

# United States Patent

[11] 3,595,128

[72] Inventor John P. Hoyt, Jr.  
Burlington, Vt.  
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[73] Assignee General Electric Company

[56] References Cited  
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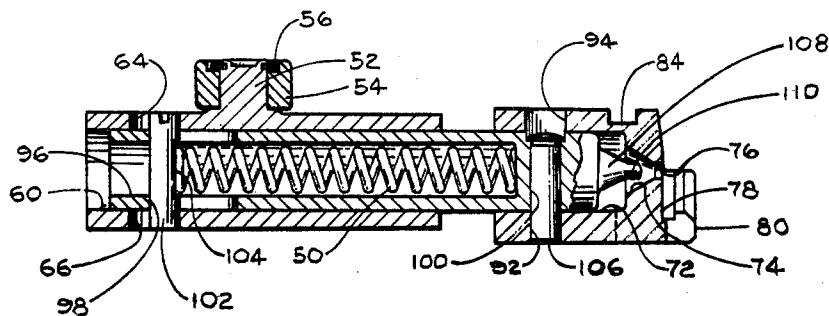
125,563	4/1872	Gatling .....	89/12
502,185	7/1893	Gatling .....	89/12
2,849,921	9/1958	Otto .....	89/12
3,380,343	4/1968	Chiabrandy et al.....	89/12

Primary Examiner—Samuel W. Engle  
Attorneys—Bailin L. Kuch, Irving M. Freedman, Harry C. Burgess, Frank L. Neuhauser, Oscar B. Waddell and Joseph B. Forman

[54] BOLT ASSEMBLY  
9 Claims, 16 Drawing Figs.

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42/16 R, 89/27  
[51] Int. Cl..... F41d 7/02  
[50] Field of Search..... 89/17, 13,  
27; 42/16, 16.1

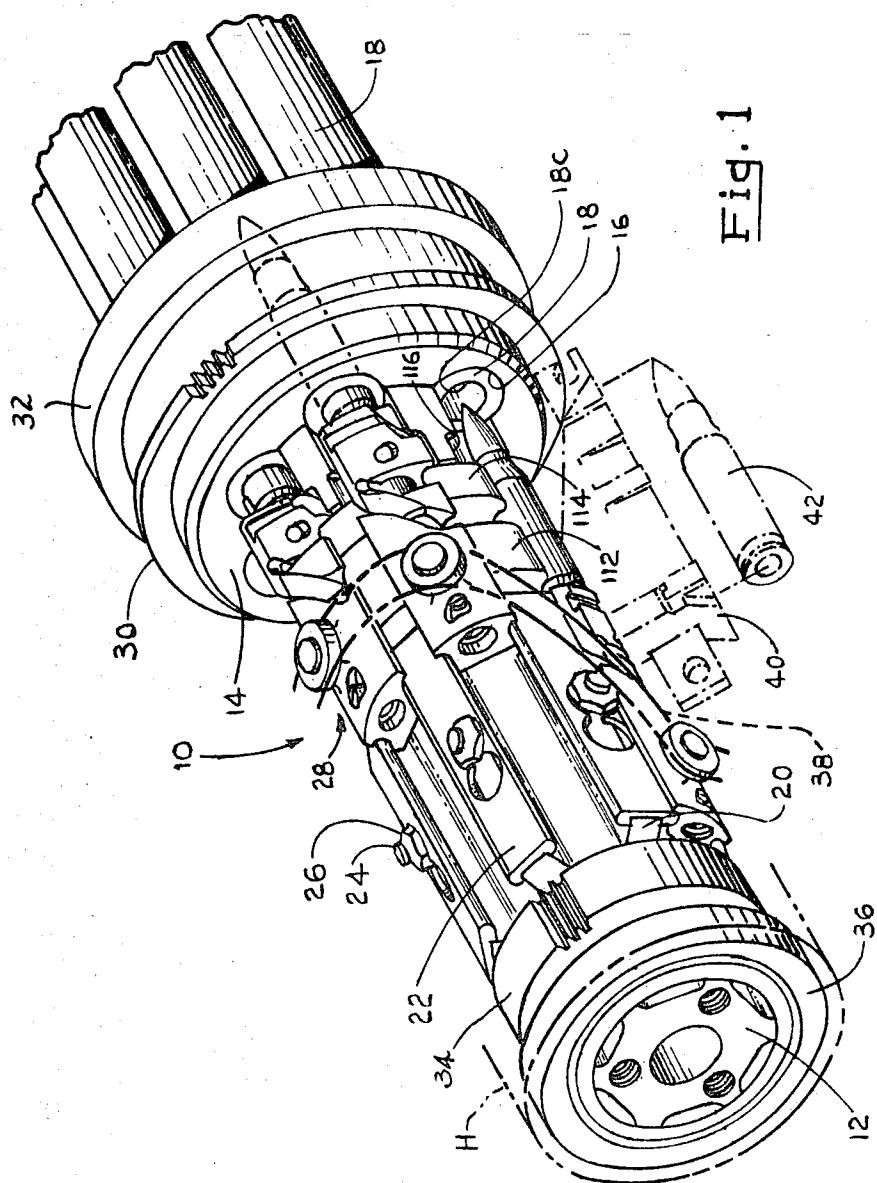
**ABSTRACT:** A bolt assembly for a Gatling gun, which gun has a stationary housing with the conventional elliptical cam track; a rotor assembly and a plurality of barrels, adapted to receive a like plurality of said bolt assemblies; includes means for cocking, searing and resetting the firing pin responsive to the longitudinal disposition of the bolt.



