United States Patent

Brint

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[54] **LOADING MECHANISMS FOR GUNS**

[72] Inventor: **Norman Treyor Brint,** Waltham Abbey, England

[73] Assignee: **The Secretary of State for Defense in Her Britannic Majesty's Government of the United Kingdom of Great Britain and Northern Ireland,** England

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[52] **U.S. Cl.** .....**89/33 A,** 89/33 B, 89/47

[51] **Int. Cl.**.....**F41d 9/00**

[58] **Field of Search**.....89/33, 33.05, 33.1, 33.12, 89/33.14, 33.2, 33.25, 45, 47

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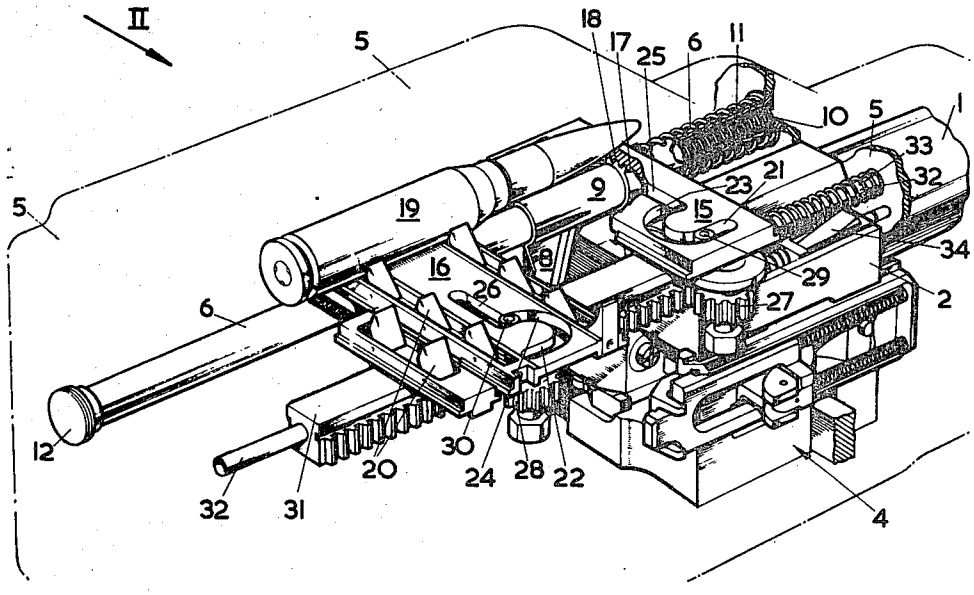
Primary Examiner—Stephen C. Bentley

Attorney—Cushman, Darby & Cushman

[57] **ABSTRACT**

A feed mechanism for an automatic gun in which a feed tray is moved transversely of the gun axis, to deliver a round, by a pinion carrying an eccentrically located member engaging in a guideway carried by the tray; which pinion is actuated by a rack moved axially against a spring, by the gun during its run-out after recoil; the rack being then disengaged from the gun whereafter the mechanism is returned to its initial position by the action of the spring. A rammer claw, carried at the end of an arm rotatable about a shaft above and parallel to the gun axis, is moved to and fro between a ramming and a receiving position by means of a pinion carried on the shaft and actuated by rack teeth carried on a sliding member operated in a similar manner to, but out of phase with, the feed tray.

