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CA 2515897 C 2008/10/07

(11)(21) 2 515 897

(12) BREVET CANADIEN
CANADIAN PATENT

(13) C

(22) Date de dépôt/Filing Date: 2004/07/15

(41) Mise à la disp. pub./Open to Public Insp.: 2004/11/28

(45) Date de délivrance/Issue Date: 2008/10/07

(62) Demande originale/Original Application: 2 474 406

(30) Priorité/Priority: 2004/07/15 (CA2,474,406)

(51) Cl.Int./Int.Cl. *E02F 5/10* (2006.01),
F16L 1/032 (2006.01), *G02B 6/46* (2006.01),
H02G 1/06 (2006.01), *H02G 9/02* (2006.01)

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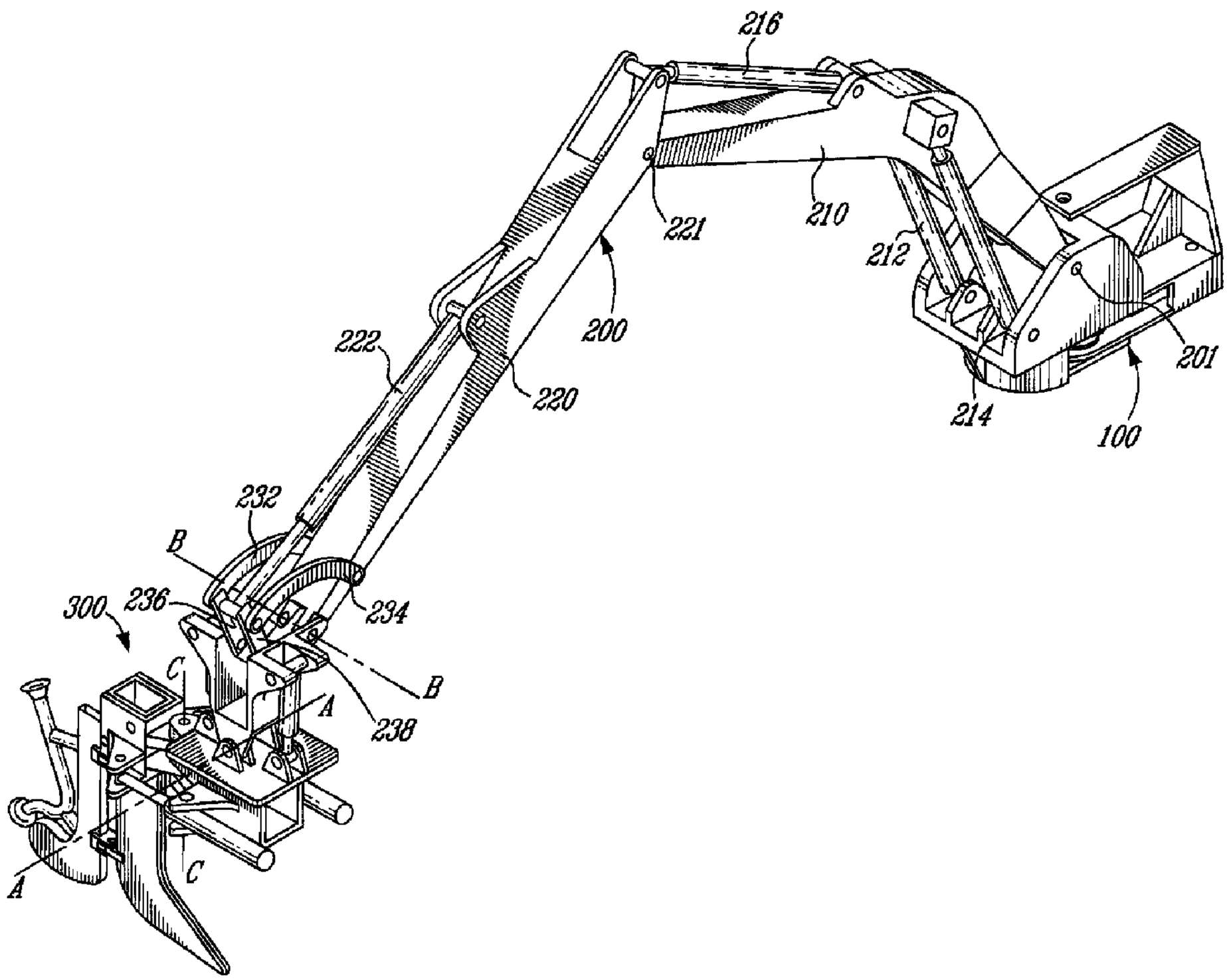
(54) Titre : DISPOSTIF ET METHODE DE POSE DE CABLE OU DE CONDUIT SOUTERRAINS
(54) Title: UNDERGROUND CABLE OR CONDUIT INSTALLING APPARATUS AND METHOD



(57) Abrégé/Abstract:
The present invention relates generally to apparatus for installing cable underground and more particularly to a specifically designed apparatus for accomplishing this task utilizing a power-driven land vehicle in combination with a cable laying plow blade

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(57) Abrégé(suite)/Abstract(continued):
and a cooperating cable feed mechanism for laying same at an offset from the trajectory of said vehicle more particularly the apparatus preferably comprises a boom extending from the vehicle to the plow blade, a connector between the vehicle and the boom and pivoting means between the boom and the plow blade.

ABSTRACT

The present invention relates generally to apparatus for installing cable underground and more particularly to a specifically designed apparatus for accomplishing this task utilizing a power-driven land vehicle in combination with a cable laying plow blade and a cooperating cable feed mechanism for laying same at an offset from the trajectory of said vehicle more particularly the apparatus preferably comprises a boom extending from the vehicle to the plow blade, a connector between the vehicle and the boom and pivoting means between the boom and the plow blade.

UNDERGROUND CABLE OR CONDUIT INSTALLING APPARATUS AND METHOD

Field of the Invention

The present invention relates generally to apparatus for installing cable underground and more particularly to a specifically designed apparatus for accomplishing this task utilizing a power-driven land vehicle in combination with a cable laying plow blade and a cooperating cable feed mechanism for laying same at an offset from the trajectory of said vehicle.

Background of the Invention

The rights-on-way along railroad tracks, roads and electrical lines provide existing paths for installation of thousands of kilometers of new cable. Many cable-laying apparatuses have been suggested over the years.

One present method of installing cable underground is to utilize a power-driven land vehicle such as a tractor, an associated cable plow blade and a cooperating cable feed mechanism, as recited above. In a typical apparatus of this type, the plow blade is supported by and for movement with the vehicle behind the latter in a way which places a lowermost end portion of the blade in the ground with its cutting edge disposed in the direction of vehicular movement. At the same time, the feed mechanism continuously feeds a supply of cable to an in-ground point on the blade and from there directly into the ground along the path taken by the blade as the latter is pulled behind the vehicle. Heretofore, this has been carried out by means of an elongated boom fixedly connected at one end to the blade and pivotally connected at its other end to a suitable support on the land vehicle.

U.S. Pat. No. 3,546,887 to Hemus disclosed an apparatus for burying lineal material adjacent to railroad tracks, utilizing a track-supported mobile base. Rearwardly trailed, elongate beams extend laterally in a positionable manner from a railroad car side and draw a blade

element through the ground to form a kerf within which continuous flexible material such as signal or electrical cable is deposited by a cable shoe carried by the blade. Hydraulic components position the beam to adjustably locate the blade for depositing the cable at selected depths and distances from the railroad tracks.

U.S. Pat. No. 3,777,500 to Kelley discloses a cable laying plow including a plow shank for connection to a prime mover. Sharpened teeth are formed along the forward edge of the plow. A motor is mounted on top of the plow shank for reciprocating and elongated frame which extends downwardly in the plow point.

U.S. Pat. No. 4,038,828 to Schuck et al. disclosed a vertical lift and tilt control for plows for laying cable, pipe and the like underground. A mast assembly has a generally vertical rail, and a slide frame is slidably mounted on the vertical rail. The plow assembly is supported on the slide frame and a power means, such as a piston, is connected to the mast and slide frames for raising and lowering the plow assembly. The mast assembly is pivotally supported on a suitable vehicle and a second power means, such as a piston, is pivotally connected to the vehicle and the mast assembly for adjusting the tilt or attack angle of the plow blade.

U.S. Pat. No. 4,040,261 to Schuck et al. disclosed a vibratory plow suitable for laying cable, pipe and the like underground. The plow blade is pivotally mounted on a frame assembly on a resilient mounting. The frame assembly includes a U-shaped yoke pivotally mounted at opposite ends to the frame assembly. A vibrator is mounted on the yoke and the yoke is pivotally connected to the blade by a link which is pivotally connected at opposed ends to the blade and the yoke. The blade is thereby vibrated in an orbital plowing motion as the blade is drawn through the earth by a suitable vehicle.

U.S. Pat. No. 4,119,157 to Schuck et al. disclosed a control mechanism for adjusting the angle and lateral position of a plow blade which is particularly useful for laying cable, pipe and the like underground. The control mechanism includes a fixed frame, which is supported on a suitable vehicle and a slide frame, which supports the plow blade. The slide frame is slidably supported on a horizontal rail of the fixed frame. A piston or other power means is

connected to the fixed and slide frames to adjust the lateral position of the supported plow blade. The plow includes a support frame which is pivotally mounted on a vertical pivot on a slide frame, and the control mechanism includes means to angularly adjust the blade on the pivot.

U.S. Pat. No. 4,430,022 to Kinnan discloses an apparatus specifically designed to lay underground cables. It is designed to be used to lay such cable by either pushing or pulling the plow such that it may by installed very close to obstacles such as walls or the like.

