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(54) INCREASED ACCURACY FIREARM

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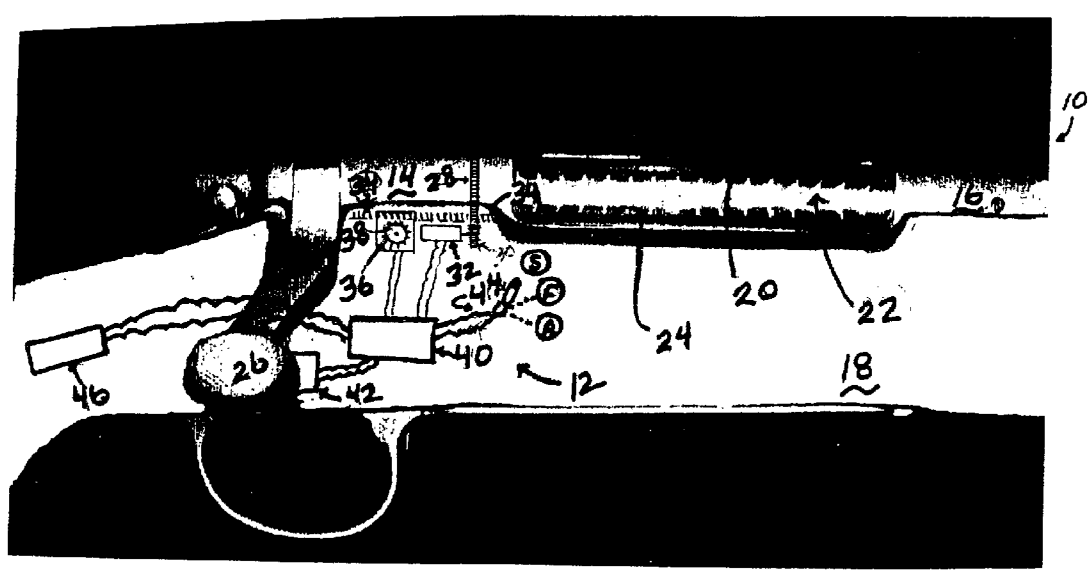
(57) ABSTRACT

A fire control system for a firearm, such as a rifle, operates a bolt action for increased rate of fire and convenience while retaining the secure locking of the firing chamber by manual bolt actions. After a controller determines that a round has been fired, one or more actuators, such as electrically actuated tooth wheels or gears, unlocks and reciprocates the bolt action to extract the spent shell and to load an unfired cartridge. Thereby, a consistent locking action is achieved avoiding the inconsistent sealing of conventional automatic bolt actions. Consistent accuracy with increased firing rate operation is further achieved with a cooling system activated when the firearm exceeds an optimum temperature operating range.



