No. 618,743. Patented Jan. 31, 1899.

L. SILVERMAN.

GAS OPERATED MACHINE GUN.

(Application filed Sept. 22, 1898.)

(No Model.) 5 Sheets—Sheet 1

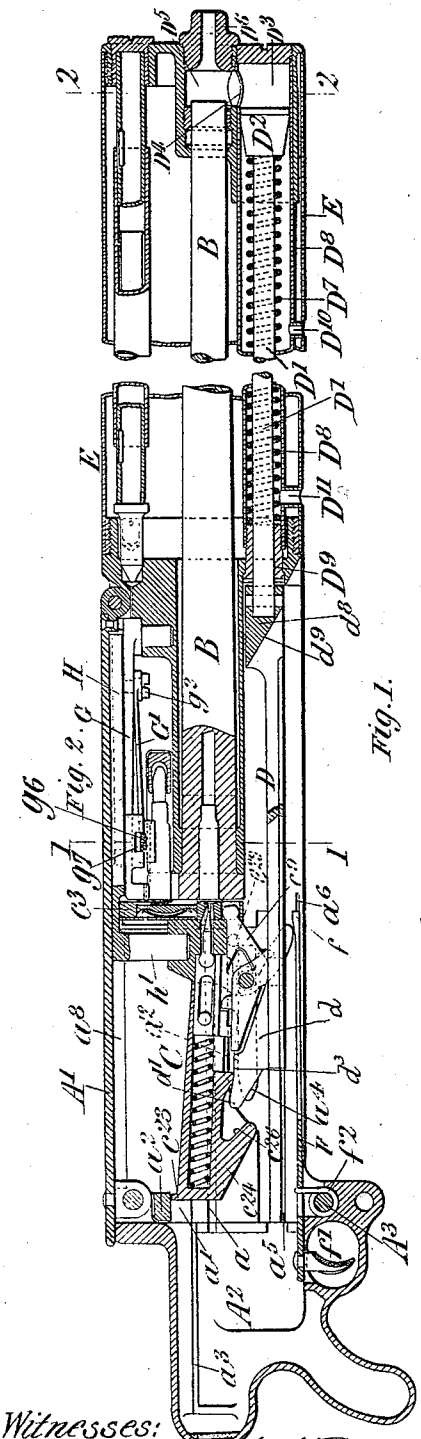


Fig. 1.

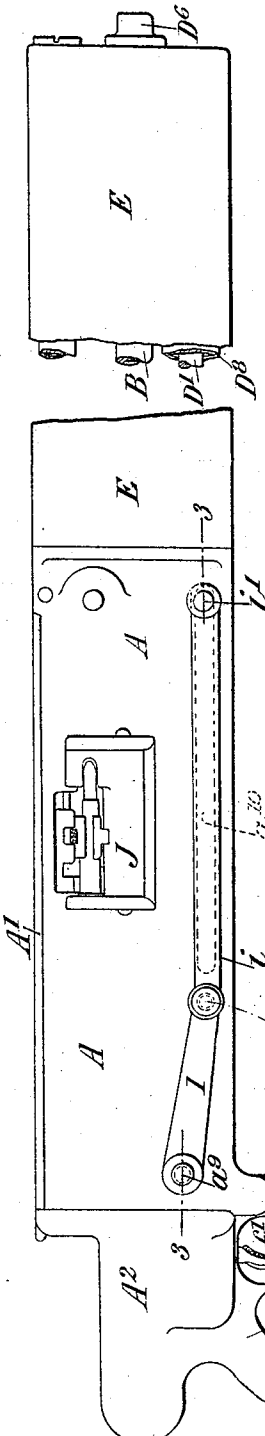
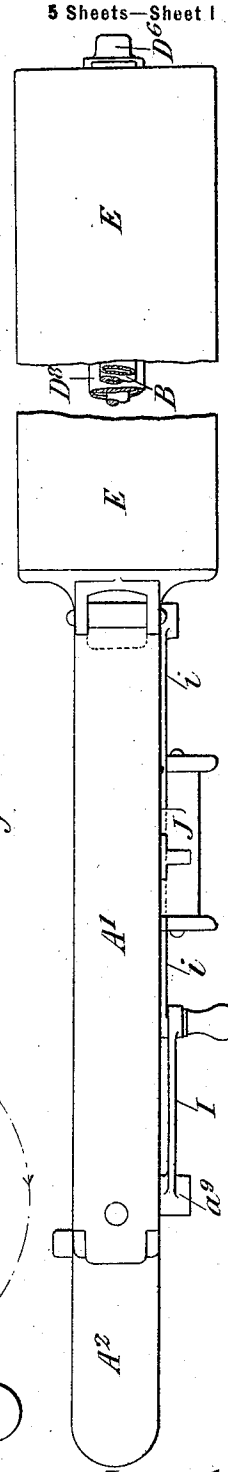


Fig. 3.



Witnesses:
Raphael Netter
Benjamin Miller

Louis Silverman, Inventor
by Kerr, Curtis & Page, Att'ys.

THE NORRIS PETERS CO., PHOTO-LITHO., WASHINGTON, D. C.

No. 618,743. Patented Jan. 31, 1899.

L. SILVERMAN.

GAS OPERATED MACHINE GUN.

(Application filed Sept. 22, 1898.)

(No Model.) 5 Sheets—Sheet 2.

Fig. 7.

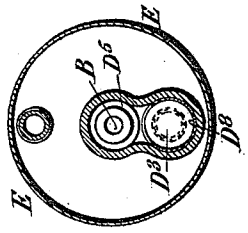


Fig. 6.

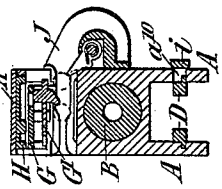


Fig. 5.

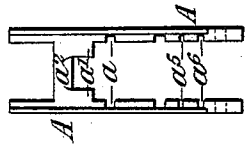


Fig. 9.

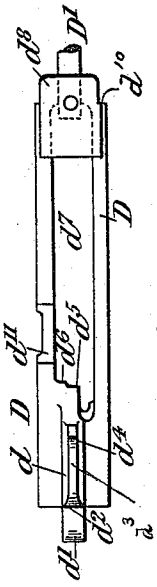


Fig. 10.

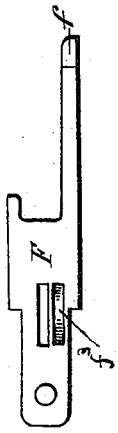


Fig. 12.

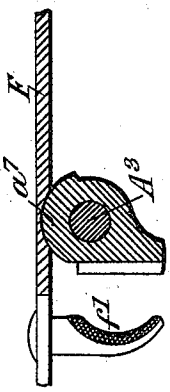


Fig. 4.

