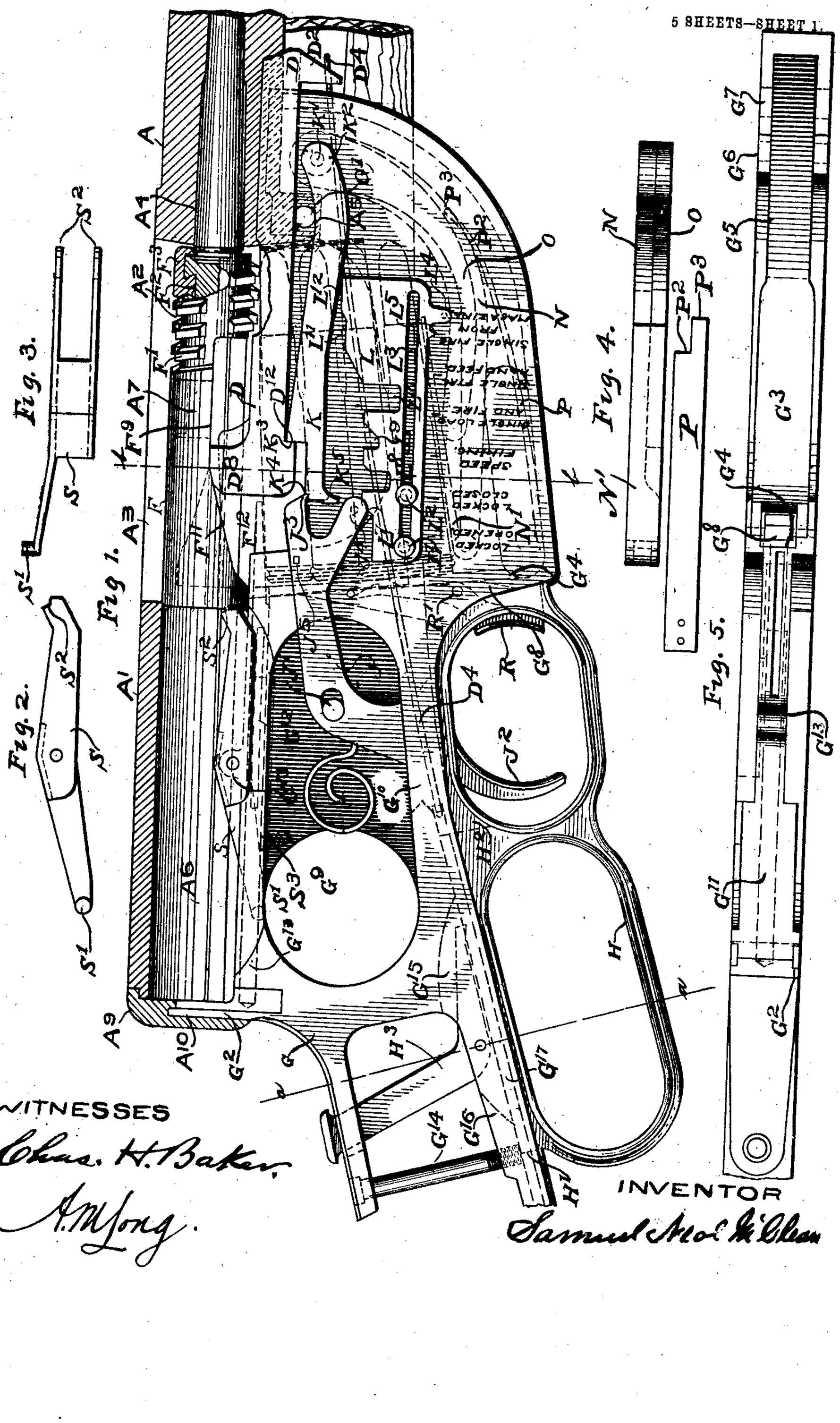
No. 827,259. PATENTED JULY 31, 1906.

S. N. McCLEAN.

DISCHARGE ACTUATED GUN.

APPLICATION FILED FEB. 17, 1900.

5 SHEETS—SHEET 1.



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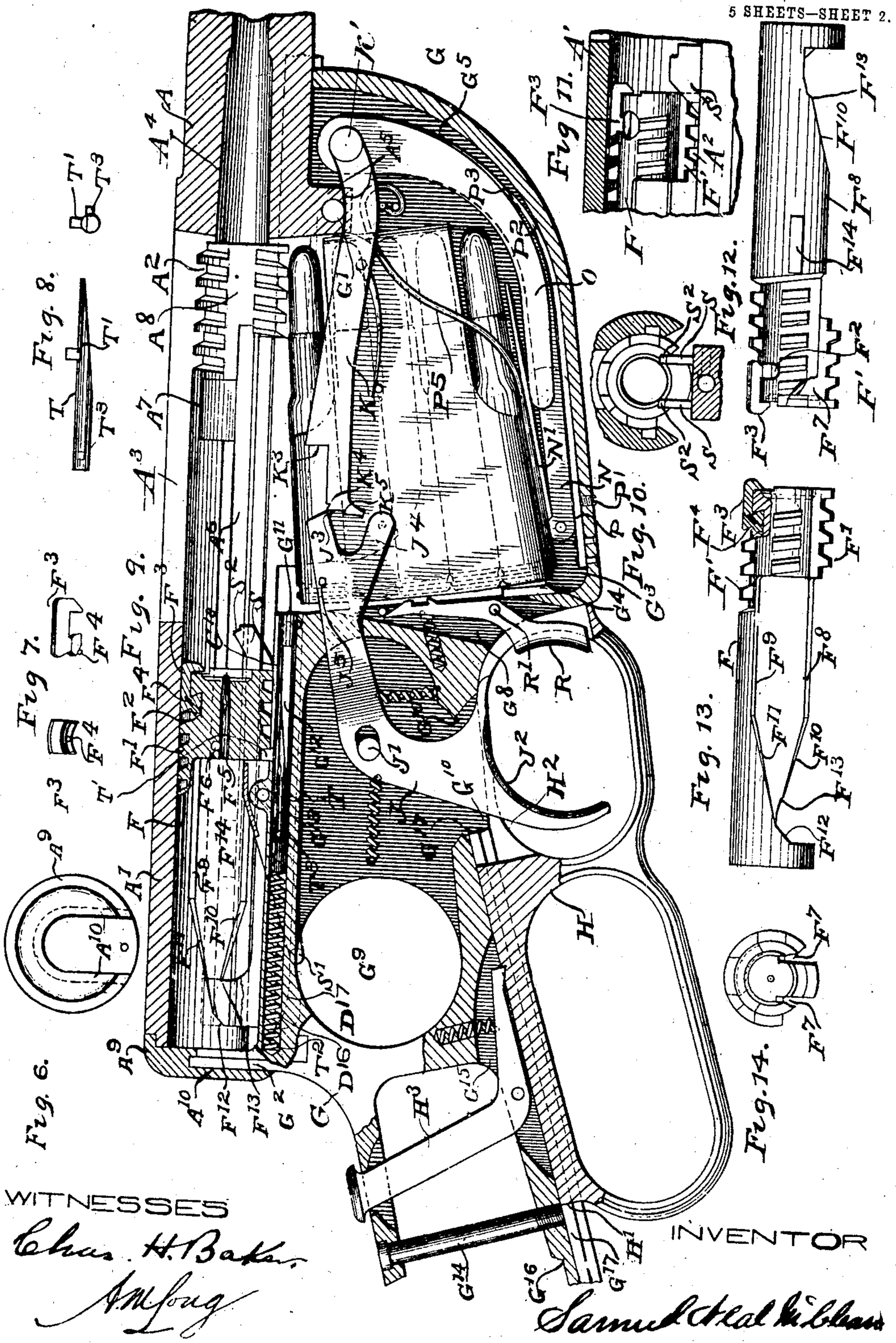

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Fig. 24.

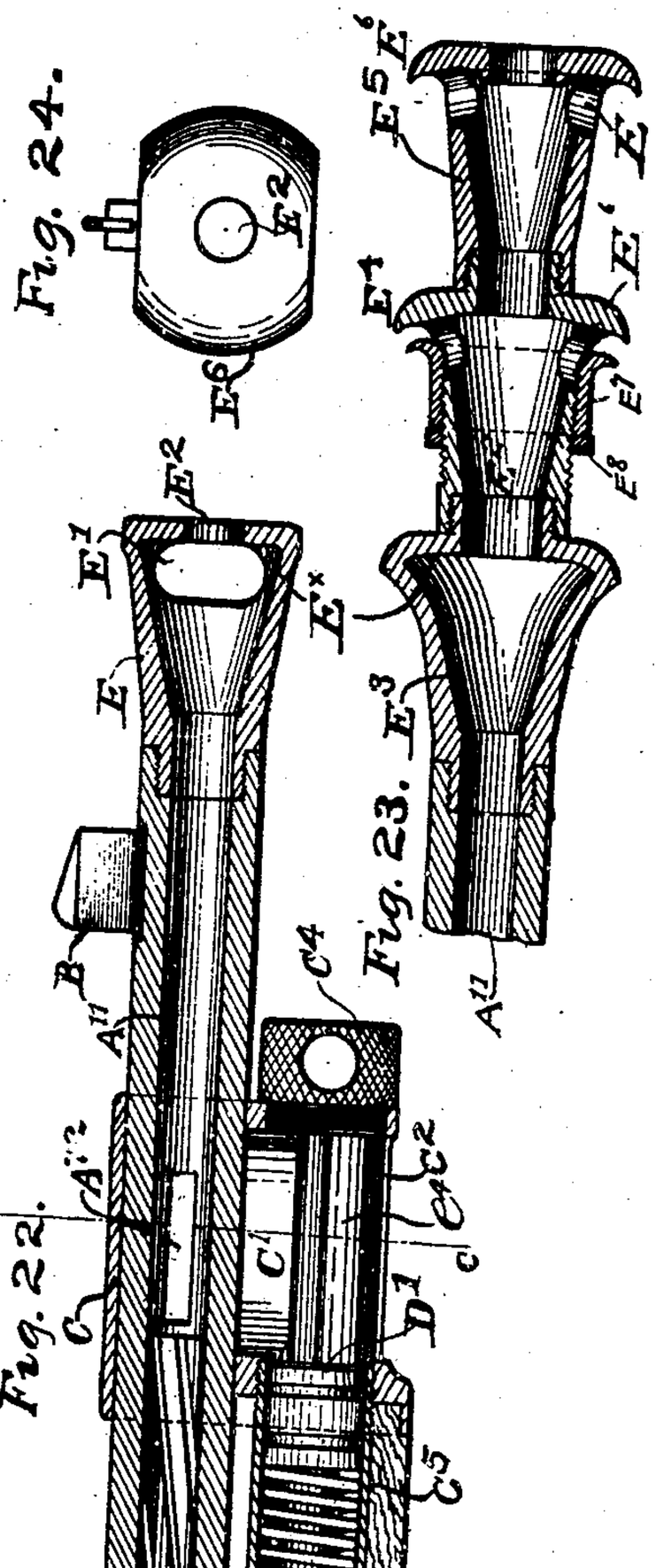

Fig. 16.