12 Claims, 12 Drawing Figures



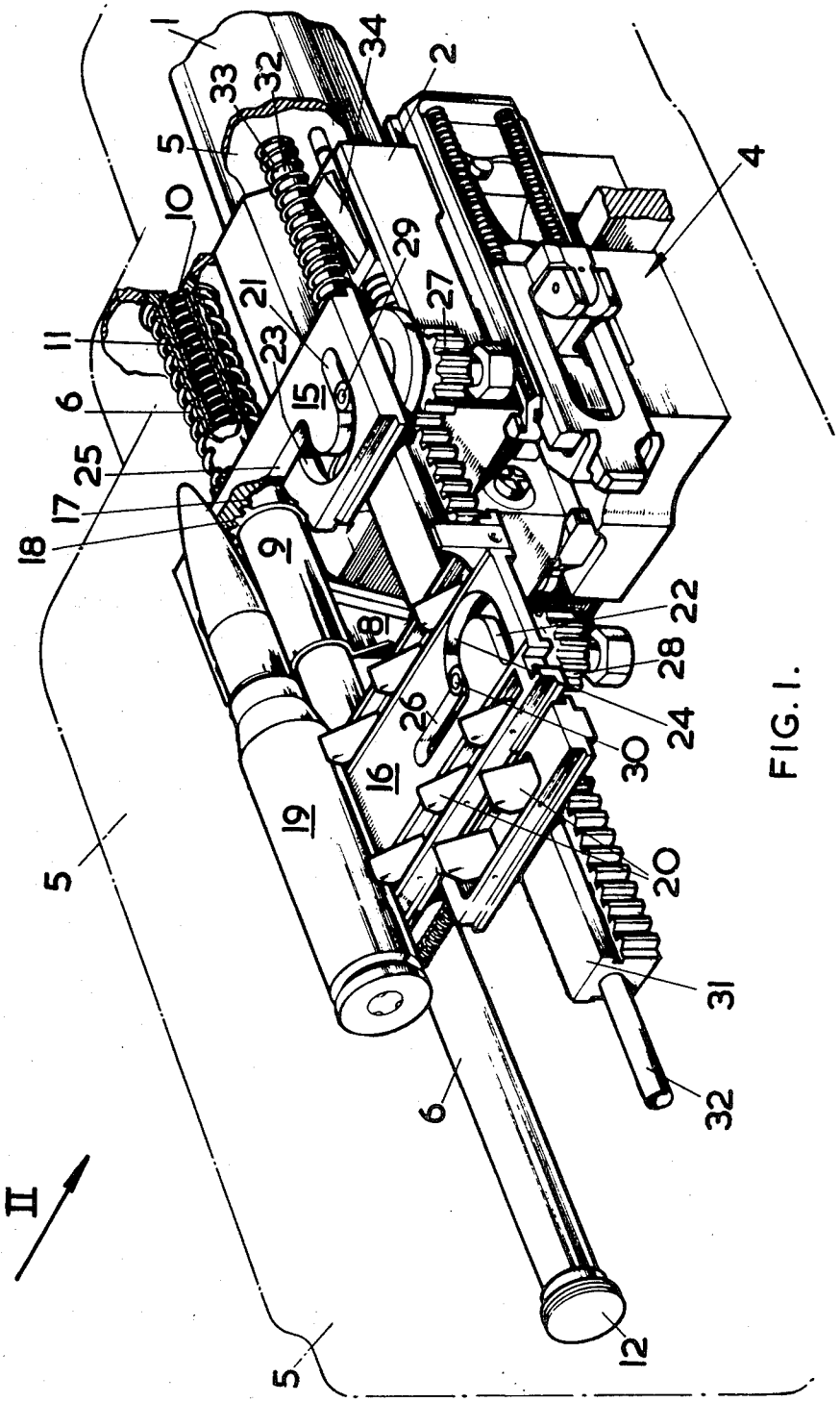


FIG. 1.

Norman J Brent
Inventor

By
Cushman, Darby & Cushman
Attorneys

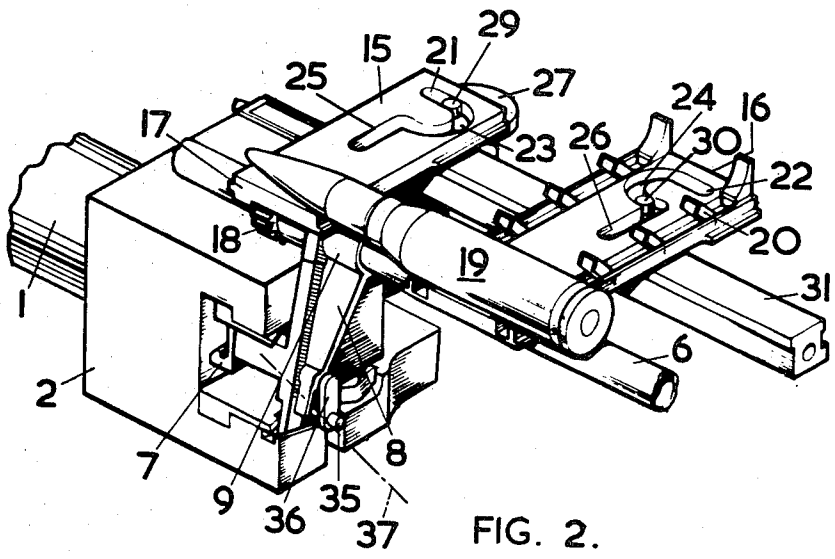


FIG. 2.

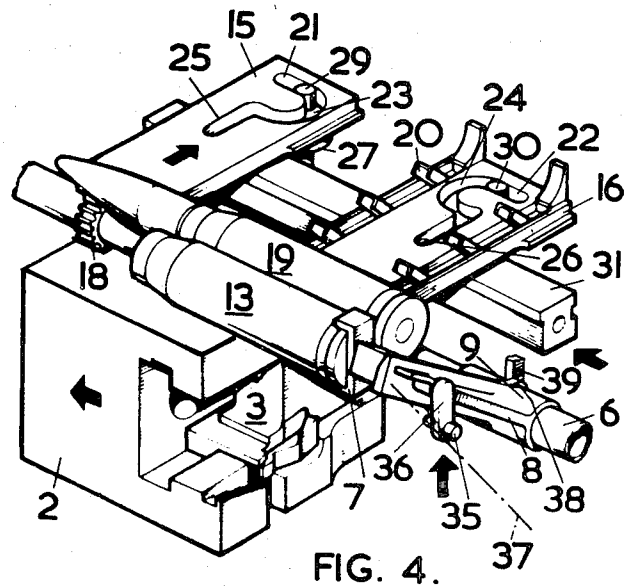


FIG. 4.