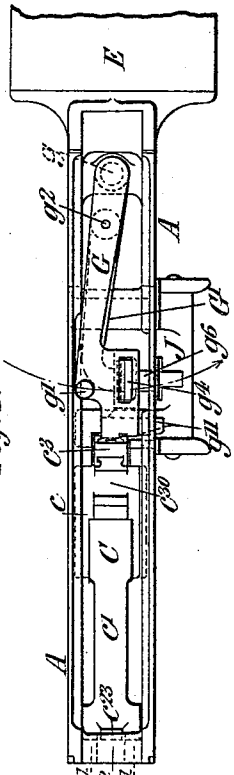


Fig. 8.

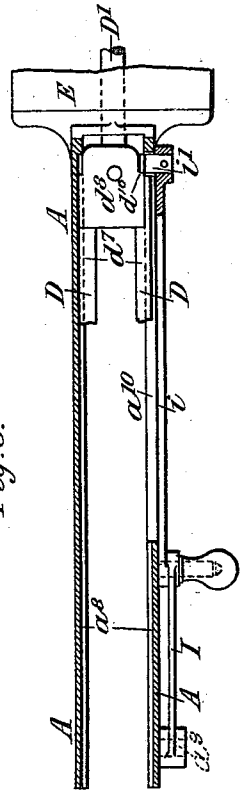
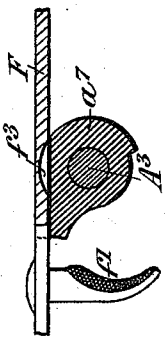


Fig. 11.



Witnesses:
Raphael Netter
Benjamin Miller.

Louis Silverman, Inventor
by Kerr, Curtis & Page Att'ys.

THE NORRIS PETERS CO., PHOTO-LITHO., WASHINGTON, D. C.

No. 618,743. Patented Jan. 31, 1899.

L. SILVERMAN.

GAS OPERATED MACHINE GUN.

(Application filed Sept. 22, 1898.)

(No Model.) 5 Sheets—Sheet 3.

Fig. 17.

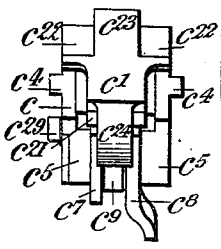


Fig. 13.

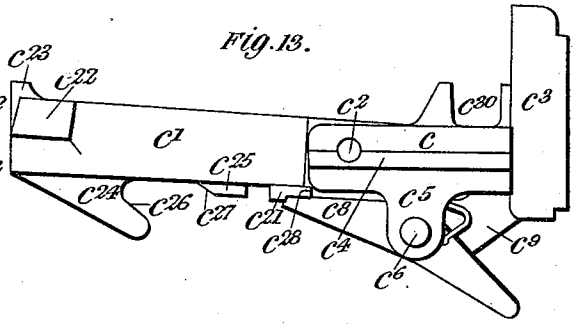


Fig. 18.

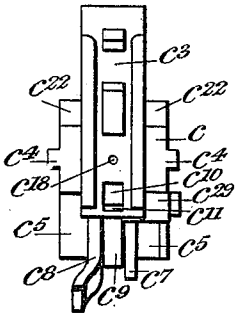


Fig. 14.

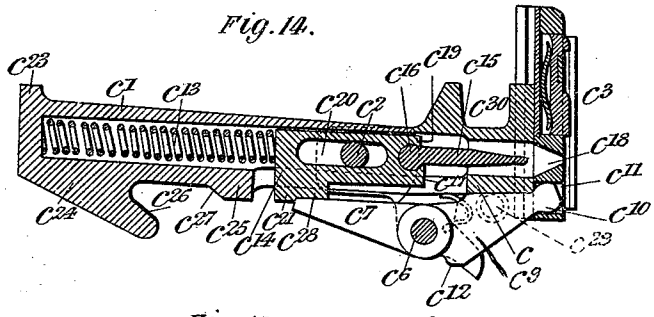


Fig. 15.

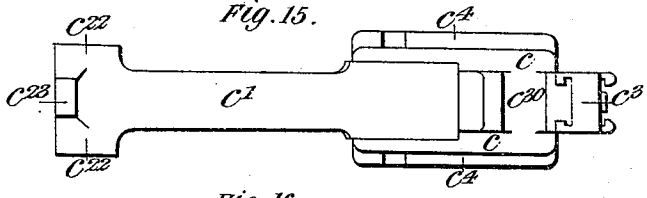
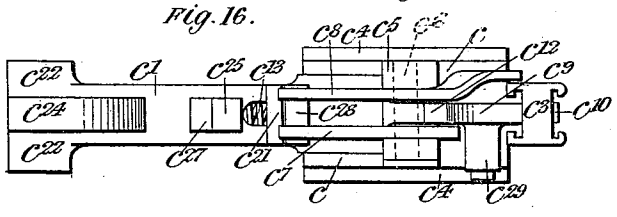


Fig. 16.



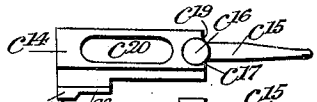


Fig. 19.

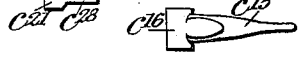


Fig. 21.

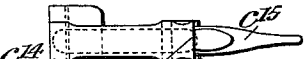


Fig. 20.



Witnesses:
Raphael Netter
Benjamin Miller

Louis Silverman, Inventor
by Kerr, Curtis Page, Attys.

THE NORRIS PETERS CO., PHOTO-LITHO., WASHINGTON, D. C.

