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**Bender**

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(54) **TWO-STAGE TRIGGER ARRANGEMENT**

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***F41A 19/45*** (2006.01)

(52) **U.S. Cl.**
CPC ..... ***F41A 19/45*** (2013.01)

(58) **Field of Classification Search**
CPC ..... F41A 19/14; F41A 19/15; F41A 19/44; F41A 19/45
See application file for complete search history.

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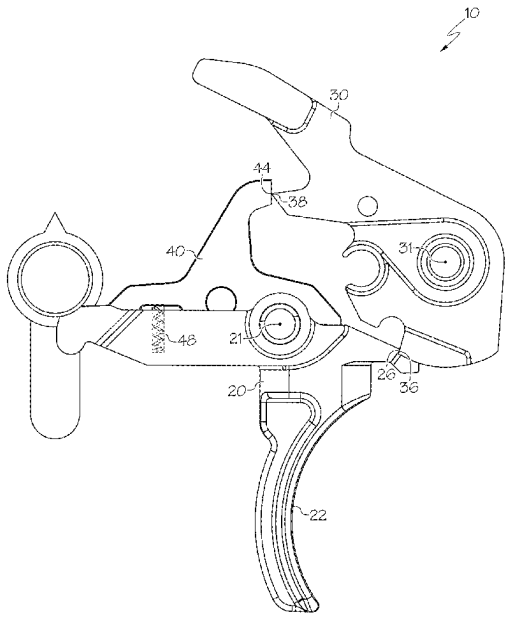
(57) **ABSTRACT**

In some embodiments, a fire control mechanism comprises a trigger, a hammer and a disconnector. The trigger comprises a trigger sear and is arranged to rotate about a trigger axis. The hammer comprises a hammer sear and a secondary sear and is arranged to rotate about a hammer axis. The disconnector comprises a disconnector sear and is arranged to move with respect to the trigger. The fire control mechanism comprises an orientation wherein the trigger sear contacts the hammer sear and the secondary sear contacts the disconnector sear.

**15 Claims, 8 Drawing Sheets**



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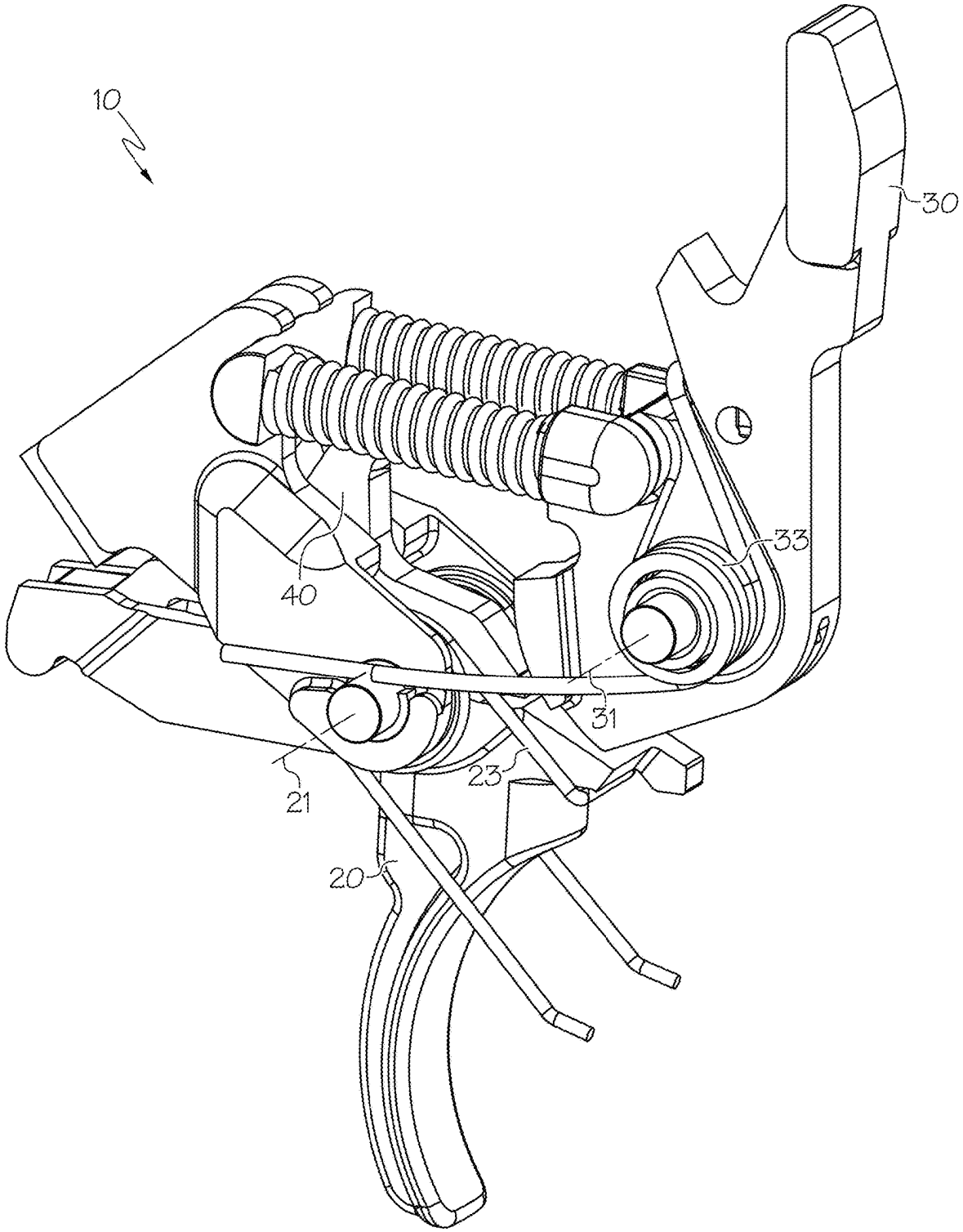



