United States Patent

[11] 3,611,871

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[21] Appl. No. **24,199**
[22] Filed **Mar. 31, 1970**
[45] Patented **Oct. 12, 1971**
[73] Assignee **General Electric Company**

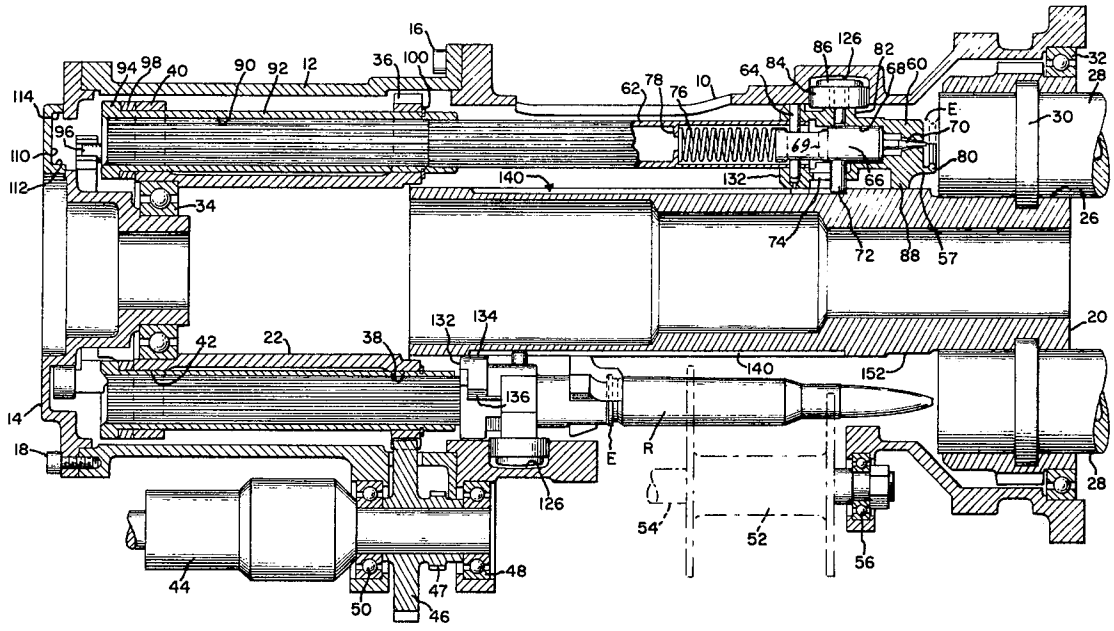
[54] **FIRING MECHANISM FOR HIGH RATE OF FIRE REVOLVING BATTERY GUN**
6 Claims, 17 Drawing Figs.

[52] **U.S. Cl.** **89/127,** 89/12
[51] **Int. Cl.** **F41d 11/16**
[50] **Field of Search** 89/12, 126, 127, 155

[56] **References Cited**
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427,239 5/1890 Murphy 89/12

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ABSTRACT: Firing mechanism for high rate of fire revolving battery gun providing a cam track in the aft end of the housing to provide locking and unlocking rotation to the bolt via a cam follower and telescoping linkage. Additionally, a positive lock is provided on the firing pin which is only released by rotation of the bolt into lock. Yet additionally, the cam track is adjustable to a safe disposition wherein rotation of the bolt into lock is precluded.



