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(54) **FIREARM TRIGGER MECHANISM**

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F41A 19/10	(2006.01)
F41A 19/12	(2006.01)
F41A 17/82	(2006.01)

(52) **U.S. Cl.**
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(58) **Field of Classification Search**
CPC F41A 19/10; F41A 19/12; F41A 19/14; F41A 19/43; F41A 17/82
USPC 89/136, 139; 42/69.01, 69.02, 69.03
See application file for complete search history.

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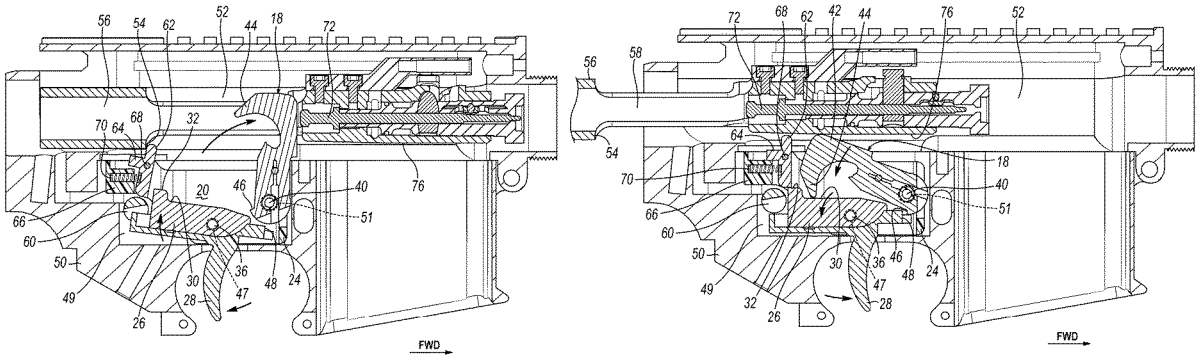
(57) **ABSTRACT**

A trigger mechanism for use in a firearm having a receiver with a fire control mechanism pocket, transversely aligned pairs of hammer and trigger pin openings in the pocket, and a bolt carrier that reciprocates and pivotally displaces a hammer when cycled. The trigger mechanism includes a hammer, a trigger member, and a locking bar. The hammer has a sear notch and is mounted in the fire control mechanism pocket to pivot on a transverse hammer pin between set and released positions. The trigger member has a sear and is mounted in the fire control mechanism pocket to pivot on a transverse trigger pin between set and released positions. The trigger member has a surface positioned to be contacted by hammer when the hammer is displaced by cycling of the bolt carrier, the contact causing the trigger member to be forced to the set position. The locking bar is pivotally mounted in a frame and spring biased toward a first position in which it mechanically blocks the trigger member from moving to the release position, and is movable against the spring bias to a second position when contacted by the bolt carrier reaching a substantially in-battery position, allowing the trigger member to be moved by an external force to the released position.

7 Claims, 4 Drawing Sheets



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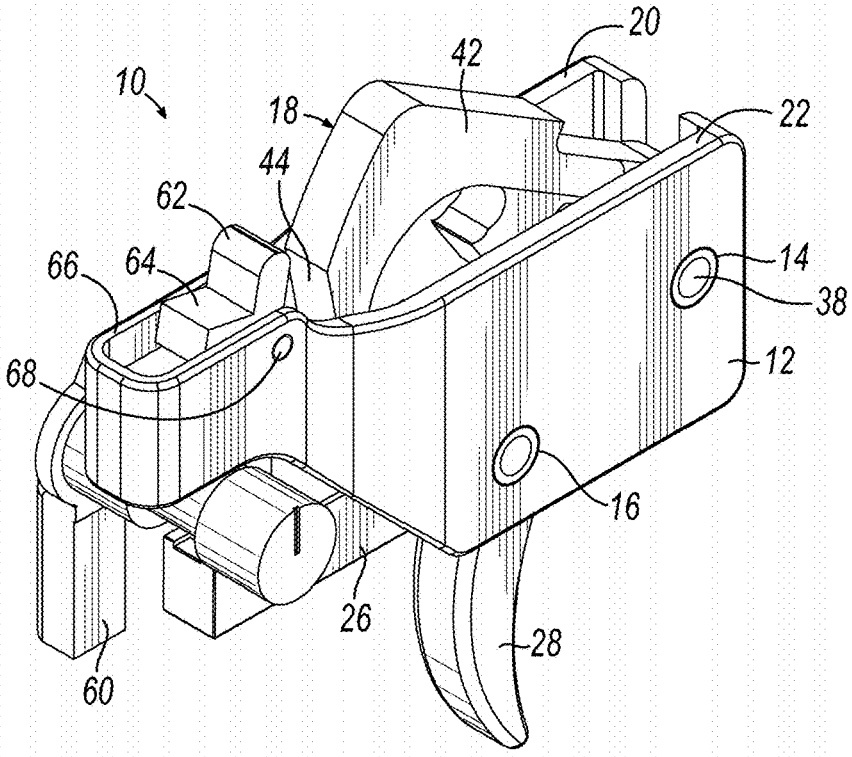
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FIG. 1