FIG. 1

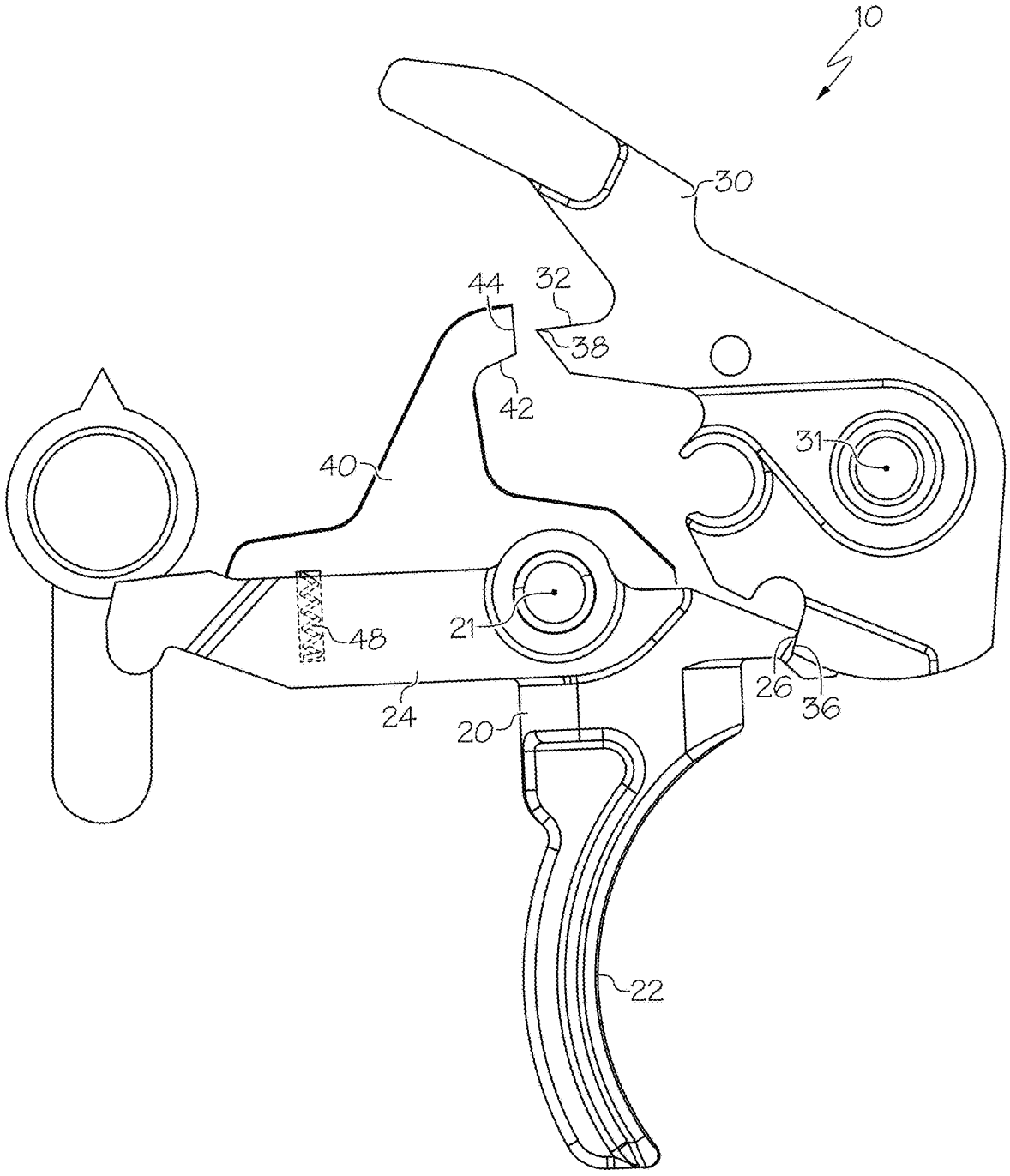



FIG. 2

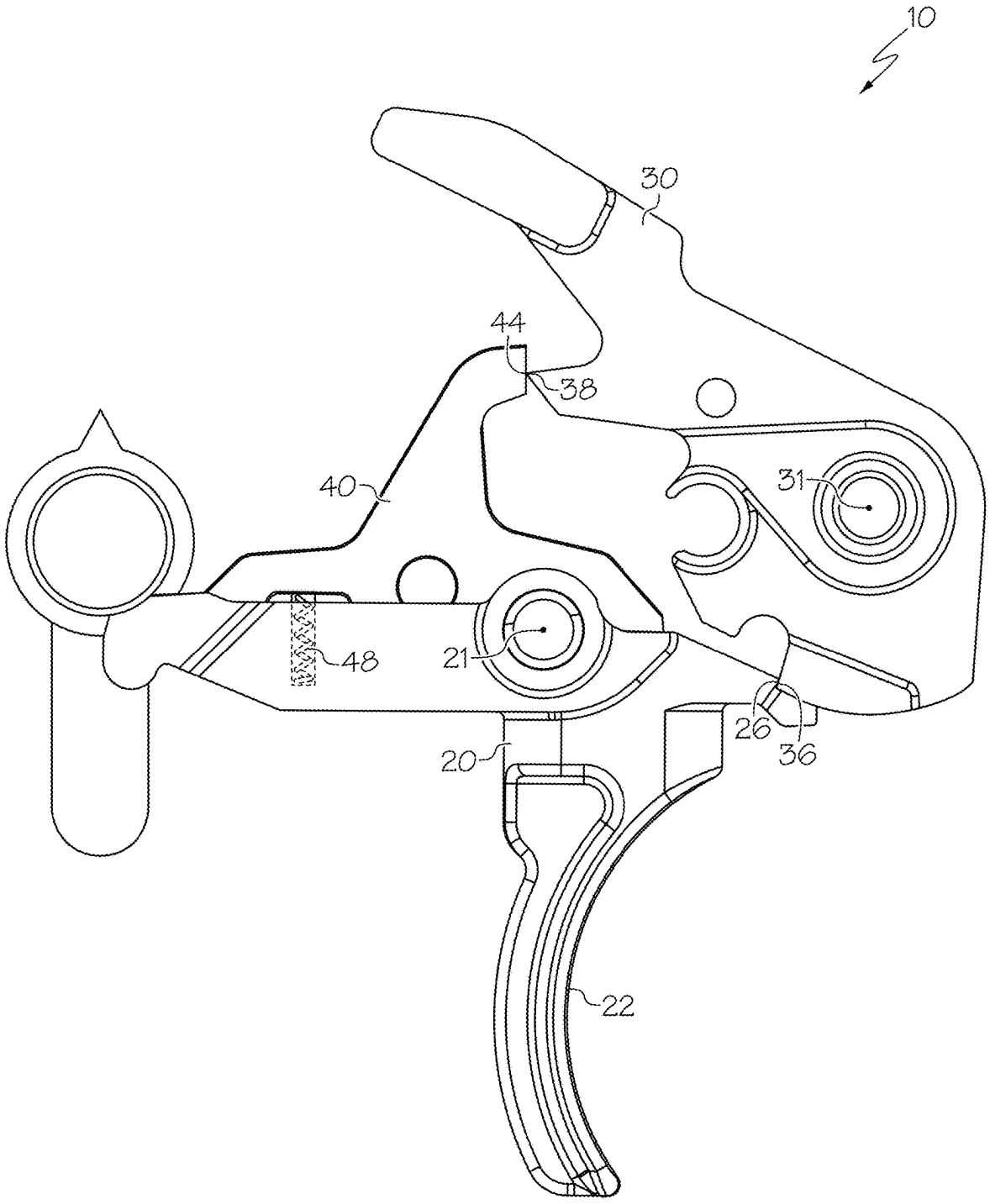



