# United States Patent

**Stoner**

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[45] **Mar. 14, 1972**


## [54] CAM ROTOR GUN


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[21] Appl. No.: **26,823**

[52] **U.S. Cl.** ..... **89/11,** 89/33 CA, 89/135, 89/185, 89/187

[51] **Int. Cl.** ..... **F41f 11/00**

[58] **Field of Search** ..... 89/9, 11, 12, 13, 33 BA, 33 BC, 89/125, 132, 135, 173, 184, 185, 187, 33 CA



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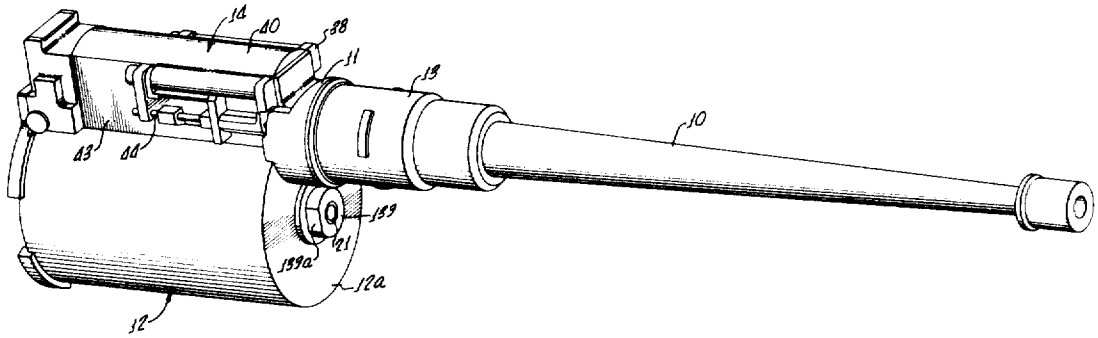
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[57] **ABSTRACT**

A cylindrical rotor having a continuous spiral cam slot formed in its periphery reciprocates a breech block to drive rounds of ammunition into a barrel, to fire the round and to extract the expended cartridges after firing. A cam on the front end of the rotor controls movement of a lock which temporarily locks the breech block during the firing operation. Ejector pins on the rotor thrust an ejected cartridge sideways as the breech block is being reciprocated rearwardly. A cam on the rear of the rotor controls the feeding ammunition into the path of the breech block.


**21 Claims, 14 Drawing Figures**



Patented March 14, 1972 3,648,561

8 Sheets-Sheet 1

FIG. 1.

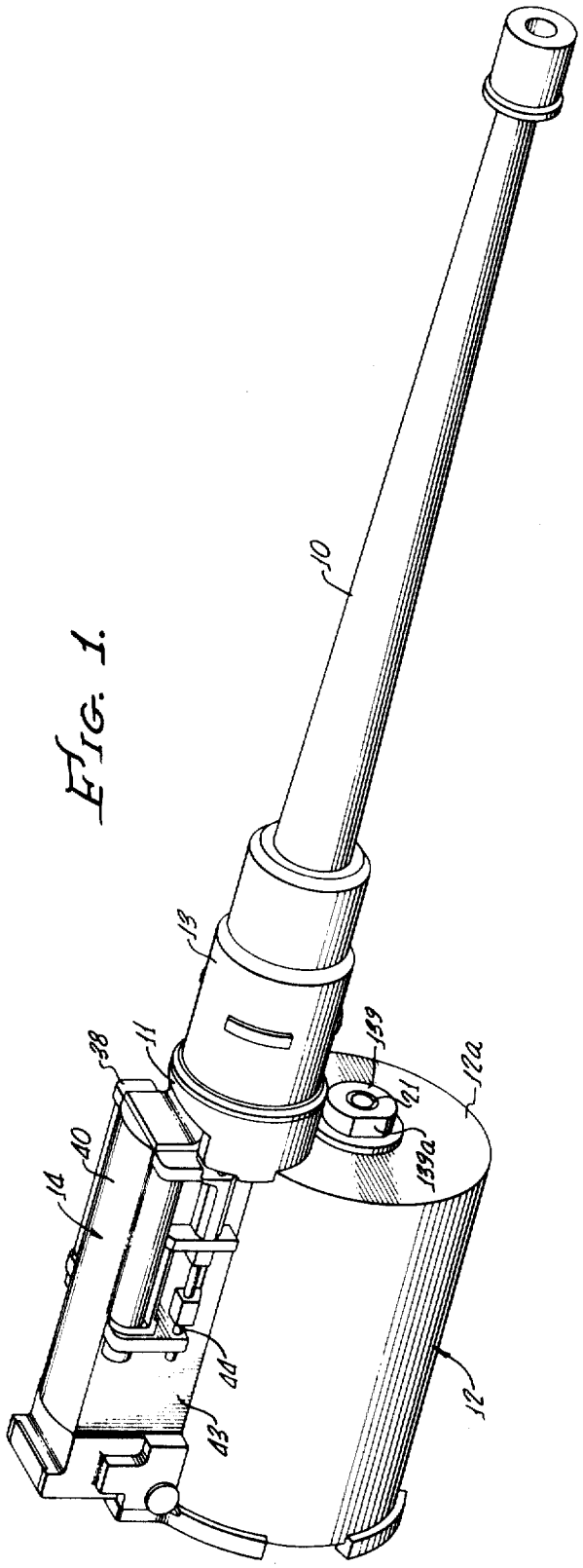
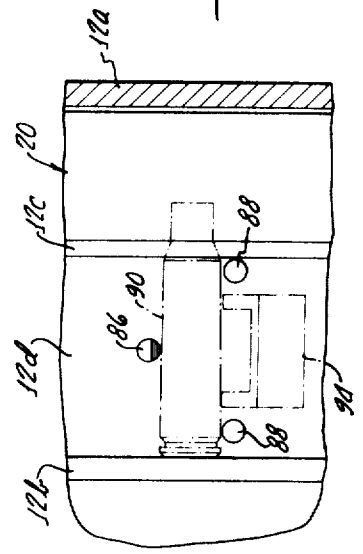



FIG. 9.




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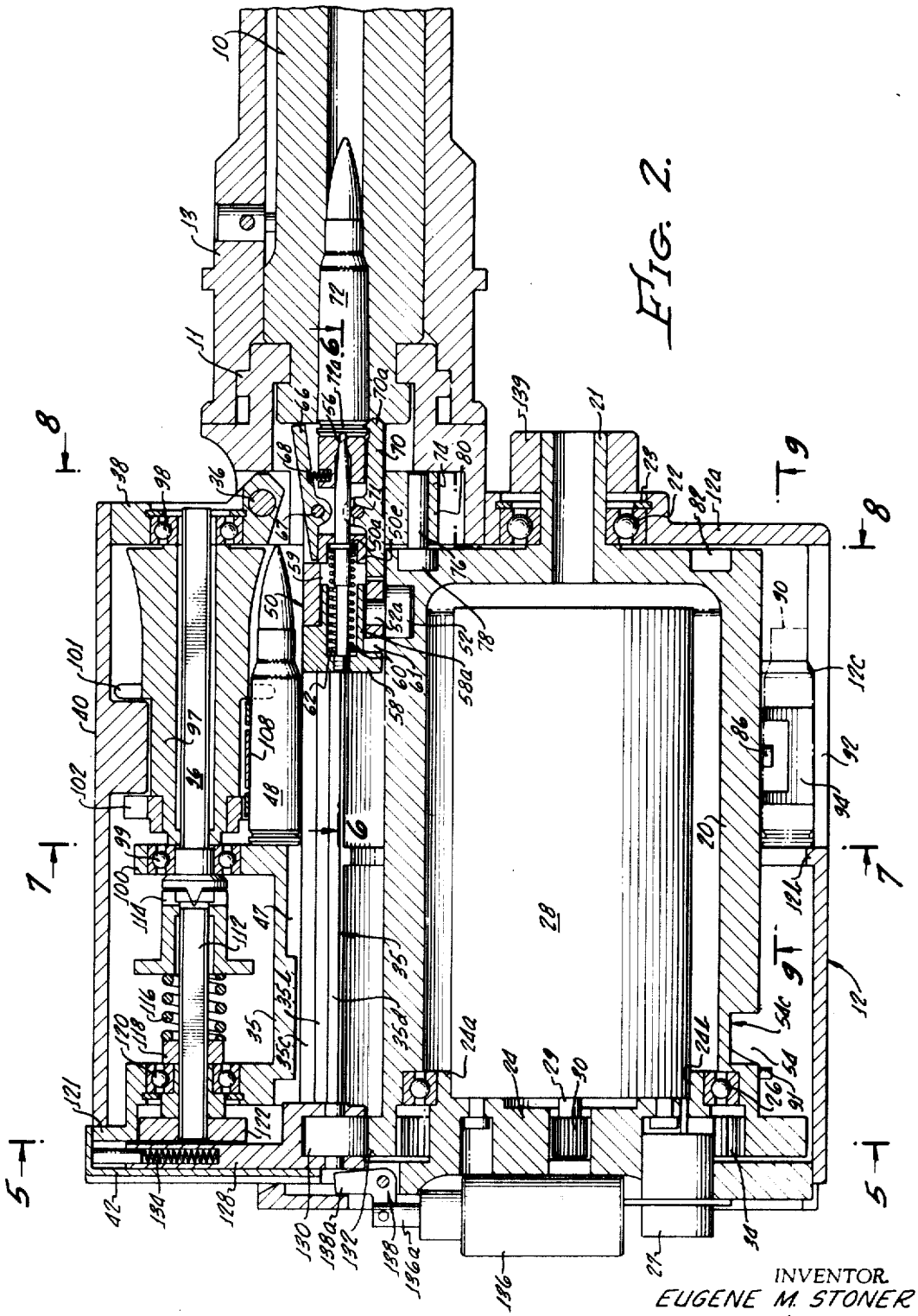


FIG. 2.

