July 10, 1945. LA VERN E. QUINNELL ET AL 2,380,262

SOLENOID INITIATING MECHANISM FOR MACHINE GUNS OR OTHER DEVICES

Filed May 10, 1941 2 Sheets-Sheet 1

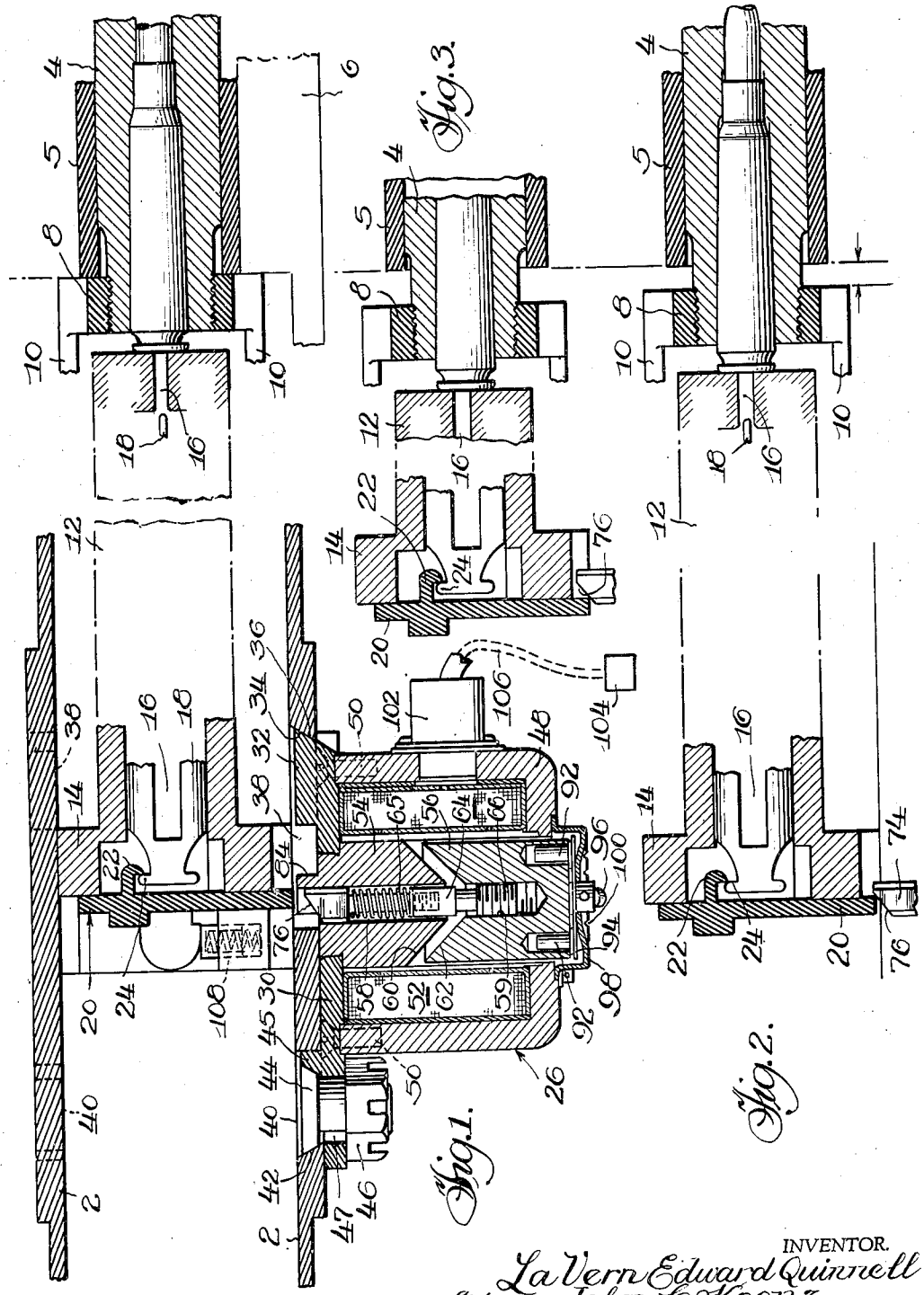


Fig. 1.