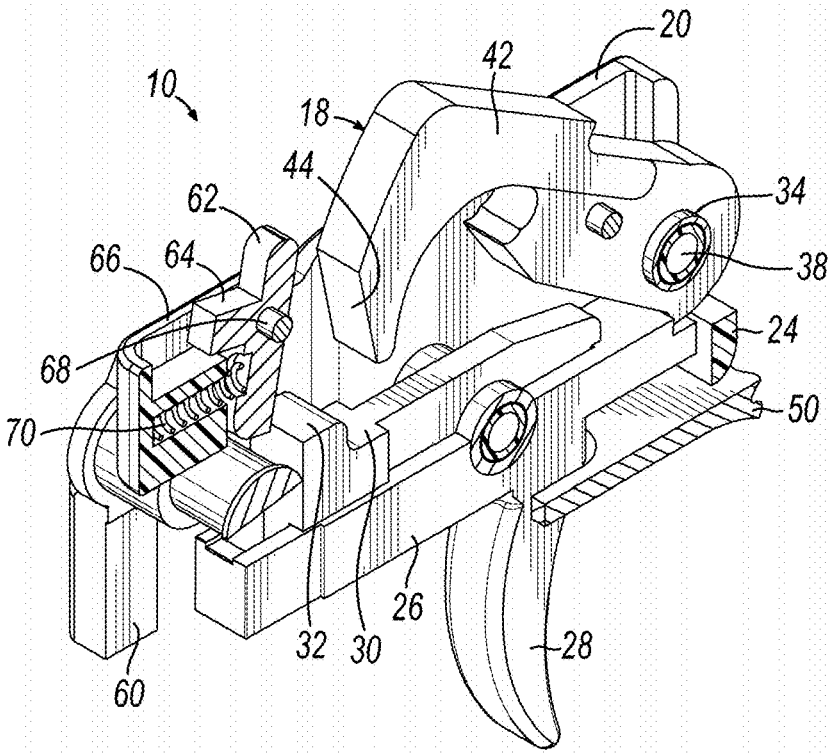
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FIG. 2

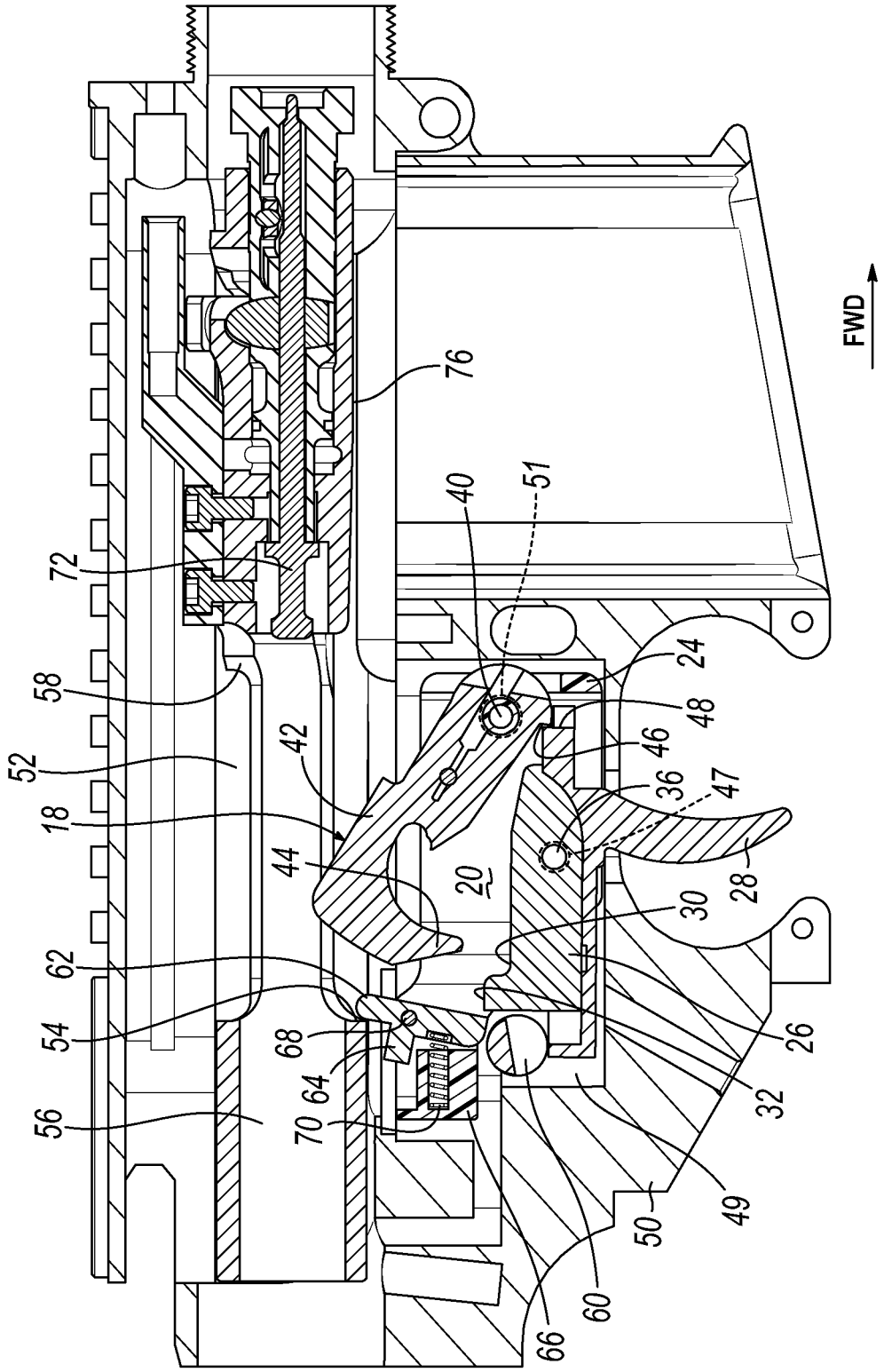
FWD
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FIG. 3