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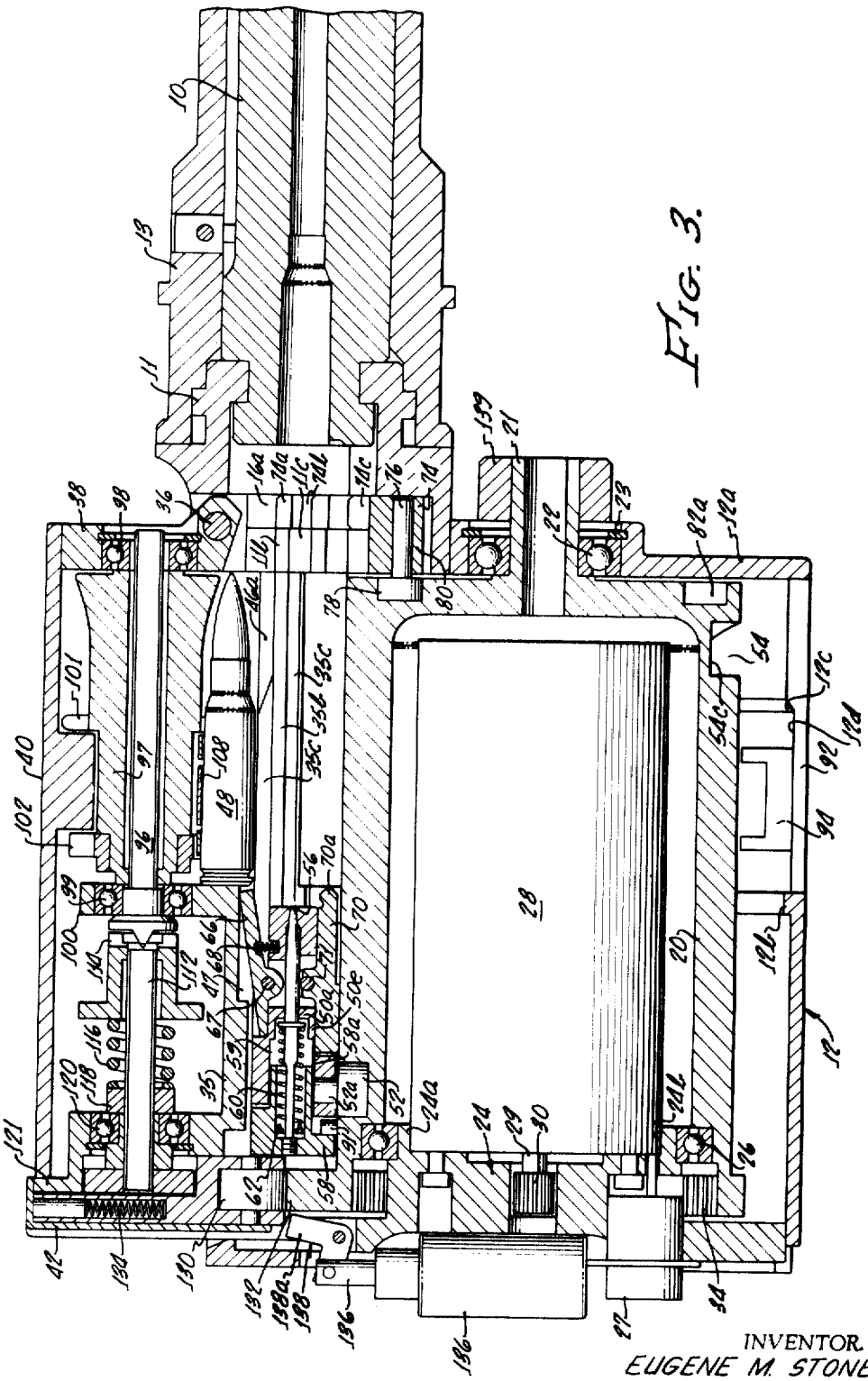
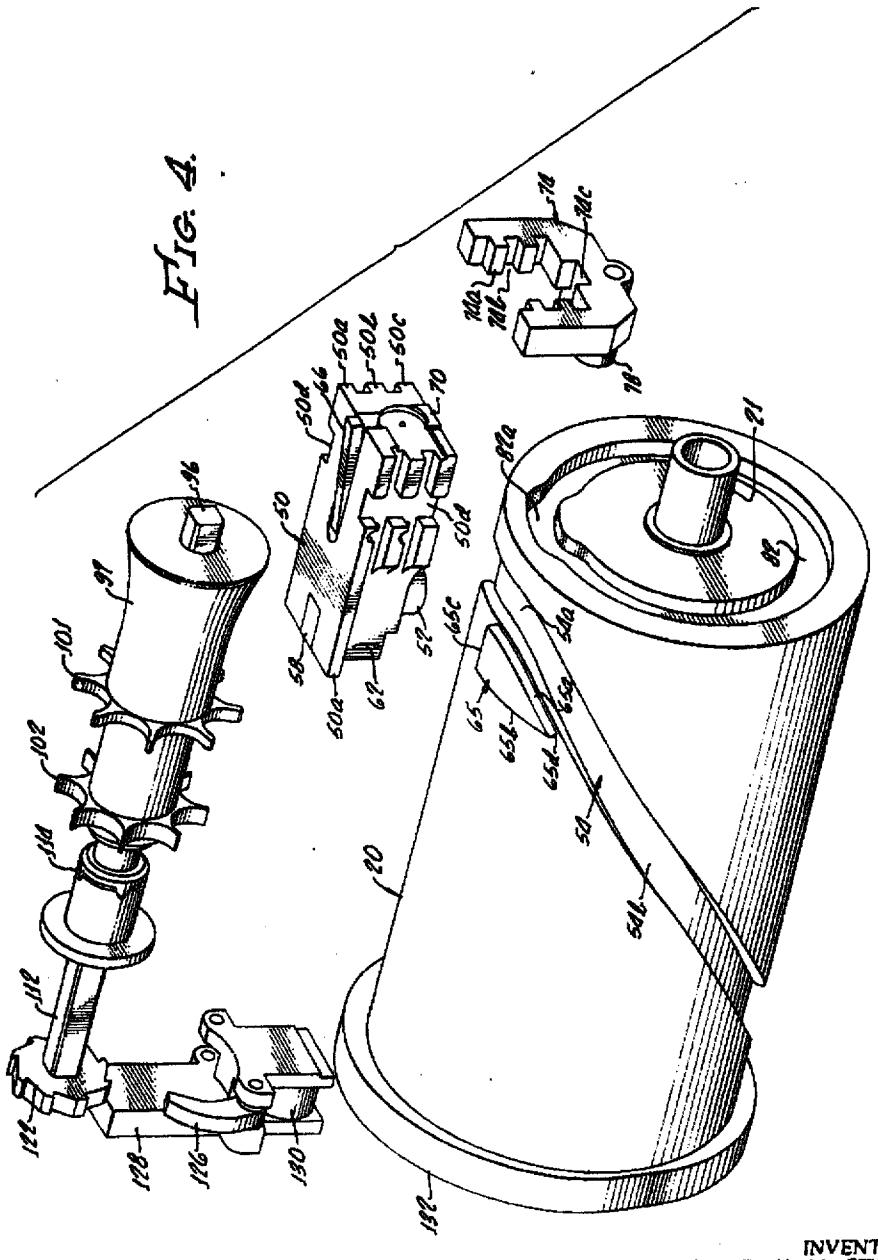


FIG. 3.

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FIG. 4.




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FIG. 5.

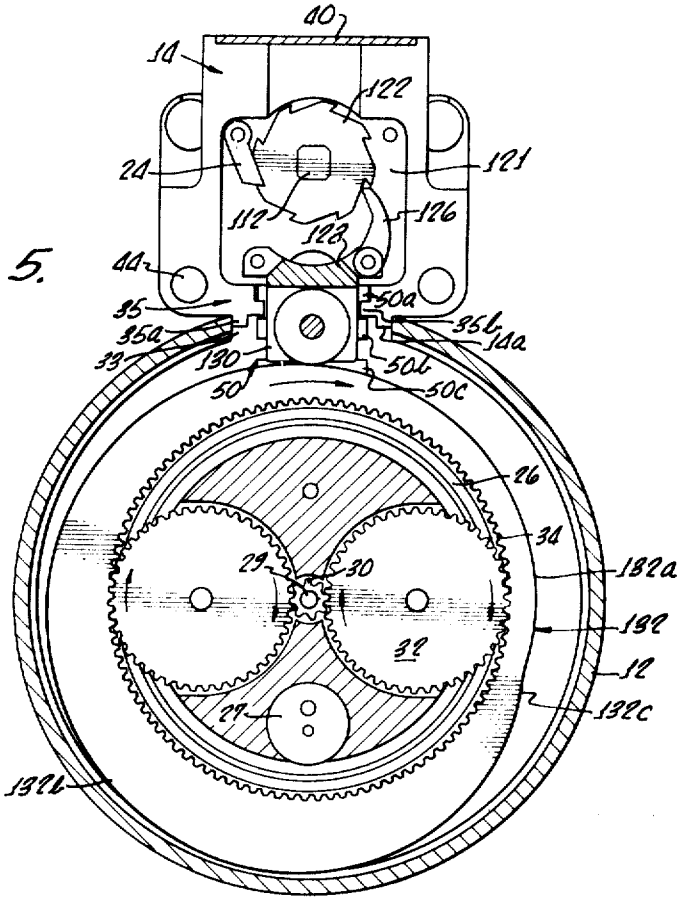
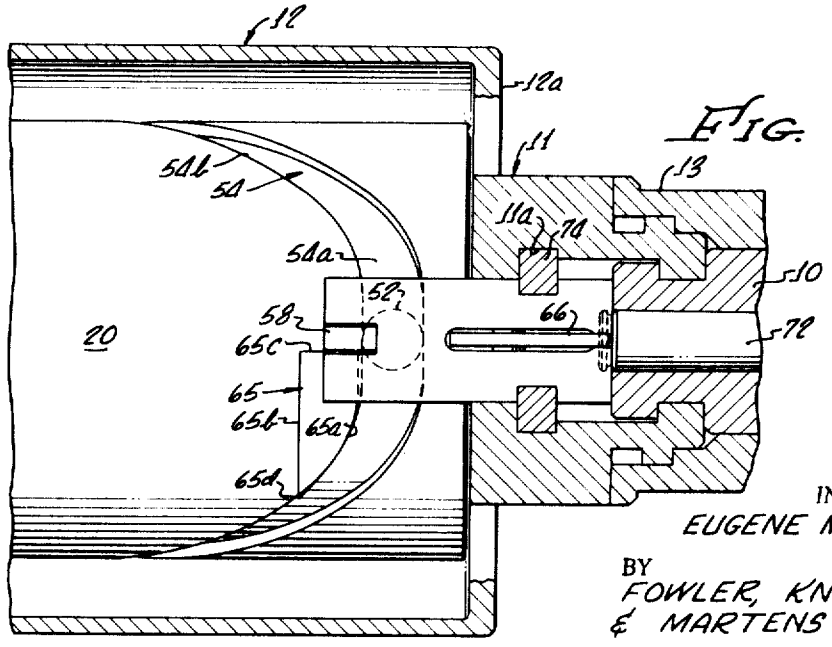



