Sept. 5, 1950 S. SCHIFF 2,520,966

RAMMER

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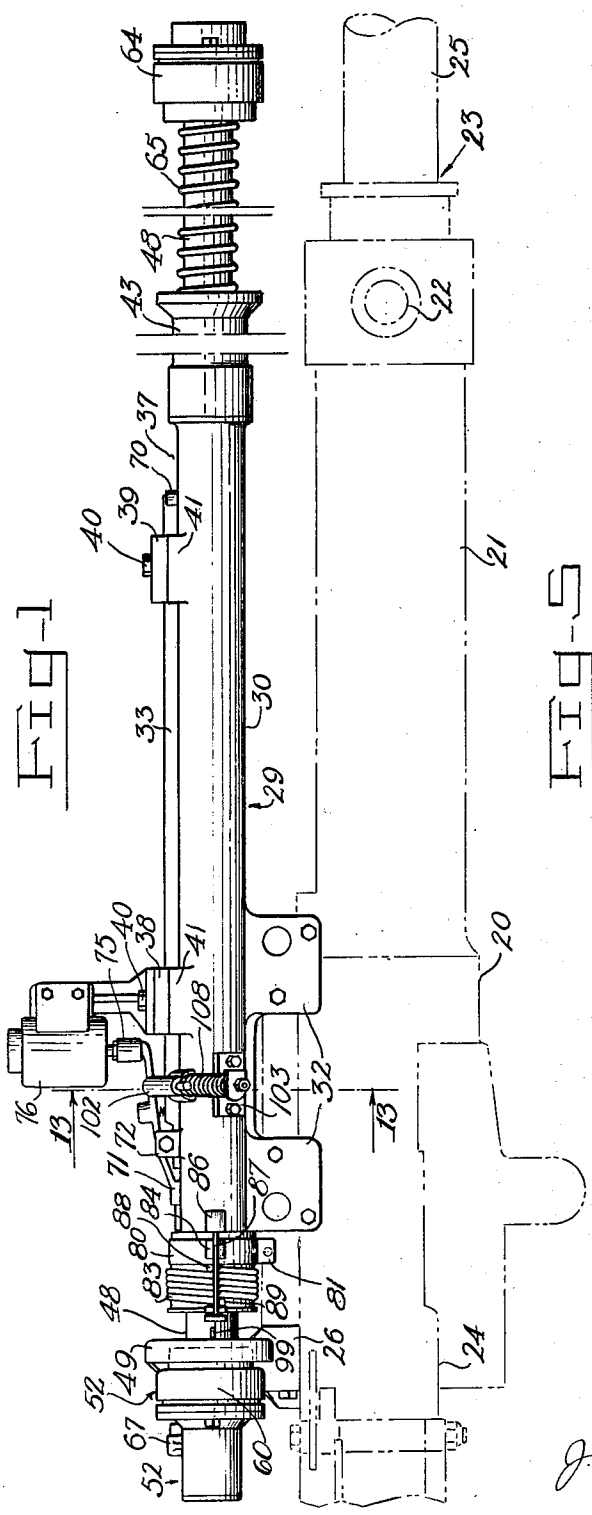


