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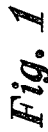
W. E. NAUGLER

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GUN CHARGING MECHANISM

Filed Dec. 23, 1943


2 Sheets-Sheet 1



Inventor

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By His Attorney

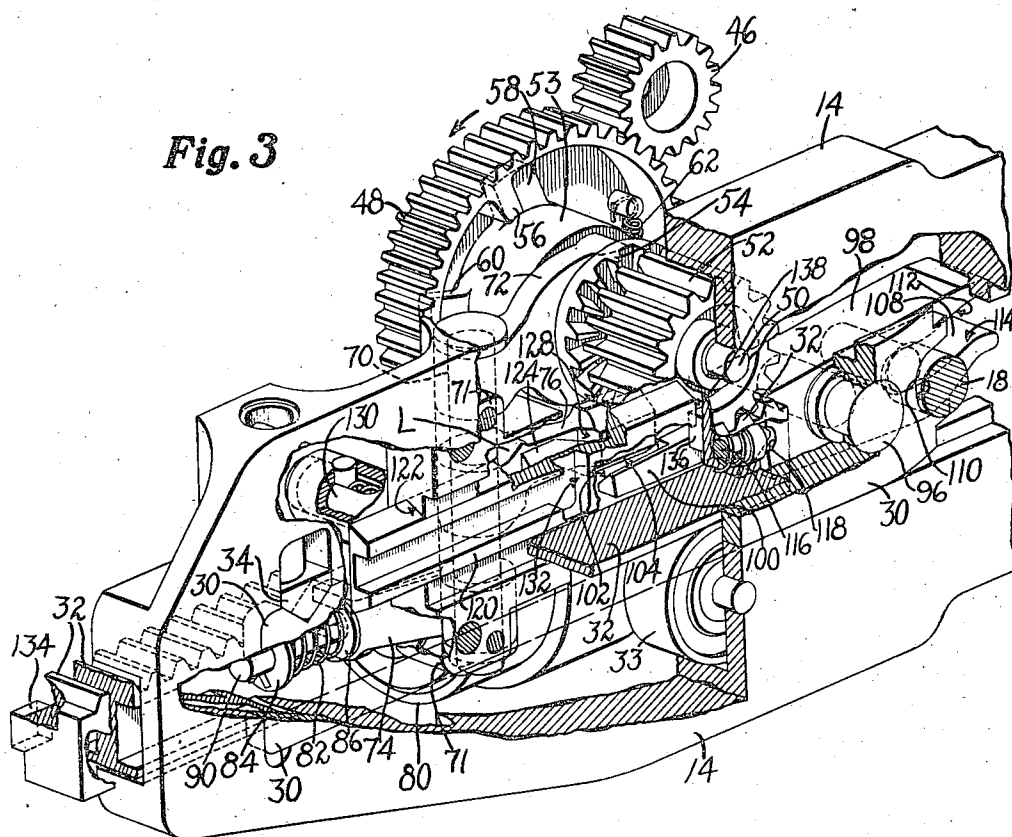
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UNITED STATES PATENT OFFICE

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GUN CHARGING MECHANISM

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16 Claims. (Cl. 89—1)

1

This invention relates to mechanism for producing in a machine-gun the recoil movement of the breech-bolt if this does not result from gun-discharge, the invention being particularly directed to the effecting of this charging automatically.

