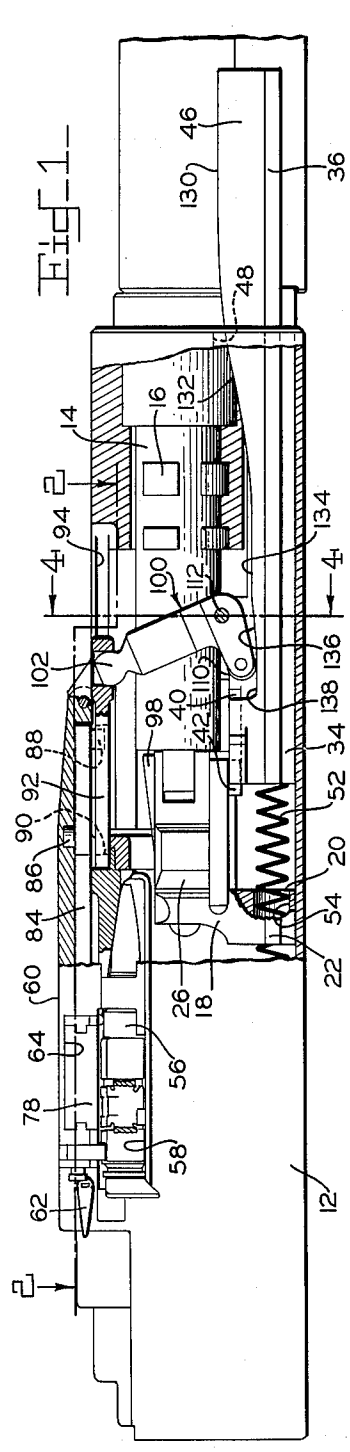
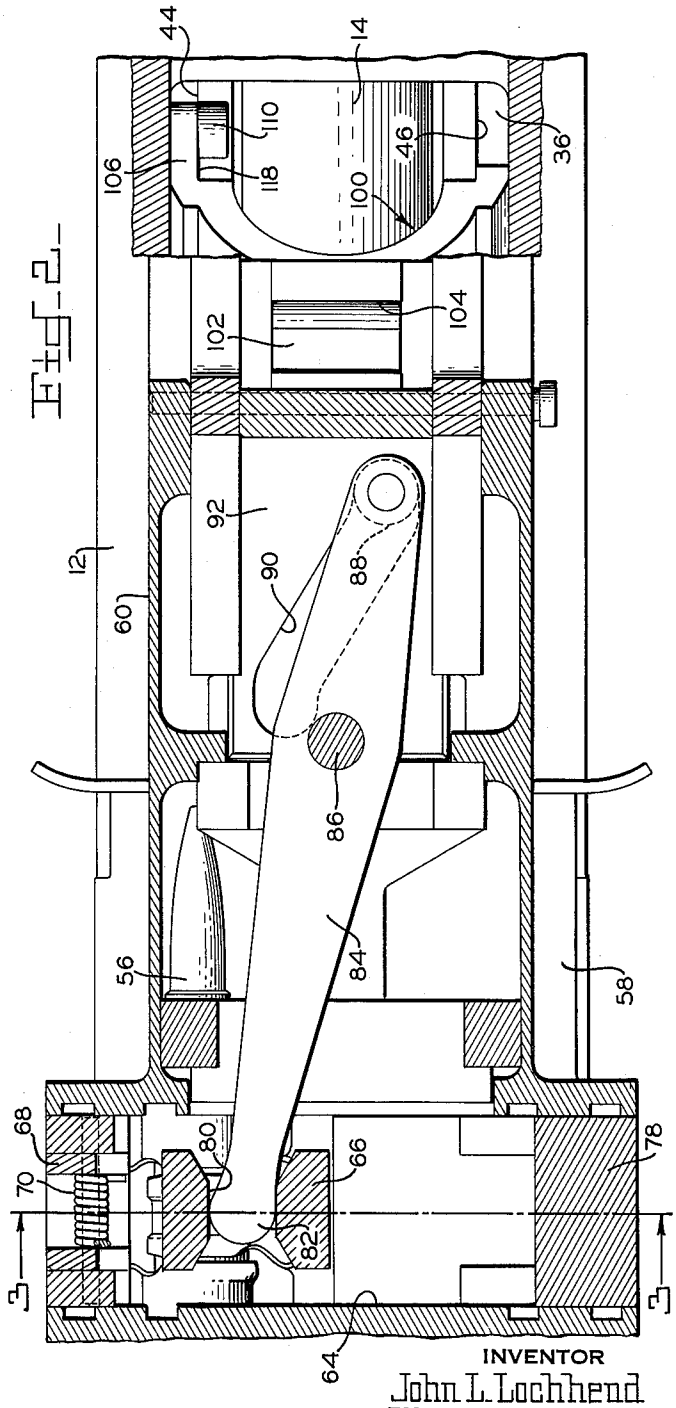
Dec. 7, 1965 J. L. LOCHHEAD 3,221,603