U.S. Pat. No. 4,720,929 to Umberson disclosed a trenching device in which an improved torsional limiting device and associated control system provide for protection of the equipment components in the event the cutting wheel encounters unforeseen obstructions.

U.S. Pat. No. 4,768,297 to Rivard disclosed a trenching wheel, especially for digging trenches. Tools are mounted on ring portions removably fixed to the periphery of the wheel.

U.S. Pat. No. 4,784,524 to Stine disclosed apparatus for holding the plow blade of a railroad car-mounted cable laying device which includes support means on the railroad car for supporting the plow blade and stop means on the support means for prohibiting the plow blade from sliding off the support means. When more than one plow blade is provided, tethering means is also provided between the plow blades for constraining the plow blades and prohibiting the plow blades from sliding off the support means.

U.S. Pat. No. 4,794,709 to Rivard disclosed a device for digging trenches, including at least one digging wheel with a wheel framework which is connected to a vehicle by means of a mobile carriage for lowering or raising the digging wheel, means for causing the digging wheel to pivot about a first pivoting axis, and means for causing the digging wheel to pivot about a second pivoting axis.

U.S. Pat. No. 4,890,958 to Dancer disclosed a railroad right-of-way cable/pipe trench-plowing machine which includes a locomotive, standard flat car, a hydraulic boomed vehicle

such as a backhoe attached to the flat car, a steerable plowing blade attached to the hydraulic boom, and a cable attached at one end to the plowing blade and the other end to the locomotive. The plowing blade is pivotally attached to the hydraulic boom and has a tooth located at its bottom end foot, which is disposed to point in the direction to be trenched. A cable guide, consisting of a J-shaped tube, is attached to the trailing edge of the vertical blade and is disposed such that a utility cable fed into the top end of the cable guide is automatically directed to the base of the trench. An optional feature provides a hydraulic ram attached between the pivoting blade and the hydraulic boom for hydraulically pivoting the blade about the boom. The hydraulic ram provides additional steering capabilities.

U.S. Pat. No. 5,482,121 to Draney et al. disclosed a vibratory cable plow assembly including a frame assembly for connecting a plow blade to a frame of a prime mover. The frame assembly supports a vibrating mechanism or shaker that is adapted to impart vibratory movements to the plow blade. A lower support mounts a blade supporting frame for rocking movement around a generally horizontal pivot mechanism. The vibratory mechanism is mounted on the blade supporting frame.

U.S. Pat. No. 5,596,822 to Desmarais et al. disclosed a rubber-tired cable-laying apparatus for burying cable in or adjacent to a railway bed. A cable-laying plough is mounted to a rubber-tired loader, and the loader moves forward under its own power while straddling the track. A pair of rail wheels are mounted on the forward and rearward ends of the loader.

U.S. Pat. No. 6,193,440 to Pidgeon et al. discloses an apparatus designed to lay cables alongside railroad tracks. A standard excavator is installed on a flat-bed rail car. A rigid element is mounted on the side of the rail car to transfer torque from the plowing assembly to the rail car.

The apparatus and methods known for laying cables, pipes and conduits have no doubt performed well in their intended uses. However, considerations of speed and efficiency have required an improved apparatus for laying cable in railroad rights-of-way or roads and more particularly alongside the railroad tracks or roads.

In this specification, the term "cable" refers to any elongate article to be installed underground and includes conventional utility cables (for e.g. electric power, telecommunications, data transmission, etc.) including particularly fiber-optic cable; conduits (such as innerduct) through which cables, wires, and fiber-optics are conventionally fed; and marking ribbons or other markers conventionally buried with or near cables to mark their locations and to warn excavators of the presence of the cables. The terms "plowshare" and "plow blade" and "plow" are used as synonyms to refer to the part of a static or vibratory cable plow that is operative for creating a trench, including any cable-guide portion usually secured to the trailing edge of a plow blade for guiding cable into the trench created by the blade and any means for vibrating the blade in conventional vibratory plows, and also including soil trenchers, rock chainsaws, wheel-shaped rock saws, and the like.

When a tractor or other vehicle is pulling a plow, resistance and high friction at the plow blade proper cause a torque applied at the plow blade. Such torque tends to rotate the boom support used to position the plow blade at the desired trench location. In conventional practice, this has often contributed to a limitation of installing cable within two meters or less of the rail or road.

Because the bottom of the ditches that are disposed alongside of road beds and rail beds are very often more than 2 meters of the side of the roadway or railway, it has not been possible to lay the cables or conduits in the bottom of the ditches while the cable laying vehicle remains on the road or rails. As a result, existing apparatus typically damage the side of said beds. While the cable laying equipment can sometimes move in the ditch, more often than not this is either not possible because of size limitation or because of damage to the environment.

Another disadvantage of existing equipment is that when protective rails alongside roads and/or small road signs are encountered, it is necessary to dismantle them or change the trajectory of the cable laying apparatus to go around them. In both cases, time and costs are increased.

Objects of the Invention

A major object of the invention is an apparatus for laying cable with improved speed and efficiency.

Another object is an apparatus engaged with improved accommodation for torque on a plow apparatus engaged in laying cable.

Still another object is an apparatus allowing the tractor or vehicle to move on the road or rail bed while allowing the cable or conduit to be laid in the bottom of the ditch placed alongside of the road or rail bed.

Yet another object of the invention is an apparatus allowing the tractor or vehicle to continue in its regular trajectory even when protective rails and/or small road signs are encountered alongside roads without the need to dismantle such rails or signs.

Other and further objects and advantages of the present invention will be obvious upon an understanding of the illustrative embodiments about to be described or will be indicated in the appended claims, and various advantages not referred to herein will occur to one skilled in the art upon employment of the invention in practice.

Summary of the Invention

In accordance with the present invention, an apparatus for laying an underground cable or conduit is provided with a connector adapted to pivotally connect a boom to a power driven land vehicle, the connector comprises:

a. a base portion adapted to be rigidly attached to the vehicle;

b. a top portion;

c. a first pivot attaching the top portion to the base portion;
d. arcuate aperture in the top portion co-axial with the first pivot;
e. a first piston having a first end connected to the base and a second end;
f. a first link and a second link connecting the second end of the piston to the top portion.

In accordance with another aspect of the invention, an apparatus for laying an underground cable or conduit comprises:

a. an extendable and articulated boom having a first end and a second end;
b. a connector adapted to pivotally connect the first end of the boom to the vehicle;
c. a cable laying plow;
d. means to pivotally attach the plow to the second end of the boom;

wherein the position of the cable laying plow can be adjusted via the connector, the boom and the attachment means.

In accordance with another aspect of the invention, an apparatus for installing a cable or conduit underground comprises:

a. a first power driven land vehicle comprising means to hold at least one spool of such cable or conduit;
b. a second power driven land vehicle;
c. means to attach the rear of the first vehicle to the front of the second vehicle;
d. an extendable and articulated boom having a first end and a second end;
e. a connector adapted to pivotally connect the first end of the boom to the second power driven land vehicle;
f. a cable laying plow;
g. means to pivotally attach the plow to the second end of the boom;

wherein the position of the cable laying plow can be adjusted via the connector, the boom and the attachment means

In accordance with still another aspect of the invention, there is provided a method for

installing a cable or conduit underground from a first point located alongside a road bed or a rail bed to a second point also located alongside a road bed or a rail bed comprising the steps of:

a. placing a first power driven land vehicle on the road/rail near the first point such that a predetermined offset is created between the road/rail bed and the first point;
b. connecting an elongated cable/conduit laying plow blade apparatus to the first land vehicle, the apparatus comprising a cable/conduit laying blade;
c. placing the blade in the ground at the first point;
d. pulling the blade with the vehicle from the first point to the second point while maintaining the offset between the road/rail bed and the blade;
e. while the blade moves from the first point to the second point, feeding cable/conduit to the blade such that the latter lays the cable in the ground along the path of the movement of the blade.

Description of the Drawings

For a more complete understanding of the present invention and for further objects and advantages thereof, reference is now made to the following description taken in conjunction with the accompanying drawings, in which:

Figure 1 illustrates a front perspective view of a cable laying system of the present invention.

Figure 2 is a rear perspective view of the cable laying system shown in figure 1.

Figure 3 is a perspective view of the pivoting boom sub-system shown in figures 1 and 2.

Figure 4 is an end view of the sub-system shown in figure 3.

Figure 5 is a perspective view of the pivoting connector between the boom shown in figure 3

and a tractor (shown in figure 2).

Figure 6 is a top view of the connector show in figure 5.

Figure 7 is a side view of the connector shown in figure 5.

Figure 8 is a sectional top view along line A-A in figure 7.

Figure 9 is a perspective view of the plow assembly shown in figure 3.

Figure 10 is a top view of the plow assembly shown in figure 9.

Figure 11 is a side view of the plow assembly shown in figure 9.

Figure 12 is an end view of the plow assembly shown in figure 9.

Description of a Preferred Embodiment

With reference to the annexed drawings, the preferred embodiment of the present invention will be herein described for indicative purposes and by no means as a limitation.

Figures 1 and 2 generally described the a cable laying system in accordance with the present invention. A first extremity of a boom 200 is connected to a first power driven vehicle in this case a tractor 10 via a connector 100. The other end of the boom 200 is connected to a plow blade sub-system 300 which is described in more detail in figures 9 to 12. A second tractor 20 is connected to the first tractor 10 via a steel cable, a chain or other known means. A bobbin 30 is attached to the front end of the second tractor 20. The bobbin 30 contains a roll of cable 35 destined to be buried under ditch 50.

