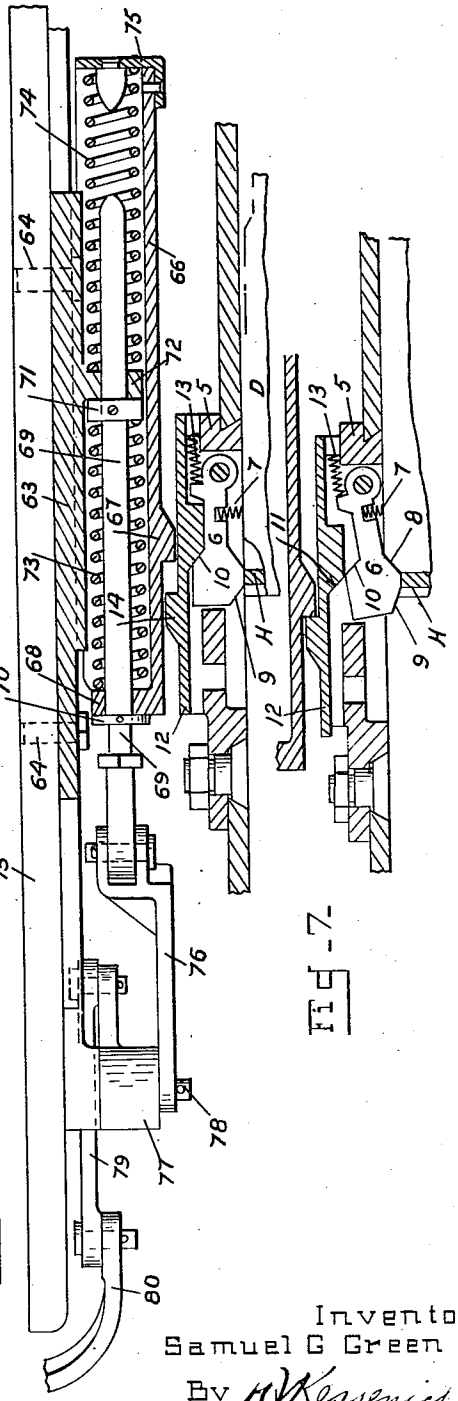


Fig. 7.

Fig. 6.

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MACHINE GUN STRUCTURE

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Fig. 8.

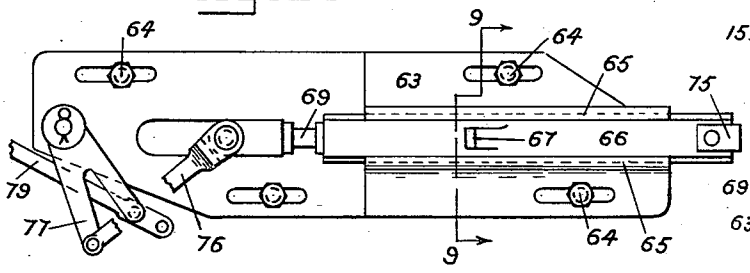


Fig. 9.

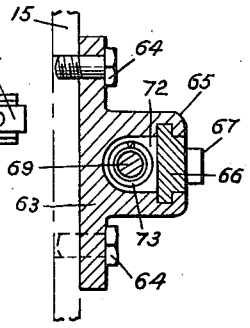


Fig. 10.

