United States Patent [19]

Chiabrandy

[11] **3,757,636**

[45] **Sept. 11, 1973**

[54] **BOLT ACCELERATOR FOR RECOIL OPERATED GUN**

[75] Inventor: **Robert E. Chiabrandy**, Burlington, Vt.

[73] Assignee: **General Electric Company**, Burlington, Vt.

[22] Filed: **Apr. 19, 1972**

[21] Appl. No.: **245,508**

[52] **U.S. Cl.** **89/169**

[51] **Int. Cl.** **F41d 5/02**

[58] **Field of Search** 89/169, 162, 177, 89/178

[56] **References Cited**

UNITED STATES PATENTS

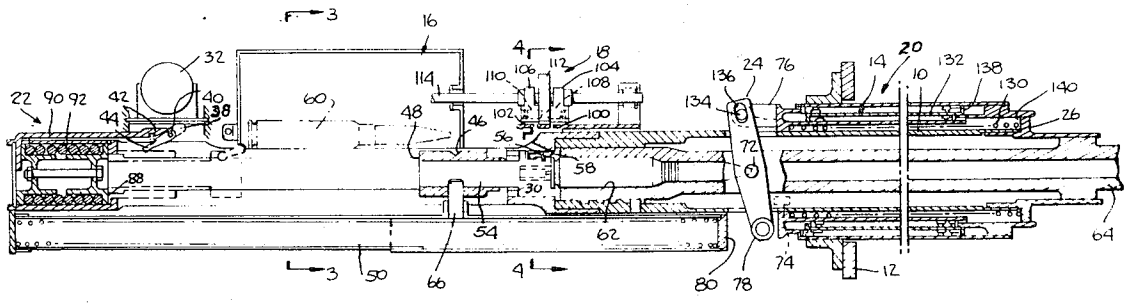
642,018	1/1900	Ternstrom	89/169
830,511	9/1906	Lehmann	89/169
1,746,471	2/1930	Herlach et al.	89/169
1,985,493	12/1934	Gebauer et al.	89/169
3,512,449	5/1970	Stoner	89/169

Primary Examiner—Benjamin A. Borchelt
Assistant Examiner—C. T. Jordan
Attorney—Bailin L. Kuch et al.

[57] **ABSTRACT**

A single barrel gun has a short recoil system of operation and a bolt accelerator which includes the barrel drive spring and barrel buffer spring as a part of its operating mechanism.