Both tractors 10 and 20 advance at the same rate. Tractor 20 is connected to tractor 10 via a

cable chain or other known device (not shown) in order to maintain the direction of tractor 10 which would otherwise, in certain circumstances, tend to deviate from its trajectory in view of the moment created by the friction of the plow 310 in the ground because of the offset 60 between the side of the road and the plow 310 that is located in the bottom of the ditch 50.

Very often the offset 60 will exceed 10 feet which is well beyond the reach of known cable laying equipment.

Figures 3 and 4 show boom 200 connected to connector 100 at one end and to the plow sub-system 300 at the other end. Connector 100 is described in more detail in figures 5 to 8 while the plow sub-system 300 is described in more detail in figures 9 to 12.

The boom 200 comprises a first section connected at a first end to pivot 201 to the connector 100 and at the second extremity to a second portion 220 via a pivot 221. A pair of hydraulic cylinders 212 and 214 are used to cause the up-ward and down-ward movement of the first section 210 of boom 200. Another hydraulic cylinder is used to cause the up-ward and down-ward movement of the second portion 220 of boom 200 in relation to first section 210.

Finally, yet another hydraulic cylinder 222 is used to cause the pivotal movement of the plow sub-system 300 around axis B-B with the assistance of links 232, 234, 236 and 238.

Connector 100 is described in more detail in figures 5 to 8. It comprises a fixed base 170 connected to the tractor (not shown) and a pivoting section 160 pivotally connected to the base 170 via pivots 165 and 175. In order to allow a wide pivoting action of the pivoting portion 160 in a relatively narrow space, it was necessary to design a special connector 100. A first set of hydraulic pistons 114 and 124 are pivotally connected to the base 170 via pivot 116 and 126 respectively. The other end 112 of piston 114 is pivotally connected via pivot 118 to arcuate links 136 and 132. Similarly, the other end 122 of piston 124 is pivotally connected through pivot 128 to arcuate links 142 and 146. Arcuate link 146 is itself pivotally connected through pivot 135 to arcuate link 136. Pivot 135 is also fixed to the base 170. The other end of arcuate link 132 is connected to the pivoting portion 160 via pivot 134.

Similarly, the other end of arcuate link 142 is connected to the pivoting portion 160 via the pivot 144.

When piston 124 is retracted, piston 114 is extended by a corresponding amount thus causing the pivots 134 and 144 to slide within the arcuate slot 173 in the base 170 thereby causing the pivoting portion 160 to pivot around pivots 175 and 165.

An opposite movement is caused by extending cylinder 124 while retracting cylinder 114.

The plow sub-system 300 is described in more detail in figures 9 to 12. A plow 310 is pivotally connected through pivots 312 and 314 to a cable link sub-system 320 which comprises a conduit 325. The cable 35 enters in to the top portion 326 of conduit 325 and exits through the lower portion 327 as the plow 310 moves forward.

A top pivoting link 340 allows the plow 310 to pivot both around horizontal axis B-B and horizontal axis A-A which is perpendicular to axis B-B. Movement around axis B-B is caused by the actuation of piston 222 (shown in figure 3) while movement around axis A-A is caused by the actuation of hydraulic pistons 342 and 344. Yet another pair of hydraulic pistons 332 and 334 allow the plow 310 to pivot around axis C-C. Axes A-A, B-B and C-C are at right angle to each other and the combined action of the hydraulic pistons described above allows great flexibility in the positioning of the plow 310 to conform to any ground configuration encountered by the cable laying apparatus.

Other embodiments of the invention will be apparent to those skilled in the art from a consideration of this specification or from practice of the invention disclosed herein. For example, some dimensions may be enlarged to allow the installation of larger conduit which can contain a number of smaller-diameter conduits within it. It is intended that the specification and examples be considered as exemplary only, with the true scope and spirit of the invention being defined by the following claims.

Claims

What is claimed is:

1. An underground cable or conduit installing apparatus adapted to be mounted to a vehicle, said apparatus comprising:
   a. an articulated boom having a first end and a second end;
   b. a connector adapted to pivotally connect said first end of said boom to said vehicle;
   c. a cable or conduit laying plow;
   d. means to pivotally attach said plow to said second end of said boom, said means to pivotally attach said plow comprising first pivot means, second pivot means and third pivot means, each pivot means being substantially perpendicular to the other two pivot means;

   wherein the position of said cable laying plow can be adjusted via said connector, said boom and said means to pivotally attach said plow.

2. An apparatus as claimed in claim 1, wherein said first pivot means are generally vertical and the second and third pivot means are generally horizontal.

3. An apparatus as claimed in claim 1, wherein said means to pivotally attach said plow further comprise a plurality of pistons.

4. An apparatus as claimed in claim 1, wherein said vehicle is a tractor.

5. A system for installing cable or conduit underground comprising:
   a. a first power driven land vehicle comprising:
      1. means to hold at least one spool of said cable or conduit;
   b. a second power driven land vehicle comprising:
      1. an articulated boom having a first end and a second end;
      2. a connector adapted to pivotally connect said first end of said boom

to said second power driven land vehicle;

3. a cable or conduit laying plow;
4. means to pivotally attach said plow to said second end of said boom, said means to pivotally attach said plow comprising first pivot means, second pivot means and third pivot means, each pivot means being substantially perpendicular to the other two pivot means;

c. means to attach said first land vehicle to said second land vehicle;

wherein the position of said cable laying plow can be adjusted via said connector, said boom and said means to pivotally attach said plow.

6. An apparatus as claimed in claim 5, wherein said first pivot means is generally vertical, said second pivot means is generally horizontal and said third pivot means is generally horizontal.

7. An apparatus as claimed in claim 5, wherein said means to pivotally attach said plow further comprise a plurality of pistons.

8. An apparatus as claimed in claim 5 wherein said first power driven land vehicle is a tractor.

9. An apparatus as claimed in claim 5 wherein said second power driven land vehicle is a tractor.

10. A method for installing cable or conduit underground from a first point located alongside a road bed or a rail bed to a second point also located alongside a road bed or a rail bed, said method comprising the steps of:

- providing a first power driven land vehicle, said first land vehicle comprising an articulated boom having a first end and a second end, a connector for pivotally mounting said first end of said boom to said first land vehicle, a cable or conduit laying plow blade and means to pivotally attach said plow blade to said second end of said boom, said means to pivotally attach said

plow comprising first pivot means, second pivot means and third pivot means, each pivot means being substantially perpendicular to the other two pivot means;

- placing said first land vehicle on said road/rail bed near said first point such that a predetermined offset is created between said road/rail bed and said first point;
- placing said plow blade in the ground at said first point;
- pulling said blade with said first land vehicle from said first point to said second point while maintaining said offset between said road/rail bed and said blade;
- while said blade moves from said first point to said second point, feeding cable or conduit to said blade such that said blade lays said cable or conduit into the ground along the path of the movement of said blade.

11. A method as claimed in claim 10 wherein said vehicle is a tractor.

12. A method as claimed in claim 10 further comprising the following steps:

- placing a second power driven land vehicle on said road/rail bed in front of said first vehicle;
- connecting the rear of said second vehicle to the front of said first vehicle;
- advancing said second vehicle at the same rate as said first vehicle.

13. A method as claimed in claim 12, wherein said second power driven vehicle comprises means to hold at least one spool of said cable or conduit.

14. A method as claimed in claim 12, wherein said second power driven land vehicle is a tractor.

15. A method for installing cable or conduit underground from a first point located alongside a road bed or a rail bed to a second point also located alongside a road bed or a rail bed, said method comprising the steps of:

- providing a first power driven land vehicle, said first land vehicle comprising an articulated boom having a first end and a second end, a connector for pivotally mounting said boom to said first land vehicle, a cable or conduit laying plow blade and means to pivotally attach said plow blade to said second end of said boom, said means to pivotally attach said plow comprising first pivot means, second pivot means and third pivot means, each pivot means being substantially perpendicular to the other two pivot means;
- providing a second power driven land vehicle, said second land vehicle comprising means to hold at least one spool of said cable or conduit;
- placing said first land vehicle on said road/rail bed near said first point such that a predetermined offset is created between said road/rail bed and said first point;
- placing said second land vehicle on said road/rail bed in front of said first vehicle;
- connecting the rear of said second land vehicle to the front of said first land vehicle;
- placing said blade in the ground at said first point;
- pulling said blade with said first vehicle from said first point to said second point while maintaining said offset between said road/rail bed and said blade;
- while said blade moves from said first point to said second point, feeding said cable or conduit to said blade from said spool on said second land vehicle such that said blade lays said cable or conduit into the ground along the path of the movement of said blade.

16. A method as claimed in claim 15 wherein said first vehicle is a tractor.

17. A method as claimed in claim 15 wherein said second vehicle is a tractor.

18. A method as claimed in claims 12 or 15, further comprising the following step:

- adjusting the position of said first land vehicle with the help of said second land vehicle.

