

Jan. 17, 1939.

H. O. EIANE
AUTOMATIC RIFLE
Filed June 1, 1936

2,144,241

4 Sheets-Sheet 1

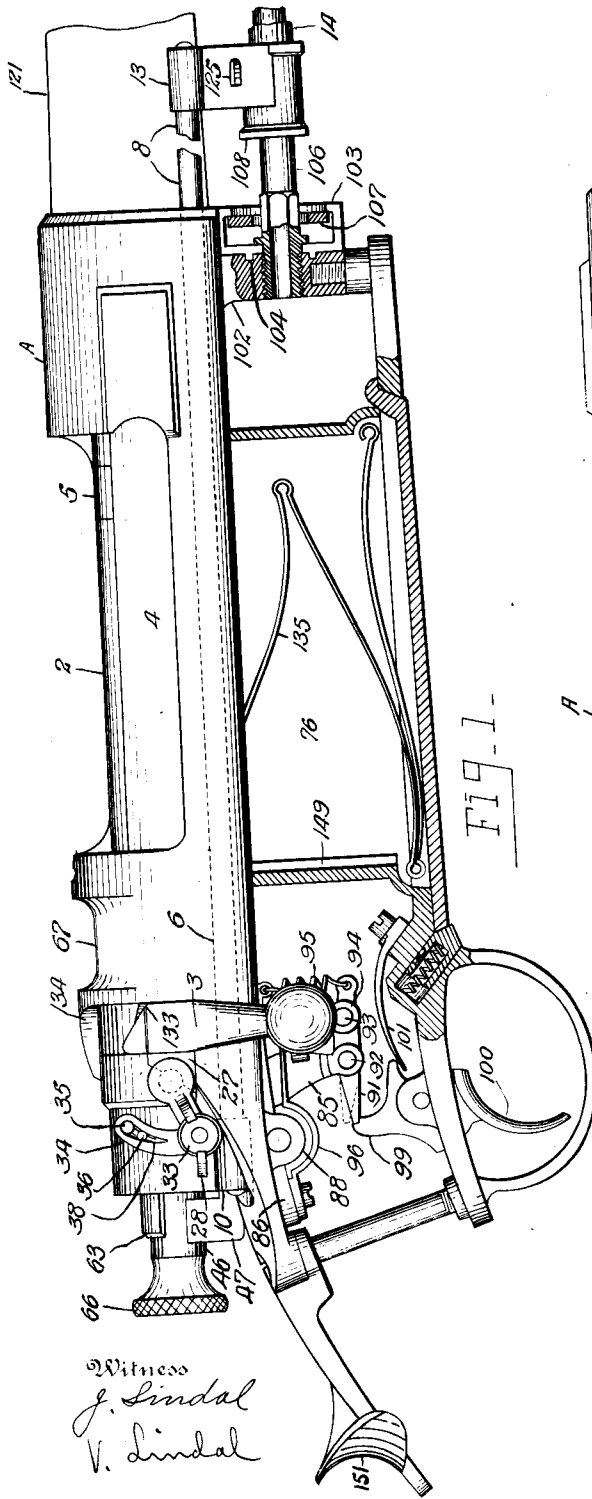


FIG. 1-

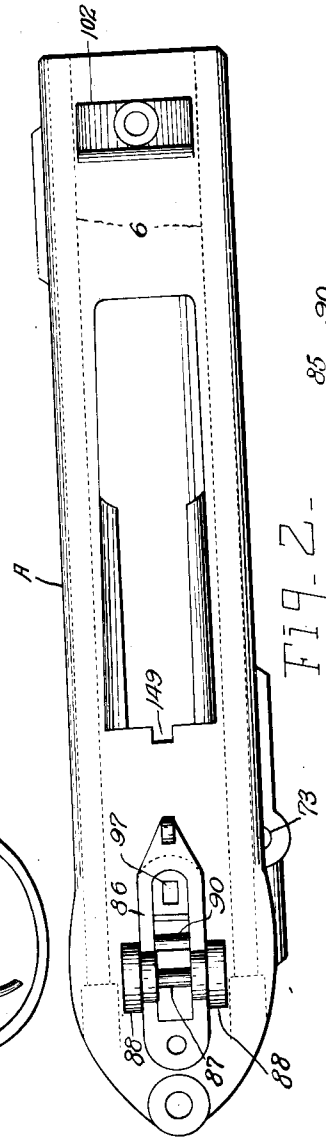


FIG. 2-

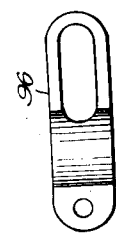


FIG. 3-

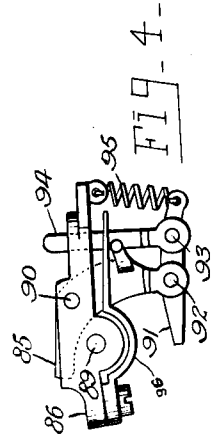


FIG. 4-

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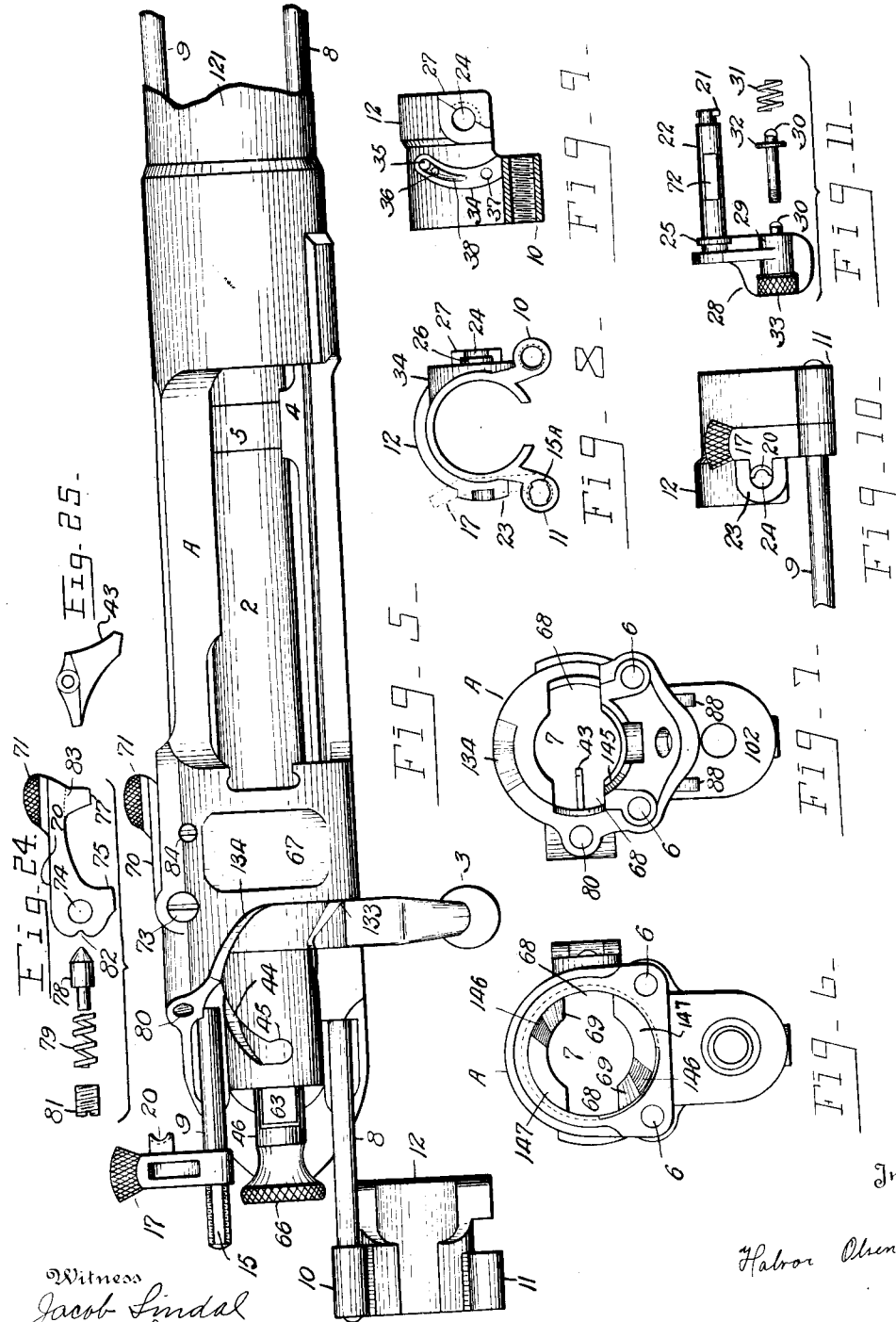
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Jan. 17, 1939.

