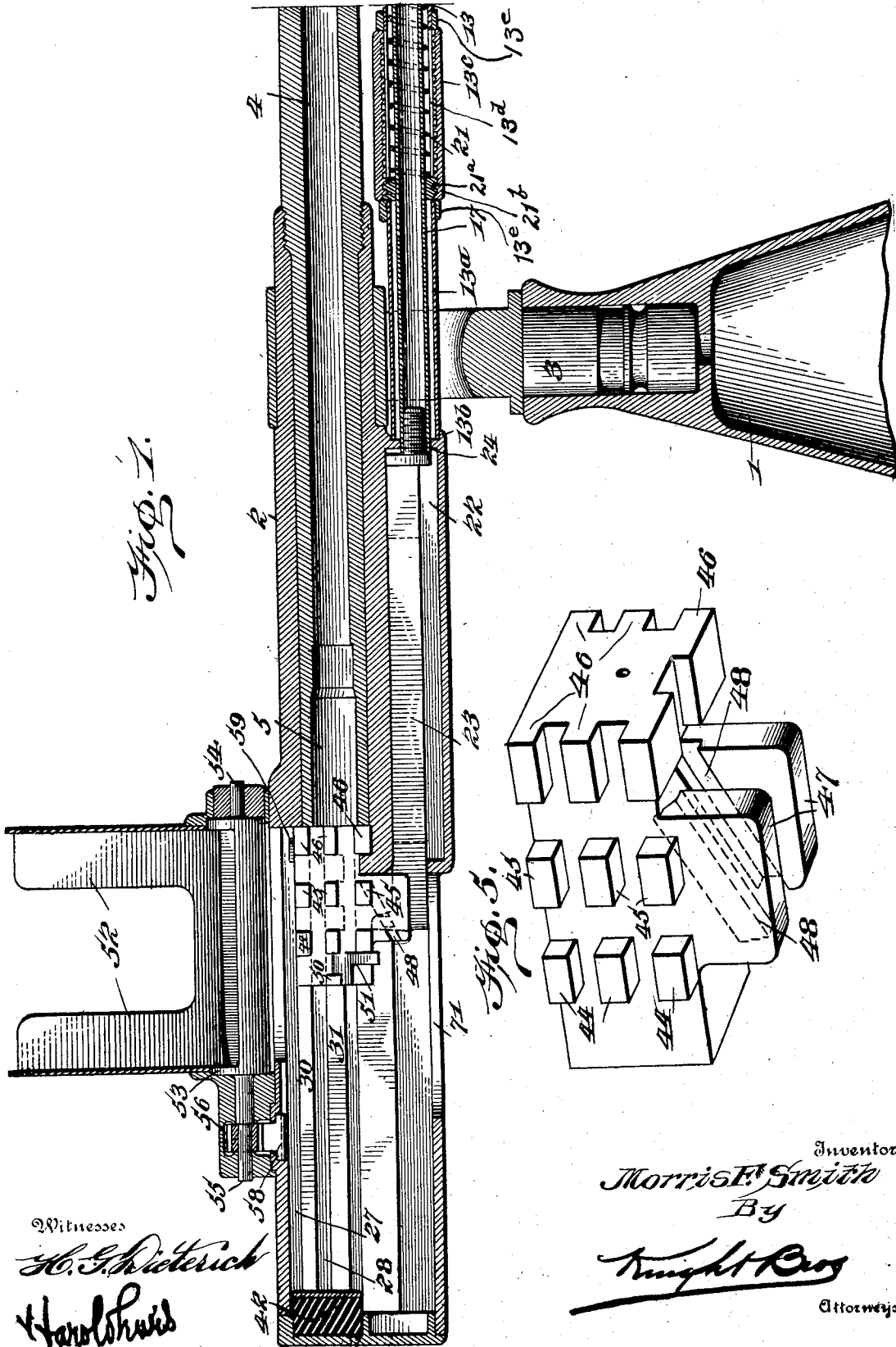


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APPLICATION FILED DEC. 3, 1902.