FIG. 6.




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FIG. 7.

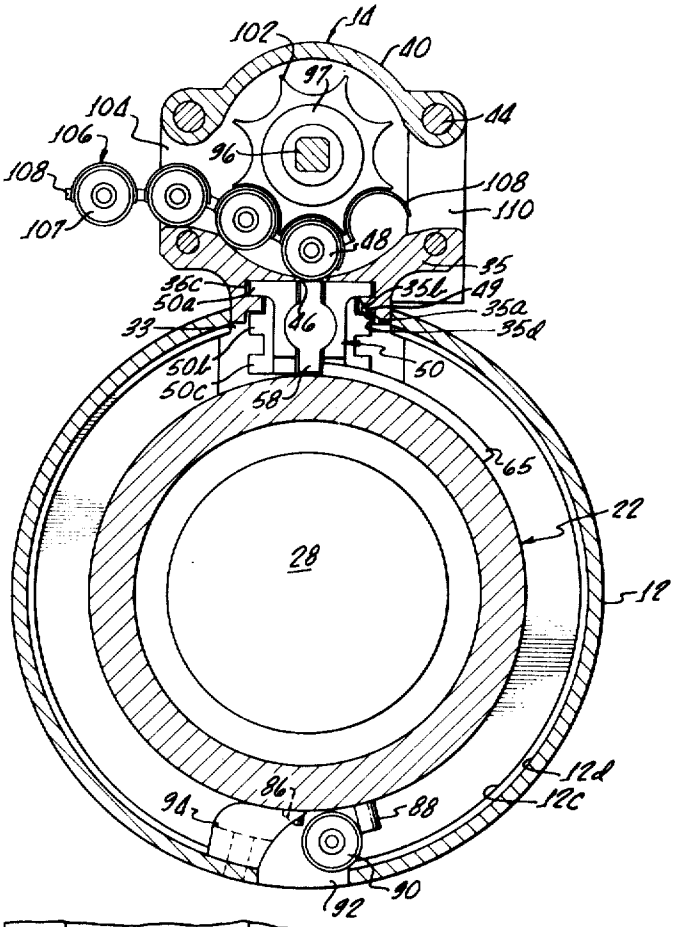
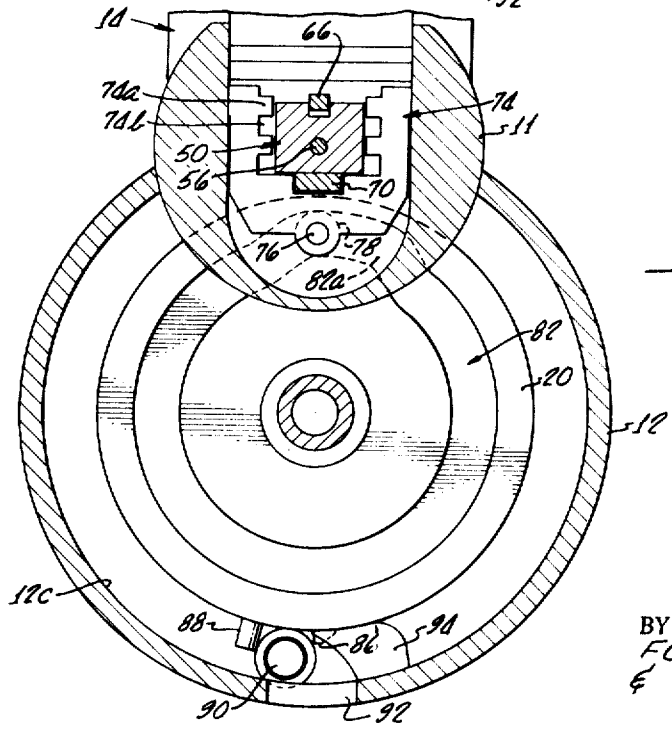



FIG. 8.




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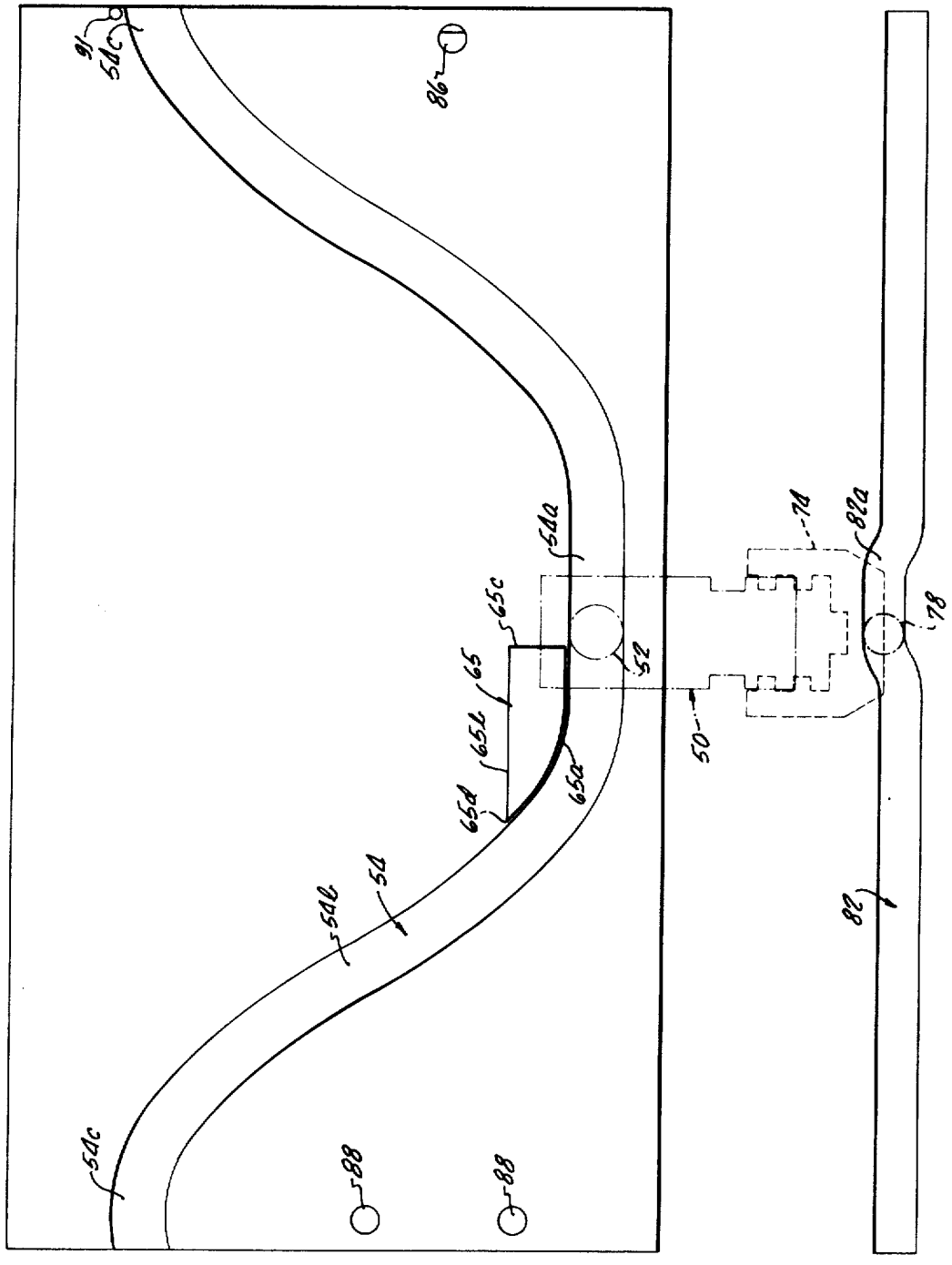
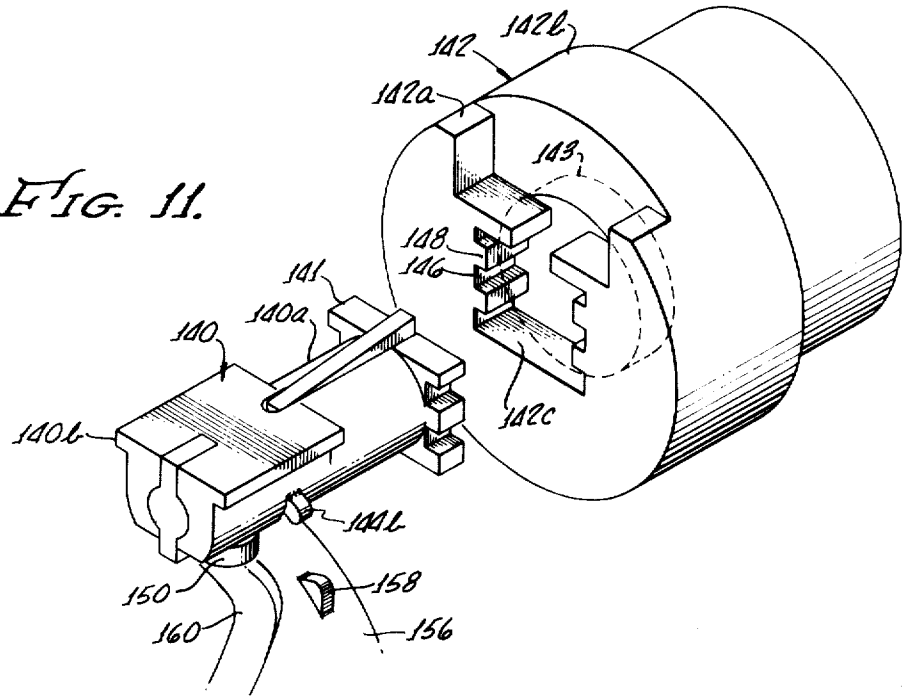



