



(22) Date de dépôt/Filing Date: 2018/08/21

(41) Mise à la disp. pub./Open to Public Insp.: 2019/02/24

(45) Date de délivrance/Issue Date: 2020/11/03

(30) Priorité/Priority: 2017/08/24 (US15/685,258)

(51) Cl.Int./Int.Cl. *B61D 5/00* (2006.01),
B65D 90/10 (2006.01)

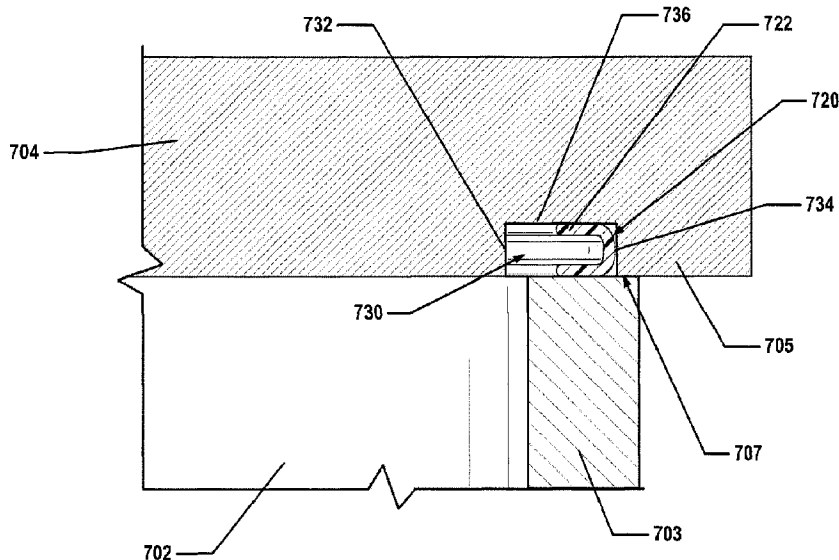
(72) Inventeurs/Inventors:
SCHMIDT, DAN, US;
WALTER, GARY C., US;
JOHNSON, SPENCER, US

(73) Propriétaire/Owner:
UNION TANK CAR COMPANY, US

(74) Agent: CPST INTELLECTUAL PROPERTY INC.

(54) Titre : ENSEMBLE DE PASSAGE DE CIRCULATION DE WAGON DE CHEMIN DE FER

(54) Title: RAILROAD TANK CAR MANWAY ASSEMBLY



(57) **Abrégé/Abstract:**

A manway assembly for a railroad tank car features a nozzle defining a central opening and having a sidewall, a cover, a hinge attaching the cover to the nozzle, and a seal assembly to seal the cover to the nozzle. The seal assembly may include a circumferential seal and a circumferential seal channel. The circumferential seal may include a top portion, a bottom portion opposite the top portion, and a side portion between the top portion and the bottom portion. An underside edge portion of the cover may be provided with the circumferential seal channel. The circumferential seal may be positioned within the circumferential seal channel. The circumferential seal may have a C-shaped cross section and may be positioned in the circumferential seal channel such that the top portion of the seal is seated against a top wall of the circumferential seal channel and the bottom portion of the seal is seated against a circumferential ledge of the nozzle.

ABSTRACT OF THE DISCLOSURE

A manway assembly for a railroad tank car features a nozzle defining a central opening and having a sidewall, a cover, a hinge attaching the cover to the nozzle, and a seal assembly to seal the cover to the nozzle. The seal assembly may include a circumferential seal and a circumferential seal channel. The circumferential seal may include a top portion, a bottom portion opposite the top portion, and a side portion between the top portion and the bottom portion. An underside edge portion of the cover may be provided with the circumferential seal channel. The circumferential seal may be positioned within the circumferential seal channel. The circumferential seal may have a C-shaped cross section and may be positioned in the circumferential seal channel such that the top portion of the seal is seated against a top wall of the circumferential seal channel and the bottom portion of the seal is seated against a circumferential ledge of the nozzle.

RAILROAD TANK CAR MANWAY ASSEMBLY

CROSS REFERENCE TO RELATED APPLICATIONS

[0001] This application claims priority from U.S. Patent Application No. 15/685,258, filed August 24, 2017. This application is also a continuation-in-part of U.S. Patent Application No. 15/353,491, filed November 16, 2016, which is a continuation of U.S. Patent Application No. 15/017,287, filed February 5, 2016, and issued as U.S. Patent No. 9,499,178 on November 22, 2016, which is a continuation of U.S. Patent Application No. 14/553,610, filed November 25, 2014, and issued as U.S. Patent No. 9,260,118 on February 16, 2016, which is a continuation-in-part of U.S. Patent Application No. 13/543,995, filed July 9, 2012, and issued as U.S. Patent No. 8,899,161 on December 2, 2014, which claims benefit of priority from U.S. Provisional Patent Application No. 61/505,828, filed July 8, 2011.

FIELD OF THE INVENTION

[0002] The present invention generally relates to railroad tank cars and, more particularly, to a manway assembly for a railroad tank car.

BACKGROUND

[0003] Railroad tank cars are well known and useful for carrying liquid commodities. A typical general purpose, non-pressurized railroad tank car is indicated in general at 22 in Figs. 1 and 2. The tank car features a tank body 24 mounted on a pair of wheel trucks 26a and 26b.

[0004] As illustrated in Figs. 1 and 2, a manway cover 28 is positioned on top of a nozzle 30 which is mounted on the tank body 24. As is known in the art, the manway cover pivots open and may be accessed by a ladder 32. The manway cover permits access to the interior of the tank body 24. Manway covers are typically designed to fit a 20" inner diameter manway nozzle. Nozzles having other inner diameters, however, have been made. These include nozzles having 24", 21", 18-112" and 18" inner diameters.

[0005] A prior art manway cover and nozzle is illustrated in Figs. 3 and 4. The manway cover is secured in the closed configuration on the nozzle by fasteners (eyebolts) that are spaced about the circumference of the manway cover. The typical quantity of eyebolts is either 6 (as illustrated in Figs. 3 and 4) or 8, however, the industry does have, on rare occasions, 10 bolt arrangements. The eyebolt nuts are individually loosened or tightened in a star pattern with a wrench or similar tool when the manway cover is opened or closed, respectively.

1 [0006] The manway cover features a hinge that permits it to be pivoted from the closed
2 configuration, illustrated in Figs. 3 and 4, to an open configuration via the handle so that access to
3 the manway is permitted. The manway cover of Figs. 3 and 4 is equipped with a torsion spring
4 arrangement (Labeled "UTC E-Z Lift" in Fig. 4) at the hinge that aids in the lifting of the cover while
5 opening. The two eyebolts nearest the handle act as safety bolts in that they secure the cover in
6 place while allowing pressure to be relieved in a safe manner. The cover must be slightly opened
7 before the safety eyebolts may be disengaged so that the cover may be pivoted open completely.

8 [0007] All manway cover designs must be approved by the Association of American Railroad Tank
9 Car Committee (AAR/TCC).

10 [0008] Manways are used for several purposes including dome loading or unloading, entry into the
11 tank car, venting (by opening the manway cover), access to view gauging level and commodity
12 sampling. The primary use of the manway at the loading rack is to open for dome loading, while
13 the primary use at the unloading rack is for venting.

14 [0009] Issues with current manway nozzle and cover designs include out of round nozzles, out of
15 flat nozzle and gasket grooves, loose hinge movements that cause interference with fit ups
16 between the manway nozzle and cover, inconsistent sealing, difficulty of assembly and
17 disassembly and loose eyebolts.

18 [0010] Prior art manway covers have been identified as a location where non-accidental leaks
19 consistently occur. Indeed, as illustrated by the graphs of Figs. 5 and 6, manway covers are the
20 largest contributor to non-accidental releases (NARs) for non-pressurized cars in transit.

21 [0011] In view of the above, it is desirable for manway nozzle and cover designs to feature a round
22 nozzle and a seating surface that is flat. In addition, one input from the operator to secure the
23 manway fasteners is desirable over the 6 to 10 individual inputs required by prior art designs. A
24 repeatable placement of the cover and clamping force on the gasket is also preferable.

25

26

BRIEF SUMMARY

27 [0012] The following presents a simplified summary of the invention in order to provide a basic
28 understanding of some aspects of the disclosure. This summary is not an extensive overview of
29 the invention. It is not intended to identify key or critical elements of the invention or to delineate
30 the scope of the invention. The following summary merely presents some concepts of the
31 invention in a simplified form as a prelude to the more detailed description provided below.

1 **[0013]** A first aspect of the disclosure provides a manway assembly for a railroad tank car, the
2 manway assembly comprising a nozzle defining a central opening and having a sidewall; a cover; a
3 hinge attaching the cover to the nozzle; and a seal assembly to seal the cover with the nozzle. The
4 hinge may attach to cover to the nozzle so that the manway cover is pivoted between an open
5 position, where the central opening is generally uncovered, and a closed position, where the
6 central opening is generally covered by the cover. The seal assembly may seal the cover with the
7 nozzle. The seal assembly may include a circumferential seal and a circumferential seal channel.
8 The circumferential seal may include a top portion, a bottom portion opposite the top portion, and a
9 side portion between the top portion and the bottom portion. An underside edge portion of the
10 cover may be provided with the circumferential seal channel and the circumferential seal is
11 positioned within the circumferential seal channel. The circumferential seal may have a C-shaped
12 cross section. The circumferential seal may be positioned in the circumferential seal channel such
13 that the top portion of the seal is seated against a top wall of the circumferential seal channel and
14 the bottom portion of the seal is seated against a circumferential ledge of the nozzle.

15 **[0014]** Another aspect of the disclosure provides a manway assembly for a railroad tank car, the
16 manway assembly comprising: a nozzle, a cover, a hinge attaching the cover to the nozzle, and a
17 seal assembly to seal the cover with the nozzle. The nozzle may define a central opening and
18 have a sidewall and a circumferential ledge on the sidewall of the nozzle. The cover may define a
19 circumferential stop portion that provides a metal-to-metal contact with the circumferential ledge
20 when the cover is in a closed position on the nozzle. The hinge may attach to the cover to the
21 nozzle so that said manway cover is pivoted between an open position, where the central opening
22 is generally uncovered, and the closed position, where the central opening is generally covered by
23 the cover. The seal assembly may include a circumferential seal and a circumferential seal
24 channel. The circumferential seal may include a top portion, a bottom portion opposite the top
25 portion, and a side portion between the top portion and the bottom portion. The circumferential
26 seal channel may include a front wall, a back wall opposite the front wall, and a top wall to form the
27 seal channel. An underside edge portion of the cover may be provided with the circumferential
28 seal channel and the circumferential seal may be positioned within the circumferential seal
29 channel. The circumferential seal may have a C-shaped cross section and may be positioned in
30 the circumferential seal channel such that the top portion of the seal is seated against the top wall
31 of the circumferential seal channel, the bottom portion of the seal is seated against the
32 circumferential ledge of the nozzle, and the side portion of the seal is seated against the back wall
33 of the circumferential seal channel.

1 **[0015]** Another aspect of the disclosure provides a manway assembly for a railroad tank car, the
2 manway assembly comprising: a nozzle, a cover, a hinge attaching the cover to the nozzle, a latch
3 mechanism to secure the cover to the nozzle; and a seal assembly to seal the cover with the
4 nozzle. The nozzle may define a central opening and may have a sidewall and a circumferential
5 ledge on the sidewall of the nozzle. A cover may define an underside edge portion with a
6 circumferential stop portion and a circumferential seal channel, wherein the circumferential stop
7 portion provides a metal-to-metal contact with the circumferential ledge when the cover is in a
8 closed position on the nozzle. The hinge may attach the cover to the nozzle so that said manway
9 cover is pivoted between an open position, where the central opening is generally uncovered, and
10 the closed position, where the central opening is generally covered by the cover. The seal
11 assembly may include a circumferential seal and a circumferential seal channel. The
12 circumferential seal may include a top portion, a bottom portion opposite the top portion, and a side
13 portion between the top portion and the bottom portion. The circumferential seal channel may
14 include a front wall, a back wall opposite the front wall, and a top wall to form the seal channel. An
15 underside edge portion of the cover may be provided with the circumferential seal channel. The
16 circumferential seal may be positioned within the circumferential seal channel. The circumferential
17 seal may have a C-shaped cross section and may be positioned in the circumferential seal channel
18 such that the top portion of the seal is seated against the top wall of the circumferential seal
19 channel, the bottom portion of the seal is seated against the circumferential ledge of the nozzle,
20 and the side portion of the seal is seated against the back wall of the circumferential seal channel.
21 An internal pressure of the railroad tank car presses the circumferential seal against the
22 circumferential seal channel and the circumferential ledge of the nozzle.

23 **[0016]** The details of these and other embodiments of the present disclosure are set forth in the
24 accompanying drawings and the description below. Other features and advantages of the
25 disclosure will be apparent from the description and drawings.

26 **BRIEF DESCRIPTION OF THE DRAWINGS**

27 **[0017]** A more complete understanding of the present invention and the advantages thereof may
28 be acquired by referring to the following description in consideration of the accompanying
29 drawings, in which like reference numbers indicate like features, and wherein:

30 **[0018]** Fig. 1 is a side elevational view of a railroad tank car equipped with a nozzle and
31 manway cover;

32 **[0019]** Fig. 2 is an enlarged perspective view of the railroad tank car of Fig. 1 ;

- 1 **[0020]** Fig. 3 is a top plan view of a prior art manway cover;
- 2 **[0021]** Fig. 4 is a top plan and side elevation view of the manway cover of Fig. 3;
- 3 **[0022]** Figs. 5 and 6 are graphs of data for non-accidental releases (NARs) for non-pressurized
4 cars in transit;
- 5 **[0023]** Fig. 7 is a perspective view of a first embodiment of the manway assembly of the present
6 technology on a tank car in a closed configuration;
- 7 **[0024]** Fig. 8 is an enlarged perspective exploded view of the nozzle assembly of Fig. 7;
- 8 **[0025]** Fig. 9 is an enlarged perspective exploded view of the cover assembly of Fig. 7;
- 9 **[0026]** Fig. 10 is an enlarged perspective exploded view of the lift arm assembly of Fig. 7;
- 10 **[0027]** Fig. 11 is a perspective exploded view of the assembled nozzle, cover and lift arm
11 assemblies of Figs. 8-10;
- 12 **[0028]** Fig. 12 is a perspective assembled view of the manway assembly of Fig. 11 in the closed
13 configuration;
- 14 **[0029]** Fig. 13 is a cross sectional view of the manway assembly of Fig. 12 taken along a vertical
15 cutting plain passing through line 13-13 of Fig. 12;
- 16 **[0030]** Fig. 14 is an enlarged view of portions of the nozzle, cover and lift arm of Fig. 13 showing
17 the detail of the seal between the cover and nozzle;
- 18 **[0031]** Fig. 15 is a cross sectional view of the nozzle and lift arm of Fig. 12 taken along a vertical
19 cutting plain passing through line 13-13 of Fig. 12 and a side elevation view of the cover of Fig. 12
20 in a partially open configuration;
- 21 **[0032]** Fig. 16 is a perspective view of the manway assembly of Fig. 12 in an open configuration;
- 22 **[0033]** Fig. 17 is a perspective view of a second embodiment of the manway assembly of the
23 present technology in a closed configuration;
- 24 **[0034]** Fig. 18 is a cross sectional view of the nozzle, lift arm and cover of Fig. 17 taken along
25 vertical cutting plain passing through line 18-18 of Fig. 17;
- 26 **[0035]** Fig. 19 is a top plan view of the manway assembly of Fig 17 with the lift arm omitted for
27 clarity;
- 28 **[0036]** Fig. 20 is a front perspective view of a third embodiment of the manway assembly of the
29 present technology in a closed configuration;

- 1 **[0037]** Fig. 21 is a rear perspective view of the manway assembly of Fig. 20 in an open
2 configuration;
- 3 **[0038]** Fig. 22A is a rear perspective view of a fourth embodiment of the manway assembly of the
4 present invention in an open configuration;
- 5 **[0039]** Fig. 22B is a front perspective view of a the manway assembly of Fig. 22A in a closed
6 configuration;
- 7 **[0040]** Fig. 23 is a top perspective view of the cover assembly of a fifth embodiment of the manway
8 assembly of the present invention;
- 9 **[0041]** Fig. 24 is a top perspective view of a manway assembly of a sixth embodiment of the
10 present invention in a closed configuration;
- 11 **[0042]** Fig. 25 is a top perspective view of the manway assembly of Fig. 24 of the present invention
12 in an open configuration;
- 13 **[0043]** Fig. 26 is a cross sectional view of the nozzle and cover of Fig. 24 taken along vertical
14 cutting plane of Fig. 24;
- 15 **[0044]** Fig. 27A is an enlarged view of portions of the nozzle and cover of Fig. 24 showing the
16 detail of the seal between the cover and nozzle;
- 17 **[0045]** Fig. 27B is an further enlarged view of portions of the nozzle and cover of Fig. 24 showing
18 the detail of the seal between the cover and nozzle;
- 19 **[0046]** Fig. 28A is a cross sectional view of the nozzle, cover, and sealing assembly of Fig. 24 in a
20 horizontal orientation or 0 degrees;
- 21 **[0047]** Fig. 28B is a cross sectional view of the nozzle, cover, and sealing assembly of Fig. 24 in an
22 angled orientation of 30 degrees;
- 23 **[0048]** Fig. 28C is a cross sectional view of the nozzle, cover, and sealing assembly of Fig. 24 in
24 an angled orientation of 60 degrees; and
- 25 **[0049]** Fig. 28D is a cross sectional view of the nozzle, cover, and sealing assembly of Fig. 24 in a
26 vertical orientation or 90 degrees.

DETAILED DESCRIPTION OF EMBODIMENTS

- 27
- 28 **[0050]** A first embodiment of the manway assembly of the present technology is indicated in
29 general at 40 in Fig. 7. More specifically, the manway cover assembly 42 and a lift arm assembly
30 44 are mounted on the top of a nozzle assembly 45 which is positioned on top of tank car body 48.

1 The nozzle of the nozzle assembly 45 defines a manway for accessing the interior of the tank car
2 body 48, as described above. Fig. 7 illustrates the manway cover assembly 42 and lift arm
3 assembly 44 in a closed configuration.

4 **[0051]** An enlarged, exploded perspective view of the nozzle assembly of the manway assembly of
5 Fig. 7, indicated in general at 45, is presented in Fig. 8. In addition to the nozzle 46, the nozzle
6 assembly includes a hinge 54, a pair of eye bolt lugs 56 and an eye bolt 58. The cylindrical interior
7 wall 62 of the nozzle includes a circumferential groove 64 cut or otherwise formed therein, as well
8 as an upper circumferential ledge 65 and a lower circumferential ledge 66.

9 **[0052]** As illustrated in Fig. 11, the eye bolt 58 is pivotally secured to the eye bolt lugs 56 by pin 67.
10 An eye bolt nut 69 engages a threaded distal portion 71 of the eye bolt 58.

11 **[0053]** The cover assembly of the manway assembly of Fig. 7 is indicated in general at 42 in Fig. 9
12 in an exploded view. The cover assembly includes a disk-shaped cover 72 having a cover lift
13 bracket 74. The cover lift bracket is generally triangular-shaped, is centrally located on the top
14 surface of the cover and includes elongated slots 76.

15 **[0054]** The cover assembly also includes latch segments that may take the form of wedge
16 segments 78a-78c. The latch segments may take other forms, including those without a wedge
17 surface. Each wedge segment is generally arc-shaped and features a wedge surface 80a-80c.
18 Wedge segment 78a is connected to wedge segment 78b by an arc-shaped link 82, while wedge
19 segment 78b is similarly connected to wedge segment 78c by arc-shaped link 84. More
20 specifically, wedge segment 78a features pin openings 86a and 88a, wedge segment 78b features
21 pin openings 86b and 88b and wedge segment 78c features pin openings 86c and 88c. Link 82
22 features pins 92 and 94, while link 84 features pins 96 and 98. Pin 92 of link 82 engages pin
23 opening 88a of wedge segment 78a while pin 94 of link 82 engages pin opening 86b of wedge
24 segment 78b. Pin 96 of link 84 similarly engages pin opening 88b of wedge segment 78b while pin
25 98 of link 84 similarly engages pin opening 86c of wedge segment 78c.