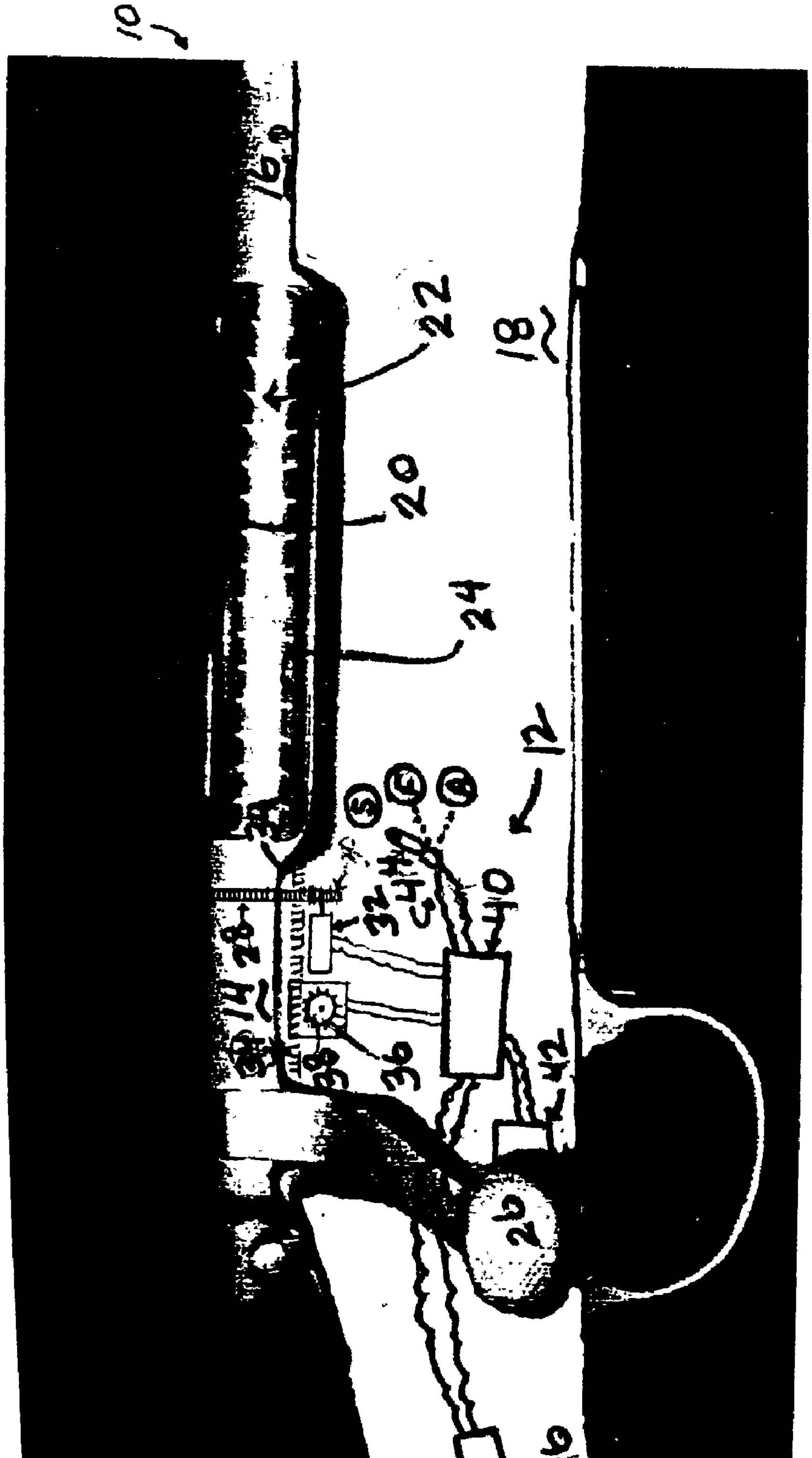


FIG. 1

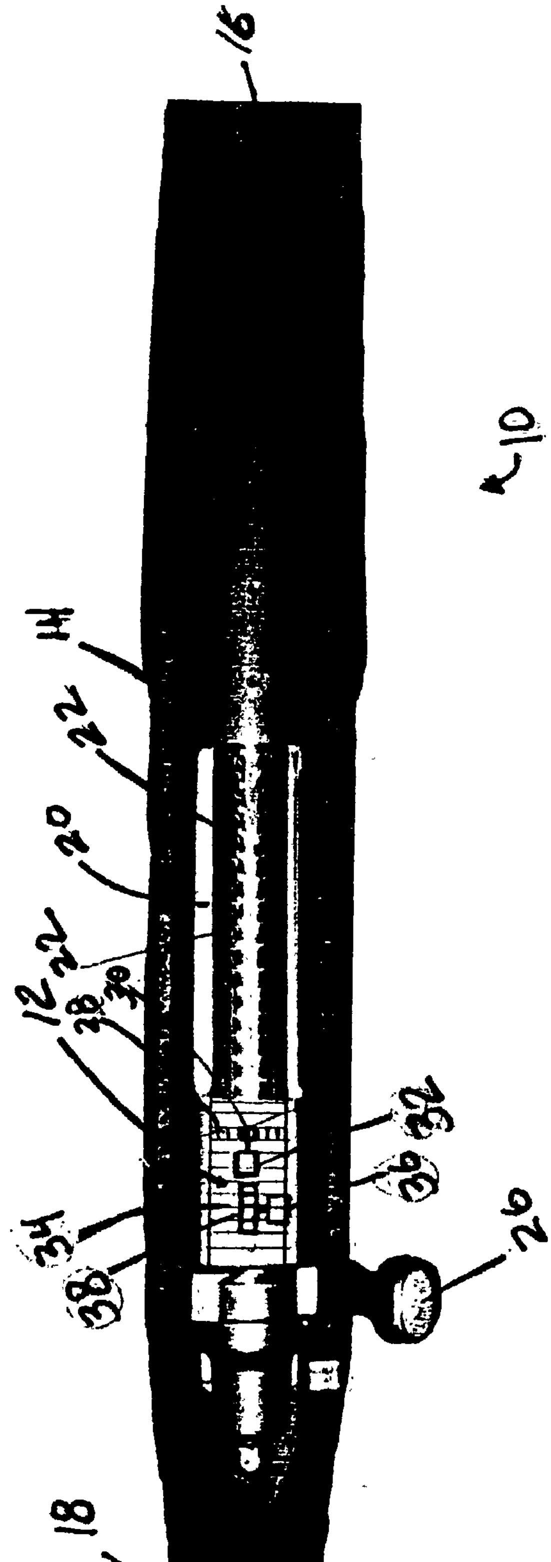


FIG. 2

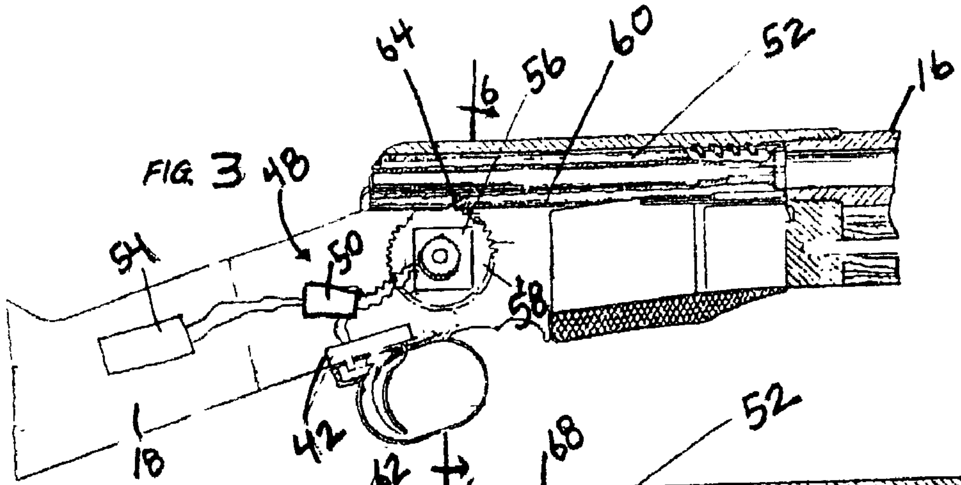


FIG. 3

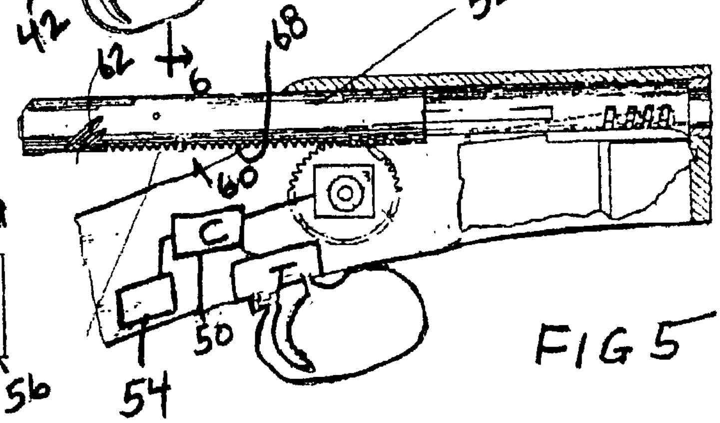


FIG 5

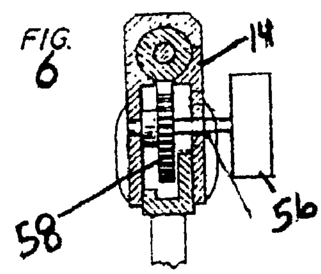


FIG. 6

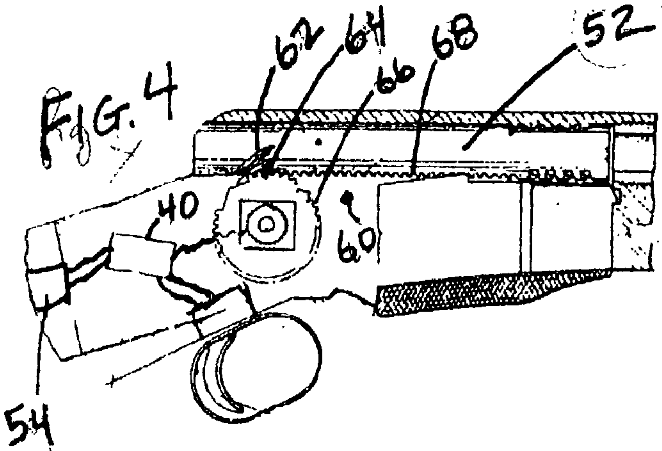


FIG. 4

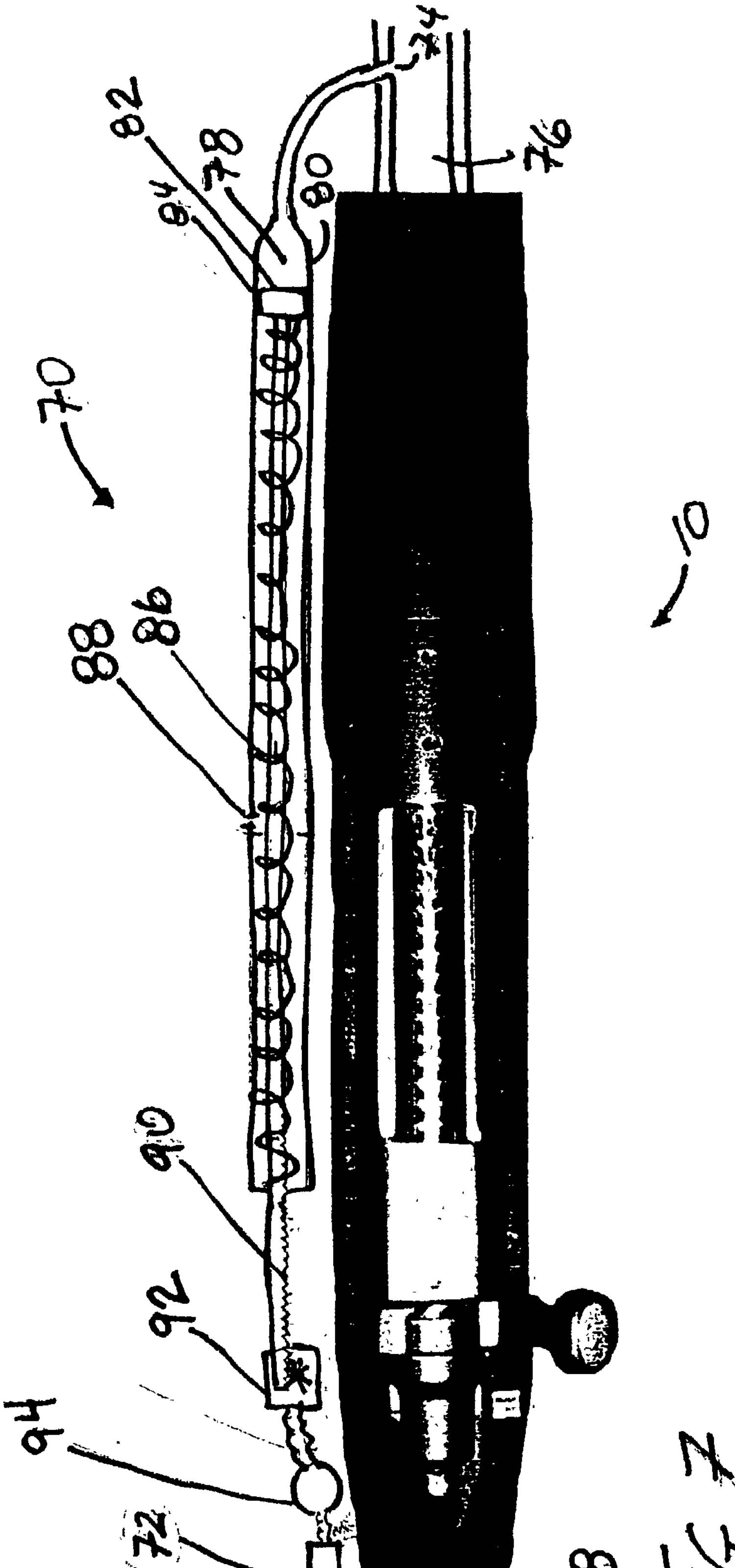


FIG. 7

