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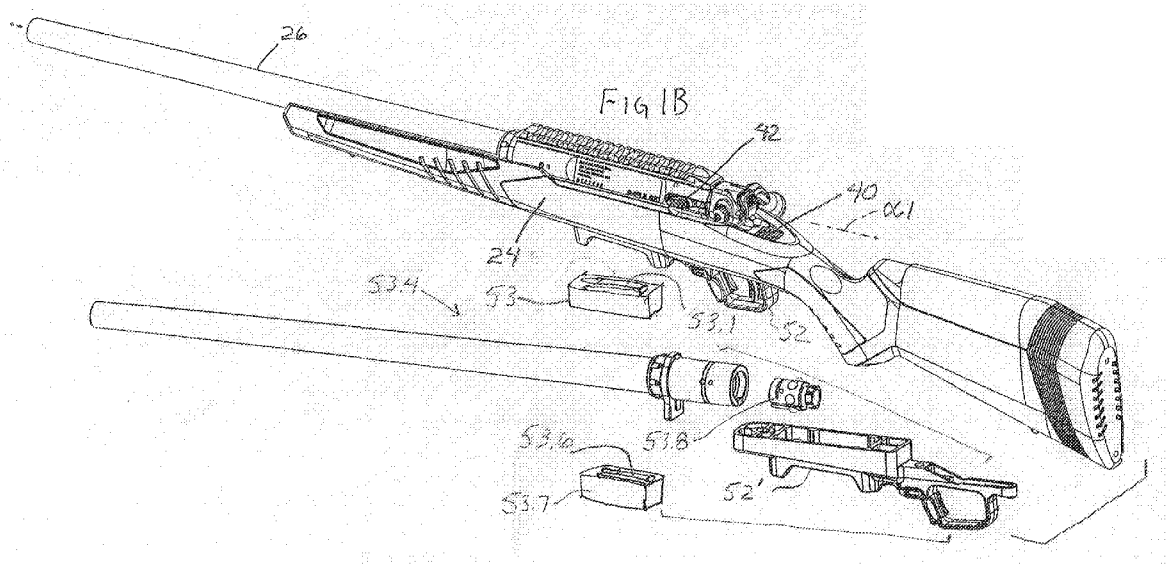

(57) Abstract: A rifle having a straight pull bolt assembly with a bolt handle that extends outward and downward from a bolt operation mechanism. The bolt handle rotatable a limited rotational range forward and rearwardly about a horizontal axis for operating the mechanism. The handle can be reconfigured to position its rotational range about the horizontal axis and can be attached to the mechanism at either left or right sides to provide for ambidextrous operation. Bolt heads, lower frame members with magazine wells, and barrel assemblies can be readily swapped to change ammunition. The bolt assembly can be unlocked by firing or by a thumb push button release at the backside of the mechanism. A bolt removal release mechanism is forward of the thumb pushbutton and an ejector includes a spring bias and cam follower surface to reliably eject casings.

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RIFLE WITH STRAIGHT PULL BOLT ACTION

BACKGROUND OF THE INVENTION

The conventional four motion bolt action is the most common manually operated cycling mechanism used in rifles. During the initial firing of the cartridge, the bolt is locked at an in-battery position. After firing, the bolt action handle is raised upwardly rotating the bolt about the barrel axis to unlock the bolt and is then pulled rearwardly. As the bolt moves rearward the fired empty cartridge is extracted from the firing chamber. After the spent cartridge is ejected, the bolt is moved forward, by the bolt handle, engaging the next cartridge in the magazine and pushing that cartridge into the chamber. The bolt handle is then rotated downwardly locking the bolt in the in-battery firing position. The torque required to lock and unlock the bolt assembly, by raising and lowering the bolt handle is not insignificant and can cause rotational movement of the firearm and generally move the firearm off of its target, requiring re-sighting.

Straight pull rifles reduce the number of motions to essentially two motions for cycling the firearm. The locking of the bolt head into the barrel or barrel extension is by means other than the user rotating the bolt action handle about the barrel axis. In that the two upward and downward motions of the bolt handle are not needed there is more stability in holding the firearm.

Thus, straight pull rifle actions are generally mechanically more complicated that four motion bolt action rifles and are typically much more expensive. The increased mechanical complexity applies to the bolt operational mechanisms, operational controls, firearm disassembly steps, and convertibility to different calibers and cartridges where available. Bolt removal releases and bolt unlock controls often are not intuitive or readily accessed. Generally, straight pull rifles, like conventional four motion bolt action rifles are not convertible from

right to left handed operation of the bolt. Any new improvements in straight pull rifles that improve on speed of operation, ergonomics, ease in finding the operational controls, convertibility from right to left handed use and vice versa, flexibility in changing calibers, less complexity in making modifications, particularly with no tools or minimal tools, and providing a robust action that can be manufactured for less than competitive straight pull rifles, would be welcomed in the marketplace.

SUMMARY OF THE INVENTION

A straight pull bolt action rifle comprises a bolt assembly mounted in a receiver, in a stock, with a trigger mechanism positioned below the bolt assembly, a barrel and barrel extension secured forward of the receiver to receive a bolt head of the bolt assembly. Locking of the bolt action in the ready-to-fire position is by way of a short rotation forward in an arcuate path about a horizontal axis of the bolt handle that is a continuation of the forward linear motion of the bolt assembly and bolt handle in chambering a cartridge. Unlocking of the bolt action after firing or to eject a cartridge utilizes a short opposite rotation of the bolt handle in an arcuate path about a horizontal axis and then the rearward linear motion of the bolt assembly including the bolt handle. The minimal arcuate paths of the bolt handle motion rearwardly combined with the linear motion of the bolt body sliding in the receiver is such that the overall motions, including the arcuate motions, are appropriately termed straight.

In embodiments, enhanced ergonomics is provided by the bolt handle being readily swappable between the left and right sides of the bolt assembly and by being angularly adjustable on each side. Further enhanced ergonomics being provided by one or more of a thumb pushbutton for unlocking the bolt handle and bolt when in the in-battery ready-to-fire position, the thumb button within reach by the user's hand while grasping the bolt handle, an ambidextrous tang safety is positioned directly below and behind the bolt assembly, and a bolt

assembly pull-out release lever is directly forward of the rotation axis of the bolt handle on the receiver for removal of the bolt.

The bolt assembly comprising a bolt carrier containing a bolt body, a bolt head, a bolt plunger, a striker, a firing pin, a firing pin spring, a rear bolt enclosure, a bolt operation mechanism, and the bolt handle connecting to the bolt operation mechanism at the rear bolt enclosure. In embodiments, the bolt head having a plurality of locking roller balls that are releasably engageable with recesses in the barrel extension and lockable therein by the bolt plunger.

A feature and advantage of embodiments is a rifle having a straight pull bolt action with improved ergonomics and functionality. The straight pull bolt action eliminates two of the four motions required to cycle a rifle compared to a traditional four motion bolt action resulting in faster ejection and loading as well as more gun stability during the cycling, less re-aiming, and improved accuracy in shooting.

In embodiments, functional operation and control of the straight pull rifle action is through the bolt operation mechanism in an enclosure at the rearward end of the bolt assembly configured as a bolt assembly cap. The bolt operation mechanism providing for all or some of the following functions: locking the bolt in the in-battery position, providing the final locking of the bolt with a plunger a gradual final locking, unlocking the bolt from the in-battery position manually or upon firing, manually unlocking the bolt at the in-battery position at a gradual reduced travel rate, locking the bolt handle forwardly, releasing the forward locked bolt handle manually, releasing the forward locked bolt handle by pulling the trigger, providing a manual gradual initial push off of the bolt assembly from the receiver at the closed most forwardly position of the bolt assembly after firing or after a manual bolt handle release, locking the bolt handle in the rearward rotational position, unlocking the bolt handle from the rearward rotational position, and compressing the firing pin spring utilizing the bolt handle. The gradual

locking of the bolt head and gradual unlocking and gradual push-off of the receiver providing smooth operation and less jarring of the rifle in cycling the action. Moreover, no or minimal rotational torque about the longitudinal axis of the rifle is caused by the cycling of the firearm.

A feature and advantage of embodiments is a bolt assembly having a downwardly angled bolt handle extending from a rear end of the bolt assembly on a bolt cap initially positioned and configured like a bolt of a conventional four motion bolt action rifle. The bolt having a rotation axis at the rear bolt cap about a horizontal axis of about 45 degrees, plus or minus 15 degrees. From a forwardly most rotation position of the bolt handle, where the bolt is in-battery and the bolt assembly locked forward, the bolt handle is manually released or automatically released and the bolt handle is rotated rearwardly to the rearwardly most rotation position unlocking the bolt assembly from the receiver and barrel extension. The bolt is then pulled rearwardly sliding the bolt assembly rearwardly, ejecting the spent casing or unfired cartridge, to a rearwardly most bolt assembly position with the bolt handle being rotationally locked in the rearwardly most rotational position. The bolt handle is then pushed forwardly, loading the next cartridge, with no bolt handle rotation, to where the bolt cap engages the receiver, the bolt handle continues to be pushed forward thereby rotating the bolt handle, locking the bolt assembly to the receiver and barrel extension, and locking the bolt handle in the forwardly most rotation position, putting the rifle in a ready-to-fire mode.

A feature and advantage of embodiments is the minimal bolt handle rotation is continuous with the forward and rearward sliding of the bolt assembly but is mostly distinct therefrom. In embodiments, a pushbutton at the rear side of the bolt cap releases the bolt handle when the bolt assembly is locked in the forward most position. The button positioned in close proximity to the bolt handle such that the pushbutton is pushable with the user's thumb while the user's fingers of the same hand are hooked onto the bolt handle. The depression of the pushbutton with the release of the locked bolt handle, and the rearward pulling of the bolt

handle and opening of the bolt assembly can be accomplished in one smooth continuous motion. The handle being used as an anchor point providing leverage for the pushing the pushbutton while simultaneously commencing the rearward force to move the bolt handle rearwardly.

In embodiments, select ones or all of the above functions are keyed off of a main rotatable drive member that is connected directly to the bolt handle and that rotates with the bolt handle about a horizontal axis (where the barrel axis is horizontal and the gun is upright). In embodiments, the main rotatable drive member rotatably fixed to the bolt carrier and being part of four separate linkage systems. The rotation about a horizontal axis providing a mechanical advantage in operating several functionalities with a plurality of linkages connected to the main rotatable drive member. The rotation of the main rotatable drive member is limited to a partial rotation, for example, a rotation range of 30 to 80 degrees, forward and rearward. The rotation of the bolt handle effecting the rotation of the main rotatable drive member being a smooth uninterrupted continuation of the linear rearward ejection motion and linear forward loading motion of the bolt assembly effected by the bolt handle.

A first linkage system is a sliding toggle mechanism with a first link being the main rotatable drive member, the second link pinned to the main rotatable drive member at an outward first arm of the main rotatable drive member and connecting to a slider at the other end, the slider being the bolt plunger. The first and second links being constrained within the bolt assembly and having an over center position of the pivots that correspond to the bolt plunger being extended and holding the locking roller balls into engagement with the barrel extension thereby locking the bolt head in the in-battery position. The second link also having cam surfaces thereon that receive a bias inward toward the first link by a spring member that maintains the over center position of the linkage. The first linkage system for locking and

releasing the bolt in the in-battery position and providing the reduced travel rate for said locking and releasing; for locking the bolt handle in the rearward most position.

A second linkage system is a toggle slider linkage with a second arm of the main rotatable drive member defining a first link, a second link pinned to the first link, a third link pinned to the second link. The second and think links slidingly constrained at the upper wall of the mechanism housing, the upper wall providing a cam surface. The third link having a catch portion for engagement with a catch surface on the receiver and being spring loaded to follow the cam surface of the mechanism housing and for catching the catch surface on the receiver. The second linkage system providing a gradual push off and separation of the rearward end of the bolt assembly from the receiver for initiating the ejection cycle, and for keeping the bolt in a closed position when the bolt is in the in-battery position.

A third linkage system is a cam and two link system for compressing the firing pin spring in preparation for firing, utilizing rotation of the bolt handle. The cam is provided by a surface on the main rotatable drive member, in embodiments the cam surface is on the first arm that is also a link in the first linkage system. The rotation of the main rotatable drive member, rotatably fixed to the bolt body, provides a cam surface that pushes a first link (the striker) rearwardly, the striker pinned to the firing pin such that as the striker and firing pin are pulled rearwardly within the bolt body the firing pin spring is compressed, the firing pin spring having a rearward end anchored to the bolt body. The striker is subsequently engaged by the sear to hold the firing pin spring in the compressed state.

A fourth linkage system is a catch and release mechanism for locking the handle forwardly when the bolt is in the in-battery ready-to-fire position and for providing a push button release button accessible by the thumb for releasing the bolt handle from said position. The main rotatable member providing a handle lock projection. A lever (the thumb pushbutton) is pivotal on the mechanism housing and is pinned to a push button actuation link, the push

button actuation link having a cam follower surface that is engaged by a cam surface on the rearward end of the striker, such that as the striker is pulled back by way of the third linkage, the push button actuation link causes a lower end of the thumb pushbutton lever to move towards the main rotatable member to catch and secure the handle lock projection, locking the rotation of the rotatable member in place, thereby locking the bolt handle in the forwardly most position of the bolt handle.

In embodiments, the rifle retains the advantages of a rotating bolt handle, for example, the locking and unlocking of the bolt assembly, but with a downwardly bolt handle, and with a rotation motion that is a continuation or commencement of the linear pull back or forward push during cycling of the bolt action. In embodiments, the rotation range of the bolt handle can be from 90 degrees to 20 degrees. In embodiments, the straight pull bolt action providing for faster, smoother, and more reliable reloading of consecutive cartridges than conventional bolt actions or other straight pull actions.

A feature and advantage of embodiments is a rifle having a straight pull bolt action including a repositionable bolt handle that can be reposition on both the left and right sides of the bolt for ambidextrous operation of the straight pull bolt action. In embodiments an ambidextrous tang safety is provided directly behind and below the rearward end of the bolt assembly.

A feature and advantage of embodiments is a rifle having a straight pull bolt action including a repositionable bolt handle that can be repositioned at different angles from horizontal for ergonomic operation of the straight pull bolt action.

A feature and advantage of embodiments is a rifle having a straight pull bolt action including a detachable bolt handle that can be removed quickly and easily without tools. In embodiments, removal of the bolt handle renders the firearm inoperable for security and safe

storage of firearm. In embodiments, a removable handle is provided to secure firearm and to prevent unintended use of the firearm.

A feature and advantage of embodiments is a rifle having a straight pull bolt action including a linkage designed to use leverage for locking the bolt and for unlocking the bolt.

A feature and advantage of embodiments is a rifle having a straight pull bolt action including a bolt with a quickly detachable bolt head. In embodiments, the caliber of the firearm can be changed by removing a first bolt head and replacing it with a second bolt head. In embodiments, the first bolt head is dimensioned and configured for a first caliber and the second bolt head is dimensioned and configured for a second caliber different from the first caliber. In embodiments, the quickly detachable bolt head provides for simple and fast caliber conversion.

In embodiments, when the bolt head is swapped out, a first barrel assembly with a barrel sized for the first caliber may be swapped out for a second barrel assembly with a second barrel sized for the second caliber. In embodiments, the respective barrel assemblies are not disassembled. Each barrel assembly comprising a barrel with a threaded end threaded onto a barrel extension and secured thereto by a barrel nut on the barrel threaded end tightened onto a forward face of the barrel extension with a barrel lug positioned between the barrel nut and the forward face of the barrel extension. The barrel assemblies are preassembled to provide the correct head spacing at the factory. The barrel lugs on each barrel interface with a forward surface of the receiver, for example a vertical rib on the barrel lugs fit into a corresponding groove on the forward face of the receiver. The receiver having a barrel assembly clamping portion where the generally tubular receiver has longitudinal slit whereby the forward receiver clamping portion has a C shape. A plurality of screws and barrel nuts pull the opposing sides of the clamping portion together on the outer cylindrical surface of the barrel extension with on barrel nut registering in a groove cut in the bottom of the barrel extensions of the barrel

assemblies. A feature and advantage is that the barrel lug with the interface rib interfacing with the forward face of the receiver establishes the relative and correct rotational position and the correct relative axial location, along with the barrel nut interfacing with the barrel extension groove.

A feature and advantage of embodiments is a rifle having a straight pull bolt action with an automatic locking bolt handle when rifle is cocked and cartridge loaded, and with a release button on back of the bolt for unlocking the locked bolt handle.

A feature and advantage of embodiments is a rifle having a straight pull bolt action having a pre-extraction plunger design with bolt handle lock back.

A feature and advantage of embodiments is a rifle having a straight pull bolt action with a single step release of a bolt stop. In embodiments, a releasable bolt stop requires first a sliding forward motion before an inward depression to release the bolt assembly from the receiver.

A feature and advantage of embodiments is a rifle having a straight pull bolt action with cam and spring activated fixed ejection arrangement.

A feature and advantage of embodiments is a rifle having a straight pull bolt action that provides for a tool-less bolt assembly/disassembly process.

A feature and advantage of embodiments is a rifle having a straight pull bolt action with a positionable handle that allows for ergonomic operation.

A feature and advantage of embodiments is a rifle having a straight pull bolt action incorporating a linkage design that enables tight closure of breech. In embodiments, the tight closure of the breech provides improved accuracy.

A feature and advantage of embodiments is a rifle having a straight pull bolt action with a barrel nut swing process applied to a barrel with an extension for adjustable head spacing and quick barrel conversion.

A feature and advantage of embodiments is a rifle having a straight pull bolt action with a bolt handle lock that locks the bolt closed when the rifle is cocked to avoid being accidently knocked open. In embodiments, the bolt handle lock can be quickly released for opening without firing if needed.

A feature and advantage of embodiments is a rifle having a straight pull bolt action including a unique plunger design for casing pre-extraction.

A feature and advantage of embodiments is a rifle having a straight pull bolt action with a simple releasable bolt stop design that provides for easy manipulation and ready accessibility.

A feature and advantage of embodiments is a rifle having a straight pull bolt action with a cam surface that cooperates with a spring to place the ejection arm in a desired position.

A feature and advantage of embodiments is a rifle having a straight pull bolt action designed to facilitate simple tool-less assembly. In embodiments, bolt components are configured to assist in assembly.

A feature and advantage of embodiments is a rifle that is configured to receive a magazine holding a plurality of cartridges to be fired by the rifle. In embodiments, the use of removable magazines allows a plurality of cartridges to be easily loaded into the rifle by inserting a single magazine into the firearm. In embodiments, the rifle that is configured to receive Accuracy International Chassis System (AICS) magazines.

A feature and advantage of embodiments is a rifle having a straight pull bolt action with a magazine well adaptor plate for long action AICS magazines.

A feature and advantage of embodiments is a rifle having a straight pull bolt action with a magazine release button extension for short action AICS magazines.

A feature and advantage of embodiments is a rifle having a straight pull bolt action with a steel plate that is used to control the AICS magazine height and eliminate wear on the receiver.

A feature and advantage of embodiments is a rifle having an aluminum receiver for reduced weight.

A feature and advantage of embodiments is the bolt operation mechanism being substantially contained in a bulbous housing at the rearward end of the bolt assembly, the bulbous housing may be formed of polymer and may provide support and components for the bolt operation mechanism and the linkages associated therewith. For example, the bulbous housing may provide a pivot pin support base for a bolt lock release thumb pushbutton, and for example, the bulbous housing many provide a cam surface and containment of a linkage providing a gradual bolt assembly-receiver separation, in particular a linkage to push the bolt assembly away from the receiver. The bolt lock release button may be configured as a rocker lever/switch formed of the same material, for example a polymer as the bulbous housing.

A feature and advantage of embodiments is a rifle having a straight pull bolt action with a magazine catch/release located on the trigger guard of the rifle. In embodiments, the magazine catch is extended for use with short magazines. In embodiments the trigger guard has a narrowed portion and the magazine catch/release has a pushbutton with a conforming slot to receive the trigger guard at the narrowed portion. In embodiments, a catch portion is displace forwardly from the pushbutton by a slider mechanism.

In embodiments herein, improvements are provided in straight pull rifles relating to speed of operation, ergonomics, ease in finding the operational controls, easy convertibility from right to left handed use and vice versa, flexibility in changing ammunition, and less complexity in making such conversions to different ammunition, particularly with no tools or minimal tools, and providing a robust action that can be manufactured for less than competitive straight pull rifles.

The above summary of the various representative embodiments of the invention is not intended to describe each illustrated embodiment or every implementation of the invention.

Rather, the embodiments are chosen and described so that others skilled in the art can appreciate and understand the principles and practices of the invention. The Figures in the detailed description that follow more particularly exemplify these embodiments.

BRIEF DESCRIPTION OF THE DRAWINGS

The invention can be completely understood in consideration of the following detailed description of various embodiments of the invention in connection with the accompanying drawings, in which:

Figure 1A is a perspective view showing a straight pull rifle according to embodiments.

Figure 1B is a perspective view of the straight pull rifle of Figure 1 and with a kit for changing the configuration of the rifle for a different ammunition.

Figure 2A is a side perspective view of a straight pull rifle with the receiver and stock removed showing the mechanisms of the rifle.

Figure 2B is the receiver removed from the straight pull rifle of Figure 2A.

Figure 2C is a side perspective view of the straight pull rifle of Figure 1A with the stock removed revealing mechanisms.

Figure 2D is a side perspective view of the rifle of Figure 2C from the opposite side and without the receiver.

Figure 2E is the receiver of the rifle of Figure 2D.

Figure 2F is an exploded view of the connection system of a straight pull rifle between the receiver and a barrel assembly.

Figure 2G is a perspective view of the receiver of Figure 2F.

Figure 2H is a perspective view of the barrel lug of Figure 2F.

Figure 2I is a cross-sectional view of the barrel extender of Figure 2F.

Figure 3 is an exploded view of a straight pull rifle.

Figure 4A is a perspective view of a portion of a straight pull rifle with a releasable bolt stop.

Figure 4B is an exploded view of the releasable bolt stop mechanism of Figure 4A.

Figure 4C is a perspective view of the mechanism of Figure 4a without the bolt stop insert housing.

Figure 4D is a perspective view of another embodiment of a releasable bolt stop.

Figure 4E is a perspective view of the releasable bolt stop of Figure 4D with the receiver removed.

Figure 4F is a perspective view of the bolt stop of Figure 4D with the bolt stop insert removed showing the engagement with the bolt stop groove in the bolt body.

Figure 4G is an exploded perspective view of the bolt stop insert and other components of the bolt stop of Figure 4D.

Figure 4H is a perspective view of a lower frame of a straight pull rifle with a magazine well and magazine release lever nested around the trigger guard.

Figure 4I is another perspective view of the lower frame of Figure 4H.

Figure 4J is an exploded perspective view of the lower frame of Figures 4I and 4J.

Figure 4K is a perspective view of the components of the magazine release mechanism.

Figure 5A is an exploded view of a bolt assembly of a straight pull rifle.

Figure 5B is a perspective view of a bolt assembly of a straight pull rifle.

Figure 5C is another perspective view of the bolt assembly of Figure 5A.

Figure 5D is an exploded view of the bolt assembly of Figure 5A.

Figure 5E is a perspective view illustrating that a bolt body can receive different bolt heads.

Figure 5F is a perspective view of the forward end of a bolt assembly of a rifle.

Figure 5G is a perspective view of the bolt assembly of Figure 5F with the bolt head removed and the latch exploded.

Figure 5H is a cross sectional view of the forward end of the bolt assembly of Figure 5F.

Figure 5I is a cross sectional view of the bolt assembly of Figure 5F with the latch for releasing the bolt head actuated.

Figure 5J is a cross sectional view of the bolt assembly of Figure 5I showing the bolt head separating from the bolt body.

Figure 6A is a perspective view of a bolt assembly with a ejector engaged in a groove of the bolt body.