Norman I. Brunt

Inventor

By

Cushman, Darby & Cushman

Attorneys

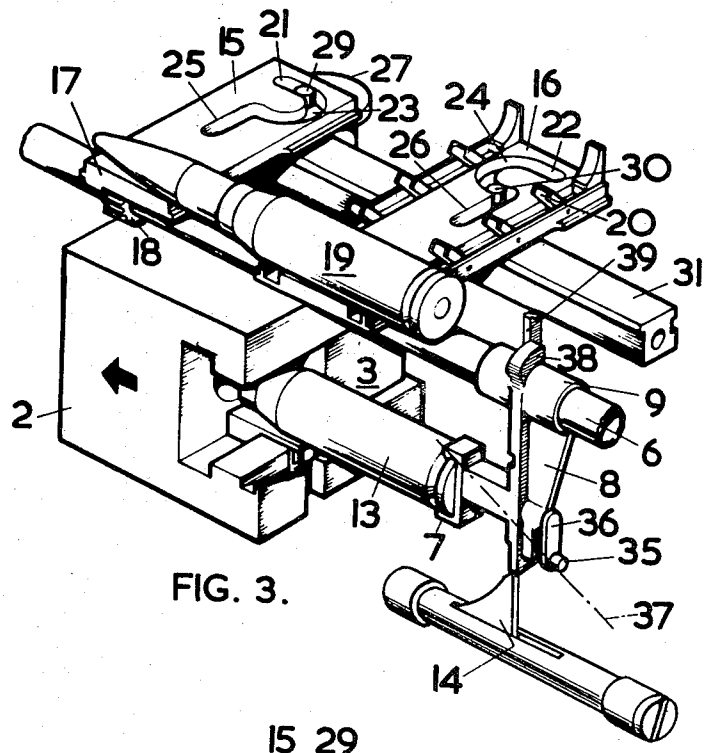


FIG. 3.

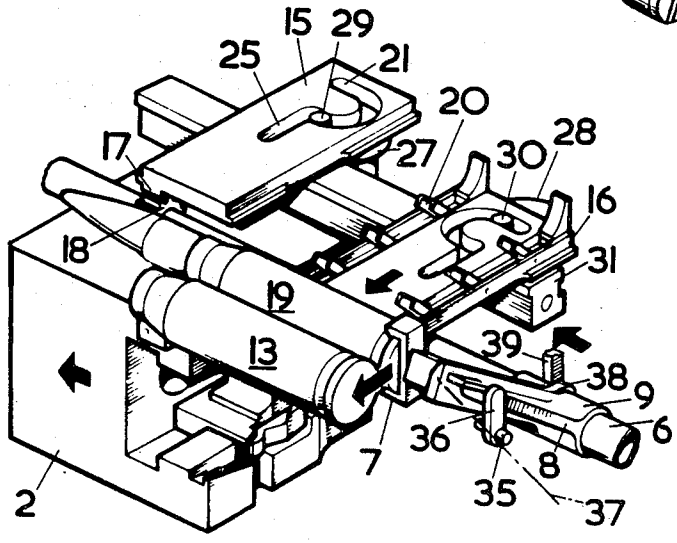


FIG. 5.

Norman J. Brint
Inventor

By
Cushman, Darby & Cushman
Attorneys

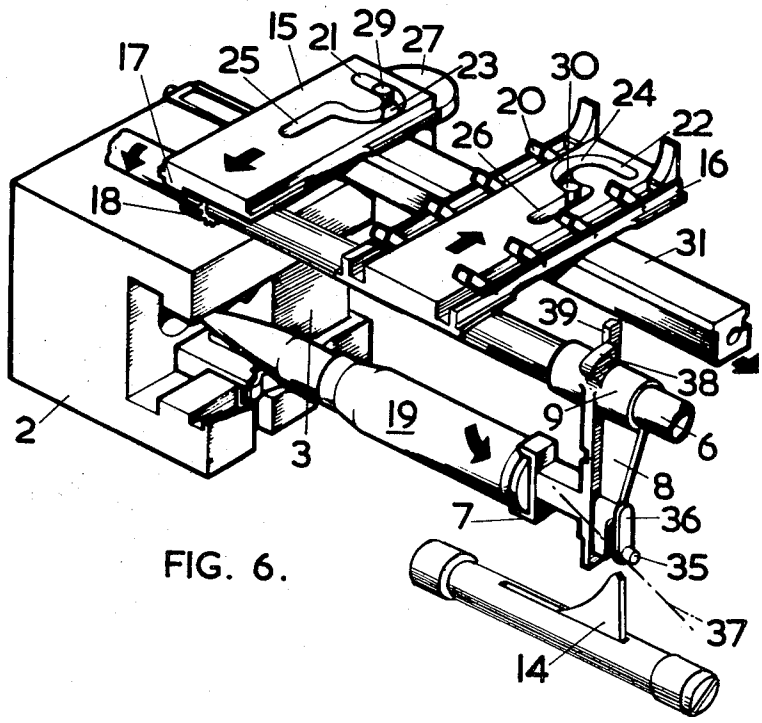


FIG. 6.