PATENTED JUL 27 1971

3,595,128

SHEET 1 OF 4



INVENTOR.

BY JOHN P. HOYT, JR.

*John. Hoyt*  
HIS ATTORNEY

PATENTED JUL 27 1971

SHEET 2 OF 4

3,595,128

Fig. 2

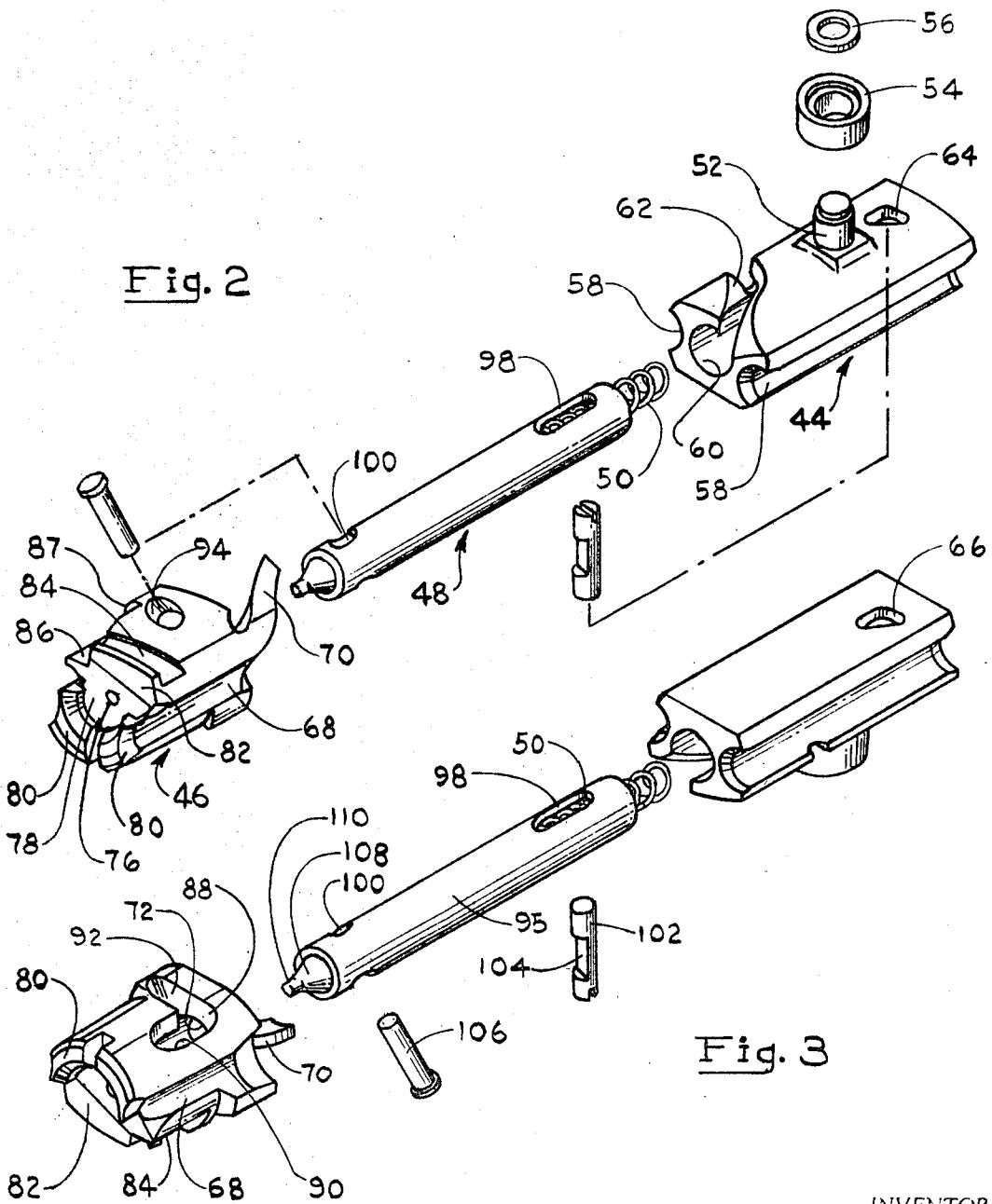


Fig. 3

*INVENTOR.*

BY JOHN P. HOYT, JR.

*Bartholomew*  
His Attorney

PATENTED JUL 27 1971

