



(22) Date de dépôt/Filing Date: 2008/10/01

(41) Mise à la disp. pub./Open to Public Insp.: 2010/04/01

(45) Date de délivrance/Issue Date: 2015/08/18

(51) Cl.Int./Int.Cl. *B65B 13/02* (2006.01),
B65B 27/00 (2006.01)

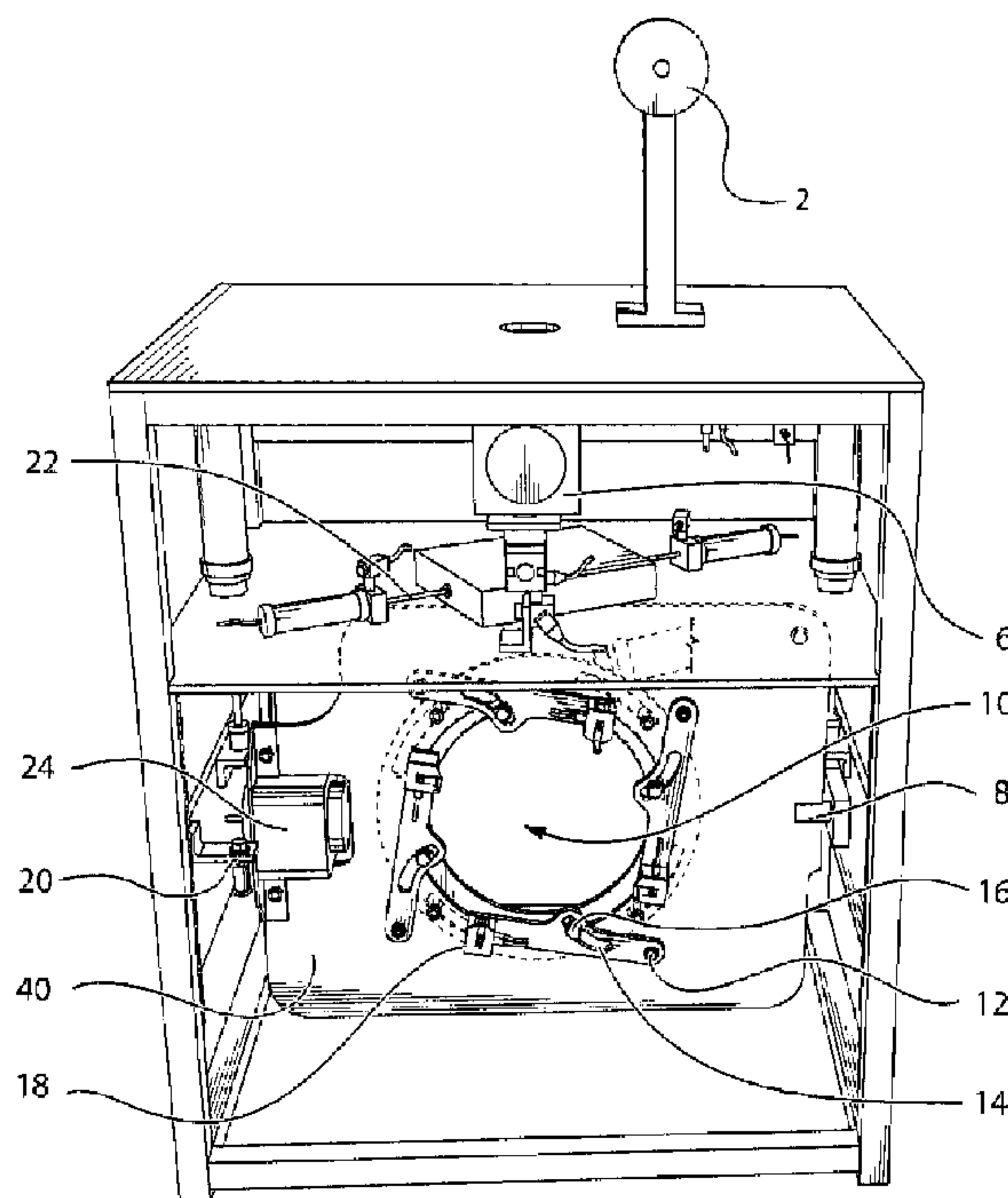
(72) Inventeurs/Inventors:
SWIFT, ROLAND, CA;
FRAIL, BRENDON, CA

(73) Propriétaire/Owner:
CUBE AUTOMATION INC., CA

(74) Agent: KERR & NADEAU

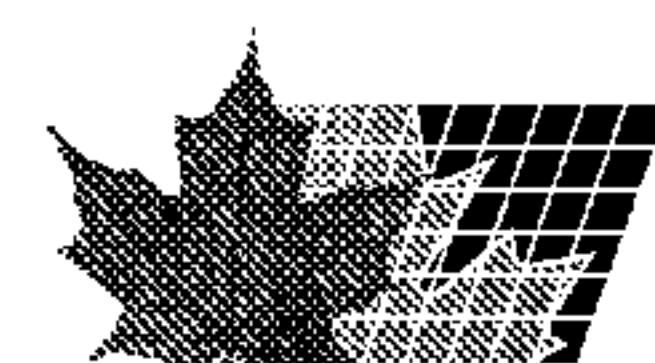
(54) Titre : MACHINE A POSER DES BANDES ELASTIQUES EN POSITION VERTICALE

(54) Title: VERTICAL BANDING MACHINE



(57) Abrégé/Abstract:

Machine for applying elastic bands onto objects comprising at least two band holding devices for receiving the elastic band from the elastic band supply mechanism; stretching the elastic band for providing a band opening surrounded by the elastic band for accommodating a plurality of objects for banding therein; and, disengaging the elastic band from the holding devices for deploying the elastic band onto the plurality of objects; an actuator coupled to the band holding devices for moving the band holding devices between a first position for receiving the elastic band and a second position for disengaging the elastic band; and, a flip mechanism having the band holding devices and the actuator mounted thereto for moving the band holding devices from a band receiving position, where the elastic band is disposed in a plane oriented substantially horizontal, to a band disengaging position, where the elastic band is disposed in a plane oriented substantially vertical, wherein in the disengaging position the band holding devices, the actuator, and the flip mechanism are disposed outside a handling space determined by projecting the band opening along a straight line through the band opening and oriented substantially perpendicular thereto.



ABSTRACT

Machine for applying elastic bands onto objects comprising at least two band holding devices for receiving the elastic band from the elastic band supply mechanism; stretching the elastic band for providing a band opening surrounded by the elastic band for accommodating a plurality of objects for banding therein; and, disengaging the elastic band from the holding devices for deploying the elastic band onto the plurality of objects; an actuator coupled to the band holding devices for moving the band holding devices between a first position for receiving the elastic band and a second position for disengaging the elastic band; and, a flip mechanism having the band holding devices and the actuator mounted thereto for moving the band holding devices from a band receiving position, where the elastic band is disposed in a plane oriented substantially horizontal, to a band disengaging position, where the elastic band is disposed in a plane oriented substantially vertical, wherein in the disengaging position the band holding devices, the actuator, and the flip mechanism are disposed outside a handling space determined by projecting the band opening along a straight line through the band opening and oriented substantially perpendicular thereto.

VERTICAL BANDING MACHINE

FIELD OF THE INVENTION

5 The present invention relates to automated material handling machines, and more particularly to a banding machine for applying elastic bands onto elongated objects.

BACKGROUND OF THE INVENTION

10 Numerous objects in agriculture or industry are combined in bundles and banded using elastic bands for shipping. In many cases these objects are of elongated nature such as, for example, asparagus, cut flowers, pipes, posts or sticks, to name a few. Typically, these objects are bundled and then hold having a horizontal orientation by one worker while another worker applies an elastic band onto the hold objects at a certain distance to one end of the objects depending on the
15 length of the same. In some instances two elastic bands are applied, placed at different locations along the objects.

US Patent 7,257,934 issued to Swift et al. teaches a banding machine comprising a mechanism for cutting elastic bands from a tubular elastic band stock, which are then disposed on fingers in
20 a gravity assisted fashion for stretching the elastic band and disposing the same onto the objects. The teachings of Swift et al. combine the production of the elastic bands - by cutting the same from the tubular elastic band stock - using a relatively simple mechanism with the mechanism for banding the objects in a single machine. Unfortunately, the finger sub-frame of the banding machine is designed for applying elastic bands on lobster claws or other short objects and does
25 not allow banding of elongated objects.

It is desirable to provide a banding machine which produces elastic bands from a tubular elastic band stock and enables provision of the elastic bands for banding of elongated objects.

30 It is also desirable to provide a banding machine which disposes the elastic bands onto the fingers in a gravity assisted fashion while the elongated objects are held having a horizontal orientation for banding in order to facilitate handling of the same.

SUMMARY OF THE INVENTION

Accordingly, one object of the present invention is to provide a banding machine which produces elastic bands from a tubular elastic band stock and enables provision of the elastic bands for banding of elongated objects.

Another object of the present invention is to provide a banding machine which disposes the elastic bands onto the fingers in a gravity assisted fashion while the elongated objects are held having a horizontal orientation for banding in order to facilitate handling of the same.

According to one aspect of the present invention, there is provided a vertical banding machine. The vertical banding machine comprises an elastic band supply mechanism for providing an elastic band in a gravity assisted fashion. Below the elastic band supply mechanism at least two band holding devices are disposed for: receiving the elastic band from the elastic band supply mechanism; stretching the elastic band for providing a band opening surrounded by the elastic band for accommodating a plurality of objects for banding therein; and, disengaging the elastic band from the holding devices for deploying the elastic band onto one or a plurality of objects. An actuator coupled to the band holding devices moves the band holding devices between a first position for receiving the elastic band and a second position for disengaging the elastic band. A flip mechanism has the band holding devices and the actuator mounted thereto for moving the band holding devices from a band receiving position, where the elastic band is disposed in a plane oriented substantially horizontal, to a band disengaging position, where the elastic band is disposed in a plane oriented substantially vertical. In the disengaging position the band holding devices, the actuator, and the flip mechanism are disposed outside a handling space determined by projecting the band opening along a straight line through the band opening and oriented substantially perpendicular thereto.

