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Blosser et al.(10) **Pub. No.: US 2022/0282946 A1**(43) **Pub. Date: Sep. 8, 2022**(54) **FIRING SYSTEM FOR A CROSSBOW****Publication Classification**(71) Applicant: **FERADYNE OUTDOORS, LLC**,
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(2013.01); **F41B 5/12** (2013.01); **F41B 5/1469**
(2013.01)(21) Appl. No.: **17/633,490**(22) PCT Filed: **Aug. 3, 2020**(86) PCT No.: **PCT/US2020/044756**

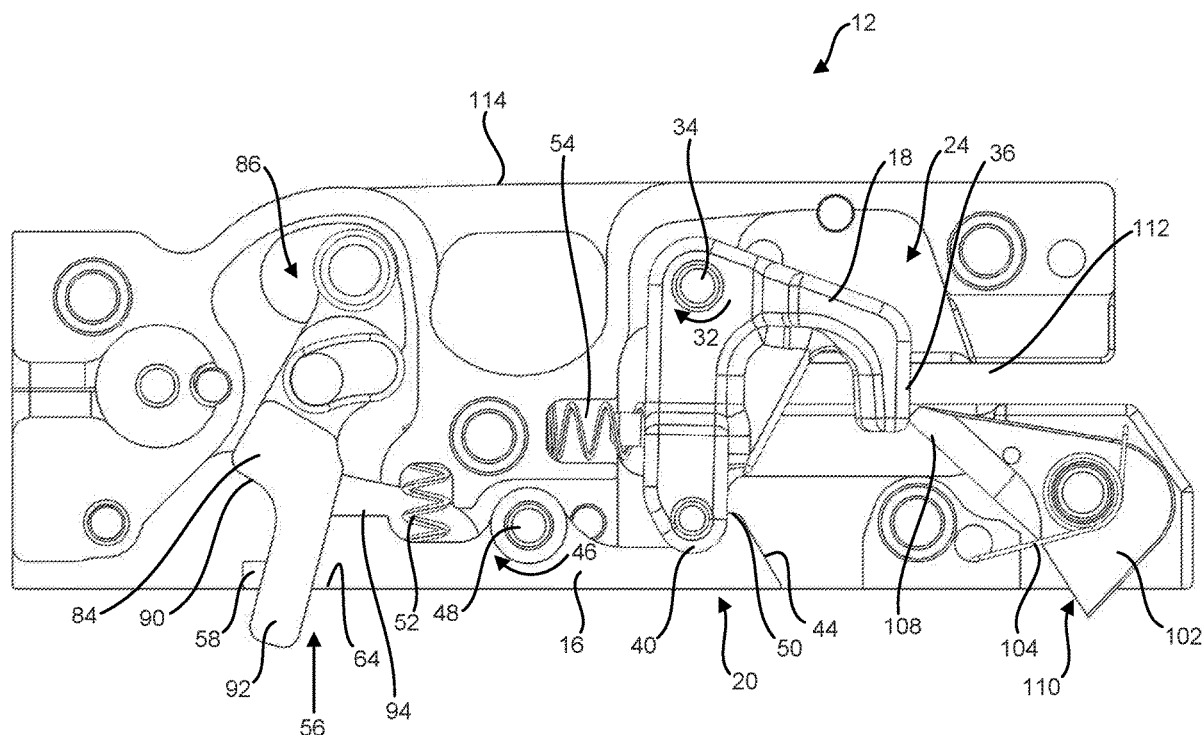
§ 371 (c)(1),

(2) Date: **Feb. 7, 2022****Related U.S. Application Data**(60) Provisional application No. 62/883,411, filed on Aug.
6, 2019.

(57)

ABSTRACT

A firing system for a crossbow includes a bowstring carrier and a trigger assembly. The bowstring carrier includes a sear and a catch. The trigger assembly includes a trigger and a trigger roller. An embodiment of the firing system includes a bowstring carrier, a trigger assembly, and a dry-fire inhibitor. Another embodiment of the firing system includes a bowstring carrier, a trigger assembly, and a safety. Yet another embodiment of the firing system includes a bowstring carrier, a trigger assembly, a dry-fire inhibitor, a safety, and a safety reset.