3,595,128

SHEET 3 OF 4

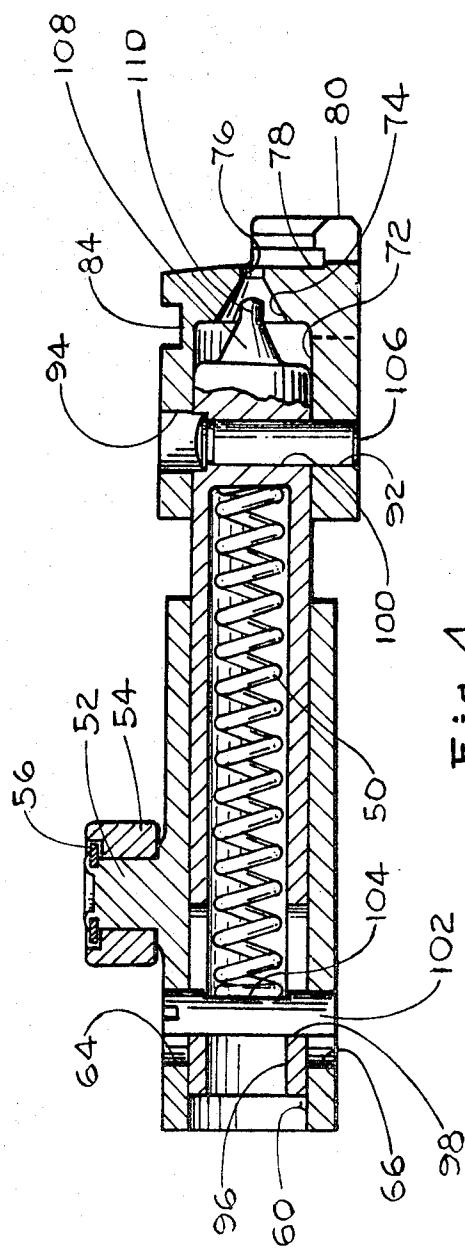
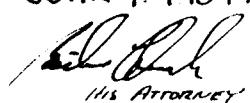


Fig. 4

INVENTOR.

BY JOHN P. HOYT, JR.

  
His Attorney

PATENTED JUL 27 1971

SHEET 4 OF 4

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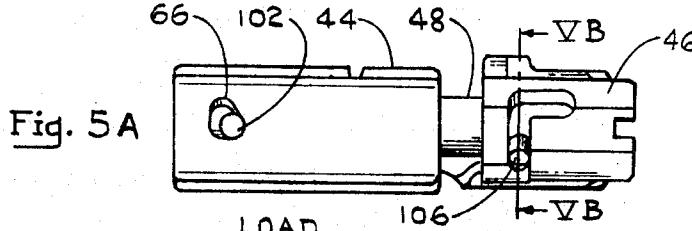