FIG-1

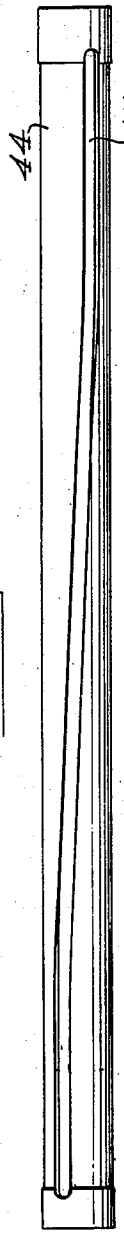


FIG-5

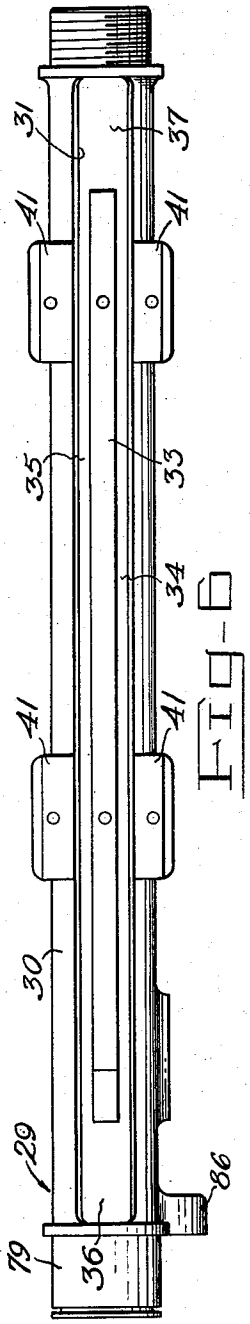


FIG-6

INVENTOR.
SIGMUND SCHIFF

BY
J. H. Church & H. E. Thibodeau
ATTORNEYS

Sept. 5, 1950 S. SCHIFF 2,520,966

RAMMER

Filed Dec. 18, 1945 5 Sheets-Sheet 2

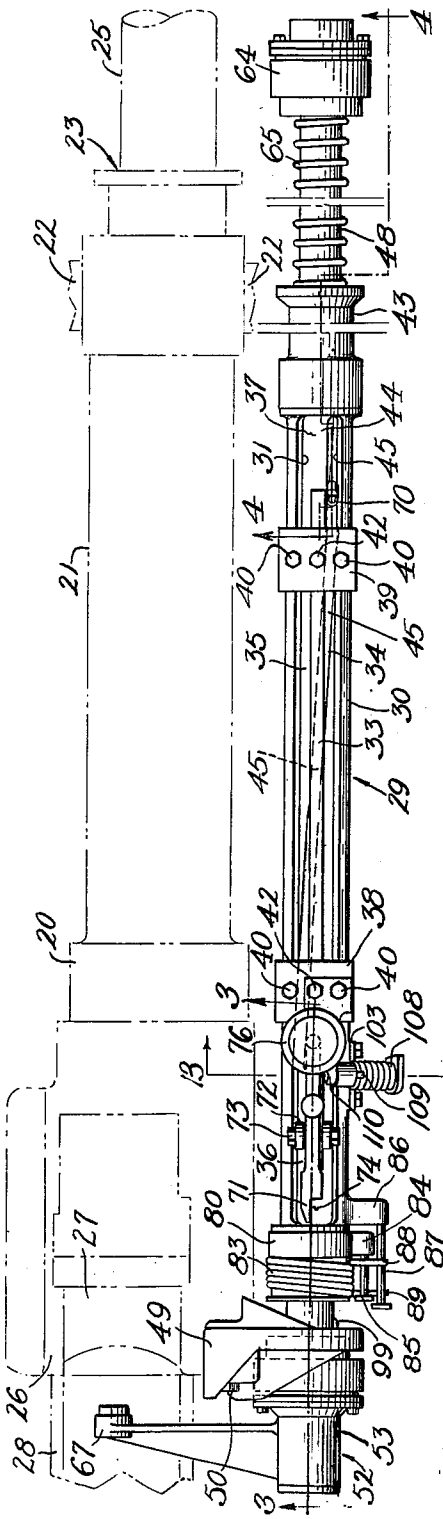


FIG-2

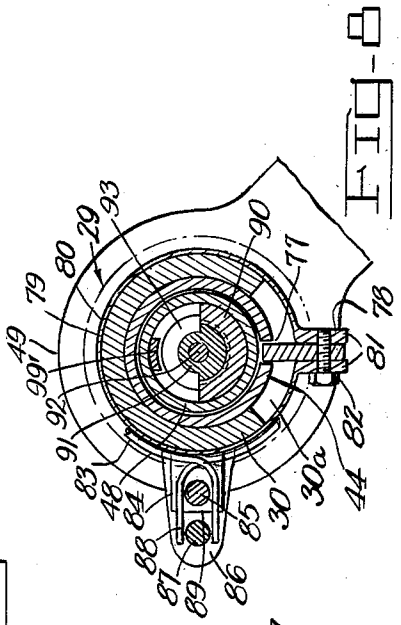


FIG-8

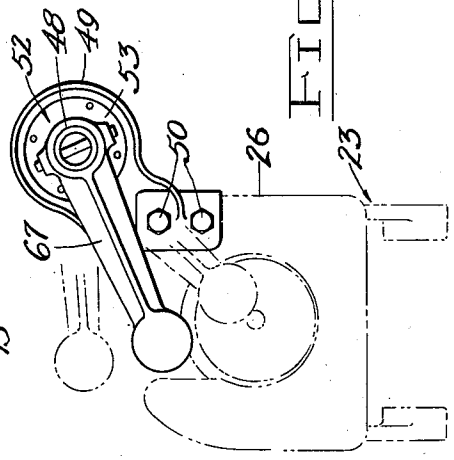


FIG-7

INVENTOR.
SIGMUND SCHIFF
BY
J. H. Church & H. C. Thibodeau
ATTORNEYS

Sept. 5, 1950 S. SCHIFF 2,520,966

RAMMER

Filed Dec. 18, 1945 5 Sheets-Sheet 3

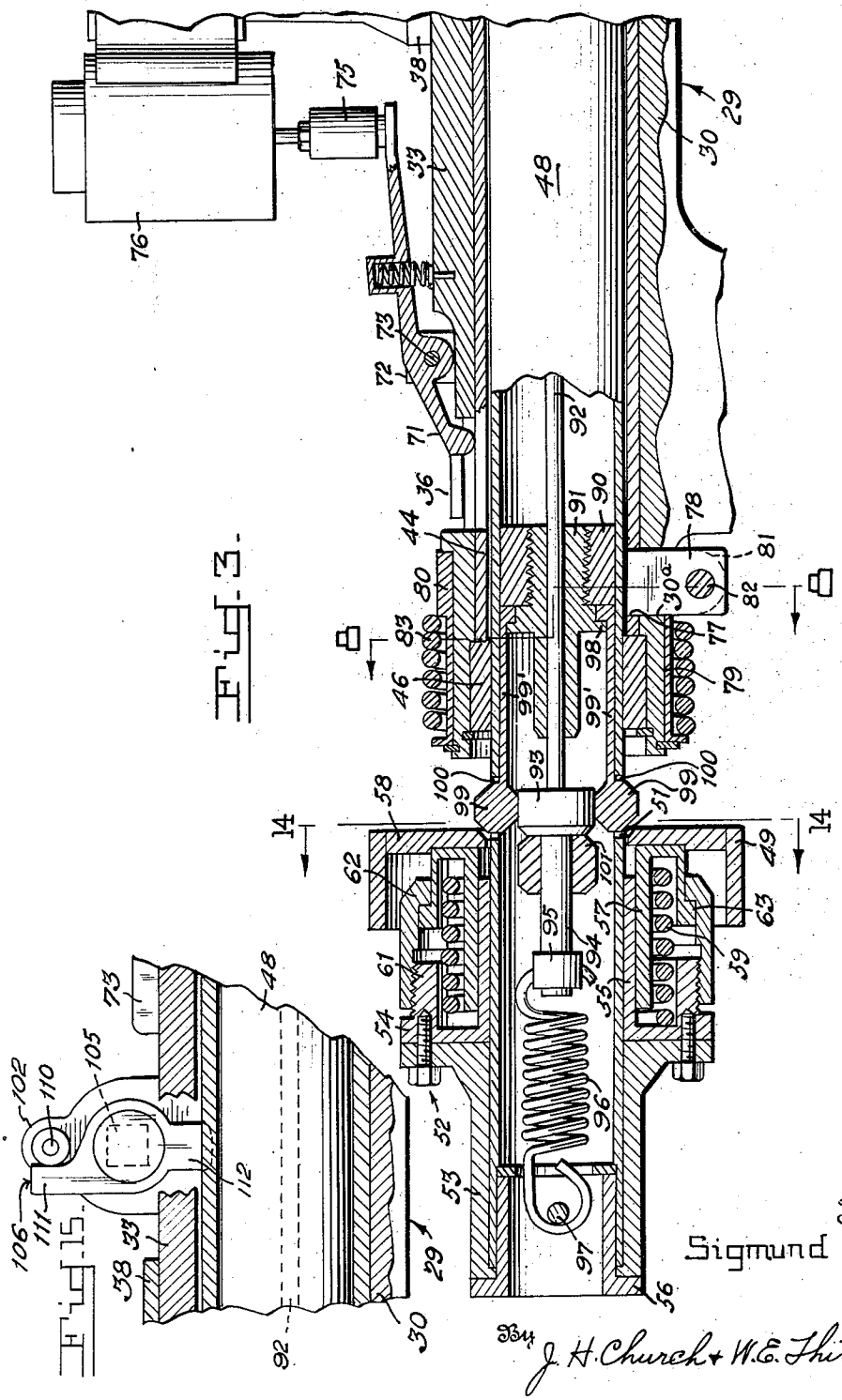


Fig. 3.

Fig. 15.