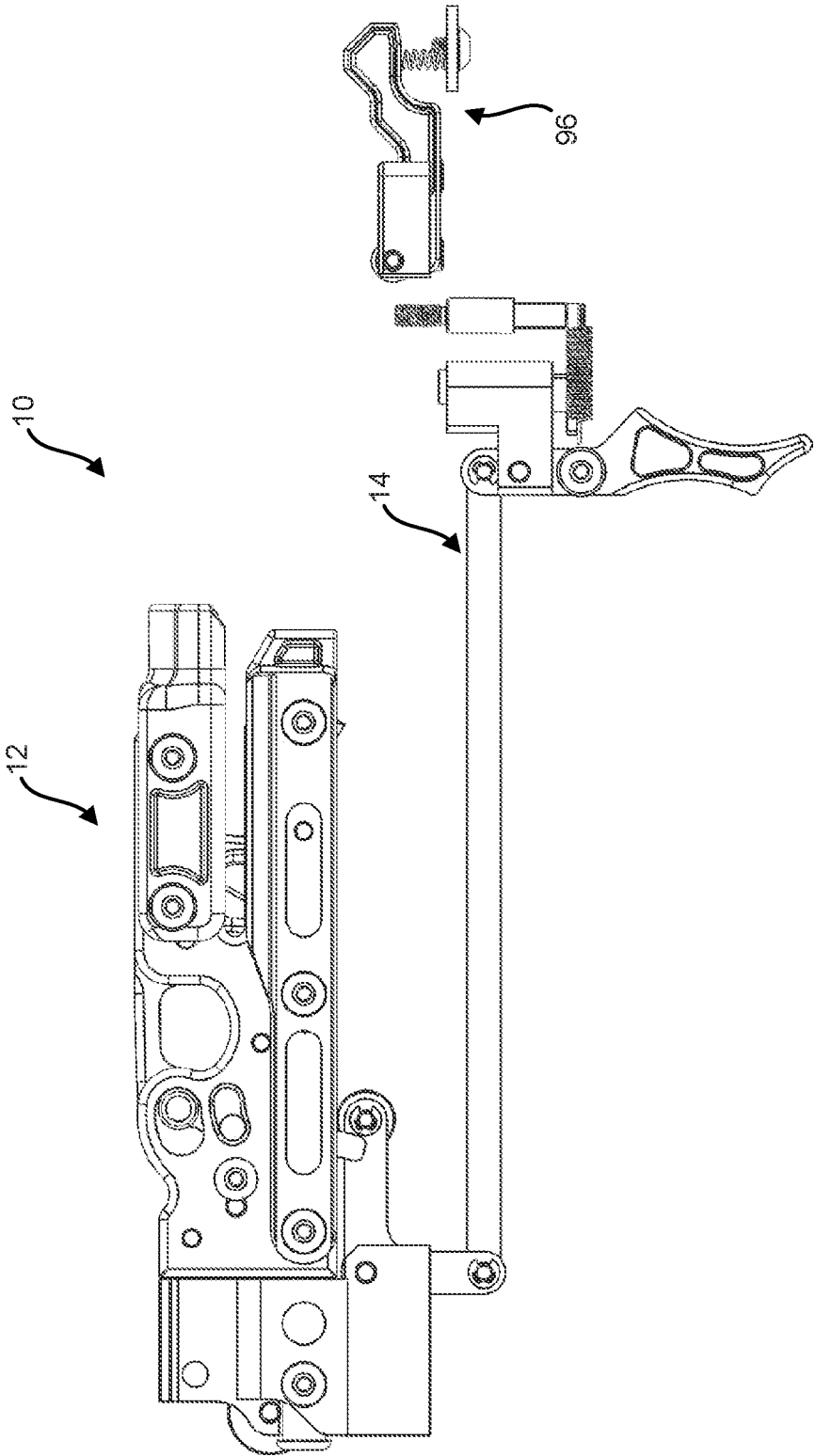


FIG. 1

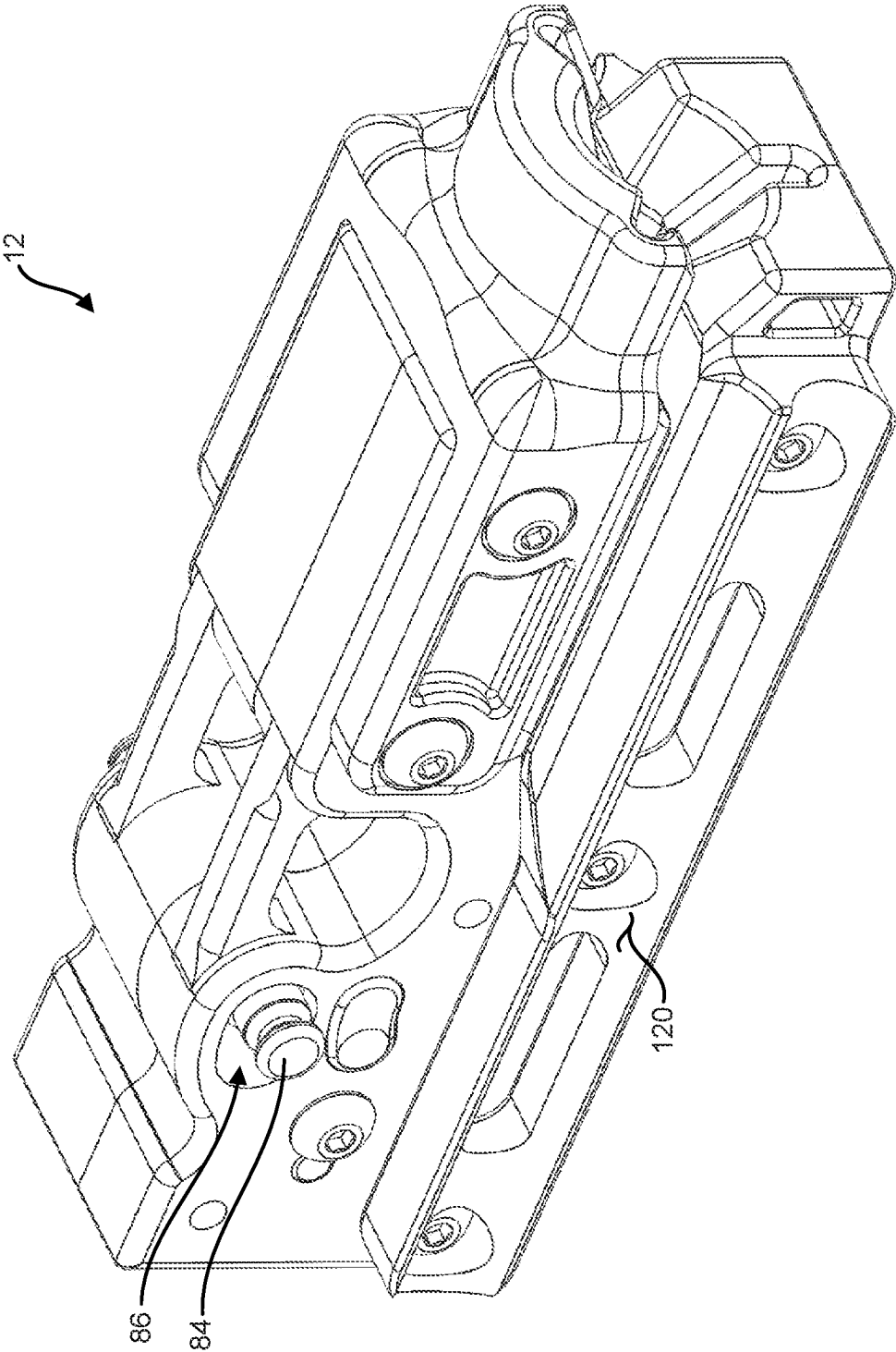


FIG. 2A

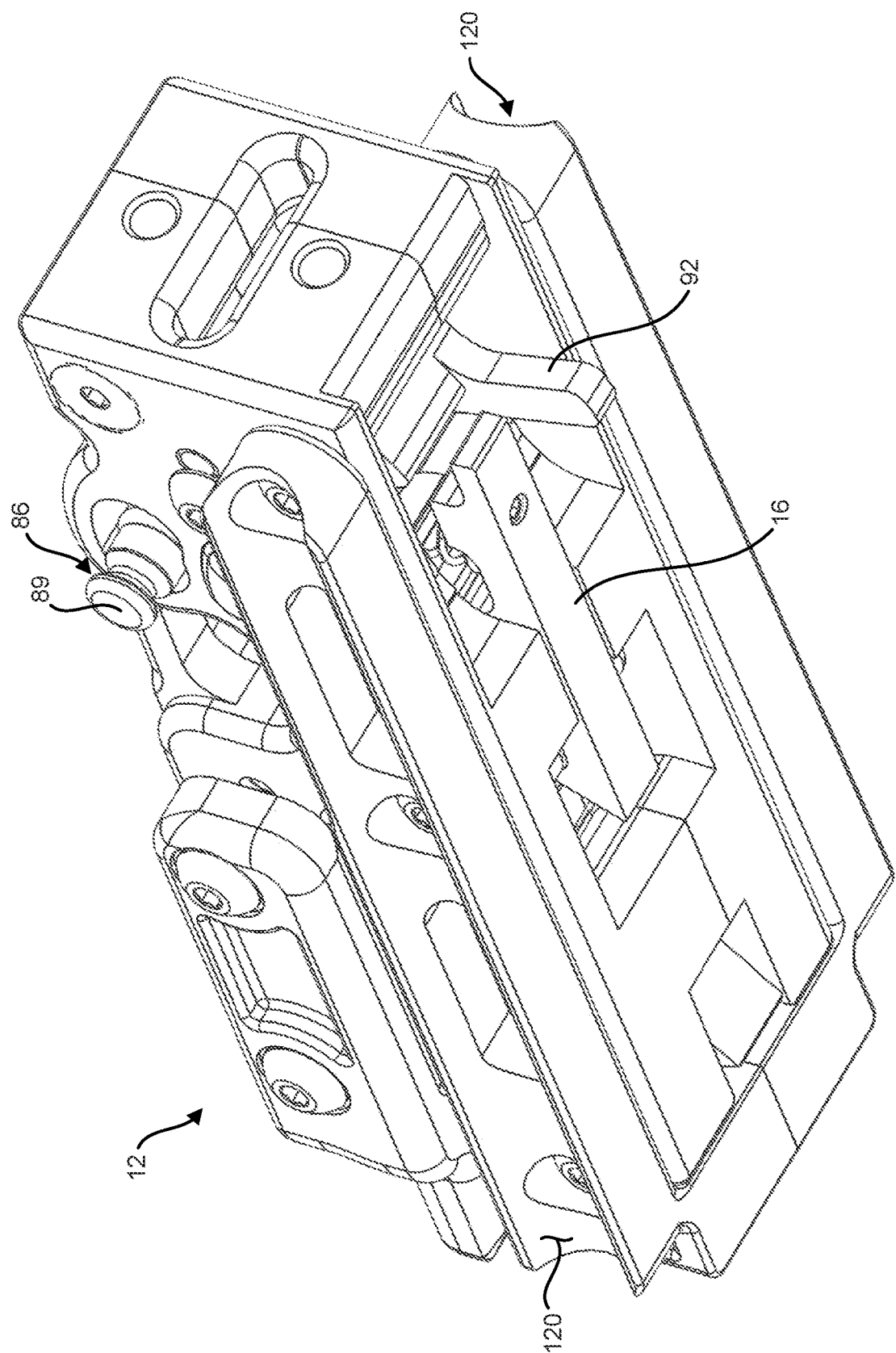


FIG. 2B

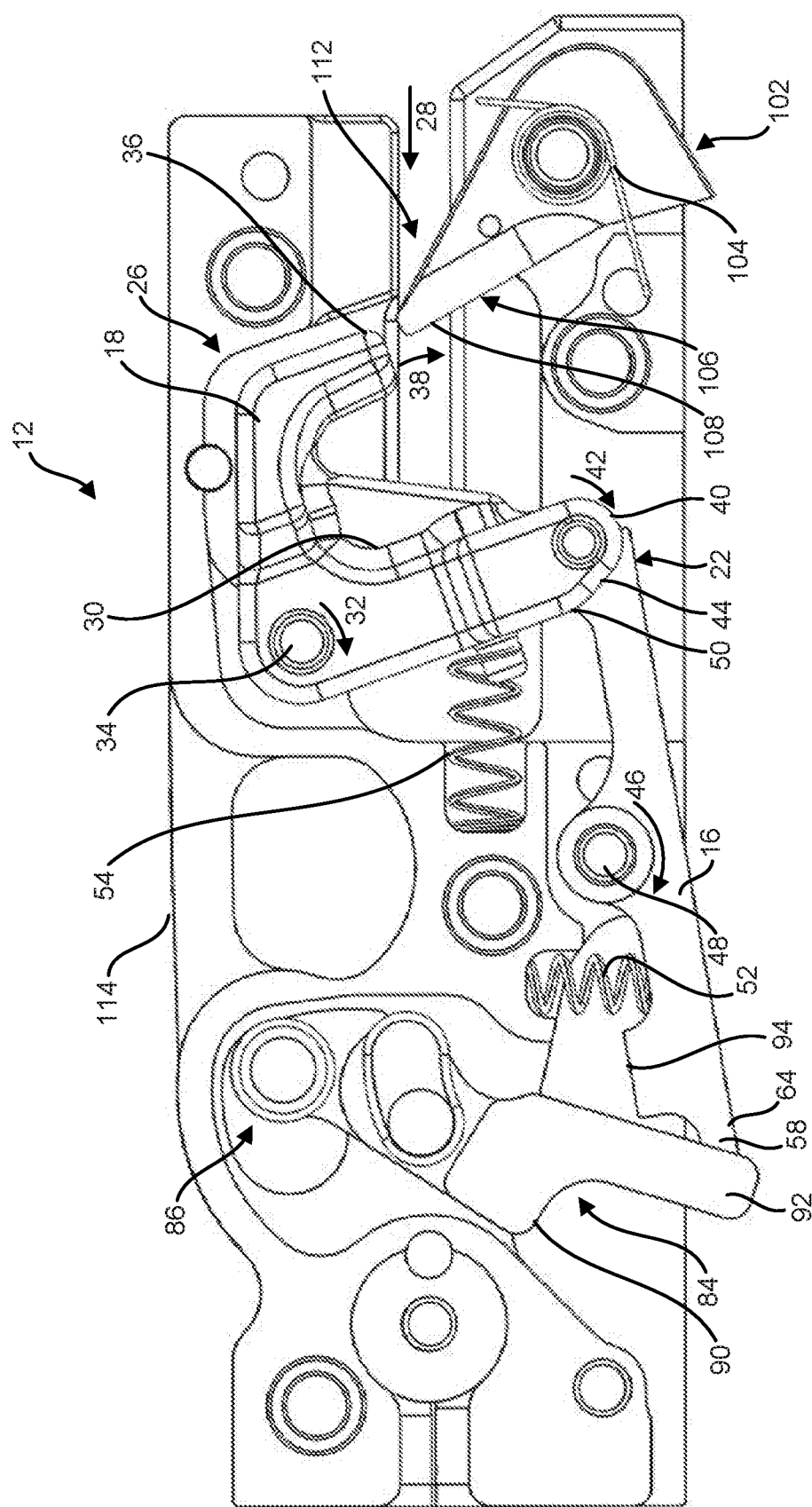


FIG. 3A

