Dec. 1, 1953 O. W. MARLOW 2,660,928

RAMMER

Filed April 15, 1946 5 Sheets-Sheet 1

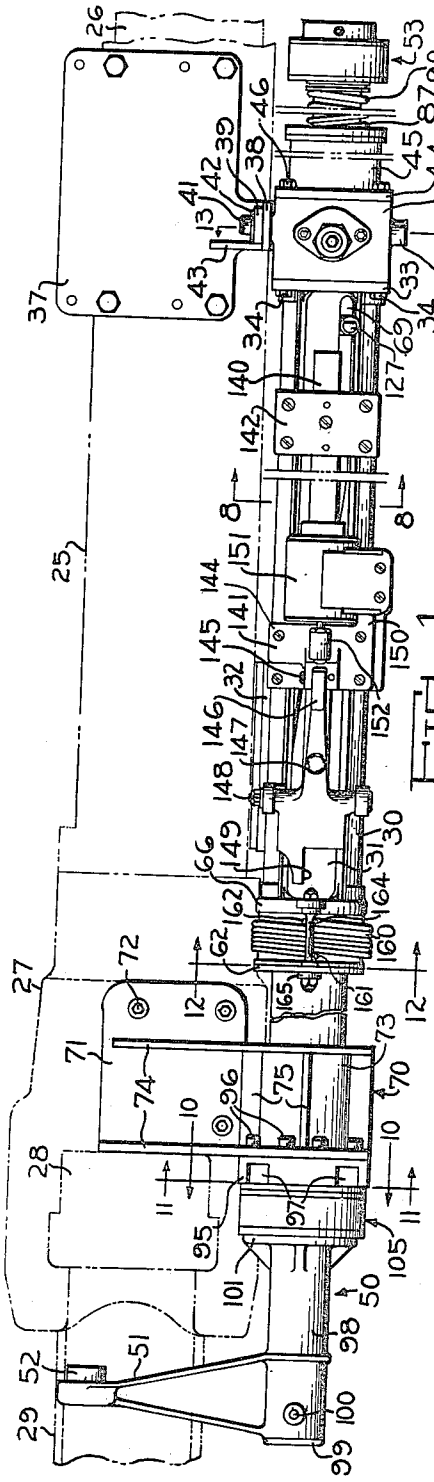


FIG-1

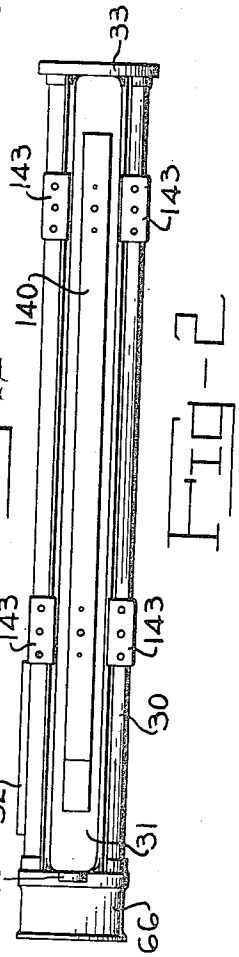


FIG-2

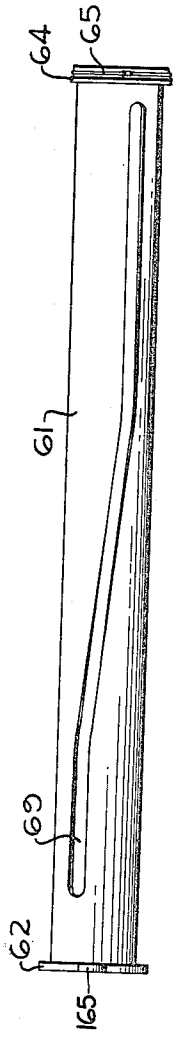


FIG-3

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RAMMER

Filed April 15, 1946 5 Sheets-Sheet 2

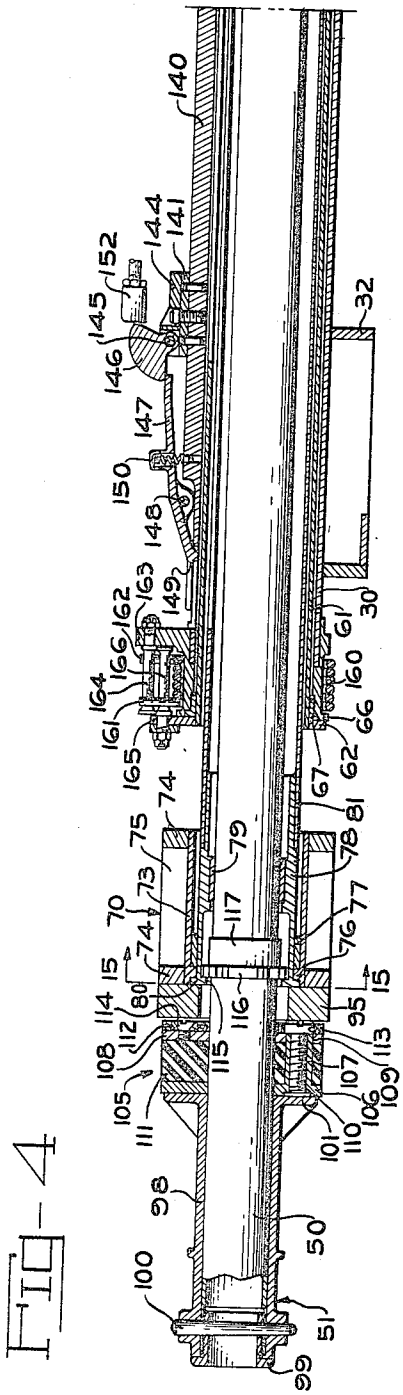


FIG. 4

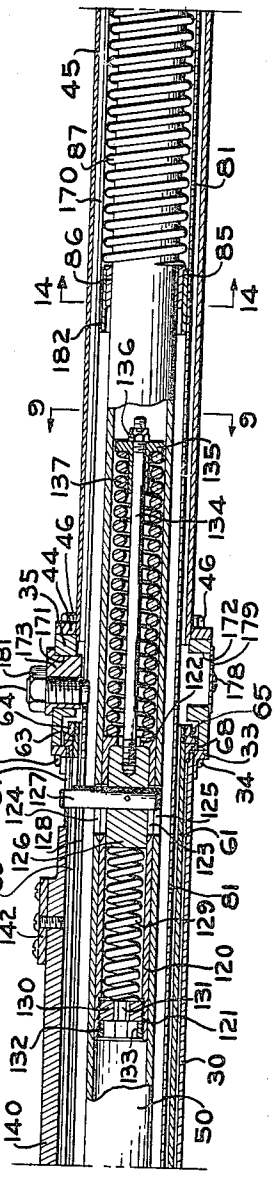


FIG. 5

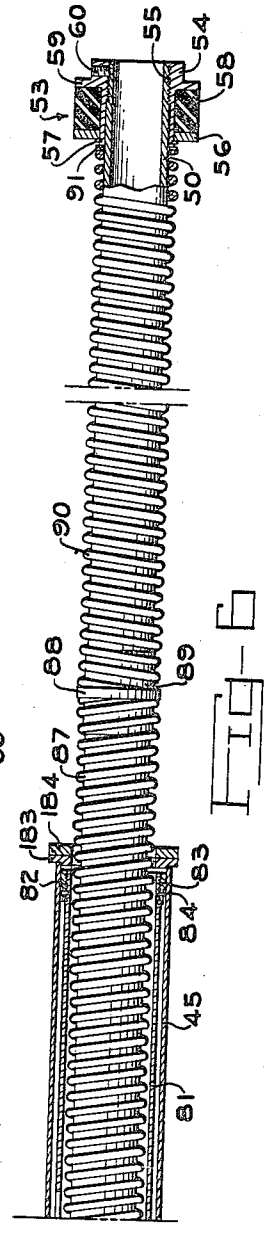


FIG. 6

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Dec. 1, 1953 O. W. MARLOW 2,660,928

RAMMER

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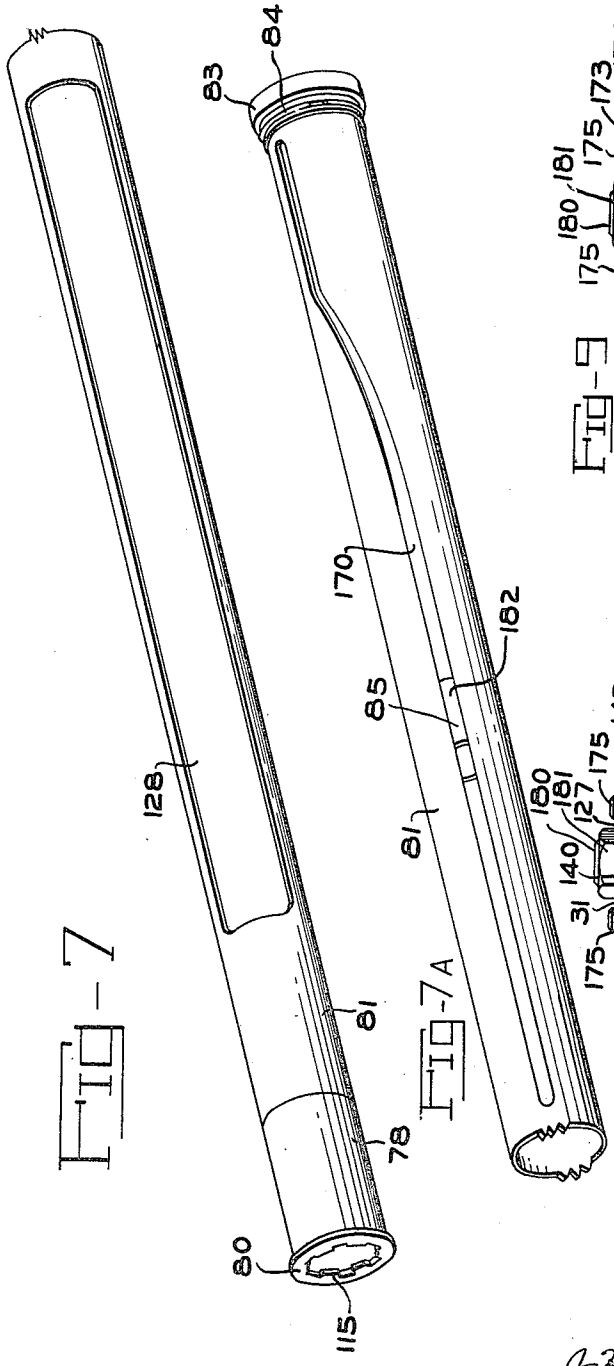