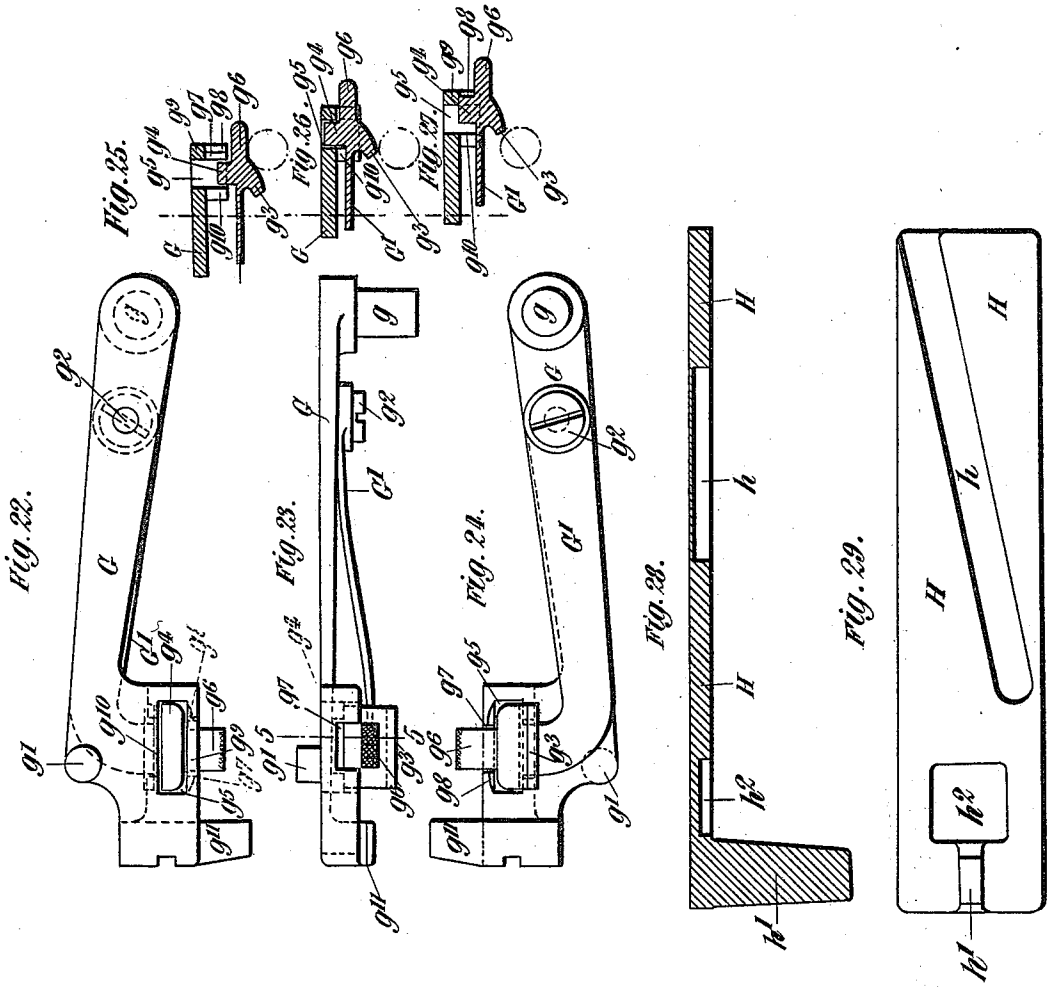
No. 618,743. Patented Jan. 31, 1899.

L. SILVERMAN.

GAS OPERATED MACHINE GUN.

(Application filed Sept. 22, 1898.)

(No Model.) 5 Sheets—Sheet 4.



Witnesses:
Raphael Netter
Benjamin Miller

Louis Silverman, Inventor
by Kerr, Curtis & Page. Attys.

THE NORRIS PETERS CO., PHOTO-LITHO., WASHINGTON, D. C.

No. 618,743. Patented Jan. 31, 1899.

L. SILVERMAN.

GAS OPERATED MACHINE GUN.

(Application filed Sept. 22, 1898.)

(No Model.) 5 Sheets—Sheet 5.

Fig. 30.

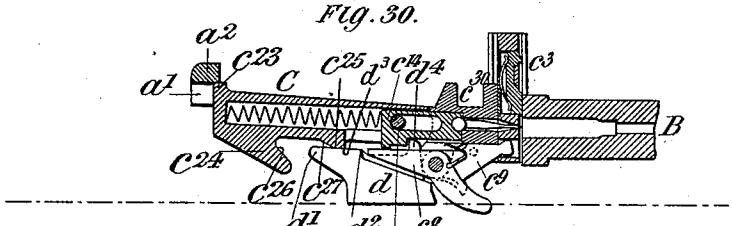


Fig. 31.

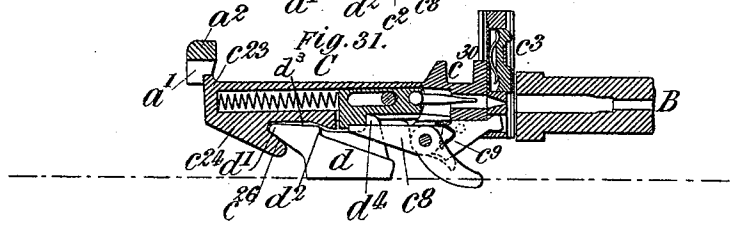


Fig. 32.

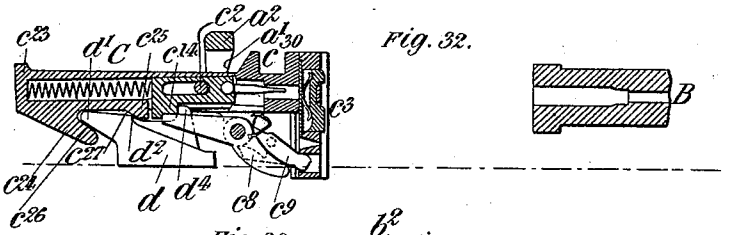


Fig. 33.

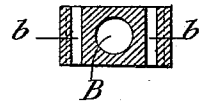


Fig. 35.

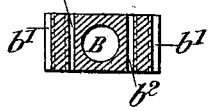


Fig. 34.

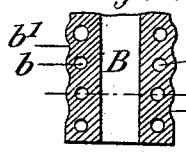
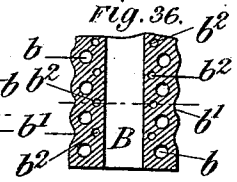


Fig. 36.



Witnesses:
Raphael Netter
Benjamin Miller

Louis Silverman, Inventor
by Kerr, Curtis & Page Attys.

THE NORRIS-PETERS CO., PHOTO-LITHO., WASHINGTON, D. C.

UNITED STATES PATENT OFFICE.

LOUIS SILVERMAN, OF CRAYFORD, ENGLAND, ASSIGNOR TO THE VICKERS, SONS & MAXIM, LIMITED, OF LONDON, ENGLAND.

GAS-OPERATED MACHINE-GUN.

SPECIFICATION forming part of Letters Patent No. 618,743, dated January 31, 1899.

Application filed September 22, 1898. Serial No. 691,579. (No model.)

To all whom it may concern:

Be it known that I, LOUIS SILVERMAN, engineer, a subject of the Queen of Great Britain, residing at Crayford Works, Crayford, county of Kent, England, have invented certain new and useful Improvements in Automatic and Similar Guns, of which the following is a specification.

This invention relates chiefly to improvements in Maxim or automatic guns of that class in which the breech mechanism is operated by the pressure of the gas escaping from the muzzle when the gun is discharged.