Fig. 2.

Fig. 3.

Witness:
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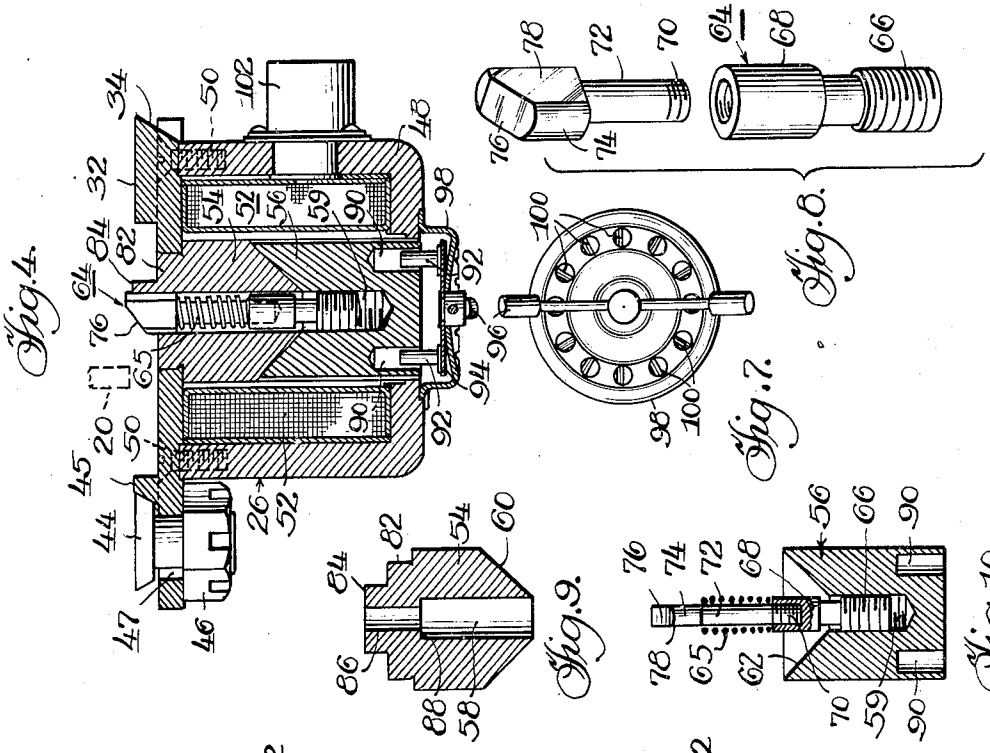


Fig. 4.

Fig. 8.

Fig. 7.

Fig. 9.

Fig. 10.

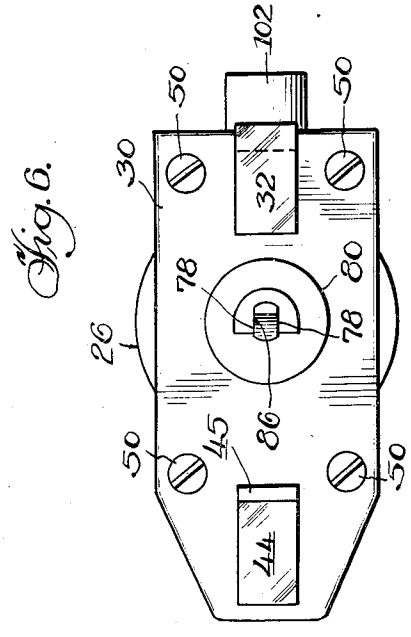


Fig. 6.