FIG - 7

FIG - 7A

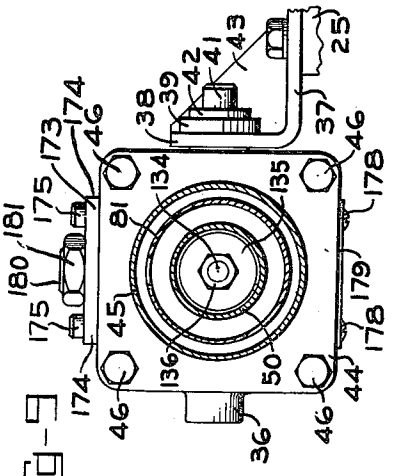


FIG - 5

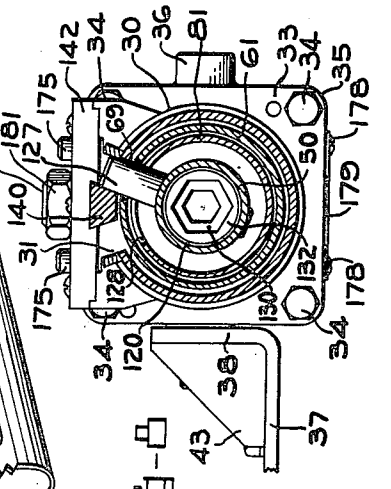


FIG - 6

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RAMMER

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FIG-10

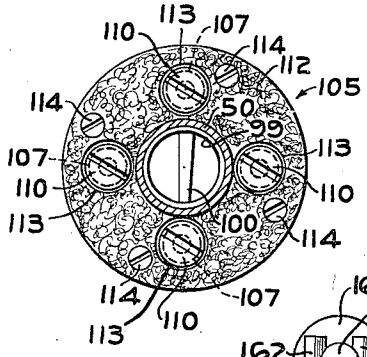
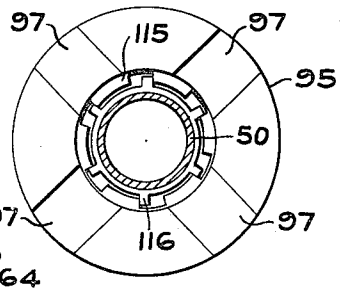


FIG-11



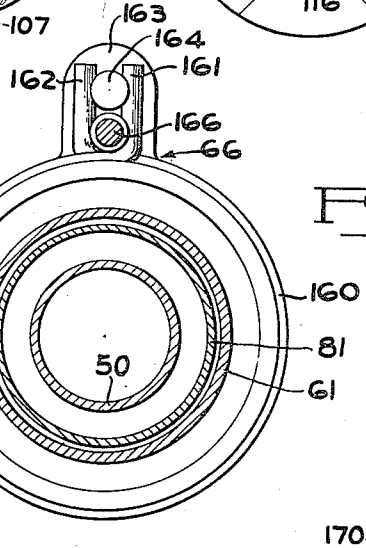


FIG 12

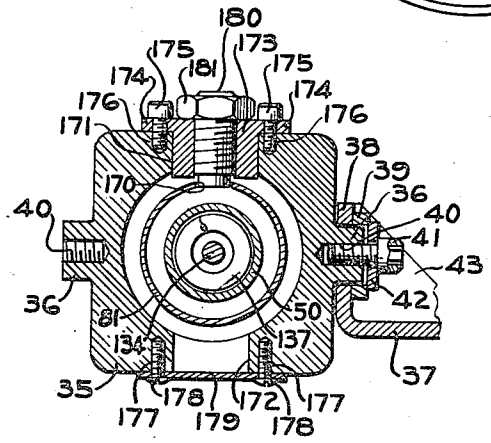


FIG-13

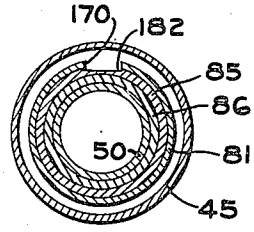


FIG-14

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RAMMER

Filed April 15, 1946 5 Sheets-Sheet 5

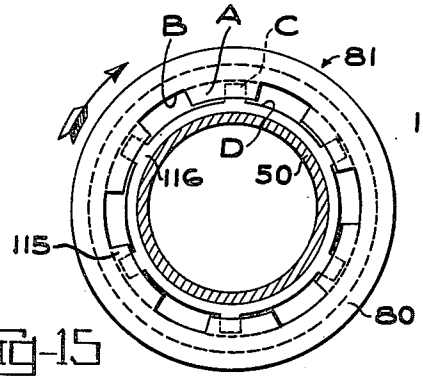


FIG-15

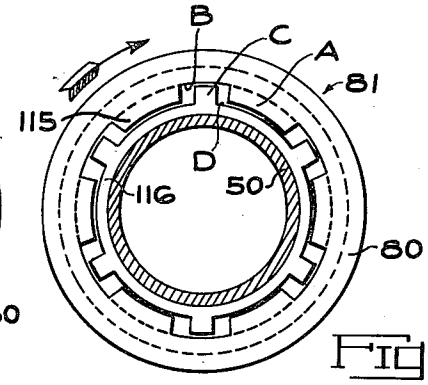


FIG-16

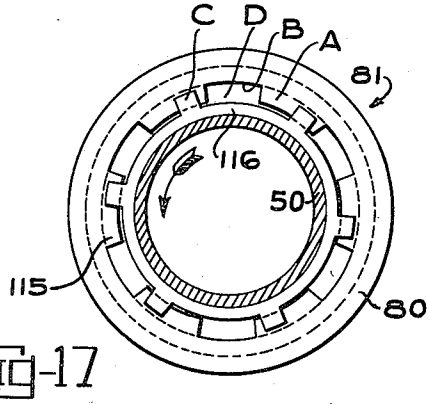


FIG-17

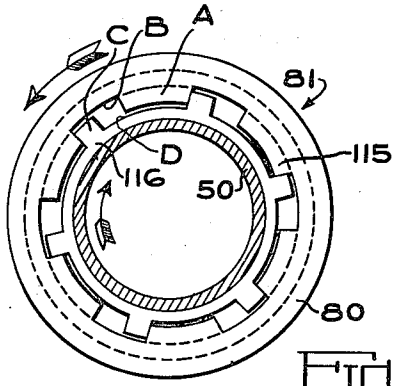


FIG-18

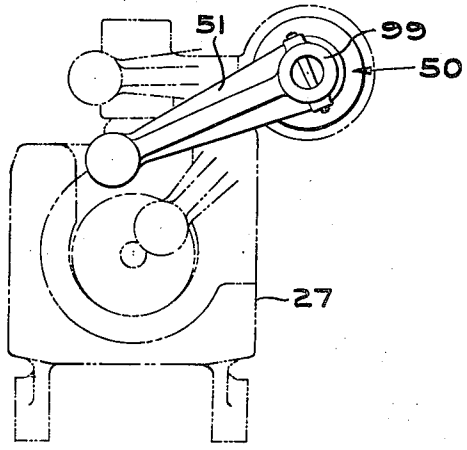


FIG-19

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Patented Dec. 1, 1953

2,660,928

UNITED STATES PATENT OFFICE

2,660,928

RAMMER

Owen W. Marlow, Rock Island, Ill.

Application April 15, 1946, Serial No. 662,158

31 Claims. (Cl. 89—47)

(Granted under Title 35, U. S. Code (1952), sec. 266)

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 rammer for a gun and more particularly to a rammer construction in which the rammer is driven or operated by power derived from the recoil of the weapon.

Rammers of the type to which the present invention particularly pertains are used mostly in automatic weapons found principally in aircraft cannon or in weapons used in antiaircraft defense. Recent developments in weapons of this type have standardized generally on a construction in which the gun is provided with a support that carries a longitudinal rammer member for reciprocation in the directions of recoil and counterrecoil and in which the power for operating the rammer is derived partly from the recoiling weapon and partly from spring mechanism loaded or tensioned upon action of the weapon in recoil.

It is characteristic of rammer constructions of the type referred to that the rammer member must travel in the direction of recoil a distance greater than that traveled by the recoiling gun tube. This requirement is due primarily to recent gun design in which the length of recoil is brought to a minimum; also, increased length of ammunition necessitates a longer rammer stroke. Accordingly, suitable mechanism must be provided to impart to the rammer sufficient recoil force to drive the rammer through its necessary phase of travel. At the same time, cognizance must be taken of the tremendous forces set up in and the high velocities attained by the recoiling parts of the weapon, and suitable provision must be made to prevent these forces and velocities from damaging the rammer mechanism. It has been found that a direct connection between the recoiling gun tube and the rammer is suitable for propelling the rammer rearwardly or in the direction of recoil. However, it is desirable that this connection should prevent free travel of the rammer independently of the recoiling gun tube until such time as the recoiling gun tube has been retarded sufficiently to eliminate destructive forces and velocities. Accordingly, it is desirable to provide a releasable connection between the gun tube and the rammer member, which connection is automatically releasable in response to the attainment by the recoiling gun tube of a predetermined position in which the rammer is freed from the gun tube so that it may travel its additional distance rearwardly to

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a point at which it may be latched while the gun tube returns to battery.

Other problems encountered in the design and operation of rammer constructions of the general class described are incident to the failure of former constructions to provide suitable buffer and shock absorbing means.

The present invention contemplates and has for its principal object the provision of a rammer construction in which the rammer is operated by power derived from the recoiling gun tube and in which there is embodied an improved control means for releasing the connection between the rammer member and the recoiling gun tube for freeing the rammer from the gun tube for additional travel in the direction of recoil, whereby the rammer member may travel through a predetermined maximum distance even though the length of travel of the gun tube in recoil may be relatively shorter.

It is an important object of the invention to provide control means for controlling the releasable connection between the rammer and the gun tube and specifically to provide this control means in the form of a pair of relatively angularly movable members conditioned for release upon a predetermined phase of travel of the gun tube and rammer member together.

It is likewise an important object of the invention to provide a release mechanism comprising a pair of coaxial, complementary release members, one of which is internally splined and the other of which is externally splined and to provide means for positioning these members angularly with respect to each other so that during one phase of operation of the rammer the teeth and grooves of the splines are relatively misaligned and in another phase of operation of the rammer the teeth and grooves of the splines are aligned, whereby in the first instance the members are locked against relative axial movement and in the second instance the members are so positioned that the teeth on one splined member may pass freely axially through the grooves on the other splined member.