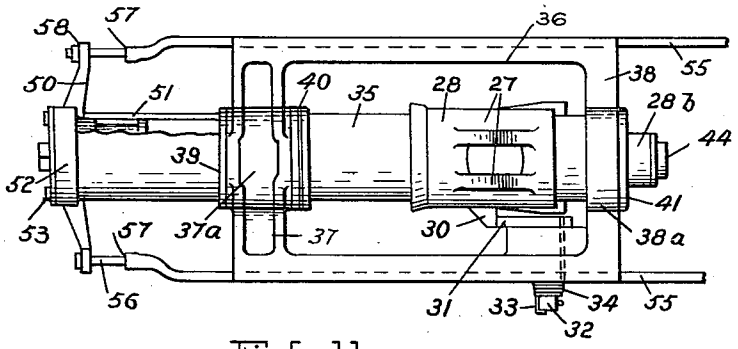
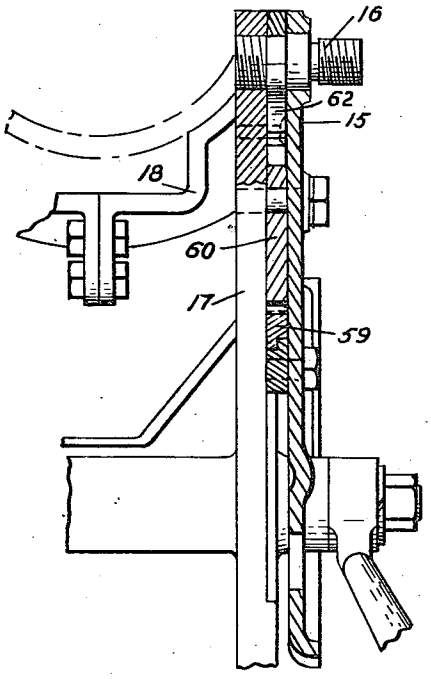


Fig. 11.



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UNITED STATES PATENT OFFICE

2,186,969

MACHINE GUN STRUCTURE

Samuel G. Green, Gray, Ga.

Application June 29, 1938, Serial No. 216,518

17 Claims. (Cl. 89—27)

(Granted under the act of March 3, 1883, as amended April 30, 1928; 370 O. G. 757)

The invention described herein may be manufactured and used by or for the Government for governmental purposes, without the payment to me of any royalty thereon.

This application is in part a continuation of application, Serial No. 45,236 filed October 16, 1935.

This invention relates to a machine gun structure and more particularly it has reference to means for automatically firing a gun that is mounted for movement in recoil.

When a gun is fired there results more or less recoil most of which is taken up in some instances by a recoil mechanism and in other instances by the mount. In either instance there is some movement of the gun and its supporting structure.

Since there will always be a recoil and counterrecoil movement when a mounted gun is fired it is desired to fire the gun in such a way as not to set up secondary periodic vibrations to add to this back and forth swing; otherwise the movement would become so irregular as to render the gun and movement unstable, entirely destroy the aim and probably cause injury to the gun or mount.

The conventional method of firing the gun is to maintain the trigger on the gun in the actuating position so that the gun fires when the breech bolt is near the closed position regardless of the position of the gun in its cycle of recoil and counterrecoil. In the present invention the trigger on the gun is maintained in inoperative position except at a predetermined position of recoil and counterrecoil both as to the bolt firing mechanism represented by the firing pin sear and the gun as a unit represented by the gun receiver frame and the trigger and trigger slide carried thereby.

The purpose of the invention, then, is to provide means for so controlling the firing of an automatic or semi-automatic gun having a recoil variable with elevation that, after the first shot, it will always fire at the proper position during a cycle of recoil, which firing position is just in rear of the in battery position of the bolt and gun receiver frame.

By in battery position is meant the normal position of the gun when not subjected to the stresses and strains of firing, and the cycle of recoil refers to the complete cycle of vibration forwardly and rearwardly.

A further object of the invention is to provide a simple and compact recoil mechanism for a free mounted cradle, that is, one in which elevation is directly controlled by the gunner.

To these and other ends, the invention consists in the construction, arrangement and combination of elements described hereinafter and pointed out in the claims forming a part of this specification.