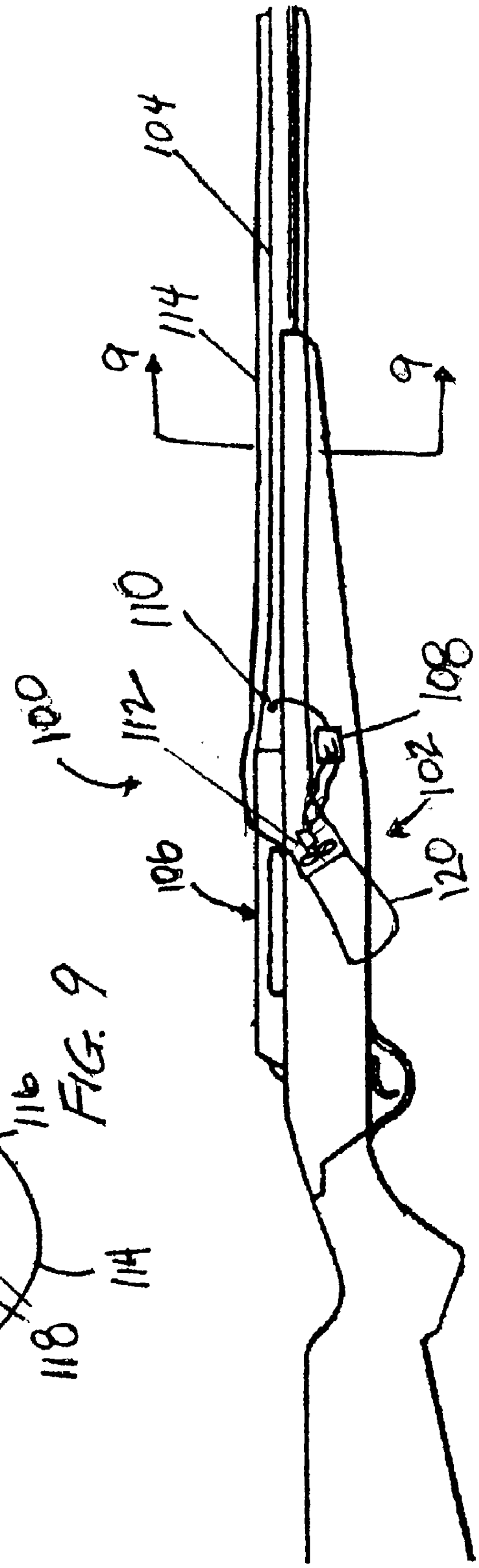


FIG. 8

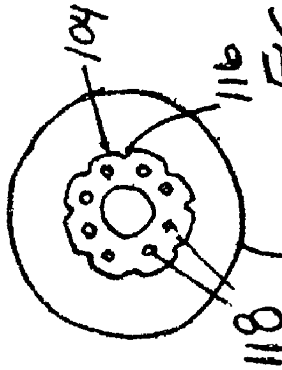


FIG. 9

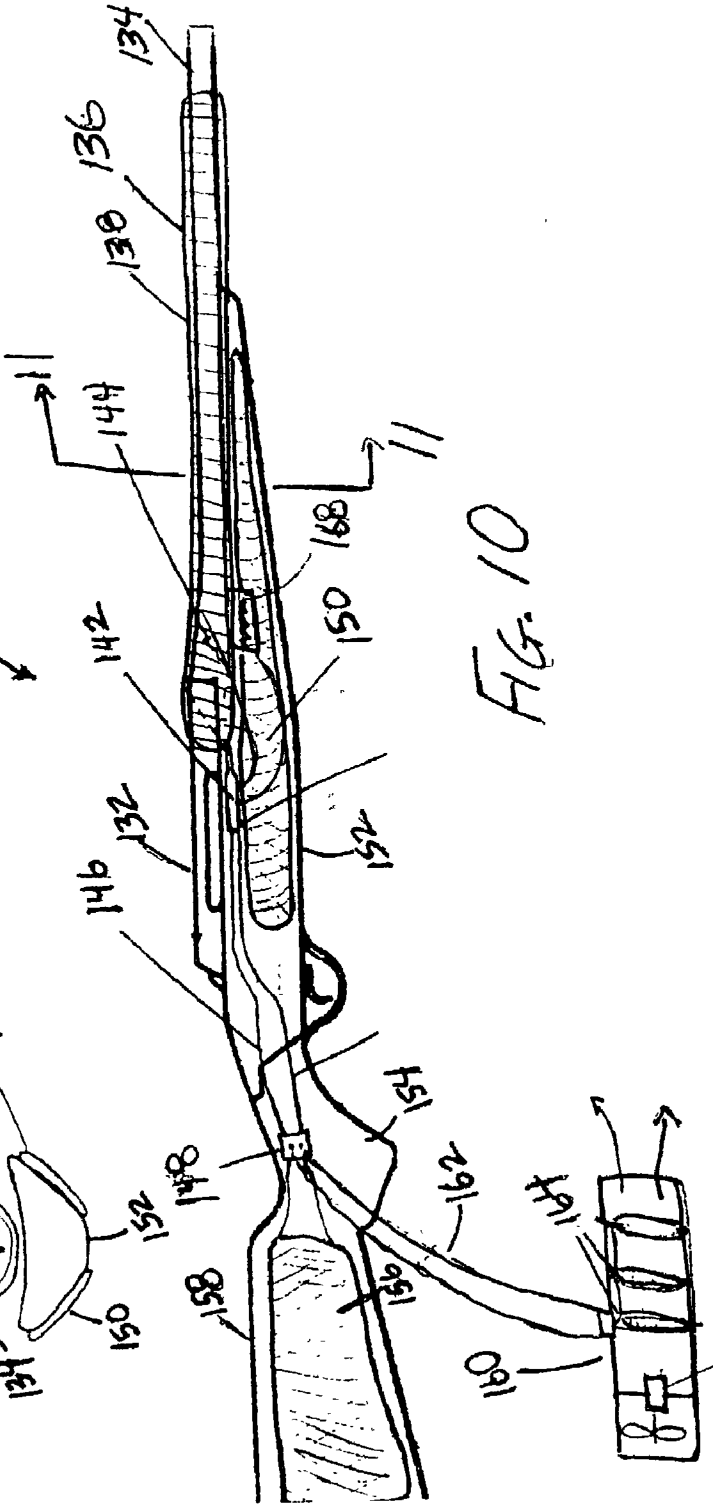

130
134
136
138
11
11
144
142
168
150
132
152
146
154
148
162
164
156
158
160
166

FIG. 10

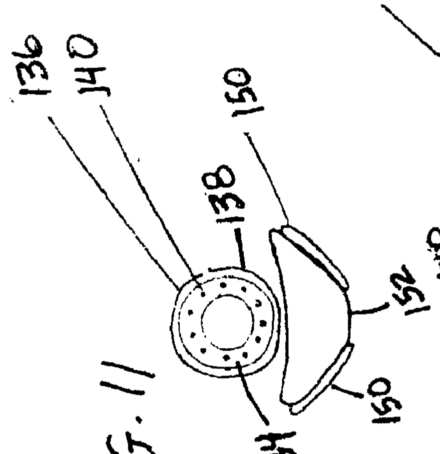

136
140
138
150
152
150
134

FIG. 11

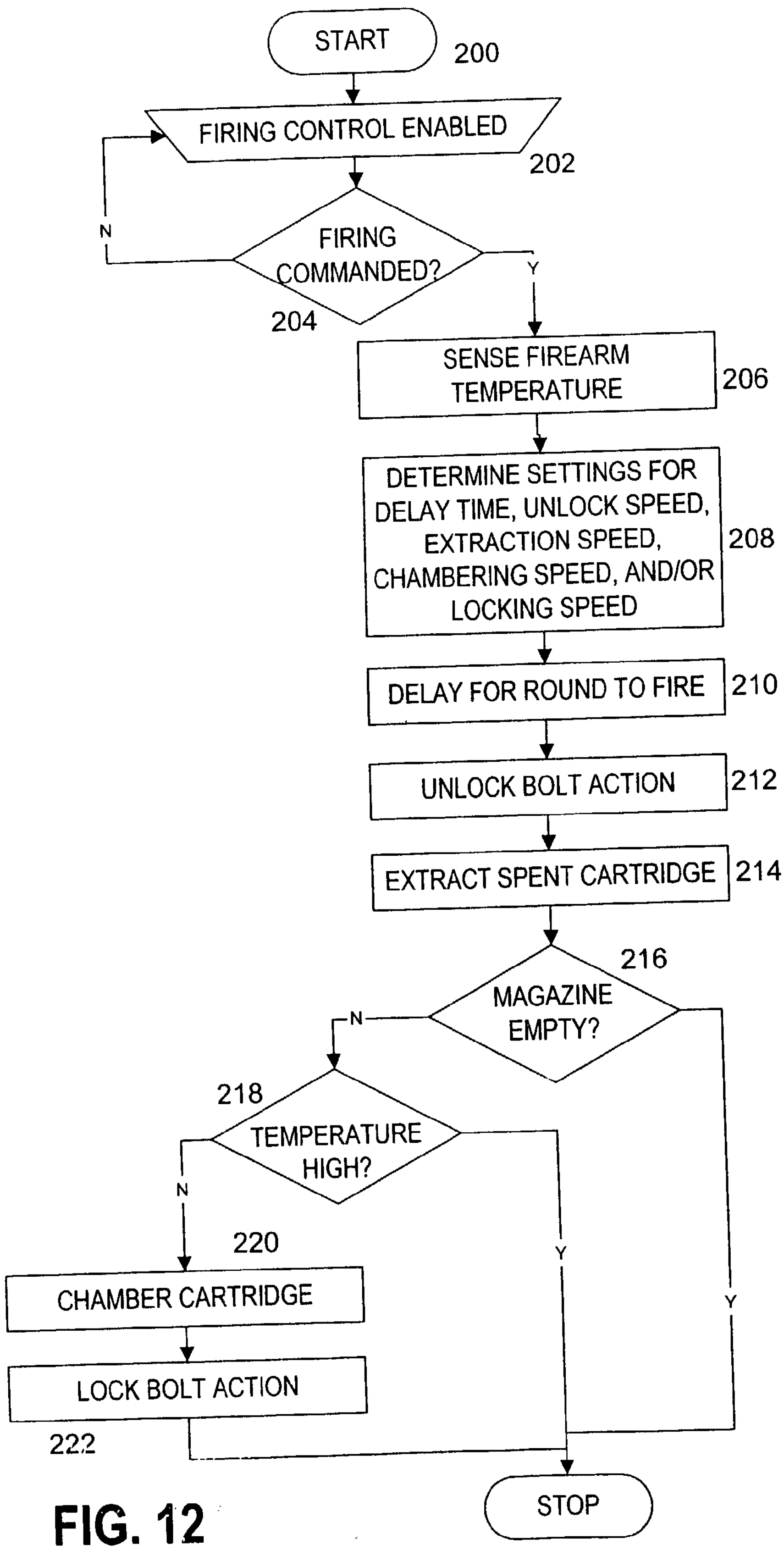

START
200
FIRING CONTROL ENABLED
202
N
FIRING COMMANDED?
Y
204
SENSE FIREARM TEMPERATURE
206
DETERMINE SETTINGS FOR DELAY TIME, UNLOCK SPEED, EXTRACTION SPEED, CHAMBERING SPEED, AND/OR LOCKING SPEED
208
DELAY FOR ROUND TO FIRE
210
UNLOCK BOLT ACTION
212
EXTRACT SPENT CARTRIDGE
214
216
MAGAZINE EMPTY?
N
218
TEMPERATURE HIGH?
N
220
Y
Y
CHAMBER CARTRIDGE
LOCK BOLT ACTION
222
STOP

