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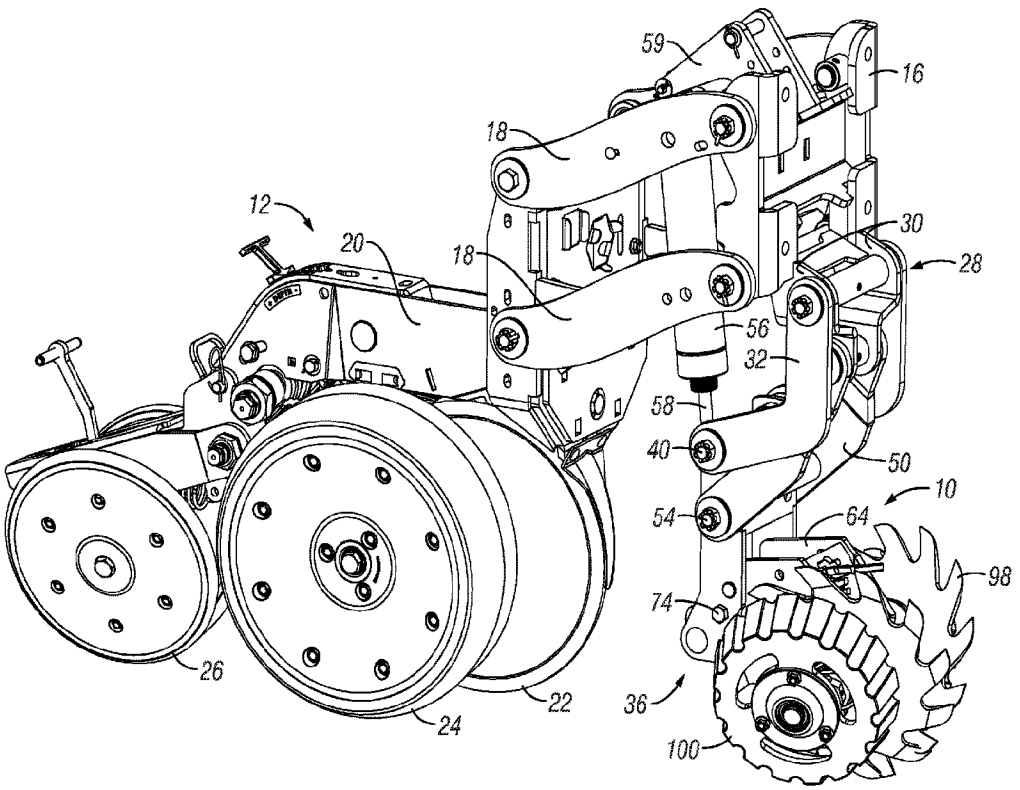
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(54) Titre : ACCESSOIRE D'UNITE DE RANGEE AGRICOLE
(54) Title: AGRICULTURAL ROW UNIT ACCESSORY



(57) Abrégé/Abstract:
A tool (10) assembly is provided for a planter row unit (12) and resides at the forward end of the row unit (12) beneath the tool bar (12, 14). The assembly includes a bracket assembly connected to the row unit (12), with a ground engaging tool (10) removably mounted on the bracket assembly for movement between raised and lowered positions. A linear actuator controls the position of the tool (10). The tool (10) may also include a depth control mechanism. Different tools can be interchanged on the bracket assembly.

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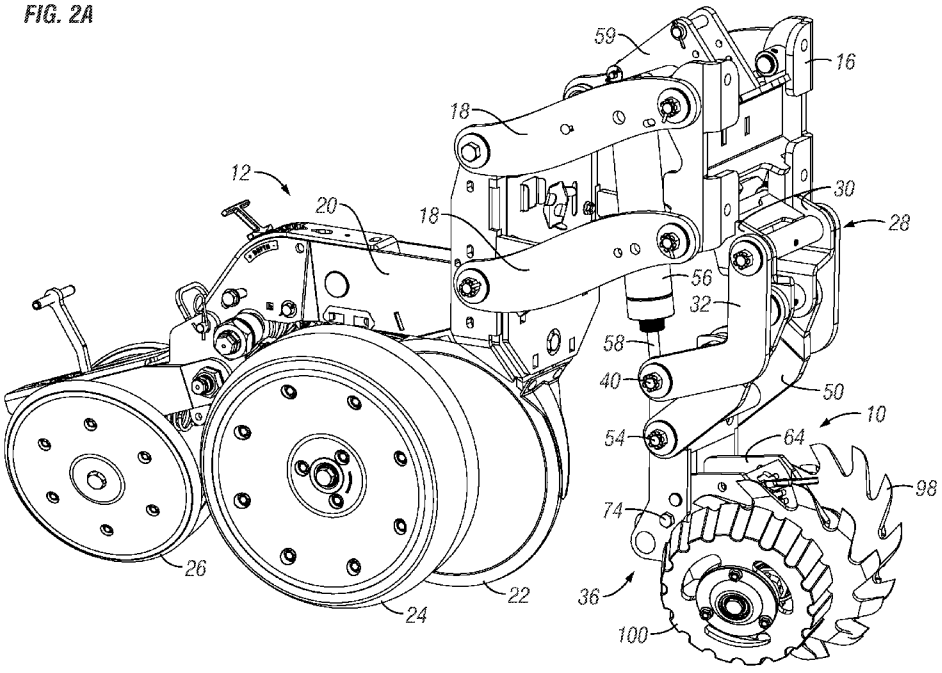
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(54) Title: AGRICULTURAL ROW UNIT ACCESSORY

FIG. 2A



(57) **Abstract:** A tool (10) assembly is provided for a planter row unit (12) and resides at the forward end of the row unit (12) beneath the tool bar (12, 14). The assembly includes a bracket assembly connected to the row unit (12), with a ground engaging tool (10) removably mounted on the bracket assembly for movement between raised and lowered positions. A linear actuator controls the position of the tool (10). The tool (10) may also include a depth control mechanism. Different tools can be interchanged on the bracket assembly.

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TITLE: AGRICULTURAL ROW UNIT ACCESSORY

FIELD OF THE INVENTION

The invention pertains to an agricultural accessory or tool, more particularly, one that is used in conjunction with a plant row unit.

BACKGROUND OF THE INVENTIONS

Modern agriculture row crop planters are operating in less tilled soils or no-till applications, due to decreased profit margins resulting from tillage costs, increased environmental concerns due to tillage, increased use of cover crops to control chemical resistant weeds, increased farm efficiency due to less tillage, and increased soil health and fertility.

To counter these changes in planting practices, row cleaners also known as "trash whippers", "residue managers" and other various names, have been added to conventional planter row units to cut, slice or move crop residue away from the planter row unit, prior to the row unit planting the seed in the soil. A clean planting seedbed is crucial to optimal crop yields and these cleaners greatly enhance a clean seedbed.

Current aftermarket row cleaner manufactures have created various designs of cleaning disc mounting brackets and configurations, but most bolt to the face plate of the row unit shank or to the side of the row unit mounting plate. These row cleaner designs vary and include cleaners which are fixed, cleaners having manually adjustable depth control, and floating row cleaner disc designs that are controlled with air or hydraulic cylinders.

Mounting the row cleaner to the front of the row unit shank adds additional draft load to the planter parallel link arms and row unit frame, and increases the risk of seed singulation issues, due to vibration caused from the row cleaners. Row unit mounted row cleaners also increase need for additional down pressure on the row unit to maintain the desired operating depth.

A majority of the floating row cleaners on the market today offer a single arm design with a pivot axis that allows the whole row cleaner assembly to pivot up/down about this axis. In single arm designs, the row cleaner discs change angle as the row

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cleaner pivots up and down, thus changing the angle of attack of the disc with the soil. This angle of attack change greatly affects how the row cleaner functions and the amount of residue that is moved out of the seedbed. If the row cleaner is too aggressive, a trench can be created which leaves the seedbed without pre-applied herbicide and potentially fertilizer. If the row cleaner is not aggressive enough, the seedbed is not cleaned of residue and "hair pinning" of trash in the seed trench can occur, leading to reduced yield.

Current row cleaner depth bands or gauge wheels are fixed to the side of the row cleaner disc and the only depth control is determined by the amount of pressure on the row cleaner through an air or hydraulic cylinder. This prior art system can cause the need for frequent adjustments to eliminate too aggressive or inadequate seedbed cleaning, as mentioned previously. Examples of prior art references include U.S. Patent 6,253,692 in the name of Wendling and U.S. published patent application 2014/262377 in the name of Winick.

Accordingly, a primary objective of the present invention is the provision of an improved row unit cleaning accessory.

Another objective of the present invention is the provision of an accessory system for planter row units which is mounted to the frame of the row unit mounting bracket.

A further objective of the present invention is the provision of a planter row unit accessory system which is not directly mounted to the row unit shank.

Still another objective of the present invention is the provision of a row unit cleaning accessory which minimizes or eliminates draft load.

Yet another objective of the present invention is the provision of a row unit accessory system which reduces vibration.

A further objective of the present invention is the provision of a row cleaner system for a planter row unit which reduces seed meter singulation errors.

Another objective of the present invention is the provision of a row cleaner system for planter row unit which eliminates additional down force on the row unit.

Still another objective of the present invention is the provision of a row unit accessory system which maintains proper seed planting depth.

A further objective of the present invention is the provision of a row unit accessory tool having a hydraulic or pneumatic cylinder, or other mechanical force, such as springs, to maintain desired contact with the soil.

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Another objective of present invention is the provision of an accessory tool system for planter row units having a quick release designed for quickly changing two different tools.

A further objective of the present invention is the provision of a row cleaner accessory for a planter row unit having adjustable gauge wheels.

SUMMARY OF THE INVENTION

The planter row unit and accessory system offers an integrated mounting bracket assembly for the row accessory tools on the planter row unit mounting bracket frame and is not directly mounted to the planter row unit shank. This design removes the draft load from the planter row unit parallel link arms, reduces the potential for row unit vibration, which can reduce seed meter singulation issues, and eliminates additional downforce or upforce on the planter row unit required to maintain proper seed depth. The mounting system for the accessory to the row unit allows the planter row unit and accessory to function together as a complete assembly. This system also utilizes an air or hydraulic down/up force cylinder, or spring or other actuator, to maintain the desired contact of the accessory tool with the soil.

Parallel link arm assemblies in conjunction with tapered greaseless non-metallic bushings and pressed in tapered bearing races are utilized to maintain the correct angle of attack with the soil and row accessory tools. This system provides the ability to remove "play" or wear in the link arm pivot points of the parallel link arms by simply removing a cotter pin, adjusting the castle nut to remove "play" and re-inserting the cotter pin. The accessory tool system also incorporated a "quick release" design that allows the operator to quickly change different configurations of tools, such as row cleaners, fertilizer application tools, small in-row rolling baskets, tillage sweeps, coulters, cover crop rollers and/or other types of ground engaging or residue removal tools. The quick release system only requires the operator to remove the quick release retention pin, slightly lift the assembly and replace it with a different tool configuration and replace the retention pin.

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In addition to the integrated design of the accessory and in the planter row unit, a row cleaner type tool utilizes adjustable depth gauge wheel design that is unique to the row cleaner industry.

The accessory gauge wheel and disc on each side of the cleaner frame are mounted on separate spindles. The gauge wheel spindle extends through the hollow disc spindle, to allow the depth control gauge wheel to be adjusted up/down to maintain constant depth of the row cleaner disc, regardless of soil conditions. This also allows constant down/up pressure from the air or hydraulic cylinder to be applied to the row cleaner tool, to maintain consistent seedbed cleaning in varying soil conditions.

The depth control gauge wheel spindle is secured to an outer right-angle disc and the gauge wheel is bolted to the arm so that the rotational axis of the wheel is offset with respect to the spindle axis. The inner end of the wheel spindle is fixed to an adjustment arm operatively connected to a depth control handle. This allows the gauge wheel depth control to move the depth gauge wheel up or down on the row cleaner disc, so as to adjust the operating depth.

The accessory depth gauge wheel operating position is determined by a depth control handle that is changed in position by pulling the spring-loaded handle out and moving the handle to the desired notch in the row cleaner tool frame. This arm then transfers this handle movement to the gauge wheel arms through a slider rod in the depth control handle assembly that is tangent to rods welded to the inner depth control arms. Additionally, the disc cleaner hollow spindle is equipped with a nonmetallic greaseless bushing and dust seals at both ends to eliminate dust build up that can cause binding of the depth control arm pivot shaft.

BRIEF DESCRIPTION OF THE DRAWINGS

Figure 1A is a side elevation view of a planter row unit mounted on a tool bar with the cleaner or sweep of the present invention mounted thereon and moved to a lowered, ground-engaging position.

Figure 1B is a view similar to Figure 1A showing the cleaner or sweep in a raised position above the ground.

Figure 2A is a perspective view of the planter row unit with the sweep in the lowered position.

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Figure 2B is a view similar to Figure 2A, with the sweep in the raised position.

Figure 3 is a front elevation view of the row planter and sweep in the lowered position.

Figure 4 is a top plan view of the row unit and sweep in the lowered position.

Figure 5 is an enlarged rear perspective view of the sweep in the lowered position.

Figure 6A is a partially exploded view of the row unit and sweep.

Figure 6B is another exploded view of the row unit and sweep.

Figure 7 is a rear perspective view of the sweep frame, detached from the row unit.

Figure 8 is a front perspective view of the sweep, with a portion of the frame hidden for clarity.

Figure 9 is a front perspective view of the sweep.

Figure 10 is a rear perspective view of the sweep.

Figure 11 is a partially exploded view of the sweep.

Figure 12 is an exploded view of one of the sweep gauge wheels and discs.

Figure 13 is a sectional view of the sweep gauge wheel and the disc as mounted on the sweep.

Figure 14 is a perspective view of the exterior side of one of the sweep discs, with the gauge wheel hidden for clarity.

Figure 15 is a perspective view of the interior side of one of the sweep discs.

Figure 16 is a sectional view of the sweep disc spindle and bushing assembly.

Figures 17A-F are various views of the sweep frame.

Figure 17A it is a rear perspective view of the sweep frame.

Figure 17B is a front perspective view of the sweep frame.

Figure 17C is a top plane view of the sweep frame.

Figure 17D is a side elevation view of the sweep frame.

Figure 17E is a front elevation view of the sweep frame.

Figure 17F is another perspective view of the sweep frame.

Figures 18A-E are various views of the sweep depth control arm assembly.

Figure 18A is as a front perspective view of the sweep depth control arm assembly.

Figure 18B is a rear perspective view of the sweep depth control arm assembly.

Figure 18C is a top plan view of the sweep depth control arm assembly.

Figure 18D is a side elevation view of the sweep depth control arm assembly.

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Figure 18E is a front elevation view of the sweep depth control arm assembly.

Figures 19A-D are various views of the sweep depth control handle.

Figure 19A is a perspective view of the sweep depth control handle.

Figure 19B is a top plan view of the sweep depth control handle.

Figure 19C is a side elevation view of the sweep depth control handle.

Figure 19D is a front elevation view of the sweep depth control handle.I

Figures 20A-D are various views of the sweep spindle and bushing assembly.

Figure 20A is an exploded perspective view of the sweep spindle and bushing assembly.

Figure 20B is a side elevation view of the sweep spindle and bushing assembly.

Figure 20C is an end elevation view of the sweep spindle and bushing assembly.

Figure 20 D is a sectional view of the sweep spindle and bushing assembly taken long lines D-D of Figure 20B.

Figures 21A-H are various views of the sweep gauge wheel spindle.

Figure 21A is a perspective view of the sweep gauge wheel spindle.

Figure 21B is a top plane view of the sweep gauge wheel spindle.

Figure 21C is a side elevation view of the sweep gauge wheel spindle.

Figure 21D is a front elevation view of the sweep gauge wheelspindle.

Figure 21E is another perspective view of the sweep gauge wheel spindle.

Figure 21F is another side elevation view of the sweep gauge wheel spindle.

Figure 21G is a rear end view of the sweep gauge wheels spindle.

Figure 21H is a view of the sweep gauge wheel spindle take along line H-H of Figure 21F.

DETAILED DESCRIPTION OF THE INVENTION

The present invention is directed towards a ground engaging accessory or tool 10 used in conjunction with a planter row unit 12 mounted to a tool bar 14. The row unit 12 includes a front mounting bracket 16 for attached to the tool bar 14, parallel link arms 18, and a frame 20 to support a pair of disc openers 22, and pair of gauge wheels 24, and a pair of closing wheels 26. The frame 20 can be raised and lowered between transport and field positions by the hydraulic system of the tractor. While the accessory 10 of the present invention can be used on any row unit, the details of the row unit 12 shown in the drawings

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are described in detail in Applicant's published applications 2017/025,8002 and 2017/030,364.

In the drawings, the accessory 10 is shown to be a sweep or cleaner for pushing aside debris in the field before seeds are planted. It is understood that the accessory may be other tools, such as fertilizer application tools, rolling baskets, coulters, cover crop rollers, and other types of residue removal tools, without departing from the scope of the present invention.