26 **[0055]** As illustrated in Fig. 11, the assembled wedge segments and links rest on the top surface
27 100 of the cover 72. Wedge segment 78b features a channel 104b formed along the underside of
28 the inner edge which receives adjacent end portions of links 82 and 84. Wedge segment 78c
29 similarly features a channel 104c formed along the underside of the inner edge which receives the
30 adjacent end portion of link 84. Wedge segment 78a features a similar channel (not visible in Fig.
31 9) that receives the adjacent end portion of link 82.

1 **[0056]** The pins and pin openings described above are sized to permit pivoting movement between
2 the links and wedge segments.

3 **[0057]** As illustrated in Figs. 9 and 11, a pair of pivot lugs 102a and 102b are pivotally secured
4 within pin opening 86a of wedge segment 78a and pin opening 88c of wedge segment 78c,
5 respectively.

6 **[0058]** As illustrated in Figs. 9 and 11, the cover assembly also features three generally arc-
7 shaped retainer blocks 110a, 110b and 110c. As illustrated in Fig. 9, each retainer includes a
8 channel formed along the underside of the outer edge (illustrated at 111b for retainer 110b and at
9 111e for retainer 110c, not visible for retainer 110a in Fig. 9). Each retainer features a set of three
10 openings, illustrated at 112a, 112b and 112c in Fig. 9, that are sized to receive fasteners 114a,
11 114b and 114c, which are preferably socket head cap screws. As illustrated in Fig. 9, the top
12 surface 100 of the cover 72 features openings 116a, 116b and 116c. As illustrated in Fig. 11, the
13 fasteners secure the retainers 110a, 110b and 110c to the top surface of the cover via the retainer
14 openings and the cover openings. The channels (such as 111b and 111e of Fig. 9) of the retainers
15 are sized to secure the wedge segments to the cover lid, yet permit movement of the wedge
16 segments parallel to the cover top surface as described below.

17 **[0059]** It should be noted that while three wedge segments, two links and three retainers are
18 illustrated in the figures, alternative numbers of each component may be used instead (for
19 example: four wedge segments joined by three links with four retainers, etc.).

20 **[0060]** The lift arm assembly of the manway assembly of Fig. 7 is indicated in general at 44 in Fig.
21 10 in an exploded view. The lift arm assembly includes a lift arm, indicated in general at 122. The
22 lift arm features a proximal portion 124, a middle portion 126 and a distal portion 128.

23 **[0061]** A latching mechanism, indicated in general at 132 in Figs. 10 and 11, is mounted to the
24 distal end of the lift arm. As illustrated in Fig. 10, the latching mechanism includes an adjusting
25 plate 134, an adjusting screw 136, adjusting plate support blocks 138a and 138b and four adjusting
26 plate fasteners 142. Four peripheral openings 143 are formed through the adjusting plate 134 and
27 a corresponding four openings 144 are formed in the top surface of the lift arm 122 and through
28 support blocks 138a and 138b. The adjusting plate, support block and lift arm openings are sized
29 to be engaged by the adjusting plate fasteners 142. As illustrated in Fig. 11, the adjusting plate
30 134 is secured to the lift arm by the adjusting plate fasteners and the adjusting plate support
31 blocks.

1 **[0062]** The adjusting plate features a central opening 146 that is sized to receive the adjusting
2 screw 136 so that the adjusting screw is free to rotate about a vertical axis. The bottom portion of
3 the adjusting screw is provided with a reduced diameter portion 150 that is secured to a pivot block
4 152 via opening 154 (such as by threads or a rivet-type connection). Pivot block 152 features an
5 inverted, generally U-shaped profile.

6 **[0063]** As illustrated in Fig. 10, the lift arm 122 is constructed from a pair of beams 160 and 162
7 that are secured to one another by spacers 164 and 166. When the lift arm assembly is
8 assembled, as illustrated in Fig. 11, the pivot block 152 is positioned between the lift arm beams
9 160 and 162 and spacers 164 and 166 provide sufficient space between the beams for the pivot
10 block to rotate 360° when adjusting screw 136 is turned.

11 **[0064]** Returning to Fig. 10, an inner linkage 170 and an outer linkage 172 are pivotally secured by
12 their proximal ends to a clevis 174 by pin 176, which engages clevis linkage opening 178. The
13 clevis 174 is secured to the pivot block via clevis transverse opening 182, pin 184 and pivot block
14 openings 186 and 188.

15 **[0065]** The lift arm features a safety catch, indicated in general at 189 in Fig. 10, which includes
16 spaced gooseneck members 190a and 190b and upon which a combination handle and safety stop
17 192 is positioned. The functionality of the safety catch and combination handle and safety stop will
18 be explained below.

19 **[0066]** As illustrated in Fig. 12, the cover assembly of Figs. 9 and 11 is attached to the lift arm of
20 Figs. 10 and 11 by a pin 194 (also shown in Figs. 10 and 11). The pin 194 engages openings 196
21 (Fig. 10) formed through the middle portion 126 of beams 160 and 162 as well as the elongated
22 slots 76 of cover lift bracket 74 (Fig. 9).

23 **[0067]** In addition, with reference to Figs. 9-12, the distal ends of the inner and outer linkages 170
24 and 172 of the latching mechanism of the lift arm assembly are pivotally connected to pivot lugs
25 102a and 102b, respectively, by pins 198a and 198b.

26 **[0068]** As illustrated in Fig. 12, the proximal portion of the lift arm 122 is secured to the hinge 54 of
27 the nozzle assembly by pin 202 which passes through openings in the hinge and the proximal
28 portion of the lift arm (204 of Fig. 8 and 206 of Fig. 10, respectively).

29 **[0069]** When the cover 72 is in the closed configuration illustrated in Fig. 12, the eye bolt 58 is
30 pivoted up and into a generally vertical position, during which it passes between the spaced
31 gooseneck members 190a and 190b of the safety catch and ultimately into the fully latched position

1 illustrated in Fig. 12. The eye bolt nut 69 is then tightened down so secure the manway assembly
2 in the closed configuration.

3 **[0070]** As illustrated in Figs. 12 and 13, when the lift arm and cover are in the fully closed
4 positions, the distal ends of the inner and outer linkages 170 and 172 of the cover assembly
5 latching mechanism, and thus the pivot lugs 102a and 102b of the cover assembly, are maximum
6 distance from one another (see also Figs. 10 and 11). With reference to Figs. 12 and 13, this
7 causes the linkages 82 and 84 and wedge segments to be positioned as radially outward towards
8 the circumferential edge of the top surface 100 of the cover 72 as possible. As a result, as
9 illustrated in Figs. 12 and 13, the wedge surfaces 80a-80c of the wedge segments 78a-78c are in
10 engagement with the circumferential groove 64 of the nozzle 46. The degree of engagement of the
11 wedge segments with the nozzle circumferential groove can be adjusted by turning the latching
12 mechanism adjusting screw 136. As best illustrated in Fig. 13, it should also be noted that pin 194
13 attaching the cover to the middle portion of the lift arm is positioned at the bottom of the elongated
14 slots 76 of the cover lift bracket 74 when the cover and lift arm are in the closed configuration.

15 **[0071]** As illustrated in Figs. 13 and 14, the underside edge portion of the cover 72 is provided with
16 a circumferential seal channel 208 and a circumferential stop portion 210. A circumferential seal
17 212 is positioned within the seal channel 208 with a portion of the seal extending radially inward
18 from the seal channel (towards the center of the cover 72). As illustrated in Figs. 13 and 14, when
19 the cover and lift arm are in the closed configuration, and the wedge segments of the cover
20 assembly are engaging the circumferential groove of the nozzle, the circumferential seal 212 is
21 gently compressed against the lower circumferential ledge 66 of the nozzle. As illustrated in Figs.
22 13 and 14, the circumferential stop portion 210 of the cover 72 engages the upper circumferential
23 ledge 65 of the nozzle to limit compression of the seal 212.

24 **[0072]** With reference to Fig. 13, when a user wishes to open the cover 72 of the manway
25 assembly, the eye bolt nut 69 is first loosened. If there is no pressure in the tank car, the user may
26 pivot the eye bolt 58 down until it abuts the handle and safety stop 192 of the closed lift arm and
27 cover. The user may then lift up on the lift arm via the handle and safety stop 192 until the lift arm
28 and cover reach the position illustrated in Fig. 15. With reference to Fig. 15, as the lift arm 122
29 moves up and away from the cover 72, pin 194 travels upward in elongated slot 76 of the cover lift
30 bracket 74. As this occurs, the distal ends of the inner and outer linkages 170 and 172 of the
31 latching mechanism of the lift arm assembly, and thus pivot lugs 102a and 102b of the cover
32 assembly, move towards one another. With reference to Figs. 12 and 15, this causes the linkages
33 82 and 84 (Fig. 12) and wedge segments 78a-78c (Fig. 12) to move radially inward towards the

1 center of the cover 72. As a result, the wedge surfaces 80a-80c (Fig. 12) of the wedge segments
2 disengage the circumferential groove 64 (Fig. 12) of the nozzle 46, as illustrated for wedge surface
3 80b of wedge segment 78b in Fig. 15.

4 **[0073]** At this point (illustrated in Fig. 15), the user may pass the eye bolt 58 and the eye bolt nut 69
5 under the handle and safety stop 192. The eye bolt 58 may then be pivoted down into a position
6 directed vertically downward, illustrated in phantom at 224 in Fig. 15. The user is then free to pivot
7 the lift arm and cover into the open position illustrated in Fig. 16.

8 **[0074]** The handle and safety stop 192 of Figs. 12, 13 and 15 prevent a user from releasing the eye
9 bolt 58 prior to venting if there is pressure in the tank car. More specifically, with reference to Figs.
10 12 and 13, when the user loosens eye bolt nut 69, the cover 72 will typically rise slightly, due to the
11 pressure in the tank acting on the underside of the cover 72, so that the pressure within the tank car
12 may vent through the circumferential space formed between the cover and the nozzle. The
13 pressure of the top surface of the lift arm 122 against the bottom surface of the nut 69 prevents the
14 user from pivoting the eyebolt 58 down over the lifting arm distal end corner 226 (Figs. 12 and 13)
15 until after the venting is complete. Once venting has completed, the lid 72 will lower back into its
16 original closed configuration, and the user may continue to loosen the nut 69. The cover may then
17 be opened following the procedure described above.

18 **[0075]** In some situations, the cover 72 may become stuck in the closed configuration illustrated in
19 Figs. 12 and 13, even though the eye bolt nut 69 has been loosened and pressure exists within the
20 tank car tank. In such a situation, the nut 69 may be loosened, but when the eye bolt is pivoted
21 downward, it will contact the handle and safety stop 192 of the closed lift arm and cover. It is
22 impossible for the user to pivot the eye bolt 58 down beyond the handle and safety stop 192 when
23 the cover 72 is fully closed.

24 **[0076]** The user may pull up on the handle and safety stop 192 until the cover becomes un-stuck.
25 Alternatively, the cover may become un-stuck on its own. When this occurs, the pressure in the
26 tank acting on the underside of the cover 72 will cause it to rise and, as a result, pressure from
27 within the tank will vent through the circumferential space formed between the cover and the
28 nozzle. In addition, due to the pressure within the tank acting on the underside of the cover 72, the
29 top surfaces of the spaced gooseneck members 190a and 190b of the safety catch on the lift arm
30 will press up against the bottom surface of the nut 69. This prevents the user from further pivoting
31 the eye bolt downwards over corner 228 (Figs. 12 and 15) of the safety catch until venting is
32 completed. When the venting is complete, the lift arm, cover and eyebolt will be in the positions
33 illustrated in Fig. 15. The eye bolt 58 may then be pivoted down into a position directed vertically

1 downward, illustrated in phantom at 224 in Fig. 15. The user is then free to pivot the lift arm and
2 cover into the open position illustrated in Fig. 16. As a result, the lift arm, safety catch, handle and
3 safety stop and eye bolt provide two levels of protection from tank pressure - one when the cover is
4 not stuck in a closed configuration and one when the cover is stuck in a closed configuration.

5 **[0077]** A second embodiment of the manway assembly of the present technology is indicated in
6 general at 300 in Figs. 17 and 18. The manway assembly 300 includes a lift arm, indicated in
7 general at 302, mounted on the top of cover 304, both of which are positioned on a nozzle 306
8 which is positioned on top of a tank car body (such as 48 in Fig. 7). The nozzle defines a manway
9 for accessing the interior of the tank car body, as described above. Figs. 17 and 18 illustrate the
10 manway cover and lift arm in a closed configuration.

11 **[0078]** Similar to the construction illustrated in Fig. 8, the nozzle 306 is provided with a pair of hinge
12 lugs 308, a pair of eye bolt lugs 310 and an eye bolt 312. The cylindrical interior wall of the nozzle
13 306 includes a circumferential groove 314 cut or otherwise formed therein. The eye bolt 312 is
14 pivotally secured to the eye bolt lugs 310. An eye bolt nut 316 engages a threaded distal portion of
15 the eye bolt.

16 **[0079]** The disk-shaped cover 304 has a cover lift bracket 320. The cover lift bracket includes a
17 pair of ears 321a and 321b and is centrally located on the top surface of the cover. The ears 321a
18 and 321b include openings for connection to the lift arm and latching mechanism as explained
19 below.

20 **[0080]** The cover is also provided with latch segments in the form of wedge segments 322a- 322e.
21 The latch segments may take other forms, including those without a wedge surface. Each wedge
22 segment is generally arc-shaped and features a wedge surface, illustrated at 324c and 324d for
23 wedge segments 322c and 322d (wedge segments 322a, 322b and 322e have similar wedge
24 surfaces, but they are not visible in Figs. 17 and 18).

25 **[0081]** As best illustrated in Fig. 19, wedge segments 322a-322e are connected together by a wire
26 spring form 326. As illustrated in Fig. 19, wire spring form 326 is formed in a generally circular
27 shape and features upturned ends 328a and 328b. The wire spring form 326 is constructed in such
28 a manner to urge the wedge segments radially outward with respect to the center cover and into the
29 positions illustrated in Figs. 17-19. As an example only, the wire spring form material may be 5/16"
30 diameter steel wire, hard drawn ASTM A 227, finish zinc plate-baked.

1 **[0082]** The assembled wedge segments and wire spring form rest on the top surface of the cover
2 304. Wedge segments 322a-322e feature arcuate channels (illustrated in phantom at 330a-330e in
3 Fig. 19) formed along their undersides that receive the wire spring form, as illustrated in Fig. 17.

4 **[0083]** As best illustrated in Figs. 17 and 19, each wedge segment includes an elongated slot
5 (332a-332e). Retainer bolts 334a-334e pass through each slot and into bores formed through the
6 top surface of the cover 304 so that the wedge segments are secured to the top surface of the
7 cover. The slots 332a-332e and retainer bolts 334a-334e are sized so that the wedges may be
8 moved between a locked position, where the wedge surfaces of the wedge segments 322a-322e
9 engage the circumferential groove 314 of the nozzle 306 (as illustrated in Figs 17), and an
10 unlocked position, where the wedge segments are disengaged from the nozzle circumferential
11 groove.

12 **[0084]** It should be noted that while five wedge segments are illustrated in the figures, alternative
13 numbers of the wedge segments may be used instead.

14 **[0085]** As illustrated in Fig. 17, the latching arm 302 includes a pair of lift arm rails 336a and 336b
15 joined by cross member 338. A latching mechanism, indicated in general at 340 in Figs. 18 and 19,
16 is mounted to the distal end of the lift arm between lift arm rails 336a and 336b. The latching
17 mechanism includes a latch arm 342 having a distal end that is provided with a latch handle 344.

18 **[0086]** As illustrated in Fig. 18, the proximal end of the latch arm 342 is pivotally mounted between
19 the ears 321a and 321b of the cover lift bracket by pin 343. In addition, a main link 346 is pivotally
20 attached between ears 321a and 321b by pin 347. A cross link 348 is pivotally attached at opposite
21 ends to the proximal end of the latch arm 342 and the main link 346.

22 **[0087]** As illustrated in Figs. 18 and 19, a hook link 349 is pivotally connected by its proximal end to
23 the bottom of main link 346. The distal end of the hook link engages openings formed in the
24 proximal portions of a pair of spring form links 350a and 350b. While a hook is illustrated for the
25 hook link, it should be noted that the hook link does not necessarily require a hook end - it may be
26 attached to the proximal portions of the pair of spring form links by other fastening arrangements.
27 As illustrated in Fig. 19, the distal ends of the spring form links 350a and 350b are engaged by the
28 upturned ends 328a and 328b of the spring form 326.

29 **[0088]** A user operates the latching mechanism 340 to release the wedge segments of the cover
30 from engagement with the circumferential groove of the nozzle as follows. The user raises the latch
31 arm 342 via handle 344 and the latch arm 342 is pivoted counter-clockwise (in the direction of
32 arrow 352 of Fig. 18) about pin 343. As this occurs, cross link 348 acts on main link 346 so that the

1 main link 346 moves clockwise about pin 347. This causes the hook 349 to move towards the
2 center of the cover (and parallel with the top surface of the cover) in the direction indicated by arrow
3 354 of Fig. 18. With reference to Fig. 19, as hook 349 moves, it causes the spring form links 350a
4 and 350b to pivot about, in the directions of arrows 356a and 356b, and slide along outer fulcrum
5 pins 358a and 358b. This causes the ends of the wire spring form 326 to be drawn closer together.
6 As the proximal ends of the spring form links 350a and 350b travel further towards the center of the
7 cover, they encounter inner fulcrum pins 362a and 362b which further drives their distal ends, and
8 thus the free ends of the spring form, closer together. This causes the wedge segments 322a-322e
9 to move radially inward (towards the center of the cover) so that their wedge surfaces disengage
10 from the circumferential groove (314 of Figs. 17 and 18) of the nozzle.

11 **[0089]** The positioning of the outer fulcrum pins 358a and 358b and the inner fulcrum pins 362a
12 and 362b provide smooth operation of the latch arm as a greater torque is applied to pulling the
13 ends of the spring form towards one another during initial upward movement of the latch arm. In
14 addition, the positioning of the inner and outer fulcrum pins and the sizing of the spring form links
15 and hook cause the spring form to maintain a generally round shape as the ends 328a and 328b of
16 the spring form are drawn closer together. This gives generally uniform disengagement of the
17 wedge segments from the nozzle circumferential groove.

18 **[0090]** As illustrated in Fig. 17 and 18, the cover 304 is attached between the rails 336a and 336b
19 of the lift arm 302 by pin 347. The pin 347 engages openings formed through the middle portion of
20 rails 336a and 336b as well as openings through the ears 321a and 321b of the cover lift bracket.
21 In addition, the proximal portion of the lift arm 302 is pivotally secured to the hinge lugs 308 of the
22 nozzle.

23 **[0091]** When the cover 304 is in the closed configuration illustrated in Figs. 17-19, the eye bolt 312
24 is pivoted up and into a generally vertical position illustrated, during which it passes between the
25 spaced rails 336a and 336b of the lift arm. The eye bolt nut 316 is tightened down so secure the
26 manway assembly in the closed configuration. In addition, as illustrated in Fig. 18, a washer 360 is
27 positioned under eye bolt nut 316. This washer engages the distal tip of the latch arm 342 so that it
28 cannot be raised until the eyebolt nut is loosened, which guards against accidental actuation of the
29 latch arm.