In certain machine-guns, the recoil caused by the discharge is depended upon to effect various operations at the breech mechanism, which prepare for the succeeding discharge. If for any reason this recoil does not occur, the action of the gun is arrested until a movement corresponding to that of recoil has been produced. This may be manually, with the expenditure of much time and effort on the part of the gunner, or automatically, by the application of power from a source external to the gun. It is an object of my invention to obtain the charging effect by simple mechanism which adds few parts and little weight to the gun, yet acts promptly and positively when recoil is absent. In the attainment of this object, I combine with a gun having a breech-bolt movable in recoil and counter-recoil, a motor, a movable charging member, as a reciprocatory rack acting upon the breech-bolt to produce its movement in the direction of recoil, and means, preferably a clutch, for connecting the motor to the member to cause the charging movement of the breech-bolt, together with means for rendering the connecting means effective, as by preparing the clutch for engagement during each counter-recoil-movement of the breech-bolt, so, if it is necessary, the power of the motor may be applied to the charging member. If the recoil-movement occurs in the normal operation of the gun, the connecting means is rendered ineffective, the engagement of the clutch being prevented. Means is provided whereby, if the charging member is set in operation by the connecting means, said connecting means is disengaged at the termination of the charging movement. More specifically, I employ a motor, which may be mounted upon the gun, said motor being geared through an interposed clutch to a reciprocatory rack acting upon the breech-bolt. A lever, fulcrumed upon the gun, has an arm acting upon the clutch, another arm acted upon by means to engage the clutch, and a third arm acted upon by means to control said clutch, as by freeing it in preparation for engagement in absence of normal recoil or by locking it against engagement if recoil occurs. This controlling means preferably consists of a cam-lever, carried by the charging rack and actuated by the breech-bolt. The third arm of the lever may also serve to cause the disengagement of the clutch at the termination of the charging movement, it being acted upon by a slide movable upon the gun under the influence of the rack.

In the accompanying drawings is shown a ma-

2

chine-gun to which a particular embodiment of my invention is applied.

Fig. 1 illustrating the breech-casing of the gun with my improved charging mechanism in side elevation;

Fig. 2 being a top plan view of said mechanism and the rear portion of the gun-casing;

Fig. 3, an enlarged perspective view taken from the rear of Fig. 2, this being of the charging mechanism separated from the gun; and

Fig. 4, an enlarged, irregular horizontal section, taken generally on the line IV—IV of Fig. 1.

At 10 appears the breech-casing of a machine-gun of the Browning type, from the forward extremity of which casing extends the barrel 12. An opening in one side of the casing, here shown as the right, is closed by a removable cover-plate 14, in which is a longitudinal slot 16. Through this slot projects a stud 18 from the breech-bolt 20, guided to reciprocate within the casing. As is usual in this gun, energization of the firing solenoid 22 mounted upon the opposite side of the casing causes the discharge of a cartridge, which the breech-bolt under the influence of its counter-recoil-spring has inserted in the barrel from a series assembled in a belt. One of these cartridges appears at C in Fig. 1. The recoil of the breech-bolt produced by the discharge causes the ejection of the empty cartridge-case and the delivery of the succeeding cartridge from the belt into position for introduction into the barrel by the breech-bolt during the counter-recoil. As long as the circuit of the firing solenoid is maintained closed, this feed of cartridges from the belt and their discharge will normally be maintained. If, however, this normal action is interrupted, as because of the failure of a cartridge to explode, it will be necessary to charge the gun by imparting to the breech-bolt its recoil-movement by a force applied to the stud 18. This force, which must compress the counter-recoil-spring, is considerable, making it difficult to perform manually and consuming considerable time. During the closure of the circuit of the firing solenoid, my invention effects the charging of the gun automatically whenever the breech-bolt fails to receive its movement of recoil.

Guided in ways in the inner face of the cover-plate 14, for reciprocation longitudinally of the gun, is a slide 30 to which is attached a charging member in the form of a rack 32, supported at its underside by a roll 33 rotatable upon the cover-plate. The slide is so located that the rear extremity is aligned and may travel in contact with the breech-bolt-stud 18. A spring-plunger 34, movable in the cover-plate, engages a depression in the slide to hold the rack releasably in its forward inactive position (Fig. 1). To move the rack rearwardly, and by its engagement with the stud impart to the breech-