A practical embodiment of the invention is illustrated in the accompanying drawings, wherein:

Fig. 1 is a view in side elevation, with parts broken away and parts in section of a machine gun mounted for recoil on a cradle;

Fig. 2 is a longitudinal sectional view of the recoil mechanism;

Fig. 3 is a view in side elevation and partly in section of the recoil slide;

Fig. 4 is a sectional view on the line 4—4 of Fig. 2;

Fig. 5 is a plan view with parts in section of the gun mounted in the cradle;

Fig. 6 is an enlarged sectional view of the firing mechanism with the parts in position of rest ready to fire the first shot;

Fig. 7 shows the firing mechanism with the parts in automatic firing relationship;

Fig. 8 is a detail view in side elevation of the actuator slide and bracket;

Fig. 9 is a sectional view on the line 9—9 of Fig. 8;

Fig. 10 is a plan view of the frame for the recoil mechanism;

Fig. 11 is a sectional view of the cradle plate taken on the line 11—11 of Fig. 1.

Referring to the drawings by characters of reference there is shown a machine gun of the Browning type employed in the armed services of this country comprising a receiver frame A having a rear apertured bracket B (Fig. 1) and front trunnions C (Fig. 5). A breech bolt D reciprocally mounted within the gun frame and normally held in battery by a driving spring (customarily not shown), carries a firing pin E which is retracted by a cocking lever F associated with the gun frame in such a manner that the firing pin is automatically out of firing position except during the final movement of the counterrecoil stroke of the bolt. A sear G for holding the firing pin in cocked position is movable to release the firing pin by a sear slide H.

One side of the gun frame carries a trigger mechanism which is similar to that shown in my prior Patent No. 2,069,244 of February 2, 1937, and includes a housing 5 (Figs. 5 and 6) in which

a trigger 6 is pivotally mounted at its front end and normally held in inoperative position by a spring 7. The rear part of the trigger is provided on its inner side with a lug 8 adapted to project through an opening in the gun frame to engage the sear slide and trip the sear. The rear face of the lug is formed with a cam surface 9 which is adapted to actuate the sear slide H, as the bolt approaches the final movement of its counterrecoil stroke.

The outer side of the trigger is formed with a cam surface 10 adapted to be engaged by the cam surface 11 on the inner side of a trigger slide 12 during retraction of said slide. The slide 12 is mounted in the housing and is normally held in a forward position by a spring 13. A lug 14 on the outer side of the trigger slide is adapted to be engaged by an actuator that is independent of the recoiling gun frame as will be explained hereinafter.

The gun is mounted for recoil and counterrecoil movement in a cradle which comprises spaced plates 15—15 and is mounted for movement in elevation on trunnion studs 16—16 (Fig. 11) threaded in a pintle 17. A sleigh 18 disposed between the front ends of the cradle plates 15 is slidably mounted on a pair of spaced, longitudinally arranged shafts 19—19 (Figs. 1 and 5) each of which is fixed in a bracket 20 secured to a cradle plate. The sleigh is provided with half-bearings for receiving the gun trunnions C—C which are retained by means of pivoted clamps 21. A nut 22 mounted on the front end of each shaft and externally threaded to the bracket forms a seat for one end of a buffer spring 23. The other end of the spring is seated on a collar 24 which is slidable on the shaft and is held against a shoulder 25 on the shaft by means of the spring. The rear faces of the collars 24 on the shafts are adapted to be engaged by the sleigh.

The rear apertured bracket B on the gun is attached by means of a pin 26 to apertured ears 27—27 on the slide 28 of a recoil mechanism or brake. In order to facilitate insertion of the pin which is passed through a slot 29 in the left cradle plate, the alignment of the apertures in the bracket and ears is insured by means of a lug 30 in the slide 28 which engages a stop finger 31. The finger 31 is on the inner end of a shaft 32 which is mounted in elements of the right cradle plate and carries a handle 33. A torsion spring 34 normally rotates the shaft to move the finger out of the path of the lug 30. When the lug is in engagement with the finger, the resilient elements of the recoil mechanism exert sufficient pressure to prevent the action of the torsion spring from disengaging the finger 31 from the lug 30, but after the first shot is fired and the slide moves rearwardly, the finger automatically returns to disengaged position under influence of the torsion spring.