The invention has for another important object the provision of a rockable control tube connected to one of the splined members and formed with a generally longitudinal spiral or helical groove with which a follower cooperates to move the tube angularly during reciprocation of the rammer member; the groove in the tube being so arranged and so positioned with respect to the follower that the tube will be partially rotated to move its connected splined member through

an appropriate angle with respect to the complementary splined member to align the teeth and grooves of the splined members so that the members may have free relative movement axially.

It is an object of the invention to provide follower means for the control tube that is adjustable through a relatively wide range of positions so that rotation of the tube may be varied with respect to its longitudinal movement whereby release of the splined members may be varied according to variations in the distance traveled by the gun tube in recoil.

The invention has for still another object the provision of an improved driving connection between the gun tube and rammer member including a pair of relatively cooperable buffer members constructed and arranged so that upon initial movement of the gun tube and rammer member in recoil there is no yielding between the members but upon return movement of the rammer the members will change position angularly so that the shock incident to that phase of rammer operation will be absorbed by resilient or yielding material incorporated in one of the buffer members.

It is still another object of the invention to provide shock-absorbing means arranged to minimize shocks incident to the attainment by the rammer of its rearwardmost position.

Other objects of the invention are to provide a rammer construction in which the parts are tubular and concentrically arranged; to enclose the shock-absorbing means within the tubular rammer member; to provide a minimum number of working parts; to form the telescopically arranged tubular members with appropriate cutout portions and cam grooves so that certain of the parts may be made to perform a plurality of functions; and to provide an improved rammer construction in which the parts may be readily adapted to certain existing rammer constructions with a minimum of modifications and expense.

Briefly and specifically, the foregoing and other important objects and features are achieved in one preferred form of the invention by a rammer construction embodying a longitudinal, generally tubular support attached to the cradle of a recoiling gun and carrying a longitudinal tubular rammer member for reciprocation in the directions of recoil and counter-recoil and for rocking and reverse rocking about its longitudinal axis. A driving connection is established between the tube-and-breech assembly of the gun and the rammer and includes an externally splined element on the rammer and a complementary internally splined element carried by the driving member that is attached to the tube-and-breech assembly. A cam track comprising a grooved rectangular path on the support and a follower on the rammer is provided for the purpose of guiding the rammer for movement rearwardly, then transversely, then forwardly, and again transversely in the opposite direction so that the rammer arm at the rear end of the rammer occupies a first position in axial alignment with the bore of the gun tube while delivering or ramming a round of ammunition, and a second position spaced from the axis of the gun tube after the round has been chambered. A control member comprising a tubular member formed with a longitudinal spiraled groove is movable longitudinally and angularly as the rammer reciprocates and cooperates with a follower on the support for the purpose of moving the aforesaid internally splined element angularly so that the teeth and grooves thereon are aligned with the teeth and grooves on the externally splined member on the rammer. This arrangement provides for a direct connection between the tube-and-breech assembly and the rammer during a predetermined amount of travel thereof in recoil and effects release of the rammer from the driving connection for continued rearward movement after the tube-and-breech assembly has attained substantially its maximum recoil travel and returns to battery. The rammer member is preferably tubular and encloses spring mechanism for absorbing shocks incident to operation of the rammer. The driving connection between the tube-and-breech assembly and the rammer includes a pair of relatively angularly movable buffer members one of which includes a rigid element and also resilient or shock-absorbing material. The arrangement of the buffer members is such that upon initial action of the parts in recoil the rigid part of the one buffer element is engaged so that there is no yielding in the driving connection. However, the parts are arranged for relative angular movement so that upon return of the rammer to its initial position the rigid element of the buffer member is recessed in the other buffer member in order that the impact of the buffer members may be taken by the resilient or shock-absorbing material. Another feature of the invention resides in the adjustable follower which is positionable with respect to the control tube for controlling the internally splined member in such a manner that compensation may be made for variations in the length of recoil of the particular gun to which the rammer is attached.

A more complete understanding of the foregoing and other objects and features of the invention may be had from the following detailed description of a preferred embodiment of the invention as shown in the accompanying sheets of drawings in which:

Fig. 1 is a plan view of the rammer shown in position on a relatively heavy caliber gun, the gun being illustrated diagrammatically and portions of the rammer being broken out to condense the length thereof;

Fig. 2 is a detailed view of the rammer support showing the rectangular cam track for guiding the rammer during its operation;

Fig. 3 is a detailed view of the cam tube which effects tensioning of the spring means for rocking the rammer;

Figs. 4, 5 and 6 are respectively longitudinal sectional views showing the details of the rammer construction, each figure representing a longitudinal section of about one-third of the rammer mechanism; the figures may be assembled end to end for the purpose of obtaining an illustration of the true length of the mechanism;

Fig. 7 is a detailed view of the rear portion or section of the control tube for regulating the release of the rammer from the tube-and-breech assembly;

Figure 7A is a view of the remaining or forward portion of the aforesaid control tube, the two Figures 7 and 7A, being joinable end-to-end to depict the entire tube.

Fig. 8 is an enlarged transverse sectional view taken substantially on the line 8—8 of Fig. 1 and showing the arrangement of the tubular members comprising the rammer mechanism;

Fig. 9 is a similarly enlarged transverse sectional view taken on the line 9—9 of Fig. 5 and

showing the relationship between the control cam follower and the tubular members of the rammer mechanism;

Fig. 10 is a transverse sectional view taken on the line 10—10 of Fig. 1 and showing the face of one of the buffer members of the driving connection between the rammer and the tube-and-breech assembly;

Fig. 11 is a complementary transverse sectional view taken on the line 11—11 of Fig. 1 and showing the face of the other buffer member;

Fig. 12 is an enlarged transverse sectional view taken on the line 12—12 of Fig. 1 and showing the details of construction of the torsion spring mechanism for rocking the rammer about its axis;

Fig. 13 is an enlarged transverse sectional view taken on the line 13—13 of Fig. 1 and showing the relationship between the control cam follower, the support, and the control tube;

Fig. 14 is an enlarged transverse sectional view taken on the line 14—14 of Fig. 5 and showing the relationship between the tubular members of the rammer mechanism, particularly the intermediate bushing and spring collar;

Figs. 15, 16, 17 and 18 are respectively transverse sectional views taken generally on the line 15—15 of Fig. 4 and showing the different positions occupied by the internally and externally splined members during operation of the rammer; and

Fig. 19 is an end elevational view, taken from the breech end of the weapon, showing the different positions occupied by the rammer arm during its different phases of operation.

As stated above, the preferred embodiment of the rammer construction has been designed with a view toward adapting this construction for attachment to certain existing guns and the illustration herein is of such an adaptation. However, is should be appreciated that the rammer construction may be appropriately modified to suit other conditions; accordingly, the description and drawings should be taken as illustrative and not limiting.

The particular type of weapon chosen for the purposes of the present illustration is a relatively heavy caliber gun (herein 75-mm.) embodying recoil mechanism of the concentric type. One such gun of this type is shown in the United States Patent to Lucht, No. 2,358,340. In this patent, the gun is shown as comprising a gun tube carried for recoil and counter-recoil in a cylindrical casing, which casing also houses, in the annular space between the gun tube and the inner periphery of the casing, a recoil mechanism of the hydrospring type. Since the gun herein illustrated is shown only as a basis for demonstrating the mounting and operation of the rammer, it is not deemed necessary to set forth the details of the gun construction.

As shown in the present drawings, the gun comprises a support or cradle 25 preferably of tubular construction and corresponding to the cylindrical casing or support referred to in the above mentioned patent. The support encloses the intermediate portion of a gun tube 26 and mounts the gun tube for recoil and counter-recoil, the recoil mechanism being contained within the cylindrical support 25 as referred to above. The rear end of the gun tube 26 is connected in the usual manner to a breech ring 27 which includes a breechblock 28 of conventional construction. It will be understood that the tube-and-breech assembly 26—27 is movable in recoil and counter-recoil with respect to the support 25 and that the support is fixed against recoil and counter-recoil and is carried in any conventional manner in a suitable gun mount (not shown). The breech ring 27 is provided at its rear end with a shell-tray 29 on which individual rounds of ammunition may be placed to be rammed into the chamber of the gun tube. In this respect, it is to be noted that the tray 29 is shown only for the purposes of illustration, for the rammer construction about to be described may be employed with other types of shell-feeding mechanism, whether fully automatic, semi-automatic or manually operable.

The rammer comprises supporting structure by means of which the rammer mechanism may be mounted on the cylindrical cradle 25 of the gun. For this purpose the rammer construction includes a generally cylindrical longitudinal tubular supporting member 30 formed at its top with an extremely elongated rectangular opening 31 (Figs. 1 and 2). The rear portion of the support 30 includes a vertical flange 32 by means of which the support may be rigidly mounted on a vertical mounting pad on the right-hand side of the gun cradle 25. The forward portion of the member 30 is provided with a square flange 33 which is appropriately bored to receive a plurality of cap screws 34 (Figs. 1 and 8) by means of which the forward end of the support may be rigidly connected to an intermediate hollow housing 35. The housing is provided with laterally extending opposite trunnions or bosses 36 (Figs. 1, 8, 9 and 13) either of which may be used to mount the housing 35 on a forward portion of the gun cradle 25. As best shown in Figs. 1 and 13, a bracket 37 is positionable on and rigidly securable to a mounting pad at the upper forward portion of the gun cradle 25. This bracket 37 extends laterally toward the housing 35 and is provided at its outer end with a vertical flange 38 apertured to receive the proximate trunnion or boss 36 of the housing 35. An apertured collar 39 fits over that portion of the trunnion 36 that extends through the apertured flange 38 and is preferably rigidly secured to the flange, as by welding or otherwise, to provide reinforcement for the flange and to provide further an adequate bearing or mounting portion for the trunnion or boss 36. Each trunnion 36 is provided with a tapped bore 40 and the trunnion used for the support of the housing 35 receives a cap screw 41 which is passed through a washer 42 that overlies the aperture in the collar 39 on the flange 38. A reinforcing rib 43 connects the mounting flange 38 with the main body portion of the bracket 37. This construction provides for rigidly mounting the forward end portion of the tubular support 30 of the gun cradle 25 and, in conjunction with the bracket flange 32, fixes the support 30 on the cradle against movement while the gun recoils and returns to battery. The forward face of the housing 35 is machined and receives a square flange 44 formed at the rear end of a longitudinal tubular member 45. A plurality of cap screws 46 (Figs. 1 and 9) serves to connect the flange 44 of the tubular member 45 rigidly to the housing 35 so that the tubular member 45 forms in effect a rigid but removable longitudinal extension or continuation of the supporting structure comprising the tubular member 30 and housing 35.