Figure 6B is an exploded perspective view of a bolt head.

Figure 6C is an exploded view of the ejector mechanism of Figure 6A.

Figure 7A is a perspective side view of straight pull rifle with the receiver removed illustrating components.

Figure 7B is a perspective view of the rifle of Figure 7A with the barrel extender and bolt release insert removed.

Figure 7C is a perspective view of the rifle of Figure 7B with the bolt body removed.

Figure 7D is a perspective view of the rifle of Figure 7C with the bolt handle removed.

Figure 8 is a perspective view of the components of a first linkage system.

Figure 9 is an exploded view of components of a second linkage system.

Figure 10A is a perspective view of the rifle with portions removed illustrating components of a third linkage system.

Figure 10B is an exploded view of the components of the third linkage system.

Figure 11 is a perspective view of a fourth linkage system.

Figure 12A and 12B are cross sectional views of the rifle illustrating the mechanisms in an in-battery and ready-to-fire mode.

Figure 12C is a side elevational view of the exterior of the rifle when in the in-battery and ready-to-fire mode

Figure 13A and 13B are cross sectional views of the rifle illustrating the mechanisms in a firing mode with the firing pin extended forward.

Figure 14A and 14B are cross sectional views of the rifle illustrating the mechanisms after firing with the bolt handle unlocked ready for extraction, the bolt head still locked in the barrel extension.

Figure 15A and 15B are cross sectional views of the rifle illustrating the mechanisms with the handle rotated rearwardly moving the striker rearwardly compressing the firing pin spring and with the third linkage system pushing away from the receiver.

Figure 16A, 16B and 16C are cross sectional views of the rifle illustrating the bolt assembly pulled rearwardly.

Figures 17A-17D are a cross sectional views of the bolt head and bolt body being retracted illustrating the ejector mechanism motion for ejection of a cartridge.

While the invention is amenable to various modifications and alternative forms, specifics thereof have been depicted by way of example in the drawings and will be described in detail. It should be understood, however, that the intention is not to limit the invention to the particular embodiments described. On the contrary, the intention is to cover all modifications, equivalents, and alternatives falling within the spirit and scope of the invention as defined by the appended claims.

DETAILED DESCRIPTION OF THE INVENTION

Referring to Figures 1A and 1B, a straight pull bolt action rifle 20 has a receiver 22 supported by a stock 24, a barrel assembly 25 with a barrel 26 extending forward of the receiver 22, a bolt assembly 30 with a bolt handle 32, a bolt release button 36, a safety tab 40, , and a releasable bolt stop 42 or bolt removal release lever, a lower frame 52 with an integral trigger guard 54 and magazine well 55. The barrel and rifle have a longitudinal axis α1. The rifle is configured for firing a first ammunition and receives a magazine 53 of said first ammunition 53.1. The rifle is modular such that with minimal effort as described in more detail below, the rifle can be readily reconfigured with a kit 53.4 for a second ammunition 53.6 in a second magazine 53.7. The kit comprising a second lower frame 52', a second barrel assembly 25', and second bolt head 53.8 (the first bolt head is not shown in Figures 1A and 1B).

Referring to Figures 2A to 2H, as well as the exploded Figure 3, further portions and components of the firearm are illustrated, in particular those associated with the receiver 22, the barrel assembly 25, and bolt assembly 30. The barrel 26 has a rearward threaded end 45 that connects to a threaded barrel extension 46 with a barrel nut 47 and barrel lug 48; these components defining the barrel assembly 25. The barrel extension 46 receives a forward end of the bolt assembly 30 as describe in further detail below. A trigger mechanism 50 is positioned below the bolt assembly above a lower frame 52 that has a trigger guard 54 and a magazine well 55 defining a magazine receiving region 56. In embodiments, a magazine release lever 57 is nested about a forward portion of the trigger guard. The trigger mechanism 50 may include features of the AccuTrigger® system of Savage Arms, Inc., the owner of the instant application. See U.S. Pat. No. 6,553,706 incorporated by reference herein. The bolt assembly includes a bolt body 58 extending from a bolt mechanism housing 60 configured as a bulbous rearward bolt cap that contains bolt operation mechanism 64. The bolt assembly disposed in the receiver secured to the stock. The stock includes components known as the

AccuStock® system by Savage Arms, Inc., see U.S. Patent No. 10,690,440 incorporated herein by reference for all purposes.

The receiver 22 has a rearward end 66, a mid-portion 67 with an ejection port 68, and a forward end 69 with a forward face 70. As best shown in Figure 2G, a slit 70.5 may extend longitudinally along a front clamping portion 71 of the receiver. The clamping portion 70 having an interior cylindrical surface 72 for engaging the cylindrical exterior surface 73 of the barrel extension 46 of a barrel assembly 25. At the slit defining a C shape of the forward clamping portion, opposing clamping lugs 74.1, 74.2 have holes 74.4 for screws 75.1 and barrel nuts 75.3 for pulling the opposing clamping lugs together about the barrel extension. The different barrel assemblies, for example for different sized ammunition, have identically configured and sized exterior surfaces and features so that all interface the same with the receiver at the forward face of the receiver providing the correct head space. The barrel lug 48 has a forward vertical rib 76 that interfaces with a vertical groove 77 on the forward face 70 of the receiver 22. Moreover, the rearward facing surface 77.2 of the barrel lug interfaces with the flat forward surface 77.5 of the forward face 70 of the receiver 22.

Referring to Figures 2C, 2F, and 2I, the barrel extension and receiver each have a vent hole 77.6, 77.7 and the barrel extension has a circumferential thinned region 77.8 extending around the barrel extension and positioned about at the breech face 77.9 of the rifle. The cross section of Figure 2I depicts the internal threaded portion 46.2 that cooperates with the threaded end of the barrel, a recess 46.3 for receiving the locking rollers of the bolt head 86. The thinned region and vents provide a failure pathway in the unlikely event of a cartridge explosion at the breech face that is potentially less hazardous than without. The vents can lessen the explosive force, and the thinned region may facilitate the barrel dislocating from the rifle in the proximity of the thinned region 77.8 rather than having more severe damage rearward of the breech face.

Referring to Figures 2A, 2B, and 4A to 4C, a releaseable bolt stop 42 embodiment is depicted and generally comprises a bolt stop lever 42.1, a bolt groove engaging plunger 42.2, a plunger pin 42.3, a pivot arm 42.4, pivot arm pin 42.5, and bias spring 42.6. The components of the bolt stop are attached to the receiver 22 at a bolt stop lever recess 42.7, as best shown in Figures 2B and 4B. The plunger 42.2 seats in the larger hole and rides in the bolt stop groove 42.8 in the bolt body 58. When the bolt assembly is retracted, that is, moved rearwardly from the in battery position, the plunger will follow the bolt stop groove in the bolt body until it reaches the stop surface 58.2 at the end of the bolt stop groove 42.8 such as is shown in Figure 2D. The stop surface will stop the retraction. The user may raise the plunger from the groove and the stop surface by depressing the forward portion 42.9 of the lever 42.1 which then allows the bolt assembly to be removed from the receiver subject to other mechanism interconnections.

Referring to Figures 2D, 2E, and 4D-4G, another releaseable bolt stop 42' is illustrated that is secured to a bolt stop insert 43.1 rather than directly to the receiver 22. The insert may generally provide structural support to the receiver 22 and a slot 43.2 in the receiver 22 provides access to the bolt stop 42' by a user. The releaseable bolt stop 42' comprises a bolt stop lever 43.3 with a bolt stop groove engaging portion 43.4 and is pivotally and movable supported in a bolt stop recess 43.5 in the insert 43.1 by pins 43.6, 43.7. A spring 43.8 in conjunction with a bolt stop plunger43.9 urge the lever 43.3 rearwardly in the recess of the insert 43.1 where, due to an L shaped slot 44.1 in the lever, the bolt stop groove engaging portion is constrained in the bolt stop groove 42.8 as shown in Figure 4F where the insert has been removed for illustration. As the bolt assembly is retracted rearwardly, the bolt stop lever stays in the groove and abuts against the stop surface 58.2, shown in Figure 2D. To retract the bolt stop groove engaging portion from the groove, the user must first push the lever forwardly in the bolt stop recess 43.5 in the bolt stop insert and then may depress the forward end 44.3 of the lever to

raise the rear end of the lever from the groove allowing the bolt assembly to be fully removed from the insert and receiver.

Referring to Figures 1A, 1B, 4H-4K, a magazine release mechanism 49 is illustrated that is attached to the lower frame 52 having the magazine well 55 and trigger guard 54. The mechanism comprises a pivoting lever 49.1 pivotally attached by a pin 49.2 to the lower frame, a slider 49.3 that has a forward magazine catch 49.4. The slider has tabs 49.5 that are received in a slot or slots 49.6 in the lower frame. A operating tab 49.6 of the pivoting lever loosely engages a slot 49.7 in the slider. The slider is constrained in the lower frame by said operating tab. A pair of finger buttons 49.8 nest around the finger guard at a narrowed region 49.9 of the forward strap. A coil spring 50.1 received in an aperture of the slider and compressed against the lower frame urges the slider forwardly and the finger guards engaged against the trigger guard. This provides a less obtrusive magazine release button and provides more surface of the button compared to the surface of the trigger guard strap than conventional magazine releases thereby making actuation easier.

Referring to Figures 3, 5A-5J, the bolt assembly 30 has a bolt body 58, a bolt plunger 78, a firing pin 80 with a firing pin tip 81, a striker 82, a firing pin spring 84, a first bolt head 86. The bolt handle 32 has a manual grasping portion 90 including a knob 91 and a shaft portion 92 with splines 93 that engage with cooperating structure in the bolt operation mechanism 64 discussed below. The bolt body 58 with an open end 95 may receive a second bolt head 53.8 or alternate bolt heads 86.2 for different size cartridges, such which will typically be associated with changing out the barrel assembly as well. In embodiments, each bolt head 86 has cogs or lugs 95.1 extending radially outward that are received in keyed slots 95.2 in the open end of the bolt body. The bolt head may be inserted in an axial direction with respect to the open end of the bolt body and then rotated with respect to the bolt body 58 to position the lugs 95.1 axially behind the radially inward projections 95.3 at the bolt body open end. So

positioned, the bolt head cannot be removed without partially rotating the bolt head. See Figure 5H illustrating the retention position. The bolt head is secured in place by a latch 96 configured as a lever seated in a cutout 96.1 with a pivot pin 96.2. The lever has an outward surface 96.3 that may be flush or recessed with the outward cylindrical surface 96.4 of the bolt body 58. The latch forward end has a stop projection 96.5 that seats between the lugs or cogs of the bolt head in an obstruction position with regard to the bolt head rotation that has been inserted and partially rotated, thereby precluding the bolt head from rotating to a removal rotational position. Again, see Figure 5H. Figure 5H shows the rearward end 96.7 of the latch depressed, raising the forward end of the latch to a bolt head rotation position, a non obstructing position. The bolt head as illustrated in Figure 5I has been rotated to a bolt head removal position and Figure 5J illustrates the bolt head being pulled out of the open end 95 of the bolt body 58.

The above operations may be performed only when the bolt assembly has been removed from the receiver. When the bolt body is in the receiver, the close tolerance between the exterior surface of the bolt body and the interior surface of the receiver, the latch cannot be moved from the obstruction position to the bolt head removal position. In other embodiments, the latch may simply have a radial inward projection that extends over a catch on the bolt head. The latch again needing to have it forward end raised to a non obstructing position to remove the bolt head.

Referring to Figures 2I, 5A, 5G-5J, and 6B, the bolt heads have a plurality of circumferentially spaced apertures 96 that receive locking rollers 98 configured as spheres, or ball bearings, for engaging with recesses on the barrel extension, discussed below. When the bolt plunger 78, specifically the bolt plunger head 78.1, is fully engaged in the interior of the bolt head 86, the roller bearings are forced outward to their fully radial extension position as shown and when in an in-battery position, engage a cooperating circumferential recess in the

barrel extension. When the plunger is not present, either by retraction within the bolt body or by removal of the bolt head from the bolt body, the rollers are free to move radially inward.

Referring to Figures 6A and 6B, an extractor 99 is retained in each bolt head by way of a spring ring 99.2.

Referring to Figures 2A, 2B, 6A, and 6C, an ejector 65 comprises an ejector bar 66 that pivots about post 65.2 and is spring biased by torsion spring 65.4. The post is fixed to the receiver 22 at ejector mounting region 65.7 as best shown in Figure 2B. The receiver is not shown in Figures 2A and 6A so it appears the ejector 65 is unattached, but it will be anchored to the receiver or other structure fixed with respect to the receiver. The forward end 65.5 of the ejector bar rides in the ejector slot 65.8 and is urged therein by the torsion spring. The ejector slot has an elevated portion 179 that acts as a cam surface when the forward end passes the raised portion and the rearward end of the ejector bar, as a cam follower, follows the raised portion and forces the forward end into the cartridge holding region of the bolt head to eject the cartridge therein. See the discussion below with reference to Figures 17A-17C.

Referring to Figures 7 and 8-11, the components of various sub-mechanisms or linkage systems that make up the bolt operation mechanism 64 and actuated by the bolt handle 32 are illustrated. The operation of the bolt operation mechanism including the linkage systems in various stages are illustrated in Figures 12A – 17D.

Figures 12A-C Bolt assembly in a ready-to-fire and in-battery position

Figures 13A-B Trigger pulled releasing striker from sear and firing pin forward

Figures 14A-B Rotation of bolt handle rearward commencing ejection cycle and cocking, bolt head still locked

Figures 15A-B Further rotation of bolt handle to the rearwardmost position, the striker pulled fully rearward, bolt head released, gradual pushing off of receiver by bolt assembly

Figure 16A-C Bolt assembly pulled rearwardly to the rearwardmost position ejecting any casing or cartridge that was in the chamber

The bolt handle 32 having a horizontal rotation axis at the rear bolt cap and an angular range A1 of about the axis of about 45 degrees, plus or minus 15 degrees, in embodiments, see in particular, Figures 12C and 16C. In embodiments the bolt handle angular range of rotational motion is 30 degrees to 90 degrees as defined by a forwardmost rotational position F1 and a rearwardmost rotational position R1. The bolt handle 32 connecting to a main rotatable drive member 100 within the mechanism enclosure 60, rotatably connecting to the bolt body 58. See Figures 5A-5C. The drive member 100 is connected to and initiates the four different linkage systems that providing the functionality of the bolt assembly in the rifle. Those functionalities can be described as follows: locking the bolt in the in-battery position, providing the gradual final locking of the bolt with the mechanism locking up in an over center arrangement, locking the bolt handle forwardly or rearwardly, unlocking the forward bolt handle manually or upon firing, gradually pushing off the receiver by the bolt assembly initiating the extraction phase, locking the bolt handle forwardly, and cocking the action.

As best shown in Figure 9, the main rotatable drive member 100 has a barrel portion 101, a first arm 102 with a pivot aperture 103, a projection 105, and a cam surface 106 all unitary with one another. Also extending outwardly from the barrel portion are a second arm 108 has a pivot aperture 110 and a bolt handle locking projection 112. The main rotatable drive member has a central opening 107 that receives the shaft portion 92 of the bolt handle 32.

Referring to Figures 8, 10A, 12A, 12B, components and interrelationships of a first linkage system 114 which is a sliding toggle mechanism with a first link 115 being the first arm of the main rotatable drive member 100, the second link 116 pivotally pinned to the first link and also pivotally pinned to a slider at the other end, the slider being the bolt plunger 78.

The first and second links being constrained within the bolt assembly and having an over center position, see Figures 12A and 12B, that corresponds to the bolt plunger being extended and holding the locking roller balls into engagement with the barrel extension thereby locking the bolt head in the in-battery position. This position also correlates to the bolt handle in the forwardmost position. The second link also having cam surfaces 119 thereon that receive a bias inward toward the first link by a pusher member 121 that helps maintain the over center position of the linkage and maintains the bolt plunger as rearward as permitted by the positioning of the linkage. The pusher member slidingly engaged with the striker 82 and a spring 123 positioned between the striker and the pusher member. The first linkage system for locking and releasing the bolt in the in-battery position and providing the reduced travel rate for said locking and releasing. The first linkage system also functions to facilitate locking the bolt handle in the rearward most position, see Figures 15A-16C.

A second linkage system 125 is illustrated in Figure 9 and 12A-16B and comprises the second arm 108 of the main rotatable drive member 100, an H-shaped connecting link 127 pivotally pinned to the second arm, and a catch link 129 with a catch portion 131 pivotally pinned to the connection link. In Figures 12A-13B, before the bolt handle 32 is rotated rearwardly, the catch portion 131 engages a catch surface 133 on a pin 134 on the receiver 22. In Figures 15A and B, the second linkage system 125 is pushing off the receiver by way of the connecting link 127 and/or the catch link 129 commencing the ejection cycle. The catch link rotating clockwise urged by the spring 130 to move the catch portion 131 out of a catch position thereby allowing the bolt assembly to be slid rearwardly.

A third linkage system 133 is illustrated best in Figures 10A, 10B and 12A-16B, where the cam 105 of the main rotatable drive member 100 and two links, the striker 82 and firing pin 80 compress the firing pin spring 84 in preparation for firing, utilizing rotation of the bolt handle and the connected drive member 100. The firing spring is anchored with respect to the

bolt body by way of a firing spring mount 137. The rotation of the main rotatable drive member, rotatably fixed to the bolt body, provides a cam surface of projection that pushes a first link (the striker) rearwardly. See figures 13A-15B, the striker pinned to the firing pin such that as the striker and firing pin are pulled rearwardly within the bolt body the firing pin spring is compressed, the firing pin spring having a rearward end anchored to the bolt body. The striker is subsequently engaged by the sear to hold the firing pin spring in the compressed state see Figure 12A and 12B.

A fourth linkage system 140 is illustrated best in Figures 11 and 12A-16C. The fourth linkage system is a catch and release mechanism for locking the handle in the forwardmost position when the bolt is in the in-battery ready-to-fire position and for providing a push button release button accessible by the thumb for releasing the bolt handle from said position. The main rotatable member 100 providing a handle lock projection 141 that engages a cooperating projection 143 on a pushbutton lever 145 at a juncture 147. See Figures 11 and 12B. The pushbutton lever 145 having a thumb pushbutton 150 that is pivotal by a pin 153 on the mechanism housing 60 at pin holes 157, The lever is biased in clockwise direction (as seen in Figure 12B) by torsion spring 149. A actuation link 161 is loosely pinned to the push button lever 145 at elongate pin hole 163 having a cam follower surface 167 that is engaged by a cam surface 168 on the rearward end 169 of the striker 82 (see Figure 10B), such that as the striker is pulled back by way of the third linkage, the push button actuation link causes a lower end of the thumb pushbutton lever to move towards the main rotatable member to catch and secure the handle lock projection 141, see Figures 14B and 15B, locking the rotation of the rotatable member in place, thereby locking the bolt handle in the forwardly most position of the bolt handle. When locked, pushing the thumb button 150 rotates the pushbutton lever 145 clockwise thereby breaking the juncture 147 as shown in Figure 12B. This allows the bolt handle to be rotated rearwardly from the forwardmost position (see Figures 12B and 12C)

thereby rotating the main rotatable drive member 100 clockwise. This then actuates the first linkage system 114 described above to pull back the bolt plunger 78 thereby releasing the bolt head 86 and moreover, putting the front nose 171 of the bolt plunger 78 in an obstructing position with the firing pin flange 173 thereby precluding the firing pin tip from reaching a cartridge, providing a bolt handle operated safety, see Figure 15A.

Referring to Figures 17A-17D, the ejection cycle is shown with the bolt assembly 30 being pulled rearwardly in the receiver 22. The ejector 65 has an ejector bar 66 rides in a slot 68 in the bolt body 58 and pivots about a post 65.2 supported by the receiver. A torsion spring 72 urges the forward ejector portion 74 toward the bolt body and keeps the ejector bar in the slot. A cam follower surface 177 on the ejector bar 66 follows the cam surface 178 defined by the slot 68 and the raised portion 179. When the cam follower surface of the ejector bar engages the raised portion, an ejector portion 181 on the forward end of the ejector bar is forced inwardly into the ejector slot on the bolt head. The camming action is supplemental to the inward urging of the ejector portion by the torsion spring 72.

The following United States patents are hereby incorporated by reference herein: US1568635, US3257749, US3341963, US3653140, US4547988, US4672762, US6393961, US9115941, US9513076, US9599417, US9810496, US10077957, US 10247500,Components illustrated in the incorporated by reference references may be utilized with embodiments herein. Incorporation by reference is discussed, for example, in MPEP section 2163.07(B). The above references to U.S. patents in all sections of this application are herein incorporated by references in their entirety for all purposes.

All of the features disclosed, claimed, and incorporated by reference herein, and all of the steps of any method or process so disclosed, may be combined in any combination, except combinations where at least some of such features and/or steps are mutually exclusive. Each feature disclosed in this specification may be replaced by alternative features serving the same,

equivalent or similar purpose, unless expressly stated otherwise. Thus, unless expressly stated otherwise, each feature disclosed is an example only of a generic series of equivalent or similar features. Inventive aspects of this disclosure are not restricted to the details of the foregoing embodiments, but rather extend to any novel embodiment, or any novel combination of embodiments, of the features presented in this disclosure, and to any novel embodiment, or any novel combination of embodiments, of the steps of any method or process so disclosed.

Although specific examples have been illustrated and described herein, it will be appreciated by those of ordinary skill in the art that any arrangement calculated to achieve the same purpose could be substituted for the specific examples disclosed. This application is intended to cover adaptations or variations of the present subject matter. Therefore, it is intended that the invention be defined by the attached claims and their legal equivalents, as well as the illustrative aspects. The above described embodiments are merely descriptive of its principles and are not to be considered limiting. Further modifications of the invention herein disclosed will occur to those skilled in the respective arts and all such modifications are deemed to be within the scope of the inventive aspects.

CLAIMS

What is claimed is:

1. A straight pull bolt action rifle comprising:

a stock, a receiver supported by the stock, a barrel extending from the receiver, a trigger mechanism below the receiver, a bolt action above the trigger mechanism and removably contained within the receiver, wherein the bolt action comprises:

a rearward mechanism housing containing a bolt operation mechanism, a bolt body extending forwardly from the rearward mechanism housing and bolt operation mechanism, the bolt operation mechanism having a main rotatable member with horizontal axis of rotation that is transverse to a longitudinal axis of the rifle when the rifle is positioned with the longitudinal axis horizontal, the main rotatable member accessible from both the right side of the rifle and the left side of the rifle, a bolt handle attachable to the main rotatable member on both the right side and the left side of the rifle.

2. The straight pull bolt action rifle of claim 1, wherein the main rotatable member has a central hole coaxial with the axis of rotation, the main rotatable member having circumferential splines about the hole, and wherein the bolt handle has a shaft portion conforming to the central hole and wherein the shaft portion is attachable at the hole and is angularly adjustable therein.

3. The straight pull bolt action rifle of claim 1 or 2, wherein the mechanism translates rotation of the bolt handle connected to the main rotatable member and has a means for

locking the bolt in the in-battery position,

providing the final locking of the bolt with a plunger a gradual final locking,

unlocking the bolt from the in-battery position manually or upon firing,

manually unlocking the bolt at the in-battery position at a gradual reduced travel rate,

locking the bolt handle forwardly, and

releasing the forward locked bolt handle manually,

4. The straight pull bolt action rifle of claim 1 or 2, wherein the mechanism translates rotation of the bolt handle connected to the main rotatable member and has a means for:

causing release of the forward locked bolt handle by pulling the trigger,

providing a manual gradual initial push off of the bolt assembly from the receiver when the bolt assembly is at a closed most forwardly position of the bolt assembly after firing or after a manual bolt handle release,

locking the bolt handle in the rearward rotational position, unlocking the bolt handle from the rearward rotational position, and

retracting the striker thereby compressing the firing pin spring.

