Oct. 19, 1971 M. RAMSAY 3,613,282

ELECTRICAL IGNITION SHOTGUN FOR FIRING CASELESS AMMUNITION

Filed Sept. 15, 1969 2 Sheets-Sheet 1

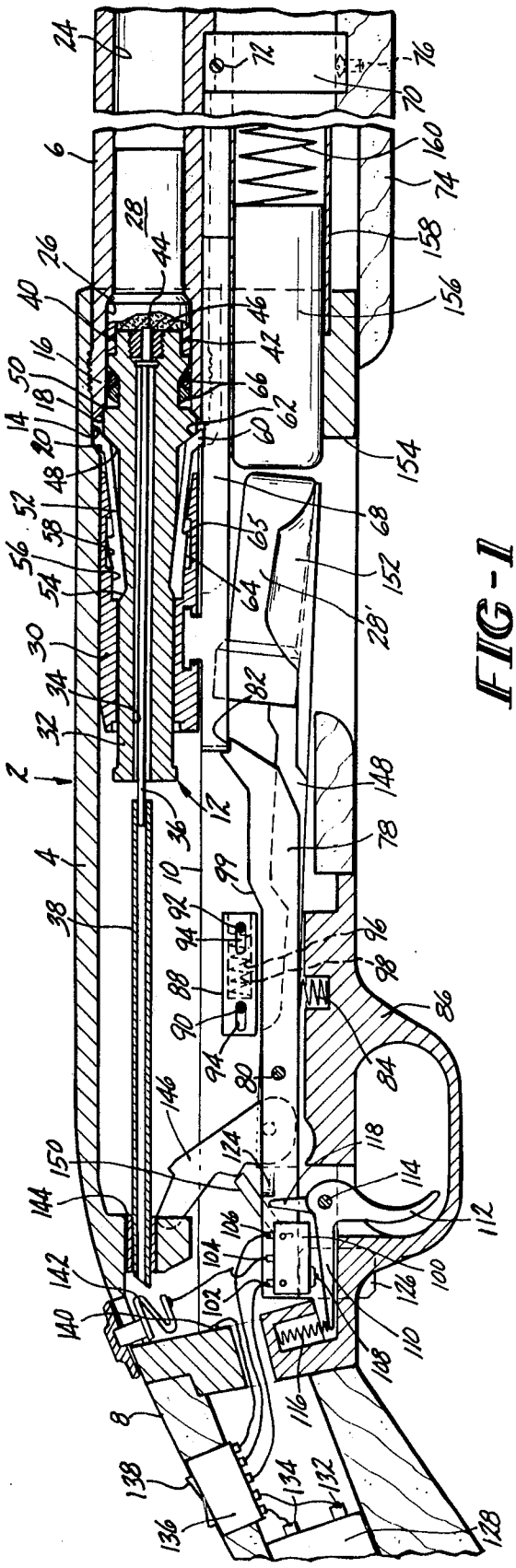

FIG-1

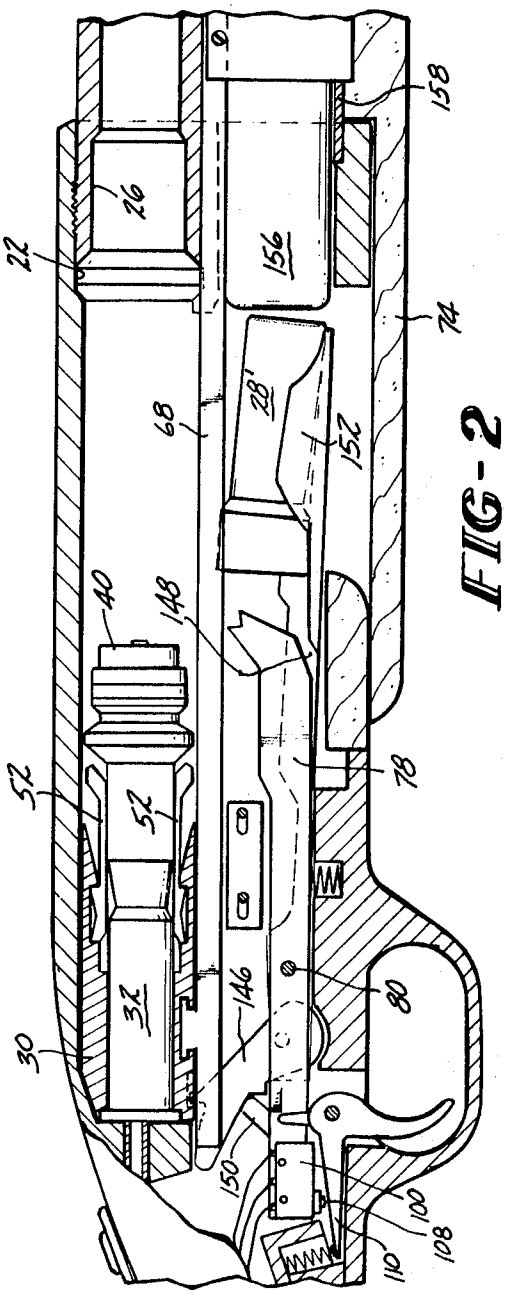

FIG-2

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ELECTRICAL IGNITION SHOTGUN FOR FIRING CASELESS AMMUNITION

Filed Sept. 15, 1969 2 Sheets-Sheet 2