The tubular supporting structure just described serves as means for carrying a longitudinally ex-

tending rammer member 50. This member is preferably tubular in cross section and extends throughout the tubular mount comprising the support 30, housing 35, and tubular member 45. The rammer 50 projects at the rear or breechward end of the tubular support 30 and carries rigidly thereon a rammer arm 51 which extends laterally toward and rearwardly of the breech ring 27. The rammer arm 51 carries at its free end a rammer head 52 for engagement with rounds of ammunition, as will presently appear. The forward or counterrecoil end of the rammer 50 extends a considerable distance beyond the forward end of the tubular member 45 (Figs. 1 and 6) and is provided at its extreme forward end with buffer means indicated generally by the numeral 53. This buffer comprises a sleeve 54 threaded on a threaded portion 55 at the extreme forward end of the rammer member 50. A ring 56 is held on the rear portion of the sleeve 54 by means of a snap ring 57. Yielding or shock-absorbing material, such as rubber or the like, indicated by the numeral 58, is carried by the sleeve 54 between the ring 56 and a radial flange 59 preferably formed integrally with the sleeve 54. A locking screw 60 rigidly secures the sleeve 54 to the end of the rammer 50.

The tubular support 30 carries intermediate its ends a longitudinal or torque tube 61, the detail of which is shown in Fig. 3. The rear portion of the tube is provided with a rigidly mounted external radial flange 62 and the forward end is threaded as at 63 to receive a securing nut 64. This nut includes a locking ring or wire 65 that prevents loosening of the nut 64 from the threaded portion 63 of the tube 61.

As shown in Figs. 2 and 4, the rear end of the tubular support 30 is provided with a cylindrical collar 66 which is annularly recessed to receive a bushing 67 by means of which the rear end of the tube 61 is rockably carried in the support 30. The forward end of the support 30, within the mounting flange 33, carries a bushing 68 which rockably mounts the forward end of the tube 61. The inner radial face of the flange 62 at the rear end of the tube 61 abuts the outer or rear radial face of the collar 66 on the support 30 and the nut 64 at the forward end of the tube 61 abuts the bushing 68 of the support 30. The tube 61 is thus held against endwise movement with respect to the support 30 but is mounted for rocking and reverse rocking, for a purpose to presently appear. The tube 61 is provided with a longitudinal, partially spiraled cam groove 69, the function of which will likewise appear below.

From the description thus far it will be seen that the rammer 50 is mounted in the support 30 for reciprocation in the directions of recoil and counterrecoil and for rocking and reverse rocking about its axis and that the tube 61, which encircles the intermediate portion of the rammer, is fixed against recoil and countercoil but may have rocking movement about its axis. For the purpose of propelling the rammer 50 rearwardly or in the direction of recoil, and for rocking the tube 61, the rammer construction includes a driving connection between the rammer and the tube-and-breech assembly 26—27.

The preferred form of driving connection herein illustrated and described comprises a driving member indicated generally by the numeral 70 and including a supporting portion 71 rigidly connected by a plurality of cap screws 72 to an upper forward portion of the breech ring 27 of the gun. A tubular or hollow cylindrical portion 73 is formed integral with the mounting portion 71 and is suitably reinforced by transverse ribs 74 and a plurality of longitudinal, circumferentially spaced ribs 75. The cylindrical portion 73 encircles the intermediate portion of that part of the rammer 50 between the rammer arm 51 and the collar 66 on the support 30 (Figs. 1 and 4) and is provided at its interior with an inwardly directed radial flange 76 at the forward side of which is mounted a bushing 77. A sleeve 78 encircles the proximate portion of the rammer 50 and is rockably carried by the bushing 77 and by a bushing 79 between the interior of the sleeve and the outer periphery of the rammer 50. The rear end of the sleeve 78 is formed with an external radial flange 80 which abuts against the radial flange 76 on the cylindrical portion 73 of the driving member 70. The sleeve 78 extends forwardly and is rigidly connected to a longitudinally extending control tube 81 (shown in detail in Figures 7 and 7A). This tube encircles the rammer 50 and is encircled by the tube 61 previously described at its rearward end, and by tube 45 at its forward end. The tube 81 extends forwardly and terminates just short of the forward end of the external tubular member 45 (Fig. 6), at which point the tube 81 is threaded, as at 82, and receives a nut 83. A locking wire 84 secures the nut 83 to the tube 81. The nut 83 is formed with a bearing surface at its outer periphery and mounts the forward end of the tube 81 for reciprocation and for angular movement within the external tubular member 45.

The tube 81 is provided intermediate its ends with an internal collar 85 (Fig. 5) which encircles a collar or bushing 86 carried on the rammer 50. The collar 85 is rigidly mounted in the tube 81, as by a press fit or by spot welding. However, the collar 86 is axially slidably mounted with respect to the rammer 50. A comparatively powerful compression spring 87 encircles the rammer 50 and has one end abutting the collar 86 (Fig. 5) and its other end abutting one side of a radial flange 88 formed integral with an intermediate collar 89 axially slidably carried on the rammer 50 at a portion thereof forwardly of the forward end of the external tube 45 (Fig. 6). One end of a similar but reversely coiled compression spring 90 abuts the other side of the radial flange 88 of the intermediate collar 89 and its other end abuts a ring 91 that encircles the rammer 50 adjacent the buffer means 53. It will be noted that the ring 91 is positively spaced from the buffer ring 56 so that the springs 87 and 90 have no effect on the resilient buffer material 58.

As best shown in Figs. 1 and 4, the driving member 70 has rigidly secured thereto at its rear face a buffer ring 95. This ring is secured to the driving member 70 by means of a plurality of cap screws 96 passed through the rear reinforcing rib 74 and threaded into the ring. As shown in Figs. 1 and 11, the buffer ring is provided with a plurality of radially extending recesses 97, spaced apart angularly at intervals of 90° for a purpose to be presently described. The rammer arm 51 includes an integral longitudinal sleeve 98 fitted on the rear end of the rammer 50. The interior of this end of the rammer 50 is threaded and receives a transversely apertured, threaded securing member 99. A tapered pin 100 is driven through the sleeve 98, securing member 99, and rammer 50 and serves to mount the sleeve 98 and rammer arm 51 rigidly on the rear end of the rammer 50. The forward portion of the sleeve 98 is provided with an integral, radially outwardly

directed flange 101 spaced longitudinally from the buffer ring 95 on the driving member 70 (Fig. 1). Buffing means, indicated generally by the numeral 105, is interposed between the flange 101 and the buffer ring 95. This buffer means comprises a radial ring 106 which abuts the flange 101 and which includes a plurality of angularly spaced, longitudinally directed rigid sleeves 107 (one of which is shown in full lines in Fig. 4 and all of which are shown in dotted lines in Fig. 10). The angular spacing between the sleeves 107 is also 90°.

Each sleeve is preferably integrally formed with the ring 106 and is internally threaded. A circular plate 108, provided with a plurality of apertures 109 corresponding to the size and spacing of the sleeves 107, is carried by the sleeves and is secured thereto by a plurality of cap screws 110 threaded respectively into the sleeves. Resilient or compressible shock-absorbing material, such as rubber or the like, indicated generally by the numeral 111, is interposed between the ring 106 and circular plate 108. The heads of the cap screws 110 are larger than the openings 109 in the plate 108 and the plate is thus held against endwise displacement forwardly but may be moved rearwardly to compress the resilient material 111. A second plate 112 is provided with a plurality of openings 113, sufficiently large to fit loosely over the heads of the cap screws 110, and is rigidly mounted on the plate 108 by a plurality of countersunk flathead screws 114.

The construction thus described functions so that upon initial action of the parts in recoil, the buffer ring 95 on the driving member 70 engages the heads of the cap screws 110. There is thus no compressing of the yieldable material 111 in the buffer means 105. However, as will hereinafter appear, when the relative angular positions of the parts change through an angle of 45° upon return of the rammer to its starting position, the heads of the cap screws 110 become aligned respectively with the recesses 97 in the buffer ring 95 so that the resilient material 111 is compressible and is available to absorb shocks incident to return of the rammer.

As best shown in Figs. 4 and 7, the radial flange 80 at the rear end of the control tube 81 is provided with means including a plurality of lugs for the purpose of engaging a complementary member on the rammer 50. In the preferred embodiment of the invention herein illustrated and described, this means comprises an internal spline 115 formed on the interior of the flange 80 and a complementary external spline 116 formed on a flanged collar 117 rigidly mounted on the rammer member 50 within the sleeve 78 of the tube 81. As will hereinafter appear, the splines 115 and 116 are so arranged and operable that relative endwise movement between the rammer 50 and driving member 70 is prevented until the tube-and-breech assembly has reached a predetermined position in recoil, at which point the control tube 81 is movable angularly with respect to the rammer 50 so that the teeth and grooves of the splined elements 115 and 116 are aligned, whereby the externally splined element 116 may pass freely axially through the teeth and grooves of the internally splined element 115 to free the rammer from the driving member 70 for additional movement rearwardly after the tube-and-breech assembly reaches its maximum recoil position and returns to battery.

As best shown in Fig. 5, the interior, intermediate portion of the tubular rammer 50 rigidly carries a tubular sleeve 120 that is internally threaded at its rear end, as at 121, and that is provided at its forward end with an apertured, transverse endwall 122. The sleeve 120 is slotted at diametrically opposed upper and lower portions thereof as at 123, these slots being respectively aligned with diametrically opposed upper and lower slots 124 and 125 formed in upper and lower wall portions of the tubular rammer 50. A cylindrical block or limit member 126 is carried for limited axial sliding movement in the sleeve 120 and is provided with a control pin 127 pinned to the block intermediate its ends and extending at its opposite ends through the slots 123, in the sleeve 120 and through the slots 124 and 125 in the rammer tube 50. As best shown in Fig. 7, the rear portion of the control tube 81 is cut out to provide an elongated rectangular opening 128 corresponding generally in size and shape to the rectangular opening 31 in the rammer support 30. The pin 127 extends through the opening 128 in the tube 81 and extends also through the spiral groove 69 in the tube 61 and upwardly into the rectangular opening 31 in the rammer support 30. As will presently appear, the pin 127 performs the double function of guiding the rammer 50 around the rectangular opening 31 and of rocking the tube 61.

