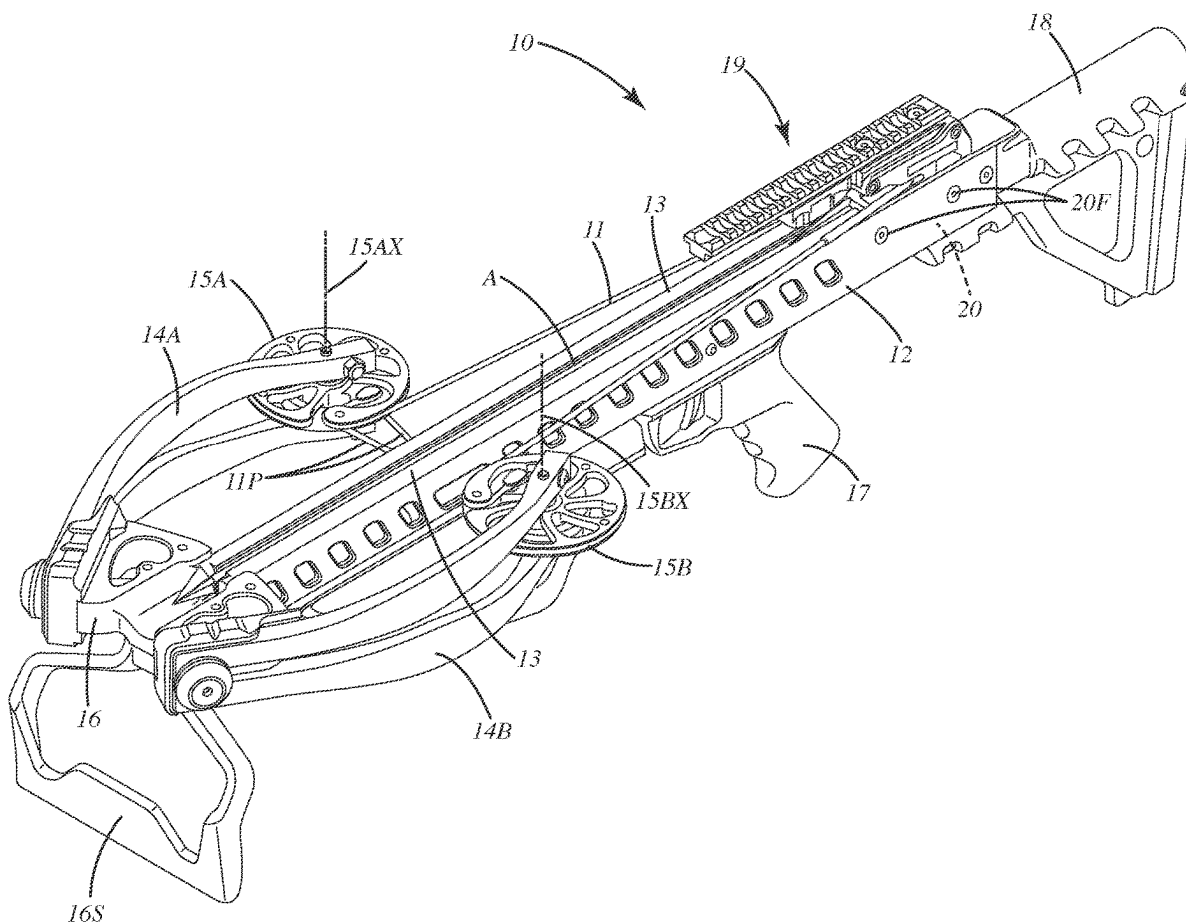




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(19) **United States**(12) **Patent Application Publication**  
**Pestruie et al.**(10) **Pub. No.: US 2025/0257975 A1**(43) **Pub. Date: Aug. 14, 2025**(54) **CROSSBOW DE-COCKER AND RELATED  
METHOD OF USE**(52) **U.S. Cl.**CPC ..... **F41B 5/1469** (2013.01); **F41B 5/123**  
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(US)(72) Inventors: **Jeffrey A. Pestruie**, St. Louis, MI (US);  
**David McNeil**, Grant, MI (US)(21) Appl. No.: **18/441,511**(22) Filed: **Feb. 14, 2024****Publication Classification**(51) **Int. Cl.****F41B 5/14** (2006.01)**F41B 5/12** (2006.01)(57) **ABSTRACT**

A crossbow can include a de-cocking system to allow a bowstring to be transitioned from a drawn mode to an undrawn mode. The de-cocking system can include a sled that engages the bowstring to draw it to a drawn mode and/or lets down the bowstring to the undrawn mode during a de-cocking operation. The sled can include a stop that prevents the sled or bowstring from engaging a safety and/or interfering with transition of the safety from a safety on mode to a safety off mode. The safety can be manually actuated from the safety on mode to the safety off mode. With the safety in the off mode, upon actuation of a trigger assembly, the sled assists transition of the bowstring to the undrawn mode. The stop can be reconfigured to a neutral mode so the sled can be used to draw the bowstring. A related method is provided.



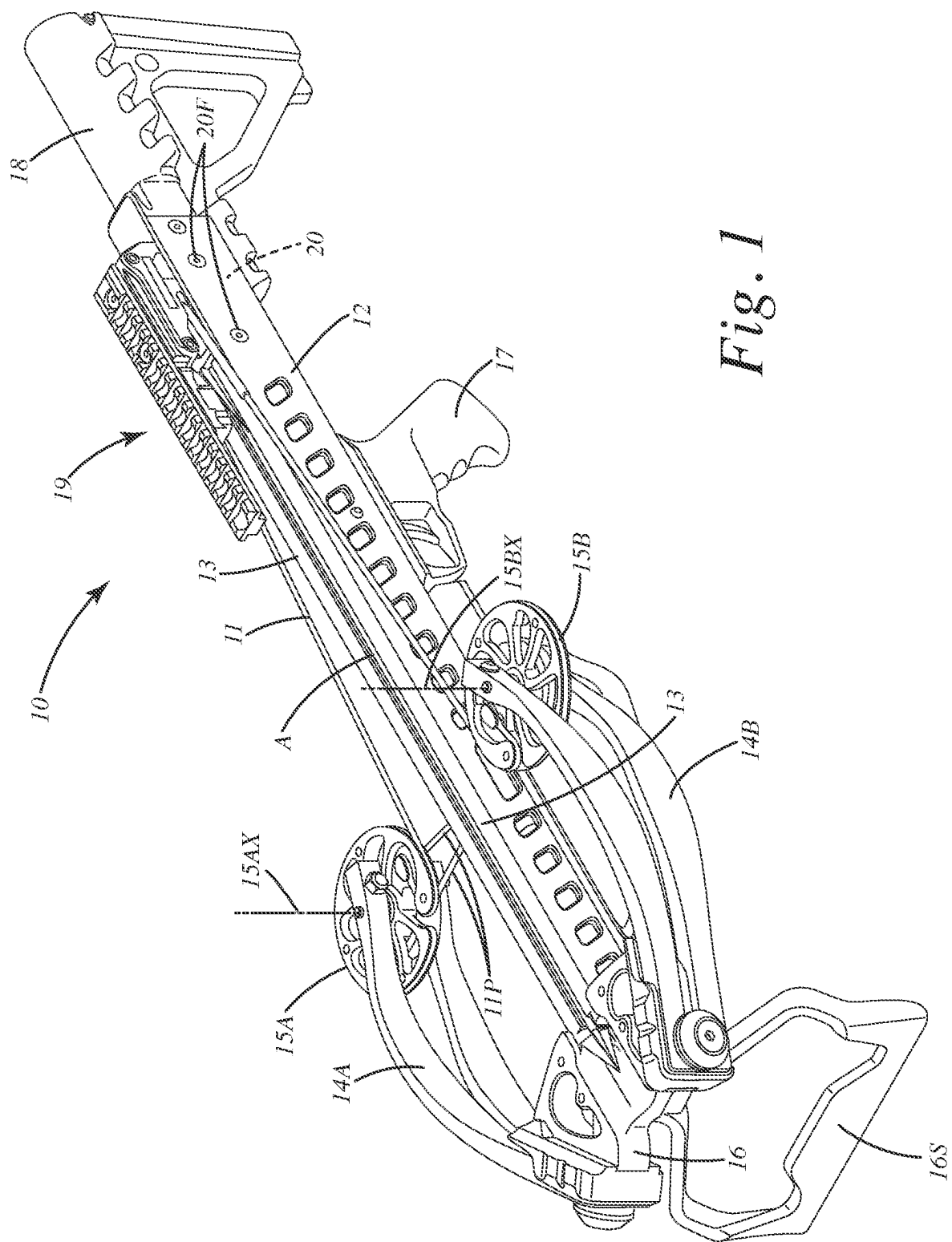


Fig. 1

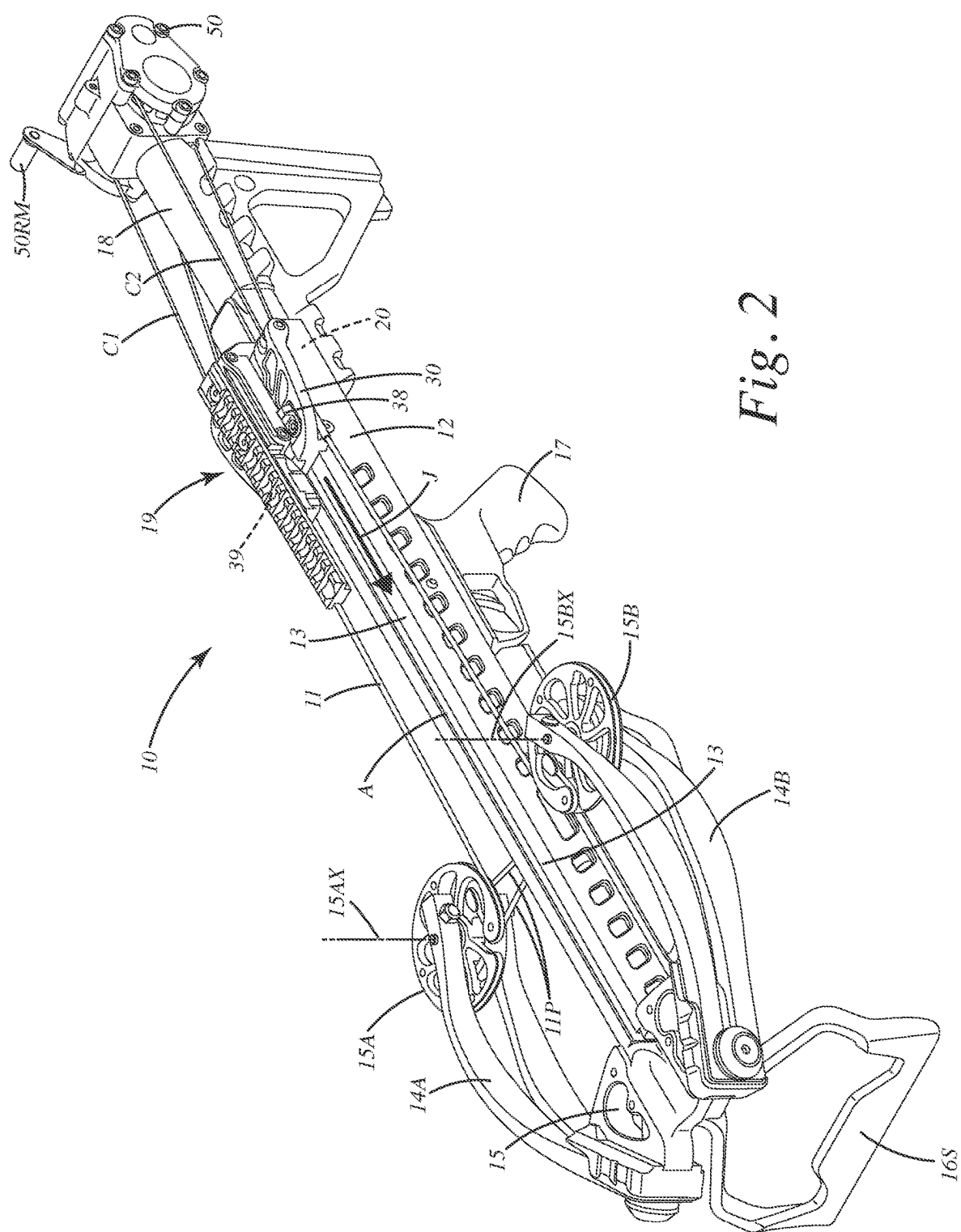
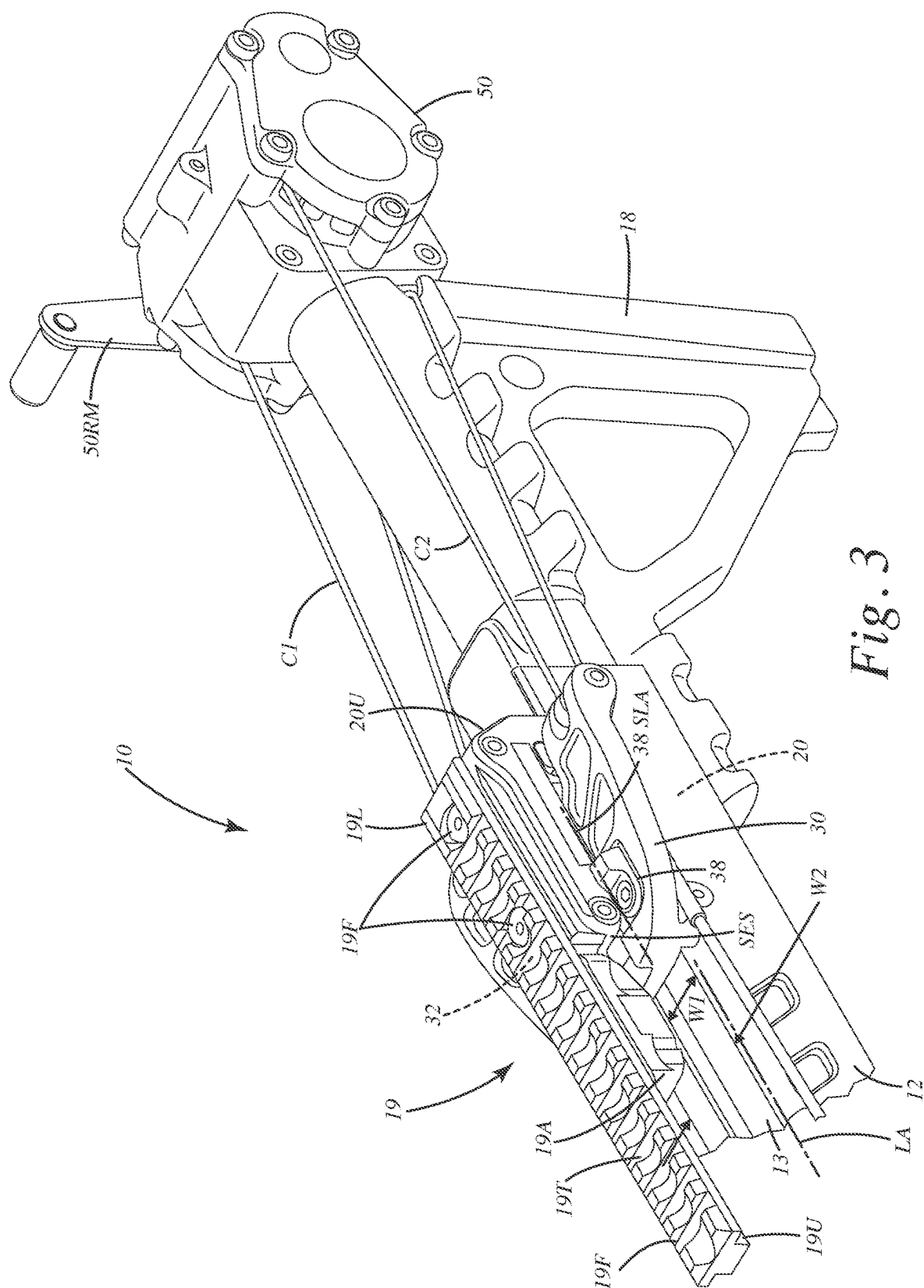
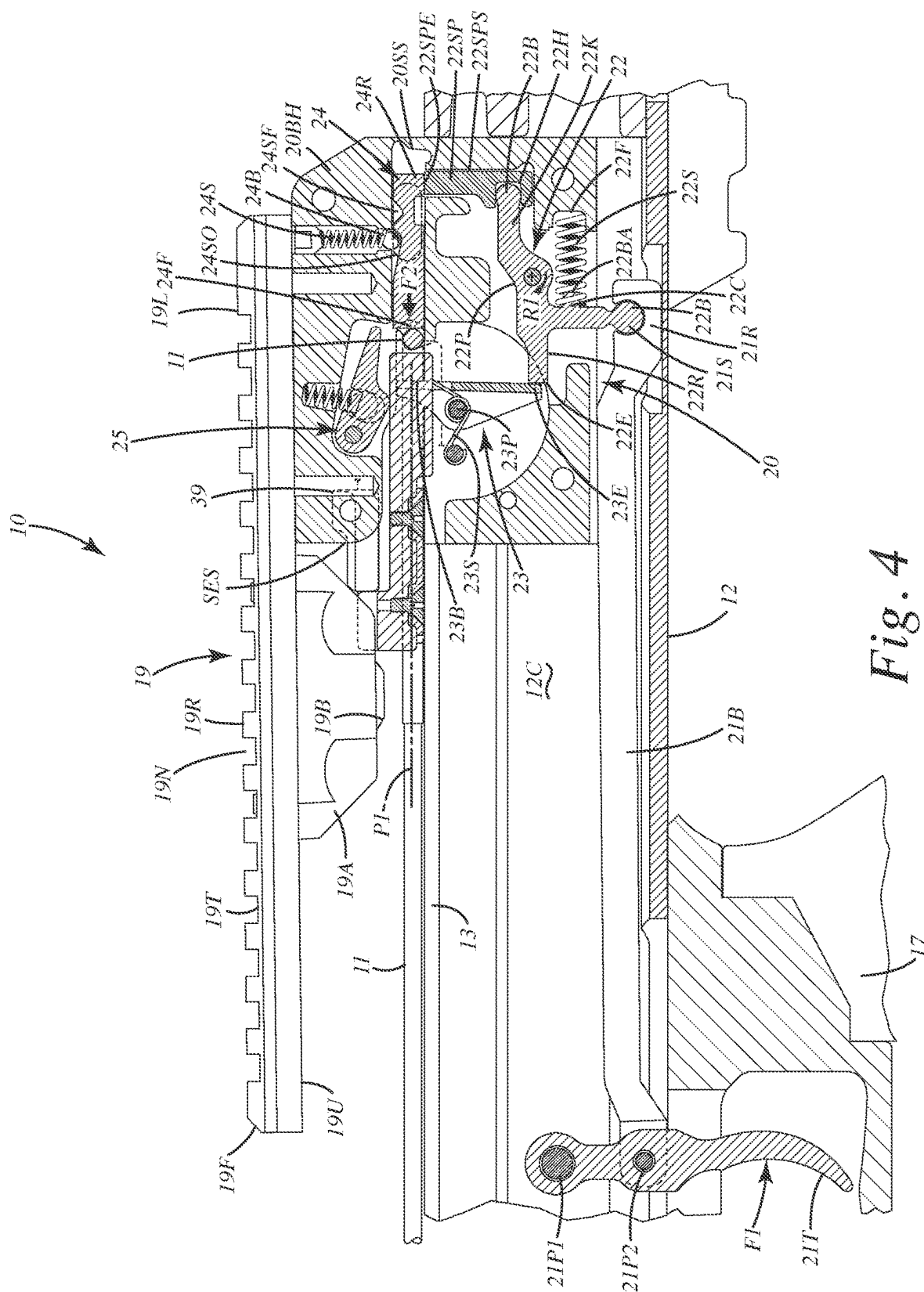