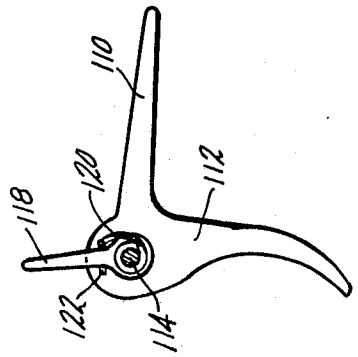

FIG-4

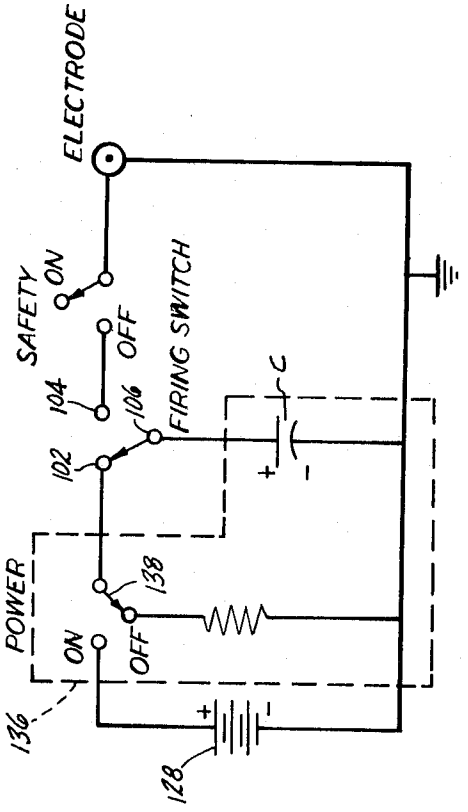

FIG-5

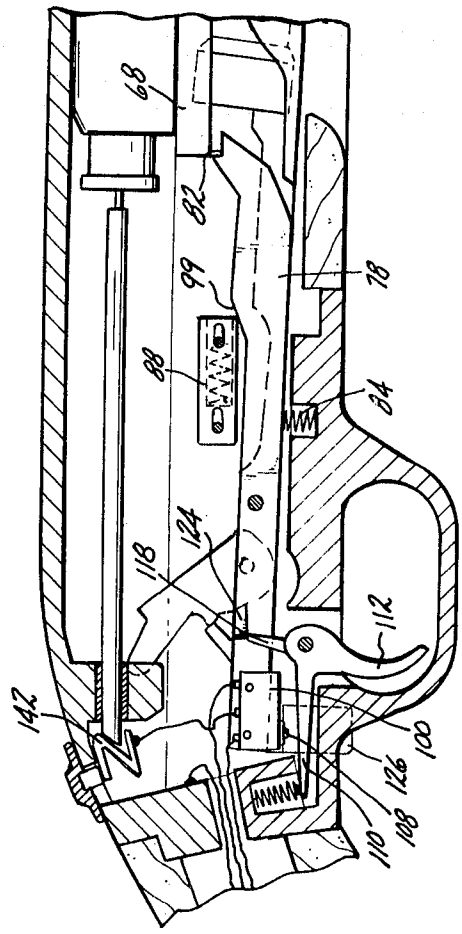

FIG-3

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3,613,282

ELECTRICAL IGNITION SHOTGUN FOR FIRING CASELESS AMMUNITION

Marcus Ramsay, New Haven, Conn., assignor to Olin Corporation

Filed Sept. 15, 1969, Ser. No. 857,665
Int. Cl. F41c 19/12
U.S. Cl. 42—84 18 Claims

