

March 31, 1936.

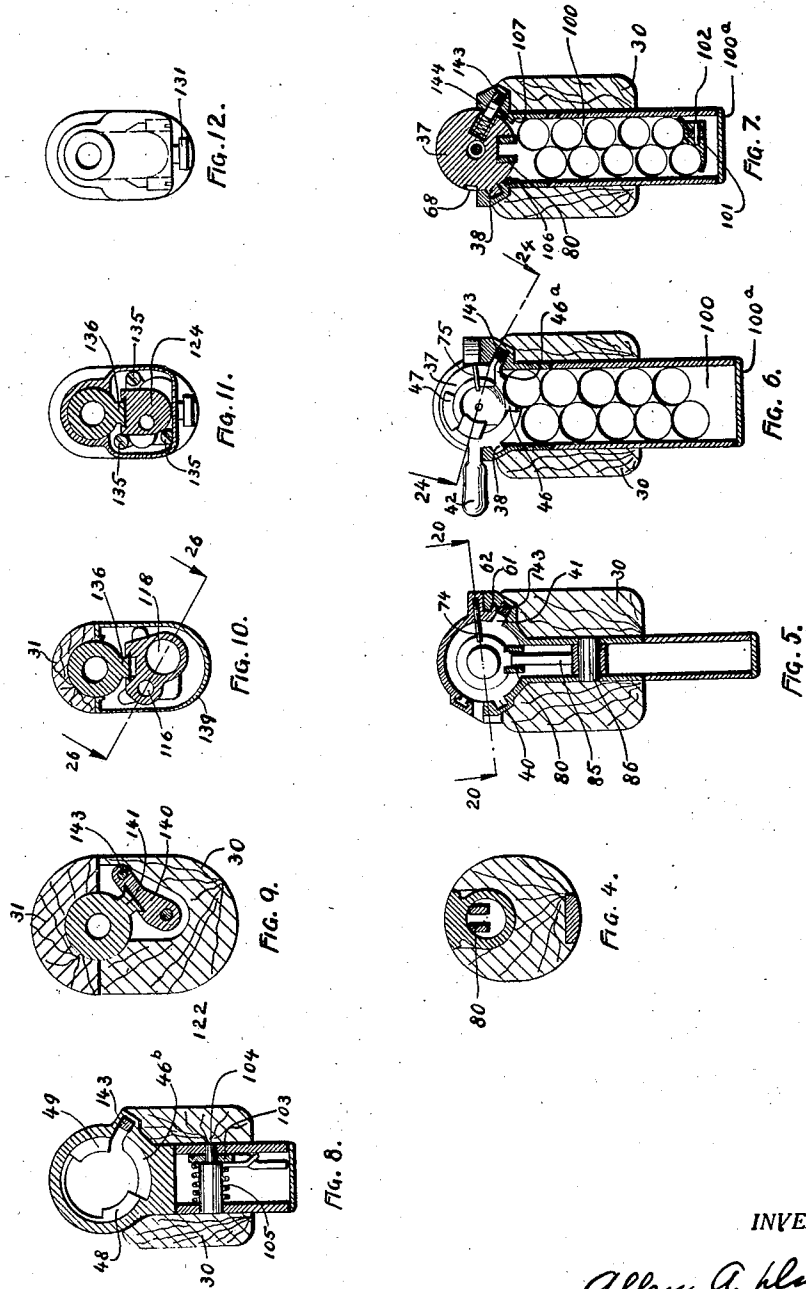
A. A. DICKE

2,035,539

REPEATING FIREARM

Filed Nov. 30, 1932

4 Sheets-Sheet 2



INVENTOR.

Allen A. Dicke

March 31, 1936.