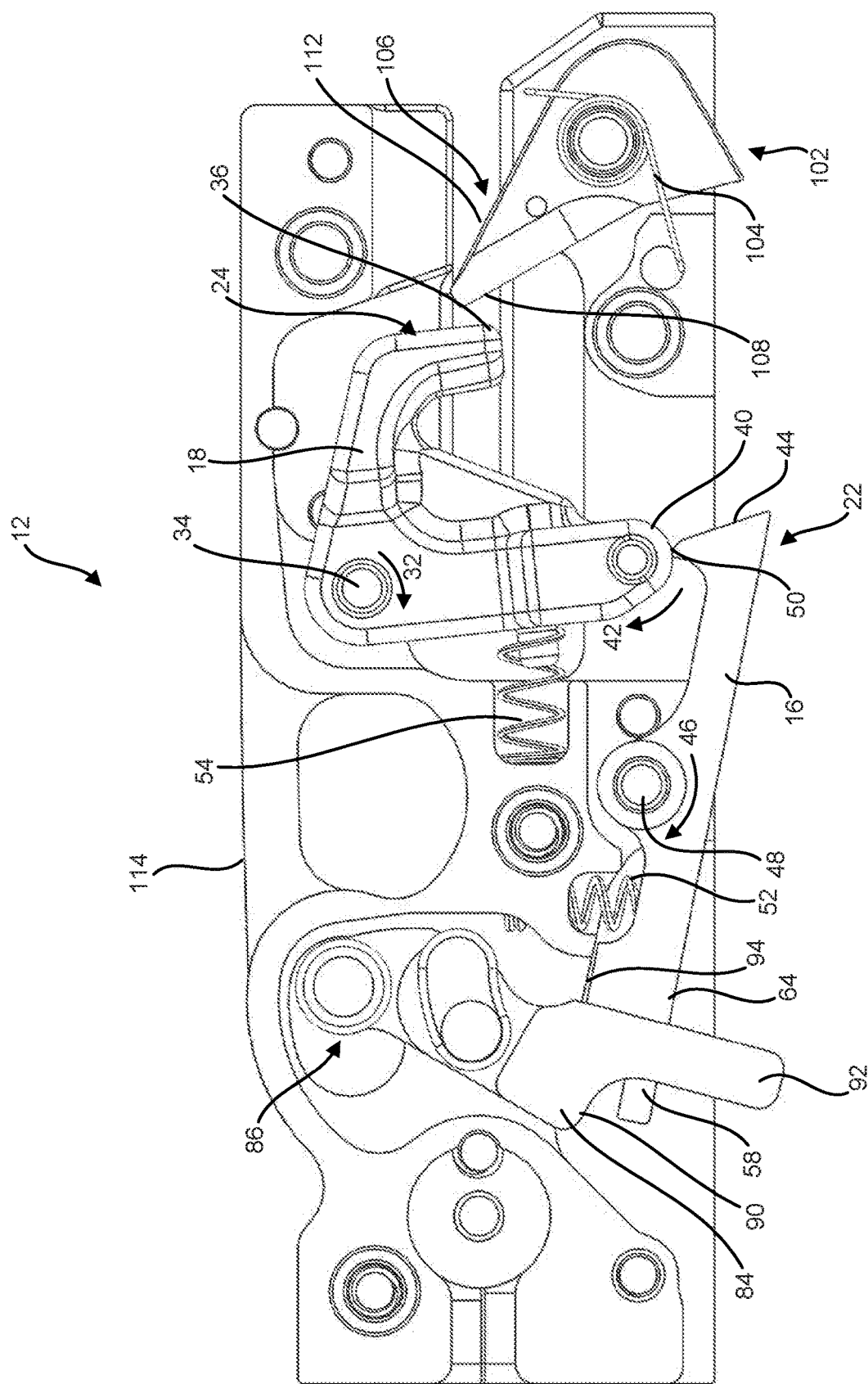


FIG. 3B

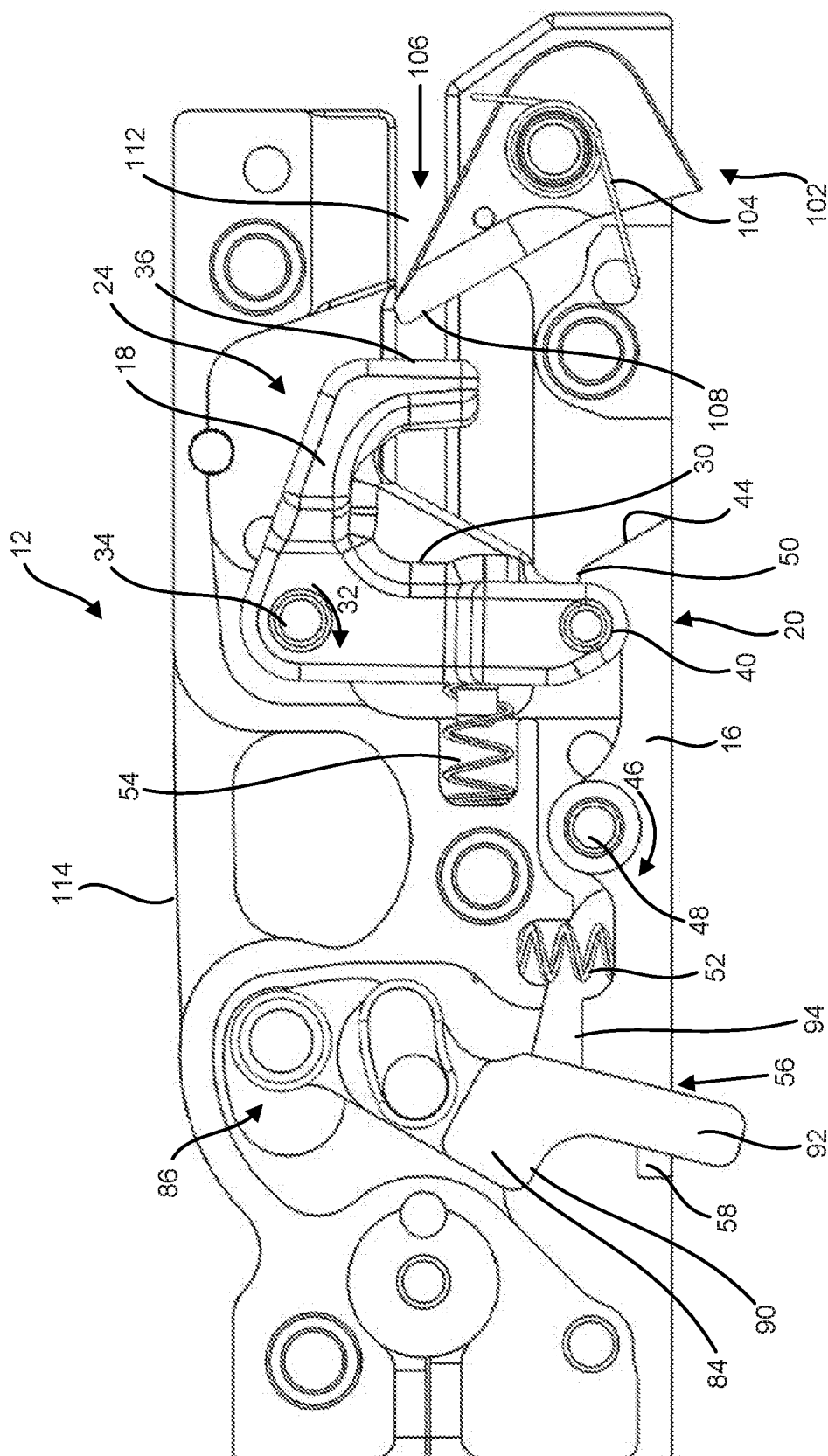


FIG. 3C

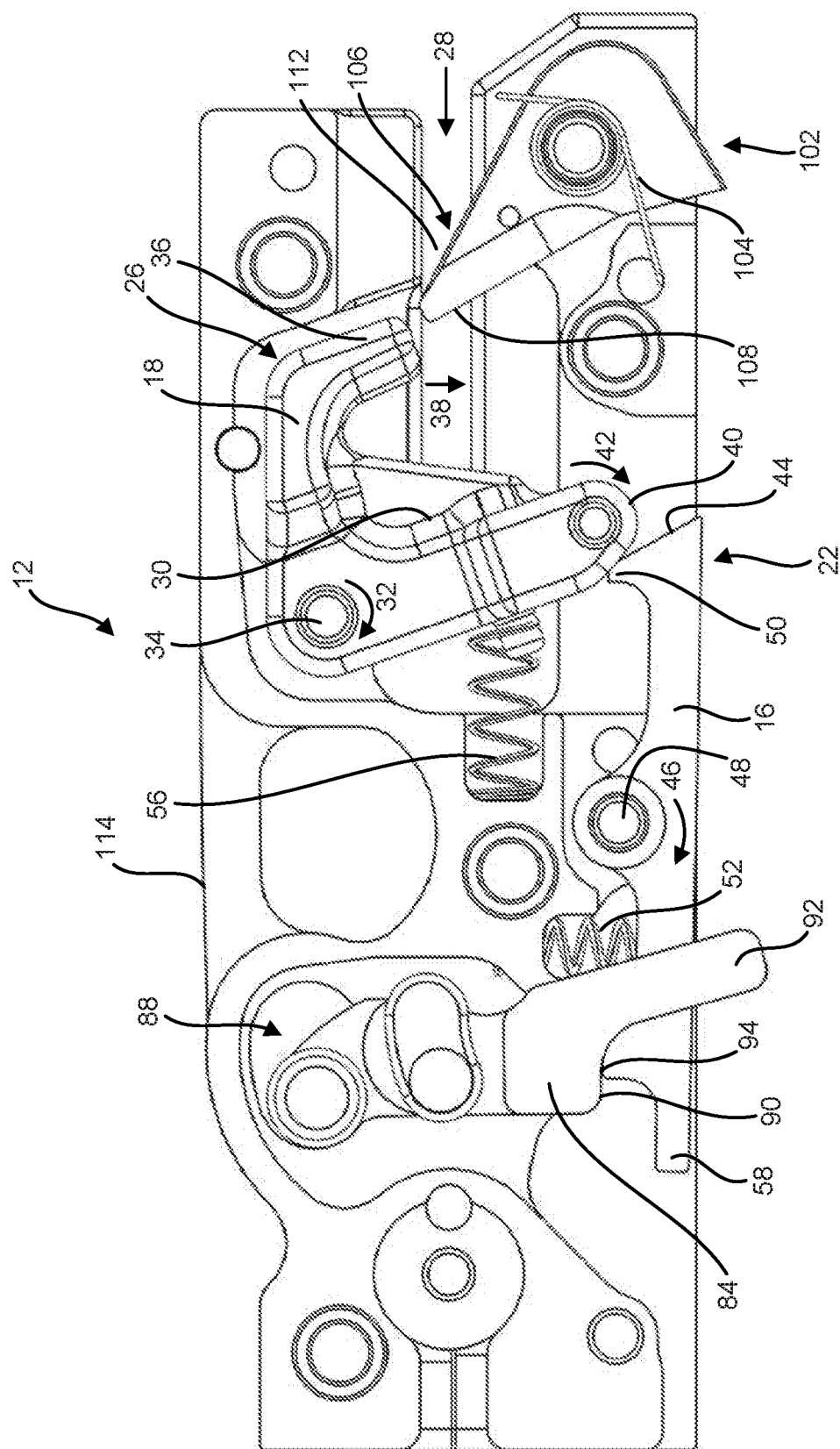


FIG. 3D

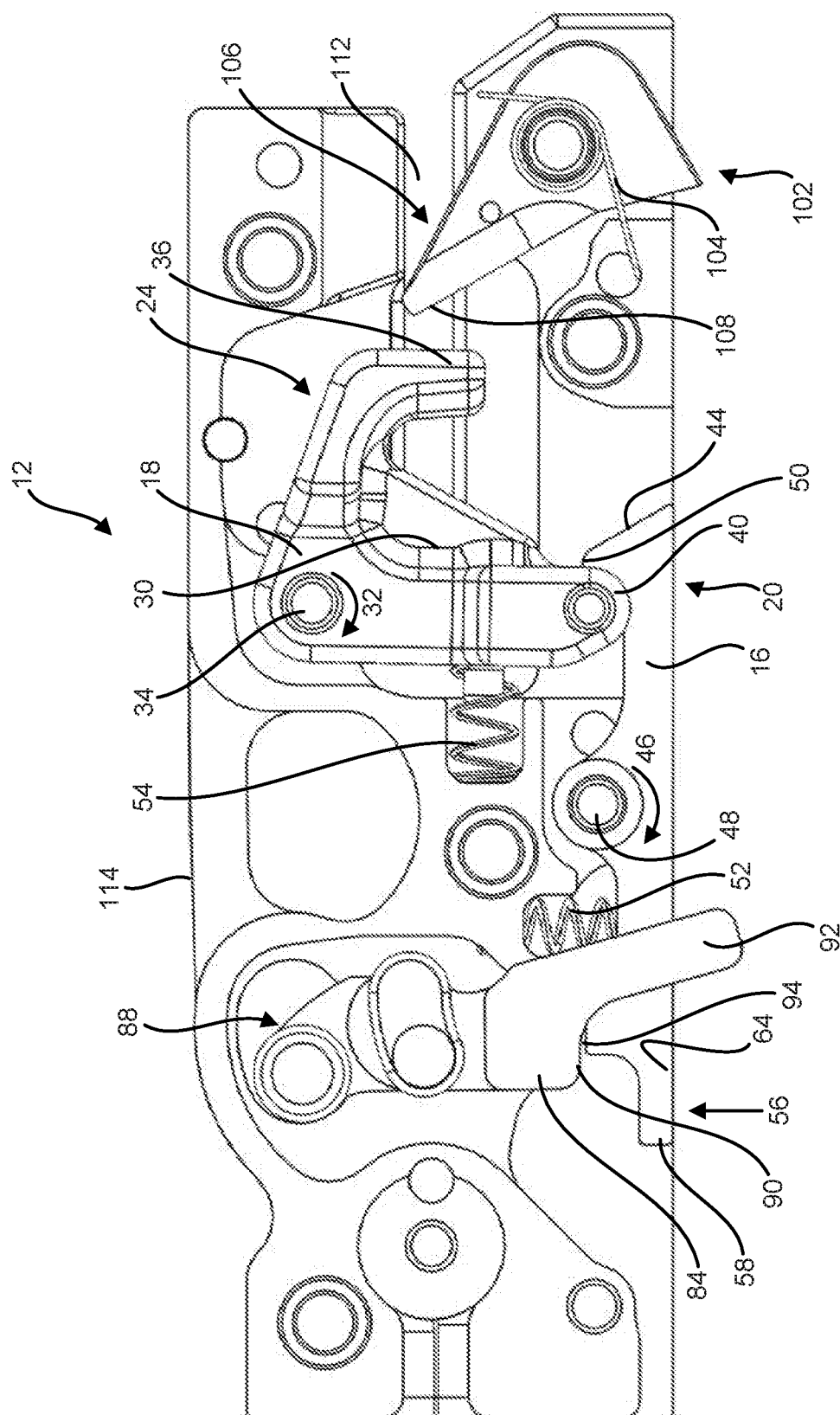
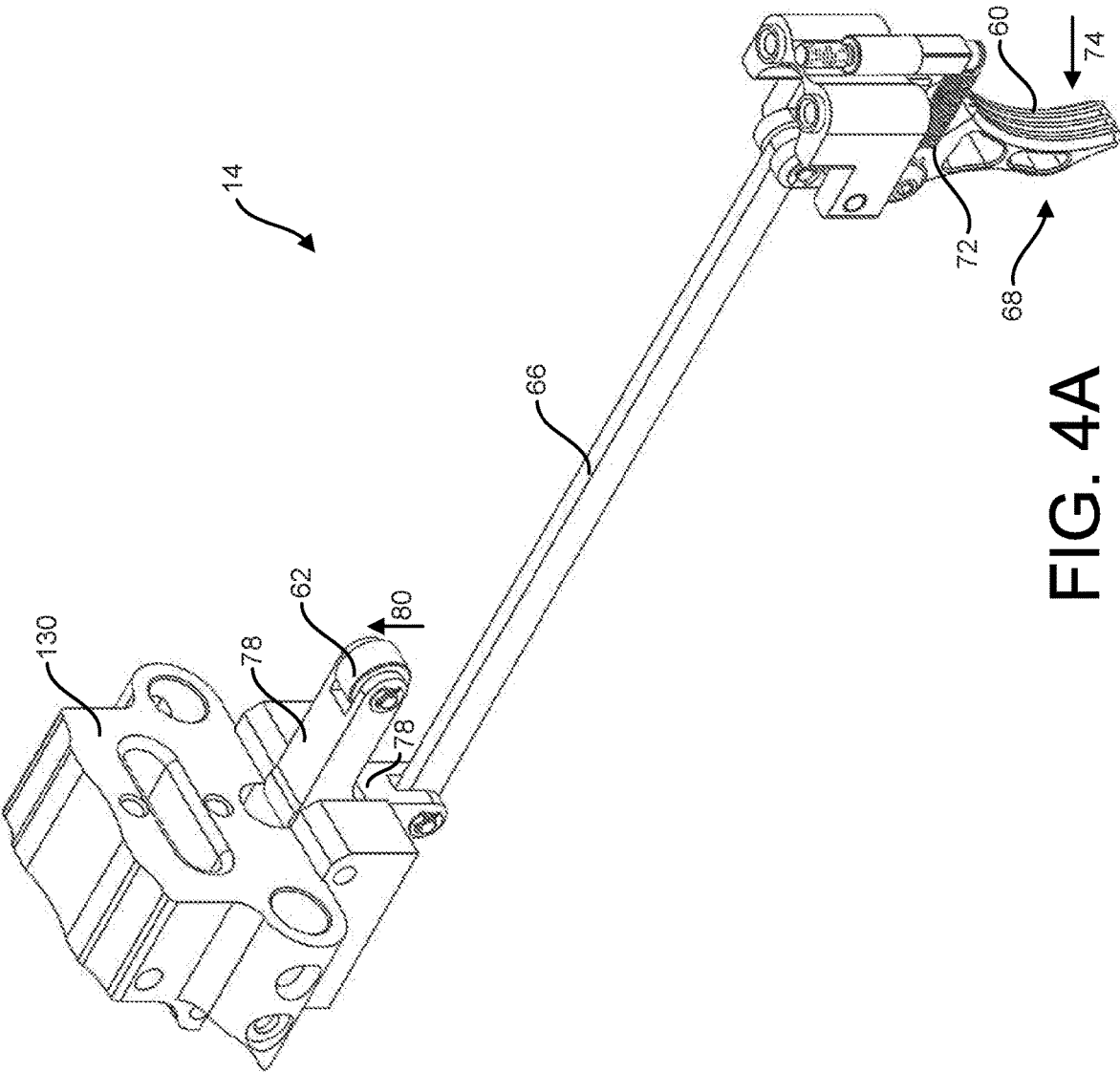