Norman I. Brust
Inventor

By
Cushman, Darby & Cushman
Attorneys

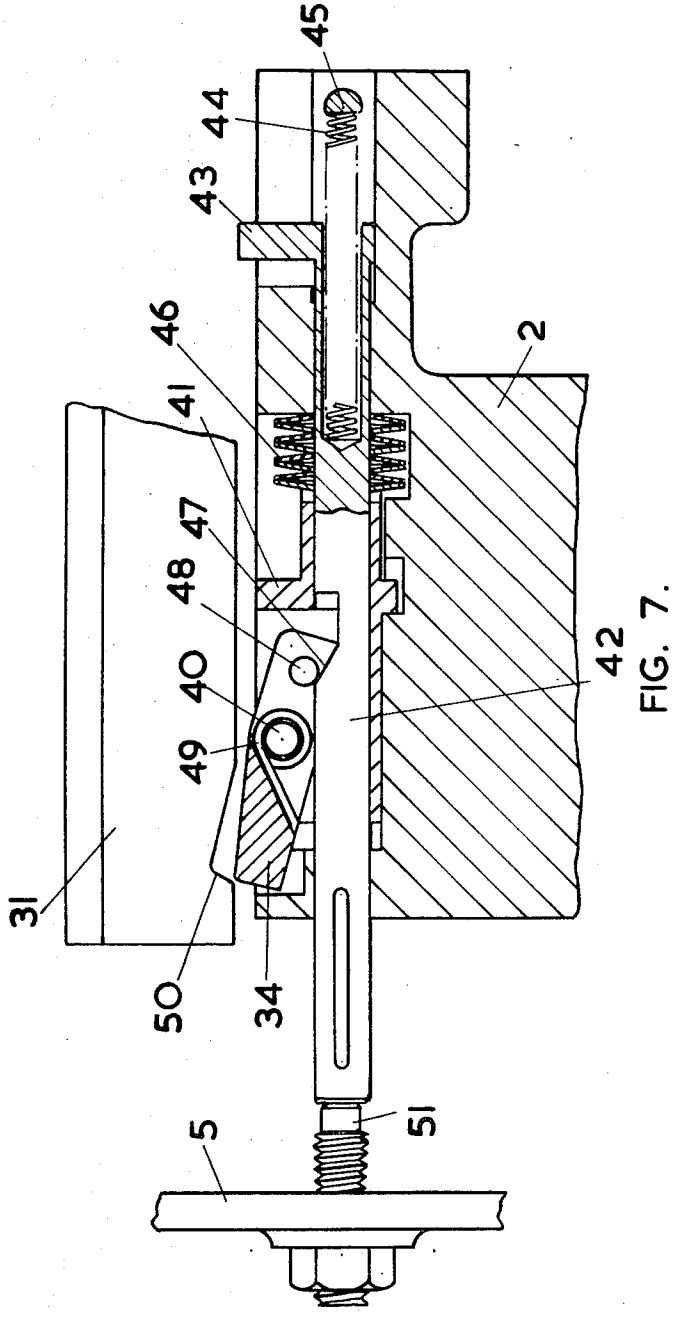


FIG. 7.

Norman J. Brint
Inventor

By
Cushman, Darby & Cushman
Attorneys

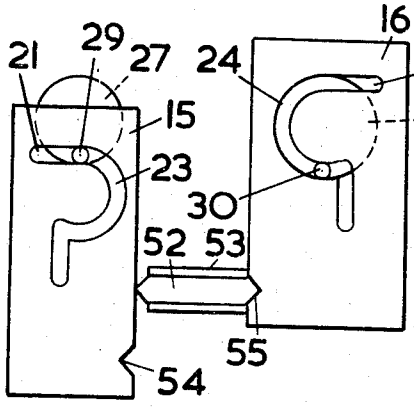


FIG. 8 (a)

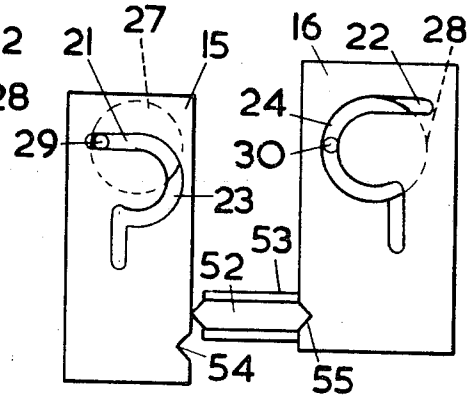


FIG. 8 (b)

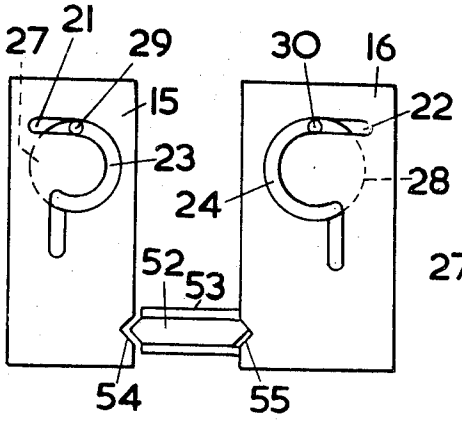


FIG. 8 (c)

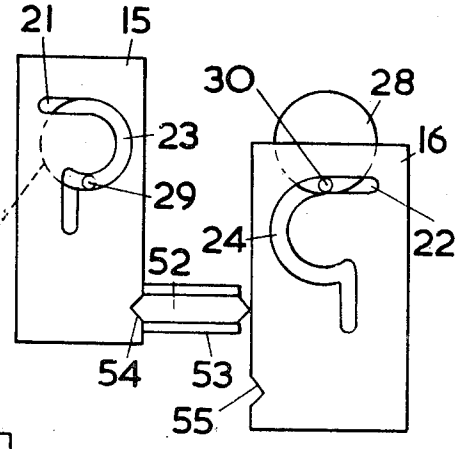


FIG. 8 (d)