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2,144,241

4 Sheets-Sheet 2

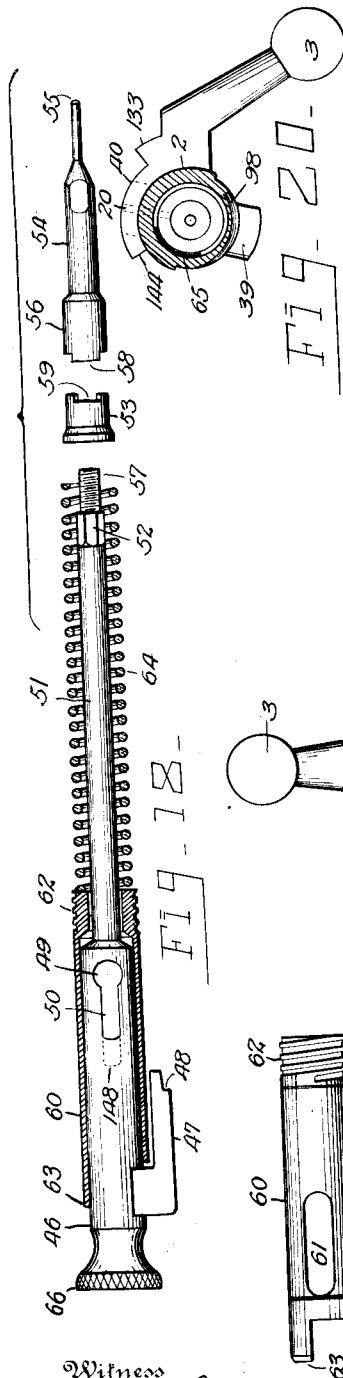


Jan. 17, 1939.

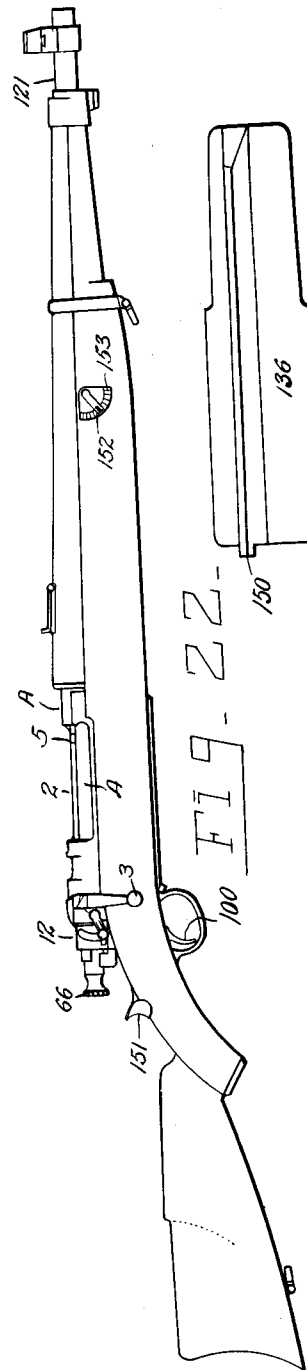
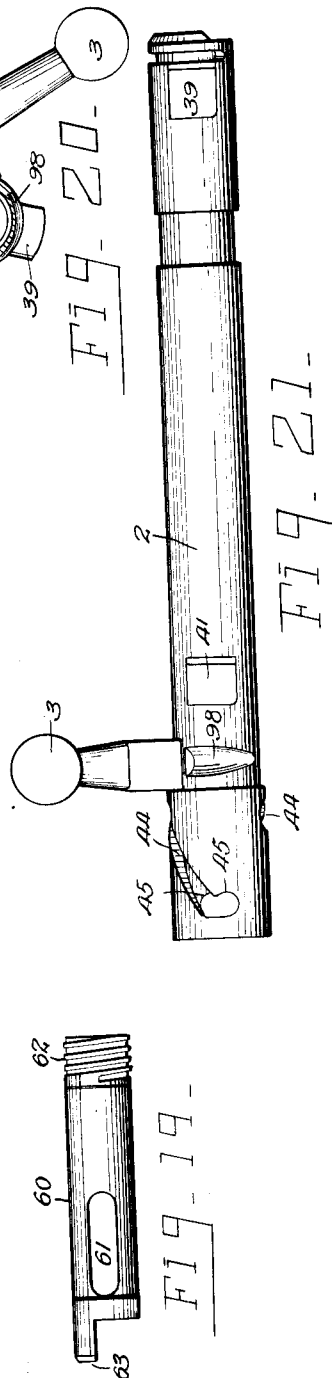
H. O. EIANE
AUTOMATIC RIFLE
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2,144,241

4 Sheets-Sheet 4



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UNITED STATES PATENT OFFICE

2,144,241

AUTOMATIC RIFLE

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Application June 1, 1936, Serial No. 82,811

17 Claims. (Cl. 42—3)

My invention relates to improvements in automatic fire-arms in which the breech bolt is locked by turning its lugs into recessed seat in the receiver and operated by the force of powder gas from the bore of the rifle; and the objects of my improvements are: First, to utilize the well known and reliable bolt action principle in conjunction with automatic operation; second, to provide means for quick and easy dismounting of the breech bolt mechanism for cleaning and inspection of the bore from the breech end of the barrel; third, to provide a fire-arm with straight striking firing pin, in order to attain the best accuracy in firing; fourth, to provide the fire-arm with automatic warning signal when the magazine is empty, by having the raised bolt handle obscure the line of sight; fifth, to utilize stored gas from a reservoir on the expansion principle as automatic motive power instead of operating the automatic mechanism on the impulse principle.