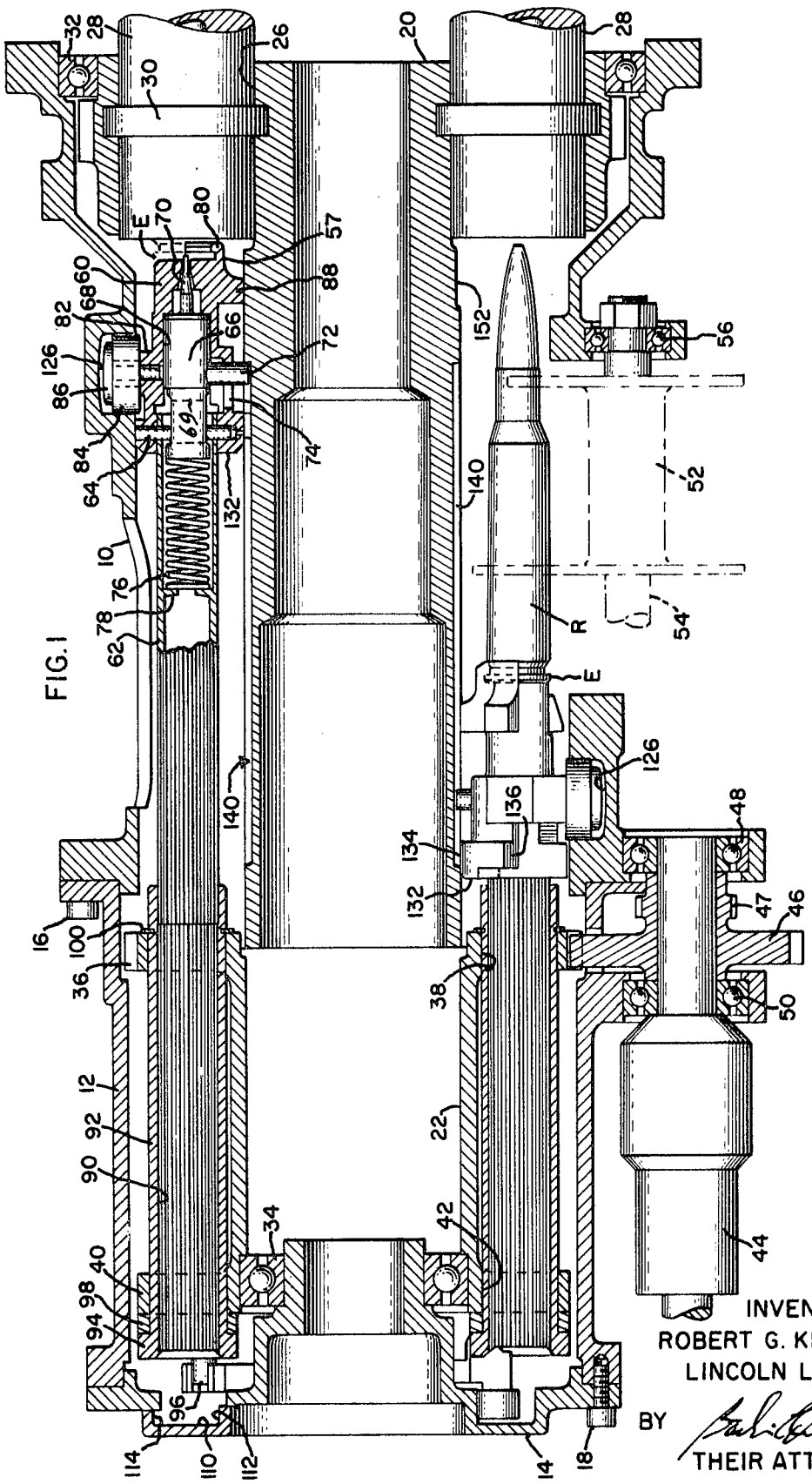


FIG. 1

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FIG.9