The said improvements comprise various novel features of construction and combinations of the parts of the gun, as hereinafter set forth, and while the improvements in the breech mechanism are especially applicable to automatic guns they are capable of use with guns of other types.

The gun has a stationary barrel, which is secured to the frame in the usual or any convenient manner. It is in some instances provided with a water-jacket; but, if desired, I may dispense with the water-jacket and form the barrel square or approximately square in cross-section, with numerous transverse passages extending through the metal walls thereof to form passages or channels for the surrounding air to pass through and cool the barrel.

The breech-block of the gun is made in two parts—viz., a forward and a rear portion. The forward portion or breech-block proper carries a vertically-sliding cartridge-carrier similar to that ordinarily employed in a Maxim gun, and the rear portion is jointed or pivoted to the forward portion, so that it is capable of a slight amount of vertical movement independently of the aforesaid forward portion. When the breech is closed, this vertical movement of the rear portion enables it to come in front of fixed projections or abutments, and thereby act as a strut to securely retain the breech closed at the moment of firing. The movement of the said rear portion or strut is effected by a suitably-shaped rib or projection on a sliding piece termed the "action-bar," acting in conjunction with inclined surfaces or projections on the strut, as hereinafter explained.

The action-bar is operated by a piston connected therewith by a rod and working in a cylinder communicating with the muzzle of the gun-barrel, so that the escaping gases from the barrel after the projectile leaves the gun can enter said cylinder and actuate the piston. A spiral spring surrounding the said piston-rod acts to return the parts to their firing position after each rearward movement of the piston.

The firing-pin is arranged within the breech-block and is formed in two parts, comprising a body portion and a forward part or head, which are detachably connected together, so that in the event of the said head becoming broken it can be readily detached and replaced by a fresh one. This construction also enables the head to properly adjust itself during its advance to fire a cartridge without subjecting the firing-pin to undue stress in the event of the hole in the cartridge-carrier, through which the head projects to reach the cartridge, not being truly in alinement with the firing-pin.

For operating the cartridge-carrier I employ a pivoted lifting-lever carried by the forward portion of the breech-block and engaging at its front end with a slot in the said carrier. The said lever has a lateral pin which is acted upon by the usual cam in the frame of the gun as the breech-block reciprocates. The said lever also has a heel against which a shoulder on the action-bar comes during the closing of the breech, and thereby raises said carrier into its highest position just before the completion of the final closing movement of the breech-block under the action of its strut.

For feeding the cartridge-belt through the gun I employ above the feed-box a lever having a vertical pivot, about which it can oscillate in a horizontal plane. Above the said lever is arranged a longitudinally-sliding bar, which receives its motion from the reciprocating breech-block. This bar has an inclined or cam groove therein with which a stud on the free end of the aforesaid lever engages, so that as the bar slides to and fro oscillatory movement is imparted to the lever. To avoid the difficulty that has heretofore been experienced by reason of the slipping of the

feed-pawls from their engagement with the cartridge-belt, I provide the said feed-lever with a spring-pawl which is capable of participating in a limited horizontal movement independently of the feed-lever, whereby it is permitted to rise vertically during each outward stroke of said feed-lever, but is restrained from so doing during each inward stroke of said lever. I also provide the gun with an external crank-handle for starting the firing of the gun or for working the gun manually, the said handle being so connected with the breech mechanism that it remains stationary during the firing. Means are also provided whereby the pulling of the trigger cannot be effected when the hinged rear end piece of the gun-casing is opened to inspect or observe the breech-block.

In order that the invention may be clearly understood and readily carried into practice, I will proceed to describe the same more fully with reference to the accompanying drawings, in which—

Figure 1 is a side elevation, Fig. 2 a central longitudinal section, and Fig. 3 a plan, of an automatic gun constructed in accordance with my invention. Fig. 4 is a plan of the rear part of the gun with the upper cover removed. Fig. 5 is a rear end view of the gun-casing with the hinged rear end piece removed. Fig. 6 is a vertical section on the line 1 1 of Fig. 2, looking toward the front. Fig. 7 is a vertical section on the line 2 2 of Fig. 2, looking toward the rear. Fig. 8 is a horizontal section, taken approximately on the line 3 3 of Fig. 1, with only so much of the internal parts shown as is necessary to clearly illustrate the manner in which the external handle is coupled to the action-bar, so that said handle remains stationary during firing. Fig. 9 is a plan of the action-bar detached. Fig. 10 is a plan of the trigger-bar detached. Figs. 11 and 12 are detail sectional views showing the means whereby the trigger-bar is prevented from being operated when the hinged rear end piece is turned down into its open position. Fig. 13 is a side elevation, Fig. 14 a longitudinal section, Fig. 15 a plan, Fig. 16 an under side view, Fig. 17 a rear end view, and Fig. 18 a front end view, of the breech-block detached and drawn to a larger scale. Fig. 19 is a side elevation, and Fig. 20 a plan, of the firing-pin detached. Fig. 21 is a plan of the head of the firing-pin detached. Figs. 22, 23, and 24 are respectively a plan, an edge view, and an under side view of the cartridge-feed lever and its spring-pawl. Figs. 25, 26, and 27 are transverse sections taken substantially on the line 5 5 of Fig. 23, looking toward the right and showing the feed-lever and its spring-pawl, respectively, in the position they occupy when the feed-lever is commencing its outward stroke to bring the pawl into engagement with a cartridge in the feed-belt, when said pawl is passing over said cartridge, and when said pawl has passed over said cartridge and the lever is commencing to perform its inward stroke. Figs. 28 and 29 are respectively a central longitudinal section and an under side view of the sliding plate by which the cartridge-feed lever is oscillated. Figs. 30, 31, and 32 are longitudinal sections, of a more or less diagrammatic nature, showing the breech-block and the action bar, respectively, in the position they occupy when the breech-block is fully closed and locked, when it is disengaged, and when it is fully retracted. Fig. 33 is a transverse section, and Fig. 34 is a horizontal section, of a gun-barrel formed with transverse channels in its walls for the passage of air to keep the barrel cool without a water-jacket. Figs. 35 and 36 are similar views of a slightly-modified arrangement of the said air-channels.

Like reference-letters indicate similar parts in all the figures.

A A are the side plates of the frame or casing inclosing the breech mechanism.

A′ is the hinged top cover, and A^2 the hinged rear end piece.

B is the barrel.

C is the breech-block.