CARTRIDGE FEEDING MECHANISM FOR FIXED-BARREL, SLIDE-OPERATED GUNS

Filed March 23 1964 3 Sheets-Sheet 1





INVENTOR
John L. Lochhead
BY
Harry M. Saragovitz, Edward J. Kelly, Herbert Berl & Albert E. Arnold Jr.
ATTORNEY

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Fig. 3

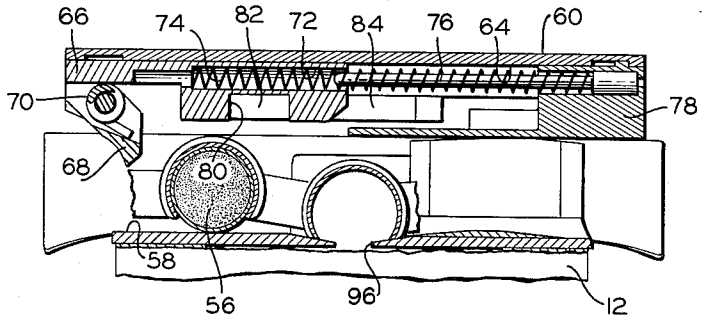


Fig. 4

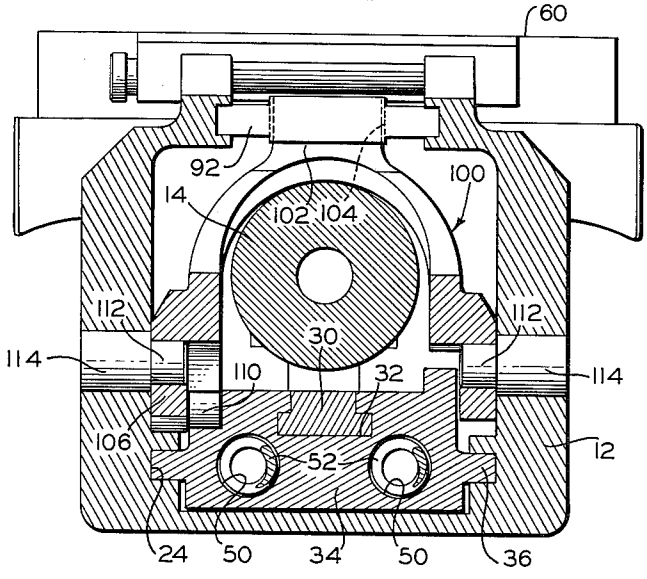
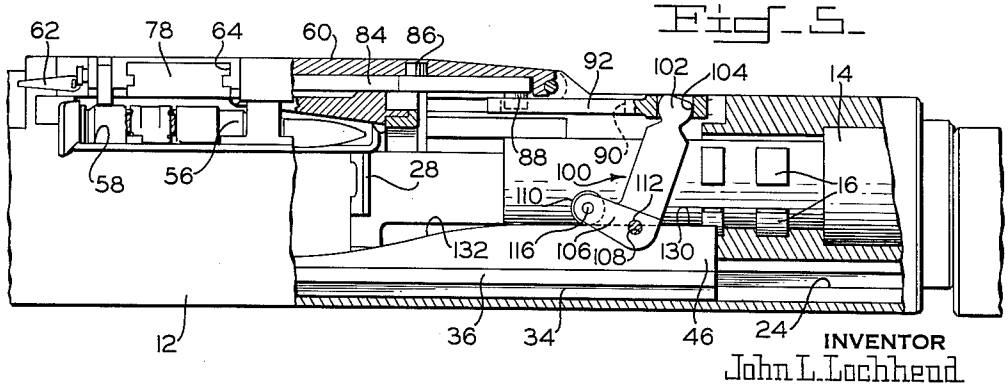