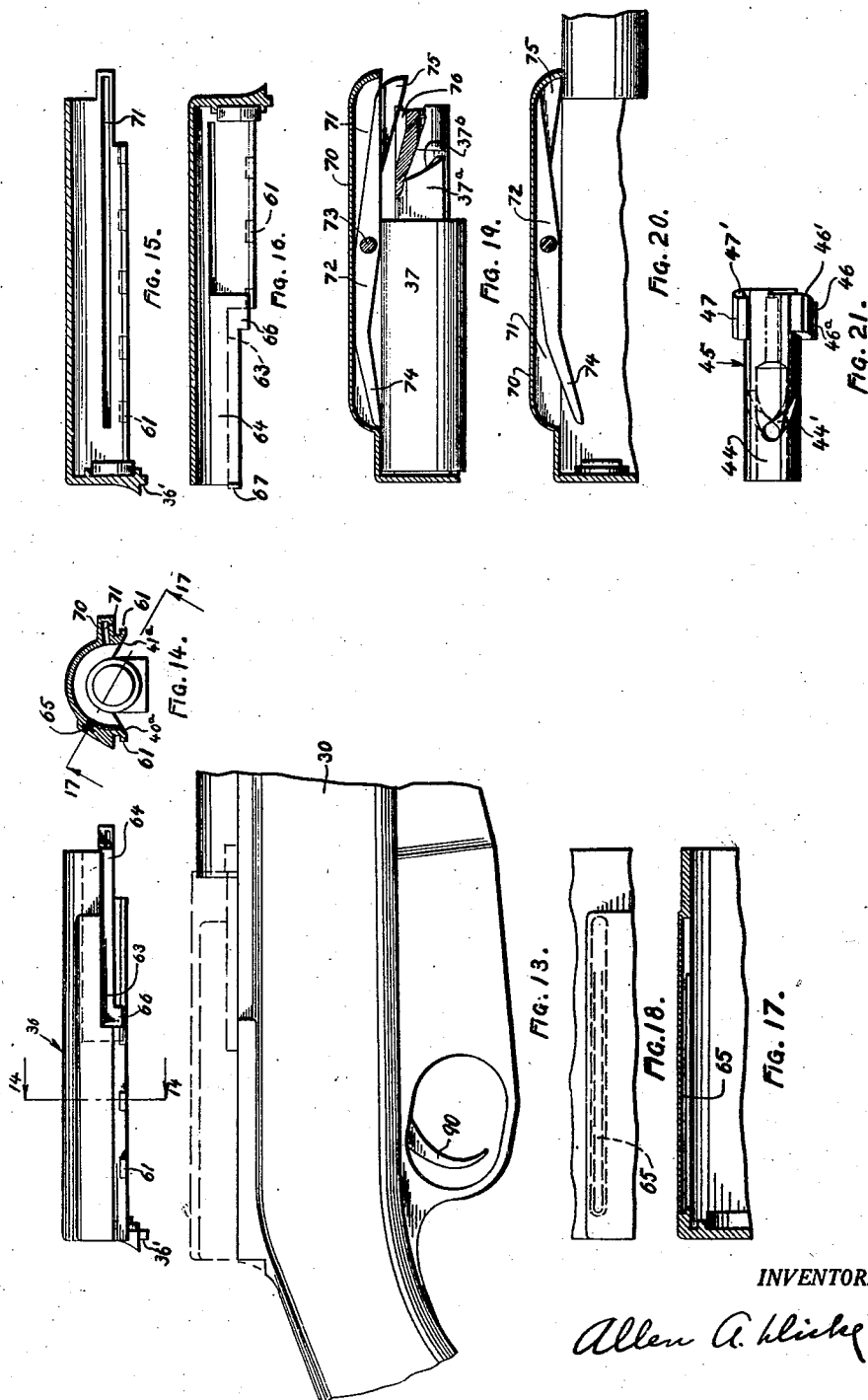
A. A. DICKE

2,035,539

REPEATING FIREARM

Filed Nov. 30, 1932

4 Sheets-Sheet 3



March 31, 1936.

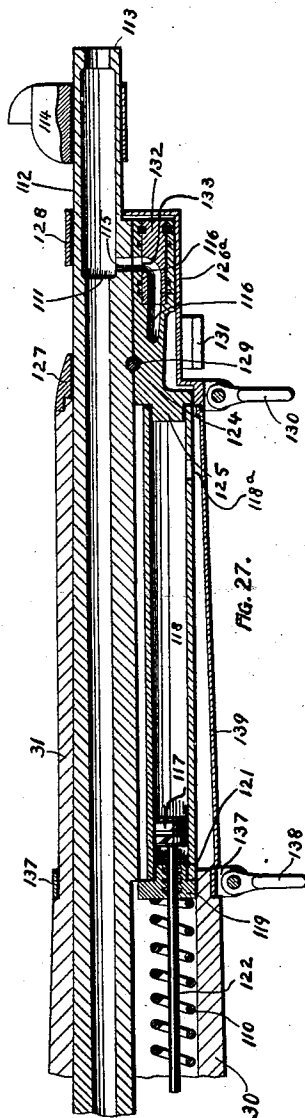
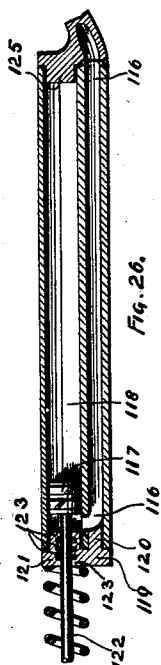
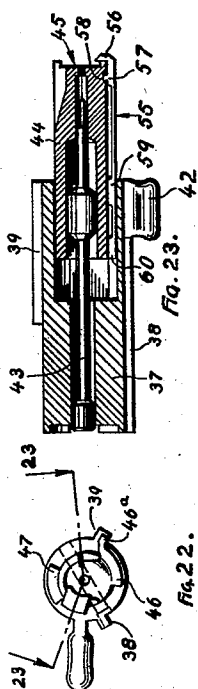
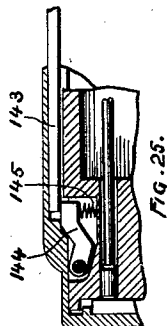
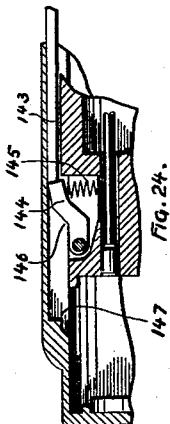
A. A. DICKE

2,035,539

REPEATING FIREARM

Filed Nov. 30, 1932

4 Sheets-Sheet 4



INVENTOR.

Allen A. Dickie

UNITED STATES PATENT OFFICE

2,035,539

REPEATING FIREARM

Allen A. Dicke, Upper Montclair, N. J., assignor
to Remington Arms Company, Inc., a corpora-
tion of Delaware

Application November 30, 1932, Serial No. 645,009

14 Claims. (Cl. 42—3)

This invention relates to repeating firearms and more particularly to self-loading rifles suitable for use by infantry troops.

A rifle for this purpose must possess great ruggedness and strength in order to withstand hard field usage under adverse conditions, all without excessive weight or sacrifice of proper balance, to enable the attachment and use of a bayonet and for other reasons the barrel must be rigidly secured to the receiver and to an integral forearm and stock. The breech mechanism must be durable, accurately guided in its movements, simple in construction, and capable of ready disassembly and re-assembly without tools.

The objects of the present invention are to provide an improved self-loading firearm meeting the above and other requirements.

Further objects are to provide in an arm of this type means for storing a part of the energy of the explosion of a cartridge, which energy is subsequently utilized to reload the arm, while holding the action completely closed until the gas pressure in the chamber has been entirely dissipated.

With these and other objects in view, the invention consists in the novel parts and combination of elements hereinafter described, and their respective equivalents.

For a full understanding of the invention which accomplishes the foregoing objects, reference may be had to the following description of one illustrative embodiment thereof and to the appended drawings, wherein:

Fig. 1 is a right side elevation of an arm illustrating the invention.

Fig. 2 is a vertical, generally central, sectional view, the action being closed and the gun ready to be fired.

Fig. 3 is a view similar to Fig. 2 with the exception that the action is open and about to close, thereby transferring the topmost cartridge from the magazine to the chamber.

Fig. 4 is a cross-sectional view on the line 4—4 of Fig. 3, looking in the direction of the arrows.

Fig. 5 is a cross-sectional view on the line 5—5 of Fig. 2, looking in the direction of the arrows.

Fig. 6 is a cross-sectional view on the line 6—6 of Fig. 3, looking in the direction of the arrows.

Fig. 7 is a cross-sectional view on the line 7—7 of Fig. 2, looking in the direction of the arrows.

Fig. 8 is a cross-sectional view on the line 8—8 of Fig. 3, looking in the direction of the arrows.

Fig. 9 is a cross-sectional view on the line 9—9 of Fig. 3, looking in the direction of the arrows.

Fig. 10 is a cross-sectional view on the line

10—10 of Fig. 3, looking in the direction of the arrows.