D is the action-bar, and E is the water-jacket.

c c′, Figs. 13 to 18, are the two portions of the breech-block, hinged together by a pivot-pin c^2. The forward portion or breech-block proper, *c*, is provided with the vertically-sliding cartridge-carrier c^3, which performs the various functions necessary for transferring the cartridge from the feed-belt to the barrel and for extracting and ejecting the spent cartridge from the barrel, like the ordinary sliding carrier of a Maxim gun. The said forward portion *c* is formed with side ribs c^4, which engage with horizontal grooves *a* in the side plates A and guide the breech-block in its reciprocating movements, as is well understood. The said forward portion is also provided with depending lugs c^5 c^5, through which passes a pin c^6, carrying the safety-sear c^7, the firing-sear c^8, and the lifting-lever c^9. The last-mentioned lever is situated between the other two levers and is provided with a rounded nose c^{10}, that engages with a vertical slot c^{11} in the carrier. It is also formed with a heel c^{12}, which is acted upon by the action-bar D, as hereinafter explained. The portions *c c′* of the breech-block are made hollow for the reception of the firing-pin and its spring c^{13}. The firing-pin comprises a body portion c^{14} and a head c^{15}, (see Figs. 19, 20, and 21,) having a cylindrical T-piece c^{16}, which is adapted to engage with a corresponding recess in the body c^{14}, and thereby connect these parts together. The engagement is effected by sliding the T-piece c^{16} lengthwise into the aforesaid recess in the body c^{14}. At the front lower part or margin of the said recess is a shoulder c^{17}, which supports the head c^{15} in an approximately horizontal position opposite the conical hole c^{18} in the carrier when the latter is fully raised, Fig. 14.

The upper part or margin c^{19} of the said recess is unprovided with a shoulder, and therefore renders the head of the firing-pin free to turn slightly upward about its T-piece, so that in the event of the said head entering the conical hole c^{18} out of true alinement with the detonator of the cartridge it will readily adjust itself to the proper position by the guiding action of the conical wall of said hole. This manner of connecting the parts of the firing-pin also enables the head c^{15} to be readily disconnected if it become broken and replaced by a fresh one. The body portion c^{14} of the firing-pin is formed with a longitudinal slot c^{20}, through which the pin c^2, connecting the portions c c' together, passes and retains the firing-pin in place without restraining its cocking and firing movements. The lower part of the body portion c^{14} is provided with a shoulder c^{21}, which projects through a slotted opening in the under side of the breech-block. With this shoulder the noses of the safety-sear c^7 and the firing-sear c^8 engage under the action of their springs when the firing-pin is fully cocked. The opposite ends or tails of the aforesaid sears c^7 c^8, respectively, are acted upon by the action-bar and trigger-bar, as hereinafter explained. The rear portion or strut c' has lateral projections or lugs c^{22}, which are adapted to engage with abutments a' on the side plates A when the said strut is elevated into the raised position represented in Figs. 2 and 30. A very rigid support to the forward portion c of the breech-block is thereby obtained at the moment of firing, which effectually resists the rearward stress tending to force it backward. Extending between and preferably forming part of the abutments a' is a bridge-piece a^3, which serves as a stop to limit the extent of upward movement which the strut c' can perform, the said strut being provided with a projection c^{23} to come against said stop. The working faces of the abutments a' and the lateral projections or lugs c^{22} are inclined or beveled to permit of their sliding on each other when the said strut c' turns about its pivot c^2 in bringing them into and out of engagement. If preferred, these working faces may be curved, the face of the projections or lugs then being an arc of a circle struck from the central point of the pivot-pin c^2 and that of the abutments being an arc of a circle struck from a point somewhat below said pivot-pin. When the strut c' assumes its lowered position, Fig. 31, the aforesaid lateral projections or lugs c^{22} come into a position to slide beneath ribs a^3 on the interior of the hollow hinged end piece A^2, and in the rearward movement of the breech-block these ribs act as guides for the said strut and prevent it from rising during the return or forward movement of the breech-block, as hereinafter explained. The under side of the said strut is provided with two projections c^{24} c^{25}, which are acted upon by a rib or projection d on the action-bar D as the latter performs its reciprocating movements. The projection c^{24} has an inclined surface c^{26}, against which a nose d' on the said rib d strikes (see Figs. 30 to 32) as the action-bar slides backward, and thereby acts, first, to depress the strut c' and disengage it from the abutments a', Fig. 31, and then to withdraw the breech-block from the barrel to open the breech, Fig. 32. The upper portion of the said rib d is of such shape that when the strut c' is depressed it will lie in the space or recess existing between the two projections c^{24} c^{25}, Fig. 31. On the return movement of the action-bar the edge d^2 of the rib will bear against the rear inclined portion c^{27} of the projection c^{25}, and as the strut c' cannot at such time rise by reason of the ribs a^3 the breech-block is pulled forward with the action-bar until the lugs on the strut escape from the said ribs a^3 and from the under side of the abutments a'. The pressure of the edge d^2 of the rib on the said rear inclined portion c^{27} of the projection c^{25} as the action-bar terminates its forward movement then raises the strut and brings the working faces of the lugs again into engagement with the working faces of the abutments a'. It is not, however, until the upper surface d^3 of the said rib d slides on the under side of the projection c^{25} as the action-bar D completes its forward movement that the final upward movement of the strut and the complete closing of the breech takes place, the said surface d^3 being for this purpose inclined slightly to the horizontal. The object of this movement is to permit the cartridge-carrier c^3 to reach its highest position just before the aforesaid final closing movement of the breech-block is completed, so that the said carrier will not be jammed too tightly against the breech end of the barrel and be thereby prevented from reaching its fully-raised position. The said surface d^3 by firmly pressing against the under side of the projection c^{25} also rigidly maintains the strut in its raised position, so that there is no possibility of the same having its security diminished by vibration of the gun in action. The aforesaid rib d is provided with a nib d^4, which lies in front of a shoulder c^{28} on the under side of the body of the firing-pin and during the first portion of the rearward movement of the action-bar—that is to say, before the nose d' reaches the incline c^{26} of the projection c^{24}—such nib pushes back the firing-pin against the resistance of its spring until the sears c^7 c^8 engage with the shoulder c^{21} and keep the firing-pin cocked. The vertical movements of the cartridge-carrier are controlled by a pin c^{29} on the lifting-lever c^9, acting in conjunction with the ordinary cam a^4, with which one of the side plates A is provided, as is well understood. The elevation of the said carrier is effected, however, by a shoulder d^5 on the action-bar, Fig. 9, striking the heel c^{12} as the said bar performs its forward movement and just before the strut terminates its upward movement under the action of the inclined surface d^3

against the projection c^{25}, as already explained. The action-bar is also formed with another shoulder d^6, which acts upon the tail of the safety-sear c^7 and disengages its nose from the firing-pin when said action-bar completes its forward movement. The said action-bar has an elongated aperture or slot d^7 therein, through which the empty cartridge-cases fall from the gun as they are extracted and ejected. In order to avoid any liability of the said empty cases getting in front of the action-bar and impeding the proper working of the gun, said bar is formed at its forward end with a block d^8, having a downward-inclined surface d^9 facing the said slot d^7. The said block is of such dimensions in cross-section as to practically fit the space within which it works immediately below the barrel, so that as the action-bar moves rearwardly the said inclined surface d^9 of the block d^8 would strike the empty cartridge-case and throw it downwardly from the gun in the event of its not having already escaped through the slot d^7. a^5 a^5 are slots in the side plates A, within which the said action-bar slides and by which it is guided during its reciprocating movements.