Fig. 2





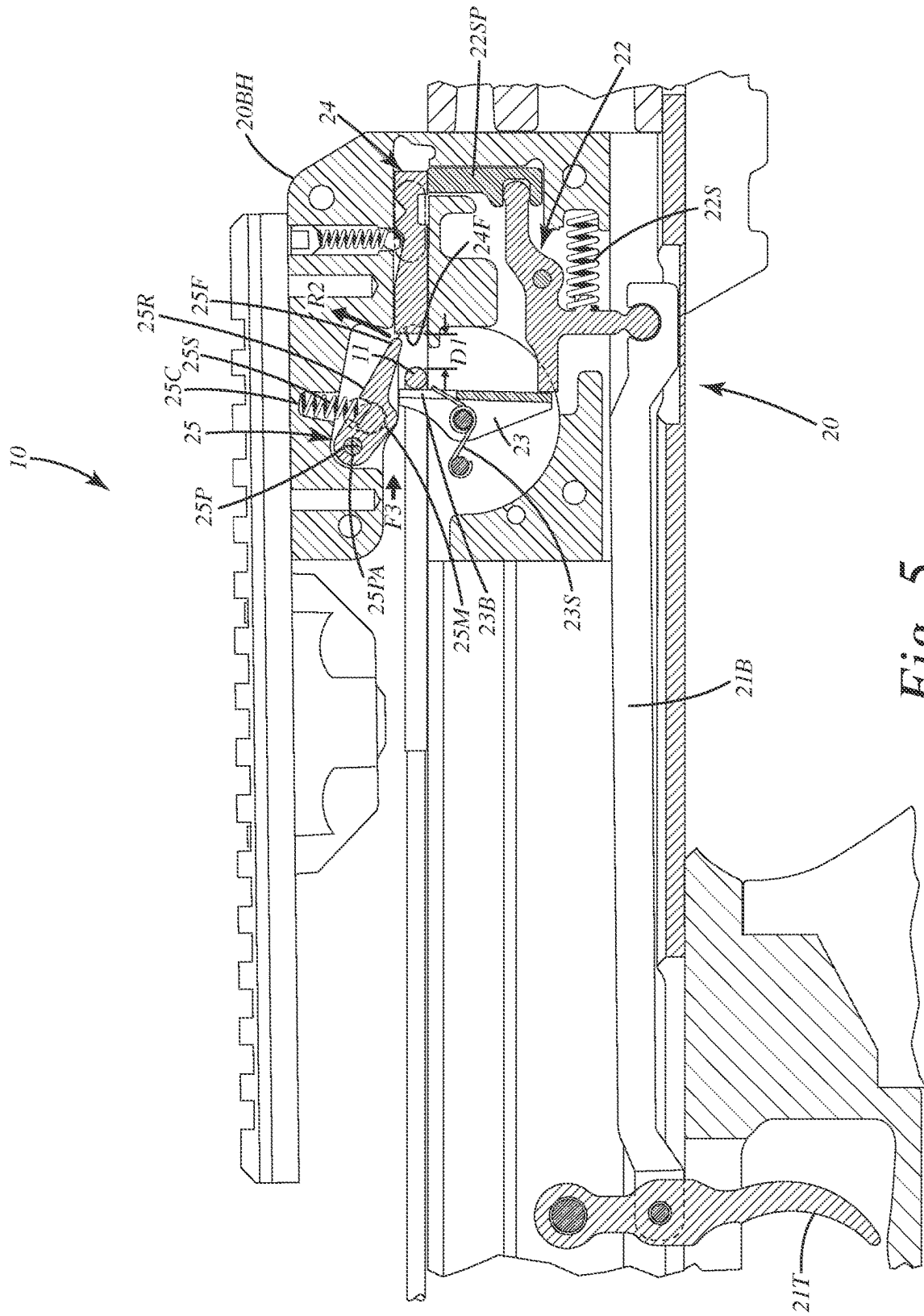
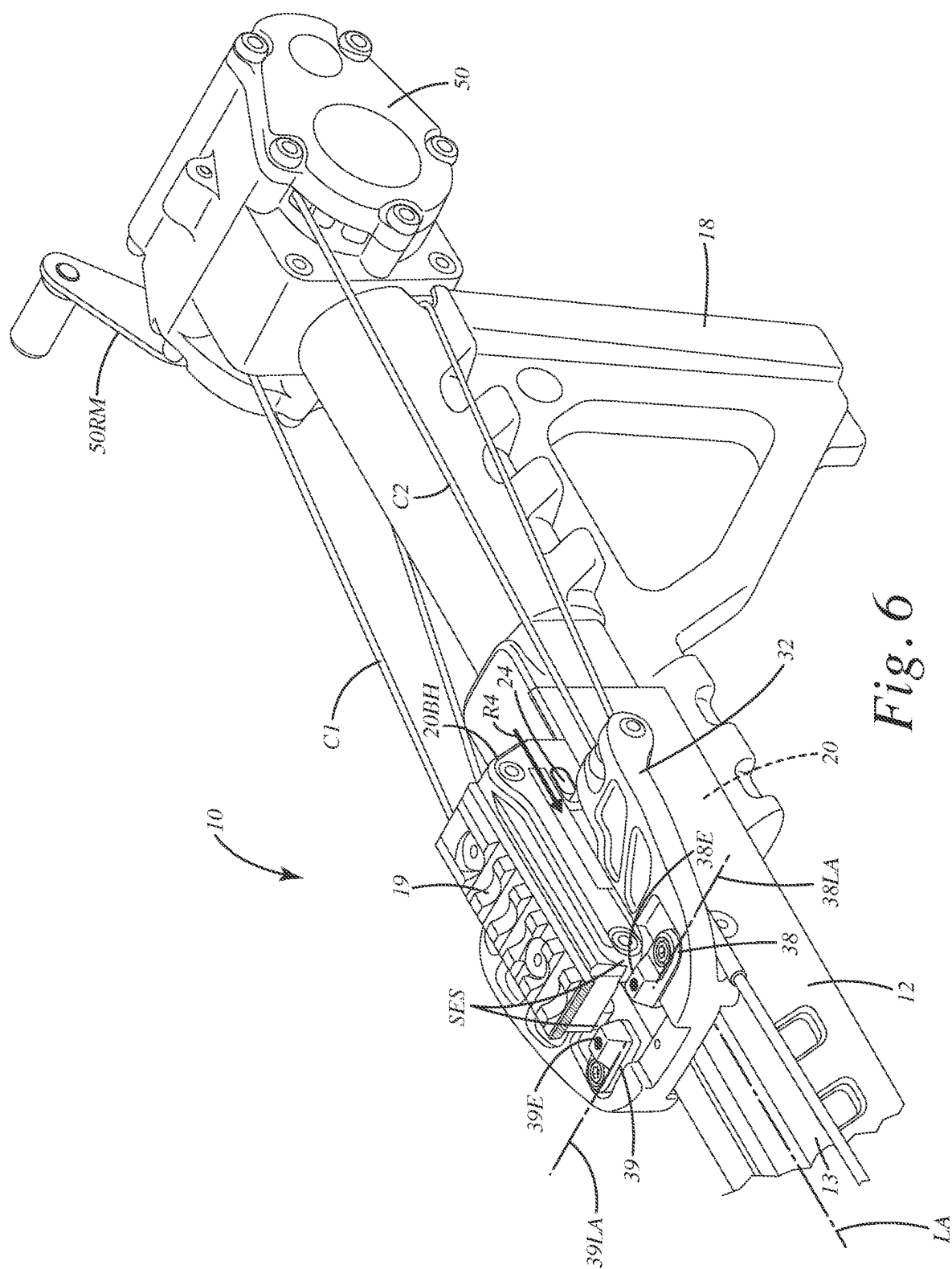
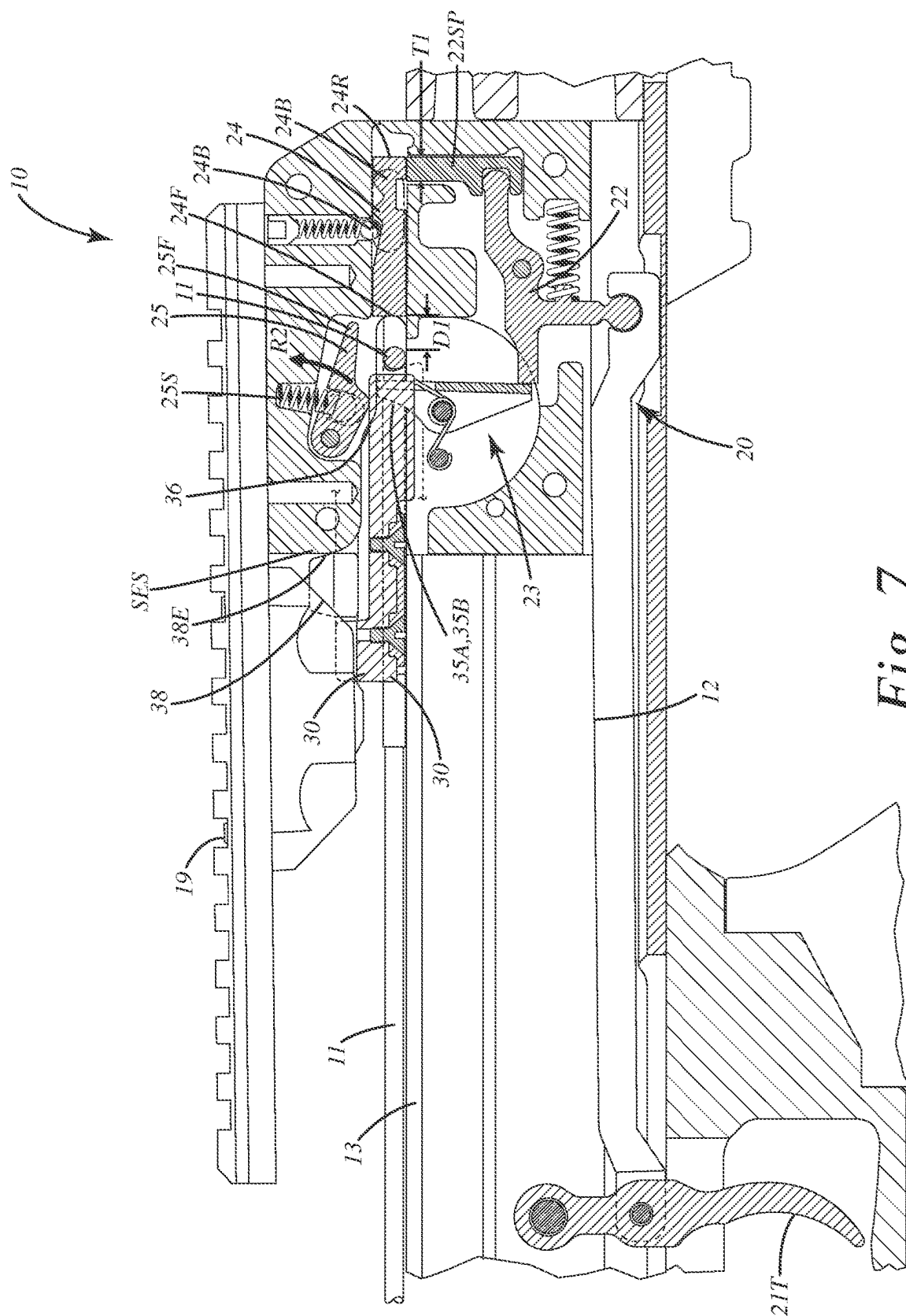
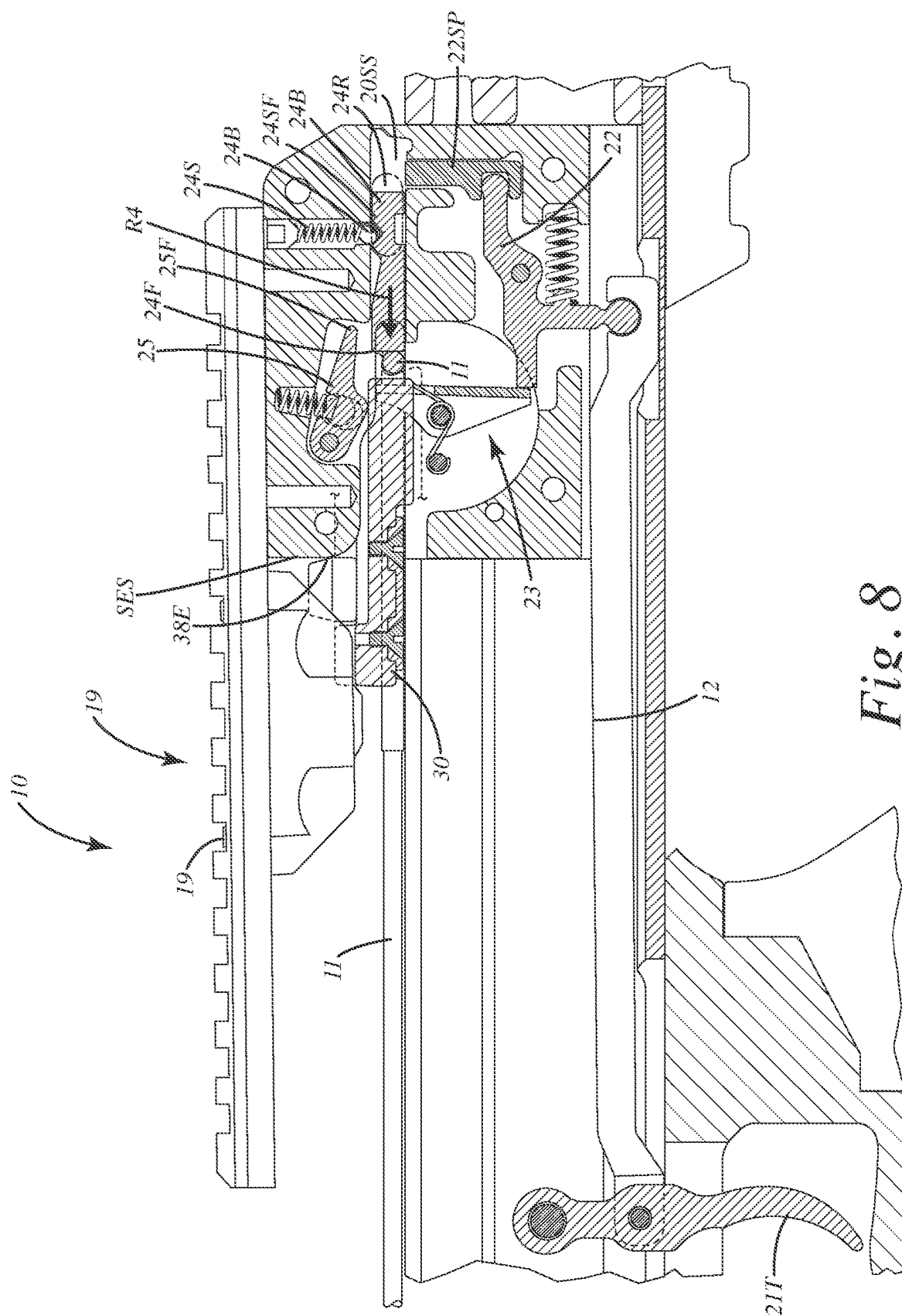