The block 126 is opposed at its rear end by one end of a compression spring 129, the other end of which abuts against a nut 130 threaded into the threaded end 121 of the sleeve 120. The nut 130 is formed with an internal hexagonal opening 131 (Figs. 5 and 8) to which a tool may be applied for tightening the nut. A lock nut 132 is threaded into the portion 121 of the sleeve 120 behind the nut 130. The nut 132 is provided with an internal hexagonal opening 133 by means of which the nut may be tightened (Figs. 5 and 8). It will be noted that the hexagonal opening 133 in the nut 132 is larger than the hexagonal opening 131 in the nut 130 so that the nuts may be independently turned in the threaded portion 121 of the sleeve 120 for the purpose of adjusting the compression on the spring 129. The other end of the block is provided with a tapped bore into which is threaded one end of a forwardly extending rod 134, the end wall 122 of the sleeve 120 being apertured to provide for the free passage therethrough of the rod. The forward end of the rod 134 is threaded and receives thereon a flanged collar 135 and nut 136. A compression spring 137 is interposed between the collar 135 and the forward face of the end wall 122 on the sleeve 120. The action of the springs 129 and 137 is such as to urge the control pin 127 toward the forward end of the slots 123, 124 and 125 and to permit limited axial movement of the block against the yielding action of the springs 129 and 137.

As stated previously, the rammer construction embodies means for controlling the movement of the rammer in a generally rectangular path. This control is accomplished by means of the cooperation of the control pin 127 of the rammer 50 with the rectangular opening 31 in the rammer support 30. As best shown in Figs. 1 and 2, the rectangular opening 31 is partially filled by an elongated rectangular control member 140 generally proportionately smaller than the opening 31. This member is spaced inwardly from the opposite sides and the opposite ends of the rectangular opening 31 to provide a continuous rectangular track or groove in which the control pin 127 travels during operation of the rammer. The member 140 is secured in position with respect to

the tubular support 30 by a pair of transverse front and rear supporting plates 141 and 142 and forms an "island" in the opening 31. The upper portion of the tubular support 30 is provided with a plurality of mounting pads 143 on which the plates 141 and 142 are rigidly carried, being secured thereto by suitable cap screws and dowel pins.

The forward transverse plate 141, that mounts the longitudinal member 140 in the opening 31, rigidly supports a bracket 144 which carries a transverse pivot pin 145. A control member 146 is rockably carried on the pin 145 and is engageable with the depressible forward end of a latch member 147. This member 147 is pivoted on a transverse pin 148 mounted on a forward portion of the longitudinal rectangular member 140. As best shown in Figs. 1 and 4, the rear end of the latch 147 is cut out as at 149 and coincides generally with the rear end of the rectangular opening 31 in the tubular support 30. A coil spring 150 is compressible between an intermediate underportion of the latch 147 and an upper portion of the rear end of the member 140 and functions to urge the latch toward the position shown in Fig. 4. When the rammer is propelled rearwardly upon recoil of the gun, the control pin 127 follows the groove established by the right side of the member 140 (as viewed from the breech of the gun) and the rectangular opening 31 and passes under the latch 147 and is engaged by the cutout portion 149 of the latch. The rear transverse supporting plate 141 carries a second bracket 150 which in turn carries a solenoid 151 having a plunger 152 engageable with the rockable member 146. It will be noted that the function of the latch 147 is to retain the rammer 50 in its rearward or recoiled position, from which position it may be released by action of the solenoid 151, which operates through the member 146 to depress the forward end of the latch 147 so that the rear end 149 thereof is raised to free the control pin 127 therefrom, whereby the rammer may return to its initial position as shown in Fig. 1.

The rammer is propelled in the direction of recoil by action of the recoiling gun tube and is returned in the direction of counterrecoil by action of the springs 87 and 90. Additional means are provided for imparting rocking and reverse rocking action to the rammer so that the control pin 127 may travel transversely (in a counterclockwise direction as viewed from the breech) across the rear end of the rectangular opening 31 and transversely in the opposite direction (or clockwise) across the forward end of the rectangular opening 31. In the present instance the means for accomplishing this result embodies torsion spring mechanism controlled by the tube 61 and operated by reciprocation of the rammer.

As best shown in Figs. 1, 4 and 12, the collar 66 at the rear end of the tubular support 30 is encircled by a torsion spring 160 having its opposite ends directed vertically upwardly and in parallel relation as at 161 and 162. The collar 66 has formed integrally therewith at its forward end an upwardly projecting ear 163 which in turn rigidly carries a longitudinally rearwardly extending pin 164. As shown in Figs. 1 and 12, the pin 164 passes between the spring ends 161 and 162. The external flange 62 at the rear end of the tube 61 (Figs. 1, 3, and 4) is provided with an integral upwardly projecting ear 165 on which is mounted a longitudinally forwardly extending pin 166. This pin parallels the pin 164 and, like the pin 164, passes between the spring ends 161 and 162. It will be seen that as the tube 61 is rocked in a clockwise direction (as viewed from the breech of the weapon) the pin 166 will engage the spring end 161 and the spring end 162 will engage the stationary pin 164. Continued rotation of the tube 61 and its pin 166 will wrap the spring 160 more tightly about the collar 66 and will load or tension the spring for reaction in a counterclockwise direction. Conversely, rocking of the tube 61 in a counterclockwise direction will cause the pin 166 to engage the spring end 162 and the stationary pin 164 on the collar 66 will engage the spring end 161; and the spring 160 will be loaded or tensioned for reaction in a clockwise direction. Rotation or rocking of the tube 61 in either direction is effected by means of cooperation between the control pin 127 on the rammer 50 and the spiral groove 69 in the tube 61.

For the purpose of imparting rotation to the control tube 81 for controlling the relative angular positions of the splined elements 115 and 116, the rammer mechanism is provided with control means comprising a longitudinal, partially spiraled groove 170 formed in the rear half of the control tube 81 (Fig. 7) and a control follower carried by the supporting structure and engageable with this spiraled groove. According to the preferred embodiment of the invention herein illustrated and described, the control follower means is incorporated in the intermediate housing 35 previously described as being mounted on the gun cradle 35 by means of the bracket 37. As best shown in Fig. 13, the housing 35 is rectangular in cross section and is hollow to the extent that it is formed with a longitudinal cylindrical opening coaxial with the tubular support 30, the external tube 45, and the other rammer components. The housing 35 is provided with upper and lower generally diametrically opposed circular openings 171 and 172. A circular, bored and tapped mounting block 173 is fitted within the upper opening 171 and is formed with a pair of apertured mounting ears 174 by means of which the block may be rigidly secured to the upper surface of the housing 35 as by a pair of cap screws 175. The upper portion of the housing 35 is provided with a pair of transversely spaced tapped bores 176 to accommodate the cap screws 175. The lower portion of the housing 35 is provided at opposite sides of the lower mounting opening 172 with a pair of similar tapped bores 177, shown in Fig. 13 as receiving a pair of screws 178 by means of which a removable cover 179 is secured over the opening 172.

The mounting block 173 carries in the tapped bore therein a follower stud 180 which has a threaded shank portion fitting the threaded bore in the plug or block 173. The inner or lower end of the follower 180 is machined and extends into the groove 170 in the control tube 81. A lock nut 181 is threaded onto that portion of the stud 180 that extends outwardly through the block 173. The stud 180 may be adjusted vertically in the block 173 and the lock nut 181 is effective to fix its position. The collar 85, previously described as being rigidly carried by the tube 81, is formed with a groove 182 which is aligned with the spiral groove 170 in the control tube 81 (Figs. 5, 7 and 14). This collar, in addition to serving as a bushing for the collar 85 on the rammer 50 also reenforces the intermediate section of the tube 81.

As best seen in Fig. 5, the parallel axes of the

circular mounting openings 171 and 172 in the housing 35 are longitudinally spaced apart. Likewise, the cam follower 180 is eccentric to or radially offset with respect to the axis of the circular mounting block 173. Hence, the block may be rotated 180° about its axis to provide for two positions of the follower 180. The design of the housing 35 is such that the mounting block 173 may be mounted in either opening 171 or 172 in either of two positions, giving a combined total of four mounting positions for the follower 180. Each of these positions bears a different relationship to the partially spiraled groove 170 in the control tube 81; that is to say, the follower 180 is variably positionable with respect to the critical curved portion of the groove 170 so that adjustment may be had as to the point at which the control tube 81 will be rotated to move the internally splined element 115 angularly with respect to the externally splined element 116 on the rammer 50. The housing 35 may be removed from the supporting bracket 37 rotated 180°, and remounted in a second position in which the opening 172 is disposed at the top of the housing. The trunnions or bosses 36, being similar, provide for the support of the housing in either position.

The front end of the external tubular member 45 (see Fig. 6) is provided with a ring 183 which in turn carries a buffer washer 184 preferably composed of fiber or other similar material. The ring 183 is rigidly secured to the tube 45, as by welding. When the rammer reaches its rearwardmost position, shocks incident to this phase of its operation will be absorbed by the buffer 53 as the buffer plate 56 engages the fiber washer 184.

In the operation of the weapon equipped with the preferred form of rammer construction just described, a round of ammunition is loaded manually into the chamber of the gun tube. After the gun is fired, the tube-and-breech assembly 26—27 recoils and, by means of the driving member 70, drives or propels the rammer 50 rearwardly. As previously stated, the initial relationship between the buffer ring 95 and the buffer means 105 is such that the ring engages the heads of the longitudinally extending cap screws 110. Thus there is no compression or yielding of the resilient material 111 in the buffer 105. The relationship between the internally splined element 115 on the control tube 81 and the externally splined element 116 on the rammer 50 is such that the teeth of the elements are axially aligned and initially occupy the positions shown in Fig. 15. In order that a better understanding may be had of the operation of the splined elements 115 and 116, one tooth and one groove on each splined element will be selected as a reference or index point from which the action of these parts may be followed. The reference tooth and adjacent grove on the element 115 will be designated by the letters "A" and "B," respectively, and the reference tooth and adjacent groove on the element 116 will be designated by the letters "C" and "D," respectively.

As shown in Fig. 15, which shows the initial positions of the parts before recoil, the tooth "A" on the splined element 115 is axially aligned with the tooth "C" on the element 116 so that axial movement of the rammer 50 in the direction of recoil with respect to the driving member 70 is prevented. This relationship between the splined elements serves to connect the rammer 50 directly and positively to the tube-and-breech assembly, at least during the initial stages of recoil. This connection is important for the reason that it prevents sudden rearward movement of the rammer upon initial impact of the driving member 70 against the buffer 105. It will be appreciated that in the absence of such connection the tremendous impetus resulting from recoil of the tube-and-breech assembly would drive the rammer 50 rearwardly with such force as to cause virtual destruction thereof.