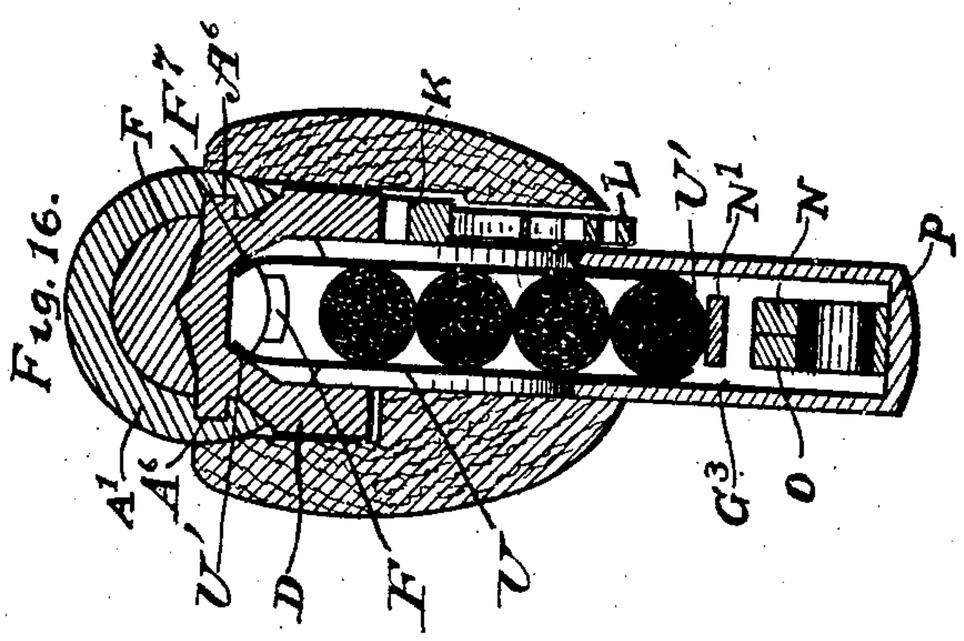

Fig. 15.

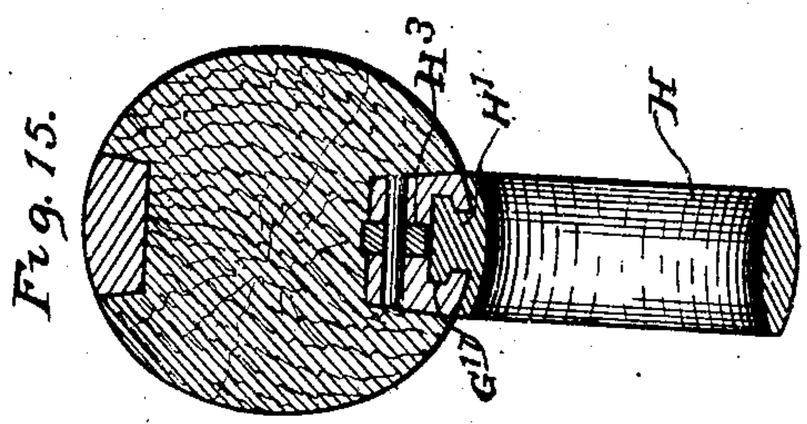

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Fig. 23.

Fig. 22.

Fig. 21.

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5 SHEETS—SHEET 4.

Fig. 19.

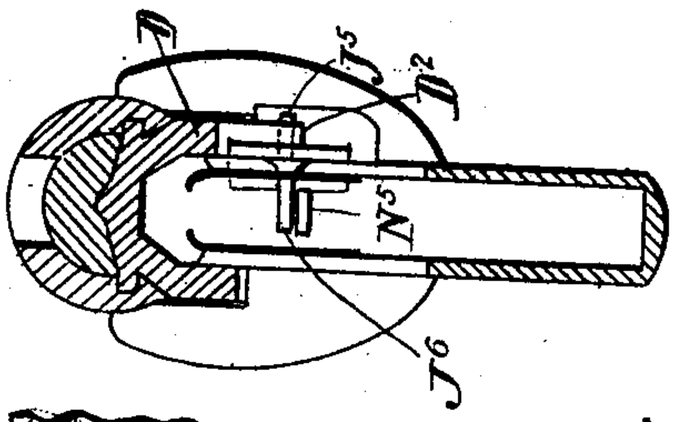


Fig. 20.

Fig. 17.

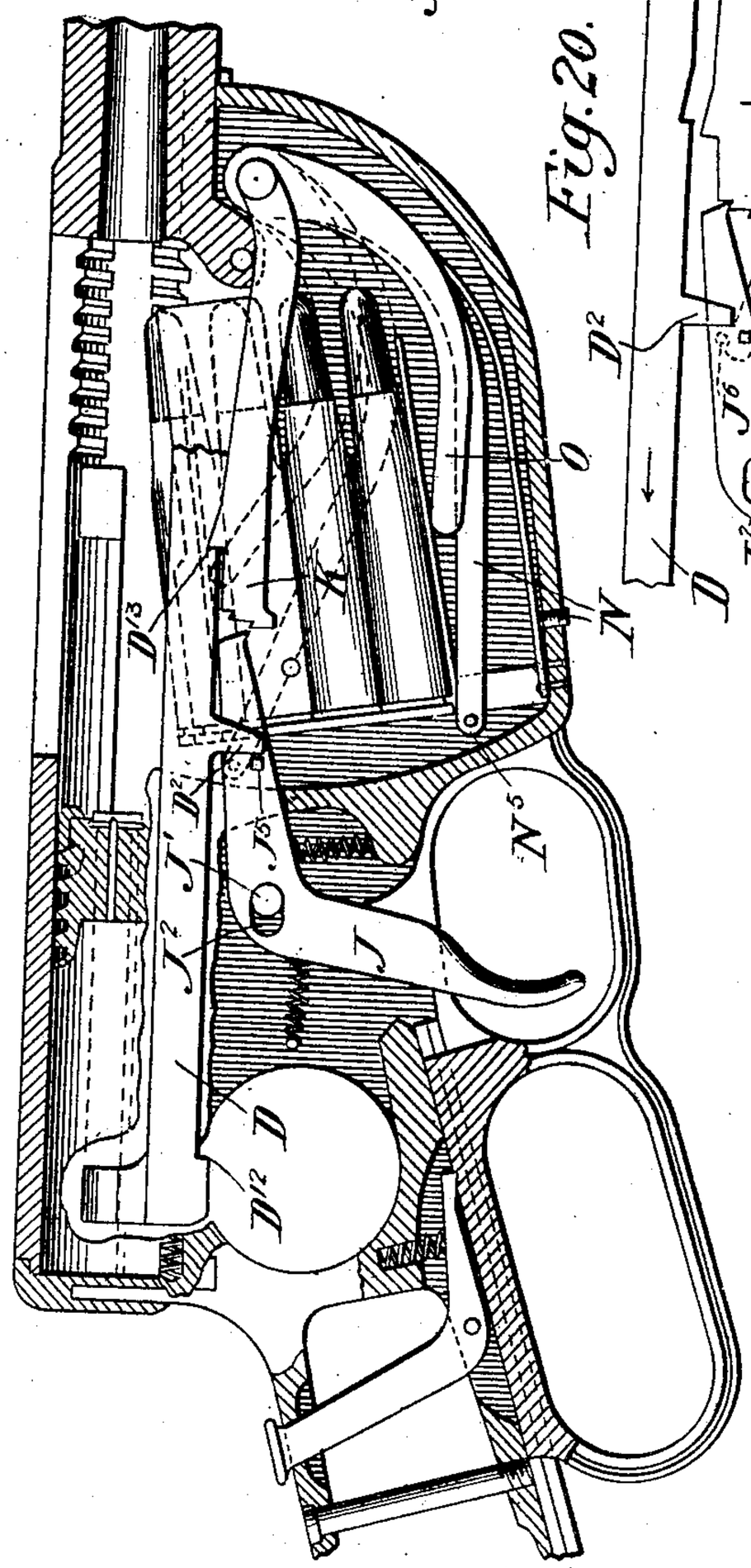
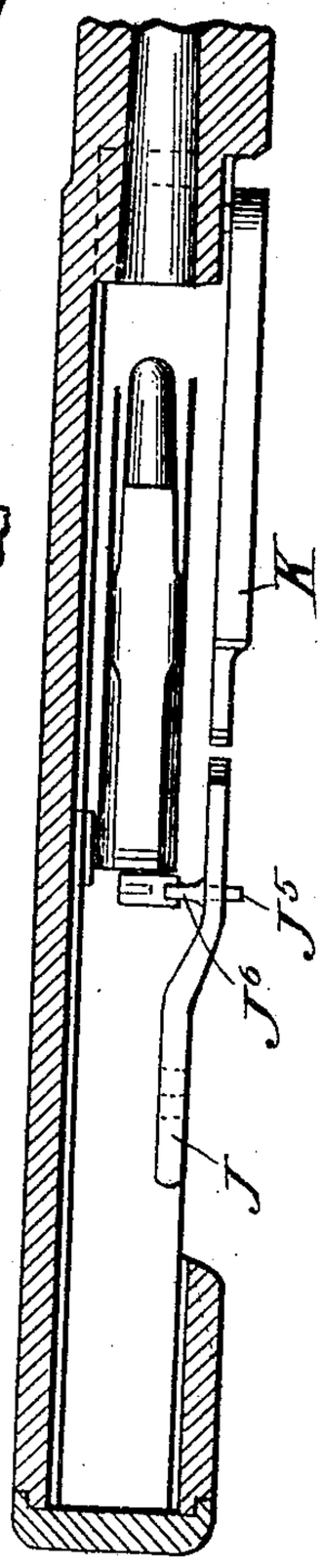


Fig. 18.