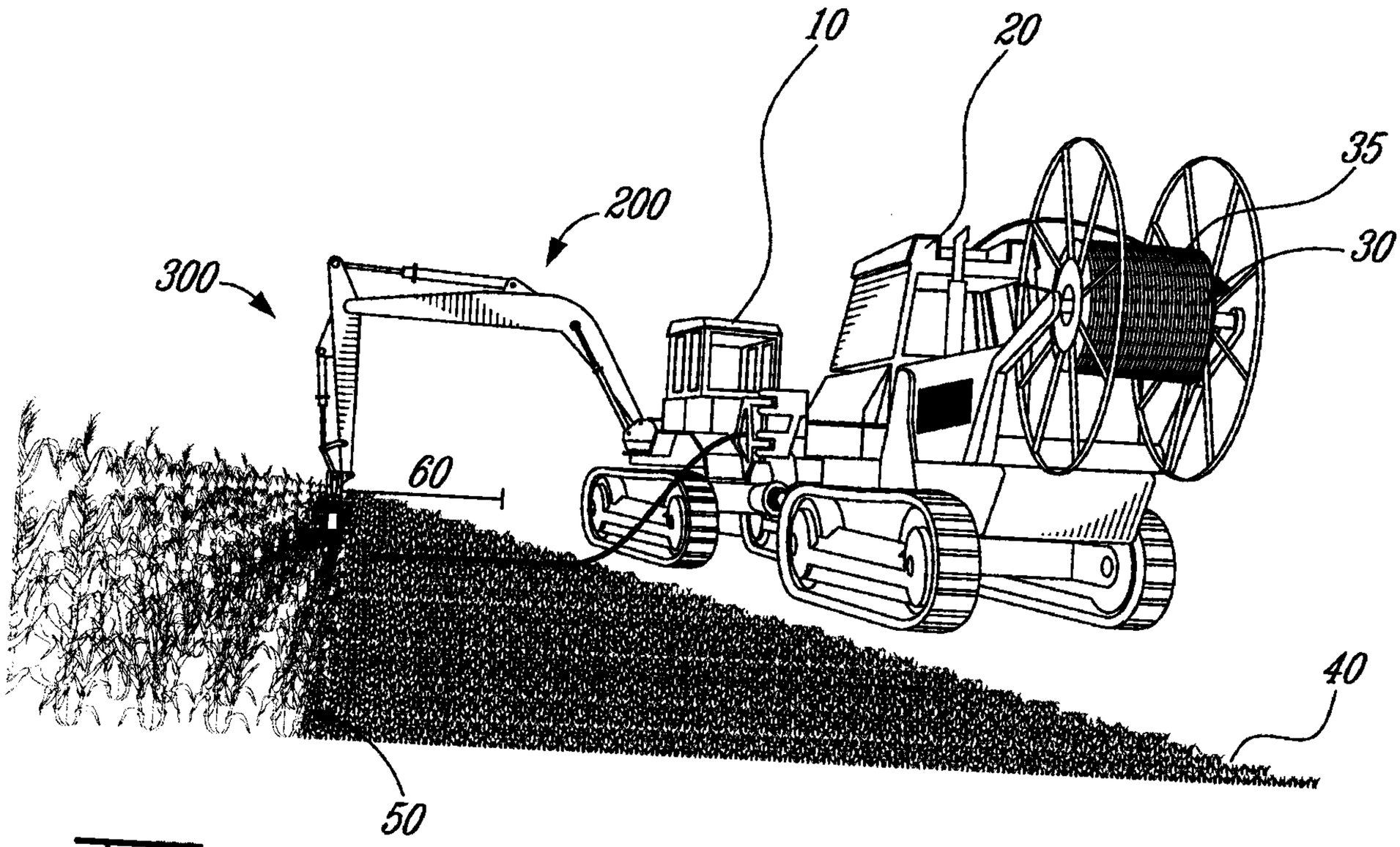

FIG_1

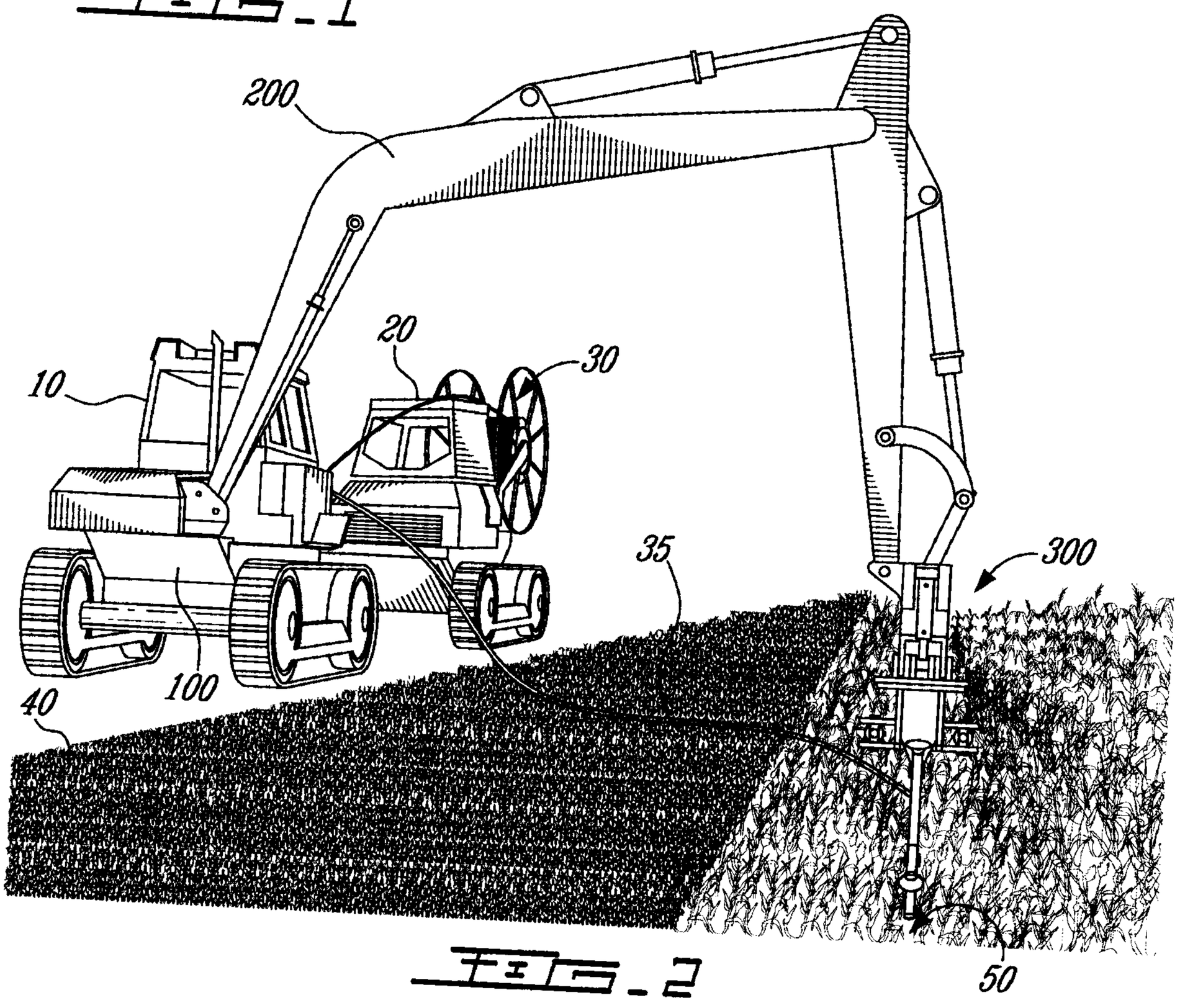

FIG_2

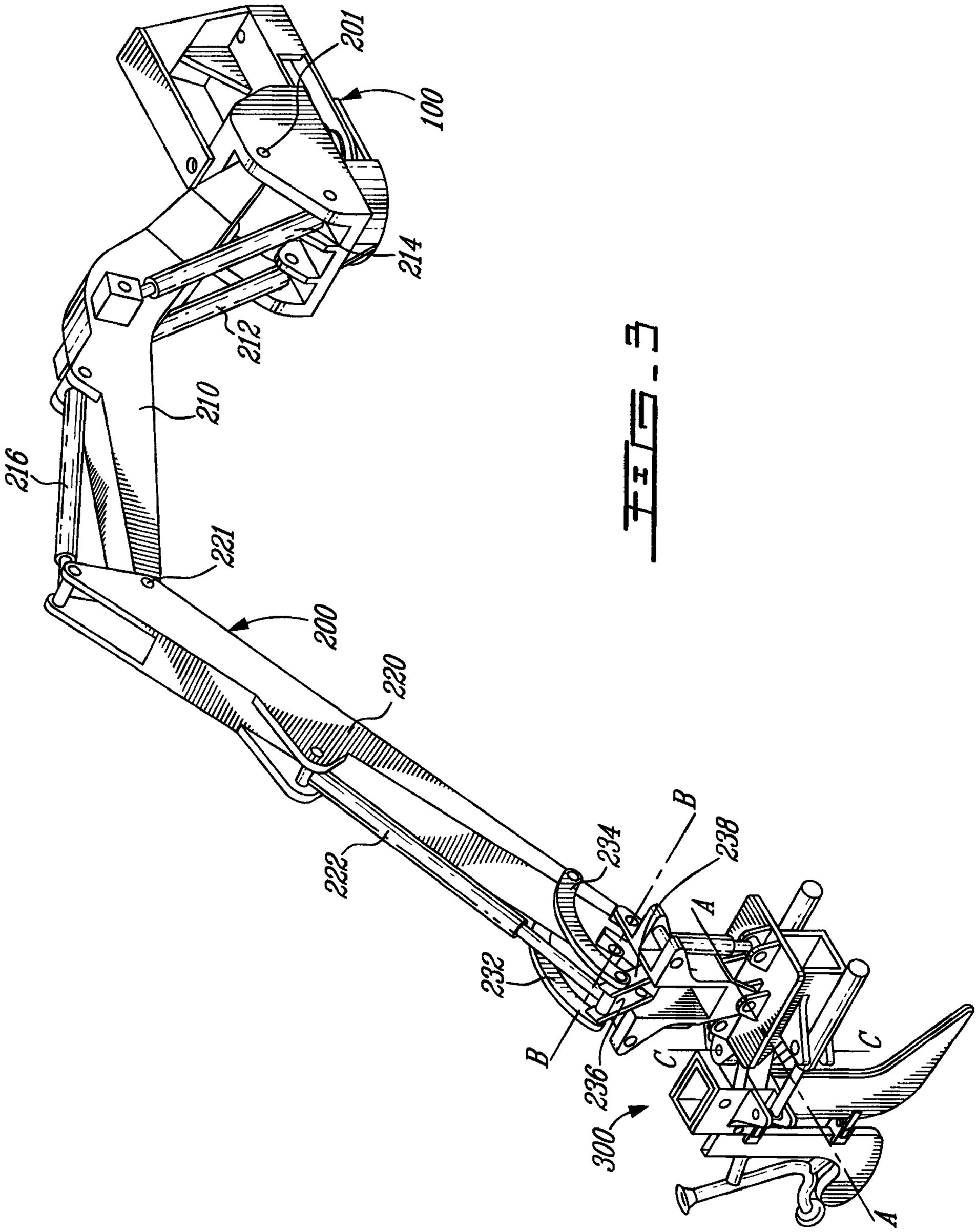
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Fig-3