bolt its travel corresponding to that of normal recoil, there is mounted upon a bracket 35 secured to the cover-plate a small electric motor 36, the rotation of its armature being communicated through reduction-gearing contained in a casing 38 to a pinion 40. This pinion meshes with a gear 42 upon a shaft 44 journaled in the casing, and a pinion 46 upon the shaft 44 meshes with a gear 48 turning about a spindle 50 extending between an extension from the casing 38 and the cover-plate of the gun. Rotatable about the inner end of the spindle is a pinion 52, meshing with the teeth of the rack 32. The rotation of the gear 48 may be communicated to the pinion 52 through a clutch-sleeve 53, rotatable with the gear and movable longitudinally of the spindle. At its inner extremity, the sleeve has teeth 54, adapted to enter between the ends of the teeth of the pinion 52 to effect its rotation. The sleeve is connected to the gear with a capacity for lost motion. From the interior of the gear, a projection 56 lies between projections 58 and 60 from the sleeve (Fig. 3). A tension-spring 62, joining the gear to the sleeve, normally holds the sleeve-projection 58 against the gear-projection. When the sleeve in its outward position is disconnected from the pinion 52, it rotates idly with the gear 48. Upon connection of the sleeve to the pinion by the teeth 54, the gear-projection first leaves the sleeve-projection 58, the spring 62 yielding and the pinion remaining at rest. This continues until the gear-projection engages the sleeve-projection 60, whereupon the sleeve and pinion begin to rotate, this continuing until the sleeve-teeth are disengaged from the pinion by outward movement of the sleeve.

To shift the clutch-sleeve 53 to produce movement of the rack rearwardly of the gun, with the slide 30 in contact with the stud 18 of the breech-bolt, or to free said rack from the driving means for return to its normal position by the breech-bolt-stud, a lever L is provided. This lever is fulcrumed by a vertical spindle 70 in a bracket 71 upon the cover-plate, and has three arms 72, 74 and 76. The upper arm 72 is yoked to enter opposite sides of a circumferential groove in the sleeve 53 to shift this. The lower arm 74, to cause the movement of the arm 72 and the sleeve, is actuated by the plunger 78 of a solenoid 80 mounted upon the cover-plate 14. When energized, the solenoid imparts to the plunger movement of a definite extent, this being communicated to the lever L through a compression-spring 82 interposed between a washer 84, held in place upon the outer extremity of the plunger, and a washer 86 abutting against the outer side of the arm 74. A flange 88 upon the plunger, against which the spring urges the arm 74, determines the normal position of the arm along the plunger and the corresponding position of the clutch-sleeve. To permit adjustment of this normal relation between the sleeve-teeth 54 and the pinion 52, the spring 82, washers 84 and 86, and flange 88 may be carried by a plunger-extension 90. This extension is threaded into the end of the plunger-proper and retained in its adjusted position by a check-nut 92. As the extension is adjusted in or out, the clutch-teeth 54 are correspondingly moved toward or from the end of the pinion 52. After energization of the solenoid, its plunger is restored to its initial position by an expansion-spring 94, interposed between the inner end of the plunger and the interior of the solenoid-casing.

The clutch-solenoid is energized simultaneously with the motor 36 and the firing solenoid 22, so that, as long as the trigger of the gun is actuated, the lever-arm 72 will tend to hold the clutch 54, 52 engaged for the production of the charging movement of the rack 32. This, however, should occur only in absence of normal recoil. To prevent the engagement of the clutch when such recoil occurs, the rack has fulcrumed at 96 upon its rear extremity a cam-lever 98. A forwardly extending arm 100 of the lever has at its outer side a cam-surface 102, which, upon upward movement of the arm, may be forced against a complementally inclined surface 104 upon the underside of the arm 76 of lever L. This holds the lever-arm 72 in its outward position, locking the clutch temporarily against engagement. At the opposite side of the fulcrum 96, the lever 98 has a cam-slot 108 opening through its end. The throat of this slot is in the path of the stud 18, so that, upon each counter-recoil-movement of the breech-bolt, the stud enters the slot. The inner or forward extremity of the slot lies somewhat beyond the end-surface 110 of the slide, so it is this surface which furnishes operating engagement with the breech-bolt-stud. From its outer opening, the slot 108 curves downwardly and inwardly, the effect being that, when the stud enters the slot, it rocks the lever 98 in a clockwise direction (Fig. 1) by contact with the upper surface 112 of the slot. This unlocks the clutch by removing the arm 100 of the cam-lever 98 from contact with the lever-arm 76, permitting engagement of the clutch and the consequent charging movement of the rack 32. When the stud 18 emerges from the slot 108, it bears against a lower surface 114 of said slot to turn the cam-lever counterclockwise, and thereby engage the lever-arm 76 to lock the clutch open. In its clutch-locking relation, the cam-lever is latched by a spring-plunger 116, movable through the end of the rack and entering a depression 118 in the lever.