FIG. 10.

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FIG. 11.



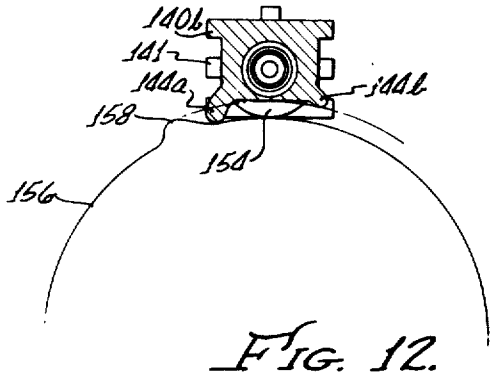




FIG. 12.

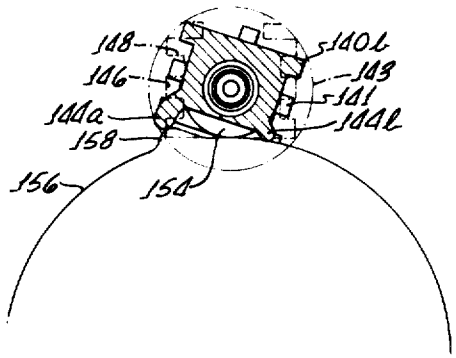



FIG. 13.

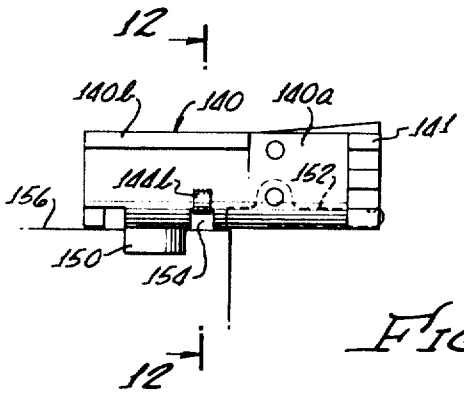



FIG. 14.

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# CAM ROTOR GUN

This invention relates to automatic guns and more particularly to an improved weapon of the type employing a fixed barrel with a continuously rotating rotor reciprocating a breech block.

In the development of high-speed automatic guns, a need always exists for improved reliability and versatility while reducing costs. It is desirable from a standpoint of simplicity and reliability that the various functions of the gun be positively performed without need for control of the operation by many different components or steps in the operation. It is preferable that as many functions as possible be controlled positively by a single component of the gun.

In recent years, many improvements have been made from a standpoint of increasing the speed of operation of weapons. One successful high speed approach has been that of using the so called Gatling gun principle in which a plurality of rotating barrels are employed. While this system has been very successful, some of its disadvantages are that the mass of the rotating barrels is quite large, and hence a large amount of power is required to operate the gun. This is a serious limitation for use of such a gun in remote operations.

Speed has also been obtained by reciprocating gun barrels using the recoil forces of the barrel to load springs for driving the barrel forward for the next firing. Again, however, this situation has the disadvantage of having a large reciprocating mass. As a result, each time a weapon with such a large moving mass is to be operated, it takes an interval of time in which to bring the weapon up to the maximum operating speed. This is a disadvantage with high speed weapons in that the rate of fire is so rapid that the weapon is only operated in very short bursts. Thus, the effective average operating speed of such a weapon is frequently less than the maximum in that it is often operating in condition where it is just getting up the speed.

One type of gun which has potential to avoid some of these difficulties is that in which a cylindrical rotor having a cam slot is used to reciprocate the gun breech block while the gun barrel remains substantially fixed. Some early attempts have been made to have weapons employing a cam rotor; however, none have become widely used because of various shortcomings.

Briefly stated, this invention comprises a rotating cylindrical drum or rotor having a continuous cam slot spirally formed in its periphery. The rotor is mounted within a support such as a cylindrical receiver housing and a fixed barrel is attached to the receiver. A reciprocating breech block aligned with the barrel is provided with a cam follower which extends into the cam slot such that the breech block is reciprocated as the rotor rotates. A lock element supported near the front of the receiver and operated by a second cam on the cam rotor locks the breech block in firing position when a round of ammunition has been chambered in the barrel. With such an arrangement, the reaction forces are received by the breech block lock and its support rather than the rotor. A third cam on the rotor operates the firing pin at the appropriate time. After a round is fired, the cam lock is moved out of the way of the breech block by the rotor, and the breech block is reciprocated rearwardly by the rotor. An extractor lever on the breech block withdraws the spent cartridge as the block moves rearwardly. Ejector means formed on the periphery of the cam rotor engage the spent cartridge as it is withdrawn and thrust it sideways to be moved away from the rotor.

The rotor may be driven by a variety of power sources including utilizing the gasses from exploding rounds of ammunition or utilizing barrel recoil forces. However, the preferred form is the use of a small electric motor positioned within the rotor to enhance the compactness of the gun.

An ammunition feed mechanism feeds ammunition to the receiver in response to movement of a fourth cam formed on the gun. Control of the feeding operation is used to initiate firing of the gun. The rotor, however, may be kept at operating speed at all times during a combat situation with minimum energy, and thus the gun is ready to operate at all times.

Further features, objects and advantages of the invention will become apparent with reference to the following detailed description and drawings in which:



FIG. 1 is a front perspective view of the gun of this invention illustrating its overall configuration;

FIG. 2 is a large cross-sectional view taken on the longitudinal axis of the gun with the breech block in its forwardmost position firing a round of ammunition, and also showing an empty cartridge about to be ejected from the receiver housing;

FIG. 3 is a cross-sectional view like that of FIG. 2 but with the firing chamber empty, and the breech block in its rearwardmost position ready to drive the next round of ammunition into the firing chamber;

FIG. 4 is an exploded perspective view illustrating the main operating components of the gun including the rotor and its cams, the breech block, the breech block lock and the ammunition feed mechanism;

FIG. 5 is a cross-sectional view on line 5—5 of FIG. 2 illustrating the means for driving the rotor and the manner in which the cam rotor operates the ammunition feed mechanism;

FIG. 6 is a cross-sectional view on line 6—6 of FIG. 2 illustrating the breech block and surrounding area at the time of firing;

FIG. 7 is a cross-sectional view on line 7—7 of FIG. 2 looking toward the front of the gun illustrating further aspects of the ammunition feed mechanism, the breech block, the cam rotor and the cartridge ejection means;

FIG. 8 is a cross-sectional view on line 8—8 of FIG. 2 looking towards the rear of the gun further illustrating the operation of the breech block, the breech block and the cartridge ejection means;

FIG. 9 is a cross-sectional view on line 9—9 of FIG. 2 further illustrating the cartridge ejection means;

FIG. 10 is a developmental view of the cylindrical exterior of the rotor illustrating its cooperation with the breech block, and further including a development of the cam groove on the forward face of the rotor in the same plane as the cylindrical exterior to show the relationship to the main cam slot;

FIG. 11 is an exploded perspective view illustrating somewhat schematically an alternate construction for the breech block and the means for locking the breech block;

FIGS. 12 and 13 are elevational views of the structure of FIG. 11 in its unlocked and locked positions; and

FIG. 14 is a side elevational view of the breech block of FIG. 11.

Referring first to FIG. 1, the gun includes an elongated barrel **10** attached in an easily releasable manner to the forward ring-shaped portion of a massive breech ring **11**. The ring **11** also has a rear U-shaped portion, best seen in FIG. 8, mounted in suitable fashion to the upper forward end **12***a* of a cylindrical receiver housing **12**. A sleevelike jacket **13** fits over the rear of the barrel and is attached to the forward portion of the breech ring **11** as may be seen in FIG. 2. This jacket serves as a suitable support for mounting the gun in its desired surroundings. An ammunition feeder housing **14** is mounted on top of the receiver **12**.

Referring to FIGS. 2 and 4, a cylindrical cam rotor or drum **20** is mounted for rotation within the receiver **12** spaced from the cylindrical wall of the receiver a distance slightly greater than the diameter of a round of ammunition. More specifically, the front end of the rotor is substantially closed and formed with an integral shaft **21** which extends through the front end **12***a* of the receiver housing **12** and is supported by suitable bearings **22** in the front end of the receiver. A retaining ring **23** helps retain the bearings in position.