As mentioned above, the maximum travel of the gun in recoil is not sufficient to carry the rammer rearwardly, via a direct connection therewith, to a position in which the rammer arm 51 will engage a round of ammunition subsequently placed on the tray 29 or fed to loading position rearwardly of the breech ring 27 by such automatic feeding mechanism as may be utilized. For this reason, the connection between the tube-and-breach assembly and the rammer is such that the rammer may be released from the driving member 70 after the tube-and-breech assembly has traveled a predetermined distance in recoil. As an example of the relationship between the distance traveled by the tube-and-breech assembly and the rammer, it will be assumed that the recoil distance of the tube-and-breech assembly of the gun herein illustrated is approximately nineteen inches and the required distance of rearward travel of the rammer 50 is approximately twenty-three inches. The spiraled groove 170 in the control tube 81 is so designed as to effect the release of the rammer 50 from the driving member 70 at or before the attainment by the tube-and-breech assembly of maximum recoil travel, at which point the tube-and-breech assembly will have been braked by action of the recoil mechanism and this braking action, because of the then direct connection between the breech ring 27 and rammer 50, will be effective to minimize the tendency of the rammer to surge rearwardly with excessive force and at an excessively high velocity. It will be noted that the groove 170 (Fig. 7) is substantially straight throughout a considerable portion of its longitudinal extent and then curves relatively sharply and finally is again substantially straight. As the rammer 50 travels rearwardly under the power derived from the recoiling tube-and-breech assembly, the control tube 81 is carried therewith. As stated above, the control tube is connected to the driving member 70 for rearward movement by means of the external flange 80 at the rear end thereof. Consequently, as the rammer 50 and tube 81 travel rearwardly and reach approximately the end of the recoil stroke, the tube 81 is rotated in a clockwise direction (as viewed from the breech of the gun) by means of engagement between the groove 170 therein and the follower 180 carried by the stationary support or housing 35 (see arrow, Fig. 15), as the follower travels along the spiral portion of the groove or slot.

When the components of the rammer are in the positions illustrated in Figs. 1 through 15, the rammer arm 51 will be in its uppermost position, or in a position in which it is spaced its greatest distance laterally or upwardly from the axis of the gun tube 26. This uppermost position of the rammer arm 51 is shown in the upper broken lines in Fig. 19. As the rammer travels rearwardly, the arm 51 remains in this position with respect to the axis of the gun tube, since the control or guide pin 127 on the rammer follows the groove established between the right-hand side of the rectangular opening 31 in the

support 30 and the proximate side of the longitudinal guide member 140. When the control tube 81 is rotated in a clockwise direction by means of engagement between the spiral groove 170 therein and the follower 180 in the housing 35 as the tube-and-breech assembly approaches its rearwardmost position, the internally splined element 115 on the control tube 81 is moved angularly so that the tooth "A" and groove "B" thereon are respectively aligned with the groove "D" and tooth "C" on the externally splined element 116 of the rammer 50, and the elements assume the positions shown in Fig. 16. When the parts are in this position, the rammer 50 is freed from its connection to the driving member 70 and may travel the necessary additional distance rearwardly by reason of its momentum. When the rammer reaches its rearwardmost position the control or guide pin 127 thereon, having followed the groove down the right-hand side of the guide means 30—140, will pass under the latch 147 and, as the rammer 50 is rocked in a counterclockwise direction by the torsion spring 160, will be engaged by the cut-out portion 149 of the latch. At this time, the externally splined element 116 will be to the rear of the internally splined element 115, and the angular relationship between the splines on these elements will be as illustrated in Fig. 17, the arrow indicating the direction of rocking of the rammer 50.

During rearward travel of the rammer 50, the torsion spring 160 will have been tensioned in a clockwise direction for reaction in a counterclockwise direction. This result follows from the engagement between the groove 69 in the tube 61 and the control pin 127. Hence, as the control pin 127 travels rearwardly it will effect clockwise rotation of the tube (the tube 61 being held as aforesaid against endwise displacement with respect to the rammer 50). Then, when the pin 127 reaches the rear end of the rectangular member 140 and is freed from the confines thereof, the spring 160 will react to rock the rammer in a counterclockwise direction until the pin 127 is stopped by the cut-out end 149 of the release latch 147, thus moving the rammer arm 51 downwardly to the full line position shown in Fig. 19, and the corresponding change in the relationship between the relative angular positions of the splined elements 115 and 116 will be as shown in Fig. 17. The change in the positions of the rammer arm 51 from its upper dotted line position to the full line position of Fig. 19 represents angular travel of 22½°. The arm 51 will move another 22½° to its lower dotted line position during a subsequent phase of rammer operation, as will appear below. It will be noted that the grooves between the teeth on the internally splined element 115 are sufficiently wide to permit escape of the teeth on the externally splined element 116, which condition is necessary because it is virtually impossible to time the relative angular movements of the control tube 81 and rammer 50 without the allowance of some latitude for discrepancy. It will be understood, of course, that the relative movement between these parts occur at such tremendous speeds that adequate provision must be made for effecting the release of the parts as rapidly and as simply as possible.

With the rammer latched in its rear position, the tube-and-breech assembly will return to battery and will carry with it the spline-control tube 81. Since the collar 85 is fixed inside the control tube 81, it will compress the springs 87 and 90 against the ring 91 (adjacent the buffer means 53 at the forward end of the rammer 50). These springs will thus be loaded for reaction to return the rammer in a forward direction upon release of the latch 147. At the same time, when the control tube 81 is returned forwardly, it is rocked in a counterclockwise direction and returns the internally splined element 115 to its original position (Fig. 18), thus conditioning the tooth "A" and groove "B" thereon to permit passage therethrough of the groove "D" and tooth "C" of the externally splined element 116, as will be brought out below. At this time, the rammer 50 is still latched in its rear position and there will be no change in the angular position of the externally splined element 116, which will remain in the position shown in Fig. 17.

When a shell has been placed on or fed to the tray 29 in position to be rammed by the rammer arm 51, the solenoid 151 is energized and the plunger 152 engages the rockable member 146 and depresses the latch 147. This action raises the rear end 149 of the latch and releases the control pin 127 therefrom. It will be noted that the cut-out portion 149 of the latch 147 is such that the pin is stopped in a position midway between its transverse travel at the rear end of the rectangular opening 31, resulting in the intermediate positioning of the rammer arm as shown in full lines in Fig. 19. When the latch 147 is actuated to release the pin 127, the rammer 50 completes its counterclockwise rocking and the rammer arm 51 is moved another 22½° to its lowermost position as shown in the lower broken line position in Fig. 19. In this position, the rammer head 52 on the rammer arm 51 is substantially in axial alignment with the bore of the gun tube 26 and in a position to positively engage a round on the tray 29. As the pin 127 completes its traverse at the rear end of the rectangular opening 31 (still under control of the partially loaded torsion spring 160), it is freed from the rear end of the longitudinal member 140, and the loaded compression springs 87 and 90 react to drive the rammer forwardly to load the round of ammunition into the chamber of the gun.

When the rammer 50 is rocked to dispose the rammer arm 51 in its lowermost position as shown in Fig. 19, the teeth on the externally splined element 116 will, of course, be redisposed with respect to the teeth on the internally splined element 115. At this point, the externally splined element 116 will have moved to the position shown in Fig. 18. In this position, the tooth "C" and groove "D" of the element 116 are again respectively aligned with the groove "B" and tooth "A" of the internally splined element 115, so that, when the rammer completes its forward travel, the teeth on the externally splined element 116 may pass freely axially through the grooves in the internally splined element 115. When the rammer reaches its forwardmost position, the pin 127, having traveled up the left side of the rectangular opening 31 and proximate edge of the longitudinal member 140, will reach the forward end of the rectangular opening 31 and will have rocked the spring-control tube 61 in a counterclockwise direction to load the torsion spring 160 for reaction in a clockwise direction; such reaction of the torsion spring 160 will rock the rammer 50 reversely so that the pin 127 again occupies the position shown in Fig. 1 and so that the rammer arm 51 is again moved 45° upwardly to the uppermost position as shown in dotted lines in Fig. 19. During this phase of

movement, the externally splined element 116 will have passed axially forwardly through the internally splined element 115 (because of the alignment shown in Fig. 18) and the elements will again occupy the positions shown in Fig. 15.

During forward travel of the rammer 50, the relationship between the buffer 105 and the buffer ring 95 is such that the cap screws 110 are respectively aligned with the recesses 97. Consequently, as the rammer reaches its forward position, the shock incident thereto will be absorbed by the resilient material 111 of the buffer 105. Then, as the rammer is reversely rocked at the end of its forward stroke, the cap screws 110 again become misaligned with respect to the recesses 97, and the rammer and its components are again conditioned for a succeeding cycle of operation.

It has been found in the operation of rammers of earlier design that latching of the rammer in its rearwardmost position results in the setting up of longitudinal vibrations of relatively high magnitude that occur because of sudden stopping of the rammer and its tendency to attempt to return forwardly under action of the springs 87 and 90. Heretofore, the shock arising from these vibrations was taken directly by the latch 147 and control pin 127 and in many instances the latch 147 became damaged and the pin 127 was sheared from the block 126. According to the present invention, these disadvantages are eliminated by means of the spring mounting of the block 126 and its pin 127. As the rammer reaches its rearward position, shocks incident to the sudden stopping thereof are absorbed by the buffer 53 and to some extent are absorbed by the springs 87 and 90 as these springs are rapidly compressed by the quick return of the gun to battery. The tendency of the pin 127 to bounce longitudinally in the cut-out 149 of the latch 147 is controlled by action of the springs 129 and 137, the pin 127 and block 126 being longitudinally slidable against the tension of the springs within the limits defined by the slots 123, 124 and 125.

One important characteristic of guns, even of the same type and model, is that the recoil length thereof vary. Likewise, recoil travel in the same weapon may vary from time to time, depending upon climatic conditions and upon the age and extent of use of the gun. Variations of this type are of major importance in such cases as the present, in which a rammer is operated and controlled by power derived from recoil. In the present instance, these variations in recoil travel will be reflected in variations in the stages at which the rammer will be released from the driving member 70; that is to say, variations will occur with respect to the points at which the control tube 81 will be rotated to free the externally splined element 116 from the internally splined element 115 for additional axial movement.