The advantage of the present invention is that it provides a banding machine which produces elastic bands from a tubular elastic band stock and enables provision of the elastic bands for banding of elongated objects.

A further advantage of the present invention is that it provides a banding machine which disposes the elastic bands onto the fingers in a gravity assisted fashion while the elongated

objects are held having a horizontal orientation for banding in order to facilitate handling of the same.

BRIEF DESCRIPTION OF THE DRAWINGS

5

A preferred embodiment of the present invention is described below with reference to the accompanying drawings, in which:

10

Figure 1A is a front view of the banding machine of one embodiment of the present invention;

Figure 1B is a cross-sectional view from one side of the banding machine of one embodiment of the present invention;

15

Figure 1C is a perspective view of the front of the banding machine of one embodiment of the present invention;

Figure 2A is a top view of the flip plate of the banding machine of one embodiment of the present invention;

20

Figure 2B is a bottom view of the flip plate of the banding machine of one embodiment of the present invention;

25

Figures 2C and 2D are perspective views of the band holding device of the banding machine of one embodiment of the present invention;

Figures 3A to 3C are perspective views of the front of the banding machine of one embodiment of the present invention at different stages of operation;

30

Figure 3D is a front view of the elastic band supply mechanism of the banding machine of one embodiment of the present invention;

Figures 3E and 3F are perspective views of the front of the banding machine of one

embodiment of the present invention at different stages of operation.

DESCRIPTION OF THE PREFERRED EMBODIMENT

Unless defined otherwise, all technical and scientific terms used herein have the same meaning as commonly understood by one of ordinary skill in the art to which the invention belongs. Although any methods and materials similar or equivalent to those described herein can be used in the practice or testing of the present invention, the preferred methods and materials are now described.

Referring to Figures 1A to 2D, a vertical banding machine 100 according to a preferred embodiment of the invention is provided, which produces elastic bands from a tubular elastic band stock and enables provision of the elastic bands for banding of elongated objects having a horizontal orientation.

As illustrated in Figures 1A to 1C, the vertical banding machine 100 comprises a frame structure 1 having in an upper portion mounted thereto an elastic band supply mechanism 3 for providing an elastic band in a gravity assisted fashion. The elastic band supply mechanism 3 receives tubing 5 made of elastic material such as, for example, rubber, but is not limited thereto, from a storage container 7 via tubing roller 2 for guiding the tubing 5 between the storage container 7 and tubing feeder 4. For example, the tubing 5 is moved a predetermined length and held using a combination of moving gripper fingers and holding gripper fingers. An elastic band is then produced by cutting a portion of the tubing having the predetermined length using a cutter assembly. It is noted, that a mechanism for moving and cutting the tubing is disclosed in US Patent 7,257,934 issued to Swift et al. After cutting, the elastic band is dropped onto band holders. An example process of the elastic band production process is described herein below with reference to Figure 3D. The gripper fingers and the cutter assembly are, for example, piston driven which are operated in a pneumatic or hydraulic or electric or electro-pneumatic fashion. Alternatively, the elastic band supply mechanism 5 comprises a mechanism for feeding elastic bands from a stock of a plurality of elastic bands.

With reference to Figure 1A, disposed below the elastic band supply mechanism 3 is an elastic band deployment mechanism as indicated by dashed lines. The elastic band deployment

mechanism comprises at least two and preferably four band holding devices 18, an actuator 19 coupled to the band holding devices 18, and a flip mechanism 11 having the band holding devices 18 and the actuator 19 mounted thereto. The band holding devices 18 receive the elastic band from the elastic band supply mechanism 3, for example, by being dropped onto respective band holders 122 after cutting; stretch the elastic band 13 for providing a band opening 15 surrounded by the elastic band 13 for accommodating one or a plurality of objects for banding therein; and disengage the elastic band 13 from the band holders 122 for deploying the elastic band 13 onto the one or plurality of objects. The actuator 19 moves the band holding devices 18 between a first position for receiving the elastic band 13 and a second position for disengaging the elastic band 13. The flip mechanism 11 moves the band holding devices 18 from a band receiving position - the elastic band 13 opening being disposed in a plane oriented substantially horizontal - to a band disengaging position - the elastic band 13 opening being disposed in a plane oriented substantially vertical. Figures 1A and 1B illustrate the band holding devices 18 in the band disengaging position. In the band disengaging position the band holding devices 18, the actuator 19 and the flip mechanism 11 are disposed outside a handling space 21 approximately determined by projecting the band opening 15 along a straight line 17 through the band opening 15 and oriented substantially perpendicular to a plane of the band opening 15. Provision of the handling space 21 enables deployment of the elastic band 13 at any location along elongated objects. As illustrated in Figure 1C, the flip mechanism 11 comprises a flip plate 40 which is rotationally movably mounted to the frame 1 such that the flip plate 40 is oriented substantially horizontal in the band receiving position and is oriented substantially vertical in the band disengaging position. The rotational movement is provided on one side of the flip plate 40, for example, using a pneumatically (hydraulically or electrically or electro-pneumatically) driven 90 degree rotary actuator 24, which is available as a standard off-the-shelf unit, while the opposite side of the flip plate 40 is freely rotationally movably mounted using, for example, a rotation pin accommodated in rotation block 8 made of, for example, a type of industrial plastic such as Acetron®. Alternatively, an electric drive is employed for providing the rotational movement. The rotary actuator 24 and the rotation block 8 are vertically movably mounted to the frame 1 using, for example, guide rails and a gear drive such as a toothed wheel interacting with a toothed rack or one of a hydraulic, pneumatic or electro-pneumatic piston, enabling vertical movement of the flip plate 40 between the band receiving position and the band disengaging position. Alternatively, the vertical movement of the flip plate 40 is omitted by enabling sufficient vertical movement, for example, of the band holders 122 leaving sufficient distance

between the flip plate 40 to the elastic band supply mechanism 3 for enabling rotation of the flip plate 40.

Referring to Figures 2A to 2D, a preferred embodiment of the flip plate 40, the band holding devices 18, and the actuator 19 according to the invention is provided. The flip plate 40 is made, for example, from an aluminum plate having a predetermined thickness to provide sufficient support and stiffness using standard computer controlled processes of cutting, milling and drilling. Optionally, the flip plate 40 is made of a material other than aluminum such as, for example, stainless steel or composite material. The flip plate 40 comprises a flip plate opening 10 which is sufficiently large for accommodating the band opening 15 therein. As shown in Figure 2A, the actuator 19 preferably comprises four swing arms 96. Each swing arm 96 has at a first end portion the band holding device 18 mounted thereto and is rotatably mounted to the flip plate 40 at a second opposite end portion via swing arm rotation pin 12. Swing arm slot 14 is a curved cam like slot disposed between the first end portion and the second end portion of the swing arm 96. The swing arm slot 14 interacts with swing arm guide pin 16, which is mounted to rotation ring 101 and freely movable accommodated in the swing arm slot 14. As illustrated in Figure 2B, the rotation ring 101 is mounted to the flip plate 40 via four rotation ring mounting pins 102, which are affixed to the flip plate 40 and freely movable accommodated in rotation ring slots 104. A rotation piston 92 is coupled to the rotation ring 101 via rotation piston clevis attachment bolt 103 to transmit linear motion of the piston 92 into rotational motion of the rotation ring 101. The rotation piston 92 is driven, for example, in a pneumatic or hydraulic or electro- pneumatic fashion. Movement of the rotation piston 92 causes the rotation ring 101 to rotate, which in turn causes the swing arm guide pins 16 to move in the respective swing arm slots 14 causing the swing arms 96 to rotate about the swing arm rotation pins 12 for moving the band holding devices 18 towards the center of the opening 10 for receiving the elastic band or opposite for stretching and deploying the elastic band. As illustrated in Figure 2B, the rotation ring slots 104 are curved such that, in concert with the rotation ring mounting pins 102, a rotating movement of the rotation ring 101 is enabled. Furthermore, the rotation ring slots 104 have a predetermined length such that movement of the band holding devices 18 between the first position for receiving the elastic band and the second position for disengaging the elastic band is enabled. Optionally, the rotational movement of the rotation ring 101 - and consequently the movement of the band holding devices 18 - is reduced by inserting a stop pin 105 into a predisposed threaded insertion opening in the flip plate 40 and accommodated in the respective

rotation ring slot 104, thus limiting the stretching of the elastic band 13 and the corresponding elastic band opening 15. The swing arms 96 and the rotation ring 101 are made, for example, from aluminum plates having a predetermined thickness to provide sufficient support and stiffness using standard computer controlled processes of cutting, milling and drilling.

5 Optionally, the swing arms 96 and the rotation ring 101 are made of a material other than aluminum such as, for example, stainless steel or composite material. The swing arm slots 14 and the rotation ring slots 104 are designed in dependence upon the number of swing arms employed and a given maximum size of the band opening 15 using standard gear engineering technology. The rotation ring 101 is mounted to the flip plate 40 via the rotation ring mounting
10 pins 102, for example, by disposing a pair of washers having an outside diameter larger than a width of the rotation ring slots 104 on each of the rotation ring mounting pins 102 such that one washer is disposed on each side of the rotation ring 101 and hold in place using a nut interacting with a threaded end portion of the rotation ring mounting pins 102. The rotation ring mounting pins 102 are, for example, steel bolts having threaded two end portions, one threaded end portion
15 for interfacing the nut and the other end portion for interfacing a threaded bore disposed in the flip plate 40. As illustrated in Figure 2B, guide bushing 106 made, for example, of a low friction plastic material, is disposed surrounding the swing arm guide pins 16 where accommodated in the respective swing arm slots 14 for providing a roller movement between the swing arm slots 14 and the swing arm guide pins 16, thus reducing wear.