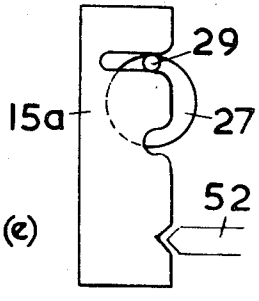


FIG. 8(e)

Norman J. Brent
Inventor

By
Cushman, Darby & Cushman
Attorneys

LOADING MECHANISMS FOR GUNS

This invention relates to loading mechanisms for guns and is particularly concerned with a feed mechanism for an automatic gun.

A feed mechanism, in accordance with the invention, for an automatic gun, incorporates a feed tray movable transversely of the gun axis; a pinion rotatable about an axis fixed with respect to a mounting in which the gun recoils on firing, which pinion has a member located eccentrically thereon and engaging in a guideway carried by the feed tray whereby the feed tray can be moved transversely of the gun by rotation of the pinion; and a toothed rack arranged to be moved relative to the mounting, against the action of a rack spring, by engagement therewith, during run-out, of a member moving with the gun, during which movement the rack engages and rotates the pinion thereby actuating the feed tray, whereafter the rack is disengaged from the gun to allow the rack and the feed tray to return to their initial positions under the action of the rack spring.

The feed tray will usually be arranged to move horizontally and the pinion may conveniently be mounted on a vertical axis below the tray and carry an eccentrically mounted pin or roller extending upwardly from its upper surface into a slot formed in the base of the feed tray. In its simplest form the slot may be straight and parallel to the gun axis. The tray may move in the horizontal axial plane of the gun to deliver a round of ammunition to a loading position on or adjacent the gun axis. In this case of course, it is necessary to ensure that the tray be retractable laterally to a position clear of the path of the recoiling parts or to locate it rearward of the maximum recoil position of the gun. In either case a considerable increase in the overall width or length of the equipment results and while this may be acceptable in a gun mounted on an open carriage it can be a serious disadvantage where the weapon is mounted in a vehicle where space saving is a most important factor.

It is preferred, therefore, to locate the tray above the path of the recoiling parts and to feed new rounds of ammunition from the tray to a rammer which then carries the new round to the loading position on the gun axis. To this end, the equipment may incorporate a rammer actuating slide, operating in a manner similar to the feed tray, which slide moves the rammer to and fro between the loading position and a receiving position.

The rammer slide and the feed tray can be actuated out of phase by introducing lost motion into the appropriate parts of the mechanism and this can conveniently be achieved by means of arcuate continuations of the respective guideways each of which continuations, at a selected stage of the cycle of movement is arranged to follow the path of the eccentrically located member on the associated pinion thus allowing the pinion to rotate through a selected sector without moving the associated slide or tray. By this means the rammer may, for example, be moved to its receiving position during the lost motion phase of the feed tray cycle and retained by its own lost motion arrangement during actuation of the feed tray, the sequence being reversed by action of the rack spring on disengagement of the rack from the gun.

It is particularly advantageous to employ the mechanism of the present invention in conjunction with an extractor/rammer of the type described in my co-pending U.S. Pat. application Ser. No. 594,312 wherein an extractor claw, carried on a beam pivoted above the breech of the gun, is moved into engagement with the spent case after firing and recoils with the weapon against the action of a rammer spring, the beam, claw and spent case being retained in a rearward position during run-out. After replacement of the spent case by a new round the extractor is released and assumes the role of rammer to insert the new round into the breech. To incorporate this extractor/rammer into the present invention, the rammer, while in the rearward position, is arranged to be rotated about its pivot, until the claw is located above the gun axis in a position ready to receive a new round of ammunition from the feed tray. After actuation of the feed tray to insert a new round into the claw, the rammer is returned to its loading position with the claw located on the gun axis. Release of the rammer effects ramming of the new round into the breech by action of the rammer spring. Rotation of the rammer to receive the new round may be achieved by means of rack teeth on the rammer slide, which teeth engage a pinion or a toothed segment on, or keyed to, a shaft carrying the rammer.

One feed mechanism in accordance with the invention will now be more particularly described, by way of example only, with reference to the accompanying drawings in which:

FIG. **1** is a perspective view of the mechanism, the majority of the mounting having been omitted for clarity,

FIGS. **2** to **6** are partly diagrammatic perspective views, in the direction of arrow II in FIG. **1**, showing a sequence of positions during the loading cycle,

FIG. **7** is a detail of a rack catch and release mechanism,

FIG. **8**(*a*) to (*d*) is a sequence of diagrammatic drawings showing the operation of a locking device and **8**(*e*) shows another form of slide,

FIGS. **1** to **6** show the breech end of a gun having a barrel **1** carrying, at its rear end, a breech ring **2** incorporating a breech block **3** actuable by a breech mechanism indicated generally at **4**. Although, for clarity, most of the mounting has been omitted, certain parts of it are indicated at **5** (FIG. **1**).