The rear end of the rotor **20** is open so that an inner cylindrical portion **24***a* of a rear cover **24** closing the end of the cylindrical receiver housing **12** extends into the open end of the rotor. Suitable bearings **26** extend between the outer peripheral surface of the inner portion **24***a* of the rear cover **24** and the inner cylindrical surface of the rear end of the rotor to rotatably mount the rear of the rotor. The cover **24** is attached to the receiver housing **12** in any suitable manner so that it can be easily removed. As can be seen from FIG. 3, the inner surface of the inner cylindrical portion **24***a* on the rear cover **24** defines a cylindrical socket **24***b* in which is received

the rear end of a suitable electric motor **28**. The motor is thus supported by the cover **24** in cantilever fashion such that it is spaced from the surrounding rotor **20**. An electrical terminal **27** for connecting a source of power is shown mounted on the cover **24**.

Referring to FIG. **5** as well as FIG. **2**, it can be seen that the output shaft **29** of the motor **28** has a small drive gear **30** which extends into an opening in the rear cover **24**. A pair of large planet gears **32** driven by the motor gear **30** are mounted in suitable fashion in the rear of the cover **24**. The inner cylindrical surface of the rear end of the rotor **20** is formed with gear teeth **34** creating a ring gear which mates with the planet gears **32**.

As can be seen from FIGS. **2**, **5** and **7**, the receiver housing **12** has an axially extending rectangular opening **33** in its upper peripheral surface extending from the rear of the receiver to its front end. Positioned within this opening **33** is the feeder housing **14**. As may be seen from FIGS. **5** and **7**, the feeder housing **14** has a bottom wall **35** formed with a pair of spaced depending wall portions **35***a* which fit within the opening in the receiver housing but do not extend beyond the wall of the receiver **12**. The forward end of the feeder housing **14** is attached by a suitable pin **36** to the breech ring **11**. More specifically, the pin **36** extends through the lower edge of a front wall **38** of the feeder housing which is approximately aligned with the front end **12***a* of the receiver **12**. The feeder housing **14** further includes a top wall **40**, a backwall **42** and sidewalls **43** in the rear part of the housing as seen in FIG. **1**. Four support pins **44** attached to the front wall **38** extend through the outer edges of the forward portions of the bottom wall **35** and the top wall **40**, as may be seen in FIGS. **5** and **7**.

Still referring to FIG. **7** as well as FIG. **3**, it may be seen that the forward portion of the bottom wall **35** has a centrally located longitudinal slit **46**. Supported on the edges of the bottom wall **35** defining the slit **46** is a round of ammunition **48**, a portion of the round being exposed to the interior of the receiver **12** and the adjacent rotor **20**. The forward portion **46***a* of the slit **46** is larger in width than the rear portion forming an ammunition inlet such that the round of ammunition **48** may be moved forwardly and downwardly out of the feeder housing and into the receiver and the barrel as will be subsequently described in greater detail. To the rear of and leading into the slit **46** is a recess **47** in the bottom wall **35**.

It may be seen that the bottom wall portions **35***a* of the feeder housing **14** are each formed with an inwardly extending rib **35***b* extending along the length of the feeder housing. Grooves **35***c* and **35***d* are formed respectively above and below the ribs **35***b*. The inner lower portion of the right rib **35***b*, as viewed in FIG. **7**, and the inner lower portion of the wall portion **35***a* are removed in the area transverse from the cartridge of the round of ammunition **48** to define a cam surface **49** for guiding a cartridge being ejected, as will be later described.

Referring now to FIG. **4** as well as to FIGS. **2** and **7**, there is shown an elongated breech block or bolt **50** having roughly a rectangular cross section. Along each upper outer longitudinal edge of the breech block there is formed an outwardly extending rib **50***a*. The width of the breech block is such that it fits between the bottom wall portions **35***a* of the feeder housing with its outwardly extending ribs **50***a* fitting within the grooves **35***c* in the bottom wall of the feeder housing. Hence, the ribs **50***a* are supported on the ribs **35***b* in the feeder housing wall **35** such that the breech block can move axially or longitudinally supported by the feeder housing on the receiver and extending into the receiver adjacent the rotor **20**.

In addition to the ribs **50***a* , the breech block is formed with ribs or lugs **50***d* and **50***c* spaced below the ribs **50***a* on each side of the forward end of the breech block as best seen in FIG. **4**. The middle rib or lug **50***b* fits within the lower groove **35***d* in the bottom wall **35** of the feeder housing **14** as may be seen in FIG. **7**. Still referring to FIG. **4**, the rib **50***a* and the lug **50***b* and *c* are interrupted on each side of the breech block by a vertical groove **50***d* spaced rearwardly from the forward end of the breech block.

Referring to FIG. **2**, a cam follower **52** in the form of a horizontally oriented roller is shown depending from the bottom of the breech block mounted for rotation on a suitable pin **52***a*. The follower **52** is positioned in a cam slot **54** formed in the periphery of the rotor. As can be seen from FIG. **4** and the development view of FIG. **10**, the cam slot **54** is continuous, extending spirally around the rotor with the slot extending from near the front of the rotor to near the rear of the rotor in 180°. The forward portion **54***a* of the slot includes a flat non-sloped portion which tapers on each edge to a curbed rearwardly extending portion **54***b* having the slope of a constant acceleration curve. The rear portion **54***c* of the slot is smoothly curved to reverse directions. As seen from FIG. **2**, the depth of the slot is sufficient to receive the entire depth of the follower **52** and the width of the slot **54** is sufficient to receiver the follower **52** so that it is positively driven in either direction as the rotor rotates.

Positioned centrally within and extending axially through the breech block **50** is a firing pin **56**, the rear end of the pin being attached to a firing pin extension **58** that includes a forward cylindrical portion **58***a* which telescopically slides within a mating socket **59** in the breech block. A flange **56***a* on the firing pin limits the forward movement of the pin by engagement with a suitable shoulder **50***e* in the breech block. A spring **60** surrounds the rear portion of the firing pin with one end of the spring engaging the flange **56***a*. The other end of the spring engages a stop **62** extending transversely across the breech block straddling the firing pin. Thus, the spring **60** urges the firing pin into its forwardmost position, and withdrawing the pin **56** rearwardly compresses the spring **60** against the stop **62**. Also, the stop **62** serves to retain the firing pin **56** and its extension **58** in the breech block.

Referring to FIG. **4**, the cam rotor **20** is provided with a three-sided wedge-shaped firing pin cam **65** which extends outwardly from the main cylindrical surface of the rotor. As can be seen a front side **65***a* of the cam extends circumferentially and forwardly from a pointed leading edge **65***d*. A rear side **65***b* extends circumferentially, and the third trailing side **65***c* extends axially a considerable distance. The firing pin cam **65** is located on the rotor **20** immediately to the rear of the forwardmost portion of the cam slot **54** at an axial location where the pointed leading edge **65**d of the cam moves into the gap **61** (FIG. **2**) in front of the bottom of the firing pin extension **58** attached to the rear of the firing pin **56** as the rotor rotates, and as the breech block is approaching its forwardmost position.

Still referring to FIG. **2**, a rammer pawl **66** is pivotally mounted in a recess in the top wall of the breech block by a horizontally mounted pin **67**. A spring **68** urges the forward end of the rammer pawl upwardly above the top surface of the breech block.

An extractor lever **70** is supported within the lower portion of the breech block by a pin **71**; and as can be seen, the forward end of the extractor is formed as a hook **70***a* that fits within the annular groove **72***a* on the rim of a round of ammunition **72** shown positioned within the firing chamber **10***a* of the barrel **10**.

For locking the breech block **50** in its forwardmost position, there is provided a breech lock **74** which, as may be seen from FIG. **4**, is a U-shaped plate-like element sized to receive the forward end of the breech block in the opening between its legs. As may be seen from FIGS. **2** and **6**, the lock is mounted to reciprocate vertically within a suitable groove **11***a* within the breech ring **11**. As best seen in FIG. **4**, the inner edges of the legs of the breech lock **74** are formed with inwardly extending lugs **74***a* which define grooves **74***b* sized to receive the ribs or lugs **50***a*, *b* and *c* on the forward end of the breech block **50**. Note from FIG. **3** that the breech ring **11** is also provided with spaced lugs **11**b and grooves **11**c to receive the breech block lugs. An additional groove or slot **74***c* is formed in the right portion of the U-shaped lock to receive the extractor lever **70** in the breech block. The axial thickness of the breech lock is sized to fit within the vertically extending groove **50***d* formed on the sides of the breech block.

Attached to the lower end of the breech block **74** is a rearwardly extending pin **76** having mounted on its rear end a cam follower **78** in the form of a roller, also carried on the pin **76** is a spacer **80**. The breech ring **11** is suitably formed to receive the spacer **80** and permit it to reciprocate with the breech lock **74**.

Still referring to FIGS. **2** and **4**, the cam follower **78** rides within a cam slot or groove **82** formed in the forward axial end face of the rotor **20**. As best seen in FIGS. **4** and **8**, the cam groove **82** has a generally annular shape concentrically formed on the rotor except for one sector **82a** of the cam groove which is radially offset outwardly from the groove. As a consequence, the cam lock **74** is normally stationary as the rotor rotates except when its cam follower **78** reaches the offset sector **82*a*** of the groove and at that point the cam lock moves vertically upwardly, stays there for a short interval and then moves downwardly.

