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(54) **ELEVATOR APPARATUS AND METHOD FOR RUNNING WELL BORE TUBING**

ELEVATORVORRICHTUNG UND VERFAHREN ZUM ABSENKEN VON BOHRLOCHROHREN

APPAREIL ELEVATEUR ET PROCEDE POUR INSTALLER UNE TIGE DE PUITS DE FORAGE

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(73) Proprietors:
- **Frank's International, Inc.**
  Houston, TX 77079 (US)
- **Mosing, Donald**
  Lafayette, LA 70403 (US)
- **Sipos, David L.**
  Youngsville, LA 70592 (US)

(72) Inventors:
- **MOSING, Donald**
  Lafayette, LA 70403 (US)
- **SIPOS, David, L.**
  Youngsville, LA 70592 (US)

(74) Representative: **Hedges, Martin Nicholas**
A.A. Thornton & Co.
235 High Holborn
London WC1V 7LE (GB)

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EP 1 346 127 B1

Description

[0001] This invention relates generally to apparatus for installing and removing well bore tubing, and more particularly to tools used to hold and lower drill pipe or casing into a well bore.

[0002] Elevators and/or spiders are essentially functionally identical gripping devices used cooperatively to hold and lower drill pipe or tubular well casing into a well bore. These tools have varied over the years, but their essential overall design and function has remained the same. Elevator and spider slip assemblies conventionally have hinged arms that latch at the unhinged ends. With arms apart, they are placed around a given section of the tubing in a tubing string, then the arms are hinged closed and latched, forming a housing surrounding the tubing. The housing is commonly referred to as a "bowl". The bowl contains a plurality of slips surrounding the tubing. The radial interior surface of the slips typically form or carry hard metal teeth for gripping the tubing. The exterior surface of the slips and interior surface of the bowl usually have opposing complementary engagement surfaces which are inclined radially inward and downwardly. The complementary surfaces between the slips and bowl serve to inject the slip and gripping elements in a longitudinal and radial direction in relation to the tubing for engagement or disengagement of the tubing. Thus, when an elevator or slip is engaged about a tubing and the weight of the tubing in the tubing string is lowered into the elevator or slip, the tubing engages the gripping elements on the slips, causing them to move downward in relation to the bowl and radially inward in a "self-tightening" securing of the tubing.

[0003] During traditional well-boring operations, a spider is located near the rotary table and is used for securing tubing in the well. An elevator is suspended from the rig hook, which is used for running or retrieving the tubing string. In a typical operation, the spider remains stationary to fix the tubing, while the elevator is lowered and placed around the tubing and engages the tubing by "self tightening". The spider then disengages from the tubing when the slips are radially removed away from the tubing string, allowing the elevator to move the tubing string relative to the rotary table as needed. The spider then re-engages the tubing, allowing the elevator to continue running or removing the tubing string.

[0004] A problein associated with the use of these tools is related to gripping the drill pipe or casing collar which is of a larger diameter than the outside diameter of the body of the tubing. The problem is caused when the elevator slip assembly is not lowered sufficiently below the collar (including, in the case of drill pipe, the portion of the pipe transitioning from the exterior of the well casing below the collar to the maximum exterior diameter of the collar, sometimes called the "upset"). The slip assemblies are designed such that the gripping forces generated are sufficient for proper gripping only when the slips are lowered far enough below a casing collar to completely grip the outside diameter of the well casing and not the collar. When the collar is gripped, the slips will not engage with the casing sufficiently to generate adequate gripping forces. The result is that partial engagement of the slips against the casing string may result in the casing slipping from the tool and dropping into the well bore causing significant down time and repair.

[0005] Further, with the advent of tubing of high chromium content, the surface damage caused by slips has become undesirable because it can lead to unacceptable stress concentrations and stress corrosion in sour well conditions. There is therefore a need for an elevator apparatus and method of operation that can hold and manipulate tubing without significantly damaging the surface of the tubing and that eliminates the risk in traditional systems of engaging the tubing collar with resultant loss of "grip".

[0006] US-A-4199847, upon which the precharacterising clause of claim 1 is based, discloses a well raiser support for supporting and guiding an assembly of well riser pipe, comprising a spider assembly containing a plurality of hydraulically actuated dogs for supporting the riser and a plurality of resilient bearings supporting the spider assembly. Each dog comprises a support arm weldment which is pivotally movable into a cavity within the support in order to support a pipe therein.

[0007] Other elevators are disclosed in US-A-5395183, US-A-3588162 and US-A-3495864.

[0008] Breaking with the conventional slip elevators of the past, this invention provides a new kind of elevator for manipulating elongate tubular goods having a collar portion that are placed in a well bore, e.g., casing tubing and drill pipe. All tubing or pipe that is run into a well bore hereinafter is called "tubing" or "tube" without distinction whether it is casing, drill pipe or other well bore tubing; all well bore tubing is comprehended. The "collar portion" of tubing means the collar proper as well as any "upset" as that term is described hereinabove.

[0009] According to the present invention there is provided an elevator apparatus for manipulating well bore tubing having a collar, comprising: a circular body having a top and a central cavity around a body axis, the cavity having a diameter allowing the collar portion of tubing to pass longitudinally therethrough; characterised by: a plurality of petal plates having radially inner and outer portions, horizontally supported on and spaced apart around the top of the body, and one or more actuators operatively associated with the petal plates, for moving each petal plate radially inward, substantially normal to the body axis, over the body, into the cavity, to an extent sufficient, in combination with the other petal plates so extended, to prevent passage of the collar portion of the tubing through the cavity, thereby to hold the tubing with the elevator, in which said body is a fulcrum for the petal plates when they are extended into the cavity and hang tubing within the elevator, and wherein the elevator apparatus further comprises a counterforce member in operative arrangement with the petal plates for opposing

leverage imparted over said fulcrum to the portion of the petal plates radially outward from said body, wherein the counterforce member is a circular member surrounding the cavity, spaced radially outward from the body and at least partially located above and adjacent the outer portion of the petal plates at least when they are extended into the cavity.

[0010] A number of forms of embodying the overall invention are provided, each with different forms of the petals and different means of moving the proximal portions of the different forms of the petals into the cavity. Within each basic subset, there are variations of the form and variations of the means of moving the forms.

[0011] For purposes of clarity, the overall invention is illustrated by a detailed description of the numerous forms of the invention.

[0012] The Basic Form of the invention comprises (a) a circular body having a top and a central cavity of diameter allowing the collar portion of the tubing to pass longitudinally therethrough, that is, to pass the entire width of the tubing including the collar portion, and (b) a plurality of "petal" plates having radially inner and outer portions horizontally supported on and spaced apart around the top of the body, and (c) one or more actuators operatively associated with the petal plates, for extending each petal plate radially inward, substantially normal to the axis of the body cavity, over the body into the cavity an extent sufficient, in combination with the other petal plates so extended, to prevent passage of the collar portion of the tubing through the cavity, that is, to allow longitudinal passage through the cavity of the width of the tubing except the collar portion, thereby to hold the tubing in the elevator. Preferably, also, the one or more actuators operate to retract the petal plates over the body radially out of the cavity, to allow the collar portion of the tubing to pass through the cavity.

[0013] The plates are called "petal" plates because in their orientation to the cavity, these plates vaguely suggest the petals of a flower horizontally arranged about the center of the flower. The word "petal" is not used in a literally descriptive or restrictive sense.

[0014] With the petal plates extended, the petal plates hold the collar portion of the well bore tubing in the elevator and thereby support the entire weight of the well bore tubing in the elevator body. When the weight of a well bore tube is on the petal plates, the elevator body that supports the pistes is a fulcrum to the petal plates, and the petal plates are a lever to the fulcrum. To oppose the lever force on the portion of the petal plates radially outward from the elevator body caused by the weight of the tubing on the portion of the petal plates inside the cavity when the petal plates are extended, the elevator preferably includes a counterforce member in operative arrangement with the petal plates. The counterforce member suitably is a circular or annular member surrounding the cavity, spaced radially outwardly from the body and located above and adjacent the outer portion of the petal plates when they are in the extended position. Advantageously the circular member is secured by one or more buttresses fixed relative to the body below the petal plates. Suitably a plurality of buttresses are interposed between the spaced apart petal plates.

[0015] In one form of the elevator of Basic Form I of the invention, the actuator comprises a cam and the plate is a cam follower. The petal plates include an aperture receiving a cam comprising an eccentric lobe and a camshaft located radially outward from said body, rotatable about an axis substantially parallel to the axis of the cavity. Rotating the cam eccentric pushes the petal plate proximal portion in or out of the body cavity. In another form, the cam is elongate, is located radially outward from the circular elevator body, and is linearly movable parallel to the axis of the elevator cavity. The cam suitably is received in an aperture in the petal plate between the inner and outer portions of the petal plate. Advantageously the cam is moved linearly parallel to the axis of the cavity by the action of a rod of a piston in a cylinder and piston assembly. The cylinder is fixed relative to the body, and the piston rod attaches to the cam at the rod end distal from the piston. The rod is moved by force of fluid admitted into or withdrawn from a cylinder within which the piston reciprocates. Alternatively, the cam is moved linearly parallel to the axis of the cavity by translation to vertical motion of rotary motion applied by rotating a ring cam surrounding the cavity. For this the elongate cam suitably includes a portion above the elevation of the body when the petal plates are retracted, and a ring is located adjacent the cam portion between such cam portion and the cavity over the body. One of the cam portion and the ring contains a helical groove facing the other and the other contains a pin facing the helical groove, whereby, upon rotation of the ring in one rotational direction about the cavity axis, the pin follows the groove and moves the elongate cam in one linear direction parallel to the axis, and upon rotation of the ring in a rotational direction about the cavity axis opposite to the one direction, the pin follows the groove and moves the elongate cam parallel to the axis in a linear direction opposite to the one linear direction. Where the helical groove is formed in the elongate cam, the ring cam moves a pin in the helical groove, elevating the elongate cam when the pin is caused by ring cam rotation to move upward in the groove, and lowering the cam when the pin is caused by ring cam rotation to move downward in the groove.

[0016] In another form of Basic Form I of the invention involving the elongate cam wherein the cam includes a portion above the elevation of the body when the petal plates are retracted, that portion has a recess facing the cavity, and an annular reciprocation piece is received in such recess. The reciprocation piece upon reciprocation moves the cam linearly parallel to the cavity axis.

[0017] In another form of Basic Form I of the invention, the actuator comprises a link affixed to the plate. The link may be a slide that reciprocates radially inwardly and outwardly in a channel substantially normal to the axis of the cavity. Suitably the slide is reciprocated by the

action of a rod of a piston moved by force of fluid admitted into or withdrawn from a cylinder within which the piston reciprocates, the cylinder being fixed relative to the body and the piston rod end distal from the piston attaching the slide.

[0018] Alternatively, the link may be a pivot member that pivots upwardly toward the cavity and downwardly away from the cavity on a pivot axis that is transverse to the axis of the cavity and is located radially outwardly of the body, for moving a petal plate radially inwardly or outwardly on pivoting the pivot member upwardly or downwardly, respectively. In this latter form, suitably, a sleeve surrounds the link, the body and the petal plates. The sleeve is linearly moveable parallel to the axis of the cavity. The link includes a finger that is remote from the link pivot axis and is received within a capture located on the interior of the sleeve, whereby, on upward movement of the sleeve, the link pivots upwardly to move a petal plate radially inwardly partially into the cavity, and upon downward movement of the sleeve, the link pivots downwardly to move the petal plate out of the cavity. Suitably the sleeve is moved by the action of a rod of a piston moved by force of fluid admitted into or withdrawn from a cylinder within which the piston reciprocates, the cylinder being fixed relative to the body and the piston rod end distal from the piston attaching the sleeve.

[0019] The apparatus of this invention embodies forms with which to perform a method which comprises this invention. In accordance with this invention, a method of manipulating well bore tubing comprises (a) introducing the tubing into the cavity of a circular body having a central cavity of diameter to admit therethrough the entire width of the tubing including the collar portion, (b) positioning the body below the collar portion of the tubing, and (c) moving a plurality of spaced apart petal plates horizontally supported on and spaced apart over the top of the body, radially inward, substantially normal to the body axis, over the body, into the cavity, to an extent sufficient to prevent passage of the collar portion of he tubing through the cavity.

[0020] In the form of Basic Form I of the invention in which the petal plates include an aperture receiving an elongate cam movable linearly parallel to the axis of the cavity for sliding on the plate, the above described step of moving the petal plates comprises actuating the cam to ride the plate onto the cam. The slider cam is suitably actuated by a rod of a piston moved by force or fluid admitted into or withdrawn from a cylinder within which the piston reciprocates, the cylinder being fixed relative to the body and the piston rod end distal from the piston attaching the cam. Alternatively, the slider cam is actuated by rotating a ring cam surrounding the cavity and operatively connected to the slider cam to translate the rotary motion of the ring cam to linear motion of the slider cam, as above described.

[0021] In the form of Basic Form I of the invention in which the petal plates are connected to a slide that reciprocates radially inward and outward substantially normal to the axis of the cavity, the above described step of moving the petal plates comprises moving the slide radially inward. The slide suitably is moveable by a rod of a piston moved by force of fluid admitted into or withdrawn from a cylinder within which the piston reciprocates, the cylinder being fixed relative to the body and the piston rod end distal from the piston attaching the slide.

[0022] In the form of Basic Form I of the invention in which the petal plates are connected to a link that pivots on an axis transverse to the axis of the cavity, the above described step of moving the petal plates comprises pivoting the link upwardly. Suitably the link is pivoted upwardly by a rod of a piston moved by force of fluid admitted into or withdrawn from a cylinder within which the piston reciprocates, the cylinder being fixed relative to the body and the piston rod end distal from the piston attaching the link distal from the link pivot.

[0023] In the form of Basic Form I of the invention in which the petal plates are connected to a link that includes a finger received within a capture located on the interior of a sleeve surrounding the body and that is slidable parallel to the axis of the cavity, the above described step of moving the petal plates comprises sliding the sleeve upwardly. Suitably, the sleeve is slid upwardly by the action of a rod of a piston moved by force of fluid admitted into or withdrawn from a cylinder within which the piston reciprocates, the cylinder being fixed relative to the body, the piston rod end distal from the piston attaching the sleeve.

[0024] In order that the invention may we well understood, there will now be described some embodiments thereof, given by way of example, reference being made to the accompanying drawings, in which:

Fig. 1 is a conceptual schematic side view, in partial section of a first form of the invention;
Fig. 2 is a conceptual schematic side view, in partial section of a second form of the invention;
Fig. 3 is a conceptual top view of a portion of the apparatus seen in side section view in Fig. 2 along the line 2-2.
Fig 4. is a conceptual schematic side view, in martial section of a third form of the invention;
Fig. 5 is a conceptual schematic side view, in martial section of a fourth form of the invention;
Fig. 6 is a conceptual schematic side view, in partial section of a fifth form of the invention;
Fig. 7 is a conceptual schematic side view, in partial section, of a sixth form of the invention; and
Fig. 8 is a conceptual schematic side view drawing, in partial section, of a seventh form of the invention.

[0025] Referring to Fig. 1, an elevator apparatus for manipulating well bore tubing having a collar is indicated generally by the reference number 10. Fig. 1 and the other figures that follow are conceptual drawings in which the elements of the invention are depicted in their relationship to one another, but in which the shape of the

elements is neither the necessary shape nor are the elements presented in necessary scale or proportion in which they might be present in a constructed apparatus making use of the invention. Elements shown in section are annular elements, those not shown in section are as seen from the particular view.

[0026] In Fig. 1, a well bore tube shown in shadow outline indicated by reference numeral 12 has a collar portion 14. Apparatus 10 includes an annular body 16 having a top 18, bottom 20, outer side 22, inner side 24 and a central cavity 26. Cavity 25 is centered on body axis 28 and has a diameter sufficient to admit through cavity 26 the entire width of a well bore tube 12, including collar portion 14, that is to be received and manipulated by apparatus 10. The bottom 20 of circular body 16 is affixed to an annular floor plate 30 that surmounts a gusseting plate 32 of a frusto-conical member 34 tapering inwardly toward cavity 26 to guide body 16 over a well bore tube that is to be received within cavity 26.

[0027] Horizontally supported on the top 18 of circular body 16 is an annular petal plate 36 that has a radially inner portion 38 and a radially outer portion 40. Fig 1 shows one of a plurality of petal plates so disposed. The other plates (not shown) are spaced apart around the top 18 of circular body 16.

[0028] A flange 42 is affixed to the outer side 22 of body 16 intermediate top 18 and bottom 20 thereof. Flange 42 pivotally mounts a link 44 on a pivot pin 46. Link 44 is notched at 48 to engage the rear 50 of petal plate 36, and has a toothed portion (not seen) that engages a recess in the floor of petal plate 36 intermediate its ends.

[0029] A sleeve 52 surrounds circular body 16, petal plate 36 and link 44, and is moveable parallel to cavity axis 28. Welded interiorly to the sleeve are a pair of rings 54, 56 spaced apart to define a capture gap 58. Link 44 has a finger portion 60 that is received in capture gap 53. Also affixed to the interior of sleeve 52 is an annular stop plate 62 that acts as a downstop limiting sleeve homing travel by impinging on floor plate 30 when sleeve 52 is moved parallel to the axis 28 in a direction traveling away from petal plate 36 (a downward movement in the normal condition Where the cavity axis 28 is substantially vertical to the horizon). Annular plate 62 also acts as an extension travel limiter when sleeve 52 is moved parallel to the axis 28 in a direction traveling towards petal plate 36, by impingement on flange 42.

[0030] Movement of sleeve 52 towards petal plate 36 (normally an upward substantially vertical movement, relative to the horizontal) engages finger portion 60 on the 1 and 55 of ring 56 and pushes finger portion 60 towards petal plate 36, rotating link 44 on pivot pin 46 (clockwise as viewed in Fig. 1), to a maximum degree limited by stop plate 62 impinging on flange 42, and causing link 44 to advance in the direction of cavity axis 28, the notched portion 48 of link 44 acting on the rear 50 of petal plate 36 to push plate 36 radially inwardly towards cavity axis 28 an extent placing the innermost portion 38 of petal plate 36 inside cavity 26 of the body, effective, in combination with the other plates so extended, to allow the entire width of the tube 12 except its collar portion 14 to pass through cavity 20. Movement of sleeve 52 away from petal plate 36 (normally a downward substantially vertical movement, relative to the horizontal) engages finger portion 60 on the land 53 of ring 54 and pushes finger portion 60 away from petal plate 36, rotating link 44 on pivot pin 46 (counterclockwise as viewed in Fig. 1) to a degree limited by stop plate 62 impinging on floor plate 30, causing link 44 to move away from the direction of cavity axis 28, drawing petal plate 36 radially outwardly from cavity axis 28, and in combination with the other petal plates also so drawn radially outwardly, enlarging the cavity to an extent allowing the entire width of tube 12 including the collar portion 14 to escape grasp of apparatus 10.