Fig. 11 is a cross-sectional view on the line 11—11 of Fig. 3, looking in the direction of the arrows.

Fig. 12 is an elevation looking towards the muzzle.

Fig. 13 is a side view of a portion of the arm, the receiver cover being shown as moved forward and lifted to show the manner of disassembly, and shown in dotted lines in its normal position.

Fig. 14 is a cross-sectional view on the line 14—14 of Fig. 13, looking in the direction of the arrows.

Fig. 15 is a longitudinal, cross-sectional view of the receiver cover, looking from right to left.

Fig. 16 is a longitudinal, cross-sectional view of the receiver cover, looking from left to right.

Fig. 17 is a view of a portion of the receiver cover taken on the line 17—17 of Fig. 14, looking in the direction of the arrows.

Fig. 18 is a fragmentary left side elevation of the receiver cover, certain concealed parts being shown in dotted lines.

Fig. 19 is a view taken on the line 19—19 of Fig. 5, looking in the direction of the arrows, the action being fully opened and the ejector being shown rocked to operative position.

Fig. 20 is a view similar to Fig. 19, showing the action closed and the ejector in its normal position.

Fig. 21 is a side view of the bolt.

Fig. 22 is a front view of the bolt carrying sleeve with the bolt therein, the latter being shown in the unlocked position.

Fig. 23 is a longitudinal, sectional view on the line 23—23 of Fig. 22, looking in the direction of the arrows.

Fig. 24 is a fragmentary longitudinal, sectional view taken on the line 24—24 of Fig. 6, the bolt carrier being, however, in a partially retracted position.

Fig. 25 is a view similar to Fig. 24, showing the bolt carrier fully retracted.

Fig. 26 is a longitudinal sectional view on the line 26—26 of Fig. 10.

Fig. 27 is a longitudinal sectional elevation of the forward portion of the arm.

Fig. 28 is a partial elevation of the arm viewed from the left side of the arm.

Fig. 29 is a partial plan view of the parts shown in Fig. 28.

Fig. 30 is a partial cross-sectional view on the line 30 of Fig. 29.

In said drawings, the numeral 30 designates

generally the combined stock and fore-end which is preferably and usually made of wood of a suitable type. Numeral 31 represents a suitable shield covering the upper half of the barrel. 32 represents the barrel, which is rigidly attached to the receiver 33 as by screw threads 34. The receiver may consist of a lower portion generally designated by 35 and referred to herein as the receiver body and a receiver cover generally designated by 36. Located within the receiver is a suitable bolt carrier, such as 37 (Figs. 6 and 23), slidably supported in the receiver by suitable means such as ribs 38 and 39 thereon located in grooves 40 and 41 (Fig. 5), respectively formed in the receiver. The bolt carrier is preferably provided with an integral operating handle 42 for permitting the bolt carrier to be retracted manually when desired. The bolt carrier as shown is formed with a passage for accommodating the firing pin or striker 43 and at its forward portion with an enlarged preferably cylindrical chamber for receiving the cylindrical rearward extension 44 of the locking bolt (Fig. 21) generally designated as 45. Said locking bolt is shown as provided at its forward end with two locking lugs 46 and 47, respectively, which lugs are arranged to co-operate respectively with stationary locking or supporting lugs 48 and 49 (Figs. 3 and 8) formed in the receiver just to the rear of the barrel. Said bolt lugs and their cooperating locking lugs are preferably of helical form as shown in Fig. 21, so that the final seating of the cartridge in the chamber may be accomplished with the aid of a larger mechanical leverage. Likewise, the forward faces 46' and 47' of the bolt lugs are preferably formed helically to co-operate with corresponding helical surfaces such as 49', Fig. 3, formed upon the end of the barrel or forming a part of the receiver, for the purpose of providing a powerful primary extraction movement during the period in which the bolt is being rotated from locked to unlocked position.

Suitable means are provided for causing the bolt to be rotated on its axis upon the occurrence of a relative movement between the bolt and the bolt carrier in seating the cartridge in the chamber and in withdrawing the empty cartridge after firing. Said means may consist of generally helical slots 44' formed in the rearward portion 44 of the bolt, which slots receive a bolt rotating pin 50 (Figs. 2 and 3) rigidly mounted in and extending between opposite walls of the bolt carrier. Said pin 50 also passes through a slot 51 in an enlarged portion of the firing pin 43, this arrangement permitting the use of a relatively small pin 50 approximately in the plane of the firing pin 43 while, nevertheless, insuring adequate strength of both parts. To provide two separate bolt rotating pins mounted in opposite walls of the bolt carrier would necessitate thicker walls and enlarge the diameter of the bolt carrier, requiring larger dimensions for the receiver and, therefore, generally enlarging the dimensions of the arm. Said pin 50 also serves to limit the motion of the firing pin and thus dispenses with a firing pin retaining device. Further functions of said bolt rotating pin 50 are to draw the firing pin out of engagement with the cartridge prior to the complete unlocking of the breech bolt, and to prevent the firing pin from being driven forward during the closing of the action with sufficient velocity to indent the primer.

The extractor, identified generally by numeral 55, Fig. 23, carries at its forward end a cartridge

rim engaging claw 56, and in the rear thereof a retaining lug 57, received in and co-operating with a circumferential groove 58 on the bolt. The rearward portion 59 of the extractor is received in a longitudinal slot 60 formed in the inner wall of the bolt carrier. This connection with the bolt carrier serves to prevent rotation of the extractor when the bolt is rotated, as in locking and unlocking, but allows longitudinal movement of the extractor with relation to the bolt carrier. It will be noted that the extractor is located intermediate the locking lugs 46 and 47 in such a position as not to interfere with said locking lugs. For this reason, it is not necessary, as in other arms, to have the extractor shaped to encircle one of the locking lugs. Since the ejector must be located approximately opposite the extractor, this arrangement of the parts also permits of having the ejector located in a portion of the locking bolt between the locking lugs so as to avoid the necessity of slotting the locking lugs as in former constructions.

Another advantage of this relative arrangement of locking lugs, extractor and ejector, is that locking lug 46 when in the unlocked position is properly located to serve as the means for feeding the top cartridge from the magazine to the chamber (see Fig. 6).