As described above, the housing 35 is so constructed as to provide for adjustable positioning of the control follower 180. When the housing 35 is in the position shown in the drawings, the mounting block 173 may be mounted in either of two longitudinally spaced positions in the upper opening 171 in the housing, which, because of the eccentric mounting of the follower 180, will afford two longitudinally spaced apart positions for the follower. If neither of the two positions thus obtainable is satisfactory, the housing 35 may be removed from the supporting bracket 37, rotated 180°, and remounted on the bracket 37. In this case it will be necessary to remove the cap screws 34 and 46 which secure the flanges 33 and 44 of the support 30 and external tube 45 respectively to opposite ends of the housing 35. In the second position of the housing the opening 172 will be at the top of the housing; the cap screws 178 and cover plate 179 are removed from the opening, and the mounting plug 176 is installed therein, the cap screws 175 being threaded into the tapped bores 177 for the purpose of holding the plug in place. The cover plate may be then secured over the opening 171, being held in place by the screws 178.

The foregoing description has set forth the principle of construction and operation of the rammer mechanism. Incidental details of the rammer construction and of the functioning of the various components thereof will readily appear to those skilled in the art, as will certain changes in construction, to adapt the rammer to various types of weapons. It will be understood, of course, that the present disclosure relates to a preferred form of the invention and that several 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, means including a release element mounted for angular movement about an axis lying along the path of reciprocation of said rammer member and forming a releasable connection between the tube-and-breech assembly and said rammer member by means of which the tube-and-breech assembly in recoil may drive said rammer member breechwardly, means for moving said release element angularly for releasing said connection 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.

2. A rammer for a gun having a tube-and-breech assembly arranged for recoil and counterrecoil, comprising a support fixed against the recoil and counterrecoil, a rammer member carried by said support for reciprocation in the directions of recoil and counterrecoil, means including a release element mounted for angular movement about an axis lying along the path of reciprocation of said rammer member, a releasable connection between the tube-and-breech assembly and rammer member by means of which the rammer member is prevented from recoil movement independently of the tube-and-breech assembly for a predetermined portion only of the recoil movement of said tube-and-breech assembly, control means responsive to the attainment of a predetermined position by the tube-and-breech assembly and said rammer member in the recoil stroke thereof for causing said release element to release said releasable connection 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 holding said rammer member in fully retracted position in the direction of recoil.

3. A rammer as set forth in claim 2 said control means being adjustable to vary the point in the recoil stroke of said rammer member and tube-and-breech assembly at which said release ele-

ment is angularly moved to release said connection.

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 to travel in the direction of recoil through a distance greater than the distance traveled by the tube-and-breech assembly during recoil, means including a release element mounted for angular movement about an axis lying along the path of reciprocation of said rammer member and forming a releasable connection between the tube-and-breech assembly and said rammer member by means of which the tube and breech assembly and said rammer member may travel breechwardly in unison through a predetermined distance upon recoil of the tube-and-breech assembly, actuating means for moving said element angularly 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.

5. A rammer as set forth in claim 4 in which said actuating means may be adjusted with respect to the recoil stroke of said rammer member and the tube-and-breech assembly so that the point of occurrence of angular movement of said release element may be varied.

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 to travel in the direction of recoil through a distance greater than the distance traveled by the tube-and-breech assembly during recoil, means including a release element mounted for angular movement about an axis lying along the path of reciprocation of said rammer member and forming a releasable connnection between the tube-and-breech assembly and said rammer member by means of which the tube-and-breech assembly and said rammer member may travel breechwardly in unison through a predetermined distance upon recoil of the tube-and-breech assembly, means operable in response to attainment by the tube-and-breech assembly and rammer member of a predetermined position in the recoil stroke thereof for moving said element angularly for releasing said connection to free said rammer member from the tube-and-breech assembly so that said rammer member may continue its travel in the direction of recoil 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.

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, a driving member connected to the tube-and-breech assembly, means between said rammer member and the breechward side of said driving member to be engaged by said driving member upon recoil of the tube-and-breech assembly, releasable means between said rammer member and said driving member and including a rotatable release element mounted for angular movement about an axis lying along the path of reciprocation of said rammer member and normally arranged to establish a connection between the tube-and-breech assembly and said rammer member so that said rammer member is prevented initally from traveling breechwardly independently of the tube-and-breech assembly, means for moving said release element angularly for releasing said releasable means to free said rammer member from said driving member so that the tube-and-breech assembly may return in counterrecoil without said rammer member, and means for returning said rammer member in the direction of recoil.

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, said rammer member being mounted for reciprocatory travel a greater linear distance than the movement of the tube-and-breech assembly in recoil, a driving member connected to the tube-and-breech assembly, buffer means carried by said rammer member for engagement by the breechward side of said driving member upon recoil of the tube-and-breech assembly to drive said rammer member in the direction of recoil, a releasable connection between said rammer member and said driving member whereby said rammer member is prevented from movement in recoil independently of said driving member, said connection including a release element mounted for angular movement about an axis lying along the path of reciprocation of said rammer member, and means responsive to a predetermined movement of the tube-and-breech assembly in recoil for moving said release element angularly for releasing said releasable connection to free said rammer member for travel in the direction of recoil independently of said driving member.

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, a driving member connected to the tube-and-breech assembly, buffer means carried by said rammer member for engagement by the breechward side of said driving member upon recoil of the tube-and-breech assembly, disengageable means connecting said rammer member and said driving member and including a pair of elements relatively angularly movable about an axis parallel with the direction of recoil and carried respectively by said driving member and said rammer member, cooperable lug means respectively on said elements and normally positioned to engage each other upon recoil of the tube-and-breech assembly to prevent said rammer member from traveling breechwardly independently of the tube-and-breech assembly, and means operable in response to movement to a predetermined position in recoil of said rammer member and tube-and-breech assembly, to move said elements relatively angularly and thereby disengage said lug means to free said rammer member for continued recoil independently of said driving member.

10. A rammer as set forth in claim 9 in which

said last-named means is adjustable to vary the point in the recoil movement of said rammer member and tube-and-breech assembly at which said elements are relatively angularly moved to disengage said lugs.

11. 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 of said assembly, a driving member connected to the tube-and-breech assembly, means carried by said rammer member and adapted to be engaged by the breechward side of said driving member to retract said rammer member upon recoil of the tube-and-breech assembly, means releasably connecting said rammer member and said driving member and including a pair of relatively angularly movable elements carried respectively by said driving member and said rammer member, cooperable lug means respectively on said elements and normally positioned to engage each other upon initial recoil of the tube-and-breech assembly so that said rammer member is initially prevented from traveling breechward independently of the tube-and-breech assembly, and means operable in response to predetermined travel of said rammer member and tube-and-breech assembly in the direction of recoil for moving said elements relatively angularly to disengage said lugs for freeing said rammer member from said driving member so that said rammer member may continue its movement in the direction of recoil independently of said driving member.

12. A rammer for a gun having a tube-and-breech assembly arranged for recoil and counterrecoil, comprising a support, rammer means including a longitudinal 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 an open internally splined element encircling said rammer member, means rigidly carried by said rammer member and including an externally splined element concentric with and complementary to said internally splined element, one of said elements being mounted for angular movement and being normally angularly positioned with respect to the other so that the teeth thereon are longitudinally aligned to lock said rammer member against longitudinal movement with respect to said driving member in the direction of recoil, means on said rammer member forming an abutment which said driving member may engage to propel said rammer member breechwardly upon recoil of the tube-and-breech assembly, and means for moving one of said splined elements angularly with respect to said other splined element so that the teeth on one are aligned with the grooves in the other whereby said externally splined element may pass longitudinally through said internally splined element to free said rammer member from said driving member.

13. A rammer for a gun having a tube-and-breech assembly arranged for recoil and counterrecoil, comprising a support, rammer means including a longitudinal 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 an open internally splined element encircling said rammer member, means rigidly carried by said rammer member and including an externally splined element concentric with and complementary to said internally splined element, one of said elements being mounted for angular movement above its axis and being normally angularly positioned with respect to the other so that the teeth thereon are longitudinally aligned to lock said rammer member against longitudinal movement with respect to said driving member in the direction of recoil, means on said rammer member forming an abutment against which said driving member may engage to propel said rammer member breechwardly upon recoil of the tube-and-breech assembly, a longitudinal tubular member coaxial with and surrounding said rammer member, means mounting said tubular member for angular movement about its axis, means connecting one end of said tubular member to said angularly movable splined element, means forming a spiral groove in said tubular member, means carried by said support and including a follower engageable with said groove, and means mounting said tubular member and said follower for relative movement in the directions of recoil and counterrecoil whereby said tubular member is moved angularly upon recoil of the tube and breech assembly to effect angular movement of the aforesaid splined element with respect to said other splined element to align the teeth of one element with the grooves of the other so that said externally splined element may pass longitudinally through said internally splined element to free said rammer member from said driving member.

14. A rammer for a gun having a tube-and-breech assembly arranged for recoil and counterrecoil, comprising a support, rammer means including a longitudinal 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 an open internally splined element encircling said rammer member, means rigidly carried by said rammer member and including an externally splined element concentric with and complementary to said internally splined element, said internally splined element being mounted for angular movement about its axis and being normally angularly positioned with respect to said externally splined element so that the teeth thereon are longitudinally aligned to lock said rammer member against longitudinal movement with respect to said driving member in the direction of recoil, means on said rammer member forming an abutment against which said driving member may engage to propel said rammer member breechwardly upon recoil of the tube-and-breech assembly, a longitudinal tubular member coaxial with and surrounding said rammer member, means mounting said tubular member on said support for angular movement about its axis and for longitudinal movement in the directions of recoil and counterrecoil, means connecting said tubular member and said driving member for movement therewith, means connecting one end of said tube to said internally splined element, means forming a spiral groove in said tube, means fixed on said support against recoil and counterrecoil and including a follower engageable with said groove whereby said tubular member is moved angularly upon recoil of the tube-and-breech assembly to effect rotation of said internally splined element with respect to said externally splined element to align the teeth of one element with the grooves of the

other so that said externally splined element may pass longitudinally through said internally splined element to free said rammer member from said driving member.

15. A rammer as set forth in claim 14 in which said follower is mounted on said support for longitudinal adjustment with respect to said spiral groove in said tubular member so that the timing of angular movement of said tubular member may be varied.