Referring to FIGS. **2**, **7**, **8**, and **9**, the rotor **20** is provided with means for transversely ejecting a spent ammunition cartridge from the grip of the extractor lever **70** on the breech block comprising three ejector pins extending radially from the outer surface of the rotor **20**. A short leading pin **86** having its leading edge beveled is spaced circumferentially from a pair of longer trailing pins **88** a distance approximately equal to the diameter of the cartridge **90**. As best seen in FIG. **9**, the leading pin **86** is centrally located with respect to the length of the cartridge **90** while the trailing pins **88** are axially spaced on the rotor so as to straddle the leading pin **86** and engage the cartridge near its ends.

The tip of the firing pin **56** extends slightly beyond the front face of the breech block in the firing position shown in FIG. **2**. Thus, the pin **56** should be later slightly withdrawn to the position shown in FIG. **3** so that the pin does not interfere with the transverse ejection of an empty cartridge. For this purpose there is provided a small diameter retractor cam pin **91** radially mounted on the cam rotor **20** to the rear of the rearwardmost portion of the cam slot **54** as shown in FIGS. **2**, **3**, and **10**. This pin **91** is axially and angularly positioned with respect to the cam slot **54** and the breech block **50** to engage the forward portion of the firing pin extension **58**, as shown in FIG. **3**, and cam it rearwardly, thereby retracting the firing pin **56** slightly.

Referring to FIGS. **2** and **3**, the forward end of the rotor **20** and the receiver **12** are actually spaced from each an amount slightly less than the diameter of a spent cartridge; however, a portion **12*d*** (FIG. **3**) of the receiver wall extends from the breech block area circumferentially to a cartridge outlet **92** in the lower receiver wall is slightly recessed outwardly so that the space **93** (FIG. **3**) between the rotor and the receiver is sufficient to receive the cartridge **90**. The axial ends of the recess **12*d*** are marked by a circumferentially extending rib **12*b*** at the rear of the cartridge and a circumferentially extending shoulder **12*c*** at the forward end of the large diameter portion of the cartridge **90**.

The rectangular cartridge outlet **92** has sufficient length and width in which to permit a cartridge to pass through the wall of the receiver. Formed on the internal wall of the receiver on one edge of the outlet **92** is a ramp **94** curved and positioned to guide a cartridge outwardly through the outlet **92**. As seen from FIG. **9**, the ramp **94** is sized such that the trailing pins **88** on the rotor straddle the ramp, and the ramp may be suitable notched to permit the leading pin to move past the ramp.

Refer now once more to the feeder housing **14** for a description of the ammunition feed mechanism as seen in FIGS. **2** and **4**. A feeder shaft **96** carrying a feeder rotor **97** has one end supported by a suitable bearing **98** mounted on the front wall **38** of the feeder housing **14**, and its other end is mounted by a suitable bearing **99** in a support **100** integral with the bottom wall **35** of the feeder housing. A pair of sprockets **101** and **102** are mounted on the feeder rotor **97** spaced to engage the central and rear portions of the ammunition round **48**. As can be seen from FIG. **7**, the feeder housing **14** has an inlet **104** on one side for receiving a belt **106** of ammunition, the rounds **107** being connected by suitable links **108** which are ejected from the feeder housing through an outlet **110** in the other side of the housing.

The rear of the feeder shaft **96** is connected to the forward end of a drive shaft **112** by a torque limiting slip clutch **114** loaded by a spring **116** extending between the clutch **114** and a fixed member **118**. A bearing **120** mounted on a support **121** rotatably supports the rear end of the drive shaft **112**. A ratchet wheel **122** mounted on the rear end of the drive shaft **112** is limited in movement to one direction by means of a keeper pawl **124** shown in FIG. **5**, pivotally mounted on the feeder housing to engage the ratchet teeth. The ratchet wheel **122** is rotated by a feeder pawl **126** mounted on a pawl carrier **128** which in turn is mounted for vertical reciprocation in the rear of the feeder housing.

Still referring to FIG. **5**, the pawl carrier supports a cam follower roller **130** on its lower end which engages a feeder cam **132** formed on the circumference of the rear of the main cam rotor **20**. As can be seen, the cam tapers outwardly from a low point **132*a*** raised only slightly from the main surface of the rotor **20** to form a circumferentially extended lobe **132*b*** which forces the pawl carrier **128** and its feeder pawl **126** upwardly. The trailing edge **132*c*** of the cam lobe **132*b*** tapers more sharply to the radially low point **132*a*** of the cam, thus enabling the feeder pawl carrier **128** to reciprocate quickly downwardly under the urging of a spring **134**.

For controlling operation of the feeder mechanism, there is provided a solenoid **136** mounted on the rear of the receiver cover **24**, the solenoid **136** having an output shaft **136*a*** pivotally connected to a crank **138** which in turn is pivotally mounted at its elbow to the rear receiver cover **24**. One arm **138*a*** of the crank extends upwardly as shown in FIG. **2** wherein it does not interfere with the reciprocating movement of the pawl carrier **128**. However, when the solenoid **136** is actuated causing its shaft **136*a*** to extend as shown in FIG. **3**, the crank **138** pivots so that the upper arm **138*a*** of the crank **138** extends into the path of the reciprocating pawl carrier **128** as shown in FIG. **3**.

One feature of the gun is ease of disassembly. By having the feeder housing **14** supporting the breech block **50** and having the housing **14** pivotally mounted on the receiver **12**, access to the breech block and to the cam rotor is obtained by simply releasing spring loaded pins (not shown) and thus pivoting the housing **14** upwardly. To do this the breech block must not be partially in the breech ring **11** as in FIG. **2**. To indicate this condition from the exterior of the gun a nut **139** (FIG. **1**) is mounted on the rotor shaft **21** by a suitable pin (not shown) formed with a flat **139a** which is angularly indexed with respect to the cam slot **54** and hence the breech block. When the flat **139** is facing the breech ring where it's difficult to see, the breech block is in its forwardmost position. Hence, the rotor should be turned to some other position such as indicated in FIG. **1**. The rotor may be turned manually by using the nut **139** as a surface to be gripped.

## OPERATION

Referring to FIG. **2**, to commence operation of the gun, the motor power terminal **27** is connected to a suitable source of external power causing the motor to be energized. The motor output shaft **29** through its gear **30** drives the planet gears **32** (FIG. **5**) which in turn cooperate with the ring gear **34** to drive the rotor **20** in the appropriate direction. Viewing the gun from the rear, as in FIGS. **5** and **7**, the rotor **20** should rotate in a clockwise direction with the gun designed as shown.

Assume that the solenoid **136** is in the position shown in FIG. **3** such that the pawl carrier **128** is interrupted, the feeder rotor **97** is stopped and ammunition **106** is not being fed into the feeder housing **14** supported on the receiver **12**. Rotation of the rotor **20**, however, causes the breech block **50** to reciprocate axially by virtue of the interaction between its cam follower **52** and the rotor cam slot **54**. Note that the breech block **50** completes one reciprocation cycle with each revolution of the rotor with the arrangement shown. Assuming that a

round of ammunition is not positioned on the bottom wall of the feeder housing **14**, the rotor **20** will simply just continue to rotate and the breech block **50** will reciprocate, but no firing will take place. The gun is, however, ready for firing at any moment at its full operating speed.

To commence firing, it is only necessary to actuate the solenoid **136** so that the crank **138** operated b the solenoid is moved out of the path of the pawl carrier **128**. Consequently the pawl carrier **128** will move down responsive to the urging of the spring **134** and the roller cam follower **130** carried by the pawl carrier **128** will engage the cam **132** on the rear of the rotor **20**. Referring to FIG. **5**, it does not matter which position the rotor **20** is in when the solenoid **136** is actuated in that the ammunition feeder mechanism operated by the reciprocating pawl carrier **128** only operates to move the ratchet wheel **122** on its upward stroke. Thus, if the rotor cam lobe **132***a* is in its upper position, nothing would happen until the rotor **20** turns to allow the pawl carrier **128** to move downwardly again wherein its feeder pawl **126** engages a tooth on the ratchet wheel **122** as indicated in FIG. **5**. The upward stroke of the pawl carrier **128** then moves the feeder pawl **126** upwardly to rotate the ratchet wheel **122** a distance approximately equal to the spacing of the ratchet teeth.

The keeper pawl **124** is spring biased to enable the ratchet wheel **122** to rotate; however, rotation in the opposite direction is prevented by the keeper pawl **124** as indicated in FIG. **5**. During the downward stroke of the pawl carrier **128**, the feeder pawl **126** moves outwardly to get past the next ratchet tooth since the feeder pawl is also spring biased. Rotation of the ratchet wheel **122** drives the feeder rotor **97** through the slip clutch **114** such that the sprockets **101** and **102** on the feeder rotor **97** move the belt **106** of ammunition a distance equal to one round so that a round **48** is positioned on the bottom wall of the feeder housing as shown in FIG. **7**.

The angular orientation of the rotor feeder cam **132** with respect to the main cam slot **54** is such that the breech block **50** is in its rearwardmost position as shown in FIG. **3** immediately after the feeder rotor **97** has moved a round of ammunition into position. As shown in FIG. **3**, the rammer pawl **66** has its forward end urged upwardly by the rammer spring **68** into the recess **47** in the bottom wall **35** directly behind the end portion of the round of ammunition **48**. As the breech block **50** is driven forwardly by the rotor cam slot **54**, its rammer pawl **66** engages the rear of the round of ammunition **48** and drives it forwardly. The forward portion of the cam rotor **97** is sloped or flared outwardly and conforms to the slope of the front bottom edge of the feeder housing as can be seen in FIG. **3**, so that the round of ammunition is guided downwardly through the opening in the feeder housing **14** and into the firing chamber **10***a* in the barrel **10**. This condition is shown in FIG. **2** wherein the round is fully chambered, or in the in-battery position.