30 **[0092]** As illustrated in Fig. 18, the underside edge portion of the cover 304 is provided with a
31 circumferential seal channel 368 and a circumferential stop portion 370. A circumferential seal 372
32 is positioned within the seal channel. As illustrated in Fig. 18, when the cover and lift arm are in the
33 closed configuration, and the wedge segments of the cover assembly are engaging the

1 circumferential groove of the nozzle, the circumferential seal 372 is gently compressed against the
2 circumferential ledge of the nozzle. As illustrated in Fig. 18, the circumferential stop portion 370 of
3 the cover 304 engages a second circumferential ledge of the nozzle to limit compression of the seal
4 372. Suitable seals are available, as an example only, from the Technetics Group (EnPro
5 Industries) of Columbia, South Carolina.

6 **[0093]** With reference to Figs. 17 and 18, when a user wishes to open the cover 304 of the manway
7 assembly, the eye bolt nut 316 is first loosened and pivoted down to the inclined safety stop at the
8 distal end of the lift arm, indicated at 374. With washer 360 out of the way, latch handle 342 may
9 be pivoted as described above to unlock the cover from the nozzle. If there is no pressure in the
10 tank car, the user may further loosen the nut 316 and pivot the eye bolt 312 down clear of the lift
11 arm and the lift arm handle 376, also attached near the distal end of the lift arm 302, may be used
12 to lift the cover into the open position.

13 **[0094]** The lift arm safety stop 374 prevents a user from releasing the eye bolt prior to venting if
14 there is pressure in the tank car. More specifically, when the user loosens eye bolt nut 316, pivots
15 the eye bolt 312 so that it is positioned over the safety stop and actuates the latching mechanism
16 as described above to unlock the cover, the cover 304 will typically rise slightly, due to the pressure
17 in the tank acting on the underside of the cover, so that the pressure within the tank car may vent
18 through the circumferential space formed between the cover and the nozzle. The pressure of the
19 top surface of the lift arm safety stop 374 against the bottom surface of the washer 360 (as held in
20 place by eye bolt nut 316) prevents the user from pivoting the eyebolt 312 further down over the
21 lifting arm distal end corner 378 (Figs. 17 and 18) until after the venting is complete. Once venting
22 has completed, the lid 304 will lower back into its original closed configuration, and the user may
23 continue to loosen the nut 316. The cover may then be opened following the procedure described
24 above.

25 **[0095]** A third embodiment of the manway assembly of the present technology is indicated in
26 general at 400 in Figs. 20 and 21. As with previous embodiments, the manway assembly 400
27 includes a lift arm 402 mounted on the top of cover 404, both of which are positioned on a nozzle
28 406 which is positioned on top of a tank car body (such as 48 in Fig. 7). The nozzle defines a
29 manway for accessing the interior of the tank car body, as described above. Fig. 20 illustrates the
30 manway cover and lift arm in a closed configuration, while Fig. 21 illustrates the manway cover and
31 lift arm in an open configuration.

32 **[0096]** The manway assembly of Figs. 20 and 21 features a construction that is basically the same
33 as the embodiment of Figs. 17-19 (including the same latching mechanism) except that the

1 embodiment of Figs. 20 and 21 includes latch segments that take the form of wedge segments
2 422a-422c (the latch segments may take other forms, including those without a wedge surface) that
3 are held in place by retainers 424a-424c (instead of the slots 332a-332e and retainer bolts 334a-
4 334e of Figs. 17 and 19). More specifically, as illustrated in Figs. 20 and 21, the cover is provided
5 with three generally arc-shaped retainer blocks 424a-424c. As illustrated in Figs. 20 and 21, each
6 retainer includes a channel formed along the underside of the outer edge (illustrated at 411b for
7 retainer 424b and at 411c for retainer 424c, not visible for retainer 424a). The retainers are
8 secured to the top surface of the cover 404 by fasteners 414a, 414b and 414c, which are preferably
9 socket head cap screws. The channels (such as 411b and 411c of Figs. 20 and 21) of the retainers
10 are sized to secure the wedge segments 422a-422c to the cover lid, yet permit movement of the
11 wedge segments parallel to the cover top surface, and radially with respect to the center of the
12 cover, for engagement with a circumferential groove 414 of the nozzle 406.

13 **[0097]** As with the embodiment of Figs. 17-19, wedge segments 422a-422c of the embodiment of
14 Figs. 20 and 21 are connected together by a wire spring form 426. The wire spring form 326 is
15 constructed in such a matter to urge the wedge segments radially outward with respect to the
16 center cover and into the positions illustrated in Fig. 20. The assembled wedge segments and wire
17 spring form rest on the top surface of the cover 404. Wedge segments 422a-422c feature arcuate
18 channels (illustrated at 430b for wedge segment 422b in Figs. 20 and 21) formed along their
19 undersides that receive the wire spring form.

20 **[0098]** It should be noted that while three wedge segments are illustrated in Figs. 20 and 21 an
21 alternative numbers of the wedge segments may be used.

22 **[0099]** As illustrated in Figs. 20 and 21, the manway assembly may include lift assist springs 440a
23 and 440b. Lift assist spring 440a features a first leg portion 442a that engages a rod 444a attached
24 to the hinge lugs of the nozzle 406. A second leg portion 406a of the lift assist spring 440a
25 engages pin 448a positioned on the lift arm 402. Lift assist spring 440b features a similar
26 construction and attachment to the nozzle and lift arm. Each lift assist spring 440a and 440b urges
27 the cover 404 towards the open position illustrated in Fig. 21 so as to assist a user lifting the cover
28 via the lift arm 402. The first and second embodiment of the manway assembly described above
29 may be equipped with a similar lift assist hinge.

30 **[00100]** A fourth embodiment of the manway assembly of the present invention is indicated in
31 general at 500 in Figs. 22A and 22B. As with previous embodiments, the manway assembly 500
32 includes a lift arm that features lift rails 502a and 502b on the top of cover 504, both of which are
33 positioned on a nozzle 506 which is positioned on top of a tank car body (such as 48 in Fig. 7). The

1 nozzle defines a manway for accessing the interior of the tank car body, as described above. In the
2 embodiment of Figs. 22A and 22B, the nozzle 506 has been provided with an annular flange 508.
3 A nozzle rim 510 has been formed separately from the nozzle 506 and features a circumferential
4 groove 511 that is engaged by the wedge segments of the cover assembly as described for the
5 above embodiments. The manway assembly components, such as the lift arm, cover and latching
6 mechanism, are attached to the nozzle rim 510, as shown in Fig. 22A. The nozzle rim 510 also
7 features downwardly extending threaded studs 512 which pass through corresponding openings
8 formed in the annular flange 508. Each threaded stud 512 is provided with a nut 514. As a result,
9 the manway assembly may be more easily retrofitted to earlier production tank cars and the entire
10 manway assembly may be removed from the tank car for replacement or repair.

11 **[00101]** The manway assembly 500 of Figs. 22A and 22B features a construction that is basically
12 the same as the embodiment of Figs. 17-19 (including the same latching mechanism) except that
13 the embodiment of Figs. 22A and 22B also includes a pivoting outer cover, indicated in general at
14 520 (shown in the open position in Fig. 22A and the closed position in Fig. 22B). The outer cover
15 features a generally round plate portion 521 and a generally continuous, circumferential wall 523
16 that is sized to receive the top portion of the nozzle rim 510 when in the closed position (described
17 below).

18 **[00102]** The outer cover 520 is pivotally mounted to the hinge of the nozzle assembly by an outer
19 cover bracket 522 which pivotally receives the pins that secure the proximal portion of the lift arm
20 rails 502a and 502b to the hinge lugs of the nozzle assembly. The outer cover bracket is secured
21 to the outer cover plate portion 521 by outer cover braces 524a and 524b. As a result, the outer
22 cover bracket 522, outer cover braces 524a and 524b and the outer cover 520 pivot as a single unit
23 about the same axis as the cover 504 between an open position (shown in Fig. 22A) and a closed
24 position (shown in Fig. 22B) that covers the manway (i.e. the central opening of nozzle rim 510),
25 and thus the cover 504, when the cover 504 is in the closed position such as is illustrated for cover
26 404 in Fig. 20. As a result, when in the closed position, the outer cover 520 of Figs. 22A and 22B
27 protects the cover assembly, including the latching mechanism, from the weather and dirt and other
28 undesirable environmental conditions.

29 **[00103]** The outer cover 520 also preferably includes a locking tab 526 having a lock opening 530.
30 When the top cover is in the closed position, the locking tab 526 is positioned adjacent to a
31 corresponding locking tab 527 secured to the nozzle ring 510 (or nozzle flange 508 or nozzle 506)
32 and having its own lock opening. As a result, a lock may be positioned between the aligned locking
33 lock openings of the locking tabs positioned on the outer cover and the nozzle to prevent the outer

1 cover 520 from being opened so as to prevent tampering with the cover 504 or its latching
2 mechanism.

3 **[00104]** A cover assembly of a fifth embodiment of the manway assembly of the present invention
4 is indicated in general at 600 in Fig. 23. The cover assembly 600 of Fig. 23 features the same
5 construction and operates the same as the cover assembly of Fig. 17 with the exception of the
6 latching mechanism, indicated in general at 602. More specifically, like the embodiment of Fig. 17,
7 the cover 603 is provided with latch segments in the form of wedge segments 604. The wedge
8 segments 604 are connected together by a wire spring form 606 that is formed in a generally
9 circular shape and features upturned ends 608a and 608b. The wire spring form 606 is constructed
10 in such a manner to urge the wedge segments 604 radially outward, and into engagement with the
11 circumferential groove of the nozzle interior wall. As an example only, the wire spring form material
12 may be 5/16" diameter steel wire, hard drawn ASTM A 227, finish zinc plate- baked. The wedge
13 segments 604 of Fig. 23 feature arcuate channels 612 formed along their undersides that receive
14 the wire spring form 606 in a sliding fashion.

15 **[00105]** Each wedge segment includes an elongated slot 614 and retainer bolts 616 pass through
16 each slot and into bores formed through the top surface of the cover 603 so that the wedge
17 segments are secured to the top surface of the cover. The slots 614 and retainer bolts 616 are
18 sized so that the wedges may be moved between a locked position (illustrated in Fig. 23), where
19 the wedge surfaces of the wedge segments 604 engage the circumferential groove of the interior
20 surface of the nozzle, and an unlocked position, where the wedge segments are disengaged from
21 the nozzle circumferential groove. It should be noted that while five wedge segments are illustrated
22 in Fig. 23, alternative numbers of the wedge segments may be used instead.

23 **[00106]** The latching mechanism 602 of Fig. 23 features a holding block 620 that is secured to the
24 cover 603 by bolts 622. The holding block includes a threaded opening that receives a first
25 threaded portion 624 of a screw rod, indicated in general at 626. A retraction block 630 rests on the
26 top surface of the cover 603, but is not secured thereto so that it is able to slide along the top
27 surface. The retraction block 630 features a threaded opening that receives a second threaded
28 portion 632 of the screw rod. The first threaded portion 624 of the screw rod features a handedness
29 that is the opposite of the handedness of the second threaded portion 632 of the screw rod such
30 that when the central portion of the screw rod is turned in a first direction, the retraction block 630 is
31 pulled towards the holding block, and when the central portion of the screw rod is turned in a
32 second direction, the retraction block 630 is pushed away from the holding block. A lever 634 is
33 attached to the central portion of the screw rod 626, preferably via a ratcheting mechanism 636.

1 **[00107]** A pair of toggles 638a and 638b join the upturned ends 608a and 608b of the wire 606 to
2 upwardly extending pins 642a and 642b attached to or formed on the top surface of the base 644 of
3 the retraction block. The toggles 638a and 638b are free to pivot with respect to both the upturned
4 ends 608a and 608b and the pins 642a and 642b.

5 **[00108]** The movement of the retraction block 630 towards the holding block 620, when the lever
6 634 is actuated in the first direction, causes the retraction block pins 642a and 642b, and thus the
7 proximal ends of toggles 638a and 638b, to move towards the center of the cover (and parallel with
8 the top surface of the cover).

9 **[00109]** A pair of fulcrum pins 648a and 648b are positioned on the cover 603. As the toggles 638a
10 and 638b travel further towards the center of the cover, they encounter the fulcrum pins 648a and
11 648b which causes the toggles to further pivot in the directions indicated by arrows 652a and 652b
12 about pins 642a and 642b. This drives the upturned ends 608a and 608b of the spring form 606
13 closer together which causes the wedge segments 604 to move radially inward (towards the center
14 of the cover) so that their wedge surfaces disengage from the circumferential groove of the nozzle
15 and the cover 603 may be opened.

16 **[00110]** A sixth embodiment of the manway assembly of the present invention is indicated in
17 general at 700 in Figs. 24 and 25 and more specifically in Figs. 24-28D. The manway assembly
18 700 of Figs. 24 and 25 features the same construction and may operate similar to any of the
19 manway assemblies of Fig. 7, Fig. 17, Fig. 20, Fig. 22A, or Fig. 23, with the exception of a seal
20 assembly, indicated in general at 720. More specifically, the seal assembly 720 as described and
21 detailed below may be utilized on any of the manway assemblies of the present invention or any
22 other manway assemblies similar to these embodiments for use on a nozzle and manway for a
23 railroad tank car, even prior art manway assemblies as illustrated in Figs. 1-4.

24 **[00111]** Generally, as illustrated in Figs. 24 and 25, the manway assembly 700 may include a
25 nozzle 702 and a cover 704. The manway assembly 700 may also include a latching mechanism
26 708 and a hinge assembly 706. The hinge assembly 706 permits the cover 704 to be pivoted from
27 a closed configuration as illustrated in Fig. 24 to an open configuration as illustrated in Fig. 25. Any
28 latching mechanism 708 or hinge assembly 706 may be utilized with this embodiment without
29 departing from this invention. For example, the latching mechanism 708 may be a pivoting eye bolt
30 as illustrated in Figs. 24 and 25. Other latching mechanisms may be utilized without departing from
31 this invention, such as those disclosed and described above, and any other hinge assemblies such
32 as eyebolts (swing bolts), toggle clamps, deadbolts, magnetic latches, spring latches, cam locking
33 mechanisms, quarter turn latches, slide bolts, or wedging mechanisms. Additionally, for example,

1 the hinge assembly 706 may be a hinge on the nozzle 702 attached to a lift arm on the cover 704
2 as illustrated in Figs. 24 and 25. Other hinge assemblies may be utilized without departing from
3 this invention, such as those disclosed and described above and any other hinge assemblies such
4 as spring assisted hinge assemblies, pneumatic hinge assemblies, or hydraulic hinge assemblies.
5 Lastly, the manway assembly 700 may include a seal assembly 720 to seal the cover 704 with the
6 nozzle 702.

7 **[00112]** The seal assembly 720 includes a seal 722 and a seal channel 730. The underside edge
8 portion of the cover 704 is provided with a circumferential seal channel 730 and a circumferential
9 stop portion 705. A circumferential seal 722 is positioned within the circumferential seal channel
10 730. As illustrated in Figs. 26, 27A, and 27B, when the cover 704 is in the closed configuration, the
11 circumferential seal 722 is gently compressed against a circumferential ledge 703 of the nozzle
12 702. As illustrated in Figs. 26, 27A, and 27B, the circumferential stop portion 705 of the cover 704
13 engages the circumferential ledge 703 of the nozzle 702 to limit compression of the seal 722.
14 Additionally, the circumferential stop portion 705 of the cover 704 provides metal to metal contact
15 707 with the circumferential ledge 703 of the nozzle 702 to limit the seal height.

16 **[00113]** The circumferential seal 722 as illustrated in Figs. 26, 27A, and 27B shows a C-shaped
17 cross-sectional shape. The circumferential seal 722 may be in the form of a lip seal as known and
18 used in seal technologies. Further, as illustrated in Fig. 27B, the circumferential seal 722 may
19 include a top portion 724 and a bottom portion 726 opposite the top portion 724. The top portion
20 724 and the bottom portion 726 may be connected by a side portion 728. Additionally, the seal
21 channel 730 may include a front wall 732, a back wall 734 opposite the front wall 732, and a top
22 wall 736 to create the seal channel 730. The seal channel 730 may be sized and shaped to receive
23 the circumferential seal 722, with the top portion 724 of the seal 722 seated against the top wall
24 736, the side portion 728 of the circumferential seal 722 seated against the back wall 734, and the
25 bottom portion 726 of the circumferential seal 722 seated against the circumferential ledge 703 of
26 the nozzle 702.

27 **[00114]** The sealing assembly 720 with the circumferential seal 722 shape and seal channel 730
28 configuration provides benefits over prior art sealing as illustrated in Fig. 27B. As illustrated in Fig.
29 27B, an internal pressure of the tank car provides a sealing with the nozzle 702 and the cover 704.
30 The circumferential seal 722 positioned in the seal channel 730 works together with the internal
31 pressure of the tank car, wherein the internal pressure of the tank car presses against with top
32 portion 724 of the circumferential seal 722 pressing against the top wall 736 to seal that area, the
33 side portion 728 of the circumferential seal 722 pressing against the back wall 734 to seal that area,

1 and the bottom portion 726 of the circumferential seal 722 pressing against the circumferential
2 ledge 703 of the nozzle 702 to seal that area.

3 **[00115]** The circumferential seal 722 may be made of various materials known and used in the art
4 without departing from this invention. For example, the circumferential seal 722 may be made of
5 polytetrafluoroethylene (PTFE), filled PTFE, silicone, nitrile fluoroelastomer (FKM),
6 perfluoroelastomer (FFKM), polyurethane, or ethylene propylene diene monomer rubber (EPDM).
7 The circumferential seal 722 may be also include a plastic/polymer seal portion of the seal that
8 could be spring energized by a coupling with a metal spring.

9 **[00116]** As illustrated in Figs. 26, 27A, and 27B, the circumferential seal 722 and the seal channel
10 730 are oriented in a horizontal direction with respect to the cover 704 and the nozzle 702. Figs.
11 28A through 28D illustrate various other orientations of the circumferential seal 722 and the seal
12 channel 730. Fig. 28A illustrates the horizontal direction or 0 degrees with respect to the cover 704
13 and the nozzle 702. Fig. 28B illustrates an angled orientation or 30 degrees with respect to the
14 cover 704 and the nozzle 702. Fig. 28C illustrates another angled orientation or 60 degrees with
15 respect to the cover 704 and nozzle 702. Fig. 28D illustrates a vertical direction or orientation or 90
16 degrees with respect to the cover 704 and the nozzle 702. As shown in Figs. 28A-28D, the cover
17 704 and the nozzle 702 may be oriented in various directions and the circumferential seal 722 and
18 the seal channel 730 may be orientated to match the cover 704 and the nozzle 702 orientation to
19 seal the manway assembly 700.

20 **[00117]** While the preferred embodiments of the invention have been shown and described, it will
21 be apparent to those skilled in the art that changes and modifications may be made therein without
22 departing from the spirit of the invention, the scope of which is defined by the appended claims.