Inventor
Sigmund Schiff

By J. H. Church & W. E. Thibodeau
Attorneys

Sept. 5, 1950 S. SCHIFF 2,520,966

RAMMER

Filed Dec. 18, 1945 5 Sheets-Sheet 4

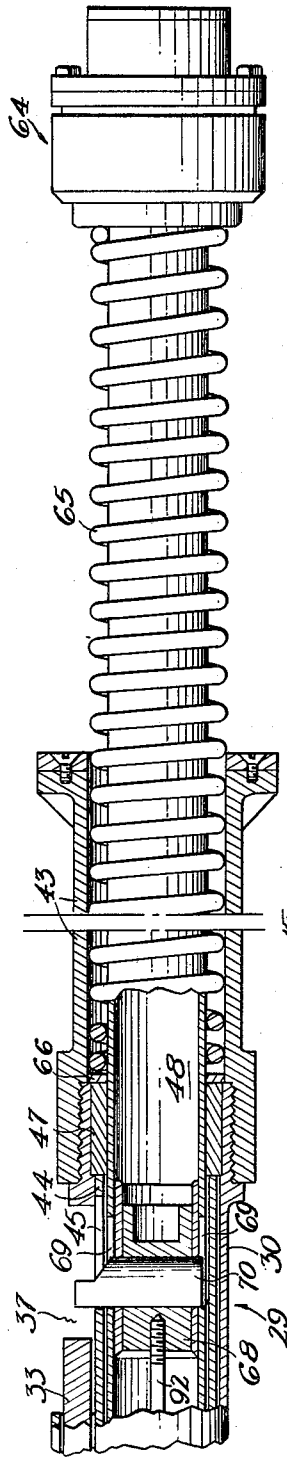


Fig-4

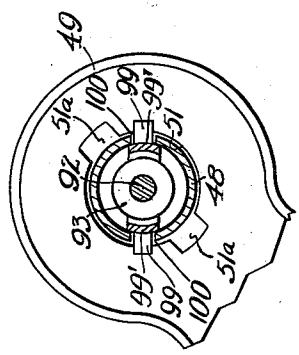


Fig-14

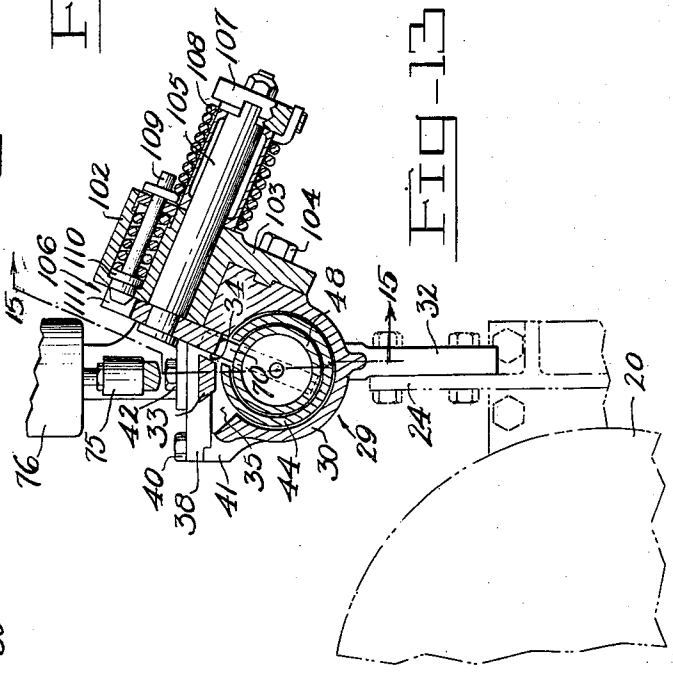


Fig-13

INVENTOR.
SIGMUND SCHIFF
BY
J. H. Church & H. C. Thibodeau
ATTORNEYS

Sept. 5, 1950 S. SCHIFF 2,520,966

RAMMER

Filed Dec. 18, 1945 5 Sheets-Sheet 5

FIG-9

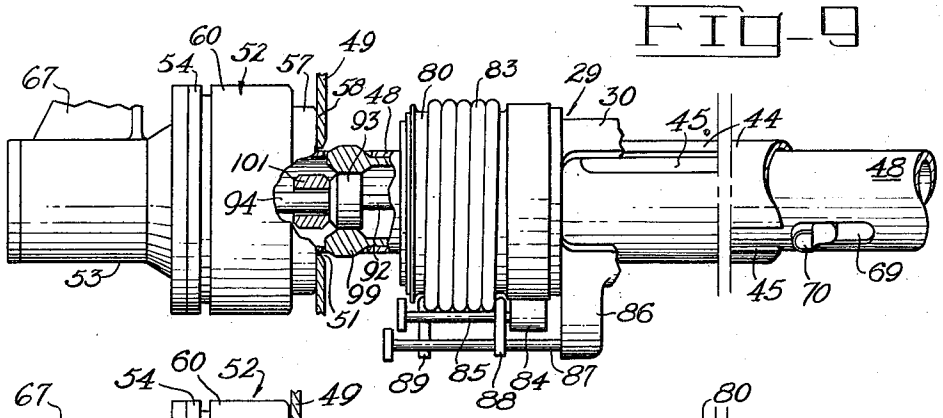


FIG-10

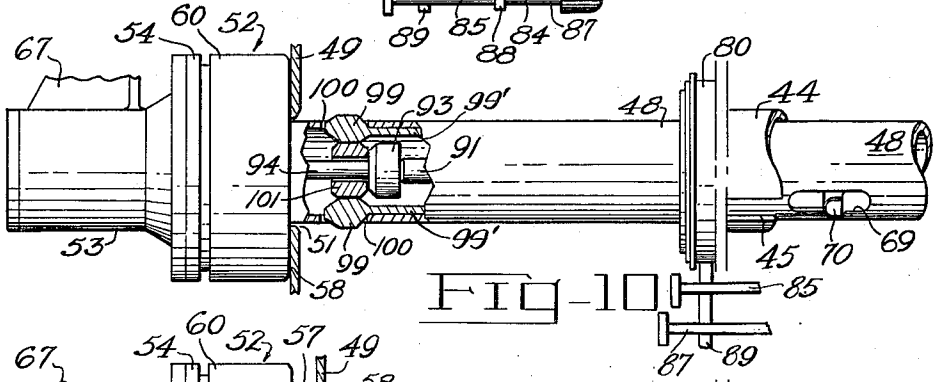


FIG-11

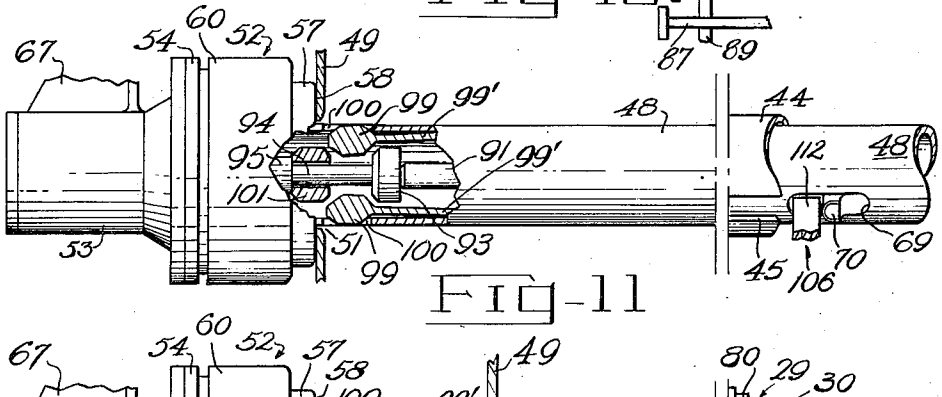
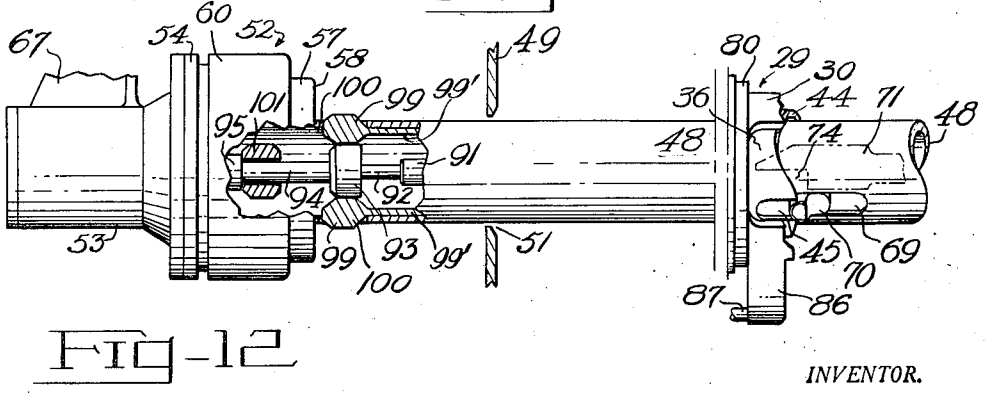


FIG-12



INVENTOR.
SIGMUND SCHIFF

BY

J. H. Church & H. C. Thibodeau

ATTORNEYS

Patented Sept. 5, 1950 2,520,966

UNITED STATES PATENT OFFICE

2,520,966

RAMMER

Sigmund Schiff, Cincinnati, Ohio, assignor to United States of America as represented by the Secretary of War

Application December 18, 1945, Serial No. 635,817

24 Claims. (Cl. 89—47)

(Granted under the act of March 3, 1883, as amended April 30, 1928; 370 O. G. 757)

1

The invention described herein may be manufactured and used by or for the Government for governmental purposes, without the payment to me of any royalty thereon.

This invention relates to a gun rammer and more particularly to a rammer of the recoil-operated type.

The invention contemplates and has for its principal object the provision of an improved rammer of the recoil-operated type and particularly a rammer adapted for attachment to and functioning with an artillery weapon of heavy caliber. As is well known to those skilled in the art, the recoiling parts of artillery weapons move with great force and at high rates of speed and it has heretofore been extremely difficult, if not impossible, to provide a recoil-operated rammer that could be suitably adapted to utilize the recoil forces. The rammer provided according to the present invention constitutes an improvement on the rammer set forth in my copending application, Serial No. 594,465, filed May 18, 1945. My present rammer eliminates the several disadvantages of known rammers and provides a rammer that is efficient in operation and that is suitably controlled so that it may be incorporated into an artillery weapon in such a manner that the operation of the weapon and the loading of rounds of ammunition into the weapon are coordinated to the extent that these two functions become automatic.

An important object of the invention is to provide a rammer structure in which provision is made for eliminating defects in operation heretofore caused by uncontrolled movement of parts resulting from the inertia and shocks ordinarily inherent in the operation of the artillery weapon.

It is another important object of the invention to provide a rammer constructed and arranged to follow a four-phase movement so that it travels rearwardly or breechwardly upon recoil of the weapon, then moves in a path normal to the recoil stroke to engage a round of ammunition, then moves forwardly after recoil of the weapon to load the round, and then moves laterally or normal to the direction of counterrecoil to move the round-engaging means out of the path of the empty cartridge case that is extracted and ejected after the weapon is fired.

Another object is to provide releasable means connecting the rammer to the recoiling parts of the weapon so that the breechward travel of the rammer is controlled to the end that the initial shock of recoil does not drive the rammer freely

2

rearwardly; such releasable connection thus eliminates possible damage to the rammer or its connections to the weapon.

Still another object of the invention is to provide the releasable means in the form of a clutch or releasable lock operable in response to a predetermined phase of the recoil stroke, such as a predetermined distance of travel or a predetermined rate of speed of the parts in recoil.

The invention has for another object the provision of a rammer that is mounted for reciprocation in the directions of recoil and counterrecoil and also for rocking movement and to provide in conjunction therewith yieldable means loaded or tensioned upon reciprocation of the rammer for reaction to rock the rammer, whereby the aforesaid four-phase movement is achieved without the use of separate driving means.

Still other objects of the invention are to provide novel mechanical movements and to apply these movements to the rammer; to provide a rammer that is simple in construction and efficient in operation; and to provide a rammer that may be suitably attached to and operated with artillery weapons of any caliber.

The foregoing and other objects and desirable features of the invention will appear more clearly as the disclosure is amplified in the following detailed description of a preferred embodiment of the invention as illustrated in the accompanying sheets of drawings in which:

Fig. 1 is a side elevation of the rammer shown in position on an artillery weapon of conventional type, the weapon being indicated in dot-dash lines;

Fig. 2 is a plan view of the same;

Fig. 3 is an enlarged, longitudinal sectional view of one end of the rammer, the view being taken on the line 3—3 of Fig. 2;

Fig. 4 is a longitudinal sectional view of the forward end portion of the rammer, the view being taken substantially on the line 4—4 of Fig. 2;

Fig. 5 is an enlarged detailed view of the means for tensioning the spring to rock the rammer in its support on the weapon;

Fig. 6 is a detailed view of the rammer-supporting housing showing in position therein the inside member or "island" that forms the plate member of the cam means for guiding the rammer during reciprocation and rocking, the view being considerably enlarged over the illustration of the same parts in Fig. 2;

Fig. 7 is an end elevation, diagrammatic in form, showing the arrangement of the rammer

arm for swinging movement from a round-free position to a round-engaging position;

Fig. 8 is an enlarged, transverse sectional view taken substantially on the line 8—8 of Figure 3;

Figs. 9 to 12, inclusive, are fragmentary views illustrating different stages of the breechward travel of the rammer upon recoil of the weapon;

Fig. 13 is a transverse sectional view, on an enlarged scale, taken substantially on the line 13—13 of Fig. 2 and illustrating detent mechanism for actuating the releasable clutch between the rammer and the recoiling parts of the weapon;

Fig. 14 is a transverse sectional view through the rammer adjacent the driving member as indicated by line 14—14, Figure 3 and showing the position of the release dogs after the rammer has been released from the tube-and-breech assembly; and

Figure 15 is a detail sectional view of the clutch-actuating mechanism as indicated by the line 15—15 of Figure 13.

Although the rammer is shown as being of a particular design and as being mounted on a weapon of a particular type, it should be understood that the rammer may be variously modified and that it may be suitably adapted for attachment to and use with weapons of other types and other calibers. Accordingly the present disclosure should be taken as illustrative and not limiting.

The weapon chosen for the purposes of illustration is of the type employing a concentric recoil mechanism and comprises a cradle 20, an outer recoil-mechanism housing 21, trunnions 22, a tube-and-breech assembly 23, and a rearwardly extending guide structure 24. The tube-and-breech assembly includes a tube 25, a breech ring 26, and a breechblock 27. There is shown at the rear of the breech ring 26 means for supporting ammunition to be fed axially into the chamber of the weapon, which means here takes the form of a tray 28. It will be understood, of course, that any suitable form of loading or feeding mechanism may be employed in conjunction with the weapon and the rammer mounted thereon, and that such mechanism may be associated with the operation of the rammer so that the weapon may be rendered optionally full-automatic or semiautomatic, as set forth in my copending application, Serial No. 635,818, filed December 18, 1945.

In general, the rammer is carried by the cradle of the weapon and is disposed generally parallel to the axis of the tube-and-breech assembly and is arranged for reciprocation and rocking on its axis. The rammer-supporting structure includes a main housing 29 having an elongated tubular portion 30 open at its top as at 31 and having at its breechward end, that is, that end of the portion adjacent the rear or breech end of the gun, provided with depending flanges 32 rigidly secured to the guide structure 24 of the cradle 20 of the weapon.

As best shown in Fig. 6 the opening 31 in the tubular housing 30 is in the form of an elongated rectangle. An inner plate member 33, also of elongated rectangular shape, is arranged within the opening 31 so that the boundaries of the plate are spaced from the inner edges of the opening, there being thus provided a pair of longitudinally running paths or grooves 34 and 35 and a pair of end spaces 36 and 37. The member 33 thus provides an "island" in the opening 31 and the relationship between the spaces 36 and 37 and the grooves 34 and 35 is such as to provide means by which the spaces 36 and 37 cross-connect the grooves 34 and 35 respectively at their opposite ends. The structure thus described forms a cam plate for guiding the operation of the rammer, the details of which will be set forth below. The inner member 33 is retained in position in the housing 30 by means of a pair of cross members 38 and 39 (Figs. 1 and 2) secured by bolts 40 to upper flat shoulders 41 on the housing. Bolts 42 rigidly secure the member 33 to the cross members 38 and 39.

As best shown in Figs. 4 and 6, the front or muzzleward end of the tubular housing 30 is threaded and receives the internally threaded end of a tubular member 43 which extends forwardly or muzzlewardly from the housing 30. It will be appreciated that because of the length of the longitudinally extending parts the drawings have illustrated these parts with portions thereof broken away. The part 43, for example, should be considered as extending a substantial distance forwardly from the housing 30. The same consideration should be borne in mind with respect to other parts of the rammer to be presently described.