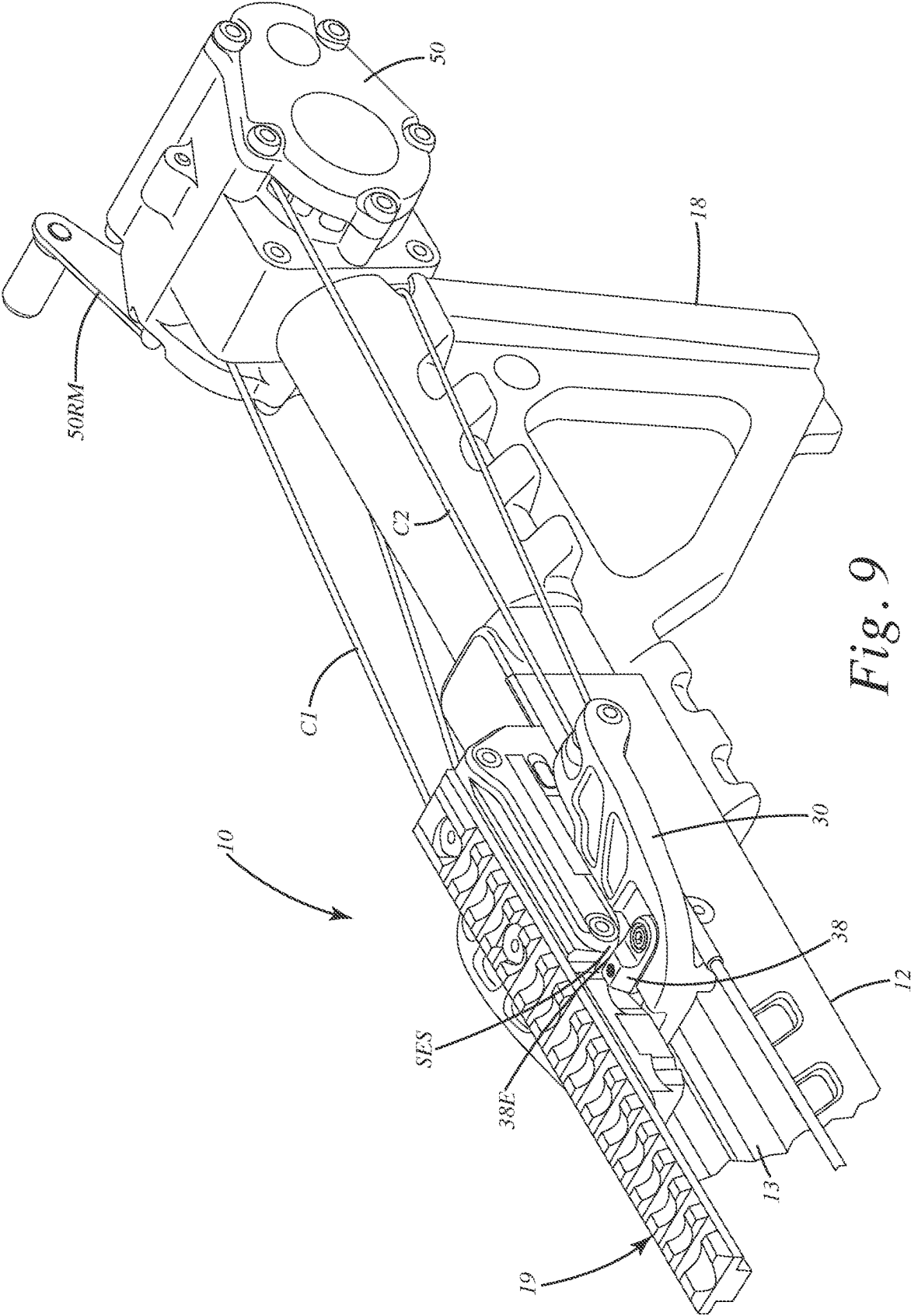
Fig. 5

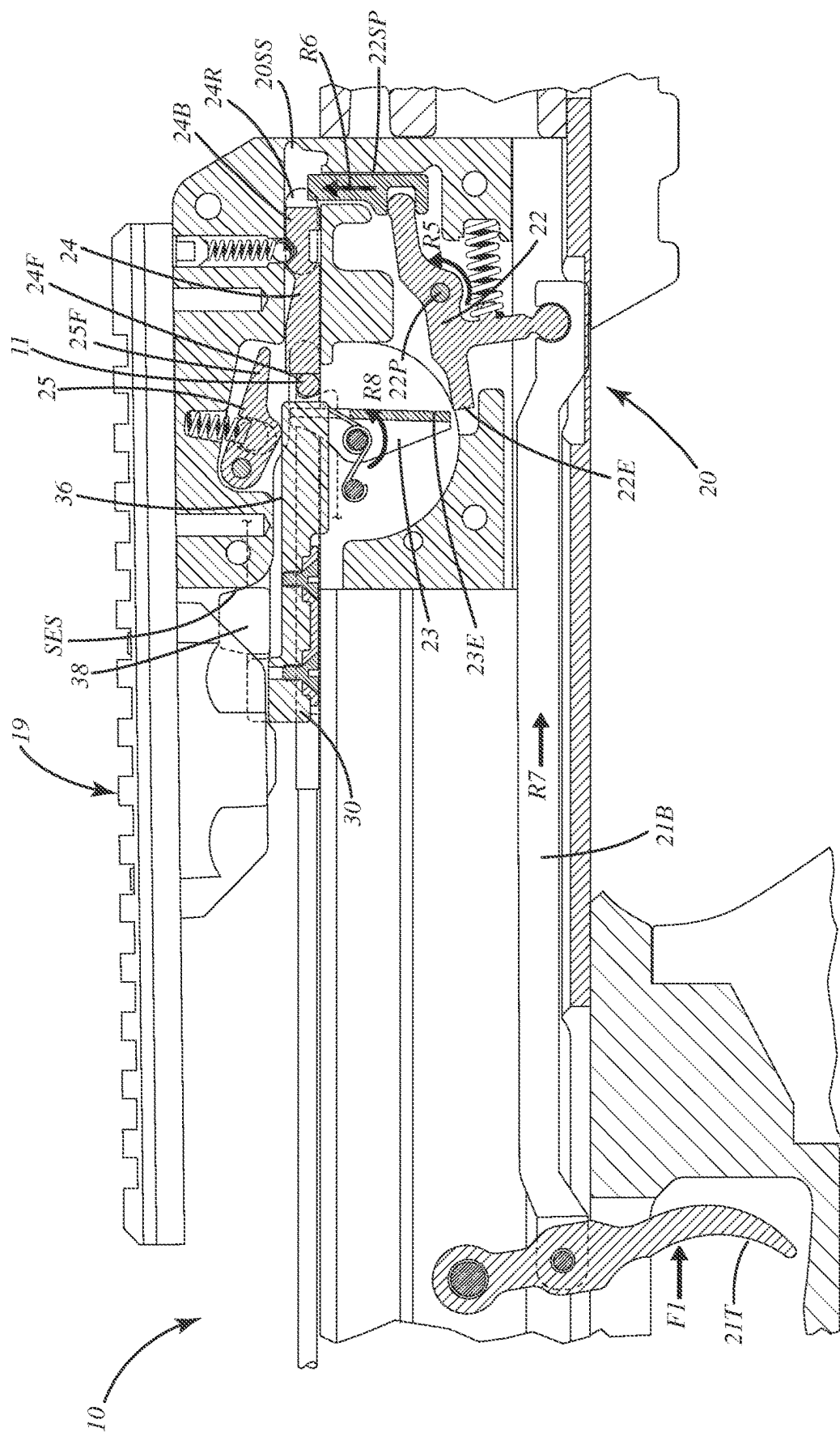


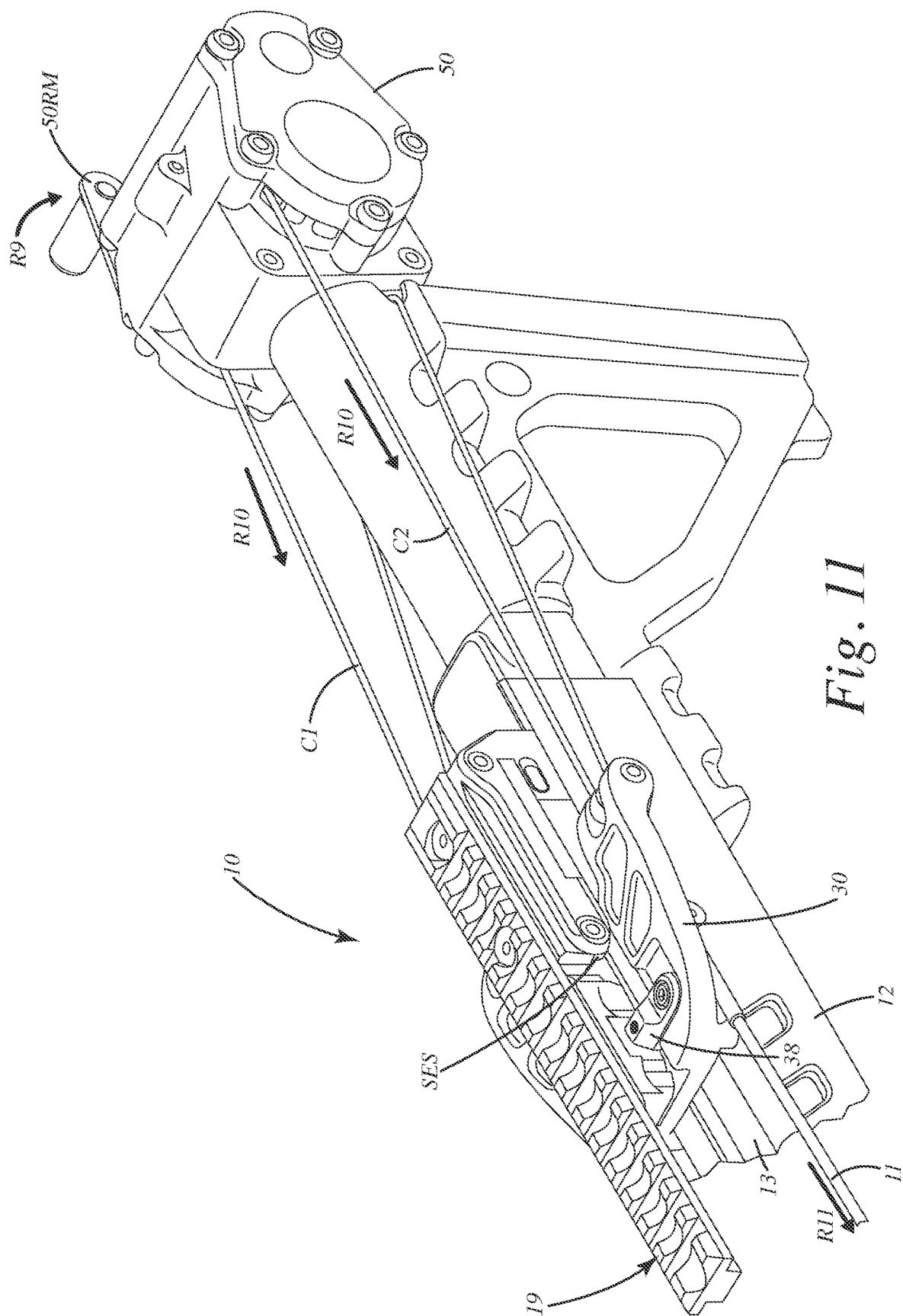


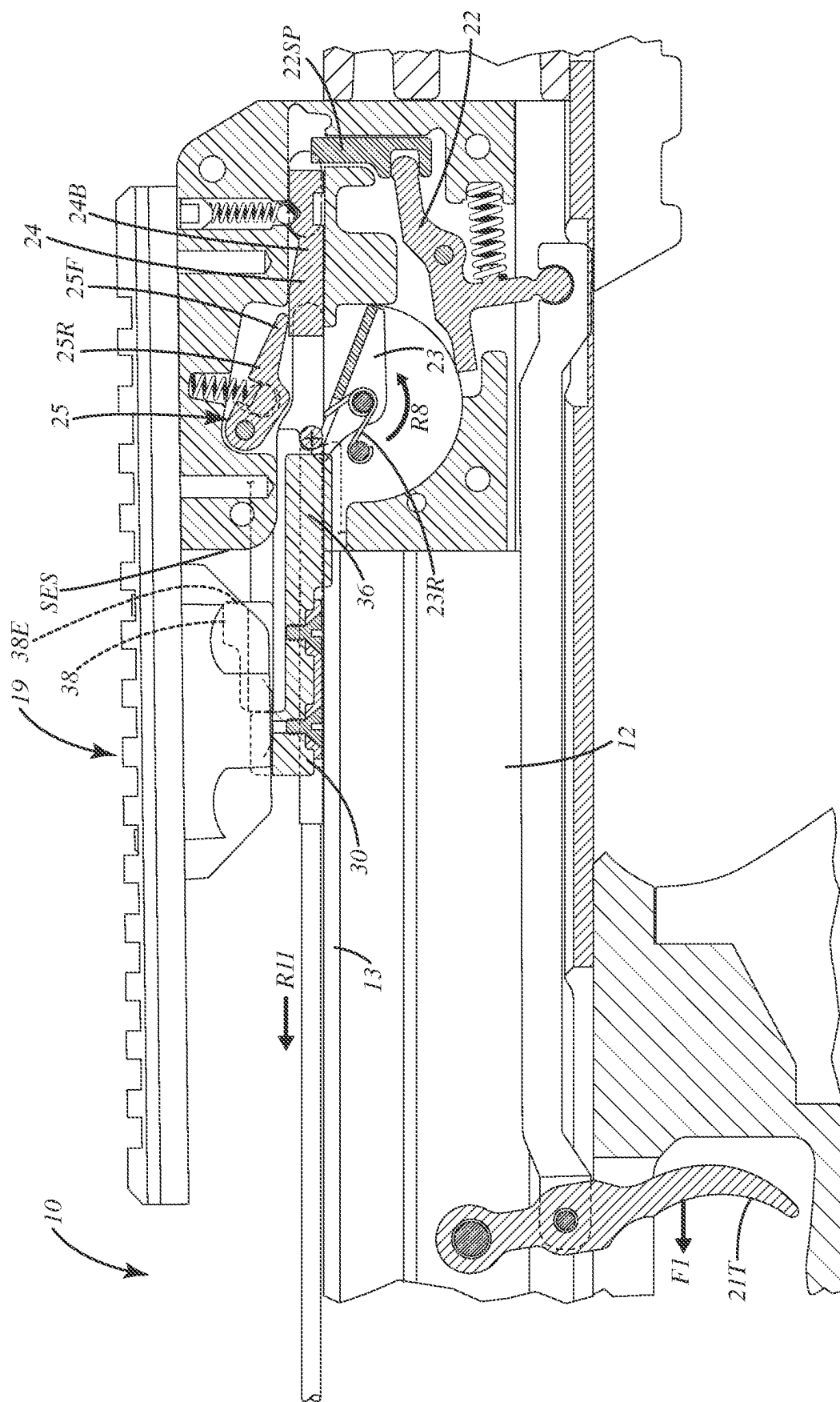












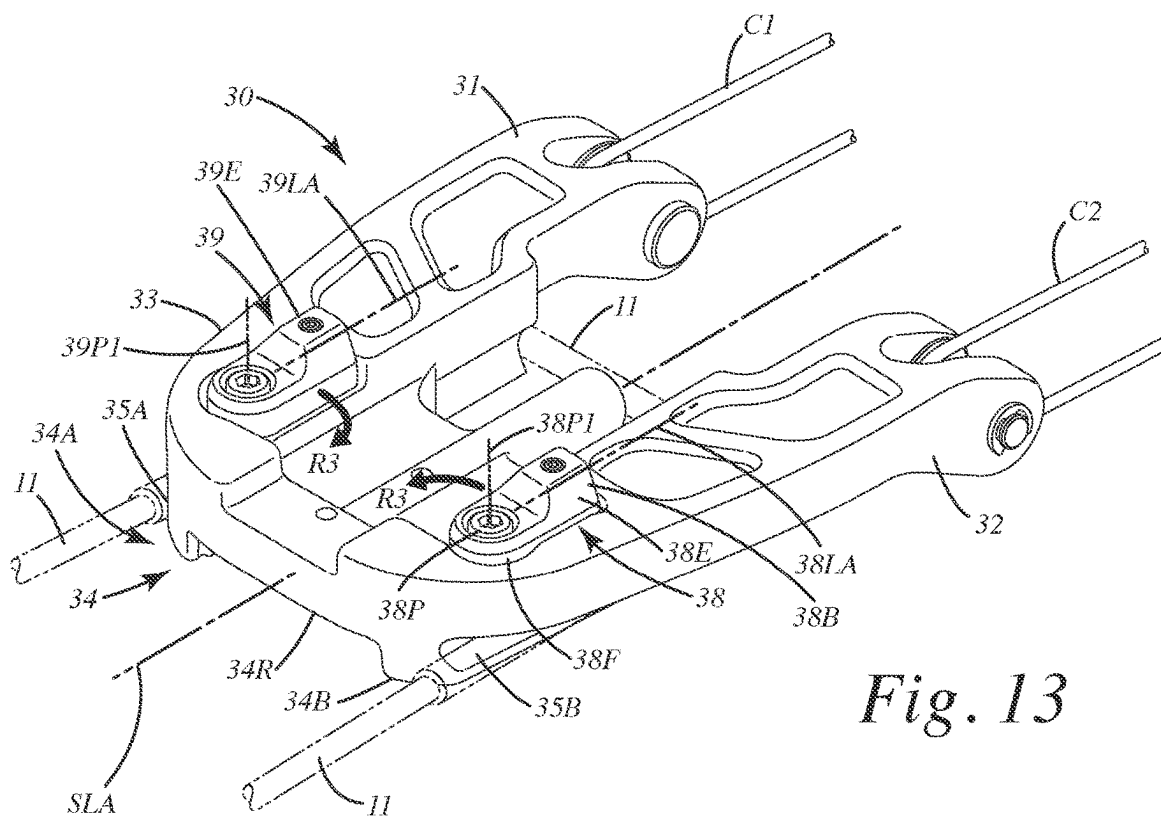


Fig. 13

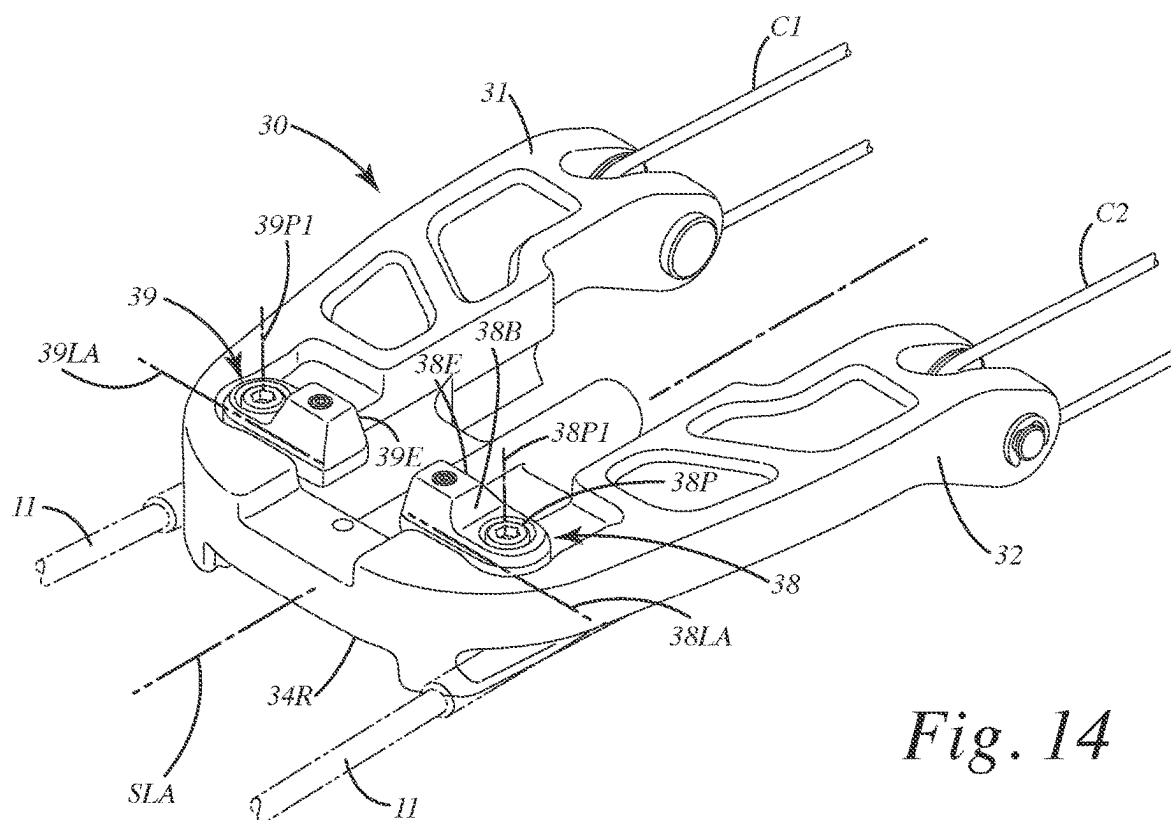
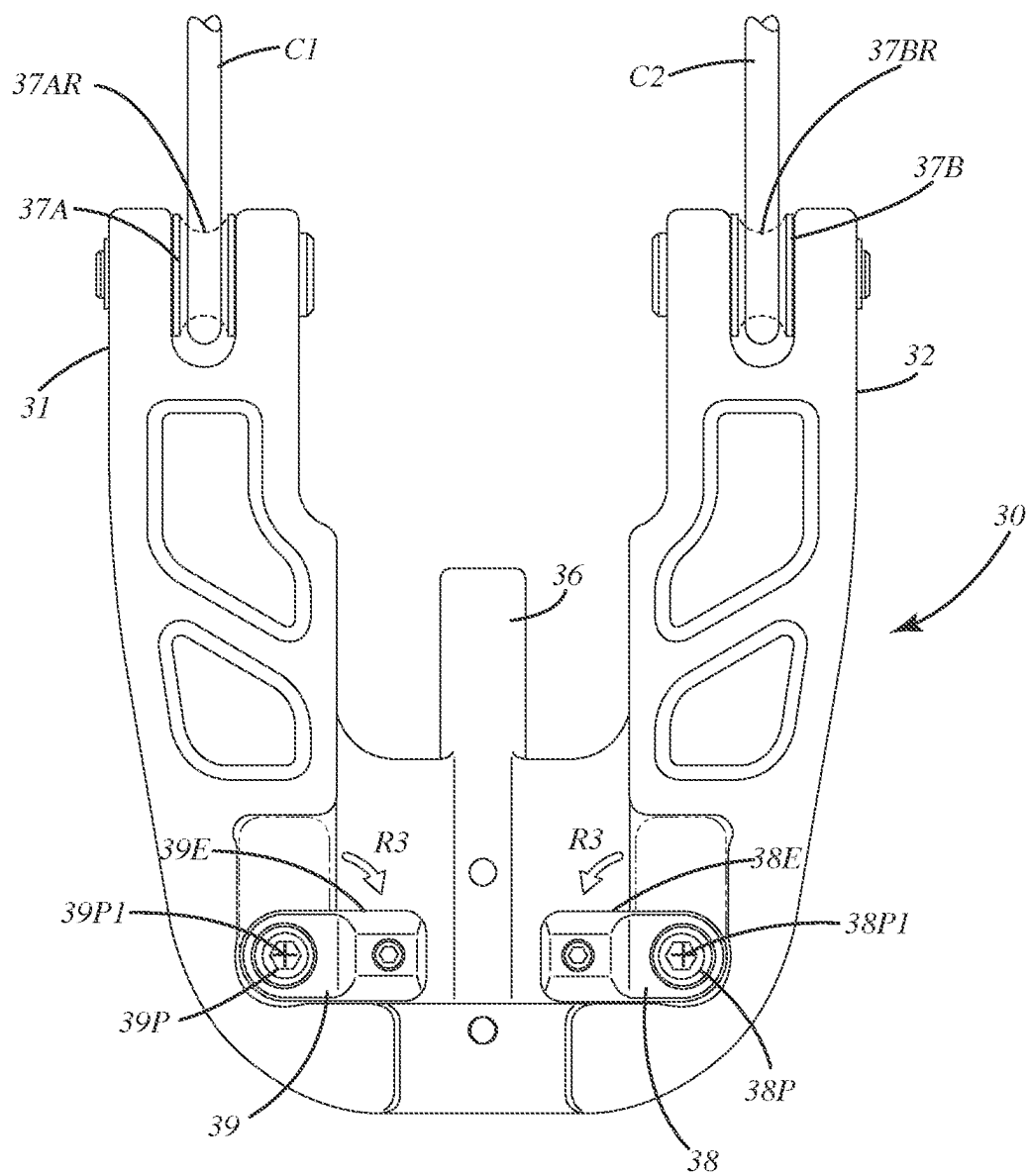
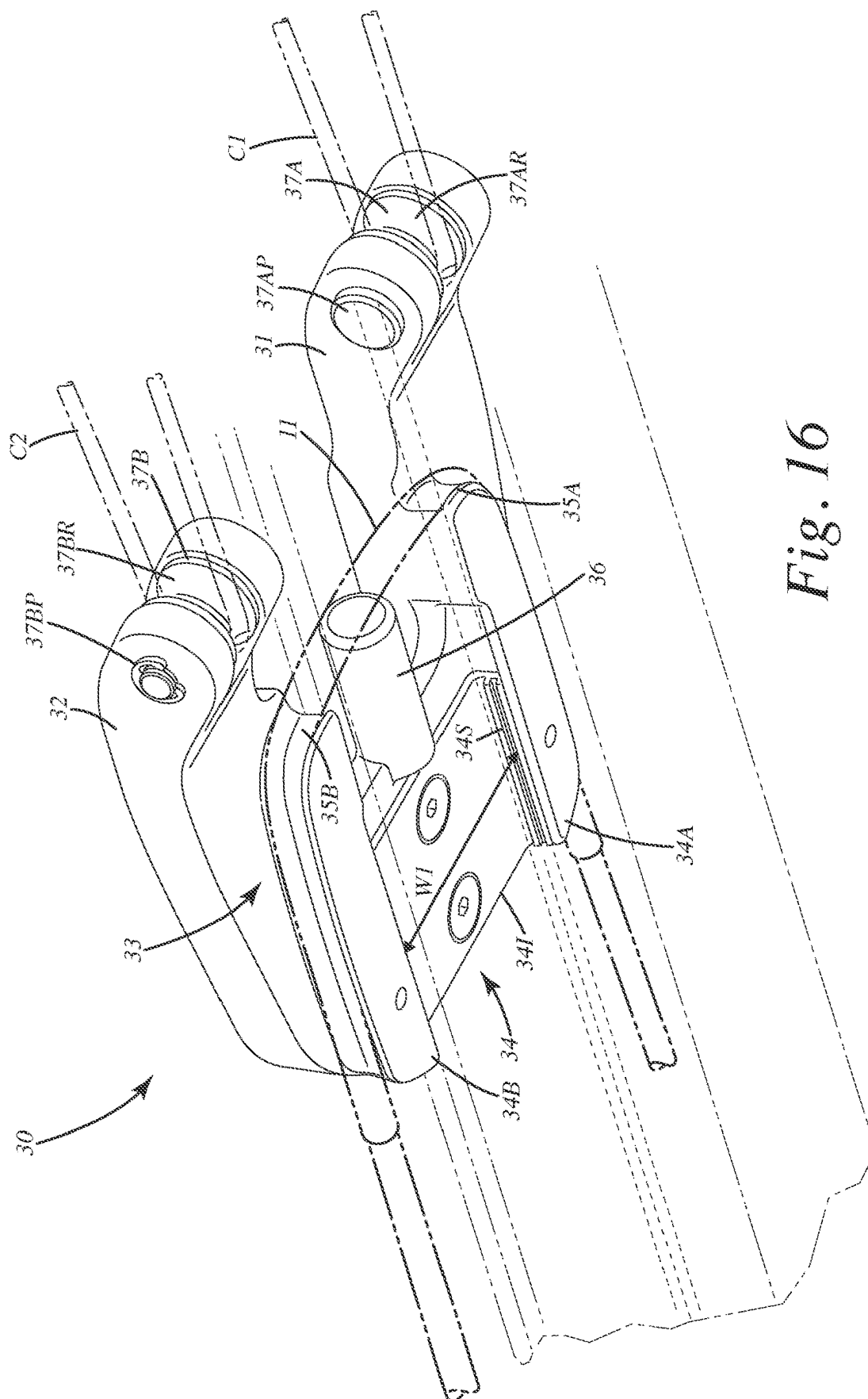