FIG. 3

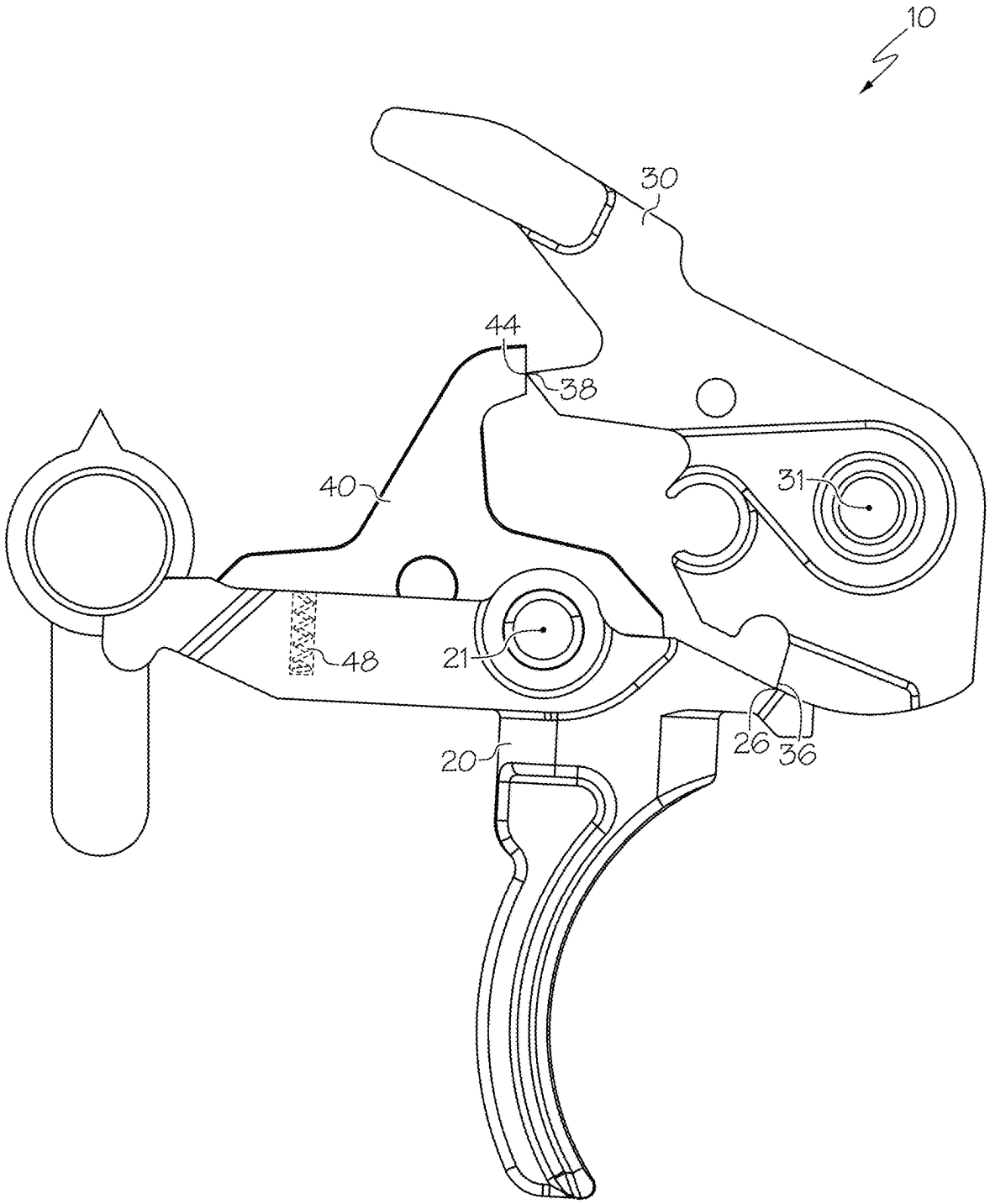



FIG. 4

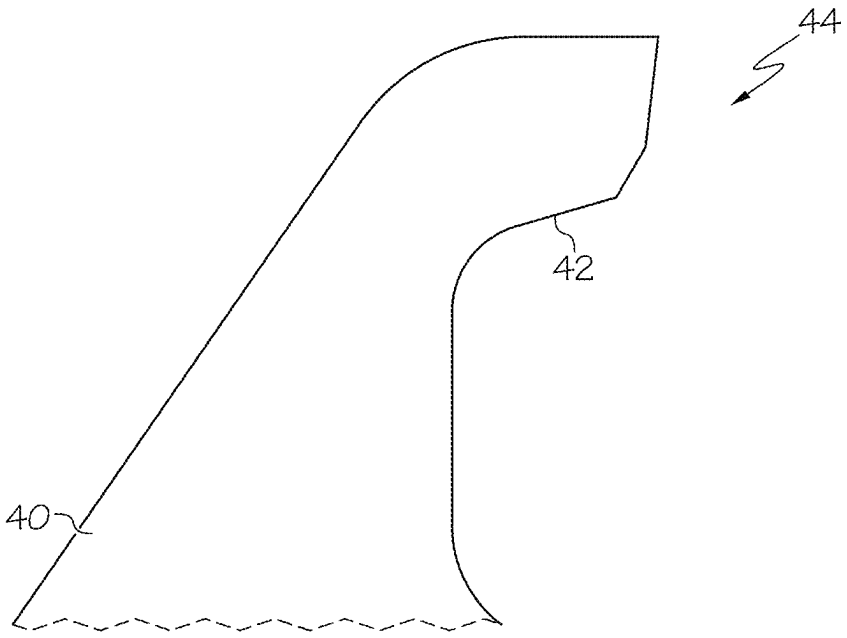