Witnesses

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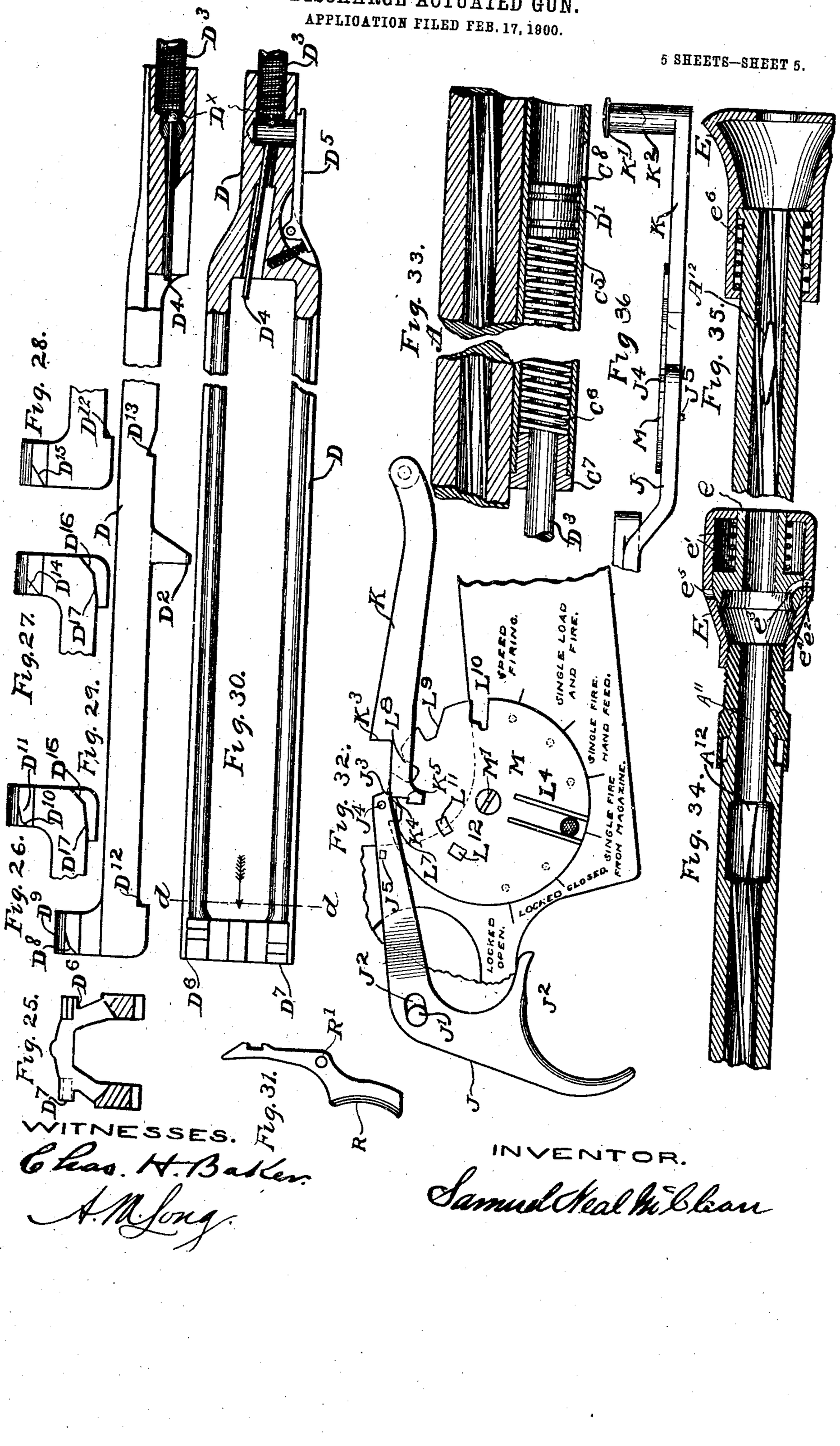
5 SHEETS—SHEET 5.



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UNITED STATES PATENT OFFICE.

SAMUEL N. McCLEAN, OF CLEVELAND, OHIO, ASSIGNOR TO THE McCLEAN ARMS AND ORDNANCE COMPANY, OF CLEVELAND, OHIO, A CORPORATION OF NEW JERSEY.

DISCHARGE-ACTUATED GUN.

No. 827,259. Specification of Letters Patent. Patented July 31, 1906.

Application filed February 17, 1900. Serial No. 5,578.

To all whom it may concern:

Be it known that I, SAMUEL NEAL McCLEAN, a citizen of the United States, residing at Cleveland, in the county of Cuyahoga, in the State of Ohio, have made certain new and useful Improvements in Breech-Loading and Discharge-Actuated Firearms, of which the following is a specification.

My invention relates to guns, and more particularly to discharge-actuated guns of either the automatic or semi-automatic class.

In my pending applications for United States patents, serially numbered 667,361, 676,520, and 710,014, I have described certain inventions of my own wherein the force of discharge, and particularly the gases of discharge, are utilized to actuate the action of a gun employing a reciprocating and rotating breech-block; and my present invention relates to means whereby I am enabled not only to operate the action of the gun by the gases of discharge, but also control the recoil or "kick" of the weapon, to the end that greater accuracy of fire may be secured and the weapon rendered easy of manipulation. In addition to this the invention consists in means for controlling the action, whereby it is rendered automatic or semi-automatic and hand-fed or magazine-fed at the will of the gunner. Furthermore, the invention consists in certain details of construction and arrangements of parts, as will be hereinafter described, and specifically pointed out in the claims.

The weapon is either a hand-operated or discharge-actuated arm. When operated by hand, the action may be withdrawn and returned by hand or withdrawn by hand and returned by the force of the actuating-spring, and when operated by the force of the discharge the projectile is utilized as a valve to sufficiently obstruct and control the forward escape of the gas and to prolong and control the action of the gas on the gun and its action. The gas-capturing device controls the pressure at which the gas operates, the length of time during which the gas shall act, and the manner and purpose for which the gas-current shall be used. The force of the gas-current is transmitted to the bolt-action by a connecting medium which engages with a system of companion coacting cam-tracks to govern both the reciprocating and locking action of the bolt, together with the loading, extracting, ejecting, and firing actions of the arm, and with the bolt operates the magazine-feed to govern and time the feeding action and controls the weapon for any required kind of firing. The weapon may be either a hand-operated, semi-automatic, or automatic arm. When used as a semi-automatic gun, the weapon may be loaded by hand or automatically loaded from the magazine. When loaded by hand, the bolt-action is retained in its open position until the cartridge is placed in the receiver, after which the primary pull of the trigger releases the action and permits the parts to return to the closed or loaded position, and the secondary pull of the trigger permits the firing action to take place. When the gun is loaded from the magazine for semi-automatic firing, the breech is automatically opened, the cartridge automatically fed from the magazine to the receiver and advanced by the bolt into the barrel, and the breech automatically closed and locked; but the firing action is restrained till it is released by a single pull upon the trigger. When hand-loading for speed-firing is desired, the parts may be set to catch and retain the action in its open position until a cartridge is placed in the receiver by hand, whereupon a single pull of the trigger releases the action, and the cartridge is driven into the barrel, the breech closed and locked, and the cartridge fired, after which the action automatically returns to and is retained in open position ready for the action to be repeated. The weapon when used as an automatic arm is adapted to the preferred form of magazine clip feeding action, and firing is continuous from the magazine until the trigger is released or the number of cartridges in the magazine is exhausted.

My invention may be constructed in various forms without departing from the spirit of the same, and it is understood that the drawings which are hereunto attached and made a part of this specification are for purposes of illustration only and do not define the precise scope or limits of the invention.

Figure 1 is a longitudinal section of the barrel and receiver with frame and operating parts in elevation. Figs. 2 and 3 show the

ejector in side elevation and plan, respectively. Fig. 4 shows in plan view the cartridge-feed levers and feed-spring. Fig. 5 is a top plan of the frame with the receiver removed. Fig. 6 is an inside elevation of the end closure or cap of the receiver. Fig. 7 shows shell-extractor in rear and side elevation, respectively. Fig. 8 shows the cartridge-feed-controlling slide in side and end elevation. Fig. 9 is a longitudinal sectional view of the breech end of the gun, parts in elevation and the operating parts in rear and open position. Fig. 10 is a fragmentary cross-section of the receiver, showing the breech-bolt and cartridge-ejector in end elevation. Fig. 11 is a fragmentary view showing a modification in which the cartridge-ejector is integrally formed with the frame. Fig. 12 is a left-hand side elevation of the breech-bolt. Fig. 13 is a right side elevation of the breech-bolt. Fig. 14 is a front end elevation thereof. Figs. 15 and 16 are cross-sections of the gun, taken, respectively, on the lines *a a* and *b b* of Fig. 1. Fig. 17 is a broken longitudinal section with parts in elevation, the cartridge-lifting lever N being shown in dotted-line position where it engages the trigger to bring a part thereon in the path of the drive-rod. Fig. 18 is a top plan view of Fig. 17 with the breech-block removed and parts broken away. Fig. 19 is a cross-sectional view of the gun with parts omitted in order to more clearly illustrate the action of the cartridge-lifting lever N upon the trigger, and Fig. 20 is a detail. Fig. 21 is a cross-section on the lines *c c* of Fig. 22, which latter is a longitudinal section of the gun at the forward end of the barrel. Fig. 23 is a like view of the forward end of the gun-barrel only, illustrating a plurality of gas-chambers. Fig. 24 is a front elevation of Fig. 23. Fig. 25 is a cross-section of the guiding-rod on the line *d d* of Fig. 30 looking in the direction of the arrow. Fig. 26 is a fragmentary left-hand side elevation of the rear end of the driving-rod. Figs. 27 and 28 are also fragmentary views of the left and right hand sides, respectively, of the rear end of the driving-rod, illustrating a modified arrangement of cam-faces. Fig. 29 is a side elevation, and Fig. 30 a top plan view, of the driving-rod, partly in section. Fig. 31 is a side elevation of the cartridge-clip locking-latch. Fig. 32 is a detailed side elevation illustrating a modified construction of a portion of the firing mechanism and the means for setting the mechanism to different modes of firing. Fig. 33 is a fragmentary longitudinal section of the gun-barrel and gas-tube. Figs. 34 and 35 are longitudinal sections of the end of the gun-barrel and modified forms of the gas-controlling device. Fig. 36 is a top plan view of the rear trigger and adjusting or setting disk shown in Fig. 32, part of the said trigger being broken away.