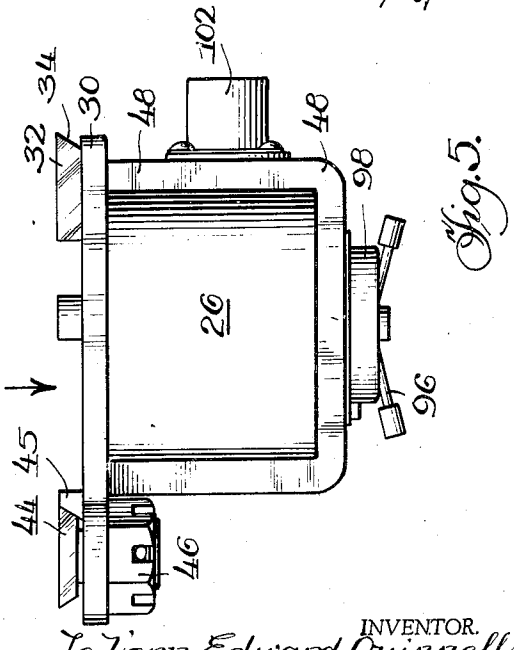


Fig. 5.

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UNITED STATES PATENT OFFICE

2,380,262

SOLENOID INITIATING MECHANISM FOR MACHINE GUNS OR OTHER DEVICES

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Application May 10, 1941, Serial No. 392,826

3 Claims. (Cl. 89—28)

This invention relates to a solenoid initiating mechanism and is particularly applicable to machine guns of the Browning type and in which the sear is operated by a sear-pin under the control of a solenoid.

Considerable difficulties have heretofore been encountered with the above-mentioned type of firing mechanism, exposed linkages and moving parts becoming coated with ice and frozen solid under certain atmospheric conditions, rendering the firing of the gun impossible.

The position of the sear-pin on the gun must be very accurately controlled when the gun is fired automatically and continuously and with present arrangements this accuracy of adjustment has been not only found difficult to obtain, but also to maintain and this primarily because with the use of a linkage between the point of adjustment and the sear-pin, particularly under varying climatic conditions, the play in the linkage destroys any chance there is of obtaining, let alone maintaining, an accurate adjustment.

Another difficulty is that this play in the linkage varies, depending upon the position of the gun, so that although a gun may fire perfectly in one position, it is apt to slow down when the gun is placed in a different position. Finally, where the gun is used in inaccessible positions, such as when employed on an airplane, the availability of the adjustment on the solenoid is important, but unfortunately this problem has not heretofore been satisfactorily solved.

With the above difficulties and disadvantages in mind, it is accordingly an object of the present invention to provide a firing mechanism for automatic firearms in which means are provided for adjusting the sear-pin with relation to the sear with micromatic exactness.

A further object of the present invention is to provide a firing mechanism which will enable the gun to be fired at that exact predetermined split second which will produce maximum efficiency and recoil power.

A still further object of the invention is to provide a firing mechanism which will be positive in action, thereby avoiding misfiring of the gun, as so often happens in existing structures.

Again another object of the invention is to provide a structure which completely encloses all of the moving parts and hence will be free from the influence of adverse atmospheric conditions.

Another object is to provide a firing mechanism in which a direct drive with no play is provided between the adjusting means and the sear pin.

Still another object is a construction in which the necessary adjustments can easily be made with one hand of the operator, and which is readily accessible in remote installations, such as in airplanes.

The invention consists in the novel constructions, arrangements and mechanisms to be hereinafter described and claimed, for carrying out the above stated objects and such other objects as will appear from the following description of the accompanying drawings which illustrate, by way of example, the application of the invention to a machine gun of the Browning type. The arrangement shown, however, is to be understood as illustrative only, and not as defining the limits of our invention.

In the drawings:

Fig. 1 is a longitudinal horizontal section showing the application of the present invention to the gun.

Fig. 2 is also a longitudinal horizontal section showing certain of the parts of the gun at the instant of sear release.