4 SHEETS—SHEET 1.



*Fig. 1.*

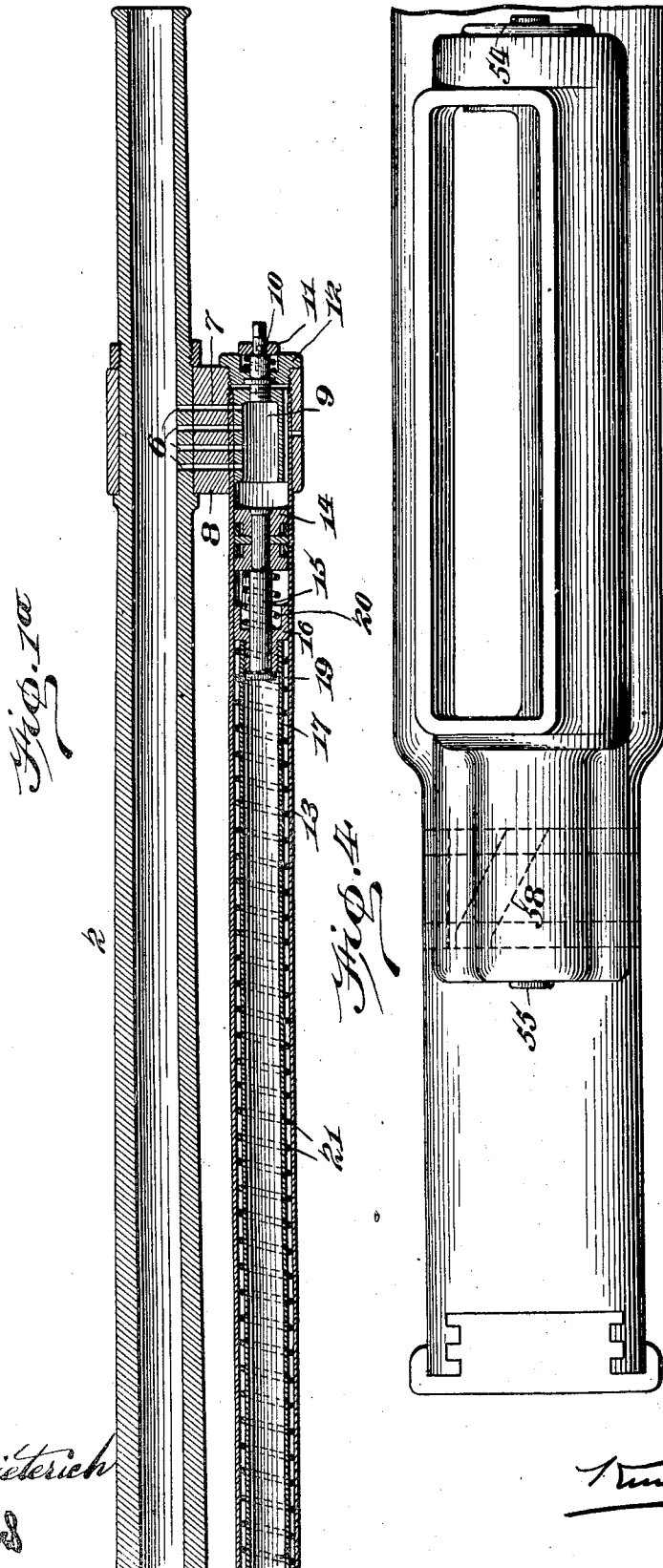
*Fig. 5.*

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4 SHEETS—SHEET 2.