FIG. 12

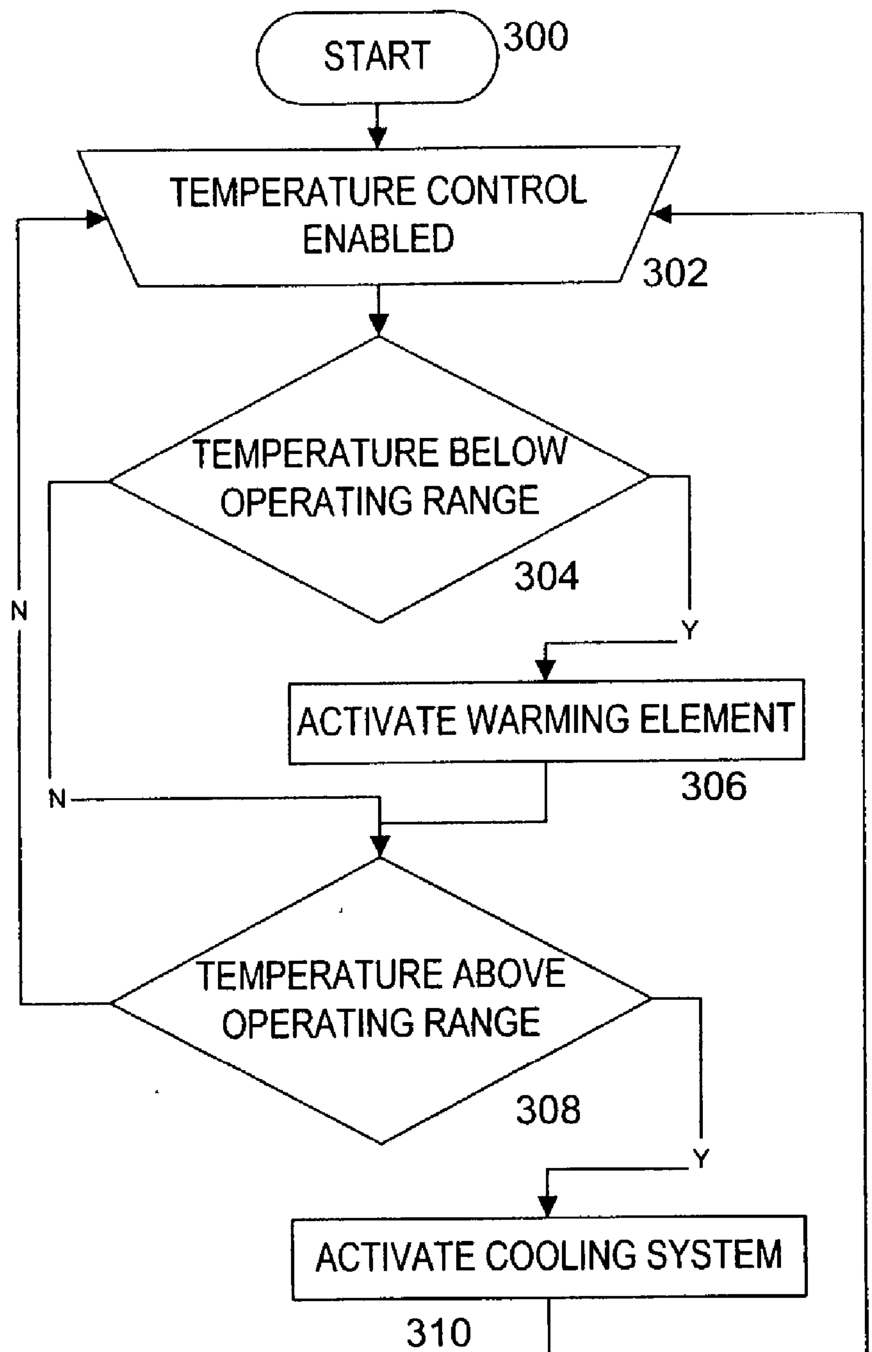

START
300
TEMPERATURE CONTROL ENABLED
302
TEMPERATURE BELOW OPERATING RANGE
304
Y
N
ACTIVATE WARMING ELEMENT
306
N
TEMPERATURE ABOVE OPERATING RANGE
308
Y
ACTIVATE COOLING SYSTEM
310

FIG. 13

INCREASED ACCURACY FIREARM

FIELD OF THE INVENTION

[0001] The present invention pertains to firearms and motion converting mechanism, and more particularly, to automatic rotating and reciprocating of a bolt operating mechanism of a rifle.

BACKGROUND OF THE INVENTION

[0002] The overwhelming majority of existing target, hunting, and sniper rifles are based on the century old Mauser system or on a various modifications thereof. The cartridge chamber of the classic Mauser system is in the form of a counterbore in the rear end of the barrel. The bolt tip is brought into contact with the end of the barrel, whereby locking takes place between the locking lugs on the bolt tip and the recesses in the receiver. The main advantage of this Mauser system is consistent setting of the cartridge in the chamber resulting in very accurate rifles. The accuracy of such manual bolt action guns has encouraged their continued use even after one hundred years of further firearm technology development. For example, most sniper units of the military, including the U.S., continue to use a manual bolt action.

[0003] The biggest disadvantage of the manual bolt action is that the right hand has to cycle the action between shots, resulting in an inherently slow firing rate. In addition to the time required to cycle the action, the shooter has to aim the rifle again. Consequently, when accuracy is not paramount, semi-automatic and automatic rifles are often preferred. The rate of fire is increased because the automatic ejection of the spent cartridge and chambering of the next round occurs faster than a manual bolt action. Furthermore, the shooter tends to take less time to reacquire and aim at the target when not inconvenienced by manually cycling the bolt.

[0004] Often, the bolt mechanism is comparable for both semi-automatic and automatic modes with mechanisms for triggering being altered to provide each mode. Hereinafter, both semi-automatic and automatic will generally referred to as "automatic", referring to bolt actions that immediately cycle, utilizing the gas pressure from a fired cartridge.

[0005] Several designs are well known for making a system operate in semi-automatic or automatic mode, such as U.S. Pat. No. 2,951,424 that describes a gas operated bolt and carrier system. In particular, an automatic rifle mechanisms such as the bolt and bolt carrier perform a double function. This double function consists of the primary function shared with manual bolt mechanism of locking the breach against the pressure of firing, and further consists of the secondary function of acting as a stationary piston to actuate the automatic rifle mechanism. When actuated by the pneumatic pressure from a fired cartridge, the bolt carrier rotates and thereby unlocks the bolt, carries the bolt back to open the receiver to expel the spent cartridge and return forward chambering the next cartridge and rotating to lock the bolt. The automatic rifle mechanism is able to achieve a high rate of firing (e.g., 400 rounds per minute) and outstanding reliability in many fielded firearms over the past forty years.

[0006] Although adequate for many purposes, automatic rifle mechanisms inherently suffer from features that degrade accuracy in order to gain the automatic capability. In order to readily unlock and reciprocate without jamming, generally the automatic bolt mechanism does not lock as securely as the manual bolt mechanism. In particular, the automatic bolt mechanism is powered by the gas pressure from the fired cartridge and must cycle very quickly before the available energy is dissipated. Thus, firm locking is generally not practical. Thus, each chambered cartridge is not seated as securely and consistently during each firing as with a manual bolt mechanism, leading to variations in the achieved muzzle velocity, and thus the accuracy of the rifle.

[0007] Thermal requirements also degrade the accuracy of automatic weapons. In particular, automatic bolt mechanisms suffer from a disadvantage related to their increased rate of fire, namely heat build-up. In order to successfully chamber rounds and expel the spent cartridges, these automatic bolt mechanisms have to accommodate the thermal expansion through the expected temperature operating range. Thus, the automatic bolt mechanism tends to require varying amounts of energy to cycle and to vary in how securely a round is chambered as a function of temperature. This additional variability further degrades the accuracy of the automatic weapon.

