Dec. 31, 1946. A. I. OSTLUND ET AL 2,413,416

AUTOMATIC CHARGING MEANS FOR MACHINE GUNS

Filed Sept. 3, 1940 2 Sheets-Sheet 1

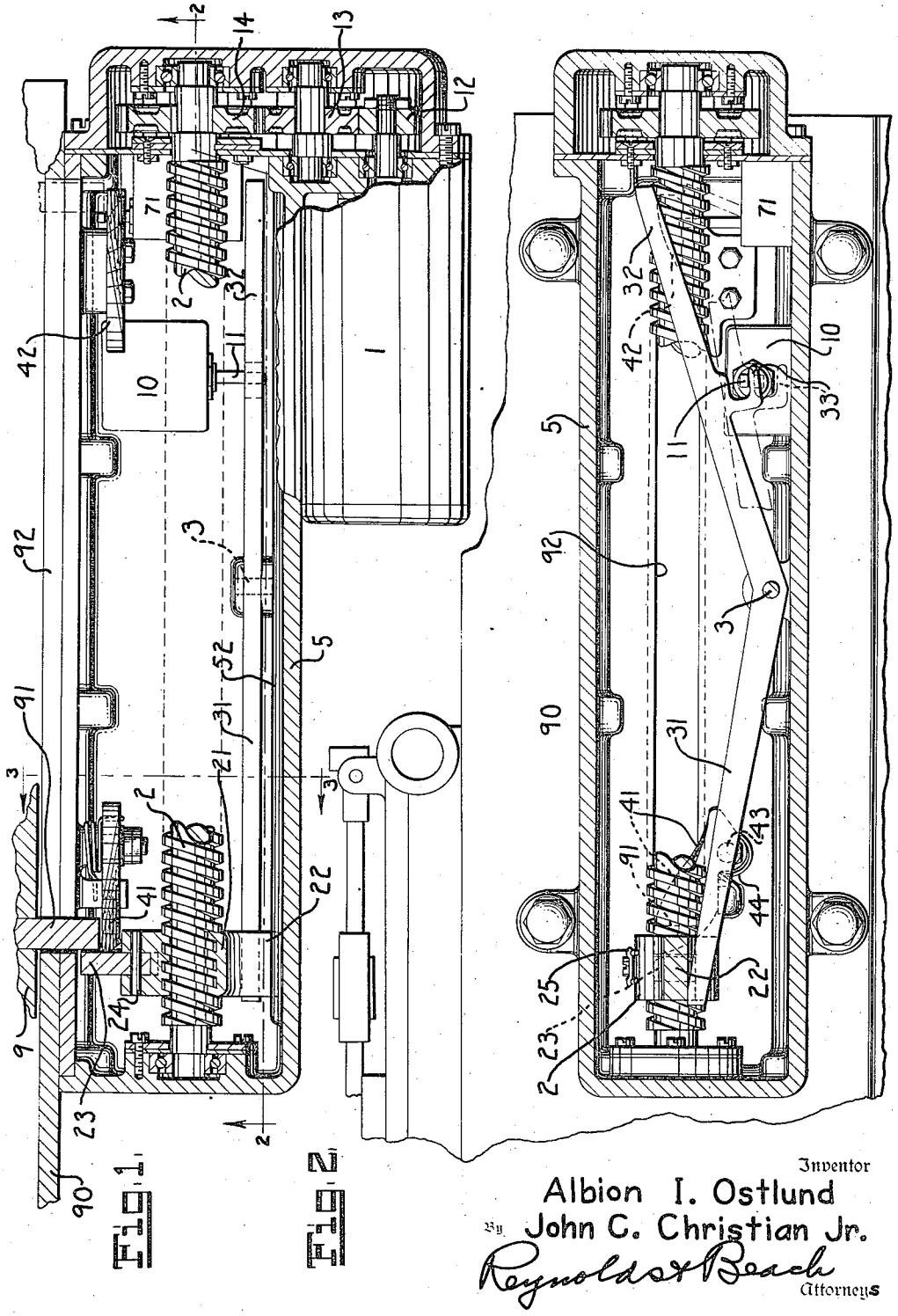


Fig. 1.