Fig. 5



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John L. Lochhead

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Harry M. Saragovitz, Edward J. Kelly,
Herbert Berl, & Albert E. Arnold Jr.

ATTORNEY

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Fig. 6

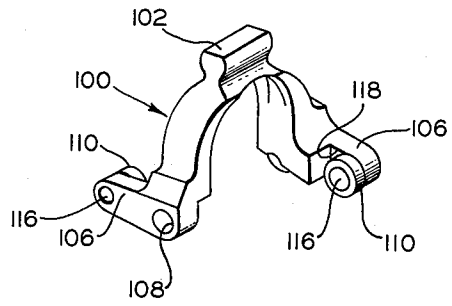
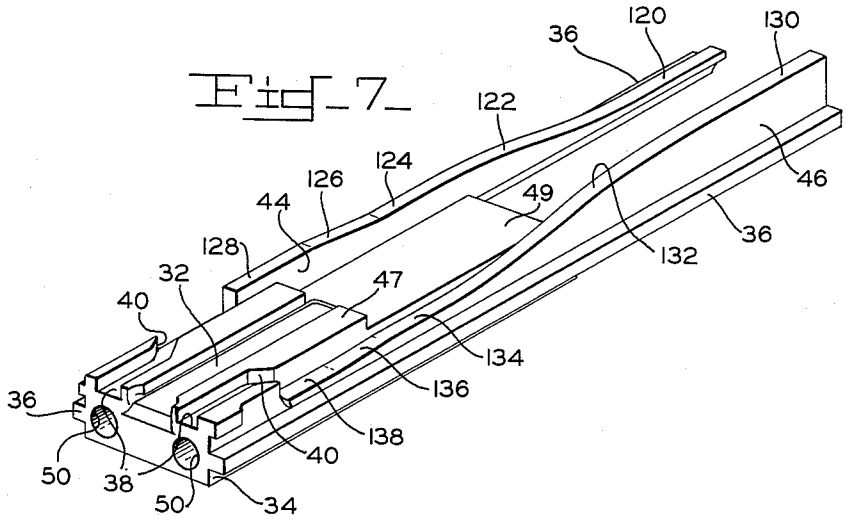


Fig. 7



INVENTOR
John L. Lochhead
BY
Harry M. Saragovitz, Edward J. Kelly, Herbert Berl & Albert P. Arnold Jr.
ATTORNEY

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CARTRIDGE FEEDING MECHANISM FOR FIXED-BARREL, SLIDE-OPERATED GUNS

John L. Lochhead, Springfield, Mass., assignor to the United States of America as represented by the Secretary of the Army

Filed Mar. 23, 1964, Ser. No. 354,183
7 Claims. (Cl. 89—33)
(Granted under Title 35, U.S. Code (1952), sec. 266)

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 automatic guns in which a slide is longitudinally reciprocated to control the opening and closing of the breech and is more particularly directed to improved means for utilizing the reciprocation of the slide to actuate mechanism for feeding ammunition into position to be rammed into the firing chamber during the closing of the breech.

Although the requirements of modern warfare create a constant demand for weapons of larger caliber and increased fire-power, considerable difficulty has been encountered in providing these characteristics in those automatic guns intended for installation in such military vehicles as tanks and aircraft. For one thing, the greater length of these larger caliber guns cannot be readily accommodated in the extremely small compartments generally provided for the operator of these vehicles. While the concept of locating the gun outside the operator's compartment for remote control firing has permitted a desirable increase in the size of many of these guns, such expedient has not been successfully extended to those guns wherein the ammunition is fed thereto in the form of a linked belt of cartridges which must be advanced along a transverse feedway in the receiver during each successive firing cycle. In belt fed guns of this type, it is essential that the operator have complete access to the feedway of the gun in order to permit the handling of the cartridge belt required in the loading and unloading thereof as well as in the correction or elimination of any feeding stoppages or malfunctions. Accordingly, these belt fed guns must be mounted so that at least the feedway and the portion of the receiver rearwardly thereof will lie within the reach of the operator. However, in current guns of this type, the required access to the feedway results in a receiver whose length interferes with the unrestricted freedom of movement so essential for optimum handling of the controls of the vehicle.