The slide 28 of the recoil mechanism is mounted on a tube 35, (Figs. 1 and 2) which is carried by a frame 36 fixed to the cradle and which includes cross pieces 37 and 38 having central bearings, respectively 37a and 38a, for receiving the tube. The tube is inserted through the bearings until a collar 39 engages the rear face of the rear cross piece 37 when lock nuts 40 are turned on the tube to bear against the front face of the rear cross piece. The front end of the tube bears against a retainer ring 41 which is held by a plug 42 threaded in the front cross piece bearing 38a.

The slide 28 consists of a large cylinder 28a (Figs. 1, 3 and 4) slidably mounted on the outside of the tube and a small cylinder 28b disposed within the tube and connected to the large cylinder by webs 28c which ride in slots 43 in opposite side walls of the cylinder. The outer end of the small cylinder 28b carries an adjusting plug 44 threaded to the interior of the cylinder.

Within the tube 35 and near its center is a nut 45 which positions a tubular plug 46. A helical main spring 47 is confined between the plug 46 and the inner end of the small cylinder 28b. An auxiliary helical spring 48 disposed within the main spring is confined between the adjusting plug 44 and a socket 49 on a cross head 50 (Figs. 2, 5 and 10) which extends through opposite slots 51—51 (Fig. 1) in the rear end portion of the tube 35. The socket seats against a retainer plate 52 secured to the end of the tube by screws 53. A guide rod 54 secured to the socket passes through the spring 48 and has its front end slidably received in the adjusting plug 44.

A pair of rack bars 55—55 (Figs. 5 and 10) slidably mounted in the frame 36 include cylindrical rear extremities 56, for slidably mounting the ends of the cross-head 50 between a shoulder 57 and a nut 58, the nut 58 normally bearing against the cross-head at zero elevation and serving when the rack bars are moved forwardly to correspondingly move the cross head to compress the springs and shorten the recoil stroke relative to its horizontal position by increasing the force of restitution of the springs. During depression of the gun from zero elevation, the rack bars are moved rearwardly but no change takes place in the spring adjustment because the cross head is held by the retainer plate 52.

The front end of each rack bar includes an arcuate rack 59 meshing with a compound pinion 60 which is pivotally mounted on a pin 61 carried by the cradle plate. The pinion 60 also meshes with a gear segment 62 fixed to the pintle 17 so that when the cradle is rotated about the trunnion studs 16 the rack bars will be displaced to vary the recoil stroke of the gun. As shown in Fig. 1 the relation of rack gears 59 with respect to the cooperating gear segments on compound gears 60 is such that movement of the rack bars 55—55 will be proportional to the cosine of the angle through which gears 60 are rotated.

The trigger slide actuating mechanism (Figs. 6, 8 and 9) is carried by the left cradle plate and comprises a support or housing member 63 adjustably secured to the cradle plate by bolts 64. It is formed with spaced flanges 65—65 between which an actuator slide 66 is mounted. The slide 66 is provided with a lug 67 adapted to engage the lug 14 of the trigger slide 12. A laterally projecting ear 68 on the rear end of the slide is apertured to receive a rod 69 which has a collar 70 bearing against the rear face of the ear. A second collar 71 on the rod intermediate its ends is arranged to bear against an apertured ear 72 on the housing and forms a seat for one end of a helical spring 73 which is seated on the inner face of the ear 68. A second spring 74 is confined between the ear 72 and an ear 75 on the front end of the actuator slide.

A link 76 pivotally connected to the rear end of the rod 69 is also pivotally connected to one arm of a lever 77 which is pivotally mounted on

a pin 78 attached to the housing. A second link 79 pivoted to the outer arm of the lever 77 is also pivoted to a hand operated lever 80 pivotally mounted in a bracket 81 adjustable on the back rest 82.

When the hand lever 80 is pressed down against the back rest 82, the rod 69 is retracted and acting through the spring 73 it causes retraction of the actuator slide 66. The lug 67 is thereby moved rearwardly into engagement with the lug 14 on the trigger slide in order to fire the first shot, and it has a further rearward displacement of ¼ of an inch to properly position it for firing subsequent shots.

The hand lever 80 when held against the back rest is not subjected to vibrations and firing impulses.