The tubular housing 30 is provided at opposite ends with bearing portions in which are respectively supported the opposite ends of a longitudinal, rotatable member or sleeve 44, a detail of which appears in Fig. 5. This sleeve is provided with a longitudinally spiraling slot or helical track 45 for a purpose to presently appear.

As best shown in Figs. 3 and 4, the tubular housing 30 is provided at its opposite ends with internal bearings or bushings, 46 at the rearward end and 47 at the forward end, which carry a longitudinally extending rammer member in the form of a tubular shaft 48. This member is carried by the housing 30 through the medium of the bushings 46 and 47 for reciprocation in the directions of recoil and counterrecoil and is also arranged for rocking movement about its axis. A bracket 49 is rigidly secured as by cap screws 50 to the breech ring 26. As will hereinafter be more fully set forth, the bracket 49 serves as a driving connection between the recoiling tube-and-breech assembly and the tubular rammer shaft 48. The bracket extends laterally toward the shaft 48 and has formed therein a circular opening 51 through which the tubular shaft 48 passes. As best shown in Fig. 14, the opening 51 is enlarged at diametrically opposed portions thereof to provide slots 51a. These slots are angularly offset (herein 45°) from a horizontal plane passed through the diameter of the opening 51 and are so arranged as to function in connection with the clutch or release mechanism to be hereinafter described.

At its breechward end the shaft 48 is provided with means adapted to be engaged by the driving member or plate 49 so that upon recoil of the weapon the tube-and-breech assembly serves to drive the rammer breechwardly that is, in the direction of the recoil of the gun from battery position. As best shown in Fig. 3, the rammer head, designated generally by the numeral 52, comprises a flanged member 53 carried externally at the end of the tubular member 48 and having secured thereto a second flanged member 54 provided with a sleeve 55 surrounding the tubular member 48. The breechward end of the tubular member 48 receives a securing means in the form of a hollow member 56 herein indicated as being pressed into the end of the tubular member which also forces it against the flanged member 53 thereby securing the members 48, 53 and 56

as a unitary unit. The outer surface of the sleeve 55 of the flanged member 54 has slidably mounted thereon a sleeved member 57 formed with an outer radial face 58 that forms a buffer surface adapted to be engaged by the rearward radial face of the driving member 49. Buffer means in the form of a coil spring 59 is interposed between the members 57 and 54 and serves as a means by which the member 58 may be moved axially breechwardly of the tubular shaft 48 against the resiliency of the spring. An external sleeve 60 is internally threaded and fits on an outer, externally threaded annular flange 61 of the member 54. The member 60 includes at its other end an inwardly directed annular flange 62 cooperable with an outwardly directed annular flange 63 on the member 57 to provide means for preventing axial separation of the parts of the rammer head assembly 52 upon extension of the buffer spring 59. The arrangement of the parts in the rammer head is such that the spring 59 serves as a buffer for absorbing the shock of initial impact occurring when the driving member 49 meets the rammer head upon initial movement of the tube-and-breech assembly in recoil.

As best shown in Figs. 1, 2 and 4 the tubular member or shaft 48 extends a considerable distance axially forwardly of the tubular housing 30 and passes through the tubular member 43. The front end of the tubular shaft 48 is provided with a buffer 64, which may be constructed according to the buffer structure in the rammer head 52. Driving means in the form of a coil spring 65 surrounds the tubular member 48 and is interposed between the buffer 64 and a thrust member 66 carried at the forward end of the tubular housing 30 adjacent the bushing 47. The spring 65 is compressed when the tubular shaft 48 is moved axially breechwardly upon recoil of the weapon and serves as driving means for returning the tubular shaft 48 axially forwardly or muzzlewardly. The rearward or breechward end of the tubular shaft 48 carries thereon for rocking movement therewith a rammer arm 67, which may be suitably formed as part of the rammer head 52, preferably being an extension of the flanged member 53 of the rammer head 52.

As previously stated, the shaft 48 is mounted for rocking in addition to reciprocation in and with respect to the support or housing 30. The combination of movement obtained by this mounting provides for a four-phase movement or function of the shaft 48 and rammer arm 67 so that upon recoil of the weapon the parts 48 and 67 may move from an initial position in the direction of recoil, then be rocked about the axis of the tubular member 48, next be moved in the direction of counterrecoil, and finally rocked reversely about the axis of the tubular member 48 to initial position. The arrangement is such that when the weapon has been loaded and is ready for firing the parts are in the positions shown in Figs. 1 to 4 with the rammer head forward and with the rammer arm 67 disposed in an upper or round-free position. This latter position is illustrated by the upper broken lines in Fig. 7. It is desirable that the rammer arm 67 be maintained in its upper position during the recoil stroke of the weapon and during the travel of the tubular shaft 48 in the direction of recoil, for the reason that the arm 67 must be disposed in a position spaced outwardly from the axis of the tube-and-breech assembly so that it does not interfere with the extraction and ejection of the empty cartridge case of the previously fired round. When the parts 48 and 67 have reached the limit of their travel in the direction of recoil it is desirable that the arm 67 swing downwardly—herein through a range of 45°—from its round-free position to a position in which it may engage a round of ammunition on the tray 28 (or on the corresponding part of any other suitable feeding mechanism). This position of the arm 67 is shown in the lower broken lines in Fig. 7. It is further desirable that the arm 67 be maintained in its round-engaging position during travel of the rammer parts forwardly or in the direction of counterrecoil, which movement occurs after the weapon has returned to battery. By this arrangement the rammer arm 67 maintains constant contact with the round throughout the ramming stroke so that the round is positively fed ino the chamber of the weapon. At the completion of the movement of the rammer parts in the direction of counterrecoil and after completion of the ramming of the round, the movement of the parts is such that the rammer arm 67 moves again to round-free position, or the upper position as indicated in Fig. 7.

As will presently appear, the total movement of the rammer arm 67 through its range of 45° when it reaches its rearwardmost position is divided into two minor ranges of 22½° each, in which case the arm temporarily occupies a halfway position as shown in full lines in Fig. 7.

As stated previously it is one of the important objects of the present invention to provide means for accomplishing the four-phase movement of the tubular member and rammer arm through its rearward and forward reciprocating phases and its counterclockwise and clockwise rocking phases. As will appear below this movement is accomplished in a simple and positive manner and without resort to separately powered driving means.

The forward end of the tubular member 48 carries slidably therein a cylindrical block 68, as best shown in Fig. 4. Diametrically opposed wall portions of the member 48 are cut out to provide a pair of diametrically opposed, longitudinally extending slots 69. A pin 70 is disposed substantially vertically within and is rigidly secured to the sliding block 68, with the lower end of the pin extending into the lower slot 69 and the upper end of the pin passing through the upper slot 69 and extending upwardly into the four-phase groove or track formed by the opening 31 and the island 33 in the tubular housing 30. Because of the cooperation between the pin 70 and the slot 69 axial movement of the block 68 with respect to the tubular member 48 is limited by the extent of the slots. For the purposes of the following description, the pin 70 may be considered as being mounted rigidly in the tubular member 48.

When the weapon recoils and the tubular member 48 is moved breechwardly the pin 70 travels along the groove or track 34 until it reaches the space 36 at the breechward end of the island 33. At this point the tubular member is latched in its breechward position and the tube-and-breech assembly may return to battery independently of return of the rammer. For the purposes of the present disclosure the means for latching or locking the rammer in its breechward position is illustrated as a spring-pressed latch member 71 pivoted on a transverse pivot 73 on a pair of upstanding ears 72 carried by the breechward end of the island 33. The breechward portion of the latch member 71 is cut out to form a notch 74

(Fig. 2) and the opposite end of the latch extends forwardly of the pivot 73 to be engaged by a plunger 75 of latch actuating mechanism herein indicated as a solenoid 76. It will be understood, of course, that any suitable means may be utilized for actuating the latch 71. When the pin 70 completes its traverse of groove section 34, and arrives at space 36 as the rammer tube 48 completes its breechward or rearward translation, tube 48, arm 67 and pin 70 are rocked counterclockwise under the urge of spring 83, in a manner subsequently described, until pin 70 engages within notch 74 and is thus held in retracted position by latch 71. At this time the rammer will have rocked 22½° in a counterclockwise direction and the rammer arm 67 will occupy the full line position as shown in Fig. 7. Then, when the latch is released from pin 70, by energization of solenoid 76, the pin 70 completes its travel across the space 36 until it reaches the opposite side of the opening 31 in the housing 30, and the rammer arm 67 will move to the lowermost dotted line position of Fig. 7 where it may engage a fresh round of ammunition in position to be rammed into the breech. The driving spring 65 will then return the tubular member 48 in the direction of counterrecoil, with the pin 70 following the longitudinal groove or track 35, at the end of which movement the pin passes into the space 37 and is returned to its initial position by the spring 83 which is now tensioned in the opposite sense, as subsequently described. Transverse movement of the pin 70 across the spaces 36 and 37 is effected by torsion spring mechanim set forth immediately below.

An important aspect of the invention consists in the means for combining the action of recoil and the action of the driving spring 65 in counterrecoil to rock the tubular member 48 so that the rammer arm 67 assumes the desired positions during the travel of the rammer parts as guided by the four-phase cam means (provided by the opening 31 and island 33).

As best shown in Figs. 3 and 8, the rearward portion of the sleeve 44 at its lower side is slotted as at 77 to receive a downwardly extending key or driving lug 78. The rearward end of the housing 30 is provided with an external cylindrical bearing surface 79 which rotatably carries a collar 80. As best shown in Fig. 8, the collar 80 is slotted at its lower side and is provided with a pair of depending ears 81 between which the key or lug 78 is fixed. The lower portion of this end of the housing 30 is also cut out at this point to provide a space 30*a* through which the key or lug 78 extends and in which it may operate. A cap screw 82 passes through the ears 81 and key 78 and secures the collar or sleeve 80 for rotation or rocking with the elongated sleeve 44 about its axis in the tubular housing 30. Energy-storing means in the form of a yieldable element such as a torsion spring 83 is carried by and encircles the collar 80, the spring being located rearwardly of the key 78 and ears 81. The collar 80 is provided at its periphery with a radially outwardly directed lug 84 which carries a longitudinally extending driving pin 85. A second lug 86 is formed integrally with or otherwise rigidly carried by the rear end portion of the tubular housing 30. This lug is located just forwardly of the lug 84 and extends laterally outwardly beyond the latter. The lug 86 carries a stop pin 87 paralleling the driving pin 85. As best shown in Fig. 8, opposite end portions of the torsion spring 83 are indicated at 88 and 89. The end 88 is bent outwardly and extends beyond and is engageable with the upper surfaces of the driving pin 85 and stop pin 87; the end 89 is bent outwardly and extends beyond and is engageable with the under or lower surfaces of the driving pin 85 and the stop pin 87.