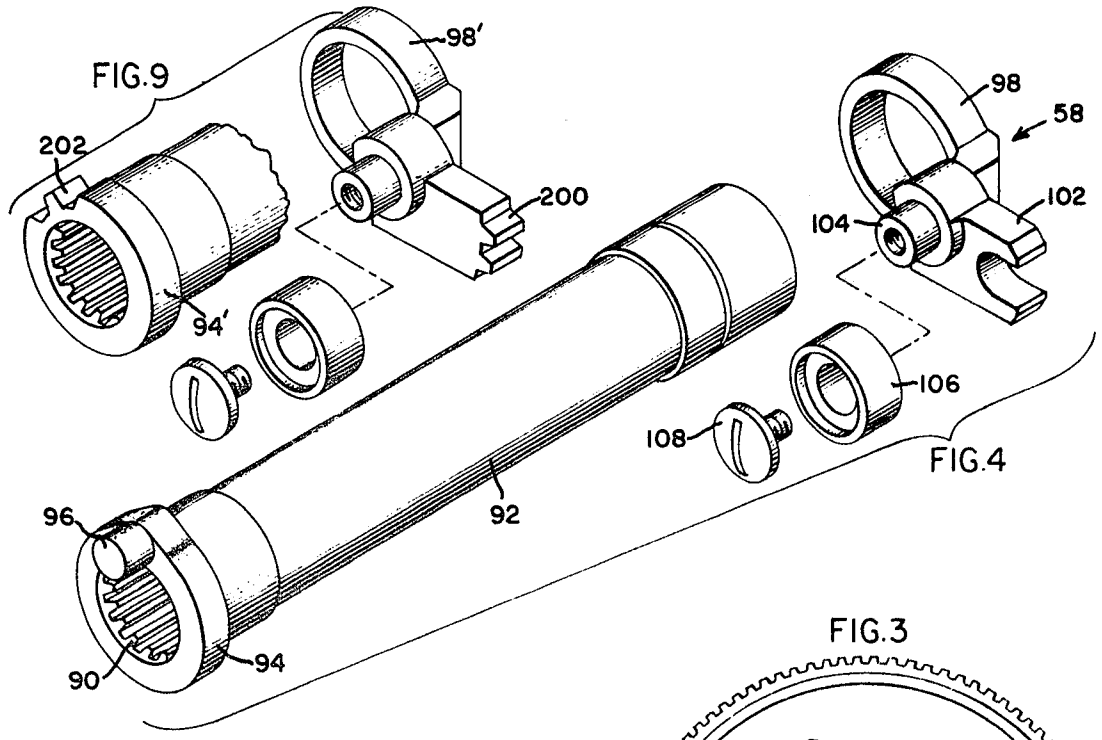


FIG.4

FIG.3

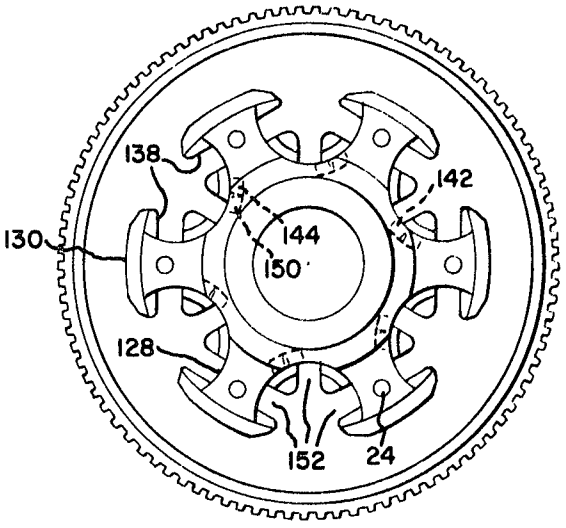
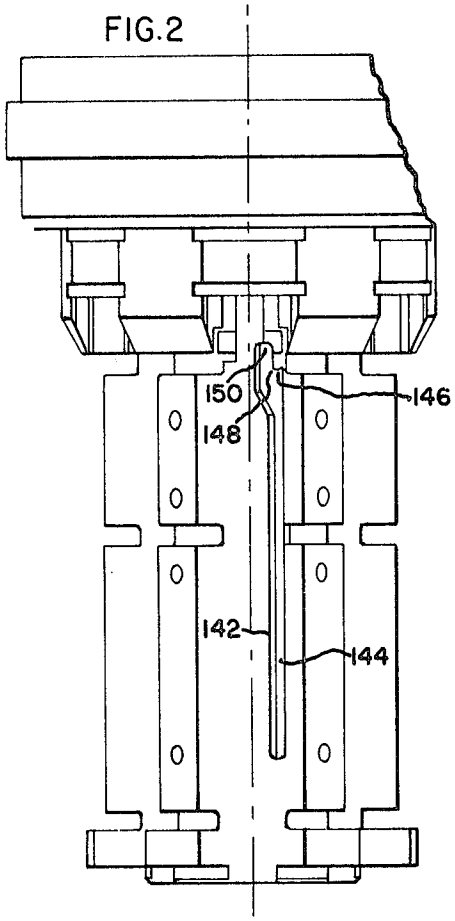