The barrel A may have any required form to adapt it to the ammunition with which it is intended to be used. The receiver A′ may be either integrally or otherwise fixedly attached to the barrel in order to attain certain mechanical, military, and manufacturing advantages. It is shown here as integrally formed with the barrel, the receiving-chamber being of sufficient length to entirely house the bolt in both its front and rear positions. The receiver is provided at its forward end with locking-lugs A^2 and on its upper side with a cartridge receiving and ejecting opening A^3. The under side of the receiver is cut out to permit the movement of the bolt-action and driving-rod and to receive the magazine system and ejecting-action. The barrel is provided at the forward end of the receiver with the usual cartridge-chamber A^4 and on its under side with the lug A^5 for attaching it to the gun frame and stock. The receiver is provided on its opposite sides with longitudinal guide-grooves A^6, Figs. 1, 9, and 16. These guide-grooves are provided with a cut-out part A^7 near their forward ends to afford a rotary path of movement for the bolt-timing lug. The receiver is also provided at its forward end with a cut-out part A^8, located between the locking-lugs of the receiver A^2 and forming a path for the reciprocating movement of the locking-lugs of the breech-bolt.

The receiver-cap A^9, located at the rear end of the receiver, conforms to the cylindrical shape of the receiver and is fixedly attached to the gun-frame and engages with the receiver to retain it in fixed position. This cap A^9 is provided with a flange-guideway A^{10} to engage with a companion flange G^2 on the gun-frame.

The gas-controlling or power-transmitting device is preferably located at or near the front end of the barrel and consists in means for obstructing, expanding, retaining, deflecting, controlling transmitting, governing, and utilizing the gas-current. In its simplest form it comprises a gas-chamber formed either with or without gas-openings for expanding, confining, controlling, obstructing, deflecting, utilizing, and transmitting the force of the gas-current. The gas controlling and transmitting device may be formed to control the gas-current at any required pressure, in any required quantity, and to prolong it for any necessary length of time. The above gas capturing or controlling device, when broadly stated, may be formed to either fixedly or adjustably control the gas-current in one or more of a series of consecutive and coacting steps and to control the gas-current for either one or more primary or auxiliary purposes. In Figs. 21 and 22 I have illustrated one form which the gas-controlling and power-transmitting device may assume. In said figures the forward

end of the barrel is formed with a bored-out chamber A^{11}, and the gas-controlling device may be either fixedly attached to the end of the barrel or integrally formed with the barrel. Located in the chamber A^{11} and preferably on opposite sides thereof are the openings A^{12}, which connect with the gas expansion and conducting chamber C and permit the gas-current to escape alike at both sides of the projectile. These openings A^{12} may be cut into the bore of the barrel, and the chamber or bored-out portions of the barrel A^{11} omitted when it is desired to allow the rifling to retain its engagement with the projectile while the projectile is passing across the opening A^{12}. This gas-expansion chamber A^{11} may also be formed with the bored-out or farther-expanded part which is shown opposite the openings A^{12} in Fig. 34 to permit a sufficient expansion of the gas-current for controlling a larger quantity of the gas at a lower pressure and for controlling the initial part of the recoil of the arm, also to expand and vary the force of the gas-current and to offer a resistance-shoulder to the gas-current.

The openings A^{12}, Figs. 21 and 22, 34 and 35, are preferably formed as long narrow slots parallel with the bore to graduate and automatically control the force of the gas-current, together with the degree of pressure at which the gas shall act, and may increase in width forwardly to permit a gradually-increasing rate of expansion of the gas-current and may be beveled outward at their forward end to deflect the gas-current and inward at their rear end to allow the gas-current to begin to escape through a gradually-increasing opening. In either the V-shaped or parallel-sided slots the amount of gas escaping through the slots will increase as the rear of the projectile crosses the same; but with the V-shaped slot of Fig. 34 the initial amount of gas passing therethrough will be less and will increase more gradually than in the case of the slot with parallel sides shown in Fig. 22. In Fig. 35 I have shown a diamond-shaped slot which gradually increases in width to its widest point and then tapers off to a point in front.

The form of the gas-controlling device C is that of a chamber into which the gases of explosion are conducted to be utilized in the operation of the weapon. It may be variously shaped and may be either integrally formed with the barrel or constructed separately and secured thereto. As shown in Figs. 21 and 22, it forms a band around the barrel and contains an opening into which the gas-tube C^5 and gas-plug C^4 are screwed, as well as a flange to receive and retain the forward end of the wooden part of the stock. Between the openings A^{12} of the barrel and the gas-tube C^5 the chamber gradually expands, as shown at C′, to its full width under the barrel, thus providing room for rapidly reducing the tension of the gases escaping through the openings A^{12}. The under side of the gas band or chamber C is provided with an opening C^2, through which the tool may be inserted for machining the inner side of the gas-chamber. The gas-plug C^4 is screwed into the forward end of the gas-chamber C and may be removed for the purpose of cleaning the parts and is formed to close the opening C^2 when inserted in its fixed position. The gas-expansion chamber C′ may also be provided with rear openings C^3, controlled by screw-plugs C^7, to allow a portion of the gas caught by this chamber to escape to the rear and afford a screw adjustment for controlling the force of the gas on the action and reducing the recoil and flash. Gas-pressure may also be taken from the gas-chamber C′ by way of ports c^5 and utilized to perform any required work about the gun.

The gas-chamber indicated at E in Figs. 22, 23, 34, and 35 is in the form of a nozzle located at the muzzle of the barrel, such chamber being so constructed as to permit the gases to gradually expand therein and to impinge upon a rearwardly-facing surface, whereby the power of the gases acts upon the structure of the gun in a forward direction—*i. e.*, a direction contrary to the recoil. Said chamber may be either rigidly or yieldingly attached to the barrel, as desired, and the surface against which the gases impinge may form either a rigid or yielding portion of the walls of said chamber. This chamber is preferably in the form of a funnel-shaped gas-expansion and gas-confining nozzle and has a forward surface or shoulder and an opening E^2 in line with the bore of the barrel of sufficient size to permit the passage of the projectile. This auxiliary gas-expansion chamber may be provided with openings E′, Fig. 22, to permit the escape of the gas-current in a lateral or deflected direction. In order to control a greater quantity of the forward power of the gas-current, I have shown in Fig. 23 a nozzle composed of a series of auxiliary gas-expansion chambers E^3, E^4, and E^5, and in order to control and deflect a greater quantity of the forward power of the gas-current these auxiliary gas-expansion chambers may be formed with projecting wings and rearwardly-inclined lateral openings E^6, which may be controlled by an adjustable screw-threaded band E^7, which is secured in its adjusted position by a lock-nut E^8. The opening E^2 for the passage of the projectile may be of relatively greater or diminished size to allow the consecutive gas-expansion chambers to catch a greater or less quantity of the forwardly-escaping gas-current.

In Figs. 34 and 35 I have shown a construction whereby the power of the gases of explosion is yieldingly transmitted to the gun-barrel. As shown in Fig. 34, the gas-chamber E has located in its forward cylindrical end a perforated piston *e*, movable in

the cylindrical chamber against the tension of a spring e', reacting between the front wall of the chamber and the piston. If desired, the chamber E may have an opening e^2 in the wall thereof, which when the piston is at rest registers with the passage e^3, extending from the face of the piston, said piston having a rearwardly-projecting flange e^4, which closes the opening upon the advancement of the piston against its spring. The gas-pressure escaping from the opening e^2 may be utilized to perform work in connection with the operation of the arm—as, for example, operating the breech-action. An opening e^5 may also be formed in such a position in the wall of the chamber E that it is normally closed, but is open to vent the chamber as soon as the flange e^4 has passed it. As shown in Fig. 35, the entire gas-controlling chamber E has movement relative to the barrel and has a spring e^6 interposed between a shoulder on the barrel and an oppositely-dispositioned shoulder in the chamber. It will be seen that in the form of gas-chamber as shown in Figs. 34 and 35 the forward action of the gas on the barrel is exerted through the yielding tension of the spring, thereby avoiding sudden and injurious strains. Furthermore, in the form of chamber disclosed in Fig. 34 the gas-chamber is one of expanded capacity by reason of the movement of the piston under the influence of the gas.

The power of the gas-current may be utilized in the operation of the weapon by transmitting the power directly or indirectly from the point where the gas is caught and controlled to the part to be operated, a suitable element or combination of elements being employed for this purpose. In the construction here illustrated the power of the gas-current is transmitted to the bolt-action through a connecting medium D, called the "driving-rod." It has at its forward end a piston D', which is movable in the gas-tube C^5 and compresses the driving-spring C^6. The rear end of the gas-tube C^5 is provided with a shoulder or screw-plug C^7, against which the spring C^6 is compressed. The tube C^5 is provided with an external opening C^8, Fig. 33, at the rearward point of travel of the piston D', to allow the external escape of the gas after the full movement of the piston D'. The rear end of the driving-rod is bifurcated to allow the respective arms to straddle the magazine and to connect the receiver and bolt-action.

The driving-rod D may be integrally formed from a single piece; but as herewith illustrated the piston-head D' is connected with the rear end of the driving-rod by the tube D^3. The flexible draw-rod D^4, Figs. 1, 29, and 30, connects the driving-rod with the handle and moves the driving-rod when the same is withdrawn by hand, but has a telescopic action in the tube D^3 when the weapon is automatically operated. The latch D^5 is pivotally supported on the driving-rod and controls its engagement with the draw-rod by straddling the latter in rear of an enlargement $D^\times$, as shown in Figs. 29 and 30. The rear end of the driving-rod is provided with lugs D^6 and D^7, located on its respective opposite sides and constructed to engage with the guide-tracks A^6. The right-hand lug D^7 is provided with cam-faces D^8 and D^9 for engaging with companion cams on the breech-bolt, and the left-hand lug D^6 is provided with companion cam-faces D^{10} and D^{11} to engage with companion cams on the breech-bolt. The rear end of the driving-rod is formed to straddle the magazine and to have a path of movement across the top of the magazine and within the body part of the breech-bolt. The driving-rod is also cut away on its upper side to allow it to conform to the shape of the receiver and barrel and is provided on its under side with a sear-lug D^{12}, a sear-notch D^{13} to enable the sear to catch and retain the driving-rod in either its front or rear position, and a depending lug D^2 on the right-hand side of the rod. I have shown a modification of the driving-rod in which the cam-faces D^8 and D^9 are united to form a single cam D^{14} for engagement with the left-hand side of the breech-bolt and the cam-faces D^{10} and D^{11}, which unite to form a single cam D^{15} to engage with the right-hand side of the breech-bolt.