[0008] Efforts to accommodate heat build up have generally included limiting the rate of fire, adding thermal mass to the firearm, providing more play between components for thermal expansion, and adding radiation fins to the barrel and housing. Unfortunately, limiting the rate of fire reduces the utility of the firearm, as does increasing the weight. Features such as radiating fins are also susceptible to clogging with debris that reduces their effectiveness. Moreover, for military sniper firearms, heat radiation is often an undesirable feature, allowing detection due to the infrared heat signature of the weapon. Consequently, the operator often is forced to wrap the exposed portions of the firearm in thermally insulating materials, further degrading the accuracy of the firearm and firing rate due to heat build up.

[0009] Consequently, a significant need exists for a firearm that has the accuracy of those operated with a manual bolt mechanism but with the convenience and rapid firing of those operated with an automatic or semi-automatic bolt mechanism.

BRIEF SUMMARY OF THE INVENTION

[0010] The invention overcomes the above-noted and other deficiencies of the prior art by providing a bolt mechanism that securely chambers each round to achieve the accuracy of a manual bolt mechanism, yet cycles automatically after the round has been fired to gain the convenience and increased rate of fire of an automatic or semi-automatic bolt mechanism. Separating the source of power for cycling the bolt mechanism, or action, allows for a securely sealing bolt action when locked for consistent and accurate results.

[0011] In one aspect of the invention, an apparatus and method are disclosed for a bolt action firearm, such as rifle, wherein a firing controller responds to a firing command by actuating at least actuator to cycle the bolt action (i.e., unlocking, reciprocating, and re-locking) using power from a power supply. By not being dependent on the short duration of pressurized gas from a fired cartridge like conventional automatic bolt actions, a secure locking of the cartridge is achieved.

[0012] In another aspect of the invention, an apparatus and method is described for enhancing the consistent and secure sealing of the bolt action by maintaining the bolt action and barrel within an optimum temperature operating range with a convection cooling system. Thereby, the tolerances between parts remain consistent by avoiding excessive contraction or expansion of metallic parts due to temperature variation.

[0013] These and other objects and advantages of the present invention shall be made apparent from the accompanying drawings and the description thereof.

BRIEF DESCRIPTION OF THE DRAWING

[0014] The accompanying drawings, which are incorporated in and constitute a part of this specification, illustrate embodiments of the invention, and, together with the general description of the invention given above, and the detailed description of the embodiments given below, serve to explain the principles of the present invention.

[0015] **FIG. 1** is a side view of a bolt action firearm partially cutaway to expose a dual-actuator fire control system consistent with the present invention.

[0016] **FIG. 2** is a top view of the firearm of **FIG. 1** partially cutaway to expose the dual actuators engaged to the bolt mechanism.

[0017] **FIG. 3** is a fragmentary side view of a bolt action firearm partially cutaway to expose a single-actuator fire control system consistent with the present invention.

[0018] **FIG. 4** is a side view of the bolt action firearm of **FIG. 3** with the single-actuator fire control system in its fully open position.

[0019] **FIG. 5** is a side view of the bolt action firearm of **FIGS. 3 and 4** with the single-actuator fire control system in its intermediate state of unlocked and closed position.

[0020] **FIG. 6** is a transverse vertical sectional view taken on the line of **6-6** of **FIG. 3**.

[0021] **FIG. 7** is a top view of a bolt action firearm incorporating a pneumatic/electric power converter for augmenting power for the fire control systems of **FIGS. 1 and 3**.

[0022] **FIG. 8** is a side view of a bolt action firearm incorporating a forced air cooling system.

[0023] **FIG. 9** is a transverse cross sectional view taken on the line of **9-9** of **FIG. 8**.

[0024] **FIG. 10** is a side view of a bolt action firearm incorporated a three-stage liquid cooling system.

[0025] **FIG. 11** is a transverse vertical sectional view taken on the line of **11-11** of **FIG. 10**.

[0026] **FIG. 12** is a sequence of steps, or routine, performed by a fire control system for automatically cycling a bolt action firearm such as depicted in **FIGS. 1 and 3**.

[0027] **FIG. 13** is a sequence of steps, or routine, performed by a temperature control system, such as depicted in **FIGS. 8 and 10**, for automatically maintaining a bolt action firearm within an optimum operating temperature range.

DETAILED DESCRIPTION OF THE INVENTION

[0028] With reference to the Drawings, wherein like numbers refer to like components through the several views, **FIGS. 1 and 2** depicts a quick firing and precise firearm, depicted as a bolt action rifle **10**. Except for a fire control system **12** and related parts described in detail, the rifle **10** is or may be of generally conventional construction and comprises basically a housing or frame **14**, a gun barrel **16** threaded into a forward end of the housing **14**, and a stock **18** supporting the housing **14** and gun barrel **16**. In the upper portion of the housing **14** is an elongated bore or recess **20**, concentric with the barrel **16**, which receives a reciprocating bolt **22**, depicted in its closed and locked position relative to the housing **14**.

[0029] It will be appreciated that from this position, the front end of the bolt **22** includes a relatively shallow cylindrical recess, which, in conjunction with the rear portion of the barrel bore, forms a firing chamber for holding a cartridge during the firing of the firearm **10**. The interface between the bolt **22** and the barrel **16** include an annular recess for securely gripping the rim portion of the cartridge for sealing the firing chamber. In addition, included in the bolt **22** is a suitable extractor that is engageable with the rim portion of a cartridge in the firing chamber to withdraw the shell of the cartridge after firing. Furthermore, in the housing **14** is another ejection device for expelling the shell of a spent cartridge from a receiver opening **24** in the housing **14**.

[0030] The depicted firearm **10** includes a conventional manual mode. In particular, the extraction of the spent cartridge may be performed in the convention, manual fashion by rotating the bolt **22** by raising a bolt handle **26**, thereby disengaging lugs on the bolt **22** from the housing **14**, and thereafter drawing the bolt **22** backward by pulling the handle **26** aft. During the aft motion of the bolt **22**, the extractor draws the spent cartridge out of the firing chamber and the ejection device expels the shell out through the receiving opening **24**. When the handle **26** is pushed forward from its fully open rearward position, an unfired cartridge is spring fed from a magazine or other cartridge supply into the position vacated by the previously ejected shell. As the handle **26** moves forward to its forward-most closed position, the bolt **22** urges the unfired cartridge into the firing chamber. Thereafter, the handle **26** is rotated into the locked position.

[0031] However, the firearm **10** advantageously includes the alternative or additional fire control system **12** for unlocking, reciprocating and re-locking the bolt **22**. To this end, the bolt **22** includes radial bolt indentations **28** that align with a radial tooth wheel **30** when the bolt **22** is in its forward-most position, abutting the barrel **16**. A locking motor **32** selectively rotates the tooth wheel **30** that engages the radial indentations **28** to thereby rotate and either lock or unlock the bolt **22**. Longitudinal bolt indentations **34** are arrayed along a portion of the length of the bolt **22**. A reciprocating motor **36** drives a toothed wheel **38** that engages the longitudinal bolt indentations **34** for cycling the bolt **22** selectively aft and forward in a reciprocating fashion.