In rifles intended for military use, it is desirable to have ejection of the fired shell occur in as nearly a horizontal direction as possible. If ejection should occur upwardly, the flight of the ejected shell might disclose the position of the shooter. It is, furthermore, desirable that ejection should occur to the right because all military firing is done with the right hand on the trigger and the left hand on the fore-end. If ejection to the left were provided for, the ejected cartridge case would strike the arm of the shooter. Furthermore, it is desirable to have the operating handle 42 located on the right side of the gun where it can be most conveniently operated by the shooter. These requirements necessitate having the operating handle located at approximately the same point as the extractor and, since the extractor must be mounted in slidable relation to the bolt carrier, it is difficult to provide an operating handle of suitable strength, particularly if it should be necessary to have the operating handle readily detachable from the bolt carrier.

These requirements were found difficult to meet, but are satisfied by the construction disclosed.

It is necessary to provide means to permit of ready removal of the bolt carrier and bolt from the arm for the purpose of cleaning the bore of the gun (which must be done from the breech). For this purpose, in the present construction the receiver is made in two parts, as stated above, the upper part 36 being detachably connected to the receiver body. This may be done by a construction similar to a bayonet slot connection, as by providing a number of lugs 61 (Figs. 13 to 16) on the side of the receiver cover 36 cooperating with similar lugs 62 (Fig. 5) on the receiver body. In order to assemble the receiver cover to the receiver body, it is placed in the position shown in Fig. 13 and laid down upon the receiver and thereupon moved rearward to cause inter-engagement of lugs 61 and 62. Between the lugs 62 spaces are provided for permitting the passage of the lugs 61 to a position where they may pass rearwardly under the lugs 62. This rearward movement is terminated when the lug 36' (Fig. 15) engages the abutment 36'' (Fig. 4) on the

receiver. This arrangement provides a solid strong shield between the action and the face of the shooter.

Suitable fastening means may be provided to prevent accidental forward movement of the receiver cover. This means may be of the form shown in Figs. 28, 29, and 30 where the receiver body 35 is shown as provided with a latch in the form of a plunger 35a biased upwardly by spring 35b. This latch is normally received in a keeper element 36a formed on the receiver cover 36, thus serving to lock the receiver cover against accidental longitudinal motion. In order to release the locking latch 35a it is depressed against action of the spring 35b by the use of an appropriate instrument such as the point of the bullet.

In order to remove the bolt carrier and bolt from the receiver, for cleaning or other purposes, it is merely necessary, after the receiver cover has been removed as described above, to draw the bolt carrier rearward, disengaging ribs 38 and 39 from the receiver slots 40 and 41, and then lift it upwardly and forwardly out of the receiver, together with the link 80, to be hereinafter described. The upper surfaces of said ribs, when the bolt carrier is in its rearward position, are abutting surfaces 40a and 41a (Fig. 14) on the lower part of the receiver cover, so that the removal of the cover allows the ready removal of the bolt carrier, as described.

In order to provide clearance for the operating handle the lower right wall of the receiver cover is cut away as at 63. When the action is closed, the rear portion of the bolt sleeve is near the forward portion of the receiver cover, which causes an opening to be formed into the receiver, through which sand and other objectionable foreign substances might enter the receiver. In order to provide means for closing this aperture, applicant has provided a slide 64 (Fig. 16) carried by the receiver cover and mounted for slidable connection therewith by suitable means such as the T-slot joint 65 (Fig. 14). The rearward portion of said slide is preferably formed with a downwardly extending wing 66 which serves to close the aperture which would otherwise be left on account of the clearance space between lugs 62, which clearance space is necessary to permit passage of the corresponding lug 61 on the receiver cover in assembling.

Furthermore, said wing 66 serves to limit the forward motion of the aperture closing slide. The forward portion of said slide is provided with an inwardly extending toe 67 (Fig. 16) which is received in a shallow groove 68 (Fig. 7) in the bolt carrier. Said groove 68 ends near the rearward end of the bolt carrier and further serves by co-operation with toe 67 to cause the slide to be drawn forwardly when the bolt carrier is moved forwardly to close the action. It will be noted that the extent of movement of said slide 64 is less than the motion of the bolt carrier, the difference being taken up by lost motion between the parts which is permitted by the groove 68 in the bolt carrier.

In order to effect the ejection of the empty cartridges after firing, the receiver cover is provided with an extension 70 on the left side of the arm, as shown in Figs. 14, 15, 19, and 20, which extension is formed with a cavity 71 for housing a suitable ejector lever 72 mounted on pivot pin 73. The normal position of the parts is shown in Fig. 20. It should be noted that during approximately the first three-quarters of the retraction of the bolt carrier the position of the ejector re-

mains unchanged. However, further rearward movement thereof causes the bolt carrier to engage the angular extension 74 of the ejector, rocking it on its pivot to the position shown in Fig. 19. In this position, the forward end 75 of the ejector passes into an ejector slot 76 formed in the locking bolt between locking lugs 46 and 47 (see also Fig. 6).

Means are provided for spring urging the bolt carrier to its forward position which may consist of a spring 77 mounted in a rearward extension of the receiver located in the grip and stock of the arm. This spring bears against a spring follower 78, the forward end of which is provided with a concave seat receiving the rearward end 79 of an operating link 80, the forward end of which is pivotally connected to the bolt carrier by means of a transverse pin 81. Said link is preferably slotted vertically for the greater portion of its length (Figs. 4, 5, and 7) to provide a passage through its center for the hammer and other parts of the firing mechanism, which will be presently described.

The firing train may be of any desired construction. The one illustrated consists of a hammer 85 pivoted on a pin 86 and biased in a clockwise direction by a hammer spring 87. When the hammer is cocked, it is held in position by a sear member 88 formed with a hook portion engaging the sear notch, as shown in Fig. 2. The sear is biased toward engaging position by a suitable spring 89, and is movable to disengaging position by a suitable trigger 90. In the form shown, the trigger 90 is formed with two sear actuating elements 91 and 92, the element 91 normally bearing against a surface on the sear. When the trigger is slowly drawn back the element 91 serves to give the sear a preliminary motion by a camming movement, but not sufficient to release the hammer. This preliminary motion is terminated by engagement of element 92 with the sear; this sets up greater resistance and notifies the shooter that further motion will result in firing the gun. In other words, this construction provides a so-called "double pull" firing mechanism which is regarded as very highly desirable in military rifles. In order to prevent the firing of a second shot, which might otherwise occur if the shooter retained the trigger retracted, a second hook member may be formed on the trigger, as shown, to co-operate with the second sear notch member formed upon the rear face of the hammer, so that the hammer will thereby be held against firing until the trigger is released; whereupon the hammer will spring forward into the position shown in Fig. 2.