Fig. 2.

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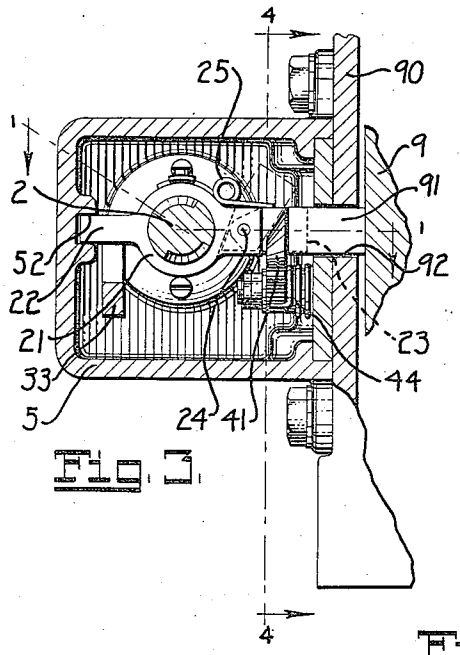


Fig. 3.

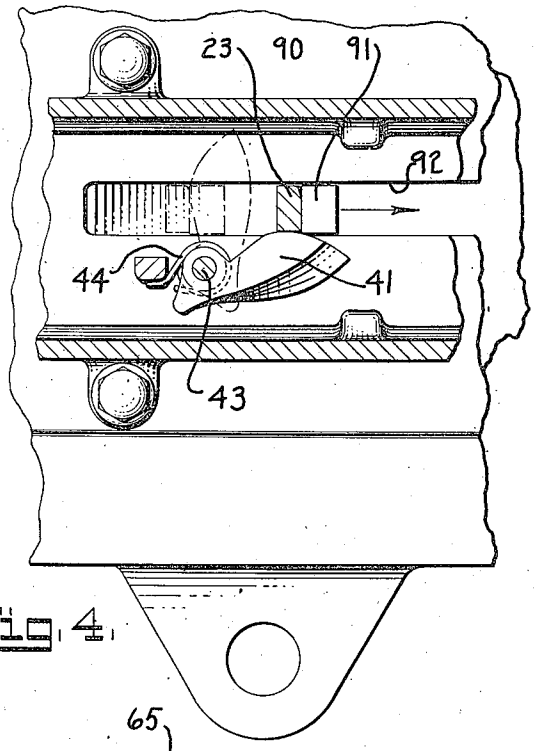


Fig. 4.