[0032] A dual actuator controller **40** sequentially activates the motors **32, 36** to perform the cycling of the bolt **22** in response to a trigger **42** and a fire selector control **44**, which can be in either "S" secure ("Safe") mode, "F" fire single shot mode, or "A" automatic mode. The controller **40** is powered by a power supply **46**. In the illustrative embodiment, the controller **40** is an electronic device such as a programmable logic array, timing relay, or microcontroller having a microprocessor and is powered by an electrical battery. Similarly, the motors **32, 36** may be advantageously be DC electrical motors that are also powered by a battery. In other applications, the controller **40** may be electrically powered and direct another form of power to the motors **32, 36**, such as pneumatic pressure from a pressurized power supply. Furthermore, in the instance of a power supply such as a compressed gas container, the controller **40** may comprise an analog fluidic device that times and sequences activation of the motors **32, 36** through mechanical means. It should be appreciated that the form of power supply may include other types of energy storage and conversion means, such as fuel cells.

[**0033**] It will be appreciated that the speed of actuation of the motors **32, 36** may be advantageously selected to reduce peak electrical current draws from the power supply **46**, and thus extend the service life of the motors **32, 36** and power supply **46**. For example, locking and unlocking may require a different amount of torque from reciprocating the bolt **22**, or the amount of torque may vary different portions of the rotation or the longitudinal motion. Also, the speed may be selected for user preference of one or more of the following considerations: firing rate, service life, safe motion, reduced noise, or other factors.

[**0034**] FIGS. **3-6** depict a single actuator fire control system **48** that includes a single actuator controller **50** for cycling a bolt **52** similar to that described in U.S. Pat. No. 3,377,730, which is hereby incorporated by reference. The controller **50**, powered by a power supply **54**, responds to the trigger **42** by cycling the bolt **52** after a suitable delay for the round to exit the barrel **16**. With the bolt **52** closed and locked as shown in **FIG. 3**, the controller **50** activates a motor **56**, which in turn rotates a gear **58** that meshes with longitudinal bolt indentations **60** on the bolt **52**. Rotating the bolt **52** for locking and unlocking is accomplished by helical indentations **62** comprising the rearmost indentations **60** that engage helical teeth **64** on the gear **58**. Remaining teeth **66** on the gear **58** are transverse to engage transverse indentations **68** of the longitudinal bolt indentations **60** for reciprocating the bolt **52** aft and forward.

[**0035**] In operation, the bolt **52** is initially closed and locked, as depicted in **FIG. 3**. The controller **50** causes the motor **56** to rotate the gear **58**, whose helical teeth **64** cause the bolt **52** to rotate to the unlocked position, as depicted in **FIG. 4**, wherein the transverse teeth **66** engage the transverse indentations **68** on the bolt **58**. Thereafter, the gear **58** is further rotated causing the bolt to traverse aft to the fully open position, extracting any cartridge in the firing chamber. Then the controller **50** causes the gear to rotate in the opposite direction, loading an unfired cartridge and locking the bolt **52**, as depicted in **FIG. 3**.

[**0036**] **FIG. 7** depicts a pneumatic-to-electrical power conversion mechanism **70** for the firearm **10** that may augment or wholly provide the power requirements for a fire control system **72**. Thus, the pneumatic power available from the fired cartridge is utilized; however, the power is used in a manner consistent with the aforementioned fire control systems **12, 48** wherein the actuation of the bolt action is delayed until after the round exits the firearm and wherein the bolt action provides a secure seal of the breech of the firing chamber. In the illustrative embodiment, the power conversion mechanism **70** is shown diagrammatically, although it will be appreciated that these features may be enclosed within the stock **18**.

[**0037**] A gas port **74** communicates with a bore **76** of the barrel **16** to receive pressurized gas as the round exits the barrel **16**. The pressurized gas enters a forward portion **78** of a piston chamber **80**. The pressurized gas acts upon a face **82** of a piston **84**, forcing the piston **84** aft, compressing a compression spring **86**. Thereafter, the pressurized gas is allowed to exit the firearm **10** either by returning to the bore **76** or through an exhaust port **88**, allowing the mechanically stored energy in the compression spring **86** to reposition the piston **84** to its forward position.

[**0038**] A piston rod **90**, connected to the piston **84**, meshes to an electrical generator **92** that is operated by the movement of the piston rod **90**. Electrical power from the generator **92** is stored in a capacitor **94** as a power supply or to augment a power supply for the fire control system. Alternatively, the generator may comprise a pump for compressing gas in a gas storage device for use in a pneumatically power fire control system (not shown).

[**0039**] **FIGS. 8 and 9** depict a firearm **100** that includes a convection cooling system, depicted as a forced air cooling system **102** that advantageously enhances cooling of the barrel **104** and bolt action **106** so that an increased firing rate may be maintained. A temperature controller **108** responds to a temperature signal from a temperature sensor **110** by activating a blower **112**. The blower **112** draws air from the end of the barrel **104** into a cooling jacket **114** that surrounds the barrel **104**. The barrel **104** may also include external longitudinal grooves **116** and internal air passages **118** that increase the surface area of the barrel **104** for further increasing the heat dissipation. The air expelled past the blower **112** may pass through a dispersion element **120** to muffle the sounds produced by the blow3er **112**.

[**0040**] FIGS. **10-11** depict a liquid cooled firearm **130** that supports a fire control system (not depicted in FIGS. **10-11**) for increased rate of fire with bolt action maintained within a desirable temperature operating range. Specifically, increased heat transfer capacity of a convection cooling system is obtained by using a liquid such as ethylene glycol. A portion of a housing **132** and barrel **134** are encompassed by a liquid cooling jacket **136** forming a liquid heat exchange passage **138** around the barrel **134**. Liquid cooling passages **140** radially spaced within the longitudinal length of the barrel **134** may advantageously communicate with the passage **138** to further enhance the heat dissipation capacity.

[**0041**] A temperature controller **142** responds to a temperature signal from a temperature sensor **144** by pumping liquid from one or more radiators and/or liquid storage devices. In the illustrative embodiment, the controller **142** draws via tubing **146** cooling liquid from a switching station **148** that communicates with available liquid reservoirs and/or radiators, depicted as a primary radiator **150** in a forearm portion **152** of a stock **154**, a secondary radiator **156** in rear portion **158** of the stock **154**, and a remote cooling unit **160** in fluid communication with the switching block **148** via tubing **162**. The cooling unit **160** further comprises a plurality of staggered radiator units **164** through which cooling air is drawn by a blower **166**.

[0042] The temperature controller **142** may advantageously activate a warming or heating element **168** in response to the sensed temperature being below the optimum temperature operating range. The heating element **168** may heat one or more of housing **14**, bolt action, firing chamber, barrel and cooling liquid. Alternatively or in addition, the temperature sensor **144** may sense both ambient temperature and the temperature of the firearm **130** and adjust the optimum temperature operating range for reducing the infrared signature of the firearm **130**.

[0043] **FIG. 12** depicts a sequence of steps, or routine **200**, performed by a firing control system for automatically cycling a bolt action of a firearm. With the firing control enabled (block **202**), such as by powering the controller, a determination is made as to whether firing has been commanded (block **204**). This determination may entail actual sensing of the round being fired or an electrical sensing of a depression of the trigger.

[0044] Once firing is commanded in block **204**, the temperature of the firearm is sensed (block **206**). Then, settings are determined for any or all of the delay time, and the unlocking, extraction, chambering, and locking speeds (block **208**). Adjusting these settings may advantageously accommodate changes in firing time, mechanism friction and actuator performance based on temperature, type of cartridge, power supply condition, type of actuator(s), and other factors.