ABSTRACT OF THE DISCLOSURE

A multi-shot firearm for electrically firing caseless ammunition having no primer. A switch is actuated by the trigger to permit passage of current from a capacitor to an electrode contacting the ammunition. Elapsed time between trigger pull and firing of the ammunition is decreased as compared to impact ignition firearms. The gun is prevented from firing automatically should the trigger be kept depressed as the action is operated.

This invention concerns a firearm for electrically igniting caseless ammunition having no primer, and wherein automatic firing of the gun is prevented.

During recent times the firearms industry has exhibited renewed interest in development of caseless ammunition for use with firearms. One such caseless shotgun-type of ammunition is disclosed in patent application U.S. Ser. No. 727,164 to William B. Woodring, filed May 6, 1968. Such interest in caseless ammunition has also spurred efforts to develop firearms for firing the ammunition, since presently available conventional firearms are not capable of utilizing caseless ammunition.

The firearm of this invention is particularly useful for firing the general type of caseless ammunition disclosed in the above-noted application to Woodring with the exception that the primer thereof is replaced by a thin coating of electrically conductive material on the rear face of the propellant charge. By removing the primer and replacing it with an electrically conductive coating, the ammunition can be electrically fired and is also rendered safer and easier to handle due to the absence of the sensitive primer. The electrical shotgun provides a shorter time lapse between the pulling of the trigger and the firing of the ammunition since the sear and hammer are eliminated from the gun, thus eliminating sear travel and hammer fall time. Thus one using the gun of this invention when firing on a moving target, need not lead the target as much as with an impact ignition gun.

The use of electrical ignition also permits the solution of the problem of undesirable automatic firing of a shotgun when the trigger is kept depressed during actuation of the shell feeding apparatus. Since there is no hammer to sear up, the prevention of automatic firing is accomplished by providing a firing switch which is actuated when the trigger is pulled and by moving the switch away from contact with the trigger as the action of the gun is operated. Prevention of automatic firing of a shotgun in particularly desirable since shotguns are generally not designed for fully automatic firing and can become dangerous if automatic firing can occur.

The shotgun of this invention includes a reciprocating bolt assembly which is mounted in a receiver. A sliding forearm is mounted below the barrel and is connected to the bolt carriage so that the action of the gun is pump operated. A pivoting cartridge carrier is mounted below the bolt in the receiver and is pivoted to a cartridge feeding position when the bolt is reciprocated to the retired position. A telescoping electrode is mounted in the bolt and protrudes from the face of the bolt to make contact with the electrically conductive layer on the cartridge propellant, the electrode being telescoping so as to permit reciprocation of the bolt. A power source in the form of a battery is housed in the stock of the gun, the battery being connected to a control box housing an "on-off" switch and a capacitor which discharges to fire the gun. The control box in turn is connected to a switch and is grounded to the receiver. A safety is interposed between the switch and the electrode. The firing switch is mounted on an action-locking member which in turn is pivoted in the receiver. The arrangement is such that the switch can only be contacted by the trigger when the action is locked in its breech-closed or battery position, thus the gun cannot be fired unless the bolt is locked in its battery position. To prevent automatic firing of the gun, a tang is connected to the trigger and is operable to prevent the action-locking member from locking the bolt in its battery position unless the trigger is released when the action is pumped.

It is, therefore, an object of this invention to provide a firearm for electrical firing of caseless ammunition.

It is a further object of this invention to provide a firearm of the character described which cannot be fired unless the bolt is locked in its battery position.

It is yet another object of this invention to provide a firearm of the character described having a switch actuated by pulling the trigger, which switch is mounted on an action-locking element for movement toward and away from the trigger.