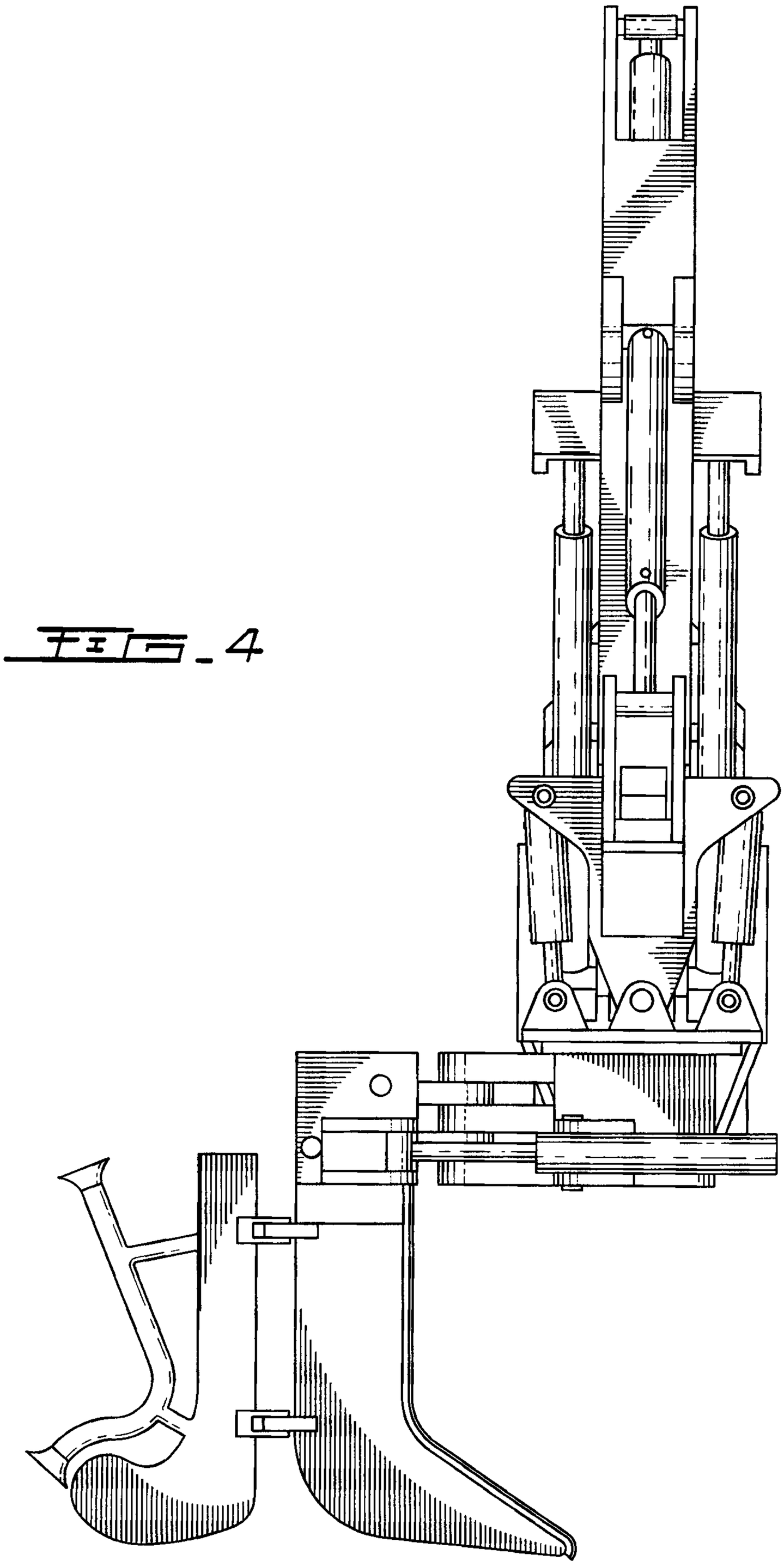

FIG_4

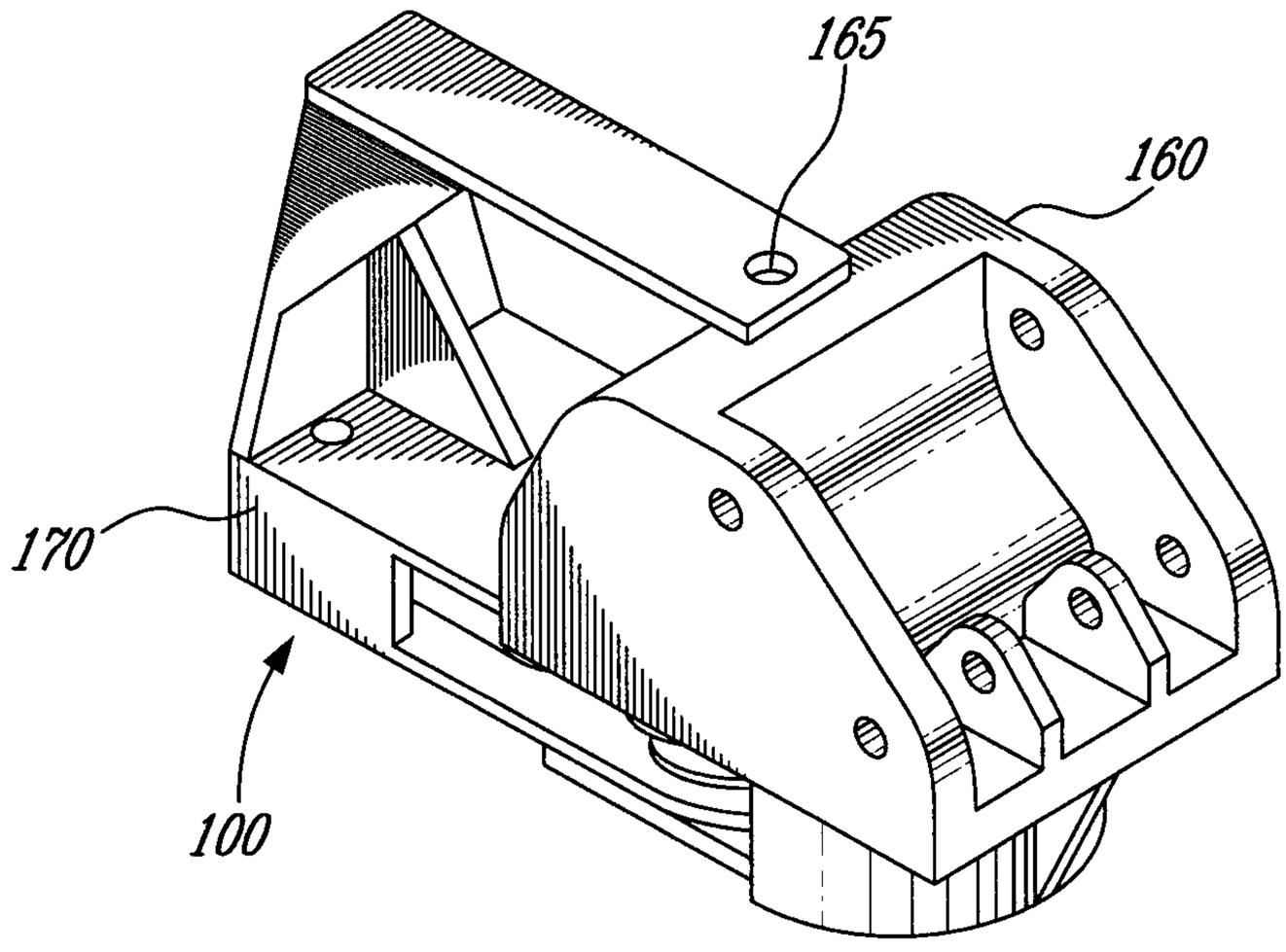

FIG_5

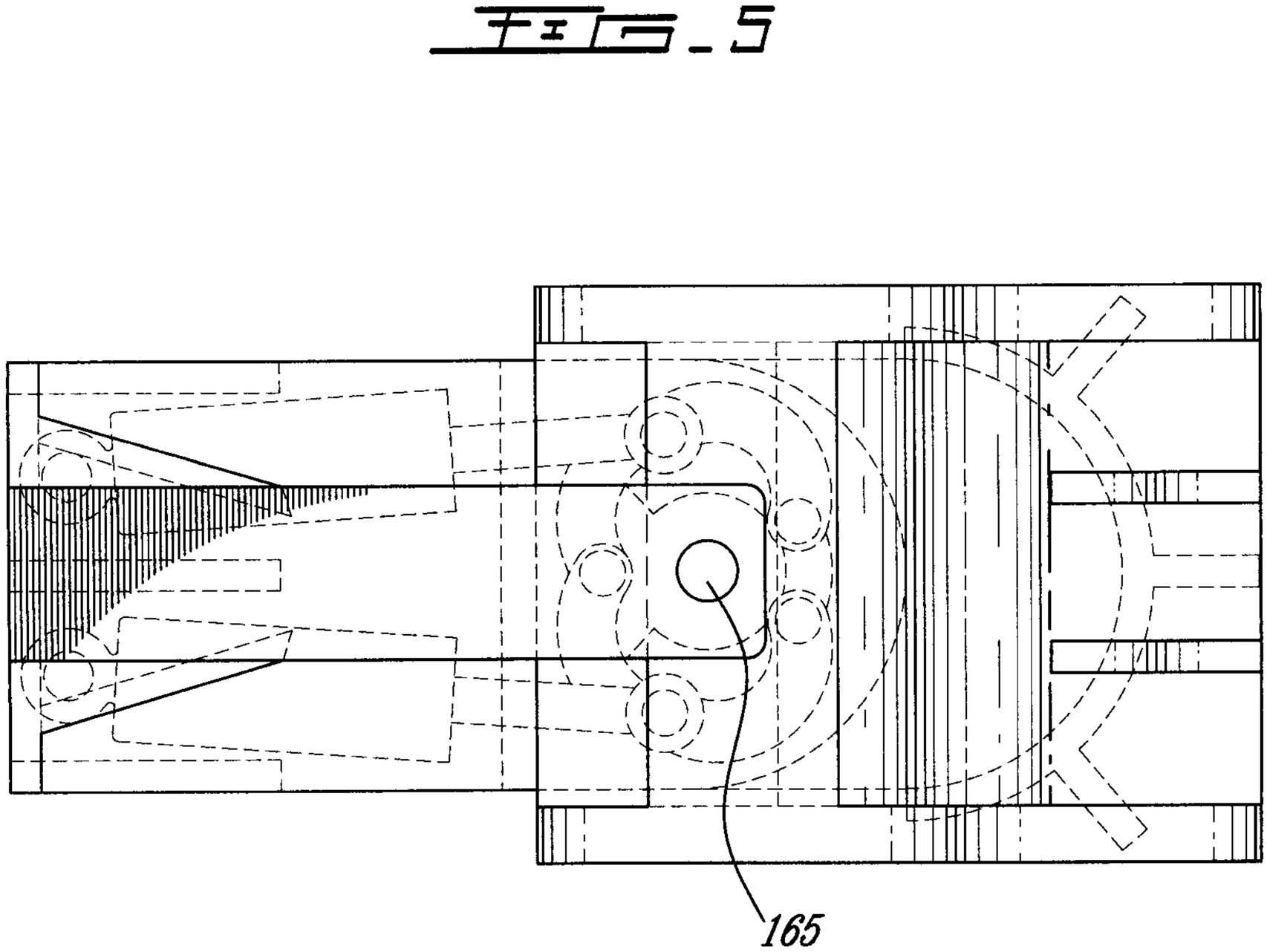

FIG_6

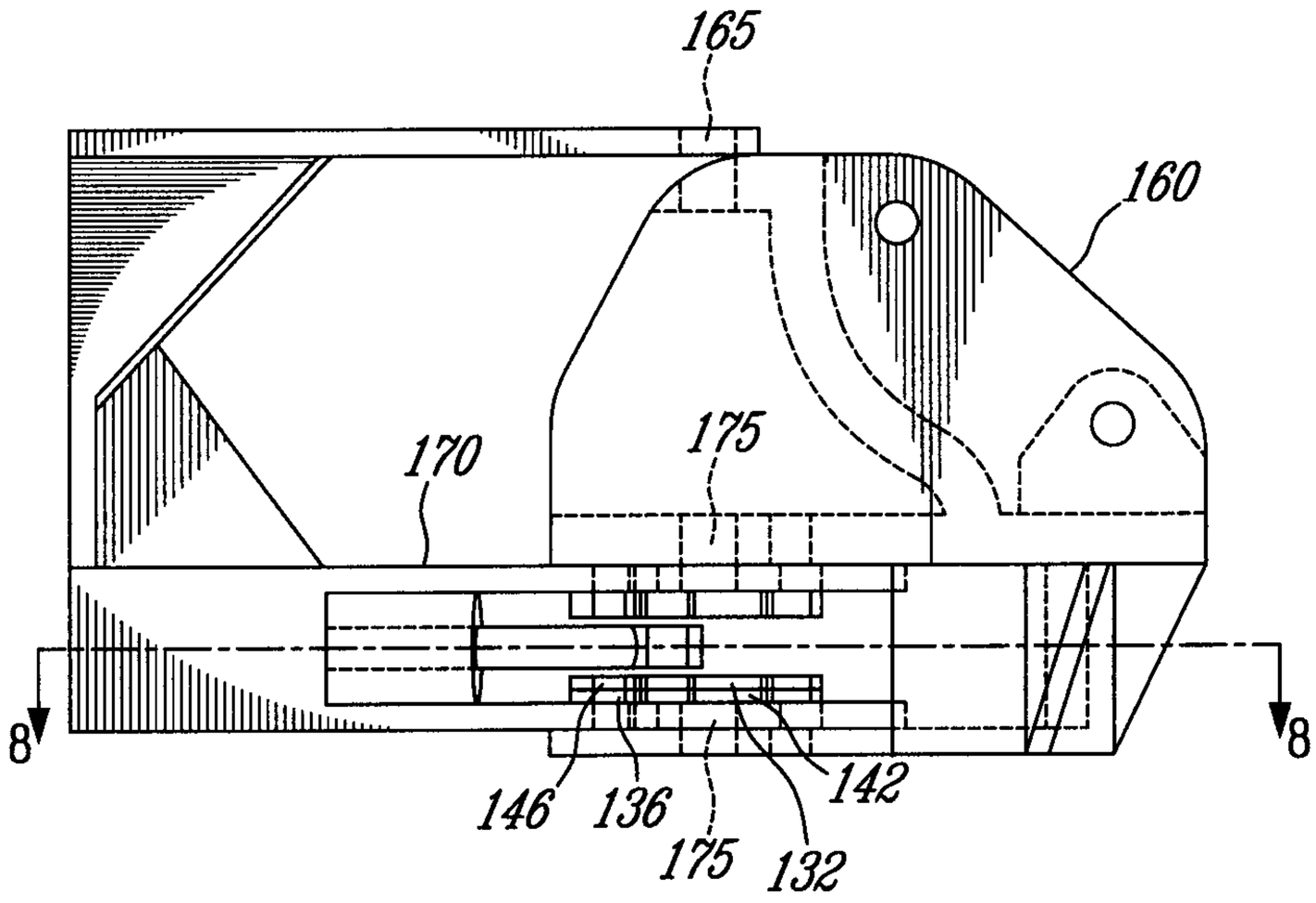