The breech-bolt may have any desired form to adapt it to the preferred form of the breech-bolt-locking action. As here illustrated it is in the form of a reciprocating and rotating bolt having its forward end formed with an interrupted screw-thread, one-half of which is cut out, leaving a series of bolt-locking lugs F' for engagement with companion lugs in the receiver A^2. These lugs F' are shown in four rows of four lugs each, and the bolt is adapted to be turned one-eighth turn in locking and unlocking. The forward end of the bolt is provided with a groove forming an extractor-seat, which groove in transverse section is formed on an arc of a circle to cause the extractor to lock with the flange or groove of the cartridge in pulling out the shell. This extractor-seat F^2 partially encircles the bolt and permits the rotary movement of the bolt independent of the extractor. The extractor-seat F^2 is also cut out at a point beyond the path of the extractor's movement to permit the extractor to be assembled and disassembled. The shell-extractor F^3 is a hook having its forward end formed to engage with the flange or groove of the cartridge and its rearward end having a flange which is formed on an arc of a circle in transverse section and permits a limited rocking and swinging movement of the extractor in the extractor-seat. In the round breech-

bolt the extractor conforms to the shape of the bolt-head and is adapted to remain stationary while the bolt turns, the extractor-seat permitting this movement. This construction of the extractor and extractor-seat forms a hinged relation of the extractor and breech-bolt, and the spring-pressed stud F^4 acts to yieldingly limit the latching movement of the extractor. The forward end of the breech-bolt is counterbored to conform to the end of the cartridge and to form a support for the under side of the cartridge opposite the extractor. This support may also be formed to slightly engage with the groove or flange of the cartridge, if required. The forward end of the breech-bolt is provided with a central opening to receive and retain the firing-pin F^5, in the form of a loose plunger having a limited movement, and is retained by the pin F^6 passing through the breech-bolt. The body part of the breech-bolt is cut out to allow the cartridge-clip or cartridge-magazine to rise up into the receiver to the rear of the barrel, and the row of locking-lugs on the inner side of the breech-bolt is formed to have a path of movement in line with the topmost cartridge between the side walls of the cartridge clip or magazine, the bolt-head being cut out or provided with grooves F^7, as shown in Figs. 12 and 14, for this purpose. These grooves F^7 in the bolt-head also afford a path of movement for the cartridge-ejector, which permits the ejector to rise into the path of the cartridge or shell when being extracted. The cut-out construction of the body part of the breech-bolt also permits the rear end of the driving-rod D to have a reciprocating movement across the top of the magazine and the topmost cartridge therein.

The body part of the breech-bolt is provided with a cam-bolt locking and firing track on its left-hand side and a cam-bolt unlocking and timing track on its right-hand side. The bolt-tracks F^8 and F^9 have a straight part at their forward end to permit a limited firing movement of the driving-rod after the locking action of the bolt is complete, and the left-hand track F^8 has a rear cam part F^{10}, which engages with a cam-face D^{11}, Fig. 26, on the slide D to govern the locking action of the bolt with the receiver and the latching action of the driving-rod with the bolt. The right-hand bolt-track F^9 has a rear cam part F^{11}, which engages with the cam-face D^9, Fig. 29, of the driving-rod to govern the unlocking action of the bolt from the receiver and to govern the latching action of the driving-rod with the breech-bolt and to time the latching action of the breech-bolt with the receiver. The bolt-unlocking cam F^{11} may also be formed with an auxiliary cam-face F^{12}, Fig. 13, and the bolt-locking cam F^{10} may have a companion cam-face F^{13} to coact, respectively, with the cams D^8 and D^{10} of the driving-rod to govern the locking or engaging action of the driving-rod with the breech-bolt and to govern the unlocking, reciprocating, and locking action of the breech-bolt with the driving-rod and the receiver. The lug F^{14} of the breech-bolt is guided in the groove A^6 of the receiver, thereby retaining the breech-bolt in fixed alinement with the receiver and causing it to lock with the receiver always at a fixed point, the cut-out part A^7 of the track A^6 permitting a sufficient rotary movement of the lug F^{14} in locking the bolt. The lugs D^6 and D^7 of the guiding-rod are fixedly guided in the grooves A^6 of the receiver and govern the reciprocating movement of the driving-rod.

The gun-frame G may have any required form to adapt it to the type of arm and operating action with which it is intended to be used and is attached to the under side of the barrel by the lug A^5 and the pin G′, Fig. 9. Its rear end is attached to the cap A^9 by means of the flanges G^2 and A^{10}. The flange G^2 is formed to be slipped into a companion groove A^{10} in the cap A^9, to which it may be suitably riveted or attached. The forward part of the gun-frame is provided with a suitable magazine-chamber which conforms in general shape and size to the ammunition with which it is intended to be used. The rear end of the magazine-chamber is provided with a groove G^4, Figs. 1, 5, and 9, to afford a sufficient clearance for the rear part of a specific form of magazine-clip and to afford shoulders for guiding the magazine-clip. The forward part of the magazine-chamber G^5 is formed on an arc of a circle to afford certain advantages in machining and manufacturing the same and to afford a clearance or space for the magazine-feed. This end of the magazine is also provided with a suitable opening G^6 for the pin G′, which connects the frame with the barrel, and a suitable opening G^7 for the pin or screw which supports the sear and magazine-feed. The rear end of the cartridge-chamber is also provided with a slot or mortise G^8, Fig. 9, to receive and retain the magazine-feed latch R, and to the rear of the magazine-chamber the frame is provided with a large circular opening G^9 to afford certain advantages in machining and inanufacturing the frame, and immediately in front of the opening G^9 the frame is partially cut away to lighten the same and to afford a clearance-space for the trigger action and spring, while on the under side of the frame the opening or mortise G^{10} is formed to allow the trigger to be centrally located. The upper side of the frame has a cylindrical chamber G^{11} to receive and retain the magazine feed-latch, and this chamber G^{11} has a slot G^{12}, through which a lug on the latch projects in the path of the breech-bolt, so the bolt engages with and controls the latch. The upper side of the frame is provided with a lug G^{13}, Fig. 9, which is lo-

cated in the center line of the arm and in the path of the breech-bolt to receive and control the cartridge-ejector. The rear end of the frame is provided with the usual tang for the reception of the tang-screw G^{14}. The under side of the frame at the rear of the magazine is provided with the usual tang and guard-strap G^{16}, which is mortised and cut out at G^{15} to receive the handle-latch H^3 and its actuating-spring. The tang G^{16} is formed with the flanged guideway G^{17}, Figs. 9 and 15, to receive the handle and trigger-guard and allow them a sufficient movement to operate the bolt-action.

The handle H forms a trigger or finger-guard and handhold. It has a reciprocating movement along the flanged guide-tracks G^{17} and is formed with a flanged rib H′, Fig. 15, which extends along its upper side and conforms to the shape of the track G^{17}. The forward end of the handle is slotted to permit the handle to straddle the trigger J and magazine-latch R.

The trigger J is pivotally supported in the frame by the pivot J′ and has a finger part J^2, which is located in the central line of the arm and conforms to the shape of the finger. The slot through which the pin J′ passes is elongated to permit the longitudinal movement of the trigger. The forward end of the trigger has a V-shaped point J^3 for engaging with the sear. The trigger also has an arm and pin J^4, Figs. 1 and 9, for engagement with the firing-dial or firing-slide. The trigger is also provided with a lug J^5, Figs. 17, 18, and 19, for engagement with the driving-rod. Normally this lug J^5 on the trigger lies below the path of movement of lug D^2 on the drive-rod, so that the rod is free to reciprocate without engaging the lug J^5. When the last cartridge has been fed from the magazine, however, the rear end of the cartridge-lifting lever N contacts with the lug J^6, Figs. 18 and 19, and slightly lifts the trigger, so as to bring the lug J^5 up into the path of movement of the lug D^2 on the drive-rod just before the drive-rod has reached its rearmost position, and said lug D^2, impinging upon the lug J^5, forces the trigger slightly rearward, this being rendered possible by the slotted opening J^2 through the trigger. This rearward movement of the trigger is sufficient to free the sear K from the restraining action of the trigger, thereby permitting it to rise and engage the forward sear-notch D^{13} upon the drive-rod and retain it, together with the breech-block, in open position. In Fig. 17 the cartridge-lifting lever N is shown in full lines in the position it occupies when there are cartridges in the magazine and in dotted lines in the position that it occupies when the last cartridge has been fed from the magazine. In Fig. 20 the sear and trigger are shown in the position which they occupy with relation to each other just before the cartridge-lifting lever N impinges upon the pin J^6 of the trigger to lift it into the path of the lug D^2 on the drive-rod.

The sear K is pivotally attached to the frame by the screw K′, Fig. 9. The forward end of the sear is provided with a lateral hub K^2, Fig. 36, having bearings in the frame to sustain the sear, and with a shoulder K^3 for engagement with the driving-rod and auxiliary sear-notches K^4 and K^5 for engagement with the trigger. These notches K^4 and K^5 are a sufficient distance from each other to permit a limited movement of the sear for governing the firing action. The firing-slide L, Fig. 1, is movably retained on the side of the frame by the pins L′ and L^2. It is provided with a longitudinal slot L^3 to permit a limited longitudinal movement of the slide, and a projecting arm L^4, having a V-shaped latch for engaging with a series of notches in the side of the frame. It is also provided with an index-point L^5. The upper side of the slide is provided with a series of notches and cam-faces for controlling the swinging and longitudinal movements of the trigger. It is also formed with a couple of locking-shoulders for locking the weapon out of action. The notch or cam-face L^7 is located in the path of the movement of the pin J^4, projecting from the side of the trigger, and engages with this pin to cause a partial longitudinal movement of the trigger and to govern the longitudinal and downward movement. This cam-face L^7 controls the sear and trigger to govern the single-firing action from the magazine. The notch L^8 controls the weapon for single-firing when fed by hand and has a sufficient depth to limit the downward movement of the pin J^4 of the trigger J and to allow a sufficient movement of the trigger for withdrawing the sear from the path of the driving-rod. The notch L^8 has also a sufficient width to allow a longitudinal movement of the trigger for freeing the trigger from the sear. This notch L^8 also has a sufficient depth to permit the trigger to be depressed far enough to bring the lug J^5 into the path of the companion lug D^2 of the driving-rod.

The notch L^9 controls the action of the arm to load the weapon by the primary pull of the trigger and to discharge it by a secondary pull of the trigger and has on its forward side a cam-face for engaging with the pin J^4. It has a depth sufficient to allow the movement of the trigger and pin J^4 to free the sear from the engagement with the driving-rod and to permit or cause a sufficient longitudinal movement of the trigger to allow it to alternately engage with the notches K^4 and K^5 on the sear K.

The notch L^{10} governs the automatic firing action of the arm and is formed to permit a sufficient movement of the trigger J and pin J^4 to retain the sear K out of the path of the driving-rod till the magazine has been emptied of cartridges. It permits a sufficient

longitudinal movement of the pin J^4 and the trigger J to allow the sear to reëngage with the driving-rod.

The shoulder L^{11} is formed on the upper side of the slide L, and it is movable into the path of the sear to lock the sear in engagement with the driving-rod when the bolt-action is in the closed position.