Fig. 5A



Fig. 5B

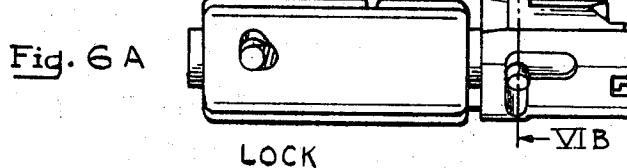


Fig. 6A

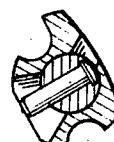


Fig. 6B

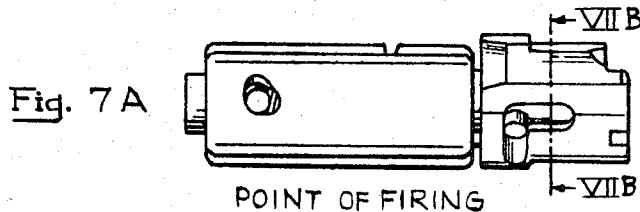


Fig. 7A



Fig. 7B

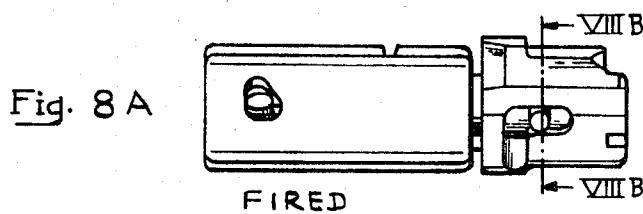


Fig. 8A

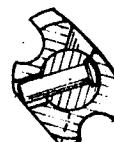


Fig. 8B

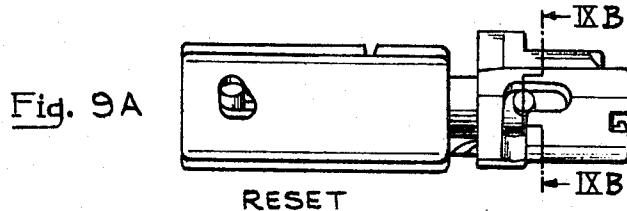


Fig. 9A

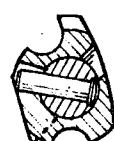


Fig. 9B

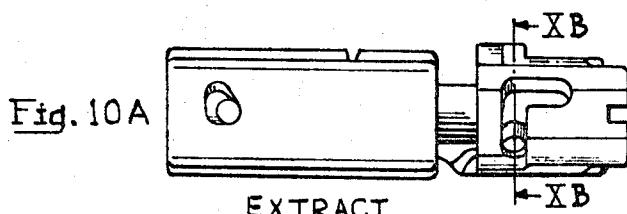


Fig. 10A

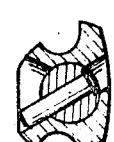
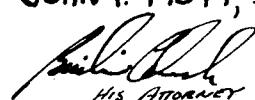


Fig. 10B

INVENTOR.

BY JOHN P. HOYT, JR.

  
His Attorney

## BOLT ASSEMBLY

## BACKGROUND OF THE INVENTION

## 1. Field of the Invention

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

This invention is an improvement in a type of Gatling gun sometimes called the minigun. The gun conventionally 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 of the bolt is provided by the conventional housing elliptical cam track. The cocking, searing, and resetting of each firing pin is controlled by respective cam track in the rotor. Obtaining and maintaining dimensional synchronism among the housing cam track, the bolt and the rotor cam track is a major economic concern.

## SUMMARY OF THE INVENTION

It is an object of this invention to provide an improved minigun utilizing a simpler mechanism for cocking, searing and resetting the firing pin.

It is another object of this invention to provide a bolt assembly wherein an internal mechanism controls the cocking, searing and resetting of the firing pin directly responsive to the longitudinal reciprocation of the bolts.

A feature of this invention is the provision of the bolt assembly for a Gatling gun, which gun has a stationary housing with the conventional elliptical cam track; a rotor assembly and a plurality of barrels, adapted to receive a like plurality of barrels, adapted to receive a like plurality of said bolt assemblies, each said bolt assembly including means for cocking, searing and resetting the firing pin responsive to the longitudinal disposition of the bolt.

Another feature of this invention is the provision of a bolt assembly which is adapted for use in single barreled guns, said bolt assembly including means for cocking, searing and resetting the firing pin responsive to the longitudinal reciprocation of the bolt.