The tail of the firing-sear c^8 is prolonged through the slot d^7 in the action-bar, so as to lie in proximity to a protuberance f on the trigger-bar F when the breech is closed. This trigger-bar is adapted to slide in slots a^6 a^6, formed in the side plates A, when the trigger f' is pulled, a spring f^2 returning said plate to its original position when the trigger is released. When the trigger is pulled, the aforesaid protuberance f comes beneath the tail of the firing-sear, and by raising it thereby trips this sear and so releases the firing-pin and fires the gun. It will be obvious that so long as the trigger is held in its pulled position the gun will continue to fire automatically. For the purpose of preventing the trigger from being pulled when the hinged end piece A^2 is turned down to uncover the rear end of the casing the said trigger-bar is formed with a cavity or recess f^3, with which a correspondingly-shaped portion or cam-piece a^7 on the hinged end piece A^2, near its pivot A^3, engages when said end piece is turned down, as represented in Fig. 12. The trigger-plate then remains locked, and the gun cannot be fired until said cam-piece a^7 is removed from the cavity or recess f^3 in the act of closing the end piece A^2, as shown in Fig. 11.

In order to impart to the action-bar D the requisite movements for actuating the breech mechanism, it is connected by a rod D′ to a piston D^2, which is arranged within the gas-cylinder D^3. (See Figs. 2 and 7.) This cylinder is located below the barrel and communicates near its front end by an opening D^4 with a chamber D^5, surrounding the muzzle of the gun-barrel. The front of this chamber is closed by a screw-plug D^6, formed with a longitudinal hole for the passage of the projectile, such plug serving to contract the outlet for the gases of discharge entering the said chamber, so that they will be caused to enter the cylinder D^3 and effectually act upon the piston D^2. By so doing they force the piston rearwardly against the resistance of the spring D^7, that surrounds the rod D′, and thereby also cause the action-bar to slide rearwardly and act upon the breech-block, as hereinbefore explained, the reaction of the spring D^7 returning the piston and the action-bar to their original position after each rearward movement. The aforesaid spring D^7 is completely inclosed by a casing D^8, extending from the cylinder D^3 to a fixed sleeve D^9, with which the gun-frame is furnished and through which the said rod D′ slides during its reciprocations. The said casing is provided with lateral openings D^{10} D^{11}. The opening D^{10} permits the gas within the cylinder to escape when the piston is forced back far enough to uncover it, and the opening D^{11} enables atmospheric air to enter the cylinder as the piston returns to its original position and avoids the retardation of the piston's forward movement, which would otherwise take place by the formation of a partial vacuum behind it.

G, Figs. 22 to 24, is the horizontal lever which forms part of the cartridge-feed mechanism. It is provided with a vertical pivot-pin g, which loosely fits a hole formed for its reception in the gun-frame at a point forward of the feed-box J. Near the opposite end of the said feed-lever and on the upper side thereof is a stud g', which engages with an inclined or cam groove h, formed in the under side of the rectilinear sliding plate H, Figs. 28 and 29, which is superimposed above the said feed-lever, as best seen in Fig. 2. This plate has a depending arm h', which engages with a socket or recess c^{30} in the forward part c of the breech-block. As the breech-block reciprocates it imparts longitudinal movement to the said plate, which slides in grooves a^8 a^8 in the side plates A. By the action of the inclined groove h on the stud g' the feed-lever G is caused to oscillate and give a step-by-step feed movement to the cartridge-belt by a pawl G′. Heretofore difficulty has been experienced by reason of the slipping of the feed-pawl from engagement with the cartridges or projections of the belt during the feeding movement of the pawl. In order to overcome this difficulty, I construct the said pawl of a thin steel strip, so as to be resilient, and pivotally connect it at one end to the feed-lever by a screw-pin g^2. Its opposite end is curved and terminates in a beveled nose or pawl proper, g^3, having an upward projection or head g^4, that is adapted to lie in a slot g^5 in the free end of the feed-lever. The said spring-pawl is also provided with a lateral extension g^6, that projects through a lateral opening g^7 in the front side wall of said slot g^5. When the said feed-le-

ver performs an outward stroke in the direction of the arrow in Fig. 4, the nose g^3, owing to the flexibility of the spring-strip G' and the beveled shape of the said nose, rises over the cartridge or projection on the feed-belt, as seen in Fig. 26, and brings the projection g^4 into the slot g^5, so that the feed-lever and the pawl move outward together. Then when the said nose g^3 reaches the opposite side of the cartridge the flexibility of the said spring-strip causes the nose to descend behind the cartridge, Fig. 27. Then on the inward or return stroke of the feed-lever the latter moves a short distance without the pawl, because the latter is engaging with a cartridge, as aforesaid, and the projection or head g^4 of the pawl enters the lateral opening g^7 until stopped by the shoulder g^8, with which such opening is provided. (See Fig. 27.) Both the feed-lever and the pawl then move together, the said pawl being at such time effectually prevented from rising by its head g^4 lying below the marginal portion g^9 of the slot g^5. At the next outward stroke of the feed-lever the head g^4 will readily escape from the lateral opening g^7 by the lateral movement of the pawl about its pivot g^2 when the nose g^3 meets the next cartridge or projection of the belt. The movement of the pawl in this direction is limited by the inner wall g^{10} of the said slot g^5, Fig. 26. The aforesaid lateral projection g^6 is made long enough to permit of the feed-lever being thereby shifted by the gunner's fingers when desired.

g^{11} is a lateral projection on the feed-lever, which projection acts to guide the rims or flanges of the cartridges into proper position for engagement with the cartridge-carrier as the belt is fed step by step through the feed-box. The aforesaid sliding plate H has a depression h^2 in order to permit the cartridge-carrier to complete its upward movement without impediment.