These and other objects and advantages of the invention will become apparent from the following detailed description when read in conjunction with the accompanying drawings, in which:

FIG. 1 is a side sectional view of a portion of a shotgun employing a preferred embodiment of this invention, the bolt of the shotgun being shown locked in its battery position with a caseless round seated in the chamber for firing;

FIG. 2 is a sectional view similar to FIG. 1 but showing the bolt in its retired position with the corresponding movement of the shell feed to a shell-pickup position, and the switch to a position wherein it cannot be contacted by the trigger:

FIG. 3 is a sectional view of the gun of FIG. 1 showing how the action locking member is released when the gun is fired;

FIG. 4 is a side view of the trigger and the tang mounted adjacent thereto; and

FIG. 5 is a diagram showing the electrical circuitry of the device of FIG. 1.

Referring now to FIG. 1, a firearm in the form of a shotgun **2** is shown containing a preferred embodiment of the firing mechanism of this invention. The gun **2** includes a receiver **4** to which is secured a barrel **6** and a stock **8**. The receiver **4** includes a pair of rails **10** (one of which is shown) along which reciprocates the bolt assembly **12**. The forward interior end of the receiver **4** is enlarged at **14** to receive the rear end **16** of the barrel **6**, with the rear face **18** of the barrel **6** being spaced apart from an oblique face **20** on the interior of the receiver to define an annular groove **22** rearward of the barrel (see FIG. 2). The barrel **6** includes a bore **24** which is enlarged at its rearward end to form a firing chamber **26** for receiving a caseless shotshell **28**.

The bolt assembly **12** includes a bolt slide **30** in which is mounted a tubular bolt member **32**, the latter being movable within the former. The bolt **32** includes a bore **34** in which is positioned a two-piece electrode having an inner rod member **36** and an outer sleeve member **38** which combine to provide a telescoping capability to the electrode. The nose of the bolt **34** is undercut as at **40** to permit the bolt to snugly engage the rear flange **42**

of the shell 28 so that the forward face 44 of the electrode rod 36 touches the exposed surface of the shell propellant charge 46, which as previously noted is coated with an electrically conductive material. An outwardly tapering shoulder 48 is formed on the bolt 32 and faces rearwardly thereon, and a second shoulder 50 is formed on the bolt 32 forwardly of the shoulder 48, the shoulder 50 being disposed for abutment with the rear face 18 on the barrel.

A plurality of elongated locking fingers 52 are mounted between the bolt 32 and the bolt slide 30. A notch 54 is cut into the exterior of the bolt 32 to permit the fingers 52 to become canted as shown in FIG. 1. The bore of the bolt slide 30 is enlarged as at 56 and a groove 58 is cut into the enlarged bore to provide a space between the bolt slide 30 and bolt 32 in which the fingers 52 are positioned. An outwardly extending tip 60 is disposed at the forward end of each finger 52, the tip 60 being slid outwardly into the groove 14 as a result of the front surface 62 of the fingers 52 being moved against the shoulder 48. A V-shaped notch 64 is cut into the outer surface of the rearward portion of the fingers 52 to permit the wall 56 of the bolt slide 30 to lock the fingers 52 in their canted position. From FIG. 1, it is readily apparent that the tips 60 of the fingers 52 will lock the bolt 32 in its battery position against longitudinal movement. A pair of expandible rings 66 are sandwiched between the bolt 32 and the wall of the firing chamber 26 to provide a seal against combustion gases when the shell 28 is fired.

A slide arm 68 is connected to the bolt slide 30 and extends forwardly therefrom below the barrel 6 to a bracket 70 which is secured to the slide arm 68 by means of a pair of bolts 72. The bracket 70 is also secured to the forearm 74 by means of a screw 76. The forearm 74 is slidably mounted beneath the barrel 6 and is operable by means of the slide arms 68 to reciprocate the bolt slide 30 and bolt 32.