7 Claims, 9 Drawing Figures



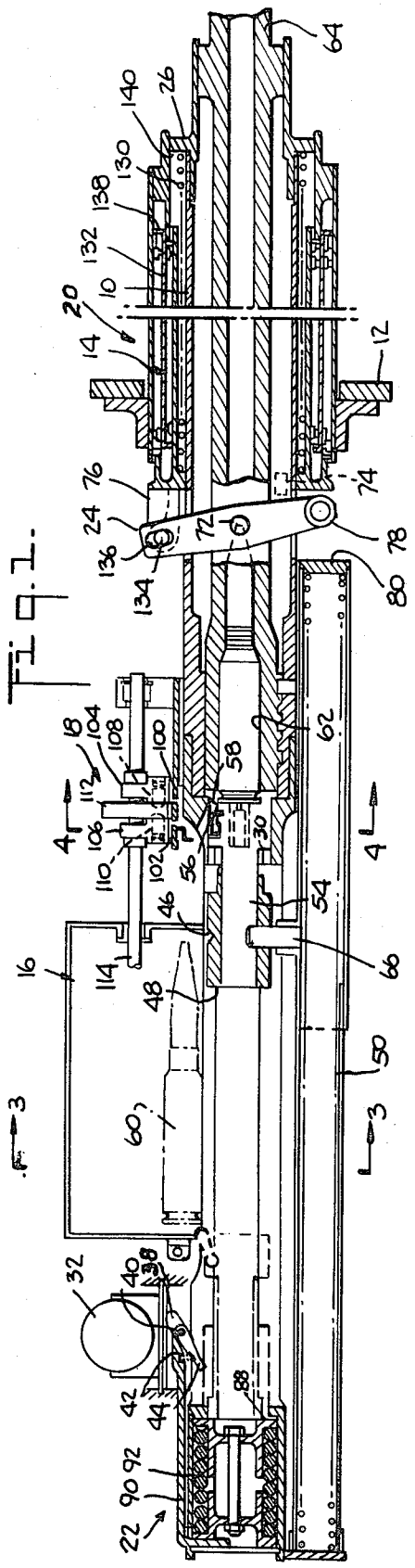


Fig. 1.

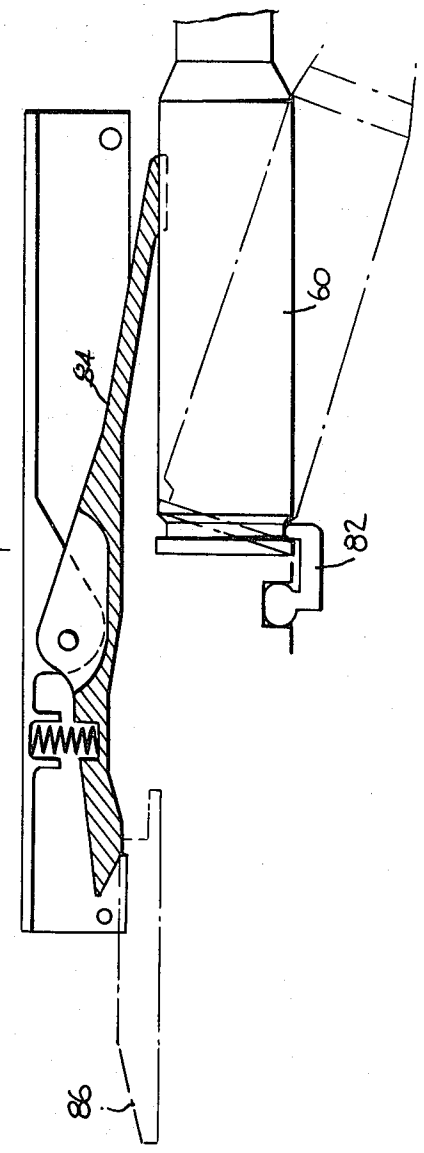


Fig. 6.

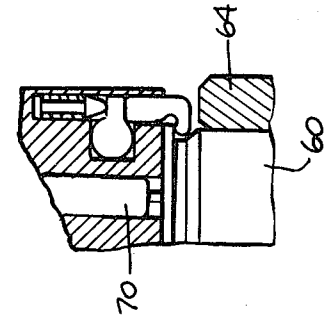


Fig. 5.