20 As illustrated in Figures 2A and 2B, four swing arms 96 are preferably equally disposed around the opening 10, but the embodiments of the invention are not limited thereto. Depending on the shape of the band holders 122 and the size and shape of a desired band opening 15, different numbers – two or more – of swing arms 96 are employed. Furthermore, other than four rotation
25 ring mounting pins 102 are employed.

Alternatively, an electric drive is employed for rotating the rotation ring 101, for example, by replacing the rotation piston 92 with a toothed gear drive comprising a driven toothed wheel interacting with a toothed surface disposed on a respective section of the rotation ring 101.

30 Further alternatively, each swing arm 96 is actuated using a separate drive, for example, by rotatable mounting the swing arm 96 to the flip plate 40 at a predetermined location between the first end portion and the second end portion and coupling a piston drive to the second end

portion.

Referring to Figures 2C and 2D, a preferred embodiment of the band holding devices 18 according to the invention is provided. The band holder 122 is mounted to band holder piston rod 120 of band holder piston drive 124. The band holder piston drive 124 provides linear movement to the band holder 122. The band holder piston drive 124 is implemented, for example, using an off-the-shelf pneumatic or hydraulic or electro-pneumatic compact piston drive. The band holder 122 comprises a first portion mounted to the band holder piston rod 120. The first portion of the band holder 122 is oriented substantially perpendicular to a longitudinal axis of the band holder piston rod 120. A second portion is oriented substantially parallel to the longitudinal axis of the band holder piston rod 120. The band holder 122 comprises slightly rounded edges 128 where in contact with the elastic band 13, as well as a push off clearance groove 130 for accommodating a portion of push off pin 126 therein. The first portion of the band holder 122 comprises an opening for enabling movement of the push off pin 126 therethrough. The push off pin 126 – for example, a stainless steel pin - is welded to push off mount 125, which is mounted to the band holder piston drive 124. The elastic band 13 is dropped onto the band holder 122 and during stretching the elastic band is in contact with the second portion of the band holder 122. During receipt and stretching, the band holder piston rod 120 is disposed in an extended position such that the push off pin 126 is placed outside the second portion of the band holder 122. During deployment of the elastic band the band holder piston rod 120 is retracted causing the push off pin 126 to move into the push off clearance groove 130, therefore, pushing the elastic band off the second portion of the band holder 122. The slightly rounded edges 128 are provided to prevent cutting of the elastic band during stretching and deployment.

Optionally, the second portion of the band holder 122 is widened such that a sufficiently large band opening 15 is provided when using only two band holding devices 18.

Alternatively, the band holder 122 is fixedly mounted while the push off pin 126 is movable.

Referring to Figures 3A to 3F, operation of the preferred embodiment of the band machine 100 according to the invention is described herein below. Figure 3A illustrates the banding machine 100 after deployment of the elastic band and rotation of the flip plate 40 into a horizontal

oriented position. Stopper 42 made of, for example, a rubber material abuts the flip plate 40 after the 90 degree rotation and provides a cushioned stop thereto. The band holding devices 18 - still in the deployment position – are then moved to the band receiving position with the second portion of the band holders 122 being disposed in close proximity to each other, and the band holder piston rod 120 being disposed in an extended position, as illustrated in Figure 3B. The flip plate 40 is then moved vertically towards the elastic band supply mechanism 3 for receiving the elastic band there from. The tubing 5 is moved a predetermined length using moving gripper fingers 150 and then hold using holding gripper fingers 152 for preventing the tubing from any movement, for example, from being pulled back into the storage container. Using cutter assembly 154 a portion of the tubing 5 having the predetermined length is then cut off producing the elastic band 13, which is then dropped onto the band holders 122, as illustrated in Figure 3D. After receipt of the elastic band, the flip plate 40 is lowered while the band holding devices 18 are moved outward for stretching the elastic band, as illustrated in Figure 3E. After reaching a predetermined vertical position which provides a sufficient distance to the elastic band supply mechanism 3 for rotation, the flip plate 40 is rotated 90 degrees into a vertical oriented position while the band holding devices 18 are moved outward to the elastic band deployment position providing a sufficiently large band opening 15 for banding, as illustrated in Figure 3F. After deployment of the elastic band, for example, as described herein above with reference to Figures 2C and 2D, the flip plate 40 is rotated 90 degrees into the horizontal position, as illustrated in Figure 3A.

The Figures 3A to 3F illustrate a sequence of snapshots of the operation of the banding machine 100. The various movements of the components are, for example, combined such that the rotation of the flip plate 40, the vertical movement of the flip plate 40 and the movement of the band holding devices 18 are executed in a simultaneous fashion. Alternatively, the various movements are executed successively. As described herein above, the various movements are actuated using pneumatic, hydraulic, electric and/or electro-pneumatic drives, which are controlled using a control system made of standard off-the-shelf components for controlling the pneumatic (or hydraulic, electric and/or electro-pneumatic) action in combination with a processor.

The present invention has been described herein with regard to preferred embodiments. However, it will be obvious to persons skilled in the art that a number of variations and

modifications can be made without departing from the scope of the invention as described herein.

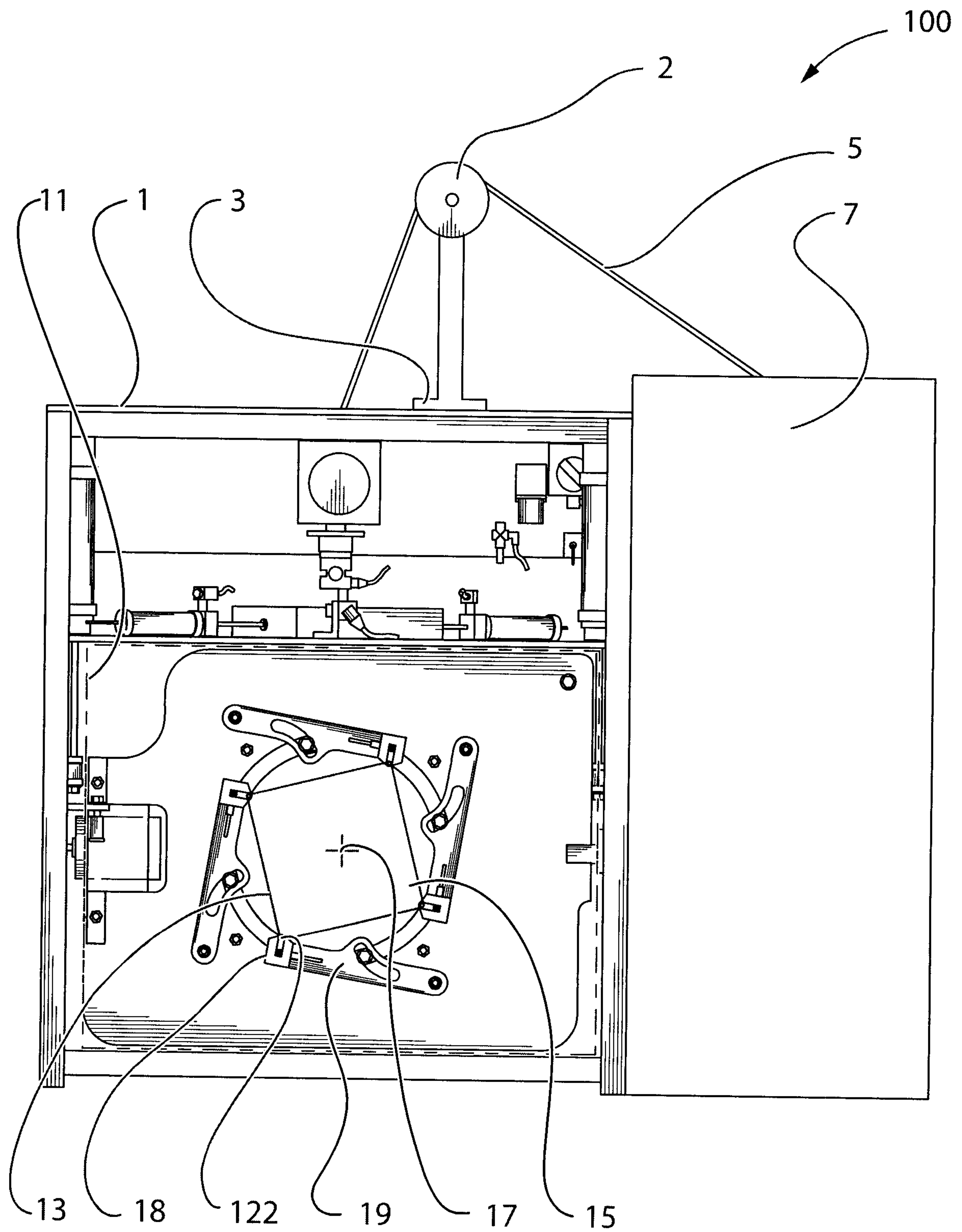
THE EMBODIMENTS OF THE INVENTION IN WHICH AN EXCLUSIVE PROPERTY OR PRIVILEGE IS CLAIMED ARE DEFINED AS FOLLOWS:

1. A vertical banding machine comprising:
an elastic band supply mechanism for providing an elastic band in a gravity assisted fashion;
at least two band holding devices for:
receiving the elastic band from the elastic band supply mechanism;
stretching the elastic band for providing a band opening surrounded by the elastic band for accommodating a plurality of objects for banding therein; and,
disengaging the elastic band from the holding devices for deploying the elastic band onto the plurality of objects;
an actuator coupled to the band holding devices for moving the band holding devices between a first position for receiving the elastic band and a second position for disengaging the elastic band; and,
a flip mechanism having the band holding devices and the actuator mounted thereto for moving the band holding devices from a band receiving position, where the elastic band is disposed in a plane oriented substantially horizontal, to a band disengaging position, where the elastic band is disposed in a plane oriented substantially vertical, wherein in the disengaging position the band holding devices, the actuator, and the flip mechanism are disposed outside a handling space determined by projecting the band opening along a straight line through the band opening and oriented substantially perpendicular thereto.
2. A vertical banding machine as defined in claim 1 wherein the flip mechanism comprises a flip plate having the band holding devices and the actuator mounted thereto, the flip plate comprising a flip plate opening which is sufficiently large for accommodating the band opening therein.
3. A vertical banding machine as defined in claim 2 wherein the flip plate is rotational movable mounted to a frame such that the flip plate is oriented substantially horizontal in the band receiving position and is oriented substantially vertical in the band disengaging position.
4. A vertical banding machine as defined in claim 3 comprising a 90 degree rotary actuator

for providing rotational movement to the flip plate.