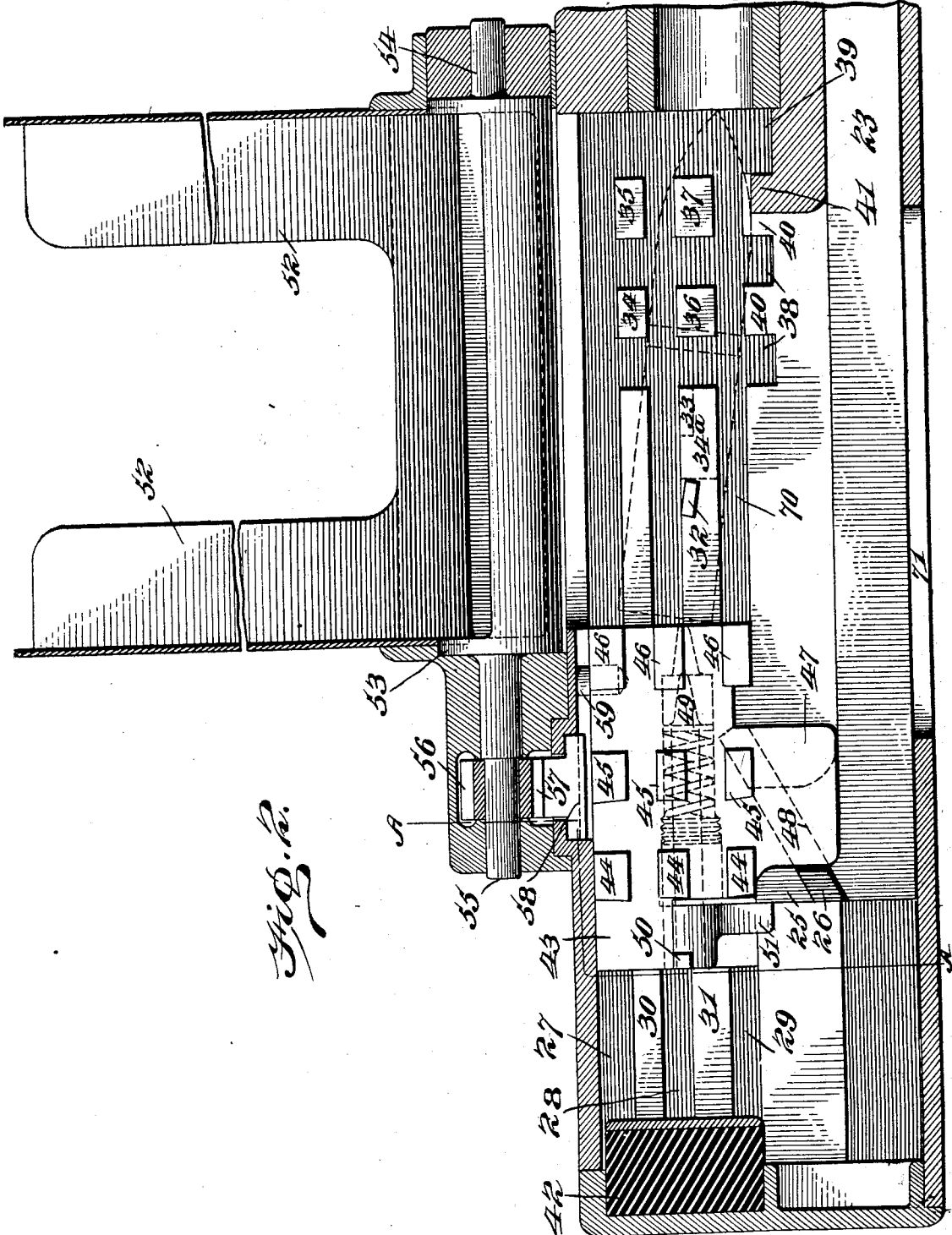


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4 SHEETS—SHEET 3.



*Fig. 2.*

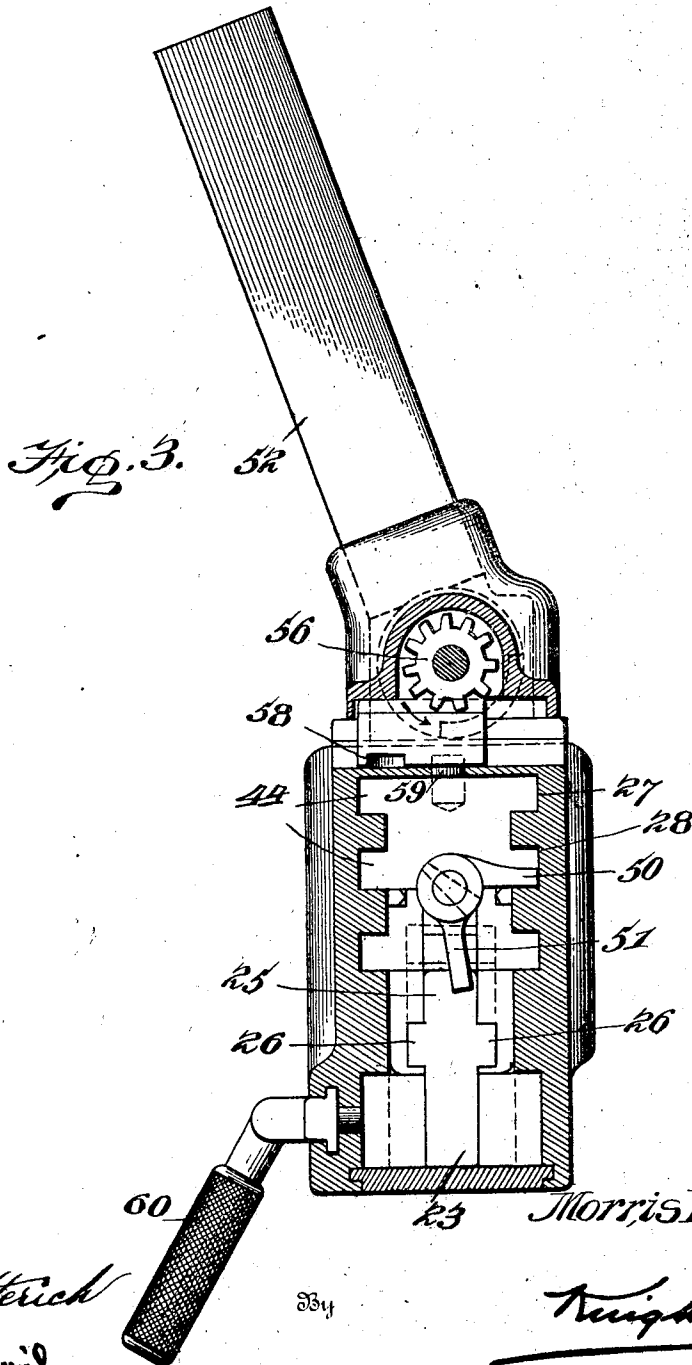
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# UNITED STATES PATENT OFFICE.