## 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 perspective view of a rotor assembly including bolt assemblies providing a first embodiment of this invention;

FIG. 2 is an exploded perspective view of a bolt assembly of FIG. 1;

FIG. 3 is an exploded perspective view of the bolt assembly of FIG. 1, rotated 180°;

FIG. 4 is a side view in cross section of the bolt assembly of FIG. 1;

FIGS. 5A and 5B are a bottom and end view in cross section respectively of the bolt assembly in the load disposition;

FIGS. 6A and 6B are a bottom and end view in cross section respectively of the bolt assembly in the lock disposition;

FIGS. 7A and 7B are a bottom and end view in cross section respectively of the bolt assembly in the point of firing position;

FIGS. 8A and 8B are a bottom and end view in cross section respectively of the bolt assembly in the fired disposition;

FIGS. 9A and 9B are a bottom and end view in cross section respectively of the bolt assembly in the reset disposition; and

FIGS. 10A and 10B are a bottom and end view in cross section respectively of the bolt assembly in the extract disposition.

## THE PREFERRED EMBODIMENT

The rotor assembly 10 shown in FIG. 1 includes a rotor body 12 having a forward head portion 14 with six ports 16 therein to respectively receive six gun barrels 18 with respective changers 18C. Six longitudinal ribs 20 project radially from the body between the ports and six track elements 22 are respectively bolted to the ribs by studs 24 extending therefrom, and nuts 26. Six bolt assemblies 28 are respectively mounted between immediately adjacent track elements in alignment with respective barrels 18. A rotor forward gear 30 and a rotor forward bearing 32 are fixed on the rotor forward head portion 14. A rotor aft gear 34 and a rotor aft bearing 36 are fixed to the aft end of the rotor body.

The rotor assembly is journaled via the forward and aft bearings for rotation in a housing H, briefly indicated by phantom lines, which has an internal, elliptical cam track 38 shown in phantom lines. A guide bar 40, shown in phantom lines, is fixed to the housing and has fingers to direct cartridges 42 from the feeder assembly, not shown, into the extractors of the bolt, and to cam the spent cartridge cases out of the extractors into the ejection chute, not shown. The feeder may be of the type shown in U.S. Pat. No. 3,333,506, issued by R.W. Henshaw et al. on Aug. 1, 1967.

Each bolt assembly 28 includes a main body portion 44, a head portion 46, a firing pin 48, and a mainspring 50. A stud 52 extends radially from a boss on the main body portion

45 and a cam follower roller 54 is captured thereon by a ring 56. A pair of longitudinal side slots 58 are formed in the main body portion to ride on the rotor track elements 22. A central longitudinal bore 60 is formed in the main body portion, together with a helical cutout 62. An upper triangular shaped

50 cutout 64 and a lower triangular shaped cutout 66 extend through the body portion to the central bore. The head portion 46 includes a pair of longitudinal side slots 68 to ride on the rotor track elements 22. A helical arm 70 extends aft to ride in the helical slot 62. A central longitudinal bore 72 is formed in the head portion, the forward portion having a cone shaped reduction 74 and a smaller diameter aperture 76 into the bolt face 78. Two extractor lugs 80 extend forwardly of the bolt face. The bolt face has a ramp relief surface 82 to guide the extractor plate of the cartridges onto the bolt face when the cartridge is fed to the bolt by the feeder. The bolt also has an alignment slot 84 to engage a rib on the guide bar 40 during feeding, and a relief 86 to clear a feeder sprocket, not shown, and a locking lug 87. The undersurface of the head portion has a L-shaped slot 88, extending to the bore 72, having a longitudinal leg 90 and a transverse leg 92. An access hole 94 extends from the upper surface to the bore 72. The firing pin 48 includes a body portion 95 having a central longitudinal blind bore 96, an aft, longitudinally extending, diametral slot 98, and a forward diametral bore 100. The mainspring 50 is captured in the bore 96 by a crosspin 102 which has a flat 104 cut thereto. The aft end of the mainspring is seated in the flat and prevents loss of the crosspin. A headed crosspin 106 is disposed through and past the access hole 94 into the bore 100

65 and extends into the L-shaped slot 88. A cone shaped penetra-

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tor 108 extends forwardly from the body portion 95 and has a cylindrical tip 110. In the assembly, the firing pin 48 is disposed in the bores 72 and 60 with the crosspin 106 retaining the head portion on the firing pin, and the crosspin 102 retaining the body portion on the firing pin.

The rotor body 12 also includes a first set of six T-shaped projections 11, a second set of six T-shaped projections 114, and a set of six annular locking recesses 116, all respectively aligned with, or intermediate with, the barrel bores 16. The edges of the T-shaped projections are aligned with the track elements 22 to provide continuing guide surfaces for the bolts as they advance from the track elements towards the barrels.