5. The straight pull bolt action rifle of any of claims 1-2, wherein the bolt operation mechanism has a bolt release thumb button on a rearward side of the bolt operation mechanism, the thumb button operably reachable by a user's thumb of the user's hand when the user's fore finger of said hand is extending partially around the bolt handle.

6. The straight pull bolt action rifle of any of claim 1 or 2, wherein the bolt handle has a manual grasping portion and a shaft portion, the manual grasping portion is on one side of the bolt assembly and the shaft portion extends through the main rotatable member to the side opposite the one side and is secured in place by an attachment piece.

7. The straight pull bolt action rifle of claim 6 wherein the attachment piece is a detent secured cap.

8. The straight pull rifle of claim 1 or 2, further comprising a lever exposed the receiver, the lever having a central pivot above a surface of the receiver, a spring receiving end with a spring positioned between the spring receiving end and the receiver providing an outward bias to the lever at the spring receiving end, a plunger end with a bolt retention plunger connecting to the plunger end, the plunger extending though an opening in the receiver for engagement with a longitudinal slot in the bolt portion, the plunger having a bolt retaining position and a bolt

release position, the lever deflectable manually from the bolt retention position to the bolt release positions whereby the bolt may be withdrawn from the receiver.

9. A straight pull bolt action rifle comprising:

a stock, a receiver supported by the stock, a barrel extending from the receiver, a trigger mechanism below the receiver, a bolt action above the trigger mechanism and removably contained within the receiver, wherein the bolt action comprises:

a rearward mechanism housing containing a bolt operation mechanism, a bolt portion extending forwardly from the rearward mechanism housing and bolt operation mechanism, wherein the bolt portion comprises a bolt body with an open front end for receiving a bolt head, the bolt head having a plurality of extendable roller balls spaced around the circumference for locking the bolt portion to the barrel or barrel extension,

the bolt head replaceable with other bolt heads configured for different sized cartridges, the bolt body having a lever flush with or below an exterior surface of the bolt body, the lever having a forward projection for engaging with the bolt head whereby depression of the lever disengages the forward projection from the bolt portion allowing the removal of the bolt head from the bolt body.

10. The straight pull rifle of claim 9, wherein the bolt head connects with the bolt body by insertion and a partial rotation and wherein the projection engaged with the bolt head precludes the bolt head from rotating.

11. The straight pull rifle of any of claims 9-10, wherein the bolt operation mechanism comprises a sliding toggle linkage with an over center position, the linkage including a sliding link configured as a plunger with a tapered tip for extending the plurality of extendable roller balls outwardly for locking the bolt head in the barrel or a barrel extension.

12. A rifle comprising a straight pull bolt assembly in a receiver mounted to a stock, a trigger mechanism positioned below the bolt assembly, a barrel and barrel extension secured forward

of the receiver to receive a bolt head of the bolt assembly, the bolt assembly comprising a bolt carrier containing a bolt body, a bolt head, a bolt plunger, a striker, a firing pin, a firing pin spring, a rear bolt mechanism enclosure, a bolt operation mechanism in the enclosure, a bolt handle connecting to the bolt operation mechanism at the rear bolt enclosure.

13. The rifle of claim 12, wherein the bolt head having a plurality of locking roller balls that are releasably engageable with recesses in the barrel extension and lockable therein by the bolt plunger.

14. The straight pull rifle of any of claims 1, 9, or 12, wherein the bolt operation mechanism comprises a sliding toggle linkage with an over center position, the linkage including a sliding link configured as a plunger with a tapered tip for extending the plurality of extendable roller balls outwardly for locking the bolt head in the barrel or a barrel extension upon rotation of the bolt handle.

15. The straight pull rifle of any of claims 1, 9, or 12, wherein the bolt operation mechanism comprises a second linkage that provides a gradual push off of the bolt assembly from the receiver upon rotation of the bolt handle.

16. The straight pull rifle of any of claims 1, 9, or 12, wherein a third linkage system pulls back the striker as the bolt handle is rotated.

17. The straight pull rifle of any of claims 1, 9, 12, wherein a fourth linkage system charges a rear thumb button for releasing the bolt handle when the bolt handle is locked in a forwardly most rotation position correlating to the in-battery position.

18. A firearm having a straight pull bolt action for chambering a cartridge, the firearm comprising:

a receiver with a barrel extending forwardly therefrom and defining a central axis, the barrel having a firing chamber configured for receiving the cartridge;

a bolt assembly slidably engaged in the receiver and movable forwardly and rearwardly along the central axis and having an in battery position, the bolt assembly comprising:

a bolt comprising a main bolt body and a bolt head attached on a forward end thereof, the bolt head having a forward cartridge head receiving region, the bolt head having a plurality of circumferentially spaced apertures with a locking roller positioned in each aperture, the plurality of circumferentially spaced apertures positioned rearward of the cartridge receiving region;

a bolt plunger captured by the bolt body, the bolt plunger having a tapered forward surface for engaging the locking rollers and pushing each of the locking rollers to a radially outward position in the respective apertures for providing a locking engagement with the barrel,

the main bolt body having an open front end with circumferentially spaced inward projections and circumferentially spaced recesses there between, a rearward end of the bolt head having circumferentially spaced radially extending projections to fit within the circumferentially spaced recesses thereby allowing the rearward end of the bolt head to be inserted into the front end of the main bolt body, wherein the bolt head may be partially rotated therein, for retention therein, and wherein the bolt body has a pivoting lever with an extendable and retractable inward projection for engaging a slot in the bolt head after the bolt head has been partially rotated to preclude rotation of the bolt head to when in use.

19. The firearm of claim 18, wherein the bolt assembly further comprises a bolt handle member extending laterally with respect to the bolt body, the handle member being selectable attachable to a left side portion of the bolt body or a right side portion of the port body to provide ambidextrous operation of the firearm.

20. A method of operating a straight pull bolt action rifle having a receiver with a bolt assembly therein, the bolt assembly with a bolt handle rotatable about a horizontal axis a range of 15 to

60 degrees with a forward most rotation positon and a rearward most rotation position, the bolt having a forward in-battery position and a rearward position, the method comprising:

manually moving the bolt handle rearwardly from the forward most rotation position to the rearward most rotation position thereby unlocking the bolt assembly from the in-battery position and pulling a striker rearwardly in the bolt assembly compressing a firing pin spring;

manually sliding the bolt rearwardly by way of the bolt handle with the bolt handle locked in the rearward most rotation position to the rearward most position thereby ejecting any casing or cartridge that is chambered in the rifle;

manually sliding the bolt forwardly by way of the bolt handle with the bolt handle continuing to be locked in the rearward most rotation position thereby chambering a cartridge from a magazine, and thereby engaging the striker with a sear of a trigger mechanism positioned below the bolt assembly for maintaining the firing spring compressed, and moving the bolt assembly toward the in-battery position; and

rotating the bolt handle from the rearward most rotation position to the forward most rotation position thereby locking the bolt assembly in the in-battery position.

21. The method of claim 20, further comprising setting a thumb button bolt release button during the rotating the bolt handle step.

22. The method of claim 21, further comprising releasing the bolt assembly from the in-battery position by depressing the thumb button.

23. The method of claim 21 or 22, further comprising grasping the bolt handle with a fore finger of a user's hand and depressing the thumb button with the thumb of the user's hand.

24. The method of claims 21-23, further comprising urging the bolt handle rearwardly as the thumb button is depressed.

25. The method of claim 24, further comprising rotating the bolt handle rearwardly after depressing the thumb button.

26. The method of claim 24 or 25, further comprising pulling the bolt assembly rearwardly from the receiver after the thumb button is depressed to a rearwardly most position.

27. The method of claim 26, further comprising releasing the bolt assembly from the receiver by lifting a lever mounted to the receiver away from the receiver and pulling the bolt assembly completely out of the receiver.

28. A method of operating a straight pull bolt action rifle having a receiver with a bolt assembly therein, the bolt assembly with a bolt operation mechanism at the rear end of a cylindrical bolt portion, the bolt operation mechanism having a bolt handle extending therefrom and rotatable about a horizontal axis within a range of 15 to 60 degrees with a forward most rotation positon and a rearward most rotation position, the bolt assembly having a forward in-battery position and a rearward position, the method comprising:

rotating the bolt to a forward most rotation position, thereby accomplishing one or more of the following:

locking the bolt in the in-battery position,

providing the final locking of the bolt with a plunger a gradual final locking,

unlocking the bolt from the in-battery position manually or upon firing,

manually unlocking the bolt at the in-battery position at a gradual reduced travel rate,

locking the bolt handle forwardly,

releasing the forward locked bolt handle manually,

causing release of the forward locked bolt handle by pulling the trigger,

providing a manual gradual initial push off of the bolt assembly from the receiver when the bolt assembly is at a closed most forwardly position of the bolt assembly after firing or after a manual bolt handle release,

locking the bolt handle in the rearward rotational position, unlocking the bolt handle from the rearward rotational position, and

retracting the striker thereby compressing the firing pin spring.

29. A bolt action rifle comprising a receiver connecting to a barrel, a bolt assembly having a bolt body and a bolt head in the receiver, the rifle further comprising a ejector bar with a dog leg shape pivotally attached to the receiver and having an ejector end and cam follower end positioned in a slot in the bolt body and bolt head, the slot having a cam surface to engage the cam follower surface of the ejector as the ejector approaches a cartridge holding space in the bolt head, the ejector mechanism further comprising a spring to urge the ejector portion inwardly.

30. A rifle having a stock, a receiver, an action, a magazine well, a trigger mechanism including a trigger guard, a frame with the trigger guard having a forward strap portion with a narrowed portion, the rifle further comprising a magazine release lever pivotal about a pin in the frame, the lever having a finger receiving a paddle with a central recess conforming to the shape of the forward strap portion with the narrowed portion.

31. The rifle of claim 30, wherein the lever is attached to a slider to move a magazine release tab forward on the frame.

32. A straight pull bolt action rifle comprising:

a stock, a receiver supported by the stock, a cartridge chamber block and barrel extending forwardly from the receiver, a trigger mechanism below the receiver, a bolt assemble above the trigger mechanism and removably contained within the receiver, wherein the bolt assembly comprises:

a bolt operation mechanism and a bolt body with a locking bolt head extending forwardly from the bolt operation mechanism, the locking bolt head lockable and unlockable at the cartridge chamber block by way of the bolt operation mechanism, the bolt operation mechanism having a main rotatable drive member with horizontal axis of rotation projection laterally to the rifle, the main rotatable drive member rotatable a range of less than 90 degrees,

a bolt handle extending laterally outward and then downwardly for rotation forwardly and rearwardly of the main rotatable drive member, the bolt assembly slidable between a forward in-battery position and a rearward position, wherein the bolt head is lockable at the chamber block when the bolt assembly is in the forward in-battery position by having the bolt handle positioned forwardly, is unlockable by rotating the bolt handle rearwardly.

33. The straight pull rifle of any one of claims 1, 9, 12, 30, 32, wherein an ejector lever is pivotally connected to the receiver and is engaged with a slot in the bolt assembly, the slot extending to the cartridge head receiving region on the bolt head, wherein when a cartridge or casing is in the cartridge head receiving region and the bolt assembly is pulled rearwardly, the cartridge or casing is ejected by the ejector lever.

34. A straight pull bolt action rifle comprising:

a stock, a receiver supported by the stock, a cartridge chamber block and barrel extending forwardly from the receiver, a trigger mechanism below the receiver, a bolt assembly above the trigger mechanism and removably contained within the receiver, wherein the bolt assembly comprises:

a bolt operation mechanism and a bolt body with a locking bolt head extending forwardly from the bolt operation mechanism, the bolt operation mechanism having a main rotatable drive member that is rotated through a rotational range by bolt handle, the bolt operation mechanism comprising:

a first linkage system that includes the main rotatable drive member for locking the bolt head in the in-battery position.

35. The straight pull bolt action rifle of clam 34, wherein the first linkage system is a toggle sliding link system.

36. The straight pull bolt action rifle of clam 35, wherein the sliding link is a plunger for moving locking rollers in the bolt head into locking recesses.

37. The straight pull bolt action rifle of any of claims 34-36, wherein the main rotatable member is connected to another linkage system for a gradual urging of the bolt assembly away from the receiver when the bolt handle is rotated rearwardly.

38. The straight pull bolt action rifle of any of claims 34-37, wherein the main rotatable member is connected to a further linkage system that cocks the bolt assembly by compressing a firing pin spring.

39. The straight pull bolt action rifle of any of claims 34-38, wherein the main rotatable member is connected to an additional linkage system that locks the main rotatable member in a forward most position corresponding to the bolt handle in a forwardmost position by engaging with a thumb release button rearwardly of the main rotatable drive member.

40. The straight pull bolt action rifle of any of claims 34-39, wherein a thumb button release is within 1.25 inches of the bolt handle.

41. the straight pull bolt action rifle of claim 40, further comprising a bolt stop comprising a lever with a pivot pin that is movable in the forward rearward direction of the rifle and a

42. A method of changing the caliber of a bolt action rifle from a first sized ammunition to a second sized ammunition, the bolt action rifle having a stock, a receiver, a first barrel assembly, a bolt action assembly, a magazine well, the method comprising the steps of:

removing from the stock the receiver with the bolt action assembly therein, removing the barrel assembly from the receiver by loosening a plurality of screws on a forward clamping portion of the receiver that clamps a barrel extension of the barrel assembly, sliding the barrel extension portion of the first barrel assembly forwardly out of the clamping portion, sliding a barrel extension of the second barrel assembly into the clamping portion, tightening the plurality of screws securing the second barrel extension into the clamping portion;

removing the bolt assembly from the receiver and removing a first bolt head from a bolt body of the bolt assembly by releasing a latch securing the first bolt head thereto, inserting a

second bolt head corresponding to the second sized ammunition into the bolt body and latching it therein, reinstalling the bolt assembly into the receiver; reinstalling the receiver with the second barrel assembly and the second bolt head into the stock.

43. The method of claim 42, further comprising replacing a first magazine well positioned in a bottom of the stock with a second magazine well.

44. The method of claim 42, wherein the first barrel assembly and the second barrel assembly each have a respective barrel lug having a rearward projection that seats into a recess on a forward face of the receiver, and the method further comprises seating the rearward projection of the second barrel assembly into the recess of the forward face of the receiver.

45. The method of claim 42, wherein the bolt action assembly is a straight pull bolt action assembly.

46. The method of claim 42, wherein the plurality of screws includes a screw that cooperates with a barrel nut, and wherein the barrel nut seats in a opening in the clamping portion of the receiver and further seats in a recess in a lower surface of each of the respective barrel extensions of the first and second barrel assemblies.

47. The method of claims 42, wherein the respective bolt heads are configured to slid on and rotate to a operational position and wherein the latch is configured as a lever with a stop end that seats in a recess in the respective bolt heads to preclude rotation of the respective bolt heads out of the operational position.

48. The method of claim 42, wherein each of the barrel assemblies has a threaded end of the respective barrel threaded into an threaded end of the respective barrel extension, and further has a barrel nut that is tightened against the respective barrel lug, the barrel lug compressed against a forward face of the receiver.

49. A method of converting a bolt action rifle from a first sized ammunition to fire a different sized ammunition, the bolt action rifle comprising a stock with a receiver, a

the method comprising:

replacing a barrel assembly comprising a barrel, with a barrel nut and a barrel lug, a barrel extension clamped to a clamping portion of a receiver of the bolt action rifle with another barrel assembly sized for the different sized ammunition by loosening a plurality of screws on the clamping portion, sliding the barrel extension into the clamping portion and tightening the plurality of screws.

50. A bolt action rifle comprising a receiver and a barrel extending forward from the receiver, a bolt assembly seated in the receiver, the bolt assembly comprising a bolt assembly with a bolt handle that extends from a the laterally receiver and is rotatable in an arc of a circle about an axis in two directions for locking and unlocking a bolt head in an in battery position, the bolt slidable in a rearward direction along a barrel axis for opening and accessing a firing chamber and ejecting a cartridge and slidable in a forward direction along the barrel axis for loading a cartridge and moving the bolt toward the in battery position, the rifle having a lower frame including a trigger guard and a magazine well, the rifle further comprising a magazine release mechanism with a push button lever nested about a forward strap of the trigger guard.

51. The bolt action rifle of claim 50, wherein the magazine release mechanism comprises a lever pivotable about a pivot pin, the lever having the push button, and a slider having a forward magazine catch, the slider connected to the lever.

52. The bolt action rifle of any one of claims 1, 9, 12, 30, and 32, wherein the bolt handle has a manual grasping portion and a shaft portion, the manual grasping portion is on one side of the bolt assembly and the shaft portion extends through the main rotatable member to the side opposite the one side and is secured in place by an attachment piece, and wherein the manual grasping portion and shaft portion can be moved to the opposite side without using tools.

53. A bolt action rifle comprising a receiver and a barrel extending forward from the receiver, a bolt assembly seated in the receiver, the bolt assembly comprising a bolt assembly with a bolt handle that extends from a the laterally receiver and is rotatable in an arc of a circle about an axis in two directions for locking and unlocking a bolt head in an in battery position, the bolt slidable in a rearward direction along a barrel axis for opening accessing a firing chamber and ejecting a cartridge and slidable in a forward direction along the barrel axis for loading a cartridge and moving the bolt toward the in battery position, wherein a tangent of the circle is parallel to the barrel axis, wherein the bolt handle is removable and replaceable to extend laterally from either of two sides of the receiver.

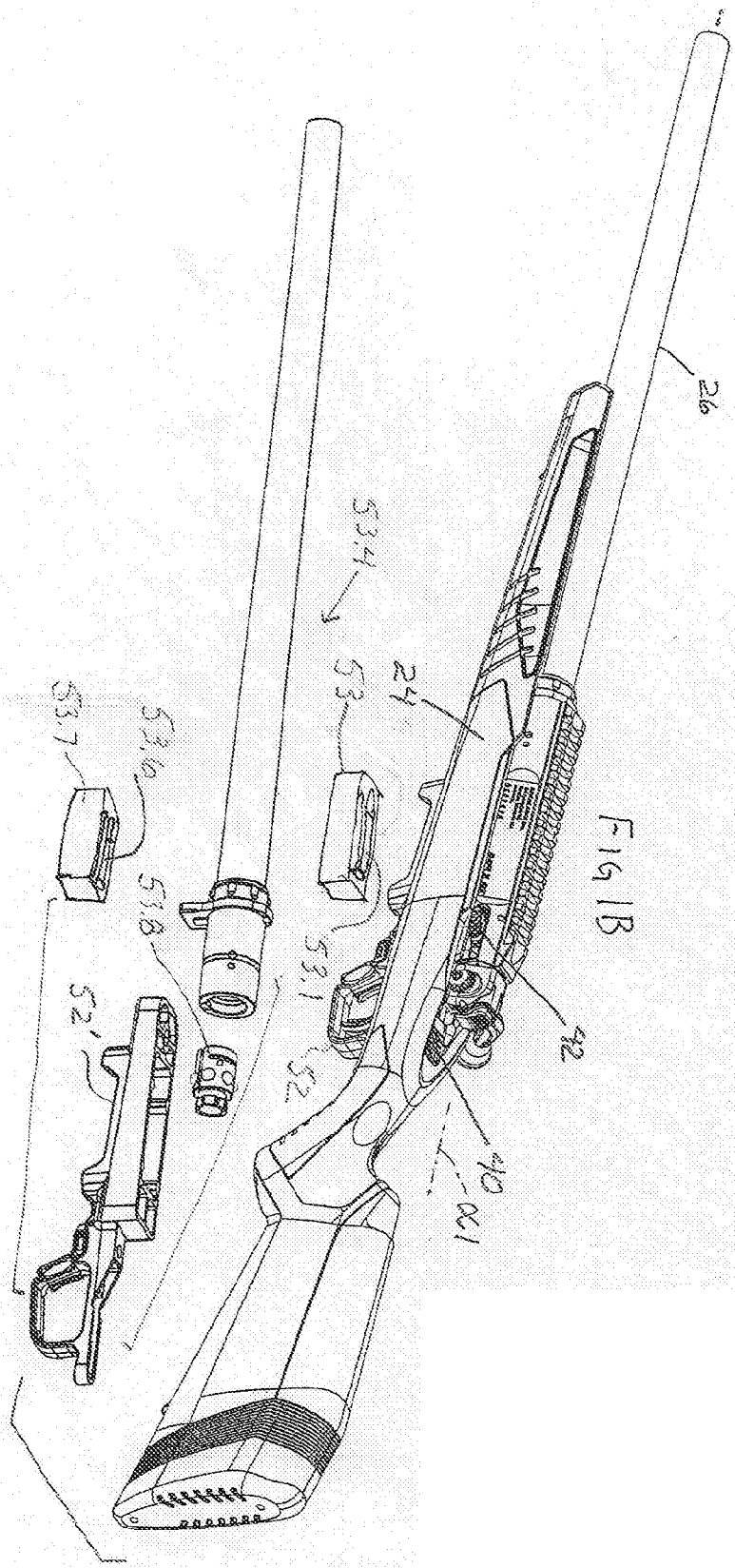


FIG 1B

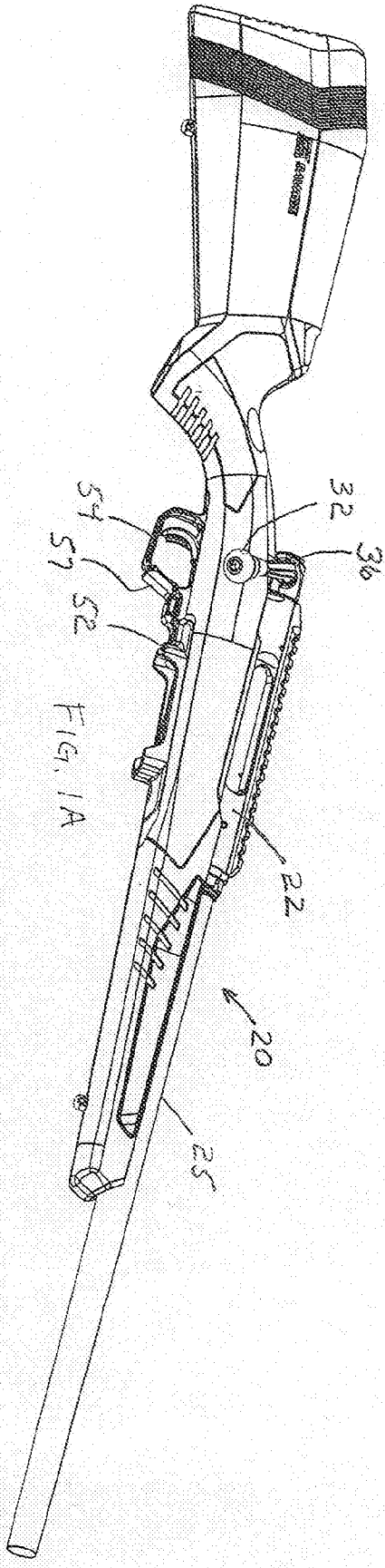
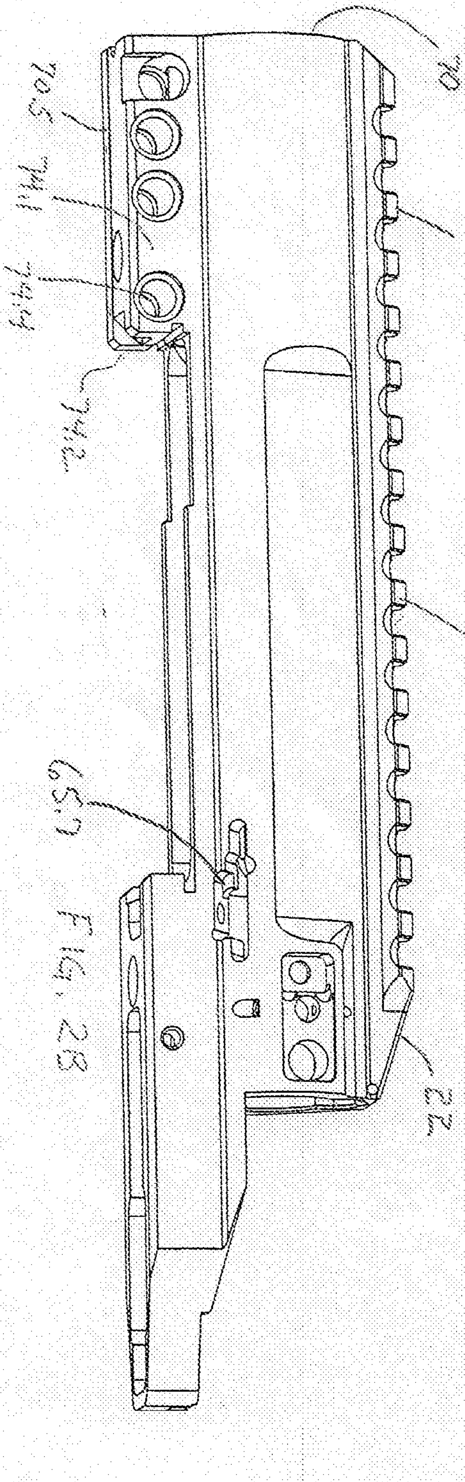