FIG.2



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FIG.5

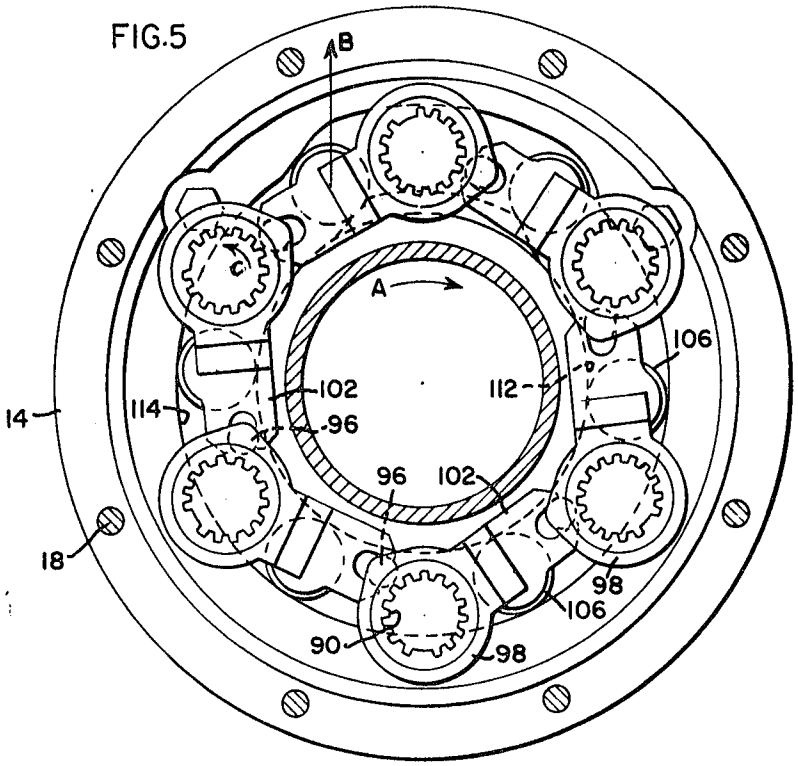


FIG.6

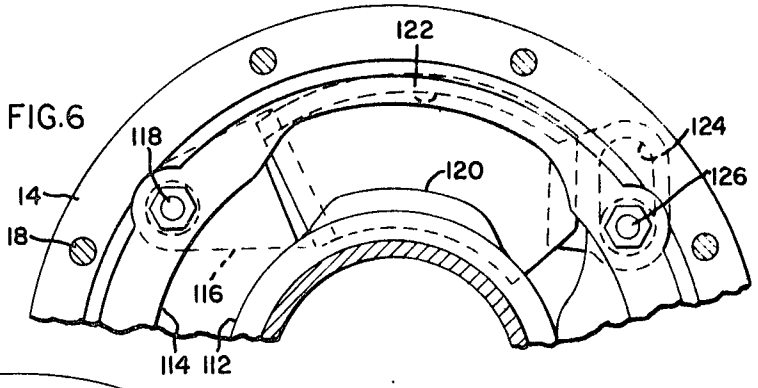
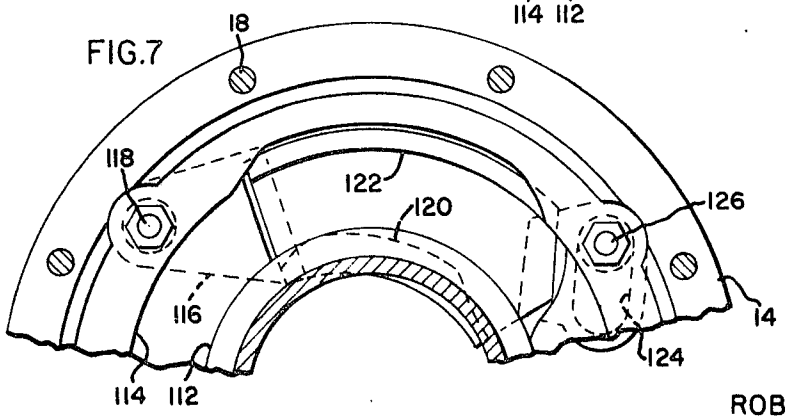
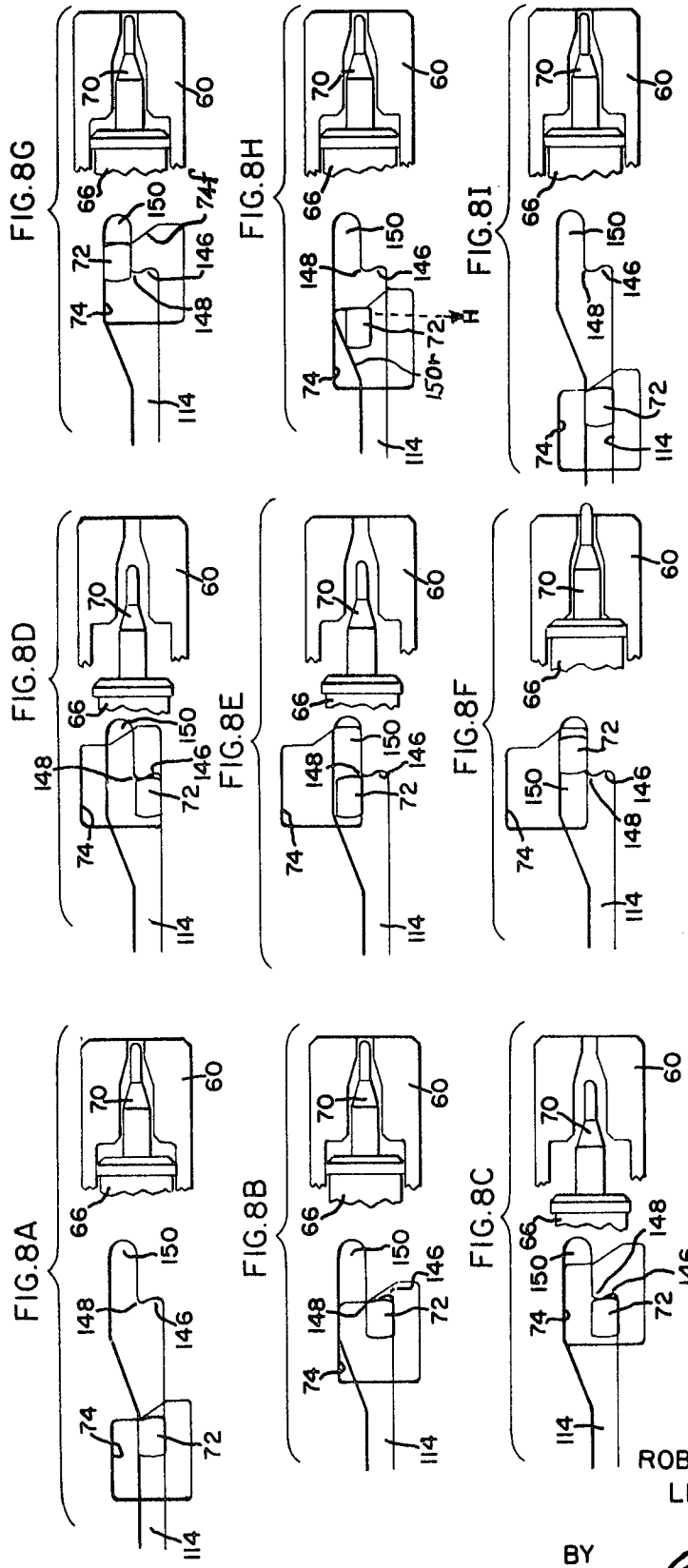