As stated above, the elongated sleeve 44 is provided with the spiral or helical slot 45. As best shown in Fig. 4, slot 45 is engaged by the pin 70. When the rammer moves in the direction of recoil, the pin 70, traveling down the longitudinal groove or track 34 between the housing 30 and island 33, serves to rock the sleeve 44 in a clockwise direction (as viewed from the breech end of the weapon). Upon this rocking or rotation of the sleeve 44 the torsion spring 83 is loaded because of the interaction between the driving key 78, collar 80, and pins 85 and 87. Stated otherwise, as the sleeve 44 is rocked, the collar 80 is rotated clockwise, as shown in Fig. 8, and the driving pin 85 through contact with the spring end 89 imparts a twist to the torsion spring 83, the other spring end 88 being held by the stop pin 87 on the lug 86. Consequently, when the rammer reaches the limit of its travel in the direction of recoil, the pin 70 reaches the end of the island 33 and at that point is no longer restrained against the reaction of the now tensioned spring 83, with the result that the spring, through the spring 80, key 78 and sleeve 44, reacts to rock the rammer in a counterclockwise direction (as viewed from the breech end of the weapon). As the pin 70 moves across the breechward end of the island 33 across space 36, it is engaged and stopped by the cutout portion 74 of the latch 71, and rocking of the rammer is limited temporarily to 22½° (intermediate position, Fig. 7). After the latch 71 is released, the pin 70 continues its movement across the space 36 and the rammer rocks through an additional 22½° (lower position, Fig. 7). The pin 70 at this point clears the rear end of the island 35 and the driving spring 65 serves to return the rammer member in the direction of counterrecoil. During this movement the pin 70, traveling reversely in the track 35 and slot 45 of the sleeve 44, will rock the sleeve 44 to reload or retension the spring means 83. In this instance the sleeve 44 is rocked in a counterclockwise direction (as viewed from the breech end of the gun) and the driving pin 85 on the collar 80 engages the spring end 88 while the stop pin 87 restrains the spring end 89. When the pin 70 reaches the forward end of the island 33 the spring 83 reacts through the sleeve 44 and the pin 70 to rock the tubular member 48 clockwise, as viewed in Fig. 8, through 45°, thus moving the rammer arm 67 from its round-engaging position to its initial round-free position (upper position, Fig. 7).

As stated earlier herein, it is an important object of the invention to provide means for controlling the initial movement of the rammer in the direction of recoil so that the rammer upon initial impact of the recoiling parts does not move rearwardly with such force as to cause damage to the rammer and its associated parts. In the present instance, this means preferably takes the form of a releasable connection between the tube-and-breech assembly and the rammer, which means includes a releasable lock or clutch operable in response to a predetermined phase of the recoil stroke, at which time the rammer is released from the recoiling tube-and-breech assembly so that the rammer may continue a short distance further in the direction of recoil and so

that, as the rammer is latched in this position by the latch 71, the tube-and-breech assembly may return to battery. In the following description of this releasable latch or clutch means, reference is had to Figs. 3, 4, and 9 to 14.

The breechward end of the tubular member 48 is provided with an internally threaded cylindrical plug 90 which receives an externally threaded bushing 91 having a cylindrical sleeve bored internally to provide an axial bearing for a control member in the form of a longitudinally extending rod 92. The forward end of the rod is threaded into the slidable block 68, previously described (see Fig. 4). The breechward end of the rod 92 rigidly carries a head member 93 with which is integrally formed an axially directed, intermediate extension member 94 terminating at its breechward end in a head 95. Yieldable means, preferably in the form of a tension spring 96, is connected at one end to the head 95 of the extension 94 and at its other end to a transverse pin 97 carried by the locking nut 56 of the rammer head assembly 52. The spring 96 is normally tensioned to act through the extension 94 and the rod 92 to urge the sliding block 68 axially rearwardly or breechwardly so that the pin 70 is maintained in its rearward position in the slots 69 in the tubular member 48.

The bushing 91 is provided with a radial flange formed with an annular recess that cooperates with the rear face of the cylindrical plug 90 to form anchor means 98 for a pair of radially movable latch members or clutch dogs 99 terminating spring members 99'. The tubular member 48 is provided with a pair of diametrically opposed openings 100 disposed just forwardly of the driving plate 49 and through which the clutch dogs 99 normally extend. As best shown in Fig. 3 the members or dogs 99 provide an obstruction to the passage of the rammer member 48 through the opening 51 in the driving member 49. The axial extension 94 carries for axial sliding thereon a collar 101. This collar is of the same diameter as the head 93 on the rod 92 and has sliding movement on the extension 94 limited by the head members 93 and 95. The function of the collar 101 and the related parts will be brought out in greater detail below.

A component part of the releasable means or clutch mechanism is the means for temporarily retarding breechward travel of the pin 70 so that it is shifted forwardly or muzzlewardly in the slots 69 in the rammer member 48. As best shown in Figs. 3 and 13 this operating means is mounted in an upwardly directed extension 102 formed integral with the supporting structure 29 on the outside of the tubular housing 30. The supporting extension 102 is provided with a transverse bore in which is carried the sleeve portion of a mounting member 103 which is non-rotatably secured to the extension by means of bolts 104 passed through a flanged portion thereof. The sleeve on the member 103 carries in its bore a bushing for rotatably mounting a transverse shaft 105. This shaft has keyed thereto at its inner end an operating member in the form of a detent lever 106. The outer end of the shaft 105 has keyed thereto a locking member 107. A torsion spring 108 encircles the shaft 105 and has one end in driving engagement with the member 107 and its other end locked against a pin 109 forming part of a spring-pressed detent 110. The action of the spring in the detent is such as to urge the head of the detent 110 outwardly of its housing 102 or into the path of an upper arm 111 on the detent lever 106. A lower arm 112 on the lever 106 is directed downwardly and extends into the longitudinal groove or track 34 formed by the opening 31 and island 33 in the tubular housing 30. The arm 112 is thus disposed in the path of the pin 70 as it proceeds down the groove or track 34. The tension of the spring 108 on the lever 106 is sufficient to cause a temporary obstruction to the travel of the pin 70, so that the pin is caused to move to the forward end of slot 69 in the rammer member 48, thus resulting in operation of the clutch or release means 92—101.

In the following description of the operation of the weapon and rammer, it will be assumed that the arrangement illustrated in Figs. 1 and 2 is such that the weapon is loaded and ready for firing. After the weapon is fired, the tube-and-breech assembly recoils and by means of the driving plate 49 carries with it the rammer assembly and its component parts. During the travel of the rammer in the direction of recoil, the rammer arm 67 is maintained in its upper or round-free position and is thus out of the path of an extracted and ejected empty cartridge case. The clutch dogs 99 are in the positions illustrated in Fig. 3, being maintained in that position by the head member 93 on the rod 92, the action of the spring 96 being such as to draw the parts 92 and 94 rearwardly so that the pin 70 is in its rearward position in the slots 69 in the rammer member 48 as shown in Fig. 4. Thus the rammer is in effect temporarily directly connected to the tube-and-breech assembly through the driving member 49. This connection is desirable because of the tremendous force delivered by the recoiling parts during initial travel thereof. For example, if the releasable clutch mechanism 92—101 had been omitted and the only connection between the rammer and the tube-and-breech assembly was the driving member 49 and rammer head 52, the impact of the recoiling parts on the rammer head 52 would be of such magnitude as to drive the rammer assembly rearwardly with such force as to cause virtual destruction thereof.

For the purposes of the present description reference will be had to specific distances in the various phases of travel of the recoiling parts and different phases of the recoil stroke. It will be understood, of course, that it is not intended to limit the present invention by reference to these descriptive distances.

In the type of weapon illustrated herein, the tube-and-breech assembly recoils approximately twenty inches. It has been found that during the first four inches of the recoil stroke tremendous forces are set up. It is also during this period that the recoiling parts attain their highest velocity. As the recoiling parts continue to the end of the recoil stroke, the forces diminish and the velocity falls off. It is desirable, therefore, that at some point near the end of the recoil stroke the rammer assembly be released from the driving member 49. This is especially true in the present instance where the rammer is designed to travel breechwardly a distance somewhat greater than the distance traveled by the recoiling parts of the weapon. For example, in the present case the arrangement is such that the rammer head, when released from the driving member 49, travels an additional three inches. This additional travel is desired in the present case for the purposes of enabling the rammer arm to move sufficiently rearwardly to engage

the next round of ammunition. During this phase of movement of the rammer, the spring-pressed latch 71 operates to retain the pin 70 on the rammer member 48 so that the rammer member rocks only half its distance and is thus retained in breechward position. Since the rammer member rocks only half its full distance, the round-engaging arm 67 moves from its round-free or upper position to the position illustrated in full lines in Fig. 7. When the solenoid 76 is energized by a manual or automatic means, not shown, the latch 71 is raised allowing the torsion spring 83 to complete the rocking movement of the rammer member 48, whereupon the arm 67 moves to round-engaging position and engages a round and the driving spring 65 returns the rammer assembly forwardly, with the pin 70 traveling up the groove or track 35 until it reaches the opposite end of the island 33, at which time the reverse reaction of the torsion spring 83 causes reverse rocking of the rammer member 48 so that the pin 70 travels across the space 37 into its initial position. During this phase of the operation the round has of course been loaded into the chamber of the breech 26.