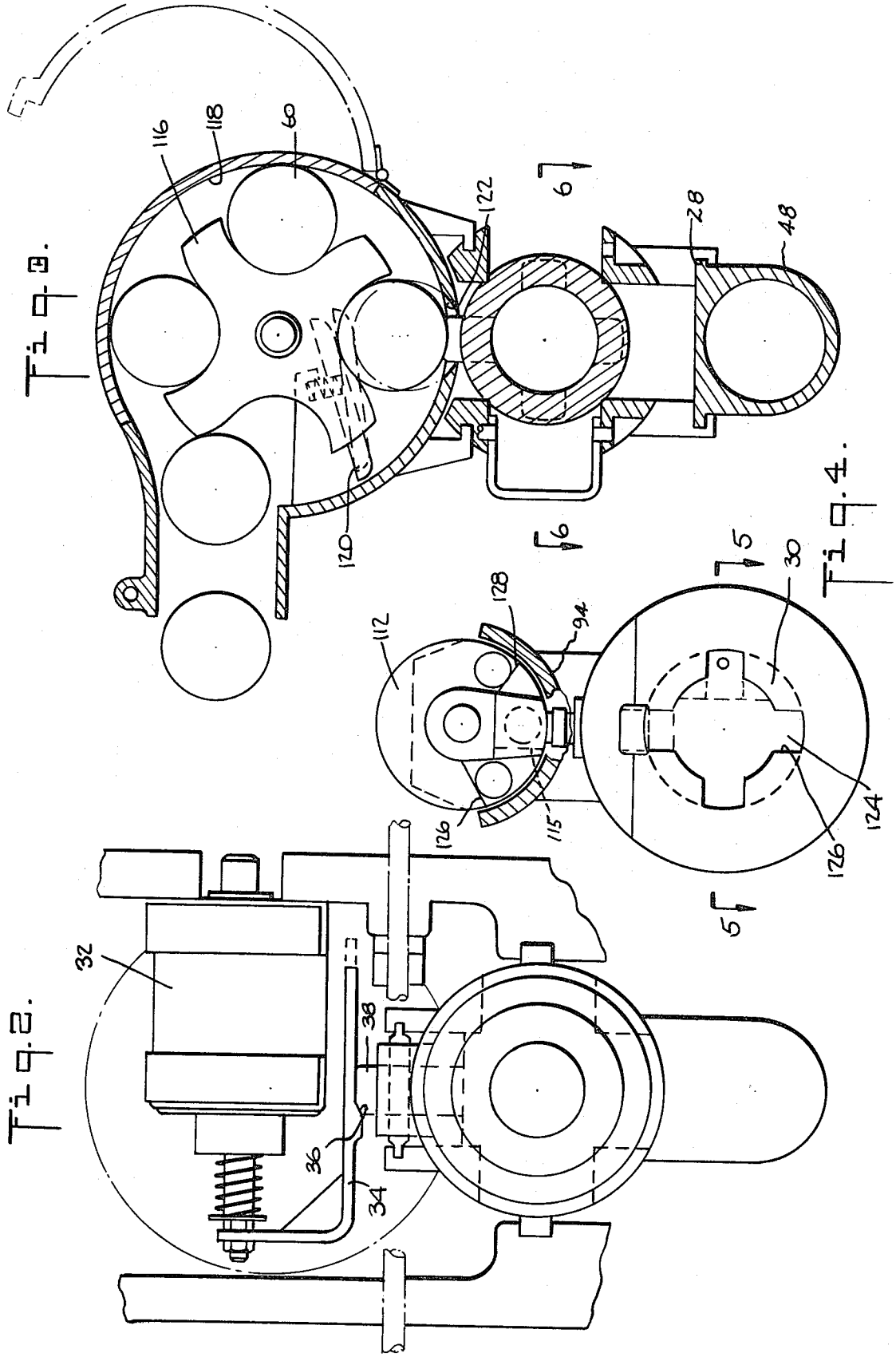


Fig. 2.
32
38
36
34
Fig. 3.
116
118
8
120
122
6
28
48
Fig. 4.
5
30
112
128
94
126
115
124
126