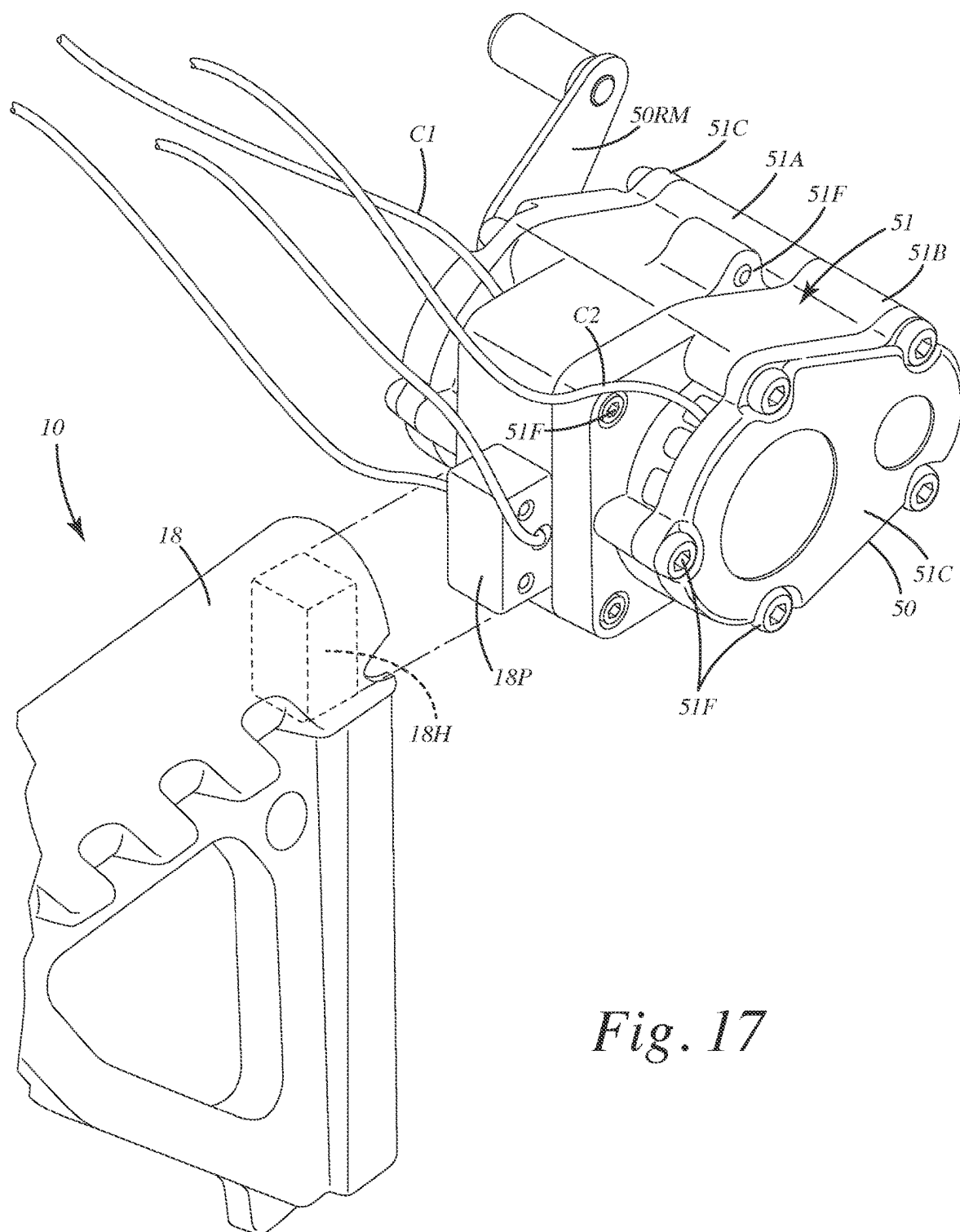
Fig. 14



*Fig. 15*







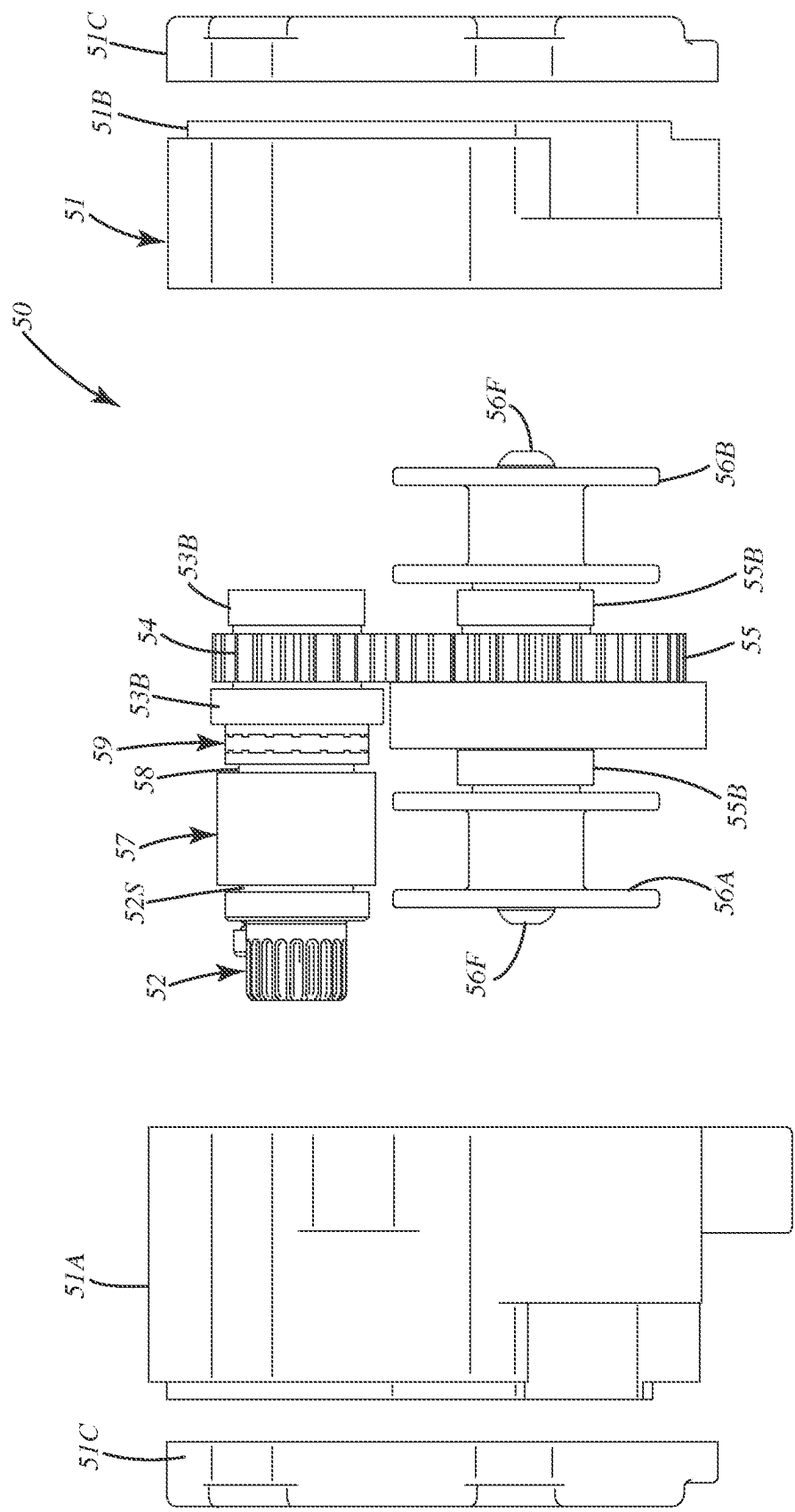


Fig. 18

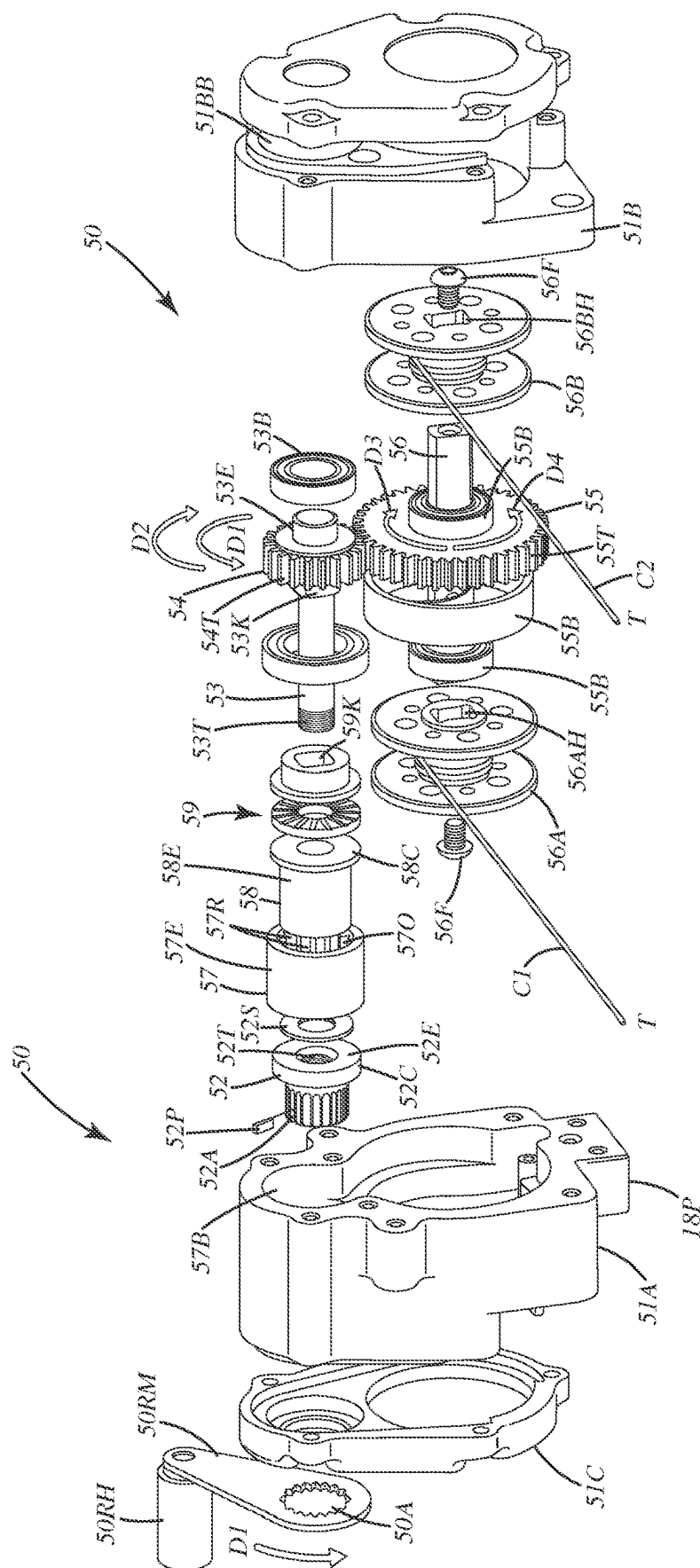


Fig. 19

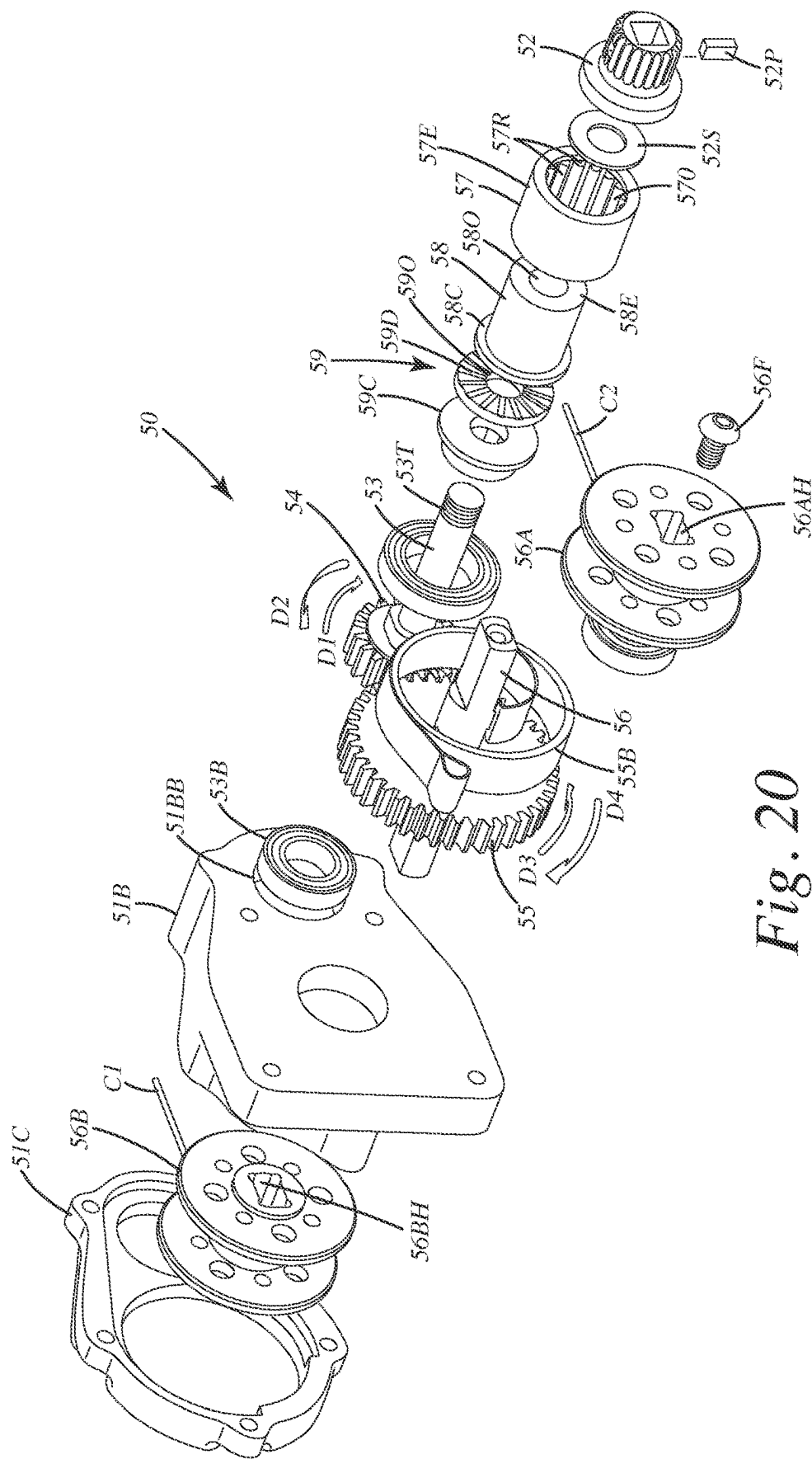
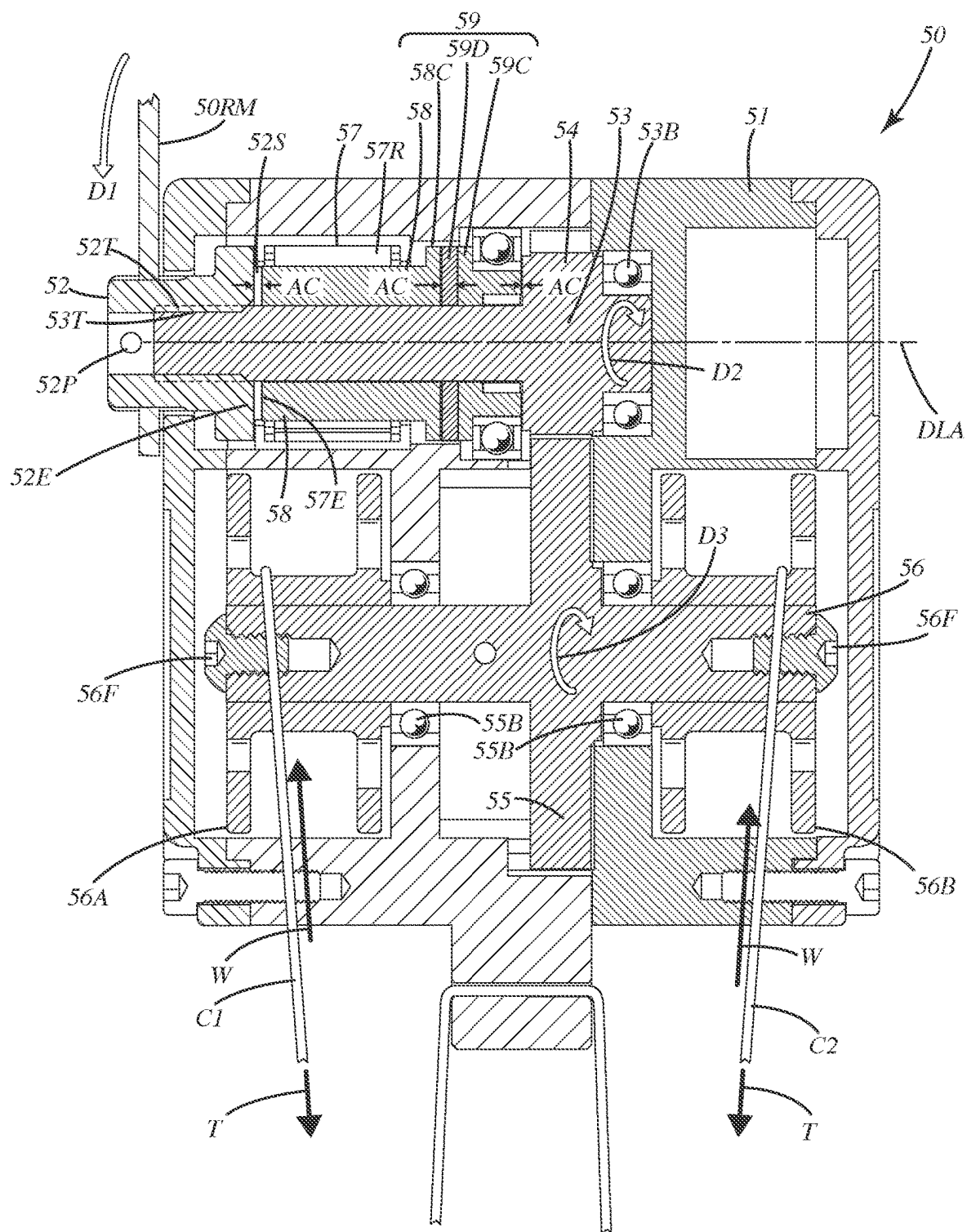
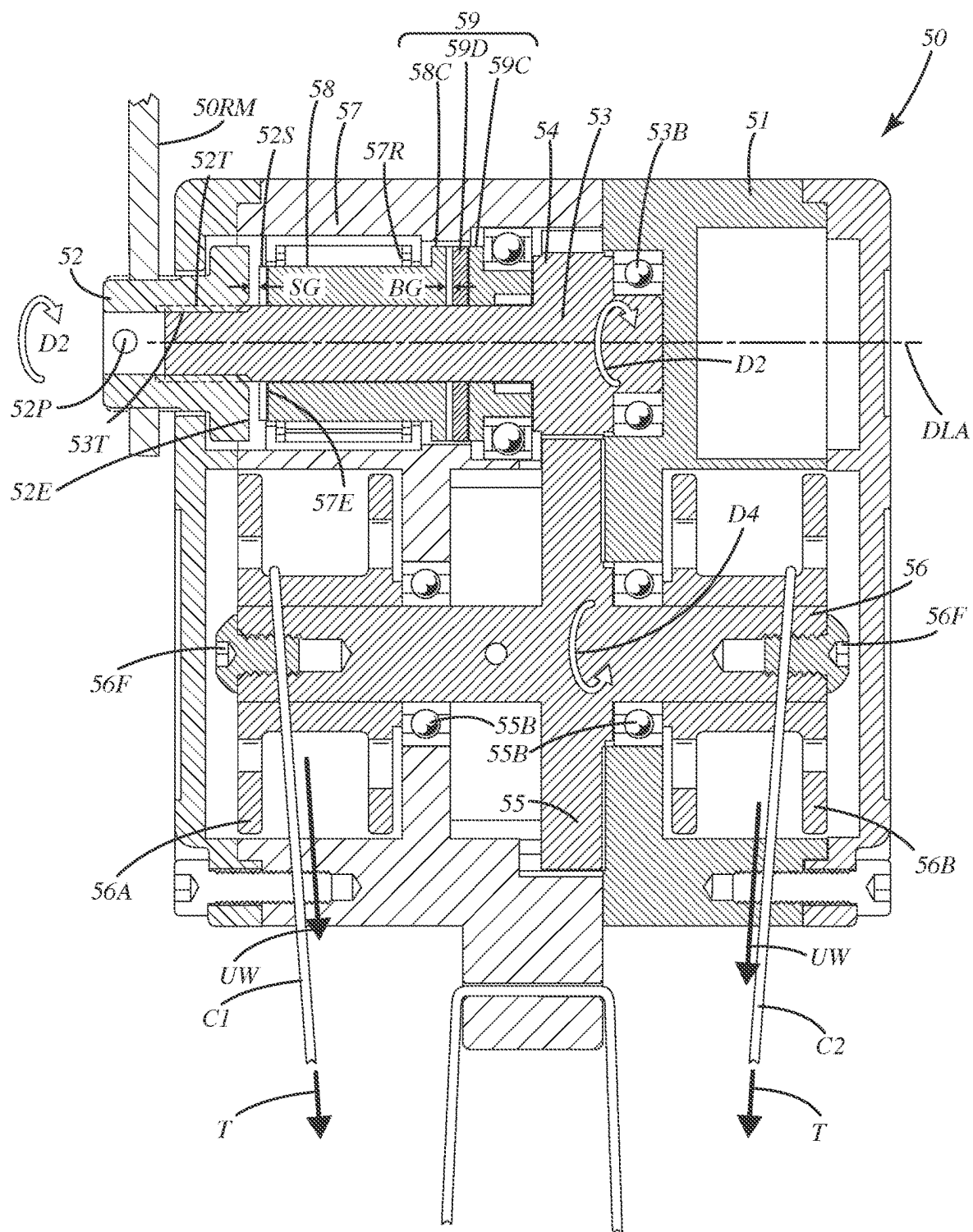


Fig. 20



*Fig. 21*



*Fig. 22*

## CROSSBOW DE-COCKER AND RELATED METHOD OF USE

### BACKGROUND OF THE INVENTION

[0001] The present invention relates to archery crossbows, and more particularly to crossbow cocking and/or de-cocking systems.

[0002] Crossbows have been used throughout the centuries for hunting, fishing and target shooting. Crossbows typically include a stock joined with a rail, upon which a bolt or an arrow is placed. A pair of bow limbs are mounted at an end of the rail and a bowstring is strung between the limbs over the rail for engagement with the bolt or arrow. Sometimes, the crossbow includes cams on the bow limbs that receive the bowstring and one or more power cables to increase stored energy. The crossbow also can include a trigger mechanism adjacent the rail operable to hold the bowstring and to release the bowstring to fire the crossbow, thereby shooting an arrow or bolt from the crossbow.

[0003] The bowstring of a crossbow usually is movable from an undrawn or un-cocked position to a drawn or cocked position. In the cocked position, the trigger mechanism secures the bowstring in a fixed, stationary position relative to the rail. When the bowstring is drawn from the undrawn position to the drawn position, this is referred to as cocking the crossbow. Sometimes, however, a user will want to convert the crossbow bowstring from the drawn position to the undrawn position without shooting a bolt or arrow. This cannot be done safely by simply removing the bolt or arrow and actuating the trigger mechanism to release the bowstring because the stored energy in the crossbow would damage or destroy the components of the crossbow, and potentially can injure the user. Accordingly, the user may desire to de-cock the crossbow by letting down the bowstring to the undrawn position. There are multiple conventional methods and systems for de-cocking a crossbow, however, many of them incorporate complicated, additional mechanical components in the trigger mechanism and/or require a complex sequence of steps to de-cock the crossbow.

[0004] Further, as mentioned above, the bowstring of a crossbow usually is movable from an undrawn or un-cocked position to a drawn or cocked position. Movement of the bowstring can be accomplished via a cord or rope being attached to the sled and pulled manually by a user. Alternatively, movement can be accomplished via a winch attached to the crossbow, typically rearward of the trigger assembly. Recently, due to higher draw weights on crossbows to improve speed, more and more crossbows are offered with a winch. Although these winches are helpful to draw a crossbow, they can be complicated to operate and control when a user wants to use such winch to de-cock a crossbow. This can discourage users from utilizing such winches, in which case the user may simply shoot the crossbow to return it to the undrawn state. Further, increased complexity in operation of the winch to de-cock a crossbow can lead to operator error, such as inadvertent release of the bowstring in a dry fire event, or a lock-up of the winch in some cases.

[0005] Accordingly, there remains room for improvement in the field of crossbows, and in particular systems and components to facilitate safe and reliable cocking and/or de-cocking of crossbows.

### SUMMARY OF THE INVENTION

[0006] A crossbow can include a de-cocking system to allow a bowstring to be transitioned from a drawn mode to an undrawn mode and thereby de-cock the crossbow.

[0007] A crossbow can include a crossbow crank to cock and/or de-cock the crossbow.

[0008] In one embodiment, the de-cocking system can include a sled that engages the bowstring to draw the bowstring to a drawn mode and/or let down the bowstring to the undrawn mode during a de-cocking operation.

[0009] In another embodiment, the sled can include a stop that prevents the sled or bowstring from engaging a safety and/or interfering with transition of the safety from a safety on mode to a safety off mode.

[0010] In still another embodiment, the safety can be manually actuated from the safety on mode to the safety off mode while the sled is used to de-cock the bowstring. With the safety in the off mode, upon actuation of a trigger assembly, the sled can assist transition of the bowstring to the undrawn mode, for example, by letting down the bowstring from the drawn mode to the undrawn mode during a de-cocking operation.

[0011] In yet another embodiment, the stop can be modifiable, such that the sled can be used in both the de-cocking operation, as well as a drawing operation in which the sled transitions the bowstring from the undrawn mode to the drawn mode. Where modifiable, the stop of the sled can be operable in both a neutral mode in which the stop does not interfere with rearward movement of the sled so that the bowstring can move to the drawn mode, and in a de-cocking mode in which the stop interferes with movement of the sled along the frame so that the sled is prevented from engaging the bowstring against the safety, which faces a catch of the trigger assembly, while the safety remains in the safety on mode.

[0012] In even another embodiment, the stop in the de-cocking mode can allow a user to manually move the safety to the safety off mode, and subsequently activate the trigger assembly so that the bowstring can be let down from the drawn mode to the undrawn mode with the sled engaging the bowstring as the letting down occurs.

[0013] In a further embodiment, the trigger assembly can be joined with the frame and can include a catch that is operable in a holding mode in which the catch retains the bow string in the holding mode and a drop mode that releases the bowstring to the undrawn mode. The trigger assembly can include a sear operable in a cocked mode that retains the catch in the holding mode and a fire mode that allows the catch to move to the drop mode to release the bowstring, for example, when the crossbow shoots a bolt or when the crossbow undergoes a de-cocking operation.

[0014] In still a further embodiment, the trigger assembly can include a trigger coupled to the sear. The sled can remain distal from, disengaged from, and/or out of contact with the safety in the de-cocking mode. The safety can be manually moveable in the de-cocking mode to transition the safety from the safety on mode to the safety off mode so that the sear is operable in the fire mode when the trigger is moved, whereby the catch can move to the drop mode to release the bowstring.

[0015] In yet a further embodiment, the crossbow can include an anti-dry fire element moveable between a lockout position that prevents the safety from moving from the safety on mode to the safety off mode, and an open position

that permits the safety to move to the safety off mode. Where the anti-dry fire element is included in the crossbow, the sled can include a protrusion that moves the anti-dry fire element to the open position when the sled is adjacent the trigger assembly, such that the safety can subsequently be converted to the safety off mode.

**[0016]** In even a further embodiment, the sled can include a guide that moves along the frame when the sled engages the bowstring. The sled can include a bowstring engager configured to receive the bowstring during movement of the bowstring to the drawn mode with the sled.

**[0017]** In another embodiment, the stop can be in the form of a first stop including a first flange and a first pivot axis about which the first flange is selectively pivotable. The first flange can include a first engagement surface. A stop engagement surface or stop limiter can be disposed adjacent the trigger assembly. The first engagement surface can contact the stop engagement surface or limiter in the de-cocking mode in which the first stop arrests movement of the sled.

**[0018]** In still another embodiment, the sled can include the first stop and a second stop. The second stop can include a second flange and a second pivot axis about which the second flange is selectively pivotable. The second flange can include a second engagement surface. The second engagement surface can contact the stop engagement surface distal from the first stop in the de-cocking mode, thereby assisting in arresting movement of the sled during a de-cocking operation.