The housing 63 is inscribed with a reference line 83 which is readable against a scale 84 on the left cradle plate, and which is graduated in value of $\frac{1}{16}$ of an inch with a heavy line 85 indicating the average setting. The back rest 82 is provided with a similar scale 86 which is read against the front face of the bracket 81. This scale 86 is used to adjust the rod 69 so that the collar 70 normally engages the ear 68 on the rear of slide 66.

The operation of the mechanism is as follows: With the parts in position of rest, that is with the breech bolt in battery, the gun receiver frame in battery, and the sear slide, and trigger in firing relationship, the actuator slide is retracted to initiate firing of the gun. The actuator slide moves $\frac{5}{16}$ of an inch into engagement with the lug 14 and then an additional ¼ of an inch, of which the first part is sufficient to swing the trigger inwardly to trip the sear and the last part is over-travel.

The breech bolt now moves in recoil and after traveling 7.2 inches it is returned by its driving spring towards its "in battery" position. When the bolt is midway of its recoil, the reaction on the gun receiver frame causes it to move in recoil for a distance of about ¾ of an inch before it is moved in counterrecoil by the springs.

Since the trigger slide carried by the gun frame was initially retracted to fire the shot it does not partake of the corresponding initial movement in recoil of the gun frame but it is later picked up by the gun frame. At the end of the recoil stroke of the gun frame, the trigger slide and the trigger have been restored by their springs to their initial position.

When the gun frame is moving in counterrecoil and is about ¼ of an inch out of battery the trigger slide engages the lug of the actuator slide and the trigger is moved through the opening in the gun frame into the path of the sear slide. At this time the sear slide on the counterrecoiling breech bolt is from $\frac{7}{16}$ to $\frac{9}{16}$ of an inch from in battery position and it then engages the inclined cam and is tripped. The next shot is actually fired when the bolt is from ¼ to ⅛ of an inch of its battery position. The bolt and the gun frame receive the impulse from the second shot and do not reach their in battery positions. As a consequence the counterrecoil buffers function only on the last shot.

The purpose in firing out of battery is to allow for variation in friction in the mount, bullet weight, velocity of bullet and variations in gun recoil velocity, external and internal, and to obtain a reduction of 25%, in recoil energy delivered to the mount for each shot after the first shot.

The mechanism as arranged fires the first and each succeeding shot semiautomatically and it will be observed that this requires that the phase relation between the gun cycle and gun frame cycle be not disturbed. Full gun cyclic rate may be maintained or even increased due to the shorter recoil and therefore decreased period of recoil under the conditions hereinabove specified.

I claim:

1. A support, a gun frame mounted on the support for recoil and counterrecoil movement and having a normal in battery position, a breech bolt mounted within the gun frame for recoil and counterrecoil movement relative thereto and having a normal in battery position, said gun frame and bolt having different lengths of recoil, a sear on the bolt, sear tripping means on the gun frame including a trigger and a slide reciprocal with respect to the gun frame and trigger with each shot for actuating the trigger, said sear and sear tripping means having a firing relationship for first shot firing when the gun frame and bolt are in their in battery position and having a firing relationship for automatic firing when the gun frame and bolt are approximately similar distances in rear of their in battery positions, which automatic firing relationship is sufficiently to the rear so that the gun frame and bolt will receive the impulse of the shot before reaching their in battery positions, means for moving and holding the sear tripping means out of the path of the sear when these members are in rear of their position of automatic firing relationship, and means carried by the support for moving the sear tripping means when the gun frame and bolt are in battery and subsequently during automatic firing.

2. The combination with a reciprocally mounted gun carrying sear tripping means and housing a reciprocable breech bolt with a sear, of a fixed support adjacent the gun, a housing adjustably carried by the fixed support, a reference line on the housing, a scale including a mark for normal setting provided on the fixed support and readable against the reference line, a slide movable in the housing and having means for actuably engaging the sear tripping means on the gun, an operating rod having means for limiting the rearward position of the slide, a spring between the rod and slide for transmitting retraction of the rod to the slide, means for retracting the rod, and a bracket carrying said retracting means and adjustable on the fixed support, a scale on the support for indicating normal setting of the bracket.