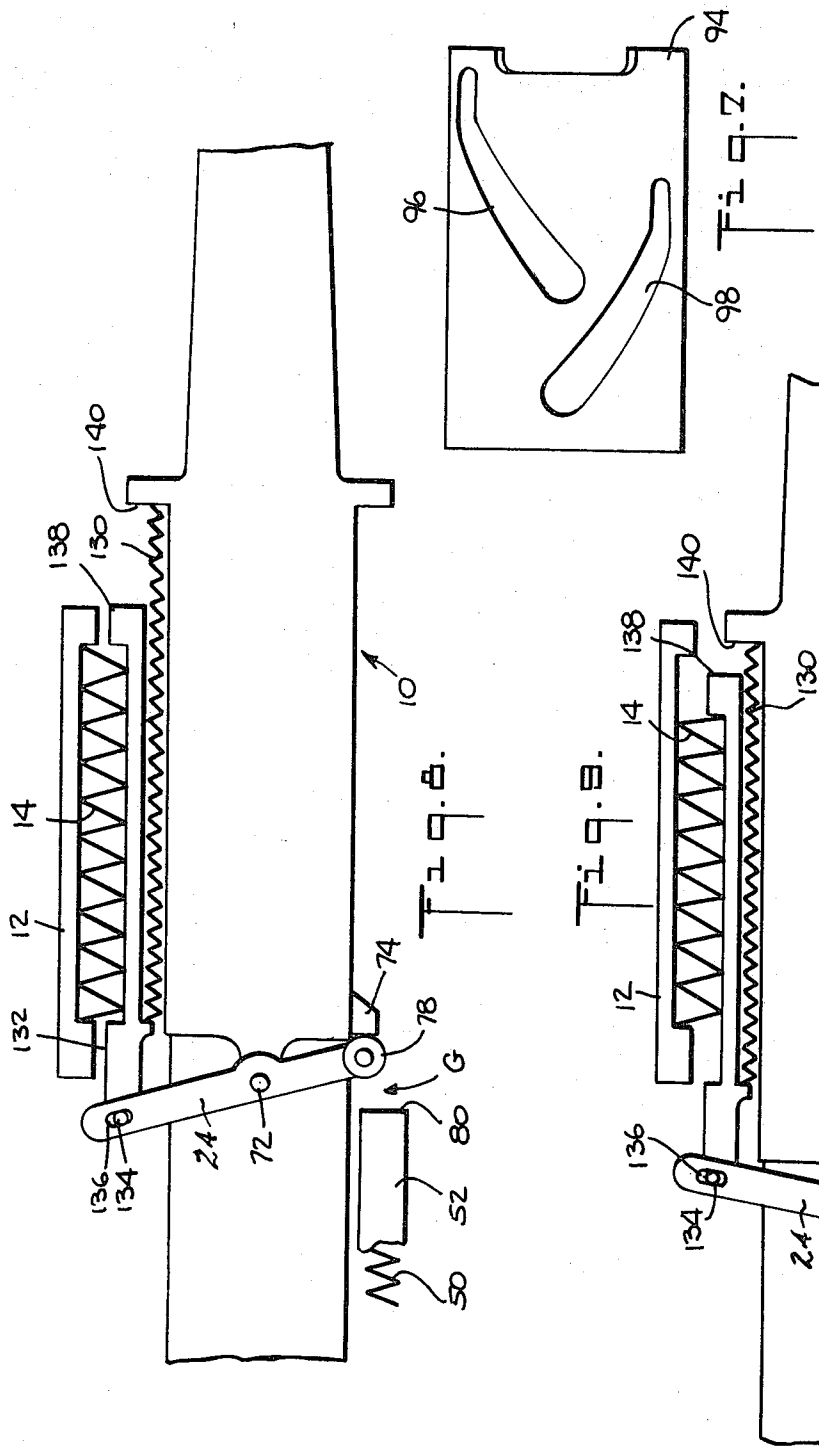


Fig. 7.

Fig. 8.

Fig. 9.

BOLT ACCELERATOR FOR RECOIL OPERATED GUN

BACKGROUND OF THE INVENTION

1. Field of the Invention

This invention relates to automatic and semiautomatic guns which are recoil operated.

2. Description of the Prior Art

Recoil operated, single barrel guns, utilizing the Browning short recoil system of operation, are well known, and are described in some detail in "The Machine Gun" Vol. IV, by G.M. Chinn, 1955, published for the Department of the Navy by the U.S. G.P.O. Most of these guns utilize a rigid mechanical device to accelerate the bolt from the barrel during recoil movement. When fired on a relatively stiff mount, these guns develop a relatively high instantaneous recoil force.