FIG. 3E



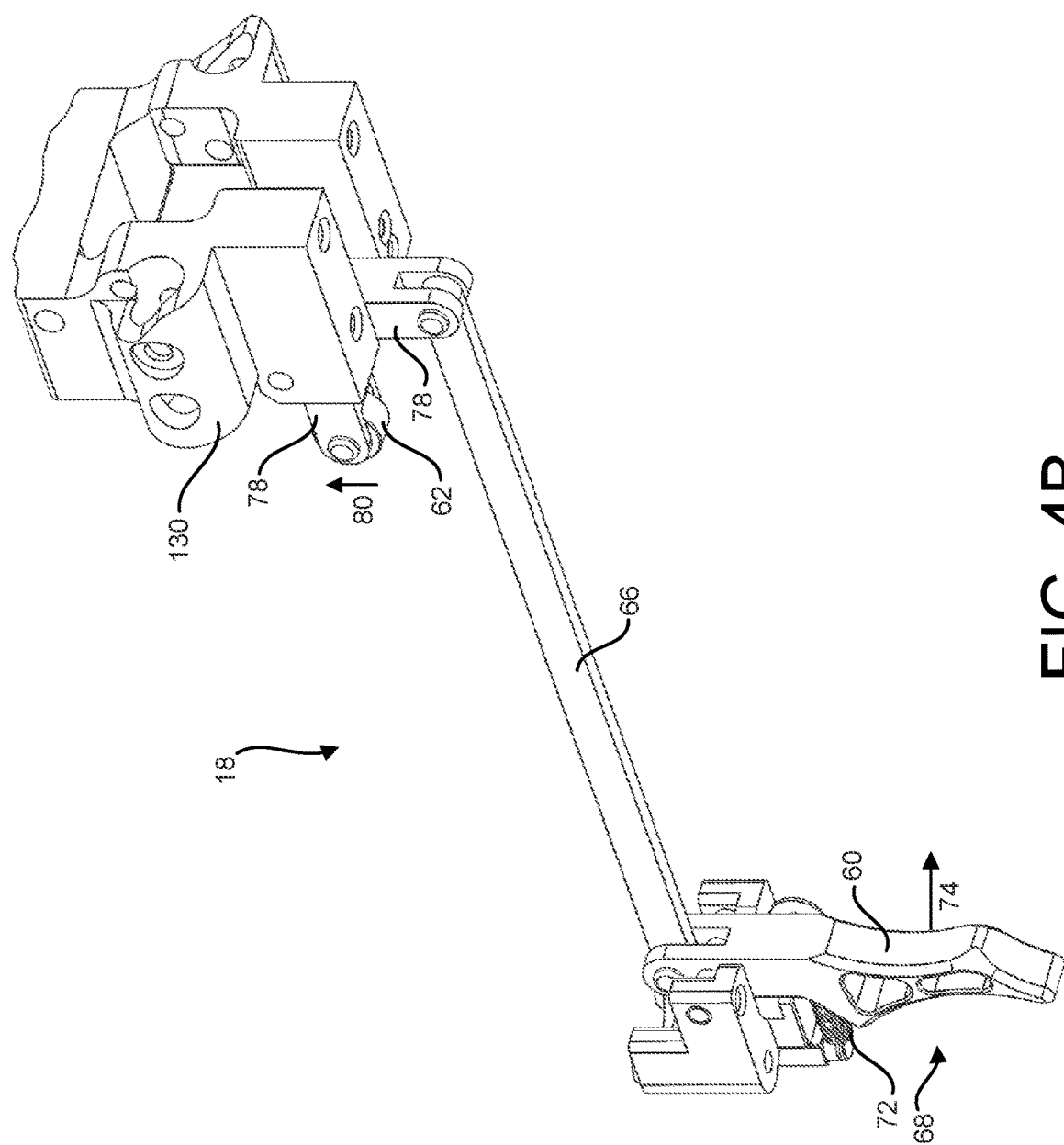


FIG. 4B

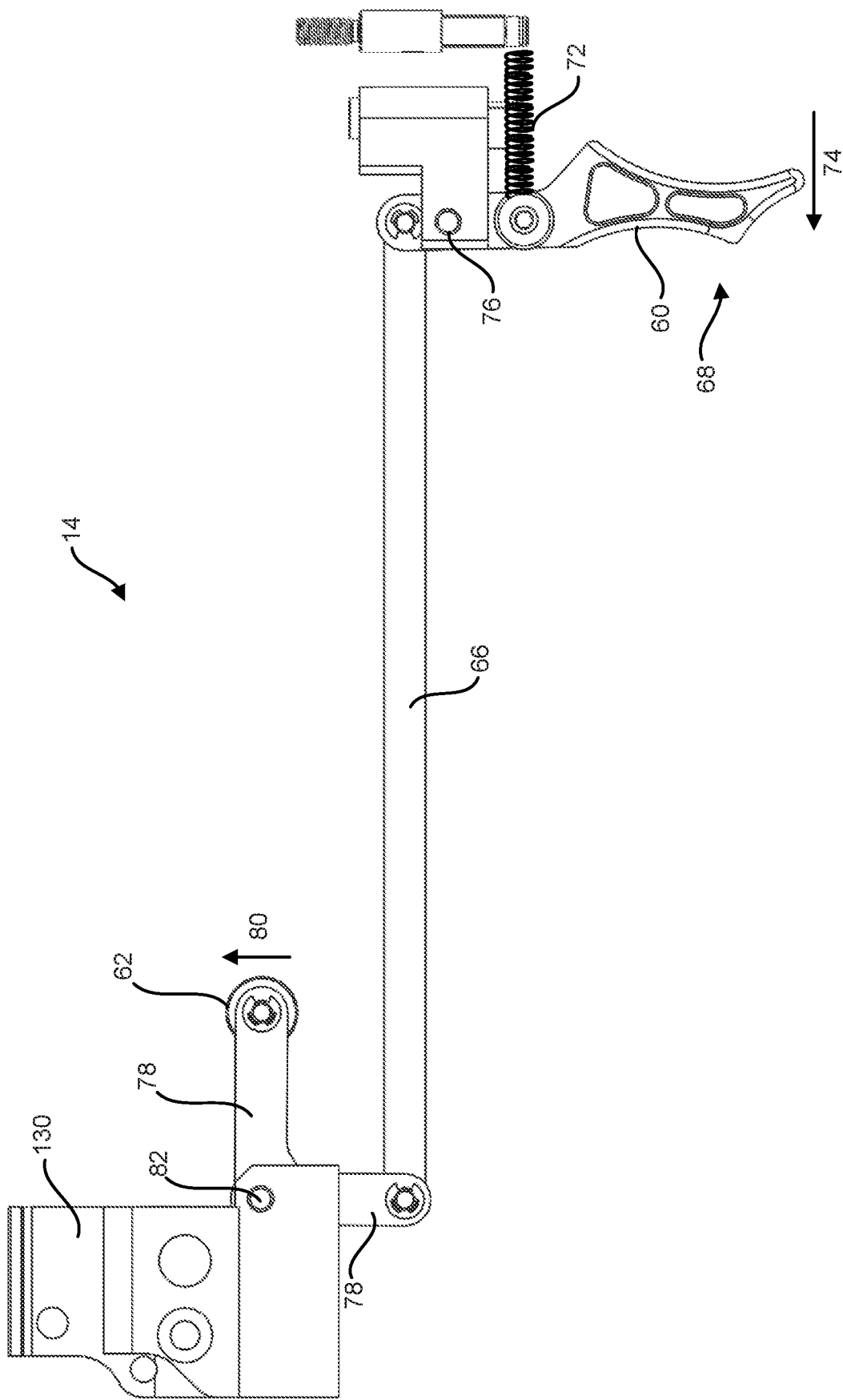


FIG. 4C

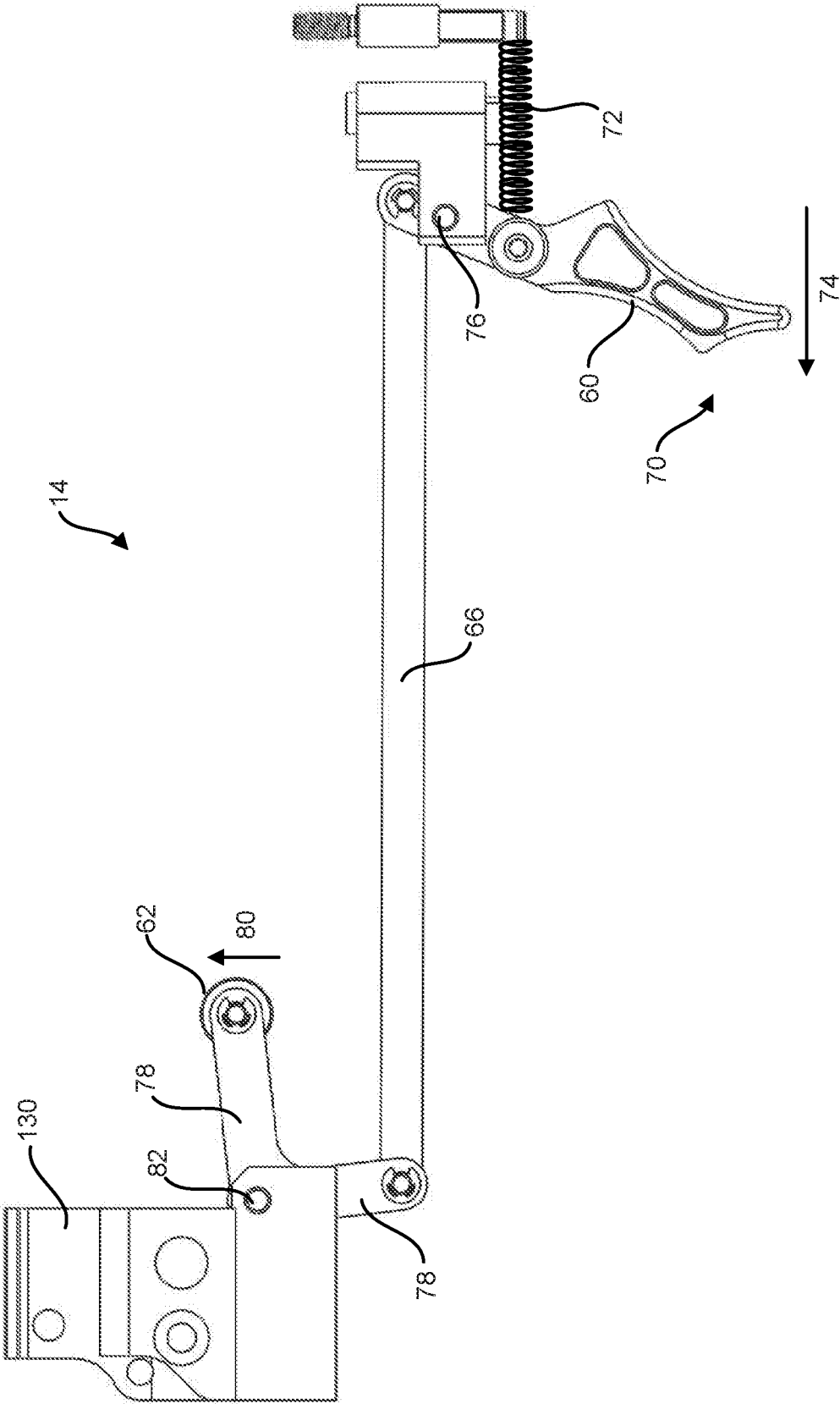
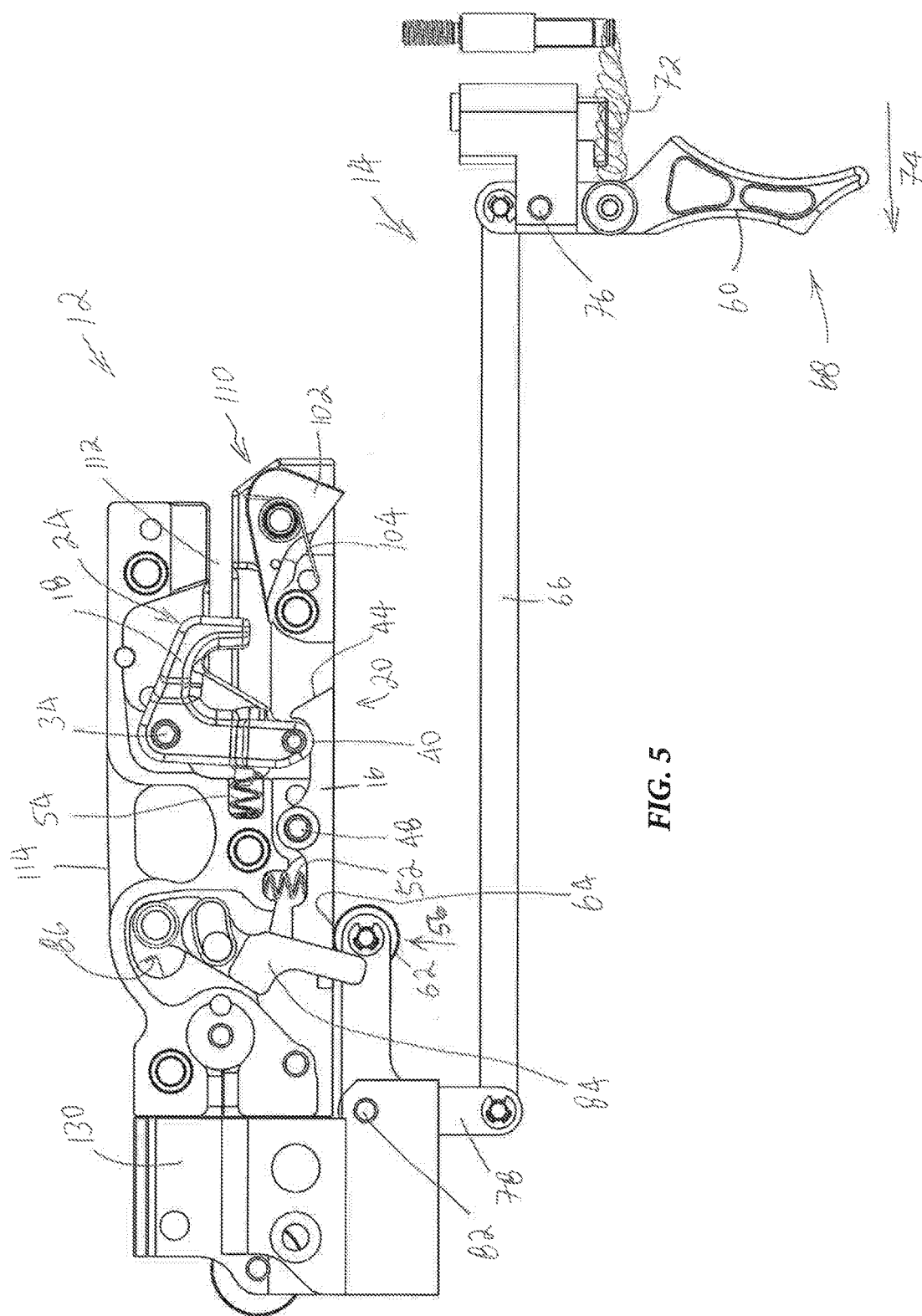