Although the prior art has attempted to reduce the distance between the rear end of the receiver and the rear end of the transverse feedway therein through the expedient of transferring the function of operating the cartridge feeding mechanism from the bolt to a reciprocating slide utilized to actuate the bolt, it was found that the relatively complex connection required between the slide and the cartridge feed mechanism invariably nullified the benefits derived from the reduction in the length of the bolt.

Accordingly, it is a general object of this invention to provide a simple and rugged cartridge feeding mechanism for a relatively large caliber automatic gun of the type wherein the bolt is actuated by a reciprocating slide to strip the leading cartridge from a linked belt and ram such cartridge into the firing chamber in the barrel.

It is a further object of this invention to locate the aforesaid cartridge feeding mechanism in a manner which will permit a substantial reduction in the length of the receiver rearwardly of the transverse feedway therein.

A more specific object of this invention is to provide

cartridge feeding mechanism, as aforesaid, wherein the linkage between the slide and the cartridge feeding pawls is accomplished with a minimum number of parts.

Another object of the present invention lies in the provision of a cartridge feeding mechanism, as aforesaid, wherein the components thereof do not extend rearwardly of the feedway in the receiver.

It is a final object of this invention to provide a cartridge feeding mechanism, as aforesaid, wherein the slide can be readily removed from the gun without the necessity for the prior disassembly of the cartridge feeding mechanism.

It has been found that the foregoing objects can be achieved by improved means for converting the longitudinal reciprocation of the slide to a transverse reciprocation of the cartridge feed mechanism. Such means essentially comprises a U-shaped actuator pivotally mounted in the receiver to straddle the breech end of the barrel. One leg of the actuator is provided with a forwardly extending roller while the opposite leg carries a similar but rearwardly extending roller. Both rollers are positioned to simultaneously ride on oppositely sloped longitudinal cam rails extending along the sides of the slide. Thus, as the slide recoils, the actuator is pivoted in a clockwise direction and as the slide returns to the battery position thereof, the actuator is pivoted in a counterclockwise direction. This pivotal movement of the actuator is utilized to reciprocate a longitudinally slidable cam plate which, in turn, actuates a pivotal feed lever to impart transverse reciprocal movement to a belt feed pawl in a conventional manner.

Since the slide is arranged to lie beneath the barrel with the cam rails thereon protruding from the front end of the receiver, the actuator can be conveniently mounted forwardly of the breech end of the barrel. Thus, the pivotal movement imparted to the actuator by the recoil of the slide is utilized to pull the cam plate forwardly thereby permitting the belt feed lever to be pivoted at a point forwardly of the feedway in the receiver and still possess sufficient length to provide the leverage necessary to actuate the belt feeding pawl even under maximum feeding loads. Since this arrangement permits actuation of the cartridge feed mechanism immediately upon the start of the recoil movement of the slide, it is not necessary to include the initial dwell period ordinarily provided to permit the unlocking of the bolt. Consequently, the feeding movement imparted to the cartridge belt can be accomplished with a bolt of reduced size whose recoil travel need be only slightly greater than the length of the cartridge thereby permitting a substantial reduction in the length of the receiver rearwardly of the feedway therein.