The shoulder L^{12} is also formed on the upper side of the slide L, and it is movable into the path of the sear to lock the sear in engagement with the driving-rod when the bolt is in its open or rear position. The slide L is also provided with an arm L^4 to engage with a series of notches (see Fig. 1) in the side of the gun-frame and maintain a semilatched relation of the slide L with the frame in the different positions, and the frame is provided with a scale for indicating the different firing positions of the slide, and for convenience of description these different positions have been labeled or named, the name being plainly written on the side of the frame.

The dial, Fig. 32, is a modification of the slide L and agrees with it in its construction and the manner in which it controls the firing action, except that it is pivotally attached to the frame by the screw M′ and rotatable to cause it to assume the different positions. L^{11} and L^{12} are shoulders which when the dial is adjusted to bring them under the rear end of the sear act to lock the action with the breech open or closed, respectively.

The magazine-feed is pivotally supported in the frame on the pivot K′, Fig. 9, and comprises a long lever N and a short lever O, which engages with an actuating-spring P, having a long arm P^3 and short arm P^2, its short arm engaging with one lever and its long arm engaging with the other lever to afford a relatively different movement of the levers. A screw-plug P′ is employed to adjust the tension of the spring P.

The lever N, Fig. 4 and Fig. 9, is provided at its rear end with a hinge, and the cartridge-shelf N′ is hinged to the lever N in such manner as to permit a limited movement. These levers N and O may have any required shape to adapt them to the cartridges and magazine system with which they are intended to be used.

The magazine-latch R is pivotally supported in the frame on the pivot R′ and projects into the path of the rear end of the cartridge-clip U, Fig. 9, when such clip is employed, and has a latch-shaped end for engagement therewith. This latching end of the latch R is preferably formed of two bevel-shaped lugs, with an opening between them to afford certain advantages in retaining the clip.

The magazine-feed slide T is interposed between the bolt-action and the magazine and has a path of movement across the top of the magazine to consecutively feed the cartridges. This slide T is movable in the chamber G^{11}. It may have any required shape to conform to the shape of the chamber in which it moves and is shown as a round bar having its forward end beveled, Fig. 8, to conform to the required position of the cartridges. It is provided on its upper side with a lug T′, projecting through slot G^{12} in the path of the breech-bolt, and at its rear end with the pin T^3 to guide and limit its movement by engagement with the slot G^{18}.

The cartridge-ejector S is pivotally supported in the lug G^{13} and has a forward extremity, which is movable into the path of the cartridge as it is extracted, and has a rear extremity, which projects into the path of the driving-rod. The forward end is preferably formed double, having separate arms to allow the lower locking-lugs of the breech-bolt to reciprocate between them, and is provided with a notch or shoulder S^2 for engagement with the butt-end of the cartridge, and its rear end is provided with a lug or cam-face S′ for engaging with the companion cam on the driving-rod to cause the ejector to rise into engagement with the shell at a fixed point in the rearward movement of the shell, preferably against the tension of the sping S^3.

The gun having been fired and the projectile having passed the opening A^{12}, Fig. 22, the gas enters the chamber C, the projectile acting as a valve to permit a gradually-increasing amount of the gas to enter the said chamber and then acting as a valve to delay the forward exit of the gas from the chamber A^{11}. This chamber may be expanded so as to have a greater diameter than the bore of the barrel, and such expansion may extend throughout its length or for only a portion thereof, as shown in Fig. 34, where it is expanded and then contracted, so as form rearwardly-facing shoulders. This expansion of the chamber A^{11} acts to reduce the force of the gas-current, which is exerted on the action through the chamber C, while the rearwardly-facing shoulders form areas of resistance to the gas-current, and thereby assist in the reduction or entire counteraction of the recoil. The graduated action of the gas on the piston D′ insures a smooth and easy movement of the parts, thus eliminating shocks and strains, while permitting any desired power to be employed for the performance of the work in connection with the gun. The current operates against the piston D′ to move the piston to unlock and withdraw the bolt-action, at which time the piston D′ crosses the opening C^8 and permits an external escape of the gas. The piston-head D′ may be provided with annular grooves to receive and distribute a suitable lubricant, such as a combination of plumbago with a suitable oil. The gas-plug C^4 may be unscrewed and withdrawn from the gas-chamber C, thus opening the action for the purpose of cleaning.

The gas-current, which is caught by the auxiliary gas-chamber E, is preferably deflected laterally or toward the rear to prevent it from exerting a rearward pressure on the arm and to cause it to exert a forward pressure against the recoil. For the purpose of adapting the gas-controlling device to heavier arms a series of auxiliary gas-controlling chambers E^3, E^4, and E^5 are formed to catch and control the gas-current in a series of consecutive steps. The opening E^2 in the auxiliary chamber E is practically formed larger than the opening E^2 in the secondary chamber E^4, and this in turn is larger than the gas-opening in the chamber E^5, thus allowing the first chamber to catch and control a required quantity of the gas-current and the second chamber E^4 to control a further quantity of the gas-current, and the third chamber to control the terminal quantity of the gas-current, this consecutive arrangement of the gas-chambers reducing and entirely controlling the flame and the recoil.

The operation of the bolt-action is as follows: Supposing the breech-bolt to be in the position illustrated in Fig. 1 and the driving-rod in its forward position, the action of the gas-current on the driving-rod compels the driving-rod to move back over the bolt-guide tracks F^9 until the cam-face D^8 comes in contact with the cam part of the bolt-unlocking track F^{11}. The driving-rod D is controlled by the lugs D^6 and D^7, Fig. 25, which move in the track A^6, and the cam action of the track F^{11} rolls the breech-bolt to the partially-unlocked position, bringing the cam-face D^8 on the driving-rod in connection with the cam F^{12} on the breech-bolt, thus causing the further movement of the driving-rod to fully unlock the bolt-action and to bring the driving-rod into a semilatched engagement with the breech-bolt. The lug F^{14}, Figs. 9 and 12, is by this movement turned out of the circular part of the track A^7 and into line with the track A^6, thus permitting a straight rearward movement of the breech-bolt and restraining it against rotation until it is returned to its forward position. The rearward movement of the breech-bolt brings it in contact with the lug T′ of the magazine-slide T and withdraws the latter from its engagement with the cartridge in the magazine, thus allowing the cartridges to be fed upward into the path of the breech-bolt when the magazine-feed firing-action is used.

In Figs. 27 and 28 I have shown a modification of the cam-faces D^8, D^9, D^{10}, and D^{11}, these cams being united to form single cams D^{14} and D^{15}. The bolt-locking cams F^{10} and F^{11} are also formed with the cam-faces F^{12} and F^{13}, thus allowing the unlocking action of the breech-bolt to be accomplished by a single cam-face on either side of the breech-bolt. The bolt-guiding lug F^{14}, Figs. 9 and 12, is guided during the rearward movement of the breech-bolt in the guide-track A^6, and the forward movement of the breech-bolt is caused by the engagement of the driving-rod with the cam-track F^{10}, the lug F^{14} preventing the rolling or locking movement of the breech-bolt till it has reached the cut-out part A^7, which permits the rolling movement of the lug F^{14} at a time when the locking-lugs of the breech-bolt F′ have reached a point opposite their companion locking-lugs of the receiver A^2. The tracks F^8 and F^9 have a considerable straight part at their forward ends to permit a firing movement of the driving-rod after the locking action of the breech-bolt is complete and to allow the driving-rod to acquire a certain momentum in the initial part of its rearward movement before unlocking the bolt-action or starting to extract the shell. The locking-lugs on both the breech-bolt and receiver are constructed to exert a cam action on the breech-bolt, causing the bolt to be drawn forward by its rotary locking movement and drawn toward the rear by its rotary unlocking movement. This construction causes a forceful action of the breech-bolt in seating the shell in the cartridge-chamber and in starting to extract the shell threfrom. The momentum of the driving-rod also causes the extractor to exert a blow in the initial extracting movement of the shell.

The extractor is prevented from being rotated with the breech-bolt by its engagement with the lug A^2 of the receiver, the extractor-seat permitting the extractor to remain stationary while the breech-bolt is rotated. The hinged relation of the extractor with the breech-bolt permits a sufficient swing or upward movement of the extractor to allow the forward or hooked extremity of the extractor to engage with the flange or groove of the cartridge, the spring-stud F^4 permitting a sufficient latching movement of the extractor for this purpose. The extractor-seat being formed on an arc of a circle and the extractor formed on a companion arc, the engagement of the extractor with the cartridge causes the bolt and extractor to draw them partially into engagement with the cartridge, and the harder the shell extracts the tighter and more fixed and immovable becomes the engagement of the extractor.

The ejecting action of the arm is controlled by a pivotally-supported cartridge-ejector which is moved into and out of the path of the cartridge by the reciprocating movement of the driving-rod. The forward end of the cartridge-ejector brings the notch S^2 into engagement with both the rear end and under side of the cartridge, thus checking the rearward movement of the cartridge and causing it to turn up and out through the opening in the upper part of the receiver. The action of the cartridge-ejector is timed by the dis-

tance of its forward end from the forward end of the receiver, and the engaging of the notch S^2 with the shell is controlled by the cams D^{16} and D^{17} on the driving-rod, the cam D^{16} engaging with the pin S′ of the ejector to swing the forward end of the ejector up into engagement with the rear end of the shell and always at a fixed point in the rearward movement of the breech-bolt. The cam D^{17} on the driving-rod causes the forward end of the ejector to have a slight upward movement after the ejector is engaged with the shell, thus causing it to follow up the ejecting or turning movement of the shell. It is also apparent that the ejector may be integrally formed with the gun-frame, as shown at $S^{\times}$ in Fig. 11, the bolt-head being sufficiently cut out to allow a path of movement over the ejector. The forward end of the ejector is preferably forked or two-armed in order to allow the locking-lugs of the breech-bolt to be reciprocated between the arms of the ejector, also to allow the ejector to engage with the end of the shell at two opposite points, thus causing it to swing out of the receiver in a fixed path of ejection and avoiding the necessity of splitting the bolt-locking lug in the middle and reducing its strength.

The firing action is accomplished by the terminal forward movement of the driving-rod and the force of the driving-spring, thus avoiding the necessity for auxiliary firing mechanism. This construction also renders the firing action of the arm perfectly safe, because the driving-rod cannot strike the firing-pin or discharge the arm in any other than a full-locked position of the bolt. The firing action of the driving-rod is controlled by a sear and trigger, and the driving-rod is provided with a series of sear-notches located in different planes in order to allow the sear to rise into the path of the movement of any of the notches which are in a higher or different plane. The sear itself is also provided with two or more notches which have different paths of movement in order to allow the trigger to engage with one sear-notch and be retained out of the path of one or more of the other sear-notches, the vertical movement of the sear being thus controlled in a series of steps, at any one of which steps it may be stopped, and the driving-rod being also controlled by the sear to divide its movement into a series of steps and both the reciprocating and swinging movement of the trigger being also controlled by a series of coacting cams. The arrangement and combination of the firing feeding action of the arm controls the weapon for any desired manner of accomplishing both the loading and discharge of the arm.