As the breech block **50** is driven forwardly, the breech block lock **74** is moved upwardly by the operation of its cam follower **78** riding in the groove **82** in the front of the cam rotor **20**. The location of the groove sector **82***a* which extends radially outwardly beyond the remainder of the groove is oriented with respect to the main slot **54** in the periphery of the cam rotor such that as the breech block **50** approaches its forwardmost position, the rib **50***a* and the lugs **50***b* and **50***c* on the breech block are axially aligned with the groves **74***b* on the breech block **74**. Consequently, the breech block can move to its forwardmost position wherein the breech block **74** is vertically aligned with the vertical grooves **50***d* on the breech block. At that point, the breech block lock **74** is moved upwardly by its cam follower **78** moving in the cam groove **82** so that the lugs **74***a* on the breech lock **74** are axially aligned with the lugs **50***a*, *b* and *c* on the breech block **50**, thereby locking the breech block in its forwardmost position.

Slightly prior to the interengagement of the breech block lugs **50***a*, *b* and *c* and the breech block lugs **74***a*, the firing pin cam **65** on the rotor is moved so that the pointed leading edge **65**d enters the gap **61** between the firing pin extension **58** and the breech block **50** to hold the firing pin **56** as the block **50** continues to move forwardly. As the rotor **20** continues to rotate and the firing pin cam **65** moves past the firing pin extension **58**, the extension is released and driven forwardly by the spring **60** causing the firing pin **56** to fire the round **72** of ammunition as shown in FIG. **6**. At this point, shown in FIG. **8**, the cam lock lugs **74***a* are interengaged with the breech block lugs **50***a*, *b* and *c* so that the breech block is locked in its forwardmost position. Thus, the recoil forces introduced by the exploding round are transmitted by the breech block lugs to the breech lock **74** and hence to the massive breech ring **11** attached to the receiver **12**, rather than having the forces transmitted from the breech block **50** to the cam follower **52** and the cam rotor **20**. Thus, the smooth rotation of the cam rotor is not interrupted and undesirable forces are not applied to the rotor bearings **22** and **26**.

The relation between the cam slot **54** and its forward groove **82** may be seen by reference to FIG. **10** wherein the breech block **50** is shown just after the round has been fired. Note that the firing pin cam **65** has just passed the central point of the breech block such that the pin extension **58** attached to the firing pin **56** has been released. Note also that the cam follower **52** is in the forward flat portion of the main cam slot **54**, and the cam follower **78** on the breech lock is in the raised sector **82***a* of the cam groove **82** in the forward end of the rotor. This shows that the breech block is momentarily stationary in its forwardmost position and also that the breech block is locked in this forwardmost position by the breech lock **74**. As the rotor **20** continues to rotate, the breech lock **74** reaches the end of the radially raised sector **82***a* so that the breech lock is once more moved downwardly to unlock the breech block. Just as this occurs, the breech block follower **52** enters the beginning of the curved portion **54** *b* of the cam rotor slot **54** so that the breech block **50** is started on its retracting stroke.

Referring to FIG. **2** as the round of ammunition **72** was moved into position in front of the breech block, the groove **72***d* in its rear rim portion of its cartridge was engaged by the forward hook **70***a* of the extractor **70**. Thus, as the breech block is moved rearwardly, the extractor withdraws or extracts the empty cartridge from the firing chamber. The breech block is dimensioned such that the withdrawn cartridge is slightly spaced from the rotor surface. Just as the breech block approaches its rearwardmost position, the short, leading ejector pin **86** (FIGS. **7** and **8**) on the cam rotor moves beneath and slightly past the cartridge **90**. At that point, the retractor pin **91** (FIG. **3**) cams the firing pin extension **58** rearwardly so that the tip of the firing pin **56** is retracted from the rear of the cartridge. While the firing pin **56** is so retracted, the longer trailing ejector pins **88** (FIGS. **7** and **8**) engage the side of the cartridge and thrust it transversely or sidewise into engagement with the cam surface **49**, which guides the cartridge downwardly further into the receiver space **92** and out of alignment with the breech block. The cartridge is thus positively held circumferentially by the three ejector pins along with the adjacent wall of the receiver to prevent twisting. At the same time, the receiver rib **12***b* and the shoulder **12**c prevent axial movement of the cartridge. Hence, it cannot become jammed between the receiver and the rotor. The rotor moves the ejected cartridge around to the cartridge outlet **92** wherein the cartridge engages the ramp **94** on the wall of the receiver which guides the cartridge out through the outlet.

Just as the cartridge is moved out of alignment with the breech block, the breech block is once more driven forwardly to engage the succeeding round of ammunition which has been moved into position by the ammunition feed mechanism while the previous round was being driven forward and fired. As previously explained, the ammunition feeder mechanism is operated by the cam **132** on the rear of the cam rotor **20**. Thus the feeder cam **132** must also be properly oriented with respect to the main cam slot **54** so that the feeder rotor **97** is operated at the appropriate time. It should be noted, however, that this is no problem in that the operation of the feeder rotor

97, the breech block **50**, the breech block lock **74**, the retraction and release of the firing pin **56** by the cam **65** and the retractor pin **91**, and the ejection of an expended cartridge are all positively controlled by the single rotating cam rotor **20**.

It should also be recognized that although the gun is shown with the feed arrangement positioned on the top side of the rotor, the gun can be operated in any desired orientation and different feed mechanisms can be employed. Similarly, although the gun is described and illustrated as having a single barrel, a single breech block and a single cartridge ejection arrangement, multiple barrel operation is quite possible by introducing additional feeder housings, breech blocks, ejector pins and cartridge ejection outlets.

It should also be noted that the gun may be made in a variety of sizes and that the diameter of the rotor may be varied to determine the slope of the main cam slot **54**. Also, along these lines, the cam slot may be formed so that 360° rotation is required to move the breech block one stroke so that two complete revolutions are required to move it one cycle or two strokes. This latter arrangement requires that the slot intersect itself and hence a cross-over arrangement is required for the cam follower.

Referring to FIGS. **11–14**, an alternate arrangement is illustrated for locking a breech block **140** during the firing operation in a breech ring **142**. The forward end of the breech block is similar to the block shown in the previous arrangement having a plurality of outwardly extending lugs **141** which fit within mating grooves **146** defined by lugs **148** along the edges of an opening **143** in the U-shaped rear portion **142*a*** of the breech ring. An opening **143** in the forward ring shaped portion **142*b*** of the breech ring is large enough to permit the breech block forward end to rotate.

The portion **140*a*** of the breech block to the rear of the lugs **141** has a generally circular cross section. The rear portion of the breech block has a semi-circular cross section on its lower half while the upper half is rectangular with a rib **140*b*** extending along the outer upper edges. A pair of cam follower wings **144*a*** and **144*b*** extend outwardly and downwardly on each side of the breech block **140** immediately in front of a cam follower roller **150** and to the rear of an extractor lever **152** shown in FIG. **14**. A slot **154** is formed in the breech block **140** between the wings **144** as seen in FIGS. **12** and **14**.

A cam rotor **156** is formed with a cam **158** on the periphery of its forward end to be engaged by the cam follower wings **144**. The rotor is also provided with a cam slot **160** on its periphery similar to the slot **54** in the cam rotor **20** of FIG. **4**. The cam **158** is oriented with respect to the cam slot **160** so that the cam **158** engages the cam followers **144** when the breech block is in its forwardmost position.

As the breech block **140** approaches its forwardmost position, the lugs **141** are aligned with the grooves **146** on the breech ring **142** so that the forward end of the breech block can enter the rings. The breech block is in its forwardmost position when the lugs **141** are just completely into the ring portion **142*b***, and the block portion **140*a*** is in the breech ring portion **142*a***. Just after reaching this position, the cam **158** on the rotor **156** engages the leading wing **144** on the breech block causing the block to rotate a few degrees around its own axis in a direction opposite to the cam rotor movement. This moves the forward lugs **141** on the breech block out of alignment with the grooves **146** in the breech ring **142** and instead into engagement with the forward surface of the breech ring lugs **148**, as shown in FIG. **13**. The breech block is hence locked in its forwardmost position for a firing operation.

When the breech block is in its forwardmost position, it is supported by the bottom wall **142*c*** in the breech ring portion **142*a*** in that the lugs **141** on the block are no longer supported by the lugs **148** in the breech ring. Moreover, the ribs **140*b*** on the rear of the breech block do not support the block in this position in that the forward portion of the feeder housing (not shown) is formed to permit rotation of the block. However, the rear of the feeder housing is formed with a groove and rib arrangement for supporting the block ribs **140*b*** when in positions other than the forwardmost position.

As the cam moves past the first wing **144*a***, it passes through the slot **154** and engages the second wing **144*b*** pivoting the breech block back to its original orientation wherein its lugs **141** are aligned with the slots **146** in the breech ring **142**, thus enabling the breech block **140** to be once more withdrawn by the cam rotor. Pivoting the breech block as described cants the breech block follower **150** slightly in its groove on the cam rotor; however, the amount of canting is such that there is sufficient play or looseness between the follower and the slot to permit this limited amount of movement.

What is claimed is:

1. A gun comprising:
a barrel with a firing chamber;
a receiver attached to the barrel and positioned to the rear of the firing chamber;
a cam rotor rotatably mounted in the receiver and having a continuous cam slot formed in its exterior extending spirally around the rotor;
a breech block mounted for reciprocation on said receiver and having a follower extending into said cam slot to reciprocate the breech block as the cam rotor rotates;
means for locking the breech block in an in-battery position in a manner to isolate the rotor from the reaction forces of an exploding round of ammunition; and
cam means formed on said cam rotor for operating said breech block lock means with the proper timing to lock and unlock the breech block.