FIG.7



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FIRING MECHANISM FOR HIGH RATE OF FIRE REVOLVING BATTERY GUN

BACKGROUND OF THE INVENTION

1. Field of Art

This invention relates to an improved locking, self-cocking, searing and resetting bolt assembly, especially adapted for automatic weapons having a plurality of barrels mounted for rotation about a common axis, conventionally known as Gatling guns.

2. Prior Art

In U.S. Pat. No. 125,563, issued Apr. 9, 1872 to R. J. Gatling, there is shown the classic modern revolving battery gun. A stationary housing encloses and supports a rotor assembly which has a plurality of barrels and a like plurality of bolts. Each bolt has its own firing pin and mainspring. Each bolt is traversed longitudinally by a stationary elliptical cam track in the housing. As the bolt is traversed forward, the firing pin is held to the rear by a stationary cam track in the housing and the mainspring is compressed until the bolt and the barrel reach the firing position, at which time the firing pin is seared. A more recent electrically fired gun is shown in U.S. Pat. No. 2,849,921, issued Sept. 2, 1958 to H. McC. Otto. Here the longitudinal movement of the bolt is controlled by a housing cam track, but the firing pin is always biased forward. Locking of the bolt is accomplished by a cam follower mechanism immediately aft of the chambers. A yet more recent Gatling gun, disclosed in U.S. Pat. No. 3,380,343, issued Apr. 30, 1968 to R. E. Chiabrandy et al., utilizes a single mainspring mounted externally of the bolt assemblies on the housing.

The most common modern Gatling, sometimes called a "-minigun," has a stationary housing and a rotor assembly with a plurality of barrels and a like plurality of bolts, each with its own firing pin and mainspring. The longitudinal movement and locking of the bolts is provided by the conventional housing elliptical cam track. The cocking, searing and resetting of each firing pin is controlled by a respective cam track in the rotor, in response to the longitudinal movement of the bolt.

SUMMARY OF THE INVENTION

It is an object of this invention to provide an improved Gatling-type gun wherein rotation of the bolt is not directly responsive to the longitudinal movement of the bolt, and wherein the mechanism providing the rotation of the bolt is remote from the area of interaction of the bolt and chamber, i.e., clear of the feed.

Another object of this invention is to provide such a gun wherein searing of the firing pin is positively precluded when the bolt is not locked.

Yet another object of this invention is to provide such a gun wherein the firing pin is positively retracted before the bolt is unlocked.

Still another object of this invention is to provide such a gun wherein the stroke of the bolt is shorter than the length of the round.

A feature of this invention is the provision of a cam track in the aft end of the housing to provide locking and unlocking rotation to the bolt via a cam follower and telescoping linkage. Additionally, a positive lock is provided on the firing pin which is only released by rotation of the bolt into lock. Yet additionally, the cam track is adjustable to a safe disposition wherein rotation of the bolt into lock is precluded.