[0031] A circular cap plate 64 welded to the top 51 of sleeve 52 prevents foreign bodies (including appendages of workers) from gaining access to the working parts of elevator apparatus 10.

[0032] Suitably sleeve 52 is moved by the action of a rod of a piston moved by force of fluid admitted into or withdrawn from a cylinder within which the piston reciprocates, the cylinder being fixed relative to the body, the piston rod end distal from the piston attaching the sleeve. Such a mover is well know in the art and such mover and the connections of he mover as so described are not illustrated.

[0033] In operation of the apparatus shown in Fig. 1, tubing 12 is introduced into cavity of circular body 16 and the body is positioned below the collar portion 14 of he tubing 12. Sleeve 52 is slid upwardly, thereby moving finger portion 60 toward petal plates 36 and pivoting link 44 on pin 46, causing each of a plurality of spaced apart petal places 36 horizontally supported on top 18 of body 16 to move radially inward to an extent positioning a radially innermost portion 40 of plates 36 within cavity 26 of body 16 sufficiently to prevent passage of collar portion 14 through cavity 26. Then to release the tubing, sleeve 52 is slid downwardly, thereby moving finger portion 60 away from petal plates 36 and pivoting link 44 on pin 46, causing each of a plurality of spaced apart petal plates 36 horizontally supported on top 18 of body 16 to move radially, outwardly to an extent removing the innermost portion 38 of plates 35 from cavity 26 of body 16, allowing passage of collar portion 14 through cavity 26.

[0034] Referring now to Figs. 2 and 3, a second form of an apparatus for manipulating well bore tubing having a collar, in accordance with this invention, is indicated generally by the reference number 100. The same reference numerals as used in Fig. 1 identify well bore tube 12 and collar portion 14. Apparatus 100 includes a circular body 116 having a top 118, bottom 120, outer side 122, inner side 124 and central cavity 126. Cavity 126 is centered on body axis 128 and has a diameter sufficient to admit through cavity 126 the entire width of a well bore tube 12, including collar portion 14, that is to be received

for manipulation by apparatus 100. The bottom 120 of circular body 116 may be affixed to an annular floor plate as illustrated in Fig. 1 (not illustrated in Fig. 2).

[0035] Horizontally supported on top 118 of circular body 116 is a petal plate 136 that has a radially inner portion 138 and a radially outer portion 140. Fig 2 shows one of a plurality of petal plates so disposed. The other petal plates are spaced apart around top 118 of circular body 116, as partially shown in the cutaway of Fig. 3. Circular body 116 that supports petal plates 135 is a fulcrum when the weight of a well bore tube 12 is impressed on the innermost portion 138 of the petal plates 136. This occurs when the petals 136, in extended position, as hereinafter described, support the weight of the well bore tube 12. To counter the force moment of such load on petal plates 130, a circular counterforce member or ring 166 surrounds body 116, horizontally spaced radially outward from body 116, and is positioned above and adjacent the top of the outer portion 140 of petal plates 136 including when they are extended into the cavity. Counterforce ring 160 is secured atop pedal plates 136 by a buttress member 168 affixed relative to the body 116 at the inner side 122 and top 118 of body 116. As seen in Fig. 3 in combination with Fig. 2, each buttress 168 is interposed between adjacent spaced petal plates 136.

[0036] A flange 142 is affixed to the outer side 122 of body 116 intermediate top 118 and bottom 120 thereof. Flange 142 pivotally mounts the cylinder 172 of a piston and cylinder assembly 170 on a pivot pin 146, pivotally fixing the cylinder relative to the body. Extending from the piston or the cylinder and piston assembly 170 is a rod 174, the end 176 distal to the piston being pivotally mounted on a pin 175 fastened to a link 144 that is affixed to petal plate 136. A slideway substantially normal to axis 12B of cavity 126 is provided for link 144 to slide radially inwardly and outwardly respectively to and from cavity 126 by opposing channel members, one of which, indicated by reference numeral 178, is viewable in Fig. 2. Slide link 144 is reciprocated by the action of rod 174, connected to the piston of cylinder and piston assembly 170 moved by force of fluid admitted into or withdrawn from the cylinder within which the piston reciprocates. On retraction of rod 174, pin 175 moves link 144 radially inward, causing a petal plate 136 among the plurality of such plates horizontally supported on top 118 of body 116 to move radially inward to an extent positioning a radially innermost portion 138 of plates 116 within cavity 126 of body 116 sufficiently to prevent passage of collar portion 14 through cavity 120. To release the tubing, rod 174 is extended from cylinder and piston assembly 170, thereby moving link slide 144 radially away from cavity 120, causing petal plate 136 among the plurality of such plates to move radially inwardly to an extent removing the innermost portion 138 of plates 116 from cavity 120 of body 116, allowing passage of collar portion 14 through cavity 120.

[0037] Referring now to Fig. 4, a third form of an apparatus for manipulating well bore tubing having a collar, in accordance with this invention, is indicated generally by the reference number 200. The same reference numerals as used in Fig. 1 identify well bore tube 12 and collar portion 14. includes a circular body 216 having a top 218, bottom 220, outer side 222, inner side 224 and central cavity 226. Cavity 226 is centered on body axis 228 and has a diameter sufficient to admit through cavity 226 the entire width of a well bore tube 12, including collar portion 14, that is to be received for manipulation by apparatus 200. The bottom 220 of circular body 216 is affixed to an annular floor plate 230 that surmounts a gusseting plate 232 of a frusto-conical member 234 tapering inwardly toward cavity 226 to guide body 216 over a well bore tube 12 that is to be received within cavity 226.

[0038] Horizontally supported on top 218 of circular body 216 is a petal plate 236 that has a radially inner portion 238 and a radially outer portion 240. Fig. 4 shows one of a plurality of petal plates so disposed. The other plates (not shown) are spaced apart around top 218 of circular body 216. Circular body 216 that supports petal plates 236 is a fulcrum when the weight of a well bore tube 12 is impressed on the innermost portion 238 of the petal plates 236. This occurs when the petal plates 236, in extended position, as hereinafter described, support the weight of the well bore tube 12. To counter the force moment of such load on petal plates 230, a circular counterforce member or ring 266 surrounds body 216, horizontally spaced radially outward from body 216, and is positioned above and adjacent the top of the outer portion 240 of petal plates 236. including when they are extended into the cavity. Counterforce ring 266 is secured atop pedal plates 236 by a buttress member 268 affixed relative to the body 216, as seen in Fig. 4 at the inner side 222 and top 218 of body 216. Each buttress 268 is interposed between adjacent spaced petal plates 236.

[0039] A flange 242 is affixed to floor plate 230. Flange 242 pivotally mounts the cylinder 272 or a piston and cylinder assembly 270 on a pivot pin 246, pivotally filing the cylinder relative to the body. Extending from the piston of the cylinder and piston assembly 270 is a rod 274, the end 276 distal to the piston being pivotally mounted on a pin 275 fastened to a link 244 that is affixed to petal plate 236. A slideway substantially normal to axis 228 of cavity 226 is provided for link 244 to slide radially inwardly and outwardly respectively to and from cavity 226 by opposing channel members, one of which, indicated by reference numeral 278, is viewable in Fig. 4. Slide link 244 is reciprocated by the action of rod 274, connected to the piston of cylinder and piston assembly 270 moved by force of fluid admitted into or withdrawn from the cylinder within which the piston reciprocates. On retraction of rod 274, pin 275 moves link 244 radially inward, causing a petal plate 236 among the plurality of such plates horizontally supported on top 218 of body 216 to move radially inward to an extent positioning a radially innermost portion 238 of plates 216 within cavity 226 of body 216 sufficiently to prevent passage of collar portion 14 through cavity 220. To release the tubing, rod 274 is ex-

tended from cylinder and piston assembly 270, thereby moving link slide 244 radially away from cavity 220, causing petal plate 236 among the plurality of such plates to move radially inwardly to an extent removing the innermost portion 238 of plates 216 from cavity 220 of body 216, allowing passage of collar portion 14 through cavity 220.

[0040] Referring now to Fig. 5, a fourth form of an apparatus for manipulating well bore tubing having a collar, in accordance with this invention, is indicated generally by the reference number 300. The same reference numerals as used in Fig. 1 identify well bore tube 12 and collar portion 14. Apparatus 300 includes a circular body 316 having a top 318, bottom 320, outer side 322, inner side 324 and central cavity 326. Cavity 326 is centered on body axis 328 and has a diameter sufficient to admit through cavity 326 the entire width of a well bore tube 12, including collar portion 14, that is to be received for manipulation by apparatus 300. Although not illustrated in Fig. 5, suitably, as shown by Figs. 1 and 4, the bottom 320 of circular body 316 may affixed to an annular floor plate that surmounts a gusseting plate of a frusta-conical member tapering inwardly toward cavity 326 to guide body 316 over a well bore tube 12 that is to be received within cavity 326.

[0041] Horizontally supported on top 318 of circular body 316 is a petal plate 336 that has a radially inner portion 338 and a radially outer portion 340. Fig. 5 shows one of a plurality of petal plates so disposed. The other plates (not shown) are spaced apart around top 318 of circular body 316; see and compare Fig. 3. Circular body 316 that supports petal plates 336 is a fulcrum when the weight of a well bore tube 12 is impressed on the innermost portion 338 of the petal plates 336. This occurs when the petal plates 336, in extended position, as hereinafter described, support the weight of the well bore tube 12. To counter the force moment of such load on petal plates 330, a circular counterforce member or bolster ring 366 at least partially surrounds body 316, horizontally spaced radially outward from body 316, and is positioned above and adjacent the top of the outer portion 340 of petal plates 336 including when they are extended into cavity 326. Counterforce bolster ring 366 is secured atop pedal plates 336 by a buttress member 368 affixed relative to the body 316, as seen in Fig. 5 at the inner side 322 of body 316. Each buttress 368 is interposed between adjacent spaced petal plates 336 (compare Fig. 3).

[0042] A flange 342 is affixed to body 316 near the bottom 320 thereof. Flange 342 pivotally mounts the cylinder 372 of a piston and cylinder assembly 370 on a pivot pin 346, pivotally fixing the cylinder relative to the body. Extending from the piston of the cylinder and piston assembly 370 is a rod 374, the end 376 distal to the piston being pivotally mounted on a pin 375 fastened to an elongate cam 344 that slidingly engages petal plate 336. Cam 344 is located radially outward from body 316 and is linearly moveable parallel to cavity axis 320. Cam 344 is received in an aperture 337 in petal plate 336 between inner portion 338 and outer portion 340 and in aperture 367 in counterforce bolster ring 366. Cam 344 is reciprocated by the action of rod 374, connected to the piston of cylinder and piston assembly 370 moved by force of fluid admitted into or withdrawn from the cylinder within which the piston reciprocates. On retraction of rod 374, pin 375 moves cam 344 downward, parallel to axis 328, causing the radially inward surface of aperture 337 of petal plate 336, among the plurality of such plates horizontally supported on top 318 of body 316, to slide up cam ramp 345, and, pushed by cam 344, move petal plate 336 radially inward, positioning radially innermost portion 338 of petal plate 316 within cavity 320 of body 316 sufficiently, with the other petal plates, similarly actuated, to prevent passage of collar portion 14 through cavity 320. To release tubing 12, rod 374 is extended from cylinder and piston assembly 370, thereby moving cam 334 to slide petal plate 336 down cam ramp 345 and, relieved from displacement by ram 345, move radially away from cavity 320, and with the similar actuation of the plurality of the other such petal plates 336, to move radially outwardly to an extent removing the innermost portion 338 of petal plates 316 from cavity 320 of body 316, allowing passage of collar portion 14 through cavity 320.

[0043] Referring now to Fig. 6, a fifth form of an apparatus for manipulating well bore tubing having a collar, in accordance with this invention, is indicated generally by the reference number 400. The well bore tube 12 and collar portion 14 in are to be understood to be present in the positions depicted in Figs. 1-5, although not illustrated in Fig. 6. Apparatus 400 includes a circular body 416 having a top 418, bottom 420, outer side 422, inner side 424 and central cavity 426. Cavity 426 is centered on body axis 428, as in the embodiments illustrated in Figs. 1-5, and has a diameter sufficient to admit through cavity 426 the entire width of a well bore tube 12, including collar portion 14, that is to be received for manipulation by apparatus 400. Although not illustrated in Fig. 6, suitably, as shown by Figs. 1 and 4, the bottom 420 of circular body 416 may affixed to all annular floor plate that surmounts a gusseting plate of a frusto-conical member tapering inwardly toward cavity 426 to guide body 416 over a well bore tube 12 that is to be received within cavity 426.

[0044] Horizontally supported on top 418 of circular body 416 is a petal plate 436 that has a radially inner portion 438 and a radially outer portion 440. Fig. 5 shows one of a plurality of petal plates so disposed. The other plates (not shown) are spaced apart around top 418 of circular body 416; see and compare Fig. 3. Circular body 416 that supports petal plates 436 is a fulcrum when the weight of a well bore tube 12 is impressed on the innermost portion 438 of the petal plates 436. This occurs when the petal plates 436, in extended position, as hereinafter described, support the weight of the well bore tube 12. To counter the force moment of such load on petal plates 430, a circular counterforce member or bolster ring 466 at least partially surrounds body 416, horizontally

spaced radially outward from body 416, and is positioned above and adjacent the top of the outer portion 440 of petal plates 436 including when they are extended into cavity 426. Counterforce ring 466 is secured atop pedal plates 436 by a buttress member 468 affixed relative to the body 416, as seen in Fig. 6, at the inner side 422 of body 416. Each buttress 468 is interposed between adjacent spaced petal plates 436 (compare Fig. 3).

[0045] Elongate cam 444 is located radially outward from body 416 and is linearly moveable parallel to cavity axis 426. Cam 444 is received in an aperture 437 in petal plate 436 between inner portion 438 and outer portion 440 and in aperture 467 in counterforce bolster ring 466. Elongate cam 444 includes a portion 443 above the elevation of petal plate 436 when the petal plates 436 are retracted. Ring cam 474 is located adjacent elongate cam portion 443 between elongate cam portion 443 and cavity 426 over body 416. One of elongate cam portion 443 and ring cam 474 contains a helical groove facing the other of 443 and 474, and the other of 443 and 474 contains a pin facing the helical groove, whereby upon rotation of ring cam 474 in one rotational direction about cavity axis 428, the pin follows the groove and moves elongate cam 444 in one linear direction parallel to axis 428, and upon rotation of ring cam 474 in a rotational direction about cavity axis 428 opposite to the one direction, the pin follows the groove and moves the elongate cam 444 parallel to axis 428 in a linear direction opposite to the one linear direction. In Fig. 6, the helical groove (not seen) is formed in elongate cam portion 443, and ring cam 474 moves a pin 475 in the helical groove, elevating elongate cam 444 when pin 475 is caused by rotation of ring cam 474 to move upward in the groove, and lowering elongate cam 444 when pin 475 is caused by rotation of ring cam 474 to move downward in the groove.

[0046] Referring now to Fig. 7, a sixth form of an apparatus for manipulating well bore tubing having a collar, in accordance with this invention, is indicated generally by the reference number 500. The well bore tube 12 and collar portion 14 in are to be understood to be present in the positions depicted in Figs. 1-5, although not illustrated in Fig. 7. Apparatus 500 includes a circular body 516 having a top 518, bottom 520, outer side 522, inner side 524 and central cavity 526. Cavity 526 is centered on body axis 528, as in the embodiments illustrated in Figs. 1-5, and has a diameter sufficient to admit through cavity 526 the entire width of a well bore tube 12, including collar portion 14, that is to be received for manipulation by apparatus 500. Although not illustrated in Fig. 7, suitably, as shown by Figs. 1 and 4, the bottom 520 of circular body 516 may affixed to an annular floor plate that surmounts a gusseting plate of a frusto-conical member tapering inwardly toward cavity 526 to guide body 516 over a well bore tube 12 that is to be received within cavity 526.

[0047] Horizontally supported on top 518 of circular body 516 is a petal plate 536 that has a radially inner portion 538 and a radially outer portion 540. Fig. 6 shows one of a plurality of petal plates so disposed. The other plates (not shown) are spaced apart around top 518 of circular body 516; see and compare Fig. 3. Circular body 516 that supports petal plates 536 is a fulcrum when the weight of a well bore tube 12 is impressed on the innermost portion 538 of the petal plates 536. This occurs when the petal plates 536, in extended position, as hereinafter described support the weight of the well bore tube 12. To counter the force moment of such load on petal plates 530, a circular counterforce member or bolster ring 566 at least partially surrounds body 516, horizontally spaced radially outward from body 516, and is positioned above and adjacent the top of the outer portion 540 of petal plates 536, including when they are extended into cavity 526. Counterforce bolster ring 566 is secured atop pedal plates 536 by a buttress member 568 affixed relative to the body 516, as seen in Fig. 7 at the inner side 522 of body 516. Each buttress 568 is interposed between adjacent spaced petal plates 536 (compare Fig. 3).

[0048] Elongate cam 544 is located radially outward from body 516 and is linearly moveable parallel to cavity axis 526. Cam 544 is received in an aperture 537 in petal plate 536 between inner portion 538 and outer portion 540 and aperture 567 of bolster ring 566. Elongate cam 544 includes a portion 543 above the elevation of petal plate 536 when the petal plates 536 are retracted. Portion 543 includes a recess 547 facing cavity 526. An annular reciprocation piece 574 is received in recess 543. Upon reciprocation of said annular reciprocation piece 574, cam 533 is moved linearly parallel to cavity axis 526.

[0049] Referring to Fig. 8, a seventh form of the invention is indicated by the reference numeral 600. The same reference numerals as used in Fig. 1 identify well bore tube 12 and collar portion 14. apparatus 500 includes a circular body 616 having a top 618, bottom 620, outer side 622, inner side 624 and central cavity 626. Cavity 625 is centered on body axis 628 (not shown, but understood; compare Fig. 1) and has a diameter sufficient to admit through cavity 626 the entire width of a well bore tube 12 including collar portion 14, that is to be received for manipulation by apparatus 600. The bottom 620 of circular body 616 is affixed to an annular gusseting plate 632 of a frusto-conical or funnel guide plate 634 that tapers inwardly toward cavity 626 to guide body 616 over a well bore tube 12 that is to be received within cavity 626.