Reference is had now to Figs. 3 and 9 to 12. Figs. 3 and 9 illustrate the positions of the parts when the gun is in battery and ready for firing. Figs. 9 to 12 illustrate different stages in the travel of the rammer assembly in the direction of recoil. In each of these figures the axial extent of the parts is interrupted and the break is indicated by dot-dash lines. The illustration in each case is such that the forward or muzzleward portions of the rammer that cooperate with the breechward portions thereof are brought into the same view and intermediate portions are omitted. Reference points to which the rammer parts may be related for purposes of identification in the following description are the driving member 49, housing 30, collar 80 and pin 70. In Fig. 9, the parts are shown in the positions they occupy prior to recoil of the gun. In Fig. 10, recoil has begun and the rammer head 52 has been driven rearwardly approximately four inches; consequently, the rammer head is shown as having moved to the left away from the breechward end of the housing 30, and the pin 70 is shown as moving rearwardly or approaching the arm 112 of Fig. 13 and which, as already explained, is disposed through the groove 34 and into the path of the pin 70 as it proceeds down the groove 34. In Fig. 11, the rammer head has moved approximately twenty inches rearwardly (or to the left of and away from the housing 30 as viewed in the drawing). Simultaneously, the pin 70 has moved the same distance rearwardly and closer to the arm 112. Because of the limited space available, the housing 30 has not been shown in Figs. 10 and 11, but reference may be had to the complete view in Fig. 2. In Fig. 12, the rammer head has moved approximately twenty-three inches rearwardly or to the left of and away from the rear end of the housing 30 and the pin 70 has moved a corresponding distance rearwardly, having tripped and passed the arm 112. In this figure, the housing 30 is again shown in the drawings (to the right of the break-lines) in order that the relationship between the pin 70 and the rear end of the opening 31 in the housing may be illustrated.

When the gun is fired and the tube-and-breech assembly recoils, the driving member 49 moves rearwardly against the rammer head 52. Because of its inherent inertia the rammer assembly tends to remain stationary and the buffer spring 59 in the rammer head is compressed (Fig. 10). However, the spring 59 quickly reacts after absorbing the initial shock of recoil, and continued breechward movement of the driving member 49 operates to drive the rammer member 48 rearwardly. However, the parts 92, 93, 94, 95 and 101, because of the inherent inertia therein, continue their tendency to remain stationary, with the result that the rod 92 and its associated parts lag behind the rammer member 48, causing tensioning of the spring 96 and causing relative movement of the pin 70 to the forward ends of the slots 69 in the rammer member 48 (Fig. 10). When this action takes place, the collar 101 on the extension 94 of the rod 92 is moved quickly into the place formerly occupied by the head member 93 so that the collar now maintains the clutch dogs 99 in their extended positions (Fig. 10). This action occurs with such speed that the collar 101 has no opportunity to slide axially on the extension 94.

The spring 96 quickly reacts and draws the rod 92 again rearwardly, moving the head member 93 again in position to maintain the clutch dogs 99 in their extended positions. The temporary substitution of the collar 101 for the head member 93 as means to keep the dogs 99 in position is required for the purpose of preventing premature release of the rammer 48 from the driving member 49. Simultaneously, the sliding block 68 and pin 70 are moved rearwardly so that the pin 70 again rests against the rearward ends of the slot 69 in the member 48, the parts occupying the same relative positions as those illustrated in Fig. 9. The tube-and-breech assembly has now traveled substantially through its complete range of movement and at this time has lost a substantial portion of its momentum and velocity. Also, the pin 70, traveling down its track or groove 34, is approaching the depending arm 112 on the detent lever 106. When the pin 70 engages the arm 112 (Fig. 11) the action is such that the travel of the pin 70 is temporarily interrupted, the tension on the torsion spring 108 (Fig. 113) being such that in effect the pin 70 is moved forwardly in its slots 69 relative to the member 48 and with respect to the other parts of the rammer assembly. Since the pin 70 is carried by the block 68, which is in turn connected to the rod 92, the rod 92 will now be drawn forwardly against action of the spring 96 and the head member 93 will be drawn out of position with respect to the clutch dogs 99 so that the latter are retracted radially inwardly of the member 48 by its spring arm 99' and into the space now created between the head member 93 and the sliding collar 101 on the extension 94 (Fig. 11). Since the clutch dogs no longer extend radially outwardly through the openings 100 in the tubular member 48, there is no longer any obstruction to the travel of the rammer member 48 through the opening 51 in the driving member 49, with the result that the rammer is free to move breechwardly and beyond the driving member 49 for an additional distance.

After the pin 70 upsets the detent lever 106, the spring 96 again draws the rod 92 and its associated parts rearwardly and again disposes the head member 93 in position between the clutch dogs 99, spreading the dogs outwardly through the openings 100 in the member 48 (see Fig. 12). However, the clutch dogs have now passed through the opening 51 in the driving member 49 and the tube-and-breech assembly is freed

from the rammer so that it may return to battery without the rammer. As previously described, the opening 51 in the driving member 49 is provided with the diametrically opposed slots 51a (see Fig. 14). These slots 51a are, as stated, angularly offset 45° from a horizontal plane passed through the axis of the rammer assembly. The normal travel of the rammer assembly is such that the clutch dogs 99 are disposed in this horizontal plane. The latch 71 (Fig. 2) traps the pin 70 after the first 22½° of rocking of the rammer member 48 and when the solenoid 76 is energized by any suitable means, not shown, to release the latch 71 the rammer completes its rocking in a counterclockwise direction (as viewed from the breech end of the weapon) and may then be driven forwardly by the spring 65. When the rammer completes its rocking phase of 45° prior to moving forwardly, the clutch dogs 99, in their positions of extension through the openings 100 in the member 48, become aligned with the slots 51a so that they may pass freely through the slots to the muzzle side of driving member 49 upon completion of the stroke of the rammer in the direction of counterrecoil. At the end of the forward stroke of the rammer member 48, the pin 70 clears the forward end of the island 33 and the rammer is reversely rocked, by action of spring 83, through a single continuous phase of 45° to its original position.

Although the foregoing description has proceeded in stages and successive steps in the operation of the rammer have been set forth, it will be appreciated that the operation is actually a smooth, continuous and rapid series of functions that occur as a result of the tremendous speed of the recoiling tube-and-breech assembly. It will be noted that the design and construction is such that the moving parts are adequately supported and freely movable in requisite bearings and that the shocks of impact and other stresses are adequately absorbed by the buffers in the units 52 and 64. The entire arrangement is such that the foregoing objects are readily and efficiently achieved. Other objects and features of the invention will undoubtedly appear to those skilled in the art. It will be understood, of course, that the disclosure herein is of a preferred embodiment of the invention and that numerous modifications and alterations may be made therein without departing from the spirit and scope of the invention as defined in the appended claims.

What is claimed is:

1. A rammer for a gun having a tube-and-breech assembly arranged for recoil and counterrecoil, comprising a support fixed against recoil and counterrecoil, a rammer member carried by said support for reciprocation in the directions of recoil and counterrecoil and arranged for rocking about its axis with respect to said support, means adjacent the breechward end of and connected to said rammer member for engaging a round of ammunition and adapted upon rocking and reverse rocking of said rammer member to be moved alternately inwardly from a round-free position spaced outwardly from the axis of the tube-and-breech assembly to a round-engaging position near the axis of the tube-and-breech assembly, cam means carried by said support, said cam means having a first groove running parallel to the direction of recoil, a second groove at the breechward end of and running normal to said first groove and in the direction of rocking of said rammer member, a third groove connecting said second groove and running generally parallel to said first groove and to the direction of counterrecoil, and a fourth groove running in the direction of reverse rocking of said rammer member and normal to and connecting the muzzleward ends of said first and third grooves, means operatively associated between said cam means and said rammer member and including a cam follower for guiding said rammer member during reciprocation and rocking thereof, means for moving said rammer member in the direction of recoil with said cam follower following the aforesaid first groove, spring means for rocking said rammer member with said cam follower following said second groove whereby said round-engaging means is moved to its aforesaid round-engaging position, means for moving said rammer member in the direction of counterrecoil with said cam follower following said third groove in said cam means, said spring means rocking said rammer member reversely with said cam follower following said fourth groove for returning said round-engaging means to its aforesaid round-free position.

2. A rammer for a gun having a tube-and-breech assembly arranged for recoil and counterrecoil, comprising a support fixed against recoil and counterrecoil, a rammer member carried by said support for reciprocation in the directions of recoil and counterrecoil and arranged for rocking about its axis with respect to said support, means adjacent the breechward end of and connected to said rammer member for engaging a round of ammunition and adapted upon rocking and reverse rocking of said rammer member to be moved alternately inwardly from a round-free position spaced outwardly from the axis of the tube-and-breech assembly to a round-engaging position near the axis of the tube-and-breech assembly, cam means comprising means forming a generally rectangular cam groove carried by said support, said cam groove having two opposed portions arranged parallel to the directions of recoil and counterrecoil and its other two opposed portions disposed normal to said first portions and in the directions of rocking and reverse rocking of said rammer member, follower means connected with said rammer member and engaging said groove for guiding said rammer member during reciprocation and rocking thereof, means for reciprocating said rammer member in response to recoil and counterrecoil of the gun, to cause said follower means to traverse the aforesaid first two portions, and means for rocking and reversely rocking said rammer member with said follower means when the latter arrives at the respective aforesaid second portions, whereby said rammer member is moved first in the direction of recoil, is then rocked to dispose the round-engaging means in its aforesaid round-engaging position, is then moved in the direction of counterrecoil with the round engaging means fixed against rocking, and is finally rocked reversely to return said round-engaging means to its aforesaid round-free position.