[0045] Thereafter, the delay time is used to wait for the round to fire and to exit the firearm (block **210**). Then, the bolt action is unlocked by rotating the bolt (e.g., helical gear enmeshing the bolt or a traversely positioned actuator to rotate the bolt) (block **212**). Then the spent cartridge is extracted by drawing the bolt back to a fully open position (block **214**).

[0046] With the bolt fully open, the routine **200** may close and lock the bolt regardless of whether a cartridge is available in a cartridge supply such as a magazine. The routine may further chamber a round without regard to the temperature of the barrel. In the illustrative depiction of **FIG. 12, a** determination is advantageously made as to whether the magazine is empty (block **216**). If not empty, then a further determination is made as to whether the temperature of the barrel is high such that chambering a round is not desirable (block **218**). For example, an excessively hot barrel may cause a malfunction.

[0047] If magazine is empty in block **216** or if the barrel is sensed to be at an unsafe temperature in block **218**, then the bolt is left open to give a visual indication to the user that the weapon is not ready to fire. If a cartridge is available in block **216** and the barrel is at a safe temperature in bloc **218**, then a cartridge is chambered by drawing the bolt forward to the closed position (block **220**) and locking the bolt action (block **222**).

[0048] **FIG. 13** depicts a sequence of steps, or routine **300**, performed by a temperature control system for maintaining a bolt action and barrel of a firearm within in optimum temperature range. With the temperature control enabled (block **302**) such as by powering the controller, a determination is made as to whether the sensed temperature is below the operating range (block **304**). If so, a warming element is activated (block **306**). If the temperature is not below the operating range in block **304** or after activating the warming element in block **306**, then a determination is made as to whether the temperature is above the operating range (block **308**). If so, a cooling system is activated (block **310**) and processing returns to block **302**. If not above the operating temperature range in block **306**, then processing returns to block **302**.

[0049] In use, a fire control system **12** of a bolt action rifle **10** responds to the firing of a cartridge by delaying for the round to exit the firearm. Then the controller **40** unlocks the bolt **22** by rotating with a power actuator, such as an electrical locking motor **32** that turns a gear meshed with radial bolt indentations **28**. The controller **40** then reciprocates the bolt **22** with an electrical reciprocating motor **36**. Accuracy further enhanced with a convection cooling system to support increased firing rate with excessive thermal build up. By virtue of the foregoing, the speed and timing of the control system **12** advantageously allows a hitherto manual bolt action to have the convenience of a gas-driven automatic bolt action without the requisite loss of accuracy.

[0050] While the present invention has been illustrated by description of several embodiments and while the illustrative embodiments have been described in considerable detail, it is not the intention of the applicant to restrict or in any way limit the scope of the appended claims to such detail. For example, an open loop convection cooling system may be employed consistent with aspects of the invention wherein the user activates the cooling system. As another example, the convection cooling system may be employed on firearms other than bolt action rifles. As a further example, additional user controls may be included to allow adjusting settings for delay time, unlocking speed, extraction speed, chambering speed and locking speed. These user controls may allow selecting for maximum firing rate, for increased power supply service life, for increased service life of the firearm. These user controls may also allow for optimizing the settings for a specific type of cartridge, such as to accommodate the time required for the cartridge to fire and exit the firearm. As yet a further example, a firearm convection cooling system may be used without aspects of the invention directed to a firing control system. Similarly, the inventive firing control system may be used without a convection cooling systems. Additional advantages and modifications may readily appear to those skilled in the art.

What is claimed is:

1. A firearm comprising:

a barrel;

a bolt mechanism reciprocating with respect to the barrel to load a cartridge into the barrel and to extract the cartridge from the barrel, the bolt mechanism including a locking member to rotatingly engage the barrel;

a power supply;

at least one actuator configured to unlock, reciprocate and lock the bolt mechanism when powered by the power supply; and

a controller configured to respond to a firing command by actuating the at least one actuator with the power from the power supply to unlock, reciprocate and lock the bolt mechanism.

2. The firearm of claim 1, wherein the at least one actuator further comprises:

a rotation actuator configured to rotate the bolt mechanism; and

a reciprocating actuator configured to reciprocate the bolt mechanism.

3. The firearm of claim 2, wherein the bolt mechanism includes a plurality of radial indentations and a plurality of longitudinal indentations, the rotation actuator comprising a motor driven tooth wheel enmeshed in the radial indentations when the bolt mechanism is closed and the reciprocating actuator comprising a motor driven tooth wheel enmeshed in the longitudinal indentations when the bolt mechanism is unlocked.

4. The firearm of claim 1, wherein the bolt mechanism includes longitudinal helical and transverse indentations and wherein the at least one actuator further comprises:

a gear including helical teeth and transverse teeth registered to the longitudinal helical and transverse indentations along the bolt mechanism; and

a motor connected to and operable to turn the gear.

5. The firearm of claim 1, wherein the controller is further configured to set a delay time between receiving the firing command and actuating the at least one actuator.

6. The firearm of claim 1, wherein the controller is further configured to set an unlocking speed for unlocking the bolt mechanism.

7. The firearm of claim 1, wherein the controller is further configured to set an extraction speed for rearward movement of the bolt mechanism.

8. The firearm of claim 1, wherein the controller is further configured to set a chambering speed for forward movement of the bolt mechanism.

9. The firearm of claim 1, wherein the controller is further configured to set a locking speed for locking the bolt mechanism.

10. The firearm of claim 1, further comprising:

a temperature sensor proximate to the barrel, wherein the controller is further configured to respond to the temperature sensor by adjusting the actuation of the at least one actuator.

11. A firearm comprising:

a barrel;

a bolt mechanism reciprocating with respect to the barrel to load a cartridge into the barrel and to extract the cartridge from the barrel, the bolt mechanism including a locking member to rotatingly engage the barrel;

a convection cooling system configured to direct a cooling flow to the firearm to cool the barrel and bolt mechanism.

12. The firearm of claim 11, wherein the convection cooling system comprises a forced air cooling system.

13. The firearm of claim 11, wherein the convection cooling system comprises a liquid cooling system.

14. The firearm of claim 11, further comprising:

a temperature sensor;

a temperature controller responsive to the temperature sensor to activate the convection cooling system.

15. The firearm of claim 11, further comprising a warming element in thermal communication with the barrel.

16. A method of operating a bolt action firearm that includes a power supply, comprising:

in response to firing the bolt action firearm, delaying cycling a bolt action;

rotating the bolt action with power from the power supply to unlock the bolt action;

reciprocating the bolt action with power from the power supply to extract a spent cartridge and to chamber an unfired cartridge; and

rotating the bolt action with power from the power supply to lock the bolt action.

17. The method of claim 16, further comprising:

determining a delay time, an unlocking speed, an extraction speed, a chambering speed and a locking speed.

18. The method of claim 16, further comprising:

sensing temperature of the bolt action firearm; and

in response to sensing temperature exceeding an upper threshold, activating a cooling system.

19. The method of claim 18, further comprising:

in response to sensing temperature below a low er threshold, activating a heating element.

20. The method of claim 18, wherein actuating the cooling system comprises:

forcing cooling air around a portion of the firearm.

21. The method of claim 18, wherein actuating the cooling system comprises:

circulating cooling liquid within the firearm.

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