Further objects and advantages of the invention will be apparent from the following specification and the accompanying drawings which are for the purpose of illustration only and in which:

FIG. 1 is a longitudinal side view of the gun partially broken away to show the slide and the bolt in battery position prior to the initiation of the feeding movement imparted to the cartridge belt;

FIG. 2 is a sectional view taken along line 2—2 in FIG. 1 and enlarged to show the structure in greater detail;

FIG. 3 is a transverse section taken along line 3—3 in FIG. 2 to show the position of the components of the cartridge belt feeding mechanism as seen when looking forwardly from within the feedway in the receiver;

FIG. 4 is a transverse section taken along line 4—4 in FIG. 1 to show the manner in which the cam plate actuator straddles the barrel forwardly of the breech end thereof;

FIG. 5 is a longitudinal view similar to that of FIG. 1 but showing the relative positions of the parts at the conclusion of the recoil movement of the slide;

FIG. 6 is a perspective view of the pivotal actuator utilized to reciprocate the feed cam plate; and

FIG. 7 is a perspective view of the slide on the same scale of FIG. 1.

As illustrated in the drawings, the gun in which the present invention is incorporated includes a receiver **12** in the forward end of which a barrel **14** is fixedly secured by means of interrupted locking lugs **16**. A bolt **18** is slidably mounted in receiver **12** in axial alignment with barrel **14** and to this end bolt **18** is provided with a depending rear end **20** having a longitudinal rib **22** along each side thereof for slidable engagement with a corresponding groove **24** in the side of receiver **12**. Bolt **18** is also provided with a pair of locks **26** pivoted in opposite sides thereof in position to be cammed outwardly, during the return of the recoiling parts to battery position, in front of correspondingly positioned abutments **28** fixed to the interior walls of receiver **12**. Forwardly of depending rear end **20**, bolt **18** is formed with a T-bar portion **30** along the underside thereof for slidable engagement in a corresponding T-slot **32** provided in the top of a slide **34** mounted for reciprocation in receiver **12** below barrel **14** by means of longitudinal ribs **36** engageable in receiver grooves **24**.

As best shown in FIG. 7, T-slot **32** extends forwardly from the rear end of slide **34** for a distance slightly in excess of the travel required to completely unlock bolt **18** for recoil movement thereof. A pair of cam slots **38** flank T-slot **32** and extend forwardly along the top of slide **34** to terminate in outwardly angled sections **40** disposed substantially midway of the length of T-slot **32**. Cam slots **38** are of sufficient width to engage a diamond-shaped follower stud **42** (FIG. 1) depending from the underside of each bolt lock **26** whereby the locking and unlocking of bolt **18** is controlled by the reciprocation of slide **34**. The opposite sides of slide **34** are respectively provided with cam rails **44** and **46** which extend forwardly therealong immediately above and adjacent to ribs **36**. In order to permit maximum travel of slide **34** in a minimum length of receiver **12**, slide **34** is formed with a body portion **47** which, although of sufficient length to maintain contact between T-slot **32** therein and the T-bar portion **30** of bolt **18** in the forwardmost position of slide **34**, is nevertheless considerably shorter than cam rails **44** and **46**. In addition, the front end of receiver **12** is provided with a pair of openings **48** (FIG. 1) which are spaced apart to permit the passage of cam rails **44** and **46** therethrough as slide **34** returns to the fully forward position thereof. Consequently, the forward half of slide body portion **47** is reduced in height, as indicated at **49**, to clear locking lugs **16** on barrel **14**. Slide body portion **47** is also forwardly bored, as shown at **50**, to form spaced apart seats for a pair of operating springs **52** which are of sufficient length to extend into openings **54** in the depending rear end **20** of bolt **18** and bear against the rear wall in receiver **12**.

In order to provide a floor for a belt of linked cartridges **56**, receiver **12** is provided with a transverse feedway **58** disposed rearwardly of barrel **14** and immediately above the path of travel of bolt **18**. Access to the top of feedway **58** is normally prevented by a cover **60** which is pivoted at the forward end thereof to receiver **12** and is adapted to be retained in the closed position thereof by a latch **62** at the rear end thereof. The underside of cover **60** is transversely slotted adjacent the rear end thereof to form a track **64** for slidably receiving a feed slide **66**. As best shown in FIG. 3, a pawl **68** is pivoted to the underside of feed slide **66** at the outer end thereof and is normally biased by a suitable torsion spring **70** into position to engage the side of one of the cartridges **56** in the linked belt. The inner and opposite end of slide **66** is bored, as indicated at **72**, to receive one end

of a longitudinal coil spring **74**. The opposite end of spring **74** is disposed in abutment with the enlarged head of a guide rod **76** seated in a block **78** which is, in turn, fixedly retained in the end of track **64** above the exit portion of feedway **58**. The underside of feed slide **66** is suitably grooved, as best shown at **80**, in FIG. 2 to engage the rounded rear end **82** of a lever **84** pivotally mounted on a pin **86** depending from the underside of cover **60** at a point slightly forward of the front end of feedway **58**.