WHAT IS CLAIMED IS:

1. A manway assembly for a railroad tank car, the manway assembly comprising:
 - a nozzle defining a central opening and having a sidewall and a circumferential ledge on the sidewall of the nozzle;
 - a cover defining a circumferential stop portion that provides a metal-to-metal contact with the circumferential ledge when the cover is in a closed position on the nozzle to limit a seal height;
 - a hinge attaching the cover to the nozzle so that said cover is pivoted between an open position, where the central opening is generally uncovered, and a closed position, where the central opening is generally covered by the cover; and
 - a seal assembly to seal the cover with the nozzle, the seal assembly including a circumferential seal and a circumferential seal channel, the circumferential seal including a top portion, a bottom portion opposite the top portion, and a side portion between the top portion and the bottom portion,
 - wherein an underside edge portion of the cover is provided with the circumferential seal channel and the circumferential seal is positioned within the circumferential seal channel, wherein the circumferential seal has a C-shaped cross section and is positioned in the circumferential seal channel such that the top portion of the seal is seated against a top wall of the circumferential seal channel and the bottom portion of the seal is seated against the circumferential ledge of the nozzle, thereby sealing the metal-to-metal contact.
2. The manway assembly of claim 1, wherein the circumferential seal and the circumferential seal channel are oriented horizontal with respect to the nozzle and the cover.
3. The manway assembly of claim 1, wherein the circumferential seal and the circumferential seal channel are angle oriented at 30 degrees with respect to the nozzle and the cover.
4. The manway assembly of claim 1, wherein the circumferential seal and the circumferential seal channel are angle oriented at 60 degrees with respect to the nozzle and the cover.
5. The manway assembly of claim 1, wherein the circumferential seal and the circumferential seal channel are oriented vertically with respect to the nozzle and the cover.
6. A manway assembly for a railroad tank car, the manway assembly comprising:

a nozzle defining a central opening and having a sidewall and a circumferential ledge on the sidewall of the nozzle;

a cover defining a circumferential stop portion that provides a metal-to-metal contact with the circumferential ledge when the cover is in a closed position on the nozzle to limit a seal height;

a hinge attaching the cover to the nozzle so that said cover is pivoted between an open position, where the central opening is generally uncovered, and the closed position, where the central opening is generally covered by the cover; and

a seal assembly to seal the cover with the nozzle, the seal assembly including a circumferential seal and a circumferential seal channel, the circumferential seal including a top portion, a bottom portion opposite the top portion, and a side portion between the top portion and the bottom portion, and the circumferential seal channel including a front wall, a back wall opposite the front wall, and a top wall to form the circumferential seal channel,

wherein an underside edge portion of the cover is provided with the circumferential seal channel and the circumferential seal is positioned within the circumferential seal channel, wherein the circumferential seal has a C-shaped cross section and is positioned in the circumferential seal channel such that the top portion of the seal is seated against the top wall of the circumferential seal channel, the bottom portion of the seal is seated against the circumferential ledge of the nozzle, and the side portion of the seal is seated against the back wall of the circumferential seal channel, thereby sealing the metal-to-metal contact.

7. The manway assembly of claim 6, wherein an internal pressure of the railroad tank car presses the circumferential seal against the circumferential seal channel and the circumferential ledge of the nozzle.

8. The manway assembly of claim 7, wherein the internal pressure of the railroad tank car presses the top portion of the seal against the top wall of the circumferential seal channel, the side portion of the seal against the back wall of the circumferential seal channel, and the bottom portion of the seal against the circumferential ledge of the nozzle.

9. The manway assembly of claim 6, wherein the circumferential seal and the circumferential seal channel are oriented horizontal with respect to the nozzle and the cover.

10. The manway assembly of claim 6, wherein the circumferential seal and the circumferential seal channel are angle oriented at 30 degrees with respect to the nozzle and the cover.

11. The manway assembly of claim 6, wherein the circumferential seal and the circumferential seal channel are angle oriented at 60 degrees with respect to the nozzle and the cover.
12. The manway assembly of claim 6, wherein the circumferential seal and the circumferential seal channel are oriented vertically with respect to the nozzle and the cover.
13. A manway assembly for a railroad tank car, the manway assembly comprising:
 - a nozzle defining a central opening and having a sidewall and a circumferential ledge on the sidewall of the nozzle;
 - a cover defining an underside edge portion with a circumferential stop portion and a circumferential seal channel, wherein the circumferential stop portion provides a metal-to-metal contact with the circumferential ledge when the cover is in a closed position on the nozzle to limit a seal height;
 - a hinge attaching the cover to the nozzle so that said cover is pivoted between an open position, where the central opening is generally uncovered, and the closed position, where the central opening is generally covered by the cover;
 - a latch mechanism to secure the cover to the nozzle; and
 - a seal assembly to seal the cover with the nozzle, the seal assembly including a circumferential seal and a circumferential seal channel, the circumferential seal including a top portion, a bottom portion opposite the top portion, and a side portion between the top portion and the bottom portion, and the circumferential seal channel including a front wall, a back wall opposite the front wall, and a top wall to form the circumferential seal channel,
 - wherein an underside edge portion of the cover is provided with the circumferential seal channel and the circumferential seal is positioned within the circumferential seal channel, wherein the circumferential seal has a C-shaped cross section and is positioned in the circumferential seal channel such that the top portion of the seal is seated against the top wall of the circumferential seal channel, the bottom portion of the seal is seated against the circumferential ledge of the nozzle, and the side portion of the seal is seated against the back wall of the circumferential seal channel, and further wherein an internal pressure of the railroad tank car presses the circumferential seal against the circumferential seal channel and the circumferential ledge of the nozzle, thereby sealing the metal-to-metal contact.

14. The manway assembly of claim 13, wherein the internal pressure of the railroad tank car presses the top portion of the seal against the top wall of the circumferential seal channel, the side portion of the seal against the back wall of the circumferential seal channel, and the bottom portion of the seal against the circumferential ledge of the nozzle.

15. The manway assembly of claim 13, wherein the circumferential seal and the circumferential seal channel are oriented horizontal with respect to the nozzle and the cover.

16. The manway assembly of claim 13, wherein the circumferential seal and the circumferential seal channel are angle oriented at 30 degrees with respect to the nozzle and the cover.

17. The manway assembly of claim 13, wherein the circumferential seal and the circumferential seal channel are angle oriented at 60 degrees with respect to the nozzle and the cover.

18. The manway assembly of claim 13, wherein the circumferential seal and the circumferential seal channel are oriented vertically with respect to the nozzle and the cover.

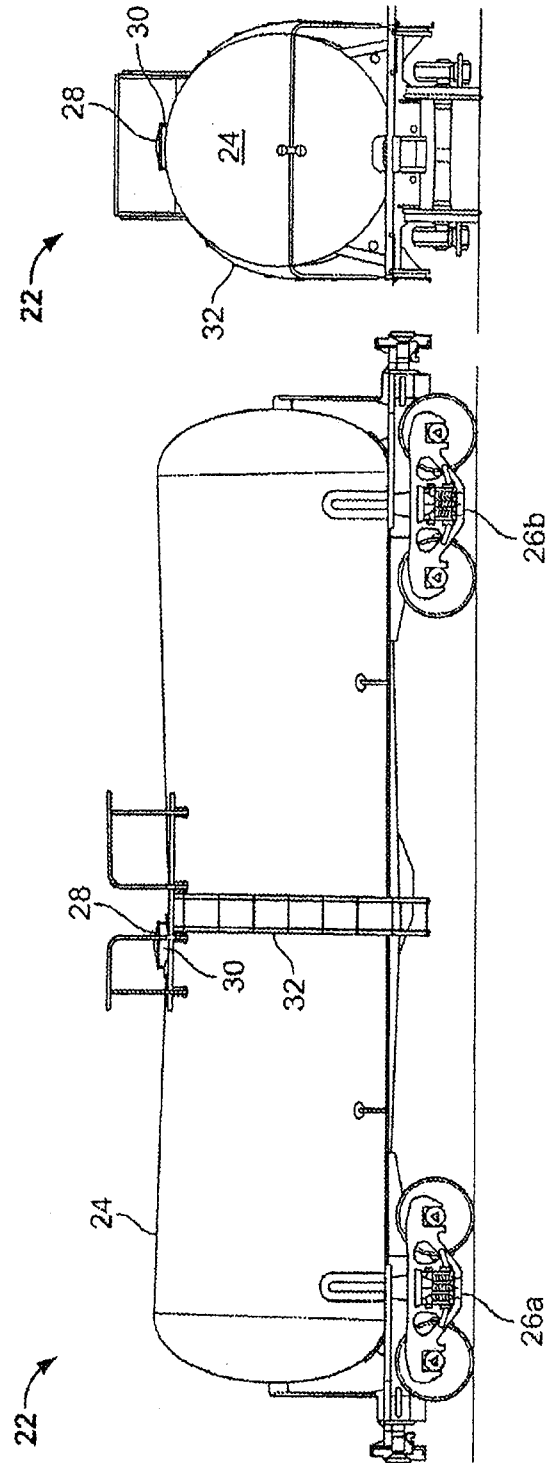


FIG. 2

FIG. 1

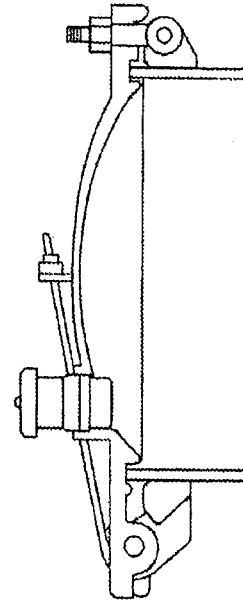
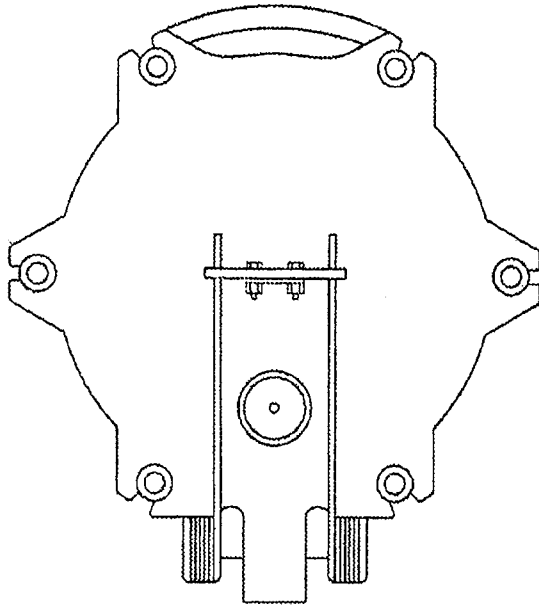