[0050] Horizontally supported on top 618 of circular body 616 is a petal plate 636 that has a radially inner portion 638 and a radially outer portion 640. Fig. 8 shows one of a plurality of petal plates so disposed. The other plates (not shown) are spaced apart around top 618 of circular body 616; see and compare Fig. 3. Circular body 616 that supports petal plates 636 is a fulcrum when the weight of a well bore tube 12 is impressed on the innermost portion 638 of the petal plates 636. This occurs when the petal plates 636, in extended position, as hereinafter described, support the weight of the well bore tube 12. To counter the force moment of such load on petal plates 630, a circular counterforce member or bolster ring 666 at least partially surrounds body 616, spaced radially

outward from body 616, and is positioned above and adjacent the top of the outer portion 640 of petal plates 636 including when they are extended into cavity 626. Counterforce bolster ring 666 is secured atop pedal plates 636 by a lower portion thereof 668 affixed relative to the body 616, as seen in Fig. 8, at the inner side 622 of body 616. An inner ring 668 vertically restrains petal plates 636 and guides then for radial movement.

[0051] Received within an aperture 637 in petal plate 636 between inner portion 638 and outer portion 640 is an eccentric cam lobe 645 on cam shaft 644 substantially parallel to body axis 628 and supported in bearing 680. Cam shaft 644 terminates in a sprocket 682 held from bearing 680 by spacer 684. Sprocket 682 may be turned manually or by hydraulic, electric or pneumatic motors. The cam shafts for all the petal plates 636 are interconnected by a chain so that motivational force is applied to all of them together to move cam lobes 645 in unison. Cam lobe 645 rotates on the axis of shaft 644 and engages the radially inward surface of aperture 637 of petal plate 636, all cam lobes 645 doing the same for all the petal plates horizontally supported on top 618 of body 616. Followingly pushed by cam lobe 645, petal plate 636 is moved radially inward, positioning radially innermost portion 638 of petal plate 616 within cavity 626 of body 516 sufficiently, with the other petal plates, similarly actuated, to prevent passage of collar portion 14 through cavity 620. To release tubing 12 from apparatus 600, cam shafts 544 are rotated to move the eccentric of cam lobe 645 away from the radially inner surface of aperture 637 towards the radially outer surface of aperture 637, to impress eccentric lobe 645 onto the radially outer surface of petal plate aperture 637 and push petal plate 636 radially outward. The similar and coincident actuation of the other such petal plates 636, moves all petal plates 636 radially outwardly to an extent removing the innermost portion 638 of petal plates 636 from cavity 626 of body 616, allowing passage of collar portion 14 through cavity 620. In the foregoing fashion petal plates 636 at their apertures 637 function as a cam follower.

[0052] From the foregoing, it will be understood that in operation the embodiments of Figs. 1-8 perform a method of the invention for manipulating well bore tubing, that comprises: introducing tubing 12 into the cavity 26, 126, 226, 326, 426, 526 or 626, respectively, of a circular body 16, 116, 216, 316, 416, 516 or 616 having a central cavity of diameter to admit therethrough a collar portion 14 of tubing 12; positioning body 16, 116, 216, 316, 416, 516 or 616 below collar portion 14 of tubing 12; and moving a plurality of petal plates, respectively, 36, 136, 236, 336, 436, 536 or 636 horizontally supported on and spaced apart around the top, respectively 18, 118, 218, 318, 418, 518 or 518 of body 16, 116, 216, 316, 416, 516 or 616 radially inward, substantially normal to body axis 28, 128, 228, 328, 428, 528 or 628, respectively, over body, 16, 116, 216, 316, 416, 516 or 616, into the cavity 26, 126, 226, 326, 426, 526 or 626, respectively, an extent sufficient to prevent passage of the collar portion 14 of tubing 12 through cavity 26, 126, 226, 326, 426, 526 or 626, respectively.

[0053] In respect to the invention in the forms described in respect to Figs. 5, 6 and 7, petal plates 336, 436 and 536, respectively include apertures 337, 437 and 537 receiving elongate cams, respectively 344, 444, and 555, movable linearly parallel to the axes 328, 428 and 528, respectively, of cavitys 326, 426, and 526, for sliding on plates 336, 435 and 535, and the step of moving petal plates 336, 436 or 536 comprises actuating elongate cam 344, 444, or 555, respectively, to ride plates 336, 436 or 536, respectively, on cam 344, 444, or 555. In the form of the invention described in respect to Fig. 5, the elongate cam 344 is actuated by a rod 374 of a piston moved by force of fluid admitted into or withdrawn from a cylinder within which the piston reciprocates, the cylinder being fixed relative to the body 316 and the piston rod end 376 distal from the piston attaching cam 344. In the embodiment depicted in Fig. 6, elongate cam 444 is actuated by rotating a ring cam 474 surrounding cavity 426 and operatively connected to said elongate cam 444 to translation the rotary motion of ring cam 474 to linear motion of elongate cam 444. In the form of the invention described in reference to Fig. 7, elongate cam 544 is actuated by reciprocating a ring 574 received in a recess 547 of an extended portion 543 of elongate cam 544.

[0054] In respect to the invention in the form described relative to Fig. 8, wherein petal plates 636 include an aperture 637 receiving a cam comprising an eccentric lobe 645 and a camshaft 644, located radially outwardly from body 616 and rotatable about shaft 644 axis substantially parallel to axis 628 of cavity 626, petal plates 636 are operated by rotating the cam eccentric 645 to push the proximal portion 538 of petal plates 630 in or out of body cavity 626.

[0055] In respect to the invention in the form of Figs. 2, 3 and 4, where petal plates 136 and 236 are connected to a link 144 and 244, respectively, that reciprocates radially inwardly and outwardly substantially normal to the axis of cavitys 126 and 226 respectively, the step of moving petal plates 136 and 236 comprises moving links 144 and 244, respectively, radially inwardly to the extent sufficient to prevent passage of the collar portion 14 of tubing 12 through cavity 126 and 226, respectively, in these embodiments, links 144 and 244 are moved by a rod 174 and 274, respectively, of a piston moved by force of fluid admitted into or withdraw from a cylinder within which the piston reciprocates, the cylinder being fixed relative to body 116 and 216, respectively, and the piston rod end 176 and 276, respectively, distal from the piston, attaching link 144 and 244 respectively.

[0056] In the embodiment described in respect to Fig. 1, petal plates 36 are connected to link 44 that pivots on an axis 46 transverse to the axis 28 cavity 26, and the step of moving comprises pivoting link 44 upwardly. Link 44 includes a finger 60 received within a capture 58 located on the interior of a sleeve 52 surrounding body 16 and moveable parallel to axis 28 of cavity 26, and the

step of moving comprises moving sleeve 52 upwardly, suitably by the action of a rod of a piston moved by force of fluid admitted into or withdrawn from a cylinder within which the piston reciprocates, the cylinder being-fixed relative to body 16, the piston rod end distal from the piston attaching sleeve 52.

[0057] As mentioned above, Figs. 1-8 are conceptual drawings in which the elements of the invention are depicted in their relationship to one another, but in which the shape of the elements is neither the necessary shape nor are the elements presented in necessary scale or proportion in which they might be present in a constructed apparatus making use of the invention. For example, the body 16, 116, 216, 316, 416, 516, or 616 might (but need not) take the shape of the annular body depicted in the apparatus described in Basic Form III of the Invention.

[0058] In one application of the invention, the forms of the inventions could have a body 16, 116, 216, 316, 416, or 515 of cavity (respectively, 26, 125, 226, 325, 426 or 526) diameter of 33 inches, with a petal plate in extended position in the cavity having an inner diameter of 30 $^{3}/_{8}$ inches for manipulating tubing whose body is 30 inches in outside diameter and that has a collar 32 inches in diameter. For further example, cylinder 370 of Fig 5 might have an external diameter of 4 inches. In accordance with the invention, the forms of the invention can use interchangeable petal plates of different inner diameters to manipulate tubing of different external diameters, whether tubing body or collars or both.

Claims

1. An elevator apparatus (100) for manipulating well bore tubing (112) having a collar (114), comprising:

   a circular body (116) having a top (118) and a central cavity (126) around a body axis (128), the cavity (126) having a diameter allowing the collar portion (114) of tubing (112) to pass longitudinally therethrough;

   characterised by:

   a plurality of petal plates (136) having radially inner (138) and outer (140) portions, horizontally supported on and spaced apart around the top (118) of the body, and one or more actuators (170) operatively associated with the petal plates (136), for moving each petal plate (136) radially inward, substantially normal to the body (116) axis, over the body, into the cavity (126), to an extent sufficient, in combination with the other petal plates (136) so extended, to prevent passage of the collar portion (114) of the tubing (112) through the cavity (126), thereby to hold the tubing (112) with the elevator, in which said body (116) is a fulcrum for the petal plates (136) when they are extended into the cavity (126) and hang tubing (12) within the elevator, and wherein the elevator apparatus (200) further comprises a counterforce member (166) in operative arrangement with the petal plates (136) for opposing leverage imparted over said fulcrum to the portion of the petal plates (136) radially outward from said body (116), wherein the counterforce member (186) is a circular member surrounding the cavity (126), spaced radially outward from the body (128) and at least partially located above and adjacent the outer portion (140) of the petal plates (136) at least when they are extended into the cavity (126).

2. An elevator apparatus of claim 1 in which said circular member (166) is secured by one or more buttresses (168) fixed relative to the body (128) below the petal plates (136).

3. An elevator apparatus of claim 2 in which a plurality of buttresses (168) are interposed between the spaced apart petal plates (136).

4. An elevator apparatus of claim 1 in which said one or more actuators (170) also operate to retract the proximal portions of the petal plates (136) radially out of the cavity (126), to allow the collar portion of the tubing to pass through the cavity (126).

5. An elevator apparatus of claim 4 in which the actuator comprises a cam (344) and the petal plate is a cam follower.

6. An elevator apparatus of claim 5 in which the cam is received in an aperture in the petal plate (336) between the inner (338) and outer (340) portions of the petal plate (336).

Patentansprüche

1. Elevatorvorrichtung (100) zum Manipulieren von Bohrlochverrohrung (112) mit einem Bund (114), die Folgendes umfasst:

   einen kreisförmigen Körper (116) mit einem oberen Ende (118) und einem zentralen Hohlraum (126) um eine Körperachse (128), wobei der Hohlraum (126) einen Durchmesser hat, der den Bundabschnitt (114) der Verrohrung (112) längs durch ihn hindurch passieren lässt,

   gekennzeichnet durch:

   eine Mehrzahl von blütenblattförmigen Platten (136) mit radial inneren (138) und äußeren (140) Abschnitten, die horizontal auf dem oberen En-

de (118) des Körpers aufliegen und um es herum voneinander beabstandet angeordnet sind, und wenigstens eine funktionell mit den blütenblattförmigen Platten (136) assoziierte Stellvorrichtung (170) zum Bewegen jeder blütenblattförmigen Platte (136) weit genug, in Kombination mit den anderen so ausgefahrenen blütenblattförmigen Platten (136), radial einwärts, im Wesentlichen senkrecht zur Achse des Körpers (116), über den Körper in den Hohlraum (126), um das Passieren des Bundabschnitts (114) der Verrohrung (112) **durch** den Hohlraum (126) zu verhindern, um **dadurch** die Verrohrung (112) mit dem Elevator zu halten, wobei der genannte Körper (116) ein Hebelpunkt für die blütenblattförmigen Platten (136) ist, wenn sie in den Hohlraum (126) ausgefahren sind und Verrohrung (12) in dem Elevator aufhängen, und wobei die Elevatorvorrichtung (200) ferner ein Gegenkraftelement (166) in funktioneller Anordnung mit den blütenblattförmigen Platten (136) umfasst zum Wirken gegen Hebelkraft, die über den genannten Hebelpunkt auf den Abschnitt der blütenblattförmigen Platten (136), der vom genannten Körper (116) radial nach außen liegt, ausgeübt wird, wobei das Gegenkraftelement (166) ein kreisförmiges Element ist, das den Hohraum (126) umgibt, von dem Körper (128) radial nach außen beabstandet ist und wenigstens teilweise über und neben dem äußeren Abschnitt (140) der blütenblattförmigen Platten (136) angeordnet ist, zumindest wenn sie in den Hohlraum (126) ausgefahren sind.

2. Elevatorvorrichtung nach Anspruch 1, bei dem das genannte kreisförmige Element (166) durch einen oder mehrere Strebebögen (168) relativ zu dem Körper (128) unter den blütenblattförmigen Platten (136) fixiert befestigt ist.

3. Elevatorvorrichtung nach Anspruch 2, bei dem eine Mehrzahl von Strebebögen (168) zwischen den voneinander beabstandeten blütenblattförmigen Platten (136) angeordnet ist.

4. Elevatorvorrichtung nach Anspruch 1, bei der die genannte wenigstens eine Stellvorrichtung (170) auch zum Zurückziehen der proximalen Abschnitte der blütenblattförmigen Platten (136) radial aus dem Hohlraum (126) heraus funktionieren, um den Bundabschnitt der Verrohrung durch den Hohlraum (126) passieren zu lassen.

5. Elevatorvorrichtung nach Anspruch 4, bei der die Stellvorrichtung einen Nocken (344) umfasst und die blütenblattförmige Platte ein Nockenstößel ist.

6. Elevatorvorrichtung nach Anspruch 5, bei der der Nocken in einer Öffnung in der blütenblattförmigen Platte (336) zwischen dem inneren (338) und dem äußeren (340) Abschnitt der blütenblattförmigen Platte (336) aufgenommen ist.

Revendications

1. Appareil élévateur (100) pour la manipulation de tubage de sondage de puits (112) ayant une masse-tige (114), comprenant :

un corps circulaire (116) ayant un dessus (118) et une cavité centrale (126) autour d'un axe du corps (128), la cavité (126) ayant un diamètre permettant à la portion de masse-tige (114) de tubage (112) de passer longitudinalement à travers celle-ci ; **caractérisé par** :

une pluralité de plaques de type pétale (136) ayant des portions radialement interne (138) et externe (140) supportées horizontalement sur et espacées autour du dessus (118) du corps, et un ou plusieurs actionneurs (170) associés de manière opérationnelle aux plaques de type pétale (136), pour le déplacement de chaque plaque de type pétale (136) radialement vers l'intérieur, de manière essentiellement perpendiculaire à l'axe du corps (116), au-dessus du corps, dans la cavité (126) dans une mesure suffisante, en combinaison avec les autres plaques de type pétale (136) étendues de cette manière, pour empêcher le passage de la portion de masse-tige (114) du tubage (112) à travers la cavité (126), pour maintenir ainsi le tubage (112) avec l'élévateur, dans lequel ledit corps (116) est un point d'appui pour les plaques de type pétale (136) lorsqu'elles sont étendues dans la cavité (126) et suspendent le tubage (12) au sein de l'élévateur, et dans lequel l'appareil élévateur (200) comprend en outre un élément de force conjuguée (166) dans un agencement opérationnel avec les plaques de type pétale (136) pour s'opposer à l'effet de levier transmis sur ledit point d'appui à la portion des plaques de type pétale (136) radialement vers l'extérieur depuis ledit corps (116), dans lequel l'élément de force conjuguée (186) est un élément circulaire entourant la cavité (126), espacé radialement vers l'extérieur depuis le corps (128) et situé au moins partiellement au-dessus et de manière adjacente à la portion externe (140) des plaques de type pétale (136) au moins lorsqu'elles sont étendues dans la cavité (126).

2. Appareil élévateur selon la revendication 1, dans lequel ledit élément circulaire (166) est fixé par un ou plusieurs contreforts (168) fixés par rapport au corps (128) en dessous des plaques de type pétale (136).

3. Appareil élévateur selon la revendication 2, dans lequel une pluralité de contreforts (168) sont interposés entre les plaques de type pétale (136) espacées.

4. Appareil élévateur selon la revendication 1, dans lequel lesdits un ou plusieurs actionneurs (170) fonctionnent également pour rétracter les portions proximales des plaques de type pétale (136) radialement hors de la cavité (126), pour permettre à la portion de masse-tige du tubage de passer à travers la cavité (126).

5. Appareil élévateur selon la revendication 4, dans lequel l'actionneur comprend une came (344) et la plaque de type pétale est un galet de came.

6. Appareil élévateur selon la revendication 5, dans lequel la came est reçue dans une ouverture dans la plaque de type pétale (336) entre les portions interne (338) et externe (340) de la plaque de type pétale (336).