5. A vertical banding machine as defined in claim 3 wherein the elastic band supply mechanism is mounted to a top portion of the frame and wherein the flip plate is vertical movable between the band receiving position and the band disengaging position.
6. A vertical banding machine as defined in claim 2 wherein the actuator comprises at least two swing arms, each swing arm having a band holding device mounted thereto at a first end portion and being rotatable mounted to the flip plate at a second opposite end portion.
7. A vertical banding machine as defined in claim 6 wherein the actuator comprises a rotation ring rotational movable mounted to the flip plate having at least two swing arm guide pins mounted thereto, each swing arm guide pin being movable interfaced with a curved swing arm slot disposed in the respective swing arm such that rotational movement of the rotation ring causes movement of the band holding devices between the first position and the second position.
8. A vertical banding machine as defined in claim 1 wherein each of the band holding devices comprises:
 - a band holder for holding the elastic band;
 - a push member for disengaging the elastic band from the band holder; and,
 - a push actuator mounted to one of the band holder and the push member for providing relative movement between the band holder and the push member.
9. A vertical banding machine as defined in claim 1 wherein the elastic band supply mechanism comprises:
 - a first gripper for holding a tubing made of elastic band material;
 - a second gripper for moving the tubing a predetermined length; and,
 - a cutter for cutting a portion of the tubing having the predetermined length, the predetermined portion forming the elastic band.
10. A vertical banding machine as defined in claim 9 wherein the elastic band supply mechanism comprises a tubular guide and a tubing roller for guiding the tubing from a

supply container to the first gripper.

**FIG. 1A**

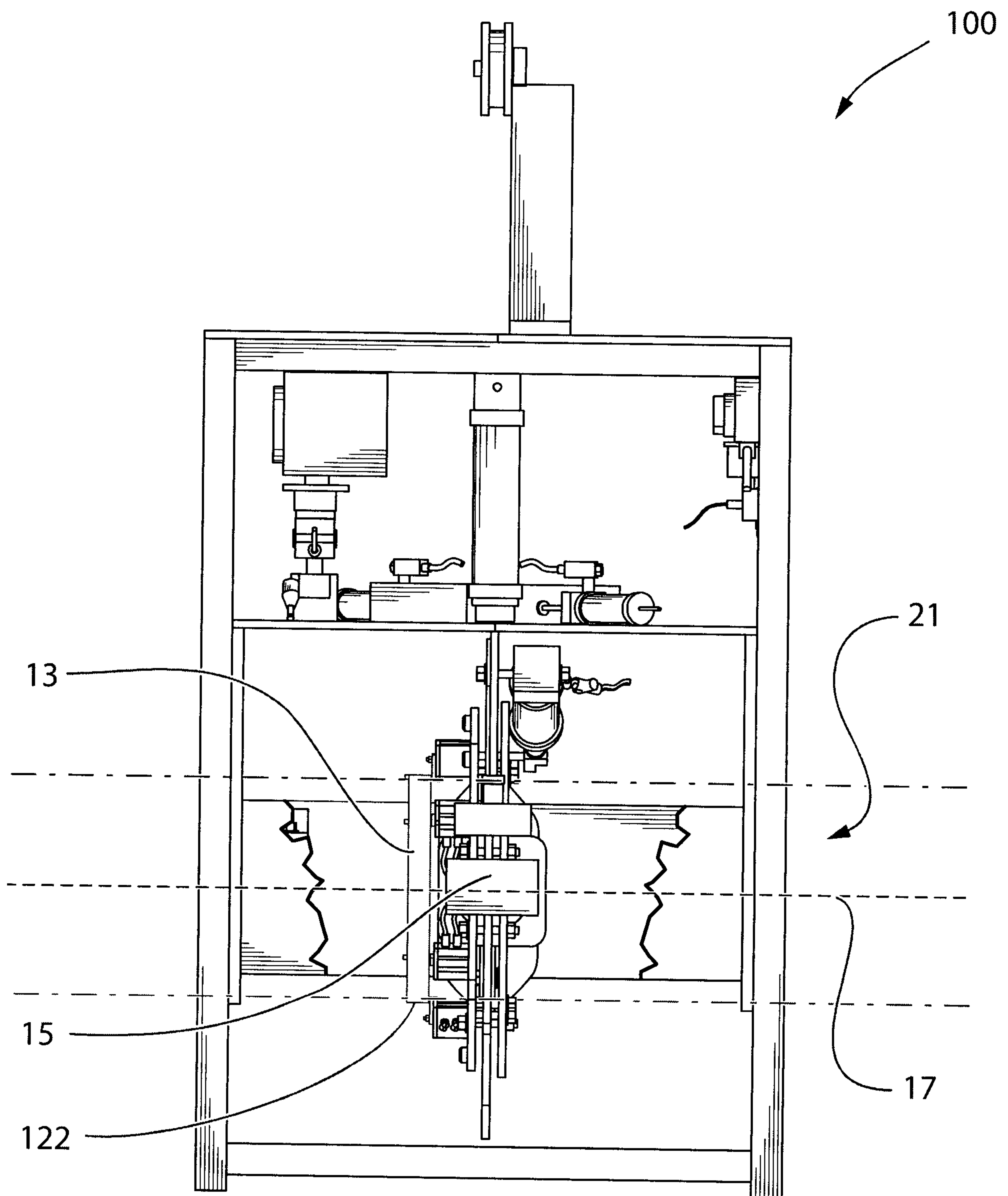
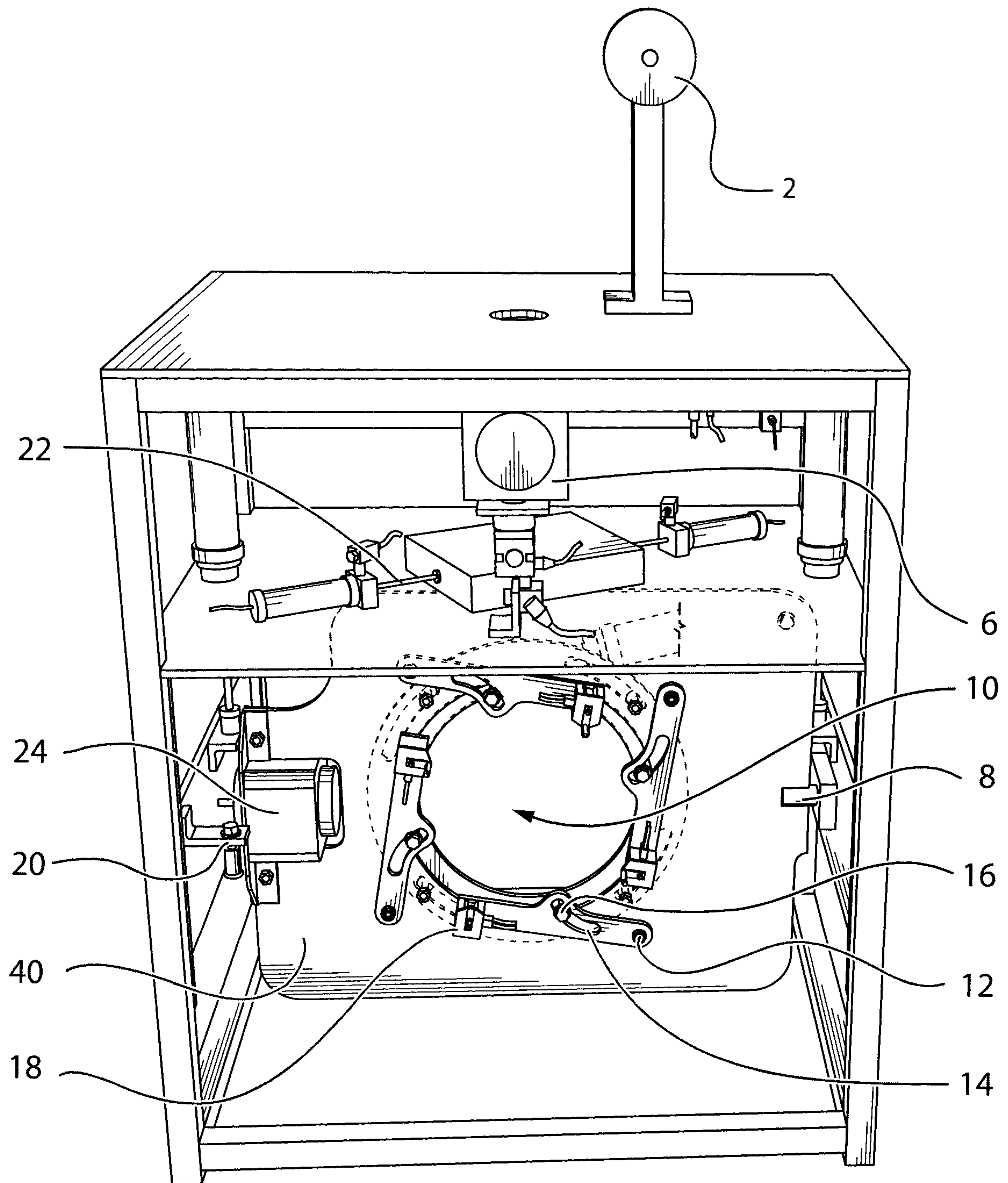