FIG. 4

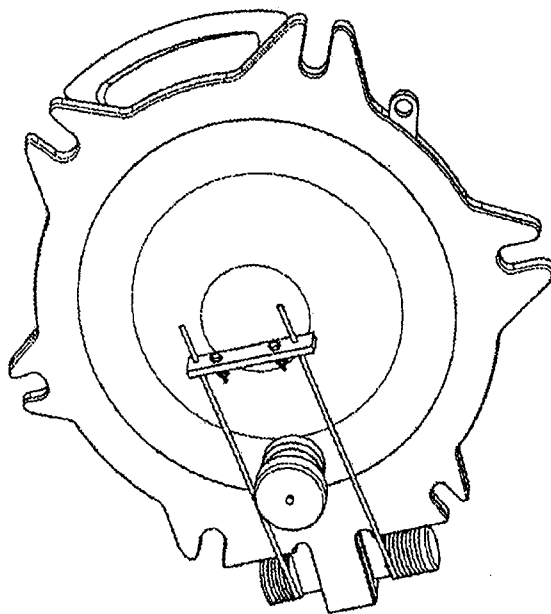


FIG. 3

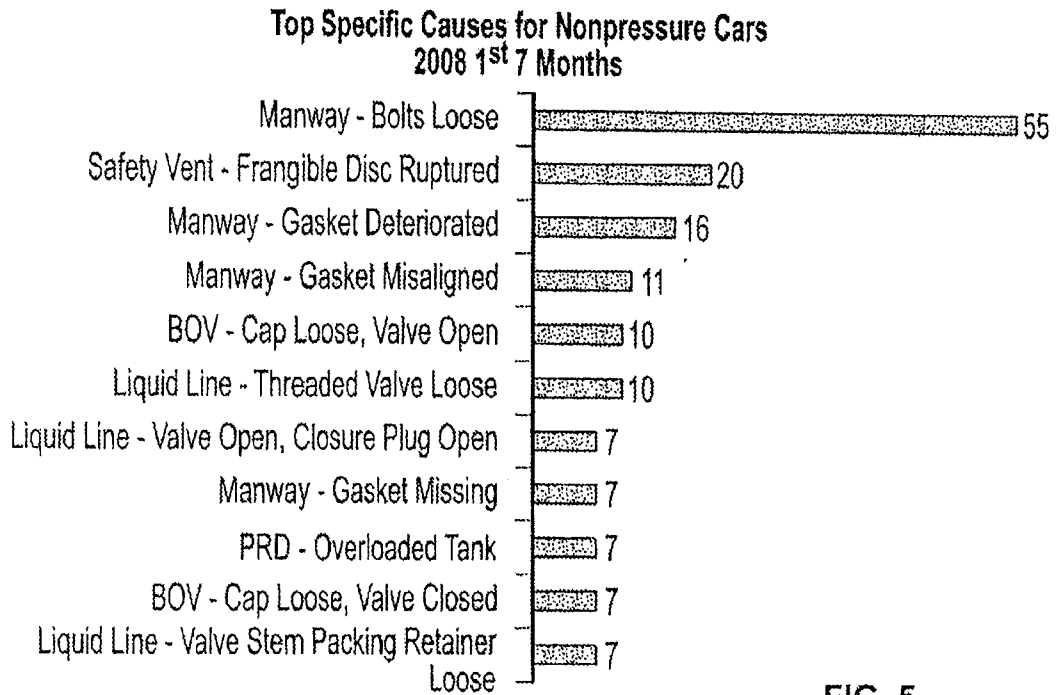


FIG. 5

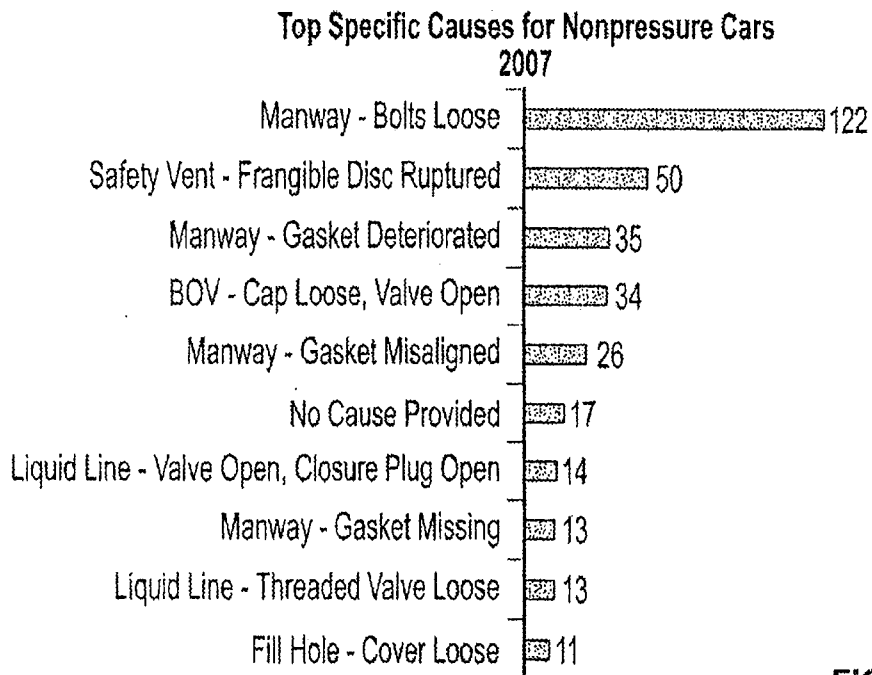


FIG. 6

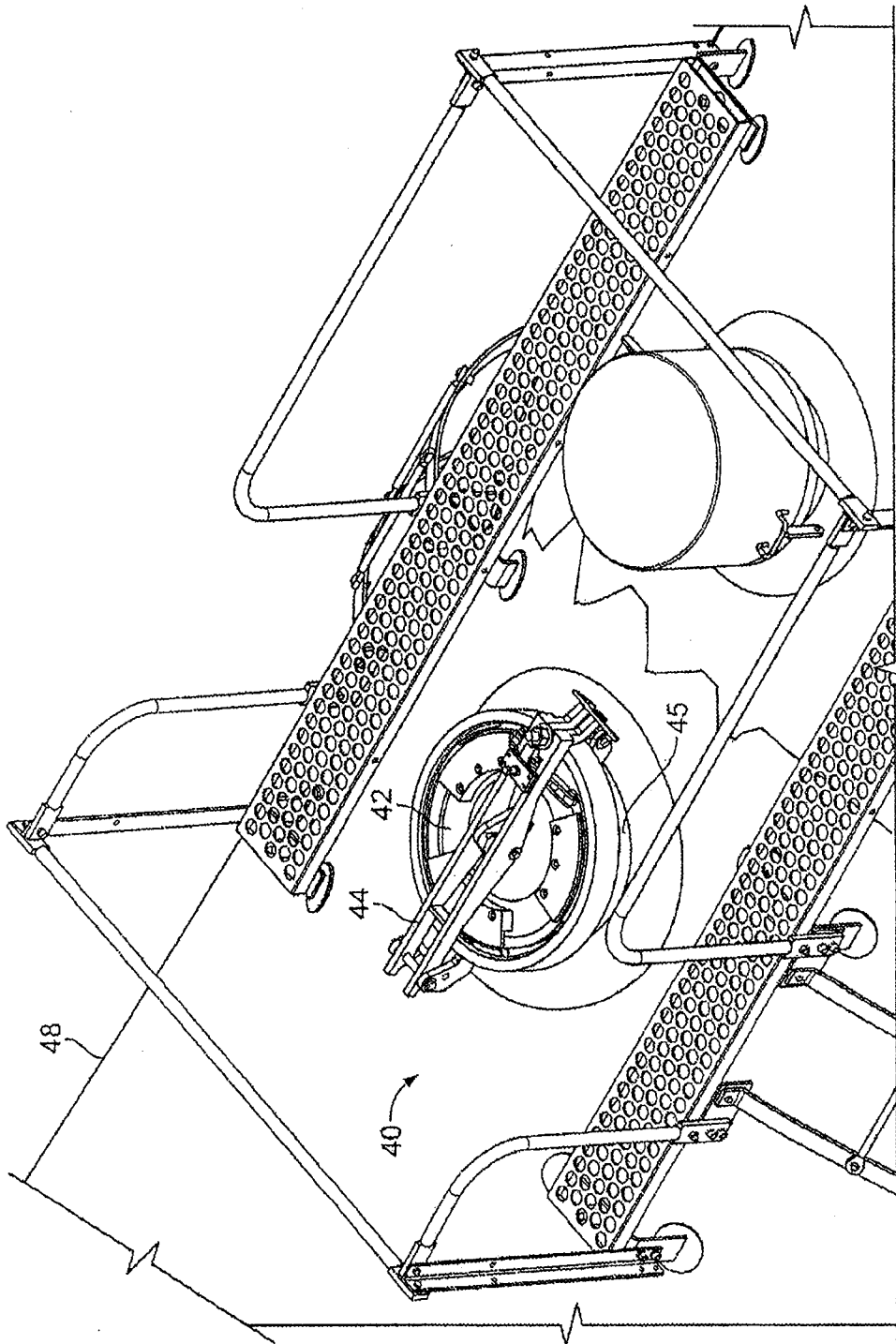


FIG. 7

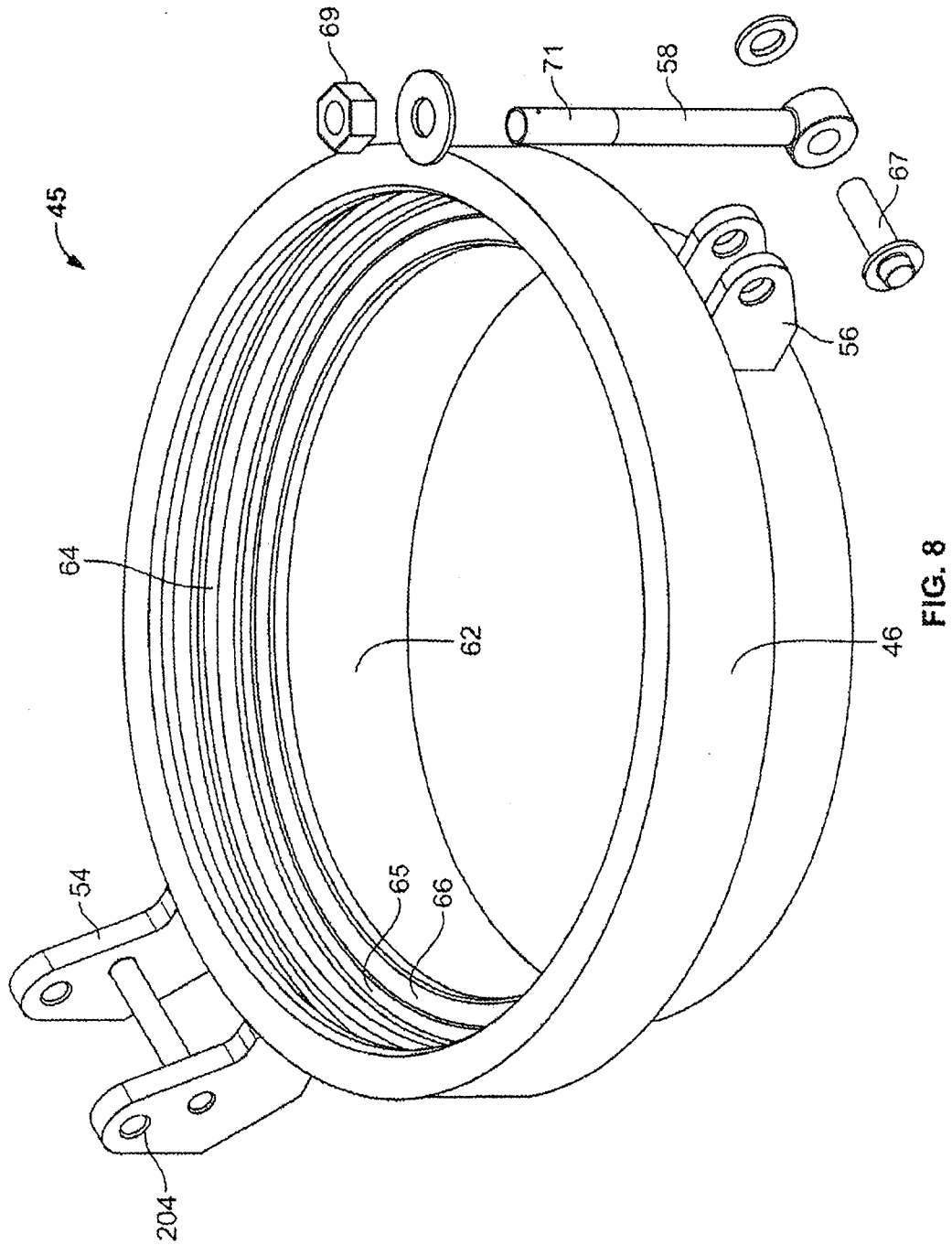


FIG. 8

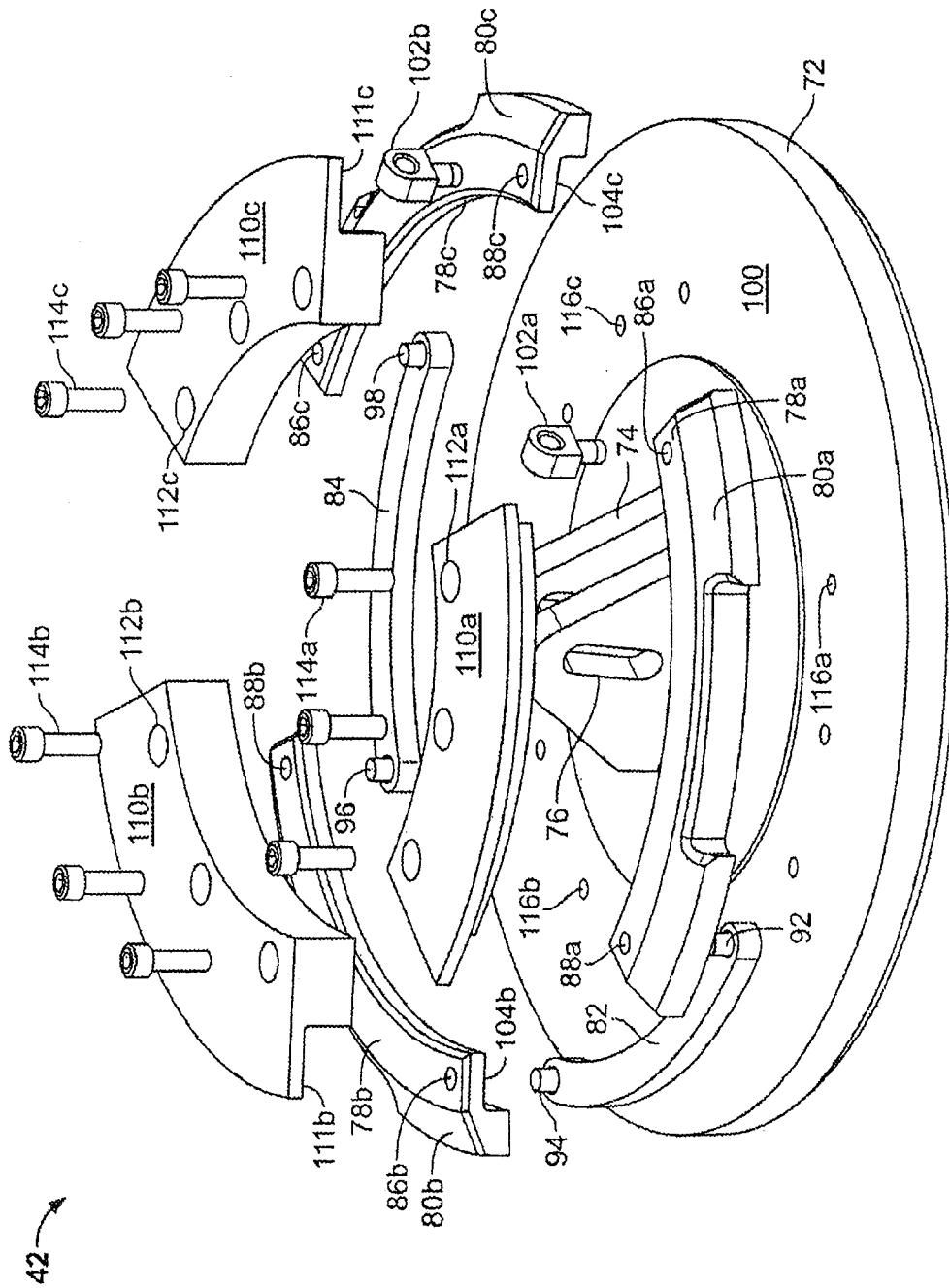


FIG. 9

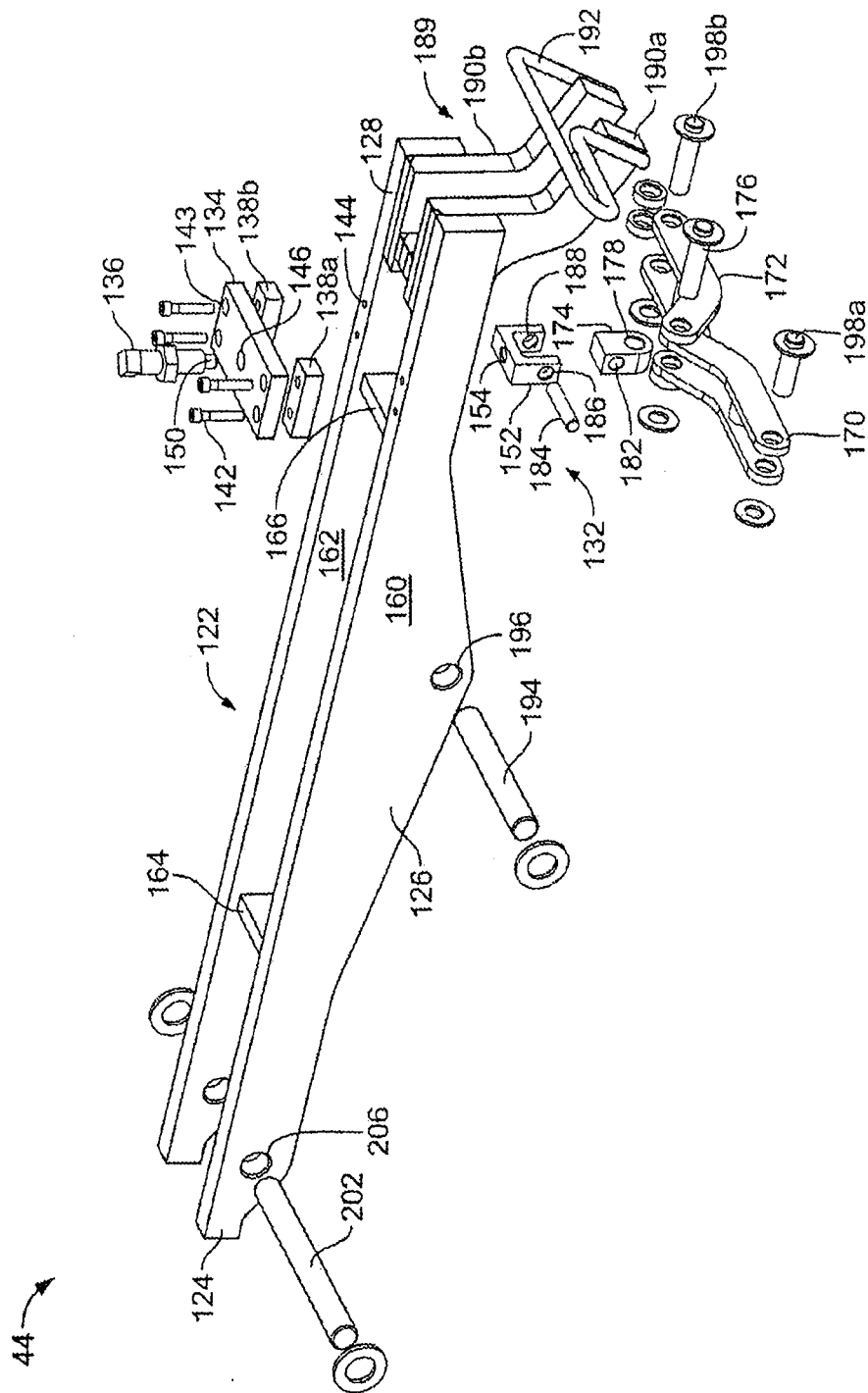


FIG. 10

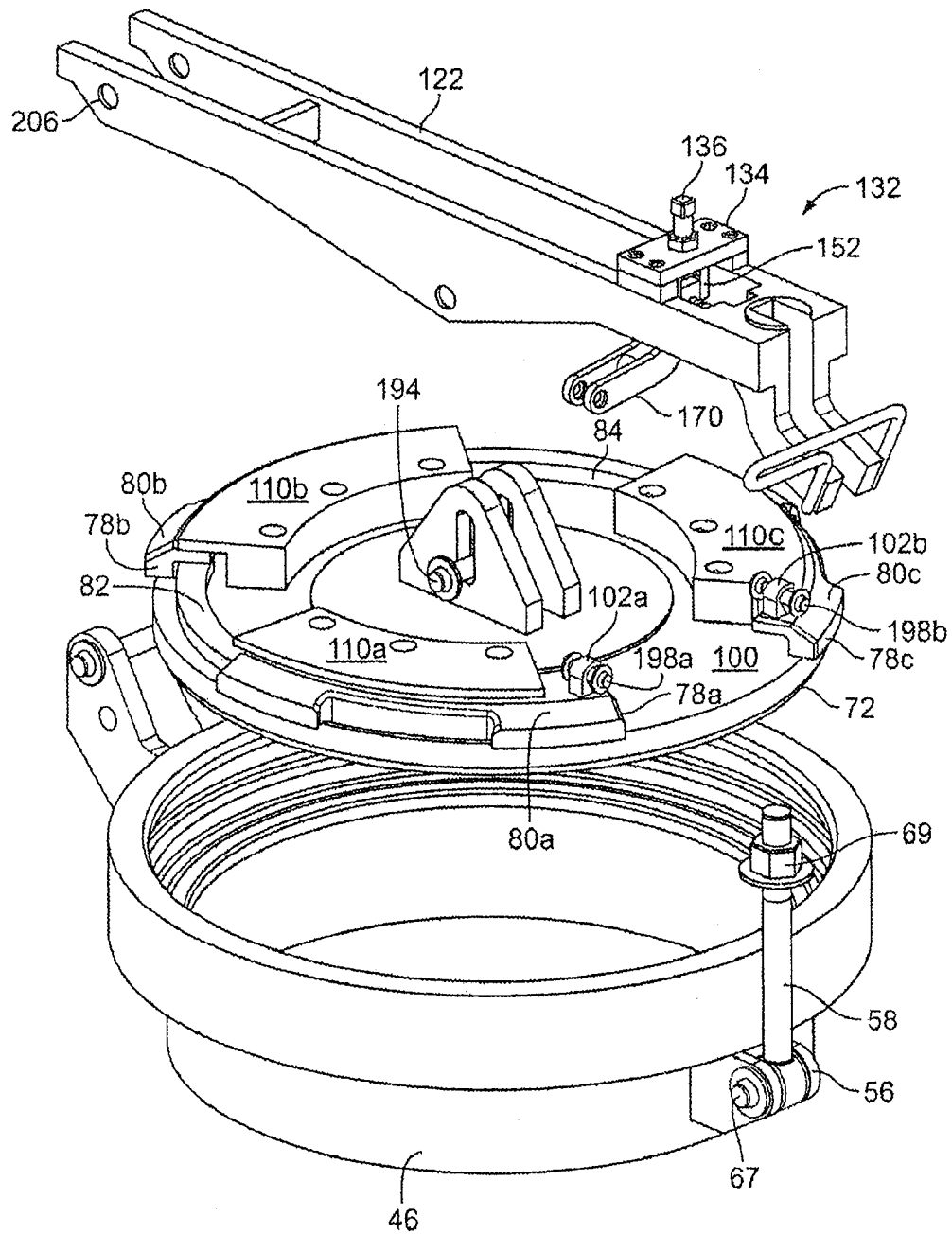


FIG. 11