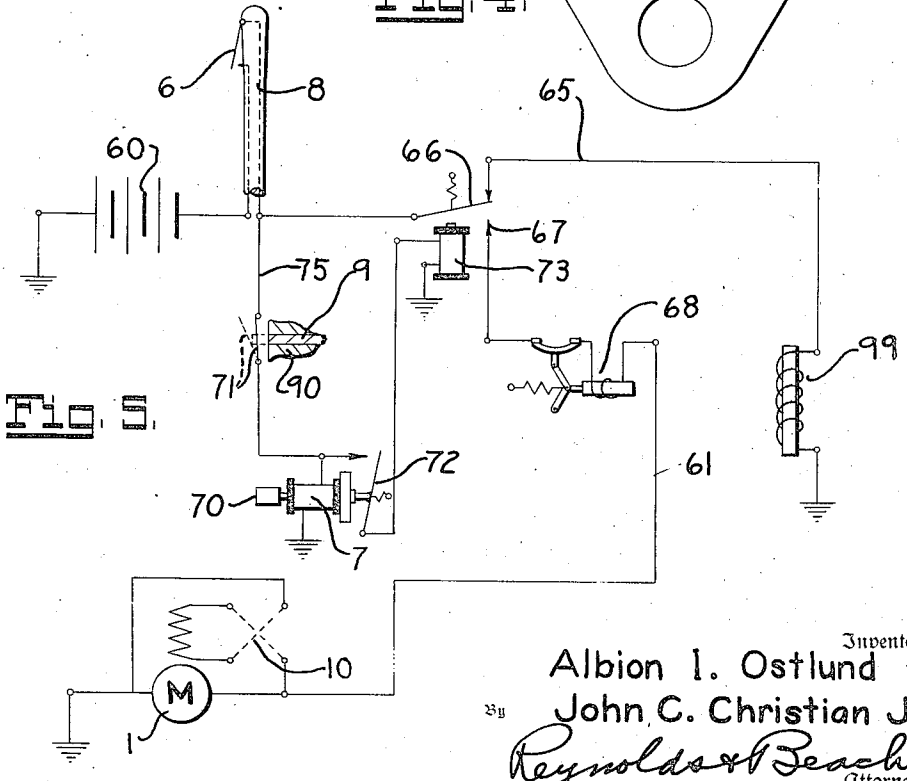


Fig. 5.

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Patented Dec. 31, 1946

2,413,416

UNITED STATES PATENT OFFICE

2,413,416

AUTOMATIC CHARGING MEANS FOR MACHINE GUNS

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Application September 3, 1940, Serial No. 355,118

7 Claims. (Cl. 89—1)

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This invention concerns machine guns, and especially such guns as are mounted at remote places upon an airplane, to be fired by the pilot or gunner by a remote control such as an electric firing key. In particular this invention concerns automatic mechanism whereby, in the event of failure to fire, which entails a failure to reload or recharge the gun, recharging means are set into operation automatically, without any action whatsoever by the pilot or gunner, to recharge the gun. If the gun has failed to fire because of a defective cartridge, in this manner this particular gun, without attention upon the part of the pilot and without interruption of firing of other guns which may be in circuit with it, is automatically recharged by power means and is again placed in condition to fire.

Associated with such means is an overload device which in the event of a jam, producing a force greater than the power means is intended to overcome, automatically disables the recharging mechanism for this particular gun, leaving all other guns free to fire without interruption.

A further object is to provide a device of the nature indicated which shall be small, compact, light, and capable of being supplied substantially as a unit for application to such machine guns as are now commonly used, and which is so constructed that it will not interfere with the normal functioning of the machine gun, yet will be so arranged and organized with respect to the machine gun parts that it will operate automatically in the manner described.

Our invention is shown in a typical form in the accompanying drawings, although it will be obvious that other forms and arrangements might be adopted within the scope of the invention as defined by appended claims.

Figure 1 is a horizontal section, substantially along the line 1—1 of Figure 3, showing the operating parts in plan and the device as applied to a machine gun.

Figure 2 is a vertical section, substantially on the line 2—2 of Figure 1, the operating mechanism being shown in elevation.

Figure 3 is a transverse section, substantially along the line 3—3 of Figure 1.

Figure 4 is a detail vertical section, the plane whereof is indicated at 4—4 in Figure 3.

Figure 5 is an electrical diagram showing the circuit arrangement incorporated with the normal firing circuit of such a gun.

In a machine gun the breech block normally reciprocates each time the gun is fired. It moves rearwardly immediately after firing under the influence of recoil or of gas pressure, admits a fresh cartridge, and, automatically reversing and moving forwardly again, advances the cartridge into the chamber, thus to recharge the gun. So long as this cycle is repeated the gun continues to fire. If a cartridge fails to fire there is no force developed to effect reciprocation of the breech block, nor consequently to effect ejection of the defective cartridge. By our invention there is provided motor means which may be associated with the breech block and with the firing circuit in such manner that the motor means is conditioned for operation, at least partially, with each firing of the gun, and so connected that when it is placed fully in operation it will positively draw back the breech block and permit the breech block to move forwardly again, to eject the defective cartridge and to recharge the gun with a fresh cartridge. However, time delay mechanism is employed in conjunction with the motor means, in such manner that the motor means is not fully conditioned for operation until after the time delay period of this time delay device expires. This period is so chosen that it is longer than the normal firing cycle of the gun. Likewise there is an interrupter, which is conveniently associated with the breech block, and which affects the power means in such fashion that every time the breech block reciprocates normally it interrupts the power means or the delivery of power thereto, and stops the further conditioning of the power means, and in addition permits or effects resetting of the time delay mechanism.