The accessory 10 is attached to the mounting bracket 16 of the row unit 12 so as to reside at the front of the row unit 12, substantially below the tool bar 14 and spaced forwardly from the disc openers 22. A bracket mount assembly 28 having a pair of spaced apart arms 30 is welded or otherwise fixed to the front mounting bracket 16 of the tool bar 12. A pair of L-shaped upper link arms 32 are pivotally mounted to the arms 30 of the mount assembly 28 via a pivot shaft 34. A receiver assembly 36 having a pair of spaced apart arms 38 is pivotally mounted to the lower rear ends of the link arms 32 by a pivot shaft 40 at the upper ends of the arms 38. The mounting of the link arms 32 on the shafts 34 and 40 includes a composite spacer or washer 42, a tapered bearing race 44, a tapered bushing 46, and a retainer nut 48 mounted on the threaded ends of the shafts 34, 40. The tapered bearing or bushing 46 and the race 44 are described in applicant's published patent application 2017/0261034..

A pair of lower link arms 50 each have upper ends pivotally attached to the arms 30 of the mount assembly 28 via a pivot shaft 52, while the lower ends of the link arms 50 are pivotally attached to the arms 38 of the receiver assembly 36 using shafts 54. The pivotal mounting of the links arm 50 on the shafts 52, 54 also include washers, racers, tapered bushings, and nuts, similar to those described above with respect to the upper link arms 32 and shafts 34, 40.

A linear actuator, such as a hydraulic or pneumatic cylinder 56 with an extendible/retractable rod 58, is mounted between the row unit mounting bracket 16 and the receiver assembly 36. More particularly, the upper end of the cylinder 56 is pivotally attached to a pair of arms 60 welded or otherwise fixed to the mounting bracket 16 and extending rearwardly therefrom, while the lower end of the rod 58 is attached to a U-shaped plate 60 pivotally attached to the lower ends of the arms 38 of the receiver assembly 36 via bolts or pins 62, or similar pivotal fasteners. It is understood that the

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cylinder 56 and the rod 58 can be reversed, such that the rod is attached to the arms 59 and the cylinder 56 is attached to the plate 60. Also, the cylinder 56 and the rod 58 can be replaced with another linear actuator, such as a spring, or an electric actuator, without departing from the scope of the invention.

The accessory tool 10 includes a frame 64, as shown in Figures 17 A-F. The rear end of the frame 64 includes a pair of upper hooks 66 and a pair of lower hooks 68. The hooks are adapted to slide over and be retained on upper and lower shafts 70 and 72 extending between the arms 38 of the receiver assembly 36. A removable retention pin or bolt 74 can be inserted through holes in the arms 38 so as to be positioned immediately above the lower hooks 68, and thereby prevent the accessory tool 10 from being removed or detached from the receiver assembly 36.

A depth control assembly 76 is mounted within the frame 64. The depth control assembly 76 includes left and right arms 78, as shown in Figures 18A-E. The depth control assembly 76 is pivotally mounted between the left and right plates 65 of the frame via a pivot bolt 80, as best shown in Figures 7 and 10. A tubular collar 82 is welded or otherwise fixed between the arms 78. A depth control handle 84, shown in Figures 19A-D, includes a rearwardly extending post 86 which extends through the collar 82 and retained in any convenient manner, such as by a snap ring 83 (Figure 7) received in a groove 88 on the post 86. A curved plate 90 is welded between the plates 65 of the frame 64 and includes a central slot 92 with laterally extending fingers, as best seen in Figure 9. The T-grip 94 of the handle 84 resides in front of the plate 90, with the post 86 extending rearwardly through the slot 92 and through the collar 82. The handle 94 includes rearwardly extending buttons or tabs 96 which can be selectively positioned in a pair of the fingers of the slot 92 so as to adjust the depth of the frame 64 of the accessory tool 10. A spring 97 (Figure 7) on the rear end of the post 86 retains the handle 84 in a selected position along the plate 90 by biasing the buttons into the fingers of the slot 92.

The accessory tool 10 shown in the drawings is a sweep or cleaner used to remove debris on the ground prior to planting, such as the crop residue resulting from no-till farming. The sweep or cleaner includes a pair of discs 98 and a pair of gauge wheels 100 which are rotatably mounted in canted orientations on the left and right sides of the tool 10, as best seen in Figure 3. The left and right discs 98 and the wheels 100 are mounted in similar manners, on each side of the tool 10. As seen in Figures 11 and 12, each disc 98 is

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mounted on a hollow hub 110 and a spindle 112. More particularly, the spindle 112 extends through the hub 110 into a pair of bushings 114 and is retained by a nut 116 on the threaded end of the spindle 112. The interior of the spindle 112 is lined with a composite bushing 118, with a dust seal 120 mounted within the spindle 112 at each end. The bushing 118 and seals 120 are described in Applicant's US patent number 10,765,055.

The depth control spindle 122 (Figures 21A-I) extends through the hollow disc spindle 112, through the bushings 114, and through the nut 116. The end of the spindle 122 extends into a gauge wheel depth control adjustment arm 123 and is secured by a bolt 124 extending through a hole in the end of the spindle 122 and a nut. The gauge wheel 100 is attached to the adjustment arm 123 by a retention bolt 126, which extends through a bearing 128 mounted in a gauge wheel hub 130 which is bolted or otherwise attached to the gauge wheel 100. A set screw 125 (Figures 12-14) extends through the arm 123 and into a recess in the end of the spindle 122, to eliminate or minimize movement and wear in the spindle 122 relative to the arm 123. Preferably, the inner end of the set screw 125 and the recess or pilot hole in the spindle 122 having mating coned shapes. Shim washers 132 may be provided between the adjustment arm 123 and the gauge wheel hub 130.

As seen in the sectional view of Figure 13, the gauge wheel retention bolt 126 is offset from the disc spindle 112. Thus, the rotational axles of the disc 98 and the gauge wheel 100 are offset, rather than being co-linear. Thus, the depth of the gauge wheel 100 can be adjusted relative to the disc 98 by turning the spindle 122 clockwise or counterclockwise. Such rotation of the spindle 122 is controlled by a depth control slider rod 134 which extends through the lower arms 78 of the depth control assembly 76 and through slots in the arm 136 extending from the spindle 122, as shown in Figure 8. A cotter pin 137 retains the slider rod 134 in the arms 78. The opposite sides of the arm slots are provided with a curved surface, such as a rod 138 welded to the arm 136 to minimize friction with the depth control rod 134.

As shown in Figures 21A-D, the arm 136 includes compound angles, such that the depth control rod 134 can move along the slots in the arms 136 without binding, as the depth control assembly is adjusted via the T-grip 94 of the handle 84.

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In use, the accessory 10 can be quickly and easily attached and detached to the row unit 12 via the hooks 66, 68 of the frame 64, and the retention pin 74. The rod 58 of the cylinder 56, or other linear actuator, can be extended and retracted for movement between the lowered position, shown in Figures 1A and 2A, and the raised position shown in Figures 1B and 2B, by controls in the tractor cab and the hydraulic system of the tractor. The desired down/up pressure is controlled by the toolbar control computer, located in the tractor cab. Cylinder pressure is displayed on the control computer screen and is adjusted with by selecting the touch screen mode selector button and then turning a rotary knob to adjust the pressure up/down. This system also has the ability to automatically maintain the desired down/up pressure on the cylinder but can quickly be over-ridden to a manual mode, by pressing the rotary knob and adjusting the rotary knob left or right to change the pressure to the cylinder. This is beneficial when planting through a wet part of the field and allows the tool to be quickly raised out of the soil to decrease the risk of pushing the tool into the wet soil. By pressing the rotary knob again, the system returns to the predetermined pressure setting and maintains this pressure automatically.

When the accessory is a sweep, such as one with the discs 98 and gauge wheels 100, the depth of the sweep can be quickly and easily adjusted by the depth control assembly 76, such that the gauge wheels 100 on each side of the sweep can be moved in unison, relative to the discs, such that the depth which the discs penetrate the soil can be increased or decreased, depending upon the debris or material being removed in front of the row planter opener discs 22.

The invention has been shown and described above with the preferred embodiments, and it is understood that many modifications, substitutions, and additions may be made which are within the intended spirit and scope of the invention. From the foregoing, it can be seen that the present invention accomplishes at least all of its stated objectives.

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WHAT IS CLAIMED:

1. A planter row unit 12 mounted on an agricultural tool bar 14 with a mounting bracket 16 attached to the tool bar, the planter row unit having a frame 20 pivotally connected to the mounting bracket and supporting a pair of disc openers 22, a pair of gauge wheels 24 behind the disc openers, and a pair of closing wheels 26 behind the gauge wheels, the frame being adapted for movement between raised and lowered positions, characterized by:

a receiver assembly 36 having an upper end operatively mounted to the mounting bracket 16 and a lower end;

a first tool 10 interchangeably mounted on the lower end of the receiver assembly 36 so as to reside beneath the tool bar 14 at a forward end of the row unit 12; and

link arms 32, 50 pivotally connecting the mounting bracket 16 and the receiver assembly so as to allow the receiver assembly to be moved between raised and lowered positions independently of the position of the gauge wheels, disc openers and closing wheels; and the link arms including left and right pairs of upper and lower arms.

2. The planter row unit of claim 1 characterized by a linear actuator 56 attached to the receiver assembly 36 to move the receiver assembly between the raised and loweredpositions.

3. The planter row unit of claim 1 characterized by the tool 10 including a height control mechanism 76.

4. The planter row unit of claim 1 characterized by the tool 10 being mounted to the receiver assembly 36 using hooks 66, 68.

5. The planter row unit of claim 4 characterized by a removable retention pin 74 to preclude unhooking of the tool 10.

6. The planter row unit of claim 1 characterized by the tool 10 including gauge wheels 100.

7. The planter row unit of claim 6 characterized by the gauge wheels 100 of the tool being height adjustable.

8. The planter row unit of claim 1 characterized by the tool 10 being centered

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longitudinally on the row unit 12.

9. The planter row unit of claim 1 characterized by the tool 10 being selected from the group consisting of a debris cleaner, a fertilizer applicator, a rolling basket, coulters, and crop rollers.

10. The planter row unit of claim 1 characterized by the receiver assembly and the frame being independent from one another such that movement of the frame does not move the receiver assembly.

11. The planter row unit of claim 1 further comprising a second tool interchangeable with the first tool.

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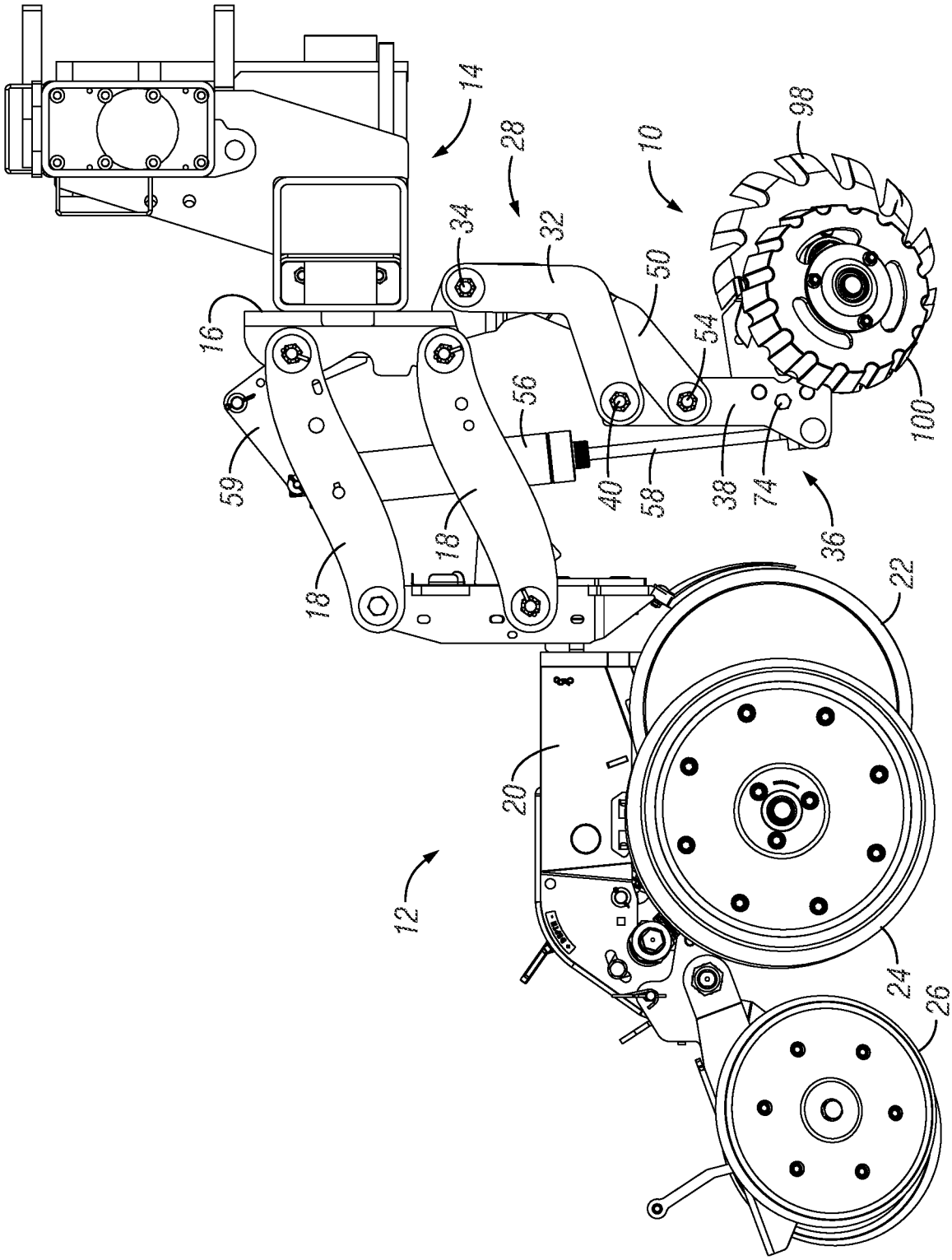