FIG. 4D



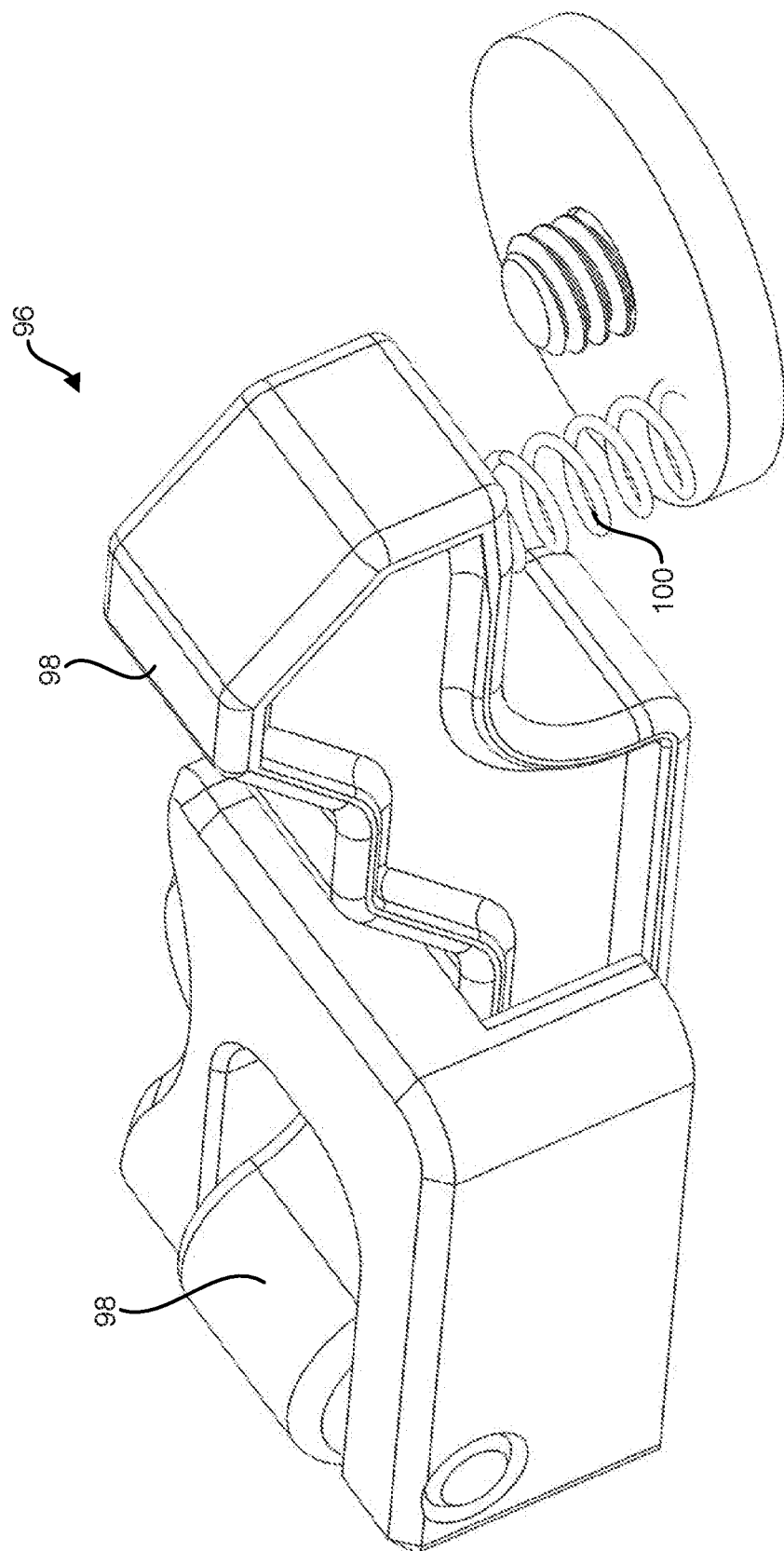


FIG. 6A

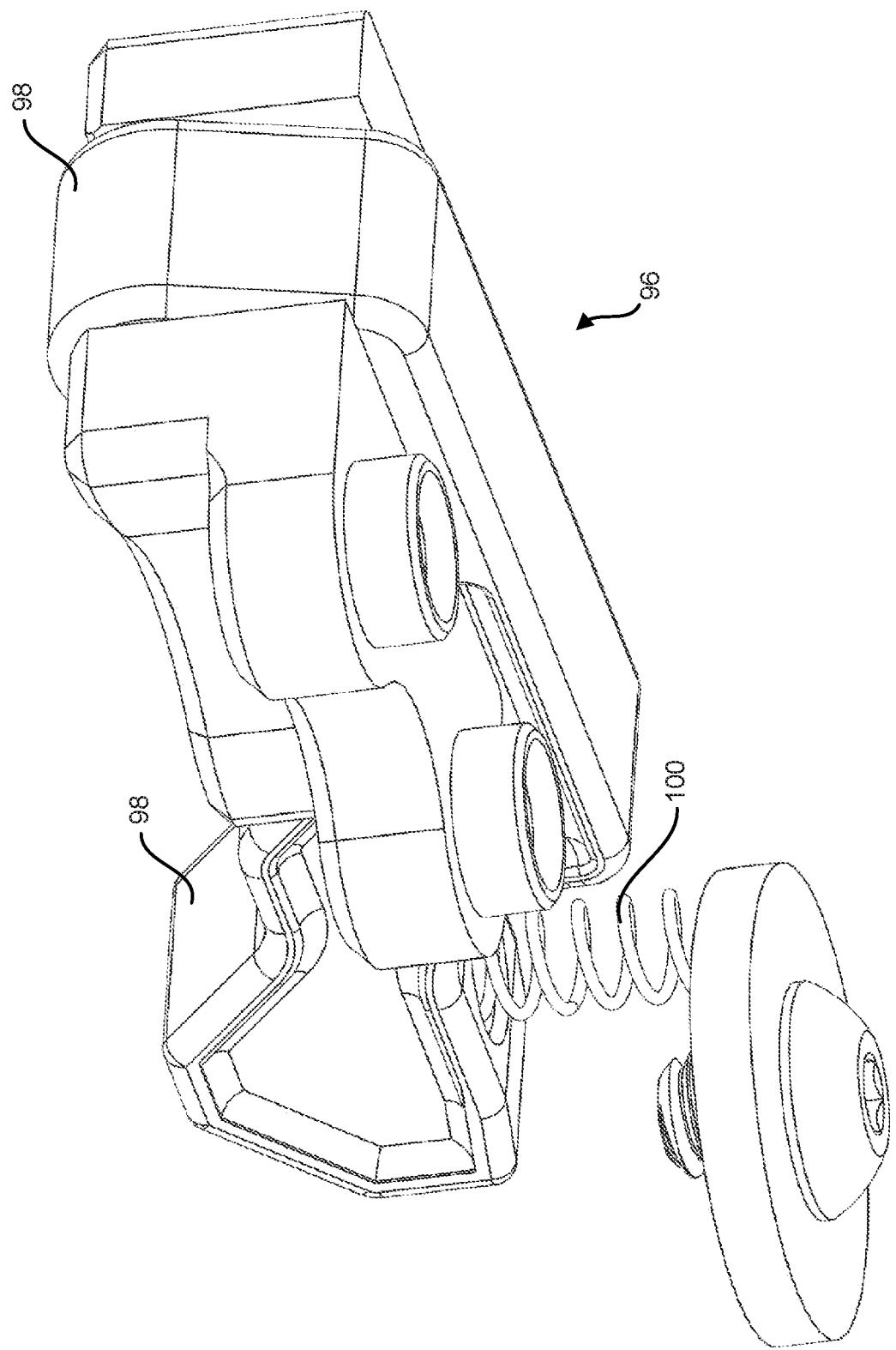


FIG. 6B

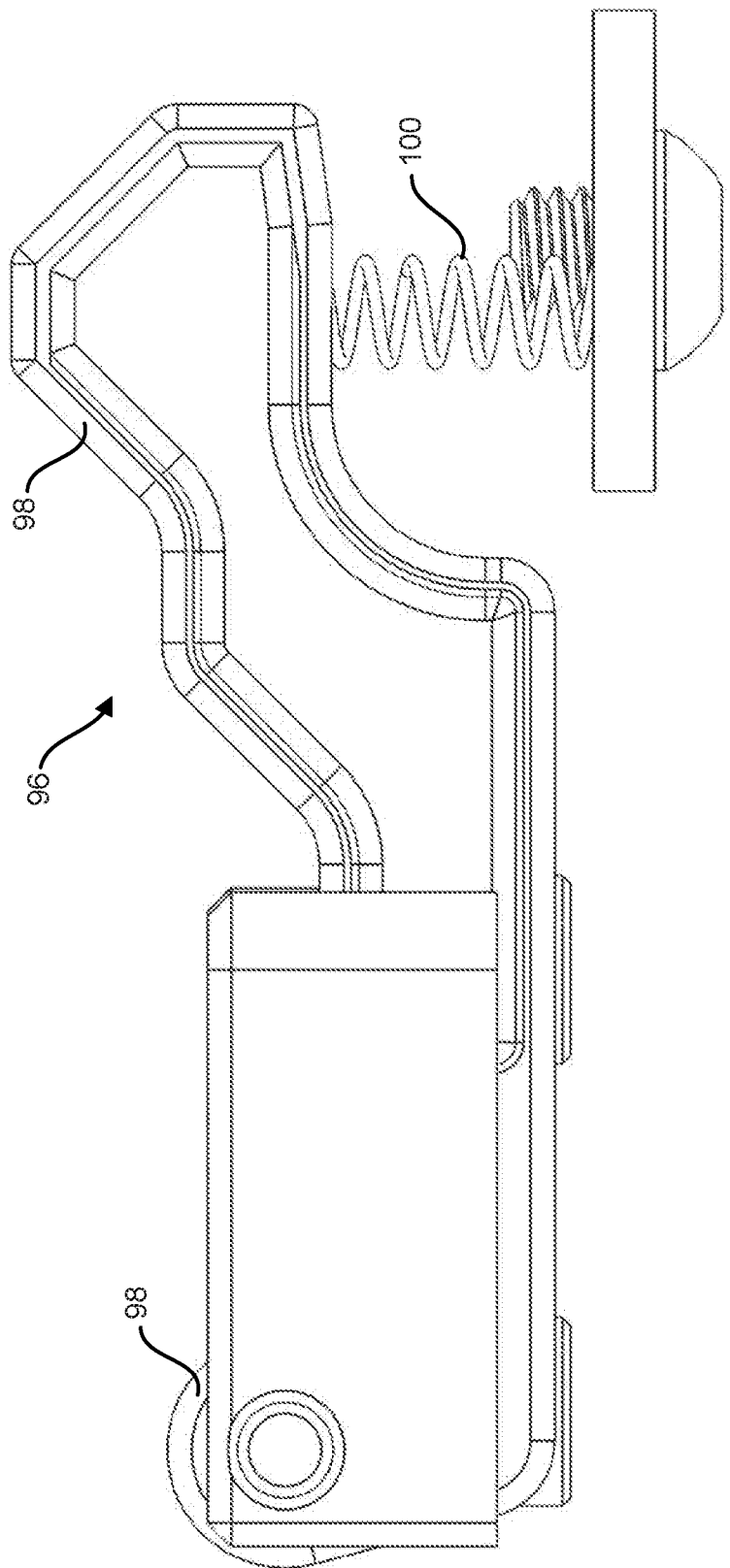


FIG. 6C

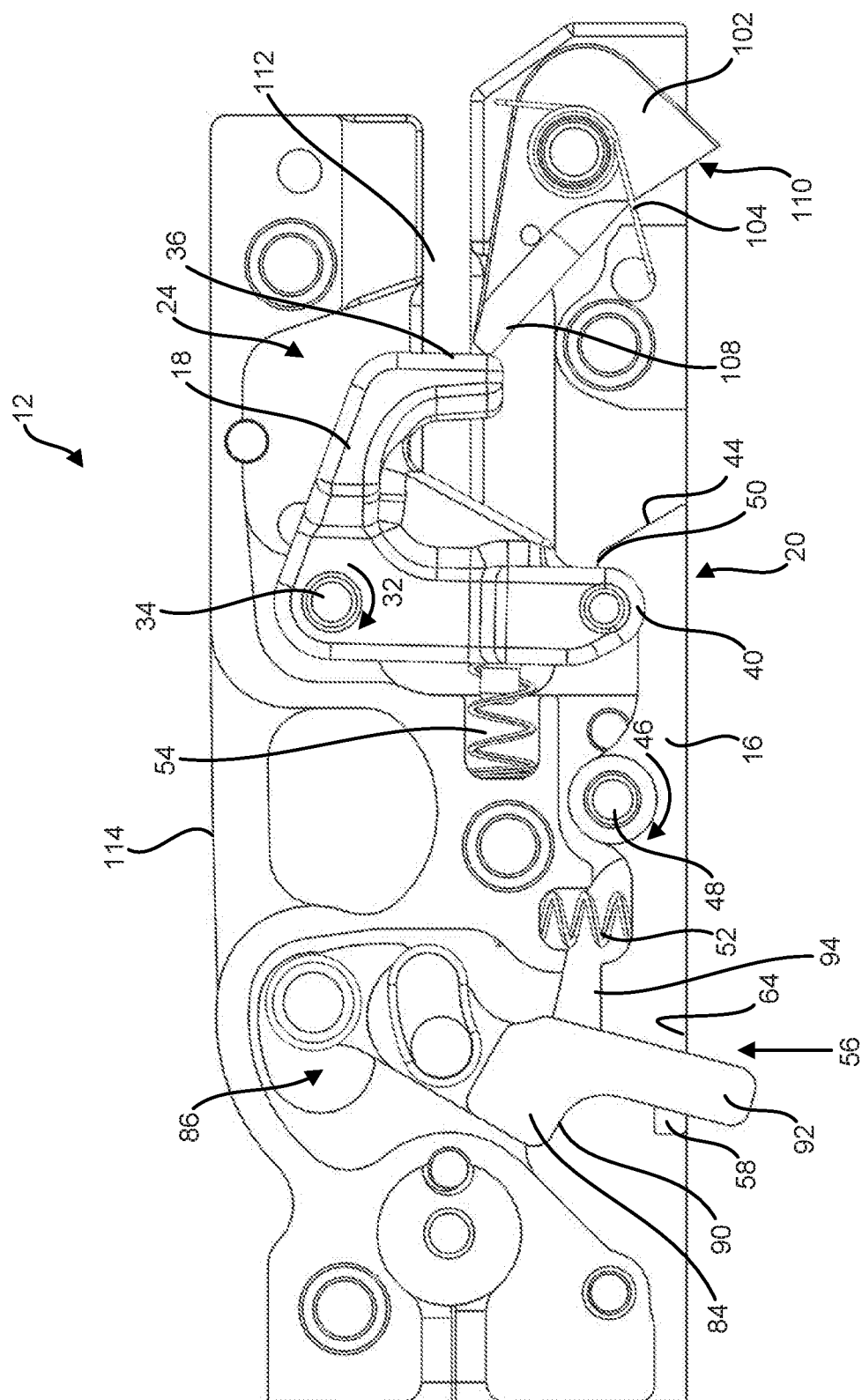


FIG. 7

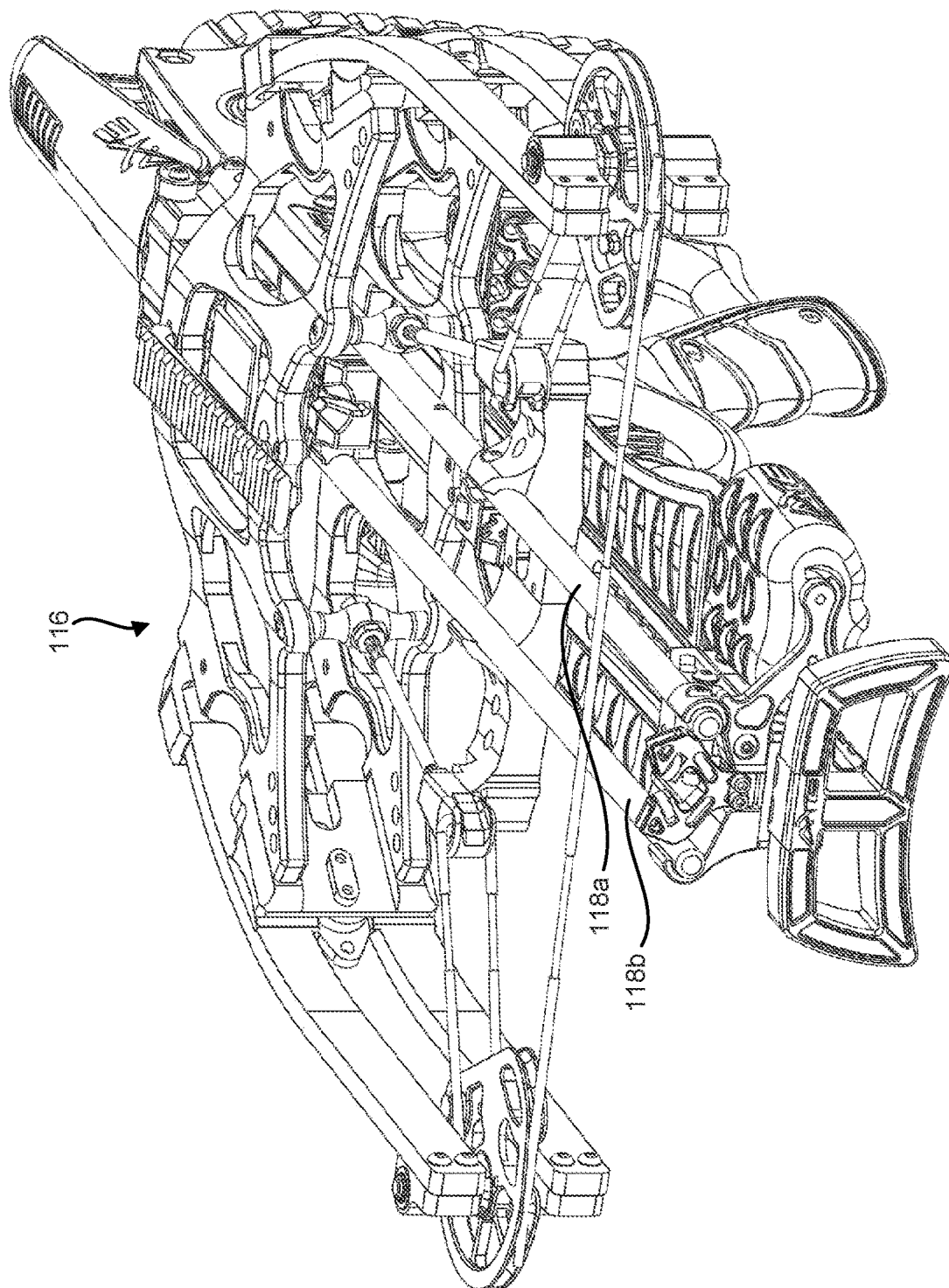


FIG. 8A

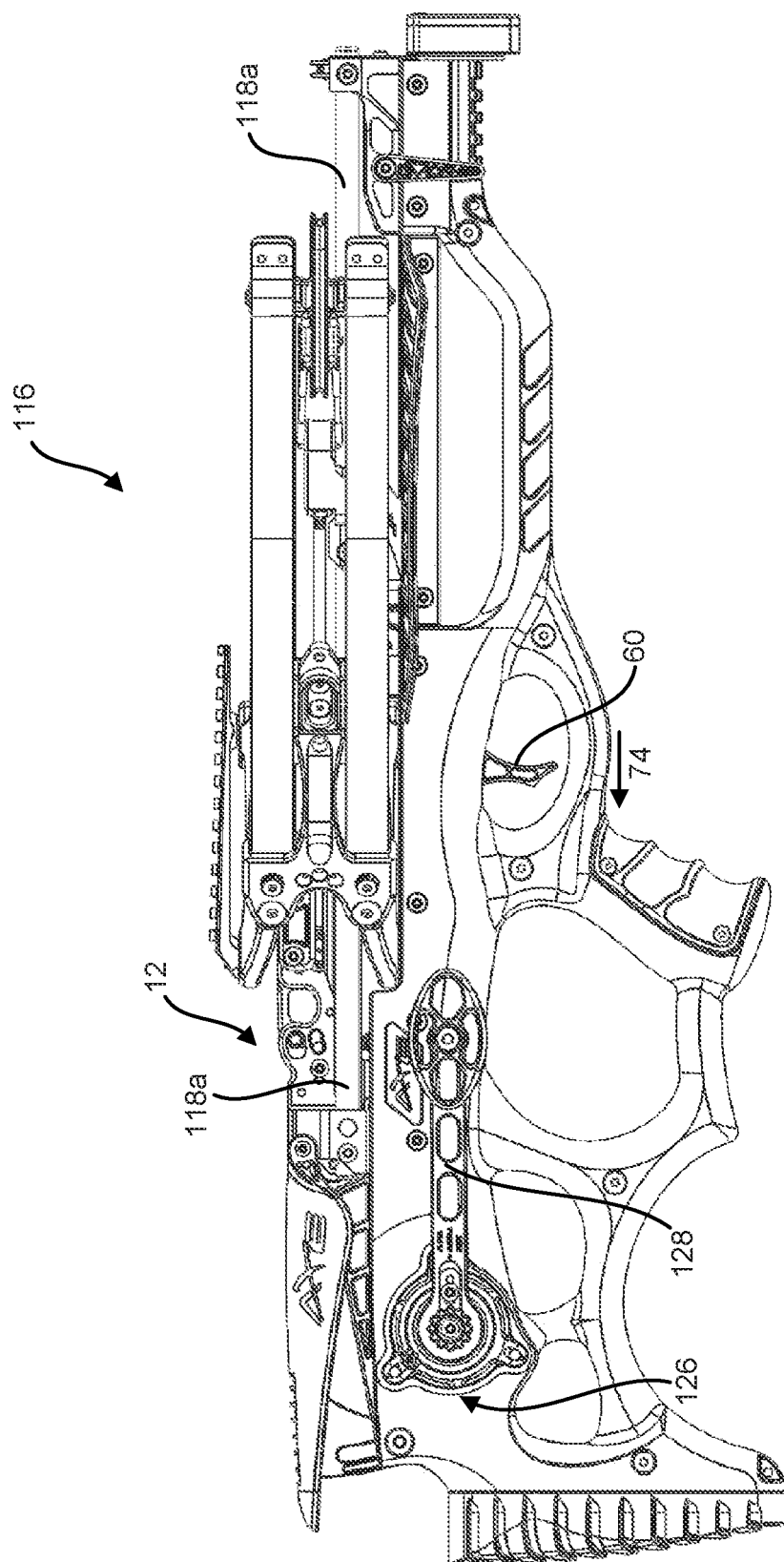


FIG. 8B

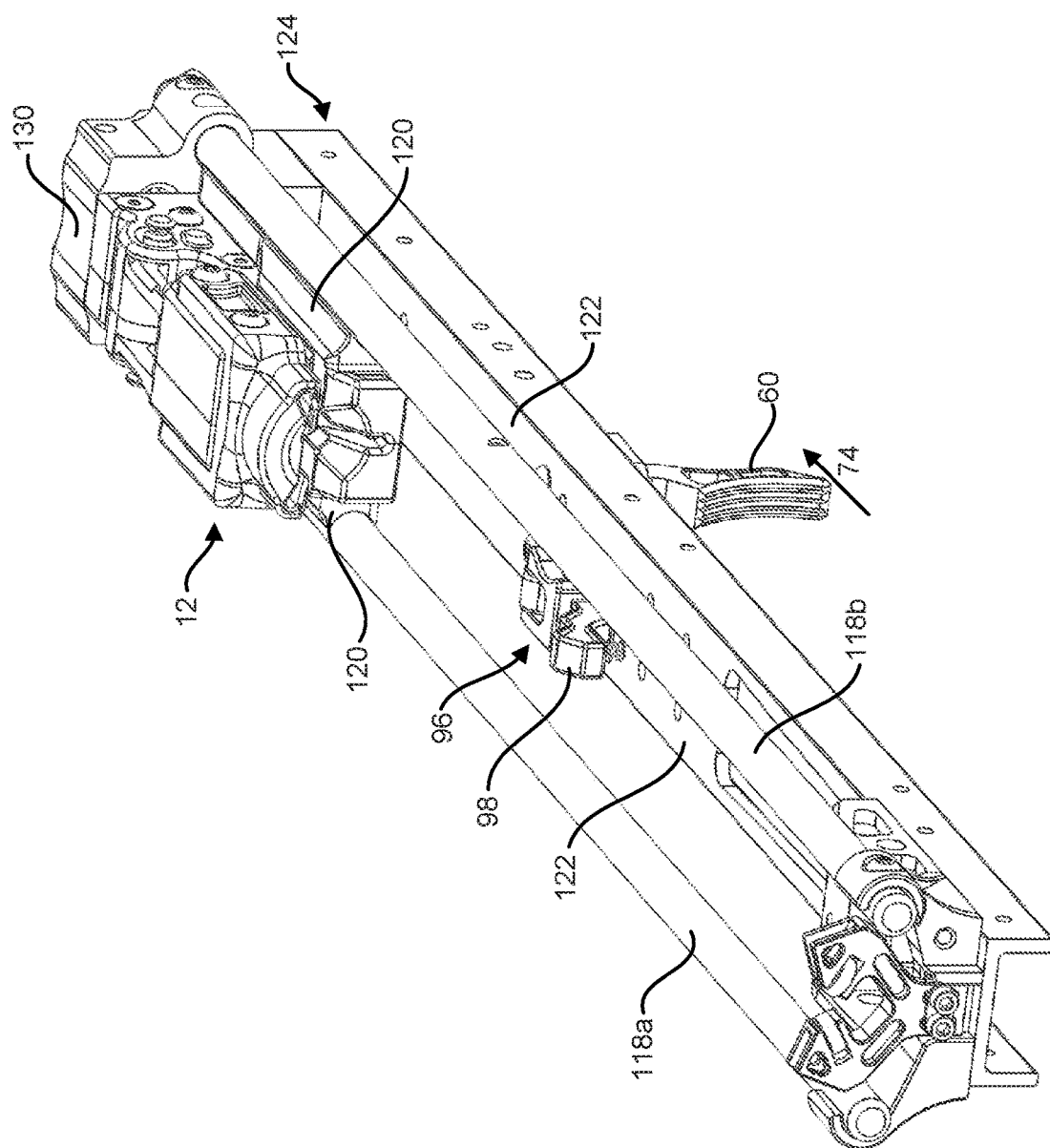


FIG. 9A

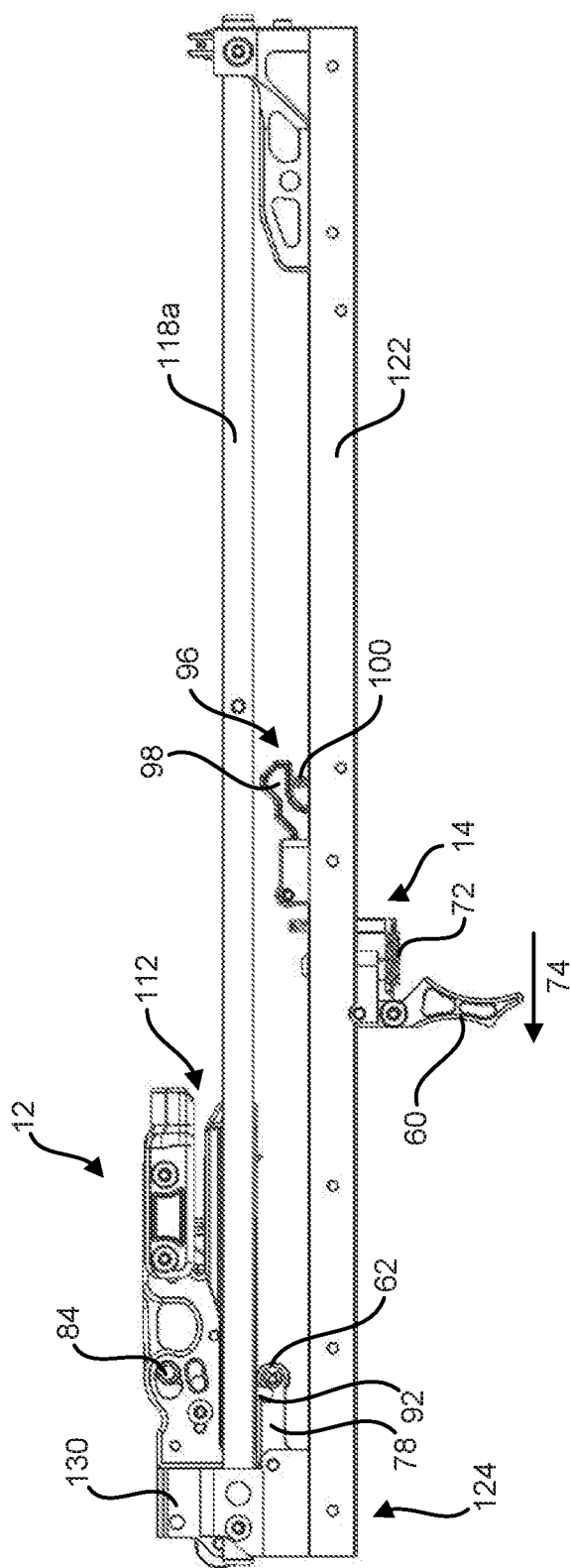


FIG. 9C

FIRING SYSTEM FOR A CROSSBOW**CROSS-REFERENCE TO RELATED APPLICATIONS**

[0001] This application claims the benefit of U.S. Provisional Patent Application No. 62/883,411 filed Aug. 6, 2019, which is herein incorporated by reference in its entirety.

STATEMENT REGARDING FEDERALLY SPONSORED RESEARCH OR DEVELOPMENT

[0002] Not applicable.

TECHNICAL FIELD

[0003] This disclosure pertains to a firing system for a crossbow.

BACKGROUND

[0004] Numerous firing systems having one or more embodiments of bowstring carriers, trigger assemblies, dry-fire inhibitor, safeties, and safety resets are disclosed in one or more of the following patents and patent application publications which are herein incorporated by reference in their entirety: U.S. Pat. Nos. 2,977,952, 3,057,101, 3,483,857, 3,490,429, 3,537,441, 3,538,901, 4,192,281, 4,693,228, 4,721,092, 4,877,008, 5,085,200, 5,170,771, 5,365,911, 5,596,976, 5,598,829, 5,649,520, 5,884,614, 6,205,990, 6,736,123, 6,802,304, 7,588,022, 7,770,567, 8,020,543, 8,091,540, 8,453,631, 8,578,916, 8,651,094, 9,010,308, 9,097,485, 9,140,516, 9,255,758, 9,354,018, 9,435,605, 9,494,380, 9,506,715, 9,523,549, 9,551,544, 9,557,134, 9,689,638, 9,726,454, 9,733,041, 9,909,832, 9,958,232, 10,066,894, 10,077,965, 10,126,088, 10,197,354, 10,247,507, 10,401,117, 10,508,884, 10,605,555, 10,677,558, US 2004/0194771, US 2006/0144381, US 2011/0253118, US 2014/0182573, US 2014/0182574, US 2015/0143731, US 2017/0115089, US 2017/0131058, US 2017/0131059, US 2019/0226794, and WO 2017-083505 among others.

SUMMARY

[0005] A non-limiting exemplary embodiment of a firing system for a crossbow includes a bowstring carrier and a trigger assembly. The bowstring carrier includes a sear operable between cocked and un-cocked positions, and a catch operable between locked and un-locked positions. The sear and the catch are operatively coupled. The sear is biased towards the un-cocked position and the catch is biased towards the un-locked position. The trigger assembly includes a trigger operable between cocked and un-cocked positions and a trigger roller. The trigger and the trigger roller are operatively coupled, and the trigger is biased towards the cocked position.

[0006] Another non-limiting exemplary embodiment of a firing system for a crossbow includes a bowstring carrier, a trigger assembly, and a dry-fire inhibitor. The bowstring carrier includes a sear operable between cocked and un-cocked positions and a catch operable between locked and un-locked positions. The sear and the catch are operatively coupled. The sear is biased towards the un-cocked position and the catch is biased towards the un-locked position. The trigger assembly includes a trigger operable between cocked and un-cocked positions and a trigger roller. The trigger and the trigger roller are operatively coupled, the trigger is

biased towards the cocked position, and the trigger roller and the sear are operatively coupled when the bowstring carrier with the cocked sear is at the proximal end of the crossbow. The dry-fire inhibitor is operable between activated and de-activated positions, and is biased towards the activated position.

[0007] Yet another non-limiting exemplary embodiment of a firing system for a crossbow includes a bowstring carrier and a trigger assembly. The bowstring carrier includes a sear operable between cocked and un-cocked positions, a catch operable between locked and un-locked positions, and a safety operable between activated and de-activated positions. The sear and the catch are operatively coupled. The sear is biased towards the un-cocked position, and the catch is biased towards the un-locked position. The trigger assembly includes a trigger operable between cocked and un-cocked positions and a trigger roller. The trigger and the trigger roller are operatively coupled, the trigger is biased towards the cocked position, and the trigger roller and the sear are operatively coupled when the bowstring carrier with the cocked sear is at the proximal end of the crossbow.

[0008] Another non-limiting exemplary embodiment of a firing system for a crossbow includes a bowstring carrier, a trigger assembly, a dry-fire inhibitor, a safety, and a safety reset. The bowstring carrier includes a sear operable between cocked and un-cocked positions and a catch operable between locked and un-locked positions. The sear and the catch are operatively coupled. The sear is biased towards the un-cocked position and the catch is biased towards the un-locked position. The trigger assembly includes a trigger operable between cocked and un-cocked positions and a trigger roller. The trigger and the trigger roller are operatively coupled, and the trigger is biased towards the cocked position. The trigger roller and the sear are operatively coupled when the bowstring carrier with the cocked sear is at the proximal end of the crossbow. The dry-fire inhibitor is operable between activated and de-activated positions and is biased towards the activated position. The safety is operable between activated and de-activated positions. The safety reset is configured for operating the safety between the activated and de-activated positions.

BRIEF DESCRIPTION OF THE DRAWINGS

[0009] FIG. 1 is a side view of a non-limiting exemplary embodiment of a firing system of the instant disclosure;

[0010] FIG. 2A is a perspective view of a non-limiting exemplary embodiment of a bowstring carrier for the firing system of the instant disclosure;

[0011] FIG. 2B is another perspective view of the bowstring carrier illustrated in FIG. 2A;

[0012] FIG. 3A is a cross-sectional view of the bowstring carrier illustrated in FIGS. 2A and 2B;

[0013] FIG. 3B is another cross-sectional view of the bowstring carrier illustrated in FIGS. 2A and 2B;

[0014] FIG. 3C is yet another cross-sectional view of the bowstring carrier illustrated in FIGS. 2A and 2B;

[0015] FIG. 3D is a cross-sectional view of the bowstring carrier illustrated in FIGS. 2A and 2B;

[0016] FIG. 3E is another cross-sectional view of the bowstring carrier illustrated in FIGS. 2A and 2B;

[0017] FIG. 4A is a perspective view of a non-limiting exemplary embodiment of a trigger assembly for the firing system of the instant disclosure;