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The effect of all this is that operation of the power means is in part initiated, although actual operation does not commence, each time the gun fires. Actual operation does not commence because the time delay mechanism delays and defers each commencement, and if the firing is proceeding normally the interrupter stops the operation before it has commenced, due to the time delay. Only if the gun does not fire normally, and thus actuate the interrupter, does the time delay period expire without interruption, completing the conditioning of the motor means, and placing the latter fully in condition for operation, thereby effecting reciprocation of the breech block and making the gun ready for firing again. If the gun now fires normally the normal operation proceeds as before.

The gun casing is indicated at 90 and the breech block at 9. The gun casing is normally provided with a slot at 92, parallel to the path of reciprocation of the breech block, and through this slot may project a pin 91 which is received in the breech

block 9 to reciprocate therewith. The pin's function is twofold, to receive the force developed by the power means to effect recharging reciprocation of the breech block, and to effect interruption of the conditioning of the power means for operation each time the gun fires normally.

Mounted preferably directly upon the gun casing 90 alongside the slot 92, so that it is parallel to the path of reciprocation of the breech block 9, is a housing 5 having a slot to register with the slot 92 and which encloses the power mechanism. The power mechanism includes a small but powerful reversible electric motor 1, a reversing switch 10 therefor, and an operating finger 11 for the switch. The motor is connected by gears 12, 13 and 14 to rotate a screw 2 which is journaled in the housing 5. The gear 14 is keyed upon the screw 2 to effect positive rotation of the latter whenever the motor 1 is energized.

A nut 21 is threaded upon the screw 2, and any suitable means are provided to prevent its rotation, whereby upon rotation of the screw the nut will travel along the screw; for instance, a finger 22 is received in guideways in the housing 5. The nut is arranged to engage the breech block 9, or the pin 91 which may be considered a part of the breech block, by suitable means such as the pivoted finger or dog 23, pivoted at 24 to be tiltable in one direction but to fall by gravity or by the force of the light spring 25 into a limit position, shown in Figure 3, in which position it is aligned with the pin 91 and ahead of that pin.

Some means is provided whereby the nut upon reaching the limit of its travel in each direction will reverse the switch 10 by throwing the finger 11 thereof into one position or the other. To this end there is provided a tilting lever having the two upwardly directed arms 31 and 32 which are positioned alongside the screw 2, and a cooperating finger 22 projecting laterally from the nut 21 transversely above these lever arms, as shown in Fig. 1. As the nut approaches the left end of Figures 1 and 2 during the charging operation the finger 22 strikes the upper surface of the upwardly projecting left lever arm 31, so that it is depressed and the switch arm 11 is raised for energization of the motor to drive the nut 21 to the right in Figures 1 and 2. As the nut 21 approaches the right end of its travel its finger 22 progressively depresses the right arm 32 of the tilting lever until the switch arm 11 is likewise depressed to reverse the motor for moving nut 21 to the left to effect a further charging operation.

For the purpose of understanding the operation of the mechanism so far described it is sufficient to remember that when the electric motor 1 is energized the reversing switch 10 controlling the same is in a position to effect movement of nut 2 to the opposite end of the housing 5, say from left to right. In so moving the tiltable finger 23 engages the pin 91 on the breech block, positively draws the breech block to the right (that is, towards ejecting position) and the normal means contained within the gun will effect movement of the breech block to the left again, to recharge the gun, provided the finger 23 is released from the pin 91 upon the nut reaching the right limit of its travel. Simultaneously, since the switch 10 is reversed, the motor M will be conditioned for returning the nut 2 to the left limit of its travel.

Means must be provided for disengaging the tiltable finger 23 from the pin 91 at the right limit of the nut's travel and for moving the finger 23 past the pin 91 in the forward position shown

in Figs. 1 and 2 when the nut moves to the left limit of its travel preparatory to a charging operation. To this end the finger 23 is tiltable about the horizontal pin 24 and cams 41 and 42 are positioned to engage the finger 23. The cam 42 is immovably fixed within the housing 5 in position to cause the tiltable finger 23 to ride thereover and to tilt in the manner shown in dot-dash lines in Figure 3, and thus to be disengaged from the pin 91. When the nut is traversed to the left limit of its movement, the cam 41 is in effect fixed in position, and is so arranged that the tiltable finger 23 similarly rides up over it, and thence over and past the pin 91, and upon disengagement of the finger 23 from the cam 41 the finger drops down behind the pin 91 under the influence of gravity or of its spring 25.