If the energization of the solenoid 80 causes the forward charging movement of the rack 32 by engagement of the clutch, this must be disengaged when said rack has completed such movement. For this purpose a slide 120 is guided in ways 122 at the inner side of the bracket 71. From the outer face of this slide are two projections 124 and 126, the former of which is movable along a depression at the inner side of the lever-arm 76 to occupy either an inactive position, as appears in Fig. 4, or forced against an inclined surface 128 upon the lever-arm. In the first of these positions, the slide is latched by engagement of a spring-plunger 130, movable in the bracket 71, with the rear side of the slide-projection 126, while the active position is temporarily maintained by the engagement of the plunger with the opposite side of this projection. Into its clutch-disengaging relation, the slide is urged by contact with a surface 132 upon it of a projection 134 from the forward end of the rack. A projection 136 from the opposite extremity of the rack strikes against a surface 138 upon the slide to release the lever-arm 76 and permit clutch-engagement.

Considering the gun is ready for firing, the breech-bolt-stud 18 is forward in its counter-recoil position at the end of the slot 108 in the cam-lever 98, as appears in Figs. 1 and 3. This stud, in seating itself in the slot after the passage 75 through the throat, has by contact with the sur-

face 112 withdrawn the cam-surface 102 of the arm 100 from engagement with the surface 104 of the arm 76, leaving the clutch lever L free for control by the solenoid 80. The projection 136 of the rack has moved the slide 120 to the right (Fig. 4), where it is latched by the plunger 130 engaging the rear side of the projection 126. The slide-projection 124 is opposite the depression in the clutch-lever-arm 76, so actuation of the clutch-lever by the solenoid is not interfered with. The gunner presses the trigger of the gun, completing not only the circuit of the firing solenoid 22, but also that of the motor 36 and the clutch-solenoid 80. If an explosion occurs normally, the recoil drives the bolt-stud back to the rear of the slot 16 in the cover-plate 14. As the stud first travels in the cam-slot 108, the energization of the solenoid 80 may cause the engagement of the clutch 54, 52, but the travel of the gear-projection 56 away from the sleeve-projection 58, where it is held yieldably by the spring 62, to the projection 60 prevents transmission of power to the rack 32 during this brief interval. Before the lost motion has been taken up, the stud will have reached the throat of the cam-slot, striking the surface 114 and raising the arm 100 of the cam-lever. The lever-surface 102 engages the clutch-lever-surface 104, and locks the clutch open and ineffective, so the rack 32 remains at rest. The cam-lever is latched in this relation by the plunger 116. The breech-bolt is returned by the counter-recoil-spring to complete the normal firing cycle, restoring the elements to the positions of Fig. 1.

If the cartridge had not exploded, so there would have been no recoil of the breech-bolt, the energization of the motor 36 and solenoid 80 with the firing solenoid 22 would occur as before. Since the arm 100 of the cam-lever has freed the clutch lever L to prepare for clutch-engagement, as above pointed out, the solenoid 80 may now operate the clutch-lever to shift the clutch-sleeve 53 into driving contact with the pinion 52. The rack is carried to the left (Fig. 1) by the motor 36 and interposed gearing, and the end 110 of the slide 30, which may be considered to be a portion of said rack, is forced against the stud 18 to shift the breech-bolt through its rearward operating travel. The cam-lever travels with the stud without movement about its fulcrum, and the clutch is unaffected. The driving of the rack and breech-bolt continues until the rack-projection 134 strikes the surface 132 of the slide 120, and forces the projection 124 against the clutch-lever-surface 128, turning such lever to disengage the clutch and terminate the charging movement. The counter-recoil of the breech-bolt, through contact of the stud with the surface 110, restores the elements to their initial positions, as previously indicated. The gun may now take up its regular operation, or, if it fails to fire, the action of the charging mechanism will be repeated automatically.