BRIEF SUMMARY OF THE INVENTION

It is, therefore, an object of this invention to provide a recoil operated, single barrel gun, having a short recoil system of operation, and an inherently lower recoil force than conventional guns of this type.

Another object is to provide a gun of this type having an operating cycle which is relatively insensitive to fluctuations in ammunition performance.

A feature of this invention is a gun having a short recoil system of operation and a bolt accelerator which includes the barrel drive spring and the barrel buffer spring as a part of its operating mechanism.

BRIEF DESCRIPTION OF THE INVENTION

FIG. 1 is a side view in longitudinal cross-section of the essential structure of a gun embodying this invention;

FIG. 2 is an aft end view of the gun of FIG. 1;

FIG. 3 is a view in cross-section taken along plane 3—3 of FIG. 1;

FIG. 4 is a view in cross-section taken along plane 4—4 of FIG. 1;

FIG. 5 is a partial view in cross-section taken along plane 5—5 of FIG. 4;

FIG. 6 is a view in cross-section rotated 90°, taken along plane 6—6 of FIG. 3;

FIG. 7 is a detail top view of the feed drive cam plate of the gun of FIG. 1;

FIG. 8 is a schematic diagram of the accelerator of the gun of FIG. 1, at the instant of firing; and

FIG. 9 is a schematic diagram of the accelerator of FIG. 2, during recoil.

DESCRIPTION OF THE PREFERRED EMBODIMENT

1. Introduction

The gun shown in FIG. 1 utilizes the barrel extension 10, in lieu of the receiver 12, as the structural housing in which most of the other components of the gun operate. The barrel extension supports the barrel extension buffer package 20 housed within the receiver 12 which functions as a gun cradle. The barrel extension supports the feeder 16 and the feeder drive 18 in all directions, except the longitudinal, wherein support is provided by a rearward extension of the receiver. The barrel extension contains the bolt and sear buffer package 22, actuates the accelerator lever 24, and provides a barrel support 26, tracks 28 for the bolt package and locking surfaces 30 for the bolt. Thus the weight which conventionally goes into the supporting structure of the receiver is incorporated in the recoiling mass, thereby lowering the energy of recoil which must be absorbed by the barrel buffer assembly.

2. Gun Cycle

To start a cycle of operation the solenoid 32 is energized. This moves the sear release 34 transversely to the right as seen in FIG. 2. This motion drives a cam surface 36 against the sear 38. The sear is swung about its pivot 40 compressing its spring 42 to withdraw its tail 44 from a notch 46 in the bolt carrier 48 to release the bolt carrier, which is driven forward by the bolt drive spring 50. This is the start of the counter-recoil stroke. The bolt body 54 moves forward and by means of a spring 56 loaded rammer 58, strips the round 60, located on the feed tray in the feeder 16, from its link and rams it into the chamber 62 of the barrel 64. The bolt body 54 is driven by the bolt carrier 48 and is cammed into a locked position by a stud 66 riding in a cam (not shown) in the bolt body. The forward motion of the bolt carrier 48, after it has locked the bolt body, is enough to provide dwell travel during the recoil stroke. (This dwell is required to allow for chamber pressure decay.) The last gun function in the counter-recoil stroke is the firing pin release. The firing pin 70 strikes the primer and fires the round. This starts the recoil cycle of the barrel 64 and barrel extension 10. The accelerator lever 24 is pivoted on the barrel extension by a pivot stud 72, and, at the instant of firing, rests against a stop lug 74 located on the barrel extension. It is held in this position by the action of the barrel recoil spring 130. As the pivot stud 72 pushes the accelerator aft, the accelerator rotator-buffer spring guide 76 restrains the upper end of the accelerator. This restraint is a spring-loaded restraint because the accelerator rotator-buffer spring guide is attached to the buffer package 20. This action causes the accelerator lever to rotate clockwise about the pivot stud 72. A roller 78 on the lower end of the accelerator lever pushes against the front surface 80 of the bolt carrier 48 and accelerates the bolt carrier aft. The stud 66 on the bolt carrier cams the bolt body 54 to the unlocked position. The bolt carrier continues to be accelerated aft by the accelerator after unlock until the barrel support 26 strikes the spring guide 76. The barrel extension continues aft until it is halted by the buffer package while the bolt body is carried aft by the bolt carrier. The extractor 82, pivotally mounted and spring loaded in the bolt body, extracts the fired case 60 from the chamber 62 and carries it aft until the ejector 84 strikes the case and drives it laterally from the gun. The ejector 84 is spring loaded, pivoted lever, and is actuated by a cam surface 86 on the bolt carrier. The aft end of the lever is struck by the recoiling bolt carrier cam surface 86 to pivot the lever so that its front end strikes the fired case and ejects it from the gun. The bolt body continues to recoil aft until it hits the bolt buffer plate 88 of the preloaded bolt buffer spring package 22. The buffer stops the bolt and reverses its direction.