BRIEF DESCRIPTION OF THE INVENTION

These and other objects, features and advantages of the invention will be apparent from the following specification thereof taken in conjunction with the accompanying drawing in which:

FIG. 1 is a longitudinal cross section of the housing and contents of a Gatling-type gun embodying this invention;

FIG. 2 is a side view of the rotor of the gun of FIG. 1;

FIG. 3 is an aft end view of the rotor of FIG. 2;

FIG. 4 is an exploded perspective view of a locking cam follower assembly for a bolt of the gun of FIG. 1;

FIG. 5 is a forward end view of the locking cam and locking cam follower rotor assembly of the gun of FIG. 1;

FIG. 6 is a detail of the locking cam assembly of FIG. 5, showing the cam track in the lock disposition;

FIG. 7 is similar to FIG. 6, showing the cam track in the safe disposition;

FIGS. 8A through 8I are a cartoon series showing the functioning of the bolt of the gun of FIG. 1; and

FIG. 9 is an exploded perspective view of an alternative locking cam follower assembly for a bolt of the gun of FIG. 1.

THE PREFERRED EMBODIMENT

A portion of a Gatling-type gun embodying this invention is shown in FIG. 1. A stationary housing assembly includes a main housing **10**, an aft housing **12** and an aft end housing **14**. The housings are fixed together by a plurality of machine screws **16** and **18**. A rotor assembly is disposed within the housing assembly and includes a main rotor **20** and an aft rotor **22** fixed by a plurality of machine screws **24**. The main rotor has a plurality of longitudinal bores **26** into which are respectively fitted a like plurality of gun barrels **28**, secured by interrupted lugs **30**. A forward bearing assembly **32** journals the main rotor **20** within and to the main housing **10** and an aft bearing assembly **34** journals the aft rotor **22** about and to the aft end housing **14**. The aft rotor **22** has a forward flange and spur gear **36** having a like plurality of longitudinal bores **38**, and an aft flange **40** having a like plurality of longitudinal bores **42**. Respective sets of gun barrels **28**, bores **26**, bores **38** and bores **42** are in longitudinal alignment. A power input shaft **44** has a double-drive spur gear **46/47** fixed thereto and is journaled to the main housing **10** and the aft housing **12** by a forward bearing assembly **48** and an aft bearing assembly **50** respectively. A feeder sprocket assembly **52** is fixed on a shaft **54** which is journaled to the main housing **10** by a forward bearing assembly **56** and an aft bearing assembly **58**, not shown. A driven spur gear, not shown, is also fixed to the shaft **54** and is meshed with the gear **47**. The gear **46** is meshed with and drives the rotor gear **36**, and thus the rotor is synchronized with the feed sprocket assembly **52**.

A bolt assembly **57** and a locking cam follower assembly **58** are provided for each gun barrel. Each bolt assembly includes a bolt body **60**; a hollow bolt shaft **62** fixed into the body by a cross pin **64**; a firing pin **66**, disposed within a longitudinal bore **68** in the body, and having a wide longitudinal slot **69** which accommodates the pin **64** and a penetrator **70** integral with and extending forwardly from the pin. A cocking pin **72** extends radially from the firing pin through a lateral opening **74** in the bolt body. A mainspring **76** is captured between a shoulder ring **78** in the hollow bolt shaft **62** and the aft end of the pin **66**. The bolt body also has a forwardly extending extractor lug **80**, a radially extending boss **82** on which is journaled a cam follower roller **84** which is retained by a post **86** which is fixed into a bore through the boss, and a plurality of radially extending locking lugs **88**. The aft end of the shaft **62** is splined and rides in a splined bore **90** in a respective tube **92** which is journaled through a respective set of bores **28** and **42** in the aft rotor **22**. The tube has an aft flange **94** having a longitudinally aft extending pin **96**. A collar **98** is disposed on the tube between the flange **94** and the flange **40**. A snap ring **100** disposed in an annular recess in the tube captures the tube in the rotor. The collar **98** extends initially longitudinally aft and subsequently radially into a clevis **102**. A boss **104** extends longitudinally aft from the base of the clevis and has a cam follower roller **106** journaled thereon and captured by a post **108**. The clevis **102** of each locking cam follower assembly **58** is adapted to straddle the pin **96** of the next adjacent locking cam follower assembly.