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FIG_7

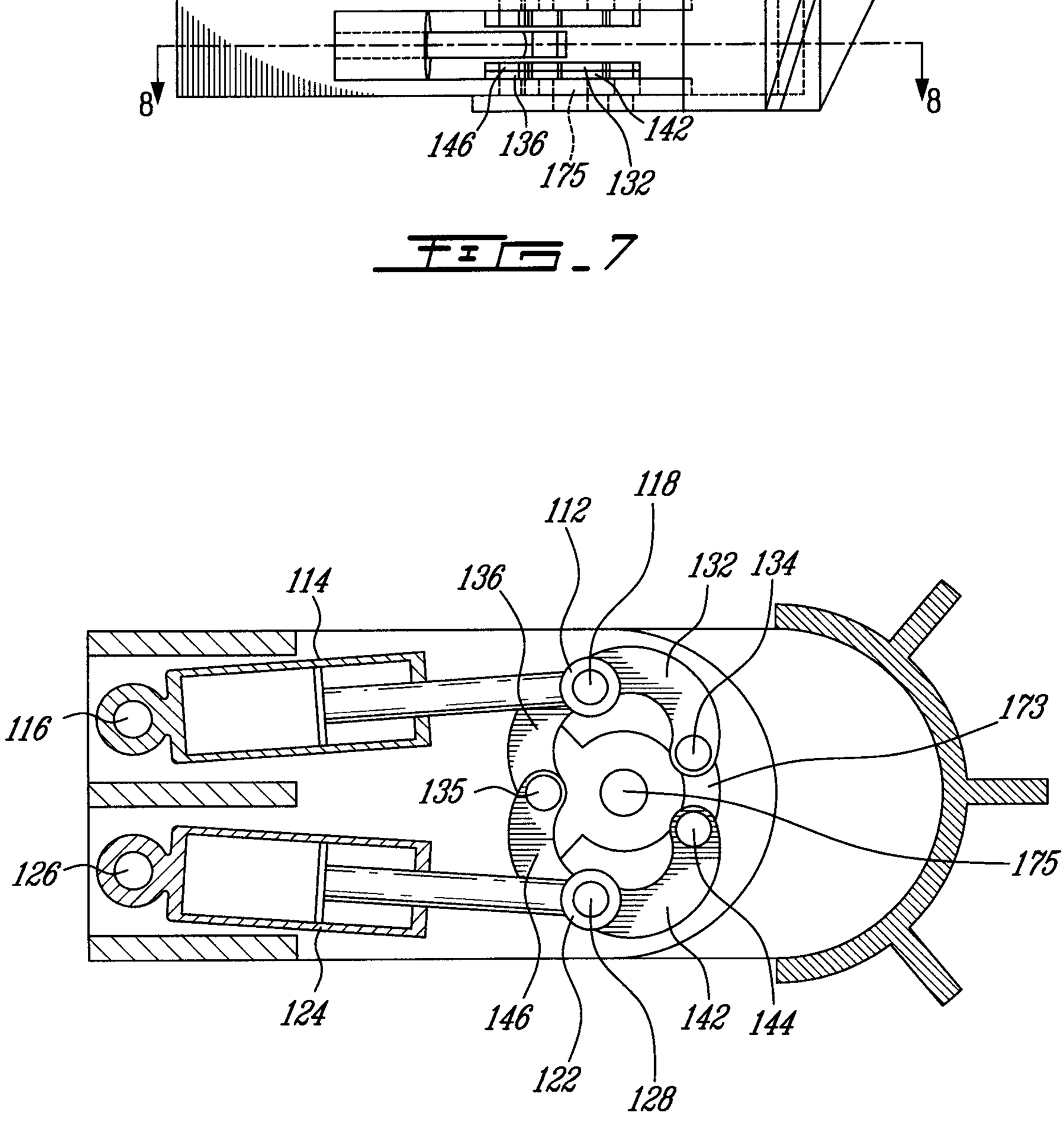
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FIG_8