A slide locking member 78 is pivotally mounted on a pin 80 in the receiver 4. The forward end of the action lock 78 is provided with a notch 82 which engages the rear end of the slide arm 68 to lock the bolt slide 30 in its forward position. Thus when a shell is chambered, both the bolt 32 and bolt slide 30 can be locked in their respective forward positions. A spring 84 seated in the trigger housing 86 contacts the slide lock 78 and biases the latter in a counter-clockwise direction (as viewed in FIG. 1) about the pin 80 to urge the notch 82 into engagement with the slide arm 68. A longitudinally slidable inertia body 88 is mounted in the receiver 4 above the slide lock 78 on a pair of pins 90 and 92. The pins 90 and 92 extend through elongated slots 94 in the body 88 to permit the body 88 to be slid longitudinally over the pins 90 and 92. The body 88 is provided with an internal recess 96 in which is positioned a spring 98. The spring 98 is sandwiched between the bottom of the recess 96 and the forwardmost pin 92 and acts to urge the body 88 rearwardly in the receiver 4. When the gun is fired, the components thereof recoil rearwardly with the exception of the inertia body 88 which moves forwardly with respect to the rest of the gun. As the inertia body 88 moves forwardly, it moves against a cam surface 99 on the slide lock 78 and causes the latter to pivot against the urging of the spring 84 thereby moving the notch 82 out of engagement with the slide arm 68, as is clearly shown in FIG. 3. This frees the bolt slide 30 for rearward movement.

A firing switch 100 is mounted on the rear portion of the slide lock 78. The switch 100 is a basic snap acting switch having three contacts 102, 104 and 106, two of which contacts are connected to a power source, and the remainder which is normally open. I prefer to use a switch manufactured by the Micro Switch Division of Honeywell which is marketed under the identifying catalogue number 1SM1–1. A plunger 108 depends from the bottom of the switch casing and is positioned above a rearwardly extending arm 110 formed on the trigger 112. The trigger 112 is pivotally mounted on a pin 114 and is biased in a counter-clockwise direction by a spring 116 seated in the trigger housing 86. When the trigger 112 is pulled, the arm 110 depresses the plunger 108 to close the normally open contact and complete the circuit from the power source to the electrode tip 44. The circuitry of the system will be set forth in greater detail hereinafter.

Referring to FIGS. 1, 3 and 4, an elongated finger 118 is mounted on the pin 114 adjacent to the trigger 112. The finger 118 is free to pivot about the pin 114 and is biased by a spring 120 against a stop 122 extending laterally from the trigger 112. A laterally extending tang 124 is cut from the slide lock 78 and positioned forward of the finger 118 and in line therewith. When the trigger 112 is pulled, the finger 118 moves against the tang 124, and when the slide lock 78 pivots so as to unlock the bolt slide 30, the spring 120 will cause the finger 118 to move under the tang 124 to hold the slide lock 78 in its unlocked position, the aforesaid occurring if the trigger 112 is not released. When the slide lock 78 pivots to the position shown in FIG. 3, the switch 100 moves correspondingly upwardly away from the trigger arm 110 so that the latter cannot depress the plunger 108. Thus the gun cannot be subsequently fired unless the trigger 112 is released after being pulled initially.

In order to permit the shooter to retract the bolt to its retired position without firing the gun, a release 126 is connected to the rear end of the slide lock 78. The release 126 extends downwardly from the slide lock 78 through a slot in the trigger housing 86 so as to be accessible to the shooter, who need merely press the release 126 upwardly to cause the slide lock 78 to pivot about the pin 80 and unlatch the slide arm 68.

In order to provide power for the operation of the gun, a battery 128 is housed in the stock 8. The battery is preferably an "Eveready" No. 416 67.5 volt battery. The battery terminals 132 and 134 are connected to a control box 136 mounted on the stock 8. The control box 136 includes an "on-off" rocker switch 138 for turning power from the battery 128 on and off. The control box 136 is connected to the switch contacts 102 and 106 and is also grounded to the receiver 4 at 140. A safety 142 is slidably mounted on the receiver 4 and is movable into and out of electrical contact with the rear end of the sleeve portion 38 of the electrode. The safety 142 is electrically connected to the third contact 104 on the switch 100. When the safety 142 is in its rearward, or "on" position, as shown in FIG. 1, the gun cannot be fired. When the safety 142 is in its forward, or "off" position, as shown in FIG. 3, contact between the switch 100 and the electrode is established and the gun can be fired. It is noted that an insulating collar 144 electrically insulates the electrode sleeve 38 from the receiver 4.