It is clear that it is necessary for the tiltable finger 23 to clear the cam 41 when the finger 23 is moving the pin 91 and breech block 9 to the right in Figures 1 and 2, in the sense to effect charging of the gun. To this end the cam 41 is not fixed in position but is tiltable upon the axis 43, and is held in the position shown in Figures 1 and 2 by a spring 44. The cam 41 is so shaped that the finger 23, in moving to the right, as is best illustrated in Figure 4, tilts the cam 41 about its pivot 43 sufficiently that the finger 23 may ride over the cam while still remaining in engagement with the pin 91, as is shown as occurring in Figure 4. Once the finger 23 is past the cam 41 the latter snaps over, under the influence of its spring 44, and returns to its normal position, that shown in Figures 1 and 2, where it in turn will cause rise of the tiltable finger 23 as the latter again moves to the left.

The operation of the mechanism will now be clear though the manner of automatic control is still to be explained. Assuming that the nut 21 in its position of rest is at or near the right end of the screw 2 and finger 23 is held raised by engagement with cam 42, upon energization of the motor 1 the nut is moved to the left, during which movement the tiltable finger 23 rides up on the cam 41 and drops down into position in front of the breech block pin 91, ready to engage the latter for a charging movement to the right upon reversal of the direction of screw rotation. Substantially simultaneously the switch 10 is reversed to reverse motor M for effecting such movement to the right. As such movement of the nut to the right is initiated, finger 23 will strike the rear edge of the cam 41 to tilt it yieldingly into the solid line position shown in Figure 4, to enable the finger to pass. In this movement of the nut to the right the breech block also is positively drawn to the right by engagement of finger 23 with the breech pin or bolt handle 91, to eject the defective cartridge. Near the end of such travel of the nut to the right the finger 23, riding up on the cam 42, disengages the pin 91 and the breech block is free to be returned to its firing position at the left by the action of the gun mechanism. At the same time, or after slight additional movement of the nut to the right, the switch 10 is reversed to reverse the direction of rotation of the motor 1 and screw 10 ready for again driving the nut 21 positively to the left for effecting another charging operation.

The automatic control is best illustrated in the electrical diagram, Figure 5. A power source is represented at 60, and the firing key at 5. By means of a lead 65 these are connected in circuit with the firing solenoid 99. This is the normal firing circuit of such a gun, safety switches or

the like being omitted, but there is incorporated in this circuit a selector switch 66.

Branching from this circuit at the selector switch 66 is a motor circuit 61 running to the motor 1. This circuit is normally open or broken at the switch 66, but may be closed and the motor energized if the switch 66 is moved to contact the point 67. An overload relay 68 is included in the circuit 61 for a purpose which will shortly appear.

The control circuit 75 branches from the firing circuit between key 6 and the solenoid 99, preferably between the firing key and selector switch 66. There are in this control circuit two successively operating control means or switches, the switch 71 and the switch 72, and finally a selector relay 73 controlling the selector switch 66. The switch 71 is normally closed, but is so positioned that it is acted upon by the breech block 9 each time the gun fires, to be thereby opened. If the gun does not fire, however, the switch 71 remains closed. This switch 71 is conveniently located in the housing which is attached to the gun. Next in order in the circuit 75 is the automatically resettable time delay relay 7, with return and time delay mechanism, such as a return spring biased plunger extending through the relay and working in dash pot 70, which retards movement of the plunger to the left in Figure 5, but not to the right, and this relay 7 controls the closing of the normally open switch 72 the switch arm being secured to the relay plunger as shown.