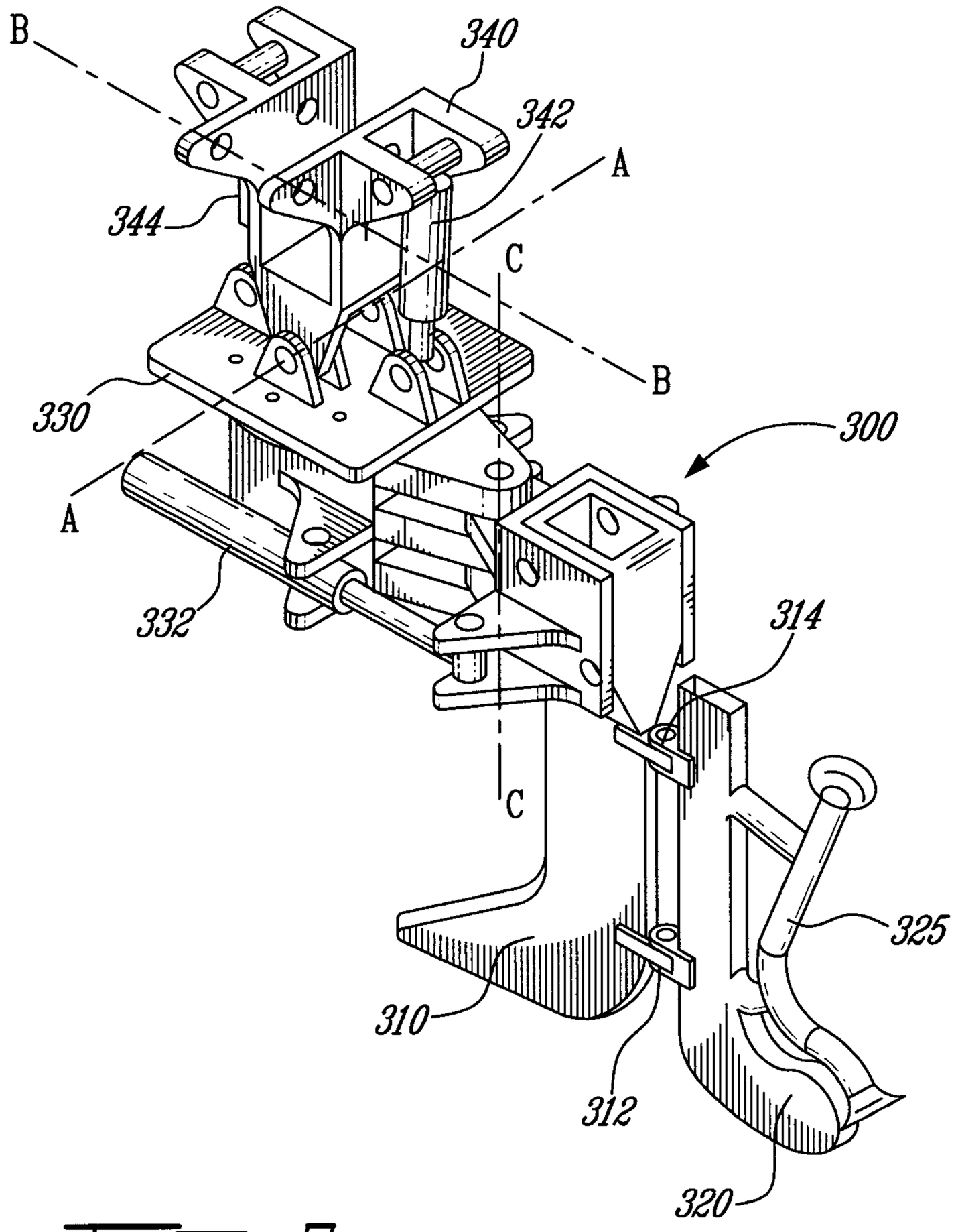


FIG. 9

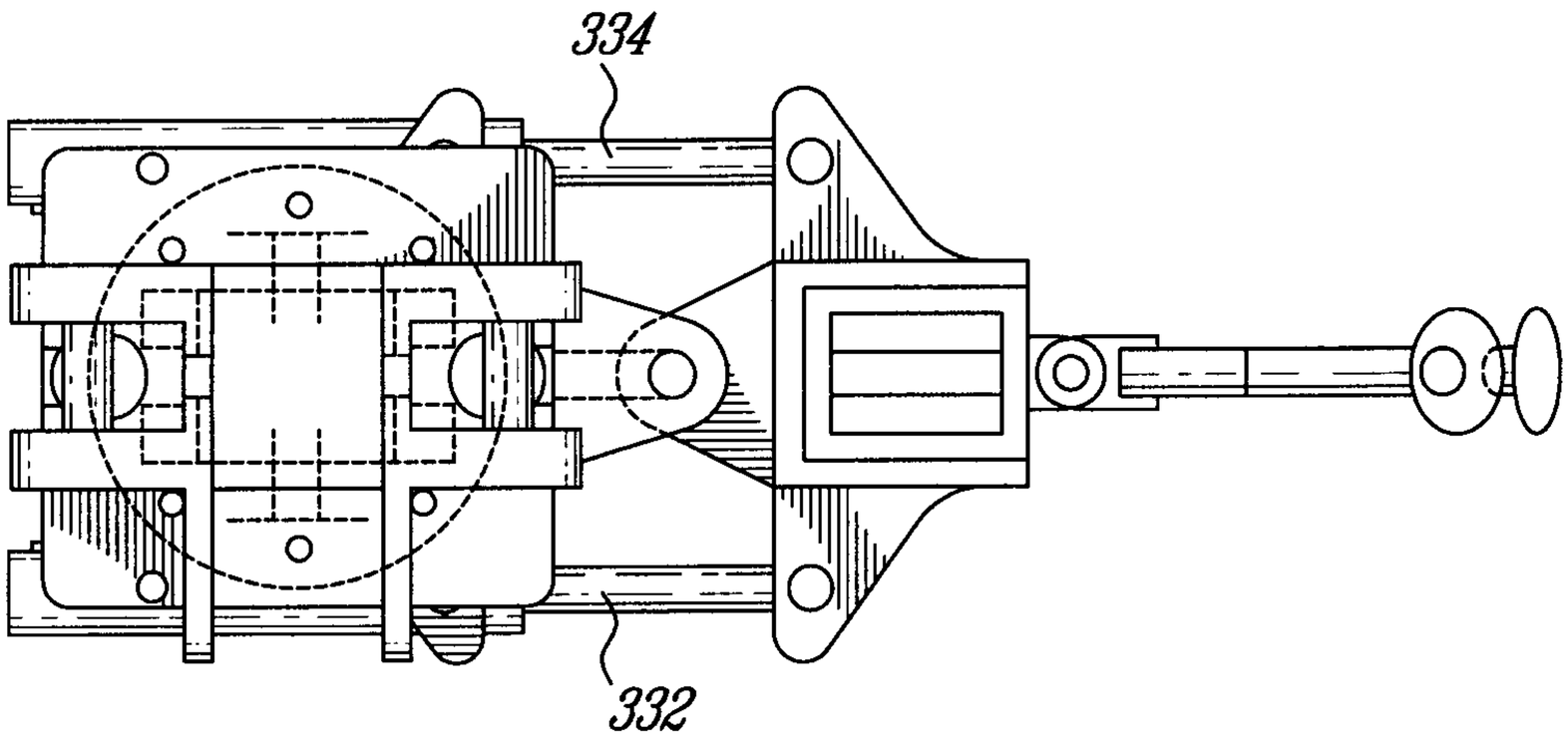


FIG_10

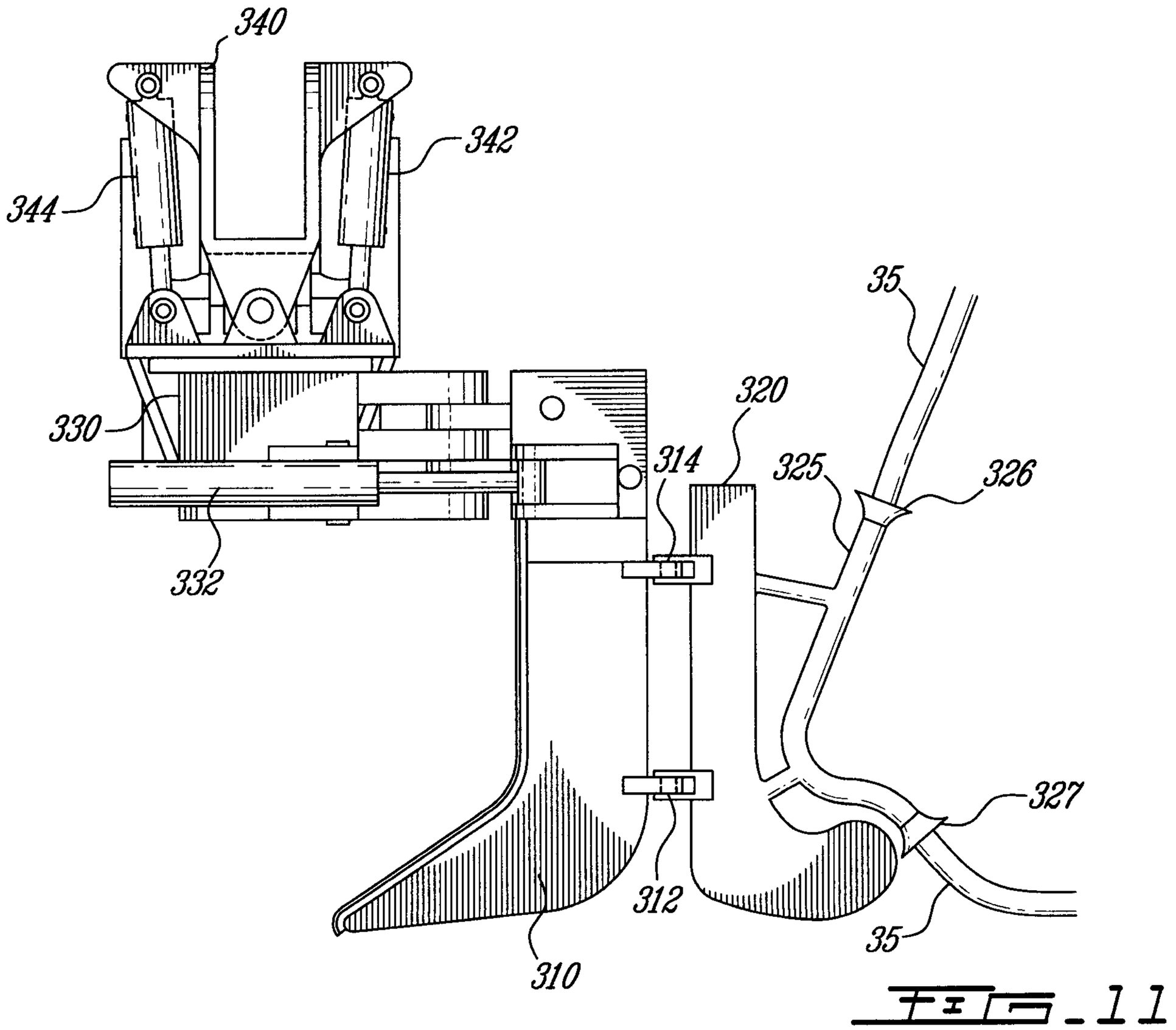