FIG. 1A

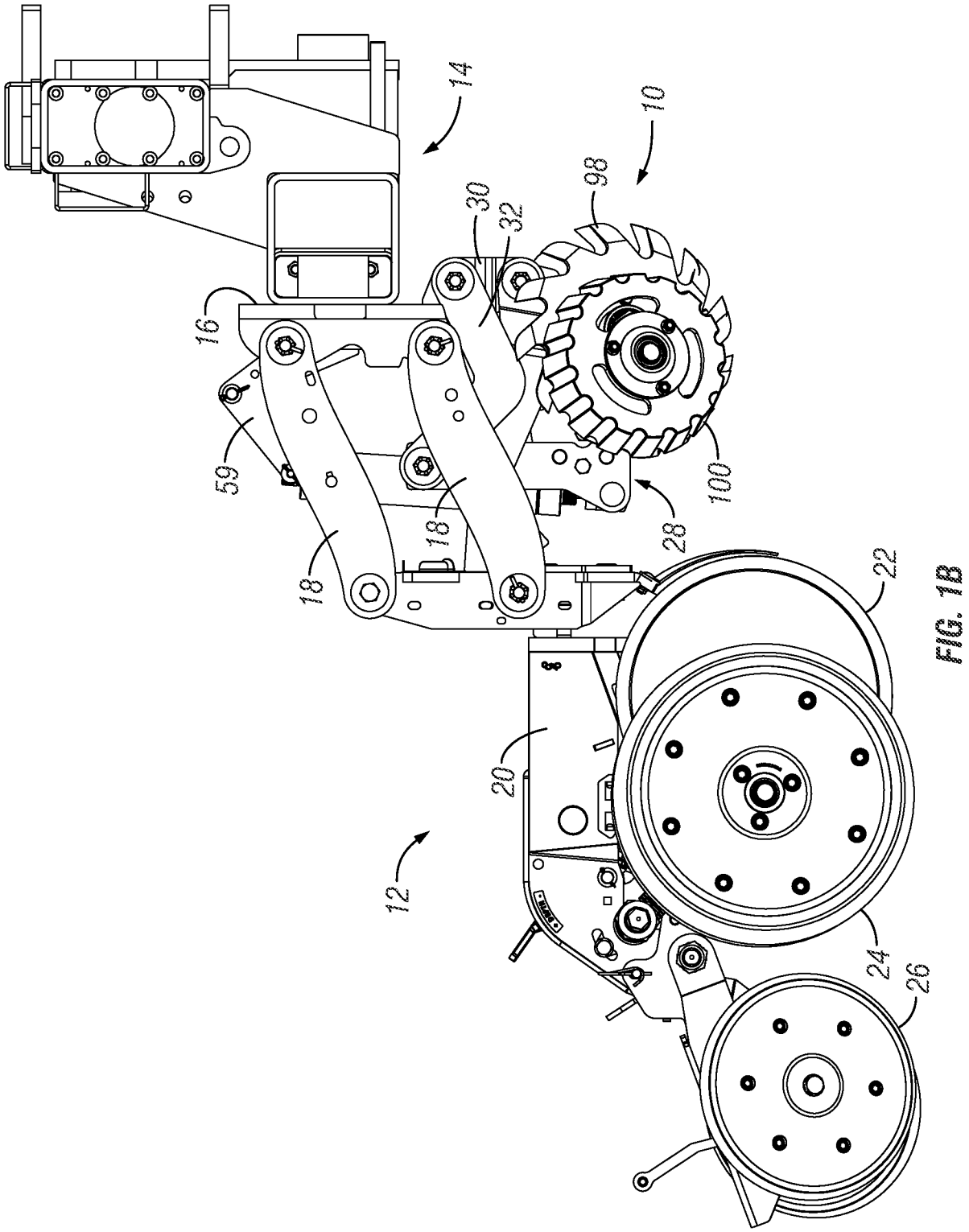


FIG. 1B

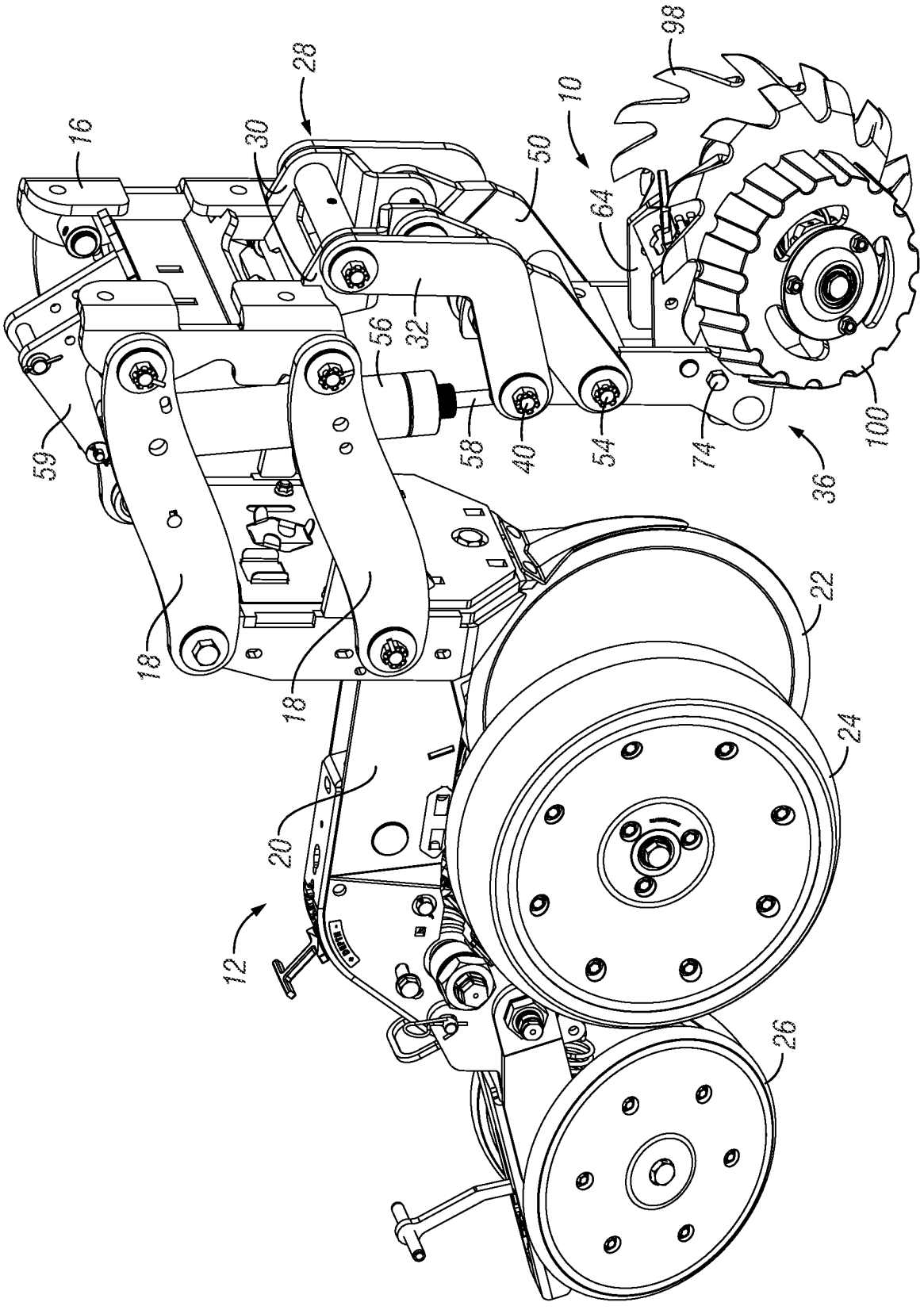


FIG. 2A

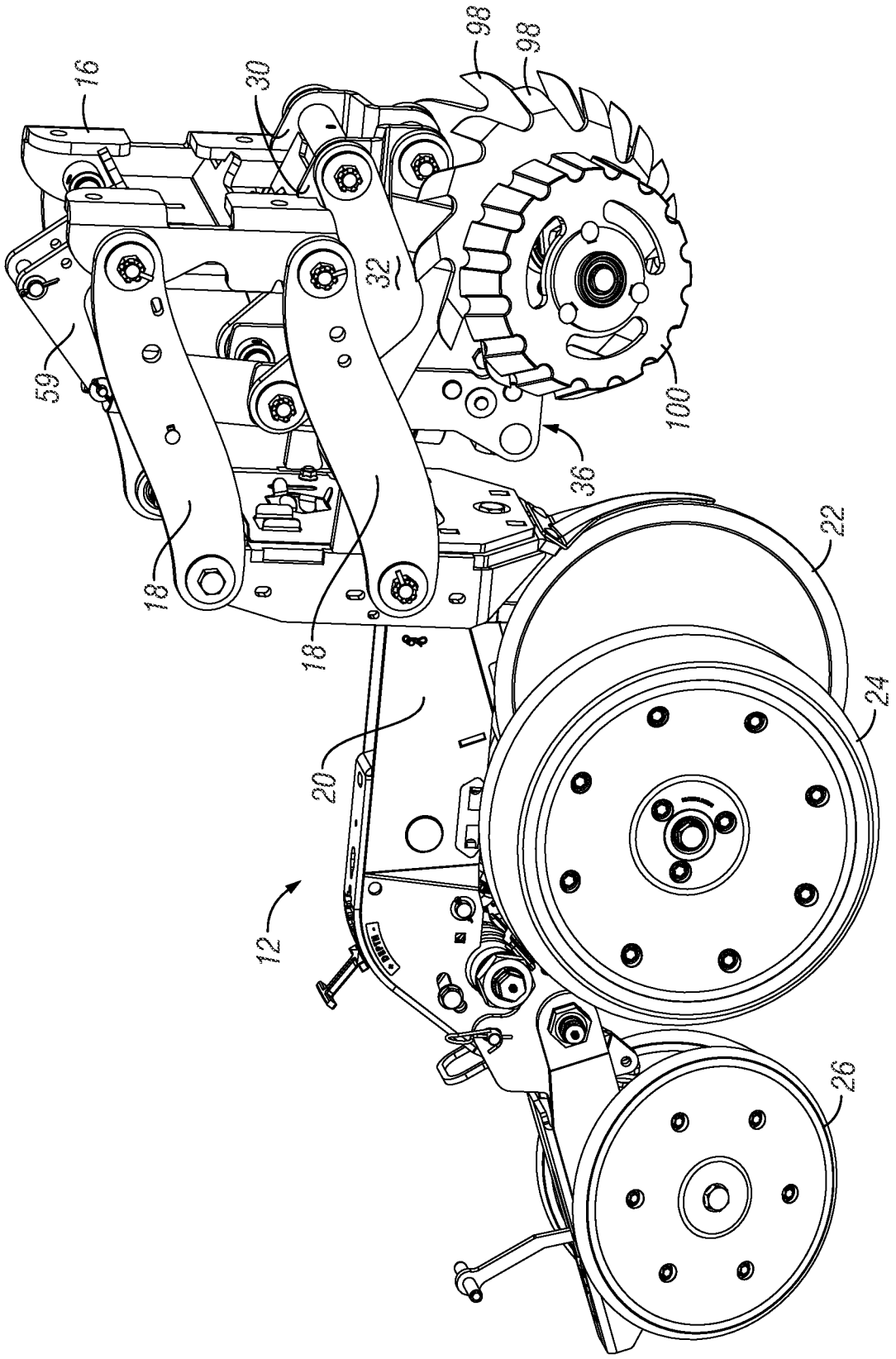


FIG. 2B

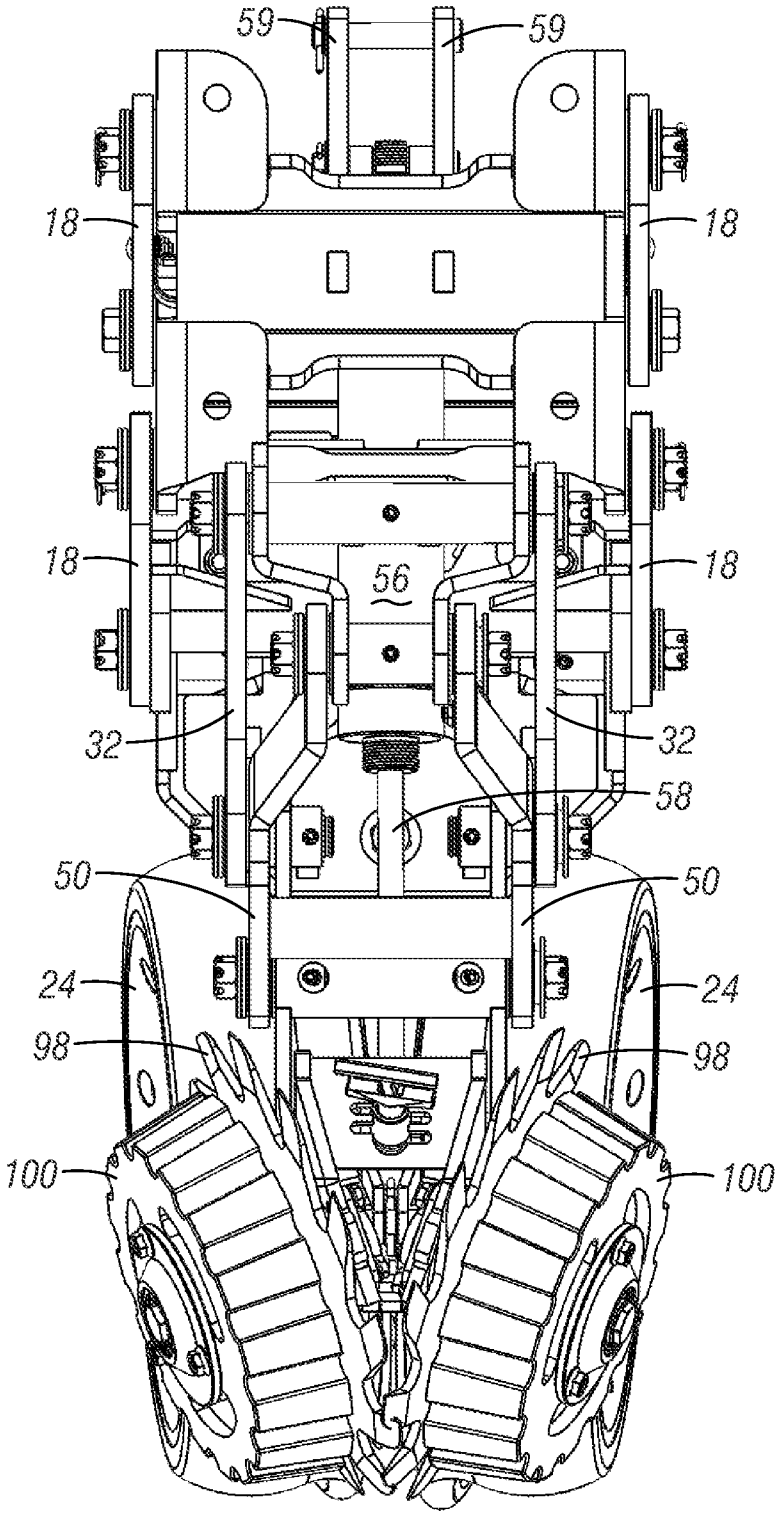


FIG. 3

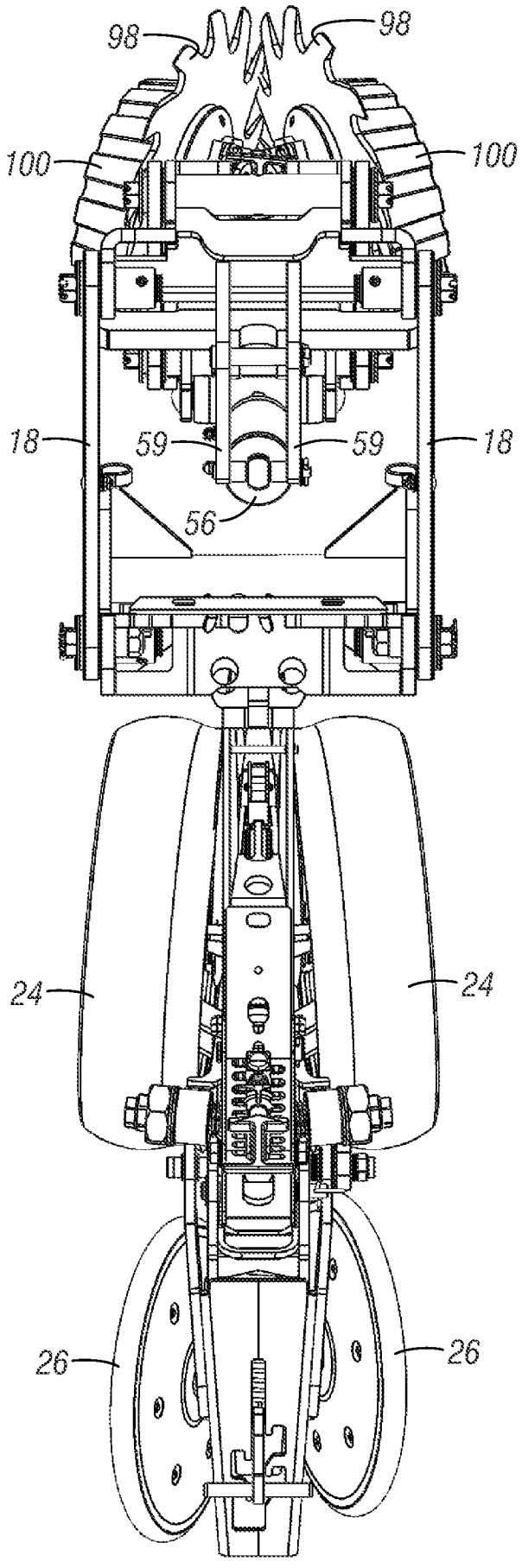


FIG. 4

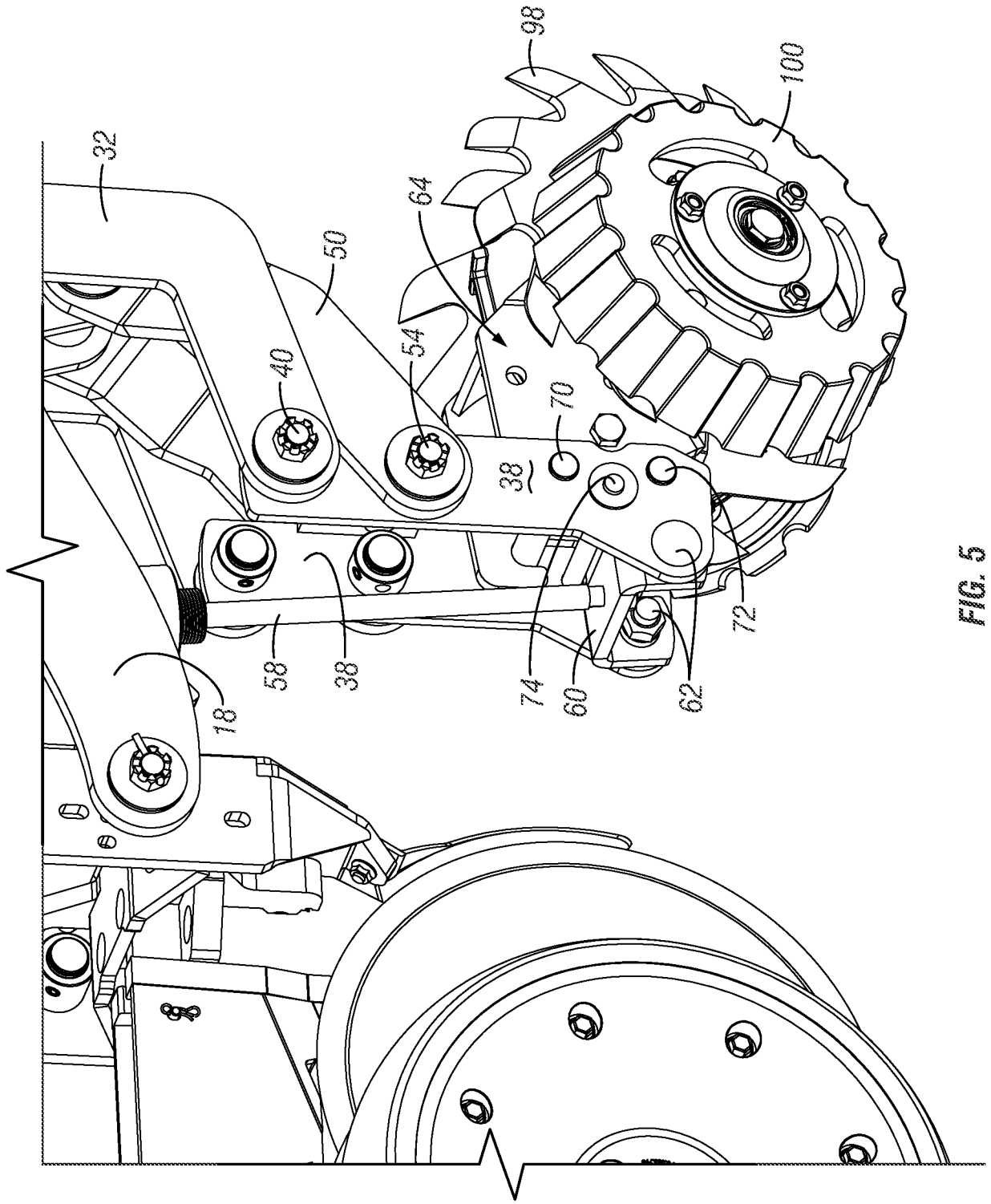


FIG. 5

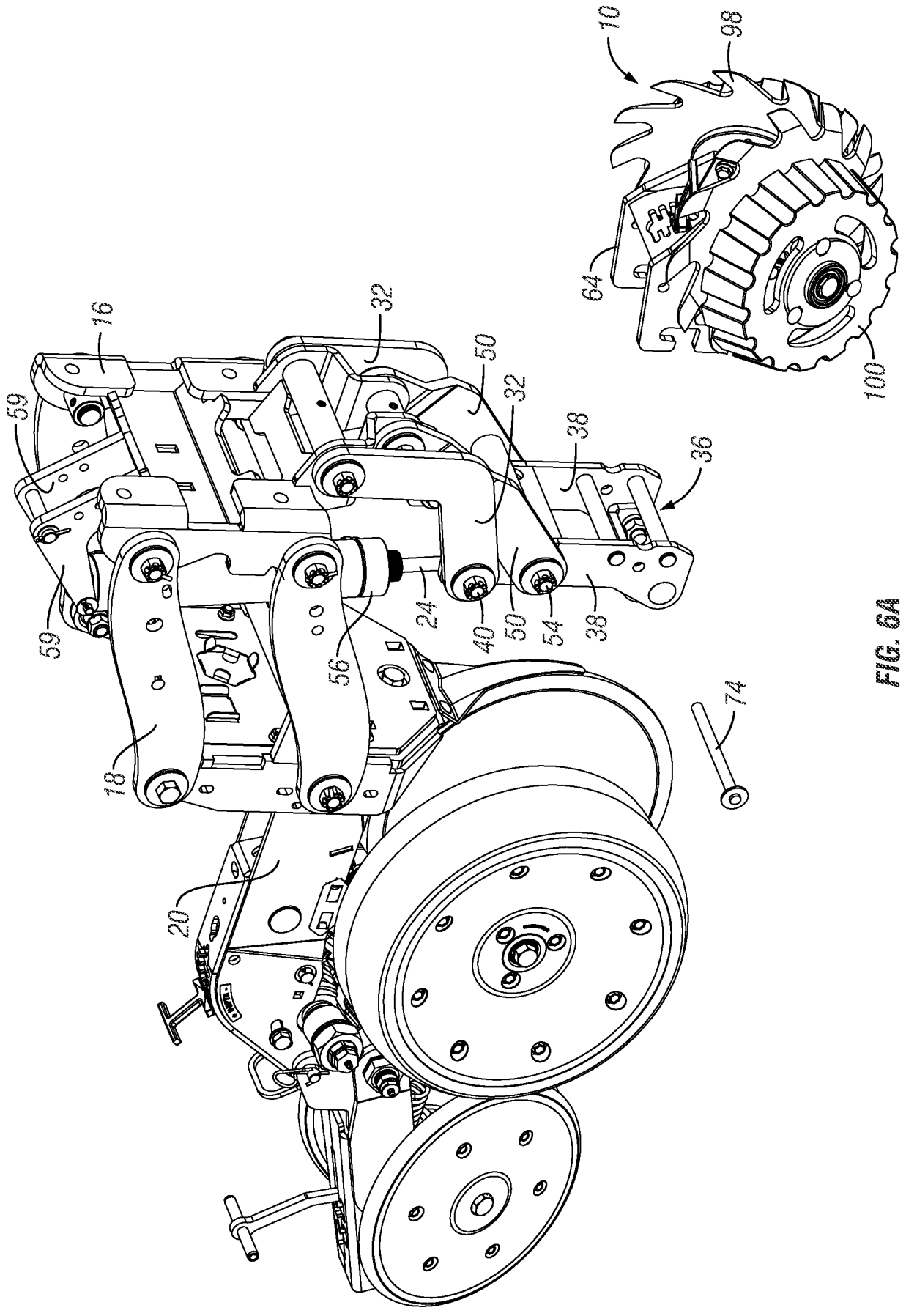


FIG. 6A

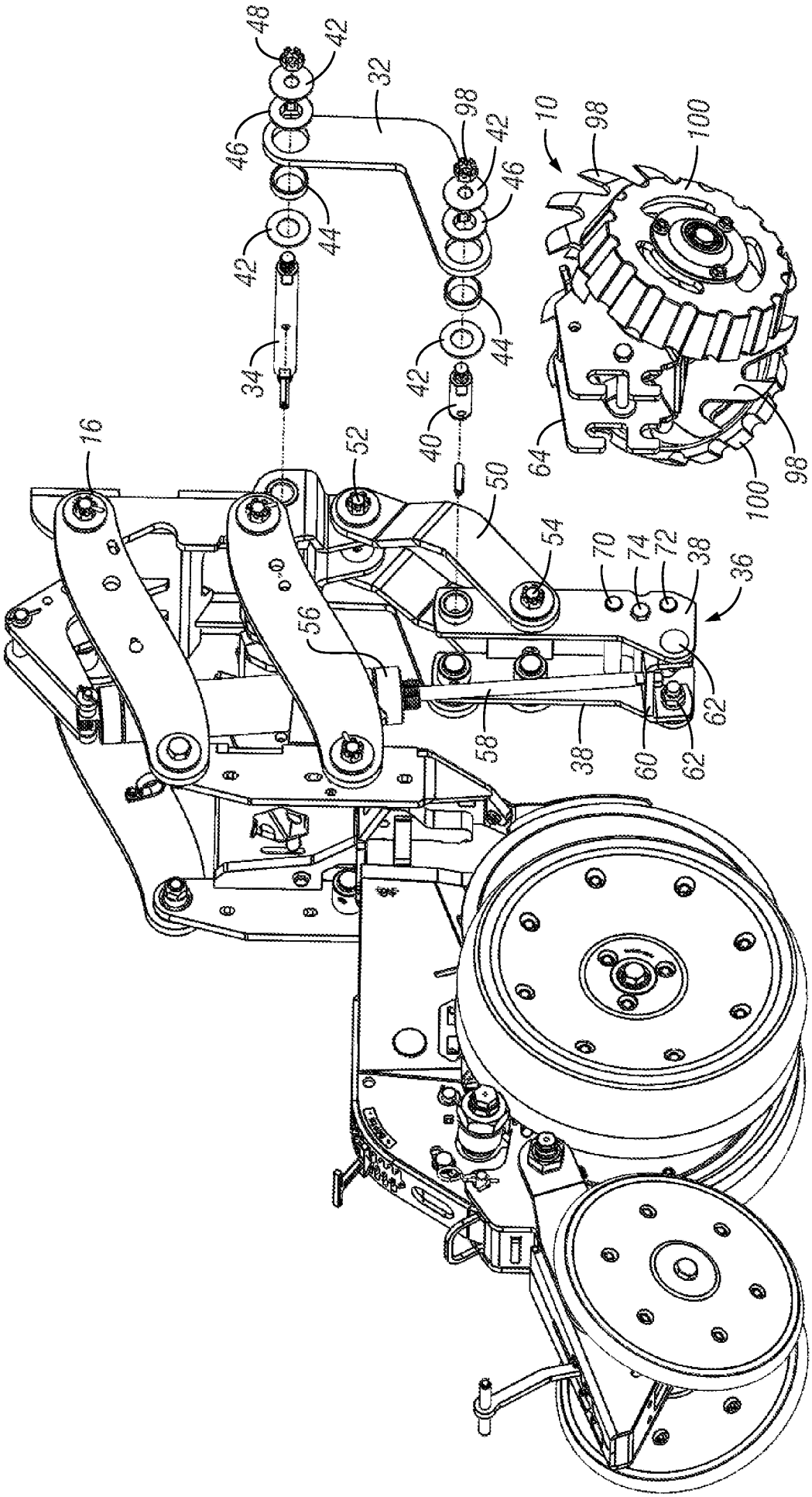