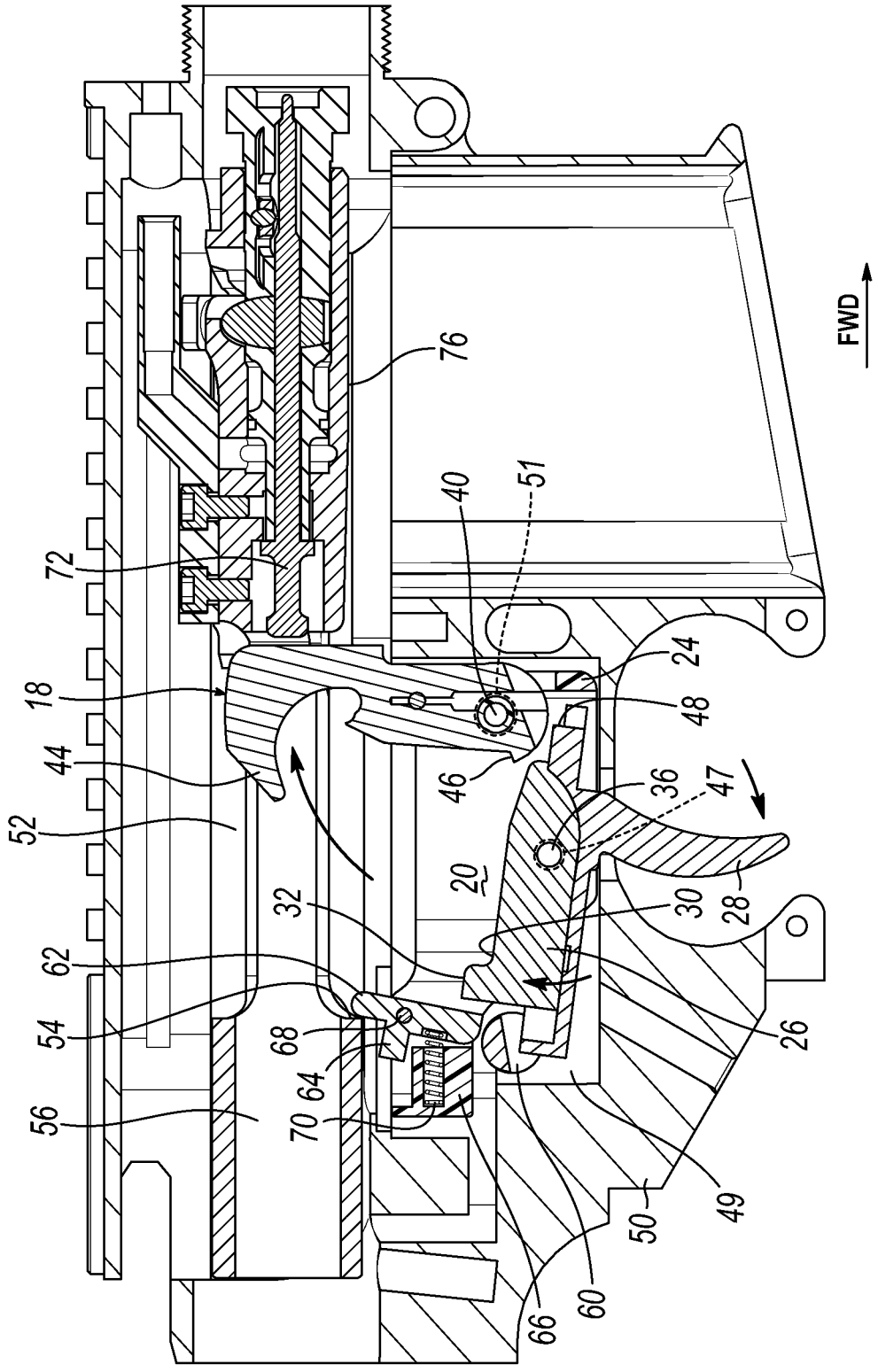
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FIG. 4