3. A rammer for a gun having a tube-and-breech assembly arranged for recoil and counterrecoil, comprising a support fixed against recoil and counterrecoil, a rammer member carried by said support for reciprocation in the directions of recoil and counterrecoil and arranged for rocking about its axis with respect to the support, a pin member fixed to said rammer member, means adjacent the breechward end of and connected to

said rammer member for engaging a round of ammunition and adapted upon rocking and reverse rocking of said rammer member to be moved alternately inwardly from a round-free position spaced outwardly from the axis of the tube-and-breech assembly to a round-engaging position near the axis of the tube-and-breach assembly, means for moving said rammer member in the direction of recoil, means engaging the pin member for temporarily restraining said rammer member against rocking to maintain said round-engaging means in round-free position substantially throughout the stroke of said rammer member in the direction of recoil, yieldable means, means including said pin member and connecting said spring means and said rammer member for loading said spring means by and in response to the stroke of said rammer member in the direction of recoil, means for releasing said pin member and thereby said rammer member at the end of its recoil stroke for rocking under the urge of said yieldable means to rock said rammer member for moving said round-engaging means to round-engaging position, and means for moving said rammer member in the direction of counterrecoil whereby said connecting means is operated to reversely load said spring means to return said round-engaging means to round-free position.

4. A rammer for a gun having a tube-and-breech assembly arranged for recoil and counterrecoil, comprising a support fixed against recoil and counterrecoil, a rammer member carried by said support for reciprocation in the directions of recoil and counterrecoil and arranged for rocking about its axis with respect to said support, means adjacent the breechward end of and connected to said rammer member for engaging a round of ammunition and adapted upon rocking and reverse rocking of said rammer member to be moved alternately inwardly from a round-free position spaced outwardly from the axis of the tube-and-breech assembly to a round-engaging position near the axis of the tube-and-breech assembly, cam means carried by said support and having a first groove running parallel to the direction of recoil, a second groove at the breechward end of and running normal to said first groove and in the direction of rocking of said rammer member, a third groove connecting said second groove and running generally parallel to said first groove and to the direction of counterrecoil, and a fourth groove running in the direction of reverse rocking of the rammer member and normal to and connecting the muzzleward ends of said first and third grooves, cam follower means connected with said rammer member adapted to traverse said grooves in succession to guide said rammer member during reciprocation and rocking thereof, means responsive to recoil of the gun for moving said rammer member in the direction of recoil with said cam follower following the aforesaid first groove, resilient means, a rotatable element connected between said rammer member and said resilient means and rotatable by conjoint action of said rammer member, cam follower means and first cam groove during recoil stroke of said rammer member for loading said resilient means, said resilient means reacting when said cam follower reaches said second groove in said cam means to rock said rammer member and follower means and move said round-engaging means to round-engaging position, and means for moving said rammer member in the direction of counter-recoil, said resilient means reacting when said cam follower reaches said fourth groove to rock said rammer member reversely and move said round-engaging means to round-free position.

5. A rammer for a gun having a tube-and-breech assembly arranged for recoil and counterrecoil, comprising a support fixed against recoil and counterrecoil, a rammer member carried by said support for reciprocation in the directions of recoil and counterrecoil and arranged for rocking about its axis with respect to said support, a pin member fixed to said rammer member, means adjacent the breechward end of and connected to said rammer member for engaging a round of ammunition and adapted upon rocking and reverse rocking of said rammer member to be moved alternately inwardly from a round-free position spaced outwardly from the axis of the tube-and-breech assembly to a round-engaging position near the axis of the tube-and-breech assembly, means for moving said rammer member in the direction of recoil, means engaging the pin member for temporarily restraining said rammer member against rocking to maintain said round-engaging means in round-free position during the recoil stroke of said rammer member, spring means, means connecting said spring means and said rammer member including cam means operable to load said spring means during the stroke of said rammer member in the direction of recoil, means for releasing said pin member and thereby said rammer member at the end of its said stroke for reaction of said spring means to rock said rammer member for moving said round-engaging means to round-engaging position, and means for moving said rammer member in the direction of counterrecoil whereby at the end of said movement the said spring means will rock said rammer member reversely to return said round-engaging means to round-free position.

6. A rammer for a gun having a tube-and-breech assembly arranged for recoil and counterrecoil, comprising a support fixed against recoil and counterrecoil, a rammer member carried by said support for reciprocation in the directions of recoil and counterrecoil and arranged for rocking about its axis with respect to said support, means adjacent the breechward end of and connected to said rammer member for engaging a round of ammunition and adapted upon rocking and reverse rocking of said rammer member to be moved alternately inwardly from a round-free position spaced outwardly from the axis of the tube-and-breech assembly to a round-engaging position near the axis of the tube-and-breech assembly, cam means carried by said support and having a first groove running parallel to the direction of recoil, a second groove at the breechward end of and running normal to said first groove and in the direction of rocking of said rammer member, a third groove connecting said second groove and running generally parallel to the first groove and to the direction of counterrecoil, and a fourth groove running in the direction of reverse rocking of said rammer member and normal to and connecting the muzzleward ends of said first and third grooves, cam follower means operatively associated between said cam means and said rammer member for guiding said rammer member during reciprocation and rocking thereof, a sleeve surrounding said rammer member and arranged for at least limited rotation with respect to said rammer member and support, means forming a helical seat in said

sleeve, said cam follower means engaging said helical slot, spring means connected between said sleeve and said support, means for moving said rammer member in the direction of recoil with said cam follower means following the aforesaid first groove and rotating said sleeve by means of said helical slot to tension said spring means for reaction to rock said rammer member when said cam follower means reaches said second groove so that said round-engaging means is moved to round-engaging position, means for moving said rammer member in the direction of counterrecoil with said cam follower means following said third groove and rotating said sleeve reversely by means of said helical slot to again tension said spring means for reaction to rock said rammer member reversely when said cam follower means reaches said fourth groove so that said round-engaging means is returned to round-free position.

7. A rammer for a gun having a tube-and-breech assembly arranged for recoil and counterrecoil, comprising a support fixed against recoil and counterrecoil, a rammer member carried by said support for reciprocation in the directions of recoil and counterrecoil and arranged for rocking about its axis with respect to said support, means adjacent the breechward end of and connected to said rammer member for engaging a round of ammunition and adapted upon rocking and reverse rocking of said rammer member to be moved alternately inwardly from a round-free position spaced outwardly from the axis of the tube-and-breech assembly, to a round-engaging position near the axis of the tube-and-breech assembly, a sleeve surrounding said rammer member and arranged for at least limited rotation with respect to said rammer member and said support, there being a helical slot in said sleeve, follower means carried by said rammer member and engaging said helical slot, spring means connected at one end to said support and at its other end to said sleeve, means responsive to recoil of the gun for moving said rammer member in the direction of recoil with said follower means thereon rotating said sleeve to tension said spring means in one direction, means associated with said follower means for temporarily restraining said rammer member against rocking during its stroke in the direction of recoil, said rammer member and follower means being rocked by reaction of said spring means at the end of said stroke so that said round-engaging means is moved to round-engaging position, and means for moving said rammer member in the direction of counterrecoil to tension said spring means in the reverse direction, whereby said spring means rocks said rammer member reversely so that said round-engaging means is returned to round-free position at the end of movement of said rammer member in counterrecoil.

8. A rammer for a gun having a tube-and-breech assembly arranged for recoil and counterrecoil, comprising a support fixed against recoil and counterrecoil, a rammer member carried by said support for reciprocation in the directions of recoil and counterrecoil, means positively but releasably connecting said tube-and-breech assembly and said rammer member for moving said rammer member breechwardly as a unit with and in response to recoil of the tube-and-breech assembly, means responsive to a predetermined distance of travel in recoil of said tube-and-breech assembly for releasing said connecting means to free the tube-and-breech assembly from said rammer member so that the former may return in counterrecoil without the latter, and means for subsequently moving said rammer member in the direction of counterrecoil.

9. A rammer for a gun having a tube-and-breech assembly arranged for recoil and counterrecoil, comprising a support fixed against recoil and counterrecoil, a rammer member carried by said support for reciprocation in the directions of recoil and counterrecoil and arranged to travel in the direction of recoil through a distance greater than the distance traveled by the tube-and-breech assembly during recoil, means positively but releasably connecting said tube-and-breech assembly and said rammer member for moving said rammer member breechwardly upon recoil as a unit with said tube-and-breech assembly, means operable after the attainment by the tube-and-breech assembly of a predetermined distance of travel in its recoil stroke for releasing said connection to free said rammer member from the tube-and-breech assembly so that said rammer member may continue its breechward travel and so that the tube-and-breech assembly may return in counterrecoil without said rammer member, and means for subsequently moving said rammer member in the direction of counterrecoil.

10. A rammer for a gun having a tube-and-breech assembly arranged for recoil and counterrecoil, comprising a support fixed against recoil and counterrecoil, a rammer member carried by said support for reciprocation in the directions of recoil and counterrecoil, said rammer member being mounted so that its reciprocatory travel is through greater linear distances than the movement of the tube-and-breech assembly in recoil and counterrecoil, a driving member connected to the tube-and-breech assembly, means between said rammer member and the breechward side of said driving member and engageable by said driving member upon recoil of the tube-and-breech assembly to drive said rammer member in the direction of recoil, releasable means between said rammer member and the other side of said driving member and normally arranged to engage said driving member so that said rammer member is prevented initially from traveling breechwardly under its own inertia upon impact of said driving member when the tube-and-breech assembly recoils, and means responsive to a predetermined phase of the recoil stroke of the tube-and-breech assembly in recoil for releasing said releasable means to free said rammer member for further travel in the direction of recoil.

11. A rammer for a gun having a tube-and-breech assembly arranged for recoil and counterrecoil, comprising a support, rammer means including a tubular member mounted on said support for reciprocation in the directions of recoil and counterrecoil, a driving member connected to the tube-and-breech assembly and including a portion forming an opening through which said tubular member passes, releasable means between said driving member and said tubular member including a disengageable lock carried within said tubular member and arranged to extend outside thereof for normally engaging said driving member to prevent passage of said tubular member through said opening in said driving member so that said tubular member is releasably connected to said driving member upon recoil of the tube-and-breech assembly, means for releasing said lock including a pair of elements carried respectively by said support and said tubular member and cooperable upon predetermined travel of

said tubular member and the tube-and-breech assembly in recoil, and means contained at least partially within said tubular member and connected between said lock and one of said aforesaid elements.