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FIG. 6B

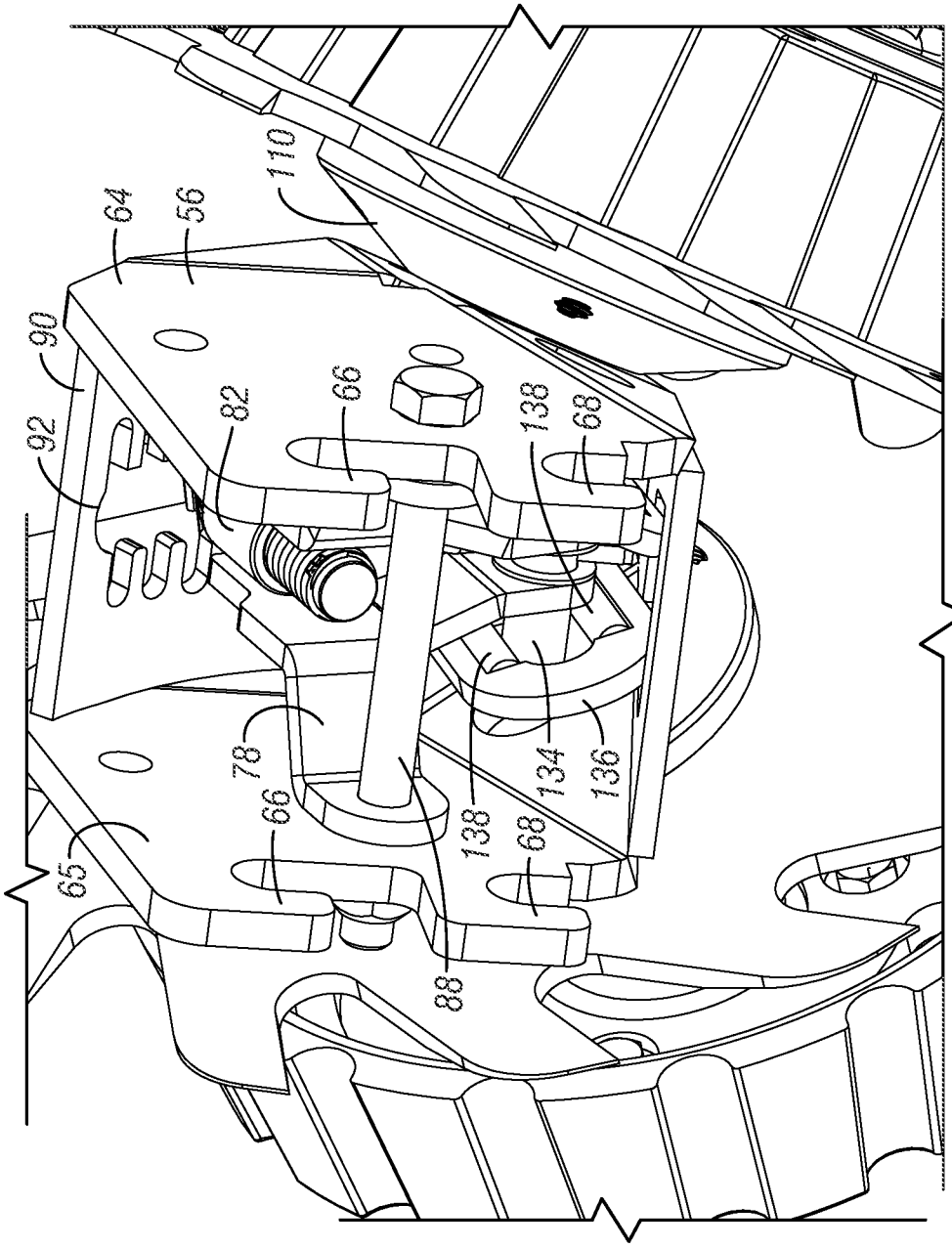


FIG. 7

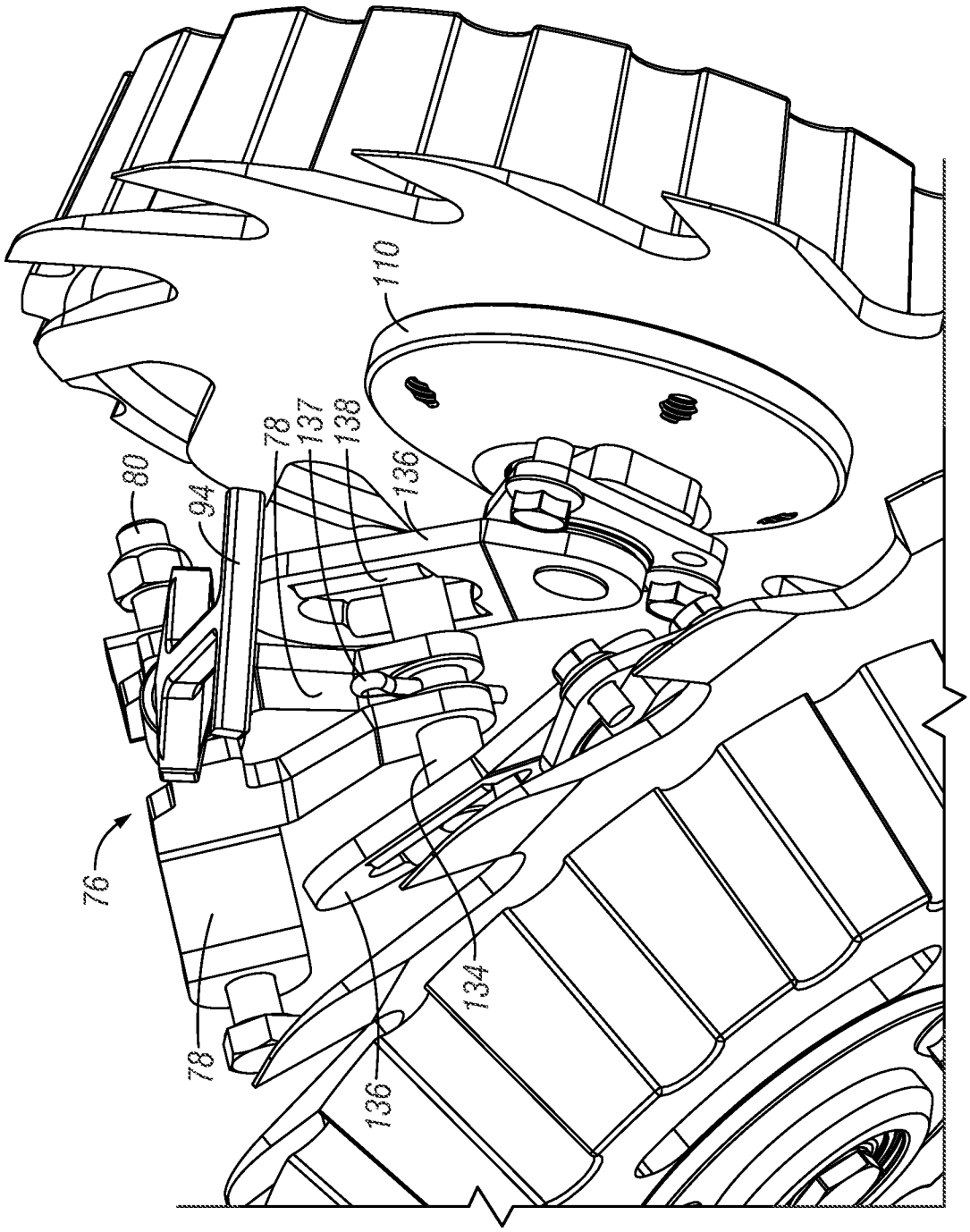


FIG. 8

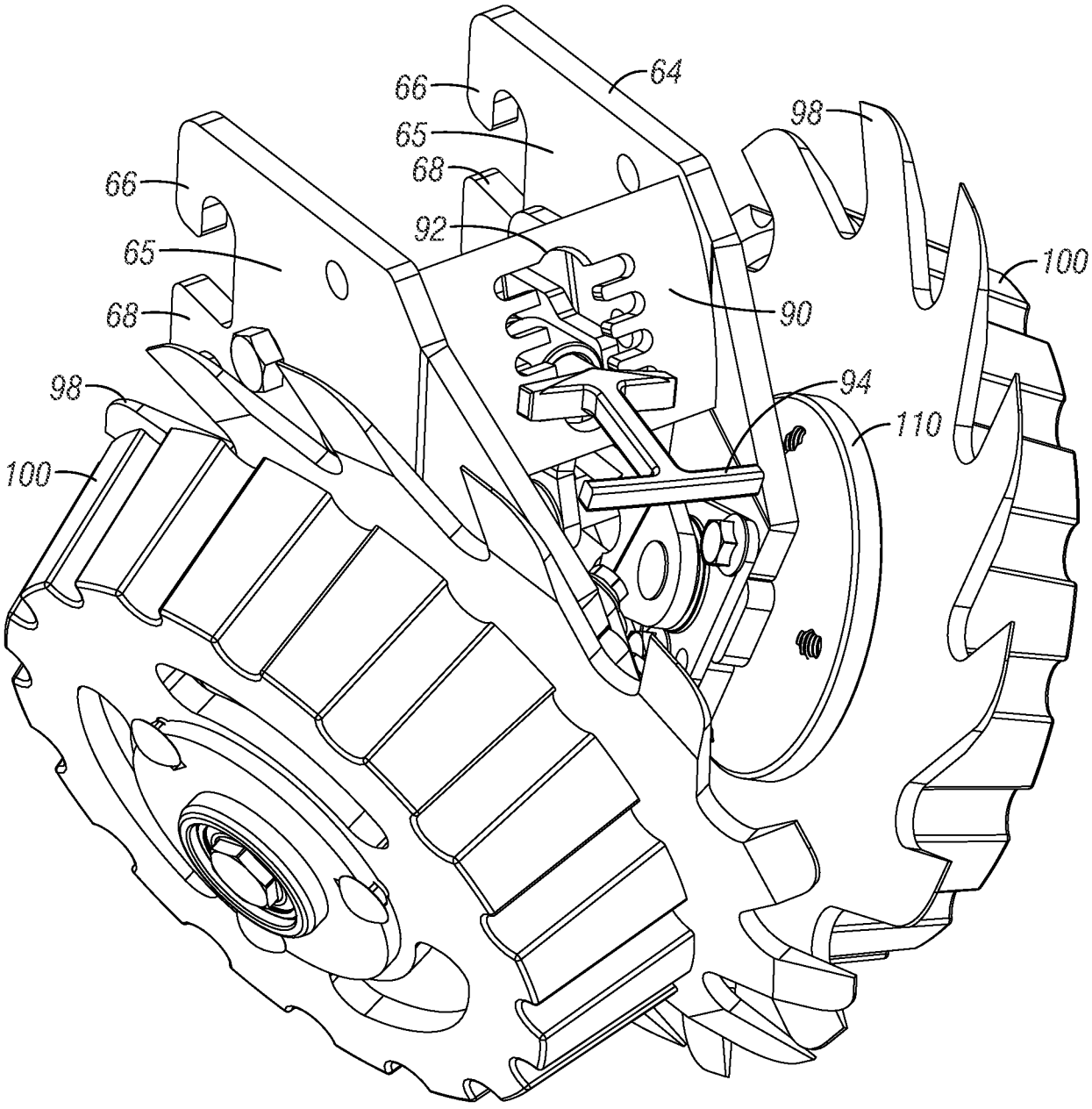


FIG. 9

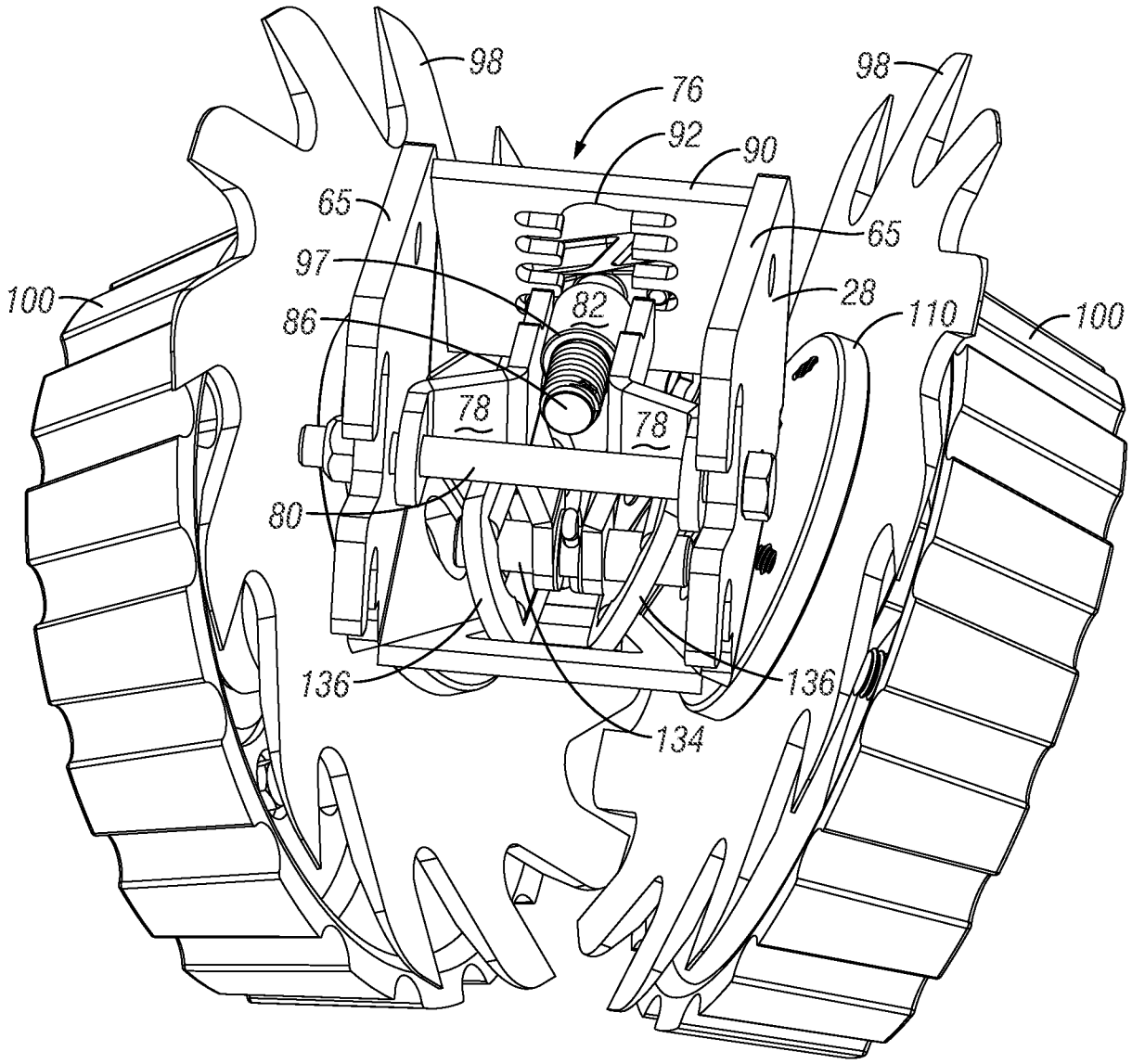


FIG. 10

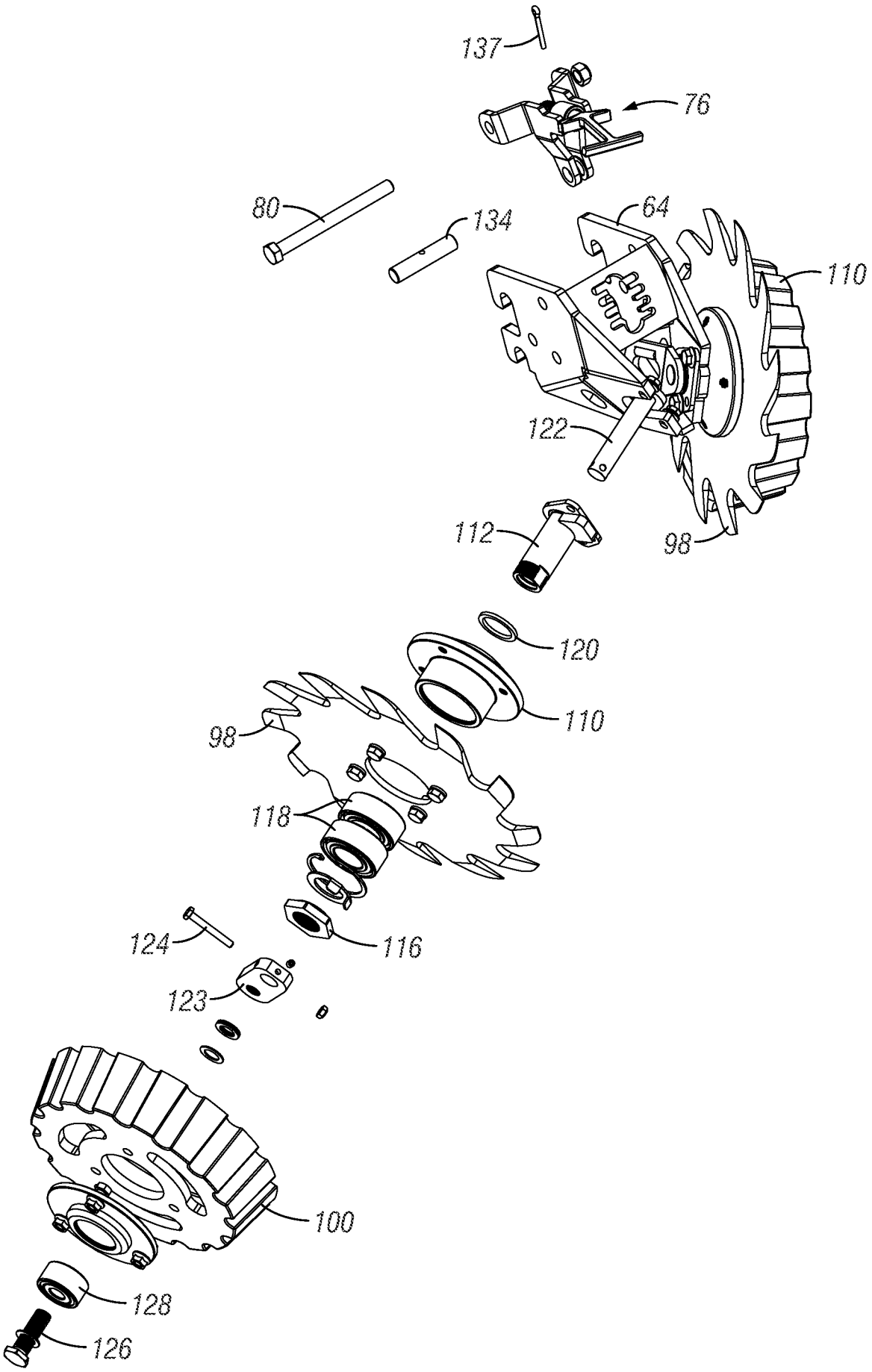

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FIG. 11

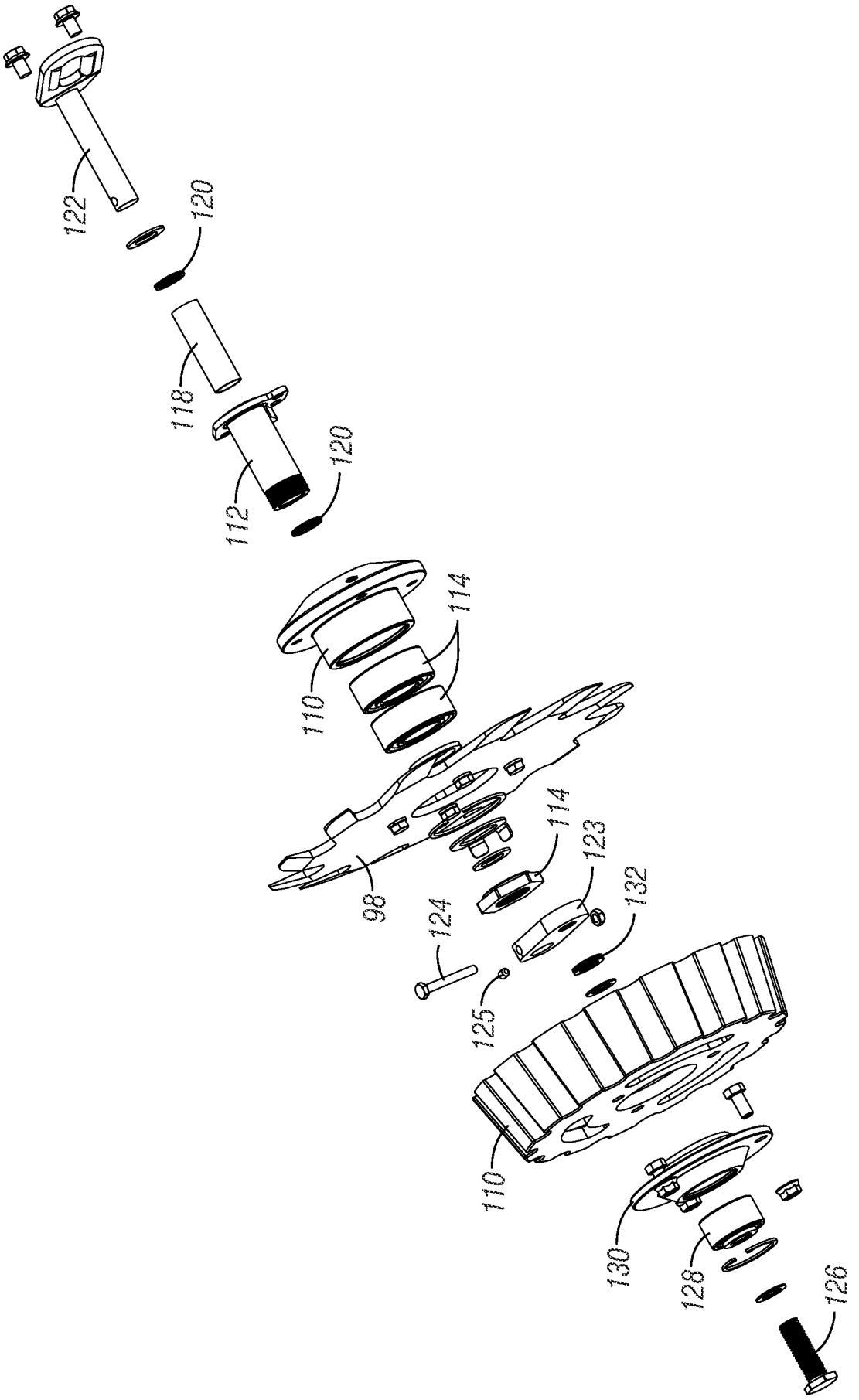

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FIG. 12