I attain these objects by the use of an automatic gun mechanism hereinafter more fully described and claimed having reference to the accompanying drawings, in which Fig. 1 is a fragmentary view in elevation partly in section of the receiver with the bolt mechanism in locked position.

Fig. 2 is a bottom plan view of the receiver, showing the magazine throat and sear box in position.

Fig. 3 is a bottom plan view of the sear spring.

Fig. 4 is a side view of the complete sear mechanism.

Fig. 5 is a top plan view of the receiver with the breech bolt in locked position, showing the crosshead sleeve detached from one of the operating connecting rods.

Fig. 6 is a front end view of the receiver with parts removed.

Fig. 7 is a rear end view of the receiver with parts removed.

Fig. 8 is a rear view of a crosshead sleeve.

Fig. 9 is a right side view of the crosshead sleeve partly in section.

Fig. 10 is a side view in elevation of the crosshead sleeve, showing the opposite side of said sleeve.

Fig. 11 is a bottom plan view of a crosshead pin, showing locking plunger and spiral spring in detached relation.

Fig. 12 is a longitudinal vertical section of the gas cylinders and valve mechanism connected to the rifle.

Fig. 13 is a fragmentary top plan view, partly

in section, of the piston-rod and piston assembly.

Fig. 14 is an enlarged vertical section of the check-valve and housing, shown in detached relation.

Fig. 15 is a top plan view of a barbed split-key, shown detached.

Fig. 16 is a cross section of the gas cylinder and valve-rod.

Fig. 17 is a bottom plan view of a control valve, showing in detached relation a collar and a nut.

Fig. 18 is a right side view of the firing pin assembly partly in section and showing certain of the elements detached.

Fig. 19 is a right side view of the bolt sleeve, shown detached.

Fig. 20 is a transverse vertical section taken at the bolt handle of the breech bolt.

Fig. 21 is a bottom plan view of the breech bolt, shown detached.

Fig. 22 is a longitudinal side view of the fire-arm constructed in accordance with the principles of my invention.

Fig. 23 is a top plan view of the magazine follower.

Fig. 24 is a top plan view of the bolt stop and associated members, shown in detached relations.

Fig. 25 is a top plan view of the ejector.

Fig. 26 is a rear end view of the piston.

Fig. 27 is a rear view of a locking sleeve.

Fig. 28 is a side view of the locking sleeve.

Referring more particularly to Figures 1, 2 and 5, it will be seen that the usual receiver A, a breech bolt 2 and a bolt-operating handle or lever 3 is provided in connection with a cartridge extractor 4 and an extractor-band 5.

The bottom of the receiver is approximately square when viewed from the front end although the lower corners of the bottom are slightly rounded so that the full strength of the material is retained at points where longitudinal passages 6 are drilled throughout the entire length of the receiver for slidably supporting connecting rods 8 and 9.

These passages are parallel to each other and likewise parallel to the bore 7 in which the breech bolt 2 operates.

The connecting rods 8 and 9 are particularly constructed at their ends so that they may be readily removed from their supports in a cross head sleeve 12 at the rear end of the receiver A and radial crosshead lugs 13 and 16 located in front of the receiver A.

The connecting rods 8 and 9 are secured within threaded lugs 10 and 11, respectively, formed on the lower rear portion of the crosshead sleeve 12.

The connecting rod 8 is provided with right hand threads at its rear end and left hand threads at its front end for the purpose of obtaining minute adjustment before being permanently fixed to the lug 10 by means of solder or rivets.

The front end of the rod 8 is threaded into a radial crosshead lug 13 formed on the rear end of the piston-rod 14.

The connecting rod 9 on the other hand is provided with left hand threads at its opposite ends and these threads are milled away in quarter sections, as shown at 15 (Figs. 5 and 13) at diametrically opposite points. Likewise, the internally threaded passages in lugs 11 and 16 are cut away to correspond with the milling of the threads of the connecting rod 9 in such a manner that when the mutilated threads on the ends of the rod 9 align with the channels 15A in lug 11 (Fig. 8) the rod may be removed from its bearings in the crosshead sleeve 12 and the crosshead lug 16. The lug 16 is shown more particularly in Fig. 13.

A thumb leaf 17 is secured to the rod 9 and is adapted to rock the rod a quarter of a turn for aligning the mutilated threads on the said rod with the channels in the bearings or lugs 11 and 16.

When the thumb leaf 17 is located in an upright locked position, the threads at both ends of the rod 9 are engaged respectively with the threads in their bearings, but a 90 degrees turn to the left of the thumb leaf disengages the threads at both ends and the rod can be moved forward to clear the lug 11 in the crosshead sleeve 12.

The front end of the connecting rod 9 beyond the lug 16 is squared to receive a collar 18 having a complementarily formed square hole and a nut 19 is threaded onto the forward end of the rod for aiding in lining up the respective threads of the rod and the lug.

The thumb leaf 17 is provided with a locking recess 20 which has a semi-circular counterbored seat into which a semi-circular collar 21 on the end of a crosshead pin 22 turns for locking the thumb leaf against accidental displacement (Figs. 10 and 11).

The crosshead pin 22 is mounted in the passage 24 in the crosshead sleeve 12 and is provided with an approximately semi-circular collar 25 which fits into a semi-circular recess 26 located in a boss 27 formed on the right side of the crosshead sleeve 12, thereby insuring the crosshead pin against lateral end play as long as the collar 25 occupies the recess 26.

A lever 28 is connected with the crosshead pin 22 and is provided with a web portion for reinforcing the same.

A cylindrical sleeve 29 is formed adjacent the free end of the lever 28 and provides a bearing for a lock plunger 30 which is acted upon by a spiral spring 31 for maintaining the free end of the plunger projected from the sleeve 29. The axis of said cylindrical sleeve is parallel to the axis of the crosshead pin 22 and said sleeve is located inwardly of the free end of the lever 28, as shown more particularly in Fig. 11.

The plunger 30 has its inner end threaded into a knurled button or head 33, after which said end is riveted or secured in any approved manner to prevent the same from working loose.

It will be noted that the button or head 33 is nested within the flange or web of the lever 28 and this web serves as a guide for the member 33 and relieves the comparatively weak plunger 30 from hard knocks incidental to rough usage.