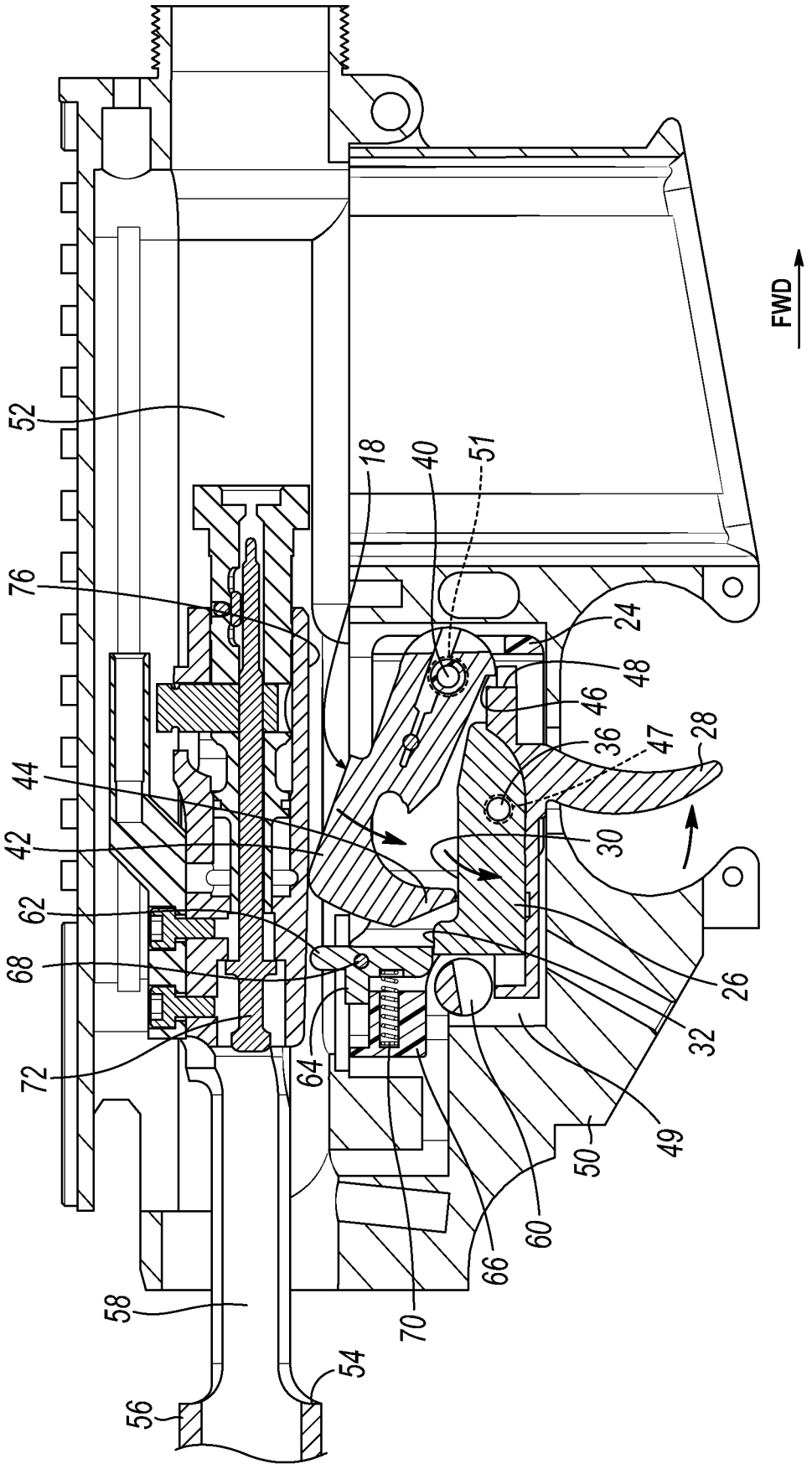
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FIG. 5

FIREARM TRIGGER MECHANISM

RELATED APPLICATIONS

This application claims priority to U.S. Provisional Patent Application No. 62/565,247 filed Sep. 29, 2017, and incorporates the same herein by reference.