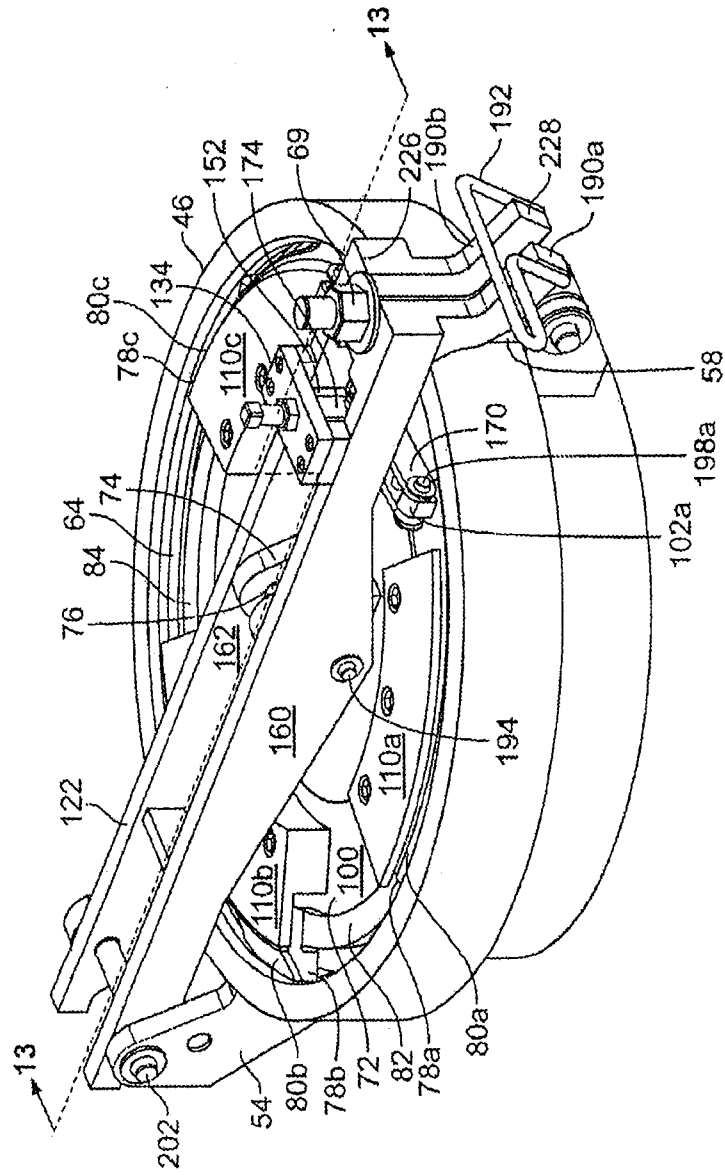


FIG. 12

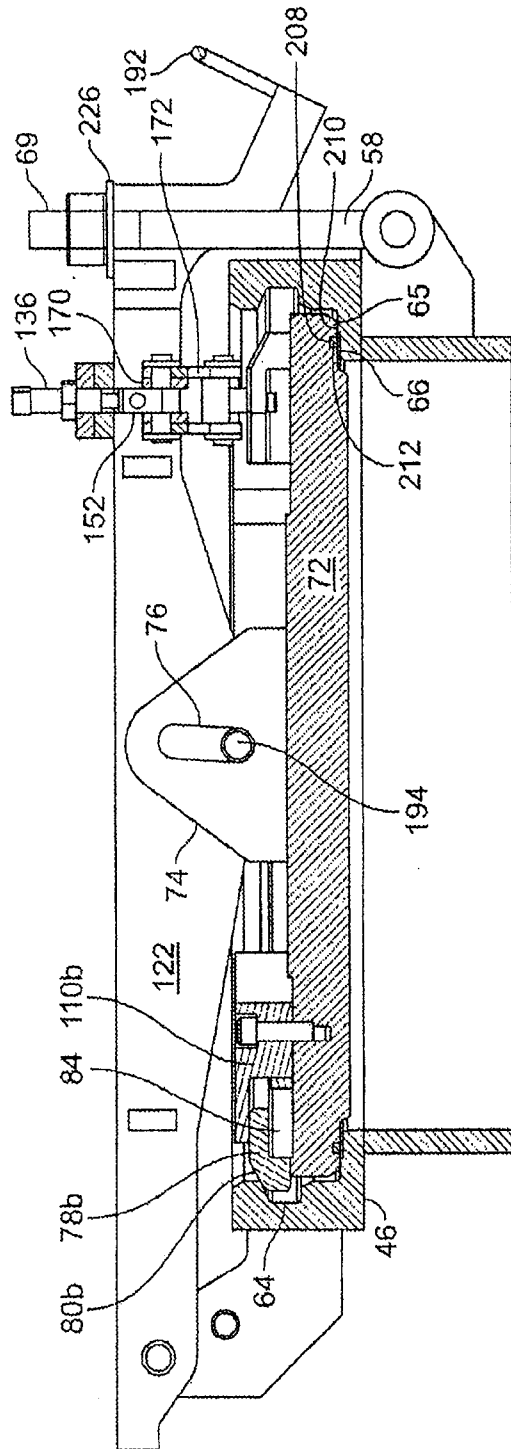


FIG. 13

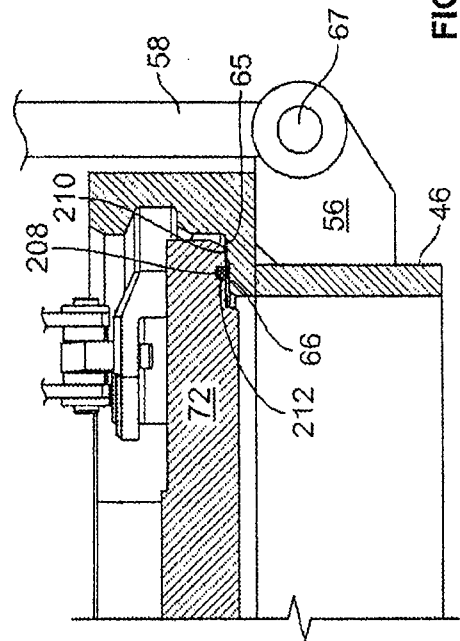


FIG. 14

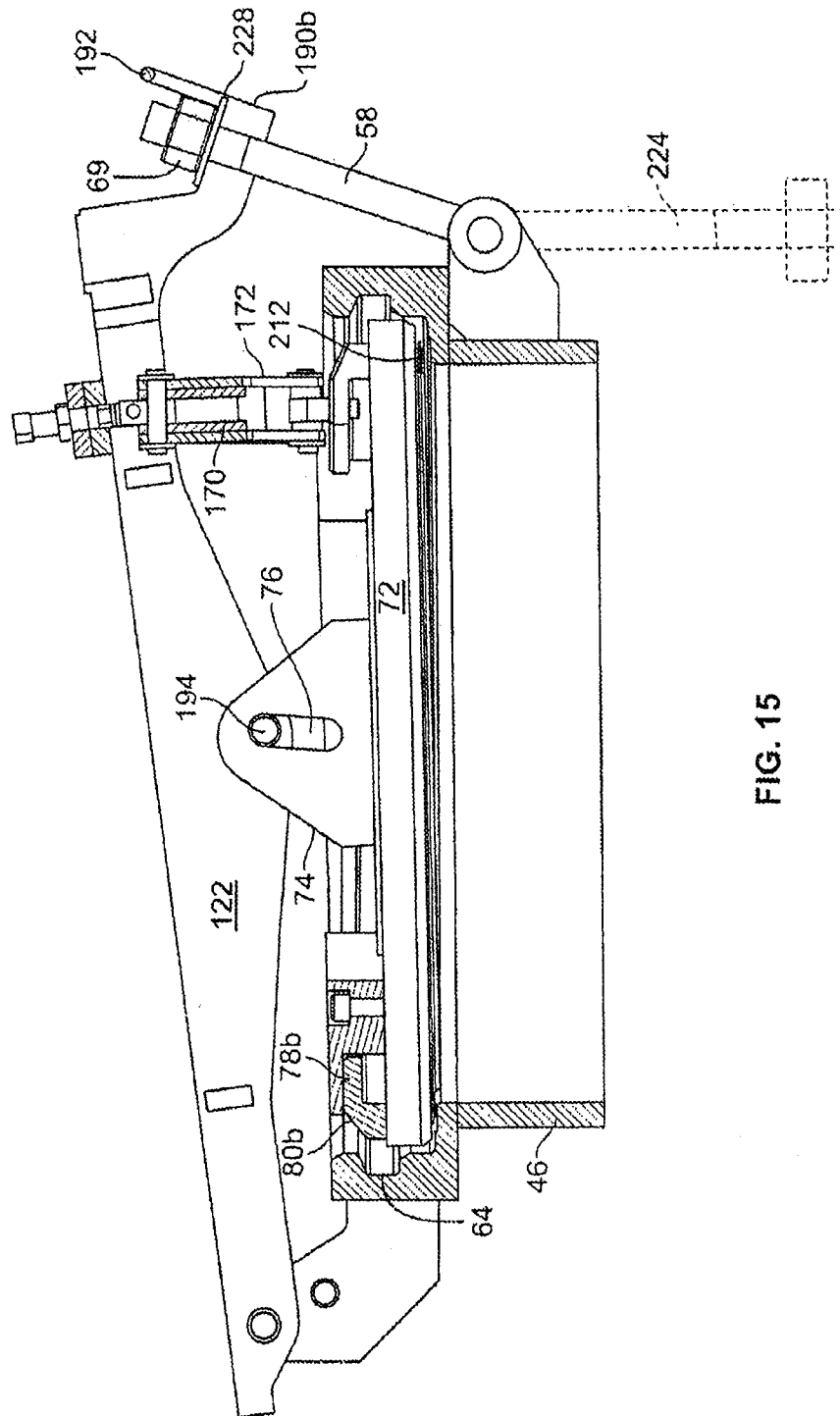


FIG. 15

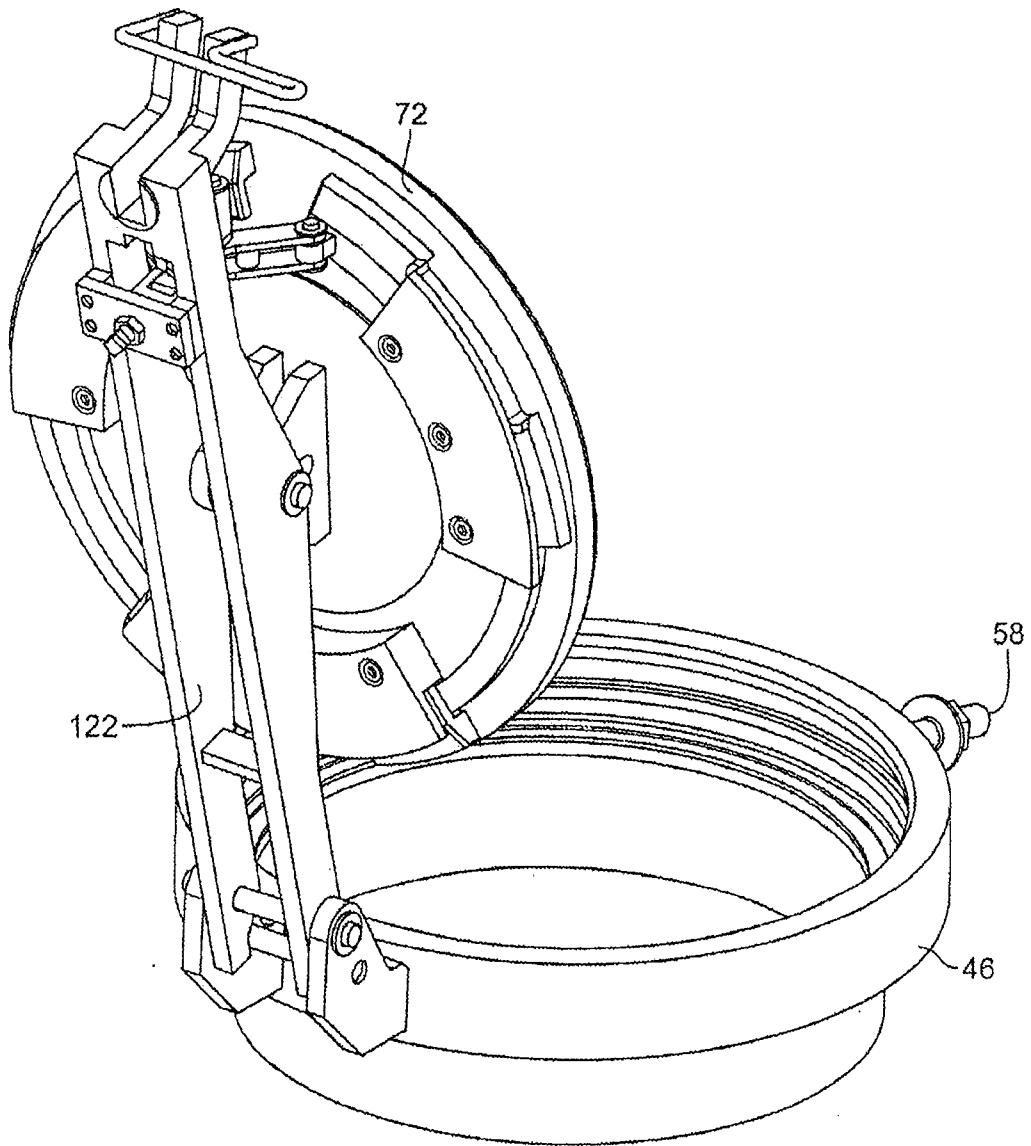


FIG. 16

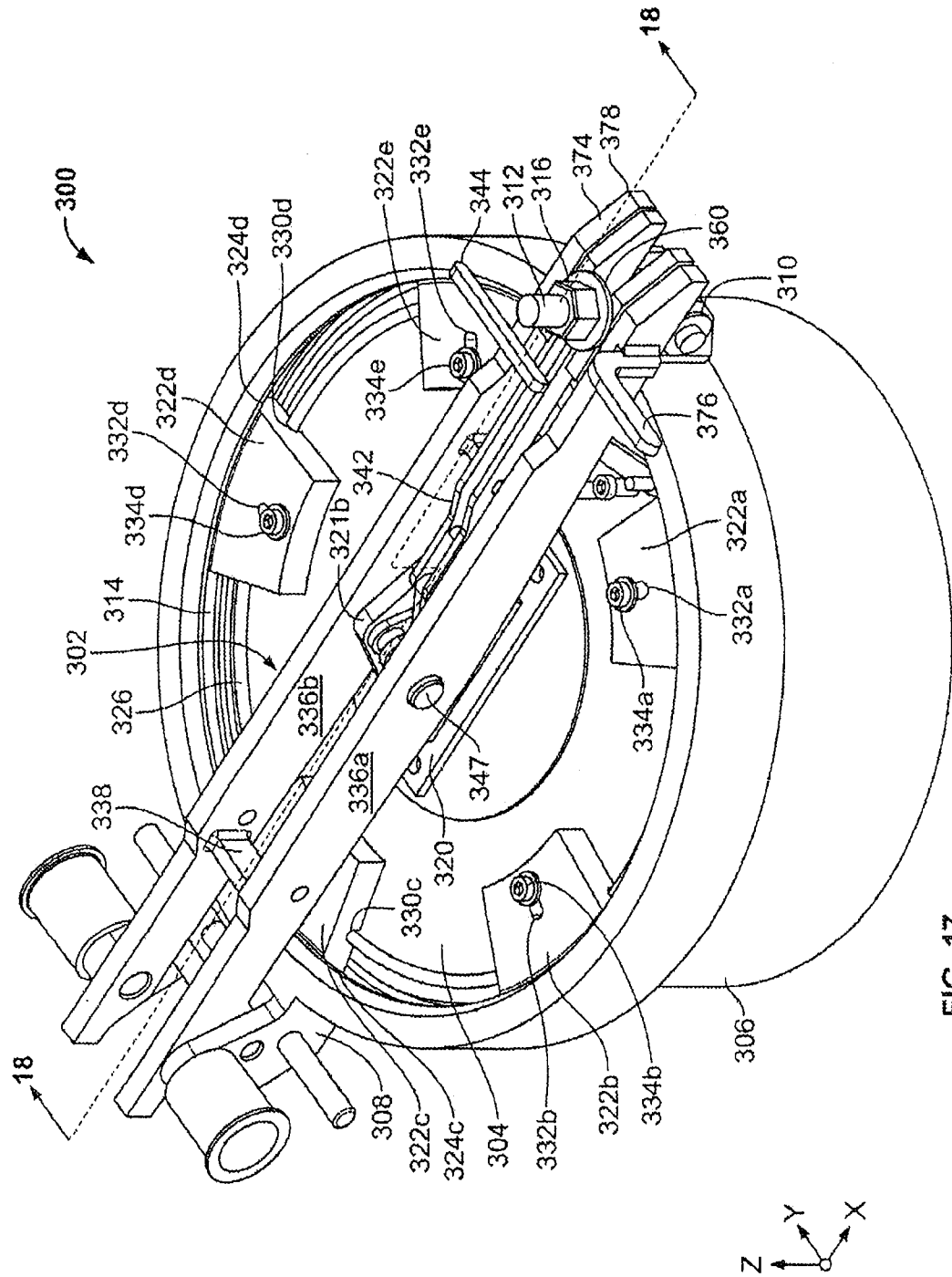


FIG. 17

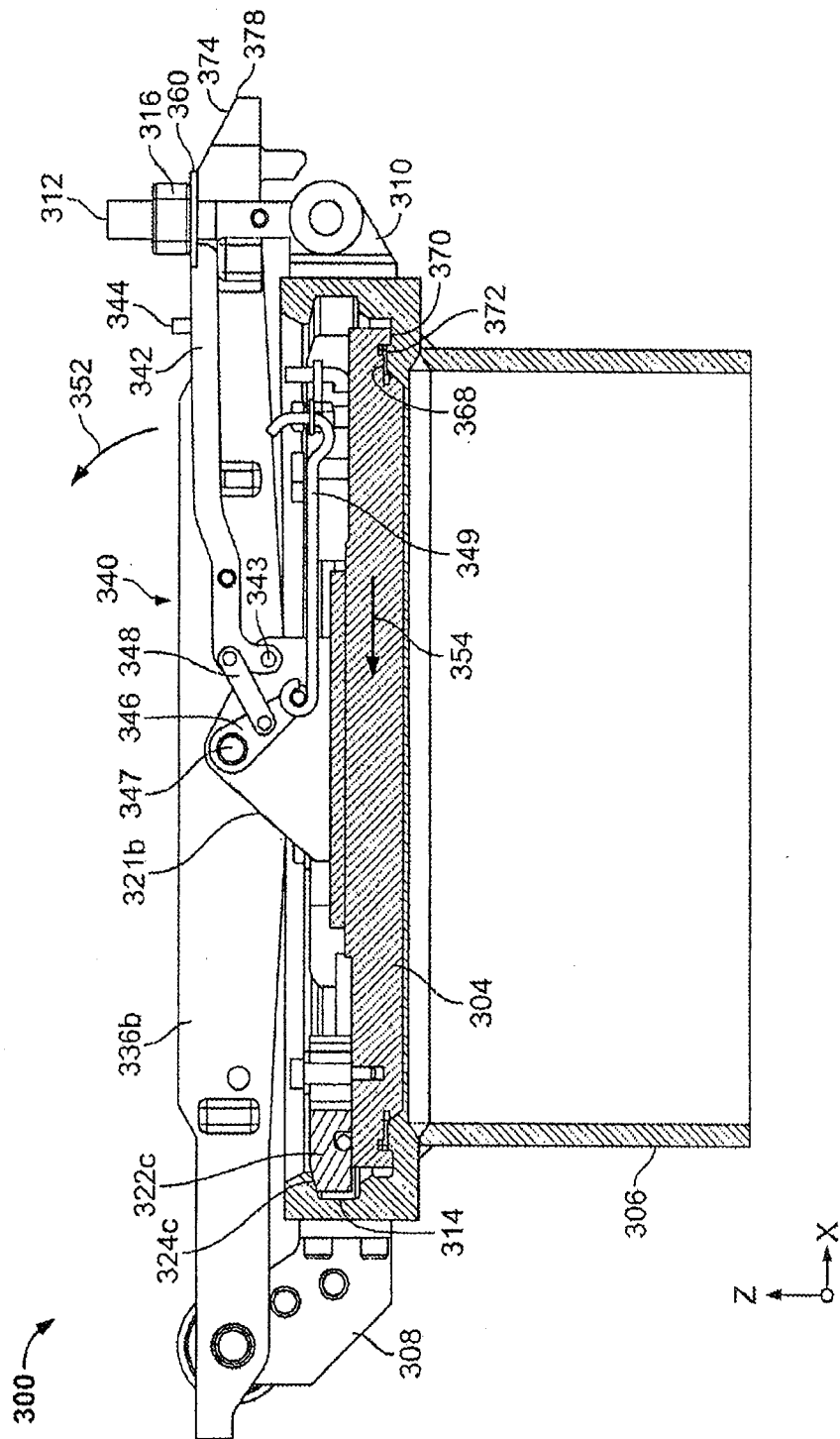


FIG. 18

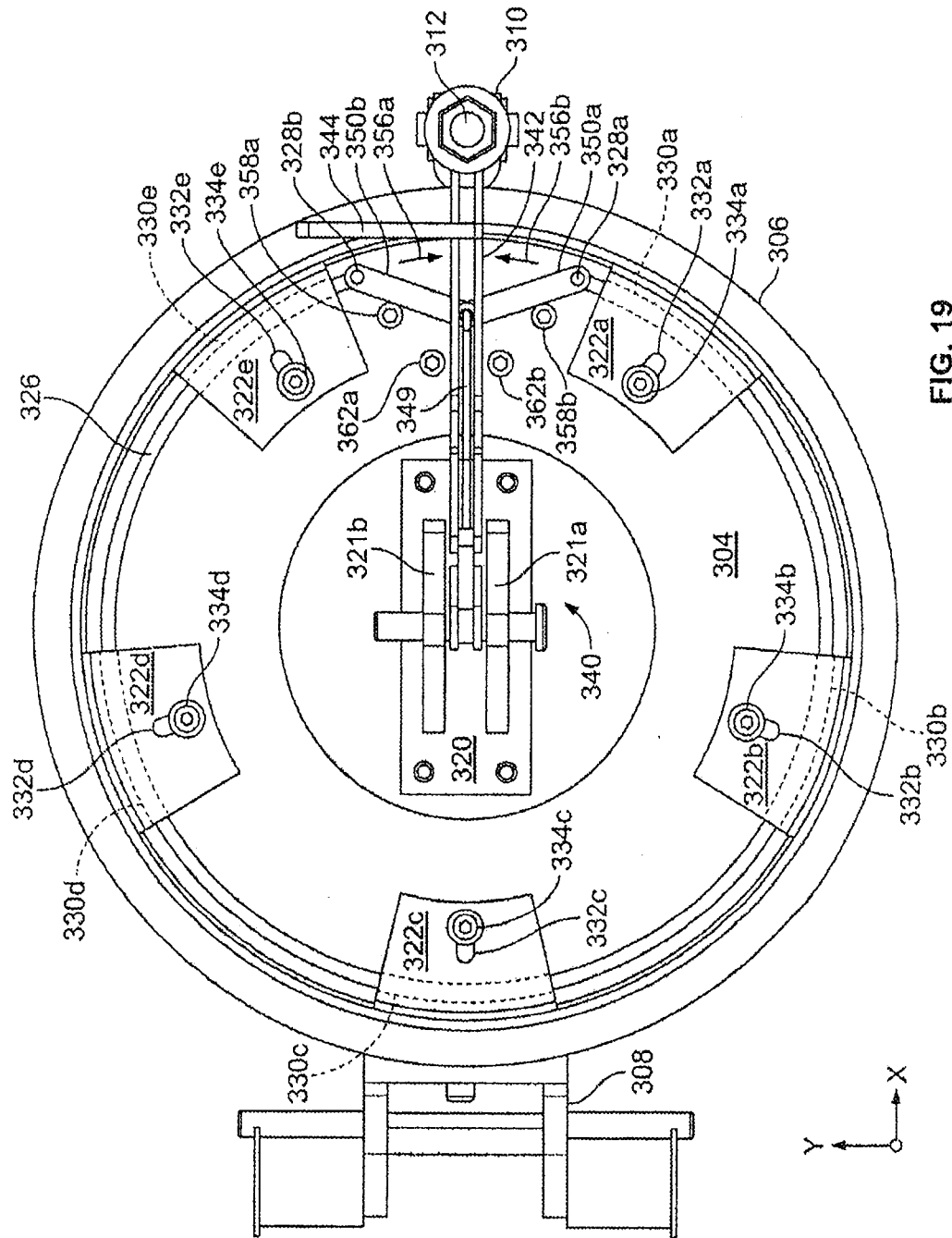
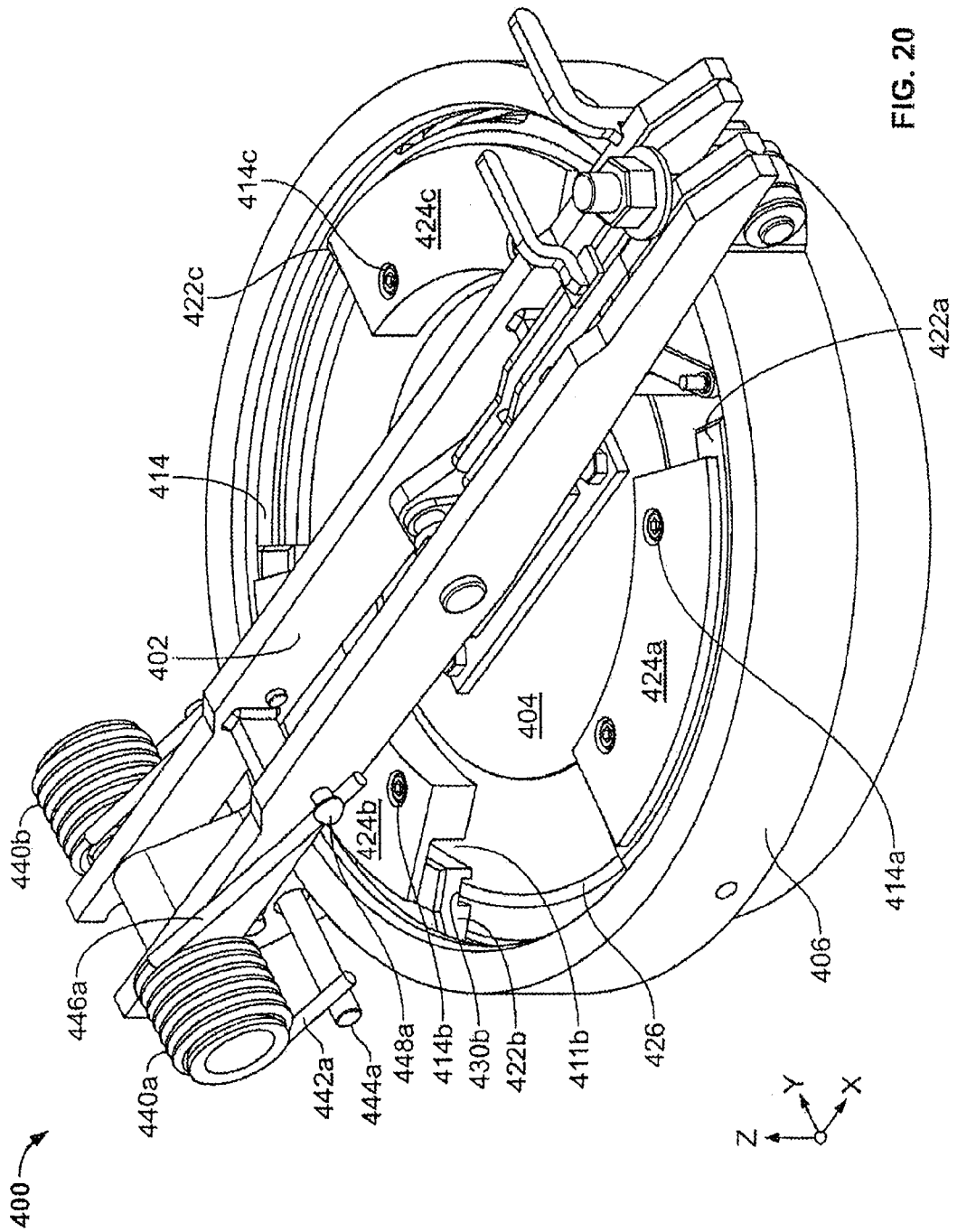