MORRIS F. SMITH, OF PHILADELPHIA, PENNSYLVANIA, ASSIGNOR OF  
THREE-FOURTHS TO WILLIAM D. CONDIT, OF DES MOINES, IOWA.

## GAS-OPERATED MACHINE-GUN.

SPECIFICATION forming part of Letters Patent No. 784,966, dated March 14, 1905.

Application filed December 3, 1902. Serial No. 133,768.

*To all whom it may concern:*

Be it known that I, MORRIS F. SMITH, a citizen of the United States, and a resident of Philadelphia, in the county of Philadelphia and State of Pennsylvania, have invented certain new and useful Improvements in Gas-Operated Machine-Guns, of which the following is a specification.

My invention relates to improved means whereby a reciprocating motion is developed from the pressure of powder-gases to operate automatic or semi-automatic machine-guns, also to an improved construction of breech-closing bolt and its operating connections, which, though applicable to some other guns, is designed more particularly for the class of machine-guns referred to, and also to means whereby the reciprocating motion referred to is utilized to feed the fixed ammunition to be used.

In carrying out my invention I employ a cylinder having communication through a controllable gas-port on the forward part of the gun-barrel; a piston in said cylinder against which the pressure of powder-gases developed by firing is exerted between the time the projectile passes the port and leaves the muzzle of the gun, whereby the projectile acts as a valve for said port; a return-spring compressed by the gas-pressure and giving back work when said pressure is released, and a suitable piston-rod extending rearwardly from the piston, providing a connection through which the reciprocating action of the gas-pressure and the spring is transmitted to the parts to be operated, a yielding or cushioning connection being interposed between the piston and its rod to absorb the shock of the suddenly-introduced gas-pressure at the time of firing.

For the breech-closure I employ a reciprocating breech-bolt for opening and closing the breech, which breech-bolt has a movement bodily in a direction at an angle (preferably perpendicular or substantially perpendicular) to the longitudinal reciprocation for locking and unlocking the bolt in its closed position, the bolt being provided with locking means on opposite sides thereof or at diametrically opposite points thereon, (preferably, though not

necessarily, the horizontally-presented sides,) which locking means, conveniently made in the form of lugs or projections on the bolt engaging in locking and guiding grooves in the inner walls of the receiver, serves not only to lock the bolt, but also to guide it in its transverse and longitudinal movements, these movements being imparted to the bolt by the reciprocating rod through the medium of a cam connection which moves the bolt transversely when it is confined longitudinally and imparts longitudinal movement when the locking-lugs are in that portion of the grooves which prevents the bolts moving transversely. The firing-pin is pushed back by the part of the stroke of the reciprocating rod which unlocks the bolt and is held throughout the opening and closing movements of the breech-bolt, so as to prevent premature firing—that is to say, to delay detonation of the cartridge until the bolt is seated in its locked position—the firing-pin being still in its retracted position when the bolt reaches its foremost position and being retained in retracted position thereafter until the bolt moves transversely to its seat under continued forward movement of the rod, at which time a projection on the firing-pin passes below a retaining-face, by which it is engaged, and comes opposite a longitudinal channel, which permits the firing-pin to be projected under the action of its own spring to detonate the cartridge or, if a sear is used, as in the case of semi-automatic guns, to permit the firing-pin to be caught by said sear to be released by pulling the trigger.

For automatically feeding the gun ammunition is placed in a suitable magazine or hopper, which feeds it toward the receiver, (in the present instance by gravity, though it might be by some of the other well-known devices,) in which magazine or hopper is arranged a gate which releases one cartridge and intercepts the remainder by its oscillation, the oscillation being controlled by a transversely-reciprocating block having cam connections with the breech-bolt and suitable controlling connections with a trunnion of the gate, preferably by a pinion on the trunnion and a rack on the block.

My invention will now be described and illustrated in detail.

For purposes of illustration my invention is shown in the accompanying drawings embodied in a one-pounder automatic gas-operated machine-gun, in which drawings—

Figures 1 and 1<sup>a</sup> represent a vertical longitudinal section of such a gun, the breech-bolt being shown in firing position in the receiver.

Fig. 2 is a vertical longitudinal section, on an enlarged scale, of the breech end of the gun, the actuating piston-rod being shown in elevation. Fig. 3 is a vertical transverse section taken on the irregular line A A, Fig. 2.