A locking sector 34 is located at the right side of the crosshead sleeve 12 and is provided with pockets 35, 36 and 37, as shown more particularly in Figs. 1 and 9. These pockets are adapted to receive the free and projecting end of the plunger 30 as the lever 28 is rocked for rocking the crosshead pin 22, and these pockets in connection with the plunger 30 will maintain the lever 28 and likewise the pin 22 in a plurality of positions.

The pocket 35 in connection with the plunger 30 locks the lever 28 in "full safety position", while the pocket 36 locks the lever in "semi-safety position".

The pocket 37 will maintain the lever 28 and likewise the pin 22 in "firing position."

When it is desired to release the lever 28 from one of its locked positions, it is only necessary to withdraw the plunger 30 by means of the knurled head 33. However, the pocket 36 is relatively shallow so that when sufficient pressure is applied to the knurled head 33 the plunger 30 will slide out of the pocket, whereby the lever 28 may be rocked as desired.

The pockets 35 and 36 are located within the confines of a tapered groove 38, so that when the free end of the plunger 30 rides in this groove the groove will guide the plunger toward the pockets 35 and 36.

Referring more particularly to Figs. 20 and 21, it will be seen that the breech bolt is provided with two locking lugs 39 and 40 at diametrically opposite points at the front end of the bolt and a safety lug 41 is disposed adjacent the bolt handle 3. The lug 40 is split to provide a narrow groove 42 (indicated by dotted lines in Fig. 20) to permit an ejector 43 (Figs. 7 and 25) to reach the head of the cartridge to be extracted. In other words, this groove is provided as a passage for the ejector 43.

The rear end of the breech bolt 2 is provided with spiral cam slots 44 having notches 45 forming neutral lock seats for the crosshead pin 22 as will be presently explained.

The handle 3 is rigidly connected to the hollow breech bolt 2 between the lug 41 and the slots 44.

The firing pin assembly (Fig. 18) is carried within the hollow breech bolt 2 and includes a firing pin 46 provided with an arm 47 which is spaced from the pin and has its upper edge parallel to the axis of the pin. The forward end of this arm is provided with a sear notch 48.

The firing pin per se is of comparatively large diameter and has a transverse passage 49 which serves as a safety lock notch for the firing pin and approximately lines up with the crosshead pin 22 when the latter is in its normal position and the firing pin is in cocked position.

A straight slot 50 extends rearwardly from the transverse passage 49 but has less width than the diameter of the passage.

This slot is adapted to receive the flat milled section 12 of the crosshead pin 22, and this section is adapted to move through the slot as will be presently explained.

The length of the slot 50 plus the diameter of the transverse passage 49 corresponds in length to approximately three-quarters of the distance the firing pin 46 is carried rearwardly by the crosshead pin 22 while said pin moves rearwardly through the spiral cam slots 44 (Figs. 5 and 21). This movement of the firing pin is utilized for striking purpose, while the remaining portion of the rearward travel is utilized for storing up reserve power for assisting in the closing operation of the breech bolt 2.

The central portion of the firing pin assembly is indicated at 51 and is of a smaller diameter than the firing pin per se but forms an integral portion of the firing pin 46. The front end of the section 51 is made hexagonal, as shown at 52, to fit into a complementarily formed passage in a lock collar 53. Beyond the hexagonal portion 52, the section 51 is threaded as shown at 57 and a spiral spring 64 embraces the section 51 and abuts the outer end of a square cut threaded section 62 formed on the sleeve 60.

The extreme front end of the firing pin assembly includes a section 54 which carries a striking point 55 at the front end.

The rear end of the section 54 is enlarged at 56 and this section is bored and threaded on the inside to receive the threaded end 57 of the section 51. A tenon 58 on the enlarged portion 57 meshes with a mortise 59 on the collar 53, so that these parts are locked together.

The firing pin 46 is centrally bored to reduce the weight, and this bore extends from the rear end to the slot 50.

The bolt sleeve 60 is received by the firing pin 46 and has a pair of diametrically disposed slots 61 through which the crosshead pin passes for maintaining the sleeve from turning to the right or left. The rear end of the sleeve is provided with an extension 63 which is for the purpose of aiding in turning the sleeve for screwing the same in position.

In assembling the bolt mechanism, the firing pin 46 is placed within the bolt sleeve 60 and the spring 64 is placed over the front of the firing pin in embracing relation with the section 51.

With the rear end of the spring abutting the threaded portion 62, the lock collar 53 is placed on the outer free end of the section 51 and is received by the hexagonal portion 52 and is moved inwardly of the section 51 and until it clears the threaded end 57. The member 54 is then screwed into place on the threaded end 57 of the section 51. When the tenon 58 aligns with the mortise 59 the parts are locked together and maintained under pressure by the spring 64.

When the spring 64 is compressed between the member 52 and the collar 53, the bolt sleeve 60 serves as a main spring shoulder for the inside of the breech bolt 2 since the threads 62 on the sleeve 60 are screwed into complementary threads 65 (Fig. 20) in the breech bolt 2.

The securing of the firing pin assembly within the breech bolt is accomplished by means of a knurled head 66 on the firing pin 46, by turning the head 66 to the right so that the arm 47 will engage the rear extension 63 on the sleeve 60 whereby the sleeve can be turned in the desired direction.

Since the intermeshing threads 62 and 65 fit rather loosely no tools are required for screwing the firing pin assembly into the breech bolt.

The receiver A, breech bolt 2, extractor 4 and the cartridge magazine are well known in the art and are of the type found in the German Mauser rifle except those portions which are located at the rear of the receiver bridge 67 and the front ends of the lug races or grooves 68 which are provided with spiral faced cams 69 (Fig. 6).

A bolt stop 70 has a knurled head 71 and is pivoted upon a screw-bolt 73 carried by the receiver A. The free end of this stop or lever is provided with a projection or prong 77, which is located within a slot formed in the left side of the receiver A.

The lever is also provided with a lug or projec-

tion 75 which blocks the left lug race or groove 68 but does not normally contact with the left locking lug 40 of the breech bolt 2 as the rearward momentum of the said bolt is broken by a buffer arrangement which will be presently described.

A pointed plunger 78 is adapted to engage a double acting cam-notch 82 at the rear of the lever 70 for retaining said lever in position. A spring located in a passage 80 (Figs. 5 and 7) maintains the plunger 78 in engagement with the cam-notch 82, and a threaded plug 81 screwed into the outer threaded end of the passage 80 maintains the spring in position.

The prong or projection 77 is split as indicated by dotted lines, as shown at 83, to enable said projection or prong to ride over the ejector 43.

Before inserting the breech bolt 2 into the bore 7 of the receiver A, the bolt stop or lever 70 is first pulled out to the left by the knurled head 71 and the passage through which the breech bolt moves is free so that the bolt may be pushed and turned into its forward position.

The crosshead sleeve 12 is then moved upwardly and towards the left from the position shown in Fig. 5 until the passage in the lug 11 lines up with the rear end of the connecting rod 9.