The forward end of feed lever **84** terminates in a depending follower stud **88** engageable in an angular cam track **90** formed in a substantially rectangular plate **92** slidably mounted in a corresponding rectangular recess **94** longitudinally formed into the top of receiver **12** to extend forwardly of feedway **58** therein. Thus, when plate **92** is reciprocated by means to be described, cam track **90** therein imparts lateral pivotal movement to feed lever **84** which, in turn, actuates feed pawl **68** to advance the leading cartridge **56** in the belt to a position in coaxial alignment with a relatively narrow slit **96** in the center of feedway **58**. In this position, the base of such cartridge **56** will be contacted by the front end of a rammer **98** pivoted in bolt **18** to project above the top thereof in response to the bias of a suitable spring (not shown).

The reciprocation required of cam plate **92** is imparted thereto by an inverted U-shaped actuator **100** pivotally secured in receiver **12** to straddle the breech end of barrel **14**. The upper end of actuator **100** is formed with a slabbed cylindrical portion **102** adapted to pivotally engage in a transverse slot **104** in the front end of cam plate **92**. Each leg of actuator **100** terminates in a foot portion **106** with a mounting hole **108** at the heel end and a roller **110** at the toe and thereof. Each mounting hole **108** in actuator **100** is sized to rotatably receive the reduced diameter end **112** of a transverse pivot stud **114** fixedly secured by any suitable means in the sidewalls of receiver **12**. Rollers **110** are each mounted on a transverse pin **116** suitably fixed in each toe end of actuator **100** which, as best shown at **118** in FIG. 6, is reduced in width by an amount substantially equivalent to the width of roller **110**.

As best shown in FIG. 7, cam rail **44** on the left side of slide **34** is formed with a section **120** of minimum height at the front end thereof which extends rearwardly in parallelism with rib **36** thereon and blends into an upwardly sloped section **122** which leads into a second section **124** parallel to rib **36**. Rearwardly of section **124**, cam rail **44** is formed with a continued upward slope **126** which extends into a third section **128** parallel to rib **36** and terminates at a point spaced forwardly of the front end of outwardly angled cam slot **40**. Rail **46** on the right hand of slide **34** is similarly contoured except that cam sections **132** and **136** thereon are inversely sloped relative to cam sections **122** and **126**. In addition, since roller **110** on the right leg of actuator **100** is disposed rearwardly of the roller **110** on the left leg thereof, sections **134** and **138** are located rearwardly of corresponding sections **124** and **128** by an amount substantially equivalent to the longitudinal distance between the centers of rollers **110**. In order to maintain this spacing between the corresponding sections of rails **44** and **46**, the length of section **130** is increased over that of section **120** and section **138** is terminated at a point adjacent the forward end of outwardly angled cam slot **40**.

Thus, in the battery positions of bolt **18** and slide **34**, the difference in height at the rear ends of rails **44** and **46** positions actuator **100** so that the portion thereof above pivot studs **114** is tilted rearwardly as best shown in FIG. 1. As slide **34** begins to recoil in response to the impact of a gas-operated piston (not shown) against the front face of body portion **47**, the rearward travel of cam sections **126** and **236** begins to pivot actuator **100**

in a clockwise direction about pivot studs **114** in receiver **12**. As a result, cam plate **92** is pulled forwardly sufficiently to bring the angular portion of cam track **90** into engagement with follower stud **88** on belt feed lever **84**. This initial pivoting of actuator **100** is momentarily interrupted as parallel sections **124** and **134** are moved into engagement with rollers **110** and, during this dwell period, the outwardly angled sections **40** of cam slots **38** in slide **34** pivot bolt locks **26** out of engagement with fixed abutments **28** in receiver **12** to unlock bolt **18** for recoil movement together with slide **34**.