In order to retract the bolt assembly to its retired position shown in FIG. 2, the slide lock 78 is pivoted to its "release" position shown in FIG. 3 either by firing the gun or by pressing the release 126. The forearm 74 is then pulled to the rear to cause the bolt slide 30 to begin moving to the rear. The slide lock 78 is held in its "release" position by contact with the lower surface on the slide arm 68 as shown in FIG. 2. As the bolt slide 30 moves initially rearwardly with respect to the bolt 32, the bolt slide wall 56 moves rearwardly away from the finger notch 64 until the slide groove 58 overlies the notch 64. The front wall of the groove 58 then contacts the surface 65 on the fingers 52 so that further rearward movement of the slide 30 pulls the fingers 52 rearwardly so that the tips 60 move downwardly out of the groove 22 and the fingers 52 pivot to a parallel position shown in FIG. 2. This frees the bolt 32 for rearward movement which occurs when the rearward movement of the bolt slide 30 is continued.

As the bolt slide and bolt move back to their retired position shown in FIG. 2, the bolt slide overrides the rearward end portion **146** of a conventional flip-up type shell feeder **148** pivotally mounted on the pin **80**. When the bolt **32** is returned to its battery position it causes the feeder **148** to pivot about the pin **80** in a conventional manner and it picks up a fresh shell and seats the latter in the chamber **26**. The rear portion of the feeder **148** is biased toward its normal position shown in FIG. 1 by a spring-biased plunger **150**. Shells are positioned on the tray portion **152** of the feeder **148** by inserting the shells through a port **154** to depress a shell follower **156** which is slidably mounted in a tube **158** and biased by a spring **160**. The shell follower **156** causes the shell to move onto the tray **152**.

It is clear from FIGS. 2 and 3 that so long as the slide lock **78** is overridden by the slide arms **68**, the switch **100** is upwardly displaced so that the trigger arm **110** cannot touch the plunger **108**. Thus the gun cannot be fired unless the bolt slide **30** is locked in its battery position.

Referring now to FIG. 5, a preferred circuitry arrangement is shown for the electrical system used to fire the gun. When the "on-off" switch **138** is switched to "on," the battery **128** is circuited to a capacitor C to charge the latter, the capacitor C being housed in the box **136**. When the safety is "off" and the trigger is pulled to close the switch **100** and connect contacts **104** and **106**, the capacitor C is circuited to the electrode so that the capacitor discharges into the electrode to fire the shell. When the trigger is released the switch contacts **102** and **106** are once again connected to permit the capacitor to recharge. When the gun is not being used, the power switch is turned "off" so that the battery will not discharge. It is noted that both the control box components and the tip of the electrode are grounded to the receiver of the gun.

It is thus readily apparent that the gun of this invention is conveniently adapted to electrically fire caseless cartridges thereby providing the shooter with the advantages of a caseless firearm along with the advantages of an electrically fired gun. The gun is equipped with several safety features in addition to the more conventional "on-off" safety switch by mounting the firing switch so that it will be moved away from contact with the trigger when the bolt assembly is moved out of its battery position. Undesirable automatic firing of the gun is prevented by requiring that the trigger be released after beng initially pulled to permit the firing switch to move back toward the trigger. In addition, a "power on" switch is provided to prevent draining of the battery when the gun is not in use, so that the battery need not be removed from the gun to preserve its power.

What is claimed is:

1. A firearm for electrically firing a round of ammunition, said firearm having a receiver and a bolt assembly reciprocally mounted in the receiver, said firearm further comprising:

(a) a telescoping electrode mounted in said bolt assembly;

(b) action lock means movably mounted in said receiver, said action lock means being operative to lock said bolt assembly in a breech-closed position, and further being deflectable to a non-locking position to free said bolt assembly for movement to a breech-open position;

(c) trigger means connected to said receiver;

(d) firing switch means movably mounted in said receiver and connected to said electrode, said firing switch means being movable between an actuable position adjacent to said trigger means, and a non-actuable position spaced apart from said trigger means, said trigger means being operable to actuate said firing switch means to close an electrical circuit to said electrode when said firing switch means is in said actuable position, and said trigger means being unable to actuate said firing switch means when the latter is in said non-actuable position; and

(e) means interconnecting said action lock means and said firing switch means and operable to move said firing switch means to said non-actuable position when said action lock means is deflected to said non-locking position whereby the firearm cannot be fired when said bolt assembly is not locked in the breech-closed position.

2. The firearm of claim **1**, further comprising manually operable release means connected to said action lock means for manually moving the latter to said non-locking position to free said bolt assembly for reciprocation.

3. The firearm of claim **1**, further comprising spring means engaging said action lock means and operative to bias the latter toward its locking position.