To halt the cycle the solenoid 32 is de-energized. The sear release 34 moves to the left and releases the sear 38. The sear snaps into the notch 46 of the bolt body and halts its forward motion. The sear 38 is mounted on a sear buffer plate 90 that transmits the sear load to

the rear of the bolt buffer spring **92**, thereby limiting the load on the sear **38**.

3. Feeder

The feeder **16** is driven by a feed drive cam plate **94** attached to the barrel extension and having two cam tracks **96** and **98**. The cam plate recoils and counter-recoils with the barrel extension. The cam motion, during both recoil and counter-recoil, is transmitted via two cam followers **100** and **102** journalled to two levers **104** and **106** that alternately drive via spring loaded plungers **108** and **110** a drive wheel **112** in a clockwise direction. The drive wheel **112** is attached to a shaft **114** that rotates the feeder sprocket **116**. The belt of ammunition is pulled through the feeder **16** by the sprocket **116**. Outer guides for the ammunition are provided by the feeder housing **118**. At the ramming position, spring-loaded depressors **120** hold the round downward in the rammer slot **122** of the feeder tray portion of the feeder housing **118**.

4. Feeder Drive

The feed drive cam plate **94** is attached to the barrel extension **10** and recoils and counter-rcoils with the extension. Lever **106** is mounted on the drive shaft. Cam follower **102** is positioned in cam **98**. Lever **104** is mounted on the drive shaft. Cam follower **100** is positioned in cam **96**. When the barrel extension recoils, lever **104** is swung clockwise by cam **96**. Lever **104**'s plunger **108** is engaged with surface **126** on the drive wheel. As the lever swings, it rotates the drive wheel **112** clockwise. This action completes the first half of the feeder action. During the same recoil of the barrel extension, lever **106** is rotated counter-clockwise by cam **98**. Lever **106** plunger **110** snaps behind surface **128** on the drive wheel. When the barrel extension counter-recoils, lever **106** rotates clockwise as directed by cam **98**. This action drives the drive wheel clockwise, thereby completing the feeding motion. During barrel extension counter-recoil lever **104**, directed by cam **96** swings counter-clockwise. Plunger **108** snaps behind surface **115**. This positions lever **106** for the next cycle.

5. Bolt Assembly

The rotating lock type, bolt assembly of the gun is shown in FIGS. **1** and **4**. Four locking lugs **124** are provided on the generally cylindrical bolt body **54**. To permit the use of four lugs, the rammer **58** and extractor **82** are located forward of the lugs and are designed to fit within the outside dimensions of the lugs. This permits the extractor and rammer to enter the barrel extension through the same spaces as are provided for the locking lugs. The rammer is spring-loaded, so that it can be depressed as it enters the barrel extension.