I is the crank-handle by which the mechanism can be operated by hand. (See Figs. 1 and 8.) It oscillates on a stud a^9, projecting from the side plate A, and is connected by a bar i to a pin i', which is capable of sliding in a long slot a^{10} in the said side plate A. The inner end of this pin lies in front of a shoulder d^{10}, Figs. 8 and 9, formed on the portion d^8 of the action-bar D, but is not connected thereto. When the handle is actuated in the direction of the arrow in Fig. 1, this pin bears against the said shoulder and draws back the action-bar against the resistance of the aforesaid spring D^7, thereby operating the breech mechanism. When, however, the gun is working automatically, the action-bar D moves rearwardly without shifting the said pin by reason of the latter's aforesaid loose connection therewith. Therefore when the gun is firing the crank-handle I remains stationary.

When it is desired to remove the breech-block, the hinged end piece A^2 is turned down about its pivot, so as to uncover the rear end of the gun-casing. The crank-handle I is then turned in the direction of the arrow in Fig. 1 as far as it will go, whereby the breech-block will be almost completely withdrawn from the rear end of the frame. Then by a slight upward movement given to the breech-block by pulling it with the hand it will readily become entirely detached from the gun. In order to permit of this upward movement of the breech-block, the action-bar is cut away or grooved at d^{11}, (see Fig. 9,) such grooved portion at this time occupying a position beyond the gun-framing, owing to the action-bar being fully retracted.

In cases where a water-jacket is not employed I prefer to construct the barrel of rectangular shape in cross-section, as shown in Figs. 33 to 36, and to form it with numerous transverse channels b b, through which currents of air can flow and cool the barrel. The said barrel may also be formed with external grooves b' b' at the parts between the holes, so as to increase the external surface exposed to the atmosphere. Additional transverse channels b^2 b^2 of less diameter than the channels b b may also be formed in the metal between the last-mentioned channels b, as shown at Figs. 35 and 36.

What I claim is—

1. In an automatic gun, the combination of a reciprocating breech-block, a rear portion or strut pivoted thereto, an abutment with which said strut engages when the breech-block is in closing position, automatic means operated by the discharge of the gun for reciprocating the breech-block and for moving the said strut, a sear arranged to maintain the firing-pin cocked when the breech is closed, and means independent of the said automatic operating means for operating the sear and firing the gun, substantially as described.

2. In an automatic gun, the combination of a reciprocating breech-block, a rear portion or strut pivoted thereto, an abutment with which said strut engages when the breech-block is in closing position, an action-bar arranged to reciprocate the breech-block, and to operate the said strut, a firing-pin which is retracted when the breech-block is moved to the open position, a sear which holds the firing-pin in such retracted position until the breech-block is completely closed, and a sear-operating mechanism independent of the action of the action-bar, substantially as described.

3. The combination of a reciprocating breech-block, a rear portion or strut pivoted thereto, an abutment with which said strut engages when the breech-block is in closing position, a firing-pin, movable relative to the breech-block, an action-bar arranged to reciprocate the breech-block, to operate the said strut, and to retract the firing-pin when the breech-block is moved to the open position, a spring arranged to move the action-bar in one direction to effect the closing of the breech, a

spring, independent of the action-bar spring for projecting forward the firing-pin, a sear which holds the firing-pin retracted until the breech is completely closed, and a sear-operating mechanism which is independent of the action-bar, substantially as described.

4. The combination of a reciprocating breech-block, a firing-pin mounted therein and adapted to be reciprocated to a limited extent independent of the breech-block, a reciprocating action-bar adapted to operate the breech-block, and to retract the firing-pin, firing and safety sears adapted to engage directly with the firing-pin to hold it in retracted or cocked position, the safety-sear being operated by the action-bar when it comes to position to move the breech-block into complete closing position, and a trigger-operated device for the firing-sear, substantially as set forth.

5. In a gun, the combination of a reciprocating breech-block, a strut pivoted thereto and arranged to be substantially in line therewith, both the said parts being recessed or hollow, the firing-pin mounted in the recess of the breech-block proper, and arranged to reciprocate to a limited extent therein, a spring for operating the firing-pin mounted in the recess of the said strut, and means for reciprocating the breech-block and for operating the firing-pin against the action of the spring, substantially as set forth.

6. In an automatic gun, the combination of the rear casing provided with a movable rear end piece to permit of the opening of the casing, a breech-block device formed of two parts pivotally united, an action-bar adapted to be manually operated and provided with an operating projection for engaging with one of the parts of the breech-block device, and guides on the casing with which the breech-block device engages, arranged both to direct the movements of the latter, and also to hold it in engagement with the operating projection of the action-bar, the casing being unobstructed in rear of the breech-block device, whereby when the casing is opened at the rear the breech-block device may be moved rearward and one part thereof disengaged from the said guides, thus allowing it to turn on its pivot and disengage the operating projection of the action-bar, whereby the breech-block device may be freely withdrawn from the casing without disturbing the action-bar, substantially as set forth.

7. The combination of a reciprocating breech-block, a sliding cartridge-carrier, a lifting-lever for the cartridge-carrier which operates the same as the breech-block is reciprocated, a strut pivoted to the breech-block, and provided with inclined projections, a fixed abutment with which said strut engages when the breech is closed, a sliding action-bar provided with a rib adapted to act on the said inclined projections of the strut as the bar reciprocates, and adapted also to operate the lifting-lever of the cartridge-carrier, and means for reciprocating the action-bar, the disposition of the working inclined projections on the strut and of the rib of the action-bar, being substantially such as described, whereby the complete upward movement of the strut to finally close the breech takes place immediately after the action-bar has operated the lifting-lever to elevate the cartridge-carrier to its highest position, substantially as set forth.

8. In an automatic gun, the combination with the reciprocating breech-block, the sliding cartridge-carrier, the pivoted strut, the fixed abutments, the action-bar and means for operating the same, of a lifting-lever pivotally mounted on a transverse pin carried by said breech-block and provided with a curved nose to engage with a slot in the carrier, a lateral pin on such lifting-lever to engage with a cam-path formed in one of the side plates of the gun-casing, a heel near the pivot of said lifting-lever, and a shoulder on the action-bar adapted to act upon said heel and thereby elevate the carrier just prior to the said action-bar completing its forward movement, substantially as described and for the purpose specified.

9. In an automatic gun, the combination with a reciprocating breech-block having a sliding cartridge-carrier and a sliding action-bar for operating said breech-block, of a spring-controlled firing-pin located within the breech-block and adapted to be cocked by the action-bar, a pivotal and detachable head to said firing-pin, a transverse cylindrical rear end or T-piece on said head to permit of its being inserted into or withdrawn from a corresponding recess in the body of the firing-pin by a lateral movement, and a shoulder at the lower part or margin of said recess to support the head in an approximately horizontal position, the upper part or margin of said recess being free to permit the head to shift upwardly about its cylindrical end or T-piece substantially as described and for the purpose specified.