Fig. 1

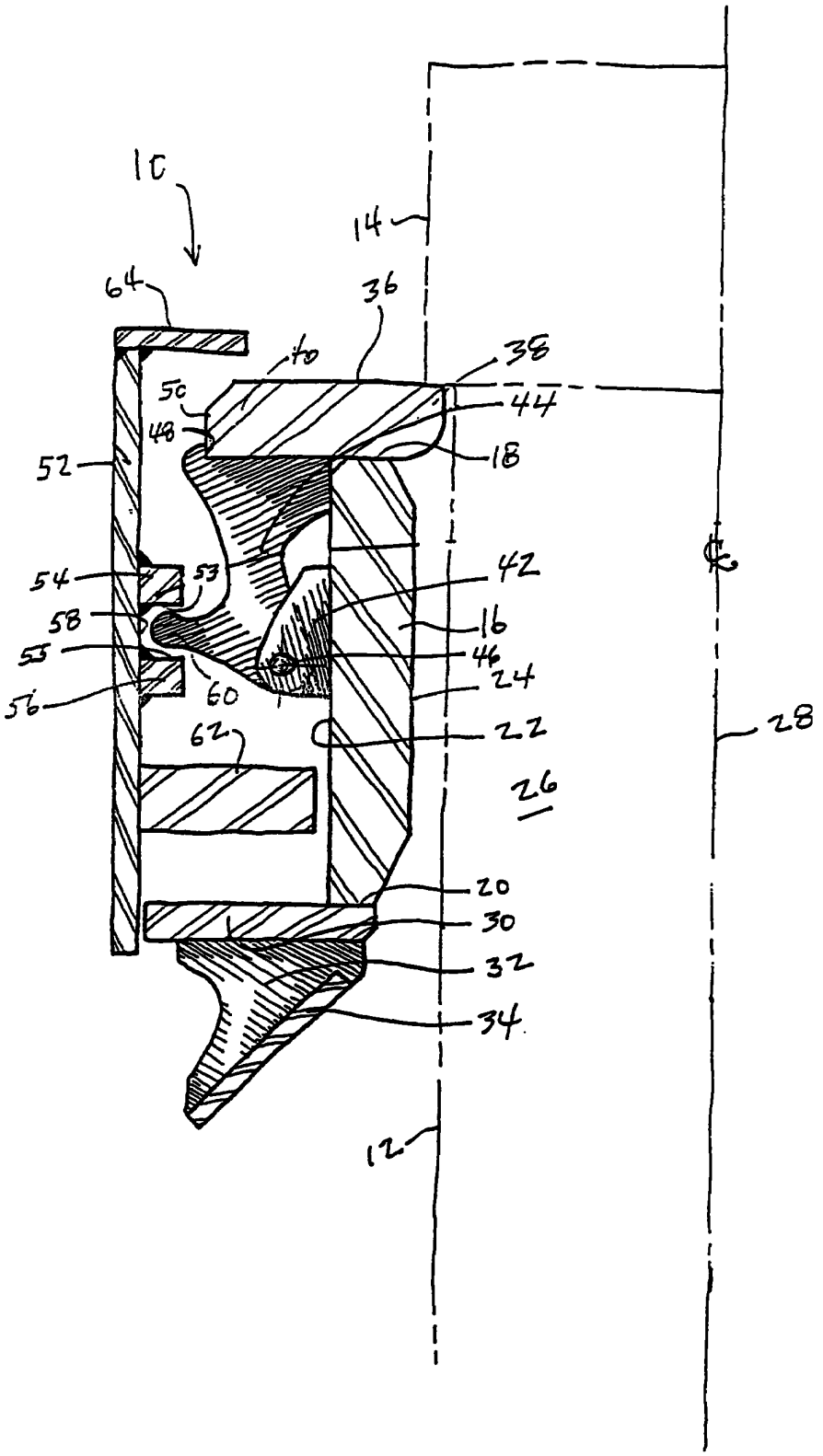
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Fig. 2

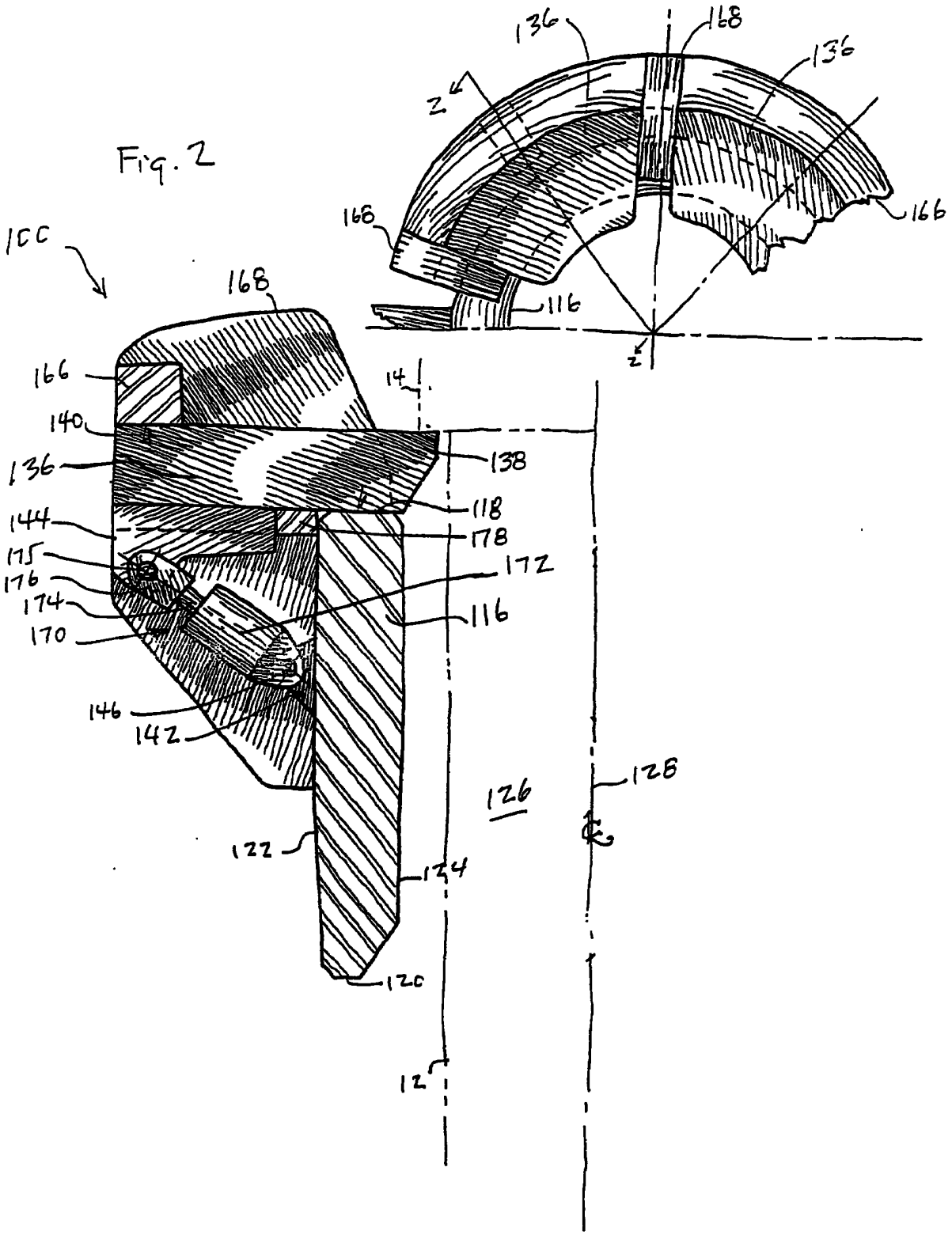
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Fig. 4

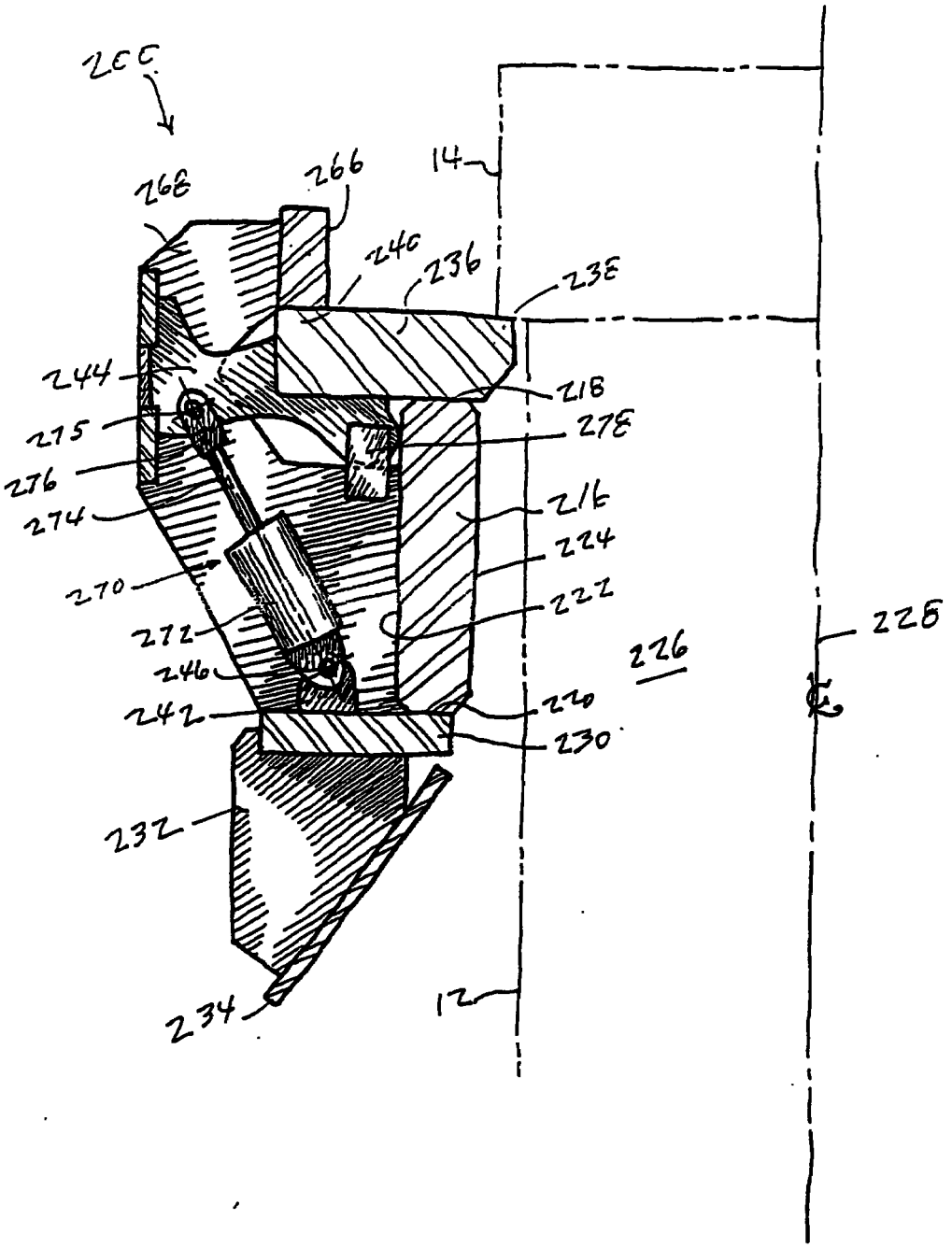
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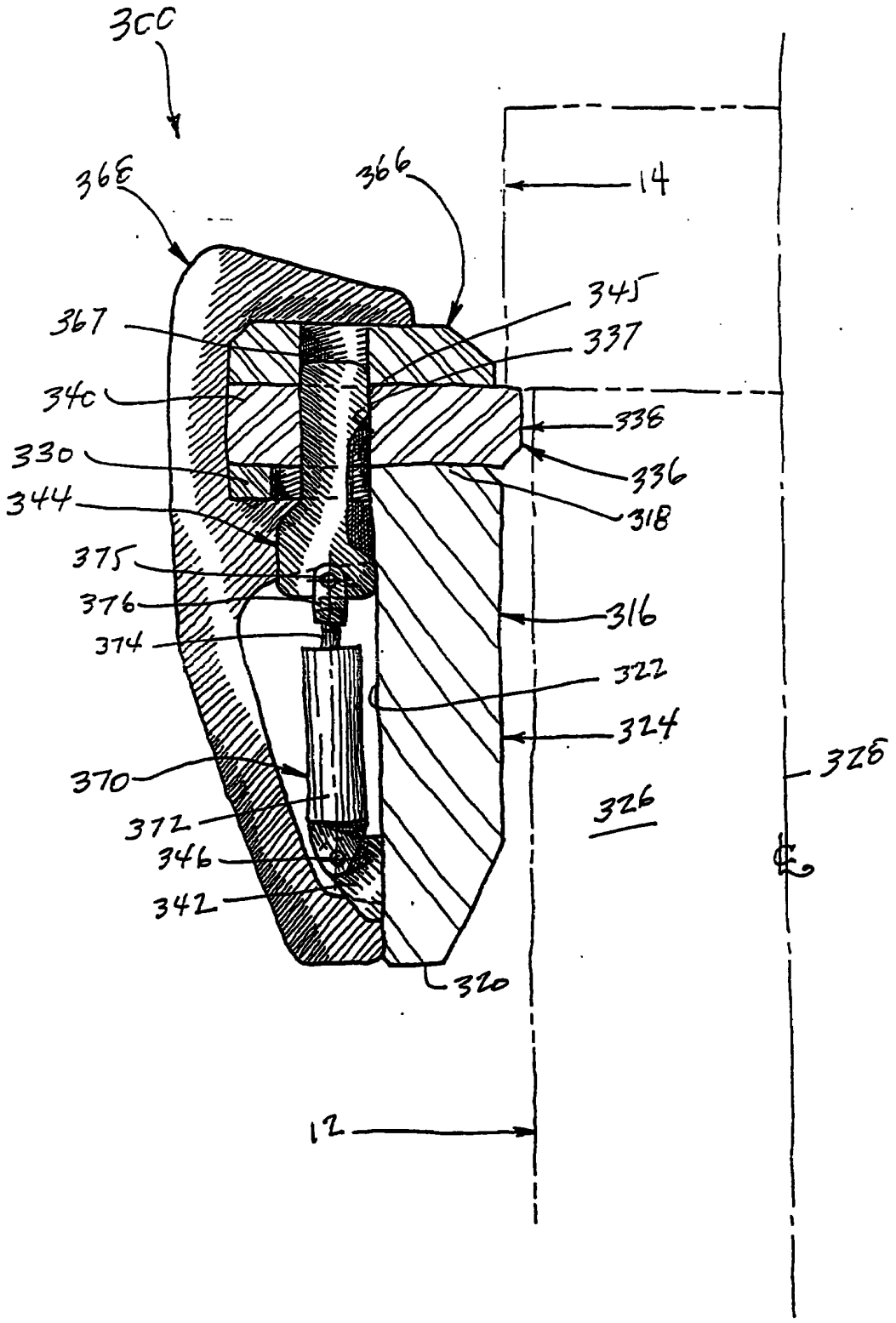
Fig. 5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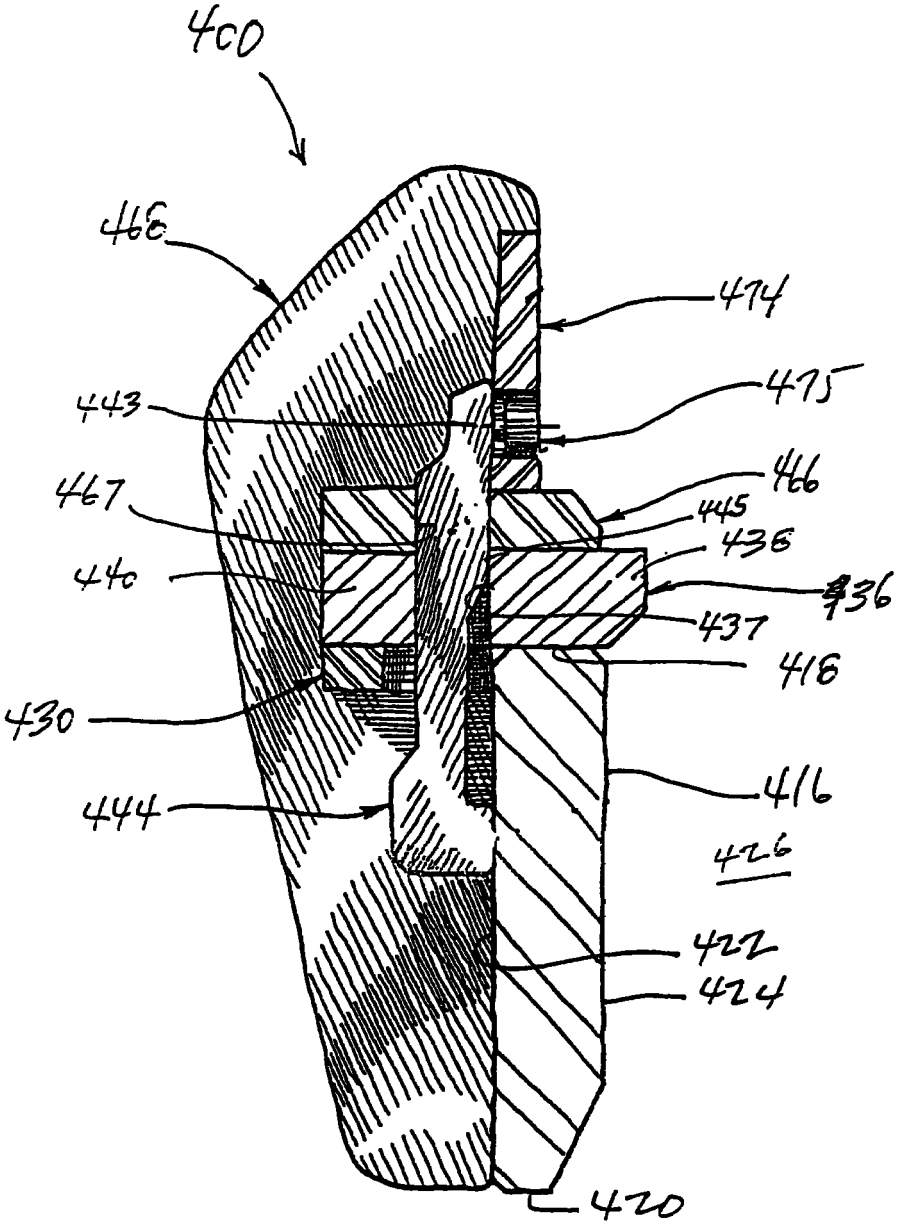
12

Fig. 6


400
466
474
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443
467
466
445
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440
436
437
418
430
416
444
426
422
424
420