In order to prevent possible premature release of the hammer, before the action is fully locked, means are provided to lock the sear against clockwise motion until the bolt carrier is fully forward. This may consist of a hook 93 on the sear co-operating with a hook 94 forming a part of a bell crank 95 biased by spring 96 into the position shown in Fig. 3. The upwardly extending arm of the bell crank extends between the two limbs of link 80, and it will be noted that as the link reaches its extreme forward position the shoulder formed by the end of the slot in the link 80 engages said upwardly extending arm and rocks the bell crank into the position shown in Fig. 2, thereby releasing the sear for actuation by the trigger. A suitable spring is provided for holding the trigger forward and, as shown in Figs. 2 and 3, the spring 96 may be utilized to perform this function.

It will be noted that this construction causes

the sear to be locked in safe position until the extreme final movement of the bolt carrier, so that the hammer cannot be released until the locking lugs 46 and 47 have practically reached, or have actually reached, the end of their locking movement, depending upon the shape of the rotating cam slot 44' of the locking bolt. If the forward end of said cam slot is provided with a slight dwell the lugs may be in fully locked position before unlocking of the sear begins.

It is necessary to provide means to prevent the rotation of the bolt in the bolt carrier except in substantially the extreme forward position of the bolt, because otherwise the bolt might be rotated out of the position where the lugs 46 and 47 can pass between the supporting lugs 48 and 49 in the receiver. To accomplish this, a bolt controlling extension 46a has been provided, preferably as an extension of lug 46 (see Figs. 6 and 22). This extension 46a is, when the bolt is rotated to unlocked position, located in line with the guide groove 41 in the receiver, which guide groove, as described above, receives and guides the rib 39 on the bolt sleeve. To provide clearance for said extension 46a, it is necessary to cut a transverse slot in the receiver as shown at 46b in Fig. 8.

It will be seen that this construction provides for complete control of the locking bolt at all times, so that it is impossible for the bolt to be rotated except in its extreme forward position.

In order to increase the length of the bearing of the locking bolt extension 44 in the bolt carrier 37 without increasing the length of the bolt extension, the bolt carrier may be formed with two forwardly extending guiding lugs 37a located generally in line with and to the rear of the locking lugs 46 and 47 when in unlocked position. One of these lugs can be seen in Fig. 19. The forward edge thereof may be of generally helical form as at 37b to clear the lug 47. When the action is closed, these lugs 37a are located in the spaces between the supporting lugs 48 and 49.

Any suitable means may be provided for furnishing a supply of cartridges. As shown in Figs. 2, 3, 7, and 8, this means may comprise the magazine cavity 100 formed in the receiver immediately under the bolt carrier. The magazine may be closed below by the magazine floor 100a. As shown, this magazine is capable of receiving ten loose cartridges arranged in two columns. The cartridges are fed upwardly by suitable means such as a magazine follower 101 pivotally carried as at 102 upon a pivoted lever 103 pivoted as at 104 in the receiver. The magazine follower 101 is stepped as shown in Fig. 7 to stagger the two columns of cartridges and thus locate only one cartridge at a time in position to be fed to the chamber, as presently described. A suitable spring such as 105 is provided for biasing the magazine follower upwardly. Abutments such as 106 and 107 are provided at the upper boundary of the magazine cavity to prevent the cartridges being pushed up out of the arm when the action is open. These abutments permit the topmost cartridge, whether it be in the right or left column, to rise to a position where it will be in the path of the locking lug 46, so that as the action is closed, the topmost cartridge will be moved forwardly toward the chamber. Said abutments 106 and 107 are so formed, as is well understood by those skilled in this art, that as the topmost cartridge is being pushed forward the bullet end thereof is allowed to rise so as to enter the chamber freely, without injury to or deformation of the bullet or cartridge.

It will be noted that the magazine construction is so arranged that instead of having the cartridges located in the magazine in bulk they may be held in a box clip of ordinary known construction. In this event, suitable and known devices for the operation of said clip, and its ejection after the last cartridge thereof has been fired, would be provided.

It is also contemplated to provide means operated by the magazine follower to place an abutment in the path of the bolt carrier to hold the action open after the last cartridge has been fired. Such devices are well known, being shown and described in such patents as Browning, No. 984,263, February 14, 1911.

The construction described heretofore comprises an entirely satisfactory and complete manually operated repeating rifle, the operation of which is as follows:

The operator grasps the operating handle and draws it rearwardly, thereby opening the action so that the magazine may be filled with cartridges. During this time the action may be held open by the operator or by suitable known means. The operator now allows the action to be closed, which is accomplished by spring 77 operating through link 80. As the bolt carrier moves forward, the forward face of lug 46 engages the base of the topmost cartridge, whether it be in the right or left column, and drives it forward into the chamber. The application of this resisting force to the bolt will tend to cause the bolt to rotate (clockwise as viewed in Fig. 6). Such rotation is, however, prevented by the engagement of extension 46a with the lower edge of the guide groove 41. When the cartridge is almost seated in the chamber and the locking lugs 46 and 47 have passed between and beyond the supporting lugs 48 and 49, the forward movement of the bolt is substantially arrested; however, at this time, the extension 46a comes into line with the cut-away portion 46b and the lug is therefore free to rotate to locked position during the additional forward movement of the bolt carrier through the co-action of the cross pin 50 with the cam slots in the portion 44 of the locking bolt.

During the last part of the movement of the bolt carrier, the abutment on the link 80 rocks the bell crank 95 in a clockwise direction to unlock the sear. When the trigger is pulled, the hammer falls and drives the firing pin forward against the primer, discharging the cartridge in the usual way. The rearward force against the locking bolt, due to the chamber pressure, is supported by the lugs 46 and 47 bearing respectively against the supporting lugs 48 and 49. No amount of chamber pressure can cause the bolt to rotate and, therefore, the gun remains closed. Thereafter, the operator grasps the operating handle 42 and draws it rearwardly. The first part of this motion causes the bolt to rotate to unlocked position but not to move rearwardly, except the slight amount due to the helical formation 46' and 47' of the front of the locking lugs 46 and 47 cooperating with suitable abutments on the rearward end of the barrel for primary extraction purposes. After the bolt has rotated to unlocked position, it can rotate no further because the pin 50 is now at the rear end of the cam slots in the bolt and, therefore, further movement of the bolt carrier serves to draw the bolt directly rearward until the position shown in Fig. 3 is reached.