16. A rammer for a gun having a tube-and-breech assembly mounted for recoil and counterrecoil, comprising a support fixed against recoil and counterrecoil, an elongated tubular housing carried by said support and generally paralleling the tube-and-breech assembly, a longitudinal rammer shaft carried by said housing for reciprocation in the directions of recoil and counterrecoil, a control tube within said housing and encircling said rammer shaft, there being a spiral control groove in said control tube, a hollow control housing at one end of said tubular housing and through which said rammer shaft and control tube extend, means connecting said control housing to said tubular housing for adjustment about the axis of said rammer shaft and control tube for disposition in either of at least two angularly spaced positions, means for connecting said control housing to the support in either of its two positions, and means positionable in either of at least two longitudinally spaced positions in said control housing in either of its positions and including a follower engageable with said spiral groove in said control tube.

17. A rammer for a gun having a tube-and-breech assembly mounted for recoil and counterrecoil, comprising a support fixed against recoil and counterrecoil, a longitudinal rammer shaft carried by said support for reciprocation in the directions of recoil and counterrecoil, a control tube carried by said support and encircling said rammer shaft, there being a spiral control groove in said tube, a control housing on said support and through which said rammer shaft and control tube extend, means connecting said control housing to said support for adjustment about the axis of said rammer shaft and control tube for disposition in either of at least two angularly spaced positions, and means positionable in either of at least two longitudinally spaced positions in said control housing in either of its positions and including a follower engageable with said spiral groove in said control tube.

18. 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 connecting said rammer member and tube-and-breech assembly for propelling said rammer member in the direction of recoil upon recoil of the tube-and-breech assembly, means for releasably retaining said rammer in its recoiled position, loadable energy-storing means connected to said rammer, and means connecting the tube-and-breech assembly and said energy-storing means for loading said energy-storing means upon counterrecoil of the tube-and-breech assembly whereby said energy-storing means returns said rammer member in the direction of counterrecoil after release of said rammer from said releasable means.

19. 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 longitudinal rammer member carried by said support for reciprocation in the directions of recoil and counterrecoil, means connecting said rammer member and the tube-and-breech assembly for propelling said rammer member in the direction of recoil upon recoil of the tube-and-breech assembly, releasable means for retaining said rammer member in its recoiled position, a coil spring encircling said rammer member, an abutment on said rammer member against which one end of said spring may abut, means including a collar portion loosely encircling said rammer member and abutting the other end of said spring, and means connecting said collar portion and the tube-and-breech assembly for compressing said spring between said collar portion and the aforesaid abutment upon counterrecoil only of the tube-and-breech assembly so that said spring is loaded to provide energy for returning said rammer member in the direction of counterrecoil upon release thereof from said releasable means.

20. 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 longitudinal rammer member carried by said support for reciprocation in the directions of recoil and counterrecoil and including a longitudinal extension portion, means connecting said rammer member and the tube-and-breech assembly for propelling said rammer member in the direction of recoil upon recoil of the tube-and-breech assembly, releasable means for retaining said rammer member in its recoiled position, a coil spring encircling said extension portion of said rammer member, a first connecting member on said extension portion to which one end of said spring is connected, means including a second connecting member loosely encircling said extension portion and connected to the other end of said spring, and means connecting said second connecting member and the tube-and-breech assembly for tensioning said spring between said first and second connecting members only upon counterrecoil of the tube-and-breech assembly so that said spring is loaded to provide energy for returning said rammer member in the direction of counterrecoil upon release thereof from said releasable means.

21. A rammer for a gun having a tube-and-breech assembly arranged for recoil and counterrecoil, comprising a support, rammer means including a longitudinal tubular rammer member carried by said support for reciprocation in the directions of recoil and counterrecoil, means connecting the tube-and-breech assembly and said rammer member for propelling said rammer member in the direction of recoil, abutment means cooperable between said support and said rammer member for limiting movement of said rammer member in the direction of recoil, said abutment means including an abutment member carried by said rammer member for longitudinal movement with respect thereto, and spring means housed within said tubular rammer member and urging said abutment member into one position with respect to said rammer member to provide a resilient stop for said rammer member.

22. A rammer for a gun having a tube-and-breech assembly arranged for recoil and counterrecoil, comprising a support, rammer means including a longitudinal tubular rammer member

carried by said support for reciprocation in the directions of recoil and counterrecoil, means connecting the tube-and-breech assembly and said rammer member for propelling said rammer member in the direction of recoil, there being an elongated opening in the wall of said rammer member, a limit member carried within said rammer member for relative longitudinal movement, an abutment member on said limit member and projecting through said elongated opening, means on said support to be engaged by said abutment member when said rammer member reaches the end of its movement in at least one direction, and spring means within said rammer member and cooperable to yieldingly hold said limit member in one position with respect to said rammer member.

23. In a rammer having a support and a longitudinally reciprocable rammer member, the combination of a sleeve encircling said rammer member and carried by said support for both longitudinal and angular movement, there being a longitudinally spiraled groove in said sleeve, and means carried by said support including a follower engageable with said groove for imparting angular movement to said sleeve upon longitudinal movement thereof, said means including a bracket having at least a pair of mounting portions spaced longitudinally with respect to the beginning and end portions of said groove, and a follower member constructed and arranged for mounting on one of said mounting portions in either one of at least two longitudinally spaced positions and for mounting on another of said mounting portions in either of at least two different longitudinally spaced positions.

24. A rammer for a gun having a tube-and-breech assembly mounted for recoil and counterrecoil, comprising a support, a rammer member mounted on said support for reciprocation in the directions of recoil and counterrecoil, buffer means on said rammer member including a rigid element and a portion formed of resilient material, both extending in the direction of counterrecoil, a driving member carried by the tube-and-breech assembly and including a buffer plate disposed at the counterrecoil side of said buffer means to engage said buffer means upon recoil of the tube-and-breech assembly to propel said rammer member in the direction of recoil, and means mounting said buffer means and said buffer plate for relative positioning so that said buffer plate is alternately engageable with either said resilient material or said rigid element.

25. A rammer for a gun having a tube-and-breech assembly mounted for recoil and counterrecoil, comprising a support, a longitudinally extending rammer mounted on said support for reciprocation in the directions of recoil and counterrecoil and for rocking about its longitudinal axis, buffer means rigidly carried on said rammer member and including a portion formed of resilient material and an angularly spaced rigid element both of which extend in the direction of counterrecoil, a buffer member carried by the tube-and-breech assembly and disposed at the counterrecoil side of said buffer means for engagement with said buffer means upon recoil of the tube-and-breech assembly, said rammer member and buffer means being normally positioned angularly with respect to said buffer member so that said buffer means engages the rigid element of said buffer means upon recoil of the tube-and-breech assembly, means for releasably locking said rammer in position after it has been moved in the direction of recoil by the tube-and-breech assembly and while the tube-and-breech assembly returns to battery, means for returning said rammer member in the direction of counterrecoil, and means for rocking said rammer member and said buffer means as aforesaid to dispose said resilient material of said buffer means in position to engage said buffer member as said rammer member completes its return in the direction of counterrecoil.

26. A control member for a rammer of the type described having an externally splined element thereon, said member comprising a tube including an internally splined element thereon, there being a generally rectangular opening in the wall of the tube and extending substantially half the length of said tube, there being an elongated groove in the wall of the tube and extending substantially the other half of the length of said tube, said groove comprising two straight longitudinally-extending end portions connected by a helical portion, said control member being adapted for releasable connection with the rammer by means of said splined elements whereby said control member will release said rammer at a predetermined portion of its movement.

27. A control member for a rammer of the type described having a first splined element thereon, said member comprising a tube including a second splined element adapted to engage and disengage with said first splined element, there being a generally rectangular opening in the wall of the tube and extending substantially half the length of said tube, there being a groove in the wall of the tube and extending substantially the remaining half of the length of said tube, said groove comprising two straight longitudinally-extending end portions connected by a helical portion, said control member being adapted for releasable connection with the rammer by means of said splined elements whereby said control member will release said rammer at a predetermined portion of its movement.

28. In a rammer mechanism for a gun mounted in a cradle for recoil, a support fixed on said cradle, a rammer tube, a control tube and a torque tube, all said tubes being coaxially mounted on said support, parallel with said gun, said control tube and torque tube each having a helical slot therein, with said control tube being rotatably and axially slidably mounted on said support and said torque tube being rotatably mounted only in said support, a driving member secured to said gun and engageable with said rammer tube in recoil, means connecting said driving member and said control tube for relative rotation only, a releasable connection between rammer tube and control tube, a rammer arm extending radially of said rammer tube, means forming a guide path on said support, a pin on said rammer tube adapted to project through said helical slot in said torque tube into cooperative relation with said means, a stud carried by said housing and engaging the helical slot in said control tube to thereby rotate the same and release said connection when said driving member, rammer and control tubes reach a predetermined point in recoil, and spring means urging said torque tube to a predetermined rotational position when displaced therefrom by rotation of said torque tube as said pin moves rearwardly with said rammer tube in recoil, whereby said pin is compelled to traverse said guide path and pivot said rammer arm into and out of the bore axis of said gun.

29. In combination with a gun mounted for

recoil and counter-recoil, a rammer reciprocable adjacent and parallel with said gun, a driving member connected for recoil and counter-recoil with said gun, and a releasable connection between said rammer and member, said connection comprising a splined sleeve on said rammer and a splined sleeve connected with said driving member for relative rotation only, the splines on said sleeves being engageable and disengageable in response to relative rotation thereof, and means responsive to recoil of said gun for relatively rotating said sleeves.

30. A ramming mechanism for a gun mounted for recoil and counter-recoil, an elongated rammer mounted parallel with said gun, a driving member fixed with said gun for movement therewith in recoil and counter-recoil, said driving member having a buffer ring provided with a recess in its face engaging said rammer, rigid and resilient contact means carried by said rammer in angularly spaced relation about the axis of said rammer, each said contact means being opposite said recess when the other is engageable by said buffer ring, means rotating said rammer so that said resilient contact means is opposite said recess when said rammer is moved in recoil and said rigid contact means is opposite said

recess when said rammer moves in counterrecoil.

31. In a rammer mechanism for a gun mounted for recoil and counterrecoil, a rammer mounted parallel with said gun, a driving member fixed to said gun and engageable with said rammer to retract the same in response to recoil, means holding said rammer retracted while said gun and member return to battery, and rigid and resilient contact surfaces between said member and rammer, said surfaces being moved alternately into alignment in a direction parallel with the path of said rammer as said rammer is moved in retraction and ramming movements, respectively.

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