FIG. 1A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74.2
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71
67
65.7
22

FIG. 2B

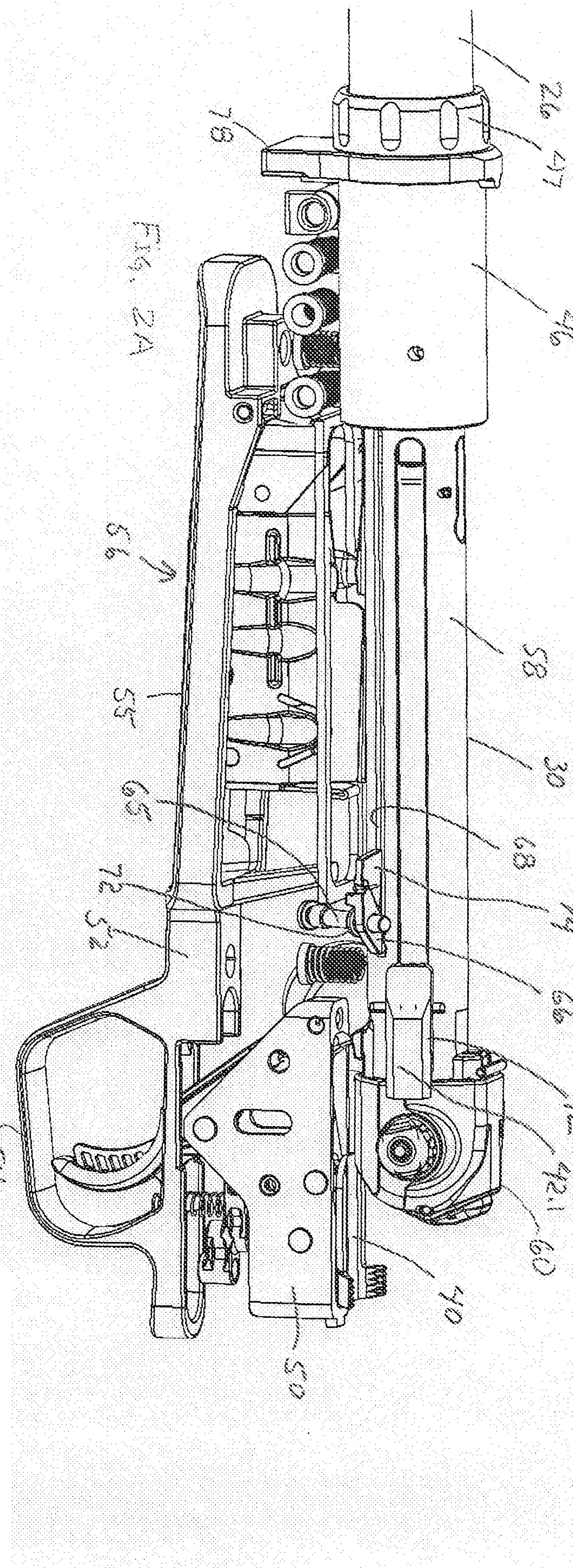
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FIG. 2A

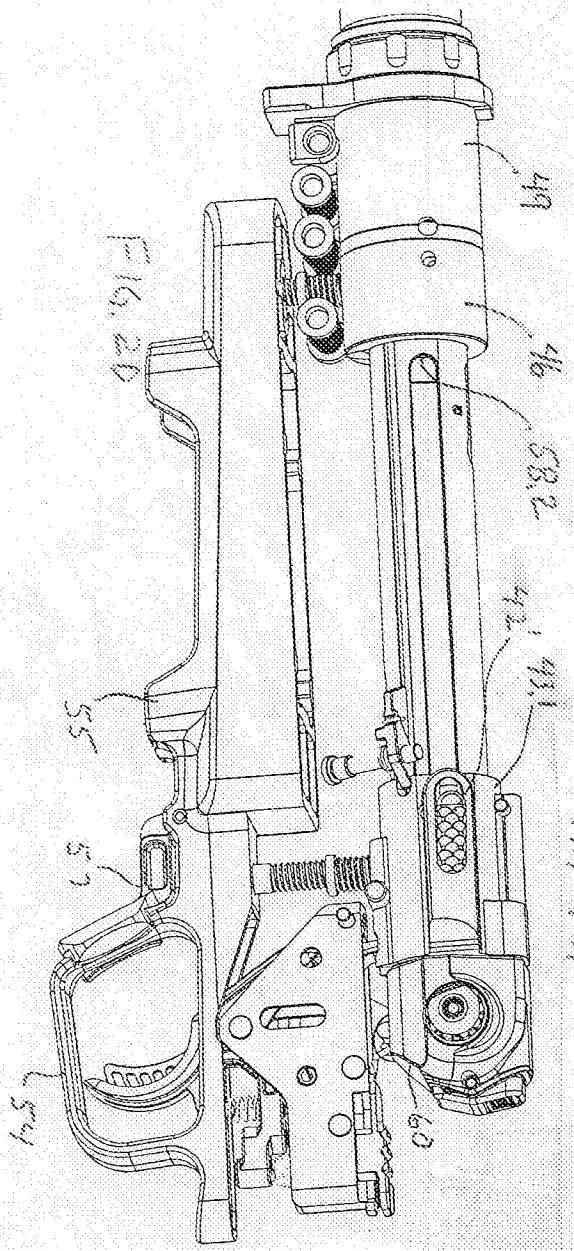
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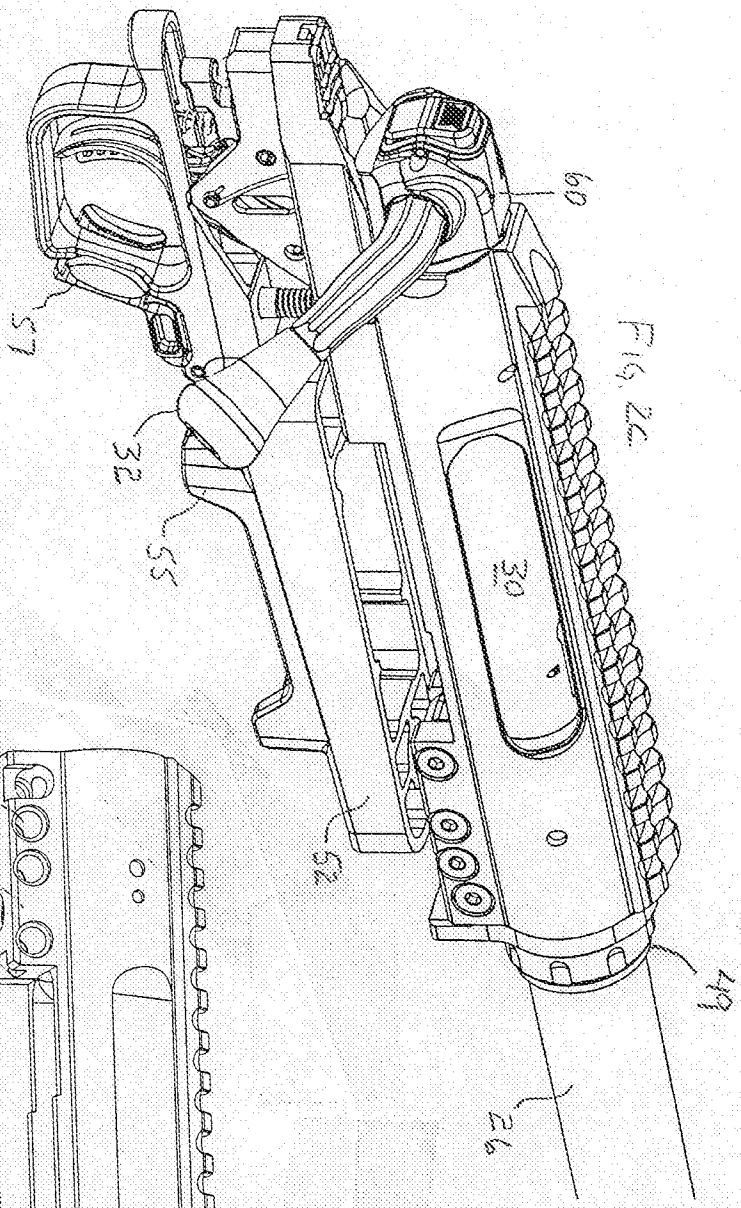
FIG. 2D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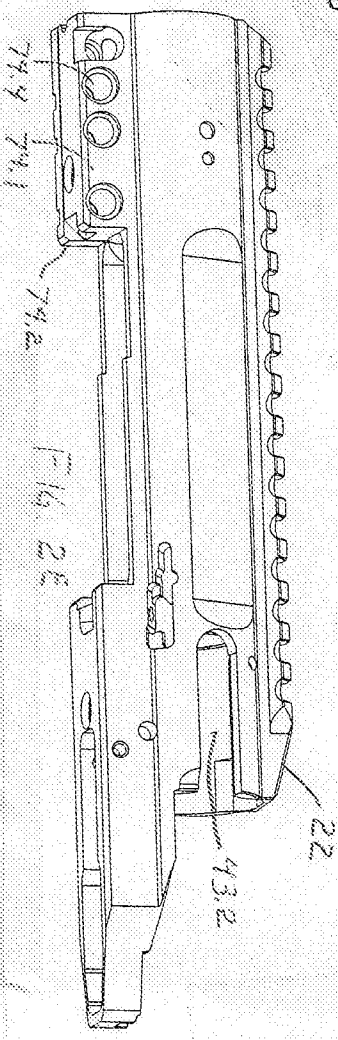
21