[0018] FIG. 4B is another perspective view of the trigger assembly illustrated in FIG. 4A;

[0019] FIG. 4C is a side view of the trigger assembly illustrated in FIGS. 4A and 4B;

[0020] FIG. 4D is another side view of the trigger assembly illustrated in FIGS. 4A-4C;

[0021] FIG. 5 is a side view of the operatively coupled bowstring carrier and trigger assembly of the instant disclosure;

[0022] FIG. 6A is a perspective view of a non-limiting exemplary embodiment of a safety reset for the firing system of the instant disclosure;

[0023] FIG. 6B is another perspective view of the safety reset illustrated in FIG. 6A;

[0024] FIG. 6C is a side view of the safety reset illustrated in FIGS. 6A and 6B;

[0025] FIG. 7 illustrates a non-limiting exemplary embodiment of a dry-fire inhibitor for the firing system of the instant disclosure;

[0026] FIG. 8A is a perspective view of a non-limiting exemplary embodiment of a crossbow equipped with an embodiment of the firing system of the instant disclosure;

[0027] FIG. 8B is a side view of the crossbow illustrated in FIG. 8A;

[0028] FIG. 9A is a perspective view of the relevant portions of the crossbow illustrated in FIGS. 8A and 8B;

[0029] FIG. 9B is another perspective view of the relevant portions of the crossbow illustrated in FIG. 9A; and

[0030] FIG. 9C is a side view of the relevant portions of the crossbow illustrated in FIGS. 9A and 9B.

DETAILED DESCRIPTION

[0031] One or more non-limiting exemplary embodiments are disclosed herein with reference to the accompanying drawings, wherein like numerals indicate like, but not necessarily identical, elements. It should be clearly understood that the embodiments described with reference to the drawings are merely exemplary in that any one or more of them may be implemented in alternative manner as may become apparent to a person of ordinary skills. The figures are not necessarily to scale. Specific structural and/or functional features and details disclosed herein are not to be construed as limiting but should rather be treated as a basis for teaching one of ordinary skills. There is no intent, implied or otherwise, to limit the disclosure in any way, shape or form to the embodiments illustrated and described herein. Accordingly, all variants for providing structures and/or functionalities similar to those described herein for the exemplary embodiments are considered as being within the metes and bounds of the instant disclosure.

[0032] FIG. 1 is a side view of a non-limiting exemplary embodiment of a firing system 10 of the instant disclosure. In some embodiments, the firing system 10 includes a bowstring carrier 12 and a trigger assembly 14.

[0033] FIGS. 2A and 2B, respectively, are perspective views of a non-limiting exemplary embodiment of the bowstring carrier 12. FIGS. 3A-3E are various cross-sectional views of the bowstring carrier 12.

[0034] In a non-limiting exemplary embodiment, the bowstring carrier 12 includes a sear 16 and a catch 18. In some embodiments, the sear 16 is operable between a cocked position 20 illustrated in FIGS. 3C and 3E and an un-cocked position 22 illustrated in FIGS. 3A and 3B. In certain embodiments, the catch 18 is operable between a locked

position 24 illustrated in FIGS. 3C and 3E and an un-locked position 26 illustrated in FIGS. 3A, 3B and 3D. As illustrated in FIG. 3A, in some embodiments, the sear 16 is biased towards the un-cocked position 22, and the catch 18 is biased towards the un-locked position 26. In certain embodiments, the catch 18 is configured for receiving a bowstring (not shown) in the direction 28.

[0035] In a non-limiting exemplary embodiment, the sear 16 and the catch 18 are operatively coupled for receiving, retaining, and releasing the bowstring. As illustrated in FIG. 3B, as the bowstring is displaced in the direction 28 against the surface 30 of the catch 18, the catch 18 rotates in the direction 32 about the pivot 34. The end 36 of the catch 18 is displaced in the direction 38 around the bowstring, and the end 40 of the catch 18 is displaced in the direction 42 along a surface 44 of the sear 16. As the end 40 of the catch 18 displaces in the direction 42, the sear 16 rotates in the direction 46 about the pivot 48 whereby the tip 50 of the sear 16 is displaced in the direction opposite the direction 42. The end 40 of the catch 18 and the tip 50 of the sear 16 displace in opposite directions until the end 40 of the catch 18 reaches the peak of the tip 50 of the sear 16. Thereafter, the end 40 of the catch 18 “trips” or “falls” over the peak of the tip 50 of the sear 16 whereby the sear 16 rotates in the direction opposite the direction 46 and the catch 18 rotates in the direction opposite the direction 32 until the sear 16 and the catch 18 latch as illustrated in FIGS. 3C and 3E. As shown, the sear 16 is in the cocked position 20 and the catch 18 is in the locked position 24 around the bowstring.

[0036] In a non-limiting exemplary embodiment, the bowstring carrier 12 includes a biasing element 52 interacting with the sear 16, and a biasing element 54 interacting with the catch 18. In some embodiments, such as illustrated in FIG. 3A, the biasing element 52 biases the sear 16 towards the un-cocked position 22, and the biasing element 54 biases the catch 18 towards the un-locked position 26. In certain embodiments, the biasing elements 52 and 54, respectively, are configured or balanced for retaining the sear 16 cocked and catch 18 locked around the bowstring, as illustrated in FIG. 3C, until an external force 56 applied proximate an end 58 of the sear 16 un-cocks the sear 16 and/or un-locks the catch 18. In some embodiments, the sear 16 and the catch 18 have complementary geometries cooperating with the biasing elements 52 and 56 for ensuring the sear 16 remains cocked and the catch 18 remains locked until the external force 56 is applied.

[0037] In a non-limiting exemplary embodiment, the external force 56 applied proximate the end 58 of the cocked sear 16 rotates the sear 16 in the direction 46 about the pivot 48 whereby the tip 50 of the sear 16 is displaced in the direction opposite the direction 42. The end 40 of the catch 18 is displaced over the tip 50 of the sear 16 un-locking the catch 18 whereby the end 36 of the catch 18 is displaced opposite the direction 38 exposing the bowstring.

[0038] In some embodiments, the biasing element 54 urges or rotates the locked catch 18 about the pivot 34 in the direction opposite the direction 32. In certain embodiments, the un-locking of the catch 18 is aided by at least some force exerted proximate the end 36 by a drawn bowstring held by the locked catch 18.