The locking and unlocking action is provided by the stud **66** of the bolt carrier **52** which travels in a cam on the bolt body **54**. This cam includes a straight portion at the front of the cam, allowing initial bolt carrier travel that does not effect the locks. This provides time for chamber pressure decay before unlocking. When the stud leaves the straight portion and enters the aft helical portion of the cam, it rotates the bolt body and unlocks the bolt, after which the bolt carrier **48** pulls the bolt body rearward. On the counter recoil stroke the locking lugs are held in respective tracks **126** in the barrel extension thereby precluding rotation of the bolt body. The stud bearing on the cam tries to rotate the head during the entire counter-recoil stroke. When the lugs **124** reach the forward ends of the tracks in the barrel extension, the bolt body is free to rotate and the lugs pass in front of the locking surfaces **30** to lock the bolt in the battery position.

6. Bolt Buffer and Sear Mechanism

The bolt buffer spring **92** performs two functions. It buffs the bolt at the end of the bolt recoil stroke; and buffs the sear when the bolt is stopped in its counter-recoil stroke.

When the bolt strikes the buffer plate **88**, the buffer spring compresses, reverses the direction of the bolt and sends it forward. When the solenoid is de-energized, the sear **38** inter engages the bolt body. The sear **38** pulls forwardly on the sear buffer plate **90** and the sear buffer plate compresses the buffer spring. This action buffs the bolt to a stop.

To release the bolt, the solenoid is energized. This actuates the sear release. The sear release pivots the sear out of engagement with the bolt body, allowing the bolt to go forward into battery and to strip and fire the next round.

7. Barrel and Barrel Extension Buffer-Bolt Accelerator

The spring-biased accelerator mechanism is shown schematically in FIGS. **8** and **9**. The barrel (barrel extension) **10** of the recoil operated automatic cannon is mounted to slide along the barrel axis in the gun receiver **12**. The barrel **10** is pushed forward by a single acting barrel recoil spring **130** and the double acting barrel buffer spring **14**, the two springs being connected in series by a buffer guide **132** which slides concentrically with the barrel bore axis.

The accelerator lever **24** is pivoted at **72** to the barrel **10** and the roller **78** on its lower end can bear on the bolt assembly drive surface **80**. The upper end of the accelerator lever **24** is connected to the buffer spring guide **132** by a pin **134** and slot **136** linkage which accommodates the change in center distance between the pin **134** and the accelerator pivot **72** as the accelerator lever rotates on its pivot **72** with the barrel. Rotation of the accelerator **24** is limited in the clockwise direction by the abutment between the surface **138** of the buffer spring guide **132** and the surface **140** of the barrel. In the counterclockwise direction, rotation of the accelerator is limited by abutment between the lower end of the accelerator lever **24** and the stop lug **74** on the barrel.

In FIG. **8** the mechanism is shown in the position which exists at the instant of firing. All parts of the mechanism are at rest, or nearly at rest. The barrel **10** is held forward by the barrel recoil spring **130** holding the lower end of the accelerator lever **24** against the stop lug **74** of the barrel. The buffer spring guide **132** is positioned in the receiver **12** by the double acting barrel buffer spring **14**. A gap G exists between the bolt assembly drive surface **80** and the accelerator lever roller **78**.

Upon firing, the bolt assembly **52**, and the barrel **10** begin recoiling together, and the accelerator lever starts to rotate clockwise about its pivot **72** on the barrel, the accelerator being restrained at its upper end by the link **134/136** and the buffer spring guide **132**. After a time delay, which is determined by the size of the gap G, the accelerator strikes the bolt assembly drive sur-

face 80, thereby imposing upon the bolt 52 an accelerating force which is determined primarily by the preload of the barrel buffer spring 14 and the proportions of the accelerator lever, the force developed by the barrel recoil spring 130 being lower than that of the buffer spring 14.