FIG. 5

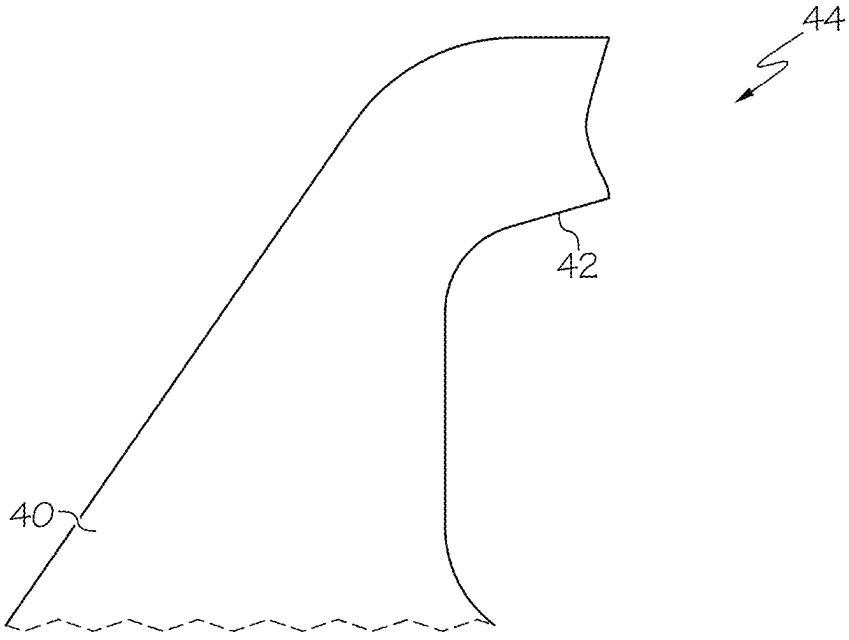



FIG. 6

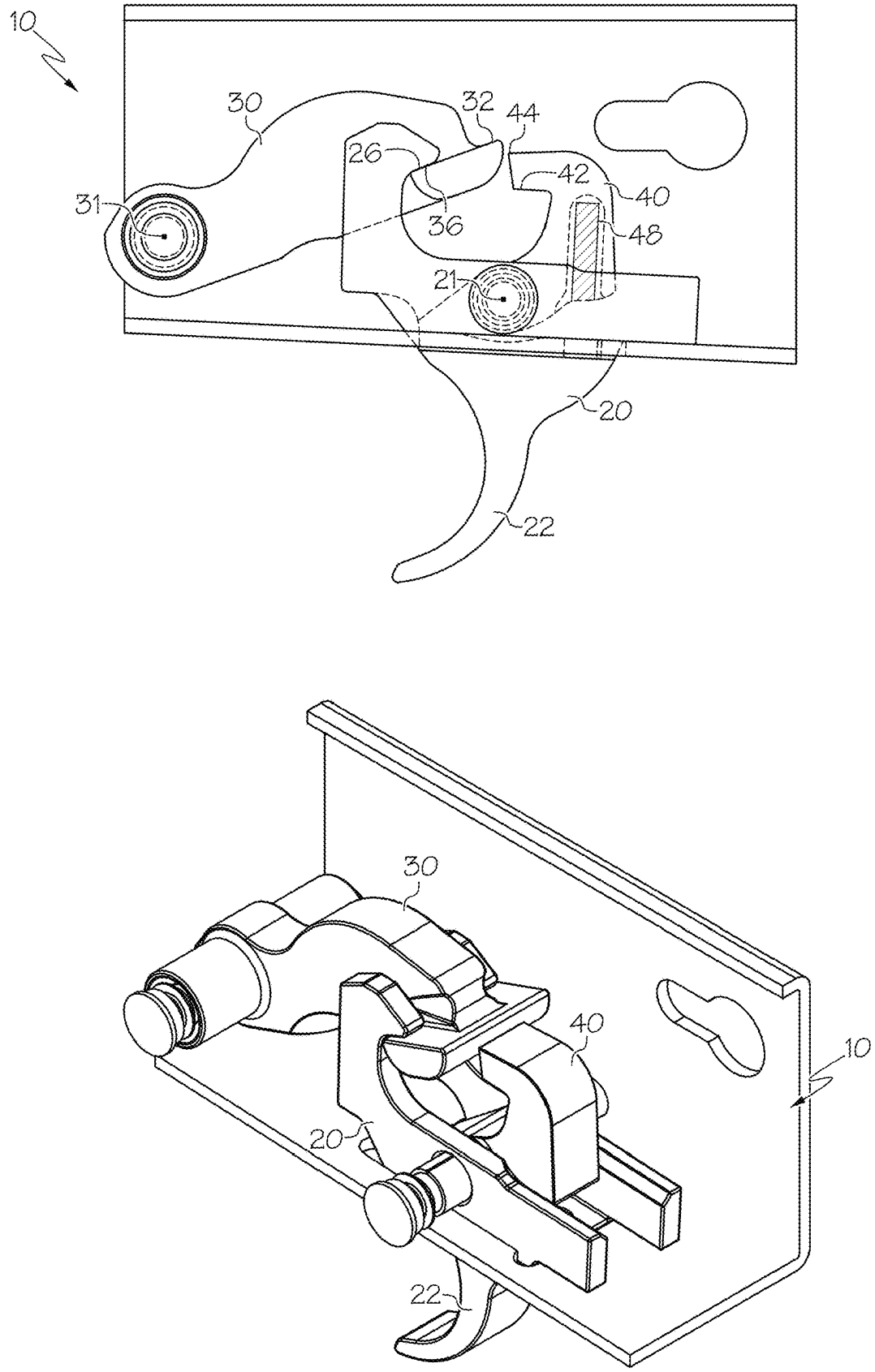