FIG. 1B

**FIG. 1C**

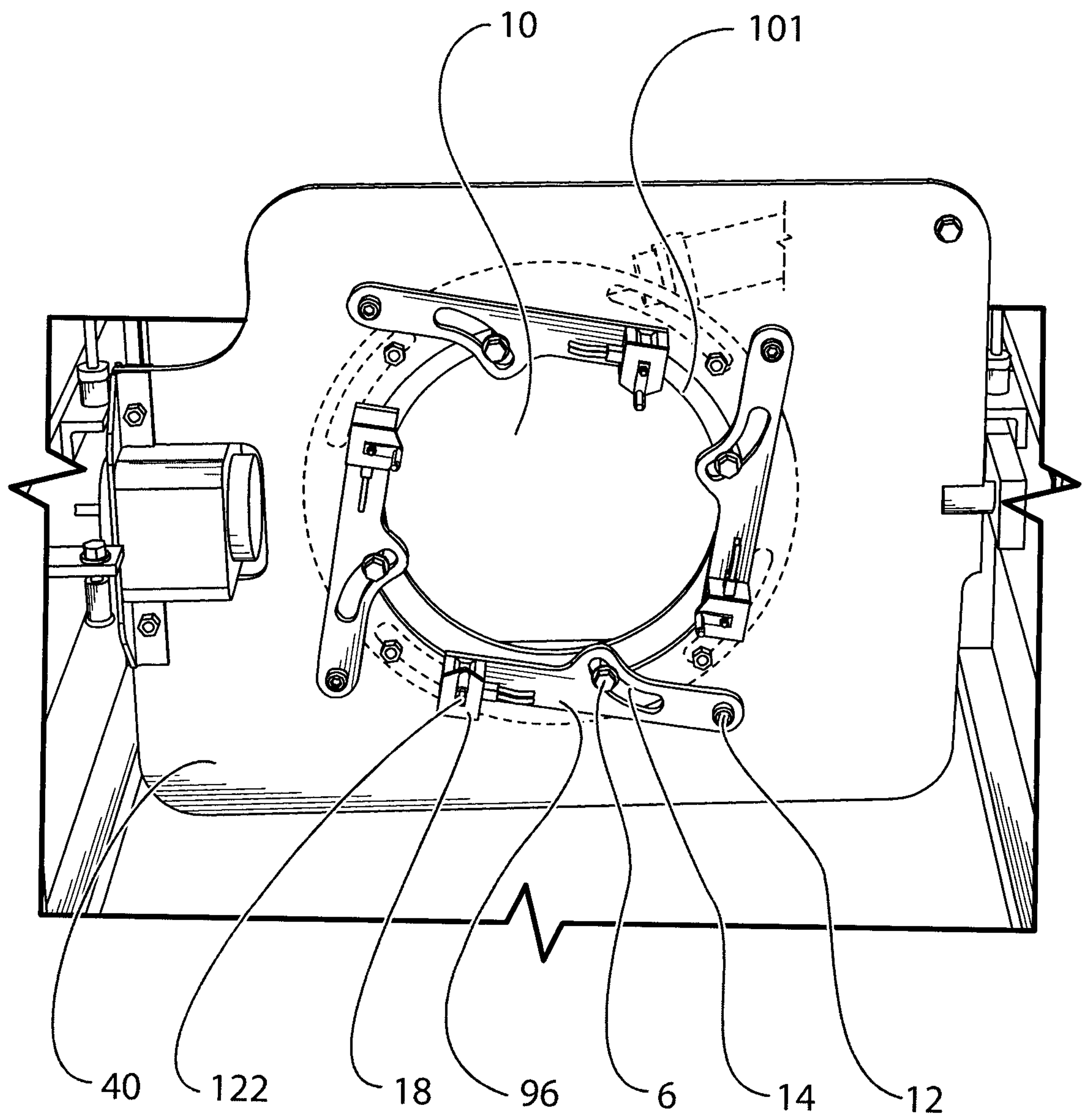


FIG. 2A

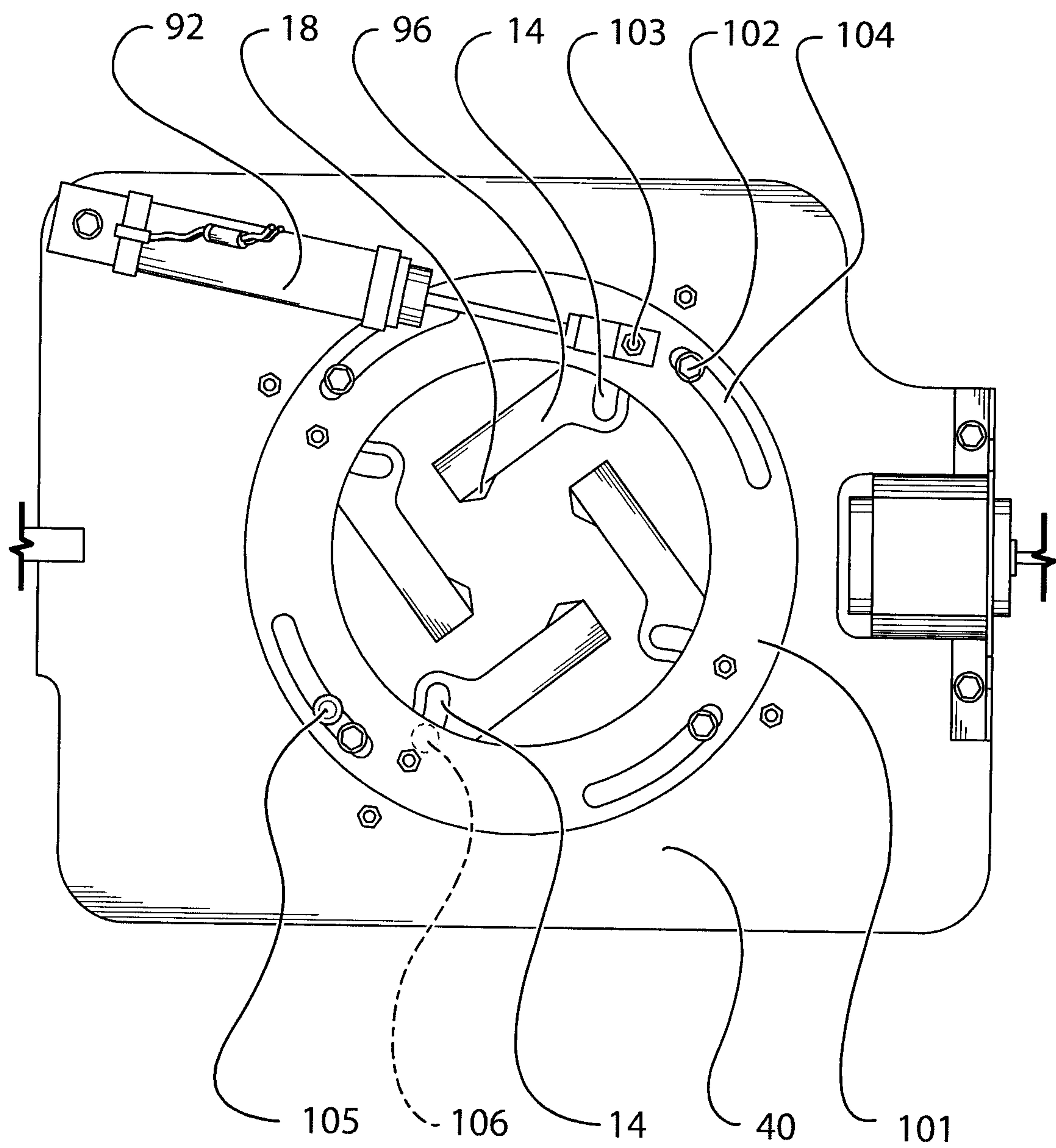


FIG. 2B