Fig. 4 is a top plan view of the magazine or feeding-hopper on an enlarged scale; and Fig. 5 is a perspective view, on an enlarged scale, of the breech-bolt.

While many of the features of my invention are applicable to a hand-operated gun or to a semi-automatic gun, I shall describe my invention as embodied in an automatic gas-operated machine-gun, selecting for illustration a gun of the one-pounder type.

1 represents the base or standard of any approved type, (shown broken away,) upon which the gun 2 is swiveled by means of the trunnion 3, having a bearing in the head of said standard.

4 is the bore of the gun, provided with the usual cartridge-chamber 5.

6 represents ports formed through the gun-barrel at a suitable distance back of the muzzle to permit the projectile to act as a valve for said ports and communicating, by means of ports 7, formed through an attaching-block 8, with corresponding ports in a cylinder-lining 9. The lining 9 is adjustable in the screw-cap 12 by means of the screw 10, threaded into said sleeve and having a shoulder 11 abutting against the cylinder-cap in order to control the amount of gases admitted from the bore of the gun into the chamber.

13 represents a cylinder connected at its forward end to the attaching-block 8 and containing a reciprocating piston 14 and a piston-rod 17, made tubular for economy of weight and material. In order to absorb the shock which would otherwise be transmitted from the piston 14 to the breech-bolt when gas due to firing the gun enters through the ports 6 and 7, the yielding or shock-absorbing connection is introduced at some point between the piston and the breech-bolt, so that said piston cannot operate the breech-bolt directly, but only indirectly through the shock-absorbing connection. I do not limit myself to any form of shock-absorbing connection, but desire it to be understood that this feature of my invention consists of a shock-absorbing medium through which the operating element of an automatic gun controls the element to be operated. I prefer to use the construction herein shown, which consists of a stem 15, secured to the piston, working in a shouldered

plug 16, threaded into the forward end of the piston-rod 17 and confined within said plug by the head 19, an absorbing-spring 20 being placed around the stem 15 between the piston and the plug. To impart movement to the reciprocating rod and the parts with which it is connected in a forward direction, I provide a return-spring 21, surrounding said piston-rod and confined between the shouldered plug 16, and an adjustable collar 21<sup>a</sup> near the rear end of the cylinder, through which collar the piston-rod works, said collar 21<sup>a</sup> being provided with radial projections 21<sup>b</sup>, extending through slots 13<sup>d</sup> in the cylinder 13 and meshing with internal threads of an adjusting-sleeve 13<sup>c</sup>, which is confined between shoulders 13<sup>e</sup> on the cylinder 13. By turning the adjusting-sleeve 13<sup>c</sup> and moving the collar 21<sup>a</sup> the force of spring 21 may be regulated at will. The rear end of piston-rod 17 extends through the end of cylinder 13 and enters a slideway 22, where it receives in its internally-threaded end the attaching-screw 24 of a reciprocating or sliding rod 23.

The rod 23 projects rearwardly into the lower part of the receiver of the gun, where the rod is provided with an upturned arm 25, carrying upon its opposite sides cam-lugs 26, which work in the cam-grooves 48 on the inner opposed faces of a yoke 47, depending centrally from the breech-bolt 43. The angle of cam-grooves 48 is such that in the rearward movement of rod 23 the cam-lugs 26, working in said walls, tend to elevate the breech-bolt 43, while in the forward movement of the rod 23 said lugs tend to draw the breech-bolt downward. These upward and downward movements take place in a substantially vertical plane. They are what I shall hereinafter term the "locking" and "unlocking" movements of the breech-bolt and take place while the breech-bolt is at the forward limit of its movement. When the breech-bolt is moved upward as far as it can go, it is obvious that continued rearward movement of the reciprocating rod will cause the breech-bolt to move rearward, and if the breech-bolt is prevented from moving vertically when in rear of its locking and unlocking position it is obvious that the forward movement of the reciprocating rod imparts a forward movement to the breech-bolt.

While I refer to the locking and unlocking movements as being vertical movements or in substantially vertical planes, I desire it understood that these movements may take place in any other direction transverse or approximately transverse to the axis of the gun.