[0039] In a non-limiting exemplary embodiment, the trigger assembly 14 is configured for exerting the force 56 for un-cocking the sear 16, un-locking the catch 18, and firing the bowstring held by the locked catch 18. FIGS. 4A and 4B

are perspective views of an exemplary trigger assembly 14, and FIGS. 4C and 4D are side views thereof. In some embodiments, the trigger assembly 14 includes a trigger 60, a trigger roller 62, and a link member 66 operatively coupling the trigger 60 and the trigger roller 62. In some embodiments, the trigger 60 is operable between a cocked position 68 shown in FIG. 4C and an un-cocked position 70 shown in FIG. 4D. In certain embodiments, the trigger assembly 14 includes a biasing element 72 which biases the trigger 60 in the cocked position 68 shown in FIG. 4C.

[0040] When the cocked trigger 60 is pulled, for example in the direction 74, the trigger 60 rotates about the pivot 76 causing the link member 66 to displace in the direction opposite the direction 74 whereby the roller arm 78 and the trigger roller 62 rotate in the direction 80 about the pivot 82, and the trigger 60 is un-cocked as shown in FIG. 4D. Then, when the un-cocked trigger 60 is released, the biasing element 72 causes the trigger 60, the link member 66, the roller arm 78, and the trigger roller 62 to move or displace in the direction opposite the direction each component moved when the trigger 60 was pulled, and the trigger 60 returns to the cocked position 68 shown in FIG. 4C.

[0041] FIG. 5 illustrates a non-limiting exemplary embodiment wherein the bowstring carrier 12 and the trigger assembly 14 are operatively coupled with the sear 16 and the trigger 60 in their respective cocked positions 20 and 68, and the catch 18 in the locked position 24 around a drawn bowstring (not shown). It will be apparent to one skilled in the art that FIG. 5 represents an embodiment described in further detail below wherein the bowstring carrier 12 with the catch 18 locked around the bowstring has been fully retracted in the proximal direction towards the user, and the bowstring carrier 12 and the trigger assembly 14 are held abutting each other, as shown, with the bowstring fully drawn. The sear 16 in the cocked position 20 and the trigger roller 62 with the trigger 62 cocked 68 abut, and are operatively coupled, along a surface 64 of the sear 16.

[0042] As described in the foregoing with reference to FIGS. 4C and 4D, when the trigger 60 is pulled, the trigger roller 62 rotates in the direction 80 along the surface 64 of the sear 16 and applies the force 56 to the sear 16 in the cocked position 20. The force 56, as described in the foregoing, causes the sear 16 to rotate to the un-cocked position 22 whereby the catch 18 rotates to the un-locked position 26 releasing the bowstring.

[0043] From the foregoing, it should be readily apparent to one skilled in the art, that the sear 16 must be in the cocked position 20 in order for the catch 18 to un-lock to release the bowstring. It will also be readily apparent to one skilled in the art that if the sear 16 is not cocked when the bowstring carrier 12 is retracted in the proximal direction towards the user, and end 58 of the sear 16 will abut the trigger roller 62 and stop the movement of the bowstring carrier 12 in the proximal direction towards the user inhibiting the sear 16 and the trigger roller 62 from being operatively coupled.

[0044] In a non-limiting exemplary embodiment, the firing system 10 includes a safety 84 operable between a de-activated position 86 illustrated in FIGS. 3A-3C and an activated position 88 illustrated in FIGS. 3D and 3E. In some embodiments, the safety 84 includes a ledge or a shoulder 90 on the safety lever 92.

[0045] In a non-limiting exemplary embodiment, the safety 84 when in the de-activated position 86 such as that illustrated in FIGS. 3A and 3B permits un-hindered rotation

of the sear 16 in the direction 46 around the pivot 48 enabling the catch 18 to rotate in the direction 32 around the pivot 34 until the catch 18 locks around the bowstring and the sear 18 cocks as shown in FIG. 3C. In a non-limiting exemplary embodiment, when the safety 84 is in the activated position 88, a ledge or shoulder 90 on the safety lever 92 of the safety 84 and a plateau 94 on the sear 16 abut, as shown in FIG. 3D, to prevent the sear 16 from being cocked by impeding the sear 16 from continuing its rotation in the direction 46 around the pivot 48 whereby the catch 18 is hindered from completing its rotation in the direction 32 around the pivot 34 and the catch 18 is inhibited from locking around the bowstring. Accordingly, as will be apparent to one skilled in the art, the safety 84 must always be in the de-activated position 86 for the catch 18 to lock around the bowstring and for the sear 16 to cock.

[0046] In a non-limiting exemplary embodiment, the safety 84 when in the de-activated position 86 such as illustrated in FIGS. 3C and 5 permits the sear 16 to un-cock and the catch 18 to un-lock when the trigger 60 is pulled and the force 56, as described in the foregoing with reference to FIGS. 4C and 4D, is applied proximate the end 58 of the cocked sear 16. In a non-limiting exemplary embodiment, when the safety 84 is in the activated position 88, the ledge or shoulder 90 on the safety lever 92 of the safety 84 and the plateau 94 on the cocked sear 16 abut, as shown in FIG. 3E, to prevent the sear 16 from un-cocking and the catch 18 from un-locking when the trigger 60 is pulled and the force 56, as described in the foregoing with reference to FIGS. 4C and 4D, is applied proximate the end 58 of the cocked sear 16. Accordingly, as will be apparent to one skilled in the art, the safety 84 must always be in the activated position 88 for the sear 16 to un-cock and the catch 18 to unlock. To that end, the safety 84 is configured for being activated and de-activated manually by the user.

[0047] As described in the foregoing, the safety 84 must be de-activated for the catch 18 to lock around the bowstring in order to draw the bowstring, and the sear 16 must be cocked and the safety 84 must be de-activate in order to pull the trigger 60 and release the drawn bowstring. Generally, the bowstring, after being released from the catch 18, will be at a location distal or downrange from the user, and the bowstring carrier 12 must be moved to the bowstring with the safety 84 de-activated for the catch 18 to lock around the bowstring. Then, as the "captured" bowstring is drawn by retracting the bowstring carrier 12 in the proximal direction towards the user, it would be advantageous to activate the safety 84 to inhibit the trigger 60 from being pulled, for example, accidentally.

[0048] In a non-limiting exemplary embodiment, the firing system 10 includes a safety reset 96 for respectively activating and de-activating the safety 84 when the bowstring carrier 12 is retracted to draw the bowstring and when the bowstring carrier 12 is moved or displaced in the distal direction to "capture" the bowstring in the catch 18. FIGS. 6A and 6B are perspective views and FIG. 6C is a side view of a non-limiting exemplary embodiment of the safety reset 96. In some embodiments, the safety reset 96 is configured for activating and de-activating the safety 84 as the bowstring carrier 12 is displaced across the safety reset 96. To that end, in certain embodiments, the safety reset 96 includes a reset lever 98 configured for interacting with the safety lever 92 as the bowstring carrier 12 is displaced across the safety reset 96.

[0049] In some embodiments, as the bowstring carrier 12 is moved from a proximal side to a distal side of the safety reset 96, the reset lever 98 sufficiently obstructs the movement of the safety lever 92 across the safety reset 96 so that the safety 84 is de-activated whereby the catch 18 is enabled to “capture” the bowstring on the distal side of the safety reset 96.

[0050] In certain embodiments, as the bowstring carrier 12 is retracted in the proximal direction to draw the bowstring captured in the catch 18, the bowstring carrier 12 moves from the distal side to the proximal side of the safety reset 96 and the reset lever 98 sufficiently obstructs the movement of the safety lever 92 across the safety reset 96 so that the safety 84 is activated whereby the trigger 60 is inhibited from being pulled accidentally until the safety 84 is de-activated.

[0051] In a non-limiting exemplary embodiment, the reset lever 98 is configured as a biasing element to “give” or deflect and yet exert sufficient force on the safety lever 92 to activate or de-activate the safety 84 as the bowstring carrier 12 moves across the safety reset 96.

[0052] In another non-limiting exemplary embodiment, the safety reset 96 includes a biasing element 100 configured for interacting with the reset lever 98. In some embodiments, the biasing element 100 is configured to permit the reset lever 98 to “give” or deflect and yet allow the reset lever 98 to exert sufficient force on the safety lever 92 to activate or de-activate the safety 84 as the bowstring carrier 12 moves across the safety reset 96.

[0053] In a non-limiting exemplary embodiment, the firing system 10 does not have the safety reset 96. In some exemplary embodiments, the user activates and de-activates the safety 84. In a non-limiting exemplary embodiment, the safety reset 96 is configured as an “obstruction element” with or without biasing properties such as, for example, a protrusion or a bar (e.g., dowel) extending across the width of the center rail 122 or a bulge or the head of a bolt, etc.

[0054] In a non-limiting exemplary embodiment, the catch 18 activates and de-activates the safety. In some exemplary embodiments, the catch 18 and the safety 84 are operatively coupled. In certain exemplary embodiments, if the safety 84 is in the activated position 88, the un-locked catch 18 first de-activates the safety 84 before locking around the bowstring. Of course, if the safety 84 is already de-activated, then the catch 18 does not need to de-activate the safety 84 before locking around the bowstring.

[0055] In a non-limiting exemplary embodiment, the safety 84 does not include the safety lever 92. In some exemplary embodiments, the safety 84 and the safety reset 96 interact or operate cooperatively to activate and de-activate the safety 84 as the bowstring carrier 12 moves across or over the safety reset 96.

[0056] Because, as described in the foregoing, the safety 84 must be de-activated before the trigger 60 can be pulled to release the drawn bowstring held by the catch 18, it will be readily apparent to those skilled in the art that the safety 84, most likely, will be in the de-activated position 86 as it traverses or is moved or displaced from the proximal side to the distal side of the safety reset 96. Therefore, in some exemplary embodiments, the safety reset 96 ensures or makes certain that the safety 84 is in fact de-activated just in case it was activated deliberately by the user and/or accidentally got activated.

[0057] As is well known in the art, dry-firing a bow, i.e., releasing a drawn bowstring without a nocked arrow or bolt to absorb the released energy, can be dangerous to the user and/or damage the equipment. In a non-limiting exemplary embodiment, the firing system 10 includes a dry-fire inhibitor 102 configured to “capture” or “arrest” a drawn bowstring released without a nocked bolt or arrow. In some embodiments, the dry-fire inhibitor 102 includes a biasing element 104 configured to bias the dry-fire inhibitor 102 “upright” or in an activated position 106 to capture the drawn bowstring if released without a nocked bolt or arrow. FIG. 3C illustrates one such exemplary embodiment wherein the sear 16 is cocked, the catch 18 is locked about a drawn bowstring (not shown), the safety 84 is de-activated, and the dry-fire inhibitor 102 is activated since an arrow or bolt has not been nocked onto the drawn bowstring. As will be readily apparent to one skilled in the art, and as described in the foregoing, the drawn bowstring, without the nocked bolt or arrow, will be released if the trigger 60 is accidentally or deliberately pulled. As will also be apparent to one skilled in the art, the released bowstring will be immediately “arrested” or “captured” or “stopped” at the surface 108 of the upright or activated dry-fire inhibitor 102. With the safety 84 in the de-activated position 86, the user may then advance or move the bowstring carrier 12 towards the dry-fire inhibitor 102 to “grab” the bowstring and lock the catch 18 around the bowstring. The bowstring carrier 12 can then be retracted in the proximal direction to again fully draw the bowstring.

[0058] In a non-limiting exemplary embodiment, the dry-fire inhibitor 102 is configured to rotate or bias out of the path of the drawn bowstring when an arrow or bolt is nocked. FIG. 7 illustrates one such exemplary embodiment, albeit without a nocked arrow or bolt, wherein the sear 16 is cocked, the catch 18 is locked about a drawn bowstring (not shown), the safety 84 is de-activated, and the dry-fire inhibitor 102 is in a de-activated position 110. As will be apparent to one skilled in the art, the dry-fire inhibitor 102 will be de-activated by the shaft (not shown) of the nocked arrow or bolt (not shown) in the groove 112 of the bowstring carrier 12. Then, when the trigger 60 is accidentally or deliberately pulled, the bowstring will be released from the catch 18, and the nocked arrow or bolt will be propelled downrange. Of course, the biasing element 104 is configured to ensure that the dry-fire inhibitor 102 remains de-activated for a sufficient amount of time to inhibit the bowstring from being prematurely captured or arrested by the dry-fire inhibitor 102.

[0059] In a non-limiting exemplary embodiment, the biasing element 104 is a torsion spring. In some embodiments, the biasing element 104 is not a spring. In a non-limiting exemplary embodiment, the dry-fire inhibitor 102 does not include the biasing element 104. In some embodiments, the dry-fire inhibitor 102 itself is a biasing element configured for being in the activated position 106 in the absence of a nocked arrow or bolts, and in the de-activated position 110 in the presence of a nocked arrow or bolt. Any and all other alternatives providing the required functionality are considered as being within the metes and bounds of this disclosure.

[0060] In a non-limiting exemplary embodiment, the end 40 of the catch 18 includes a roller configured for rotating as the end 40 is displaced along the surface 44 of the sear 16. In some embodiments, the end 44 of the catch 18 is rounded or curved. In certain embodiments, the surface 44 of the sear

16 includes a groove or a channel configured as a guide or track along which the end 40 moves. In some embodiments, the end 40 of the sear 16 and the surface 44 of the sear 16 are substantially smooth or slippery to permit their unhindered movement against each other. In certain embodiments, the end 40 of the sear and the surface 44 of the sear 16 are configured to minimize or eliminate friction therebetween as they move or slide against each other.

[0061] In a non-limiting exemplary embodiment, the trigger roller 62 is configured for rotating along the surface 64 of the sear 16. In some embodiments, the trigger assembly 14 includes a rounded or curved end or surface instead of the trigger roller 62. In certain embodiments, the surface 64 of the sear 16 includes a groove or a channel configured as a guide or track along which the trigger roller 62 rotates or alternatively along which the rounded or curved end or surface of the trigger assembly 14 moves. In some embodiments, the rounded or curved end of the trigger assembly 14 and the surface 64 of the sear 16 are substantially smooth or slippery to permit their unhindered movement against each other. In certain embodiments, the rounded or curved end of the trigger assembly 14 and the surface 64 of the sear 16 are configured to minimize or eliminate friction therebetween as they move or slide against each other.

[0062] In a non-limiting exemplary embodiment, the bowstring carrier 12 includes a housing 114. In some embodiments, the sear 16 and the catch 18 are disposed or housed within the housing 114. In a non-limiting exemplary embodiment, the safety 84 is disposed or housed within the housing 114. In a non-limiting exemplary embodiment, the dry-fire inhibitor 102 is disposed or housed within the housing 114. In a non-limiting exemplary embodiment, the sear 16, the catch 18, the safety 84, and the dry-fire inhibitor 102 are disposed or housed within the housing 114. In some embodiments, the safety 84 is external of the housing 114. In certain embodiments, the dry-fire inhibitor 102 is external of the housing 114. In some embodiments, the safety 84 and the dry-fire inhibitor 102 are external of the housing 114.

[0063] FIGS. 8A and 8B, respectively, are perspective and side views of a non-limiting exemplary embodiment of a crossbow 116 equipped with an exemplary embodiment of the firing system 10 of the instant disclosure. FIGS. 9A and 9B are perspective views and FIG. 9C is a side view of the relevant portions of the crossbow 116 to which the firing system 10 is coupled with or attached to or installed on.

[0064] In a non-limiting exemplary embodiment, the crossbow 116 includes a pair of substantially parallel rails 118a and 118b extending between the proximal and distal ends of the crossbow 114. In some embodiments, the rails 118 are cylindrical shaped, i.e., have a circular cross-section. In certain embodiments, the rails 118 have an oval or oblong cross-section. In some embodiments, the rails 118 have a triangular cross-section. In some embodiments, the rails 118 have a polygon shaped cross-section. Any and all other geometries for the rails 118 that are or may become apparent to a person of ordinary skill are considered as within the metes and bounds of the instant disclosure.