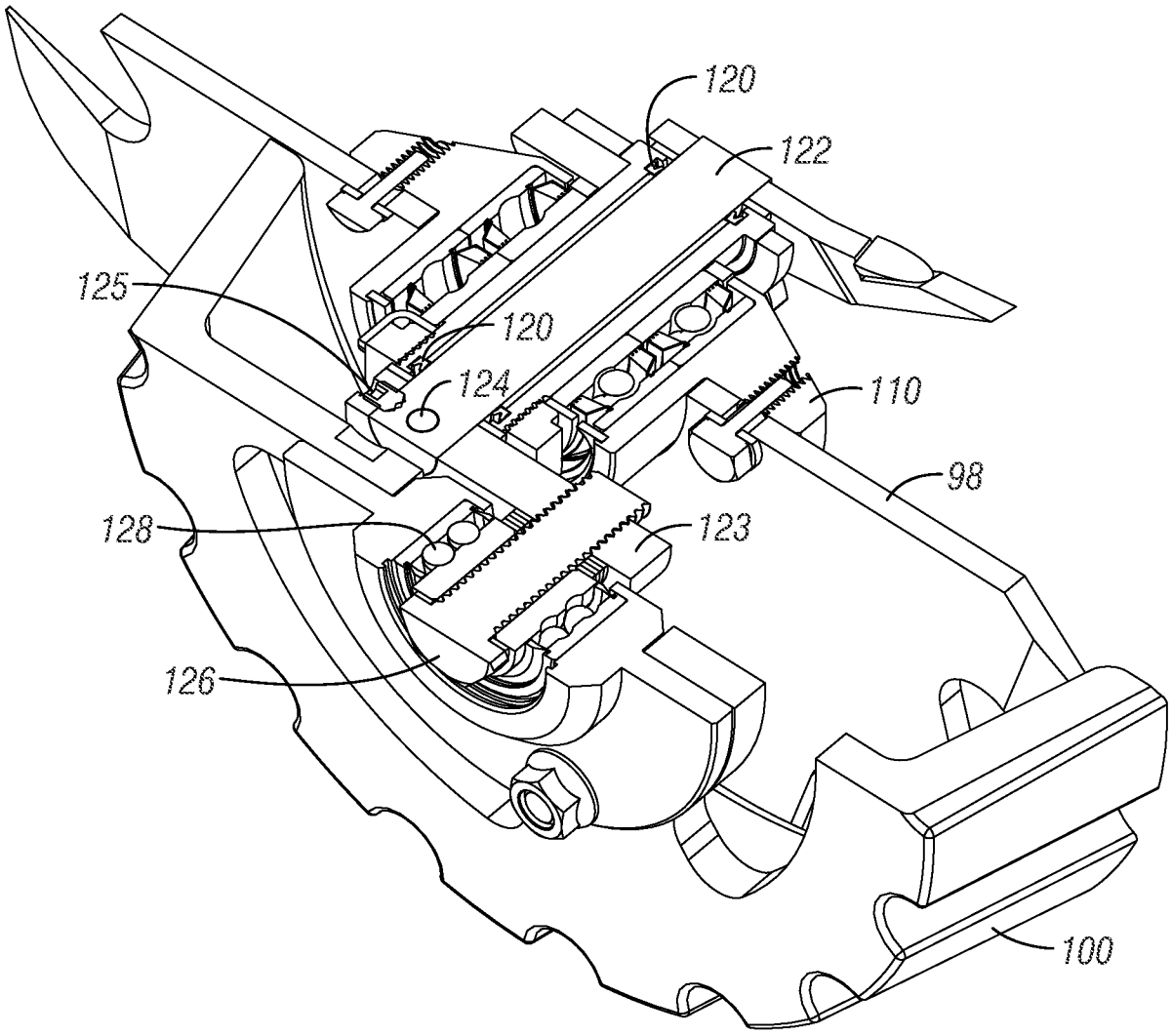


FIG. 13

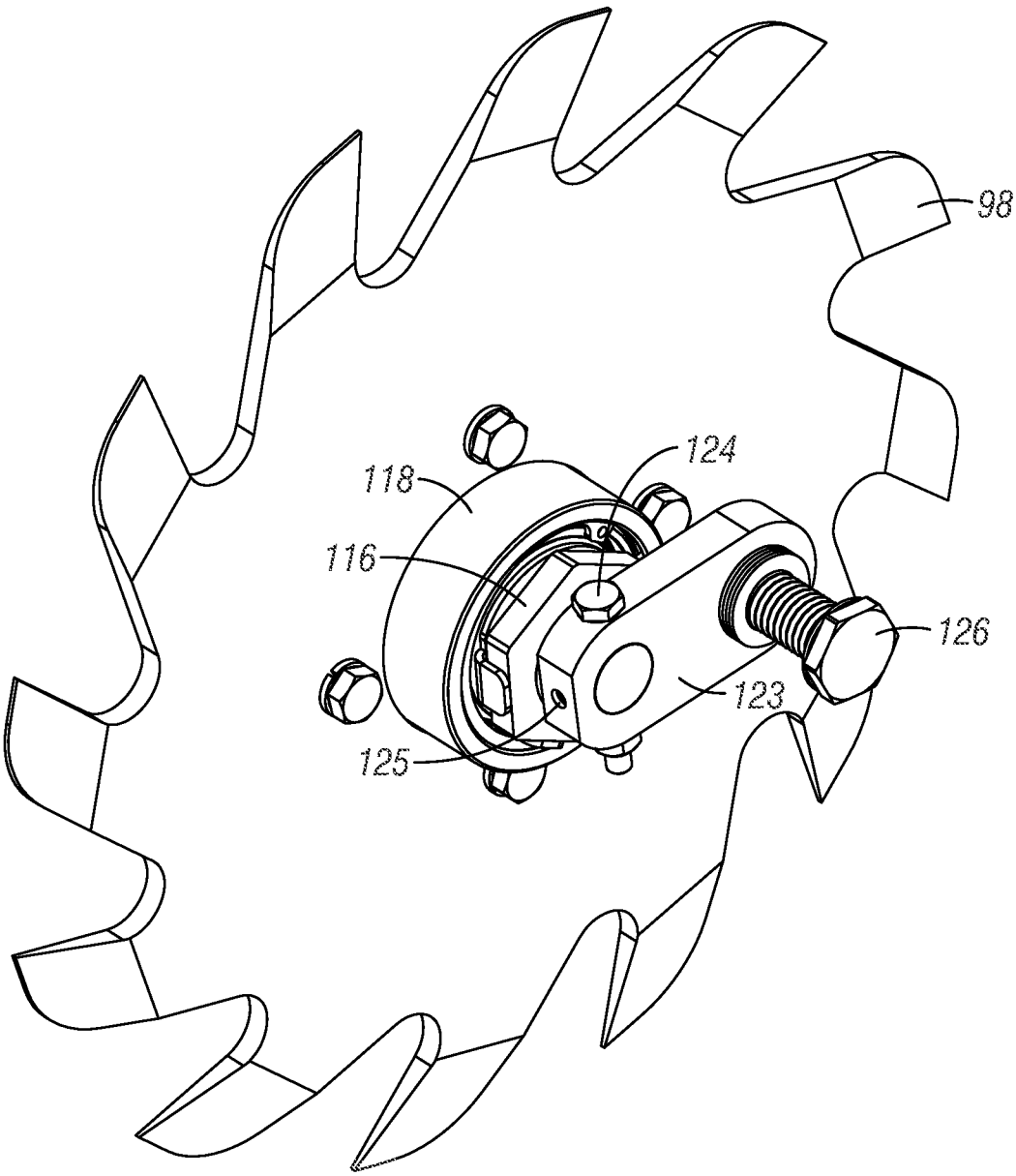


FIG. 14

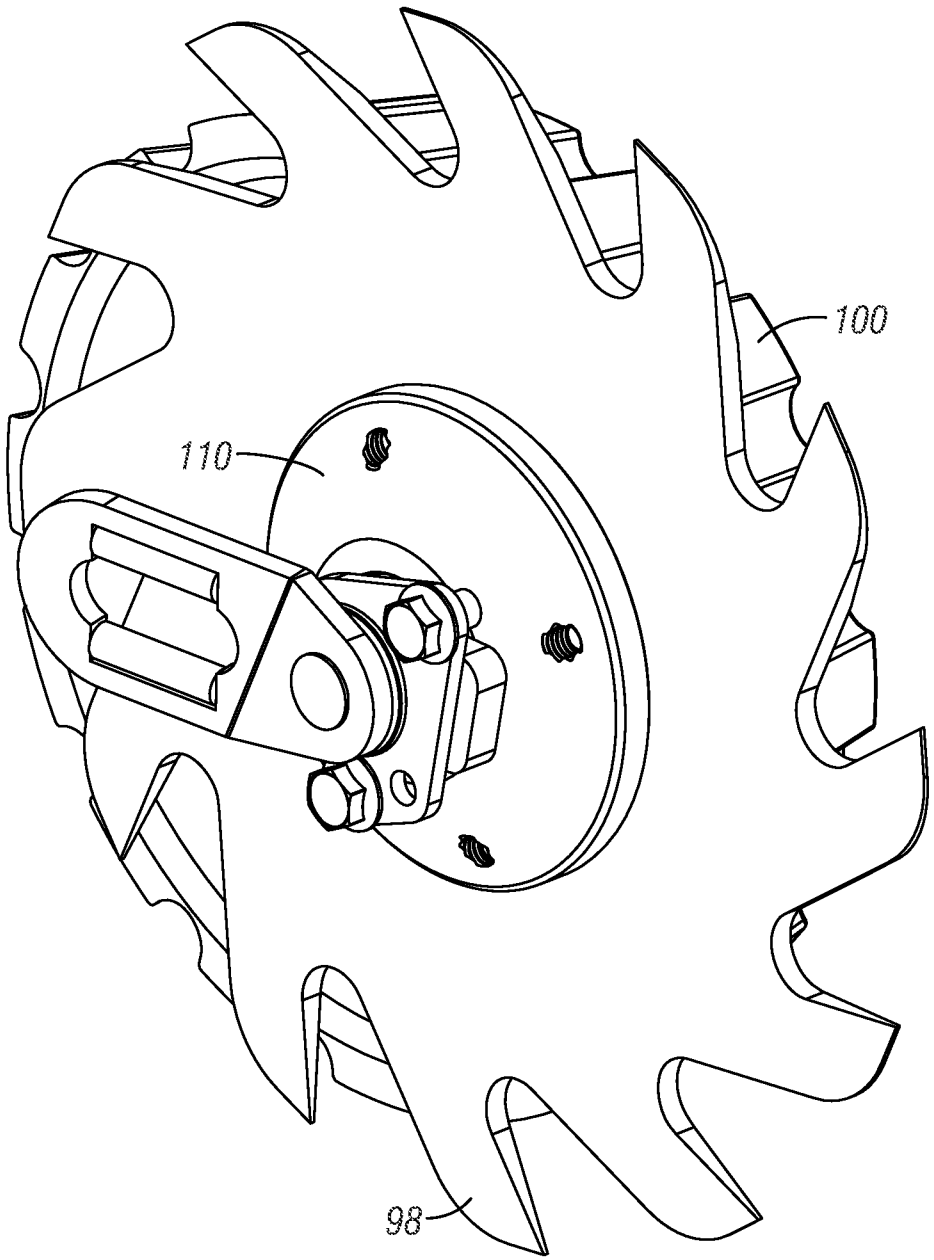


FIG. 15

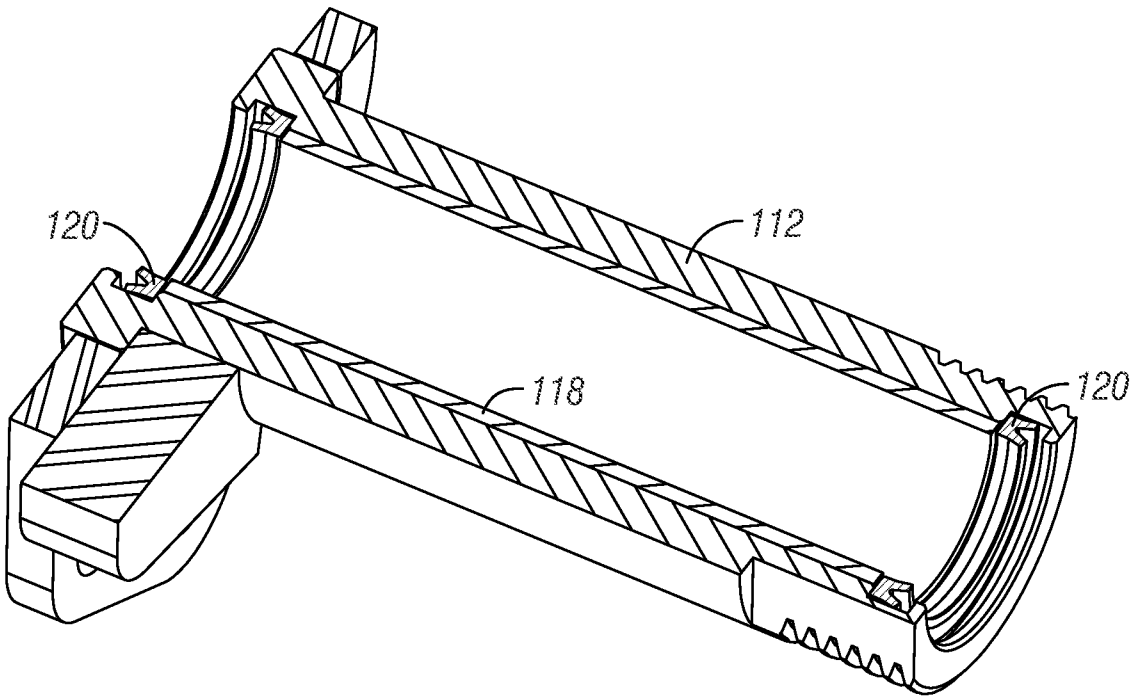


FIG. 16

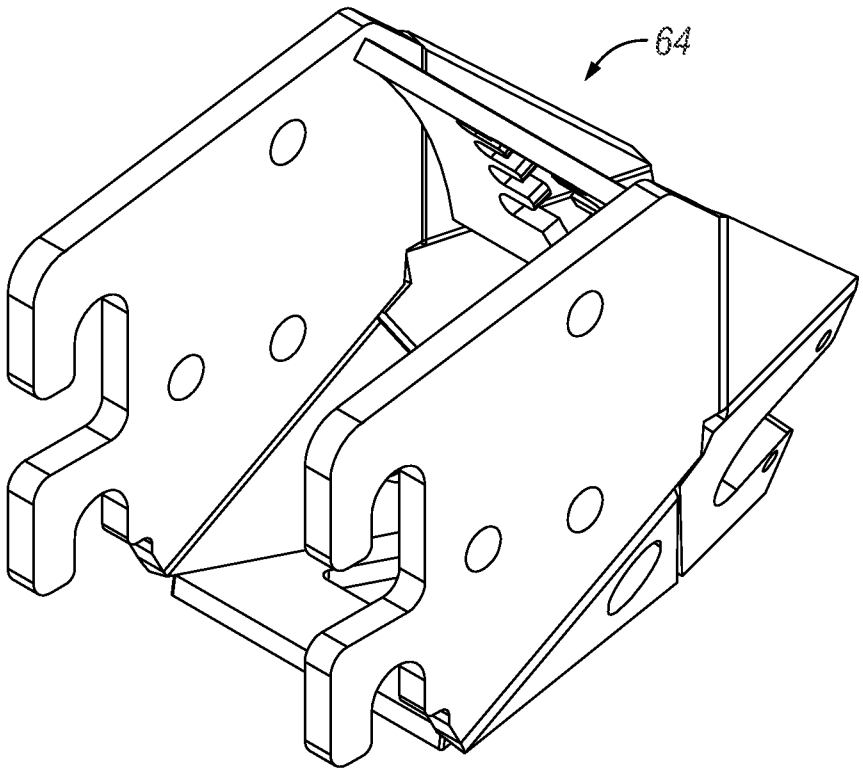


FIG. 17A

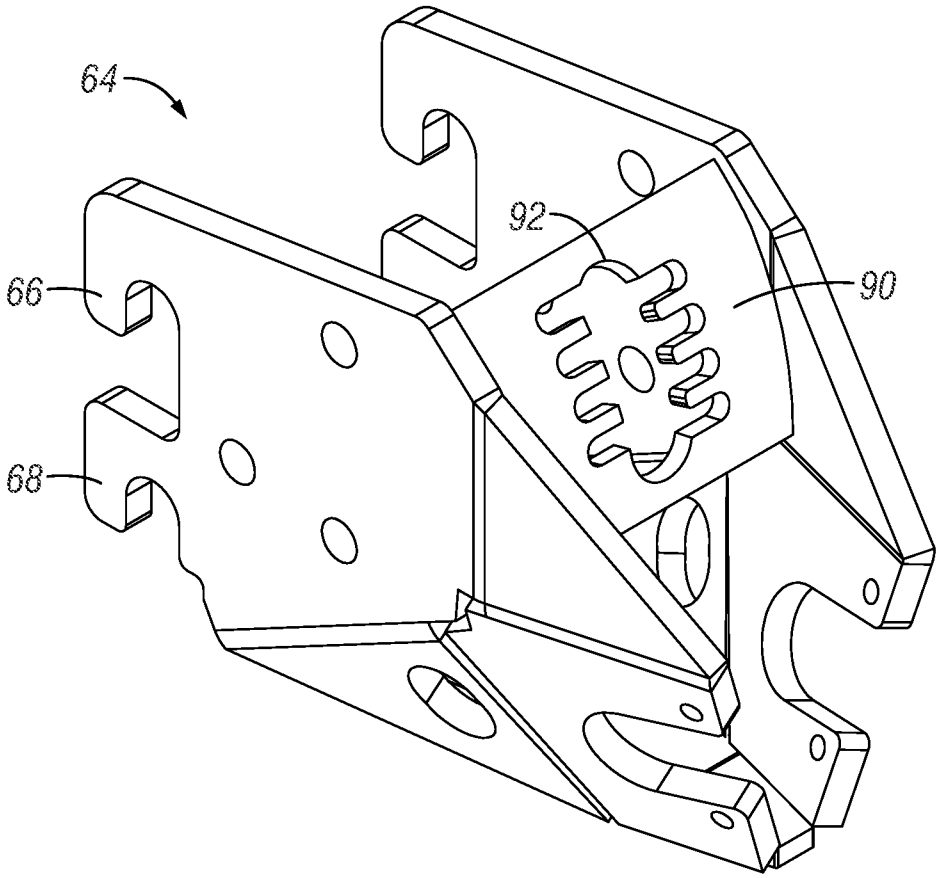


FIG. 17B

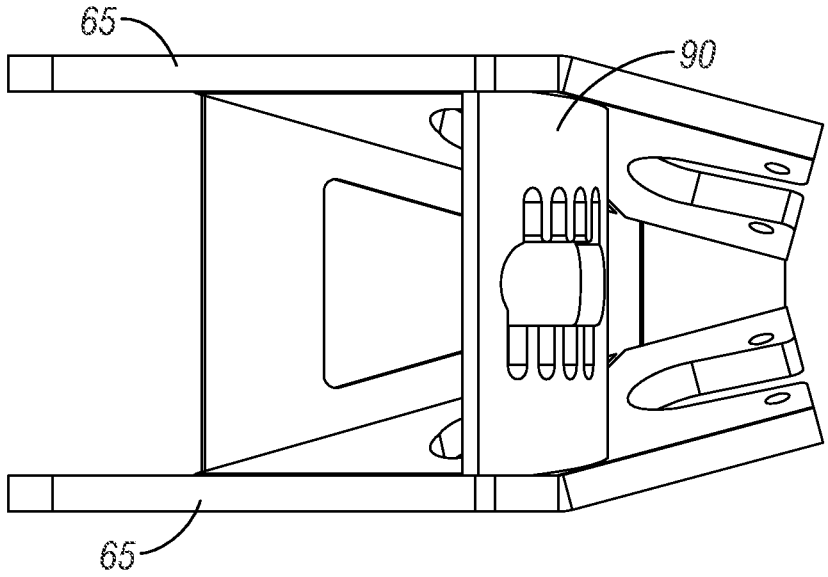


FIG. 17C

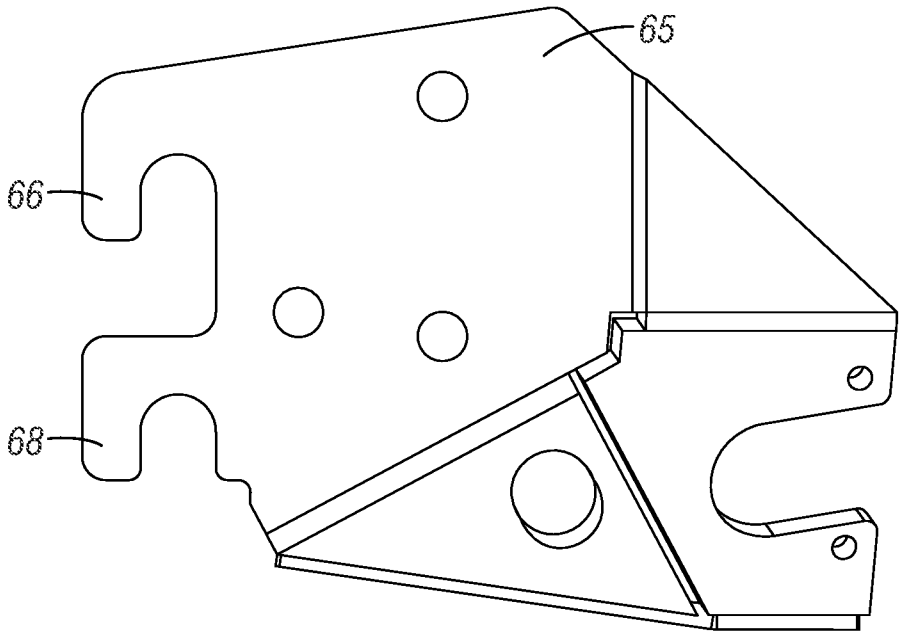


FIG. 17D