2. The gun of claim 1:
including a breech ring connecting the barrel to the receiver, and wherein said breech block lock means comprises a reciprocating lock mounted in said breech ring adjacent the front of the cam rotor and having means for cooperating with the breech block to lock and unlock the breech block; and
said cam means comprises a cam groove formed on the forward end of the cam rotor, the breech block lock having a follower which rides within said groove to cause the breech block lock to reciprocate at the proper time.

3. The gun of claim 2 wherein said lock reciprocates in a plane perpendicular to the breech block movement, the lock having an opening for receiving the forward end of the breech block and having a follower which extends into the cam groove on the rotor forward end, the breech block lock and the breech block having interengaging lug and groove means for locking the block in its forwardmost position, said cam groove having generally an annular shape except for a locking portion which protrudes radially outwardly from the remainder of the groove, said locking portion being circumferentially aligned with the forward end of said slot in the side of the rotor so that the cam lock is moved to its locking position when the breech block is in its forwardmost position.

4. The gun of claim 1:
including a breech ring connecting the barrel to said receiver having an opening for receiving the forward end of the block, the block and the ring having interengaging grooves and lugs; and
wherein said breech block has cam follower means formed thereon, said cam means on said cam rotor comprises an outwardly extending cam on the forward peripheral surface of the rotor, said cam follower means engaging said cam to rotate and lock the breech block after the breech block enters the breech ring, and to rotate the block to unlock it from the breech ring after a firing operation.

5. A gun comprising:
a receiver;
a barrel fixed to the receiver and having a firing chamber;
an ammunition feeder attached to the receiver positioned to the rear of the firing chamber;
a cam rotor rotatably mounted in said receiver positioned to the rear of the barrel and to the side of the feeder with the exterior of the rotor being open to the feeder, said rotor having a continuous cam slot formed in its exterior extending spirally around the rotor; and

a breech block mounted for reciprocation in said feeder and having a cam follower extending into said cam slot to reciprocate the breech block as the cam rotor rotates;

extractor means on said breech block for withdrawing the spent cartridge; and

ejector means on said rotor for thrusting the spent cartridge sidewise out of the receiver.

6. The gun of claim 5 wherein said receiver is a cylindrical housing enclosing said rotor and said feeder extends along an opening in the housing, said housing having a cartridge outlet in its sidewall spaced from the feeder, and said housing having the ramp means on an internal wall which guide a spent cartridge out of the housing as it is moved by said ejector means.

7. A gun comprising:

a barrel with a firing chamber;

a receiver positioned to the rear of the firing chamber;

a cam rotor rotatably mounted in the receiver and having a continuous cam slot formed in its exterior extending spirally around the rotor;

a breech block mounted for reciprocation on said receiver and having a follower extending into said cam slot to reciprocate the breech block as the cam rotor rotates;

means operated by said cam rotor for locking and unlocking the breech block in an in-battery position;

means on said rotor for operating a firing pin carried by said breech block; and

means on said rotor for moving spent cartridges out of said receiver.

8. The gun of claim 7 including means on said rotor for operating an ammunition feed mechanism for feeding ammunition to the breech block in accordance with rotation of the cam rotor.

9. The gun of claim 8 wherein said ammunition operating means comprises a cam formed on the periphery of the rear portion of the rotor, a high portion of the ammunition feed cam extending radially outwardly beyond the low portion of the cam, the location of the high portion being correlated with the position of the breech block such that a round of ammunition is fed at the correct time in the firing cycle.

10. A gun comprising:

a barrel with a firing chamber;

a receiver positioned to the rear of the firing chamber;

a cam rotor rotatably mounted in the receiver and having a continuous cam slot formed in its exterior extending spirally around the rotor;

a breech block mounted for reciprocation on said receiver and having a follower extending into said cam slot to reciprocate the breech block as the cam rotor rotates; and

a motor assembly positioned within said cam rotor and connected to rotate the cam rotor.

11. The gun of claim 10 wherein said motor assembly includes mounting means attached to the rear of the receiver, an electric motor attached to the mounting means and extending into the rotor, and gear means driven by the motor cooperating with a gear attached to the rotor for rotating the rotor.

12. The gun of claim 11 wherein said receiver comprises a cylindrical housing and said mounting means comprises a cover for the rear of said receiver, the cover including a portion which extends inwardly to support rotatably the rear of the cam rotor and to support the motor.

13. A gun comprising:

a breech block mounted for axial reciprocation to drive ammunition into an aligned gun barrel;

a cam follower carried by the breech block;

a cam rotor rotatably mounted adjacent the breech block having a cam slot in its periphery receiving said cam follower and oriented to reciprocate the breech block;

an ammunition feeder for moving a round of ammunition into the path of the reciprocating breech block;

a cam surface on said rotor connected to operate said feeder; and

ratchet and pawl means for driving said feeder including a pawl carrier mounted for movement by said cam surface.

14. The gun of claim 13 wherein said feeder is an elongated rotor having a sprocket for engaging a round of ammunition, the feeder rotor being mounted on a shaft parallel to the barrel axis, said ratchet being mounted on the shaft driving said feeder rotor, said pawl carrier being mounted for reciprocation adjacent the end of said cam rotor, the pawl carrier supporting a cam follower engaging said cam surface which extends radially from the end of said cam rotor.

15. A high speed gun comprising:

a generally cylindrical receiver housing;

a breech ring attached to the upper portion of the front wall of the receiver;

a barrel supported by the breech ring having its axis approximately parallel to the axis of the receiver and approximately aligned with the outer periphery of the receiver;

a cam rotor positioned within the receiver with its forward end rotatably mounted in the front wall of the receiver, said rotor having a continuous cam slot formed in its exterior and extending spirally around the rotor;

a rear cover attached to the rear of the receiver and including an inwardly extending portion which rotatably supports the rear of said rotor;

a motor supported by said cover and extending into said rotor, gear means supported by said cover drivingly connecting the motor drive shaft to said rotor;

a breech block mounted for reciprocation on said receiver aligned with the barrel, said breech block carrying a cam follower extending into said cam slot to reciprocate the breech block as the cam rotor rotates;

a breech lock mounted for reciprocation in said breech ring in a plane perpendicular to the reciprocating movement of the breech block, said block having a U-shaped portion for receiving the forward end of said breech block as it is reciprocated into its forwardmost position, said breech block and said lock having interengaging lugs and grooves which permit the forward end of the breech block to be moved into the lock and which lock the block in its forwardmost position, said cam rotor having a cam slot on its forward face and said lock having a cam follower extending into said cam slot, said cam slot being oriented such that the lock is reciprocated to lock and unlock the breech block as the cam rotor rotates;

a firing pin included in said breech block, and means mounted on said rotor for operating the firing pin;

ammunition feed means mounted on said receiver for positioning a round of ammunition in the path of said reciprocating breech block;

cam means on said cam rotor for operating said ammunition feed mechanism in accordance with rotation of the cam rotor; and

ejector pins mounted on said cam rotor for ejecting a spent cartridge of a round of ammunition sideways out through an outlet in the wall of said receiver.

16. A gun comprising:

a cylindrical receiver;

a barrel attached to the upper forward end of the receiver;

a cylindrical cam rotor rotatably mounted in the receiver with the ends of the rotor being positioned close to the ends of the receiver, and the cylindrical wall of the rotor being spaced from the surrounding receiver wall sufficiently to define a circumferentially extending space to receive the cartridge of a spent round of ammunition,

ammunition feed means mounted on said receiver transversely from the rotor, means defining an opening leading downwardly from the feed means into the forward part of the receiver and into the firing chamber;

a breech block mounted for reciprocation in the upper part of the receiver aligned with the barrel and having rammer means extending into the feed means to drive a round of ammunition into the barrel, said breech block further having a firing pin for firing the round and means for extracting the spent cartridge from the barrel into said space between the rotor and surrounding wall of the receiver;

ejector means mounted on said rotor which engage the side of a spent cartridge to thrust it sideways out of axial alignment with the breech block; and

cam means on said rotor for reciprocating the breech block as the rotor rotates.

**17**. The gun of claim **16** wherein said ejector means includes a pair of axially spaced radially extending ejector pins.

**18**. The gun of claim **16** including means formed on the receiver for limiting axial movement of the spent cartridge being ejected by said ejector means.

**19**. The gun of claim **17** wherein:

the breech block is dimensioned such that when the empty cartridge is withdrawn it is spaced transversely a slight amount from the rotor and the gun includes cam means guiding the cartridge downwardly into the space between the rotor and the receiver wall; and

the gun further includes a radially short, leading ejector pin which is mounted on the rotor at a point axially between the pair of ejector pins but circumferentially spaced from the pair of ejector pins a distance about equal to the diameter of the cartridge whereby the short pin can pass beneath the cartridge and the cartridge is then thrust sideways by said pair of pins and guided downwardly by said cam means and the cartridge is held by the three ejector pins.

**20**. The gun of claim **19** including means defining a cartridge outlet in the wall of said receiver, and ramp means mounted on the receiver wall for guiding the cartridge away from the ejector pins and out through said outlet.

**21**. A gun comprising:

a receiver;

a barrel attached to the receiver;

a cylindrical cam rotor rotatably mounted in the receiver;

a breech block mounted for reciprocation in the receiver aligned with the barrel and having means for driving a round of ammunition into the barrel, a firing pin for firing the round, and means to extract the spent cartridge into the receiver adjacent the rotor;

cam means on said rotor for reciprocating the breech block as the rotor rotates;

ejector pins mounted on said rotor which engage the side of the spent cartridge to thrust it sideways out of alignment with the breech block; and

means mounted on said rotor for retracting the firing pin slightly when said ejector pins engage the spent cartridge so that the tip of the firing pin is withdrawn from the path of the cartridge.

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