This rod can then be pulled rearwardly by the thumb leaf 17 until stopped by contact with the lug 11. After this the thumb leaf is then raised to its normal locked position on the left side of the crosshead sleeve 12. The last act of assembling includes the insertion of the crosshead pin 22 through the passage 24 from the right side of the crosshead sleeve 12, then through the spiral cam slot 44 and through the right side longitudinal slot 61 in the bolt sleeve 60.

The firing pin 46 is then drawn up by its knurled head 66 slightly beyond the full cocked position to which point the transverse passage 49 aligns with the crosshead pin 22 and then said pin can be moved into place.

During these operations, care must be exercised so that the lever 28 is in a forward and upward position before the final movement takes place of the crosshead pin 22 so that the collars 21 and 25 (Fig. 11) can pass into their respective recesses 20 and 26 after which the turning leaf or lever 28 is rocked to the rear and locked in any desired position.

At this stage of assembling the bolt mechanism is ready for action.

The flattened section 72 of the crosshead pin 22 permits the crosshead pin to pass freely back and forth through the slot 50 when the lever 28 is in locked position at the locking pocket 37. This is the position termed "ready-to-fire". When the lever 28 is in safety locked position, it is retained in position by the plunger 30 and the pocket 35. The crosshead pin cannot then move through the slot 50, or vice versa and the firing pin is in "safety" locked position.

When the pocket 36 is engaged by the plunger 30, the firing pin is then in "semi-safety" locked position. When locked in either of the two last mentioned positions the firing pin 46 is retained slightly beyond its full cocked position so that the full force of the compressed spring 64 will rest on the crosshead pin 22 and not on the trigger or sear arrangement. In other words, when the firing pin is in safety position the sear and trigger arrangements are free to resume their former positions in case the trigger is accidentally pulled.

The breech bolt 2 is held in its rearward posi-

tion by means of manipulation of the lever 70 so that the prong 77 engages the front face of the lug 40, whereby cartridges may be loaded into the magazine 76.

Referring particularly to Figs. 1, 2 and 4, it will be seen that the trigger mechanism co-operates with a sear 85 housed in a frame or box 86 which in turn is fitted into a recess in the bottom of the receiver A and held in place by a pin 87. A pair of lugs 88 project from the bottom of the receiver A and are spaced apart to accommodate the sear box 86, and the pin 87 is supported by said lugs and received by the passage 89 in the walls of said sear box.

The sear box 86 is so constructed that it will directly locate a pin 90 upon which the sear 85 is pivoted as near as possible to the arm 47, depending upon the firing pin 45.

A rocker arm 91 is pivoted on the lower end of the sear 85 by means of a pin 92 located near the longitudinal center of the arm.

A push rod 94 is pivoted to the rocker arm 91 in front of the sear member 85 by means of a pin 93 and urged in one direction by a spiral spring 95 connected between the front of the rocker arm 91 and the sear box 86.

The spring 96 maintains the sear 85 in contact with the arm 47.

An elongated opening 97 is provided in the bottom of the receiver A through which the push rod 94 projects and makes contact with an eccentric groove 98 (Figs. 20 and 21) disposed on the underside of the breech bolt 2 and so arranged that when the breech bolt is in locked position the upper end of the push rod 94 rests in the deepest end of said eccentric groove and normal contact is then established between the rear end of the rocker arm 91 and the inside extension 99 of the trigger 100.

When the breech bolt 2 however, is in unlocked position the rocker arm 91 is disengaged from the extension 99. This extension is maintained in a rearward position ready for contact by a spring 101.

Referring more particularly to Fig. 1, it will be seen that a receiver lug 102 located at the front of the receiver A supports a buffer housing 103 and this housing consists of two semi-circular sections which are held together by semi-annular ribs 104, mounted in an annular groove 105 formed in the lug 102.

These semi-circular sections are secured to the lug by means of a flanged guide tube 106 which is screwed into the lug 102.

A steel washer 107 is placed within the housing 103, and behind this steel washer, soft rubber or cork washers are placed (not shown) to absorb the shock of the moving parts constituting the automatic mechanism of the gun when the buffer head 108 on the rear end of the piston-rod 14 comes into contact with said steel washer.

The piston-rod 14 is hollow and slides over the guide tube 106.

A ball-head 110 on the forward end of the piston-rod 14 is mounted in a ball-socket 111 in a piston 109.

The ball-head 110 is faced flat on diametrically opposite sides (not shown) to permit insertion into the socket 111 (Figs. 13 and 26), and the piston 109 given a quarter turn with respect to the rod 14, and retained in that position by means of a split lock sleeve 112 inserted at the rear end of the piston 109 in such manner that the extensions or prongs 113 of which there are two, will take the place of the milled

off portions of the ball-head 110 which correspond to the entrance to the socket 111, shown in Fig. 26.

A pair of ridges or projections 114 (Figs. 27 and 28) expand into an inner circular groove 115 in the rear of the piston 109 and retain the lock sleeve 112 in its proper position.

The piston 109 is provided with a plurality of bull rings 116 and a like number of split expansion rings 117, and these rings are held in position by means of a threaded nut 118 screwed onto the front end of said piston.

The piston 109 slides within a cylinder 119 attached to a projection or valve housing 120 which is integral with a rifle barrel 121.

A spiral action spring 122 embraces the cylinder 119 and is secured at its front end by means of slots 123 of which there are two, located in lugs 124 (Figs. 12 and 16) through which the end of the spring is passed. The rear end of the spring 122 is secured in slots 125 located in the lugs 13 and 16 (Figs. 12 and 13).

The spring 122 is bent at its rear end to point forward and at its front end to point rearward, and split-keys 126 provided with barbs 127 inserted into the slots 123 and 125 to prevent the ends of the spring 122 from working loose.

The barbed split-key 126 (Fig. 15) is shaped as part of a circle and of a diameter corresponding to that of the action spring 122.

A passage 128 communicating between the cylinder 119 and the bore 121A in the barrel 121 is provided with a control valve 129 to regulate the opening thereof and to provide means for closing of said passage when so desired.

A spring-pressed check-valve 130 is located in the passage 128 which normally closes said passage until opened by gas pressure from the bore 121A of the barrel 121. The check-valve 130 is operatively supported in a housing 130A and held to its seat by pressure of a spiral spring 130B (Fig. 14). A plurality of vents 130C pass through the valve-housing 130A for passage of gas when in operation.

A cylindrical gas-reservoir 131 is attached by means of screw threads to the valve-housing or projection 120 (Fig. 12), and is in communication with the bore 121A and the cylinder 119.

When gas enters the cylindrical reservoir 131, a piston 132 is forced to yieldingly move outward against pressure of a spiral spring 132A located in front of said piston, and uncovers a relief port 132B when excessive pressure accumulates in said reservoir. A collar 132C limits the inward movement of the piston 132 against the action of the spring 132A.

All valves are of well known and tried patterns, so they require no detailed descriptions.