In view of the inter-connection between the extractor 55 and the locking bolt, at 57, 58, the

extractor partakes of the translatory movement of the bolt but it cannot participate in the rotary movement thereof due to the extractor's connection with the bolt carrier. The fired cartridge case is withdrawn from the chamber and thereafter the left side of the head thereof strikes against the head 75 of the ejector, whereby it is ejected from the arm in a generally horizontal direction.

Now, upon releasing the operating handle, the action is again closed by the operating spring 77, thereby transferring another cartridge to the chamber and placing the gun in condition for the next shot.

Self-loading mechanism

Means will now be described whereby the manually operable repeating rifle hereinabove described is enabled to operate as a self-loading arm.

The most important characteristic of the self-loading mechanism is that the action does not start to open until the chamber pressure has dropped to normal. In order to provide the energy necessary to rotate and unlock the bolt, extract the fired shell, recock the hammer, and transfer a new cartridge to the chamber, and rotate the bolt to locked position, means are provided for capturing and storing a portion of the energy of a previously fired cartridge in such a way that it may be utilized after the lapse of a time interval required for diminishing the chamber pressure. Such energy may be stored as any form of potential energy, but in the construction here shown it is stored in an operating spring such as spring 110 (Figs. 2, 3, and 27). As it is desired to have the stored energy act in a rearward direction, the operating parts are so arranged that they will be made to move forward to compress the spring while the energy is being stored. The necessary energy may be taken off in various ways, such as a port in the barrel or by utilizing a portion of the muzzle blast acting on any suitable piston to move it preferably in a forward direction. In the embodiment illustrated, a part of the muzzle blast is utilized to operate the gun.

The barrel muzzle proper is at 111, (Fig. 27) and forward from 111 is a chambered extension 112 which may be an integral part of the barrel. Said extension may be closed to the extent required by the characteristics of the particular cartridge to be used by a perforated end wall 113. Said extension will also serve to support the front sight 114, co-operating with any suitable rear sight, such as the one shown generally at 114-a or, if desired, an aperture sight may be mounted on the tang or receiver cover. The extreme forward end of the barrel will on occasion receive the supporting ring of a bayonet of the usual construction.

The barrel extension 112 is shown as provided with an aperture 115 near the bottom part thereof. This aperture 115 is the beginning of a gas passage 116 which leads, as shown especially in Figs. 26 and 27, to the rear of a gas operated piston 117 in the cylinder 118. The cylinder and a part of the gas passage 116 may be formed integrally, as shown in Figs. 10 and 26. The rear end of said cylinder and gas passage may be closed by a plug 119, one portion 120 of which seals up the end of the gas passage 116 and the other portion 121 thereof is formed with a central aperture for the piston rod 122. Any suitable means may be used to seal the joint between the

element 121 and the piston rod 122 but the preferred means illustrated consists in forming a plurality of baffle walls 123 which may be formed by cutting a series of annular grooves therein. The piston rod should be a reasonably good fit but it is not necessary that it be a rubbing fit, because the construction shown provides a series of baffle plates between which are located a series of expansion chambers. As the gas pressure is suddenly applied, a small amount thereof will leak past the forward baffle and start to flow into the first expansion chamber but a substantial time interval will be required for sufficient gas to flow therethrough and build the pressure within the first expansion chamber to a substantial amount. Therefore, the pressure difference between the first chamber and the next is relatively low so that a smaller quantity of gas will flow past the second baffle. The pressure in the third chamber will be further reduced and during the small time interval will be little, if anything, above atmospheric pressure so that very little or no gas will escape to the atmosphere. The forward end of the combined gas passage and cylinder member is shown as having applied thereto a member 124 having a plug extension 125 sealing up the forward end of the cylinder. Said member 124 is formed with a passage therethrough forming a part of the gas passage 116, and is held in place against the barrel by a housing member 126 which may consist of the floor portion 126a and two ring portions 127 and 128 surrounding the barrel. It may be held against movement in a longitudinal direction by the pin 129. The portion adjacent said ring 127 may be formed with a support for the sling swivel 130 and the floor portion 126a may serve as a support for the bayonet locking lug 131.

In order to vary the action of the gas upon the piston, which may be made necessary by changes in the power of the cartridges employed, the element 124 may be formed with a rotary plug 132 having an L-shaped passage therein so that rotation of plug 132 will control the size of the gas passage at the point 133. The gas-tight connection between the plug 132 and the member 124 may be of the same general construction as is shown for the piston rod packing gland. The members 119 and 124 may be drawn together by means of longitudinally arranged screws 135 (Fig. 11), and the cylinder assembly is attached to the barrel by suitable means, such as the dovetail 136 (Figs. 10 and 11) formed on the bottom of the barrel and received in a correspondingly shaped dovetail groove formed in the top portion of the combined gas passage and cylinder member and in the top of the member 124. It will be seen that the cylinder assembly can therefore be attached to the barrel by sliding it lengthwise thereon and subsequently clamping it in place by the application of the clamping rings 127 and 128 and a supplemental clamping ring 137, which may also be used as a support for a sling swivel 138. Since, during rapid firing, the cylinder may become somewhat heated, it is preferred to cover it by means of a semi-circular guide 139 formed of metal or other suitable material.

The coil spring 110 is shown as surrounding the piston rod 122 and abutting at its forward end against the member 119 and at its rearward end against a cross-head member 140 (Figs. 2, 3, and 9) rigidly attached to the piston rod. Said cross-head is slidably supported in relation to the barrel upon a dovetail rib 141 preferably

formed integral with the barrel, and a suitable abutment 142 is provided which is carried by the barrel and at its forward edge carries a buffer of suitable relatively soft material, such as raw hide, fiber or the like.

Rigidly attached to the said cross-head and extending rearwardly therefrom is the operating rod 143 (Fig. 9) which may be of circular cross-section where it is attached to the cross-head and of rectangular cross-section rearwardly therefrom. Said operating rod lies in and is guided by the lower portion of the guideway in which the guide rib 39 of the bolt carrier travels (see Figs. 5, 6, 24, and 25). The rear end of the operating rod is shown as co-operating with the forward end of an element of suitable construction such as the pawl 144 pivotally mounted upon and partly within a recess in the bolt carrier, a spring 145 being provided to press the pawl 144 outwardly (Figs. 24 and 25).