FIG. 2E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74.1
74.3
22
43.2

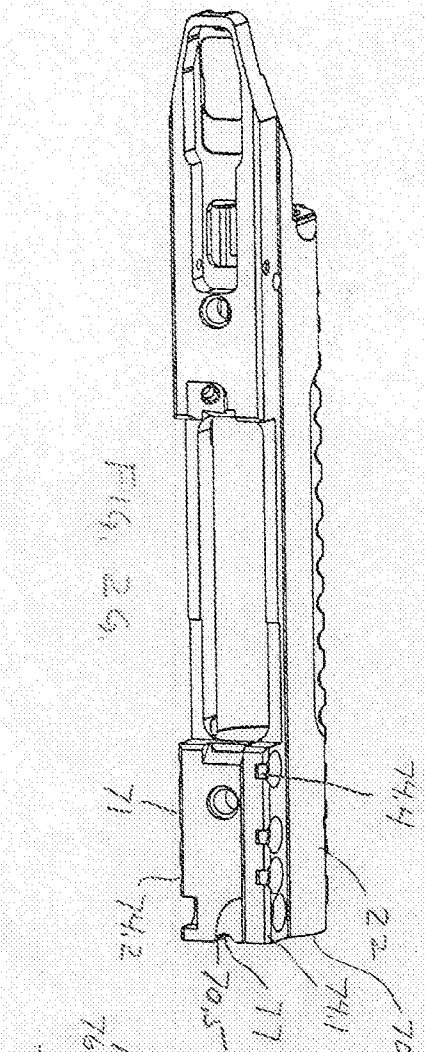

Fig. 23

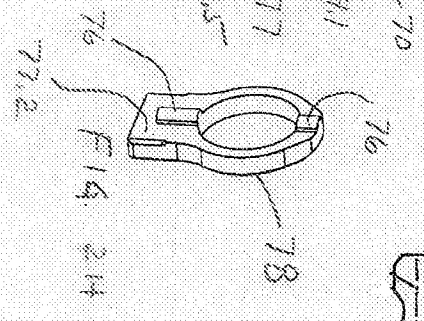

Fig. 24

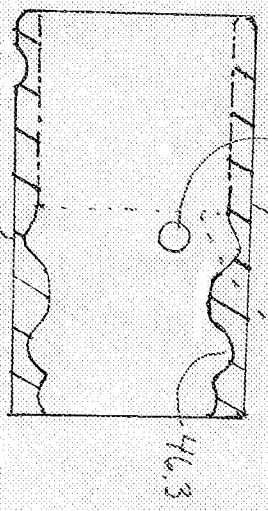

Fig. 21

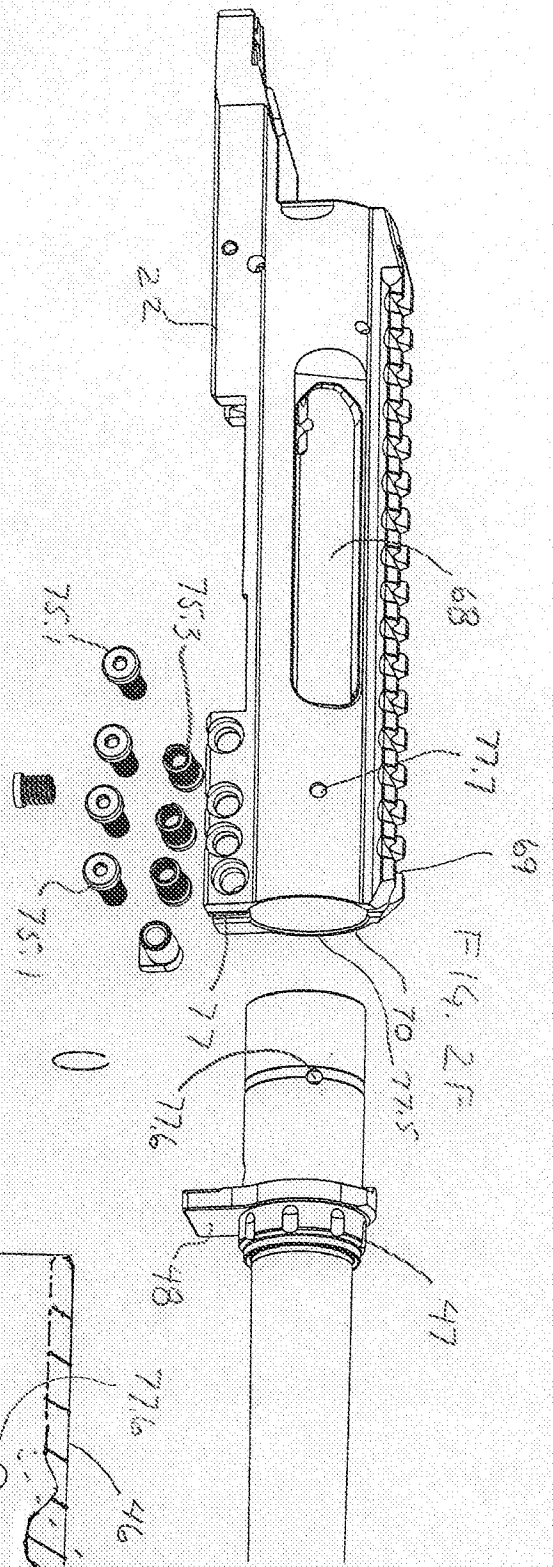

Fig. 22

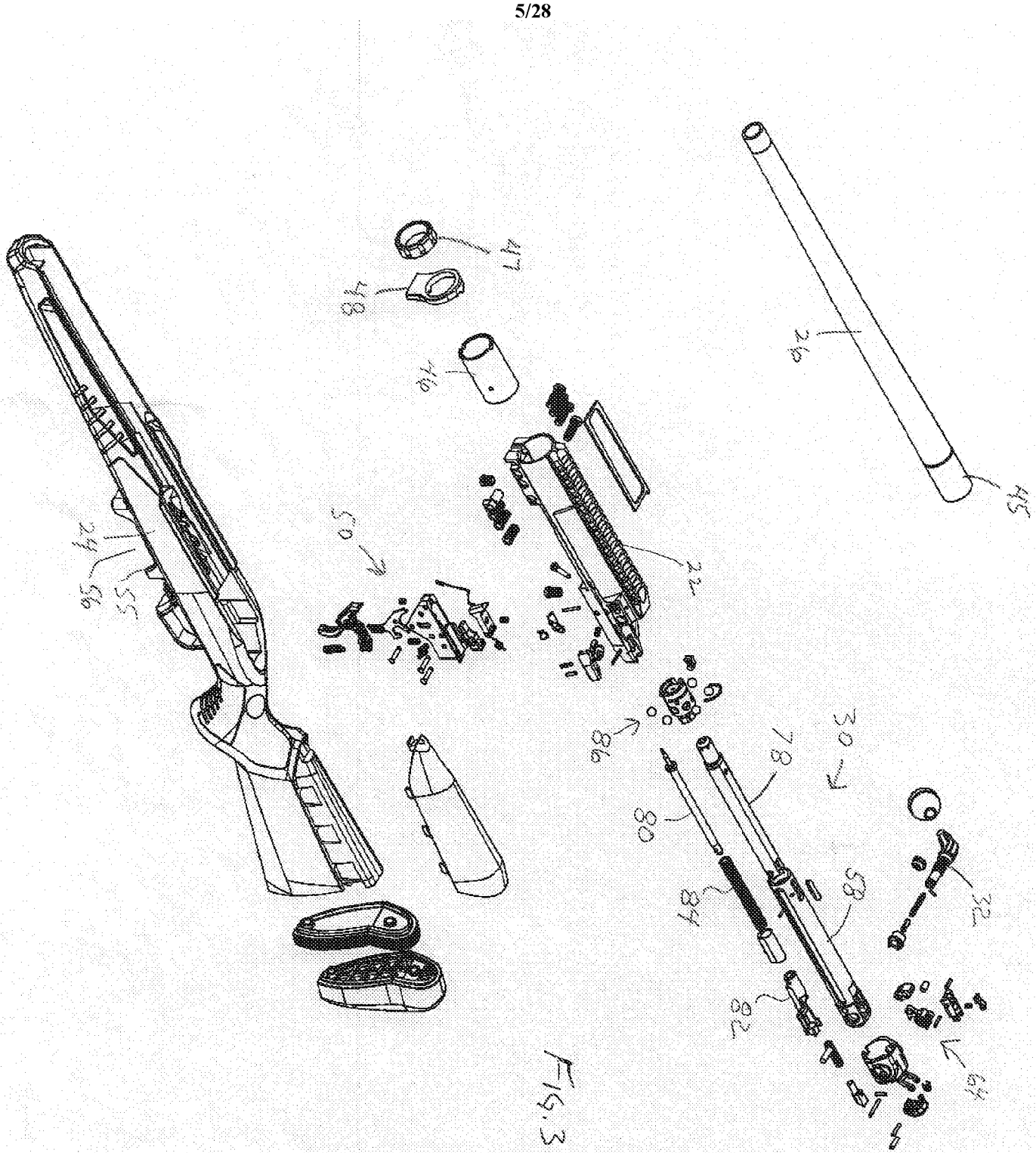

FIG. 3

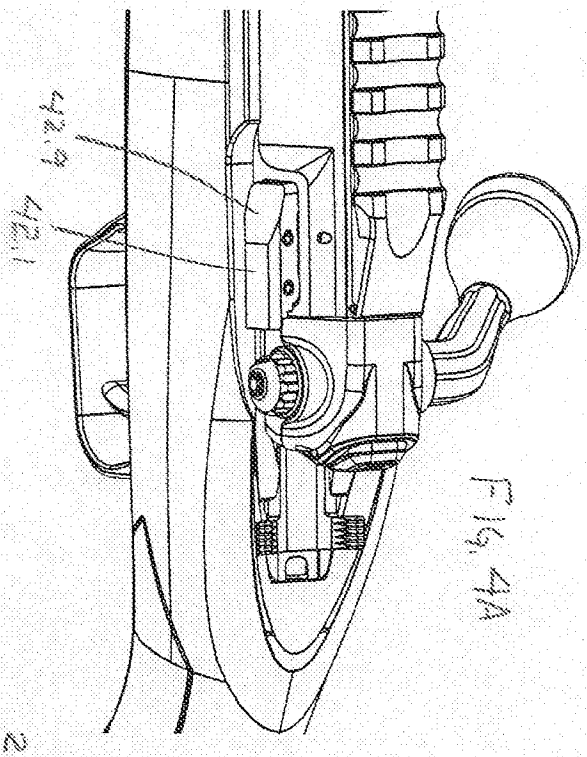

FIG. 4A

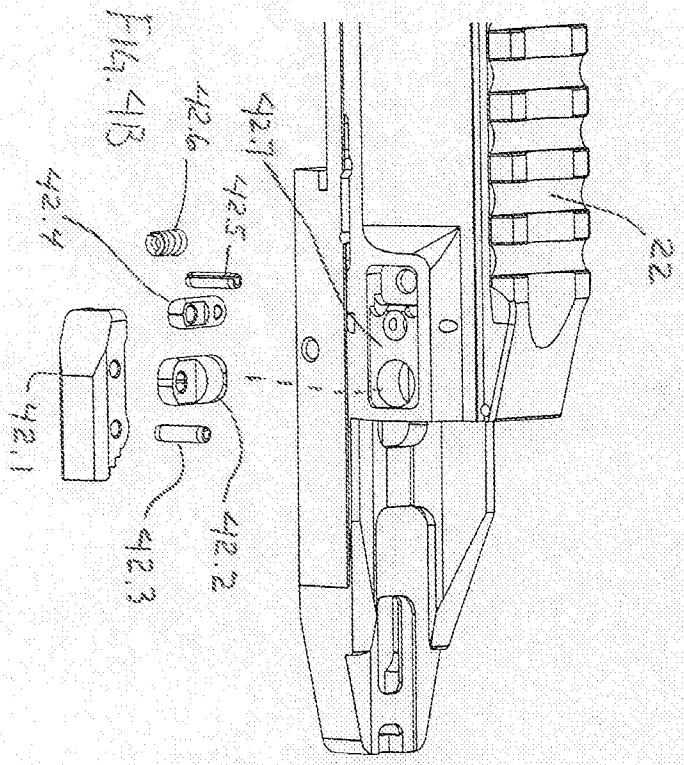

FIG. 4B

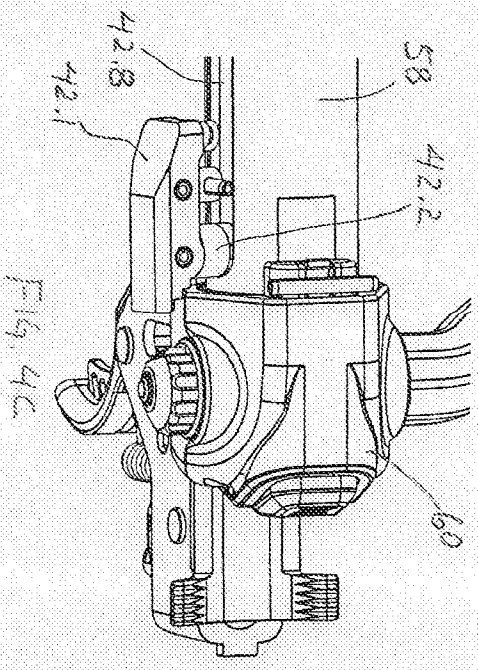

FIG. 4C

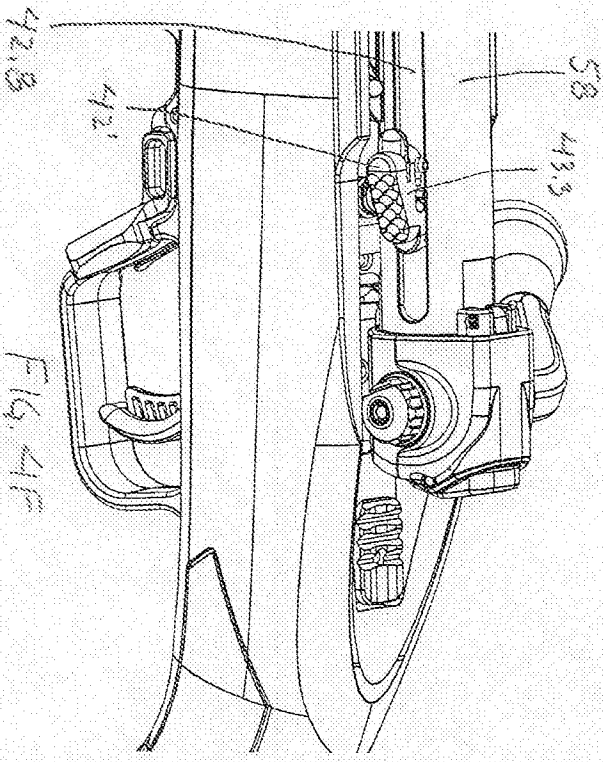

FIG. 41F

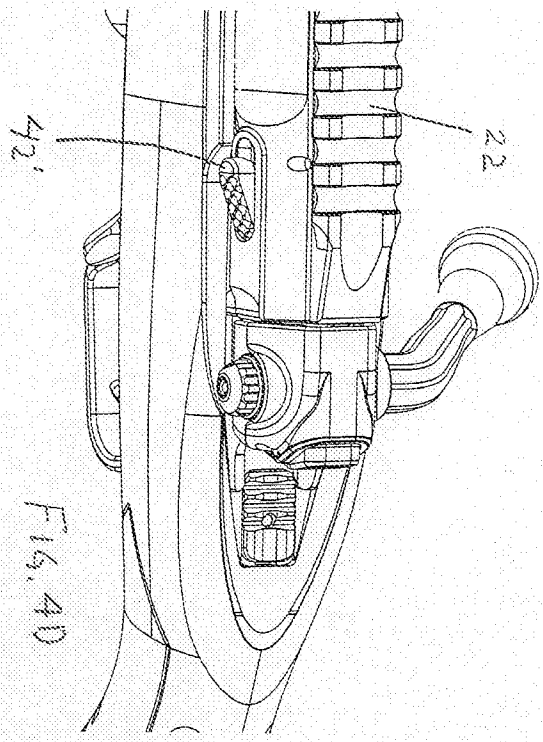

FIG. 40

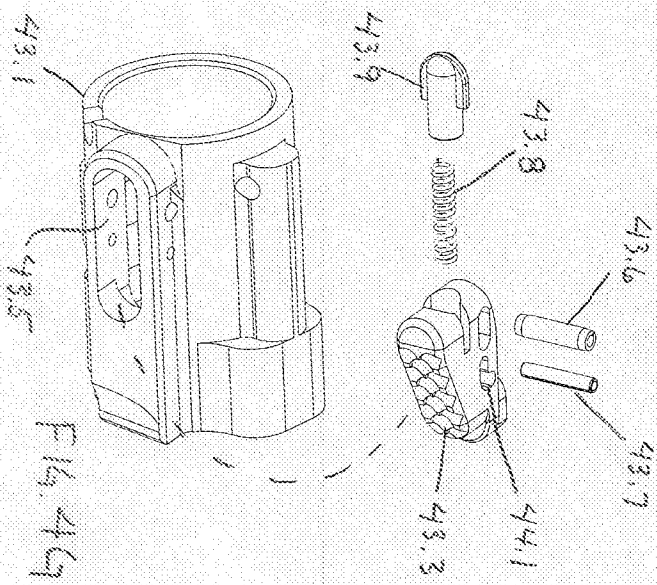

FIG. 46

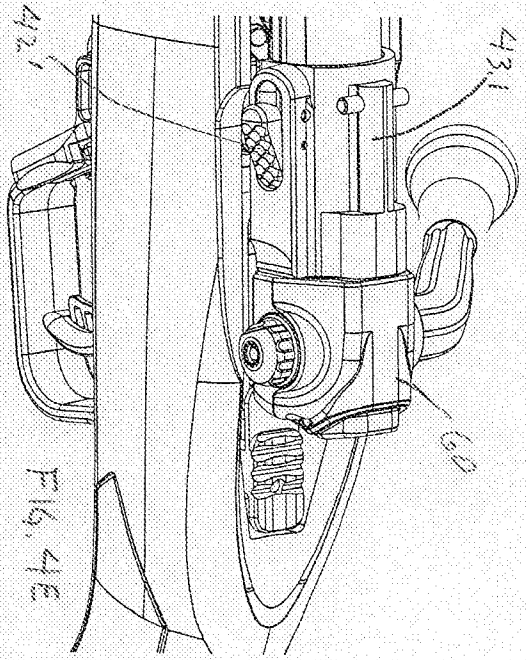

FIG. 43

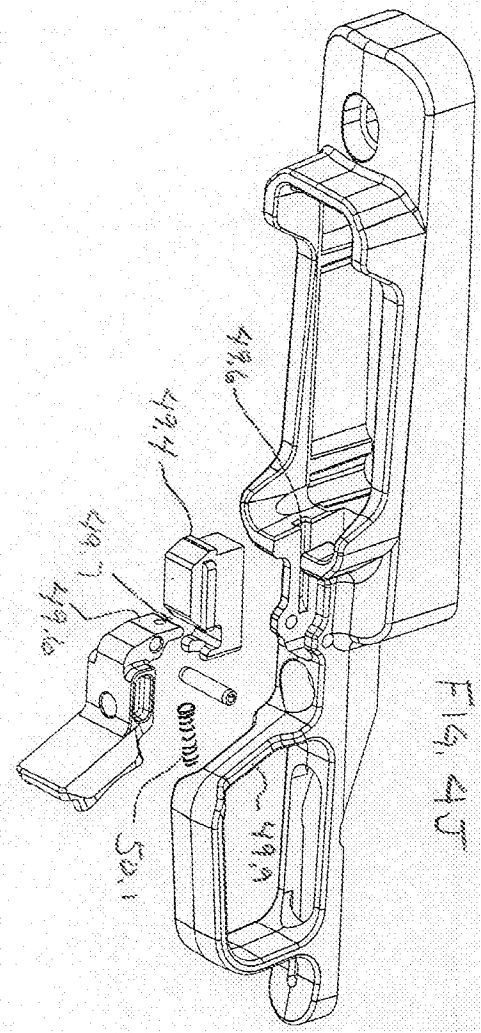

FIG. 47J

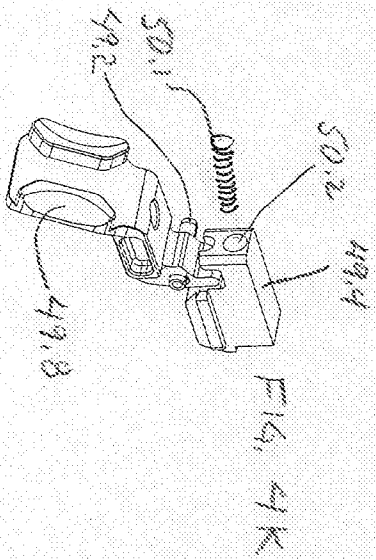

FIG. 47K

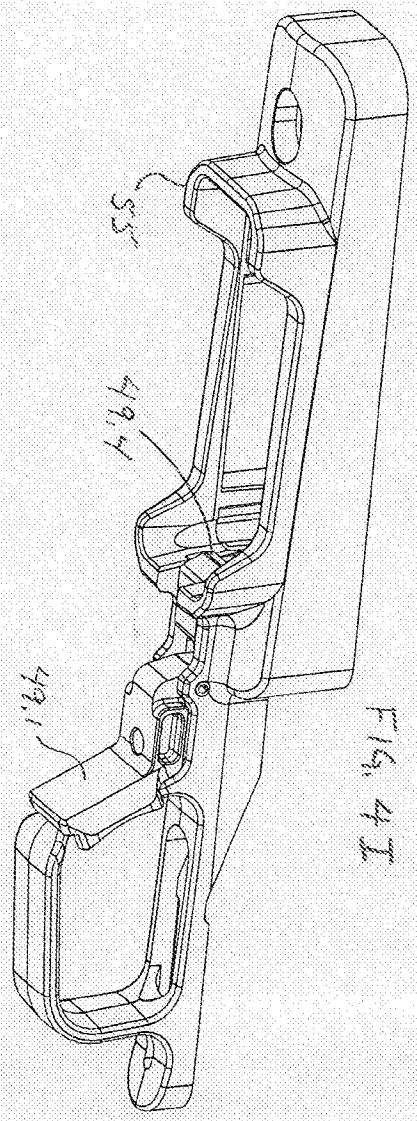

FIG. 47L

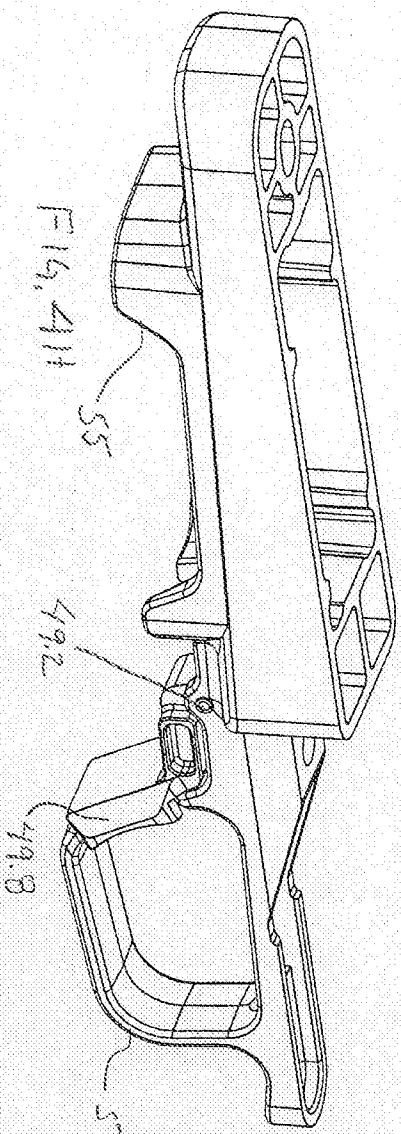

FIG. 47M

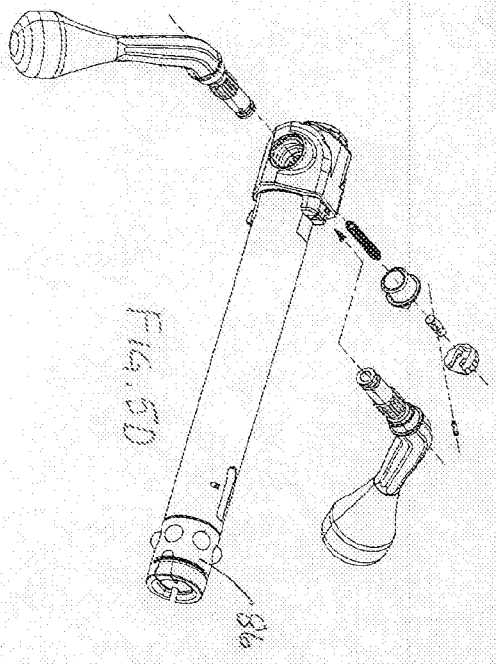

FIG. 5D

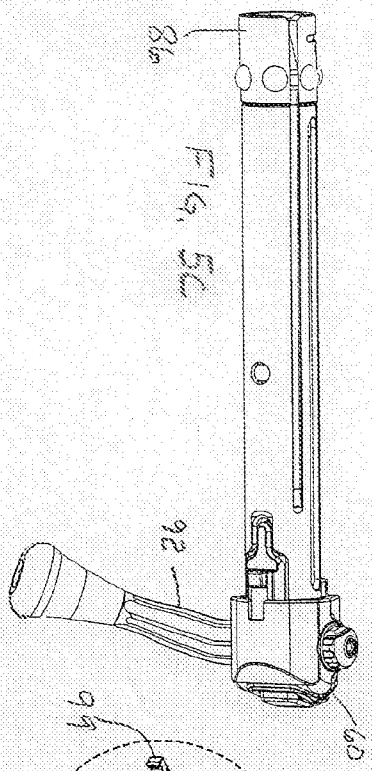