FIG. 7

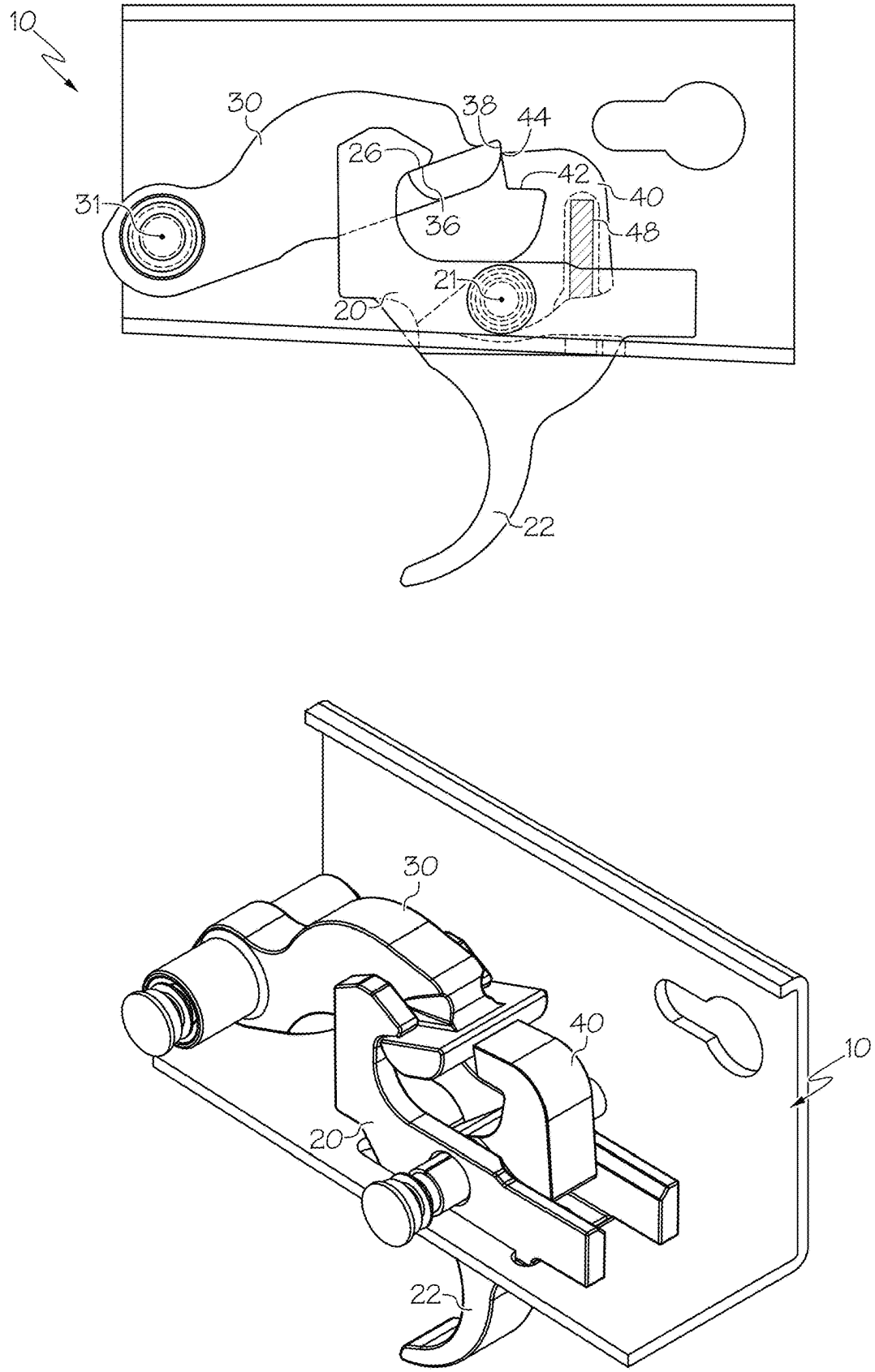
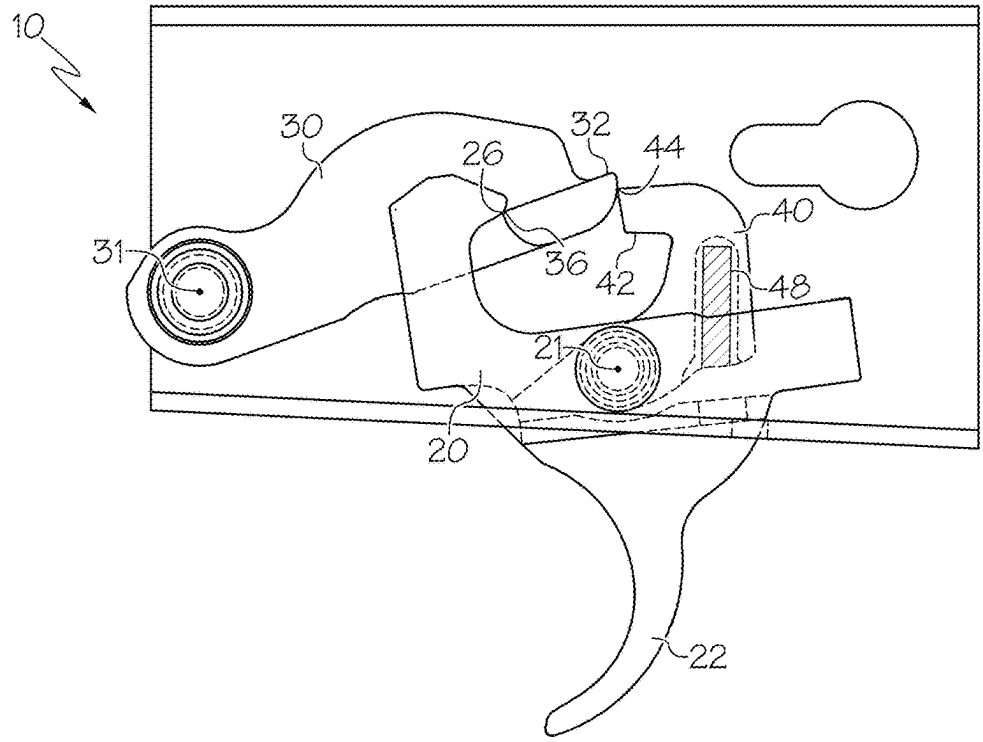