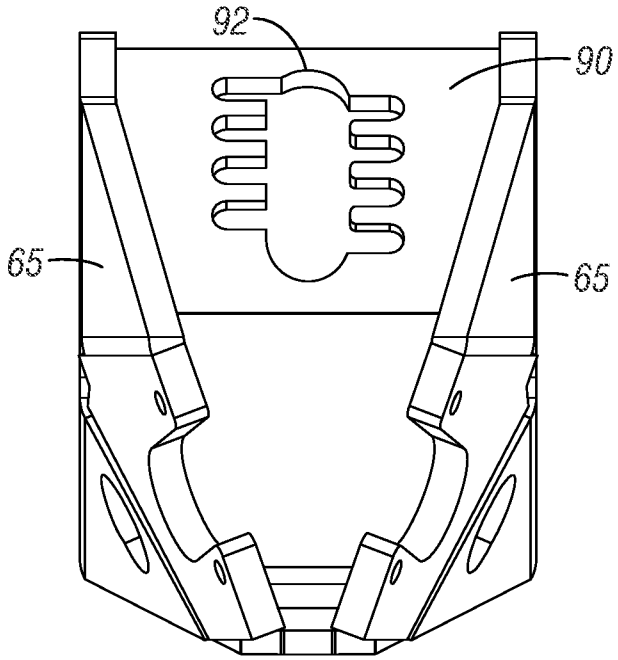


FIG. 17E

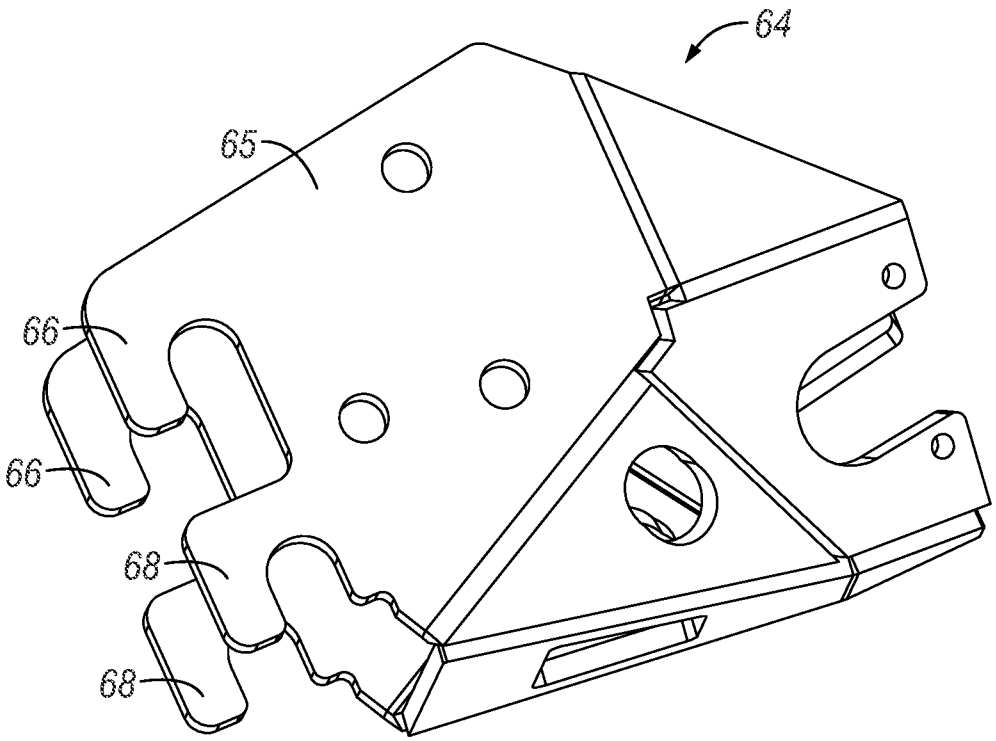


FIG. 17F

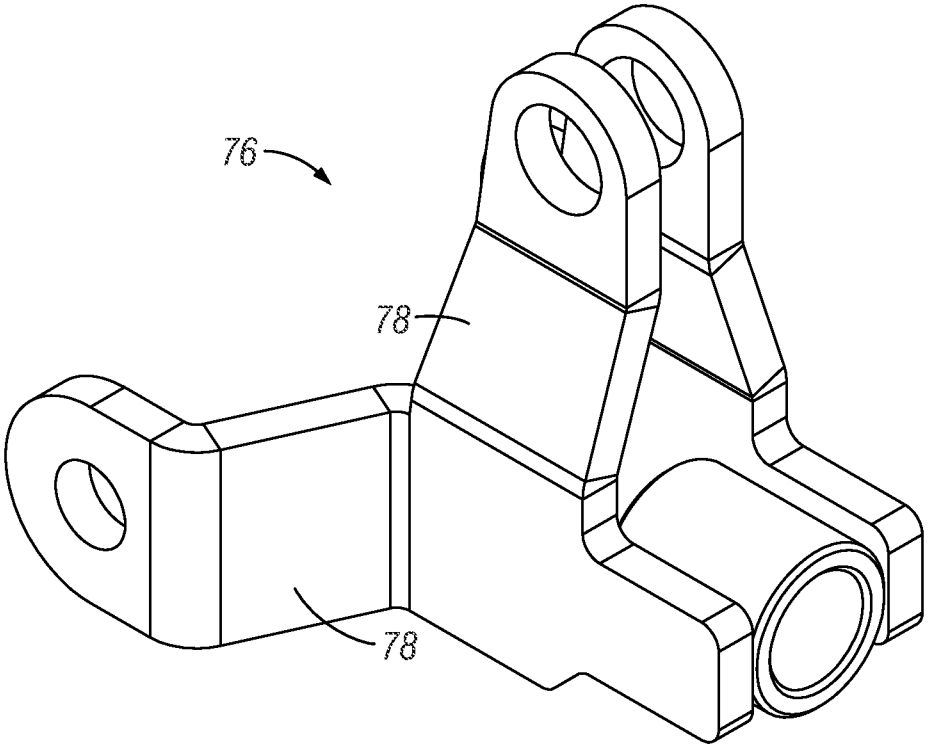


FIG. 18A

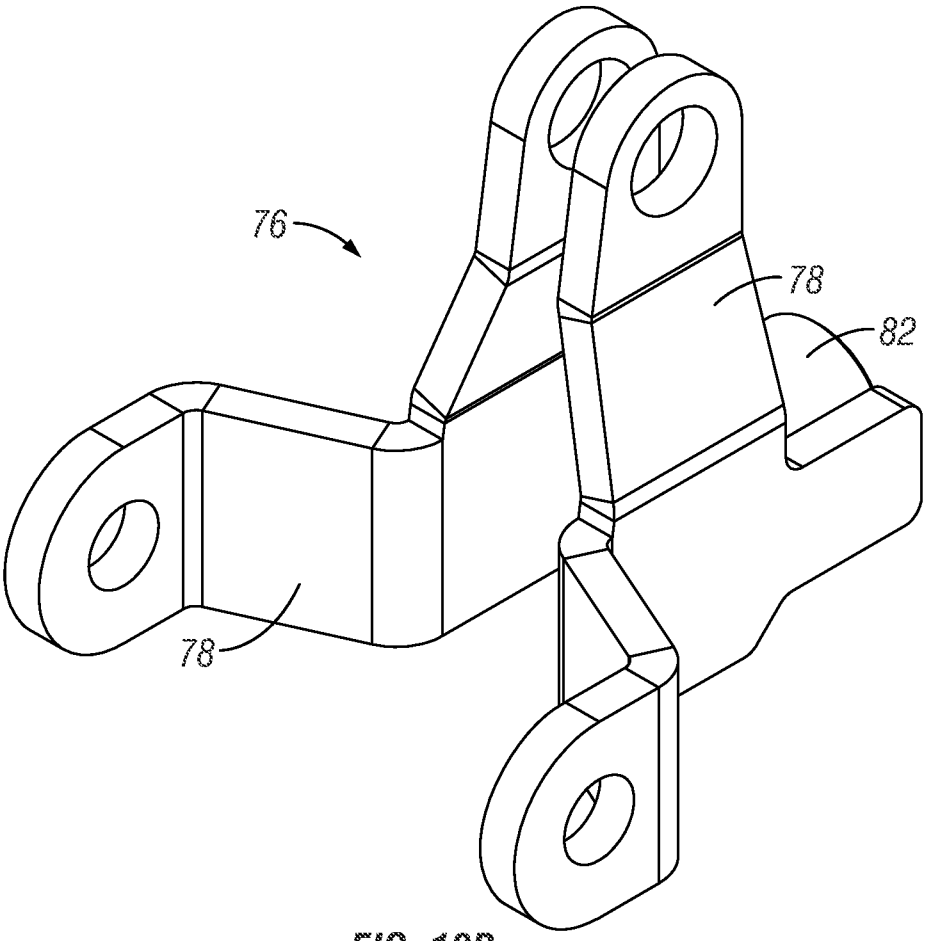


FIG. 18B

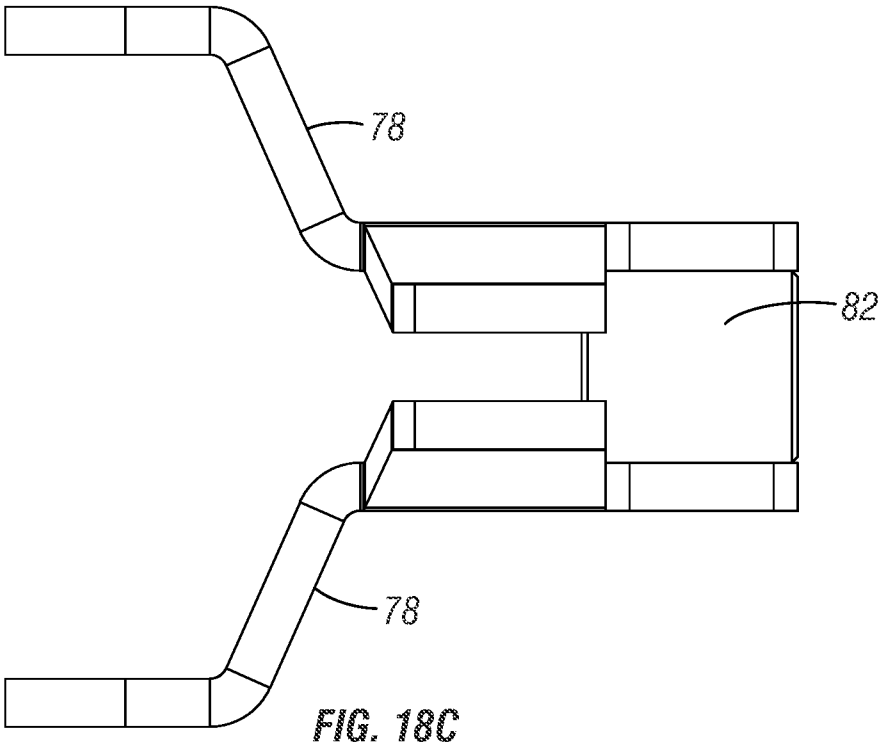


FIG. 18C

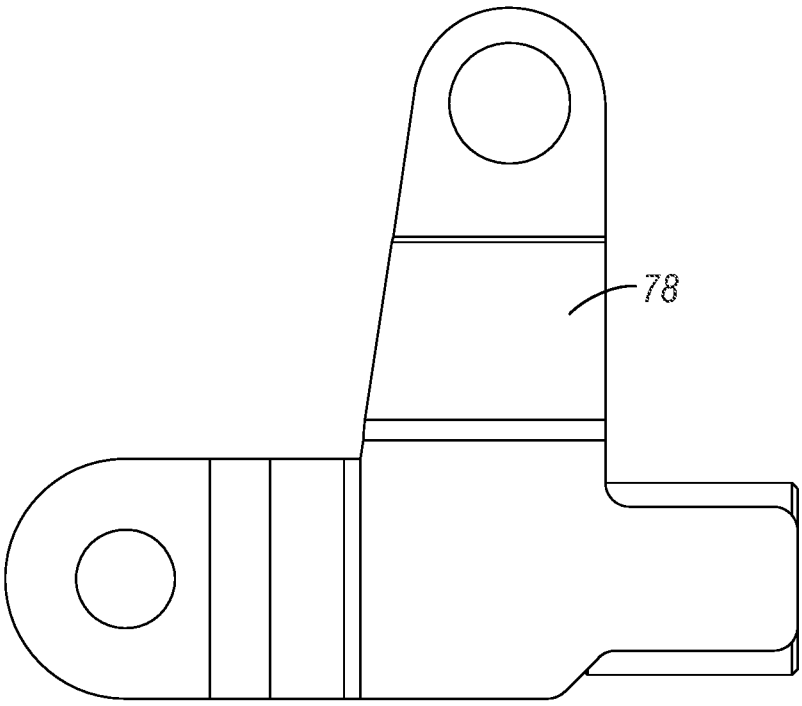


FIG. 18D

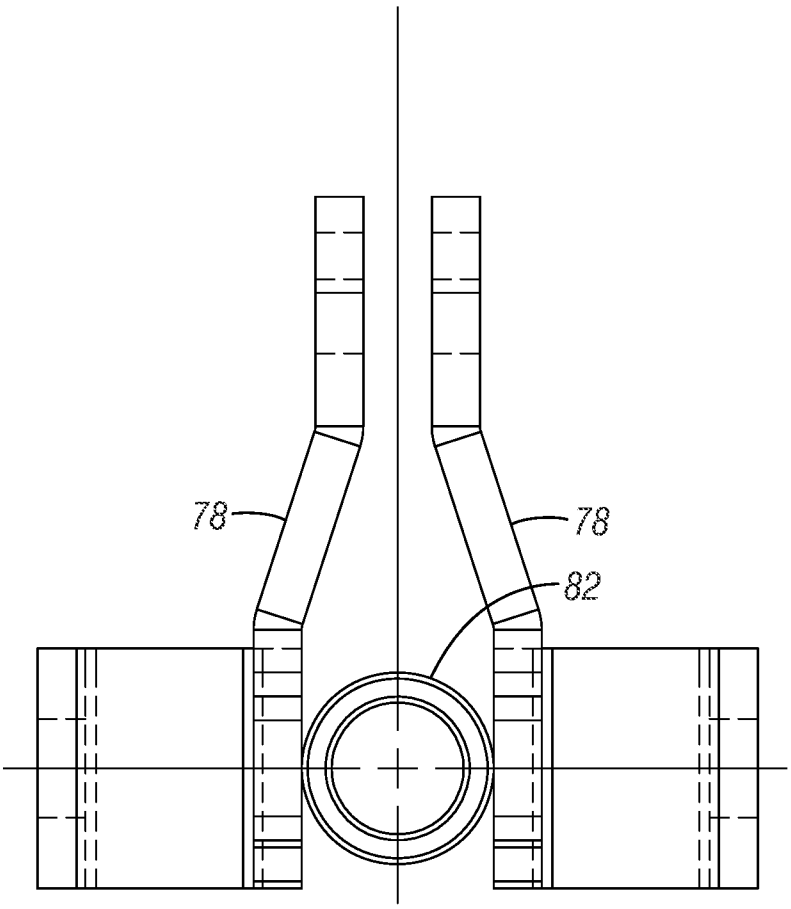


FIG. 18E

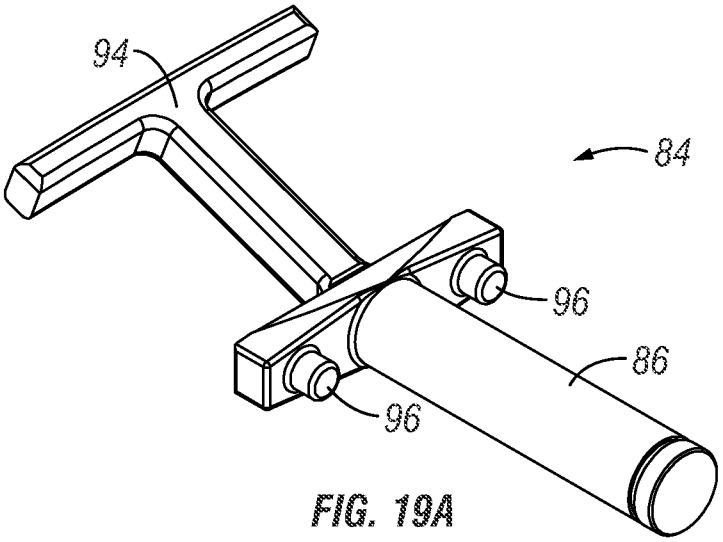


FIG. 19A