12. A rammer for a gun having a tube-and-breech assembly arranged for recoil and counterrecoil, comprising a support, rammer means including a tubular member mounted on said support for reciprocation in the directions of recoil and counterrecoil, a driving plate connected to the tube-and-breech assembly and having an opening through which said tubular member passes, there being a plurality of openings in the wall of said tubular member in the vicinity of said driving plate, a plurality of movable lock members contained within said tubular member, means mounting said lock members in positions to extend respectively through said openings in the tubular member for engagement with the forward side of said driving plate so that said tubular member and driving plate recoil as a unit upon recoil of the tube-and-breech assembly, head means within said tubular member and operable in one position to maintain said lock members in positions extended through said openings, and means responsive to a predetermined position in recoil of said tubular member to move said head means to a second position to permit inward movement of said lock members to thereby release said tubular member from said driving plate.

13. A rammer for a gun having a tube-and-breech assembly arranged for recoil and counterrecoil, comprising a support fixed against recoil and counterrecoil, a rammer member carried by said support for reciprocation in the directions of recoil and counterrecoil and for rocking about its axis, means connected to said rammer member for engaging a round of ammunition and adapted upon rocking and reverse rocking of said rammer member to move alternately between a round-free position and a round-engaging position, a pair of cam elements carried respectively by said support and rammer member, one of said elements comprising a cam follower and the other comprising a cam means having a configuration to guide the rammer member in sequential movement of reciprocation in the direction of recoil, then rocking to move the round-engaging means to round-engaging position, next reciprocation in the direction of counterrecoil and finally reverse rocking to move said round-engaging means to round-free position, means including a releasable connection between said rammer member and the tube-and-breech assembly and normally positioned so that said rammer member and the tube-and-breech assembly move together upon recoil, and means for releasing said releasable connection to free said rammer member from the tube-and-breech assembly and including a connection between said releasable means and one of the aforesaid cam elements.

14. A rammer for a gun having a tube-and-breech assembly arranged for recoil and counterrecoil, comprising a support fixed against recoil and counterrecoil, rammer means including a tubular member carried by said support for reciprocation along its axis in the directions of recoil and counterrecoil and arranged for rocking about its axis with respect to said support, means connected to said rammer means for engaging a round of ammunition and movable alternately inwardly from a round-free position spaced outwardly from the axis of the tube-and-breech assembly to a round-engaging position near the axis of the tube-and-breech assembly upon rocking and reverse rocking of the tubular member, cam means carried by said support and having a first groove running parallel to the direction of recoil, there being a second groove at the breechward end of and running normal to said first groove and in the direction of rocking of the tubular member, a third groove connecting said second groove and running parallel to the first groove and to the direction of counterrecoil, and a fourth groove running in the direction of reverse rocking of the rammer member and normal to and connecting the muzzleward ends of said first and third grooves, means operatively associated between said cam means and said tubular member and including a cam follower for guiding said tubular member during reciprocation and rocking thereof, a sleeve surrounding said tubular member and arranged for rotation with respect thereto, there being a helical slot in said sleeve engageable with said cam follower, spring means connected between said sleeve and support, means including a releasable connection between said tubular member and tube-and-breech assembly for moving said tubular member as a unit with said assembly in the direction of recoil with said cam follower following the aforesaid first groove and rotating said sleeve by means of said helical slot to load said spring means for reaction to rock said tubular member with said cam follower following said second groove, whereby said round-engaging means is moved to its aforesaid round-engaging position, release means connected between said releasable connection and the aforesaid cam follower and operable in response to the attainment by said cam follower of a predetermined position in its movement so that the tube-and-breech assembly is freed from said tubular member for return in counterrecoil without said tubular member, and means for moving said tubular member in the direction of counterrecoil with said cam follower following said third groove in said cam plate, said means rocking said groove in said cam plate, said sleeve, cam follower, and third groove cooperating to rock said tubular member reversely in response to counterrecoil movement, to thereby reversely stress said spring means to urge said follower member along said fourth groove for returning said round-engaging means to its aforesaid round-free position, at the terminus of counterrecoil movement.

15. In combination, a support, a first member carried by said support for reciprocation with respect thereto, a second member carried by said support for reciprocation with respect thereto and including a tubular portion having an opening in the wall thereof, means for releasably connecting said members for reciprocation together in one direction and independently of each other in the other direction, said means including a connecting element carried by said first member, a lock element carried within said tubular portion of said second member adjacent said opening therein, a release member within said tubular portion and slidable axially thereof, said release member being engageable in one position with said lock element to hold said lock element extended through the aforesaid opening to engage said connecting element on said first member and cause said members to reciprocate as a unit, means normally holding said release member in position engaging said lock element,

and means for moving said release member axially of said tubular member to permit retraction of said lock element from engagement with the aforesaid connecting element upon movement of said first and second members together in at least one direction of reciprocation.

16. In combination, a support, a first member carried by said support for movement with respect thereto, a second member carried by said support for movement with respect thereto and including a tubular portion having an opening in the wall thereof, means for releasably connecting said members for movement together through a predetermined distance and including a connecting element carried by first member, a lock element carried within said tubular portion of said second member adjacent said opening therein, a release member within said tubular portion and slidable axially thereof, means on said release member for holding said lock element in position to extend through the aforesaid opening to engage said connecting element on said first member, spring means normally holding said release member in lock-engaging position, and means responsive to movement of said first and second members together through the aforesaid predetermined distance for moving said release member axially of said tubular member to permit retraction of said lock element from engagement with the aforesaid connecting element.

17. In combination, a support, a movable member carried by said support and including a portion arranged for four-phase movement in a rectilinear path with respect to said support, means for guiding said movable member in its movement including a pair of cam members carried respectively by said support and said movable member, one of said cam members comprising a cam follower and the other grooved cam having a quadrilateral configuration according to said rectilinear path of said movable member, means for moving said movable member in its first phase, yieldable means connected between said movable member and said support, means connected between said movable member and said yieldable means and operable in response to first-phase movement of said movable member to load said yieldable means for reaction to move said movable member in its second phase, means for moving said movable member in its third phase, said loading means being operable in response to third-phase movement of said movable member to load said yieldable means for reaction to move said movable member in its fourth phase.

18. In a ramming mechanism for a gun, a rammer reciprocable parallel with the bore axis of the gun and effective, in a counterrecoil direction of reciprocation, to ram a shell into the breech of the gun, a driving member fixed to the gun for movement therewith in recoil and counterrecoil, a releasable connection positively connecting said rammer and driving member for movement as a unit in recoil, and means responsive to attainment by the gun and driving member of a predetermined position in recoil, to release said connection to permit continued movement in recoil of the rammer independently of the driving member.

19. In combination, a support, a member carried by said support and including a portion arranged for movement with respect to said support through a first path and through at least a second path intersecting and arranged at an angle to said first path, means for guiding said member in its movement including a pair of cam elements carried respectively by said support and said member, one of said elements comprising a cam follower and the other comprising a cam plate having a configuration defining and determining said paths of movement of said member, means for moving said member in its first path, spring means connected between said member and said support, and means connected between said spring means and said member and operable upon movement of said member along its first path to load said spring means for reaction to move said member in its second path.

20. In combination, a support, a member carried by said support and including a portion arranged for movement with respect to said support through a first path and through at least a second path connected to and arranged at an angle to said first path, means for guiding said member in its movement including a pair of cam elements carried respectively by said support and said member, one of said elements comprising a cam follower and the other comprising a cam plate having a configuration according to said paths of movement of said member, means for moving said member in its first path, a sleeve surrounding said member and arranged for rotation with respect to said member and said support, there being a helical slot in said sleeve engageable with one of the aforesaid cam elements, spring means connected between said sleeve and said support whereby movement of said member in its first path causes rotation of said sleeve by means of said helical slot to load said spring means for reaction for moving said member in its second path.

21. A rammer for a gun having a tube-and-breech assembly arranged for recoil and counterrecoil, comprising a support fixed against recoil and counterrecoil, a rammer member carried by said support for reciprocation in the directions of recoil and counterrecoil, said rammer member being mounted so that its reciprocatory travel is through greater linear distances than the movement of the tube-and-breech assembly in recoil and counterrecoil, a driving member connected to the tube-and-breech assembly, means between said rammer member and the breechward side of said driving member and engageable by said driving member upon recoil of the tube-and-breech assembly to drive said rammer member in the direction of recoil, releasable means between said rammer member and the other side of said driving member and normally arranged to engage said driving member so that said rammer member is prevented initially from traveling breechwardly under its own inertia upon impact of said driving member when the tube-and-breech assembly recoils, and means for releasing said releasable means to free said rammer member for further travel in the direction of recoil.

22. In a ramming mechanism for a gun, a rammer reciprocable parallel with the axis of said gun and effective in one direction of reciprocation to ram a shell into the breech of said gun, a driving member movable with said gun in recoil and counterrecoil, releasable means positively connecting said rammer and driving member for initial recoil as a unit, and means responsive to attainment of a predetermined point by said driving member in recoil of said gun for automatically releasing said releasable means to permit continued movement in recoil of said rammer independently of said driving member.

23. In a rammer mechanism for a gun mounted

in a cradle for recoil, a support on said cradle, a tubular rammer carried by said support for axial reciprocation parallel with said gun and for rotation about its axis, a rammer arm extending radially from the rear end of said rammer, means forming a rectangular guide on said support, a driving member carried by said gun and engageable with said rammer for moving the same rearwardly as the gun recoils, a pin carried by said rammer and engaging said guide, and means on said support to cause said pin to traverse said guide whereby said rammer is rocked to move the end of said arm into and out of ramming positions at the respective termini of travel of said rammer.

24. A rammer mechanism as in claim 23, said last-named means comprising a tube having a helical slot in its wall, said tube being mounted for rotation only in said housing, said pin having a smooth fit through said slot to thereby oscillate said tube as said rammer reciprocates, and spring means urging said tube to predetermined rotational position for either direction of oscillation therefrom.

SIGMUND SCHIFF.

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