Having described my invention, what I claim as new and desire to secure by Letters Patent of the United States is:

1. The combination with a gun having a breech-bolt movable in recoil and counter-recoil, of a motor, a movable charging member acting upon the breech-bolt to produce its movement in the direction of recoil, means for connecting the motor to the member to cause the charging movement of the breech-bolt, said connecting means being normally ineffective to produce such move-

ment, and means controlled by the breech-bolt for rendering the connecting means effective.

2. The combination with a gun having a breech-bolt movable in recoil and counter-recoil, of a motor, a movable charging member acting upon the breech-bolt to produce its movement in the direction of recoil, means for connecting the motor to the member to cause the charging movement of the breech-bolt, said connecting means being capable of being effective or ineffective to cause such movement, and means movable by the breech-bolt for rendering the connecting means effective during a portion of each counter-recoil-movement of the breech-bolt and for rendering the connecting means ineffective if the recoil-movement of the breech-bolt occurs.

3. The combination with a gun having a breech-bolt movable in recoil and counter-recoil, of a motor mounted on the gun and rotating continuously during the operating period of the gun, a movable charging member acting upon the breech-bolt to produce its movement in the direction of recoil, means connecting the motor to the member including a clutch having elements constructed and arranged for engagement with each other in the performance of their function of transmitting power from the motor to the member to cause the charging movement of the breech-bolt, and means movable by the breech-bolt for preparing the clutch for engagement.

4. The combination with a gun having a reciprocatory breech-bolt movable in recoil and counter-recoil, of a motor mounted on the gun and rotating continuously during the operating period of the gun, a movable charging member acting upon the breech-bolt to produce its movement in the direction of recoil, means connecting the motor to the member including a clutch having elements constructed and arranged for engagement with each other in the performance of their function of transmitting power from the motor to the member to cause the charging movement of the breech-bolt, and means actuated by the breech-bolt upon each counter-recoil movement for preparing the clutch for engagement and for preventing engagement of the clutch if the recoil-movement of the breech-bolt occurs.

5. The combination with a gun having a reciprocatory breech-bolt movable in recoil and counter-recoil, of a motor mounted on the gun, a movable charging member acting upon the breech-bolt to produce its movement in the direction of a recoil, means for connecting the motor to the member to cause the charging movement of the breech-bolt, said connecting means being capable of being effective or ineffective to cause such movement, and means having a portion carried by the charging member and actuated by the breech-bolt for rendering the connecting means effective upon each counter-recoil-movement of the breech-bolt and for rendering the connecting means ineffective if the recoil-movement of the breech-bolt occurs.

6. The combination with a gun having a reciprocatory breech-bolt movable in recoil and counter-recoil, of a motor mounted on the gun and rotating continuously during the operating period of the gun, a movable charging member acting upon the breech-bolt to produce its movement in the direction of recoil, means connecting the motor to the member including a clutch having elements constructed and arranged for engagement with each other in the performance of their function of transmitting power from the motor to the member to cause the charging move-

ment of the breech-bolt and for disengagement from each other to stop the charging movement, means for preparing the clutch for engagement upon each counter-recoil-movement of the breech-bolt, means for producing the engagement of the thus-prepared clutch, and means other than the engaging means for disengaging the clutch at the termination of the charging movement.

7. The combination with a gun having a reciprocatory breech-bolt movable in recoil and counter-recoil, of a motor mounted on the gun, a movable charging member acting upon the breech-bolt to produce its movement in the direction of recoil, means for connecting the motor to the member to cause the charging movement of the breech-bolt, said connecting means being normally ineffective to produce such movement, means for rendering the connecting means effective in each counter-recoil-movement of the breech-bolt, and means for introducing lost motion in the connecting means during the initial portion of the recoil-movement.