Mounted on a guide tube **6**, located parallel to the gun axis above the breech ring and extending rearwardly thereof, is a combined extractor/rammer comprising an extractor claw **7** carried at the end of a beam **8** which extends radially from a tubular sleeve **9** mounted on the guide tube **6**. The guide tube **6** is carried rotatably in the mounting **5** and the rammer sleeve is keyed into an elongated slot in the guide tube to prevent relative rotation while allowing the sleeve to slide along the guide tube. The sleeve **9** is further keyed, through the slot, to an inner tube **10** slideable within the guide tube **6**, which inner tube **10** moves longitudinally with the rammer and is biased forwardly by a rammer spring **11** in compression between a flange at the forward end of the inner tube **10** and the forward face of the rear end **12** of the guide tube **6**. The rammer is arranged, in a manner already proposed in the aforementioned co-pending application and not further

described here since it forms no part of the present invention, to engage the spent cartridge case 13 as the breech opens and the gun recoils after firing, whereafter the rammer is carried rearward by the recoiling breech ring 2, compressing the rammer spring 11. At the end of recoil the rammer is engaged by a spring catch 14 and retained, as the gun runs-out, to extract the cartridge case 13 from the breech. The position at this stage is shown in FIG. 3.

Mounted above the path of the breech ring 2, are two longitudinally spaced slides 15, 16 slidable transversely above said path. The first of these constitutes the rammer slide 15 and incorporates, on its underside, a set of rack teeth 17, which are in engagement with a toothed segment 18 fixed or keyed to the guide tube 6 which is rotatable with the segment 18. Transverse movement of the rammer slide 15 will thus rotate the segment 18 and, with it, the guide tube 6 and the rammer. The second slide constitutes the feed tray 16 and carries the new rounds of ammunition 19 which are arranged to progress along the tray, in known manner, by the action of spring fingers 20 as each successive round is fed into the gun. Each of the slides 15 and 16 has, formed therein, a slot comprising a straight, actuating portion 21, 22 and an arcuate continuation 23, 24 extending from the straight portion, in the form of a semi-circle, on the inner side of the straight portion, which is parallel to the gun axis. The term 'inner' is used here to refer to that side of the straight slot nearer to the gun axis. The further straight portions 25, 26 of the slots, extending transversely to the gun axis, are not essential to the operation of the mechanism but are incorporated to assist assembly.

Below the slotted portions of the slides 15, 16, are two pinions 27, 28, rotatable about vertical axes, fixed relative to the mounting 5, which axes intersect the respective transverse diameters of the arcuate portions 23, 24 of the slots. Carried eccentrically upon each of the pinions is a roller 29, 30 which extends upwardly into the slot in the associated slide 15, 16. The eccentricity of the rollers 29, 30 is equal to the radius of the arcuate portions 23, 24 of the slots so that the rollers can move around these portions of the slots without producing movement of the slides, but will move the slides transversely when moving in the straight portions 21, 22. The arcuate portions of the slots are in opposition, that is to say, the arcuate portion 23 of the slot in the rammer slide 15 is rearward of the straight portion 21 while in the feed tray 16 the arcuate portion 24 is forward of the straight portion 22.

A toothed rack 31, slidable on a guide rod 32 fixed to the mounting 5 has teeth in engagement with the pinions 27, 28 and is biased toward a rearward position by means of a rack spring 33. As the gun runs out the rack 31 is engaged by a spring catch 34, which will be more fully described, hereinafter, with reference to FIG. 7. The rack 31 then moves forward, rotating the pinions 27, 28, which cause the slides 15, 16 to move as shown in the sequence FIGS. 2 to 6. FIG. 2 shows the gun ready for firing. The rollers 29, 30 are at their innermost positions with roller 29 engaged in the straight portion 21 of its slot, the rammer slide being at the inner extremity of its travel; while roller 30 is engaged in the arcuate portion of its slot, the feed tray being at the outer limit of its travel. In FIG. 3, the gun has recoiled and is running out but the rack has not yet begun its movement and the slides 15, 16 have not moved from the position shown in FIG. 2. In FIG. 4, the rack 31 has moved sufficiently to rotate the pinions a half turn clockwise. Roller 29 has moved the rammer slide to its outermost position, but roller 30 has merely moved round the arcuate portion 24 of its slot. The rammer has been raised through about 120° to its receiving position ready to accept a new cartridge from the feed tray 16. The vertical position of the rammer claw 7 which is pivoted in the rammer is maintained by engagement of a pin 35 on a crank 36, attached to the claw pivot, with a cam surface, indicated by chain dotted line 37, on the mounting. The catch 14, which retained the rammer in its rearward position, has been released and has moved rearward, clear of the rammer but the rammer is now retained by engagement of a flange 38, on the sleeve 9, with a stop surface 39 on the mounting. (See also FIG. 6).

In FIG. 5 the pinions 27, 28 have executed a further half turn clockwise bringing the rollers back to their innermost positions. Roller 29 has merely moved round the arcuate portion 23 of its slot while roller 30 has operated in the straight portion of its slot to move the feed tray 16 inward and to feed a new round 19 to displace the empty case 13 in the rammer claw 7. In FIG. 6 the rack has been disengaged from the catch 34 and has moved rearward, under the action of its spring 33 (FIG. 1), reversing the previous movements of the slides whereby they have been returned to the position they occupied in FIG. 2. The rammer is now in its loading position (flange 38 having disengaged stop face 39) and is about to move forward under the action of its spring 11 (FIG. 1) to load the new round 19 into the breech.