The aft end housing **14** includes a circular cam cutout **110** having an inner cam wall **112** and an outer cam wall **144** which accommodate the cam follower rollers **106**

therebetween. A sector of the cam cutout 110 is omitted, and a sector plate 116 is mounted to the housing 14 by a pivot 118. The sector plate has a cam cutout which is wider, radially, than the cutout 110, and has an inner cam wall 120 and an outer cam wall 122 which are one-half the longitudinal depth of the walls 112 and 114. The distal end of the sector plate has a slot 124 which receives a post 126. When the sector plate is swung inwardly, as shown in FIG. 7, the sector outer cam wall 122 is on the same radius with the housing outer cam wall 114. In this safe disposition of the sector, the cam follower rollers are guided through the sector between the remaining forward half of the housing inner wall 112 and the sector outer wall 122. When the sector plate is swung outwardly, as shown in FIG. 5, the sector inner cam wall 120 is on a larger radius than the housing inner cam wall 112. In this armed disposition of the sector, the cam follower rollers are guided onto a rise on the sector inner wall 120. A suitable set of holes may be drilled in the sector and the aft end housing to accommodate a manually inserted locking pin when the sector is in the safe disposition.

The main housing 10 also includes a quasi-elliptical main cam track 126 which receives the cam follower roller 84 of each of the bolt assemblies and serves to traverse the bolt assemblies longitudinally fore and aft as they are carried around the gun axis by the rotor.

The main rotor 20 includes a like plurality of bolt slots 128 which are capped by a like plurality of tracks 130. Each bolt body 60 includes a transversely pie-shaped collar portion 132 having a transversely arcuate bearing surface 134 and two transverse bearing surfaces 136. The bolt arcuate bearing surface rides within and against the rotor slot 128 and the surfaces 136 ride under and against the overhanging surfaces 138 of the adjacent tracks 130. Additional alignment is provided by the splined aft end of the shaft 62 riding in the splined bore 90 of the tube 92. The main rotor also includes a like plurality of cocking pin control slots 142, each cut into a respective rotor slot 128. Each slot 142 includes an aft, longitudinally extending free portion 144, a transverse, concave, cocking surface 146, a searing shoulder 148, and a forward, longitudinally extending firing portion 150. A plurality of locking slots 152 are also provided in the rotor bolt slots to receive the bolt locking lugs 88.

In operation, each bolt assembly cam follower roller 84 rides in the quasi-elliptical main cam track 126 in the main housing 10, which drives the respective bolt body 60 longitudinally fore and aft in the bolt slot 128 and the splined shaft 62 in the splined tube 92, as the bolt assembly and its respective locking cam follower assembly are carried around by the rotor assembly. Each cam follower roller 106 rides in the circular cam cutout 110 in the aft end housing. When the sector plate 116 is in its safe disposition; no rotation of the tube 92 is effected. When the sector plate 116 is in its armed disposition, each cam follower roller 106 moves outwardly as it rides out on the sector inner cam surface 120. Each roller 106 is pivoted on a level arm whose length is the distance between the center of the roller 106 and the center of its tube 92. The clevis 102 is a linear extension of this lever arm and captures the pin 96. As seen in FIG. 5, as the rotor rotates in the direction A and the roller of the preceding tube rides up the sector inner wall in the direction B, it swings its lever arm in the direction B about the center of the preceding tube, and the distal end of the arm cranks the pin 96 of the succeeding tube in the direction C about the center of the succeeding tube. With a lever arm ratio of 1:2 here shown, a cam rise of 10° effects a tube rotation of 30°.

A round of ammunition R, is handed by the sprocket assembly 52 into the bolt assembly when the bolt is in its rearmost feed position as shown in the lower half of FIG. 1. The extractor lugs 80 of the bolt body engage the extractor plate E of the round's case. The cocking pin 72 of the firing pin 66 is disposed in the free portion 144 of the control slot 149. As the rotor comes around, the bolt assembly comes forward to the disposition shown in FIG. 8A. Continued forward movement of the bolt assembly brings the cocking pin 72 into engagement with the concave cocking surface 146 as shown in FIG. 8B. The firing pin 66 is biased forward, but not projecting, by the mainspring 76. The bolt assembly continues to its maximum forward position as shown in the upper half of FIG. 1, while the cocking pin 72 is halted by the cocking surface 146, thereby positively retracting the firing pin 66 and compressing the mainspring 76 between the web 78 and the firing pin, as shown in FIG. 8C. The tube 92 is now rotated by the sector plate inner wall 120, which concurrently rotates the splined shaft 62 and the bolt body 60, and swings the bolt-locking lugs 88 into the rotor-locking recesses 152, to start locking the bolt, as shown in FIG. 8D. The sector plate inner cam wall continues to rotate the shaft 62 and the bolt body 60, and continues to swing the bolt-locking lugs into the rotor-locking recesses to fully lock the bolt, and concurrently the sidewall of bolt lateral opening 74 cams the cocking pin laterally out of the cocking surface 146 and off the searing shoulder 148 into the firing portion 150 of the slot, as shown in FIG. 8E. The compressed mainspring now drives the firing pin forward, with the cocking pin riding in the firing portion of the slot, until the penetrator projects forwardly of the bolt body, impacting the cartridge primer. The sector plate inner cam wall now counterrotates the tube 92, the shaft 62 and the bolt body 60, and the forward edge 74*f* of the bolt lateral opening wipes against the forward face of the cocking pin 72, positively camming the cocking pin and the firing pin aft, positively retracting the penetrator 70 into the bolt body as shown in FIG. 8C. The bolt body continues rearwardly, the forward edge 74*f* of the bolt lateral opening carries the cocking pin rearwardly against the diagonal camming face 150*r* which positively cams the cocking pin laterally in the direction H into the free slot portion 144. The bolt body continues rearwardly to the rearmost feed position shown in FIGS. 8I, 8A, and 1.