TECHNICAL FIELD

This invention relates to a firearm trigger mechanism. More particularly, it relates to a semiautomatic trigger that is mechanically reset by movement of the hammer when it is reset by the bolt carrier.

BACKGROUND

In a standard semiautomatic firearm, actuation of the trigger releases a sear, allowing a hammer or striker to fire a chambered ammunition cartridge. Part of the ammunitions propellant force is used to cycle the action, extracting and ejecting a spent cartridge and replacing it with a loaded cartridge. The cycle includes longitudinal reciprocation of a bolt and/or carrier, which also resets the hammer or striker.

A standard semiautomatic trigger mechanism includes a disconnector, which holds the hammer or striker in a cocked position until the trigger member is reset to engage the sear. This allows the firearm to be fired only a single time when the trigger is pulled and held, because the user is not typically able to release the trigger rapidly enough so that the sear engages before the bolt or bolt carrier returns to its in-battery position. The disconnector prevents the firearm from either firing multiple rounds on a single pull of the trigger, or from allowing the hammer or striker to simply "follow" the bolt as it returns to battery without firing a second round, but leaving the hammer or striker uncocked.

For various reasons, shooters desire to increase the rate of semiautomatic fire. Sometimes this is simply for entertainment and the feeling of shooting a machine gun. In the past, users have been known to employ "bump firing" to achieve rapid semiautomatic fire. Bump firing uses the recoil of the semiautomatic firearm to fire shots in rapid succession. The process involves bracing the rifle with the non-trigger hand, loosening the grip of the trigger hand (but leaving the trigger finger in its normal position in front of the trigger), and pushing the rifle forward in order to apply pressure on the trigger from the finger while keeping the trigger finger stationary. When fired with the trigger finger held stationary, the firearm will recoil to the rear and allow the trigger to reset as it normally does. When the non-trigger hand pulls the firearm away from the body and back forward toward the original position, it causes the trigger to be pressed against the stationary finger again, firing another round as the trigger is pushed back.

Other devices have been offered that facilitate the bump fire process. One is shown in U.S. Pat. No. 6,101,918, issued Aug. 15, 2000, to William Akins for a Method and Apparatus for Accelerating the Cyclic Firing Rate of a Semiautomatic Firearm. This device, sold for some time as the Akins Accelerator™, allowed the receiver and action of the firearm to move longitudinally relative to the butt stock and used a spring to assist forward return movement. Other devices, such as that shown in U.S. Pat. No. 8,127,658, issued Mar. 6, 2012, and other patents owned by Slide Fire Solutions provide a replacement stock and handgrip assembly that facilitates bump firing, but without spring assistance.

Other solutions to increase the rate of semiautomatic fire include pull/release trigger mechanisms. These devices cause one round to be fired when the trigger is pulled and a second round to be fired when the trigger is released. Such a device is shown in U.S. Pat. No. 8,820,211, issued Sep. 2, 2014, entitled Selectable Dual Mode Trigger for Semiautomatic Firearms. A device like this is offered by FosTecH Outdoors, LLC as the ECHO TRIGGER™. Another device, offered by Digital Trigger Technologies, LLC under the name DigiTrigger™, provides a dual mode trigger in which the pull/release operating function is achieved electronically.

The above-described devices either require practice to use reliably, are complex, and/or are expensive to manufacture and install.

Another device for increasing the rate of semiautomatic fire is shown in U.S. Pat. Nos. 9,568,264; 9,816,772; and U.S. Pat. No. 9,939,221, issued to Thomas Allen Graves. The devices shown in these patents forcefully reset the trigger with rigid mechanical contact between the trigger member and the bolt as the action cycles. This invention, however, does not provide a "drop-in" solution for existing popular firearm platforms, like the AR15, AK47 variants, or the Ruger 10/22™. To adapt this invention to an AR-pattern firearm, for example, would require not only a modified fire control mechanism, but also a modified bolt carrier.

SUMMARY OF INVENTION

The present invention provides a semiautomatic trigger mechanism for increasing rate of fire that can be retrofitted into popular existing firearm platforms. In particular, this invention provides a trigger mechanism that can be used in AR-pattern firearms with an otherwise standard M16-pattern bolt carrier assembly. The present invention is particularly adaptable for construction as a "drop-in" replacement trigger module that only requires insertion of two assembly pins and the safety selector. In the disclosed embodiments, the normal resetting of the hammer, as the bolt or bolt carrier is cycled, causes the trigger to be forcibly reset by contact between the hammer and a surface of the trigger member. Once reset, movement of the trigger is blocked by a locking bar and cannot be pulled until the bolt has returned to battery, thus preventing "hammer follow" behind the bolt or bolt carrier.

Other aspects, features, benefits, and advantages of the present invention will become apparent to a person of skill in the art from the detailed description of various embodiments with reference to the accompanying drawing figures, all of which comprise part of the disclosure.