FIG. 5C

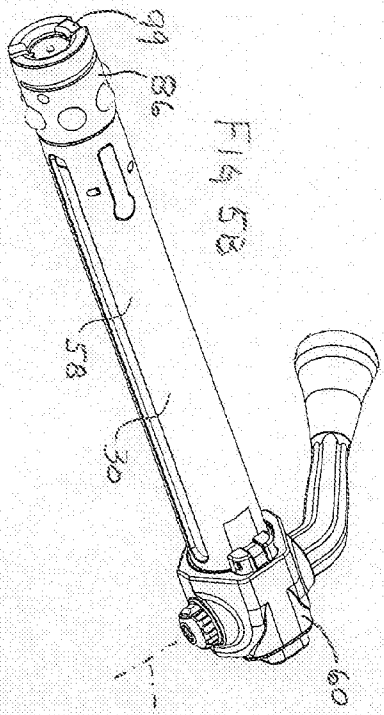

FIG. 5B

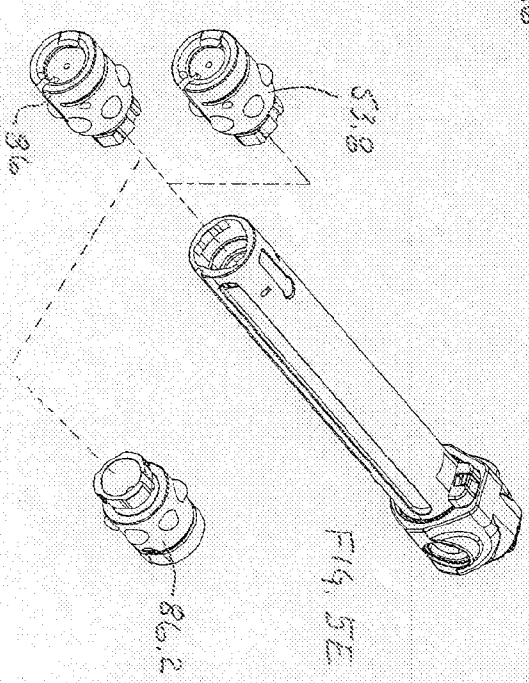

FIG. 5E

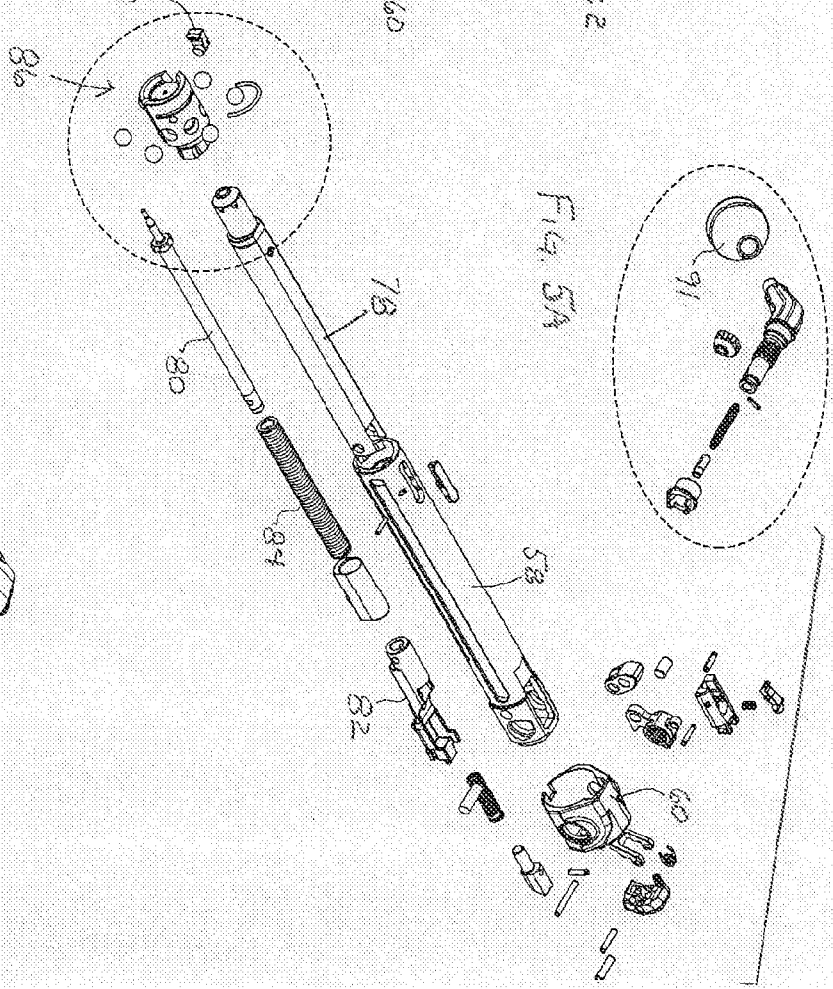

FIG. 5A

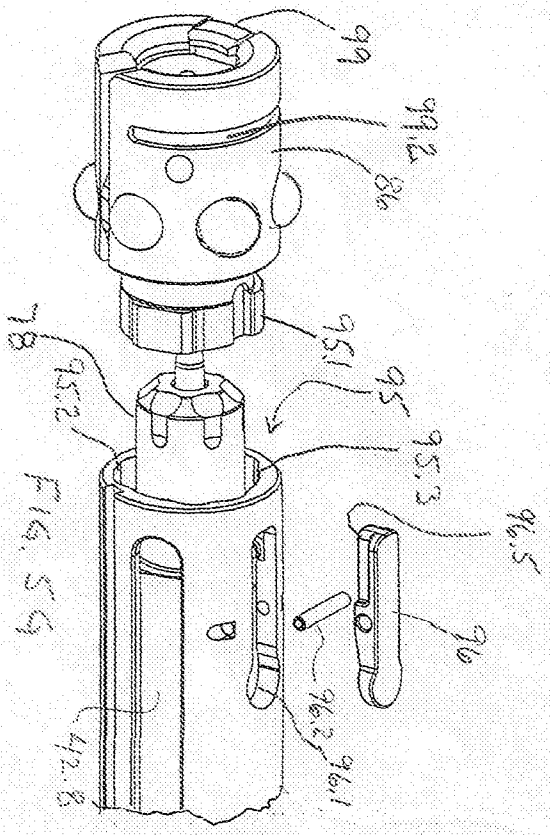

FIG. 5G

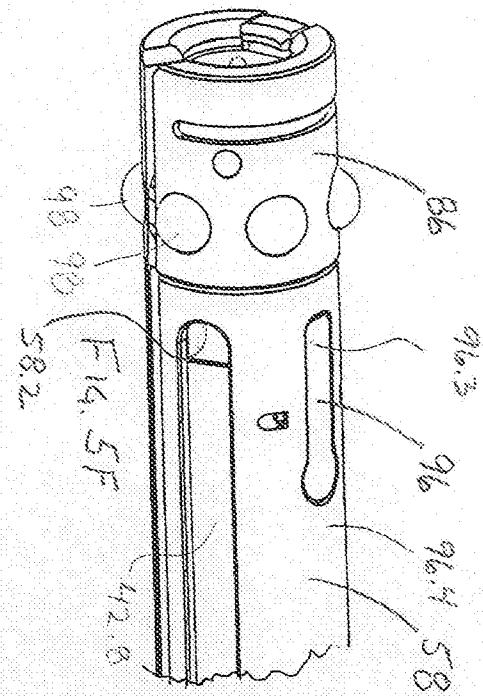

FIG. 5F

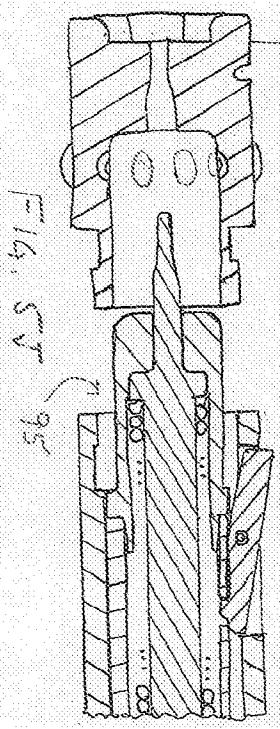

FIG. 5J

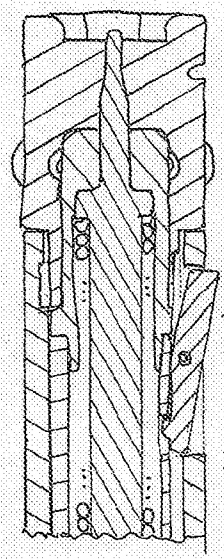

FIG. 5I

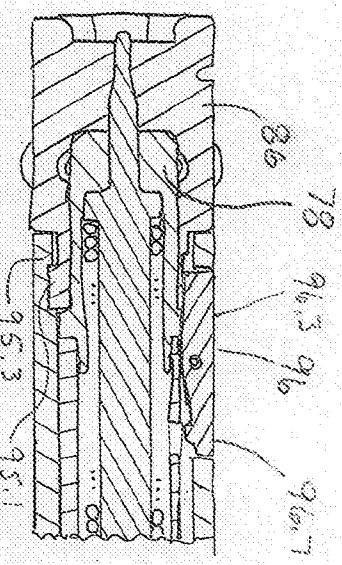

FIG. 5H

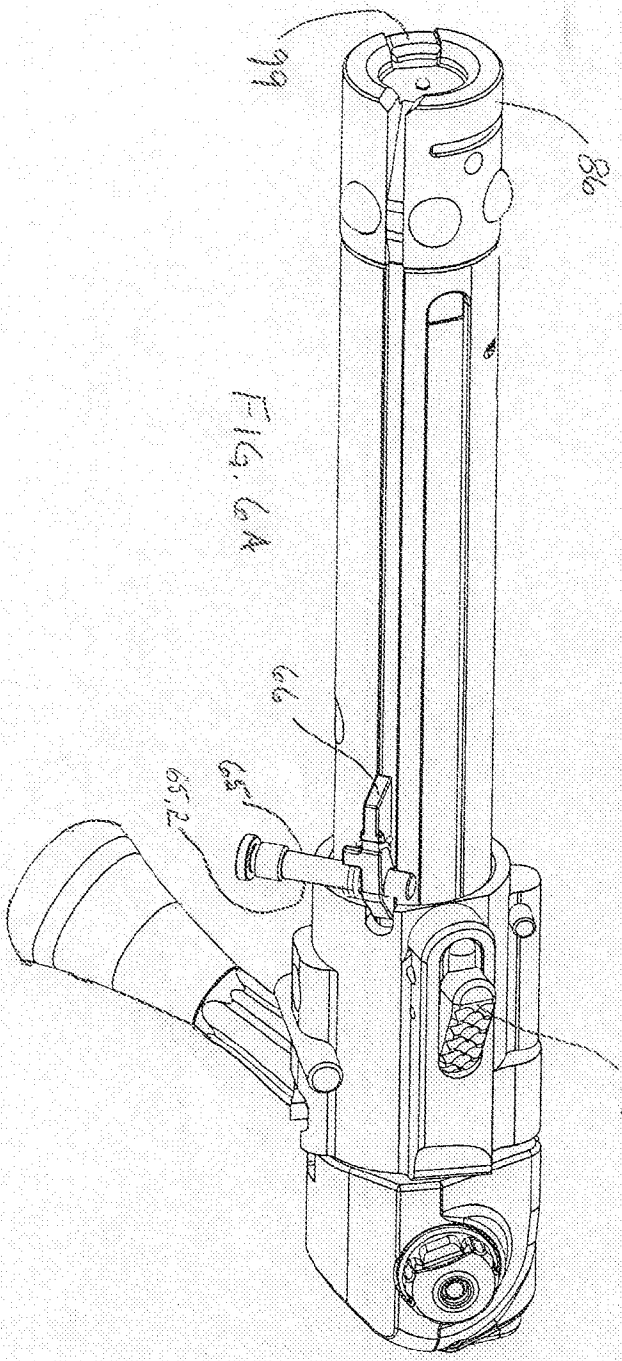

FIG. 6A

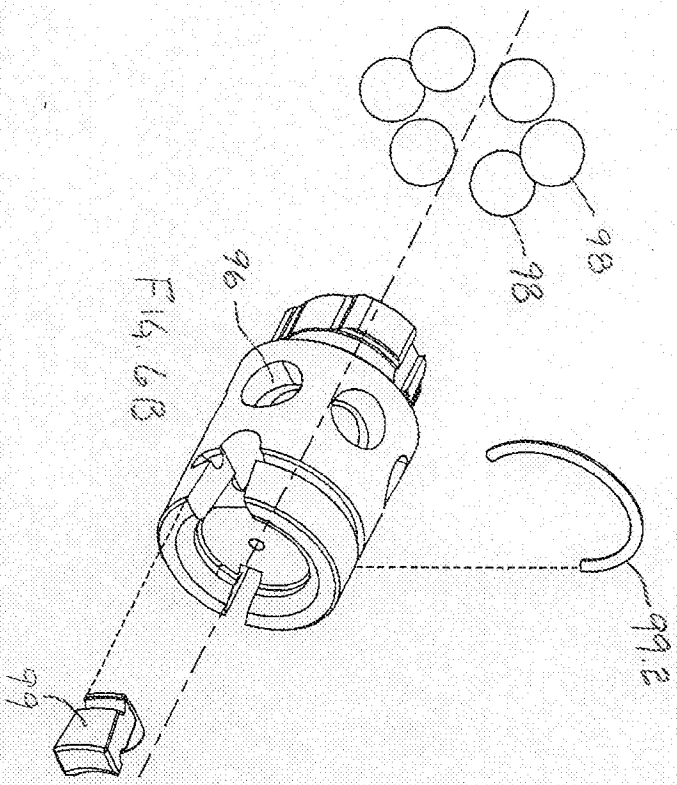

FIG. 6B

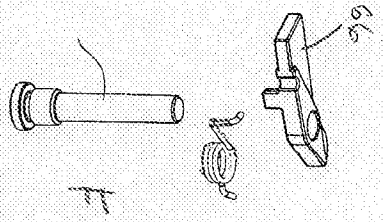

FIG. 6C

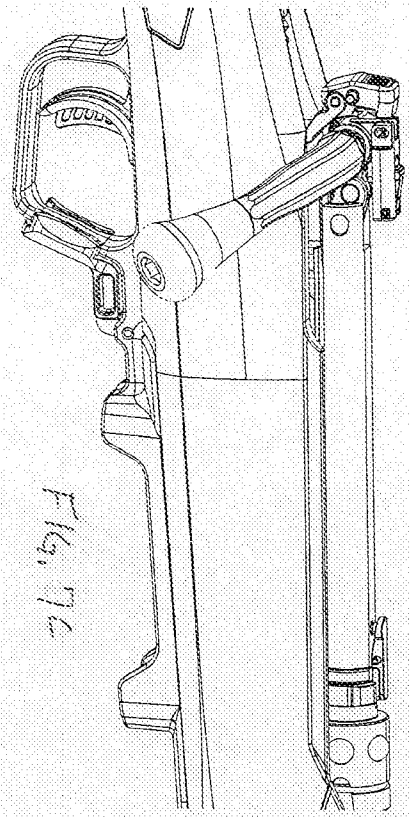

FIG. 7C

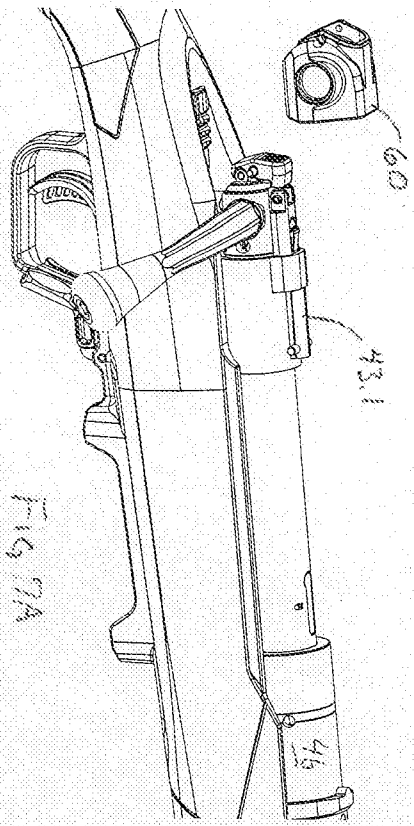

FIG. 7A

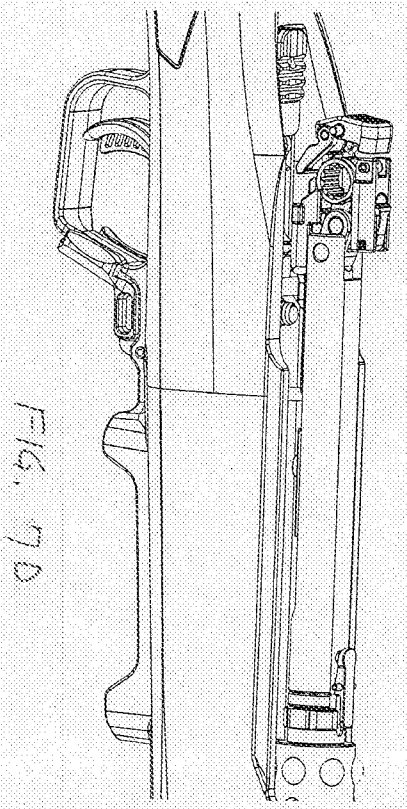

FIG. 7D

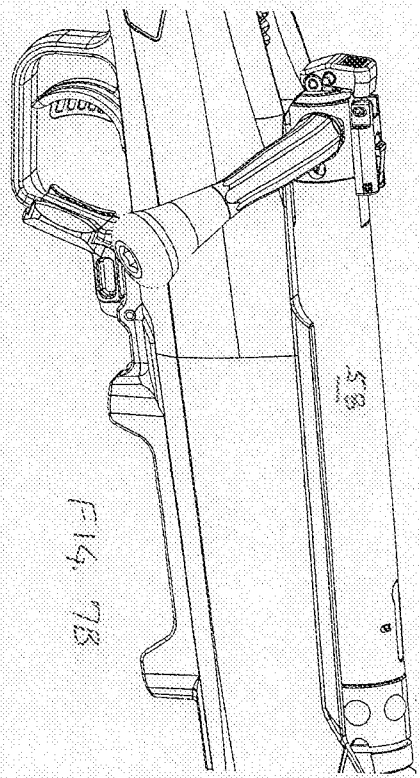

FIG. 7B

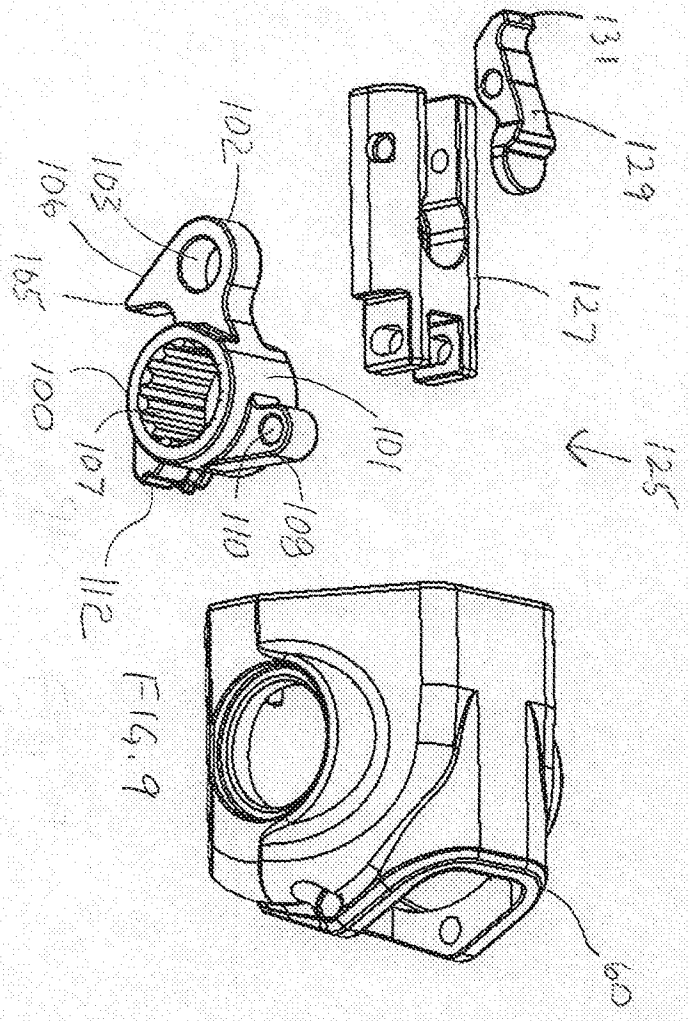
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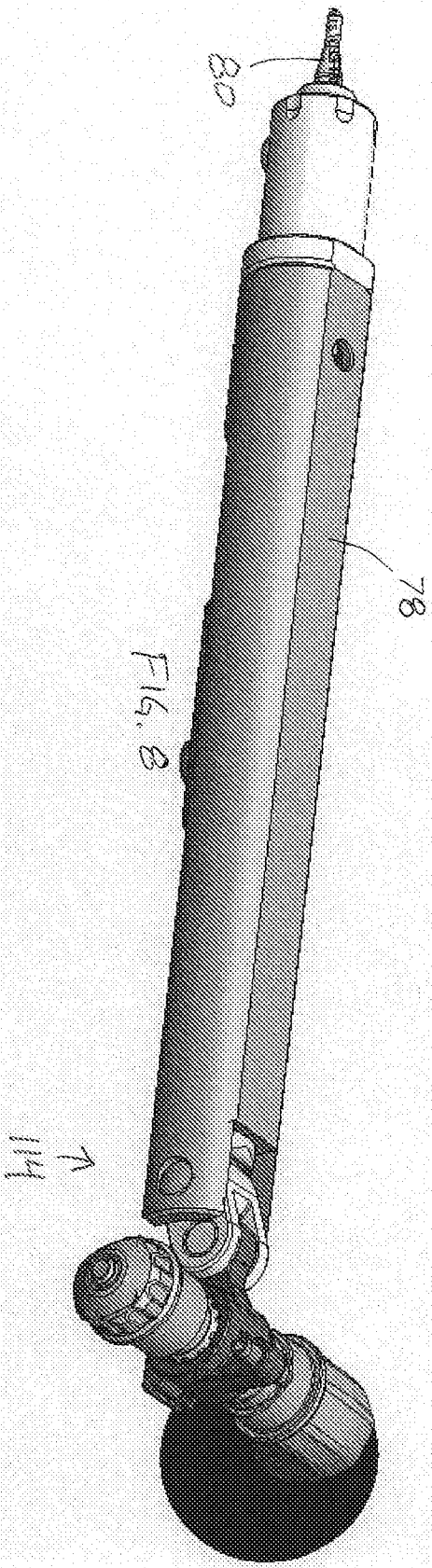
FIG. 4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114