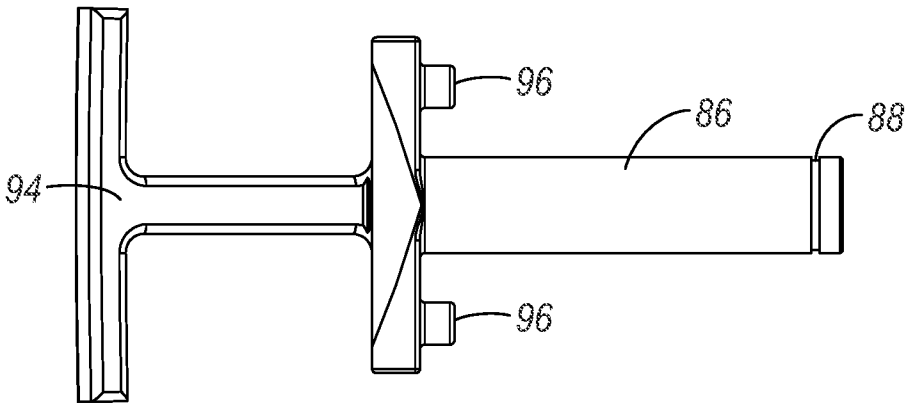


FIG. 19B

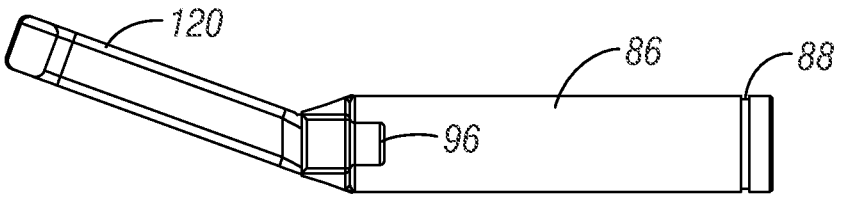


FIG. 19C

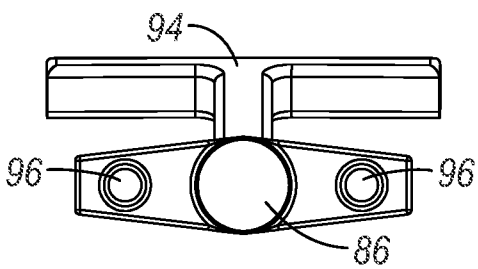


FIG. 19D

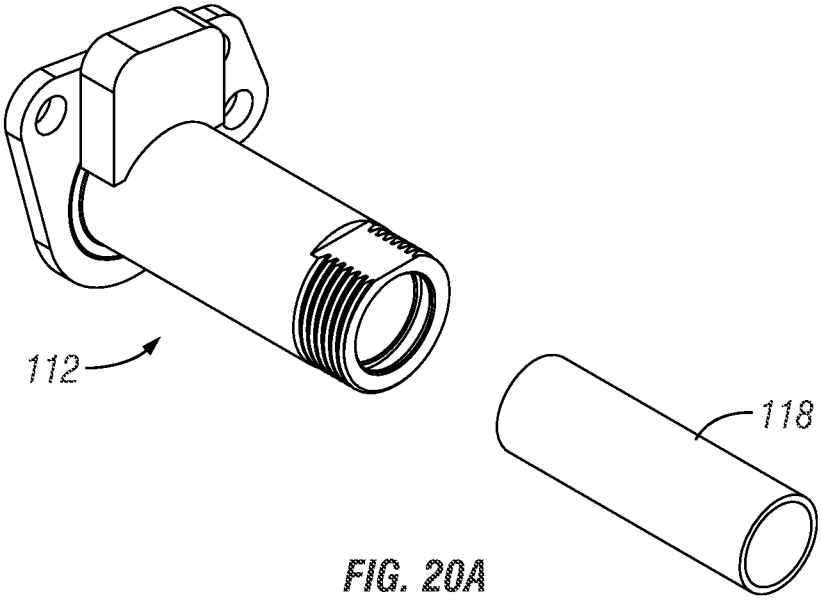


FIG. 20A

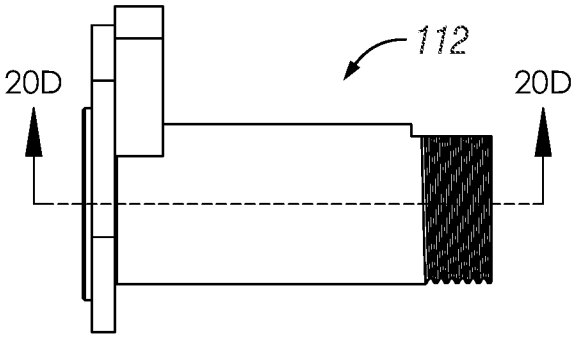


FIG. 20B

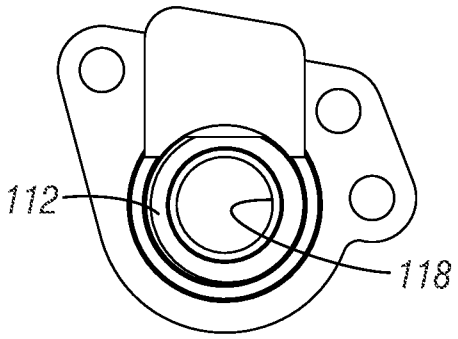


FIG. 20C

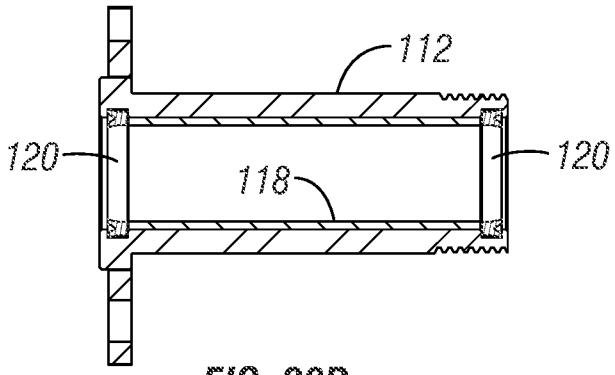


FIG. 20D

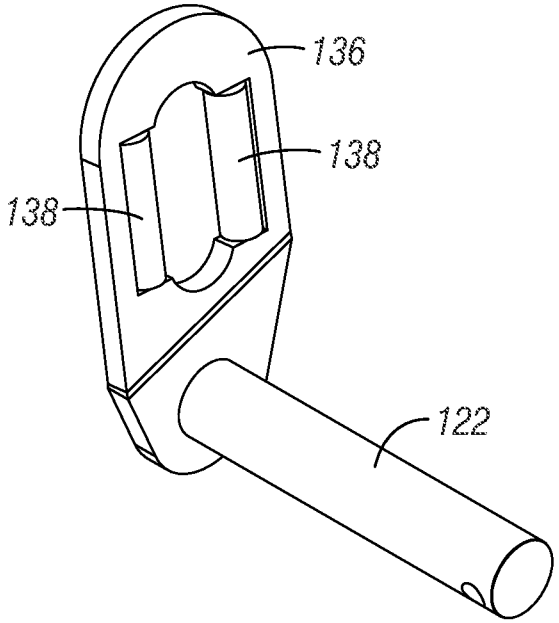


FIG. 21A

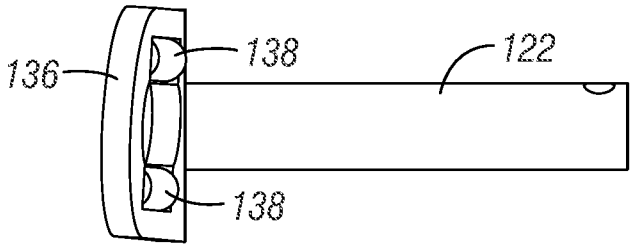