[0065] In a non-limiting exemplary embodiment, the bowstring carrier 12 is slidably coupled to the rails 118 and configured for being displaced along the rails 118 between the proximal and distal ends of the crossbow 116. In some embodiments, the housing 114 has an external complementary surface 120a and 120b for slidably coupling the bow-

string carrier 12 between the rails 118. In certain embodiments (not shown), the rails 118 extend through an interior of the bowstring carrier 12.

[0066] In some embodiments, the crossbow 116 includes a center rail 122 extending between the proximal and distal ends of the crossbow 116. In a non-limiting exemplary embodiment (not shown), the bowstring carrier 12 is slidably coupled to the center rail 122 and configured for being displaced along the center rail 122 between the proximal and distal ends of the crossbow 116. In a non-limiting exemplary embodiment, the cross-section of the center rail 122 is any one of circular, oval, oblong, polygonal, and any and all other geometries that are or may become apparent to a person of ordinary skill. In some embodiments, the housing 114 has an external complementary surface for slidably coupling the bowstring carrier 12 and the center rail 122 to each other. In certain embodiments (not shown), the center rail 122 extends through an interior of the bowstring carrier 12.

[0067] In a non-limiting exemplary embodiment, the trigger assembly 14 is fixedly attached to the center rail 122 proximate the proximal end 124 of the center rail 122. In a non-limiting exemplary embodiment, the safety reset 96 is fixedly attached to the center rail 122 in the path of the bowstring carrier 12 as it moves between the proximal and distal ends of the crossbow 116.

[0068] In a non-limiting exemplary embodiment, the bowstring carrier 12 and the trigger assembly 14 are discrete components configured for abutting against each other. In a non-limiting exemplary embodiment, the bowstring carrier 12 and the trigger assembly 14 are discrete components configured for being removably attached to each other. In a non-limiting exemplary embodiment, the bowstring carrier 12 and the trigger assembly 14 are discrete components fixedly attached to each other. In a non-limiting exemplary embodiment, the bowstring carrier 12 and the trigger assembly 14 are a unitary component.

[0069] In a non-limiting exemplary embodiment, the crossbow 116 includes a retractor 126 configured for drawing the bowstring locked in the catch 18 by retracting or pulling the bowstring carrier 12 toward or to the proximal end of the crossbow 116. In a non-limiting exemplary embodiment, the retractor 126 is a winch such as the non-limiting exemplary embodiments disclosed in Applicant's co-pending patent application number PCT/US19/55159 which is herein incorporated by reference in its entirety.

[0070] In a non-limiting exemplary embodiment, the retractor 126 includes one or more straps and/or one or more cables having an end attached to the bowstring carrier 12. In a non-limiting exemplary embodiment, rotating a crank or handle 128 of the retractor 126 in a first direction pulls on the straps and/or the cables to retract or displace the bowstring carrier 12 towards the proximal end of the crossbow 116. In certain embodiments, retracting or pulling the bowstring carrier 12 draws the bowstring locked in the catch 18. In some embodiments, the retractor 126 pulls on the bowstring carrier 12 until it abuts a housing 130 of the trigger assembly 14. In a non-limiting exemplary embodiment, the retractor 126 holds or retains the bowstring carrier 12 with the drawn bowstring abutting the housing 130 of the trigger assembly 14 proximate the proximal end of the crossbow 116.

[0071] In a non-limiting exemplary embodiment, rotating the crank or handle 128 of the retractor 126 in a second direction opposite the first direction unwinds the straps and/or the cables from the retractor 126. If the bowstring carrier 12, more specifically the catch 18, no longer holds the bowstring, i.e., after the bowstring has been released, unwinding the straps and/or the cables from the retractor 126 creates a slack in the straps and/or the cables which then enables the user to manually displace or move the bowstring carrier 12 towards the bowstring for locking the catch 18 around the bowstring. If the drawn bowstring is still held or locked in the catch 18, then unwinding the straps and/or the cables enables or permits or provides for controlled movement or displacement of the bowstring carrier 12 towards the distal end of the crossbow 116 under the influence of the energy stored in the limbs of the crossbow 116 and/or the force of the drawn bowstring.

[0072] In a non-limiting exemplary embodiment, the retractor 126 retracts or pulls the bowstring carrier 12 to the proximal end of the crossbow 116 for being removably attached to the trigger assembly 14 at the proximal end of the crossbow 116. In a non-limiting exemplary embodiment, the retractor 126 retracts or pulls the bowstring carrier 12 to the proximal end of the crossbow 116 for being fixedly attached to the trigger assembly 14 at the proximal end of the crossbow 116. In a non-limiting exemplary embodiment, the retractor 126 retracts or pulls the bowstring carrier 12 to the proximal end of the crossbow 116 for being removably attached to the rails 118 at the proximal end of the crossbow 116. In a non-limiting exemplary embodiment, the retractor 126 retracts or pulls the bowstring carrier 12 to the proximal end of the crossbow 116 for being fixedly attached to the rails 118 at the proximal end of the crossbow 116. In a non-limiting exemplary embodiment, the retractor 126 retracts or pulls the bowstring carrier 12 to the proximal end of the crossbow 116 for being fixedly attached to the center rail 122 at the proximal end of the crossbow 116. In a non-limiting exemplary embodiment, the retractor 126 retracts or pulls the bowstring carrier 12 to the proximal end of the crossbow 116 for being fixedly attached to the center rail 122 at the proximal end of the crossbow 116. In a non-limiting exemplary embodiment, the retractor 126 retracts or pulls the bowstring carrier 12 to the proximal end of the crossbow 116 for being removably and/or fixedly attached to one or more of the trigger assembly 14, the rails 118 and the center rail 122 at the proximal end of the crossbow 116.

[0073] In a non-limiting exemplary embodiment, the straps and/or the cables of the retractor 126 extend through the housing 128 of the trigger assembly 14.

[0074] In a non-limiting exemplary embodiment, the crossbow 116 includes a retractor (not shown) having one or more straps and/or one or more cables having ends configured for being removably attached to the bowstring prior to drawing the bowstring and for being detached from the bowstring after the bowstring has been drawn and locked in the catch 18 of the bowstring carrier 12. In a non-limiting exemplary embodiment, rotating the crank or handle of the retractor in a first direction pulls on the straps and/or the cables to retract or displace the bowstring towards the catch 18 of the bowstring carrier 12. Once the catch 18 is locked around the bowstring, the straps and/or the cables can be detached from the bowstring.

[0075] In a non-limiting exemplary embodiment, rotating the crank or handle of the retractor in a second direction opposite the first direction unwinds the straps and/or the cables from the retractor. If the bowstring carrier 12, more specifically the catch 18, no longer holds the bowstring, i.e., after the bowstring has been released, unwinding the straps and/or the cables from the retractor creates a slack which then enables the user to attach the straps and/or cables to the released bowstring. If the drawn bowstring is still held or locked in the catch 18, then unwinding the straps or the cables enables or permits or provides for controlled movement or displacement of the drawn bowstring towards the distal end of the crossbow 116 under the influence of the energy stored in the limbs of the crossbow 116 and/or the force of the drawn bowstring.

[0076] In a non-limiting exemplary embodiment, one or both biasing elements 54 and 56 are compression springs. In a non-limiting exemplary embodiment, one or both biasing elements 54 and 56 are expansion springs. It will be apparent to one skilled in the art that the location and/or the configuration of the biasing elements 54 and 56 is not limited to those illustrated.

[0077] In view thereof, modified and/or alternate configurations of the non-limiting exemplary embodiments illustrated and described herein may become apparent or obvious to one of ordinary skill. All such variations are considered as being within the metes and bounds of the instant disclosure. For instance, while reference may have been made to particular feature(s) and/or function(s), this disclosure is considered to also encompass any and all equivalents providing functionalities similar to those described herein with reference to the accompanying drawings. Accordingly, the spirit, scope and intent of the instant disclosure embraces all variations. Consequently, the metes and bounds of the instant disclosure are defined by the appended claims and all equivalents thereof.

What is claimed is:

1. A firing system for a crossbow, the firing system comprising: a bowstring carrier, comprising
 - a sear operable between a cocked position and an un-cocked position; and
 - a catch operable between a locked position and an un-locked position; wherein,
 - the sear and the catch are operatively coupled;
 - the sear is biased towards the un-cocked position; and
 - the catch is biased towards the un-locked position; and
- a trigger assembly comprising
 - a trigger operable between a cocked position and an un-cocked position; and
 - a trigger roller; wherein,
 - the trigger and the trigger roller are operatively coupled; and
 - the trigger is biased towards the cocked position.
2. The firing system of claim 1, wherein pressing a bowstring against the un-locked catch concurrently locks the catch around the bowstring and cocks the sear.
3. The firing system of claim 2, wherein the sear and the trigger roller are operatively coupled and the trigger is cocked when the bowstring carrier with the cocked sear is at a proximal end of the crossbow.
4. The firing system of claim 3, comprising a safety operable between an activated position and a de-activated position, wherein pulling the trigger with the safety de-

activated un-locks the catch; and the trigger is inhibited from being pulled when the safety is activated.

5. The firing system of claim 4, comprising a dry-fire inhibitor operable between an activated position and a de-activated position, wherein the dry-fire inhibitor is biased towards the activated position configured to arrest the bowstring if the catch is un-locked without a bolt nocked onto the bowstring.

6. The firing system of claim 4, comprising a safety reset configured for operating the safety between the activated and de-activated positions, wherein the safety reset de-activates the safety when the bowstring carrier is displaced from a proximal side of the safety reset to a distal side of the safety reset; and

the safety reset activates the safety when the bowstring carrier is displaced from the distal side of the safety reset to the proximal side of the safety reset.

7. The firing system of claim 2, comprising a dry-fire inhibitor operable between an activated position and a de-activated position, wherein the dry-fire inhibitor is biased towards the activated position configured to arrest the bowstring if the catch is un-locked without a bolt nocked onto the bowstring.

8. The firing system of claim 1, comprising a safety operable between an activated position (88) and a de-activated position, wherein

pressing a bowstring against the un-locked catch with the safety de-activated concurrently locks the catch around the bowstring and cocks the sear; and

the catch is inhibited from locking when the bowstring is pressed against the un-locked catch with the safety activated.

9. The firing system of claim 8, wherein

the sear and the trigger roller are operatively coupled and the trigger is cocked when the bowstring carrier is at a proximal end of the crossbow with the sear cocked;

pulling the trigger with the safety de-activated un-locks the catch; and the trigger is inhibited from being pulled when the safety is activated.

10. The firing system of claim 9, comprising a dry-fire inhibitor operable between an activated position and a de-activated position, wherein the dry-fire inhibitor is biased towards the activated position configured to arrest the bowstring if the catch is un-locked without a bolt nocked onto the bowstring.

11. The firing system of claim 8, comprising a safety reset configured for operating the safety between the activated and de-activated positions, wherein

the safety reset de-activates the safety when the bowstring carrier is displaced from a proximal side of the safety reset to a distal side of the safety reset; and

the safety reset activates the safety when the bowstring carrier is displaced from the distal side of the safety reset to the proximal side of the safety reset.

12. The firing system of claim 1, comprising a pair of substantially parallel rails extending between a proximal end and a distal end of the crossbow, wherein the bowstring carrier is configured for sliding along the rails.

13. The firing system of claim 1, comprising a retractor comprising a strap attached to the bowstring carrier, wherein the retractor is operable to pull the bowstring carrier to a proximal end of the crossbow and retain the bowstring carrier abutting at least a portion of the trigger assembly; and

the retractor is operable to unwind the strap whereby the bowstring carrier is displaceable towards a distal end of the crossbow.

14. The firing system of claim 1, comprising a dry-fire inhibitor operable between an activated position and a de-activated position, wherein the dry-fire inhibitor is biased towards the activated position configured to arrest a drawn bowstring if the bowstring is released without a bolt nocked thereon.

15. A firing system for a crossbow, the firing system comprising: a bowstring carrier comprising

a sear operable between a cocked position and an un-cocked position; and

a catch operable between a locked position and an un-locked position; wherein,

the sear and the catch are operatively coupled;

the sear is biased towards the un-cocked position; and the catch is biased towards the un-locked position;

a trigger assembly comprising

a trigger operable between a cocked position and an un-cocked position; and

a trigger roller; wherein,

the trigger and the trigger roller are operatively coupled; the trigger is biased towards the cocked position; and

the trigger roller and the sear are operatively coupled when the bowstring carrier with the cocked sear is at a proximal end of the crossbow; and

a dry-fire inhibitor operable between an activated position and a de-activated position, wherein the dry-fire inhibitor is biased towards the activated position.

16. A firing system for a crossbow, the firing system comprising:

a bowstring carrier comprising:

a sear operable between a cocked position and an un-cocked position; and

a catch operable between a locked position and an un-locked position; wherein,

the sear and the catch are operatively coupled;

the sear is biased towards the un-cocked position; and the catch is biased towards the un-locked position;

a trigger assembly comprising

a trigger operable between a cocked position and an un-cocked position; and

a trigger roller; wherein,

the trigger and the trigger roller are operatively coupled; the trigger is biased towards the cocked position; and

the trigger roller and the sear are operatively coupled when the bowstring carrier with the cocked sear is at a proximal end of the crossbow; and

a safety operable between an activated position and a de-activated position.

17. A firing system for a crossbow, the firing system comprising: a bowstring carrier comprising

a sear operable between a cocked position and an un-cocked position; and

a catch operable between a locked position and an un-locked position; wherein,

the sear and the catch are operatively coupled;

the sear is biased towards the un-cocked position; and the catch is biased towards the un-locked position;

a trigger assembly comprising
a trigger operable between a cocked position and an un-cocked position; and
a trigger roller; wherein,
the trigger and the trigger roller are operatively coupled; the trigger is biased towards the cocked position; and
the trigger roller and the sear are operatively coupled when the bowstring carrier with the cocked sear is at a proximal end of the crossbow;
a dry-fire inhibitor operable between an activated position and a de-activated position, wherein the dry-fire inhibitor is biased towards the activated position;
a safety operable between an activated position and a de-activated position; and
a safety reset configured for operating the safety between the activated and de-activated positions.

18. The firing system of claim **17**, wherein pressing a bowstring against the un-locked catch with the safety de-activated concurrently locks the catch around the bowstring and cocks the sear.

19. The firing system of claim **18**, wherein pulling the trigger with the safety activated inhibits the catch from un-locking.

20. The firing system of claim **18**, wherein the trigger is cocked when the bowstring carrier with the cocked sear is at the proximal end of the crossbow.

21. The firing system of claim **20**, wherein pulling the trigger when the bowstring carrier is at the proximal end of the crossbow with the safety de-activated un-locks the catch.

22. The firing system of claim **21**, wherein the dry-fire inhibitor arrests the bowstring.

23. The firing system of claim **21**, wherein nocking a bolt onto the bowstring prior to pulling the trigger de-activates the dry-fire inhibitor.

24. The firing system of claim **17**, wherein pressing a bowstring against the un-locked catch with the safety activated inhibits the catch from locking.

25. The firing system of claim **17**, wherein
the safety reset de-activates the safety when the bowstring carrier is displaced from a proximal side of the safety reset to a distal side of the safety reset; and
the safety reset activates the safety when the bowstring carrier is displaced from the distal side of the safety reset to the proximal side of the safety reset.

26. The firing system of claim **17**, comprising a retractor comprising a strap attached to the bowstring carrier.

27. The firing system of claim **26**, wherein the retractor is operable to pull the bowstring carrier to the proximal end of the crossbow and retain the bowstring carrier abutting at least a portion of the trigger assembly.

28. The firing system of claim **26**, wherein the retractor is operable to unwind the strap whereby the bowstring carrier is displaceable towards a distal end of the crossbow.

29. The firing system of claim **17**, comprising a pair of substantially parallel rails extending between the proximal and distal ends of the crossbow, wherein the bowstring carrier is configured for sliding along the rails.

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