FIG. 8

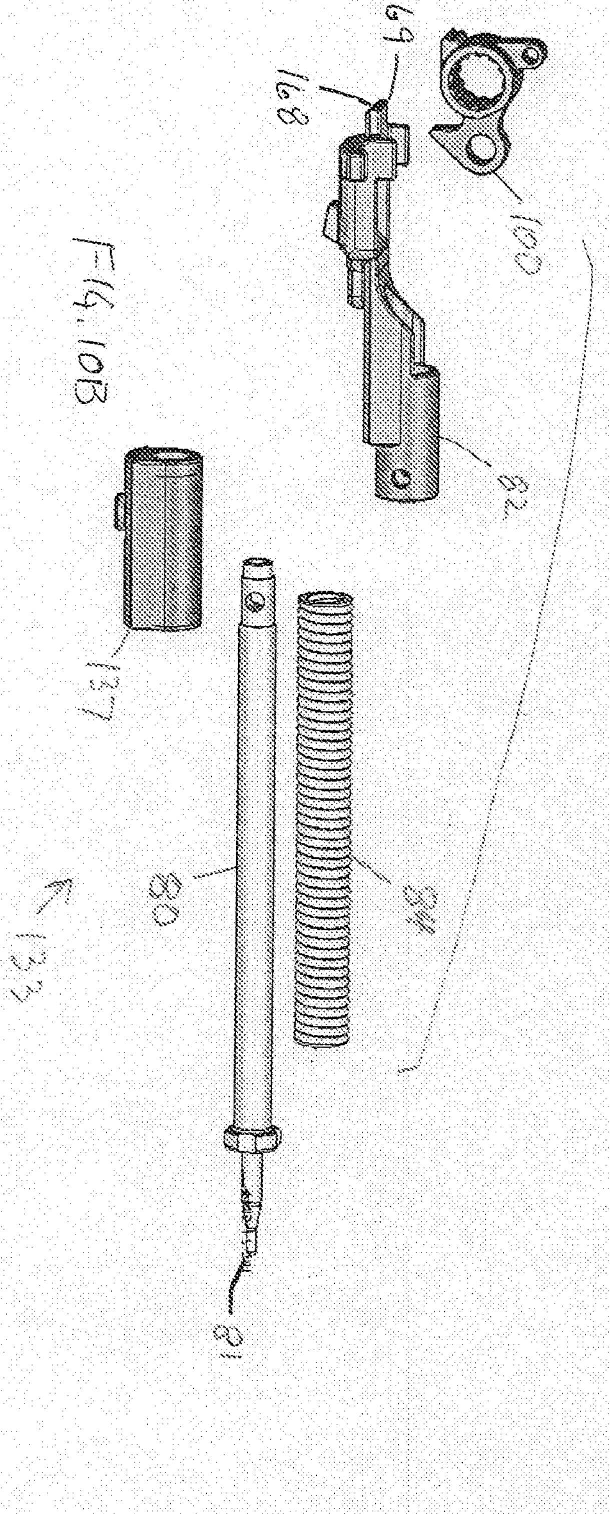


FIG. 10B

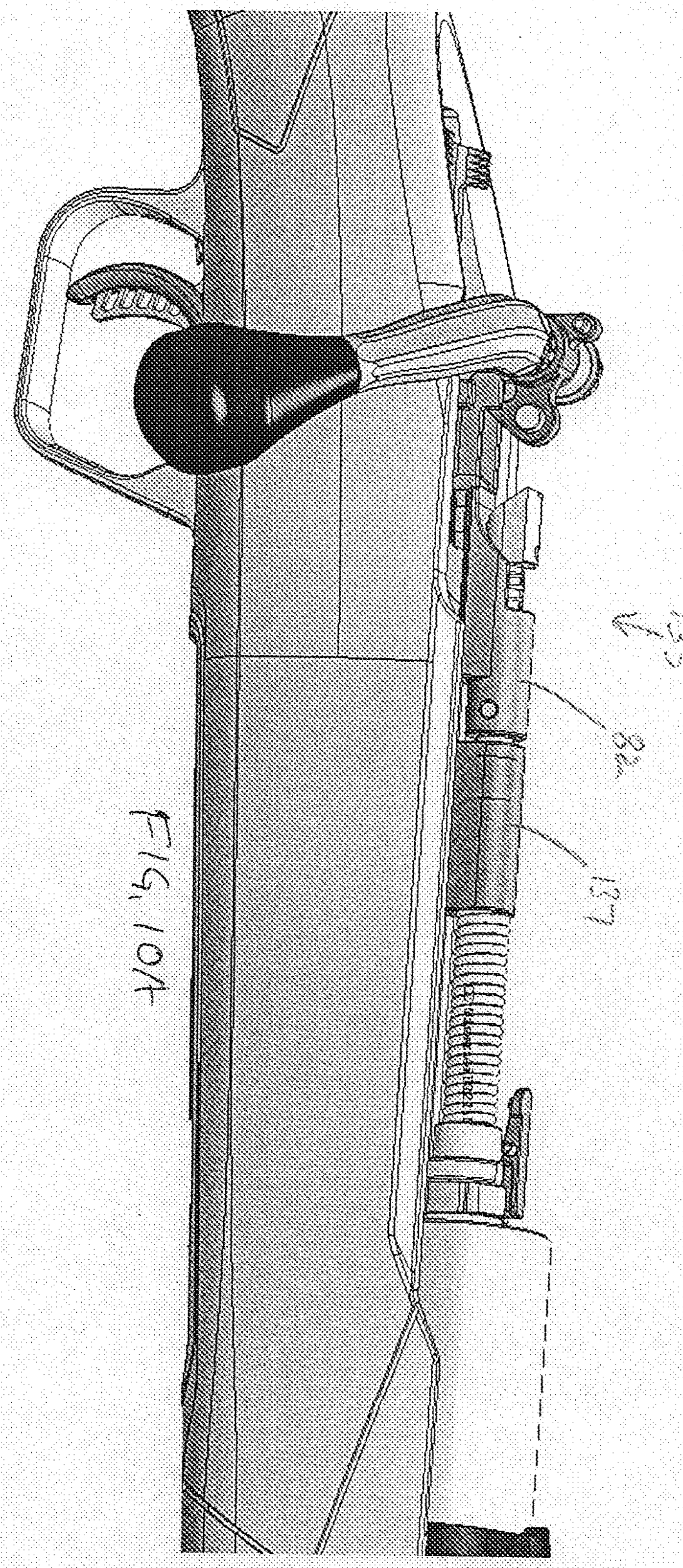


FIG. 10A

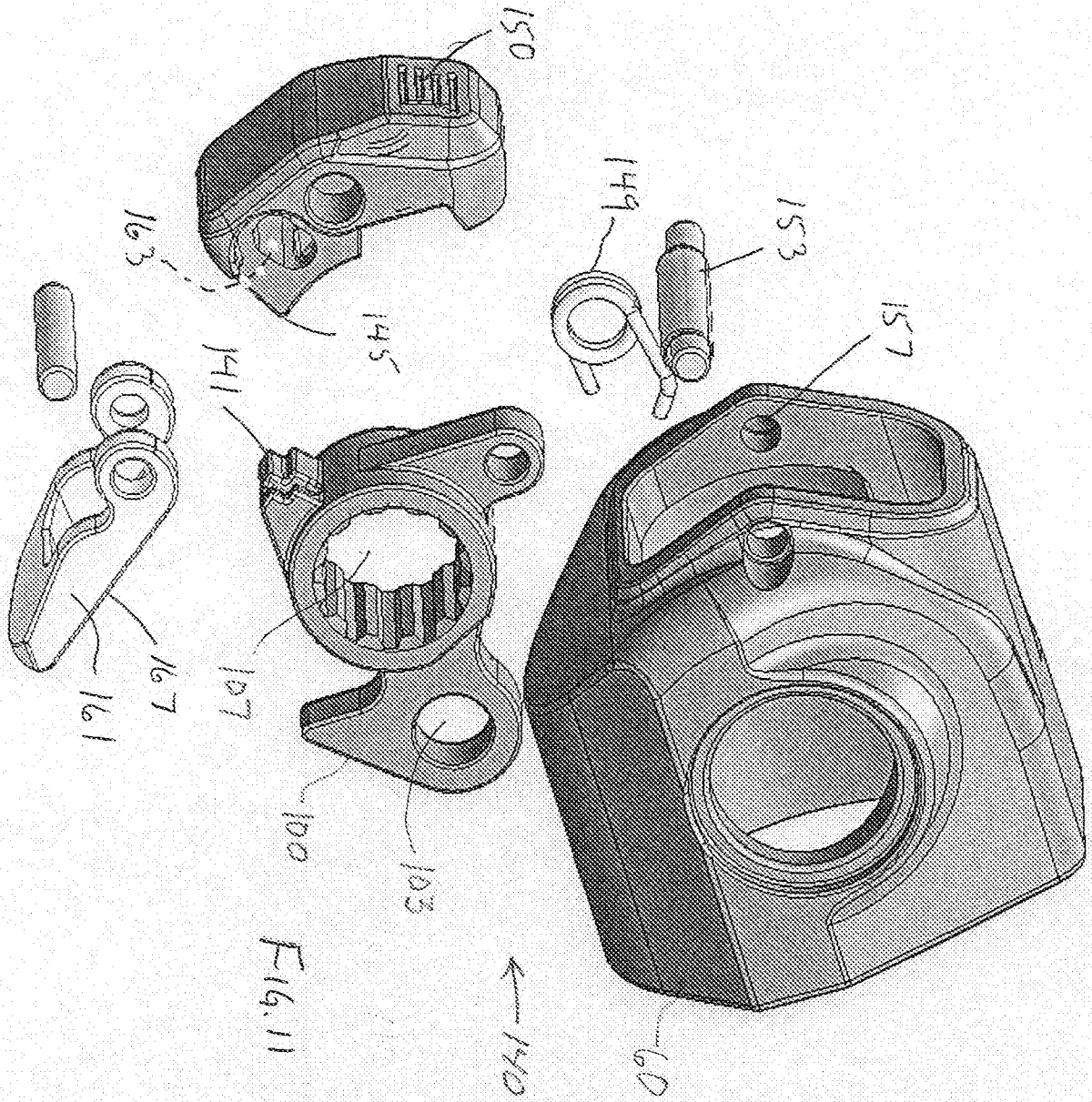


Fig. 11

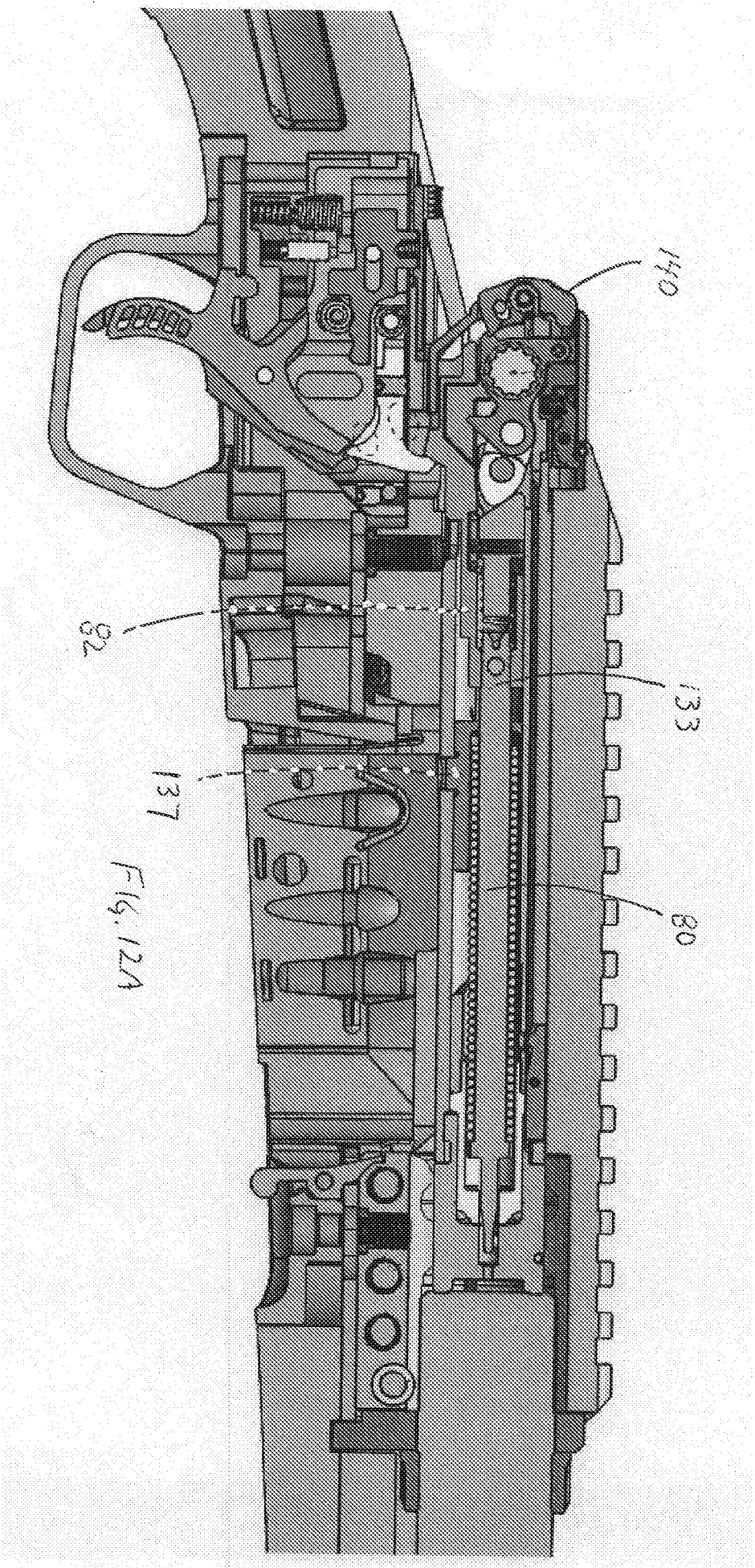
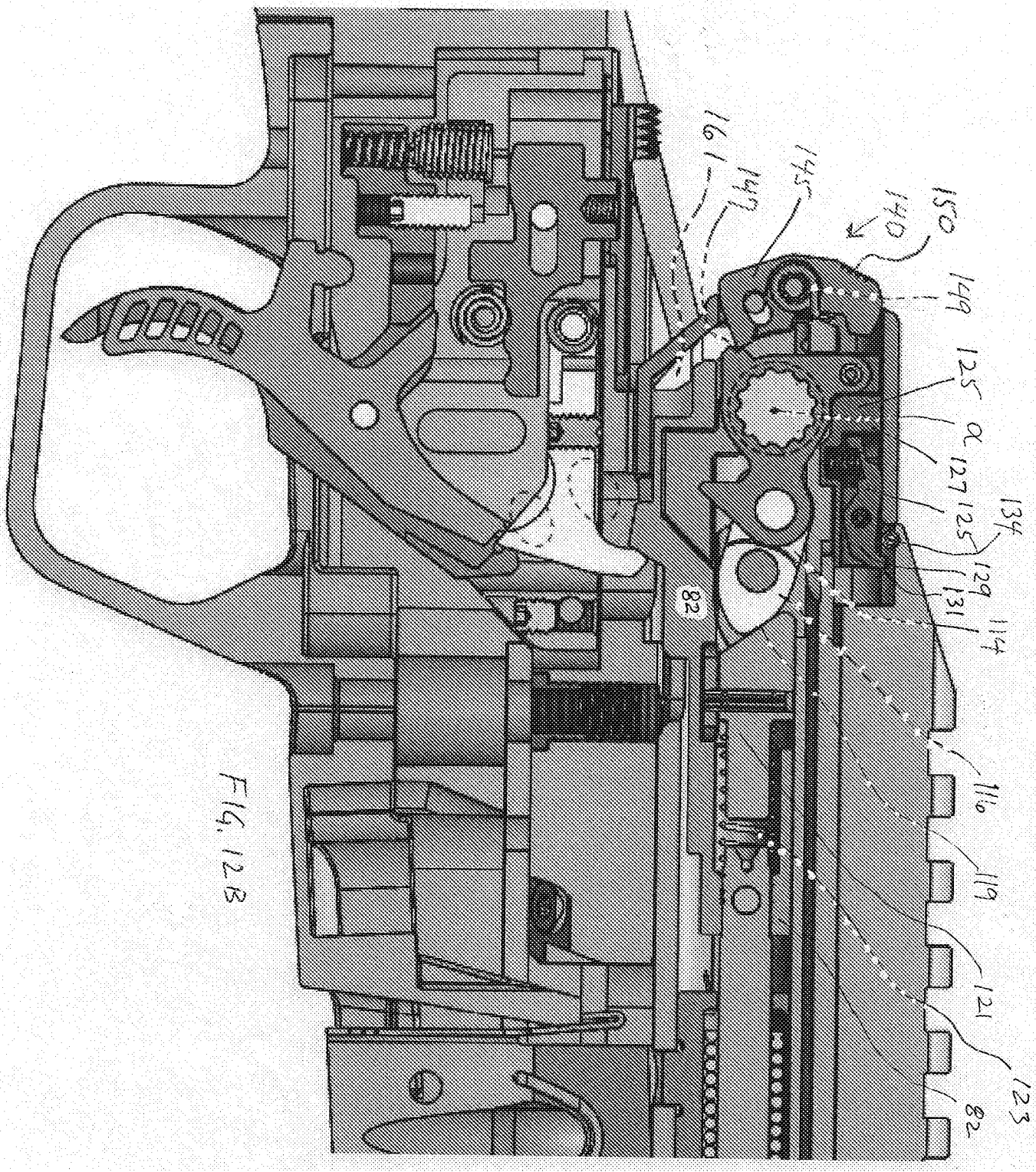