The longitudinal position of each bolt assembly is controlled by the elliptical cam track 38 in the housing into which is disposed the cam follower roller 54 of each bolt assembly. A cycle of operation may be considered to start with the load function, which is shown in FIG. 5A. The bolt assembly is in its maximum aft position and is adjacent the feeder guide bar. A cartridge is handed off by the feeder sprockets, guided by the guide bar, onto the bolt face 82, where it is held by the extractor lugs 80. The body portion and the head portion are at their maximum mutual separation, with their side slots riding on the track elements 22. The distal end of the crosspin 106 is in the distal end of the transverse leg 92 of the L-slot 88. The distal ends of the crosspin 102 are in the forwardmost apexes of the triangular cutouts 64 and 66. As the bolt assembly is moved forward it carries the cartridge with it until the cartridge is fully seated in the respective chamber 18C of the respective barrel 18, and the forward edges of the extractor lugs 80 abut the rear face of the barrel. Further forward movement of the bolt head portion is now precluded. The cam follower continues to traverse the bolt body portion forward, so that it rides forward on the now stationary firing pin, and the helical slot 62 cams the helical arm around the firing pin, and with it the head portion which rotates within the annular locking recess 116 so that the bolt locking lug 87 is below and forward of the projection 114, locking the bolt, as shown in FIG. 6A. Concomitantly, the crosspin 102 rides along the longitudinal sides of the triangular cutouts 64 and 66, until it reaches the transverse sides of the cutouts and thereafter the mainspring is progressively compressed as the crosspin 102 is carried forward in the firing pin slot 98. Further movement forward of the cam follower and the body portion continues the compression of the mainspring, rotation into full lock of the bolt head, and further movement of the transverse leg 92 to the position shown in FIG. 7A, whereat the crosspin 106 is just short of being seared out of the transverse leg 92 into the longitudinal or firing leg 90. Further forward movement of the cam follower sears the pin 106 into the longitudinal leg 90, releasing the firing pin which shoots forward under the bias of the compressed mainspring. The penetrator 110 projects forward of the bolt face to impact the base of the cartridge. The pin is halted by the cone portion 108 mating with the bore cone portion 74. It will be noted that the forward extension of leg 90 is made longer than the travel of the crosspin 106 to permit venting of any primer gas.

After firing, the cam follower begins to move aft, carrying the body portion aft, away from the locked head portion, so that the helical cam slot 62 cams the helical cam follower arm 70 and the integral therewith head portion into unlocking rotation. Concomitantly, the stationary crosspin 102 abuts the ramp surfaces on the triangular cutouts 64 and 66 and is cammed aft long the ramp surfaces by the aft-moving bolt body to slightly rotate and positively retract the firingpin and its penetrator without stress on the helical slot and arm. Continued aft movement of the bolt body brings the bolt assembly to the reset position shown in FIG. 9A. Yet further aft movement of the bolt body continues to rotate the bolt head via the helical slot and arm and to shift the cross pin 106 aft in the leg 90 until the cross pin 106 reaches the leg 92. Now further aft movement of the bolt body cams the crosspin 102 relatively forwardly on the ramp surfaces of the cutouts 64 and 66 and thereby provides further rotation of the firing pin and thereby

swings the crosspins 106 into the distal end of leg 92. Concomitantly, the helical slot and arm provide final unlocking rotation of the bolt head portion to unlock the bolt assembly which is now at the extract position shown in FIG. 10A.

5 Further aft movement of the cam follower 54 carries the bolt assembly aft together with the spent cartridge case to the full aft position whereat the spent cartridge is ejected, and after further rotation of the rotor assembly, the bolt assembly is ready to receive a fresh cartridge.

10 Thus, there has been described a self-operating bolt assembly that does not require any mechanism external to the reciprocating bolt assembly to cock, sear or reset the firing pin. The bolt assembly is, therefore, extremely durable, reliable and economical to manufacture. Although the invention has been described in an embodiment adapted for use in a Gatling type, multiple barrel gun, utilizing an elliptical cam for bolt actuation, it is adapted for use in other guns, such as have a single barrel using other means to provide reciprocation of the bolt assembly. All that is required to cock, sear and reset the firing pin is relatively longitudinal motion between the bolt head and the bolt body.