The rack catch 34 is shown in more detail in FIG. 7. The catch 34 is pivoted, 40, in a carrier 41 mounted in a recess in the upper surface of the breech ring 2. A release rod 42, which is urged forwardly by a spring 44, extends through bores in the breech ring 2 and through the carrier 41 and is retained by a projection 43 at its rear end. The rod 42 can slide rearwardly a limited amount against the spring 44, further movement being prevented by abutment with a pin 45 which also forms a rear abutment for the spring 44. The carrier 41 can also slide a short distance in its recess and is buffered by a series of dished washers 46 between its rear end and the rear wall of the recess. The rod 42 has a cam surface 47 formed on it below the rearward end of the catch 34 which carries a pin 48 in engagement with the cam surface. The catch is loaded by a spring 49 which tends to raise its forward end above the surface of the breech ring. As the gun recoils the catch is depressed by the under surface of the rack 31, against the action of the spring 49. At an appropriate point during run-out the catch 34 springs up into a recess 50 formed in the under surface of the rack 31 and, hence, carries the rack forward, the impact shock being buffered by the washers 46. After actuation of the slides 15, 16 to effect loading of the weapon, the forward end of rod 42 engages a stop 51 carried in the mounting 5 and is moved rearward against its spring 46 whereupon the cam surface 47 raises the pin 48 to pivot the catch 34 free of the recess 50 thus disengaging the rack which is then free to move rearward again under the action of the rack spring 11.

A simple, positive, locking device may be incorporated to lock the stationary slide in position while the other slide executes its required movement. This will eliminate any tendency of the stationary slide to move during passage of the corresponding roller around the arcuate portion of its slot with possible, consequent, malfunctioning of the mechanism. A shuttle type locking device, for this purpose, is shown diagrammatically in a sequence of four positions in FIG. 8(*a*) to (*d*). A shuttle member **52** is arranged between the slides **15**, **16** and can slide freely, lengthwise, in a guide channel **53** perpendicular to the direction of motion of the slides. The device can be mounted in any convenient manner upon any suitable, stationary part of the mounting and the precise construction for any particular weapon will readily occur to those skilled in the art and is not, therefore, illustrated. Each slide **15**, **16** is provided with a notch **54**, **55** in its edge on the side adjacent the shuttle **52** which notch is aligned with the shuttle when the slide is in its stationary position. The length of the shuttle is substantially equal to the distance between the slides plus the depth of a notch so that, when one end of the shuttle is engaged in the notch of one slide, the other slide can just move past the other end of the shuttle. The notches and the ends of the shuttle are tapered or otherwise shaped so that, at the appropriate moment, the beginning of the movement of a slide engaged by the shuttle will move the shuttle by cam action out of its own notch into that of the other slide. FIG. 8 (*a*) shows the mechanism in the rest position corresponding to FIGS. **2** and **3** with shuttle **52** engaged in notch **55** of slide **16** and retained there by the edge of slide **15**. Run-out of the gun moves slide **15** by action of the roller **29** on the straight portion **21** of its slot, the slide **15** moving past the end of the shuttle **52** through the halfway position shown in FIG. 8(*b*) to the position shown in FIG. 8(*c*) which corresponds to that in FIG. **4**. Meanwhile slide **16** is locked by engagement of the shuttle **52** with its notch **55** while roller **30** moves round the arcuate portion **24** of its slot. Further run-out now moves slide **16**, and its initial motion causes the shuttle **52** to move, under cam action, across into slot **54** of slide **15** which is thus locked while slide **16** moves past its end of the shuttle to the position shown in FIG. 8(*d*) which corresponds to FIG. **5**. Release of the rack **31** as previously described now reverses the movement of the slides which return to the position shown in FIG. 8 (*a*) by way of the positions shown in FIGS. 8(*c*) and 8(*b*).

With such a locking device the arcuate portions of the slots can if desired be dispensed with using only the parallel portion with a suitable lead in, the travel of the roller during the stationary or "dwell" period being allowed to take place in any space or cutaway area of the slide. A slide may for example be shaped as shown at **15***a* in FIG. 8(*e*) which corresponds to the position of slide **15** in FIG. 8(*c*).

It will be clear that many modifications may be carried out without departing from the scope of the invention. For example the pinions and slots need not be, as shown, of the same size. Although this arrangement is simple and convenient it may sometimes be desirable to vary the motions of the slides and their relative timing which may be achieved by suitable design of the pinions and slots. The slots may include arcuate portions smaller than semi-circles, in some instances, according to the degree of lost motion required. The 120° rotation of the rammer may not be the best angle in all circumstances. In some instances the rammer may be rotated through 180° into its receiving position in which case the arrangement for rotating the claw would not be required since the claw would resume its vertical position at the end of its travel.