The barrel 121 is provided with a cartridge chamber at its rear end (not shown) and into this chamber an initial cartridge is placed through manual operation of the breech bolt 2 by means of the bolt handle 3.

When this cartridge is fired the bullet or projectile is forced out through the bore 121A by expanding gases and when the projectile has uncovered the communicating passage 128 a portion of the expanding gases forces the check-valve 130 open and fills the cylindrical reservoir 131 and simultaneously exerts pressure against the two pistons 109 and 132, but as the piston 109 is connected to the breech bolt mechanism with its inherent inertia in addition to pressure exerted from the bore 121A, the piston 132 therefore moves in advance of the former and at the

same time increases the volume capacity of said reservoir.

When the pressure in the bore 121A is decreased sufficiently, the valve 130 will automatically close the communicating passage 128 and the entrapped expansive gas aided by pressure from the spring-pressed piston 132 will cause the piston 109 connected to the breech mechanism to move out through the cylinder 119 and simultaneously pull or stretch out the action spring 122.

As the piston 109 advances out through the cylinder 119 the stored or entrapped gas pressure decreases, which in turn causes the piston 132 to close up on the receding gases by reason of stored power in the spiral spring 132A and thereby prolongs the effective expansive power of the gases.

As the crosshead pin 22 carried by the crosshead sleeve 12 moves through the spiral slots 44 rotary motion to the breech bolt 2 is thereby effected, and as a cam 133 located at the inner end of the bolt handle 3 (Fig. 5) engages a rearwardly faced cam 134 located at the rear of the receiver bridge 67, the tightly expanded cartridge-shell gripped by the extractor 4 is unseated from its chamber.

At this stage of rotary motion, the crosshead pin 22 has reached the rearward limit of its travel through the spiral slots 44 and simultaneously carried along the firing pin 46 to its full travel limit with respect to the breech bolt 2, and the pin 22 from then on exerts only rearward pressure to the bolt 2, while means for effecting a continuous rotary movement of said bolt is shifted in co-ordinated order to the forward locking lugs 39 and 40 which slide along in the spirally faced cam grooves 69 until the pin 22 is seated in the neutral lock seat notches 45.

At the point where the crosshead pin 22 comes to rest in the lock seat notches 45 the breech bolt 2 has completed its rotary movement and the lugs 39 and 40 entered into the regular longitudinal lug races or grooves 68.

It will be noted that the pitch of the spirally faced cam grooves 69 corresponds closely to the pitch in the spiral cam slots 44.

As the breech bolt 2 approaches its rearward travel limit, the empty cartridge-shell is ejected by the ejector 43 and the rearward momentum of the breech bolt and its connected automatic mechanism gradually broken by means of the buffer arrangement shown in Fig. 1.

Referring again to Fig. 12, it will be seen that the cam rod 137 is provided with a return bend 138 adapted to fit the inside wall of the cylinder 119 and located in the path of the piston 109.

When the piston 109 approaches its rearward travel limit the return-bend 138 is encountered and a rod 137 provided with a cam 139 carried along which causes said cam to impart rocking movement to a rocker arm 140 which in turn lifts an exhaust valve 141 off its seat, and the gases in the cylinders 119 and 131 escape out to the atmosphere by way of a plurality of vents 142.

As the breech bolt 2 commences on its return stroke by action of stored power in the action spring 122, a loaded cartridge is raised up in front of the bolt by action of a magazine spring 135 attached to a follower 136 and carried along toward the chamber in the barrel 121 (not shown).

As the breech bolt 2 and its connected moving parts travel along on its return stroke, momentum

is gained and this force is utilized to give the bolt 2 a powerful turning movement when the cam 133 engages the cam 134 and thus, effect unlocking of the seats 45 from the crosshead pin 22.

At a point where the crosshead pin 22 enters the spiral cam slots 44 from their rear ends, a portion of the stored energy in the spring 64 is utilized to assist in the closing movement of the breech bolt 2, during action of cartridge seating when the lugs 39 and 40 engage the seating cams 146 (Fig. 6).

When the lugs 39 and 40 commence to engage their respective locking seats 147, first then, does the sear 85 engage the notch 48, located on the arm 47 (Fig. 18).

During the remaining part of the closing action of the breech bolt 2, the forward part of the buffer head 108 (Fig. 12) returns the cam rod 137 to its forward and normal position, and the exhaust valve 141 is closed by action of the spring 141A, and the fire-arm is again ready for action.

Referring again to Fig. 16, it will be seen that the guides 143 are raised a trifle above the cam rod 137 so as to prevent the action spring 122 from rubbing against said rod.

Referring again to Figs. 1 and 2, it will be seen that a vertical groove 149 is provided in the rear wall of the magazine 76, and into this groove, an extension 150 located on the rear end of the follower 136 (Fig. 23) is adapted to operate and directly retain the breech bolt 2 in a retracted and inoperative position, and simultaneously give warning by means of the raised bolt handle 3 that the magazine is empty.

In Fig. 18, dotted line 148 indicates distance traveled by the firing pin 46 while giving off its stored surplus power in co-operative action for closing of the breech bolt 2.

This important and effective arrangement is accomplished by the simple method of providing, first, an extra strong main spring 64, and secondly, by increasing the rearward travel of the firing pin 46 with respect to the breech bolt 2, and lastly, by fixing of the point at which the sear 85 engages the notch 48, located on the arm 47 of the firing pin 46.

Referring more particularly to Fig. 5, it will be seen that two cams 133 and 134, the first mentioned located at the inner end of the bolt handle 3, and the latter located in the rear part of the receiver bridge 67, are double-acting but continuous and of different pitch and for different purposes. The front portions of the cams 133 and 134 are of narrow pitch and are designed to give a powerful extraction pull when the cam 133 rotates against the rearward faced cam 134 while the breech bolt 2 is on its way out, but the rear portions of the cams have a longer pitch and are designed to give a powerful turning movement of the breech bolt on its forward travel in order to unlock itself from the crosshead pin 22 seated in the neutral lock seats 45, which are a trifle deep and requires force to effect unlocking.

Additional cams 144 and 145 (Figs. 7 and 20) each have a pitch corresponding to the rear portions of the cams 133 and 134 and co-operate with the latter to impart rotary movement to the breech bolt 2.

Referring to Figs. 1 and 22, it will be seen that a thumb guard 151 attached to the rear end of the receiver A is provided to protect the hand of the operator from getting into the path or sweep of the breech bolt 2.

Referring more particularly to Figs. 17 and 22, it will be seen that the control valve 129 is pro-

vided with a spring turning leaf 152 which is adapted to operate in a sunken quarter section dial 153, which in turn is adapted to retain said turning leaf in any position within the limits of said dial.

In Fig. 17, the square collar 154 and the nut 155 prevent lateral end play to the valve 129.