FIG. 12A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82

FIG. 12B

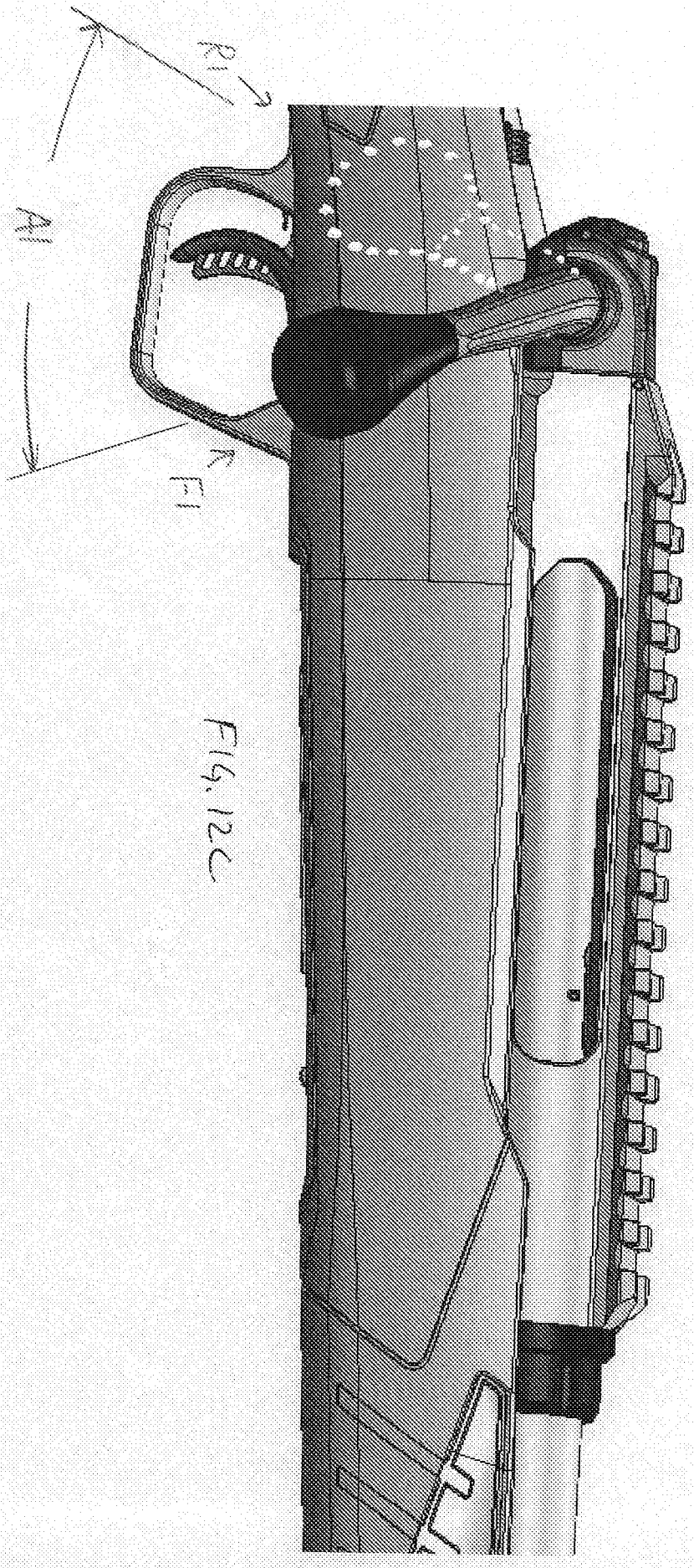

FIG. 12C

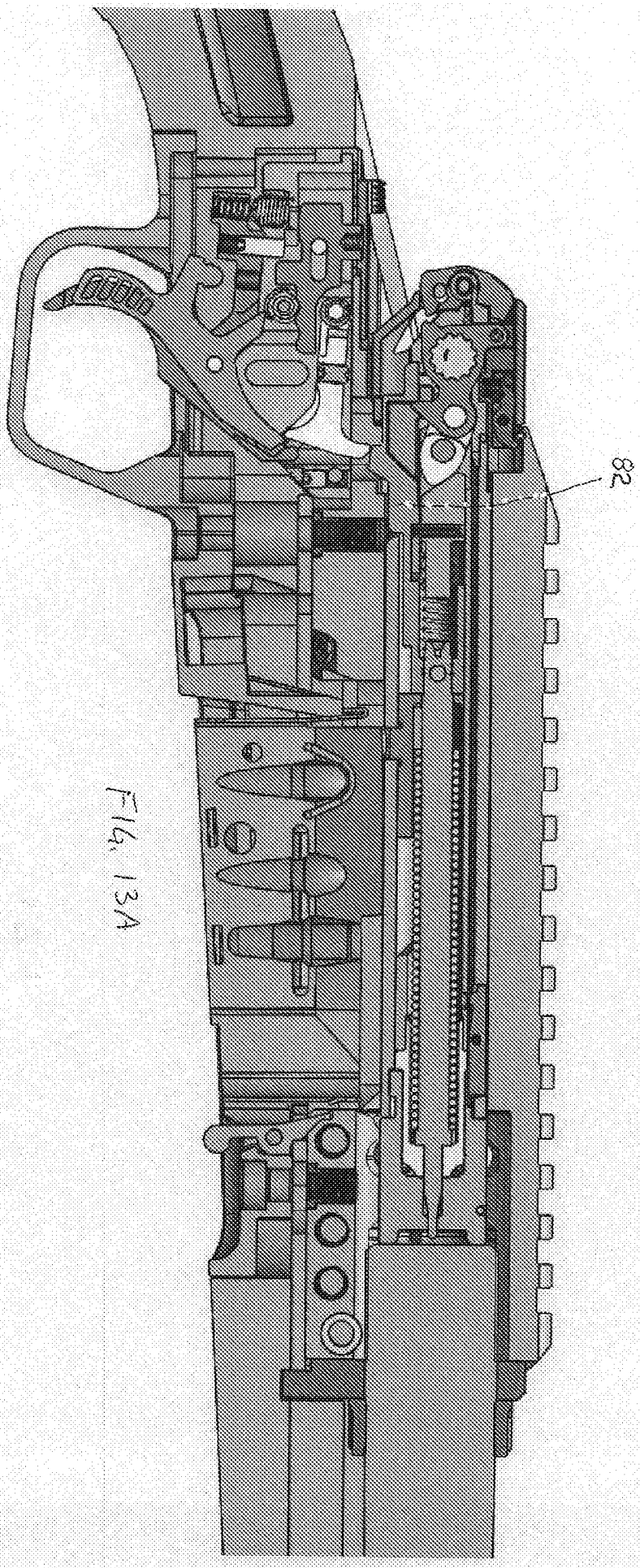

FIG. 13A

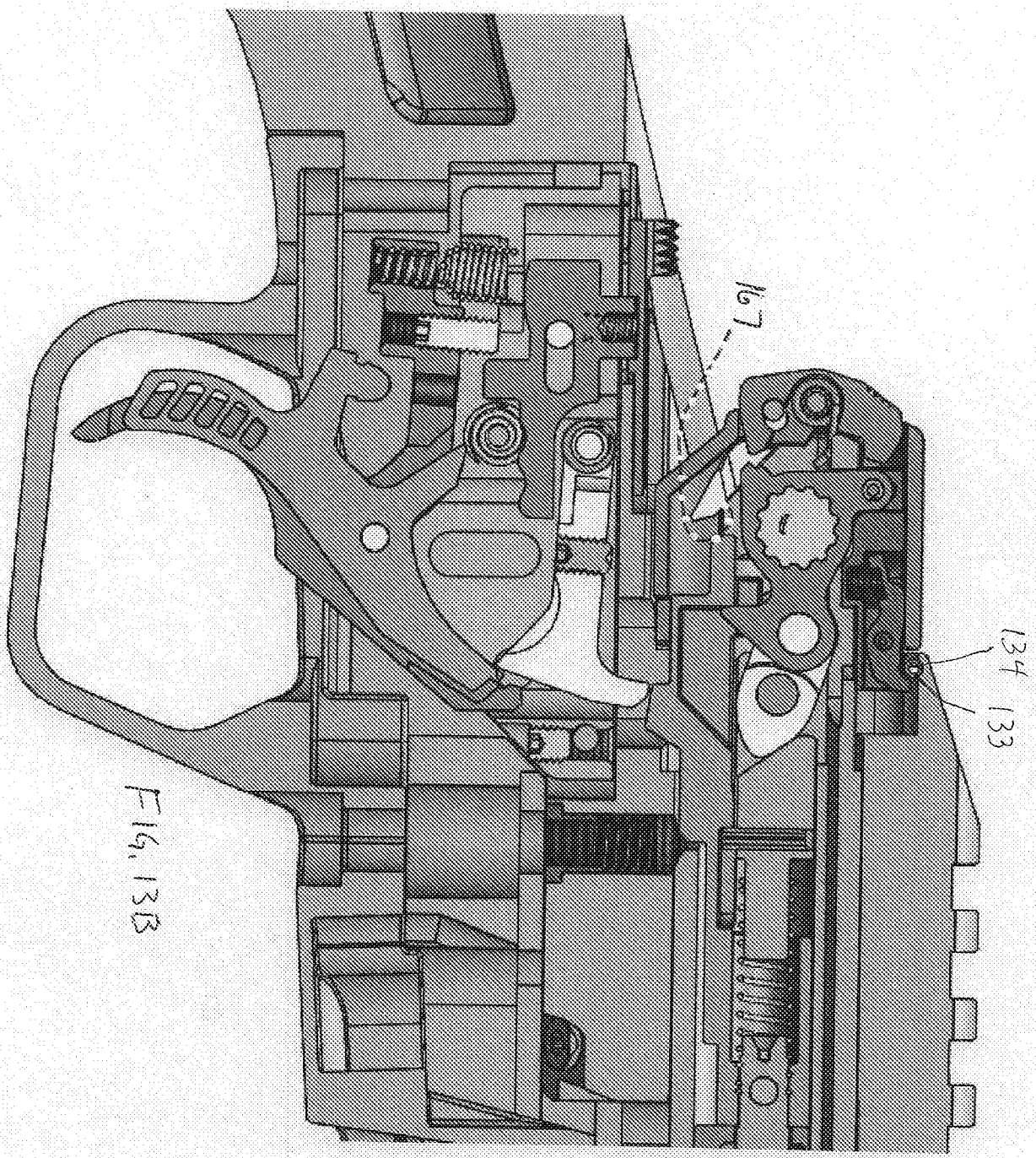

FIG. 13B

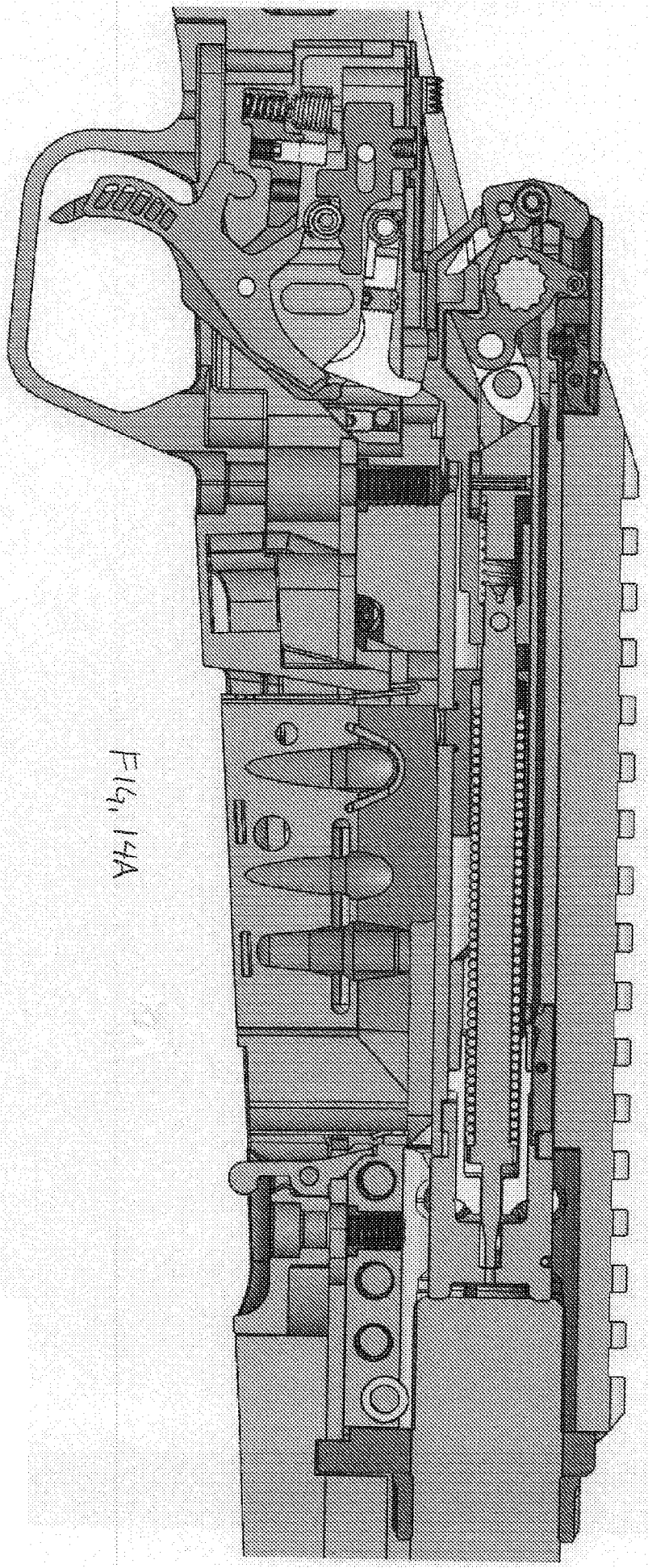

Fig. 14A

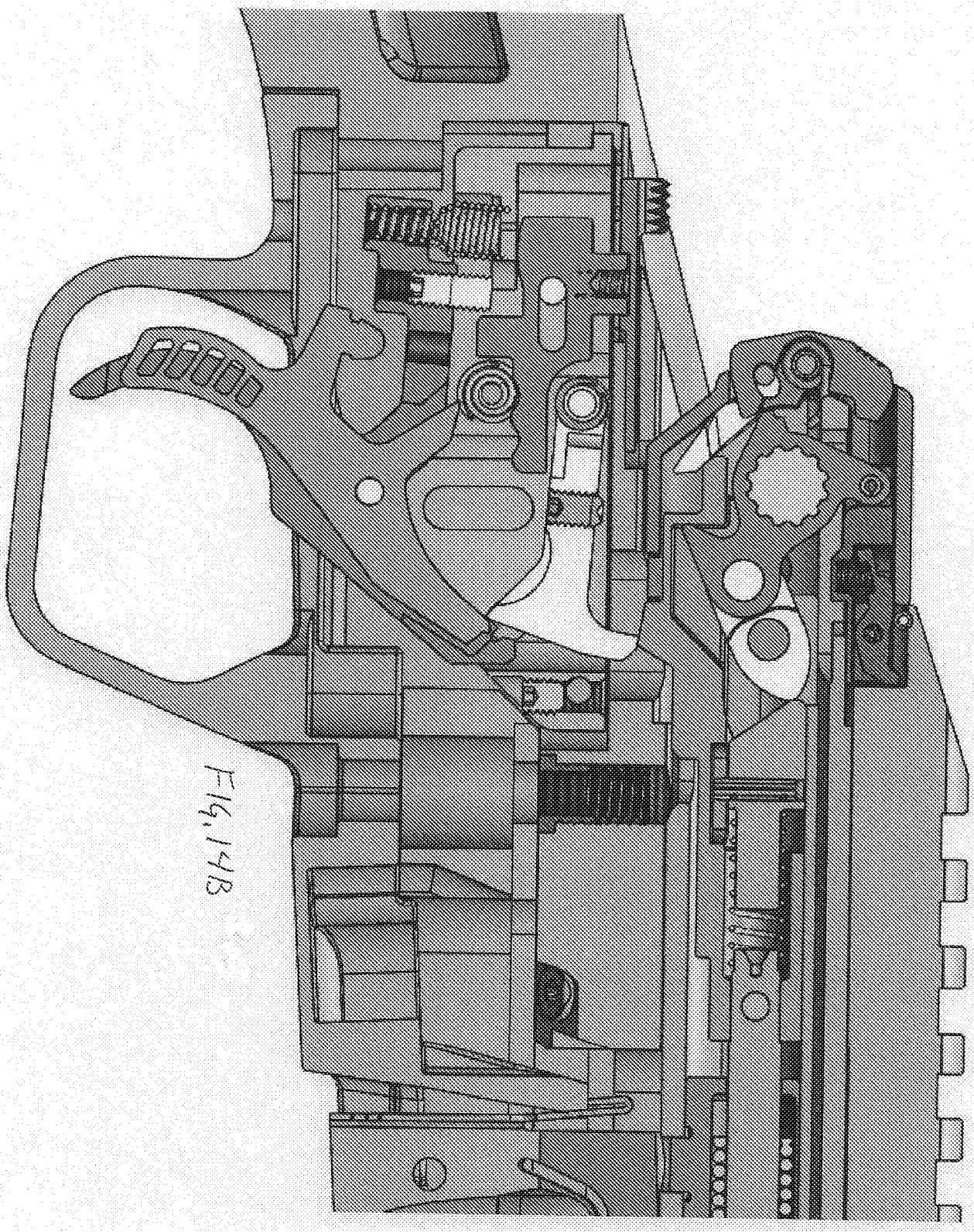

FIG. 14B

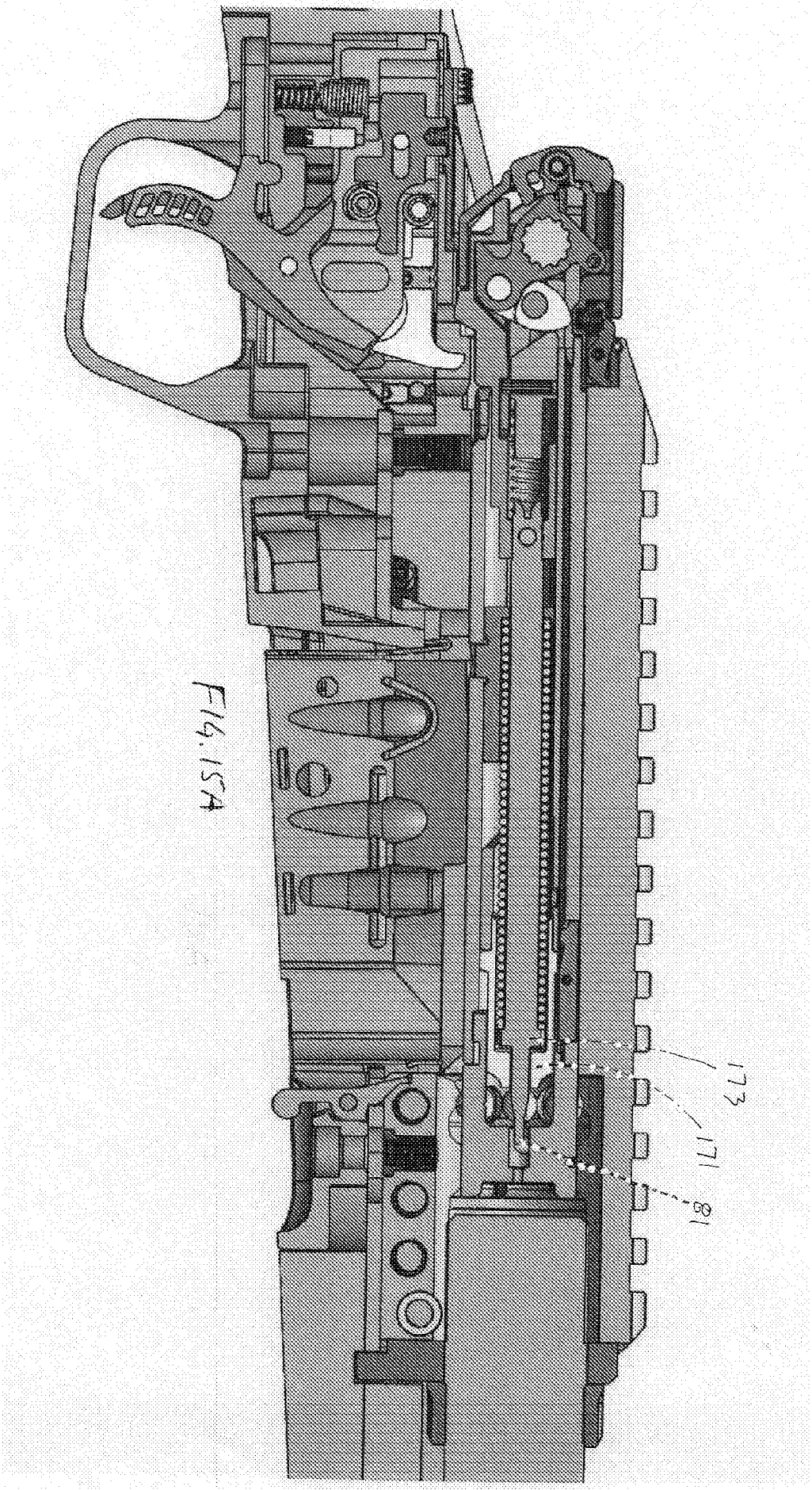

FIG. 15A

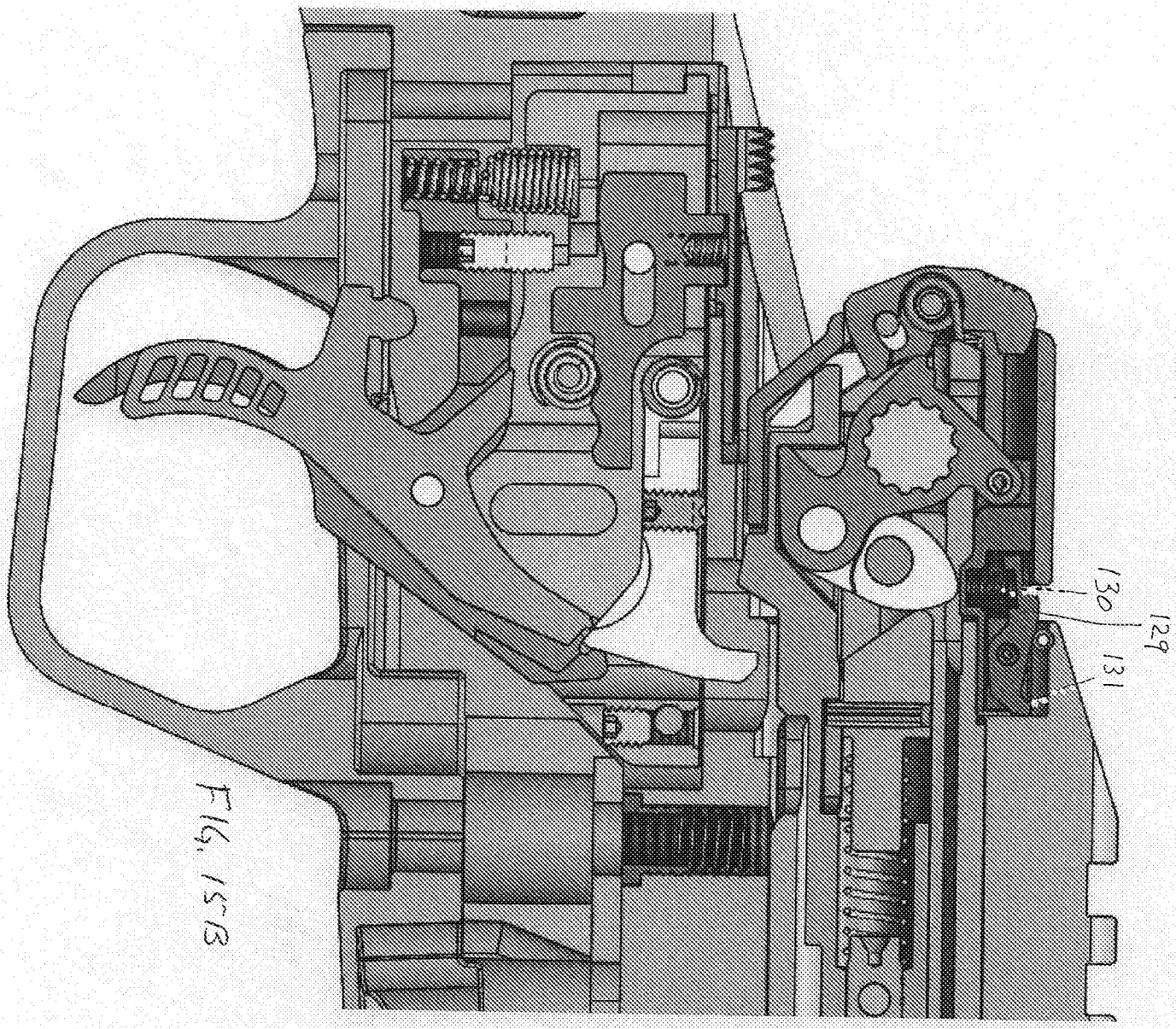

FIG. 15B

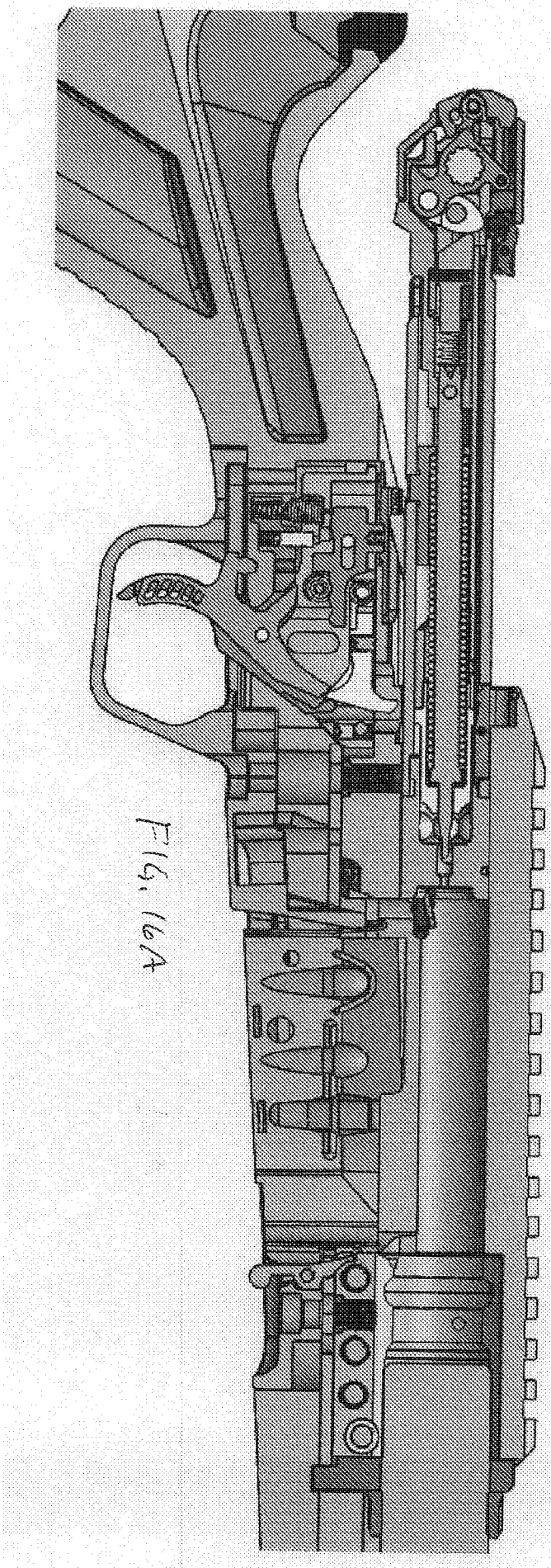

FIG. 16A

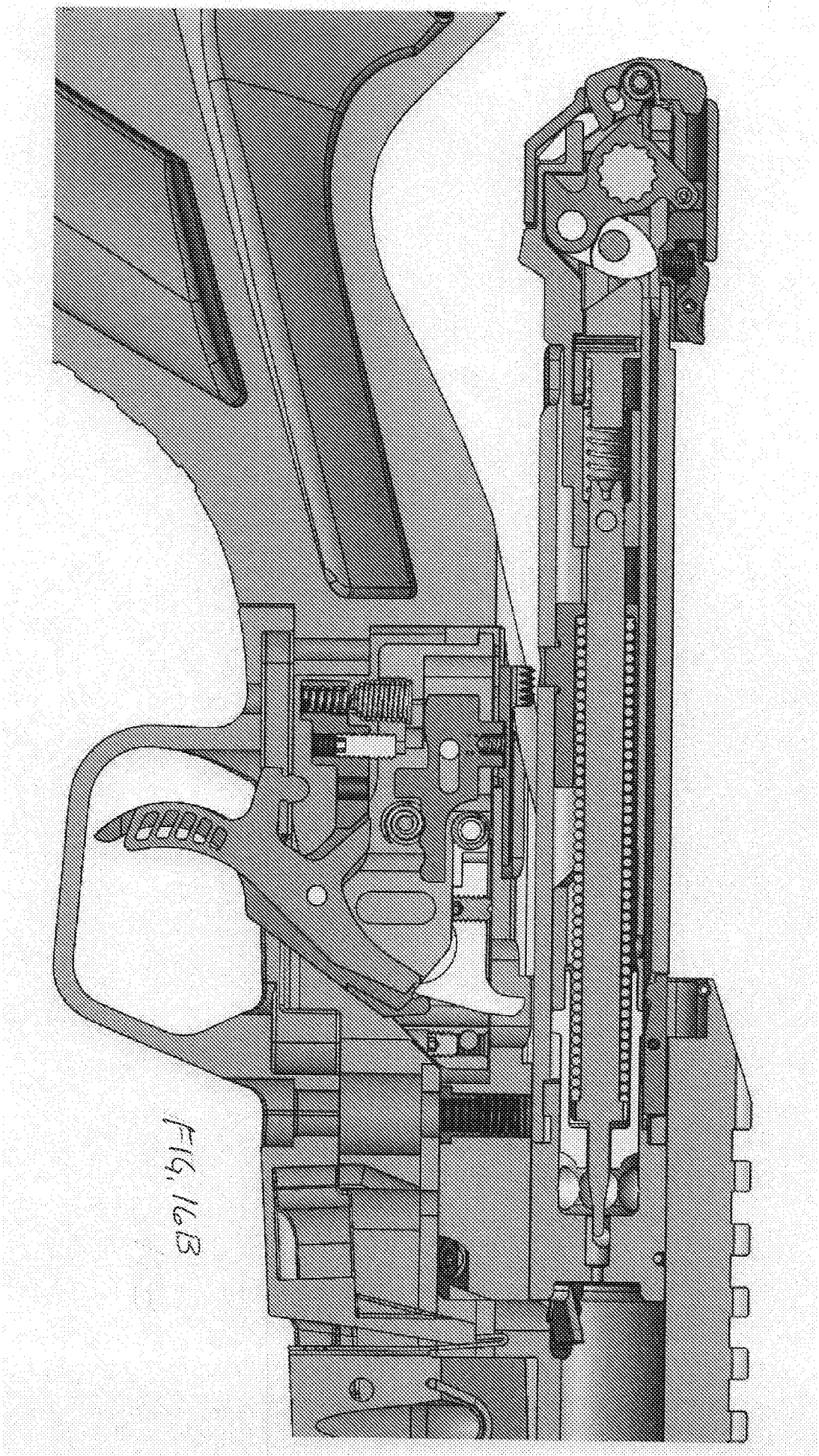

FIG. 16B

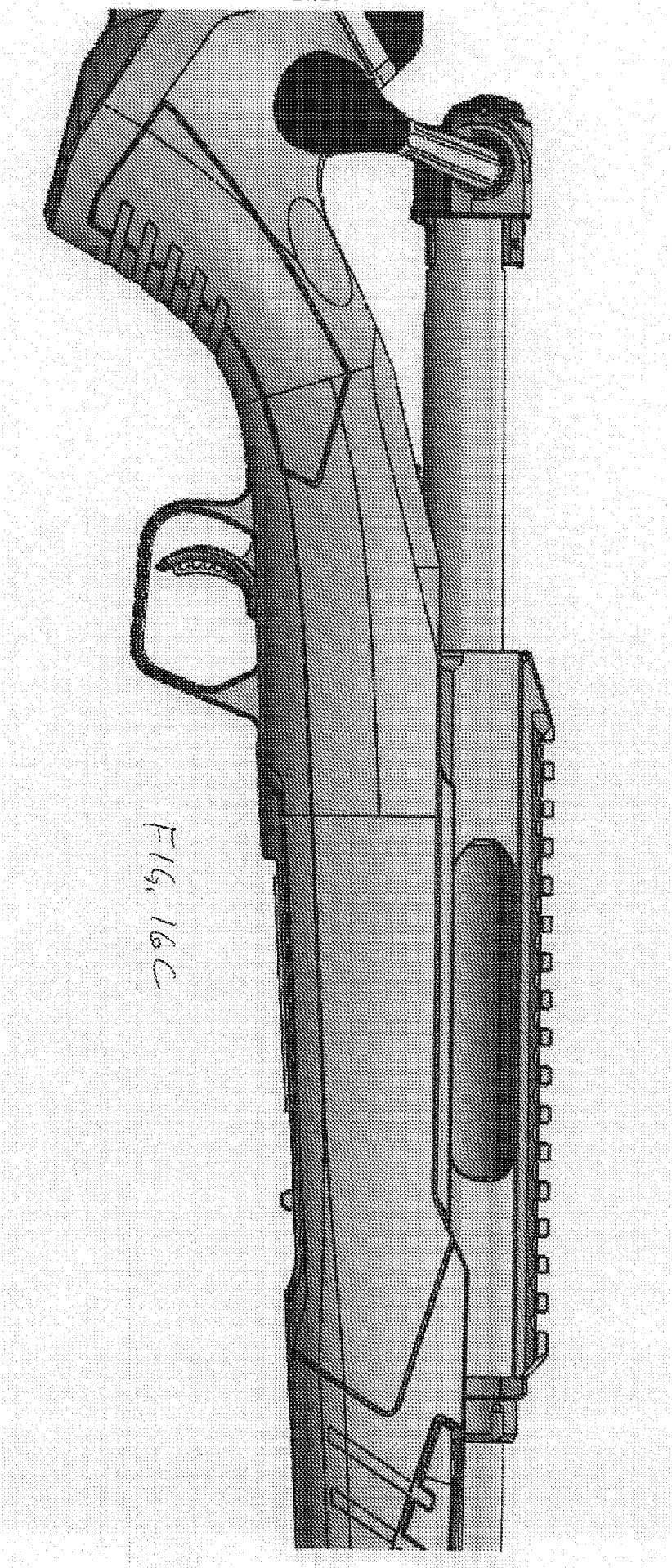

FIG. 16C

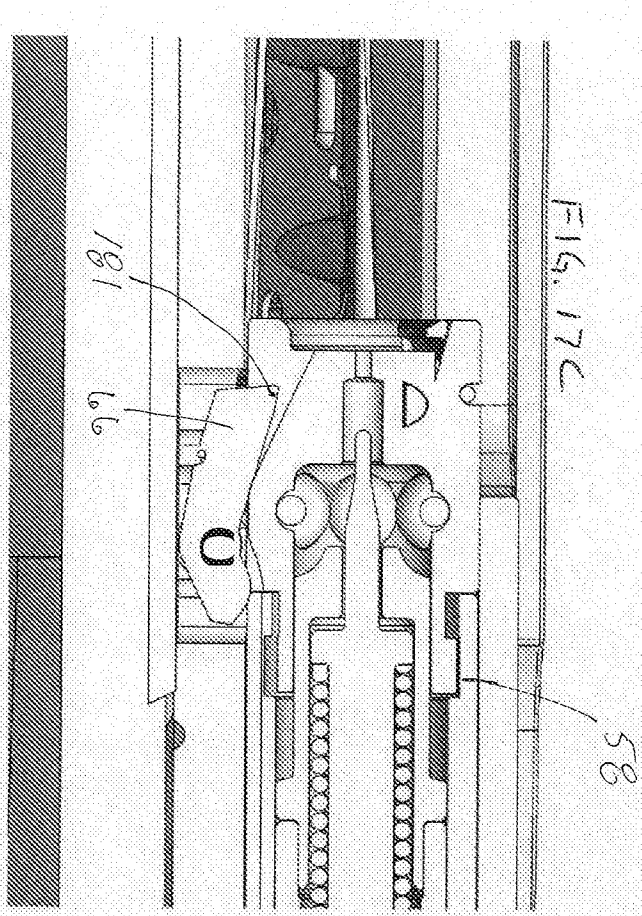

FIG. 17C

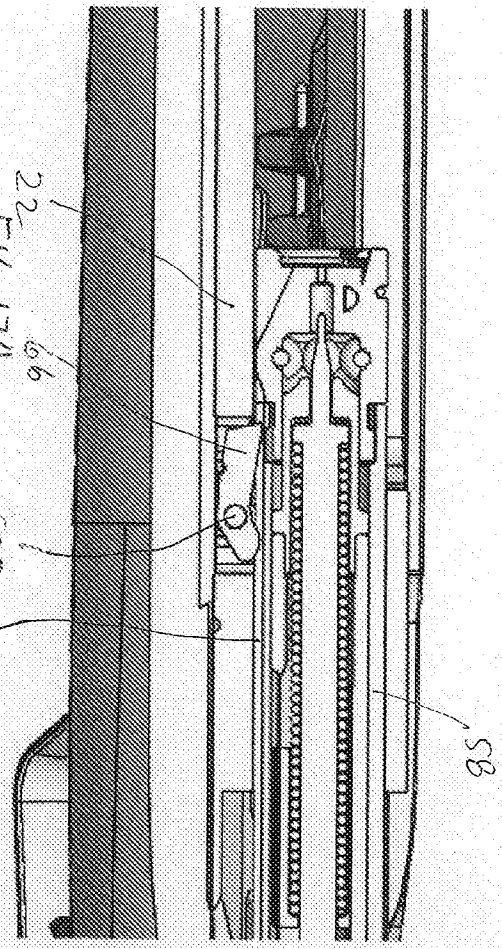

FIG. 17A

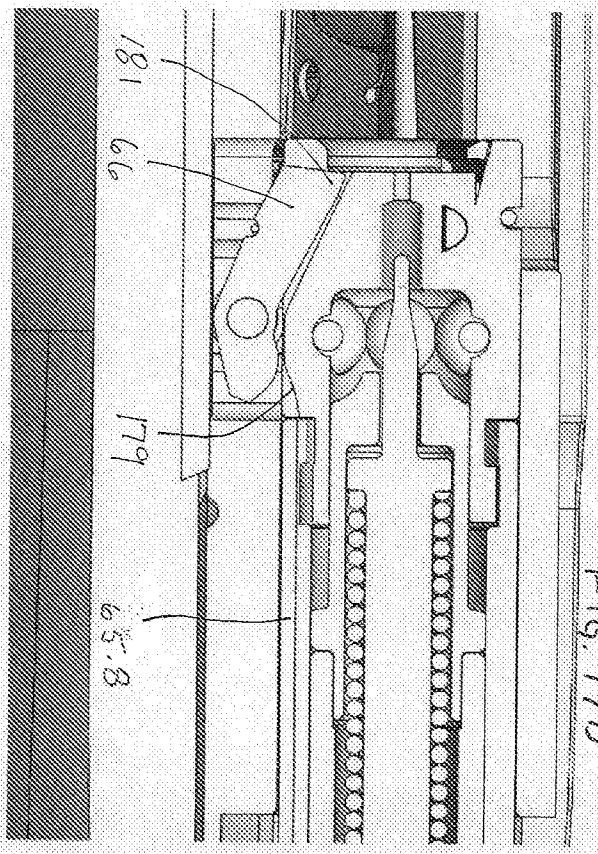

FIG. 17D

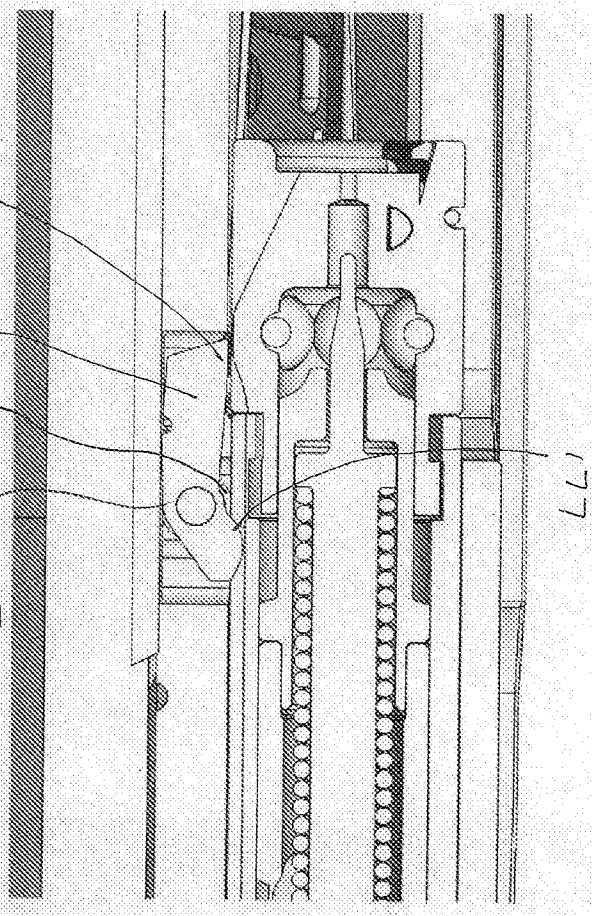

FIG. 17B