In order to cause the breech-bolt to reciprocate longitudinally under the influence of the reciprocating rod and its cam connection when said breech-bolt is in the rear of its forward limit of movement or locking position and also to compel it to receive the aforesaid transverse movement from said cam con-

nection when it is at the forward limit of its movement, I provide the inner walls of the receiver of the gun with intersecting longitudinal and transverse grooves, guideways, or channels and the breech-bolt with cooperating lugs, these channels and lugs being preferably at diametrically opposite points or upon opposite sides with respect to the breech-bolt and being multiplied in both longitudinal and transverse series, so that the breech-bolt is nicely balanced and accurately directed in its movements. I have shown the walls of the receiver provided with three longitudinal grooves 27 28 29, extending forwardly from the rear limit of the breech-bolt's movement, and three intersecting transverse channels 30 31 32 near the forward limit of said movement and upon the breech-bolt cooperating lugs or projections, (numbered 33<sup>a</sup> to 41<sup>a</sup>, inclusive,) grouped in three longitudinal and three transverse series, so as to fit accurately in the longitudinal and transverse grooves. This disposition of the lugs on the breech-bolt causes the latter to move smoothly in the guiding-grooves, and the central disposition of the depending yoke 47 avoids throwing the block out of balance as it is moved by the reciprocating rod. The intersection of the transverse grooves with the ribs between the longitudinal grooves forms locking-shoulders, (numbered consecutively 33 to 41, inclusive, and respectively corresponding in position to and sustaining the lugs numbered 33<sup>a</sup> to 41<sup>a</sup>, inclusive, when the breech-bolt is in its locked position.) From this description of the parts it will be obvious that in moving the breech-bolt forward from the position shown in Fig. 2 the cam-lugs 26 in the grooves 48 seek to draw the breech-bolt downward, but the bolt is guided in a longitudinal direction by the engagement of its lugs in the grooves 27 28 29; but the moment the breech-bolt reaches the forward limit of its movement, with its forward face abutting the breech of the gun-barrel, it is permitted to move downward under the influence of the cams 26 48 coming opposite the grooves 30 31 32, and continued forward movement of the reciprocating rod 23 relatively to the breech-bolt draws the latter firmly down to its seat, where it tightly closes the breech of the gun. To draw the breech-bolt to a tight seat at the breech of the gun, some of the lugs—for instance, those numbered 36<sup>a</sup> and 38<sup>a</sup>—may be slightly beveled on their rearward faces, or all of such lugs may be so beveled, if desired.

42 represents a buffer, of rubber or other suitable resilient material, which arrests the rearward movement of the breech-bolt.

49 represents a firing-pin, which may be of any approved construction, suitably mounted in the breech-bolt, with a projecting spring and carrying at its rear end a laterally-projecting arm 50 and a downwardly-projecting

arm 51. The arm 51 overlaps the arm 25 on the reciprocating rod 23 sufficiently to cause engagement between these parts, so that the portion of the rearward movement of the rod 23 which causes the upward movement in the breech-bolt 43 and which consequently results in relative movement between the rod and bolt forces the firing-pin 49 rearward to its cocked position, after which continued rearward movement of the rod 23 imparts the opening movement to the breech-bolt. When the rod 23 moves forward to impart the closing movement to the breech-bolt, its relative position in the breech-bolt is not changed until the latter reaches its forward limit and begins to descend to its locked position. This downward movement of the breech-bolt, at which time the rod 23 moves forward therein, causes the arm 50 on the firing-pin to enter the vertical portion of a slot 34<sup>a</sup> in one of the ribs between the longitudinal grooves and to engage behind a shoulder 33, formed by said slot. The arm 50 remains in engagement with the shoulder 33 until the breech-bolt completes its downward locking movement, after which the arm 50 will have entered the longitudinal portion of the groove 34<sup>a</sup> and be free to move forward to snap the cap, the rod 23, with its upwardly-projecting arm 25, having in the meantime moved forwardly in the breech-bolt in seating the latter a distance ample to permit the projection of the firing-pin. In unlocking the breech-bolt the construction of the cams 26 48 is such that upward movement in the breech-bolt immediately follows rearward movement of the rod 23, and this at a time when the arm 50 is beneath the shoulder 33. To avoid jamming, the arm 50 is adapted to swing downwardly upon the axis of the firing-pin as a center until said arm has moved rearwardly a sufficient distance to enter the vertical portion of the slot 34<sup>a</sup>. By referring to Fig. 3 it will be observed that the depending arm 51 has ample room to swing in the breech-bolt for this purpose and without moving in either direction out of the vertical plane of the arm 25 on the rod 23.

In order to feed ammunition, cartridges are placed in the hopper 52, the bottom of which is closed by an oscillating gate 53, mounted on trunnions 54 55, the gate being segmental and adapted to intercept the remaining cartridges as the lowermost is released. Oscillating movement sufficient to release the cartridges successfully is imparted to the gate 53 by a pinion 56 on its trunnion 55, engaged by a transversely-reciprocating toothed block 57, which carries on its under face an angularly-disposed groove 58, engaged by a pin 59 in the top of the breech-bolt. As the pin 59 moves longitudinally of the gun, the angle of the groove 58 is sufficient to cause a transverse movement of the block 57, and this in turn imparts the oscillating movement through pinion 56 to the

gate 53. As each cartridge is released it drops upon a pair of arresting-studs 32 on opposite sides of the receiver, the projectile resting upon the shelf in rear of the gun-breech. As the movements of the parts are timed to deposit the cartridge in this position as the breech-bolt passes beyond the vertical line of the hopper, the return movement of the breech-bolt will force the cartridge into the gun. After firing, the cartridge-shell will be withdrawn by a suitable extractor of any known construction and by its weight will pass beneath studs 32 and drop out of the gun, the rod 23 having a central opening 23<sup>a</sup> (indicated by dotted lines in Fig. 3) to permit its passage.