For convenience of description I have designated the different loading and firing actions of the arm in several successive steps, one of which is "single firing from the magazine." (See Figs. 1 and 32.) In this position of the parts a single shot only may be fired from the magazine by each successive pull of the trigger. The shoulder of the sear K^3 engaging with the shoulder D^{12} on the driving-rod and stopping the forward movement of the rod at the beginning of the straight parts F^8 F^9 of the bolt-locking tracks, as illustrated in Fig. 1, the nose J^3 of the trigger being in engagement with the notch K^4 of the sear, and the cam-face L^7 being in the path of the downward movement of the pin J^4 on the trigger, the initial pull of the finger on the trigger acts to first depress the sear and free it from the driving-rod, which then advances to discharge the gun, while the continued pull on the trigger brings the pin J^4 into contact with the cam L^7 and causes a rearward movement of the trigger sufficient to free it from the notch K^4 of the sear and bring it into the path of the notch K^5 of the sear. The continued pull on the trigger, with its nose J^3 engaging the sear-notch K^5, depresses the sear sufficiently to prevent the shoulder K^3 from engaging the notch D^{13}, Fig. 29, on the driving-rod, but permits the sear to rise high enough to engage the shoulder D^{12}, so that the gases of explosion act to drive the rod to its full rear position, and the spring C^6 at once advances it to close the breech without the sear engaging the notch D^{13}. The shoulder K^3, however, engages the shoulder D^{12}, so that the gun is loaded, the breech-block closed and locked, and the gun held cocked. The pull of the finger upon the trigger is now released and under the influence of its spring it is returned to the position shown in Fig. 1 with the nose J^3 engaging the shoulder K^4. This adjustment permits the driving-rod to discharge the arm, extract the shell, and reload the gun, ready for firing at each pull of the trigger.

The second firing action of the arm, which I have designated as "single-fire when the weapon is fed by hand," is controlled by moving the dial or slide until the notch L^8 registers with the pin J^4 of the trigger J. This notch L^8 permits a sufficient movement of the trigger and pin J^4 to swing the sear entirely out of the path of the driving-rod and to bring the lug J^5 on the trigger into the path of the lug D^2 on the driving-rod. The last part of the rearward movement of the driving-rod will thus cause a rearward movement of the trigger and free the trigger from the sear through engagement of the lug D^2 with the pin J^5 and allow the sear to reëngage with the notch D^{13} of the driving-rod, retaining the action in its rear or open position. When the trigger is freed from the finger, it reëngages with the notch K^5, the trigger in this kind of firing engaging with the under side of the driving-rod to prevent it from rising high enough to engage with the notch K^4. The weapon being thus held open with the

breech-bolt in its rear position, a cartridge may be inserted by hand, and a single pull of the trigger carries the cartridge into the cartridge-chamber in the barrel, rotates and locks the breech-bolt, fires the arm, and the gas action operating through the driving-rod unlocks and withdraws the breech-bolt, the last part of the rearward movement of the driving-rod engaging with the trigger to free it from the sear and allow it to engage with the forward sear-notch D^{13} in the driving-rod, as before.

In controlling the weapon for the next firing action of the arm the firing dial or slide is moved till the notch L^9 registers with the pin J^4 of the trigger J and the point L^5 registers with the index marked "Single load and fire," at which time the latch or arm L^4 engages with the gun-frame to maintain the firing-dial or firing-slide latched in this position. This position of the firing device controls the parts to lock the action open and allow the cartridges to be fed from the magazine or by hand, the initial pull of the trigger freeing the sear from the driving-rod and bringing the shoulder K^3 of the sear into the path of the shoulder D^{12} of the driving-rod, and a second pull of the trigger operating to free the sear from the driving-rod and at the same time free the trigger from the sear by the engagement of the pin J^4 with the cam-face of the notch L^9, so that the sear rises and engages with the notch D^{13} of the driving-rod to retain the action open for the next shot.

In the "automatic" action of the arm the trigger acts to retain the sear out of engagement with the driving-rod, so that the gun is continuously reloaded and fired until the trigger is released from the finger or until, the cartridges being exhausted from the cartridge-feed, the sear is again set free by the terminal rearward movement of the action after the firing of the last cartridge. In this kind of firing action the firing device is moved till the notch L^{10} registers with the pin J^4 of the trigger J and the latch L^4 registers with the position of the scale marked "Speed fire." The notch L^{10} permits a sufficient movement of the pin J^4 to free the sear from the driving-rod and carry it entirely out of the path of the driving-rod and retain it in this position until the upward movement of the cartridge-feed as the breech is opened after discharging the last cartridge brings the feed-lever N into engagement with the trigger and lifts it, so that the pin J^5 lies in the path of the terminal rearward movement of the lug D^2, which strikes the pin J^5 and drives it slightly rearward, and thus frees the trigger from the sear, allowing the sear to reëngage with the notch D^{13} of the driving-rod and retain the action in its open position. In the ordinary positions of the trigger, with a cartridge or cartridges in the magazine, the pin J^5 on the trigger lies just below the path of the lug D^2, and hence the trigger and sear are not affected by the movements of the drive-rod D; but when the arm J^6 on the trigger is struck by the nose N^5 of the cartridge-feeding lever (see Figs. 18 and 19) after the last cartridge has been fed from the magazine the pin J^5 is raised above its normal position and into the path of lug D^2, as above described.

The bottom of the notch L^{10} is provided with shoulders (see Fig. 32) to engage with the pin J^4 and prevent the pull of the finger or speed firing shock of the arm from freeing the trigger from the sear till the cartridge-lifter engages with the trigger and lifts the pin J^4 above the shoulder at the bottom of the notch L^{10}. The notch L^{10} thus retains a latched engagement with the trigger until freed by the magazine-feed or by releasing the finger. The weapon may be locked in its loaded or firing position by moving the firing dial or slide until it registers with the position of the scale marked "Locked closed" and the shoulder L^{11} is brought into locked engagement with the end of the sear while the latter engages the notch D^{12} of the driving-rod. The weapon may be locked in its open position by moving the dial or slide till it registers with the position on the scale marked "Locked open," at which time the shoulder L^{12} is brought into engagement with the sear and locks the sear in engagement with the notch D^{13} of the driving-rod. The operation of the sear and dial is essentially the same, excepting that the one controls the firing by a rotary movement and the other by a longitudinal sliding movement.

The operation of the magazine cartridge-feed is as follows: The feed automatically controls the manner in which the cartridges are fed up and passed from the magazine to the barrel, the cartridge-lifter being formed to maintain a parallel feeding movement of the cartridges, the cartridge-follower automatically adjusting itself to the different steps in the feeding movement as the cartridges are successively removed from the magazine. The automatic adjustment of the cartridge-lifter to the position of the cartridges may be formed to give any required position to the topmost cartridge and to pass the succeeding cartridges from the magazine successively to the barrel in the same relative position and relation to the barrel and bolt-action.

The operation of the short and long levers and the adjustment of these levers to the required position of the cartridge is maintained by the difference in length between the long and short arm of the spring with which these levers engage. A faster movement is imparted to the short lever than to the long one, because the long arm of the spring moves faster than the short one or moves through the arc of a greater circle and its point of contact is nearer to the pivotal support of the le-

ver. The adjustment of the spring to the different feeding positions of the respective levers will depend upon the shape of the lever at its point of contact with the spring and the shape of that part of the lever over which the engaging part of the spring passes. A slower movement is given to the long lever than to the short one by reason of the fact that it engages with the short arm of the spring—that is, the shoulder which is nearer to the attached end of the spring, thus connecting it with the spring at a point which has less travel of the spring and at a point farther from the pivotally-supported returning-point of the lever. The cartridge-shelf may be hinged to either lever, but is here shown hinged to the longer lever as a preferred form of construction to form an adjustable shelf for the cartridge in passing it from the magazine to the barrel. The spring which actuates the cartridge-feed may have its tension adjustably increased or diminished by any suitable form of adjustable screw, such as P′, Fig. 9.

The magazine feed-latch R engages with the cartridge-clip, when such is used, to maintain the clip in either its upper or lower position, and its engaging end is formed to engage with the clip at its central part for holding the clip in its lower position, thus enabling the clip to be formed so that it may be inserted either side up, and the feed will correctly engage it. The latch engagement with the clip is preferably formed to hold the clip so that it cannot be moved either up or down. The latch R may be moved out of the path of the cartridge-clip by the finger, thus allowing the clip to rise into its upper position and reengage with the latch. The cut-out construction of the under side of the breech-bolt which allows the under locking-lugs of the breech-bolt to pass between the side wings of the cartridge-clip or magazine to rise up into the path of the bolt far enough to form a direct and easy path of movement for the cartridge as it is passed therefrom into the barrel by the breech-bolt. This construction does not materially reduce the strength of the bolt-action, but at the same time affords a direct path of movement for the cartridge-feeding action.

The handle-latch H^3 is spring-pressed, and its forward or latched ends project into the path of the handle and engages with the handle to lock it in its forward position.

What I claim is—

1. In a gun, the combination of a barrel, and a breech-block, with a chamber constituting an enlargement of the bore, a slotted opening thereinto, a cylinder having a piston therein operatively connected to the breech-block, and a gradually-expanding passage extending from said slotted opening to said cylinder.

2. In a gun, the combination of a barrel and a breech-block, with a chamber constituting an enlargement of the bore, a slotted opening thereinto, a cylinder having a piston therein operatively connected to the breech-block, a gradually-expanding passage extending from said slotted opening to said cylinder, a vent in said passage, and means for adjusting the area of said vent.

3. In a gun the combination of a barrel and a receiver, with a reciprocating and rotating breech-block having reversely-inclined cams on its opposite sides, a slide actuated by the gases of discharge and operatively engaging said cams to rotate the block, and a lug on the bolt engaging a longitudinally-extending groove in the receiver, whereby the bolt is restrained from rotation except in its forward position.

4. In a gun the combination of a barrel and a receiver, with a reciprocating and rotating breech-block, a discharge-actuated slide imparting movements of reciprocation and rotation to said block, and an engagement between the block and receiver restraining the block from rotation except in its forward position.