10. In an automatic gun, the combination with a reciprocating breech-block and the sliding action-bar for operating the same, of a spring-controlled firing-pin adapted to be cocked by the said action-bar, a spring-controlled sear for engaging with said firing-pin when it is cocked, and a sliding trigger-bar located below the action-bar and having a cavity or recess in it, a hinged end cover for the casing of the gun, and a cam-piece near the pivot of said end cover adapted to engage with the cavity or recess in the said trigger-bar and to lock the same, when said end cover is turned downward about its pivot to expose the breech mechanism substantially as described.

11. In an automatic gun, the combination with a reciprocating breech-block, the sliding cartridge-carrier and the lifting-lever for actuating the latter, of a sliding action-bar having an elongated opening or slot therein and

provided with means for acting on said lifting-lever to cause it to elevate the carrier as the said bar performs its forward movement, and a block at the forward end of said action-bar, such block having a downwardly-inclined surface facing the slot in the action-bar, so that as the action-bar performs its rearward movement and an empty cartridge-case is falling through the slot, the said block will prevent the cartridge-case from getting in front of the action-bar and the said incline will direct it in a downward direction substantially as described and for the purpose specified.

12. An automatic gun, provided with a reciprocating breech-block and a sliding action-bar for operating the same, a lateral shoulder on the forward end of the action-bar, a pin projecting through a longitudinal slot in one of the side plates of the gun-casing and adapted to lie in front of and in engagement with said shoulder, without however being connected therewith, so that the action-bar when automatically operated will slide without acting on the pin, an external crank-handle mounted on a stud on the aforesaid side plate, and a link coupling the said handle with the said pin whereby the action-bar can be operated by hand substantially as described.

13. In an automatic gun provided with a non-recoiling barrel, the combination with a reciprocating breech-block and a sliding action-bar for operating the same, of a rod connecting the said action-bar with a piston, a gas-cylinder within which the piston works, a chamber surrounding the muzzle of the barrel and communicating with the said gas-cylinder and also provided with an aperture at its front through which the projectile passes as it is discharged from the barrel, and means for returning said piston to its normal position each time it has been actuated by the gases of discharge escaping from the muzzle substantially as described.

14. In an automatic gun provided with a non-recoiling barrel, the combination with a reciprocating breech-block and a sliding action-bar for operating it, of a rod connecting the said action-bar with a piston, a gas-cylinder located below the barrel at the muzzle thereof and within which the said piston works, a chamber surrounding the muzzle and communicating with the said gas-cylinder at a point in front of the piston, a screw-plug in the front of said chamber provided with a longitudinal aperture for the projectile to pass through as it is discharged from the barrel, a spiral spring surrounding said rod, and a casing forming part of the gas-cylinder and inclosing the said rod and spring, suitable passages being formed in the wall of the casing for the escape of the gases and for the entrance of air, substantially as described and for the purposes specified.

15. In an automatic gun, the combination with a reciprocating breech-block and means for operating it at each discharge of the gun, of a sliding cam-plate, a pivoted cartridge-feed lever furnished with a projection to engage with said sliding cam-plate, and means for connecting said plate with said breech-block so that the plate receives rectilinear motion therefrom as the latter reciprocates and the feed-lever oscillates about its pivot substantially as described.

16. In an automatic gun, the combination with a reciprocating breech-block and means for operating it at each discharge of the gun, of a pivoted cartridge-feed lever, means for connecting said lever with the breech mechanism so that it will be oscillated during the breech-block's reciprocation, a spring-pawl carried by the said cartridge-feed lever and means for positively retaining such pawl in engagement with the cartridge-belt during each feeding-stroke of the said lever substantially as described and for the purpose specified.

17. In an automatic gun, the combination with a reciprocating breech-block and means for operating it at each discharge of the gun, of a pivoted cartridge-feed lever, means for connecting said lever provided in its free end with a slot with the breech-block so that it will be oscillated during the lock's reciprocation, a spring-pawl connected to said feed-lever by a pivot-pin to permit of its performing a short independent movement in a plane parallel with the plane of movement of the feed-lever, and a head on the pawl adapted to engage with the slot in the free end of the feed-lever when the latter performs an outward stroke so as to render the pawl free to rise, and adapted to engage with a lateral aperture in the outer wall of the aforesaid slot when said feed-lever performs its inward stroke so as to restrain said pawl from rising substantially as described and for the purpose specified.

18. In an automatic gun, the combination with a reciprocating breech-block and means for operating it at each discharge of the gun, of a pivoted cartridge-feed lever, means for connecting said lever provided in its free end with a slot with the breech-block so that it will oscillate during the breech-block's reciprocation, a spring-pawl connected to said feed-lever by a pivot-pin to permit of its performing a short independent movement in a plane parallel with that of the movement of the feed-lever, a head on the pawl adapted to engage with the slot in the free end of the feed-lever and with a lateral aperture in the outer wall of the said slot, upon the return and operative movements, respectively, of the feed-lever, a lateral projection on the pawl, which projection extends through the aforesaid lateral aperture and is capable of being operated by the fingers of the gunner, and means for limiting the amount of the aforesaid independent movement of the pawl, substantially as described.

19. In an automatic gun, the combination

with a reciprocating breech-block and means for operating it at each discharge of the gun, of a sliding plate having a cam slot or groove therein, a feed-lever located below said plate and furnished with a vertical pivot-pin entering a vertical hole for its reception in the gun-frame at a point forward of the cartridge-feed box, a stud on said feed-lever engaging with the said cam slot or groove in the sliding plate, and a depending arm on said plate engaging with a recess in the breech-block so that as the latter reciprocates the said plate is likewise reciprocated and oscillatory movement thereby imparted to the feed-lever, substantially as described.

20. In an automatic gun, the combination with a reciprocating breech-block having a sliding cartridge-carrier and the oscillatory feed-lever, the spring-pawl and the means for oscillating said feed-lever, of a lateral projection on said feed-lever which acts to guide the rim of the cartridges into proper position for engagement with the cartridge-carrier substantially as described.

21. In an automatic gun, the combination with a reciprocating breech-block operated by a sliding action-bar connected with a spring-controlled piston working in a gas-chamber, of a non-recoiling barrel of rectangular cross-section formed with a series of transverse passages in the walls thereof to enable currents of air to flow through said passages and cool the barrel without a water-jacket substantially as described.

In testimony whereof I have hereunto set my hand, in presence of two subscribing witnesses, this 9th day of September, 1898.

LOUIS SILVERMAN.

Witnesses:
F. McLELLAN,
G. F. WARREN.