Fig. 7

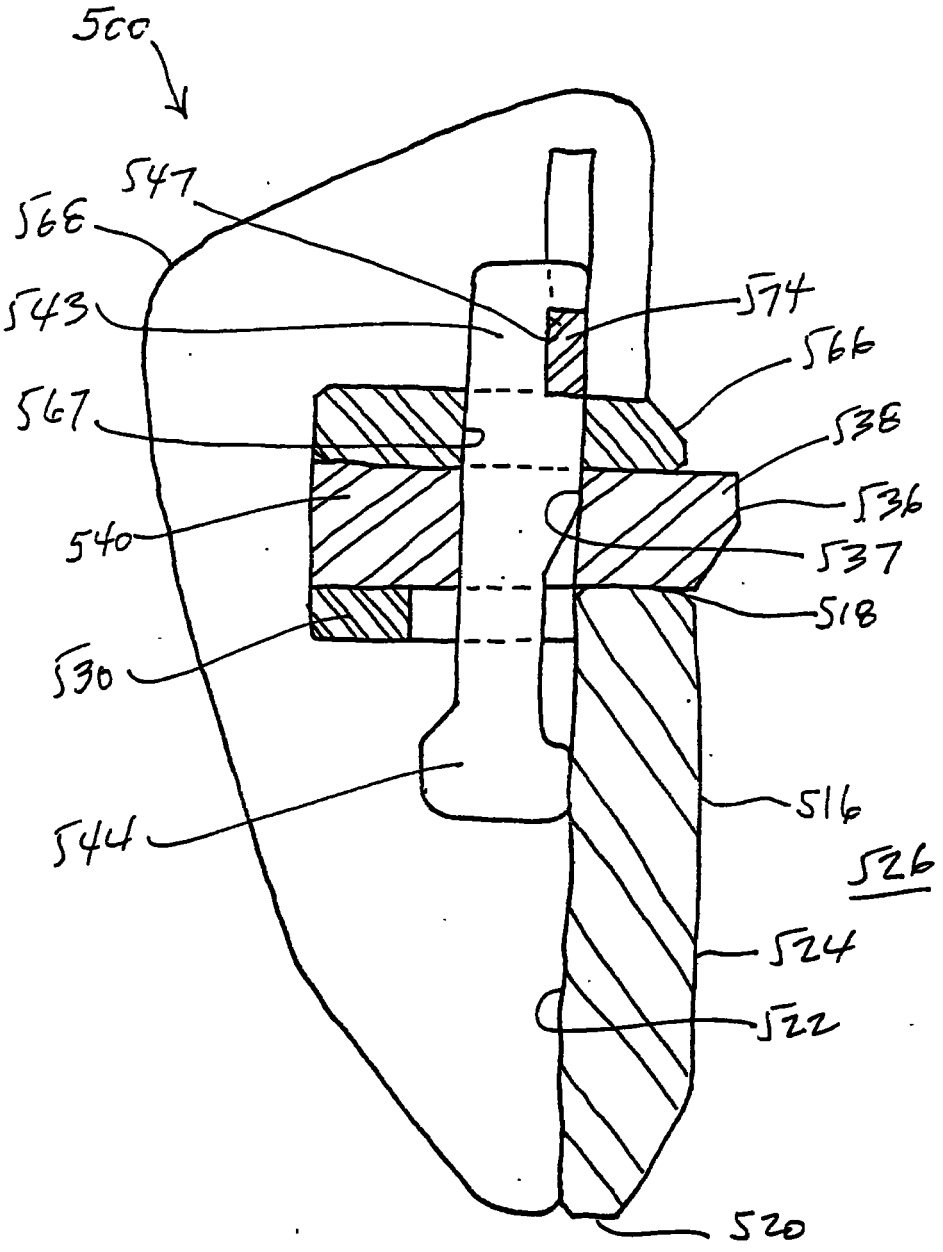
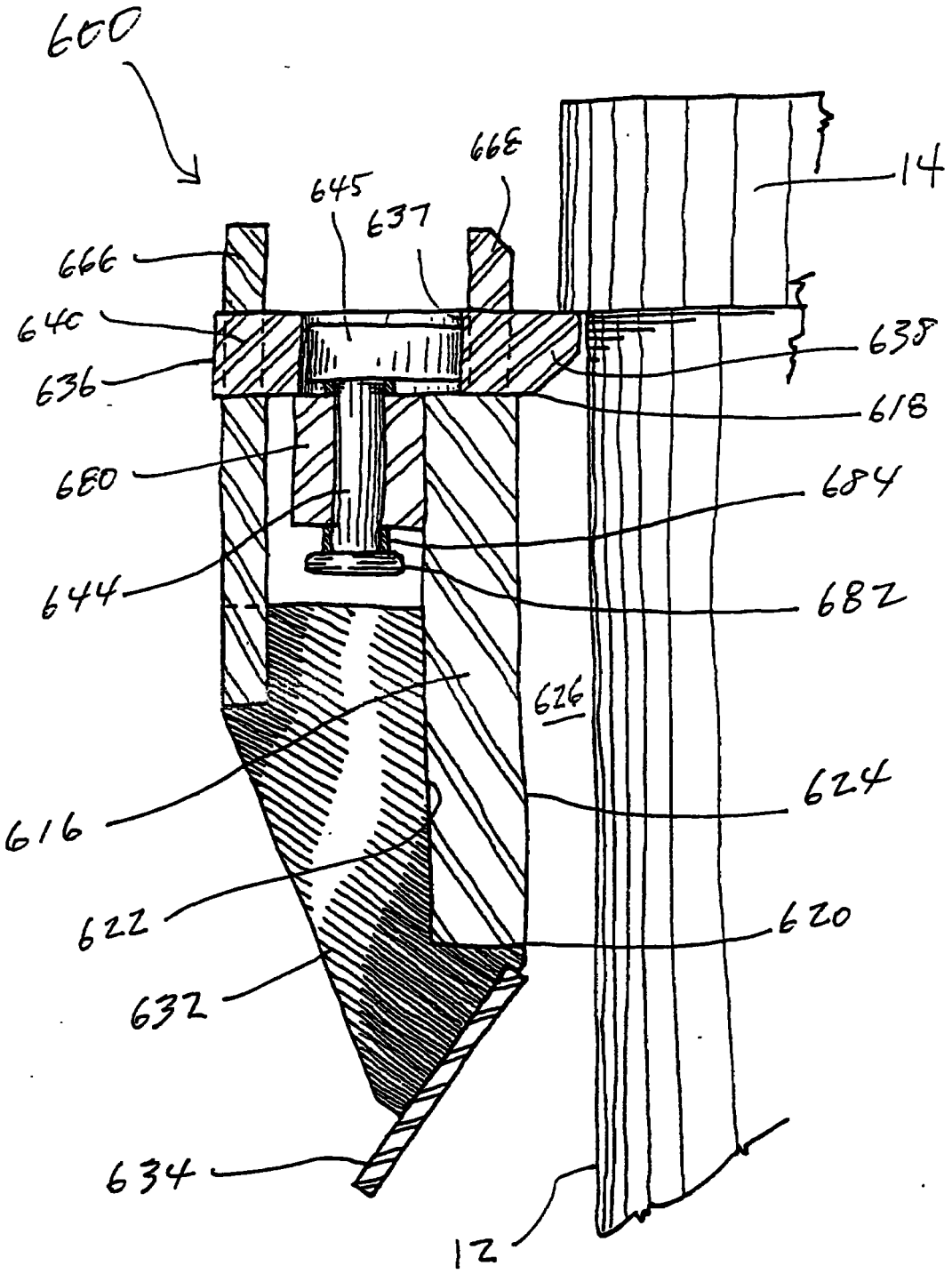

500
547
566
543
574
566
567
538
536
540
537
518
530
516
544
526
524
522
520

Fig. 8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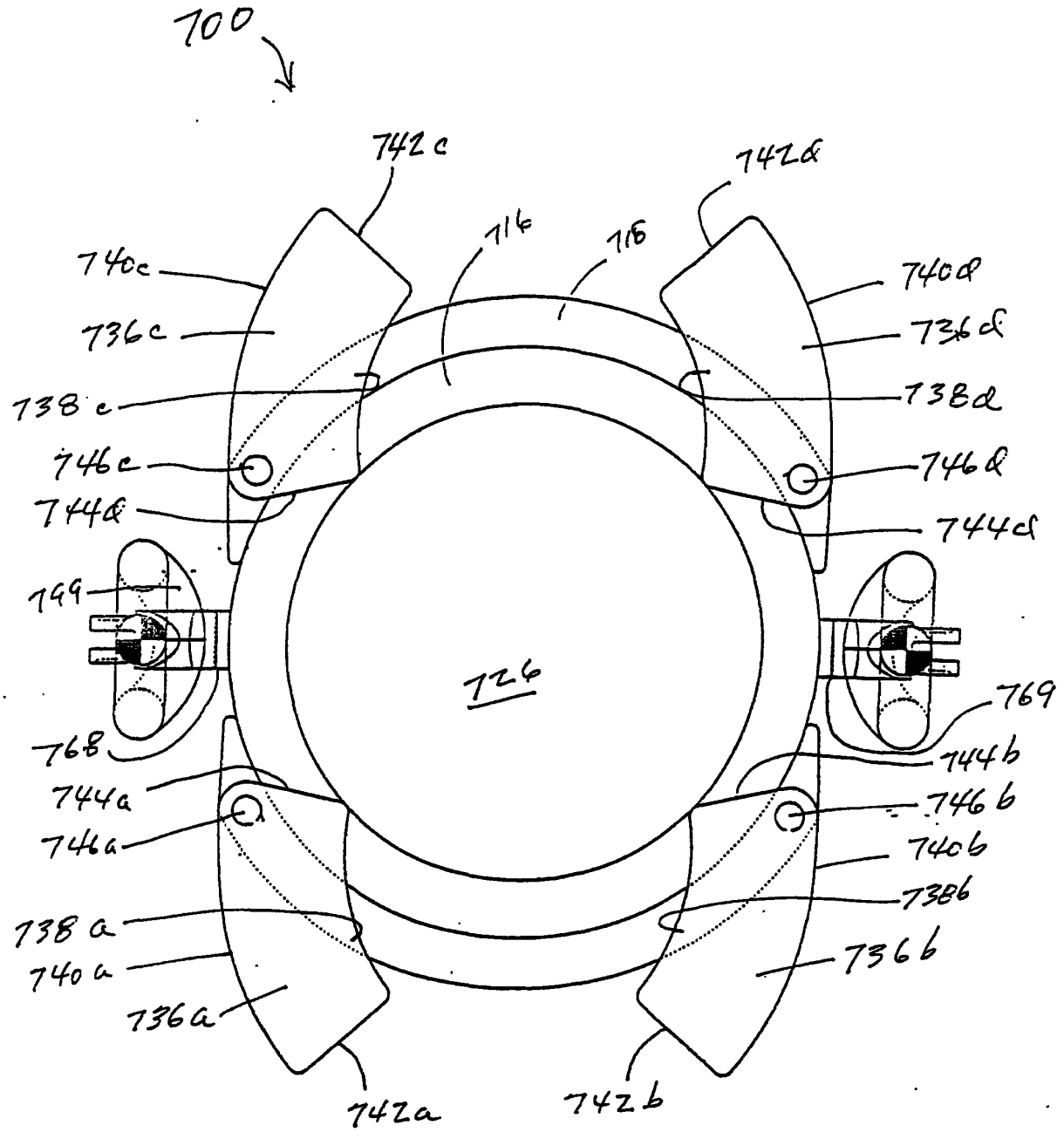
645
637
666
14
666
640
638
636
618
680
684
644
682
626
624
616
622
620
632
634
12

Fig. 9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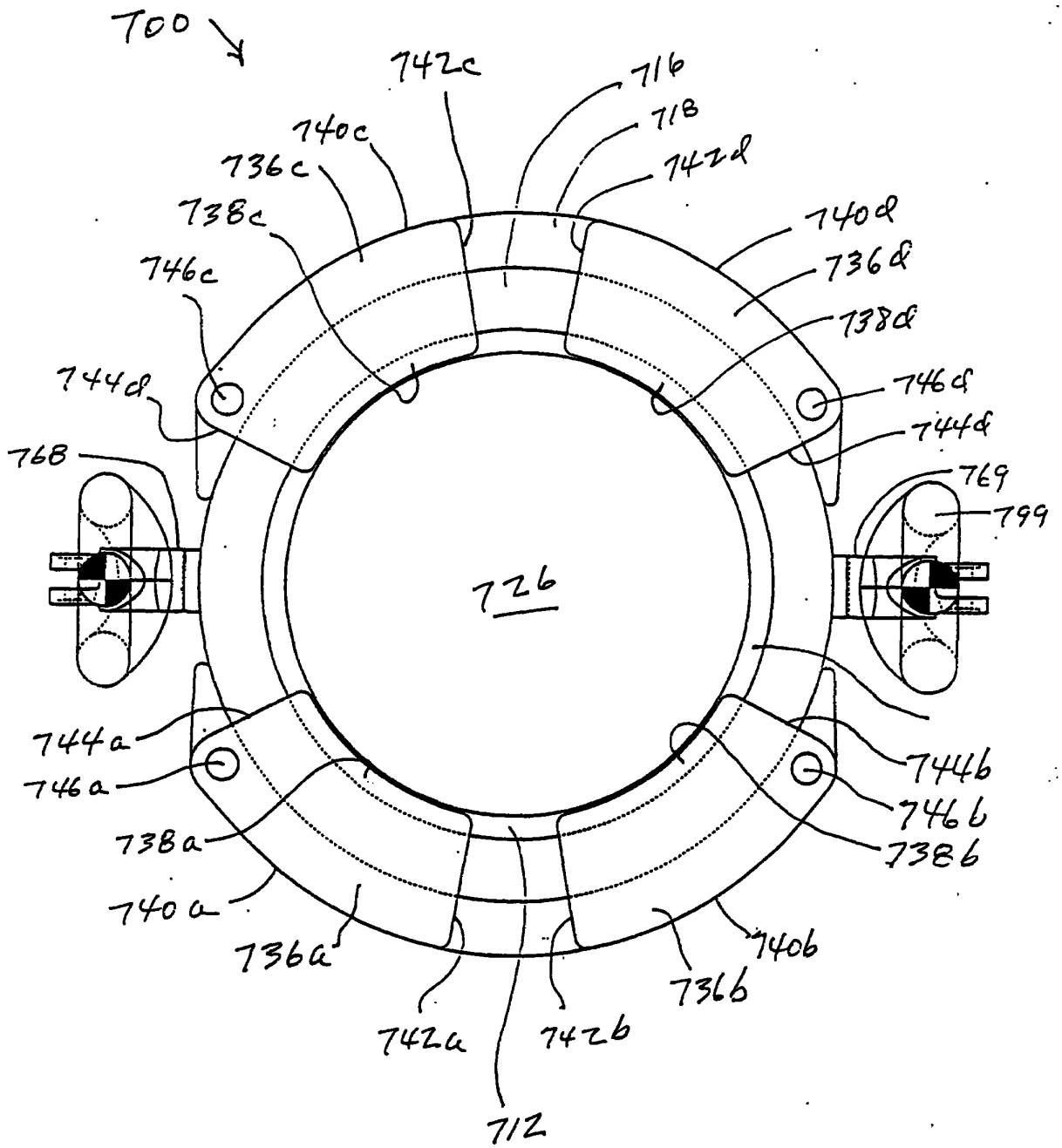
742c
742d
716
716
740c
740d
736c
736d
738c
738d
746c
746d
744d
744c
749
726
769
768
744b
744a
746b
746a
740b
738b
738a
740a
736b
736a
742a
742b

fig. 10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742c
716
718
740c
742d
736c
738c
740d
736d
746c
738d
744d
746d
744d
768
769
799
726
744a
746a
738a
740a
736a
742a
742b
712
736b
740b
738b
746b
744b

Fig. 11

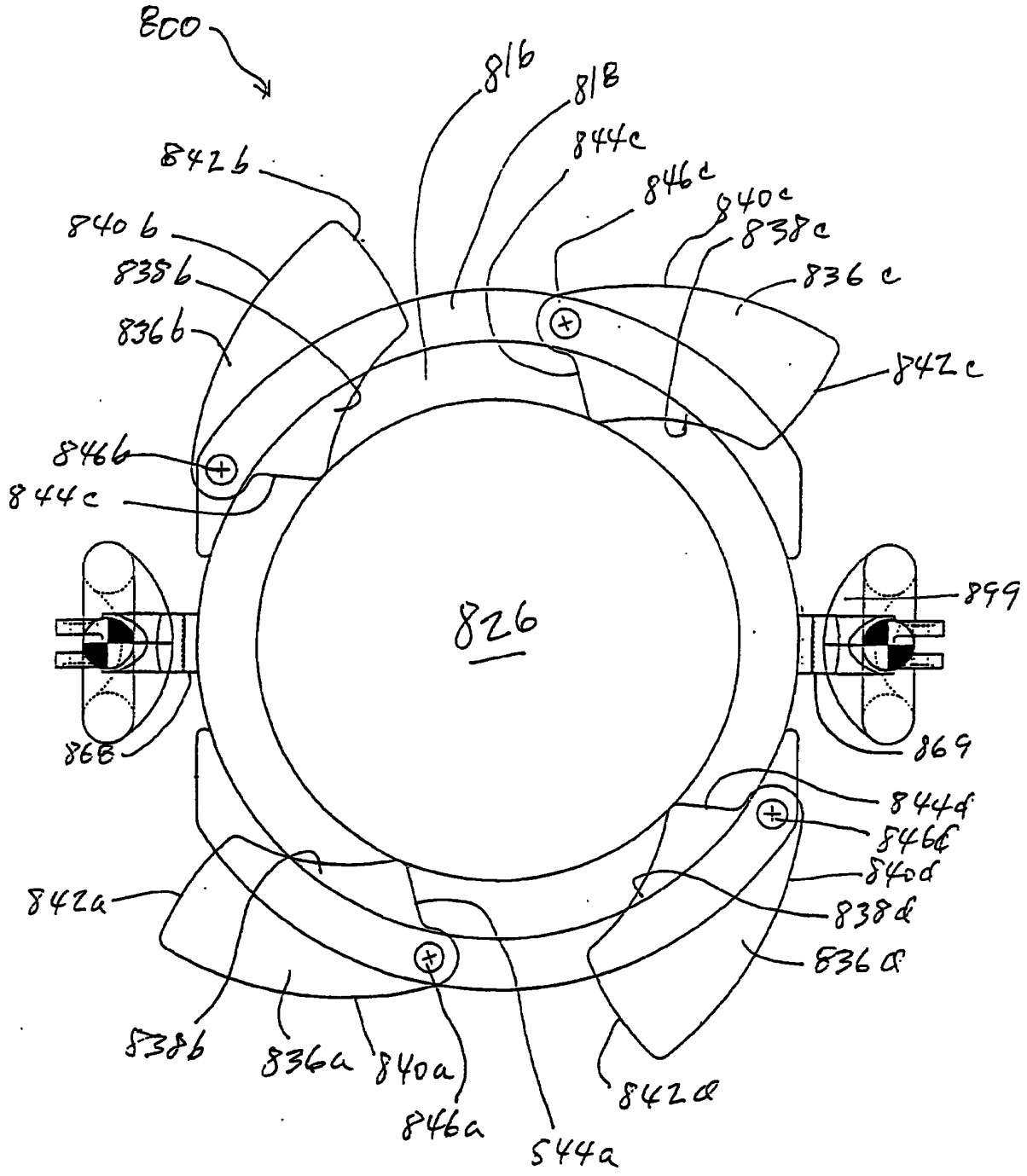

800
816
818
844c
842b
846c
840c
840b
838c
838b
836c
836b
842c
846b
844c
826
899
868
869
844d
846d
840d
838d
836d
842a
838b
836a
840a
846a
544a
842d