3. The combination with a reciprocally mounted gun carrying sear tripping means and housing a reciprocable breech bolt with a sear, of a fixed support adjacent the gun, a housing adjustably carried by the fixed support, a reference line on the housing, a scale including a mark for normal setting provided on the fixed support and readable against the reference line, a slide movable in the housing and having means for actuably engaging the sear tripping means on the gun, an operating rod having means for limiting the rearward position of the slide, a spring between the rod and slide for transmitting retraction of the rod to the slide, and means for retracting the rod.

4. The combination with a reciprocally mounted gun carrying sear tripping means and housing a reciprocable breech bolt with a sear, of a fixed support adjacent the gun, a housing adjustably carried by the fixed support, a slide movable in the housing and having means for

actuably engaging the sear tripping means on the gun, an operating rod having means for limiting the rearward position of the slide, a spring between the rod and slide for transmitting retraction of the rod to the slide, and means for retracting the rod.

5. The combination with a reciprocally mounted gun carrying sear tripping means and housing a reciprocable breech bolt with a sear, of a fixed support adjacent the gun, a slide movable on the fixed support and having means for actuably engaging the sear tripping means on the gun, a rod passing through the rear end of the slide and having a collar engageable with the fixed support, a spring confined between the rear end of the slide and the collar on the rod, means for retracting the rod to move the slide through the spring into position to yieldingly actuate the sear tripping means, and a return spring seated on the fixed support and engaging the slide.

6. The combination with a reciprocally mounted gun carrying sear tripping means and housing a reciprocable breech bolt with a sear, of a fixed support adjacent the gun, a slide movable on the fixed support and having means for actuably engaging the sear triping means on the gun, a rod passing through the rear end of the slide and having a collar engageable with the fixed support, a spring confined between the rear end of the slide and the collar on the rod, means for retracting the rod to move the slide through the spring into position to yieldingly actuate the sear tripping means.

7. In a mount for guns, a support, a cradle trunnioned thereon for movement in elevation, a tube fixed on the cradle, a recoil slide comprising a large cylinder mounted on the outside of the tube and a small cylinder mounted within the tube, an adjusting plug in the small cylinder, an adjustable plug within the tube, an outer spring confined between the adjustable plug and the small cylinder, an inner spring having one end seated on the adjusting plug, a movable seat for the other end of the inner spring and means operable on elevation of the cradle for varying the position of the movable seat.

8. In a mount for guns, a cradle trunnioned for movement in elevation, a recoil slide mounted on the cradle, an adjusting plug in the slide, a spring having one end seated on the adjusting plug, a movable seat for the other end of the spring, and means having a lost motion connection with the movable seat operable on elevation above the horizontal only of the cradle for varying the position of the movable seat.

9. In a mount for guns, a cradle trunnioned for movement in elevation, a recoil slide mounted on the cradle, a spring having one end seated on the slide, a movable seat for the other end of the spring, and means having a lost motion connection with the movable seat operable on elevation above the horizontal only of the cradle for varying the position of the movable seat.

10. In a mount for guns, a cradle trunnioned for movement in elevation, a recoil slide mounted on the cradle, a spring having one end seated on the slide, a movable seat for the other end of the spring, means for limiting rearward displacement of the movable seat under influence of the spring, and means operable on elevation only of the cradle for displacing the movable seat forwardly, said last named means having a lost motion connection with the movable seat whereby it is movable rearwardly with respect to the movable seat on depression of the cradle below horizontal.

11. In a mount for guns, a cradle, a recoil slide mounted on the cradle and having gun attaching means, resilient means normally moving the slide forwardly on the cradle, a shaft mounted in the cradle, a finger on the shaft for engaging the slide to predetermine the position of the gun attaching means, and a spring for moving the fingers out of the path of the slide on retraction of the slide.