BRIEF DESCRIPTION OF THE DRAWINGS

Like reference numerals are used to indicate like parts throughout the various drawing figures; wherein;

FIG. **1** is an isometric view of a drop-in trigger module for an AR-pattern firearm according to one embodiment of the invention;

FIG. **2** is a partially cut-away view thereof;

FIG. **3** is a longitudinal section view showing the module of the embodiment installed in a typical AR15-pattern lower receiver in a cocked and ready to fire status with the bolt and bolt carrier in an in-battery position;

FIG. **4** is a similar view in which the trigger has been pulled and the hammer has fallen against a firing pin; and

FIG. **5** is a similar view showing the bolt carrier in a retracted position, forcing the hammer and trigger into a reset status.

DETAILED DESCRIPTION

With reference to the drawing figures, this section describes particular embodiments and their detailed construction and operation. Throughout the specification, reference to "one embodiment," "an embodiment," or "some embodiments" means that a particular described feature, structure, or characteristic may be included in at least one embodiment. Thus, appearances of the phrases "in one embodiment," "in an embodiment," or "in some embodiments" in various places throughout this specification are not necessarily all referring to the same embodiment. Furthermore, the described features, structures, and characteristics may be combined in any suitable manner in one or more embodiments. In view of the disclosure herein, those skilled in the art will recognize that the various embodiments can be practiced without one or more of the specific details or with other methods, components, materials, or the like. In some instances, well-known structures, materials, or operations are not shown or not described in detail to avoid obscuring aspects of the embodiments.

Referring first to FIGS. **1** and **2**, therein is shown at **10** a "drop-in" trigger module adapted for use in an AR-pattern firearm according to a first embodiment of the present invention. As used herein, "AR-pattern" firearm includes the semiautomatic versions of the AR10 and AR15 firearms and variants thereof of any caliber, including pistol caliber carbines or pistols using a blow-back bolt. While select fire (fully automatic capable) versions of this platform, such as the M16 and M4, are also AR-pattern firearms, this invention only relates to semiautomatic firearm actions. The concepts of this invention may be adaptable to other popular semiautomatics firearm platforms, such as the Ruger 10/22™ or AK-pattern variants.

The module **10** includes a frame or housing **12** that may be sized and shaped to fit within the internal fire control mechanism pocket of an AR-pattern lower receiver. It includes first and second pairs of aligned openings **14**, **16** that are located to receive transverse pins (**40**, **36**, respectively, shown in FIGS. **3-5**) used in a standard AR-pattern trigger mechanism as pivot axes for the hammer and trigger member, respectively. The housing **12** includes left and right sidewalls **20**, **22**, which extend substantially vertically and parallel to one another in a laterally spaced-apart relationship. The sidewalls **20**, **22** may be interconnected at the bottom of the housing **12** at the front by a crossmember **24**.

A hammer **18** of ordinary (MIL-SPEC) AR-pattern shape and construction may be used. The illustrated hammer **18** may be standard in all respects and biased by a typical AR-pattern hammer spring (not shown).

A modified trigger member **26** may be sized to fit between the sidewalls **20**, **22** of the housing **12** and may include a trigger blade portion **28** that extends downwardly. The trigger blade portion **28** is the part of the trigger member **26** contacted by a user's finger to actuate the trigger mechanism. The trigger blade portion **28** may be curved (shown) or straight, as desired. The trigger member **26** may pivot on a transverse pin **36** (not shown in FIGS. **1** and **2**) that extends through aligned openings **16** in the sidewalls **20**, **22** of the housing **12**. The same pin **36** is aligned and positioned within aligned openings **47** of a lower receiver **50** to assemble the module **10** into a fire control mechanism pocket **49** of the lower receiver **50**, as shown in FIGS. **3-5**, for example. The modified trigger member **26** may have integral first and second contact surfaces **30**, **32**. Some part of the trigger member **26** includes contact surfaces for interaction with the hammer **18** and locking bar **62**. For example, the trigger member **26** can include first and second upwardly extended rear contact surfaces **30**, **32**. The first contact surface **30** is positioned to interact, for example, with a tail portion **44** of the hammer **18** that extends rearwardly from a head part **42** of the hammer **18**. The second contact surface **32** is positioned to interact with a locking bar **62**. The contact surfaces may be integral to a specially formed trigger body or may be a separate insert (shown) that is made to closely fit and mate with a standard AR-pattern trigger member, held in place by the trigger pin **36**, with no lost motion between the parts.