Fig. 3 is again a longitudinal horizontal section of certain parts of the gun and is included for the purpose of comparison.

Fig. 4 is a horizontal sectional view of the apparatus of the invention, but showing the parts in a position different from that in which they are shown in Fig. 1.

Fig. 5 is a top plan view of the device shown in Fig. 4.

Fig. 6 is a side elevation of the device shown in Fig. 5 looking in the direction of the arrow.

Fig. 7 is a front view of the adjusting dial.

Fig. 8 is a view of the sear-operating pin disassembled.

Fig. 9 is a vertical sectional view of the core of the solenoid, and

Fig. 10 is a vertical sectional view of the plunger of the solenoid and includes the sear-operating pin.

Referring to the drawings, the machne gun shown therein comprises a breech casing which houses the breech mechanism, the casing being as usual rectangular in form and includes the two side plates 2, 2.

Projecting from the casing at the front is a barrel 4, which again as usual, upon recoil is movable rearward to a limited extent. The barrel extends rearwardly into a bearing 5 in the trunnion block 6. Connected to the barrel 4 at the rear end thereof and bodily movable therewith is a barrel extension 8, said extension including two rearwardly extending side members 10, and

on which are mounted for longitudinal movement independently thereof a breech bolt 12 in the well-known manner. The rear part 14 of the bolt is extended transversely so as to occupy the entire width of the casing between the two side plates 2, 2.

The breech bolt 12 has a central opening 16 therein adapted to receive the firing pin 18.

At the rear of the breech bolt 12 is located a transversely and horizontally movable sear 20. The sear has a forward extending hook portion 22 which is adapted to engage a locking shoulder 24 formed on the firing pin 18.

All of the parts above described are standard in machine guns of the Browning type, as is also the mechanism through the instrumentality of which their relative operation is effected and hence it is thought unnecessary to include a more detailed description herein, as reference can be had to Patent No. 1,293,021, issued February 4, 1919, to John M. Browning, for a more detailed description, as well as to various patents issued subsequently thereto and such, for example, as Patent No. 1,803,350, issued May 5, 1931, to George H. Tansley.

Coming now to the structure according to the present invention, in order to bring about the operation of the sear 20 to effect release of the firing pin 18 at the exact predetermined split second, in one of the side plates 2, 2 of gun casing there is mounted the sear-operating mechanism designated generally by the reference 26. (See Fig. 1.)

Such mechanism comprises a solenoid having a base plate 30 at one side of which is an integral projection 32 provided with a sloping face 34 adapted to engage a cooperating face 36 forming one boundary of an opening 38 formed in the side plate 2 of the gun casing. The latter is also provided with a second opening 40 having a sloping wall 42 to receive a bolt 44 having a tapered base, said base being adapted to be secured in place between said sloping wall 42 and an opposed sloping wall on a projection 45 formed integral with the base plate 30. The bolt projects through an opening 47 in the base plate where it receives a shear nut 46 and by the screwing up of which on the bolt the sear-operating mechanism is secured firmly in place on the side plate 2.

The other side plate 2 is provided with similar openings 38 and 40, thereby making provision for the attachment of the operating mechanism to either side of the gun casing, as may be found necessary or desirable.

The yoke 48 of the solenoid is secured to the base plate 30 by any suitable means, such as screws 50. 52 indicates the field coil or coils of the solenoid, 54 the fixed core and 56 the plunger of the solenoid. Both the core 54 and plunger 56 are centrally bored to provide co-axial openings 58 and 59 extending longitudinally thereof, respectively. The juxtaposed ends of the core 54 and plunger 56 are V-shaped in cross section to afford co-operating surfaces 60, 62.