12. In a recoiling mounted automatic gun in combination, a support rotatable in elevation, a gun frame mounted on the support for recoil movement from a normal battery position, recoil brake means having a force of restitution adapted to be varied interposed between the support and gun frame and normally holding said gun frame in its battery position, a recoiling breech bolt mounted within said gun frame and having a normal battery position therewithin, firing mechanism adapted to fire the first shot of a series with the breech bolt and gun frame in their respective battery positions and thereafter automatically displaceable to fire all subsequent shots of said series in a predetermined counterrecoil position of the breech bolt and gun frame, and means for maintaining said predetermined counterrecoil position of firing substantially constant which includes mechanism for varying said force of restitution in accordance with the angle of elevation of the support.

13. In a recoil mounted automatic gun in combination, a support rotatable in elevation, a gun frame mounted on the support for recoil and counterrecoil movement at a uniform periodic cyclic rate and having a normal battery position, recoil brake means interposed between the support and gun frame and normally holding said gun frame in its battery position under a restorative force, a breech bolt mounted in said gun frame for recoil and counterrecoil movement at a uniform periodic cyclic rate and phase relation in advance of that of the gun frame and having a normal battery position, firing mechanism actuable to fire the first shot of a series to initiate automatic operation of the breech bolt and gun frame in their respective phase relation and thereafter automatically displaceable to fire all subsequent shots at a predetermined position of the breech bolt and gun frame in counterrecoil in the same said phase relation, whereby their cyclic rates will be increased, and means for maintaining the cyclic rate of the breech bolt and gun frame uniform through various angular positions of the support which includes mechanism automatically operable by movement of the support in elevation to vary said restorative force.

14. In a recoiling mounted automatic gun, in combination, a support, a gun frame mounted on the support for recoil movement from a normal battery position, a recoiling breech bolt mounted within said gun frame and having a normal battery position therewithin firing mechanism including a cam actuable trigger and cam means adapted to actuate the trigger operatively mounted on the gun frame and a resiliently loaded actuator mounted on the support and adapted to actuably engage the cam means, resilient means normally holding said cam means in inoperative position and means for displacing said actuator to engage and displace the cam means and trigger in the battery position of the breech bolt and gun frame to fire a first shot and thereafter automatically displaceable to actuably engage

said cam means in a predetermined counterrecoil position of the breech bolt and gun frame to fire succeeding shots.

15. In a mount for guns, a cradle comprising a pair of parallel side plates adapted to be mounted for rotation in elevation, a recoil brake mounted on the rear portion of the cradle between said side plates, a cross head secured to the recoil brake in operative relation to vary the force of restitution thereof upon movement, a rack bar secured to either arm of said cross head and extending forwardly of the cradle, racks on said rack bars and compound pinions on the side plates engaging said racks and adapted to be engaged by pinions fixed on a support for the cradle.

16. In a mount for guns, a cradle comprising a pair of parallel side plates adapted to be mounted for rotation in elevation, a frame provided with guide means mounted on the rear portion of the cradle between the side plates, a slotted tubular member having spring retaining means at its front and rear ends mounted longitudinally of the cradle in said frame, a spring compressed within the tubular member between said retaining means, a cross head having arms protruding through the slots interposed between the rear spring retaining means and corresponding end of the spring, complementary rack bars extending forwardly of the cradle and slidably mounted in said guides, means securing the rear ends of the rack bars to the cross head arms for relative movement, arcuate racks attached to the forward ends of the rack bars and compound pinions having complementary gear sectors engaging said racks, whereby the force of restitution of said spring may be varied as a function of the elevation of the cradle.

17. In a trigger mechanism a support member having an ear intermediate its ends, a trigger actuating slide mounted on the support member with end portions disposed on either side of said ear, an operating rod disposed substantially parallel to the slide and having a collar normally engaging the ear, resilient means interposed between the collar and one end portion of the slide on one side of said ear for transmitting movement of the operating rod in one direction to the slide and additional resilient means interposed between the ear and the other end portion of the slide on the opposite side of said ear.

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