The hammer **18** may include bosses **34** coaxial with a transverse pivot pin opening **38** that receives an assembly/pivot pin **40** (not shown in FIGS. **1** and **2**) through the first set of aligned openings **14** in the housing **12** (and through openings **51** in the firearm receiver, to position the trigger module **10** within the fire control mechanism pocket **49** of the lower receiver **50**, as shown in FIGS. **3-5**). The bosses **34** may fit between the sidewalls **20**, **22** of the housing **12** to laterally position the hammer **18**, or can be received in the openings **14** (if enlarged) so that the hammer **18** stays assembled with the module **10** when the hammer's pivot pin is removed and/or when the module **10** is not installed in a firearm receiver. The hammer **18** includes a head portion **42** and a tail portion **44**. The hammer **18** also includes a sear catch **46** that engages the sear **48** on the trigger member **26**, when cocked. The trigger and hammer pins **36**, **40** provide pivot axes at locations (openings **47**, **51**, shown in FIGS. **3-5**, for example) standard for an AR-pattern fire control mechanism. Although FIGS. **3-5** are a longitudinal section view and only show one of the aligned openings **47**, **51**, it is understood that a typical AR15-pattern lower receiver **50** includes second, corresponding and aligned openings **47**, **51** in the half of the receiver **50** not shown).

Referring now also to FIG. **3**, the trigger module **10** is shown installed in the fire control mechanism pocket **49** of an AR-pattern lower receiver **50**. Other lower receiver parts not important to the present invention are well-known in the art and are omitted from all figures for clarity. As is well-known in the art, the bolt carrier assembly **52** (or blow-back bolt) would be carried by an upper receiver (not shown) and engage the breach of a barrel or barrel extension. As used herein, "bolt carrier" and "bolt carrier assembly" may be used interchangeably and include a blow-back type bolt used in pistol caliber carbine configurations of the AR-platform. The hammer **18** is shown in a cocked position and a bolt carrier assembly **52** is shown in an in-battery position. The sear **48** engages the sear catch **46** of the hammer **18**.

The bolt carrier assembly **52** used with the embodiments of this invention can be an ordinary (mil-spec) M16-pattern bolt carrier assembly, whether operated by direct impingement or a gas piston system, that has a bottom cut position to engage an auto sear in a fully automatic configuration. The bottom cut creates an engagement surface **54** in a tail portion **56** of the bolt carrier body **58**. This is distinct from a modified AR15 bolt carrier that is further cut-away so that engagement with an auto sear is impossible. The semiautomatic AR-pattern safety selector switch **60** may also be standard (MIL-SPEC) in all respects.

The trigger module of the present invention includes a trigger locking bar **62** carried on a frame **66** for pivotal movement on a transverse pivot pin **68**. The frame **66** may be part of the module housing **12**, if configured as a "drop-in" unit. An upper end of the locking bar **62** extends above the upper edge of the housing **12** and lower receiver **50** to be engaged by the engagement surface **54** of the bolt

carrier body **58** when the bolt carrier assembly **52** is at or near its in-battery position (as shown in FIG. **3**). Contact between the engagement surface **54** and upper end of the locking bar **62** causes the locking bar **62** to pivot into a first position (FIG. **3**) against a biasing spring **70** and allows pivotal movement of the trigger member **26**. If desired, the locking bar **62** may include a rearward extension **64** that serves as a means to limit the extent to which it can pivot toward the blocking position.

Referring now also to FIG. **4**, when the safety selector **60** is in the "fire" position (as shown in all figures), finger pressure pulling rearward against the trigger blade portion **28** causes the trigger member **26** to rotate on the pivot pin **36**, as indicated by arrows. This rotation causes the sear **48** to disengage from the sear catch **46** of the hammer **18**. This release allows the hammer **18** to rotate by spring force (hammer spring omitted for clarity) into contact with the firing pin **72**. Any contact between the rear portion of the trigger member **26** and front surface of the locking bar **62** will simply cause the locking bar **62** to rotate out of the way, as illustrated in FIG. **4**.

Referring now to FIG. **5**, discharging an ammunition cartridge (not shown) causes the action to cycle by moving the bolt carrier assembly **52** rearwardly, as illustrated. The same effect occurs when the action is cycled manually. As in an ordinary AR15-pattern configuration, a lower surface **76** of the bolt carrier body **58** pushes rearwardly against the head portion **42** of the hammer **18**, forcing it to pivot on the hammer pivot/assembly pin **40** against its spring (not shown) toward a reset position. As the rearward movement of the bolt carrier body **58** and pivotal movement of the hammer **18** continues, mechanical interference or contact between a rear surface **74** of the hammer **18** (such as on the tail portion **44**) and a contact surface **30** of the trigger member **26** forces the trigger to pivot (arrows in FIG. **5**) toward and to its reset position. At the same time, as the trigger member **26** is reset, the biasing spring **70** moves the lower end of the locking bar **62** into a second position (FIG. **5**) in which it blocks pivotal movement of the trigger **26**, including by finger pressure applied (or reapplied) to the trigger blade **28**. Thus, as the bolt carrier assembly **52** returns forward, the trigger member **26** is held in its reset position by the locking bar **62** where the hammer sear catch **46** will engage with the sear **48** carried on the trigger member **26** to reset the fire control mechanism. The trigger member **26** cannot be pulled to release the sear/hammer engagement, thus precluding early hammer release or "hammer follow" against the bolt carrier assembly **52** and firing pin **72** as the bolt carrier assembly **52** is returning to battery. A trigger return spring (not shown) of the type used in a standard AR-pattern trigger mechanism may be unnecessary in this case, because the trigger member **26** is forced to return by the hammer **18**, but may be used, if desired.