The firing key 6 is located conveniently to the pilot, for instance on the control column or stick 8, and upon closure of the key 6, power from the source 60 is delivered by the selector 66 and circuit 65 to the solenoid 99. Current is likewise delivered by way of the control circuit 75 through the normally closed switch 71 to energize the time delay relay 7. This time delay relay is thus conditioned to close the switch 72, but does not immediately act because of the time delay enforced by the dash pot 70 or equivalent element. The latter delays closing of the switch 72 for a predetermined time, which is greater than the firing cycle of the gun. Before the relay 7 can overcome the resistance of the dash pot 70 and close the switch 72, the control circuit 75 is broken by the reciprocation of the breech block 9 and the consequent opening of the switch 71, provided the gun is firing normally. This interrupts the supply of current to the relay 7, and the relay plunger's return spring immediately resets it to its initial position, and the switch 72 likewise is fully reopened. In consequence current has not reached the selector relay 73, and there has been no change of position of the selector switch 66. The firing circuit 65 continues closed uninterruptedly, and the gun continues normal firing.

Should the gun fail to fire, the switch 71 will not be opened, as described, but after the time delay, enforced by the dash pot 70, the time delay relay 7 will close the switch 72, the selector relay 73 will be energized thereby, the selector switch 66 will move from its normal position to contact with the point 67 in the motor circuit 61, and the motor will be energized, thereby automatically effecting a charging reciprocation of the breech block. When the nut 21 approaches the right end of the screw 2, pushing the breech block ahead of it, the breech block will open switch 71 to deenergize the charging circuit including motor M, thereby releasing switch 66 to complete the firing circuit again. The coast or overrun of the motor will be sufficient to push finger 23 far enough up cam 42 to release breech block pin 91, so that the breech block can be returned forward by the gun mechanism, as previously explained. The nut 21 will thus remain in this position until the charging circuit is again energized. Whether the reversing switch 10 is shifted during the overrun of the motor or after the next charging cycle is initiated is immaterial. All this time the firing key 6 is closed normally, and if the gun is thus made ready to fire, it will resume firing and will continue to fire in the normal manner. So long as it is firing the switch 71 is opened with each firing and there is no further energization of the motor means, until the gun again fails to fire, and then energization of the motor means is automatic, through the instrumentality of the firing key.

In case of a jam, the gun may fail to fire, and the motor circuit will become energized, as described, but will be unable to clear the jam and to resume firing. It is undesirable to maintain the motor circuit closed if the motor cannot function, therefore the overload relay 68 is provided in the motor circuit, which, at such a time, will open the motor circuit, and the efforts to recharge the gun will then cease.

In all this there is no positive action required by the pilot or gunner. So long as he wishes to fire, he merely holds the firing key 6 closed, and the gun will either fire normally or will be automatically operated by the power means to recharge it and to resume automatically the normal firing.

What we claim as our invention is:

1. Control mechanism for a machine gun of the type including a breech block forwardly and rearwardly movable between closed and open positions, respectively, said mechanism comprising a screw to be mounted on the gun alongside the path of movement of the breech block, a nut threaded upon said screw for forward and rearward movement therealong responsive to rotation of the screw, normally inactive motor means operatively connected to said screw for rotating the same, a finger mounted upon said nut for movement therewith along said screw and also for movement transversely with respect thereto and during such movement being adapted to engage a portion of the breech block, cam means operable in response to forward movement of said nut and finger along said screw to deflect said finger transversely relative to said nut so that it will not engage said portion of the breech block during said forward movement, means to deflect said finger to adapt it to assume a position in front of said portion of the breech block following its first mentioned deflection so that upon subsequent rearward movement of said nut and finger the latter is adapted to act against said portion of the breech block to retract the latter, means mounting said cam means for deflection by said finger out of the path of rearward movement of said finger, and means for controlling operation of said motor means.

2. Control mechanism for a machine gun of the type including a breech block forwardly and rearwardly reciprocable between closed and open positions, respectively, said mechanism comprising a screw to be mounted on the gun alongside the path of reciprocation of the breech block, a nut threaded upon said screw for forward and rearward movement therealong responsive to rotation of said screw, normally inactive motor means operatively connected to said screw for rotating the same, a finger mounted upon said nut for movement therewith along said screw and

also for movement transversely with respect thereto and during such movement being adapted to engage a portion of the breech block, means operable in response to forward movement of said nut and finger along said screw to deflect said finger to cause it to assume a position in front of a portion of the breech block when the latter is in its forward position whereby upon subsequent rearward movement of said nut and finger the breech block will be retracted, means operable by rearward movement of said nut and finger to move said finger transversely relative to said nut and thus shift said finger from in front of said portion of the breech block to release the latter for return to its forward position, and means for controlling operation of said motor means.