FIG. 8



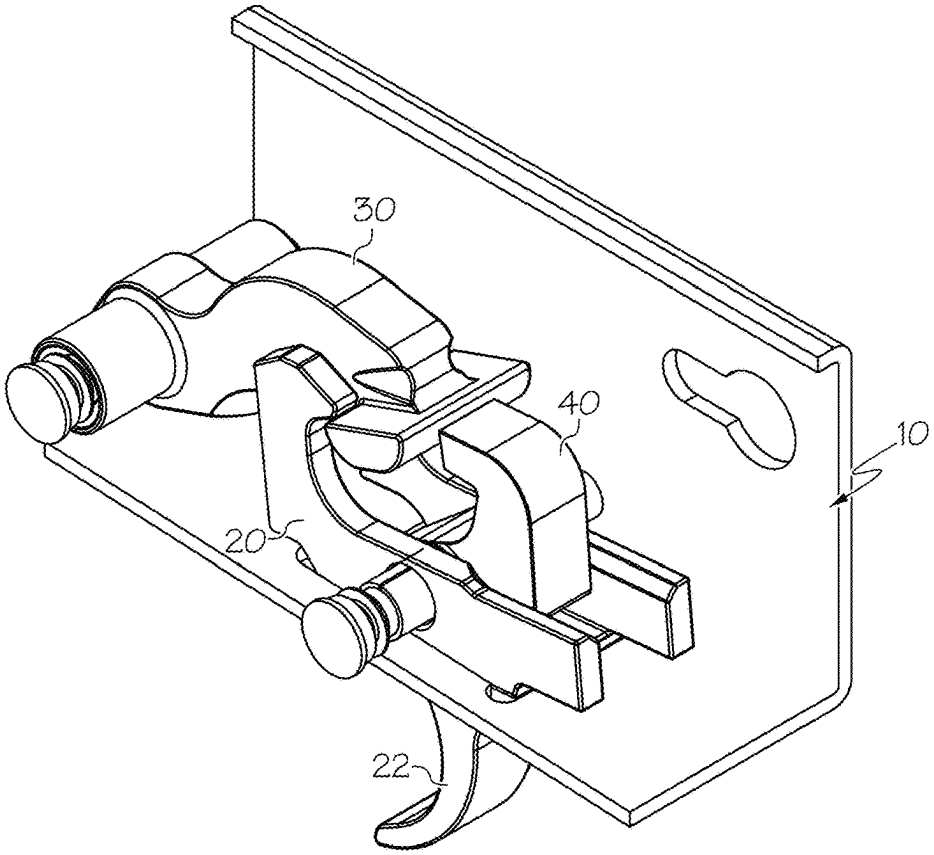




FIG. 9

# TWO-STAGE TRIGGER ARRANGEMENT

## CROSS-REFERENCE TO RELATED APPLICATIONS

This application claims the benefit of U.S. Patent Application No. 63/048,055, filed Jul. 3, 2020, the entire content of which is hereby incorporated herein by reference.

## BACKGROUND OF THE INVENTION

This invention relates generally to firearms and more specifically to trigger and fire control systems for firearms.

Fire control systems are generally used to control the release of bullets from a gun. A fire control system is limited by the specifics of the gun at issue. A gun can provide a housing cavity of predetermined size, with preset locations for a hammer, a trigger, a safety mechanism. The fire control system will typically impact a firing pin. Different guns, such as AR-style guns, AK-style guns, etc., often have fire control systems configured differently from one another. Within a single type of gun, such as an AR-style gun, there can be many different fire control designs that are each suitable to control firing but are different from one another in various ways. Various designs will have different benefits and drawbacks. For example, a very precise, light-pull trigger may be more susceptible to carbon fouling than a mil-spec trigger.

There remains a need for novel fire control arrangements that provide improvements over known designs in trigger feel, shooting experience and product longevity.

All US patents and applications and all other published documents mentioned anywhere in this application are incorporated herein by reference in their entirety.

Without limiting the scope of the invention a brief summary of some of the claimed embodiments of the invention is set forth below. Additional details of the summarized embodiments of the invention and/or additional embodiments of the invention may be found in the Detailed Description of the Invention below.

A brief abstract of the technical disclosure in the specification is provided as well only for the purposes of complying with 37 C.F.R. 1.72. The abstract is not intended to be used for interpreting the scope of the claims.

## BRIEF SUMMARY OF THE INVENTION

In some embodiments, a fire control mechanism comprises a trigger, a hammer and a disconnector. The trigger comprises a trigger sear and is arranged to rotate about a trigger axis. The hammer comprises a hammer sear and a secondary sear and is arranged to rotate about a hammer axis. The disconnector comprises a disconnector sear and is arranged to move with respect to the trigger. The fire control mechanism comprises an orientation wherein the trigger sear contacts the hammer sear and the secondary sear contacts the disconnector sear.

In some embodiments, the disconnector comprises a catch. In some embodiments, the catch is arranged to capture the hammer after a round is fired.

In some embodiments, the fire control mechanism comprises an orientation wherein the trigger sear contacts the hammer sear and the secondary sear does not contact the disconnector sear.

In some embodiments, a disconnector spring is compressed while the trigger sear contacts the hammer sear.



In some embodiments, a fire control mechanism comprises a trigger, a hammer and a disconnector. The trigger comprises a trigger sear and is arranged to rotate about a trigger axis. The hammer comprises a hammer sear and a secondary sear and is arranged to rotate about a hammer axis. The disconnector comprises a disconnector sear and is arranged to rotate about the trigger axis. The fire control mechanism comprises a first stage and a second stage. In the first stage, the hammer sear contacts the trigger sear. In the second stage, the hammer sear contacts the trigger sear and the secondary sear contacts the disconnector sear.

In some embodiments, disconnector comprises a catch that is oriented at an angle to the disconnector sear.

These and other embodiments which characterize the invention are pointed out with particularity in the claims annexed hereto and forming a part hereof. However, for a better understanding of the invention, its advantages and objectives obtained by its use, reference can be made to the drawings which form a further part hereof and the accompanying descriptive matter, in which there are illustrated and described various embodiments of the invention.

## BRIEF DESCRIPTION OF THE DRAWINGS

A detailed description of the invention is hereafter described with specific reference being made to the drawings.

FIG. **1** shows an embodiment of a fire control mechanism.

FIG. **2** shows an embodiment of a fire control mechanism in a first orientation.

FIG. **3** shows an embodiment of a fire control mechanism in a second orientation.

FIG. **4** shows an embodiment of a fire control mechanism in a third orientation.

FIGS. **5** and **6** show embodiments of a disconnector.

FIGS. **7-9** show another embodiment of the fire control mechanism.

## DETAILED DESCRIPTION OF THE INVENTION

While this invention may be embodied in many different forms, there are described in detail herein specific embodiments of the invention. This description is an exemplification of the principles of the invention and is not intended to limit the invention to the particular embodiments illustrated.

For the purposes of this disclosure, like reference numerals in the figures shall refer to like features unless otherwise indicated.

FIG. **1** shows an embodiment of a fire control mechanism **10**. In some embodiments, a fire control mechanism **10** is configured for use in an AR-15 style firearm.

In some embodiments, a fire control mechanism **10** comprises a trigger **20** arranged to rotate about a trigger axis **21** and a hammer **30** arranged to rotate about a hammer axis **31**. In some embodiments, the hammer **30** is biased in a predetermined direction (e.g. clockwise) by a hammer spring **33**. In some embodiments, the trigger **20** is biased in a predetermined direction (e.g. counter-clockwise) by a trigger spring **23**. In some embodiments, a fire control mechanism **10** comprises a disconnector **40** arranged to rotate about the trigger axis **21**. In some embodiments, the disconnector **40** is arranged to capture the hammer **30** while the trigger **20** remains depressed after firing a round.

In some embodiments, a fire control mechanism **10** comprises features as disclosed in U.S. Pat. Nos. 8,572,880,

9,696,103 and/or U.S. Ser. No. 10/222,161, the entire disclosures of which are hereby incorporated herein in their entireties.

FIG. **2** shows an embodiment of a fire control mechanism **10** in a first orientation. In some embodiments, a first orientation represents a cocked or ready-to-fire orientation.

In some embodiments, the trigger **20** comprises a finger portion **22** and an arm **24**. In some embodiments, the finger portion **22** extends away from the trigger axis **21** in a first direction and the arm **24** extends away from the trigger axis **21** in a second direction. In some embodiments, a user can apply a force to the finger portion **22** to operate the fire control mechanism **10**.