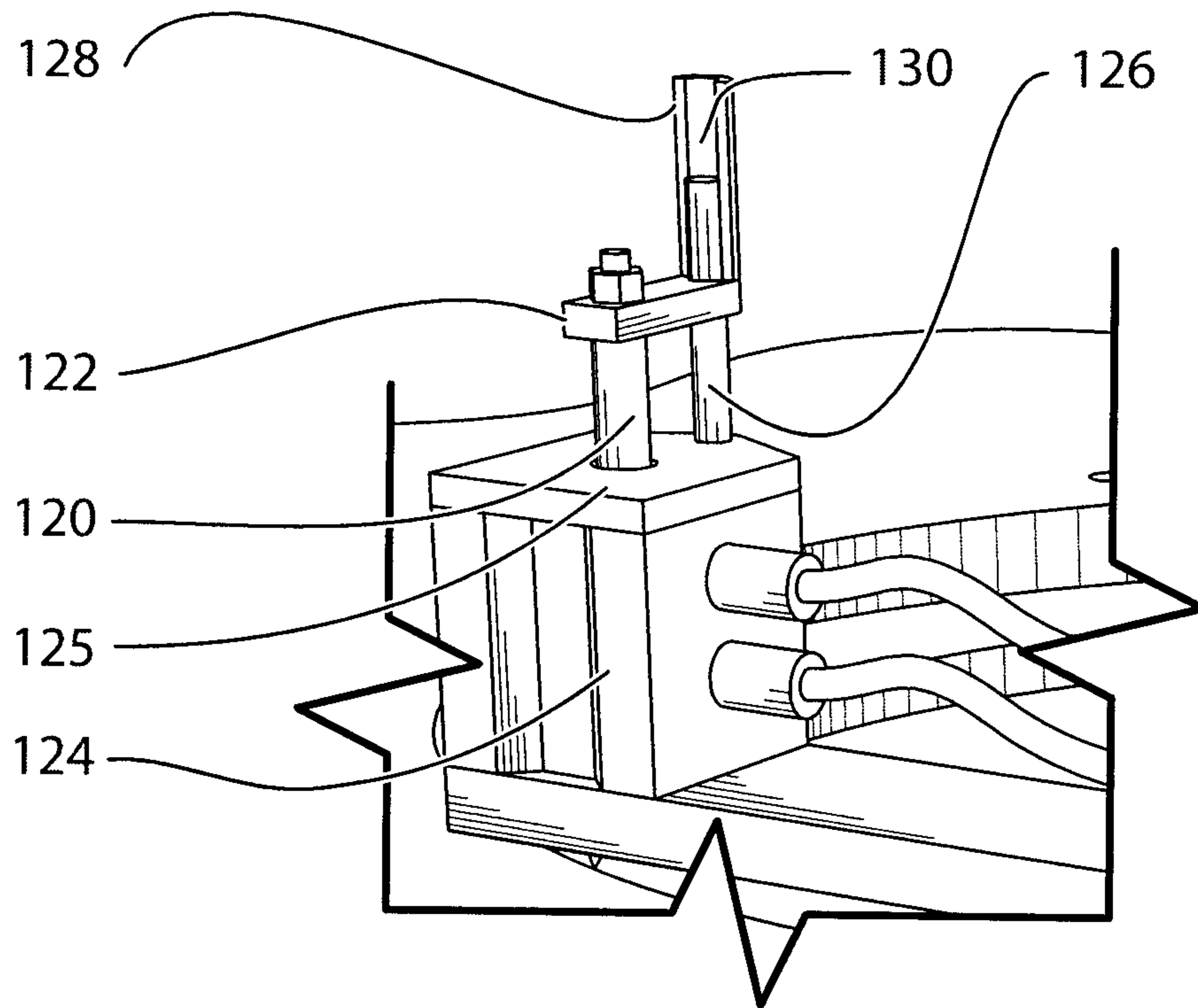


FIG. 2C

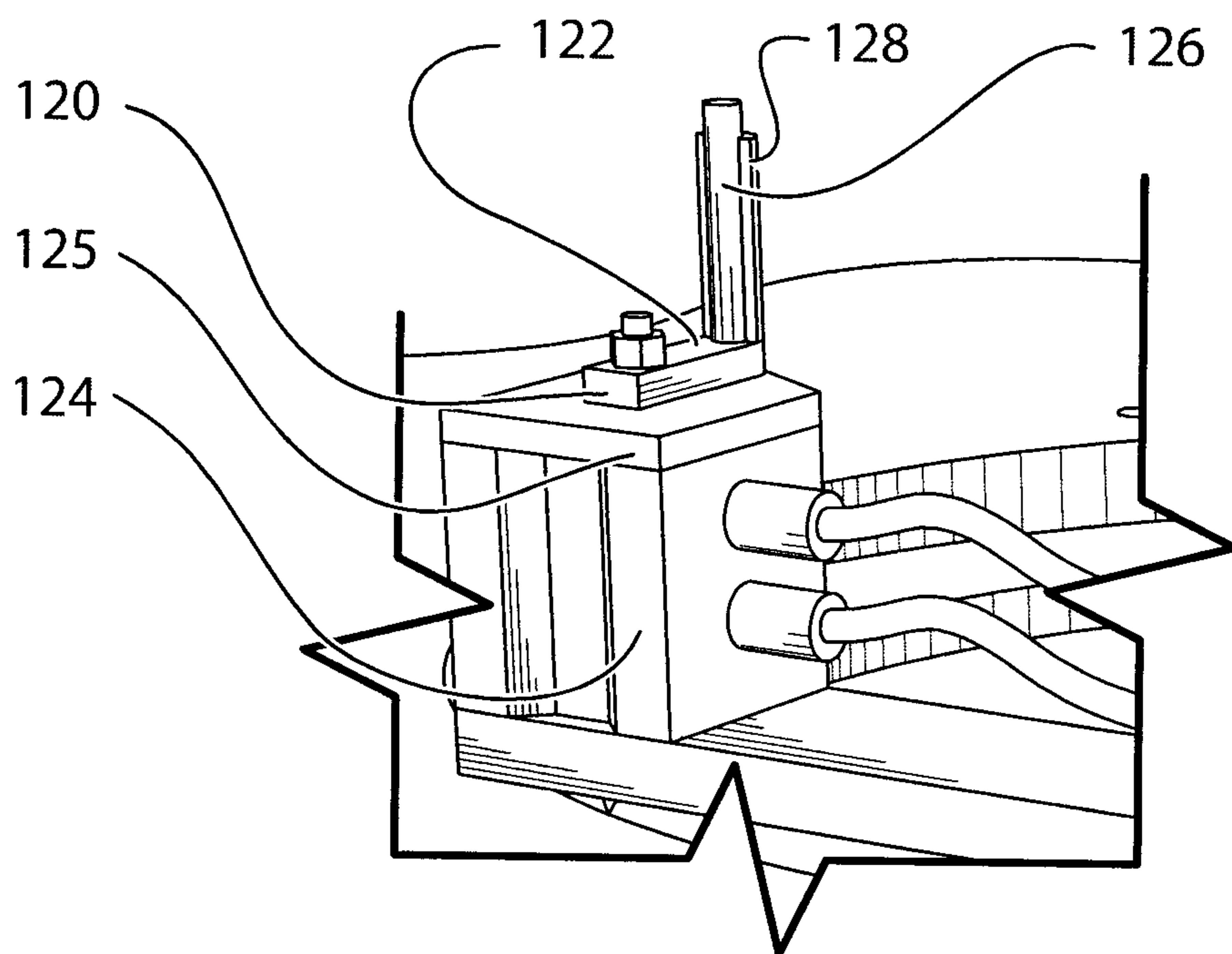


FIG. 2D

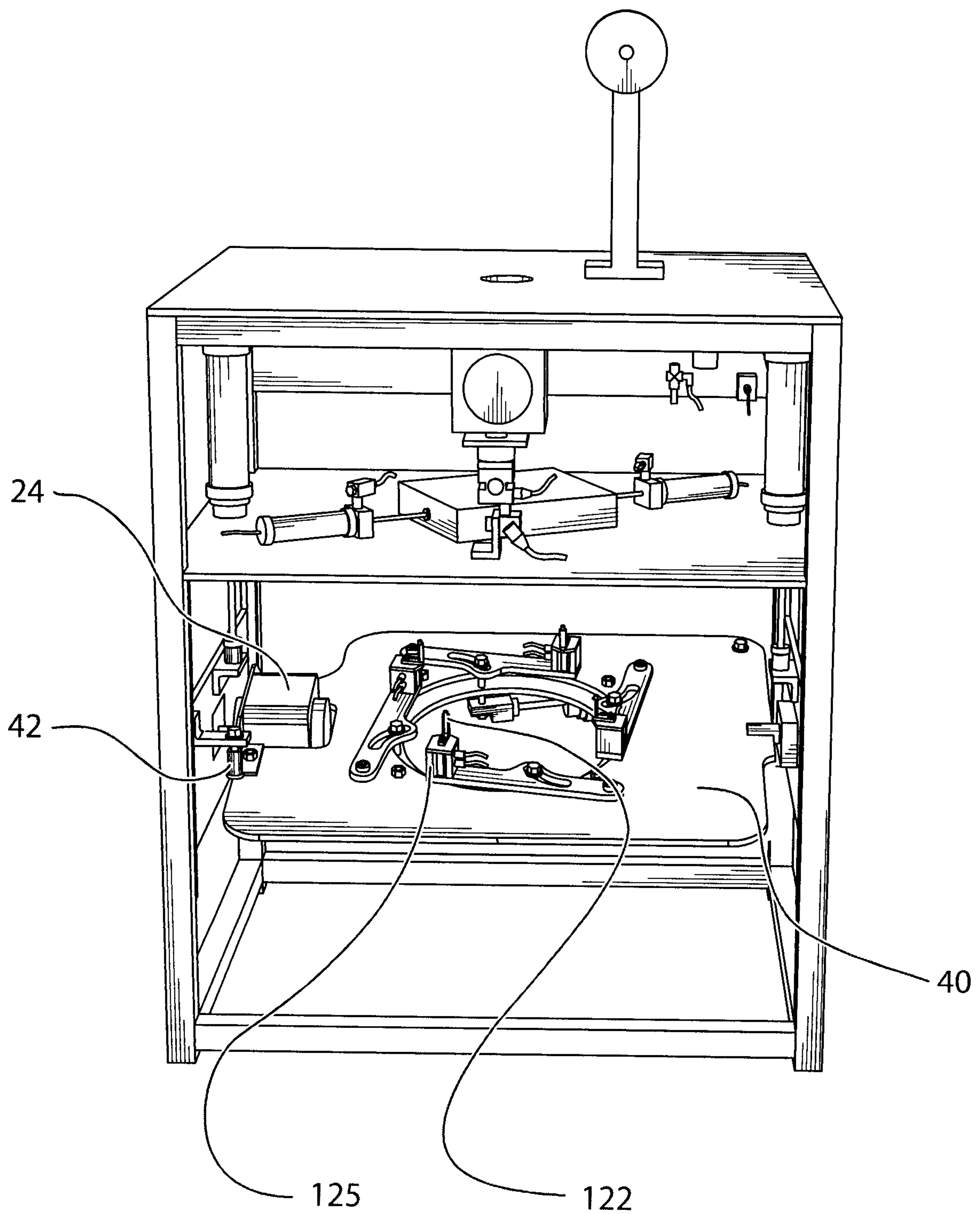