FIG. 19



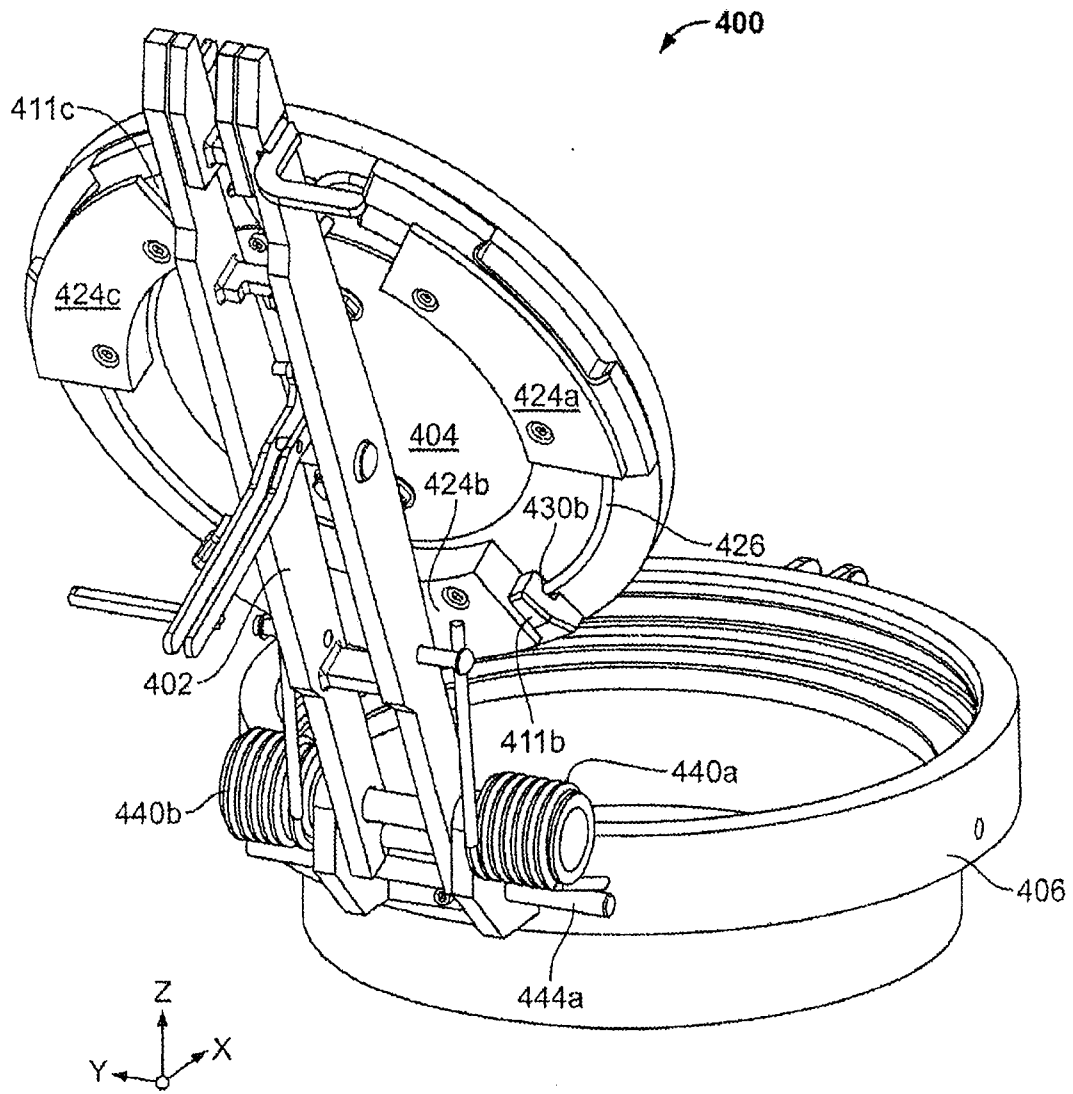


FIG. 21

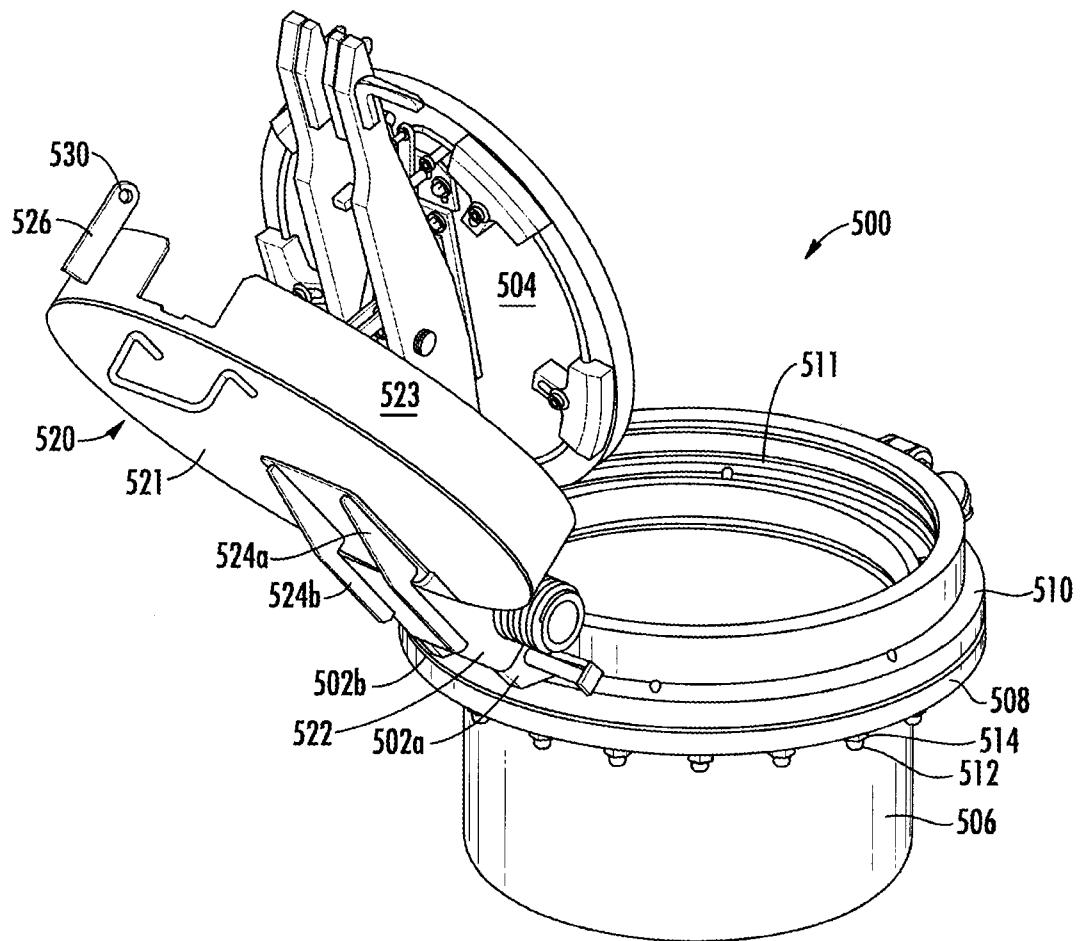


FIG. 22A

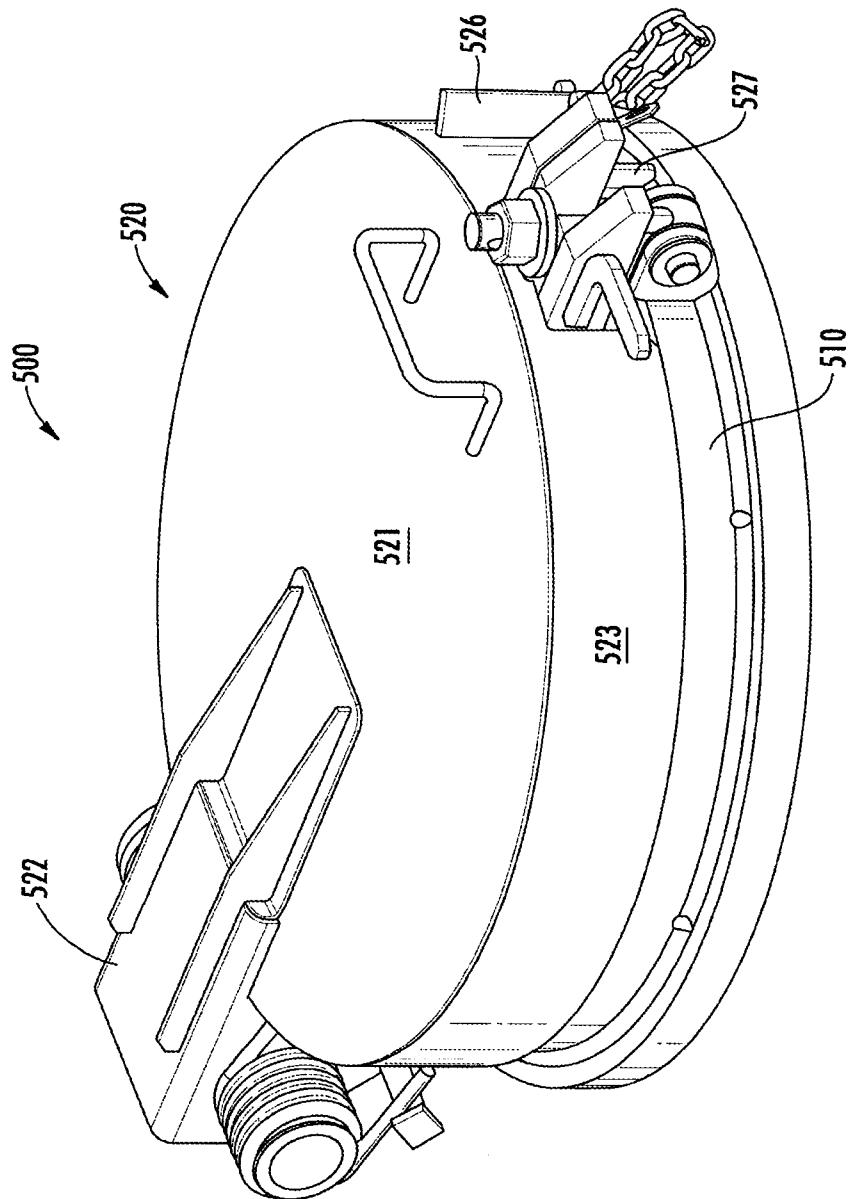


FIG. 22B

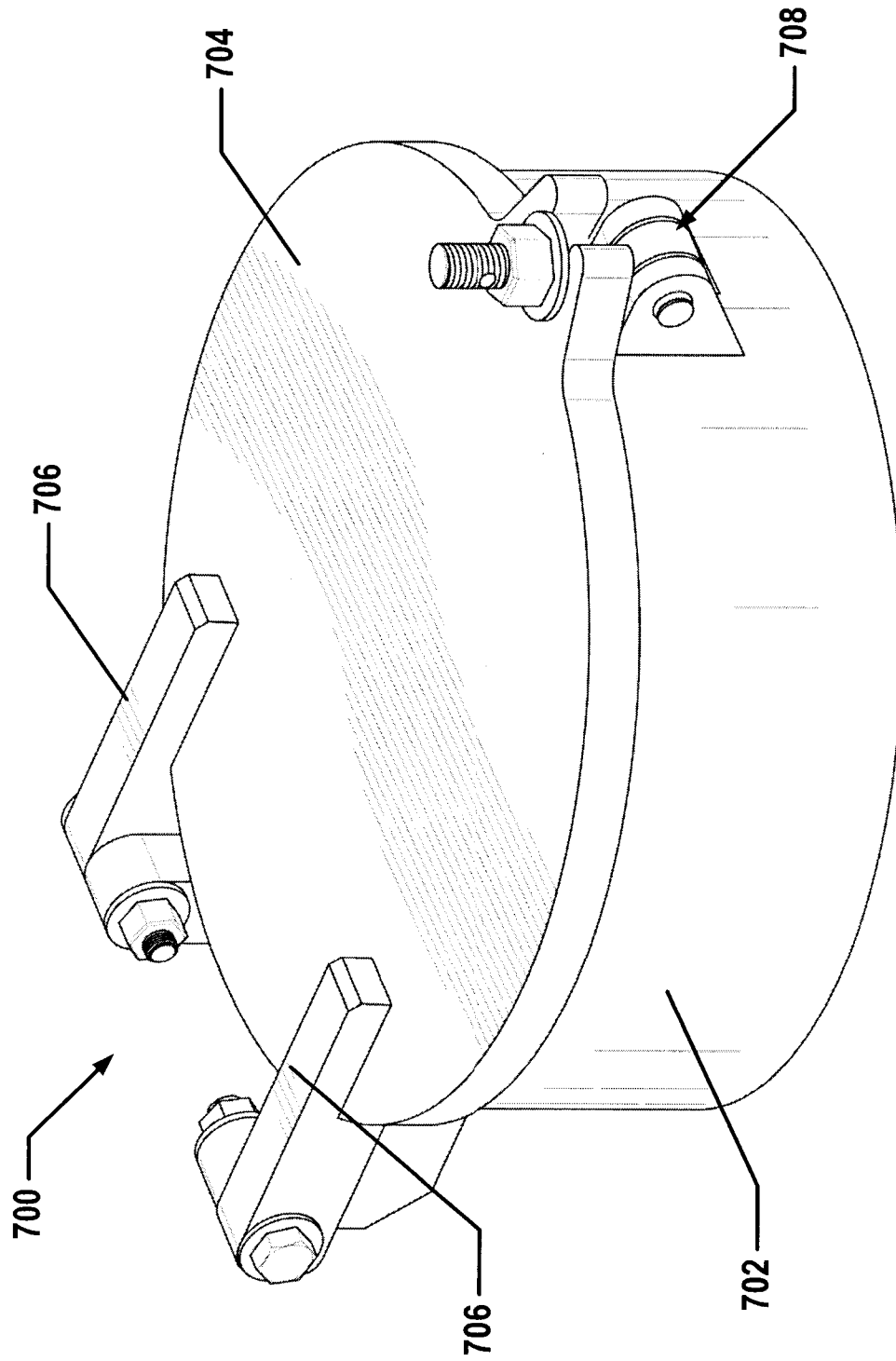


Fig. 24

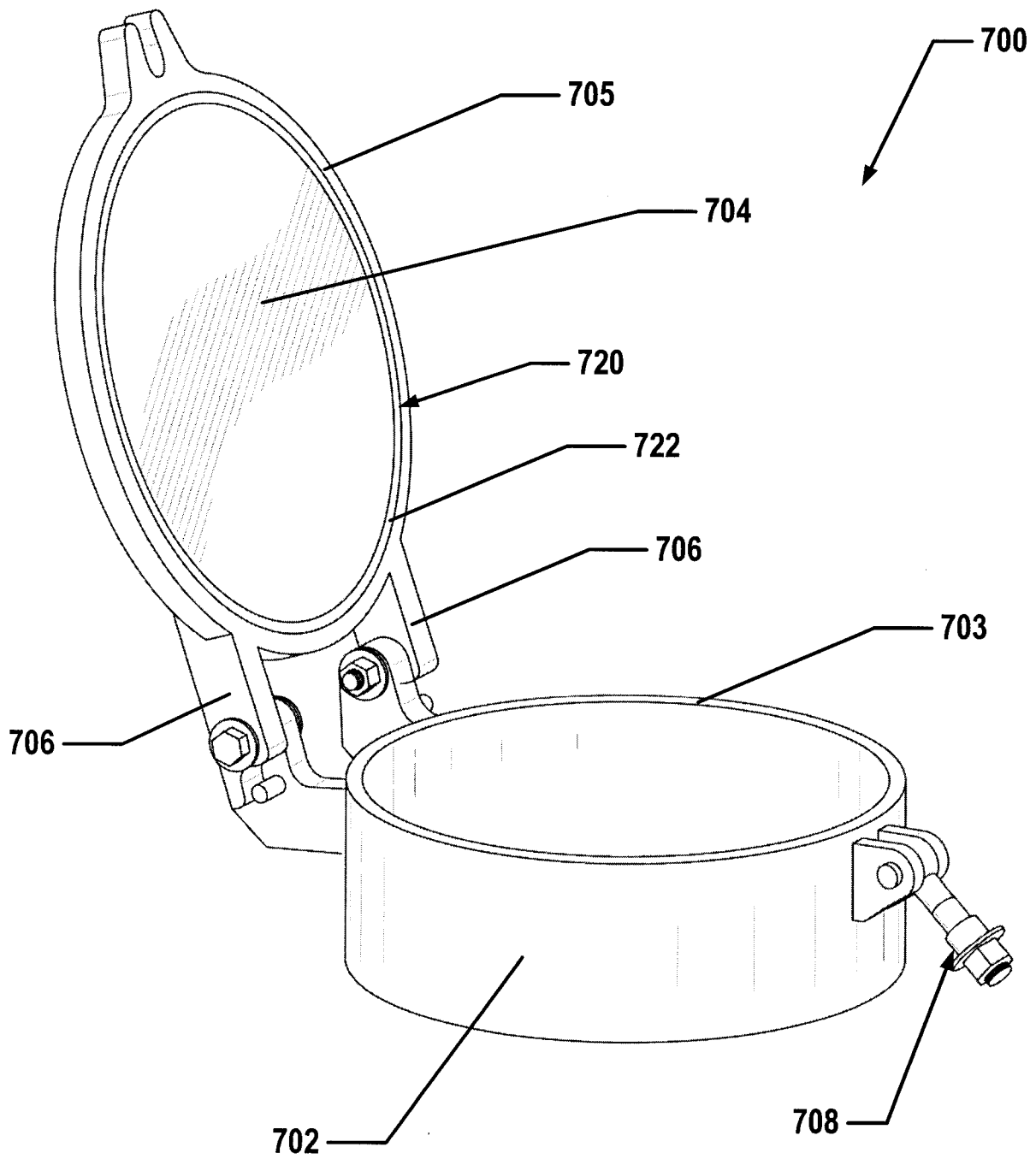


Fig. 25

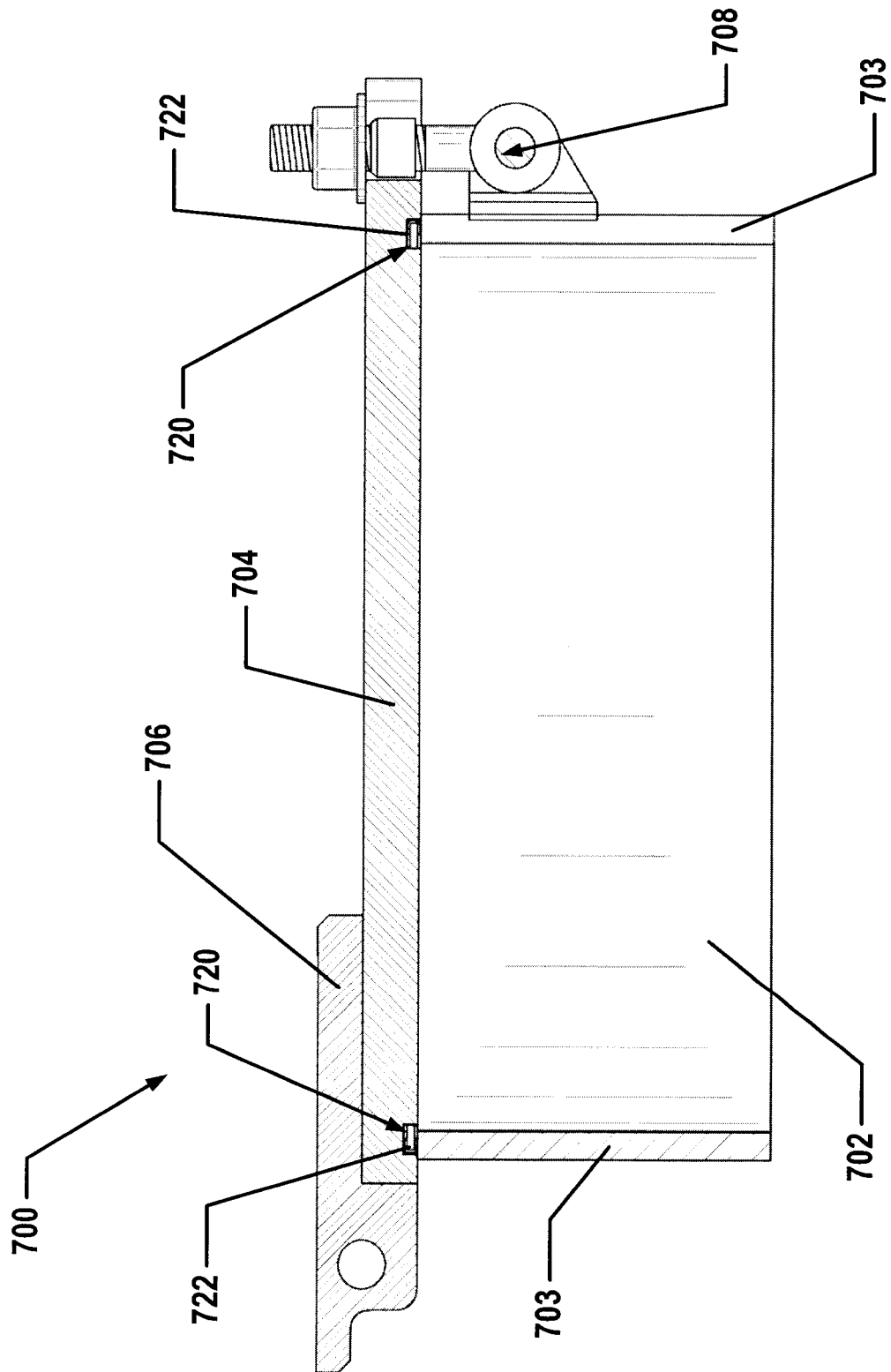


Fig. 26