When the bolt carrier assembly **52** has reached (or nearly reached) its closed, in-battery position (shown in FIG. **3**), the engagement surface **54** of the bolt carrier tail portion **56** contacts and forwardly displaces the upper end of the locking bar **62**, disengaging the second contact surface **32** of the trigger member **26**, allowing the trigger **26** to be pulled a second time. The distance of travel during which there is no interference between the locking bar **62** and second contact surface **32** of the trigger member **26**, allowing the trigger member **26** to be manually displaced, may be about from about 0.10 to 0.31 inch. This prevents early release of the hammer **18** and contact of the hammer against the firing pin **72** before the bolt is completely locked and in-battery.

Force applied by the user's trigger finger against the trigger blade portion **28** is incapable of overcoming the mechanical interference and force of the hammer **18** against the contact surface **30** of the trigger member **26**. However, the trigger can immediately be pulled again—only by application of an external force—as soon as the locking bar **62** has been rotated against the spring **70** and out of blocking engagement with the trigger member **26**, as the bolt carrier assembly **52** approaches or reaches its in-battery position. This allows the highest possible standard rate of fire, without risk of hammer-follow, for the semiautomatic action of the firearm.

While various embodiments of the present invention have been described in detail, it should be apparent that modifications and variations thereto are possible, all of which fall within the true spirit and scope of the invention. Therefore, the foregoing is intended only to be illustrative of the principles of the invention. Further, since numerous modifications and changes will readily occur to those skilled in the art, it is not intended to limit the invention to the exact construction and operation shown and described. Accordingly, all suitable modifications and equivalents may be included and considered to fall within the scope of the invention, defined by the following claim or claims.

What is claimed is:

1. For a firearm having a receiver with a fire control mechanism pocket, transversely aligned pairs of hammer and trigger pin openings in side walls of the pocket, and a bolt carrier that reciprocates and pivotally displaces a hammer when cycled, a trigger mechanism, comprising:

a hammer having a sear notch and mounted in the fire control mechanism pocket to pivot on a transverse hammer pin between set and released positions;

a trigger member having a sear and mounted in the fire control mechanism pocket to pivot on a transverse trigger pin between set and released positions, the trigger member having a surface positioned to be contacted by the hammer when the hammer is displaced by cycling of the bolt carrier, the contact causing the trigger member to be forced to the set position;

a locking bar pivotally mounted in a frame and spring biased toward a first position in which the locking bar mechanically blocks the trigger member from moving to the released position, and movable against the spring bias to a second position when contacted by the bolt carrier reaching a substantially in-battery position, allowing the trigger member to be moved by an external force to the released position.

2. The trigger mechanism of claim **1**, wherein the trigger member has a second surface positioned to be contacted by the locking bar when the locking bar is in the first position.

3. The trigger mechanism of claim **1**, wherein the locking bar includes means for limiting the extent to which the locking bar can pivot by the spring bias toward the first position.

4. For a firearm having a receiver with a fire control mechanism pocket, assembly pin openings in side walls of the pocket, and a bolt carrier that reciprocates and pivotally displaces a hammer when cycled, a trigger mechanism, comprising:

a housing having transversely aligned pairs of openings for receiving hammer and trigger assembly pins;

a hammer having a sear notch and mounted in the housing to pivot on a transverse axis between set and released positions;

a trigger member having a sear and mounted in the housing to pivot on a transverse axis between set and

released positions, the trigger member having a surface positioned to be contacted by the hammer when the hammer is displaced by the bolt carrier when cycled, the contact causing the trigger member to be forced to the set position;

a locking bar pivotally mounted in the housing and spring biased toward a first position in which the locking bar mechanically blocks the trigger member from moving to the released position, and movable against the spring bias to a second position when contacted by the bolt carrier reaching a substantially in-battery position in which the trigger member can be moved by an external force to the released position.

5. The trigger mechanism of claim **4**, wherein the trigger member has a second surface positioned to be contacted by the locking bar when the locking bar is in the first position.

6. The trigger mechanism of claim **4**, wherein the housing's transversely aligned pairs of openings for receiving hammer and trigger assembly pins are aligned with the assembly pin openings in the fire control mechanism pocket of the receiver.

7. The trigger mechanism of claim **4**, wherein the locking bar includes means for limiting the extent to which the locking bar can pivot by the spring bias toward the first position.

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