The parts are so constructed and arranged that when the piston is in its normal rearward position (Figs. 2 and 3) the operating rod is in the rearward position as shown in Fig. 25. It will be noted that the pawl is provided with a suitable camming portion 146 cooperating with an abutment such as 147 on the receiver cover to rock the pawl clockwise as the bolt carrier approaches its rearward position; thus removing the pawl from the end of the operating rod so that the operating rod may move further rearward and the bolt carrier, unless otherwise prevented, can be returned to its forward action closed position.

The operation of the arm is as follows:

Assuming that there is a cartridge in the chamber and one or more cartridges in the magazine; when the gun is fired the breech remains locked and the piston and connected parts remain in the normal position shown. As the bullet passes through the barrel no substantial increase in pressure occurs in the barrel extension 112. However, as soon as the bullet leaves the muzzle proper 111 the following gases which are still of a high order of pressure (possibly $\frac{1}{4}$ to $\frac{1}{2}$ of the maximum pressure) attempt to expand in every possible direction; a certain quantity thereof will therefore flow through the aperture 115 rearwardly through the gas passage 116 in the plug 132 and the member 124 and the combination cylinder and gas passage member and into the space behind the piston, thus driving the piston forward and compressing spring 110. During this time, the action being closed, the bolt carrier is forward, so that pawl 144 is pressed against the side of the operating rod 143. However, as the piston approaches its extreme forward position, the rearward end of the operating rod passes in front of the pawl 144 which is forced outwardly by spring 145 to a position behind the operating rod 143. Nothing further happens until the gas pressure in the barrel extension 112 has subsided to normal; thereupon, and as soon as the momentum of the gases flowing in the passage 116 and partly within the cylinder 118 has been overcome, the gases start flowing in the opposite direction, exhausting back through passage 116 and aperture 115. Thereupon, the spring 110 will begin to expand, driving the operating rod rearwardly which, through its engagement with pawl 144, drives the bolt carrier rearwardly, causes the bolt to rotate to unlocked position, simultaneously loosening the empty cartridge case in the chamber. Continued motion of the bolt carrier and bolt fully extracts

the cartridge case which thereupon strikes the ejector 75 which causes the case to be thrown transversely out of the gun. During this motion the action spring 77, which is not as strong as the spring 110, is compressed, and said spring 77 will drive the bolt carrier forward as soon as the pawl 144 is cammed inwardly away from the end of the operating rod 143. The closing movement of the action operates just as explained in connection with manual operation to feed the topmost cartridge from the magazine into the chamber so that the arm is in a position to be fired again.

It will be noted that the construction and arrangement is such that the opening of the action cannot begin until the pressure in the chamber has returned to normal, which avoids the many difficulties inherent in self-loading guns in which the fired shell is extracted from the chamber while it is being expanded against the chamber walls by internal pressure.

It will be noted that in the construction shown the operating rod 143 will push the bolt carrier rearwardly to substantially the full extent of its movement. As this operation occurs quickly and considerable velocity is imparted to the bolt carrier and connected parts, it is not necessary to have the moving force applied to the bolt carrier the entire distance of its travel since the momentum of the rearward movement initiated by the operating rod will be sufficient to carry the bolt carrier to the full extent. Thus, the stroke of the piston and connected parts might be reduced to a small part of the amount shown, the abutment 147 being moved forward to the position necessary for effecting the proper control of the pawl 144.

If desired, an exhaust port 118a may be provided in the cylinder 118, which port will be uncovered by the piston near the end of its forward stroke, thus preliminarily exhausting the gases so that only a portion thereof is returned reversely through the gas passage 116 and aperture 115. Such a port will speed up return movement of the piston and it will be especially desirable if, as described above, the piston stroke is shortened and a part of the movement of the bolt carrier is effected by momentum.

It will be noted that the construction shown in the drawings and described above accomplishes the purposes hereinabove stated. It is obvious that those skilled in the art may vary the construction and arrangement of parts, or substitute equivalents of said parts and combinations of parts, without departing from the spirit of the invention, which, therefore, is not limited to the constructions shown, except as may be required for a proper interpretation of the claims.

What is claimed is:

1. In a firearm, the combination of a receiver comprising a receiver body and a detachable cover for said receiver body, a slidable action element housed within said receiver, said element being provided with an operating handle, and said cover being provided with a cut away portion to provide a clearance slot for said operating handle, and a longitudinally slidable member for closing said clearance slot, said slidable member and action element being provided with cooperating means enabling a limited relative motion, whereby movement of said action element controls the movement of said slidable member.

2. In a firearm, the combination of a receiver and a barrel carried by said receiver, a chamber formed within said barrel and a longitudinally

movable chamber closing member, said member comprising a rotatable locking bolt and a bolt carrier slidably mounted within said receiver, a slotted firing pin positioned centrally of said locking bolt, and means for causing rotation of said locking bolt within the bolt carrier incidental to relative longitudinal movement, said means comprising generally helical cam slots formed within said locking bolt and an operating pin extending through the slot in said firing pin and entirely through said bolt carrier and passing through said cam slots.

3. In a firearm, the combination of a receiver and a barrel carried by said receiver, a chamber formed within said barrel and a longitudinally movable chamber closing member, said member comprising a rotatable locking bolt and a bolt carrier slidably mounted within said receiver; means for causing rotation of said locking bolt within the bolt carrier incidental to relative longitudinal movement, said means comprising generally helical cam slots formed within said locking bolt and an operating pin extending entirely through said bolt carrier and passing through said cam slots, said cam slots being of approximately helical formation except the extreme forward portions thereof which extend generally longitudinally; a firing mechanism, a safety member to prevent release of said firing mechanism, and means for disabling said safety member during the last part of the movement of the bolt carrier.

4. In a firearm, the combination of a receiver and a barrel carried by said receiver, a chamber formed within said barrel, and a longitudinally movable chamber closing member, said member comprising a rotatable locking bolt, said bolt being formed with a locking lug cooperating with a supporting lug in the receiver, a cartridge magazine comprising side walls which are substantially parallel throughout their length and spaced to receive two columns of cartridges in staggered relation, the opening of said magazine into said receiver being substantially the width of the body of the magazine, whereby cartridges are delivered to the receiver from either of the columns in the magazine without substantial lateral displacement, said locking lug and supporting lug being so arranged that when the bolt is rotated to unlocked position the locking lug is positioned behind the topmost cartridge in either column in the magazine so that upon forward movement of said bolt said lug engages said topmost cartridge and moves it forwardly into the chamber irrespective of the column in which the cartridge is located.