8. The combination with a gun having a reciprocatory breech-bolt movable in recoil and counter-recoil, of a motor mounted on the gun and rotating continuously during the operating period of the gun, a movable charging member acting upon the breech-bolt to produce its movement in the direction of recoil, gearing connecting the motor to the member to cause its charging movement, one of the elements of the gearing being yieldable with respect to another of said elements, said gearing including a clutch having elements constructed and arranged for engagement with each other to transmit the charging movement from the motor to the member, means for preparing the clutch for engagement in each counter-recoil-movement of the breech-bolt, and means other than the preparing means for producing engagement of the clutch.

9. The combination with a gun having a breech-bolt, of a motor rotating continuously during the period of operation of the gun, a member movable upon the gun and acting upon the breech-bolt, gearing rotatable by the motor to move the member, and a clutch controlled by the breech-bolt and through which the rotation of the gearing is transmitted to the member.

10. The combination with a gun having a reciprocatory breech-bolt, of a motor rotating continuously during the period of operation of the gun, a rack guided to reciprocate upon the gun and acting upon the breech-bolt, a gear rotatable by the motor and meshing with the rack, a clutch element constructed and arranged for engagement with the gear to transmit the rotation of the motor to the gear, and a member movable upon the rack and controlling the engagement of the clutch element.

11. The combination with a gun having a reciprocatory breech-bolt, of a motor rotating continuously during the period of operation of the gun, a rack guided to reciprocate upon the gun, a gear rotatable by the motor and meshing with the rack, means connecting the motor to the gear including a clutch through which the rotation of the motor is transmitted to the gear, and a member movable upon the rack by contact of the breech-bolt with the member to control the clutch.

12. The combination with a gun having a reciprocatory breech-bolt, of a motor, a rack guided

to reciprocate upon the gun, a gear rotatable by the motor and meshing with the rack, means for transmitting the rotation of the motor to the gear including a clutch having elements constructed and arranged for engagement with each other to cause rotation of the gear and for disengagement from each other to stop rotation of the gear, a member movable upon the rack by contact of the breech-bolt to control the clutch, and a member movable by the rack to disengage the clutch.

13. The combination with a gun having a reciprocatory breech-bolt provided with a projection, of a motor rotating continuously during the period of operation of the gun, a rack guided to reciprocate upon the gun, a gear rotatable by the motor and meshing with the rack, means for transmitting the rotation of the motor to the gear including a clutch having elements constructed and arranged for engagement with each other to cause rotation of the gear, a lever fulcrumed upon the rack and having a cam-slot to receive the breech-bolt-projection and thereby move the lever upon the rack by contact of the projection with the slot-wall, and means movable by the lever to control the clutch.

14. The combination with a gun having a reciprocatory breech-bolt provided with a projection, of a motor mounted upon the gun, a rack guided to reciprocate upon the gun, a gear rotatable by the motor and meshing with the rack, means for transmitting the rotation of the motor to the gear including a clutch having elements constructed and arranged for engagement with each other to cause rotation of the gear, a lever fulcrumed upon the rack and having a cam-slot to receive the breech-bolt-projection and thereby move the lever upon the rack by contact of the projection with the slot-wall, means movable by the lever to prepare the clutch for engagement, and slide movable upon the gun by the rack to disengage the clutch.

15. The combination with a gun having a reciprocatory breech-bolt, of a motor rotating continuously during the operating period of the gun, a rack guided to reciprocate upon the gun, a gear rotatable by the motor and meshing with the rack, means for transmitting the rotation of the motor to the gear including a clutch having elements constructed and arranged for engagement with each other to cause rotation of the gear and for disengagement from each other to stop rotation of the gear, a lever fulcrumed upon the gun, and means acting upon the lever to engage and disengage the clutch.

16. The combination with a gun having a reciprocatory breech-bolt, of a motor mounted upon the gun and rotating continuously during the operating period of the gun, a rack guided to reciprocate upon the gun, a gear rotatable by the motor and meshing with the rack, means for transmitting the rotation of the motor to the gear including a clutch having elements constructed and arranged for engagement with each other to cause rotation of the gear and for disengagement from each other to stop rotation of the gear, a lever fulcrumed upon the gun and having a plurality of arms, one of said arms being arranged to lock the clutch against engagement, means acting upon a second arm to engage the clutch, and means acting upon a third arm to disengage the clutch.

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