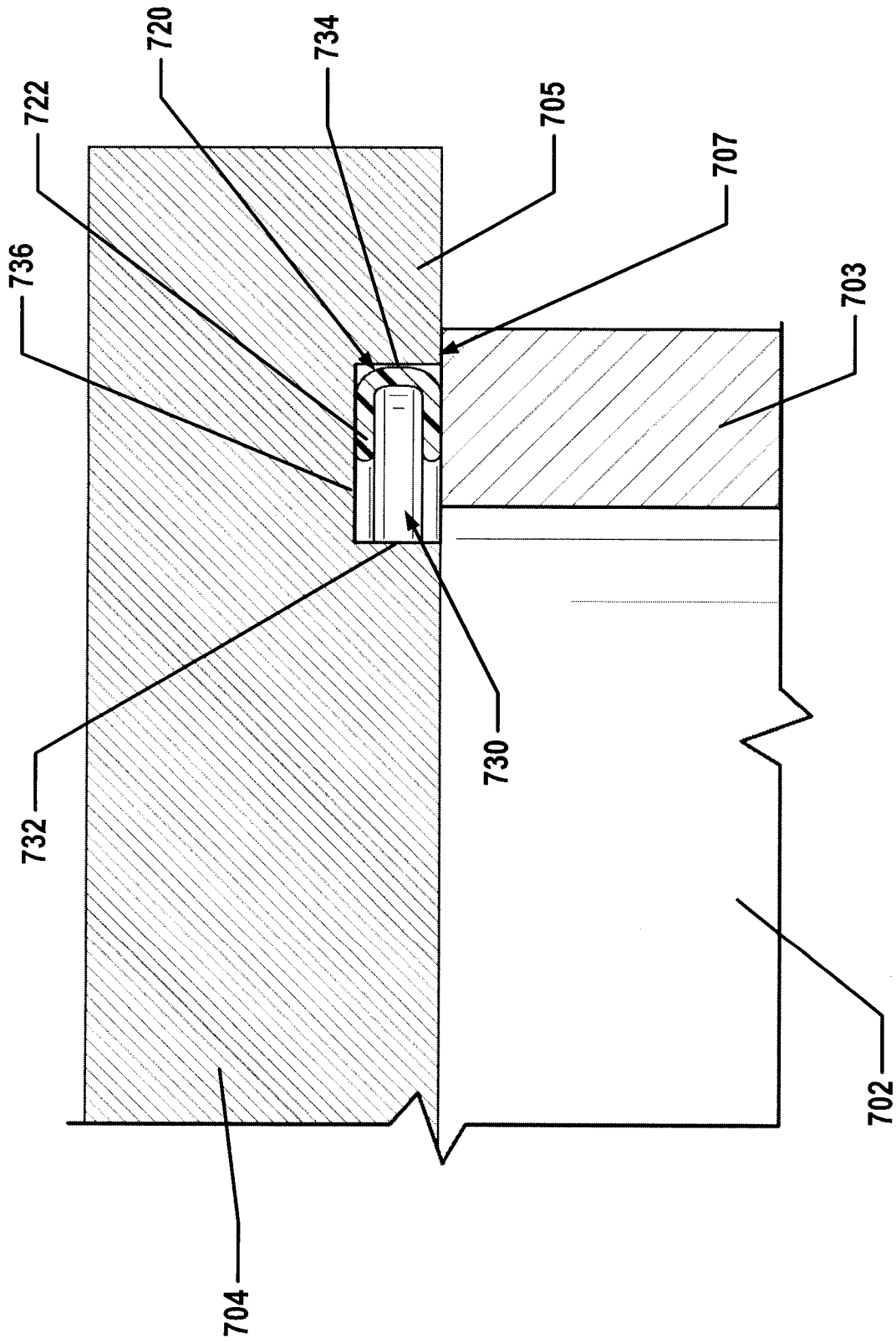


Fig. 27A

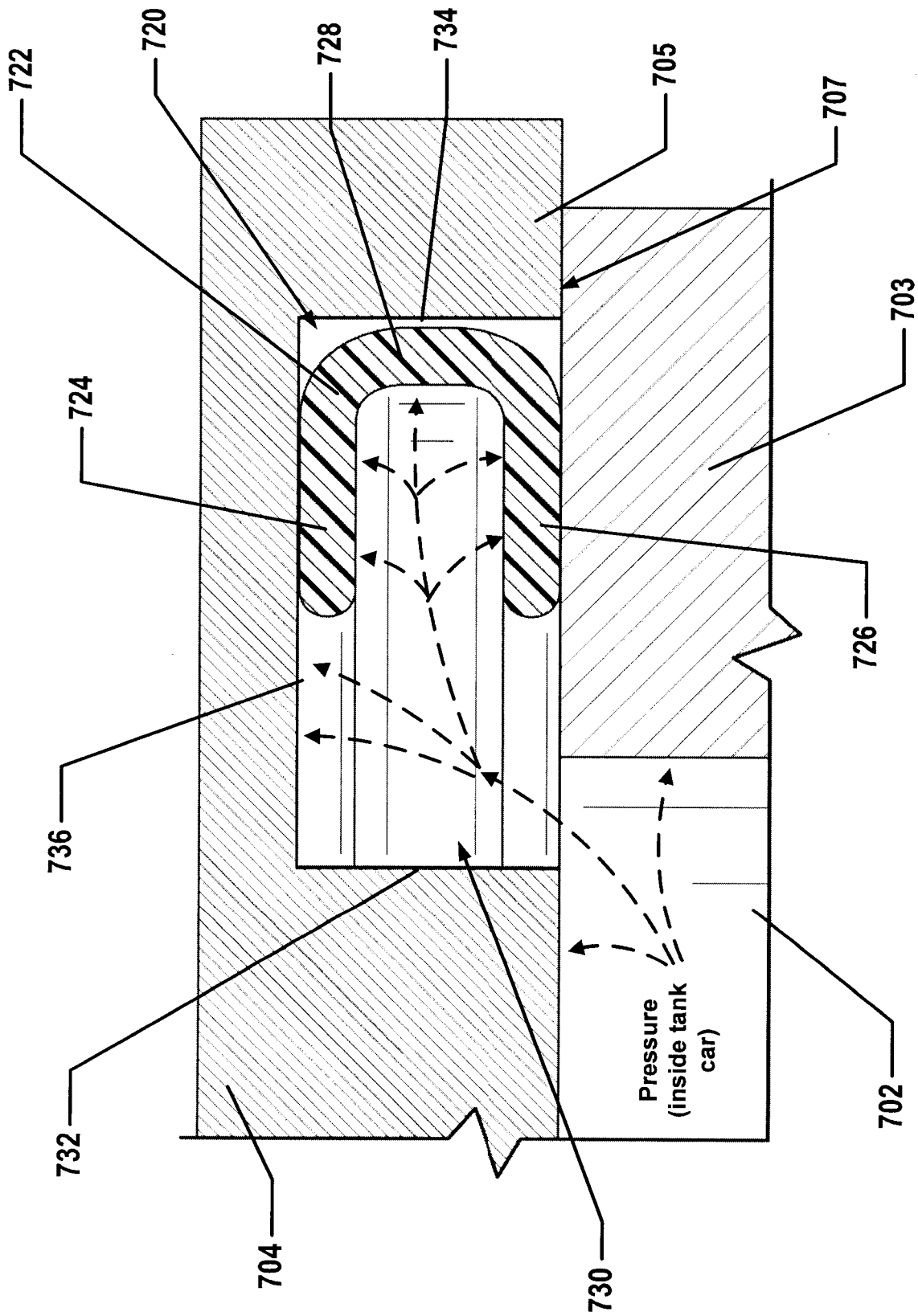


Fig. 27B

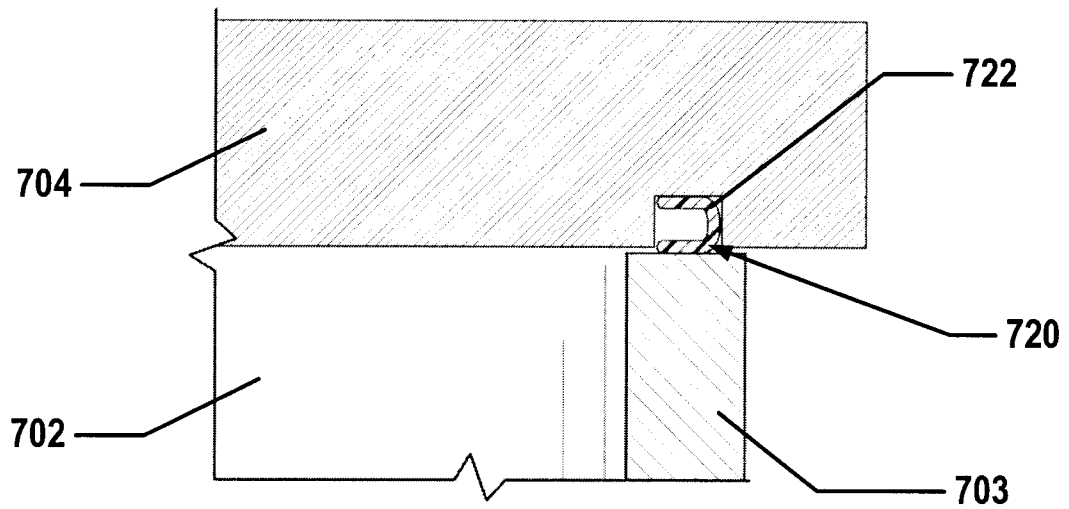


Fig. 28A

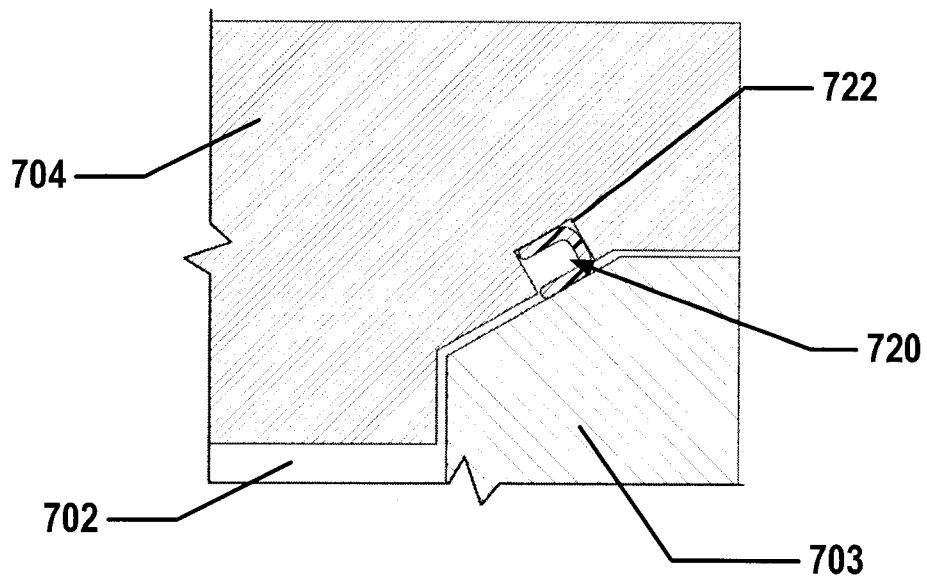


Fig. 28B

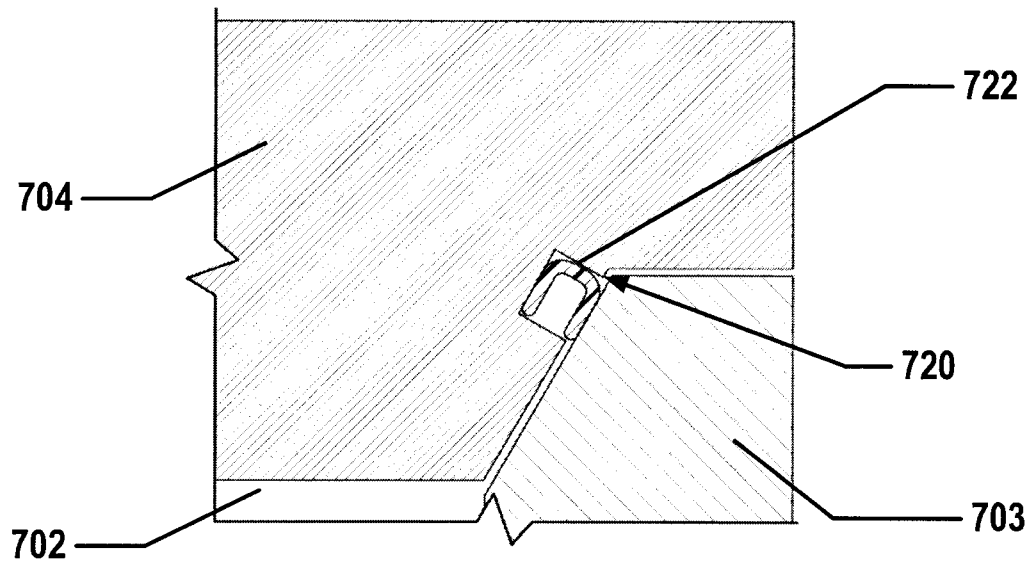


Fig. 28C

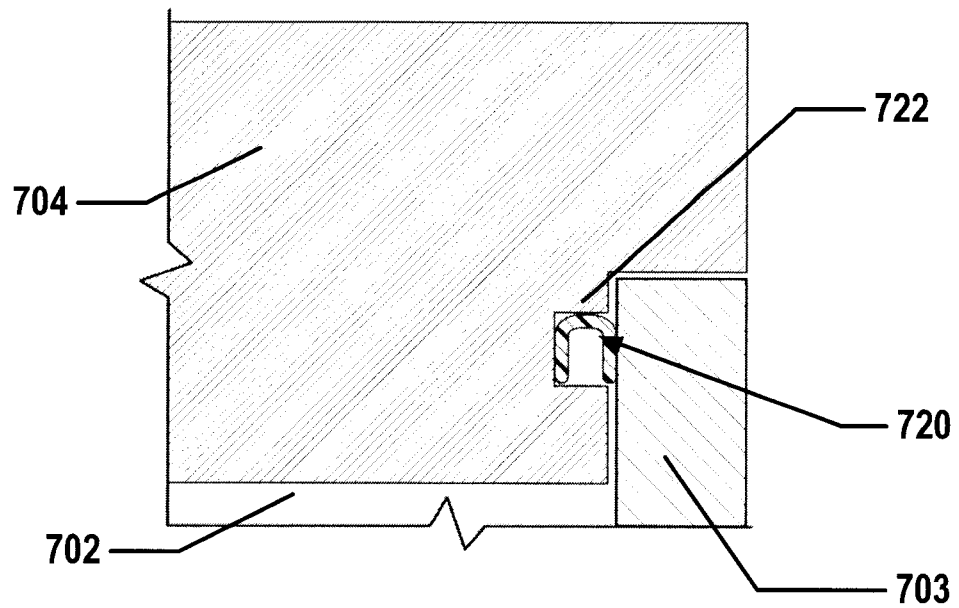


Fig. 28D