Referring again to Figs. 5 and 7, it will be seen that the longitudinal passages 6 are counter bored at their rear ends to accommodate the lugs 10 and 11 of the crosshead sleeve 12 (Figs. 1 and 8), while the middle sections of said passages are reamed out (not shown) preferably with expansion reamers, but leaving a sufficient portion thereof at each end to provide bearings for the rods 8 and 9.

I do not intend to limit my invention to any particular size or style of guns or fire-arms, nor to the exact drawings and descriptions as herein given, as many changes can be made without departing from the principles involved.

Having thus described my invention what I claim as new and desire to secure by Letters Patent is:

1. In an automatic firearm, a receiver having a longitudinal bore, a breech bolt in the bore and provided with spiral cam slots at the rear end, a crosshead sleeve slidably carried by the receiver and embracing the slotted end of the breech bolt, a rockable pin carried transversely by the sleeve and passing through the cam slots, a firing pin within the breech bolt having a keyhole-shaped slot also receiving the rockable pin, an arm depending from the firing pin and provided with a sear notch, a sear mechanism having a sear engaging the notch, said rockable pin co-operating with the keyhole-shaped slot for effecting cocking movement of the firing pin, means for retaining the firing pin in a safety locked position when said rockable pin is shifted to a predetermined position with respect to said crosshead sleeve, means for rocking and retaining the pin in prefixed positions with respect to said sleeve, said means comprising a turning leaf on the pin, a spring-pressed locking plunger carried within the turning leaf, an externally guided head on the plunger, a semi-circular collar on the pin, a semi-circular recess on the sleeve to receive the collar, and a lock sector with locking pockets on said sleeve to receive the locking plunger when brought into alignment, and means for rotating and reciprocating the breech bolt, substantially as described.

2. In an automatic firearm, a receiver having a bore, a reciprocating breech bolt in the bore, a reciprocating crosshead sleeve for moving the bolt, a rockable pin carried by the sleeve, a pair of action rods, one rod being threaded and fixed to the sleeve, the second rod being connected to the sleeve by demountable means comprising a fixed turning leaf on the rod, a semi-circular recessed seat on the leaf, a semi-circular collar on the rockable pin adapted to engage the seat and lock the leaf to the sleeve, interrupted threads on the rod engageable with similar cut threads in the sleeve and full threads and interrupted threads respectively at the opposite ends of the rods for further connections, means connected with the rods and acted on by the explosive gases in the barrel of the firearm for causing rearward movement of the rods and sleeve, said bolt having cam slots to receive the pin, a firing pin having a slot to receive the pin likewise, for causing the bolt to be rotated and simultaneously effect the cocking movement of

the firing pin, the walls of the bore having cam grooves, lugs on the bolt and disposed within the grooves for causing further rotation of the bolt, all substantially as shown and described.

3. In an automatic firearm, a firing pin provided with a transverse slot, a sleeve on the pin having diametrically opposed slots aligning with the slots in the pin, a crosshead pin received by the aligned slots, a receiver provided with a bore, a bolt in the bore receiving the firing pin, said bolt having cam slots receiving the crosshead pin, means for causing reciprocation of the bolt and likewise the firing pin, the crosshead pin causing relative movement between the firing pin and said bolt.

4. In an automatic firearm, a receiver having a bore, a breech bolt mounted for rocking and reciprocating movement in the bore, the walls of the bore being provided with cam grooves, diametrically disposed lugs on the bolt received by the grooves, a safety lug on the breech bolt, a spring-pressed firing pin located within the bolt and provided with a transverse sectional passage and a longitudinal slot extending from said passage which is narrower than said passage, a crosshead sleeve slidably mounted on the receiver, a crosshead pin rockably mounted transversely of the sleeve and received by the passage in the firing pin, whereby said crosshead pin may be rocked, said crosshead pin having a reduced section to be received by the slot in the firing pin to permit longitudinal movement of the two engaged parts, the breech bolt being provided with cam slots at the rear end thereof and receiving the crosshead pin, said bolt having seats at the ends of the cam slots so that when the crosshead pin is received by said seats said pin will be locked therein, co-operating means between the receiver and the breech bolt for causing rocking of the breech bolt and for moving the seats away from the crosshead pin, and means for causing reciprocation of the breech bolt.

5. In an automatic firearm, a receiver having a longitudinal bore, a magazine having a throat opening into the bore, the receiver having a pair of lug grooves, a pair of spiral faced cam grooves and a pair of recessed locking seats, the lug grooves being connected with the seats by the cam grooves, a pair of longitudinal passages extending through the solid walls of the receiver at opposite sides of the throat opening and parallel to the bore, a complementary action rod comprising a pair of parallel spaced rods in its rear end and a singular piston-rod in its front end slidably mounted in the passages, a crosshead sleeve provided with threaded lugs attached to the rear ends of said action rod, a breech bolt provided with locking lugs at the front end and spiral cam slots with locking seats at the rear end, a rockable crosshead pin carried transversely by the sleeve and passing through the slots in the bolt, a piston universally joined to the front end of the piston-rod, said bolt adapted to be rotated and reciprocated in the bore and further rotated when the lugs engage the cam grooves, the rearward movement of the bolt while rotating causing the seats at the ends of the cam slots to receive the crosshead pin and lock the seats onto the pin, stationary cams on the rear end of the receiver and means on the bolt engageable with the cams for effecting release of the seats from the pin at the end of the forward or return movement of the breech bolt, and means for causing the piston and action rod to reciprocate when acted on by direct gas pressure

from a closed reservoir, all substantially as shown and described.

6. In an automatic firearm, a firing pin, a stem projecting from the pin, a sleeve mounted on said pin and provided with a shoulder at the inner end thereof, a collar on the outer end of the stem, a spiral spring on the stem and abutting at the ends thereof on the shoulder and said collar, a firing point threaded onto the outer end of the stem and interlocking means between the stem and collar and collar and firing point, said interlocking means comprising a hexagonal faced portion of the stem adapted to assembling of said sleeve and spring and a lock collar having a complementary passage adapted to engage said hexagonal faced portion and interlocking tenon and mortise between said collar and firing point.

7. In an automatic firearm, a receiver having a bore, a breech bolt in the bore and provided with an eccentric groove, a sear mechanism including a frame connected to the bottom of the receiver, a sear pivoted in the frame, a rocker arm pivoted to the sear, a contact rod pivoted at one end to the arm, a spring acting on the arm for causing the other end of the rod to seat in the groove, a trigger mechanism having contact with the rocker arm, rotary movements of the bolt causing reciprocation of rod for causing release of the rocker arm from the trigger mechanism.

8. In an automatic firearm, a receiver having a bore, a breech bolt in the bore and provided with an eccentric groove, a sear mechanism including a frame connected to the bottom of the receiver, a sear pivoted in the frame, a rocker arm pivoted to the sear, a contact rod pivoted at one end to the arm, a spring acting on the arm for causing the other end of the rod to seat in the groove, a trigger mechanism having contact with the arm, rotary movements of the bolt causing reciprocation of the rod for causing release of the rocker arm from the trigger mechanism, a firing pin in the bolt, an arm depending from the firing pin and provided with a notch, said sear adapted to engage the notch until released by means of pressure on the trigger, substantially as described.