3. Control mechanism for a machine gun of the type including a breech block forwardly and rearwardly reciprocable between closed and open positions, respectively, and having a pin projecting laterally therefrom, said mechanism comprising a screw to be mounted on the gun alongside the path of reciprocation of the breech block, a nut threaded upon said screw for forward and rearward movement therealong responsive to rotation of said screw, normally inactive motor means operatively connected to said screw for rotating the same, a finger mounted upon said nut for movement therewith along said screw and also for movement transversely with respect thereto and during such movements being adapted to engage said pin, means operable in response to forward movement of said nut and finger along said screw to deflect said finger so that it assumes a position in front of said pin when the breech block is in its forward position whereby upon subsequent rearward movement of said nut and finger the breech block will be retracted, cam means operable responsive to rearward movement of said nut and finger to move the latter transversely relative to said nut and thus shift said finger from its position in front of said pin to release the breech block for return to its forward position, and means for controlling operation of said motor means.

4. Gun charging mechanism for a machine gun, said mechanism comprising an electric motor to be mounted upon and operatively connected to the gun to effect positive actuation thereof in the event of its failure to function, a motor energizing circuit in which said motor is included, a normally open motor control switch in said circuit, a control circuit including electrically operable means for closing said motor control switch upon closing of said control circuit, a normally closed switch in said control circuit, a time delay switch device also in said control circuit between said normally closed switch and said electrically operable means to delay closing of said control circuit and consequent closing of said motor control switch in the event of said normally closed switch remaining closed during an appreciable period of time as when the gun fails to function, and means for momentarily opening said normally closed switch during each cycle of operation of the gun to insure against the control circuit remaining closed amply long to close said motor control switch as long as the gun functions properly.

5. Gun charging mechanism as set forth in claim 4 including a firing key switch controlling both the motor energizing circuit and the control circuit.

6. Gun charging mechanism for a machine gun of the type including a breech block forwardly and rearwardly reciprocable between closed and open positions, respectively, said mechanism comprising a reversible electric motor to be mounted upon the gun and operatively connected to the breech block to effect positive retraction and subsequent release thereof whenever the gun fails to function, a motor energizing circuit in which said motor is included, a reversing switch in said circuit, means driven by said motor to actuate said switch to effect reversal of said motor for effecting retraction and subsequent release of the breech block, a normally open motor control switch also in said circuit, a control circuit including electrically operable means for closing said motor control switch upon closing of said control circuit, a normally closed switch in said control circuit, a time delay switch device also in said control circuit between said normally closed switch and said electrically operable means to delay closing of said control circuit and consequent closing of said motor control switch in the event of said normally closed switch remaining closed during an appreciable period of time as when the gun fails to function, means for momentarily opening said normally closed switch during each cycle of operation of the gun to insure against the control circuit remaining closed amply long to close said motor control switch as long as the gun functions properly, and a firing key switch controlling both said motor energizing circuit and said control circuit.

7. Control mechanism for a machine gun of the type including a breech block forwardly and rearwardly reciprocable between open and closed positions, respectively, said mechanism comprising a reciprocable traveler to be mounted upon the gun for forward and rearward movement in a path alongside the path of reciprocation of the breech block, means including a motor for effecting forward and rearward movement of said traveler, means for controlling operation of said motor, means including a cam operable in response to forward movement of said traveler to shift the latter so that it assumes a position in front of a part of the breech block when the latter is in its forward position whereby upon subsequent rearward movement of the traveler the breech block will be retracted, means mounting said cam for deflection by said traveler during rearward movement thereof to a position out of the way of rearward movement of said traveler, and a second cam operable in response to rearward movement of said traveler to shift the latter and thus move it from its position in front of the breech block part to release the breech block for projection to its forward position.

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