I claim:

1. A feed mechanism for feeding ammunition to an automatic gun carried in a mounting relative to which it recoils on firing, said mechanism incorporating a feed tray carried by said mounting and movable therein transversely of the gun axis; a guideway carried by the feed tray; a pinion carried on the mounting and rotatable about an axis fixed relative thereto; a member located eccentrically upon the pinion and arranged to engage said guideway whereby the feed tray can be moved transversely of the gun axis by rotation of the pinion; a toothed rack carried by the mounting and slidable therein parallel to the gun axis to engage and rotate the pinion; a rack-spring arranged to urge the rack rearwardly in the mounting; rack engaging means carried by the gun for engaging the rack during run-out of the gun to move the rack forwardly against the action of the rack-spring to actuate the feed tray; and release means for disengaging the rack from said rack engaging means to permit the mechanism to return to its initial position under the action of the rack-spring.

2. A feed mechanism as claimed in claim **1** wherein the guideway consists of a slot in the base of the feed tray and the eccentrically located member is a roller extending from the pinion into said slot.

3. A feed mechanism as claimed in claim **2** wherein the feed tray is arranged to move substantially horizontally and the pinion is mounted on a substantially vertical axis below the feed tray, the roller extending upwardly from said pinion into the slot.

4. A feed mechanism as claimed in claim **1** wherein the guideway is, at least in part, rectilinear and parallel to the gun axis.

5. A feed mechanism as claimed in claim **1** wherein the path of movement of the feed tray is located above the path of the recoiling parts of the gun and which incorporates transfer means for accepting ammunition from the feed tray and delivering it to a loading position on the gun axis.

6. A feed mechanism as claimed in claim **5** wherein the transfer means incorporates a beam pivoted about an axis parallel to but offset from the gun axis and extending transversely of its pivotal axis; a claw carried by said beam, and claw actuating means for rotating said beam about said pivotal axis, in timed relationship with the movement of the feed tray, to move the claw to and fro between a receiving position adjacent to the path of the feed tray and a loading position athwart the gun axis.

7. A feed mechanism as claimed in claim **6** wherein the claw actuating means comprises pinion means nonrotatably connected to the beam and coaxial with said pivotal axis; a slide carried in the mounting and movable therein transversely of the said pivotal axis; a second guideway carried by said slide; a second pinion carried by the mounting and arranged to be rotated by the toothed rack; a second member located eccentrically upon said second pinion and arranged to engage

said second guideway to actuate said slide; and a set of rack teeth carried by said slide and engaging said pinion means whereby movement of the slide is effective to rotate the beam.

8. A feed mechanism as claimed in claim 5 wherein the transfer means comprises an extractor arranged to recoil with the gun and incorporating a beam extending transversely across the breech face of the gun and pivoted about an axis parallel to and offset from the gun axis and an extractor claw carried by said beam; means for retaining the extractor in a rearward position during run-out of the gun; actuating means for rotating the beam about its pivotal axis, in timed relationship with the movement of the feed tray, while the extractor is in said rearward position to move the claw to a receiving position adjacent the path of the feed tray to receive a round of ammunition and to return the claw, with said round, to a loading position athwart the gun axis; means for releasing the extractor from its rearward position after its return to the loading position and a rammer spring operative between the extractor and a fixed portion of the mounting and against the action of which the extractor recoils for moving the extractor forward, after release, to ram the round into the gun.

9. A feed mechanism as claimed in claim 8 wherein the actuating means comprises pinion means non-rotatably connected to the beam and co-axial with its pivotal axis; a slide carried in the mounting and movable therein transversely of said pivotal axis; a second guideway carried by said slide; a second pinion mounted on said mounting and rotatable by the toothed rack; a member located eccentrically upon said second pinion and arranged to engage said second guideway to actuate the slide in a manner similar to the actuation of the feed tray; and a set of rack teeth carried by said slide and engaging said pinion means whereby movement of the slide is effective to rotate the beam.

10. A feed mechanism as claimed in claim 7 wherein the guideways in the feed tray and the slide each incorporates a straight portion parallel to the gun axis and extending, one rearwardly and the other forwardly, from the respective planes perpendicular to the gun axis through the axes of the associated pinions; and each has a cutaway portion on the other side of said plane which cutaway portion includes a semicircular portion of the path of the associated member eccentrically located on the pinion, whereby each of the tray and slide can remain stationary during passage of its associated eccentrically located member through this part of the guideway.

11. A feed mechanism as claimed in claim 10 wherein said cutaway portion of each guideway comprises a semicircular channel just wide enough to accommodate the eccentrically located member and coincident with the path of said member whereby each of the tray and slide is maintained stationary during passage of the associated eccentrically located member around this portion of its guideway.

12. A feed mechanism as claimed in claim 10, wherein the slide and feed tray are arranged to move along parallel paths and a locking device is provided comprising a guide channel extending perpendicular to said paths between the slide and the feed tray and a shuttle, slidable in said channel, for engagement in one or other of two notches formed one in each of the respective adjacent sides of the feed tray and slide; the length of the shuttle being substantially equal to the distance apart of the tray and slide plus the depth of one notch, whereby each of the tray and slide is locked by engagement of the shuttle in its notch while the other is moving and the notches and the ends of the shuttle are tapered so that each of the tray and slide can, at the commencement of its movement, move the shuttle across into engagement with the other by cam action when the notches are aligned.

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