Fig. 12

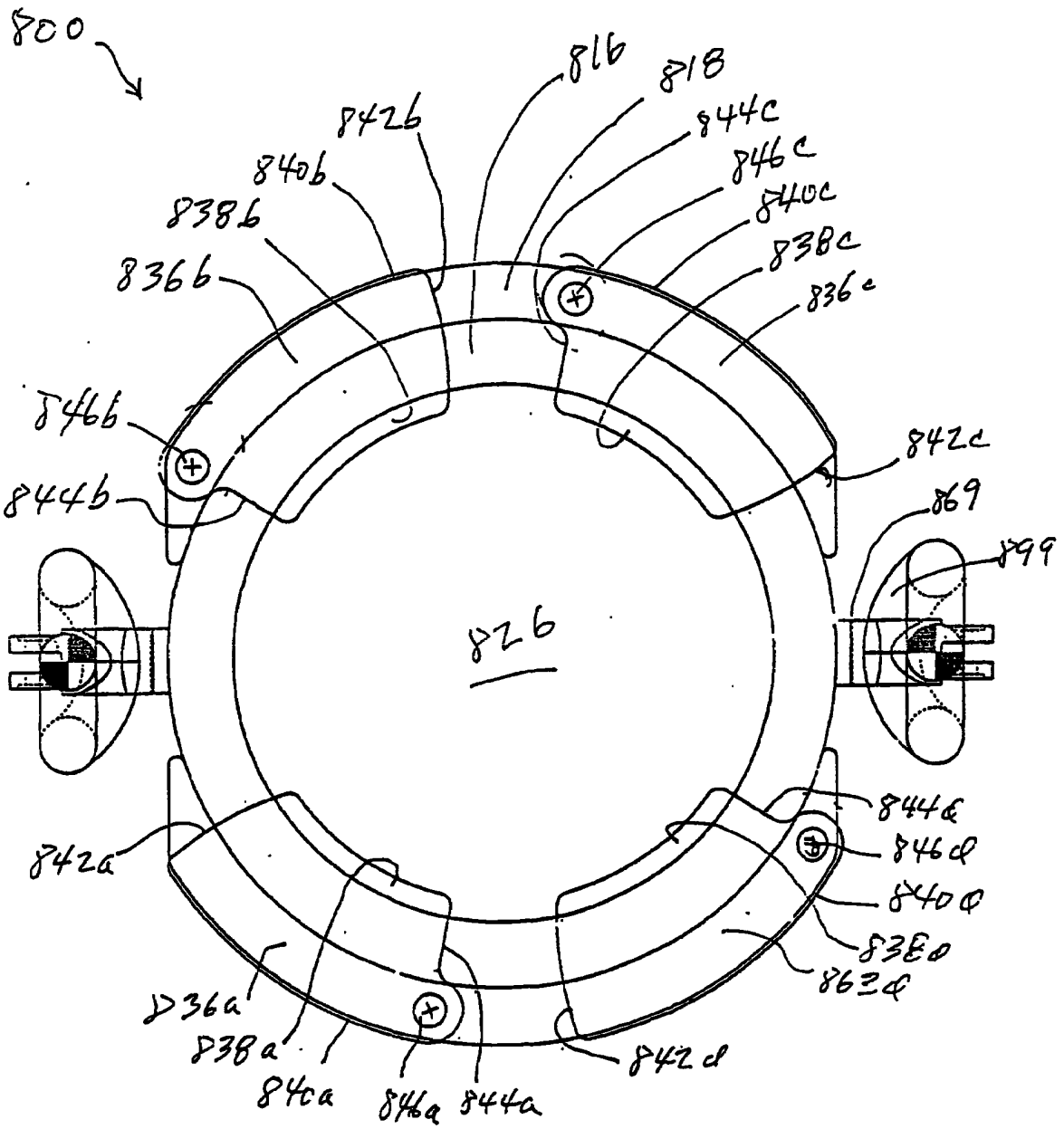

800
816
818
842b
844c
846c
840b
840c
838b
838c
836b
836c
846b
842c
844b
869
899
826
844d
846d
840d
838d
836d
842a
836a
838a
840a
846a
844a
842d

Fig. 13

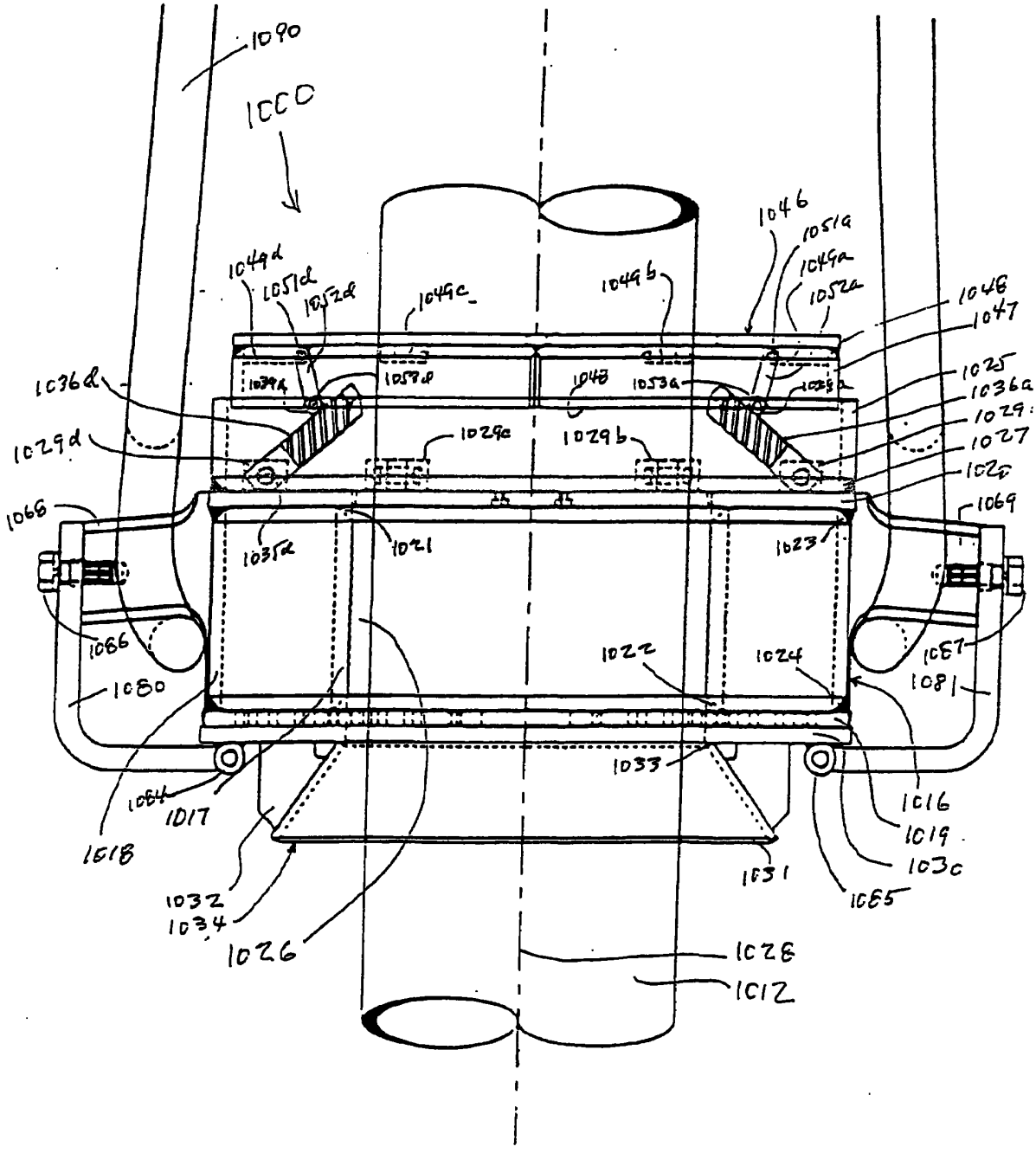

1090
1000
1046
1051a
1049a
1052a
1049d
1051d
1052d
1049c
1049b
1048
1047
1025
1036a
1029c
1027
1036d
1029d
1029a
1029b
1048
1053a
1066
1035a
1021
1023
1069
1086
1080
1022
1024
1067
1081
1033
1084
1017
1018
1016
1019
103c
1032
1034
1026
1031
1065
1028
1012

Fig. 14

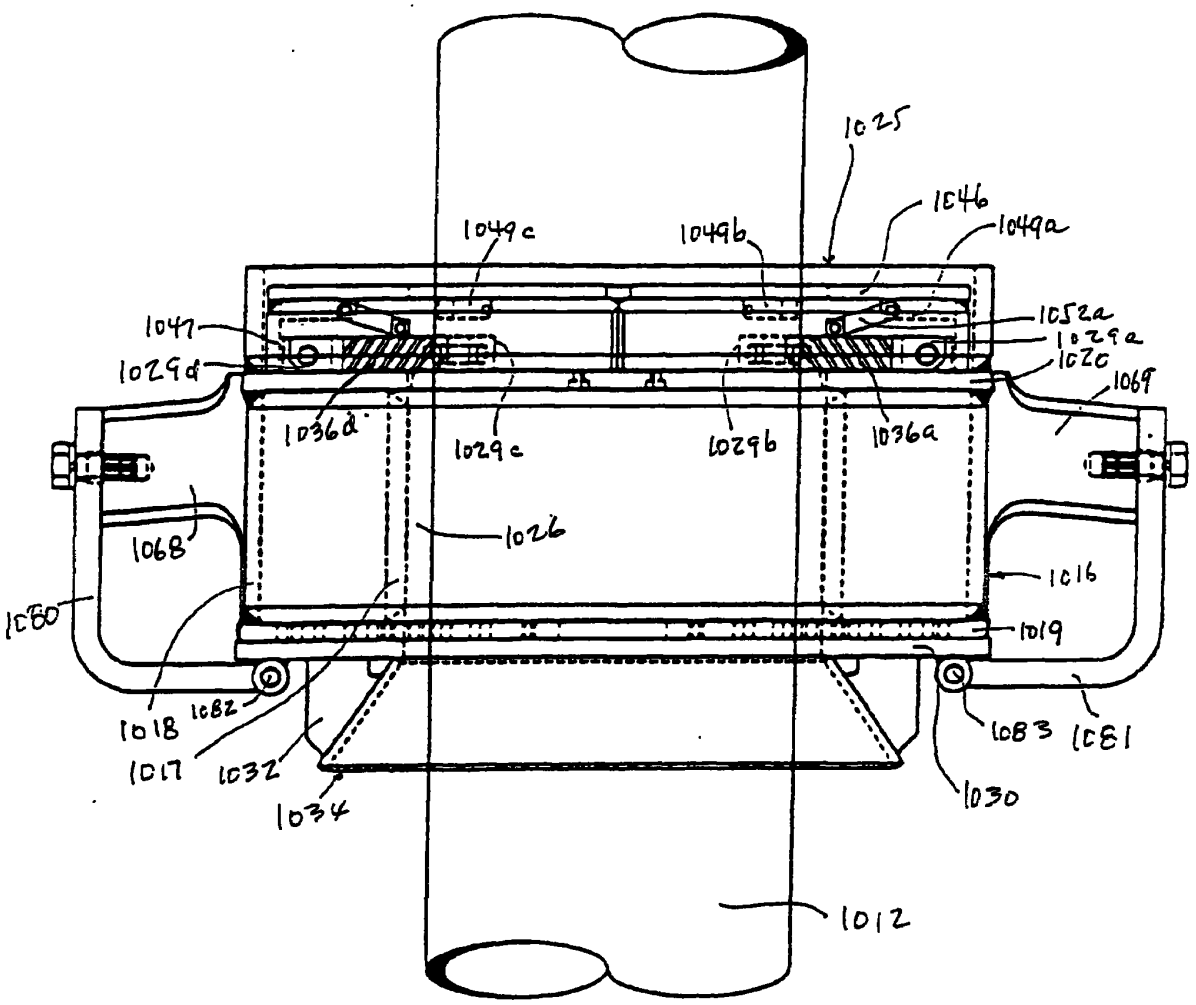
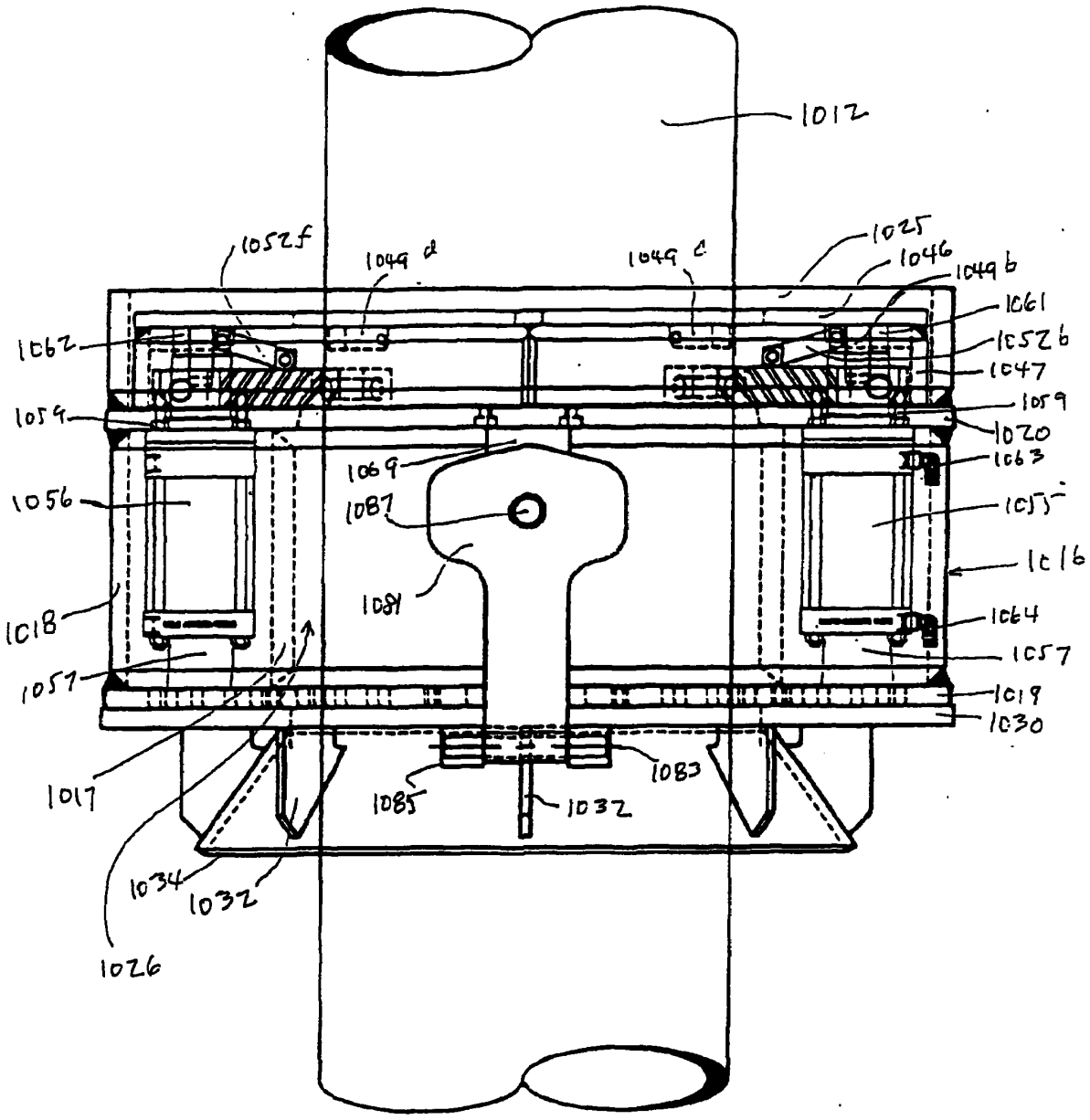

1025
1046
1049c
1049b
1049a
1047
1052a
1029a
1029d
1020
1069
1036d
1029c
1029b
1036a
1026
1068
1016
1060
1019
1018
1082
1017
1032
1034
1083
1081
1030
1012

Fig. 15


1012
1052f
1049 d
1049 c
1025
1046
1049 b
1061
1062
1052 b
1047
1059
1070
1063
1069
1087
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1016
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1018
1064
1057
1019
1030
1083
1085
1032
1017
1034
1032
1026

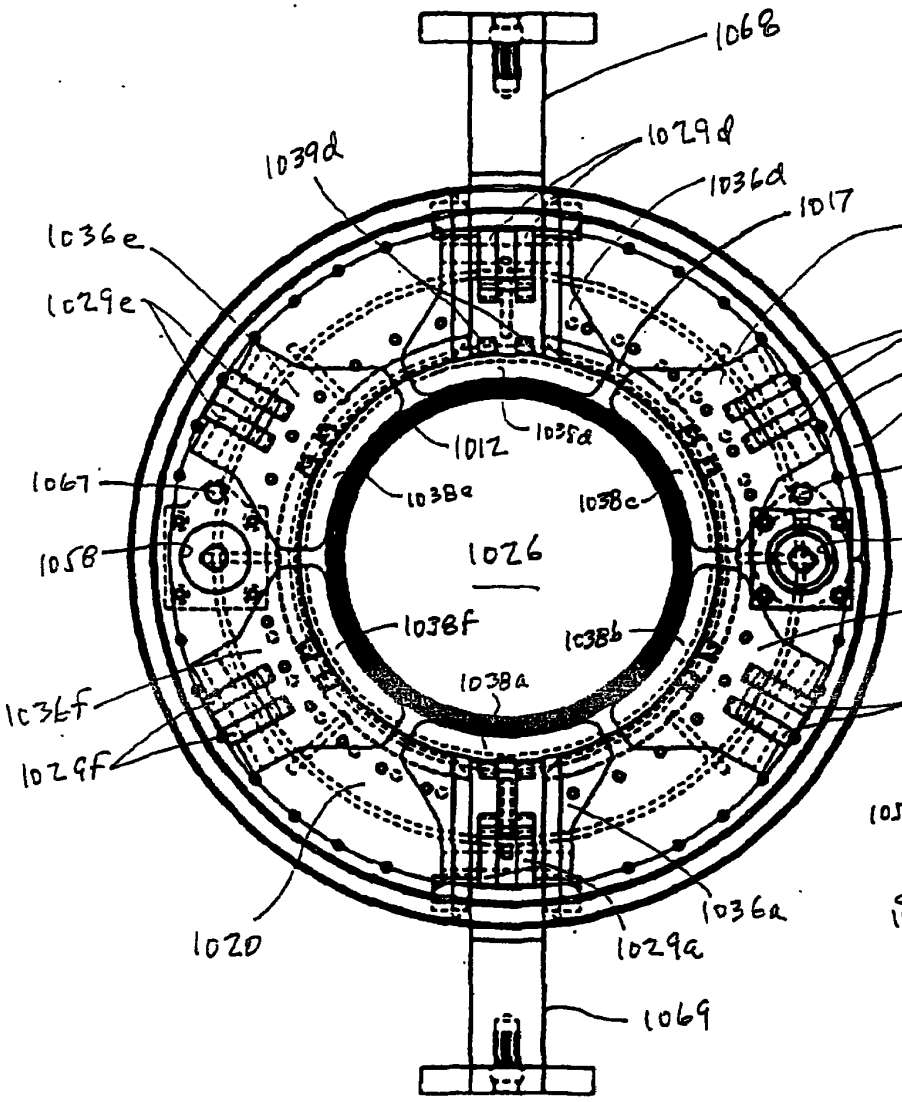
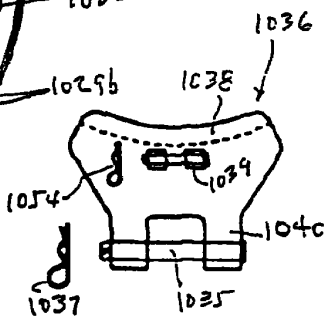