FIG. 21B

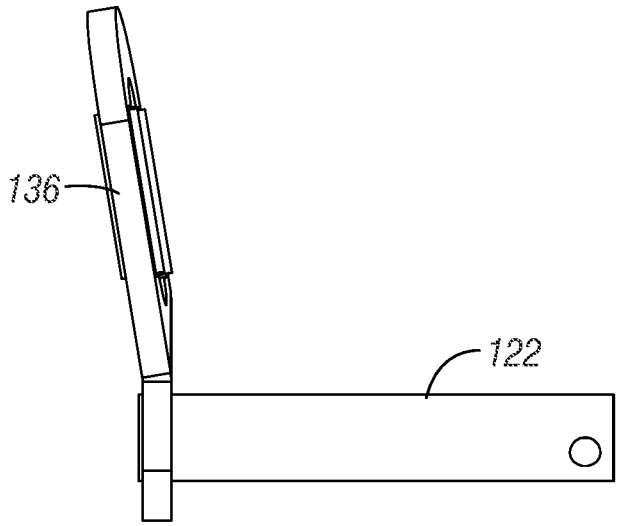


FIG. 21C

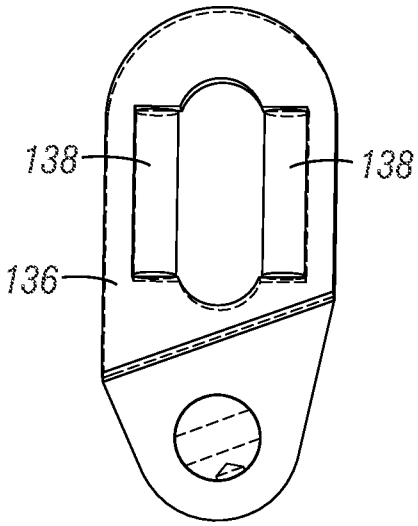


FIG. 21D

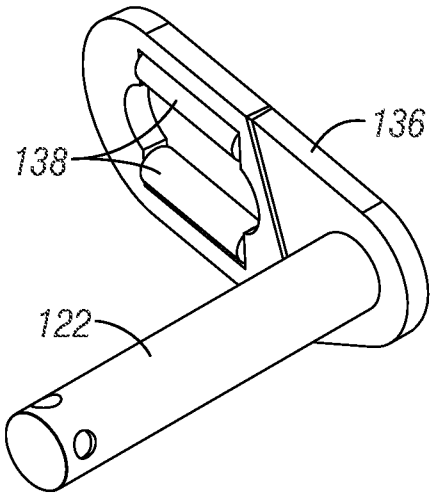


FIG. 21E

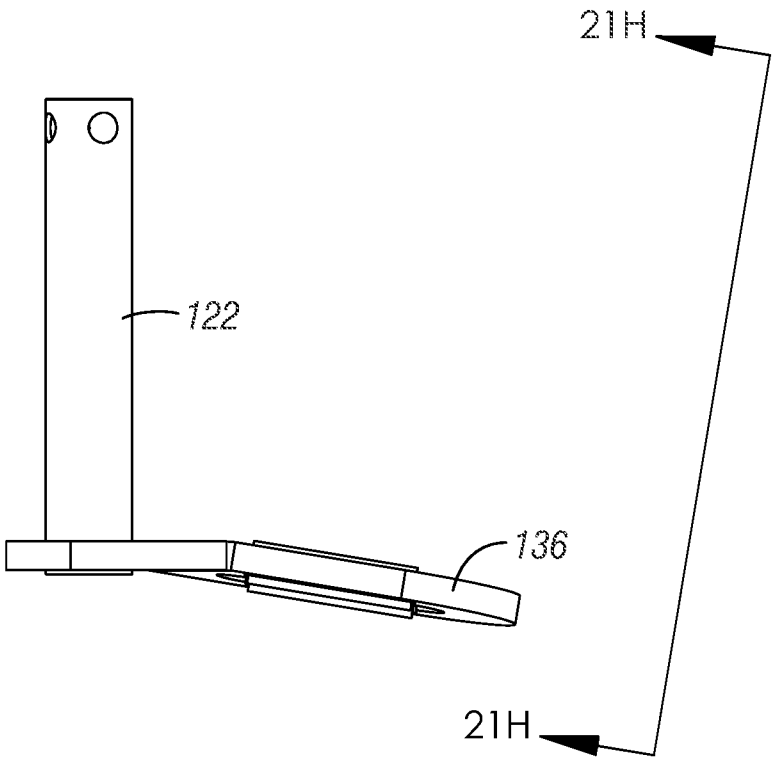


FIG. 21F

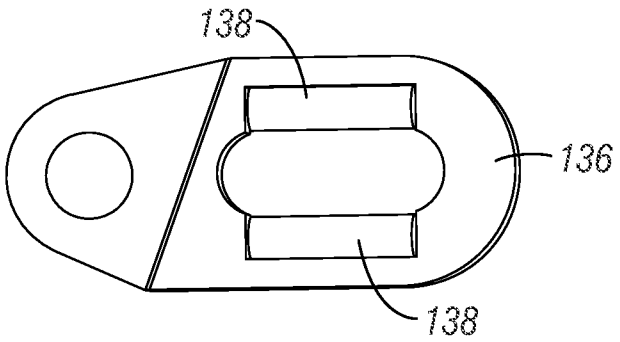


FIG. 21G

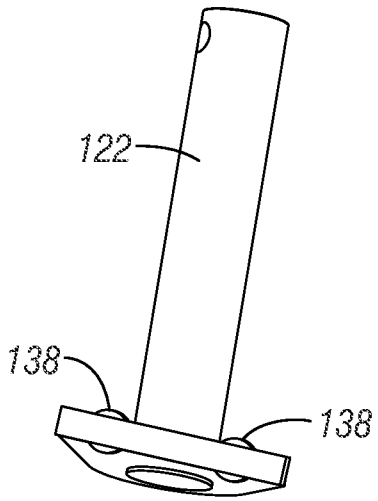
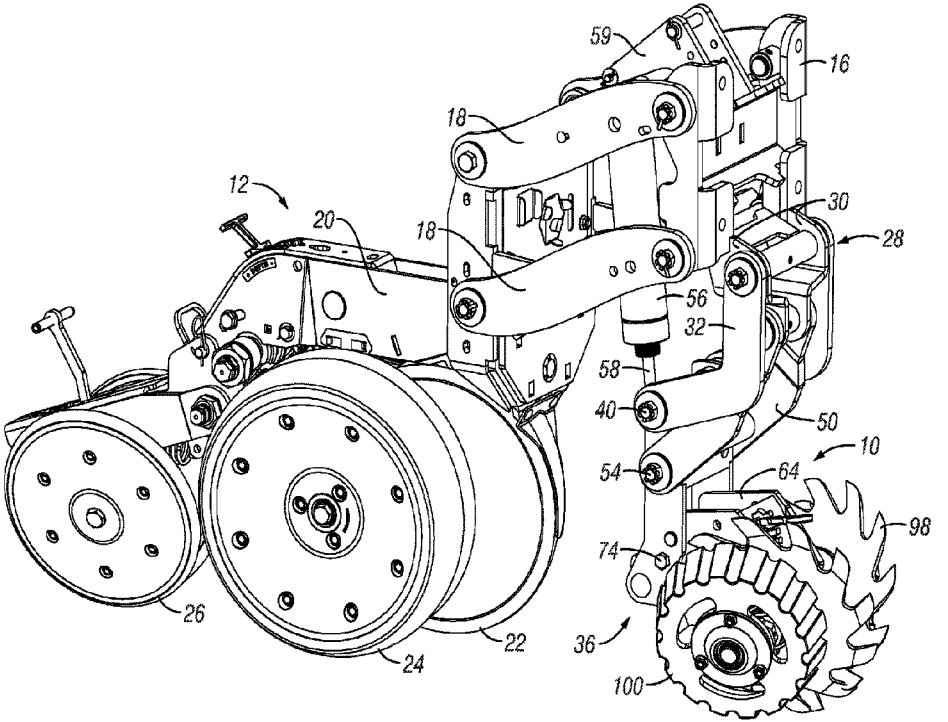


FIG. 21H


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