As the barrel continues to recoil the barrel recoil spring 130 and the buffer spring 14 are both compressed, and the resulting force applied to the bolt assembly 52 causes it to accelerate away from the barrel 10 as shown in FIG. 9. The acceleration continues until the surface 140 of the barrel abuts the surface 138 of the buffer spring guide 130, after which the bolt continues aft independently of the barrel. Continuing action of the buffer spring 14 brings the barrel 10 to a stop, reverses its direction, and returns all components of the mechanism except the bolt 52 to the battery position, as shown in FIG. 8. The bolt driving spring 50 then returns the bolt assembly 52 to battery position to initiate another cycle of the mechanism.

The spring-biased accelerator mechanism has been described as applied to a short recoil automatic gun in which the barrel is free to return to battery before the return of the bolt assembly. Should a barrel hold back feature be desired it can be provided by any of several means, without interfering with the objectives of this invention. Such means would preferably retain the barrel with respect to the buffer spring guide in such position that surfaces 138 and 140 remain in close proximity to each other, and such that the hold back feature is buffered with respect to the gun receiver or cradle by means of the barrel buffer spring.

Several details of the construction of the device can be varied without effect on its overall function. For example, the barrel recoil spring, described as operating in series with the barrel buffer spring, could operate in parallel, that is, between the barrel and the receiver. The link 134/136 may be replaced by any of several connecting means which will provide the relative connection between the accelerator and the buffer spring guide. The bolt drive spring could operate between the bolt assembly and receiver, rather than between the bolt assembly and barrel extension. Similarly, the pivot of the accelerator could be placed on the spring guide and a link similar to link 134/136 used to connect the accelerator to the barrel. (Note that the term "barrel" as used includes all parts which are fixed to the barrel, such as barrel extension, etc.) The functions of the stops for the springs may be replaced in any manner which provides proper limits for the motion of the accelerator. The delay provided by the gap G can be obtained, for some types of bolt assemblies, by a similar functional gap elsewhere in the bolt assembly.

What is claimed is:

1. An at least partly self acting gun which comprises, in combination:
- a receiver;
- a barrel disposed for recoil and counter-recoil movement in said receiver;
- a bolt means disposed for recoil and counter-recoil movement in said receiver for chambering and locking a round of ammunition; and
- a bolt accelerator means including
  - crank means pivotally mounted to said barrel for rotation in a first direction, and in a second direction opposite to said first direction,
  - first spring means coupled to and between said receiver and said crank means,
  - second spring means coupled to and between said barrel and said crank means,
  - means fixed to said barrel and engagable with said crank means for limiting the extent of rotation of said crank means in said first direction,
  - third spring means coupled to and between said barrel and said bolt means for biasing said bolt means towards and adjacent said crank means;
- whereby when said bolt means is biased adjacent said crank means and said crank means is rotated in said second direction, said crank means abuts said bolt means.

2. A gun according to claim 1 wherein:
said first spring is the barrel buffer spring.

3. A gun according to claim 1 wherein:
said second spring is the barrel drive spring.

4. A gun according to claim 1 wherein:
said third spring is the bolt drive spring.

5. A gun according to claim 1 wherein:
said crank means includes
- an accelerator arm having a first end, a second end, and a mediate pivot to and carried by said barrel, and
- a spring guide journalled between said receiver and said barrel and coupled to said first end of said accelerator arm;

said first spring is a compression spring captured between said receiver and said spring guide;
said second spring is a compression spring captured between said spring guide and said barrel;
the force developed by said first spring being greater than the force developed by said second spring.

6. A gun according to claim 5 wherein
when said gun is in its battery position
said accelerator arm is disposed with said second end at its maximum rotation in said first direction; and
when said gun is fired and said barrel recoils,
said medial pivot of said arm is carried aft by said barrel, while said spring guide is biased forward by said first spring while compressing said second spring, thereby swinging said second end of said arm in said second direction.

7. A gun according to claim 6 wherein:
said bolt means includes a surface for receiving an impact from said second end of said arm, which, when said gun is in its battery position, is adjacent to but spaced from said second end of said arm.

* * * * *