**[0019]** In yet another embodiment, the frame can include a rail. The first stop and first flange can be mounted on a first side of the rail. The second stop and second flange can be mounted on the second side of the rail, opposite the first flange. The first flange and the second flange can be configured to simultaneously engage the limiter or a stop engagement surface thereof in the de-cocking mode.

**[0020]** In even another embodiment, a method is provided. The method can include pulling on a bowstring that is in a drawn mode with a sled including a stop, so the stop engages a limiter on the crossbow and ceases movement of the sled and stop relative to a frame of the crossbow in a de-cocking mode, leaving a first distance between the bowstring and a safety, without the sled and stop engaging the safety; moving the safety toward the bowstring to reduce the first distance to a second distance between the bowstring and the safety, the second distance being less than the first distance; pulling a trigger so that a catch disengages the bowstring; and transitioning the bowstring to an undrawn mode while the sled engages the bowstring to de-cock the crossbow.

**[0021]** In a further embodiment, the method can include manually engaging the safety to slide the safety in a slot so that a forward face of the safety moves toward the bowstring without engaging the bowstring during the moving step. This movement can occur without any part of the sled or its components engaging the safety.

**[0022]** In still a further embodiment, the method can include transitioning the stop from the de-cocking mode to a neutral mode by rotating the stop toward another stop on the sled after the crossbow is de-cocked and the bowstring is in the undrawn mode; and drawing the bowstring from the undrawn mode to the drawn mode while the stop is in the neutral mode.

**[0023]** In another embodiment, the crossbow can include a crossbow crank comprising a drive shaft selectively coupled to a one-way bearing that allows rotation of the

drive shaft and an associated spool in a first direction, and impairs rotation of the drive shaft and the spool in a second direction.

**[0024]** In still another embodiment, the drive shaft can be automatically locked and unlocked relative to the one-way bearing, allowing the bearing to control operation of the drive shaft, via a brake.

**[0025]** In yet another embodiment, the brake can be axially compressible along the drive shaft to automatically lock the drive shaft and a sleeve so they are fixed relative to one another and rotate in unison when the drive shaft is rotated in the first direction. The brake can be deactivated by operation of a crank so that the drive shaft can rotate freely relative to the sleeve and thus the bearing in a second direction.

**[0026]** In even another embodiment, a crossbow crank can comprise: a sleeve disposed in a one-way bearing; a drive shaft extending through the sleeve; a drive gear joined with the drive shaft so the drive gear and drive shaft rotate in unison; a spool coupled to the drive gear, the spool configured to engage a cord; and a crank joined with the drive shaft. The sleeve and drive shaft can automatically lock to one another upon actuation of the crank to rotate the drive shaft in the first direction, so that the sleeve and drive shaft rotate in unison. The sleeve and drive shaft can automatically unlock from one another upon actuation of the crank to rotate the drive shaft in the second direction, so that the drive shaft rotates freely relative to the sleeve.

**[0027]** In a further embodiment, the crossbow crank can include a brake mounted along the drive shaft. The brake can be axially compressible along the drive shaft to lock the drive shaft and the sleeve with one another when the drive shaft is rotated in the first direction. This locking can occur automatically when the crank is manually actuated or rotated.

**[0028]** In still a further embodiment, the crossbow crank can include a drive nut. The hand crank can be joined with the drive nut. A brake can be disposed along the drive shaft. The drive nut can be threadably joined with the drive shaft. Manual rotation of the crank in the first direction can tighten the drive nut on the drive shaft so that the drive nut axially compresses the sleeve and the brake between the drive nut and the drive gear so that the drive shaft and sleeve automatically lock to one another upon manual actuation of the crank. Accordingly, the sleeve and drive shaft can rotate in unison in the first direction. The sleeve and drive shaft however, can be impaired from rotating in a second direction opposite the first direction.

**[0029]** In yet a further embodiment, manual rotation of the crank in a second direction opposite the first direction can loosen the drive nut on the drive shaft so that the drive nut decompresses or no longer axially compresses the sleeve and the brake between the drive nut and the drive gear. Accordingly, the drive shaft and sleeve automatically unlock from one another upon manual actuation of the crank in the second direction. As a result, the brake no longer holds the sleeve and shaft in a relative to one another, so the one-way bearing no longer impairs rotation of the drive shaft in the second direction, so the drive shaft and other components such as the spool can rotate in the second direction, optionally unwinding a cord from the spool to de-cock the bowstring when the crank is secured to the bowstring directly or via a sled, such as the one described herein.



**[0030]** In even a further embodiment, the brake can be mounted along the drive shaft and can comprise a first brake collar; a second brake collar; and a brake disc mounted between the first and second brake collars. The brake can be axially compressible along a longitudinal axis of the drive shaft so that the first brake collar, second brake collar and brake disc frictionally engage one another. The second brake collar can be joined with the drive shaft in a nonrotatable manner.

**[0031]** In a further embodiment, the crossbow crank can include a secondary gear rotatable in response to the drive gear and a secondary shaft joined with the secondary gear so that the secondary gear and secondary shaft rotate in unison. The secondary shaft can be offset and/or parallel to the drive shaft. The spool can be fixedly and non-rotatably mounted to the secondary shaft. In some cases, the secondary gear is the only gear on the secondary shaft, and the drive gear can be the only gear on the drive shaft.

**[0032]** In still a further embodiment, a method of using a crossbow is provided. The method can comprise: rotating in a first direction a shaft fixedly joined with a gear in a housing, the gear being rotatably coupled to a spool so that the spool winds a cord thereon; and axially compressing a brake along the shaft during and as a result of said rotating in the first direction to fixedly join the shaft with a sleeve disposed around the shaft so that the shaft, gear and sleeve rotate in unison. The sleeve can be disposed in a one-way bearing that is joined with the housing so that when said rotating in the first direction ceases, the shaft and gear can be impaired from rotating in a second direction opposite the first direction via the one-way bearing interacting with the sleeve.

**[0033]** In yet a further embodiment, the method can comprise rotating the shaft in the first direction; and rotating the shaft in the second direction via manual input. The shaft can free spin relative to the sleeve during said rotating in the second direction so that the one-way bearing does not impair rotation of the shaft in the second direction.

**[0034]** In even a further embodiment, the method can comprise ceasing rotating the shaft in the second direction via manual input. A tension in the cord can automatically urge the shaft to rotate in the second direction after said ceasing which causes axial compression of the brake along the shaft. Accordingly, the shaft and gear can again be impaired from rotating in the second direction via the one-way bearing interacting with the sleeve.

**[0035]** In another embodiment, a crank arm can be joined with the shaft via a threaded drive nut threaded to the shaft. A tension in the cord can automatically urge the shaft to rotate in the second direction to tighten the threaded drive nut relative to the shaft. This can push or move the sleeve relative to the brake whereby the shaft and gear again can be impaired from rotating in the second direction opposite the first direction via the one-way bearing interacting with the sleeve.

**[0036]** In still a further embodiment, the crossbow crank and the de-cocking system having a sled with one or more stops both can be incorporated into a crossbow. The crank can be used to draw the bowstring from the released mode to the drawn mode with the sled via one or more cords extending between the crank and the sled, and let down the crossbow from the drawn mode to the released mode.

**[0037]** In yet a further embodiment, the crank can move the sled so the one or more stops when in the de-cocking

mode, engage the stop engagement surface on the frame and/or a mounting arm of the crossbow, or some other portion of the crossbow, to arrest movement of the sled and thus the bowstring so the bowstring and/or sled do not engage the safety, allowing the safety to move from the safety on mode to the safety off mode. The one-way bearing of the crank can hold the drive shaft and drive gear, preventing them from moving or rotating in the second direction in the de-cocking mode.

**[0038]** In even a further embodiment, the safety can be converted to the safety off mode, and the trigger assembly can be actuated such that the sear converts to the fire mode, and the catch to the drop mode so that the catch no longer holds the bowstring in the drawn mode, and such that the bowstring is free to convert to the released mode but for the sled being held by the crank via the one or more cords extending therebetween. Again, the crank can hold the bowstring in the drawn mode via the one-way crank interacting with the sleeve and the drive shaft that are coupled or locked to one another, and nonrotatable relative to one another.

**[0039]** In another embodiment, the crank arm can be rotated in the second direction by a user, thereby releasing the sleeve from the drive shaft, such that the drive shaft can rotate relative to the one-way bearing in the second direction, which can allow the cord to spool off a spool coupled to the drive shaft via a secondary shaft and secondary gear. The user can controllably let down the bow string by continuing to rotate the crank arm in the second direction.

**[0040]** In still another embodiment, when rotation of the crank arm ceases, the tension on the cord by the bowstring during the transition to the released mode causes the drive shaft and sleeve to automatically lock rotationally relative to one another, and urge these temporarily secured components to attempt to rotate in the second direction, however, due to the sleeve interacting with the one-way bearing, these components are impaired from rotating in the second direction, in which case, the sled attached to the one or more cords cannot move away from the crossbow crank, and the bowstring is prevented from letting down any farther toward the released mode or configuration.

**[0041]** The current embodiments provide a crossbow and method for efficiently and safely drawing and de-cocking the crossbow.

**[0042]** These and other objects, advantages, and features of the invention will be more fully understood and appreciated by reference to the description of the current embodiment and the drawings.

**[0043]** Before the embodiments of the invention are explained in detail, it is to be understood that the invention is not limited to the details of operation or to the details of construction and the arrangement of the components set forth in the following description or illustrated in the drawings. The invention may be implemented in various other embodiments and of being practiced or being carried out in alternative ways not expressly disclosed herein. Also, it is to be understood that the phraseology and terminology used herein are for the purpose of description and should not be regarded as limiting. The use of “including” and “comprising” and variations thereof is meant to encompass the items listed thereafter and equivalents thereof as well as additional items and equivalents thereof. Further, enumeration may be used in the description of various embodiments. Unless otherwise expressly stated, the use of enumeration should

not be construed as limiting the invention to any specific order or number of components. Nor should the use of enumeration be construed as excluding from the scope of the invention any additional steps or components that might be combined with or into the enumerated steps or components.

#### BRIEF DESCRIPTION OF THE DRAWINGS

**[0044]** FIG. 1 is a perspective view of the crossbow of a current embodiment.

**[0045]** FIG. 2 is a perspective view of the crossbow being cocked using a sled and crank of the current embodiment;

**[0046]** FIG. 3 is a close-up view of the sled with a pair of stops on the sled in a neutral mode to draw the bowstring;

**[0047]** FIG. 4 is a partial section view of a trigger assembly including a safety, with the bowstring drawn by the sled past a catch and engaging a safety bar of the safety.

**[0048]** FIG. 5 is a partial section view of a trigger assembly with the bowstring drawn and held in a fully drawn mode and the catch in a holding mode to hold the bowstring in position, with the safety in a safety on mode to prevent a sear from actuating, and an anti-dry fire element in a lockout mode preventing the safety from moving from the safety on mode shown.

**[0049]** FIG. 6 is a close-up view of the sled with the pair of stops on the sled in a de-cocking mode and arrested against an engagement surface atop the crossbow to stop rearward movement of the sled toward the safety.

**[0050]** FIG. 7 is a partial section view of a trigger assembly with the bowstring drawn and a sled on the frame in a de-cocking mode in which an anti-dry fire protrusion has moved the anti-dry fire element to the open position when the sled is adjacent the trigger assembly, but wherein the sled is prevented from moving rearward by the stops far enough to push the sled or the bowstring against the safety so that a gap remains between the bowstring and the safety and so the safety can still be moved to a safety off mode.

**[0051]** FIG. 8 is a partial section view of a trigger assembly with the bowstring drawn and a sled on the frame in a de-cocking mode in which an anti-dry fire protrusion has moved the anti-dry fire element to the open position when the sled is adjacent the trigger assembly, but wherein the sled is prevented from moving rearward by the stops far enough to push the sled or the bowstring against the safety so that a gap remains between the bowstring and the safety, but wherein the safety is moved from a safety on mode to a safety off mode, thereby moving into the gap and toward the bowstring.

**[0052]** FIG. 9 is a close-up view of the sled with the pair of stops on the sled still in the de-cocking mode and arrested against the stop engagement surface atop the crossbow to stop rearward movement of the sled toward the safety.

**[0053]** FIG. 10 is a partial section view of a trigger assembly with the bowstring drawn and a sled on the frame in a de-cocking mode in which an anti-dry fire protrusion has moved the anti-dry fire element to the open position when the sled is adjacent the trigger assembly, wherein the safety is in the safety off mode, wherein the trigger has been pulled and a sear is in a fire mode, with the sear safety element moving past the safety and a catch initially transitioning from a holding mode to a drop mode to release the bowstring while the bowstring is still held by the sled in the de-cocking mode so that the bowstring does not thereby move into the gap and toward the bowstring.

**[0054]** FIG. 11 is a close-up view of the sled with the pair of stops on the sled still in the de-cocking mode but with the stops and sled moving slightly forward under operation of a crank mounted on the stock of the crossbow.

**[0055]** FIG. 12 is a partial section view of a trigger assembly with the bowstring drawn and a sled on the frame in a de-cocking mode, with the sled moving forwardly under control of the crank and the safety in the safety off mode, wherein the trigger has been pulled and a sear is in a fire mode, with the sear safety element past the safety and the catch fully transitioned from the holding mode to the drop mode such that the bowstring moves forwardly with the sled in the de-cocking mode.

**[0056]** FIG. 13 is an upper perspective view of the sled with the stops in a neutral mode, used for example in FIG. 2 to cock the crossbow.

**[0057]** FIG. 14 is an upper perspective view of the sled with the stops in a de-cocking mode, used for example in FIG. 6 to de-cock the crossbow.

**[0058]** FIG. 15 is a top view of the sled with the stops being moved from a neutral mode to the de-cocking mode.

**[0059]** FIG. 16 is a bottom perspective view of the sled showing a bowstring engaged by the sled and a cord pulling on the sled in either a cocking mode or a de-cocking mode.

**[0060]** FIG. 17 is a perspective view of a crossbow crank being installed on a crossbow.

**[0061]** FIG. 18 is partially exploded view of the crossbow crank.

**[0062]** FIG. 19 is a further exploded view of the crossbow crank.

**[0063]** FIG. 20 is another exploded view of the crossbow crank.

**[0064]** FIG. 21 is a section view of the crossbow crank with a drive shaft locked relative to a sleeve via a brake, so that a one-way bearing allows rotation of the drive shaft, a drive gear and one or more spools in a first direction, but impairs rotation of the drive shaft, the drive gear and one or more spools in a second direction opposite the first direction.

**[0065]** FIG. 22 is a section view of the crossbow crank with a drive shaft spinning freely relative to a sleeve and a one-way bearing so that the drive shaft and a drive gear and one or more spools can rotate in a first direction and/or an opposite direction, without being impaired by the one-way bearing in either direction.

#### DETAILED DESCRIPTION OF THE CURRENT EMBODIMENTS

**[0066]** A current embodiment of the crossbow with a de-cocking system and a crossbow crank is shown in FIGS. 1-12 and generally designated 10. The crossbow 10 shown in FIG. 1 is shown as an archery crossbow. It will be appreciated that the de-cocking system and crossbow crank as described herein can be used with any type of projectile shooting device that uses or shoots an arrow, bolt or other projectile. As used herein an arrow can refer to an arrow, a bolt or some other elongated projectile. As generally shown in FIG. 1, the crossbow 10 is shown with its bowstring 11 in a drawn mode, held in place by a trigger assembly 20 that is mounted within a barrel or frame 12 of the crossbow. The bowstring 11 can be selectively released via the trigger assembly 20 to shoot the arrow A from the crossbow. As the crossbow transitions and the bowstring moves from the drawn mode shown in FIG. 1, to an undrawn mode or released mode, which are used interchangeably herein, the

bowstring **11** moves forward until it extends generally perpendicular to the frame **12** and the rail **13** upon which the arrow **A** rests or moves as it is propelled by the bowstring.

**[0067]** As shown in FIG. **1**, the crossbow **10** can include a first limb **14A** and a second opposing limb **14B** disposed that opposite sides of the barrel or frame **12** and the rail **13**. To each of these respective limbs **14A** and **14B**, respective cams **15A** and **15B** can be joined. These cams **15A** and **15B** can be any type of cam, pulley, disc and/or round or oval member capable of rotating about the respective axes **15AX** and **15BX**. To these respective cams, the bowstring **11** can be joined and journaled in respective tracks of the cams. The bowstring generally can unwind or unfurl from the respective cams on opposing sides of the frame when moving from an undrawn mode, also referred to as a released mode herein, to a drawn mode or cocked mode as shown in FIG. **1**. Generally the bowstring can extend transverse to the frame and rail, between the respective cams in most if not all of these modes. Further, power cables **11P** can be joined with and extend from one cam **15A** to the other cam **15B** to transfer energy stored in the limbs **14A** and **14B** in a conventional manner to the bowstring **11** to shoot the arrow **A** from the crossbow **10**.

**[0068]** The crossbow **10**, as mentioned above, can include the barrel or frame **12** which can extend rearwardly from a riser **16** of the crossbow. An optional stirrup **16S** can be joined with the riser **16** and/or the frame **12** to allow a user to stabilize the crossbow **10** as it is drawn and/or de-cocked as described below. Limbs **14A** and **14B** can be fastened or secured to the riser **16** and/or the frame **12**. The barrel or frame **12** can extend rearward from the riser and/or can be integral with the riser and/or the limbs depending on the configuration of the same. As shown in FIG. **1**, the riser can extend rearwardly past the limbs and cams and is generally of an elongate structure. The frame **12** can include an internal compartment **12C** as shown in FIG. **4**. This internal compartment can house the trigger assembly **20** described below. The frame **12** can include and/or can be joined with a grip **17**, which as shown can extend downward from the frame **12** generally between the riser **16** and a stock **18** that is secured to the rearward portion of the frame **12**. The grip **17** can be in the form of a pistol grip and ergonomically configured to receive a user's hand allowing the user to grip, manipulate, hold and/or steady the crossbow **10** in a variety of configurations.

**[0069]** The frame **12** optionally can include a mounting arm **19**. This mounting arm **19** can be joined with the frame **12** directly or joined with a trigger assembly **20** and secured thereto via a system of fasteners **20F**. The mounting arm **19** in FIGS. **1** and **3** can be joined within upper portion of the trigger assembly **20**, sometimes referred to as a trigger box, via one or more fasteners **19F**. The fasteners can be in the form of screws that are screwed into corresponding threaded holes in the upper portion **20U** of the trigger box **20**. The mounting arm **19** can include a forward end **19F** and an opposing rearward end **19L** closer to the stock **18**. The forward end **19F** can extend any cantilevered manner forwardly over the rail **13** and the frame **12**. The mounting arm **19** can include an arrow holder **19A** that can extend downwardly from a lower surface **19U** of the mounting arm **19**. This arrow holder **19A** as shown can include a button **19B** that can engage a portion of the arrow **A** when the arrow is disposed on the rail **13** and generally within a channel **13C** of the rail to hold the arrow down against the rail before it

is shot from the crossbow. This can ensure that the arrow does not inadvertently become dislodged or drop out of the crossbow during transport. Although shown as a button **19B**, the arrow holder **19A** can include bristles, a plunger, or any other type of element that can touch, contact or engage the arrow **A** with a low amount of force sufficient to hold the arrow in place along the rail **13**. Of course, in some applications the arrow holder can be absent from the crossbow.

**[0070]** As shown in FIG. **4**, the mounting arm **19** also can include an upper portion of rail that includes multiple ridges **19R** and notches **19N**. This rail can be in the form of a picatinny or dovetail rail and constructed to receive a sighting device (not shown) such as a scope, reflex sight, red dot or other type of sighting device. The mounting arm **19** as mentioned above can be secured and/or can be integral with the trigger assembly **20** at its rearward end **19L**. Adjacent to the mounting arm **19** or the trigger assembly **20** can be a sled limiter, also sometimes referred to as a sled engagement surface **SES**. This sled limiter or sled engagement surface **SES** can be configured to engage one or more stops **31**, **32** of the sled **30** shown in FIG. **2** in a de-cocking mode using the de-cocking system as described below. As shown in FIG. **4**, this sled engagement surface **SES** can be a portion of the trigger assembly or trigger box **20**. Of course, depending on the application, the sled engagement surface **SES** can form or be a portion of the mounting arm **19**, the frame **12** and/or the rail **30** or some other component extending adjacent the rail and frame near the trigger assembly **20**.

**[0071]** Optionally, the sled engagement surface **SES** can be in the form of a wall or surface which can be flat, planar, curved, angled or of some other contour or configuration. The sled engagement surface can be configured again to engage the stops **31**, **32** of the sled **30** and generally impair rearward movement of the sled **30** toward the stock and/or further rearward relative to the trigger assembly. As used herein, the word impair can include an operation to impair, arrest, stop, interfere with (fully and/or partially) movement of the sled and/or components thereof. The operation and interaction of the sled engagement surface **SES** with the sled and in particular the stops **31** and **32** are described further below.

**[0072]** Turning to the trigger assembly **20**, its various components will be described with reference to FIG. **4**. The trigger assembly **20** can include or be coupled to a trigger **21T**. The trigger **21T** can be adjacent a grip **17** and can extend inward into a portion of the compartment **12C** defined by the frame **12**. The trigger **21T** can be joined pivotally with the frame **12** via a pivot pin **21P1**. The trigger **21T** can include a second pivot pin **21P2** that joins the trigger **21T** with a trigger bar **21B**. The trigger bar **21B** can extend rearward from the trigger and the grip **17** toward the trigger assembly or trigger box **20**. The trigger bar can include a rearward end **21R** that couples to a sear **22** of the trigger assembly **20** at a socket **21S**. The socket **21S** can define a hole that receives a ball **22B** of the sear **22** to operably connect the trigger bar and thus the trigger with the sear **22**. Of course, other constructions can be used to join the trigger and the sear depending on the application. Optionally, the trigger bar can be removable from the sear **22**, for example the ball **22B** can be removed from the socket **21S** to provide removal of the trigger box **20** from the frame

12 to provide service, repair and/or replacement of the trigger assembly 20 relative to the crossbow 10.

[0073] The sear 22 can be selectively rotatable about a pivot pin 22P and a corresponding pivot axis. The sear can include a ball arm 22BA that extends down to the ball 22B. The ball arm can include a projection 22C that engages a biasing element 22S which can be in the form of a coil spring, leaf spring or elastomeric element. The spring 22S can be held in a cup 22F and can generally urge the sear to rotate in direction R1 about the pin 22P. The spring 22S also can provide resistance to a force F1 exerted on the trigger 21T. The sear can include a sear catch arm 22R that extends forwardly to a sear catch engagement surface 22E. This engagement surface 22E can be configured to engage a bowstring catch 23 of the trigger assembly. The engagement surface 22E can be highly polished as can be a corresponding catch engagement surface 23E of the catch 23 so that the two members can slide and move smoothly and cleanly with regard to one another during actuation as described below. The sear also can include a safety engagement portion 22K that extends rearwardly from the pin 22P. The safety engagement portion 22K can include a rounded or ball shaped end 22B that interfaces with a receiver hole 22H in a sear safety pin 22SP.