1068
1029d
1039d
1036d
1017
1036e
1029e
1029c
1047
1025
1065
1060
1036b
1029b
1067
1058
1012
1038d
1038a
1038c
1026
1038f
1038b
1038e
1036f
1029f
1020
1029a
1036a
1069

Fig. 16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1038
1039
1054
1040
1037
1035

Fig. 19

Fig. 17

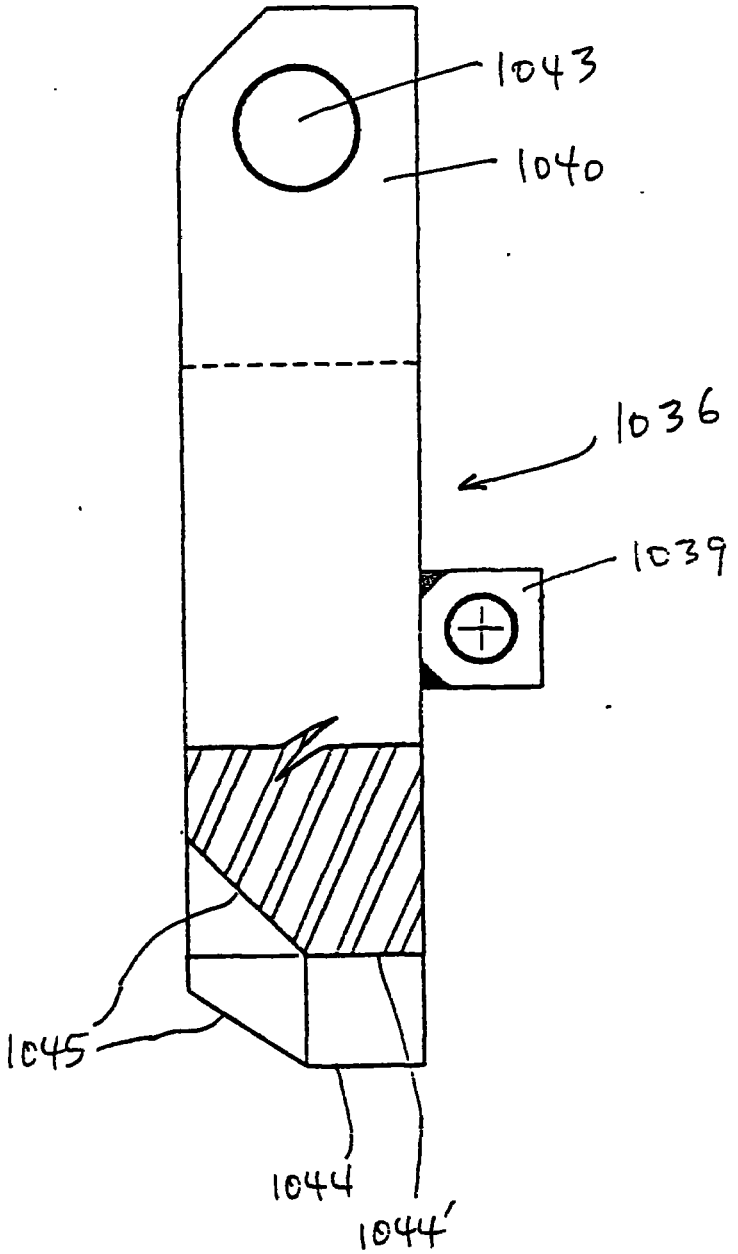
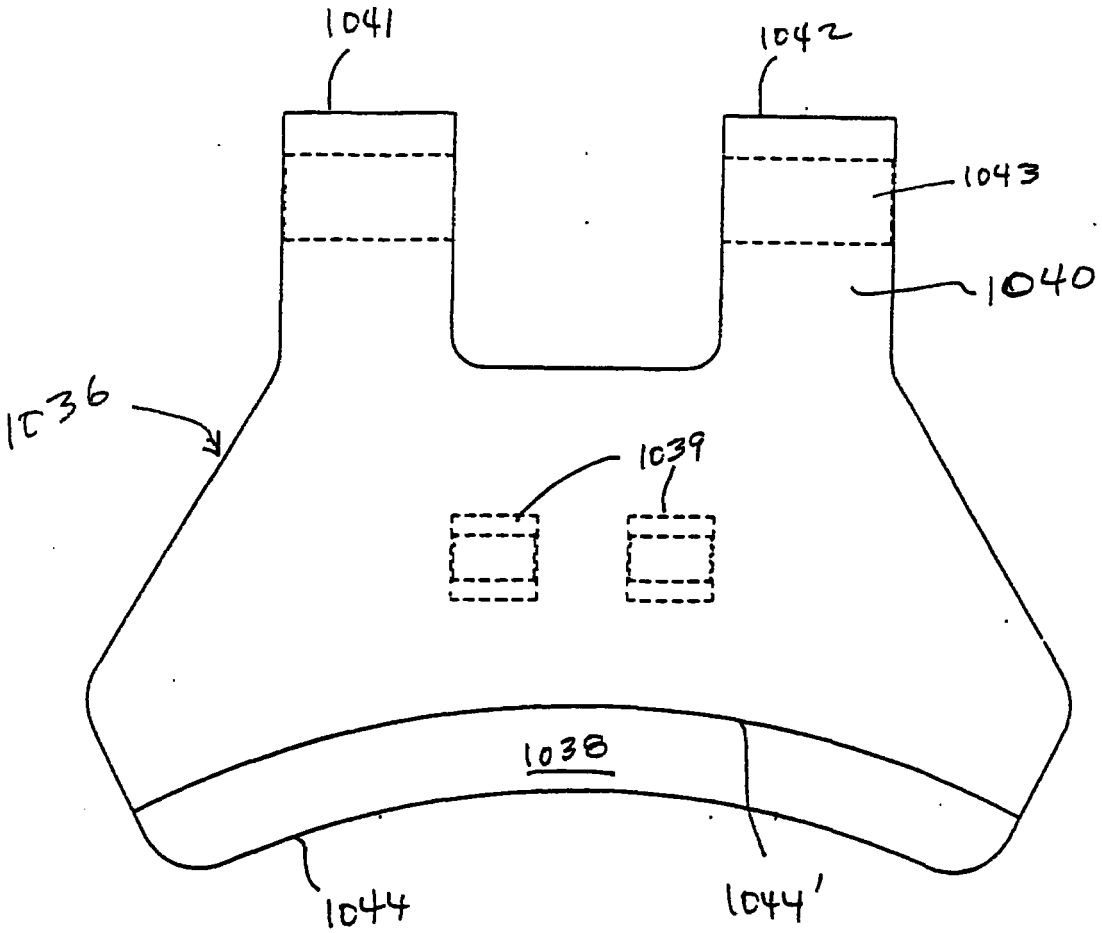


Fig. 18



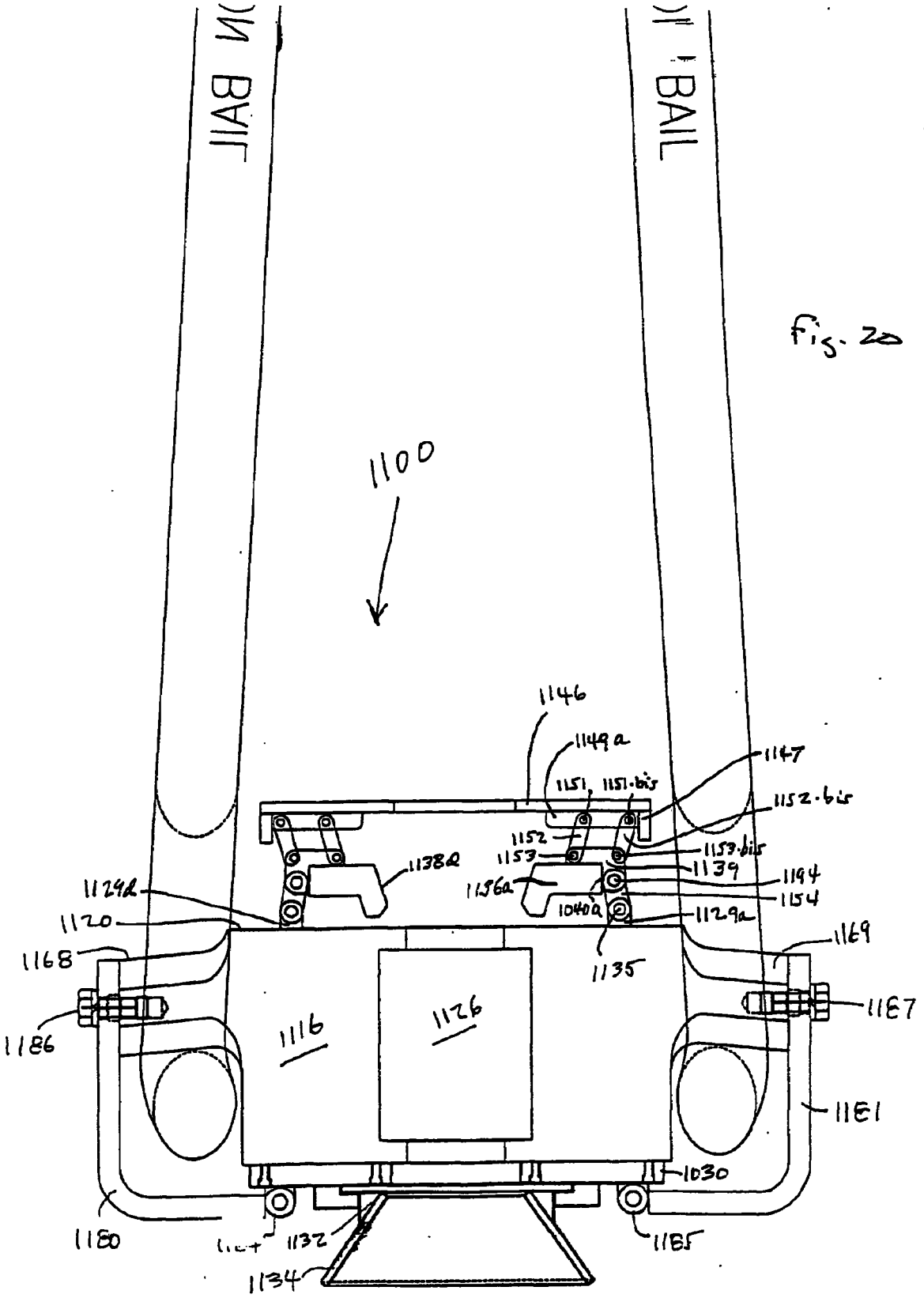

BAIL
BAIL
1100
1146
1149a
1147
1151, 1151-bis
1152-bis
1152
1153
1153-bis
1139
1194
1154
1129a
1138a
1124a
1120
1168
1156a
1040a
1135
1169
1167
1186
1116
1126
1161
1030
1180
1132
1134
1165

Fig. 2a

Fig. 21

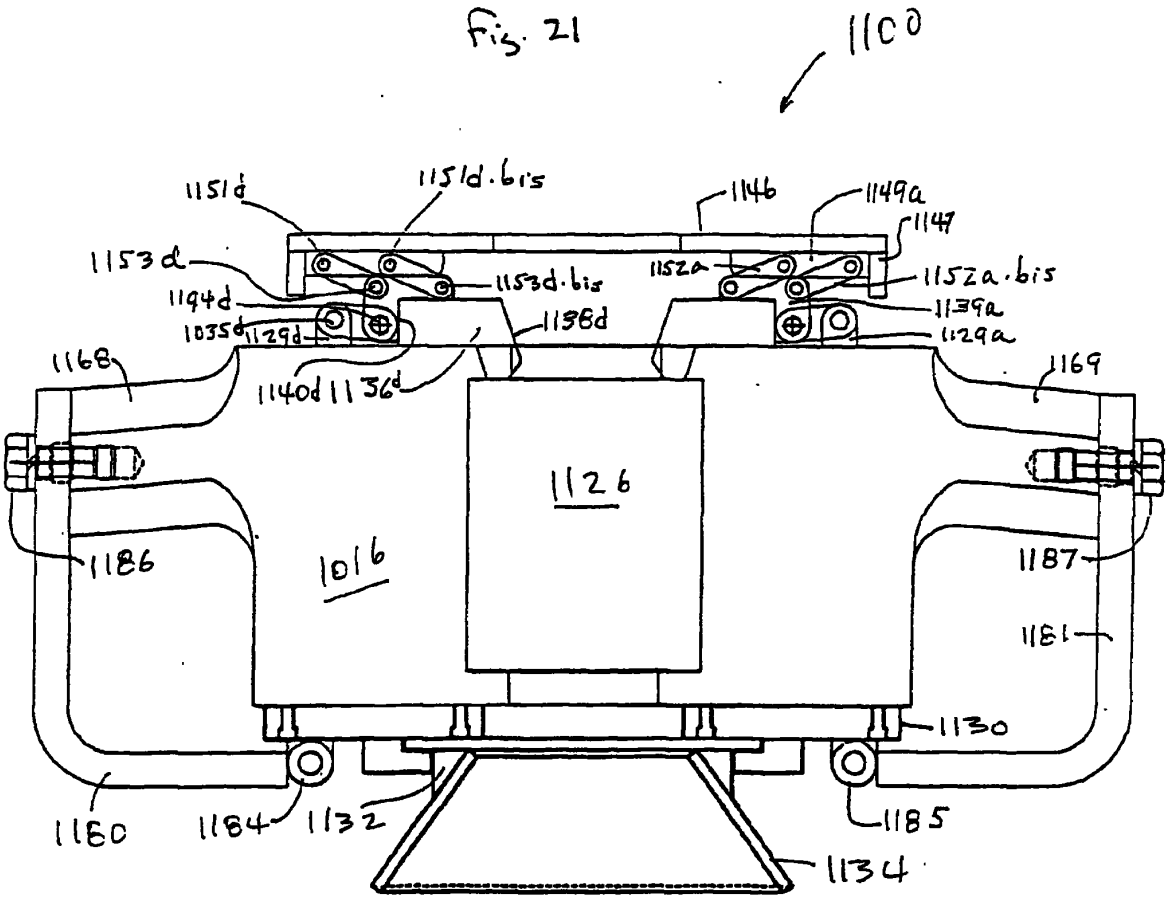
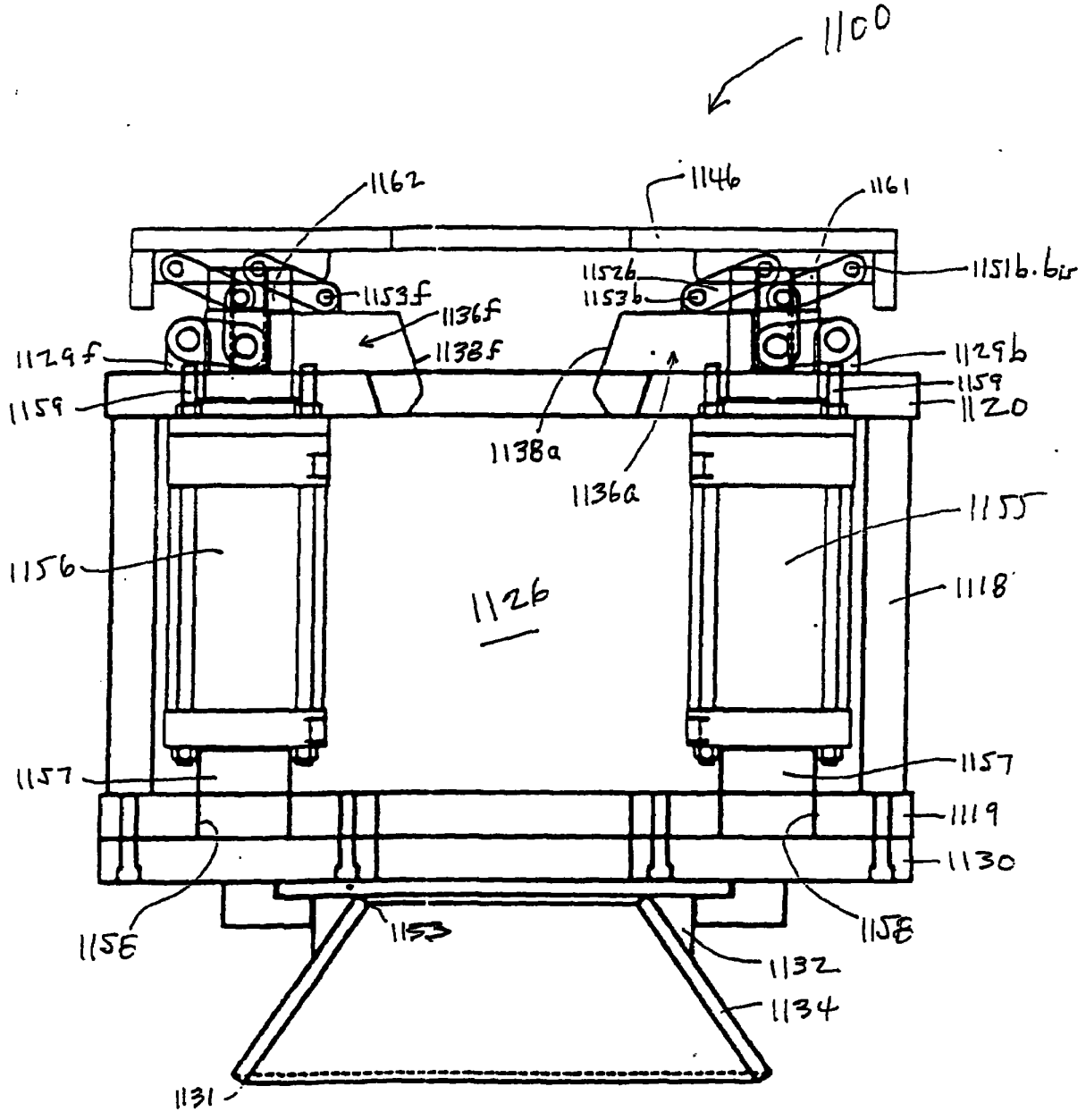

1100
1151d
1151d.bis
1146
1149a
1147
1153d
1153d.bis
1152a
1152a.bis
1144d
1139a
1035d
1129d
1158d
1129a
1168
1140d
1136d
1169
1126
1186
1016
1187
1181
1130
1160
1184
1132
1185
1134