Within the openings 58, 59 is housed the sear-operating assembly comprising a pin assembly generally designated as 64 and a spring 65 encompassing a portion of the pin assembly 64. By reference to Fig. 8 it will be seen that the pin at one end is provided with an externally screw-threaded portion 66 which screws into the opening 59 (which is cooperatingly screw-threaded) in the plunger 56. Spaced from the portion 66 on the stem of the pin assembly is an internally threaded collar 68 adapted to receive a correspondingly threaded end 70 of a second pin portion 72, the opposite end of this second portion 72 being provided with a head 74 which has an angularly disposed or sloping face 76, the purpose of which will hereinafter appear. The reason for making the pin assembly in two parts is, of course, to enable the spring 65 to be slipped into place on the pin assembly 64. The head 74 is also formed with opposed flat faces 78 whereby to prevent the pin assembly from rotating with relation to the core 54 and plunger 56 by the means hereinafter described.

It will be seen from Fig. 6 that the base plate 30 is provided with a circular opening 80 to receive a stepped-back portion 82 of the core 54 (see Fig. 9), which also has a semicircular portion 84 surmounting the stepped-back portion 82 and which projects into line with the outer surfaces of the projections 32 and 45 of the base plate 30. A flat-sided opening 86 of reduced diameter is formed through the portions 82 and 84 to provide a continuation of the opening 58. This opening 86 houses and guides the head 74, the flat faces 78 cooperating with the flat sides of the opening 86, preventing the rotation of the pin assembly 64 with relation to the core 54 and plunger 56. It will be observed that the reduced diameter of the opening 86 provides a shoulder 88 at one end of the opening 58 and it is against this shoulder that one end of the spring 65 presses (instead of against the underside of the head 74), the other end of the spring engaging the collar 68.

Means is provided for adjusting the position of the plunger 56 with relation to that of the core 54 and hence of controlling the amount of movement that will be imparted to the sear-operating member, namely, the pin assembly 64, on its actuation by the solenoid. With this end in view, the plunger 56 adjacent its outer face is formed with a pair of diametrically opposed recesses 90 into which project pins 92, which, at their outer ends, are secured to or formed integral with a disc 94 adapted to be rotated by an operating lever 96 which in turn is journaled in a dish-shaped cap 98, the peripheral edges of which are fixed to the yoke 48 in any suitable manner or by any convenient means.

As shown best in Fig. 7, on its outer face the cap 98 is provided with a plurality of spaced-apart circumferentially arranged notches or recesses 100 adapted to be engaged by the lever 96. In order to insure that the lever, once it has been moved to engage a selected slot, will remain in engagement therewith, it is preferably made of spring metal and being bowed out in tension by the outer dished surface of the cap (see Fig. 5), will always "spring" into any slot with which it is brought into engagement.

102 indicates diagrammatically the connection through which the solenoid may be energized from any suitable source of power, and this may include control from a remote station 104 through a cable or electrical conductor 106.

Coming now to the operation of the gun, it is believed unnecessary to either illustrate or describe in detail the mechanism by which this is effected, as this is identical with that usually employed in guns of the type to which the invention is shown applied. Further, any well-known means, and such as the spring 108, can be employed to bias the sear 20 for movement in the direction to engage and hold the firing pin 18.

The operation of the sear 20 in the opposite direction, that is to say, to release the firing pin

18 from the sear hook 22, is brought about by the sear-operating pin assembly 64 of the present invention, the sloping or angularly disposed face 76 providing a positive and accurate means of operating the sear, and, what is more important, one by which the release of the firing pin can be timed to that exact predetermined split second to utilize fully the greatest recoil power and thus produce full maximum efficiency of the gun.

This predetermined accurate timing of release of the firing pin 18 is enhanced by the means for adjusting the extent or distance the sloping face 76 of the operating pin assembly 64 projects into the path of the sear 20, the pin assembly 64 and said adjusting means in combination providing a micrometer adjustment of the former with relation to the sear 20. The micrometric timing of the firing pin release will be appreciated when it is pointed out that the rotation of the lever 96 from one notch 100 to the next adjacent notch can be made to provide, for example, an adjustment of the sear pin assembly 64 of the order of .003". Such rotation of the lever 96 rotates the disc 94 which in turn rotates the pins 92 and the plunger 56. As the pin assembly 64 is prevented from rotating relative to core 54 and plunger 56, the pin assembly will be adjusted so that its head 74 will project more or less into the path of the sear 20 depending upon the direction of rotation of the lever 96 and the extent of movement thereof.