Having thus described the invention, the following is what is claimed as new therein:

1. In a gun, a breech-bolt reciprocating therein to open and close the breech, having a transverse movement to lock and unlock the bolt, and having locking means at opposite points thereon, whereby the bolt is balanced in its locked relation.
2. In a gun, a breech-bolt having a longitudinal movement to open and close the breech, and a transverse movement to lock and unlock it, and locking lugs or projections at opposite points on the bolt, whereby the locking effect is balanced.
3. In a gun, a breech-bolt having a longitudinal movement to open and close the breech and a transverse movement to lock and unlock the bolt, and locking and guiding lugs or projections at opposite points on the bolt engaging in longitudinal and transverse ways in the gun for locking and guiding the bolt in its respective movements.
4. In a gun, a longitudinally-reciprocating breech-bolt moving bodily at an angle to its longitudinal movement to lock and unlock it, and having locking means at diametrically opposite points thereon, engaging in locking and guiding grooves.
5. In a gun, a breech-bolt having a longitudinal opening and closing movement, and a bodily locking and unlocking movement at an angle thereto, and balancing locking and guiding means on opposite faces thereof.
6. In a gun, a breech-bolt having a longitudinal opening and closing movement and a bodily locking and unlocking movement at an angle to its longitudinal movement, locking and guiding means whereby the bolt is locked and guided in the adjacent portion of the gun located at diametrically opposite points with respect to the bolt; said locking means consisting each of intersecting grooves corresponding in direction to the movements of the bolt and projections cooperating with said groove.
7. In a gun, the combination of a breech-bolt having longitudinal opening and closing movement, and a locking and an unlocking

movement at an angle to the longitudinal movement, and locking and guiding means on opposite sides of the bolt, consisting of intersecting grooves corresponding in directions to the movements of the bolt, and cooperating projections working in said grooves; a plurality of said projections being provided in the direction of the longitudinal movement to maintain the alinement of the bolt in its opening and closing movement.

8. In a gun, the combination of a breech-bolt having a longitudinally-reciprocating opening and closing, and a bodily locking and unlocking movement, and locking and guiding means on opposite sides of the bolt, consisting of intersecting grooves corresponding in direction respectively to the opening and closing and to the locking and unlocking movements, and cooperating projections working in said grooves; a plurality of said projections being provided in the line of the locking and unlocking movement to maintain the alinement of the bolt during such movement.

9. In a gun, the combination of a breech-bolt having a longitudinally-reciprocating opening and closing, and a bodily locking and unlocking movement, and locking and guiding means on opposite sides of the bolt, consisting of intersecting grooves corresponding in direction respectively to the opening and closing and to the locking and unlocking movements, and cooperating projections working in said grooves; a plurality of said projections being provided in the line of the opening and closing movement, and also in the line of the locking and unlocking movement, to maintain the alinement of the bolt during such movements.

10. In combination with a gun, a breech-bolt having a longitudinal movement to open and close the breech, and a movement transverse thereto for locking and unlocking the bolt in closed position; these relatively moving parts engaging by lugs on one part, and intersecting longitudinal and transverse grooves on the other part in which the lugs are guided in the opening and closing and in the locking and unlocking movements respectively.

11. In a gun, the combination of a breech-bolt having an opening and closing, and a locking and unlocking movement and locking and guiding means on opposite sides of the bolt, consisting of a plurality of grooves corresponding in direction to the opening and closing movement, a plurality of intersecting grooves corresponding to the locking and unlocking movement, a plurality of lugs or projections engaging in the grooves which guide the opening and closing movement, and a plurality of lugs engaging in the grooves in the line of the locking and unlocking movement.

12. In a gun, the combination of a breech-



bolt having on opposite sides thereof a plurality of series of lugs or projections arranged in longitudinal and also in transverse lines on the bolt, and a corresponding number of series of grooves in the gun receiving said lugs or projections with the transverse grooves intersecting the longitudinal grooves, whereby the bolt may receive its respective movements successively.

10 13. In combination with a gun, a breech-bolt moving longitudinally therein to open and close the breech and transversely therein to lock and unlock the bolt; said bolt engaging the receiver by a longitudinal series of lugs 15 on one part engaging in longitudinal grooves on the other part to guide the bolt in its longitudinal movement and in a series of transverse grooves on said other part to lock and unlock the bolt; said lugs being of different 20 dimensions to insure their return to the corresponding transverse groove on completing the forward movement of the bolt.