I claim:

1. A gun bolt assembly comprising:

a main body subassembly;

a head subassembly; and

a firing pin subassembly;

said main body subassembly including:

a main body having forward and aft ends,

means for providing longitudinal reciprocation to said body,

a longitudinal bore in said body opening through said forward end,

a helical cam slot, and

a triangular, diametral, slot having a longitudinal surface, a transverse surface, and a ramp surface;

said head subassembly including:

a head body having forward and aft ends,

a longitudinal bore through said head body,

a helical cam follower arm mating with said helical cam slot,

an L-shaped, diametral, slot having a longitudinal leg and a transverse leg; and

said firing pin subassembly including:

a firing pin having a forward penetrator end disposed in said head body longitudinal bore and an aft end disposed in said main body longitudinal bore,

a longitudinal bore in said pin opening through said aft end,

a diametrical, longitudinally extending, slot through said pin,

a helical mainspring disposed in said firing pin longitudinal bore,

an aft crosspin disposed in said firing pin slot, capturing and abutting said mainspring, and extending into main body triangular slot, and

a forward crosspin extending radially from said firing pin and extending into said head body L-shaped slot.

2. A gun bolt assembly comprising:

a main body subassembly;

a head subassembly; and

a firing pin subassembly;

said main body subassembly including:

a main body having forward and aft ends,

means for providing longitudinal reciprocation to said body,

a longitudinal bore in said body opening through said forward end,

a helical cam slot, and

a triangular, diametral, slot having a longitudinal surface, a transverse surface and a hypotenuse or ramp surface;

said head subassembly including:

a head body having a forward bolt face and extractor lugs, and an aft end,

a transversely extending locking lug,

a longitudinal bore through said head body,  
a helical cam follower arm mating with said helical cam slot,  
an L-shaped, diametral, slot having a longitudinal leg and a transverse leg; and  
said firing pin subassembly including:  
a firing pin having a forward penetrator end disposed in said head body longitudinal bore and an aft end disposed in said main body longitudinal bore,  
a longitudinal bore in said pin opening through said aft end,  
a diametral, longitudinally extending, slot through said pin,  
a helical mainspring disposed in said firing pin longitudinal bore,  
an aft crosspin disposed in said firing pin slot, capturing and abutting said mainspring, and extending into main body triangular slot, and  
a forward crosspin extending radially from said firing pin and extending into said head body L-shaped slot. 20

3. A gun bolt assembly according to claim 2 wherein:  
in the feed position said main body and said head body are at a maximum mutual longitudinal separation and are journaled on said firing pin, with said aft crosspin disposed against the longitudinal forward apex of the triangular slot and the forward crosspin disposed in the distal end of said transverse leg of said L-shaped slot, and said mainspring is relatively uncompressed; 25  
in the locked and latched position, said main body and said head body are at a relatively closer mutual longitudinal separation with said head body rotated about said firing pin, with said aft crosspin disposed against the longitudinal aft apex of said triangular slot and said forward crosspin disposed in said transverse leg of said L-shaped slot closely adjacent to said longitudinal leg, and said mainspring is compressed; 30  
in the seared position, said main body and said head body are at a minimum mutual longitudinal separation with said head body further rotated about said firing pin, with said aft crosspin disposed against said longitudinal aft apex of said triangular slot and said forward crosspin disposed in said longitudinal leg of said L-shaped slot, with said penetrator of said firing pin extending forward of said head body face. 35

4. A gun bolt assembly according to claim 3 wherein:  
during the extraction function, said aft crosspin is cammed relatively aft along said ramp surface of said triangular slot to positively withdraw said penetrator aft into said head body, and  
during the reset function, said aft crosspin is cammed relatively forward along said ramp surface of said triangular slot to swing said forward crosspin into said distal end of said transverse leg of said L-shaped slot. 50

5. A multibarreled gun comprising:  
a housing having a interior elliptical cam groove; 55  
a rotor assembly, journaled for rotation with said housing, including:  
a rotor body having a plurality of barrel receiving ports in an annular row, and a like plurality of bolt receiving guideways respectively aligned with said ports, including an annular locking recess adjacent said port, and a like plurality of bolt assemblies, respectively disposed in said guideways,  
each bolt assembly comprising:  
a main body subassembly; 60  
a head subassembly; and  
a firing pin subassembly;  
a main body having forward and aft ends, cam follower means disposed in said housing cam groove for providing longitudinal reciprocation to said body,  
a longitudinal bore in said body opening through said forward end, 70  
a helical cam slot, and