4. The firearm of claim **1**, further comprising inertia body means movably mounted in said receiver and operable to deflect said action lock means to said non-locking position when the firearm is fired.

5. The firearm of claim **1**, further comprising safety means electrically connected to said firing switch means and operable to interrupt the electrical circuit between said firing switch means and said electrode.

6. The firearm of claim **1**, further comprising shell feed means operative to position a fresh shell for chambering in front of said bolt assembly when the latter is in a retired position.

7. The firearm of claim **1**, further comprising tang means connected to said trigger means and operable to hold said action lock means in its deflected non-locking position when said trigger is held in a pulled position and said bolt assembly is reciprocated, thereby preventing automatic firing of the firearm.

8. A firearm for electrically firing a round of ammunition, said firearm comprising:

(a) a receiver;

(b) a bolt assembly movably mounted in said receiver;

(c) an electrode mounted in said bolt assembly;

(d) means operative to reciprocate said bolt assembly between a breech-closed position and a breech-open position;

(e) action lock means movably mounted in said receiver and operable to engage the lock said bolt assembly in said breech-closed position;

(f) a source of electrical current mounted in the firearm;

(g) firing switch means mounted in said receiver and electrically connected to said current source and to said electrode, actuation of said switch means being operative to electrically connect said current source to said electrode;

(h) trigger means connected to said receiver and operable to actuate said switch means; and

(i) means operatively connected to said action lock means to prevent said trigger means from actuating said switch means when said bolt assembly is not locked in said breech-closed position.

9. The firearm of claim **8**, further comprising inertia body means movably mounted in said receiver and operable to disengage said action lock means from said bolt assembly when the firearm is fired.

10. The firearm of claim **8**, further comprising release means connected to said action lock means and manually operable to disengage the latter from said bolt assembly.

11. The firearm of claim **8**, further comprising spring means connected to said action lock means and operable to bias the latter into engagement with said bolt assembly.

12. The firearm of claim **8**, further comprising tang means connected to said trigger means and operable to prevent said trigger means from actuating said switch means when said trigger means is held in a pulled position and said bolt assembly has been unlocked from said breech closed position.

13. A firearm for electrically firing a round of ammunition, said firearm comprising:

(a) a receiver;

(b) a bolt assembly movably mounted in said receiver;

(c) a telescoping electrode mounted in said bolt assembly;

(d) means operative to reciprocate said bolt assembly between a breech-closed position and a breech-open position;

(e) trigger means movably mounted on said receiver;

(f) an action locking lever pivotally mounted on said receiver and pivotable between a bolt locking position to lock said bolt assembly in said breech-closed position, and a bolt unlocking position to free said bolt assembly for reciprocation;

(g) spring means contacting said action locking lever to bias the latter toward said bolt locking position; and

(h) firing switch means mounted on said action locking lever and movable thereon between a position adjacent said trigger means for actuation by the latter when said action locking lever is in its bolt locking position, and a position spaced apart from said trigger means to prevent actuation by the latter when said action locking lever is in its bolt unlocking position whereby said trigger means cannot actuate said firing switch when said bolt assembly is unlocked.

14. The firearm of claim 13, further comprising a battery mounted on the firearm; a capacitor mounted on the firearm; control switch means mounted on the firearm and operative to electrically connect said battery to said capacitor to charge the latter; said capacitor being connected to said firing switch means and said firing switch means being connected to said electrode with actuation of said firing switch means being operable to cause electrical current to flow from said capacitor to said electrode.

15. The firearm of claim 13, further comprising inertia body means movably mounted in said receiver and operable to pivot said action locking lever to said bolt unlocking position when the firearm is fired.

16. The firearm of claim 14, further comprising a safety interposed between said firing switch means and said electrode and operable to interrupt the electrical connection between said firing switch means and said electrode to present a condition wherein the firearm cannot be fired.

17. The firearm of claim 13, further comprising release means connected to said action locking lever and manually operable to pivot the latter to said bolt unlocking position.

18. The firearm of claim 13, further comprising tang means connected to said trigger means for engagement with said action locking lever when said trigger means is pulled and said action locking lever is in said bolt locking position to hold said action locking lever in said bolt unlocking position until said trigger means is released.

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BENJAMIN A. BORCHELT, Primary Examiner

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