Fig. 22


1100
1162
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1161
11516.bir
11526
11536
1153f
1136f
1138f
1129f
1129b
1159
1159
1120
1138a
1136a
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1119
1130
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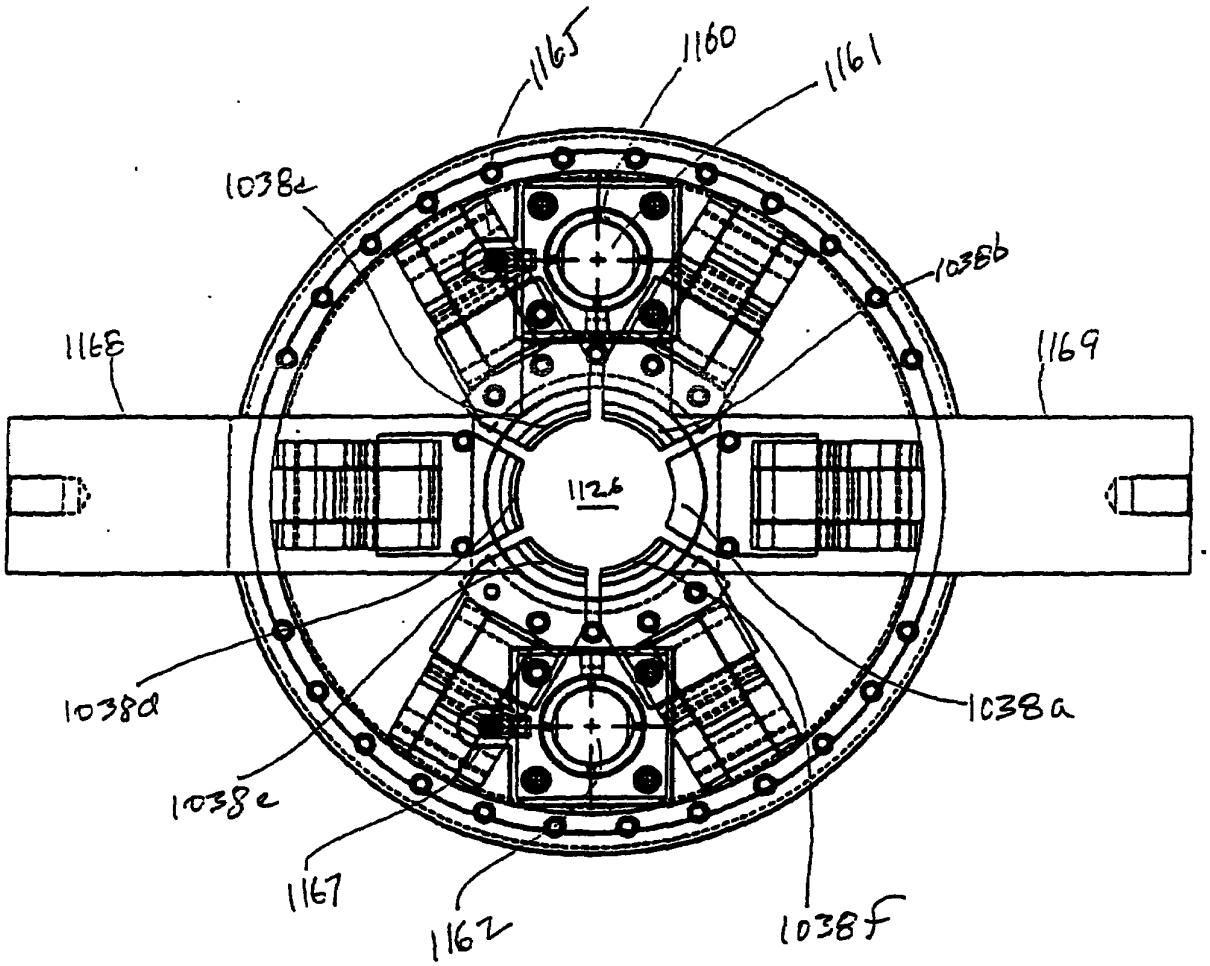
1153
1132
1134
1131

Fig. 23


1165
1160
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1038c
1038b
1168
1169
1126
1038d
1038a
1038e
1167
1162
1038f

Fig. 24

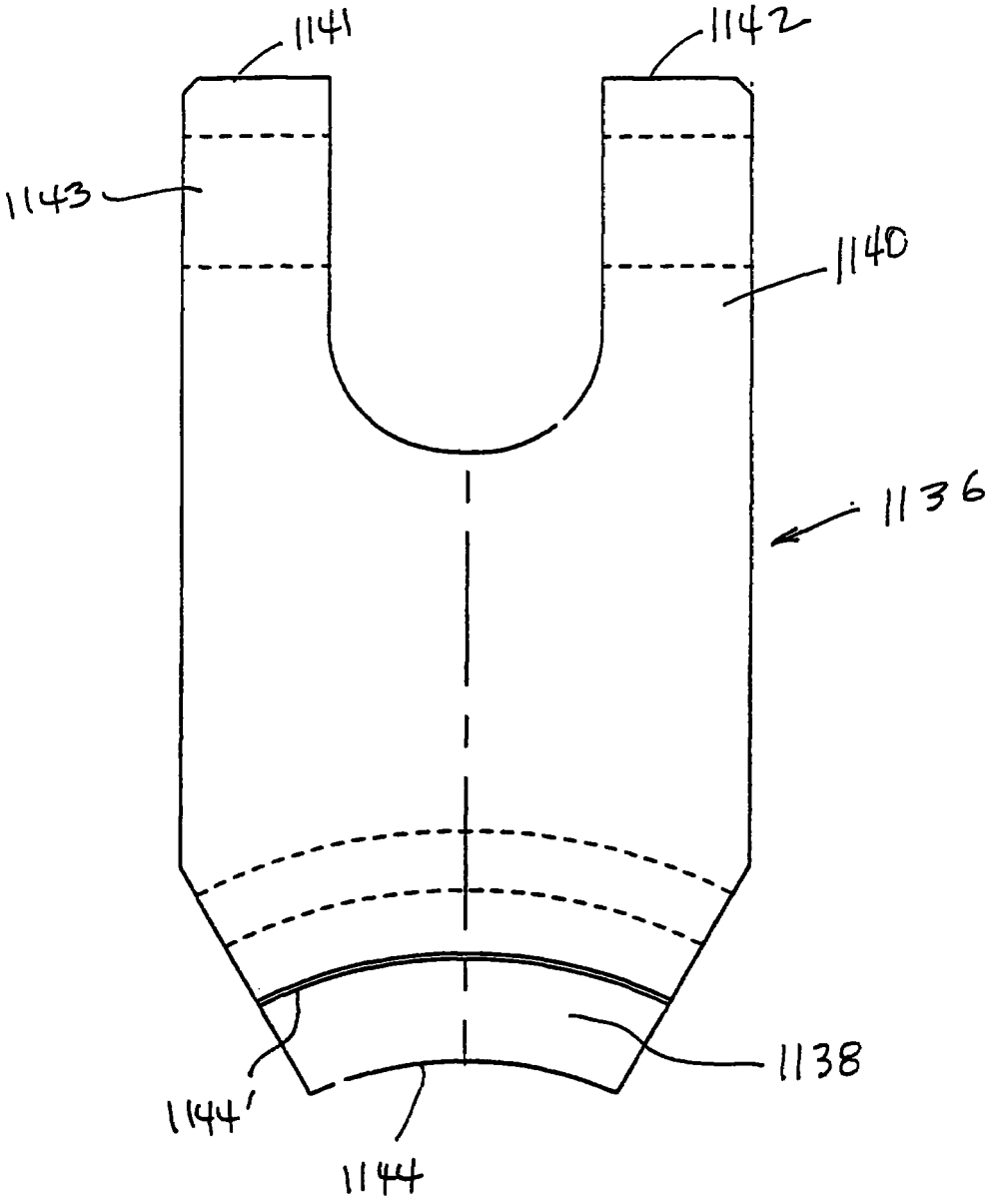
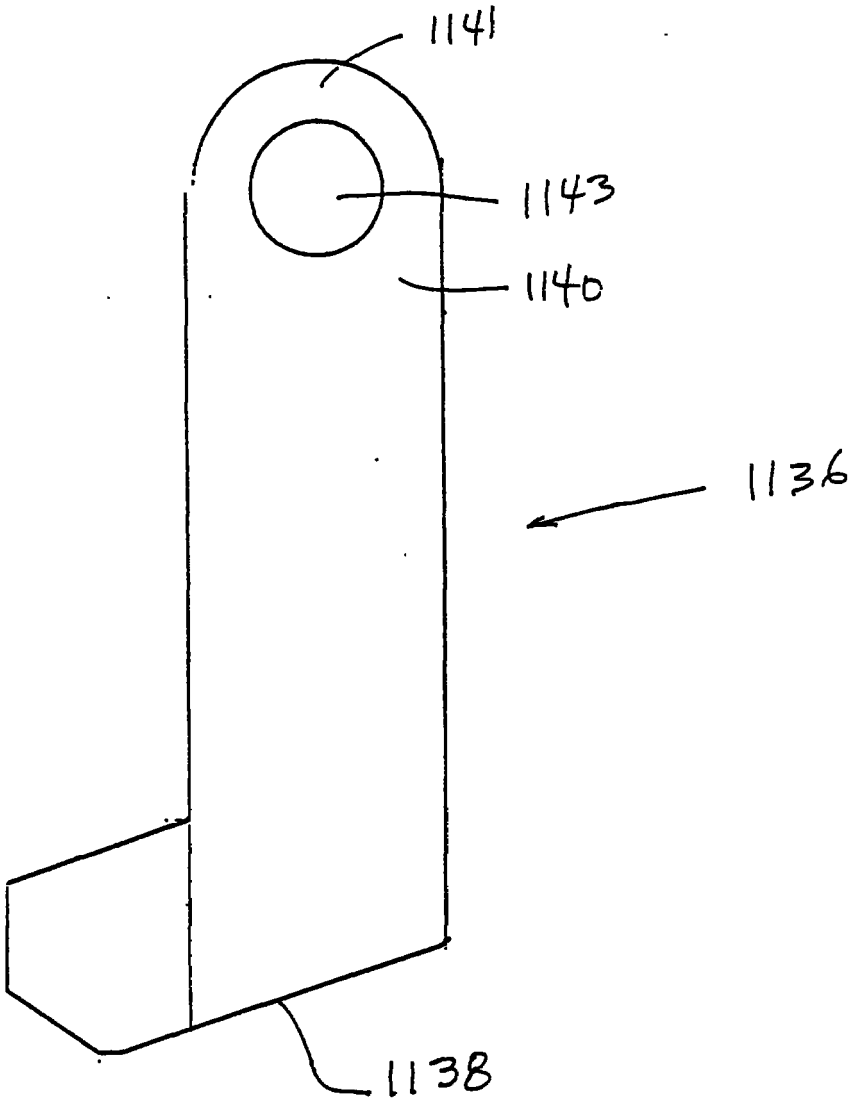
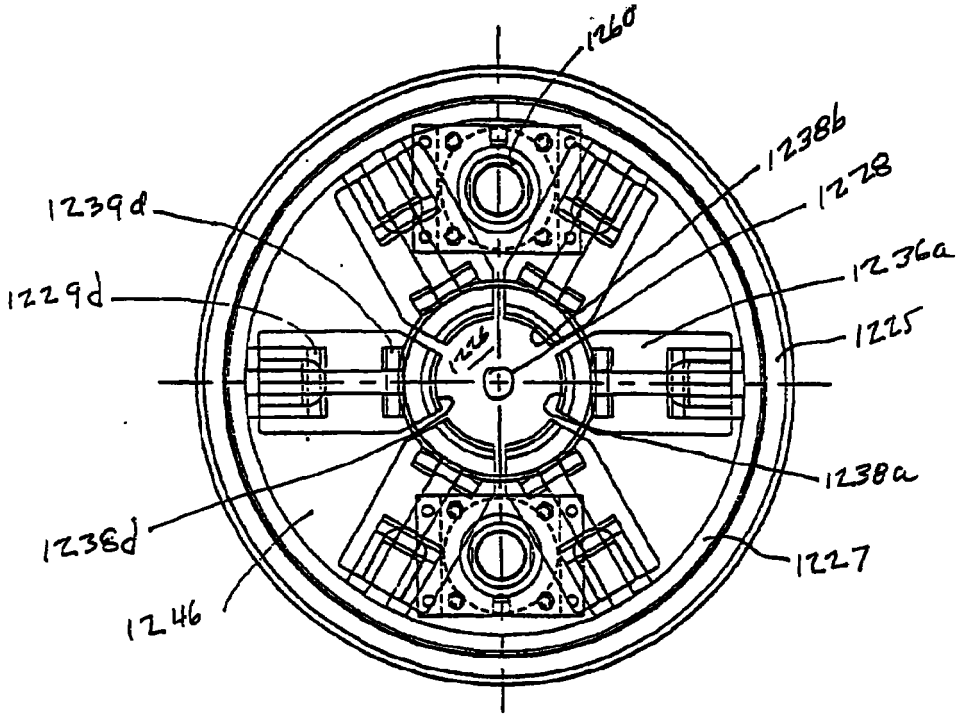


Fig. 25




1260
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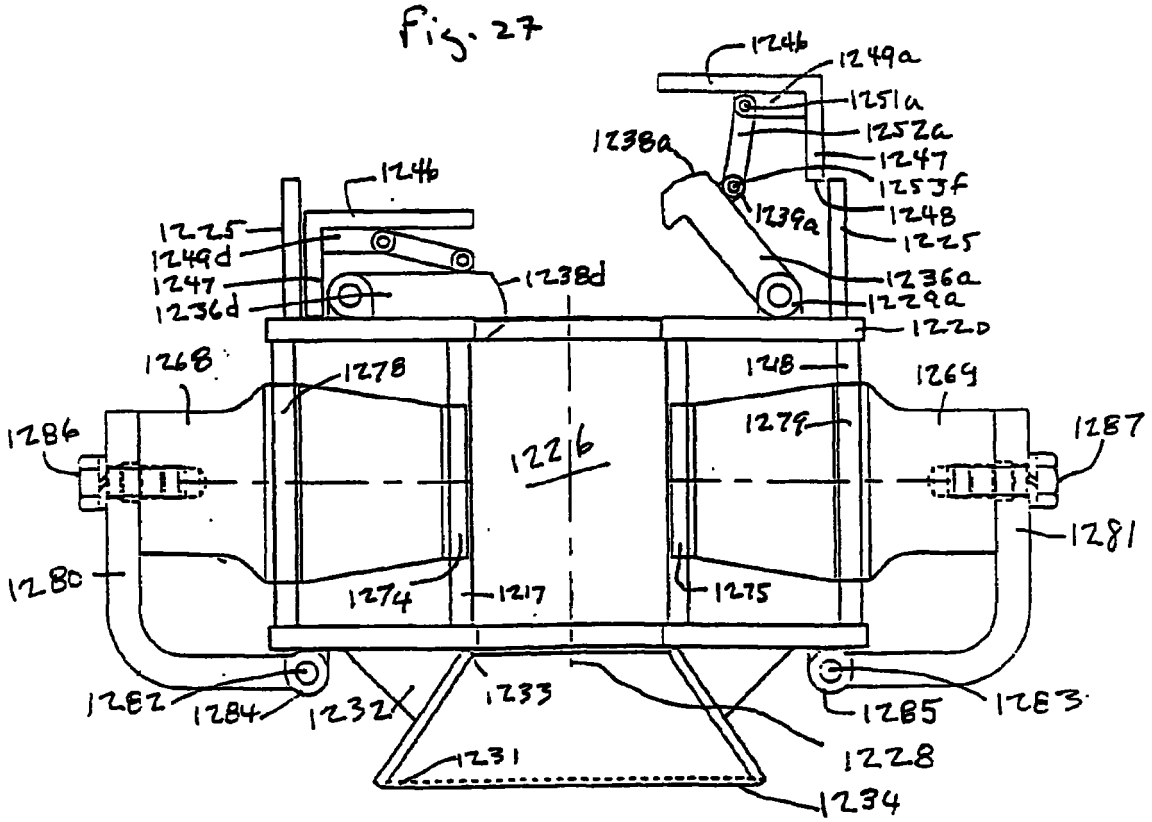
1239d
1236a
1229d
1225
1238a
1238d
1227
1246

fig. 27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1253f
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1239a
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1246
1225
1249d
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1238d
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1236d
1229a
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1226
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1231
1234

fig. 26

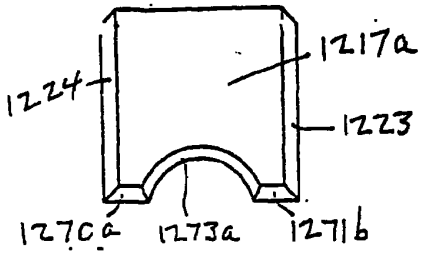

Fig. 28

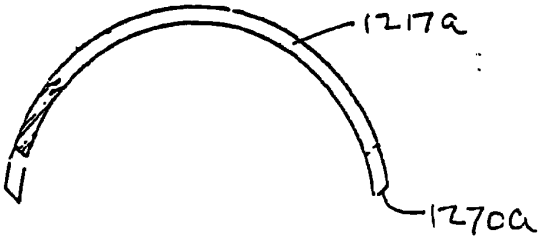

Fig. 29

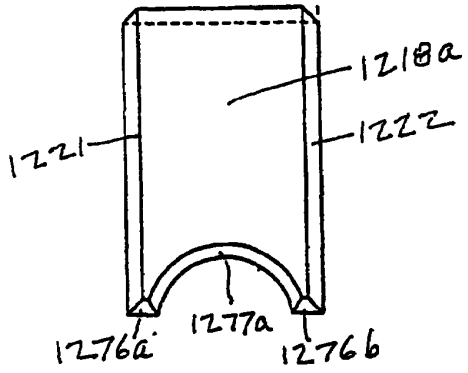

Fig. 30

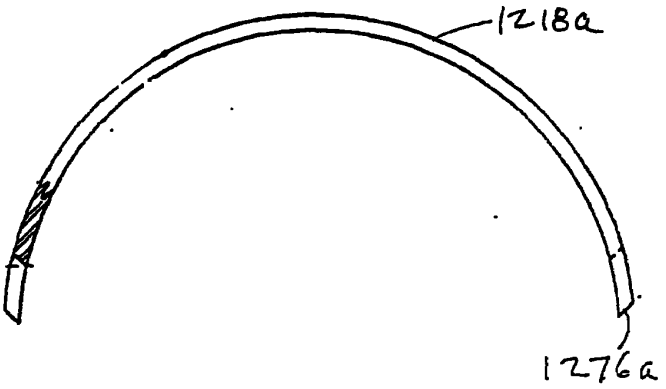

Fig. 31