a triangular, diametral, slot having a longitudinal surface, a transverse surface, and a ramp surface, said head subassembly including:  
a head body having forward and aft ends,  
a longitudinal bore through said head body,  
a helical cam follower arm mating with said helical cam slot,  
an L-shaped, diametral, slot having a longitudinal leg and a transverse leg, and  
a transversely extending locking lug adapted, upon rotation of said head body to enter said guideway locking recess;  
said firing pin subassembly including:  
a firing pin having a forward penetrator end disposed in said head body longitudinal bore and an aft end disposed in said main body longitudinal bore,  
a longitudinal bore in said pin opening through said aft end,  
a diametral, longitudinally extending slot through said pin,  
a helical mainspring disposed in said firing pin longitudinal bore,  
an aft crosspin disposed in said firing pin slot, capturing and abutting said mainspring, and extending into main body triangular slot, and  
a forward crosspin extending radially from said firing pin and extending into said head body L-shaped slot.

6. A gun bolt assembly comprising:  
a main body subassembly;  
a head subassembly; and  
a firing pin subassembly;  
said main body subassembly including:  
a main body having forward and aft ends,  
means for providing longitudinal reciprocation to said body,  
a longitudinal bore in said body opening through said forward end,  
a helical cam slot, and  
a diametral aperture;  
said head subassembly including:  
a head body having forward and aft ends,  
a longitudinal bore through said head body,  
a helical cam follower arm mating with said helical cam slot,  
an L-shaped, diametral, slot having a longitudinal leg and a transverse leg; and  
said firing pin subassembly including:  
a firing pin having a forward penetrator end disposed in said head body longitudinal bore and an aft end disposed in said main body longitudinal bore,  
a longitudinal bore in said pin opening through said aft end,  
a diametrical, longitudinally extending slot through said pin,  
a helical mainspring disposed in said firing pin longitudinal bore,  
a first crosspin disposed in said firing pin slot, capturing and abutting said mainspring, and extending into said main body diametral aperture,  
a second crosspin extending radially from said firing pin and extending into said head body L-shaped slot, and  
firing pin resetting means including said first crosspin for converting relative rotational movement of said main body to said firing pin into relative longitudinal movement aft of said firing pin to said main body.

7. A gun bolt assembly according to claim 6 wherein:  
said main body diametral aperture is a triangular slot having a longitudinal surface, a transverse surface, and a ramp surface, and  
said firing pin resetting means includes said ramp surface.

8. A multibarreled gun comprising:  
a housing having an interior elliptical cam groove;  
a rotor assembly, journaled for rotation with said housing, including:

a rotor body having a plurality of barrel receiving ports in an annular row, and a like plurality of bolt receiving guideways respectively aligned with said ports, including an annular locking recess adjacent said port, and a like plurality of bolt assemblies, respectively disposed in said guideways,  
 each bolt assembly comprising:  
 a main body subassembly;  
 a head subassembly; and  
 a firing pin subassembly;  
 said main body subassembly including:  
 a main body having forward and aft ends,  
 cam follower means disposed in said housing cam groove for providing longitudinal reciprocation to said body,  
 a longitudinal bore in said body opening through said forward end,  
 a helical cam slot, and  
 a diametrical aperture;  
 said head subassembly including:  
 a head body having forward and aft ends,  
 a longitudinal bore through said head body,  
 a helical cam follower arm mating with said helical cam slot,  
 an L-shaped, diametral, slot having a longitudinal leg and a transverse leg, and  
 a transversely extending locking lug adapted, upon rotation of said head body, to enter said guideway

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locking recess;  
 said firing pin subassembly including:  
 a firing pin having forward penetrator end disposed in said head body longitudinal bore and an aft end disposed in said main body longitudinal bore,  
 a longitudinal bore in said pin opening through said aft end,  
 a diametral, longitudinally extending slot through said pin,  
 a helical mainspring disposed in said firing pin longitudinal bore,  
 a first crosspin disposed in said firing pin slot, capturing and abutting said mainspring, and extending into said main body diametral aperture,  
 a second crosspin extending radially from said firing pin and extending into said head body L-shaped slot, and  
 firing pin resetting means including said first crosspin for converting relative rotational movement of said main body to said firing pin into relative longitudinal movement aft of said firing pin to said main body.  
 9. A gun according to claim 8 wherein:  
 said main body diametral aperture is a triangular slot having a longitudinal surface, a transverse surface, and a ramp surface, and  
 said firing pin resetting means includes said ramp surface.