In some embodiments, the disconnector **40** is moveable with respect to the trigger **20**. In some embodiments, the disconnector **40** is rotatable with respect to the trigger **20** about a disconnector axis **41**. In some embodiments, the disconnector axis **41** is offset from the trigger axis **21** (not shown). In some embodiments, the disconnector **40** is supported by the trigger **20**.

In some embodiments, the trigger **20** is supported by a trigger pin **27**. In some embodiments, the disconnector **40** is supported by the trigger pin **27**. In some embodiments, the disconnector axis **41** is collinear with the trigger axis **21**, and both the trigger **20** and the disconnector **40** are arranged to rotate about the trigger axis **21**. In some embodiments, the disconnector **40** is rotatable with respect to the trigger **20** about the trigger axis **21** between first and second positions. In some embodiments, a disconnector spring **48** is arranged to bias the disconnector **40** to the first position. In some embodiments, the disconnector spring **48** is arranged to bias the disconnector **40** in a first direction (e.g. clockwise) about the trigger axis **21**. In some embodiments, the disconnector spring **48** biases the disconnector **40** away from the trigger **20**. In some embodiments, the disconnector spring **48** comprises a compression spring positioned between the disconnector **40** and the trigger **20**. In some embodiments, a first end of the disconnector spring **48** contacts the disconnector **40** and a second end of the disconnector spring **48** contacts the arm **24** of the trigger **20**.

In some embodiments, the first and second positions of the disconnector **40** with respect to the trigger **20** represent end stop positions of travel of the disconnector **40**. In some embodiments, the disconnector spring **48** is fully extended when the disconnector **40** is in the first position. In some embodiments, the disconnector spring **48** becomes loaded, or becomes subject to a greater amount of load, when the disconnector **40** moves from the first position. In some embodiments, the disconnector spring **48** is under the most load when the disconnector **40** is in the second position.

In some embodiments, the trigger **20** comprises a trigger sear **26** and the hammer **30** comprises a hammer sear **36**. In some embodiments, the trigger sear **26** contacts the hammer sear **36** in the first orientation as shown in FIG. **2**. In some embodiments, a force can be applied to the finger portion **22** of the trigger **20**, causing the trigger **20** to rotate about the trigger axis **21**, which causes the trigger sear **26** to slide along the hammer sear **36**. When the trigger **20** has rotated enough for the trigger sear **26** to clear the hammer sear **36**, the hammer **30** will fall (i.e. rotate, for example due to force provided by the hammer spring **33**—see FIG. **1**).

In some embodiments, the fire control mechanism **10** comprises a two-stage mechanism having two stages of operation or two stages of trigger **20** travel. In some embodiments, the pull weight required to rotate the trigger **20** about the trigger axis **21** in the second stage is different from the pull weight required to rotate the trigger **20** about the trigger axis **21** in the first stage. In some embodiments, the second stage requires a greater amount of force than the first stage.

In some embodiments, a full cycle of the fire control mechanism **10** comprises a first stage of trigger **20** travel, a second stage of trigger **20** travel, break/hammer **30** fall, catch and reset. The stages of trigger **20** travel are discussed with respect to FIGS. **2-4**. In some embodiments, the break stage generally causes the hammer **30** to fall, which in turn fires a round and causes the associated firearm action to cycle, blowing back the hammer **30** and causing the hammer **30** to rotate in a second direction back toward the trigger **20** (e.g. counter-clockwise in FIG. **2**). The hammer **30** contacts and displaces the disconnector **40**, moving the disconnector **40** from its first position with respect to the trigger **20** as the hammer **30** moves past the disconnector **40** and reaches the end of its travel in the second direction. The hammer **30** then rotates in the first direction (e.g. clockwise), for example under the force of the hammer spring **33** (see FIG. **1**), leading to the catch stage of operation. In some embodiments, the catch **42** of the disconnector **40** engages a hammer catch **32** portion of the hammer **30**, allowing the disconnector **40** to stop movement of the hammer **30**. In some embodiments, the disconnector **40** catch **42** will remain engaged with the hammer **30** until the user releases the finger portion **22** of the trigger, which allows the fire control mechanism **10** to reset. As force is lifted from the finger portion **22**, the trigger **20** and disconnector **40** rotate about the trigger axis **21**, allowing the hammer catch **32** to clear the disconnector **40** catch **42**. In some embodiments, the fire control mechanism **10** is reset to the first orientation as shown in FIG. **2**, with the trigger sear **26** contacting the hammer sear **36**.

In some embodiments, the hammer sear **36** comprises a surface that is spaced apart from the hammer catch **32**. In some embodiments, the hammer sear **36** comprises a surface that is oriented at an angle to the hammer catch **32** surface.

FIG. **3** shows the fire control mechanism **10** of FIG. **2** in a second orientation. In some embodiments, the first stage of trigger **20** travel comprises the movement of components from the first orientation (FIG. **2**) to the second orientation (FIG. **3**). In the first and second orientations, the disconnector **40** is in its first position with respect to the trigger **20**. In the second orientation, the trigger **20** and disconnector **40** have rotated about the trigger axis **21** in a first direction (e.g. clockwise) when compared to the first orientation.

In some embodiments, the hammer **30** comprises a secondary sear **38**. In some embodiments, the disconnector **40** comprises a disconnector sear **44**. In some embodiments, the secondary sear **38** contacts the disconnector sear **44**. In some embodiments, in the second orientation (FIG. **3**) the secondary sear **38** contacts the disconnector sear **44** and simultaneously the trigger sear **26** contacts the hammer sear **36**.

In some embodiments, the second orientation as shown in FIG. **3** comprises a transition from the first stage to the second stage of operation. In some embodiments, movement of the trigger **20** beyond the second orientation (e.g. into the second stage) requires further rotation of the trigger **20** about the trigger axis **21**; however, due to contact between the disconnector **40** and the hammer **30**, the disconnector **40** must be displaced from its first position with respect to the trigger **20** to achieve further rotation of the trigger **20**. Thus, in some embodiments, the disconnector spring **48** must be loaded or compressed during the second stage of operation.

FIG. **4** shows the fire control mechanism **10** of FIG. **2** in a third orientation. In some embodiments, the second stage of trigger **20** travel comprises the movement of components from the second orientation (FIG. **3**) to the third orientation

(FIG. **4**). In some embodiments, in the third orientation, the disconnector **40** has been displaced from its first position with respect to the trigger **20**. In some embodiments, in the third orientation, the disconnector spring **48** is compressed. In some embodiments, movement of the trigger **20** through the second stage of operation requires the pull force required to move the trigger **20** through the first stage of operation plus the pull force required to displace the disconnector **40**.