FIG_11

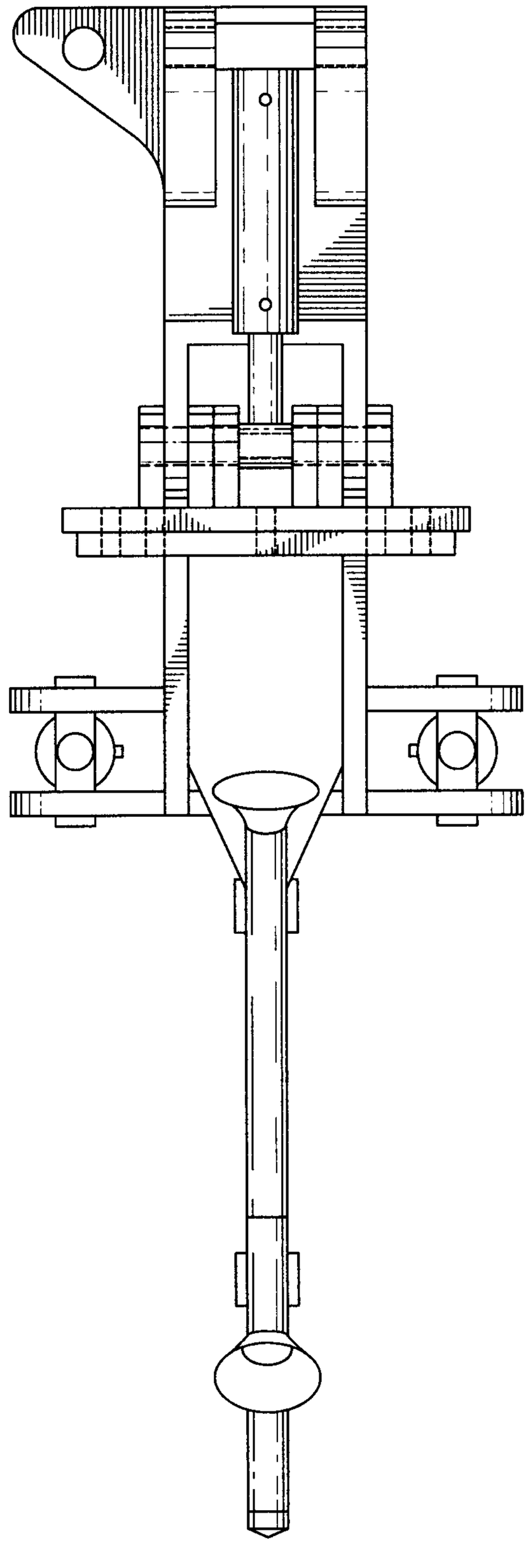
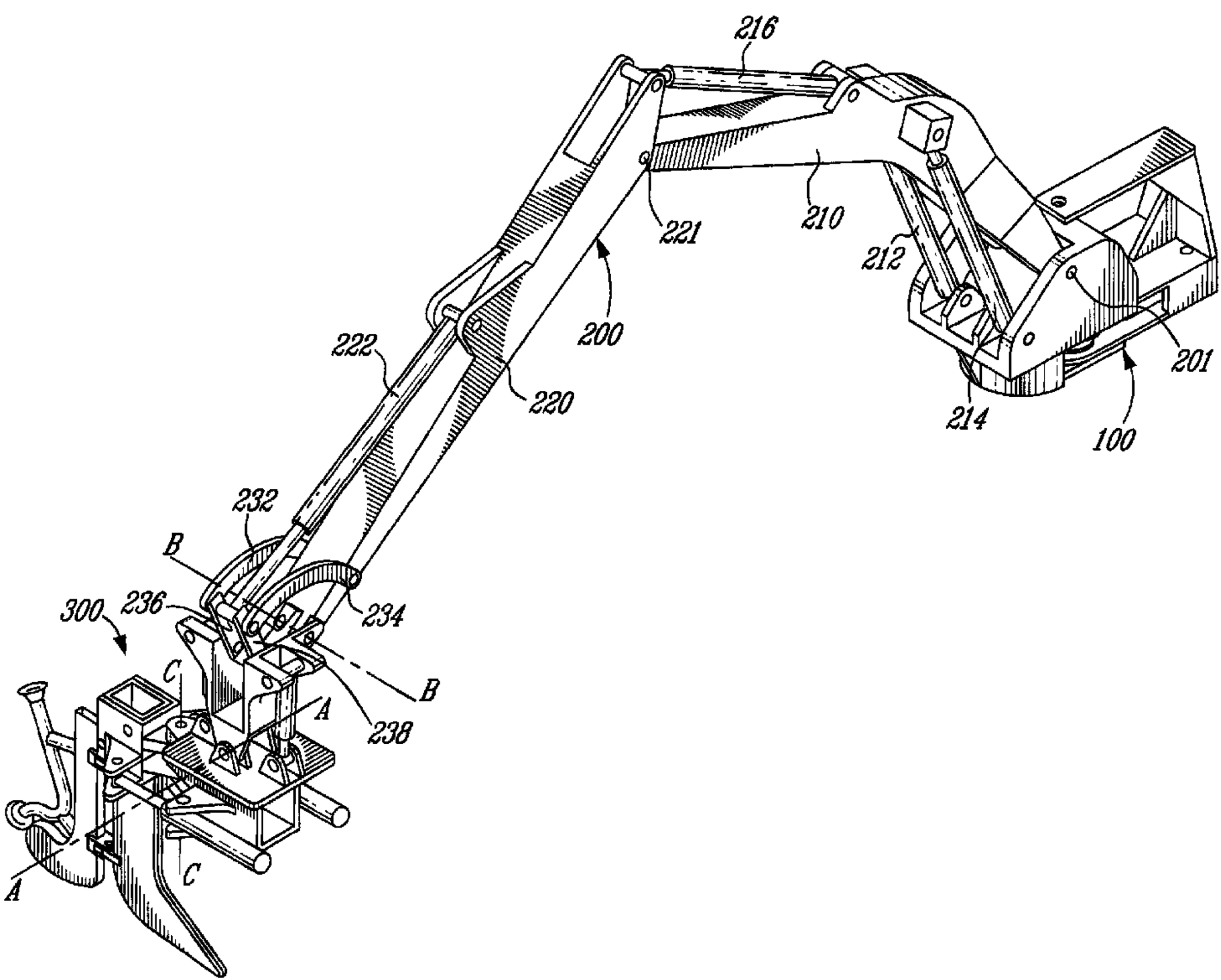


FIG_12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