FIG. 3A

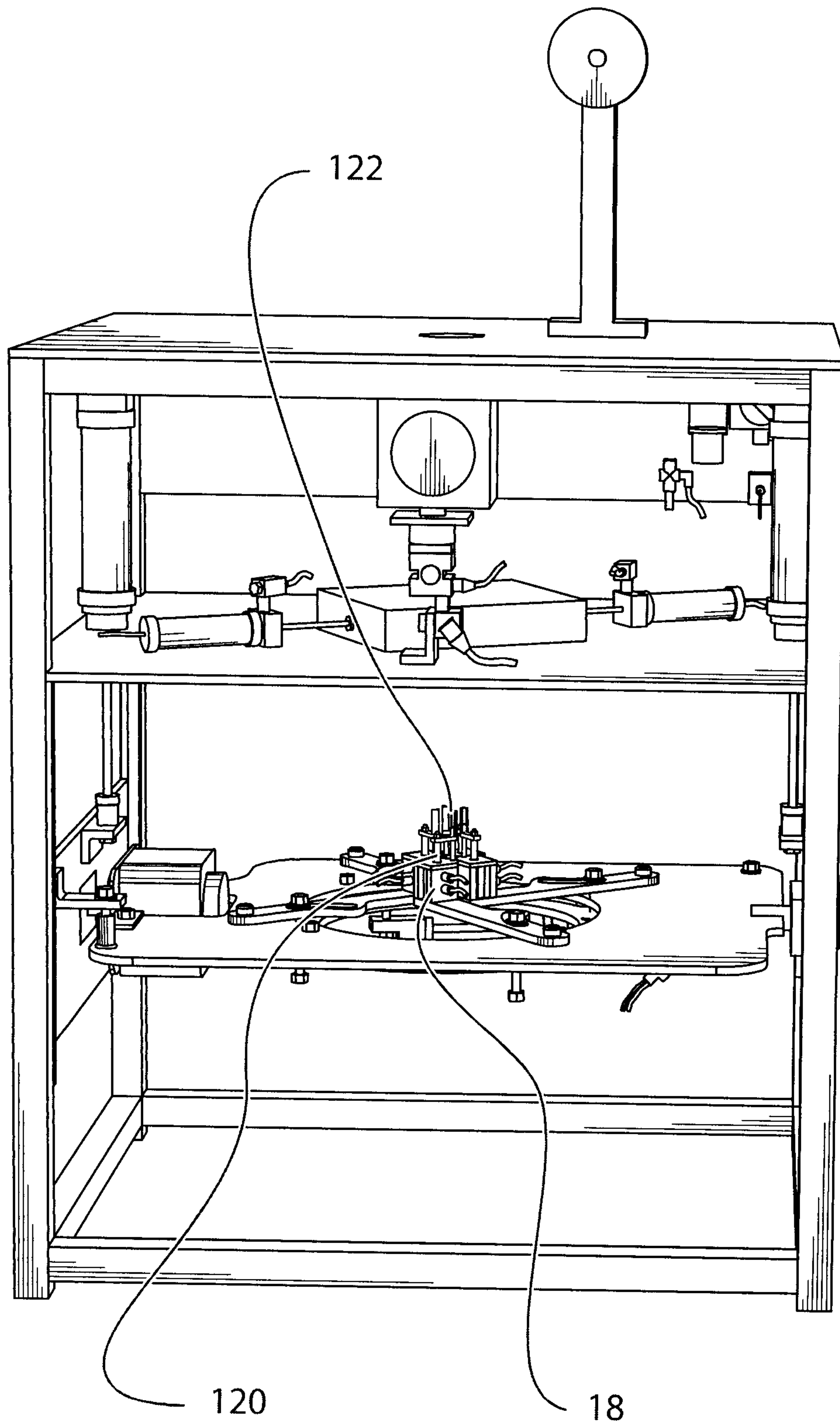


FIG. 3B

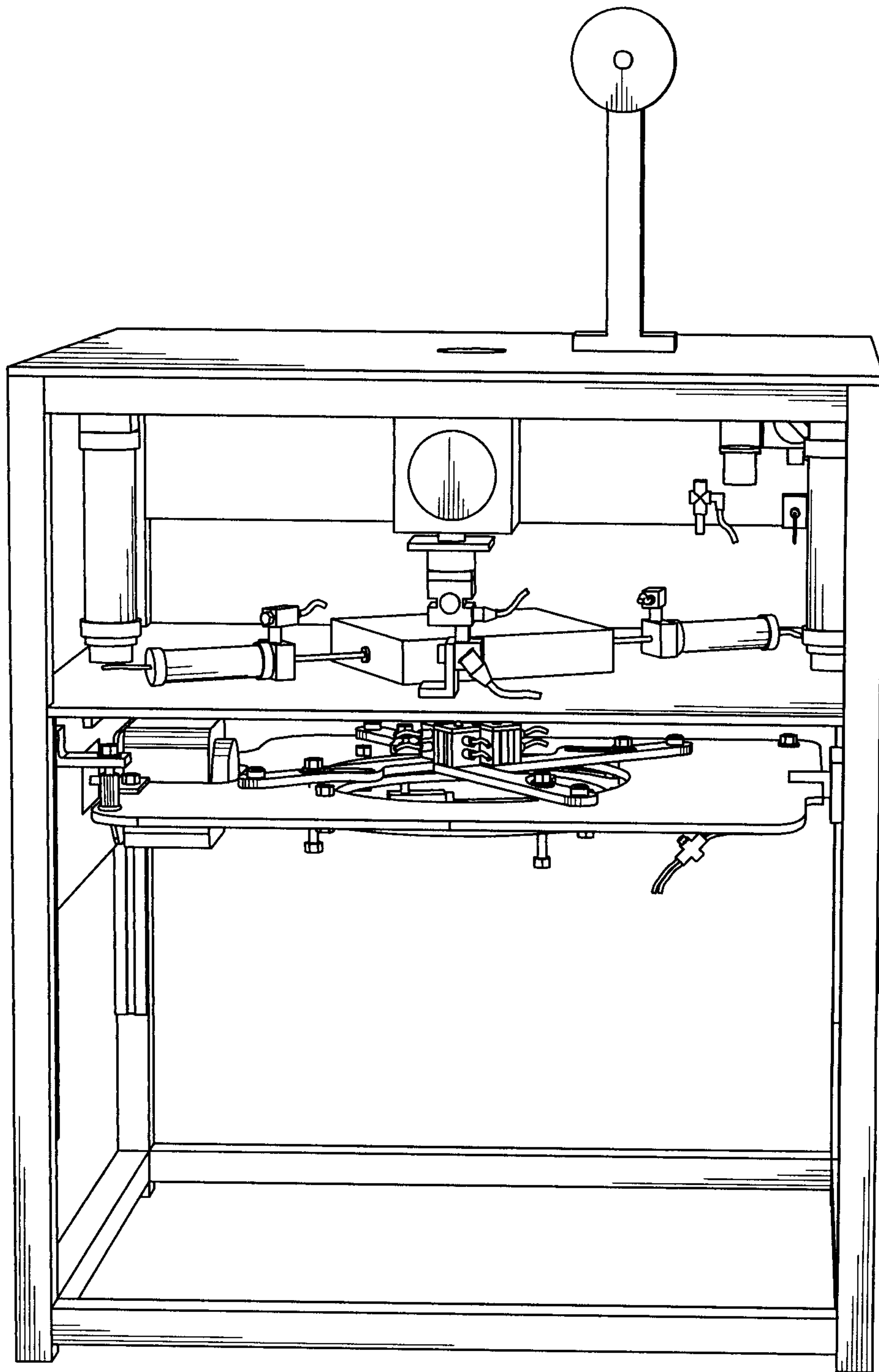


FIG. 3C