The energization of the solenoid in the usual manner will, of course, move the plunger 56 from the position shown in Fig. 1 to that shown in Fig. 4 to move pin assembly 64 from its inoperative to its operative position, the parts being returned to their inoperative position, on the de-energization of the solenoid, by the spring 65.

In our experiments and investigations, we have ascertained that a machine gun can be made to operate at maximum efficiency if the sear is released to in turn release the firing pin at a point when the mechanism in its forward motion is a certain distance from its extreme forward position of rest; in other words, before the barrel extension 8 contacts the rear face of the trunnion 6 of the gun in such forward motion.

In one application maximum efficiency has been found to be provided when the sear 20 is operated to release the firing pin when the front face of the extension 8 in its forward movement is .074 of an inch from the rear face of the trunnion. This is illustrated in Fig. 2 which shows the parts in the position which they occupy at the instant the firing pin 18 is released, the bolt 12 is still moving forward and by the time the .074 gap between the barrel extension 8 and the trunnion 6 is covered, the firing pin contacts the primer and explosion occurs at the exact instant that the barrel extension 8 engages the rear face of the trunnion.

By way of comparison, Fig. 3 can be referred to wherein, in the position there shown, the sear pin has been adjusted to extend too far into the path of the sear 20. Therefore, the sear 20 contacts the pin too early, with the result that firing will take place before the barrel extension 8 has had time to come to rest against the trunnion, and loss of power will follow.

Of course, our improved solenoid may be utilized as an initiating or operating means in connection with other devices, particularly where predetermined exact split second action is necessary or desirable.

Having thus described our invention, and shown one form of its application, we claim:

1. Firing pin release mechanism for automatic firearms having a breech bolt, a transversely and horizontally movable sear carried by the breech bolt, and means for biasing the sear in one direction to engage the firing pin to hold it in cocked position, comprising a solenoid, means for energizing said solenoid, a fixed core and a cooperating plunger disposed within said solenoid, a sear-operating pin housed within said plunger and core and having an angularly disposed face adapted to engage the sear in its operative position, and means for adjusting the position of said pin with relation to the sear, comprising pins mounted in openings in said plunger, a plate secured to said pins, a cap member closing the end of the solenoid, an adjustment lever secured to said plate and pivotally mounted in said cap, and a plurality of notches in the outer surface of said cap adapted to be engaged by said adjustment lever.

2. Mechanism operating means comprising a solenoid, means for energizing said solenoid, a fixed core and a cooperating plunger disposed within said solenoid, a pin assembly housed within said plunger and core and having an angularly disposed face adapted in its operative position to initiate the operation of said mechanism, and means for adjusting the position of said pin assembly with relation to said mechanism, comprising pins mounted in openings in said plunger, a plate secured to said pins, a cap member closing the end of the solenoid, an adjustment lever secured to said plate and pivotally mounted in said cap, and a plurality of notches in the outer surface of said cap adapted to be engaged by said adjustment lever.

3. In a solenoid operating mechanism, a solenoid coil, a fixed core mounted within the solenoid and having an opening therethrough extending axially of the solenoid, a pin received in said opening, said opening and pin being constructed to permit rectilinear movement of said pin in said opening and for preventing rotation thereof relative to the core, a plunger in said solenoid, means for slidably and rotatably supporting said plunger, means adjustably connecting said plunger to said pin for adjusting said pin axially of the solenoid upon the rotational adjustment of said plunger adjustably to predetermine the throw of the pin, and rotary adjustment means for micrometrically adjusting said plunger rotationally.

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