[0074] The sear safety pin 22SP shown in FIGS. 4-5 can extend vertically to selectively interact with the safety 24 of the trigger assembly 20. The sear safety pin 22SP can move upward and downward in the sear safety pin slot 22SPS depending on the movement of the sear 22 as described below. The upper end 22SPE of the sear safety pin 22SP can be blocked to prevent or impair upward movement via its engagement with the lower surface of a safety bar 24B or the safety 24 in general. For example, the rearward portion 24R of the safety 24 can be in the position shown in FIG. 4 in which the safety blocks movement of the sear safety pin 22SP and thus rotation of the sear 22 about the pin 22P in direction R1. As a result, the trigger 21T cannot activate the sear to release the bowstring catch 23.

[0075] As shown in FIG. 4, the sear 22 is in the cocked mode, thereby preventing the catch 23 from releasing the bowstring, and the safety is in the safety on mode in which it interferes with movement of the sear safety pin 22SP in an upward direction and thus does not allow rotation of the sear in direction R1. As mentioned above, the catch 23 is rotatable about the pin 23P. This rotation can be biased by a spring 23S which can generally return the catch to the position shown in FIG. 4 after the bowstring 11 is released from a drawn mode to the released or undrawn mode, for example, when the bowstring is used to shoot an arrow or is de-cocked as described below.

[0076] The catch 23 can include a bowstring engagement surface 23B above the pivot 23P and generally above the sear engagement surface 23E. This bowstring engagement surface 23B can engage the bowstring and when the catch 23 is engaged against the sear can hold the bowstring in the drawn mode. Additional catches can be joined with the catch 23 as shown to hold the bowstring in multiple locations, depending on the application. The bowstring catch is shown disengaged from the bowstring 11 in FIG. 4 because the sled 30 has been used to draw the bowstring 11 to its maximum position, engaging the bowstring 11 against the safety 24, before this sled is removed from the bowstring. In this position, the bowstring 11 might not engage the bowstring engagement surface 23B of the catch, and instead might

engage the forward facing end 24F of the safety 24. As shown in this position in FIG. 4, when the sled has pulled the bowstring beyond full draw, the safety 24 generally is not movable in direction F2, so it cannot be disengaged from the safety on mode. The safety pin 22SP thus cannot be moved upward, and sear 22 cannot rotate in this condition.

[0077] The trigger box 20 can include the safety 24 as mentioned above. The safety 24 can be moveable, for example, slidable in a safety slot 20SS defined by the trigger assembly box or housing 20BH. The safety can be configurable in the safety on mode shown in FIGS. 4 and 5 or alternatively in the safety off mode shown in FIGS. 8 and 10. In the safety on mode, the safety obstructs movement upward of the safety sear pin 22SP which prevents rotation of the sear 22 in direction R1, so that the sear engages the catch 23 to keep the catch in the holding mode as shown for example in FIG. 5. The safety also is operable in the safety off mode shown in FIGS. 8 and 10 such that the sear can be converted to the fire mode shown in FIG. 10 and the catch 23 can be converted or move to the drop mode shown in FIG. 12 to release and allow the bowstring to transition from the drawn mode to the released or undrawn mode in either a shooting operation or a de-cocking operation of the crossbow as described below.

[0078] Optionally, the safety 24 can be aligned with and can move against a common plane P1 with the bowstring 11. Further optionally, the safety 24 can slide primarily along or linearly within that plane P1 without rotating. The safety slot 20SS also can be aligned with and/or intersected by the plane P1 as shown. The safety 24 can slide linearly within this safety slot 20SS as shown. The safety can interface with a detent ball 24B that is urged via a spring 24S into a safety on notch 24SO when the safety is in the safety on mode shown in FIG. 4 or into a safety off notch 24SF when the safety is in the safety off mode shown in FIG. 8. The interface of the ball and notches can secure the safety 24 in the safety on mode and/or safety off mode depending on the notch. Of course, other mechanisms can be used to secure hold or locate the safety 24 in the safety on mode and the safety off mode.

[0079] The crossbow 10 optionally can include an anti-dry fire element 25 that can prevent inadvertent or unintentional dry firing of the crossbow 10 when an arrow A is not satisfactorily engaged with the bowstring or is absent from the crossbow altogether. The anti-dry fire element can be selectively movable between a lockout position shown in FIG. 5, which prevents the safety 24 from being transitioned from the illustrated safety on mode, where the safety 24 will not allow the sear 22 to rotate, and an open position shown in FIG. 10 that permits the safety to move to the safety off mode shown there for de-cocking, or for shooting an arrow from the crossbow. As shown in FIG. 5, the anti-dry fire element 25 can pivot about a pivot pin 25P and generally about a pivot axis 25PA. The anti-dry fire element 25 can be disposed generally above an arrow when the arrow is engaged via its nock with the bowstring 11, which is held in place in the drawn mode shown in FIG. 5 via the catch 23 in a holding mode. The anti-dry fire element 25 can include an arm 25F that extends toward and selectively is placed against or adjacent the forward facing end 24F of the safety 24. As shown in FIG. 5 in this configuration, the safety 24 cannot be moved forwardly from the illustrated safety on

mode, to a safety off mode. Likewise, the safety cannot be moved forward toward the bowstring 11 held by the catch 23.

**[0080]** In this lockout position of the arm 25F and the anti-dry fire element 25 in general, the safety 24 is locked out from being able to transition from the safety on mode shown in FIG. 5 to the safety off mode shown in FIG. 10. The anti-dry fire element arm 25F can be biased to the locked mode via a biasing element 25S which can be in the form of a spring pressing against the arm 25F and seated in a recess 25R. Another portion of the spring 25S can be disposed in a cup 25C of the trigger box housing 20BH. When an arrow A or the protrusion 36 of the sled 30 is moved toward the bowstring 11, for example, as shown in FIG. 5, the arrow or sled will exert a force F3 upon a ramp 25M of the anti-dry fire element 25. This force F3 causes the arm 25F to move upward in direction R2 and thereby disengage or move out of an interference position relative to the safety 24. The spring 25S under such engagement force F3 also can compress slightly. When the arm 25F is no longer positioned in the lockout position or generally is in the open position after moving in direction R2, the anti-dry fire element will allow the safety 24 to slide or otherwise move forwardly from a safety on mode to a safety off mode.

**[0081]** As mentioned above, the crossbow optionally can be supplied with a sled 30 which can be used to cock and de-cock the crossbow 10. The sled can be used to move the sled from a released or undrawn mode, where the bowstring is all the way forward extending between the cams in a generally perpendicular manner, to a fully drawn or unreleased mode shown for example in FIG. 1. The sled in this embodiment optionally can be used as part of a de-cocking system for de-cocking the crossbow from the drawn mode to a released or undrawn mode.

**[0082]** With reference to FIGS. 13-16, the sled will now be described in further detail. Optionally, the sled 30 can include a body 33 which can be of a generally U or V shape. The body can include rearward extending first arms 31 and 32 disposed on opposite sides of a sled longitudinal axis SLA. The body 33 can further include a guide 34 which can have a first guide rail 34A and a second guide rail 34B disposed on opposite sides of the sled longitudinal axis SLA. These rails can cooperate to form a recess 24R which is sized to receive an upper portion of the rail 13 or the barrel 12 of the crossbow 10. The recess 34R can be of a width W1 that is greater than a width W2 of the rail 13. Optionally, the guide 34 can include an insert 34I that has built in slots 34S they can receive corresponding protrusions or rails along the rail 13 or frame 12 to assist further in smooth sliding along the rail as the sled 30 is used to draw and/or de-cock the crossbow 10.

**[0083]** With further reference to FIG. 16, the sled 30 can be configured so that the body 33 includes one or more bowstring engagers 35A and 35B. These bowstring engagers can be in the form of channels, slots, recesses, grooves or tracks that extended rearward from a forward portion of the body 33 and rearward of a protrusion 36 that is configured to move the anti-dry fire element of the crossbow to the open position from its lockout position when the sled is adjacent the trigger assembly 20. The bowstring engagers 35A and 35B can be configured to allow the bowstring 11 to wrap in a U shape as shown in FIG. 16 around the rearward portion of the sled 30 but forward and optionally above the cord engagement elements 37A and 37B. These cord engagement

elements can be joined with the rearward portions of the respective arms 31 and 32. Further optionally, these cord engagement elements can include rollers 37BR and 37AR that are mounted on respective pins 37BP and 37AP that extend through the respective arms 31 and 32. The rollers can rotate relative to the arms to facilitate movement of the cord and in particular portions of the cord C1 and C2 relative to those rollers and the sled when the cord portions C1 and C2 are under tension by a user pulling manually on the cord and/or a crank 50 associated with the crossbow 10 as described below. As used herein, a cord or a portion of the cord can mean a cord, rope, string, set of filaments, cable, strap, web, ribbon or any other elongated element.

**[0084]** The sled 30 shown in FIGS. 13-16 optionally can be outfitted with one or more stops to allow the sled to assist in drawing or cocking the crossbow, as well as letting down or de-cocking the crossbow, in particular the bowstring, from a drawn mode to a released mode or undrawn mode. The one or more stops can include a first stop 38 and a second stop 39. The first and second stops each can be selectively operable in a neutral mode shown in FIGS. 4 and 13, in which the first and second stops do not interfere with rearward movement of the sled 30 along the barrel 12 or rail 13. This is so that the bowstring 11 can move completely to the drawn mode and past the catch 23, and more particularly past the catch bowstring engagement surface 23B during a drawing operation or a de-cocking operation.

**[0085]** With the stops in the neutral mode, the user can pull on the sled 30 via the cord and its portions C1 and C2 such that the bowstring 11 actually contacts the safety 24 and in particular a front surface 24F of the safety as shown in FIG. 4 at a maximum drawing extent of the bowstring during a drawing operation with the sled. However, when the sled is disengaged from the bowstring and removed from the rail and frame, the bowstring 11, shown in FIG. 5, can retract forward and can be spaced a distance D1 from the forward facing end 24F of the safety 24. This distance D1 can correspond to a gap between the bowstring 11 and the forward facing end 24F of the safety. This gap between the bowstring and the safety 24 can be sized to accommodate the safety while transitioning the safety from the safety on mode to the safety off mode as described further below.

**[0086]** Returning to the sled and stops shown in FIGS. 13 and 14, each of the stops can generally be identical but disposed on opposite sides of the sled longitudinal axis SLA so only the first stop 38 will be described in detail here. The first stop 38 can include a first pivot axis 38P1 about which it can rotate direction R3, generally toward the sled longitudinal axis. The first stop can be fastened to the body 33 via a stop fastener or pin 38P. This fastener or pin can be of any configuration to allow the first flange 38F to rotate about the pivot access 38P1. The first flange 38F can include a stop block 38B which can include a first engagement surface 38E. The first flange, stop block 38B and engagement surface 38E each can rotate together with the flange about the pivot axis 38P1 in direction R3, from the neutral mode shown in FIG. 13 which is used to draw the archery bow, to a de-cocking mode shown in FIG. 14.

**[0087]** In the de-cocking mode, the flange, stop block, and/or first engagement surface can engage a stop limiter or sled engagement surface SES described above or some other component of the barrel, rail, trigger box, or mounting arm that is generally disposed along a travel path of the stop block when the stop block is deployed to the de-cocking

mode. This is shown for example in FIG. 6, where the crossbow 10 is in the initial stages of a de-cocking mode. There, the first stop 38 and the second stop 39 each are deployed, for example, as further shown in FIG. 14. In this configuration, the respective and first engagement surface 38E and the second engagement surface 39E are each deployed to the de-cocking mode. In this mode, the stops and respective flanges and engagement surfaces are each on opposing first and second sides of the rail, opposite one another. These stops and engagement surfaces are configured to simultaneously engage the stop engagement surface SES in the de-cocking mode. As a result, with these engagement surfaces 38E and 39E engaging, contacting or pushing against the sled engagement surface SES, this engagement and contact will impair and/or completely arrest movement of the sled so that it can no longer move rearward. This is further shown in FIG. 7 where the stop 38 and the stop engagement surface 38E engages the sled engagement surface SES as the sled 30 is used to engage the bowstring 11 during a de-cocking mode. As this occurs, the bowstring 11 also enters into the respective bowstring guides or engagers 35A and 35B.

[0088] Optionally, with reference to FIGS. 6, 13 and 14, the stops 38 and 39 can include respective stop longitudinal axes 38LA and 39LA. In the neutral mode of the stops 38 and 39, shown in FIG. 13, the stop longitudinal axes 38LA and 39LA can be generally parallel to the frame 13 and the sled longitudinal axis SLA. In the de-cocking mode, the stops 38 and 39, shown in FIGS. 6 and 14, and the stop longitudinal axes 38LA and 39LA can be rotated such that these stop longitudinal axes are substantially perpendicular to the sled longitudinal axes SLA and substantially perpendicular to the barrel or frame 12 and/or the rail 13 and/or the crossbow longitudinal axis LA. These stops can rotate about the respective pivot axis 38P1 and 39P1, which optionally can be substantially vertical when transitioning and moving the stop longitudinal axes from the parallel to the frame configuration to the substantially perpendicular to the frame configuration in the de-cocking mode. Of course, when the respective pivot axes of the stops are oriented differently, the movement of these stops can change as well.

[0089] Although the sled 30 is shown with first and second stops on opposite sides of the sled longitudinal axis SLA that generally engage a portion of the trigger assembly or box 20, the stops can be attached in different locations or positions on the sled and the sled engagement surface can be disposed on different components or portions of the crossbow. For example, the stops can include one or more stops that are joined with the sled and are movable from first position to a second different position. The first position can be out of the way of and not contact any portion of the trigger box, mounting arm, frame or other component of the rail. The second position of the stop can be such that when it is moved, the stop or a portion thereof engages or contacts some portion of the trigger box, mounting arm, frame or other component of the rail to impair or otherwise arrest or stop rearward movement of the sled toward the safety 24. Regardless of the configuration of the stops, in the de-cocking mode, they will enable the sled to engage the bowstring 11 as shown in FIG. 7 while the sled is in the rearmost position, being drawn by the cord and its respective cord portions C1 and C2 discussed above. In this rearmost position, the bowstring 11 remains out of contact and

disengaged from the safety 24 and in particular the safety bar 24B and its forward most end 24F.

[0090] As mentioned above, the forward most end 24F can be spaced at distance D1 from the bowstring 11. This distance D1 can be greater than the thickness T1 of the sear safety pin 22SP such that when the forward end 24F of the safety bar 24B moves forward reducing the distance D1 between it and the bowstring 11, the sear safety arm can be moved upward past the rearward end 24R of the safety bar 24B as shown for example in FIG. 8. In some cases, the safety moves closer to the bowstring, thereby reducing the distance D1 between the bowstring and the forward end of the safety in the de-cocking mode, particularly when the safety is converted to the safety off mode. In other cases, as shown in FIG. 8, the forward facing end 24F may actually contact the bowstring 11 when the safety is converted from the safety on mode shown in FIG. 7 to the safety off mode shown in FIG. 8. Of course in other applications, contact between the forward end 24F of the safety bar 24B and the bowstring 11 does not occur and a small gap having a distance less than the distance D1 remains between the bowstring and the forward facing end 24F of the safety bar.

[0091] Further optionally, during the transition of the safety bar 24B and the safety 24 in general from the positions in FIG. 7 which is a safety on mode, to the safety off mode shown in FIG. 8, the sled 30 can remain stationary and the stop engagement surfaces 38E and 39E can remain in contact with, engaging or immediately adjacent the sled engagement surface SES. The bowstring 11 also can continue to have its same tension during this transition. The cord and its portions C1 and C2 also can maintain the same tension T therein as the safety is converted from the safety on mode to the safety off mode.

[0092] A method of using the crossbow 10 of the current embodiment, and in particular a method of de-cocking the crossbow during a de-cocking operation will now be described in further detail. Generally, the method can comprise pulling on a bowstring that is in a drawn mode with a sled including a stop so the stop engages a limiter on the crossbow and ceases movement of the sled and stop relative to a frame of the crossbow in a de-cocking mode, leaving a first distance between the bowstring and a safety bar, without the sled and stop engaging the safety bar; moving the safety bar toward the bowstring to reduce the first distance to a second distance between the bowstring and the safety bar, the second distance being less than the first distance; pulling a trigger so that a catch disengages the bowstring; and transitioning the bowstring to an undrawn mode while the sled engages the bowstring to de-cock the crossbow.

[0093] Optionally, the method can include manually engaging the safety to slide a safety bar in a slot so that a forward face of the safety bar moves toward the bowstring without engaging the bowstring during the moving step. In some cases, the method can include manually sliding the safety bar toward the bowstring while the stop is in the de-cocking mode, without any part of the sled engaging the safety bar. The method can further include transitioning the stop from the de-cocking mode to a neutral mode by rotating the stop toward another stop on the sled after the crossbow is de-cocked and the bowstring is in the undrawn mode; and drawing the bowstring from the undrawn mode to the drawn mode while the stop is in the neutral mode.

[0094] Turning to FIGS. 1-12, the method can include converting the crossbow 10 from a fully drawn mode to a

released mode or undrawn mode where the bowstring is fully released and no longer held by the trigger assembly 20. The method can begin as shown in FIG. 1 where the crossbow 10 is fully drawn and an arrow A is disposed on the rail 13, fully engaged with the bow string 11 which is in the drawn mode being held by the catch 23 of the trigger assembly 20. The arrow A can be removed from the rail so that the crossbow 10 is readied for de-cocking the bowstring from the draw mode to the released or undrawn mode. When the arrow A is removed from the rail 13 and frame 12, the trigger assembly 20 can be in the configuration shown in FIG. 5. There, the sear 22 is in the cocked mode and holds and engages the catch 23 so that the catch is still in the holding mode shown there, holding the bowstring 11 in the drawn mode. The safety 24 is still in the safety on mode which engages the sear safety pin or otherwise prevents it from moving upward in the configuration shown in FIG. 5.

[0095] With the arrow A removed, the force F3 also is removed from the anti-dry fire element such that the spring 25S pushes the arm 25F downward in front of the forward end or face 24F of the safety 24 so that the safety cannot be actuated from the safety on mode to the safety off mode. The bowstring 11 remains secured via the catch 23 with the bowstring engagement surface 23 being engaged fully by the bowstring 11, which again is under tension. A significant force is thus exerted against that catch 23 due to energy stored in the limbs.

[0096] As shown in FIG. 2, a crank 50 can be installed relative to the stock 18 and the crossbow 10 in general. With further reference to FIG. 17, the stock 18 can define a hole, aperture other feature that receives a projection 18P associated with the crank 50. The interface of the projection 18P and the hole 18H can be sufficient to secure the crank 50 to the crossbow 10. The cord portions C1 and C2 can extend forwardly from the crank 50 and can be joined with the bowstring engagement elements of the sled 30. Another portion of the cord can extend through a hole defined by the projection 18P and forwardly to connect with the other cord portions C1 and C2.

[0097] The crank can be actuated to move the sled 30 to the position shown in FIG. 6. There, as mentioned above, the sled can be in the de-cocking mode along with the first and second stops 38 and 39. When the sled is drawn rearward with the cord and its portions C1 and C2 toward the brake 50 via a user cranking the crank arm 50RM of the crank 50, the protrusion 36 of the sled 30 can engage the ramp 25M of the anti-dry fire element 25 such that it rotates in direction R2 against the bias of the spring 25S. When this occurs, the arm 25F of the anti-dry fire element moves upward, generally from the position shown in FIG. 5 to be positioned shown in FIG. 7, such that the arm 25F is no longer in front of and cannot interfere with movement of the safety 24 and/or the safety bar 24B thereof. The anti-dry fire element and the arm 25F therefore are no longer in front of the forward end 24F of the safety.

[0098] With the stops 38 and 39 in the de-cocking mode, rearward movement of the sled 30 via tension in the cord portions C1 and C2 exerted by the crank 50, if optionally included, or tension in the cord portions exerted by a user manually pulling on the cord and thus the sled 30, can be impaired. In particular, as shown in FIG. 7 rearward movement of the sled can be completely arrested and stopped when the stops 38 and 39 engage the stop engagement surface SES or some other stop limiter that is associated with

the trigger assembly 20, frame 12, rail 13 or mounting arm 19 depending on the application. Accordingly, the sled will not push the bowstring 11 against or into engagement with the safety 24 and/or its forward end 24F. As further shown in FIG. 7, there can remain a distance D1 between the bowstring 11 and the front forward face 24F of the safety. In this configuration, the safety 24 can remain in the safety on mode, however no part of the sled or the bowstring is engaging the safety 24. Thus if desired by a user, the user can switch the safety, thereby moving it from the position shown in FIG. 7, to, for example, the position shown in FIG. 10 which corresponds to the safety off mode. In doing so, the bowstring is out of the path of movement of the safety, and does not interfere with its satisfactory movement. Optionally, as described below, when the crank 50 is used to move the sled via the cord and its portions C1 and C2, the crank can automatically lock so that the cord portions C1 and C2 will not unwind or unspool from the crank, and thus the cord portions can hold the sled and bowstring under a constant force while the de-cocking operation is commenced and continues.

[0099] With the sled 30 in the de-cocking mode and the stops 38 and 39 against the stop engagement surface SES or stop limiter, the safety as mentioned above can be converted from the safety on mode shown in FIG. 7 to the safety off mode shown in FIG. 8. To do so, again, a user can simply engage the safety shown in FIG. 6 and move it forward in direction R4 as shown in FIG. 8. In doing so, the forward end 24F of the safety 24 and in particular the safety bar 24B, optionally can move closer to the bowstring, reducing the distance D1 between the bowstring and that forward end. The safety detent 24B also can move from the forward notch to the second or rearward notch 24SF of the safety and/or safety bar 24B. The rear end or portion 24R of the safety also can move forwardly within the safety slot 20SS such that the rear end 24R clears the sear safety pin 22SP. In this configuration, the sear safety pin 22SP can move upward and optionally into the safety slot 20SS upon movement thereof via the sear 22 which can be affected via movement of the trigger 21T as described below.

[0100] With reference to FIGS. 9 and 10, the sled 30 can remain in place, held by the crank 50, holding the bowstring 11 in a fixed position even though the bowstring exerts significant forward force on the sled. The stops 38 and 39 remain engaged with the stop engagement surface SES to prevent any further movement of the bowstring 11. The safety 24, in particular the safety bar 24B, remains forward as shown. The anti-dry fire mechanism remains disengaged from the safety 24 via the protrusion 36 of the sled. In this condition, a user can exert the force F1 on the trigger 21T which in turn moves the trigger bar 21B rearward in direction R7. This rotates the sear 22 about the pivot pin 22P which in turn engages the sear safety pin 22SP moving it up in direction R6. Again because the safety is in the safety off mode, the sear safety pin 22SP can move into the safety slot 20SS behind the rear surface 24R of the safety bar 24B. The engagement surface 22E of the sear also moves downward out of engagement with the engagement surface 23E of the catch. As a result, the catch is free to rotate in direction R8 under any force exerted upon the catch via the bowstring 11.