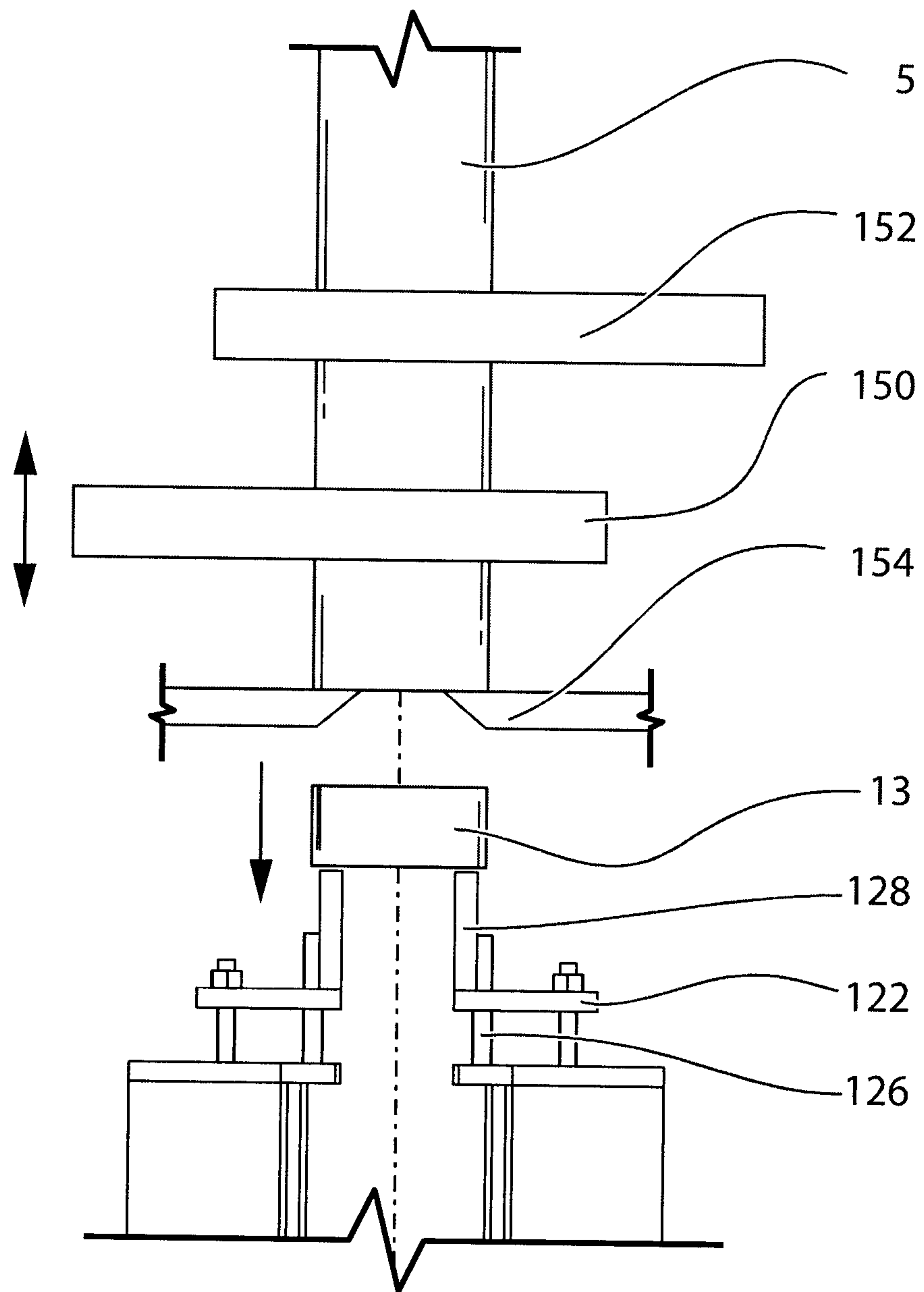


FIG. 3D

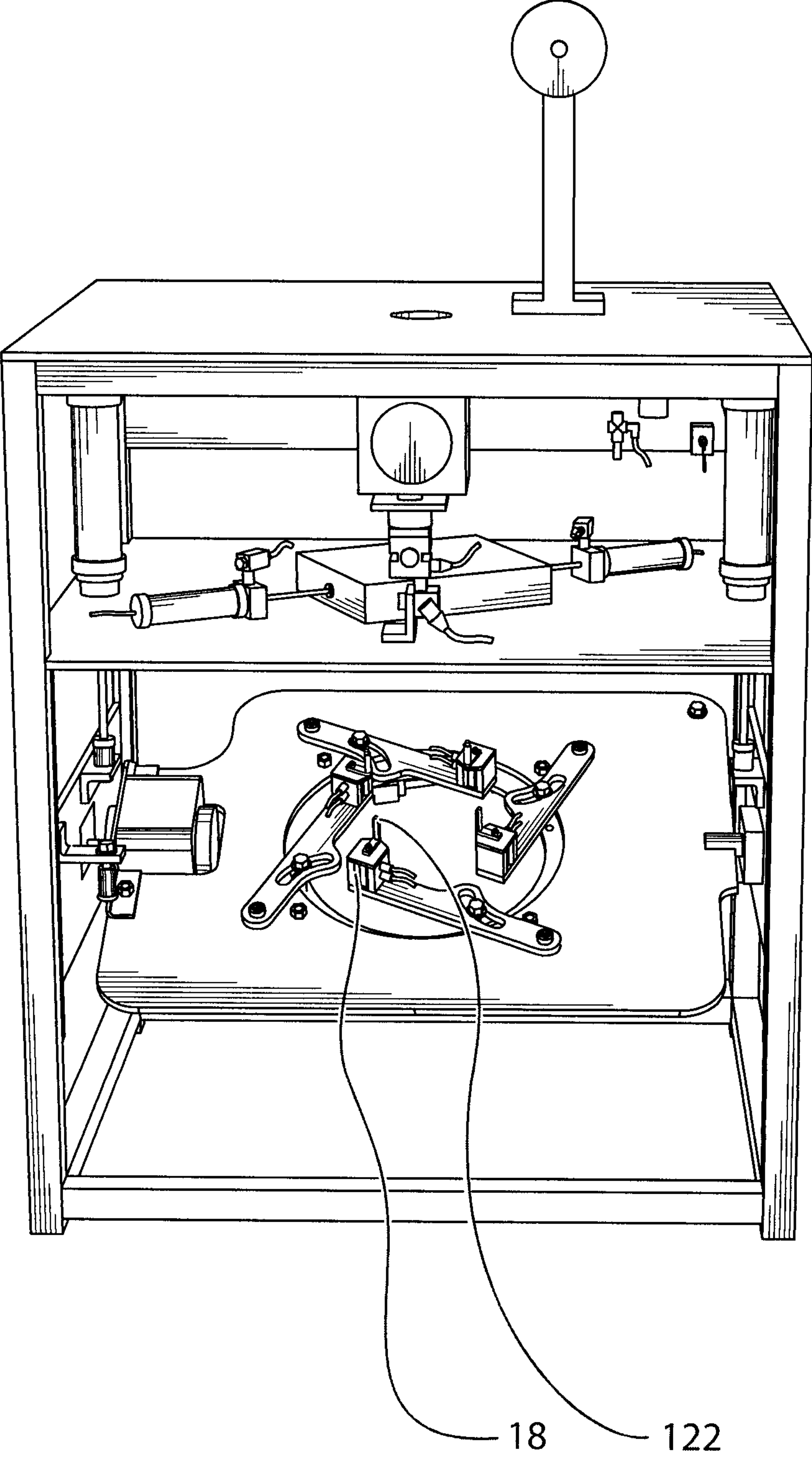


FIG. 3E

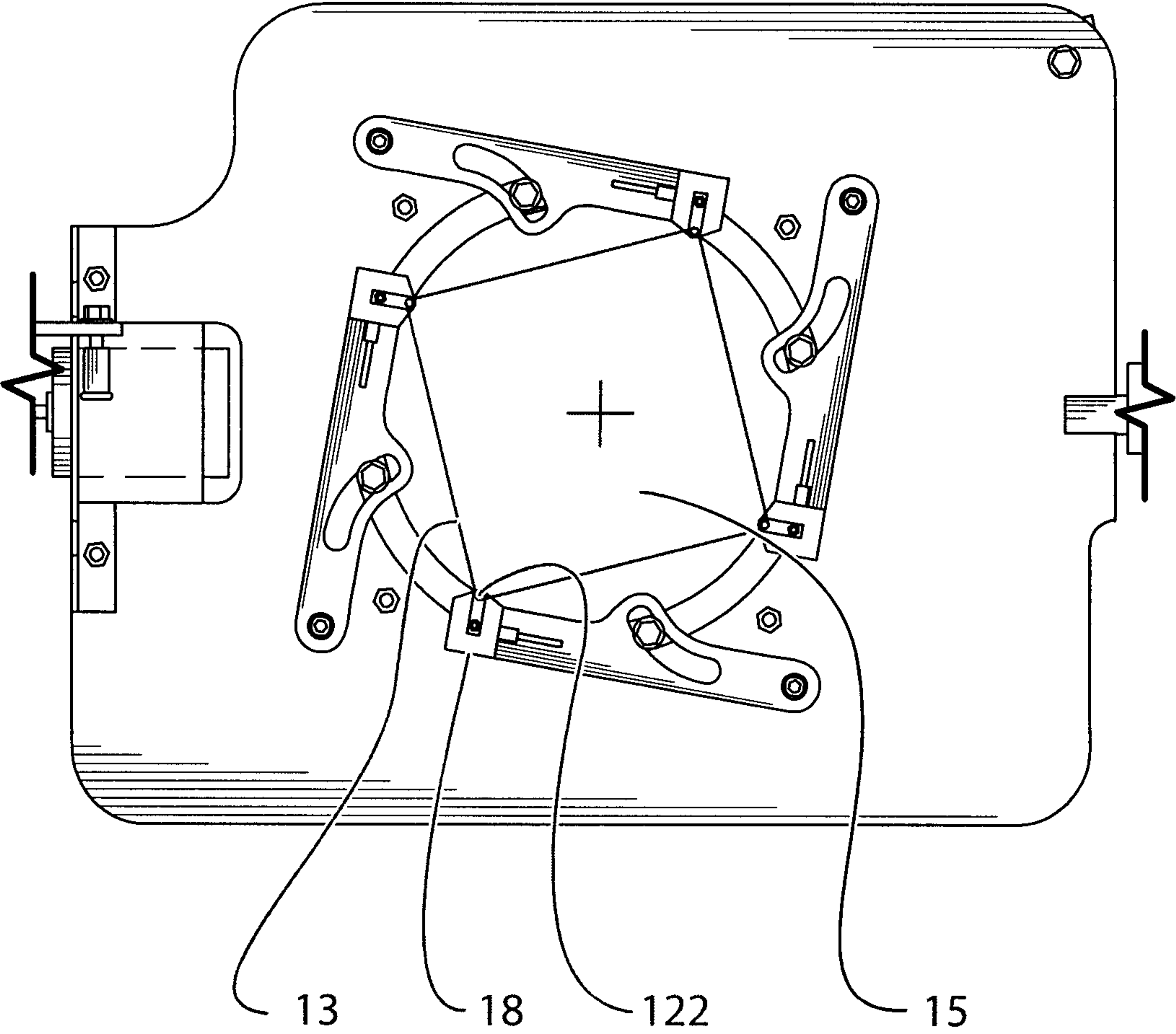


FIG. 3F