5. In a firearm comprising a receiver and a barrel carried by said receiver, the combination of a rotatable locking bolt, a plurality of locking lugs on said bolt, cooperating supporting lugs on said receiver, and a slidable non-rotating bolt carrier for said bolt, said bolt carrier being provided with a forward guiding extension located in line with said locking lugs when the bolt is in unlocked position and extending between said supporting lugs when the bolt is in locked position.

6. In a firearm, the combination of a receiver and a barrel carried by said receiver, a chamber formed within said barrel, and a longitudinally movable chamber closing member, said member comprising a rotatable locking bolt and a bolt carrier slidably mounted within said receiver, said bolt carrier being formed with a guide rib and said receiver being formed with a groove

within which said rib slides, said rotatable locking bolt being formed with an extension arranged to slide within and to be guided by an edge of said groove whereby the rotatable locking bolt is held in unlocked position during its longitudinal movement.

7. In a firearm, the combination of a receiver and a barrel carried by said receiver, a chamber formed within said barrel and a longitudinally movable chamber closing member, said member comprising a rotatable locking bolt and a bolt carrier slidably mounted within said receiver, said bolt carrier being formed with a guide rib and said receiver being formed with a groove within which said rib slides, said rotatable locking bolt being formed with an extension arranged to slide within and to be guided by an edge of said groove whereby the rotatable locking bolt is held in unlocked position during its longitudinal movement, and a slidable rod for operating said bolt carrier also located in said groove.

8. In a firearm, in combination, a receiver body, a breech closing mechanism, a detachable receiver cover, cooperating means on said receiver body and cover to hold said cover in place comprising a plurality of spaced lugs on said receiver body and cooperating lugs on said receiver cover, guide means associated with said breech closing mechanism, and a guideway for receiving said guide means comprising a guide surface in said receiver body and a guide surface formed by the lugs on said receiver cover.

9. In a firearm, in combination, a receiver, an action member housed in said receiver and movable longitudinally therein, an operating handle associated with said action member, a slot in said receiver to be traversed by said operating handle, a cover for said slot slidably held in said receiver, a longitudinal groove in said action member adapted to receive a portion of said cover, a shoulder adjacent said groove adapted to actuate said cover, whereby said cover moves with said action member through a portion only of its travel.

10. In a firearm, the combination of a receiver body, a substantially cylindrical bolt carrier within and projecting above said receiver body, the margins of said receiver body constituting continuous upwardly facing plane surfaces, a detachable semi-cylindrical receiver cover comprising continuous downwardly facing plane surfaces adapted to contact with the upwardly facing plane surfaces of said receiver body to substantially completely enclose said receiver, a plurality of lugs projecting inwardly from the plane surfaces on said receiver body, flanges projecting downwardly from the plane surfaces on said receiver cover, a plurality of spaced lugs projecting outwardly from said flanges and adapted to engage beneath the lugs on said receiver body, whereby said receiver is closed and said cover locked in place.

11. In a firearm, the combination of a receiver body, a substantially cylindrical bolt carrier within and projecting above said receiver body, the margins of said receiver body constituting continuous upwardly facing plane surfaces, a detachable semi-cylindrical receiver cover comprising continuous downwardly facing plane surfaces adapted to contact with the upwardly facing plane surfaces of said receiver body to substantially completely enclose said receiver, a plurality of lugs projecting inwardly from the plane surfaces on said receiver body, flanges projecting downwardly from the plane surfaces on said re-

ceiver cover, a plurality of spaced lugs projecting outwardly from said flanges and adapted to engage beneath the lugs on said receiver body, a fixed abutment on said receiver body for limiting the longitudinal movement of said receiver cover when said lugs are fully engaged, and a movable abutment adapted to be displaced to permit movement of said receiver cover away from said fixed abutment to disengage said lugs.

12. In a self-loading firearm, a barrel formed with a chamber, a receiver to which said barrel is attached, a slidable action member housed within said receiver adapted to close said chamber and provided with locking means to hold said member in chamber closed position, a unitary member secured to said barrel comprising a cylinder and a gas passage communicating with the rear end of said cylinder and the front end of said barrel, a piston in said cylinder adapted to be driven forward by the gas admitted through said passage from said barrel, a piston rod connected with said piston and extending rearwardly therefrom, an action member operating spring adapted to be stressed by the forward movement of said piston, a guide for said piston rod secured to said barrel, a thrust rod rigidly connected with said piston rod and extending into said receiver, and means for coupling said thrust rod to said action member at the end of the forward movement of said piston whereby said action member is moved to chamber open position by said spring as said piston is restored to home position.

13. In a self-loading firearm, a barrel formed with a chamber, a receiver to which said barrel is attached, a slidable action member housed within said receiver adapted to close said chamber and provided with locking means to hold said member in chamber closed position, a unitary member secured to said barrel comprising a cylinder and a gas passage communicating with the rear end of said cylinder and the front end

of said barrel, a piston in said cylinder adapted to be driven forward by the gas admitted through said passage from said barrel, a piston rod connected with said piston and extending rearwardly therefrom, an action member operating spring adapted to be stressed by the forward movement of said piston, a guide for said piston rod secured to said barrel, a thrust rod rigidly connected with said piston rod and extending into said receiver, and means for coupling said thrust rod to said action member at the end of the forward movement of said piston whereby said action member is moved to chamber open position by said spring as said piston is restored to home position, and means independent of said piston and said spring for restoring said action member to chamber closed position.

14. In a self-loading firearm, a barrel formed with a chamber, a receiver to which said barrel is attached, a slidable action member housed within said receiver adapted to close said chamber and provided with locking means to hold said member in chamber closed position, a unitary member secured to said barrel comprising a cylinder and a gas passage communicating with the rear end of said cylinder and the front end of said barrel, a piston in said cylinder adapted to be driven forward by the gas admitted through said passage from said barrel, a piston rod connected with said piston and extending rearwardly therefrom, an action member operating spring adapted to be stressed by the forward movement of said piston, a thrust rod extending forwardly from said receiver, means for connecting said thrust rod and piston rod comprising a cross head, a guide for said cross head secured to said barrel and having a dovetail sliding connection with said cross head, and means for coupling said thrust rod to said action member at the end of its forward movement by said piston.

ALLEN A. DICKE.