As cam sections **122** and **132** move into engagement with rollers **110**, the previous clockwise pivotal movement of actuator **100** is again continued, pulling cam plate **92** forwardly to the position shown in FIG. 5. During this portion of the pivotal movement of actuator **100**, belt feed lever **84** is pivoted to advance belt feed pawl **68** inwardly along cartridge feedway **58** and carry the leading cartridge **56** in the linked belt into coaxial alignment with the longitudinal slit **96**. As this is accomplished, parallel sections **120** and **130** contact rollers **110** on actuator **100** to provide a dwell period during which the rearward travel of slide **34** to reversed for subsequent counterrecoil movement in response to the energy of compressed operating springs **52**.

Actuator **100** is thereupon pivoted in a counterclockwise direction in a manner which is the exact opposite of the movement imparted thereto during the clockwise pivoting thereof. During this counterrecoil movement of slide **34**, bolt **18** is advanced therewith so that rammer **98** pushes the leading cartridge **56** in the belt out of the link engaged therewith and into the firing chamber in barrel **14**. At the same time, the forward movement of cam plate **92** returns belt feed pawl **68** to the outermost position thereof into engagement with the side of the cartridge **56** next adjacent to the one being chambered by bolt **18**. At the conclusion of the forward movement of bolt **18**, the continued forward movement of slide **34** brings follower studs **42** on bolt locks **26** into cam slots **38** to be pivoted into locking engagement with receiver **12**. Thus, the recoiling parts of the gun are positioned for the firing of the next shot in an automatic or semi-automatic manner.

Thus, there is here provided an extremely compact design wherein no more than two components are required to impart the energy of a reciprocating bolt-operating slide to a conventional belt feed lever. Furthermore, these components are specifically located in the receiver to limit the rearward travel of the slide to that required to position the face of the bolt behind the leading cartridge in the feedway. As a result, the length of that portion of the receiver which includes the cartridge feedway and the space rearwardly thereof is reduced to a minimum. This, of course, results in a gun which can be conveniently mounted in a tank or aircraft in a manner which provides a significant reduction in the extension thereof into the compartment of the operator without any corresponding decrease in the accessibility of the cartridge feeding mechanism.

Moreover, inasmuch as only an actuator and a cam plate are required to transmit the reciprocation of the slide to the belt feed lever, this invention provides an unusually simple and rugged mechanism in comparison to the prior art arrangements which required that a considerable portion of the cartridge feed mechanism extend rearwardly of the feedway in the receiver.

In addition, the concept of pivoting actuator **100** to the interior sidewalls of receiver **12** is particularly noteworthy since it enables the bolt and the slide to be removed from the receiver without the necessity for disassembly of any portion of the cartridge feeding assembly. Thus, the operator of the gun can accomplish any emergency adjustment of the various components in the bolt such as the extractor, ejector, or rammer without disconnecting the cartridge belt. This is important since firing can be initiated as soon as the gun is assembled without the additional step of ammunition loading heretofore required in guns of this type.

The present invention has been described in detail above for the purpose of illustration only and is not intended to be limited by this description or otherwise except as defined by the scope of the appended claims.

I claim:

1. In an automatic gun having a receiver with a transverse feedway therein for slidably receiving a linked belt of cartridges, a barrel fixedly secured in the forward end of the receiver, a bolt reciprocably disposed in the receiver in coaxial alignment with the barrel, a slide reciprocably disposed in the receiver for imparting recoil and counterrecoil movement to the bolt, and cartridge belt feed means slidably disposed in the feedway for successive engagement with each leading cartridge in the belt, the improvement in means for actuating said cartridge belt feed means in response to the reciprocating movement of the slide comprising, an actuator pivotally mounted about a transverse axis in the receiver forwardly of the breech end of the barrel, a cam plate slidably disposed in the receiver in simultaneous engagement with said actuator and the cartridge belt feed means, and cam means on the slide engageable with said actuator for imparting pivotal movement thereto and thereby reciprocating said cam plate to actuate the cartridge belt feed means for advancing the leading cartridge in the belt along the feedway into the counterrecoil path of the bolt.