[0101] With reference to FIGS. 11 and 12, the de-cocking system continues to de-cock the crossbow 10, letting the bowstring move from the drawn mode to the released or undrawn mode generally in direction R11. The bowstring 11

also remains under a very high tension when moving in this direction R11 due to the energy stored in the limbs and applied via the limbs and cams to the bowstring 11. The crank 50, however as described below can counter this force selectively based on input from the user. Optionally, the user rotates the crank arm 50RM in the direction R9. This allows the cord and its portions C1 and C2 to unwind from the crank 50 in directions R10. As a result, the sled 30 moves with the bowstring 11 forwardly along the frame 12 and rail 13, toward the riser of the crossbow. This let down of the bowstring, however, again is selectively controlled by the crank as described below. As shown in FIG. 12, because the catch 23 is allowed to move in direction R8, without the sear 22 engaging the catch any longer, that catch 23 can allow the bowstring 11 to ride over it and effectively release the bowstring. The catch 23 thus no longer holds the bowstring in the drawn mode because the catch is effectively in its drop mode. In the condition shown in FIG. 12, the sear also is in the fire mode, with the safety in the off mode. The anti-dry fire element is also in a lockout position. Of course, as the protrusion 36 of the sled 30 moves farther forward, the anti-dry fire element 25 and in particular the arm or finger 25F can move downward to touch a portion of the safety 24 and/or the safety bar 24B. The movement of the sled forwardly toward the riser can continue, with the crank 50 being operated via rotation of the crank arm 50RM moving in direction R9 until the bowstring is in its released mode or undrawn mode.

[0102] After this is completed, the bowstring can be considered de-cocked. When it is de-cocked, the sled can be disengaged from the bowstring and the crank 50 with their respective cord joined with the sled can be removed from the crossbow 10 for storage until the sled and crank are used again to draw the bowstring from the release mode to a drawn mode during a cocking operation of the crossbow. Of course, with the above de-cocking operation, a user need not shoot the arrow A shown in FIG. 1 from the crossbow to effectively convert the bowstring from the drawn mode to the released mode. Further, it will be appreciated that after the de-cocking operation, the trigger assembly 20 can be reset to a configuration shown generally in FIG. 5, without the bowstring present via the system of springs 22S and 23S within the trigger assembly. A user also can move the safety from the safety off mode back to the safety on mode before cocking the archery bow again. Further, if the same sled 30 and crank 50 are used, a user can reset the stops from the de-cocking mode to the neutral mode by rotating the respective stop blocks and flanges from the configuration shown in FIG. 14 to the configuration shown in FIG. 13.

[0103] As mentioned above, the current embodiment of the crossbow optionally can include a crossbow crank 50. As shown in FIGS. 2 and 17-22, the crossbow crank 50 will now be described in further detail. The crossbow crank can be used in lieu of a manual rope joined with the sled 30 to draw or cock the bowstring 11 to the drawn mode and/or to undraw or de-cock the bowstring 11 to the released or undrawn mode. The crank 50 can work in concert with the sled 30 as described above, or can be used in connection with another type of sled that is not particularly configured with a de-cocking system like the illustrated sled 30. As shown in FIG. 17, the crank can be temporarily mounted to the stock 18 of the crossbow 10 via a protrusion 18P that fits within the hole 18H defined by the stock. Of course, the crank 50 can be connected to the frame 12 or some other

portion of the crossbow 10 in some other manner. Further, the protrusion and hole can be reversed on the stock 18 and crank 50, respectively.

[0104] Optionally, the crossbow crank can include a housing 51 comprised of multiple parts that conceal and protect other internal parts. The housing 51 can include a first section 51A and a second section 51B that are joined to one another via one or more fasteners. These fasteners 51F can be removed and replaced to disconnect their respective housing parts 51A and 51B to access the internal components of the housing. The housing also can include one or more covers 51C to cover the portions of respective spools as described below to gain access to the cord portions C1 and C2 that are wrapped on those spools or wrapped off those spools during a cocking and/or de-cocking operation with the crank 50. The crank can include a crank arm 50RM which can include a handle 50RH that can be rotatably joined with the arm 50RM. The crank can include an aperture 58 to which a portion of a drive nut 52 is joined. The drive nut can include one or more splines that interface with splines of the aperture 50A. The crank arm 50RM can be joined with the drive nut 52 via a pin 52P that fits within an aperture 52A to prevent the crank arm 50RM from sliding off the drive nut 52. Of course, other features can be included on the arm and the drive nut to secure these two elements together. The drive nut 52 can include internal threads 52T which again threadably engage threads 53T of the drive shaft 53, which is further connected to a drive gear 54 as shown in FIGS. 19 and 20. Optionally, a portion of the drive nut 52 in particular the collar 52C and the engagement surface 52E can be disposed inside the housing 51.

[0105] As shown in FIGS. 19-22 the crossbow crank can include a drive shaft 53 that is joined with a drive gear 54. The drive shaft 53 can be threadably joined with the drive nut 52. As mentioned above, the drive nut 52 can be joined with the crank arm 50RM so that a user can rotate the drive nut 52 which engages the drive shaft 53 which again is connected to the drive gear 54.

[0106] Optionally, the drive shaft 53 can be an elongated round or cylindrical bar with a first end that includes threads 53T and a second end 53E that extends past the drive gear 54. The drive gear can be fixedly and non-rotatably joined with a drive shaft so that the drive gear and drive shaft rotate in unison. These components can be a single integral piece or can be connected via interfitting parts that prevent rotation. The drive shaft 53 can be mounted inside a drive shaft bearing 53B at the end 53E to promote rotation within the housing. The drive gear 54 can include a plurality of teeth 54T that mesh with corresponding teeth 55T of a secondary gear 55. The secondary gear 55 can be fixedly and rotatably mounted relative to a secondary shaft 56. The secondary shaft 56 can be mounted within the housing and can be disposed within bearings 55B on opposing sides of the secondary gear 55 to facilitate rotation of the secondary gear and secondary shaft 56 within the housing. These bearings 55B can be mounted in corresponding bearing holes or mounting holes in the housing 50.

[0107] The secondary shaft can further be joined with first 56A and second 56B spools, reels or pulleys. These spools can be mounted to the shaft 56 at opposing ends, on opposite sides of the secondary gear 55 via fasteners 56F. The spools each optionally can include respective apertures 56AH and 56BH that are of a corresponding non-circular shape as the secondary shaft 56. Thus, when the spools are mounted on



the shaft, the shaft is inserted in the respective apertures 56AH and 56BH such that the spools do not rotate relative to that shaft 56. As shown, each of the spools can be fixedly and non-rotatably mounted to the secondary shaft. The spools thus rotate with the secondary drive gear 55. The spools each can be configured to accommodate the cord that extends to the sled. For example, as shown in FIG. 19, the first spool 56A can accommodate the first cord portion C1 and the second spool 56B can accommodate the second cord portion C2. These cord portions of the cord can wrap onto and off from the spools depending on rotation of the secondary shaft that is motivated by the respective rotation of the secondary gear 55 and the primary or drive gear 54.

[0108] Optionally, the secondary gear 55 can be rotatable in response to rotation of the drive gear 54. As shown in FIG. 19, when the drive gear 54 rotates in direction D1, the secondary gear 55 and associated spools rotate in the third direction D3. As another example, when the drive gear 54 rotates counterclockwise, the secondary gear 55 rotates clockwise, as do the spools. In turn, the cord portions C1 and C2 wind onto the respective spools to pull on the cord and facilitate movement of the sled toward the crank. When the drive gear 54 rotates in a second direction D2, the secondary gear 55 rotates in a fourth direction D4 along with the spools 56A and 56B which in turn unwind the cord portions C1 and C2 from therefrom to release the cord and facilitate movement of the sled away from the crank. As further shown in FIG. 19, the respective gears 54 and 55 can be mounted on the drive shaft 53 and the secondary shaft 56 which can be parallel to one another. The spools can be fixedly and non-rotatably joined with the secondary shaft 56. As illustrated, the drive gear optionally can be the only gear on the drive shaft. Likewise, the secondary gear can be the only or single gear on the secondary shaft 56. Of course, in other applications, there may be additional drive gears and/or secondary gears mounted to the respective shafts. Moreover, if desired, there can be additional secondary shafts and/or additional drive shafts mounted in the crank housing to provide additional mechanical advantage in some applications.

[0109] Optionally, a biasing element 55B can be mounted in the housing and to the secondary shaft 56. This biasing element can be in the form of a spring and optionally can be a flat plate coil spring that is configured to urge the secondary gear 55 in a second direction D4 for example shown in FIG. 19 which in turn can assist in rotating the drive gear 54 and thus the drive shaft in direction D2 to tighten the threads 53T of the drive shaft 53 relative to the drive nut 52 and tighten the drive nut 52 relative to the sleeve and the brake 59 along the drive shaft 53 thereby actuating the brake 59 as described below.

[0110] As shown in FIGS. 19-22, the crank 50 can include a one-way bearing 57 defining an opening 570 within which a sleeve 58 is disposed. The sleeve can be joined with a brake 59 that is disposed along the drive shaft 53. Optionally, the one-way bearing 57, sleeve 58 and brake 59 can be located between the drive nut 52 and the drive gear 54 along the shaft 53. Each of these components will now be described in further detail. The one-way 57 bearing can be any one-way device that allows rotation of the drive shaft 53 and thus the drive gear 54 in a single direction, for example a first direction D1, but impairs rotation of the drive shaft 53 and thus the drive gear 54 in a second direction, for example

D2. Of course, the directions D1 and D2 can be reversed depending on the configuration of the respective shafts, gears and spools. Optionally, rotation of the shaft in the first direction D1 can translate to the portions of the cord C1 and C2 being drawn onto the respective spools 56A and 56B, thus pulling on the sled 30 and drawing and/or de-cocking the bowstring 11 and the crossbow 10 in general. This one-way bearing 57 can be disposed in the housing 50 and for example, press fit or frictionally fit into a bore 57B of the housing 51A. Alternatively, the one-way bearing can be adhered to, glued, cemented, or secured in a fixed, non-rotational manner relative to the housing along its exterior 57E. Of course, fasteners welds or other constructions can be used to fix the bearing to the housing or some other structure. In this configuration, the exterior 57E of the bearing 57 is fixed and non-rotational relative to the bore 57B and the housing 51A. However, the rollers 57R that extend within the opening 570 of the bearing 57 can allow relative rotation of the sleeve 58 disposed in the opening relative to those rollers selectively in the first direction D1, but not in the second direction D2. Of course in other applications, the rollers can be reversed and can allow rotation in the second direction D2 but not the first direction D1.

[0111] As used herein, a one-way bearing can comprise a one-way bearing, a one-way clutch, a roller clutch, a sprag clutch, a backstopping clutch or similar one-way devices. Generally, however, the one-way bearing is not in the form of and does not include a one-way ratcheting mechanism having a pawl that intermittently interfaces with teeth and a gear. The one-way bearing herein is smoother, more quiet and less noticeable in actuation than a such a ratcheting mechanism and can be well suited for hunting environments. One commercial example of a one-way bearing is the one-way bearing under the name of TRITAN Needle Roller Bearing, available from Grainger of Lake Forest, Illinois. Another commercial example of a one-way bearing is a one-way clutch roller bearing under the name of the HF Series, available from MiSUMi of Schaumburg, Illinois. Yet another commercial example of a one-way bearing is a sprag clutch available from GMN Bearing USA of the name of Katy, Texas.

[0112] With further reference to FIGS. 19 and 20, the one-way bearing is arranged along the drive shaft 53 between the brake 59 and the drive nut 52. The drive shaft 53 can extend through the opening 570 of the one-way bearing 57. The sleeve 58 can be interposed between the shaft 53 and the rollers 57R. As shown, the sleeve 57 can be a generally cylindrical and/or tubular element that includes an opening or bore 580 through which the shaft is disposed. The shaft 53, when simply fit through the sleeve 58, can rotate relative to the sleeve and the sleeve relative to the shaft, in conditions where the brake 59 is not axially compressed as described below. The sleeve 58 can include a brake collar 58C at one end and an engagement surface 58E at the other end. The engagement surface 58E can be directly adjacent a drive nut spacer 52S that fits within the opening 570 or slightly outside of it and the one-way bearing 57. The drive nut spacer does not optionally contact any of the rollers 57R or the one-way bearing 57 in general. It can however selectively be frictionally engaged against the engagement surface 58E of the sleeve 58 as described below when compressed thereagainst by the drive nut 52 tightening on the threads 53T of the drive shaft 53. The drive nut spacer

**52S** can be constructed from a softer material, such as brass, a composite, and/or a polymeric material. Optionally it can bite into and provide good engagement and contact between the drive nut **52** and the sleeve **58**.

[0113] As further shown in FIGS. **19** and **20**, the sleeve can include and/or be joined with the brake collar **58C**, which can be referred to as a first brake collar. The brake **59** can comprise this first brake collar **58C**, as well as a second brake collar **59C** and a brake disc **59D**. These components, that is the first brake collar **58C**, second brake collar **59C** and brake disc **59D** can be disposed along the shaft **53**, optionally between the drive gear **54** and the one-way bearing **57** and/or drive nut **52**. The brake disc itself **59D** can be disposed between the first brake collar **59C** and the second brake collar **58C**. The brake disc **59D** can include an opening **590** through which the shaft **53** is disposed and can rotate relative thereto. The second brake collar **59C** also can define an opening through which the drive shaft **53** can be disposed and can rotate relative thereto. Optionally, each of the openings of the sleeve, the brake collars and the disc are all of a diameter that is larger than the diameter of the drive shaft **53** such that all of the sleeve **58** and brake **59** components can rotate freely relative to the drive shaft **53**, when the brake **59** is not actuated as described below. Further optionally, the second brake collar **59C** can define a contoured portion of the opening having one or more the first lands **59K**. This contour opening and the first lands **59K** can mate with one or more corresponding second lands **53K** that are fixed and stationary relative to the drive gear **54** and/or the shaft **53**. Accordingly, the first and second lands **53K** and **59K** can contact and/or mate with one another to prevent rotation of the second brake collar **59C** relative to the drive shaft and/or the drive gear **54**. However, these components can be disassociated from one another so that the second brake collar **59C** can be removed from the drive shaft, along with the disc and the sleeve and other components.

[0114] The crossbow crank **50** can be constructed to include the one-way bearing and the brake as described above to provide certain functionality. For example, the crank **50** can be manually operated by user by rotating the crank arm **50RM** in a first direction, for example **D1**. As this occurs, the shaft **53** and sleeve **58** automatically lock to one another to rotate the drive shaft in the first direction **D1**, with the sleeve and drive shaft rotating in unison, optionally with the drive gear **54** which in turn rotates the secondary gear **55** spooling on the portions of the cord **C1** and **C2** to the respective spools **56A** and **56B**. This in turn pulls the sled **30** along the barrel or frame **12** to move the bowstring during a drawing and/or de-cocking operation of the crossbow **10**. However, the sleeve and drive shaft can automatically unlock from one another upon manual actuation of the crank arm **50RM** in a second, opposing direction **D2**. As a result, the drive shaft **53** can rotate freely relative to the sleeve **58** and unencumbered by the one-way bearing **57**. The associated drive gear **54** can rotate the secondary gear **55** and the respective spools **56A** and **56B** in a fourth direction **D4** so as to allow the cord portions **C1** and **C2** to unwind from those spools. As a result, a sled connected to the spools via the cord can be controllably pulled by the tension in the bowstring **11**, pulling down the sled to de-cock the bowstring or move the bowstring from the drawn mode to a released or undrawn mode. The aforementioned locking and

unlocking can be at least partially affected via the interaction of the brake **59** with the drive shaft **53** and drive gear **54** as described below.

[0115] As mentioned above, the brake can be disposed along the drive shaft **53**, optionally distal from the one-way bearing **57**. The brake can be axially compressible along the drive shaft **53** to fixedly join the drive shaft with the sleeve **58** that is disposed in the opening of the one-way bearing when the drive shaft is rotated in the first direction **D1**, for example upon manual input by user on the arm **50RM**. Upon this axial compression, the one-way bearing **57** allows rotation of the sleeve **58** in that direction **D1**. The rollers **57** optionally can rotate relative to the exterior surface **58E** of the sleeve **58** as the sleeve rotates in unison with the drive shaft **53**. This axial compression of the brake along the drive shaft can fix the drive shaft to the sleeve in a non-rotatable manner. The axial compression also temporarily fixes the sleeve, brake, shaft and drive gear as a single unitary rotating structure.

[0116] Optionally, when manual user input is discontinued to the arm **50RM** of the crank **150**, the tension in the cord, for example, the cord portion **C1** will urge the secondary gear **55** to rotate in the fourth direction **D4** which in turn will urge or attempt to rotate the drive gear **54** and the shaft **53** in the second direction **D2**. However, because the drive shaft **53** and drive gear **54** are fixed non-rotatably to the sleeve **58**, when that sleeve attempts to rotate initially against the rollers **57R** in the second direction **D2**, due to the brake automatically locking and all the components rotating as a single unit, the one-way bearing **57** will engage the sleeve to impair the drive shaft, sleeve, drive gear, secondary gear and spools from rotating in a manner that allows the cord portions **C1** and **C2** to unravel or unwind from the respective spools **56A** and **56B**. As a result, the sled **30**, even though being pulled under the forces of a partially or fully drawn bowstring **11**, will not be moved or pulled toward the riser **16** of the bow. Further, due to the arresting of rotation in the second direction **D2** of the shaft **53**, the crank arm **50RM** likewise will not begin to spin uncontrollably in the direction **D2** with the shaft **53** upon cessation of the manual actuation of the crank.

[0117] In most cases, any tension **T** in the cord and its cord portions **C1** and **C2** caused by the bow string pulling on the sled counteracts rotation of the drive shaft **53**, drive gear **54** and crank arm **50RM** in the first direction **D1**, and urges the drive shaft or generally produces a force attempting to rotate the drive shaft in the second direction **D2**, however, the drive shaft and drive gear are prevented from rotating in the second direction via the one-way bearing **57** interacting with the sleeve **58** which is again locked to the shaft in a fixed and non-rotational manner relative via the brake **59**.

[0118] The automatic activation and deactivation of the brake **59** and thus the automatic locking and unlocking of the sleeve **58** and drive shaft **53**/drive gear **54** relative to one another can be provided via rotation of the drive nut **52** with the crank arm **50RM**. For example, as shown in FIG. **21**, when the crank arm **50RM** is rotated in direction **D1**, this likewise rotates the drive nut **52** in that same direction **D1**. As a result, the threads **52T** of the drive nut tighten relative to the threads **53T** of the drive shaft **53**. The distance between the drive nut **52** and the drive gear **54** is reduced or decreased. This in turn causes the drive nut engagement face **52E** to press against the drive nut spacer **52** which in turn pushes farther against the engagement face **58E** of the sleeve

**58.** This compression continues axially, parallel to the drive shaft longitudinal axis DLA and along the drive shaft **53**. As a result, the various components of the along the drive shaft **53** begin to and continue to axially compress under an axial compression force AC. This in turn causes the brake collar **58C** to compress against the brake disc **59D** which compresses against the other brake collar **59C** which in turn compresses against the drive gear **54** or lands of the drive shaft **53**. With all of these components axially compressed, the brake **59** effectively rotationally locks the sleeve **58** relative to the drive shaft **53** and drive gear **54**. Thus, all of these components rotate in unison as a single unit, that is, the drive nut **52**, sleeve **58**, brake **59**, drive shaft **53** and drive gear **54** all rotate in unison about the drive shaft longitudinal axis DLA. These components can rotate in unison in the direction first direction D1, however, when rotation ceases in direction D1, and the tension in the one or more cord parts C1 and C2 urge rotation of the drive gear **54** and thus the drive shaft **53** in direction D2, this rotation in direction D2 is impaired via the one-way bearing **57** interacting with the sleeve which again is axially compressed with the brake and rotationally fixed to the drive shaft due to the brake **59**. Accordingly, the drive shaft **53** is impaired from rotation in that second direction D2. This impairment of rotation in the second, opposite direction D2 can be achieved without any further manual input by the user on the crank arm and/or the winch in general. Again, this is because the brake is activated automatically to ensure that the drive shaft and sleeve that extends within the opening of the one-way bearing **57** are all locked rotationally to one another.

**[0119]** As briefly described above, it will be appreciated that upon manual rotation of the crank arm **50RM** in direction D1, the drive shaft **53** rotates in direction D1 along with the drive gear **54**, which turns the secondary gear in direction D3 which in turn rotates the respective spools **56A** and **56B** to pull the cord, and in particular the portions of the cord C1 and C2 in the winding direction W and thereby wind those cord portions C1 and C2 on the respective spools. This cord winding translates to movement of the sled to which the cord is attached to draw or cock the bowstring of the crossbow **10**. Optionally, as the user rotates the drive shaft **53** in the first direction D1, that shaft **53** is fixedly joined with a gear **54** in a housing, with the gear **54** being rotatably coupled to the spools **56A**, **56B** so that the spools wind the cord portions C1 and C2 thereon. The rotation axially compresses the brake **59** along the shaft **53** during and as a result of the rotating in the first direction D1 to fixedly join the shaft **53** with the sleeve **58** disposed around the shaft **53** so that the shaft **53**, gear **54** and sleeve **58** rotate in unison. As mentioned, the sleeve can be disposed in the one-way bearing **57** that is joined with the housing **51** so that when the rotating in the first direction D1 ceases, the shaft and gear are impaired from rotating in a second direction D2 opposite the first direction D1 via the one-way **57** bearing interacting with the sleeve **58**.

**[0120]** The crank **50** can be used to draw the bowstring of the crossbow **10**. For example, as shown in the configuration shown in FIG. 21, where the sleeve **58** and drive shaft **53** are automatically locked to one another via the brake **59**, the user can rotate the crank arm **50RM** to pull on the cords C1 and C2 in the winding direction W as shown. The user can do this to pull the sled **30** and draw the bowstring **11** as shown for example in FIG. 2. In this configuration, the sled can be set up so that the stops **38** and **39** are in the neutral

mode to allow full draw of the bowstring past the catch **23** is shown in FIG. 4, optionally with the safety **24** in the safety on mode.

**[0121]** After the bowstring **11** is captured by the catch **23**, for example, as shown in FIG. 5, the sled **30** can be removed. This removal can be facilitated by slack being established in the cord and its cord portions C1 and C2. To provide this slack, a user, as shown in FIG. 22 can rotate the crank arm **50RM** in direction D2. This rotation in direction D2 unthreads the threads **52T** of the drive nut **52** from the threads **53T** of the drive shaft **53**. As a result, the drive shaft becomes disengaged from the sleeve and can rotate freely with the drive nut and crank arm **50RM** as the user holds the crank arm **50RM**. As this occurs, the drive gear **54** can rotate in direction D2 as well which in turn causes the secondary gear **55** to rotate in direction D4 causing the spools **56A** and **56B** to likewise rotate and direction D4. This rotation and direction D4 allows the cord portions C1 and C2 to unwind in direction UW from the spools. The user can pull the sled **30** as shown in FIG. 2 forwardly in direction J to disengage the sled from the bowstring and remove it from the rail **13**. The user subsequently can remove the crank **50** from the crossbow along with the cord portions C1 and C2, and the sled **30**, to ready the crossbow for loading an arrow and shooting.