5. In a gun, the combination of a barrel and a receiver, with a reciprocating and rotating breech-block, a discharge-actuated slide imparting movements of reciprocation and rotation to said block, and a lug on the block engaging a longitudinally-extending groove in the receiver during the reciprocation of the breech-block, whereby the block is restrained from rotation except in its forward position.

6. In a gun, the combination with the barrel, of a gas-chamber in communication therewith and one or more gas-chambers in line with the bore of the barrel, said chamber or chambers increasing in cross-sectional area in a forward direction.

7. In a gun, the combination with the barrel, of a gas-chamber in communication therewith, and a plurality of additional gas-chambers in line with the bore of said barrel and having openings, of different diameters for the passage of the projectile.

8. In a firearm the combination of a gun-barrel having slotted openings into the bore of the barrel, and gas-chamber encircling the barrel and detachably attached to it, said gas-chamber having a longitudinal slotted opening on its under side to facilitate the machining and manufacturing of the chamber, and a gas-tube connecting with the gas-chamber and means closing the external opening for machining it.

9. In a gun, the combination of a barrel, a gas-chamber connected thereto and having a vent-opening, and a band encircling the chamber and adjustable over the vent-opening.

10. In a gun, the combination of a barrel with a gas-chamber, connected thereto and having a vent-opening, a band encircling the

chamber and adjustable over the vent-opening, and a lock-band maintaining said band in its adjusted position.

11. In a gun, the combination of a barrel with a series of gas-chambers in line with the bore of the barrel, one of said chambers having a vent-opening and means for adjusting the size of said vent-opening.

12. In a gun, the combination of a barrel with a nozzle having one or more gas-expansion chambers in line with the bore of the barrel and provided with an opening for the passage of the projectile, a vent from said chamber, and a screw-adjustment for controlling the area of said vent.

13. In a firearm, a power-controlling device comprising a gun-barrel combined with a nozzle consisting of a series of gas-expansion chambers consecutively arranged, the openings into the several chambers being of different diameters to allow the consecutive chambers to catch a greater or less amount of the gas-current.

14. In a magazine-gun, a cartridge-lifter comprising a spring having a long and a short arm each of which has a lifting action on the cartridge.

15. In a magazine-gun, a cartridge-lifter comprising a long and a short lever, and a spring engaging each of said levers at different points of the spring.

16. In a gun, a magazine-feed system comprising a cartridge-magazine and a long and short lever pivotally supported and movable in the magazine, a spring attached to the magazine and having a long and short arm, the long arm of the spring engaging with one lever and the other engaging with the other lever to afford a relatively faster movement of one lever than of the other for maintaining a relative feeding movement of the cartridges.

17. In a gun, a magazine cartridge-feed comprising a long and short lever pivotally supported and movable in the magazine, a cartridge-shelf hinged to the long lever and engaged by the short lever, and an actuating-spring having a shoulder and forwardly-projecting finger or arm and engaging with the said levers to govern the relative movement of the levers and to control the feeding movement and position of the cartridges.

18. In a gun, a magazine cartridge-feed comprising a cartridge-magazine, a spring-pressed cartridge-lifter feeding the cartridges from the magazine into the receiver, and a feed-controlling slide movable into and out of the path of the topmost cartridge, and a breech-bolt engaging with the slide to time and feed the cartridges from the magazine.

19. In a gun, the combination of a reciprocating breech-bolt, an operating-rod engaging with the breech-bolt, a cartridge-ejector pivotally supported in the frame and engaging with the operating-rod to swing its forward end into and out of the path of the cartridges, and a cartridge-extractor carried by the breech-bolt.

20. In a gun the combination with the barrel and receiver of a reciprocating and rotating breech-bolt having locking-lugs, a cartridge-ejector pivotally supported in the gun-frame and having arms movable into and out of the path of the extracted cartridges on either side of the locking-lugs of the breech-bolt, the said cartridge-ejector engaging with the operating-rod to throw the ejector into the path of the cartridge and a spring to reverse this movement.

21. In a gun, the combination with the barrel and the receiver of a reciprocating breech-bolt having its under side cut out to allow the cartridge-magazine to rise up into the path of the bolt, a cartridge-magazine having resilient sides for retaining and guiding the cartridges, said sides rising up into the path of the cut-out portion of the breech-bolt, to feed the cartridges from the magazine to the barrel.

22. In a gun, the combination with the barrel and receiver, of a reciprocating and rotating breech-bolt, the under side of the breech-bolt cut out to allow the cartridge-magazine to rise up into the path of the bolt, said bolt having a locking-lug guided between the resilient sides of the clip or magazine, a cartridge-magazine having resilient sides rising up into the path of the bolt to bring the topmost cartridge into the path of the bolt, and consecutively feed the cartridges into the barrel.

23. In a gun, a bolt-action comprising a receiver having a longitudinal guide-track and locking-lugs, a breech-bolt having companion locking-lugs and an auxiliary lug movable in the guide-track in the receiver, the body part of the bolt provided with a cam-track on one side for governing the locking action of the bolt and on the other side for governing the unlocking action of the bolt, a driving-rod guided in the receiver and engaging with the cam-tracks in the breech-bolt to reciprocate, lock and unlock the bolt, the tracks in the receiver permitting the rolling action of the bolt when at a fixed point.

24. In a gun the combination of a barrel and a receiver with a breech-block, a reciprocating slide operating said block and also acting as the striker or hammer to discharge the gun, a sear movable into engagement with said slide when the block is fully open and fully closed, a trigger tripping said sear, and means controlling the tripping action of the trigger, whereby the gun may be fired from the open position of the breech-block by one or by two pulls on the trigger as desired.

25. In a gun, the combination of a barrel and a receiver, with a breech-block, a reciprocating slide operating said block and also acting as a striker or hammer to discharge

the gun, a sear movable into and out of the path of said slide, a trigger engaging the sear, and means disengaging the trigger from the sear and permitting immediate reëngagement therewith, whereby the sear may be tripped to permit the slide to move forward to close the breech and reëngage the slide before the latter discharges the gun.

26. In a gun, the combination of a barrel, a receiver, a breech-block, a magazine, and a magazine-slide controlling the feed of cartridges from the magazine, with a reciprocating slide operating said block and acting as a striker to discharge the gun, a sear having a shoulder normally in the path of said reciprocating slide, a trigger engaging said sear, and means disengaging said trigger from the sear when the trigger is pulled, whereby a pull of the trigger acts to first disengage the sear from the slide and then permit the sear to rise and reëngage the slide.

27. In a gun the combination of a barrel and receiver, with a reciprocating and rotating breech-block, a discharge-actuated slide operatively engaging the block, and acting as a striker to discharge the gun, a sear capable of engaging the slide when the breech-block is in its fully-open and fully-closed positions, a trigger capable of successively tripping said sear from said engagements or of holding the sear wholly out of engagement with the slide, and means governing the action of the trigger on the sear for said purposes.

28. In a gun, the combination of a barrel, a receiver, a breech-block, a discharge-actuated slide operatively engaging the breech-block, a sear engaging the slide when the breech-block is in its fully-open position after the last cartridge has been fired, a cartridge-lifter, a trigger engaging said sear and having a part in the path of the cartridge-lifter after the last cartridge has been fed from the magazine, and a part on the trigger in the path of the rearward movement of the slide when said trigger has been raised by the cartridge-lifter, whereby the slide is engaged by the sear with the breech-block open after the last cartridge has been fed from the magazine.

29. In a gun, the combination of a breech-block, an automatic operating-slide therefor, a cartridge-feed lever, a sear engaging the slide when the breech-block is in open position after the last cartridge has been fired, a trigger engaging said sear and having a part in the path of the terminal movement of the feed-lever after the last cartridge is fed from the magazine and raised by said feed-lever into the path of the operating-slide whereby the trigger is shifted into the path of the slide and disengaged from the sear.

30. The combination of a breech-block-opening slide having a plurality of sear notches or shoulders in different planes, a sear mounted to engage said shoulders, a trigger for tripping said sear, and adjustable means limiting the swing of the trigger and thereby controlling the vibrations of the sear toward said slide.

31. The combination of a breech-block-opening slide having a plurality of sear notches or shoulders in different planes, a sear mounted to engage said shoulders, a trigger capable of longitudinal movement engaging said sear to trip it, and means imparting longitudinal movement to the trigger when pulled.

32. The combination of a breech-block-operating slide having sear notches or shoulders in different planes, a sear for engaging said notches, a pivoted longitudinally-movable trigger for tripping said sear, and adjustable means controlling the oscillatory and reciprocatory movements of said trigger.

33. The combination of a breech-block-operating slide having sear notches or shoulders in different planes, a sear for engaging said notches, an oscillatory reciprocatory trigger engaging said sear, and means limiting and controlling the oscillations and reciprocations of said trigger.

34. The combination of a breech-block-operating slide having sear-notches, a sear for engaging the same, an oscillatory reciprocatory trigger engaging said sear and a shoulder formed thereon, and a disk also having a shoulder and adjustable into and out of the path of the shoulder on the trigger, whereby the trigger may be locked against movement and its oscillations and reciprocations controlled.

35. The combination of a breech-block-operating slide having a plurality of sear notches or shoulders in different planes, a sear mounted to engage said shoulders and having a plurality of notches thereon in different planes, and a trigger successively engaging said notches on the sear.

36. The combination of a gun-barrel, and a nozzle in front of the muzzle end of the barrel, said nozzle having interior circumferential areas of resistance to the flow of the gases of discharge and rearwardly-inclined lateral vents extending through the walls of the nozzle from points adjacent to but to the rear of said areas of resistance.

37. The combination of a gun-barrel, and a nozzle in front of the muzzle end of the barrel, said nozzle having a plurality of rearwardly-facing surfaces on its interior, and a plurality of rearwardly-inclined vents in proximity to said surfaces.

38. The combination of a gun-barrel, and a nozzle in front of the muzzle end of the barrel, said nozzle having a plurality of rearwardly-facing resistance-surfaces decreasing from the muzzle end of the barrel forward and rearwardly-inclined vents in proximity to said surfaces.

39. The combination of a gun-barrel and a

nozzle in front of the muzzle end of the barrel, said nozzle having a plurality of rearwardly-facing annular surfaces on its interior, the area of each surface being greater than that of the one in front of it, and a plurality of rearwardly-inclined vents located to the rear of but adjacent to said surfaces.

40. The combination of a gun-barrel, and a nozzle in front of the muzzle end of the barrel, said nozzle having several sets of rearwardly-inclined vents formed in its walls, the vents of each set being symmetrically arranged in a plane at right angles to the path of the projectile through the nozzle.

In testimony whereof I have signed this specification this 16th day of February, 1900.

S. N. McCLEAN.

Witnesses:

REEVE LEWIS,

S. T. CAMERON.