9. In an automatic firearm, a receiver provided with a bore and a slot in its left side wall, a barrel connected with the receiver, a magazine having a throat leading into the receiver, a follower in the magazine, a spring for urging the follower toward the throat, a vertical groove in the rear wall of the magazine, a rearward extension on the follower and adapted to travel in the groove, a breech bolt in the bore, an action rod operatively connected to the breech bolt, a main action spring connected to said rod and urging the bolt in a forward direction, said extension adapted to engage in direct contact with the bolt and retain said bolt in an inoperative position beyond the rear wall of the magazine, a lever pivotally mounted in said slot and provided with an inward projecting prong which communicates with said bore, said lever adapted to engage and retain the bolt in its retracted position by means of manual pressure to facilitate the loading of cartridges into said magazine, and self-acting release between said lever and bolt by means of said action spring coincident with release of said manual pressure.

10. In an automatic firearm, a receiver having a bore, a hollow breech bolt in the bore, means including a crosshead sleeve for causing rotation and reciprocation of the bolt in the bore,

a firing pin in the hollow bolt, a dependent arm on the firing pin provided with a sear notch, a spring adapted to be placed under compression in the hollow bolt for urging the firing pin in one direction, a sear mechanism, a portion of the energy stored in the compressed spring being utilized for co-operative assistance in the rotary closing movement of said breech bolt prior to engagement between said sear notch and said sear mechanism, and means for causing reciprocation of said crosshead sleeve.

11. In an automatic firearm, a receiver having a bore, a hollow breech bolt in the bore, means including a crosshead sleeve for causing rotation and reciprocation of the bolt in the bore, a firing pin in the hollow bolt, a dependent arm on the firing pin provided with a sear notch, a spring adapted to be placed under compression in the hollow bolt for urging the firing pin in one direction, a sear mechanism, a portion of the energy stored in the compressed spring being utilized for co-operative assistance in the rotary closing movement of said breech bolt prior to engagement between said sear notch and said sear mechanism, means for causing reciprocal movement of the crosshead sleeve, the bolt having spiral slots, the walls of which forming cams, the last mentioned means including the cams and a crosshead pin passing through the slots, said pin being rockable in the crosshead sleeve.

12. In an automatic firearm, a receiver having a bore, a hollow breech bolt in the bore, means for rotating and reciprocating said bolt, means on the receiver including a split buffer housing provided with inward crimped edges for rotating cushioning material therein and engageable with the reciprocating means at the limit of the rearward movement of said breech bolt.

13. In an automatic firearm, a receiver having a bore provided with lug races or grooves, a hollow breech bolt in the bore provided with lugs, means for rotating and reciprocating said bolt, means on the receiver including a split buffer housing provided with inward crimped edges for retaining cushioning material therein and engageable with the reciprocating means at the limit of the rearward movement of the bolt, a lever pivoted on the receiver and having a projection extending into and blocking one of said lug races, said lever adapted as a reserve stop to engage directly a lug of said breech bolt upon failure of said reciprocating means.

14. In an automatic firearm, a receiver, a barrel provided with a bore attached thereto, a breech bolt turnable and reciprocable in the receiver, a pair of longitudinal passages extending through the receiver, a crosshead sleeve, a pair of rods slidably mounted in the passages and detachably connected to the sleeve, a rockable pin connecting the bolt with the sleeve, an extension projecting from the barrel, a cylinder connected to the extension, said extension having a passage connecting the cylinder with the bore, a spring-pressed valve in the passage normally closing said passage until gas pressure from the bore opens the valve for admission of gas to the cylinder, a spring-pressed piston in the cylinder, and means connecting the rods with the piston, said means comprising a piston-rod provided with a pair of internally threaded lugs at one end for connecting with the rods and the other end of the piston-rod provided with a ball-head adapted for flexible connection with a ball-socket in said piston, all substantially as shown and described.

15. In an automatic firearm having a receiver, a barrel provided with a bore attached to the receiver, a crosshead sleeve, a pair of action rods connected to the sleeve and slidably mounted in the receiver, a rockable pin connecting the bolt with the sleeve, an extension projecting from the barrel, a cylinder connected to the extension, said extension having a passage connecting the cylinder with the bore, a spring-pressed valve in the passage normally closing said passage until gas pressure from the bore opens the valve for admission of gas to the cylinder, a spring-pressed piston in the cylinder, a piston-rod connecting said piston with the action rods, a spring-pressed exhaust valve in the extension, a passage communicating between the cylinder and the atmosphere, said exhaust valve normally closing said last mentioned passage, a pivoted rocker arm adapted to contact with said exhaust valve, a cam-rod slidably mounted in guides on the cylinder and having its cam end in operative contact with said rocker arm, and means on the other end of the cam-rod engageable with means on the piston-rod for actuating and timing the opening and closing of said exhaust valve at predetermined points in relation to the position of the piston in said cylinder.

16. In an automatic firearm having a receiver, a barrel provided with a bore attached to the receiver, a breech bolt turnable and reciprocable in the receiver, a crosshead sleeve, a pair of action rods connected to the sleeve and slidably mounted in the receiver, a rockable pin connecting the bolt with the sleeve, an extension projecting from the barrel, a cylinder connected to the extension, said extension having a passage connecting the cylinder with the bore,

a spring-pressed valve in the passage normally closing said passage until gas pressure from the bore opens the valve for admission of gas to the cylinder, a spring-pressed piston in the cylinder, a piston-rod connecting said piston with said action rods for actuating the movement of said breech bolt, a second cylinder forming a gas reservoir connected to the extension and communicating with said passage and said first-mentioned cylinder, a relief port in the second cylinder, and a spring-pressed piston in said second cylinder adapted to be moved in advance of the first-mentioned piston and adapted to act as cushion and relief valve when excessive pressure accumulates in the cylinders, all substantially as shown and described.

17. In an automatic firearm, a receiver having a bore, a breech bolt turnable and reciprocable in the bore, a crosshead sleeve embracing the rear portion of the breech bolt, a rockable pin connecting the bolt with the sleeve, a barrel provided with a bore attached to the receiver, a pair of longitudinal passages extending through the receiver, a pair of action rods slidably mounted in the passages and detachably connected to said crosshead sleeve, means including a gas-reservoir for causing rotary and reciprocating movements to said breech bolt, a cartridge magazine, a throat opening communicating between the magazine and the bore in the receiver, a cartridge extractor connected by means of a band to said breech bolt, a pivoted cartridge ejector mounted in the receiver, and a bolt-handle or lever projecting from said breech bolt adapted for manual operation of said bolt in effecting initial cartridge loading into the bore of the barrel from said magazine.

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