**[0122]** As mentioned above, the rotation of the crank in direction D2 as shown in FIG. 22 facilitates disengagement of the drive shaft **53** from the sleeve **57**. This can occur when the drive nut **52** threads or loosens relative to the drive shaft **53**. When this occurs, the drive nut **52** moves away from the drive nut spacer **52S** and the sleeve engagement surface **58E**. The drive nut engagement surface **52E** thus becomes spaced by a gap SG from the spacer **52S**. Optionally, the spacer **52S** also becomes slightly spaced from the engagement surface **57E** of the sleeve. When the drive nut no longer engages the spacer **52S**, the axial compression AC, shown in FIG. 21, is decreased and/or eliminated. Thus, the brake **59** and its components, that is, the collars **58C** and **59C** as well as the disc **59D** no longer are frictionally engaged with one another and small gaps BG can be established between one or more of these components. In this manner, the brake no longer locks the sleeve **58** to the drive shaft **53**. Thus, these components can rotate freely relative to one another and more particularly, the drive shaft **53** and drive gear **54** can rotate and freely spin relative to the sleeve and the one-way bearing **57**. Thus, the one-way bearing can no longer impair or act on the drive shaft **53** rotating in the second direction D2. As a result, the drive shaft **53** can freely rotate in the second direction D2 again without being prevented impaired or stopped from rotating via the one-way bearing **58**.

**[0123]** Optionally, the disengagement of the drive nut **52** relative to the sleeve can occur automatically upon rotation of the crank arm **50RM** in direction D2. No other input to any other components of the crossbow winch **50** are required to rotate the drive shaft **53** in direction D2 to let out or unwind the cord portions C1 and C2 in direction UW. Further optionally, the engagement of the drive nut relative to the sleeve can occur automatically upon rotation of the crank arm **50RM** in direction D1, as shown in FIG. 21. No other input to any other components of the crossbow crank **50** are required to rotate the drive shaft **53** in direction D1 to wind or hold cord portions C1 and C2 in direction W.

**[0124]** The crossbow crank **10** can be used to de-cock the crossbow **10**. For example, as shown in the configuration

shown in FIG. 21, where the sleeve 58 and drive shaft 53 are automatically locked to one another via the brake 59, the user can rotate the crank arm 50RM to pull on the cord and its cord portions C1 and C2 in the winding direction W as shown. The user can do this to pull the sled 30 during a de-cocking operation, for example, as shown in FIGS. 6-12. In this configuration, the sled can be set up so that the stops 38 and 39 are in the de-cocking mode so that the bowstring 11 is not compressed against the safety 24 and so the safety can be actuated from the safety on mode shown in FIG. 7 to the safety off mode to actuate the trigger assembly as shown in FIGS. 10 and 12, thereby allowing the catch 23 to move to the drop mode, thereby allowing the bowstring 11 to move forward to the released or undrawn mode in a de-cocking operation.

[0125] When the catch is released to the drop mode and before that operation, the sled 30 can be urged forward by the bowstring. Tension T can be established in the cord portions C1 and C2, and this tension can be increased or greater after the catch 23 is moved to its drop mode. The sled can be held in place, for example, as shown in FIG. 10 via the cord portions that are around the spools in the crank. Due to the tension T in the cord portions, the drive shaft 53 can remain engaged with the sleeve 58 which can remain engaged with the one-way bearing 57. Accordingly, the drive shaft 53 can be prevented from rotating in the second direction D2, and thus the cord portions C1 and C2 can be prevented from unwinding from the respective spools 56A and 56B.

[0126] It will be noted, however, that as a tension T is applied via the cord portions C1 and C2 in a manner to unwind the cord portions in a direction UW, as shown in FIG. 22, this can automatically urge the secondary gear 55 to rotate in direction D4 slightly which will cause the drive gear 54 to also rotate in second direction D2 opposite the first direction D1. When this occurs, the drive shaft 53 will rotate in direction D2 slightly and thus drive shaft threads 53T thread into the threads 52T of the drive nut 52. Because the drive nut 52 is resting or positioned through the crank housing 51, and the arm 50RM provides some inertia, the drive nut 52 will not rotate. Thus, the drive shaft 53 will tighten relative to the drive nut 52 thereby axially compressing the components with the axial compression force AC via the brake 59 along the drive shaft 53 as shown in FIG. 21. As a result, the drive shaft 53 becomes non-rotatable relative to the sleeve 58. Because the sleeve 58 is disposed in the one-way bearing that prevents rotation in the direction D2, any further rotation of the drive shaft 53 in direction D2 is impaired and/or prevented. Further, the drive shaft, drive gear and spools are impaired from rotation so that the cord portions C1 and C2 will not unwind any direction UW off from the spools. In turn, this will prevent the bowstring 11 from uncontrollably pulling the sled 30 as it moves from the drawn mode to the released or undrawn mode.

[0127] Returning to FIGS. 22 and 12, after a user actuates the safety 24 and the catch 23 releases the bowstring, a user can manually actuate the arm 50RM and rotate it in direction D2. As a result, the drive nut 52 loosens relative to the drive shaft 53 and the threads 53T unthread from the threads 52T. Accordingly, one or more gaps SG, BG can be established between various components along the shaft, such as between the drive nut spacer 52S, the sleeve 58 and the brake 59 components. This in turn allows the drive shaft 53 and drive gear 54 to rotate unimpaired by the one-way

bearing 57 in direction D2. As this occurs, the drive gear 54, also rotating in direction D2 rotates the secondary gear 55 and spools in direction D4. As a result, the cord portions C1 and C2 unwind in direction UW from the spools 56A and 56B while the user continues to rotate the arm 50RM manually in direction D2. This disengagement of the brake unlocks the sleeve 58 from the drive shaft 53 automatically and again allows the drive shaft 53 to rotate freely in either the first direction D1 or the second direction D2 without any constraint on rotation of the shaft via the one-way bearing 57. The user can continue to rotate the arm 50RM in direction D2, with the bowstring pulling on the sled 30 until the bowstring achieves the released mode. After that point, the user can remove the sled from the bowstring and the crank from the stark until the next cocking operation of the ball crossbow is warranted.

[0128] During the de-cocking operation, while the bowstring is let down via the sled 30 connected to the crank 50 via the cord C1 and C2, sometimes a user may cease rotating the shaft 53 in the second direction D2 via manual input through the crank arm 50RM. When this occurs, the crank prevents the crank arm 50RM from continuing to rotate uncontrollably in direction D2. In particular, the tension T in the cord portions C1 and C2 automatically urges the shaft 53 to rotate in the second direction D2 while the arm 50RM and drive nut 52 remain stationary. As a result, the threads 53T thread into the threads of the drive nut 52T to axially compress all the components between the drive nut 52 and the drive gear 54 along the drive shaft 53. This in turn causes axial compression of the brake 59 along the shaft such that the shaft and gear are again impaired from rotating in the second direction D2 via the one-way bearing interacting with the sleeve which is locked rotationally to the drive shaft.

[0129] The following additional statements are provided, the numbering of which is not to be construed as designating levels of importance.

[0130] Statement A. A crossbow comprising: at least one limb joined with a frame; a bowstring joined with the limb and transverse to the frame, the bowstring moveable between a drawn mode and an undrawn mode; a trigger assembly joined with the frame and including a catch that is operable in a holding mode in which the catch retains the bowstring in the drawn mode and a drop mode that releases the bowstring so the bowstring can transition to the undrawn mode; a safety including a forward end facing toward the catch, the safety operable in a safety on mode and a safety off mode; a sled comprising: a guide that moves along the frame when the sled engages the bowstring; a bowstring engager configured to receive the bowstring during movement of the bowstring to the drawn mode with the sled; and a first stop that is selectively operable in a neutral mode in which the first stop does not interfere with rearward movement of the sled along the frame so that the bowstring can move to the drawn mode, and in a de-cocking mode in which the first stop interferes with movement of the sled along the frame so that the sled is prevented from engaging the bowstring against the forward end of the safety facing the catch, while the safety remains in the safety on mode.

[0131] Statement B. The crossbow of Statement A, comprising: a crossbow crank mounted to the crossbow; the crossbow crank including a sleeve disposed in a one-way bearing; a drive shaft extending through the sleeve; a drive gear joined with the drive shaft so the drive gear and drive

shaft rotate in unison; a spool coupled to the drive gear, the spool configured to engage a cord; and a crank joined with the drive shaft, wherein the sled is joined with the crossbow crank via a cord wrapped on the spool.

[0132] Statement C. The crossbow of any preceding Statement, wherein the crossbow crank provides tension in the cord to pull the sled so that the stop engages another part of the crossbow, with the sled's movement toward the crank being arrested by such engagement of the stop.

[0133] Statement D. The crossbow of any preceding Statement, wherein the drive shaft and drive gear rotate in a first direction about a first axis, wherein the one-way bearing permits such rotation so that the spool rotates in a second direction opposite the first direction, wherein the cord wraps on the spool in the second direction.

[0134] Statement E. The crossbow of any preceding Statement, wherein a user rotates the drive shaft and drive gear in the first direction during the de-cocking mode until the stop engages the other part of the crossbow, and wherein upon cessation of the rotating in the first direction, the cord urges the drive shaft and drive gear to rotate in the second direction, however, the one-way bearing impairs such rotation in the second direction, optionally automatically by engaging the sleeve and preventing rotation in the second direction.

[0135] Statement F. The crossbow of any preceding Statement, wherein a drive nut threads onto the drive shaft to axially compress a brake along the drive shaft against the sleeve to lock the sleeve and drive shaft to one another, so the sleeve is engaged by the one-way bearing to impair the rotation in the second direction.

[0136] Statement G. The crossbow of any preceding Statement, wherein upon rotation of a crank arm that rotates the drive shaft and drive gear in the second direction, the brake automatically releases and is no longer axially compressed along the drive shaft so that the one-way bearing no longer impairs the rotation of the drive shaft and drive gear in the second direction, because the drive shaft is no longer rotationally joined with the sleeve engaged by the one-way bearing and can rotate freely relative to the one-way bearing.

[0137] Statement H. The crossbow of any preceding Statement, wherein as the crank arm, drive shaft and drive gear rotate in the second direction, the spool rotates in the first direction, opposite the second direction, to allow the cord to unwind from the spool in a controlled manner during the de-cocking of the crossbow, wherein the bowstring moves farther toward the released mode.

[0138] Statement I. The crossbow of any preceding Statement, wherein the stop disengages the portion of the crossbow, such as a limiter, optionally a mounting arm or the frame, as the crossbow is de-cocked.

[0139] Statement J. The crossbow of any preceding Statement, wherein the sleeve and drive shaft automatically lock to one another upon manual actuation of the crank to rotate the drive shaft in the first direction, so that the sleeve and drive shaft rotate in unison.

[0140] Statement K. The crossbow of any preceding Statement, wherein the sleeve and drive shaft automatically unlock from one another upon manual actuation of the crank to rotate the drive shaft in the second direction, so that the drive shaft rotates freely relative to the sleeve.

[0141] Statement L. The crossbow of any preceding Statement, wherein the rotation of the drive shaft in the second direction rotates a spool on a secondary axis in the first

direction so that a cord unwinds from a spool on the secondary axis, wherein the cord is attached to the sled, wherein the bowstring is under tension to urge the sled forward, away from the crank, toward a released mode, wherein a brake impairs the drive shaft, drive gear and spool from spinning uncontrollably by automatically engaging with a sleeve disposed in a one-way bearing.

[0142] Statement M. The crossbow of any preceding Statement, wherein a crossbow crank automatically locks via a brake being axially compressed along the drive shaft to rotationally fix the drive shaft to a sleeve, with a one-way bearing preventing the sleeve and thus drive shaft from rotating in a second direction opposite the first, whereby a user can manually move the safety to the safety off mode while the first stop is in the de-cocking mode, and subsequently activate the trigger assembly so that the bowstring can be let down from the drawn mode to the undrawn mode with the sled engaging the bowstring as the letdown occurs.

[0143] Although the different elements and assemblies of the embodiments are described herein as having certain functional characteristics, each element and/or its relation to other elements can be depicted or oriented in a variety of different aesthetic configurations, which support the ornamental and aesthetic aspects of the same. Simply because an apparatus, element or assembly of one or more of elements is described herein as having a function does not mean its orientation, layout or configuration is not purely aesthetic and/or ornamental in nature.

[0144] Directional terms, such as "vertical," "horizontal," "top," "bottom," "upper," "lower," "inner," "inwardly," "outer" and "outwardly," are used to assist in describing the invention based on the orientation of the embodiments shown in the illustrations. The use of directional terms should not be interpreted to limit the invention to any specific orientation(s).

[0145] In addition, when a component, part or layer is referred to as being "joined with," "on," "engaged with," "adhered to," "secured to," or "coupled to" another component, part or layer, it may be directly joined with, on, engaged with, adhered to, secured to, or coupled to the other component, part or layer, or any number of intervening components, parts or layers may be present. In contrast, when an element is referred to as being "directly joined with," "directly on," "directly engaged with," "directly adhered to," "directly secured to," or "directly coupled to" another element or layer, there may be no intervening elements or layers present. Other words used to describe the relationship between components, layers and parts should be interpreted in a like manner, such as "adjacent" versus "directly adjacent" and similar words. As used herein, the term "and/or" includes any and all combinations of one or more of the associated listed items.

[0146] The above description is that of current embodiments of the invention. Various alterations and changes can be made without departing from the broader aspects of the invention as defined in the appended claims, which are to be interpreted in accordance with the principles of patent law including the doctrine of equivalents. This disclosure is presented for illustrative purposes and should not be interpreted as an exhaustive description of all embodiments of the invention or to limit the scope of the claims to the specific elements illustrated or described in connection with these embodiments. For example, and without limitation, any individual element(s) of the described invention may be

replaced by alternative elements that provide substantially similar functionality or otherwise provide adequate operation. This includes, for example, presently known alternative elements, such as those that might be currently known to one skilled in the art, and alternative elements that may be developed in the future, such as those that one skilled in the art might, upon development, recognize as an alternative. Further, the disclosed embodiments include a plurality of features that are described in concert and that might cooperatively provide a collection of benefits. The present invention is not limited to only those embodiments that include all of these features or that provide all of the stated benefits, except to the extent otherwise expressly set forth in the issued claims. Any reference to claim elements in the singular, for example, using the articles “a,” “an,” “the” or “said,” is not to be construed as limiting the element to the singular. Any reference to claim elements as “at least one of X, Y and Z” is meant to include any one of X, Y or Z individually, any combination of X, Y and Z, for example, X, Y, Z; X, Y; X, Z; Y, Z, and/or any other possible combination together or alone of those elements, noting that the same is open ended and can include other elements.

[0147] Reference throughout this specification to “a current embodiment” or “an embodiment” or “alternative embodiment” means that a particular feature, structure, or characteristic described in connection with the embodiment is included in at least one embodiment herein. Accordingly, the appearance of the phrases “in one embodiment” or “in an embodiment” or “in an alternative embodiment” in various places throughout this specification are not necessarily all referring to the same embodiment. Furthermore, the particular features, structures, or characteristics may be combined in any suitable manner in one or more embodiments.

What is claimed is:

1. A crossbow comprising:

- a first limb and an opposing second limb;
- a bowstring extending between the first limb and the second limb;
- a frame joined with the first limb and the second limb, the bowstring extending transverse to the frame and moveable between a drawn mode and an undrawn mode;
- a trigger assembly joined with the frame and including a catch that is operable in a holding mode in which the catch retains the bow string in the drawn mode and a drop mode that releases the bowstring to the undrawn mode, the trigger assembly including a sear operable in a cocked mode that retains the catch in the holding mode and a fire mode that allows the catch to move to the drop mode to release the bowstring;
- a safety including a forward end facing toward the catch and a rearward end facing away from the catch, the bowstring being disposed between the catch and the forward end in the drawn mode, the safety operable in a safety on mode in which the safety interferes with movement of the sear from the cocked mode to the fire mode, thereby preventing the catch from releasing the bowstring, the safety operable in a safety off mode in which the safety allows the sear to move from the cocked mode to the fire mode;
- an anti-dry fire element moveable between a lockout position that prevents the safety from moving from the safety on mode to the safety off mode, and an open position that permits the safety to move to the safety off mode; and

a sled comprising:

- a guide that moves along the frame when the sled engages the bowstring;
- a bowstring engager configured to receive the bowstring during movement of the bowstring to the drawn mode;
- a protrusion that moves the anti-dry fire element to the open position when the sled is adjacent the trigger assembly; and
- a first stop that is selectively operable in a neutral mode in which the first stop does not interfere with rearward movement of the sled along the frame so that the bowstring can move to the drawn mode, and in a de-cocking mode in which the first stop arrests movement of the sled without the sled pushing the bowstring against the forward end of the safety facing the catch, wherein the safety is transitionable to the safety off mode when the first stop is in the de-cocking mode, so the user can transition the catch from the holding mode to the drop mode such that the user can move the bowstring from the drawn mode to the undrawn mode, thereby de-cocking the crossbow.

2. The crossbow of claim 1,

wherein the first stop includes a first flange and a first pivot axis about which the first flange is selectively pivotable,

wherein the first flange includes a first engagement surface,

wherein a sled engagement surface is disposed adjacent the trigger assembly, the sled engagement surface being joined with the frame,

wherein the first engagement surface contacts the sled engagement surface in the de-cocking mode in which the first stop arrests movement of the sled.

3. The crossbow of claim 2 comprising:

a second stop mounted to the sled, the second stop including a second flange and a second pivot axis about which the second flange is selectively pivotable,

wherein the second flange includes a second engagement surface,

wherein the second engagement surface contacts the sled engagement surface distal from the first stop in the de-cocking mode.

4. The crossbow of claim 3,

wherein the frame includes a rail,

wherein the first flange is mounted on a first side of the rail,

wherein the second flange is mounted on the second side of the rail, opposite the first flange,

wherein the first flange and the second flange are configured to simultaneously engage the stop engagement surface in the de-cocking mode.

5. The crossbow of claim 1,

wherein the protrusion moves the anti-dry fire element to the open position in the de-cocking mode.

6. The crossbow of claim 1,

wherein the trigger assembly includes a trigger coupled to the sear,

wherein the sled remains distal from and out of contact with the safety in the de-cocking mode,

wherein the safety is manually moveable in the de-cocking mode to transition the safety from the safety on mode to the safety off mode so that the sear is operable

- in the fire mode when the trigger is moved, whereby the catch moves to the drop mode to release the bowstring.
- 7.** The crossbow of claim **1**, wherein the first stop is distal from and out of contact with the safety in the de-cocking mode.
- 8.** The crossbow of claim **1**, wherein the safety includes a safety bar that is moveable in a slot defined by the trigger assembly, wherein the safety bar moves linearly, without rotating, while transitioning from the safety on mode to the safety off mode.
- 9.** The crossbow of claim **1**, wherein the safety is forwardly moveable when the first stop is in the de-cocking mode, and the sled is stationary, such that the safety moves closer to the bowstring, thereby reducing a distance between the bowstring and the forward end of the safety in the de-cocking mode.
- 10.** The crossbow of claim **1**, wherein the first stop includes a first body having first stop longitudinal axis, wherein the first stop is rotatable about a first pivot axis that is substantially vertical, wherein the first stop longitudinal axis transitions from substantially parallel to the frame in the neutral mode to substantially perpendicular to the frame in the de-cocking mode.
- 11.** A crossbow comprising:  
at least one limb joined with a frame;  
a bowstring joined with the limb and transverse to the frame, the bowstring moveable between a drawn mode and an undrawn mode;  
a trigger assembly joined with the frame and including a catch that is operable in a holding mode in which the catch retains the bowstring in the drawn mode and a drop mode that releases the bowstring so the bowstring can transition to the undrawn mode;  
a safety including a forward end facing toward the catch, the safety operable in a safety on mode and a safety off mode; and  
a sled comprising:  
a guide that moves along the frame when the sled engages the bowstring;  
a bowstring engager configured to receive the bowstring during movement of the bowstring to the drawn mode with the sled;  
a protrusion that moves the anti-dry fire element to the open position when the sled is adjacent the trigger assembly; and  
a first stop that is selectively operable in a neutral mode in which the first stop does not interfere with rearward movement of the sled along the frame so that the bowstring can move to the drawn mode, and in a de-cocking mode in which the first stop interferes with movement of the sled along the frame so that the sled is prevented from engaging the bowstring against the forward end of the safety facing the catch, while the safety remains in the safety on mode, whereby a user can manually move the safety to the safety off mode while the first stop is in the de-cocking mode, and subsequently activate the trigger assembly so that the bowstring can be let down from the drawn mode to the undrawn mode with the sled engaging the bowstring as the letdown occurs.
- 12.** The crossbow of claim **11**, wherein the safety remains stationary when the first stop interferes with movement of the sled along the frame, and until the user manually moves the safety to the safety off mode.
- 13.** The crossbow of claim **11**, wherein the safety includes a safety bar that is disposed in a slot and is configured to move linearly along a safety bar axis when the safety transitions between the safety on mode and the safety off mode.
- 14.** The crossbow of claim **13**, comprising:  
a first limiter joined with the frame,  
wherein the first stop travels along a first path as the sled moves toward the safety as the bowstring is drawn with the sled to the drawn mode,  
wherein the first limiter is disposed along the first path, wherein the first stop engages the first limiter along the first path in the de-cocking mode, with the first limiter remaining stationary upon engagement of the first stop with the first limiter.
- 15.** The crossbow of claim **11**, wherein the first stop and sled remain distal and disengaged from the safety in the de-cocking mode, wherein a crank is configured to pull on the sled via a cord, the crank including a one-way bearing and a brake that automatically cooperate to draw or de-cock the bowstring.
- 16.** The crossbow of claim **11**, wherein the safety includes a safety bar that is moveable toward the catch along only a linear path when the safety transitions from the safety off mode to the safety on mode, while the first stop is in the de-cocking mode.
- 17.** A method of using a crossbow, the method comprising:  
pulling on a bowstring that is in a drawn mode with a sled including a stop so the stop engages a limiter on the crossbow and ceases movement of the sled and stop relative to a frame of the crossbow in a de-cocking mode, leaving a first distance between the bowstring and a safety, without the sled and stop engaging the safety;  
moving the safety toward the bowstring to reduce the first distance to a second distance between the bowstring and the safety, the second distance being less than the first distance;  
pulling a trigger so that a catch disengages the bowstring; and  
transitioning the bowstring to an undrawn mode while the sled engages the bowstring to de-cock the crossbow.
- 18.** The method of claim **17**, wherein the safety includes a safety bar that is slidably disposed in a slot, wherein the safety is manually engaged to slide the safety bar in the slot so that a forward face of the safety moves toward the bowstring without engaging the bowstring during the moving step.
- 19.** The method of claim **18** comprising:  
transitioning the stop from the de-cocking mode to a neutral mode by rotating the stop toward another stop on the sled after the crossbow is de-cocked and the bowstring is in the undrawn mode; and  
drawing the bowstring from the undrawn mode to the drawn mode while the stop is in the neutral mode.

**20.** The method of claim **17** comprising:  
manually sliding the safety along a linear path, without  
rotating the safety, toward the bowstring while the stop  
is in the de-cocking mode, without any part of the sled  
engaging the safety.

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