FIG. **4** shows an orientation near the end of the second stage, with the trigger sear **26** close to clearing the hammer sear **36**. Further rotation of the trigger **20** in the first direction (e.g. clockwise) will allow the hammer **30** to fall.

In some embodiments, a shape of the disconnector **40** can be adjusted to adjust the trigger pull forces required in the second stage. In some embodiments, a shape of the disconnector sear **44** can be adjusted to adjust the trigger pull forces required in the second stage. In some embodiments, a shape of the hammer **30** can be adjusted to adjust the trigger pull forces required in the second stage. In some embodiments, a shape of the secondary sear **38** can be adjusted to adjust the trigger pull forces required in the second stage. In some embodiments, the disconnector spring **48** can be adjusted, for example increasing or decreasing spring force, to adjust the trigger pull forces required in the second stage. Any suitable geometry can be used for these components to achieve any suitable trigger pull force and travel distance profile.

In some embodiments, the disconnector sear **44** comprises a bearing surface that bears against the secondary sear **38** of the hammer **30**. In some embodiments, the secondary sear **38** comprises a bearing surface that bears against the disconnector sear **44**. In some embodiments, the disconnector sear **44** comprises a surface that slides along the secondary sear **38**. In some embodiments, the secondary sear **38** comprises a surface that slides along the disconnector sear **44**.

FIGS. **5** and **6** show additional embodiments of a disconnector **40**. In some embodiments, a disconnector sear **44** comprises a flat surface. In some embodiments, a disconnector sear **44** comprises a planar surface. In some embodiments, a disconnector sear **44** comprises a curved surface. In some embodiments, a disconnector sear **44** comprises an angled surface. In some embodiments, the disconnector sear **44** is oriented at an angle to the disconnector catch **42**.

FIGS. **7-9** show another embodiment of a fire control mechanism **10**.

In some embodiments, a fire control mechanism **10** is configured for use in an AK-style firearm.

In some embodiments, a hammer **30** comprises a surface comprising the hammer sear **36** and the hammer catch **32**.

The above disclosure is intended to be illustrative and not exhaustive. This description will suggest many variations and alternatives to one of ordinary skill in this field of art. All these alternatives and variations are intended to be included within the scope of the claims where the term "comprising" means "including, but not limited to." Those familiar with the art may recognize other equivalents to the specific embodiments described herein which equivalents are also intended to be encompassed by the claims.

Further, the particular features presented in the dependent claims can be combined with each other in other manners within the scope of the invention such that the invention should be recognized as also specifically directed to other embodiments having any other possible combination of the features of the dependent claims. For instance, for purposes of claim publication, any dependent claim which follows should be taken as alternatively written in a multiple dependent form from all prior claims which possess all antecedents referenced in such dependent claim if such multiple dependent format is an accepted format within the jurisdiction (e.g. each claim depending directly from claim **1** should be alternatively taken as depending from all previous claims). In jurisdictions where multiple dependent claim formats are restricted, the following dependent claims should each be also taken as alternatively written in each singly dependent claim format which creates a dependency from a prior antecedent-possessing claim other than the specific claim listed in such dependent claim below.

This completes the description of the preferred and alternate embodiments of the invention. Those skilled in the art may recognize other equivalents to the specific embodiment described herein which equivalents are intended to be encompassed by the claims attached hereto.

The invention claimed is:

**1**. A fire control mechanism comprising:

a trigger arranged to rotate about a trigger axis, the trigger comprising a trigger sear;

a hammer arranged to rotate about a hammer axis, the hammer comprising a hammer sear and a secondary sear; and

a disconnector arranged to move with respect to the trigger, the disconnector comprising a disconnector sear and a catch, the disconnector sear oriented at an angle to the catch;

a first reference plane extending through the trigger axis and the hammer axis;

the fire control mechanism comprising an orientation wherein the trigger sear contacts the hammer sear, and the secondary sear contacts the disconnector sear, the hammer sear is located to a first side of the first reference plane and the secondary sear is located to a second side of the first reference plane;

the disconnector sear comprising a planar surface defining a second reference plane, the second reference plane intersecting the first reference plane at an intersection, wherein the intersection and the hammer axis are located on opposite sides of the trigger axis.

**2**. The fire control mechanism of claim **1**, the catch arranged to capture the hammer after a round is fired.

**3**. The fire control mechanism of claim **1**, the orientation comprising a second orientation, the fire control mechanism comprising a first orientation wherein the trigger sear contacts the hammer sear and the secondary sear does not contact the disconnector sear.

**4**. The fire control mechanism of claim **3**, the disconnector moveable with respect to the trigger between first and second positions, the disconnector in the first position in the second orientation.

**5**. The fire control mechanism of claim **4**, the disconnector in the first position in the first orientation.

**6**. The fire control mechanism of claim **4**, the fire control mechanism comprising a third orientation wherein the trigger sear contacts the hammer sear, the secondary sear contacts the disconnector sear and the disconnector is not in the first position.

**7**. The fire control mechanism of claim **6**, comprising a disconnector spring, the disconnector spring fully extended in the first position.

**8**. The fire control mechanism of claim **7**, the disconnector spring compressed in the second orientation.

**9**. The fire control mechanism of claim **1**, the disconnector arranged to rotate about the trigger axis.

**10**. The fire control mechanism of claim **9**, the trigger and disconnector supported by a trigger pin.

11. The fire control mechanism of claim 1, the disconnector arranged to rotate about a disconnector axis, the disconnector axis offset from the trigger axis.

12. The fire control mechanism of claim 1, the disconnector supported by the trigger.

13. A fire control mechanism comprising:

a trigger arranged to rotate about a trigger axis, the trigger comprising a trigger sear;

a hammer arranged to rotate about a hammer axis, the hammer comprising a hammer sear and a secondary sear; and

a disconnector arranged to rotate about the trigger axis, the disconnector comprising a disconnector sear;

a first reference plane extending through the trigger axis and the hammer axis;

the fire control mechanism comprising a first stage and a second stage, in the first stage, the hammer sear contacts the trigger sear, in the second stage, the hammer sear contacts the trigger sear, and the secondary sear contacts the disconnector sear, the hammer sear is located to a first side of the first reference plane and the secondary sear is located to a second side of the first reference plane;

the disconnector sear comprising a planar surface defining a second reference plane, the second reference plane intersecting the first reference plane at an intersection, wherein the intersection and the hammer axis are located on opposite sides of the trigger axis.

14. The fire control mechanism of claim 13, comprising a disconnector spring, wherein the disconnector spring is compressed during the second stage.

15. The fire control mechanism of claim 13, the disconnector comprising a catch, the catch oriented at an angle to the disconnector sear.

* * * * *