An alternative embodiment of the locking cam follower assembly is shown in FIG. 9. In lieu of the clevis 102 and the pin 91 of FIG. 4, a gear sector 200 is formed on the collar 98' and a gear sector 202 is formed on the aft flange 94'. The meshed gear sectors provide a uniform angular velocity of the bolt body during its rotation provided by the sector inner cam wall.

It will be appreciated that the longitudinal stroke of the bolt is actually shorter than the length of the cartridge. The aft end of the cartridge extends aft of the barrel, as shown in FIG. 1. The fired cartridge case is extracted before the new cartridge is chambered, and thus while the longitudinal distance between the aft end of the barrel and the forward bolt face must be long enough to clear the length of the cartridge, the distance the bolt must come forward to lock the cartridge is significantly shorter. This feature is made possible by the omission of bolt-rotating mechanism for the longitudinal section of the gun involving the lateral feeding movement of the cartridges.

While there have been shown and described the preferred embodiments of the invention, it will be understood that the invention may be embodied otherwise than as herein specifically illustrated or described, and that certain changes in the form and arrangement of parts and in the specific manner of practicing the invention may be made without departing from the underlying idea or principles of this invention within the scope of the appended claims.

What is claimed is:

1. A revolving battery gun comprising:

a relatively stationary housing;

a relatively movable rotor journaled for rotation within said housing;

said rotor having a plurality of barrels disposed in an annular row, and a like plurality of bolt guide ways, each in alignment with a respective barrel, and a like plurality of bolts, each disposed in a respective guideway;

each bolt having a laterally extending cam follower and a longitudinally extending cam follower;

said housing having an inner peripheral cam track receiving each of said bolt laterally extending cam followers, for

providing each bolt with longitudinal movement along its respective guideway as said rotor rotates, and having an inner annular cam track receiving each of said bolt longitudinally extending cam followers, for providing each bolt with rotational movement within its respective guideway during the rotation of said rotor.

2. A gun according to claim 1 wherein:

said bolt comprises a longitudinally telescoping, and rotationally interlocked assembly of a forward body having said laterally extending cam follower and an aft unit having said longitudinally extending cam follower.

3. A gun according to claim 2 wherein:

said bolt body has a longitudinal bore therethrough with a lateral aperture, and

a mainspring and a firing pin with a forward penetrator are disposed in said bore, said firing pin having a laterally extending cocking pin projecting through said aperture,

a cocking pin control slot formed in each of said bolt guideways for receiving the distal end of the cocking pin of the respective bolt,

said control slot having an aft, longitudinally extending cocking portion, a forward longitudinally extending fire portion, and an intermediate, transverse portion, having a forward-searing surface and an aft resetting camming surface;

said lateral opening of said bolt body having a forward surface which in conjunction with said control slot cocking portion precludes forward movement of said cocking pin and projection of said penetrator from said bolt body until said bolt body has been rotated into lock.

4. A gun according to claim 2 wherein:

the longitudinally extending cam follower of each said aft unit is mounted on an arm extending laterally from said unit and is journaled on an axis spaced from the axis of said unit, the distal end of said arm being pivotally coupled to the next adjacent arm, the pivot being journaled on an axis spaced from the axis of said next adjacent unit.

5. A gun according to claim 1 wherein:

said annular cam track has two alternative configurations, one being circular, the other having a rise and fall,

said one configuration being adapted to preclude any rotation of said bolts, said other configuration being adapted to provide rotational movements to said bolts.

6. A gun according to claim 3 wherein:

said forward surface of said lateral opening has a camming portion for camming said cocking pin aft and retracting said penetrator into said bolt body before said bolt body is completely unlocked.