14. In a gun, the combination with a reciprocating rod, having a cam, and a breech-bolt 25 moving bodily in a transverse direction for locking and unlocking and moving longitudinally for opening and closing and having a groove in which said cam works to impart the locking and unlocking movement to the 30 breech-bolt, and the opening and closing movement thereto, and suitable locking means for said bolt; the cam-groove being disposed at an intermediate point on the bolt, whereby the bolt is substantially balanced in the locking 35 and unlocking movement imparted thereto.

15. In a gun, the combination of a reciprocating rod, a breech-bolt having locking means on opposite sides thereof, and moving 40 transversely to lock and unlock the bolt and longitudinally to open and close the breech, and a cam connection between the reciprocating rod and the breech-bolt transmitting a bodily transverse movement to the bolt in locking and unlocking it.

45 16. In a gas-actuated machine-gun, the combination of a breech-bolt having locking means on opposite sides thereof, moving bodily in a transverse direction to lock and unlock the breech-bolt and in a longitudinal direction 50 to open and close the breech, and gas-actuated reciprocating rod, having a cam connection with an intermediate point on the bolt for the purpose set forth.

17. In a gas-operated machine-gun, the combination with the receiver, having vertical and longitudinal grooves therein, a breech-bolt 55 having lugs working in said vertical and longitudinal groove, and a gas-actuated reciprocating rod having a cam connection through which it imparts the movements of the bolt 60 permitted by the engagement of the lugs in the grooves.

18. In a gun, the combination of the receiver, the breech-bolt reciprocating longitu-

dinally in said receiver, the cartridge-magazine 65 feeding cartridges to said receiver, the oscillating gate in said magazine, the transversely-reciprocating part controlling the oscillation of said gate, and a cam connection between the breech-bolt and the transversely-reciprocating part actuating the latter as the breech-bolt reciprocates. 70

19. In a gun, the combination of the receiver, the breech-bolt reciprocating in said receiver, the cartridge-magazine feeding cartridges to said receiver, the gate oscillating in 75 said receiver, the pinion controlling the oscillation of said gate, the transversely-reciprocating toothed block engaging said pinion and having a cam-groove therein, and a pin 80 carried by the breech-bolt engaging said cam-groove.

20. In a gun, the combination of the receiver, the breech-bolt reciprocating in said receiver and carrying a firing-pin, the operating connections for imparting movements 85 to the breech-bolt, a groove in the side of the receiver having a transverse and a longitudinal portion, a projection on the firing-pin entering the transverse portion of said groove 90 as the breech-bolt reaches its forward position, and passing into the longitudinal portion as the breech-bolt reaches its seat.

21. In a gun, the combination of the receiver, the breech-bolt having a longitudinal 95 movement and a transverse movement in said receiver, the reciprocating rod imparting movement to said breech-bolt, the firing-pin in the breech-bolt cocked by the reciprocating rod, having a projection thereon, and a groove 100 in the side of the receiver having a transverse and a horizontal portion in which the projection on the firing-pin enters, said pin entering the transverse portion as the bolt reaches its forward limit and passing into the longitudinal 105 portion to detonate the cartridge when the bolt reaches its seat.

22. In an automatic machine-gun, the combination of the breech-bolt having a firing-pin, the reciprocating rod actuating the breech-bolt to open and close the breech and engaging 110 the firing-pin to cock it by a motion relative to the breech-bolt, a projection on said firing-pin, an arresting-shoulder on the receiver adjacent to the forward position of the 115 breech-bolt, maintaining the firing-pin in cocked position as the breech-bolt moves to its seat, but releasing said firing-pin as the breech-bolt reaches its seat.

23. In an automatic machine-gun, the combination of the receiver, the breech-bolt having a locking movement and a closing movement in said receiver, as well as motions for 120 unlocking and opening the same, a firing-pin movable in said breech-bolt and having a projection thereon, a slot in the wall of the receiver having a vertical portion and a longitudinal 125 portion in which the projection on the

firing-pin engages as the breech-bolt reaches its forward limit, and a reciprocating rod engaging the firing-pin to retract it, and also moving the breech-bolt; the reciprocating rod  
5 continuing its movement to seat the bolt, after it reaches its forward limit, and the projection on the firing-pin engaging in the vertical part of the slot during said seating movement and entering the longitudinal portion of the

slot as the breech-bolt is seated so as to permit the projection of the firing-pin to fire the gun.

The foregoing specification signed this 26th day of November, 1902.

MORRIS F. SMITH.

In presence of--

WILLIAM D. CONDIT,

J. R. McQUIGG.