2. The combination defined in claim **1** wherein said cam means on the slide comprises a rail extending along each side thereof and wherein said actuator is provided with rollers engageable with said rails.

3. In an automatic gun having a receiver with a transverse feedway therein for slidably receiving a linked belt of cartridges, a barrel fixedly secured in the forward end of the receiver, a bolt reciprocally disposed in the receiver in coaxial alignment with the barrel, a slide reciprocally disposed in the receiver for imparting recoil and counterrecoil movement to the bolt in response to the firing of a cartridge, cartridge belt feed means slidably disposed in the receiver for successive engagement with each leading cartridge in the belt, and a lever pivoted on a vertical pin in the receiver for actuating the cartridge feed means to position each leading cartridge into the counterrecoil path of the bolt, the improvement in means for pivoting the cartridge belt feed lever, comprising an actuator pivotally mounted in the receiver for reciprocal movement about a transverse axis and having a pair of oppositely spaced legs straddling the barrel forwardly of the breech end thereof, a cam plate slidably disposed in the receiver above the barrel for simultaneous engagement with the upper end of said actuator and the forward end of the belt feed lever, said actuator legs terminating in respective forwardly and rearwardly extending rollers, and a cam rail longitudinally disposed along opposite sides of the slide for contact with said rollers, said cam rails being inversely sloped whereby the reciprocation of the slide pivots said actuator to reciprocate said cam plate and impart reciprocal pivotal movement to the cartridge belt feed lever.

4. The combination defined in claim **3** wherein said cam plate includes an angular cam track and wherein the belt feed lever is provided with a depending follower stud at the forward end thereof slidably engageable in said angular cam track.

5. In an automatic gun having a receiver with a transverse feedway therein for slidably receiving a linked belt of cartridges, a barrel fixedly secured in the forward end of the receiver, a bolt slidably disposed in the receiver in coaxial alignment with the barrel for reciprocating movement into and out of locked battery position, a slide reciprocably disposed in the receiver for imparting recoil and counterrecoil movement to the bolt in response to the firing of a cartridge, cartridge belt feed means slidably

disposed in the receiver for successive engagement with each leading cartridge in the belt, and a longitudinal lever pivoted on a vertical pin fixed in the receiver at a point above the forward sidewall of the transverse cartridge belt feedway, the improvement in means for pivoting the cartridge belt feed lever to actuate said cartridge belt feed means, comprising an inverted U-shaped actuator having a pair of spaced legs pivotally mounted about a transverse axis in the receiver in position to straddle the barrel forwardly of the breech end thereof, said legs having respectively oppositely extending feet terminating in roller ends, a longitudinal cam plate having an angular cam track therein, a depending follower stud at the forward end of the cartridge belt feed lever, said cam plate being slidably disposed in the receiver in pivotal engagement with the upper end of said actuator and with said cam track in slidable engagement with said follower stud on the belt feed lever, and a cam rail extending longitudinally along each side of the slide for slidable engagement with said roller ends on said actuator, said cam rails being inversely sloped at locations which are relatively displaced longitudinally for a distance equivalent to the corresponding separation between the axial centers of said roller ends on said actuator feet whereby the longitudinal

reciprocation of the slide reverses the respective elevation of said roller ends and thereby pivots said actuator about a transverse axis to impart correspondingly opposite reciprocation to said cam plate and thereby pivot the belt feed lever to actuate the cartridge belt feed means.

6. The combination defined in claim 5 wherein said sloped contour of said cam rails includes linear parallel sections adapted to interrupt the pivotal movement of said actuator during the interval in which the bolt is being locked and unlocked.

7. The combination defined in claim 5 wherein said angular cam track in said cam plate is formed with enlarged portions at each end thereof whereby the initiation and completion of the pivotal movement imparted to the cartridge belt feed lever is delayed to provide overtravel of the slide relative to said cam plate.

References Cited by the Examiner

FOREIGN PATENTS

723,469 8/1942 Germany ---------- 89/33

BENJAMIN A. BORCHELT, *Primary Examiner.*

FRED C. MATTERN, JR., *Examiner.*