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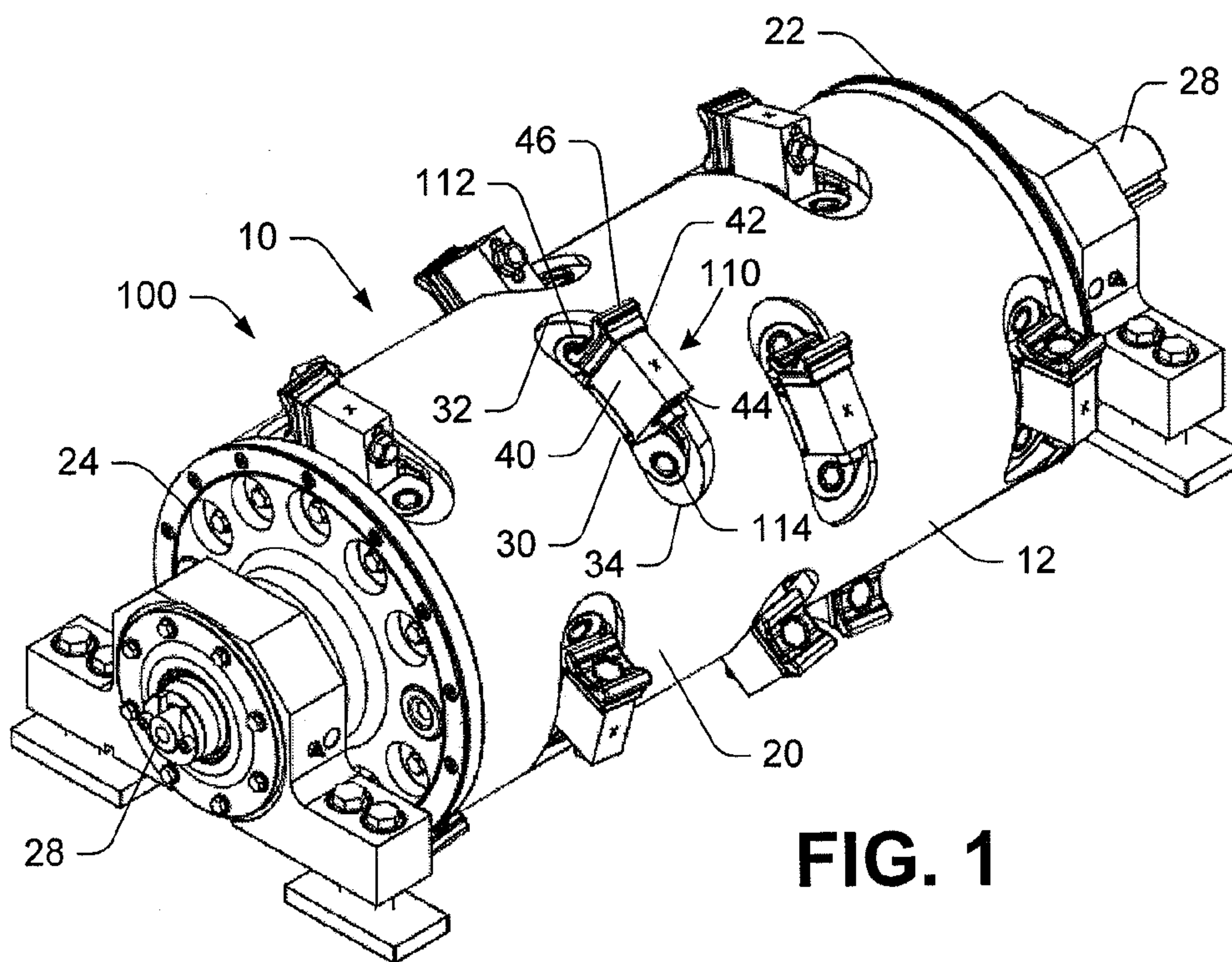


FIG. 1

(57) Abrégé/Abstract:

A hammer support system for a rotary tool has a hammer receiver including a first alignment opening having a first curved alignment surface. A first wedge part has a curved surface, and a second wedge part is configured to interact with the first wedge part. A fastener is provided for drawing down the first wedge part against the second wedge part such that the curved surface of the first wedge part engages the first curved alignment surface to self-align the first and second wedge parts as the first wedge part is drawn down by the fastener.

Abstract

A hammer support system for a rotary tool has a hammer receiver including
5 a first alignment opening having a first curved alignment surface. A first wedge part
has a curved surface, and a second wedge part is configured to interact with the first
wedge part. A fastener is provided for drawing down the first wedge part against the
second wedge part such that the curved surface of the first wedge part engages the
first curved alignment surface to self-align the first and second wedge parts as the
10 first wedge part is drawn down by the fastener.

HAMMER SUPPORT FOR ROTARY TOOL

Cross Reference to Related Applications

5 **[0001]** This application is being filed on 10 September 2014, as a PCT International patent application, and claims priority to U.S. Provisional Application No. 61/875,920, filed September 10, 2013, and U.S. Patent Application No. 14/313,368, filed June 24, 2014, the disclosures of which are hereby incorporated herein by reference.

Background

10 **[0002]** The present disclosure relates generally to rotary tools such as rotary grinders for grinding or shredding material, such as waste material. Waste material such as trees, brush, stumps, pallets, railroad ties, peat moss, paper, wet organic materials and the like are often processed with hammermill machines that generally fall into
15 one of two categories: grinders or shredders. Grinders typically function by forcing the material into contact with a rotating member such as a drum having cutters at the outer diameter. The cutters of grinders travel at a relatively high rate of speed, typically exceeding 5000 feet per minute. Shredders typically function by forcing the material into contact with a rotating drum with cutters at the outer diameter. The
20 cutters of shredders travel at a relatively low rate of speed, typically less than 500 feet per minute.

[0003] In both types of hammermill machines, the cutters are subjected to extreme loads. Although the loading differs, due to the differing speeds, the cutters must be securely attached to the rotating member. Further, the cutters in either machine can
25 experience high rates of wear, particularly if the waste material is abrasive. For this reason the cutters are typically replaceable.

[0004] Improvements in rotary tools are desired.

Summary

[0005] In accordance with aspects of the present disclosure, an example rotary tool
30 has a rotatable member including a receiving aperture with a first side and a second

side. A hammer is positioned in the receiving aperture and has a first side and a second side. A first self-aligning support member is positioned between the first side of the receiving aperture and the first side of the hammer. A second self-aligning support member is positioned between the second side of the receiving aperture and the second side of the hammer.

[0006] In certain embodiments, at least one of the first and second self-aligning support members includes a wedge arrangement for clamping the hammer within the receiving aperture. The wedge arrangement includes a fastener for drawing down a component of the wedge arrangement to clamp the hammer within the receiving aperture. The wedge arrangement also includes a curved interface for self-aligning the wedge arrangement as the component is drawn down by the fastener.

[0007] In some examples the rotary tool further includes a hammer receiver including a first alignment opening, with the first self-aligning support member is received in the first alignment opening. The first alignment opening has a first alignment surface and the first self-aligning support member has a second alignment surface that contact one another. In some implementations, the first and second alignment surfaces are curved.

[0008] In accordance with further aspects of the present disclosure, an example hammer support system has a hammer receiver including a first alignment opening having a first curved alignment surface. A first wedge part has a curved surface, and a second wedge part is configured to interact with the first wedge part. A fastener is provided for drawing down the first wedge part against the second wedge part such that the curved surface of the first wedge part engages the first curved alignment surface to self-align the first and second wedge parts as the first wedge part is drawn down by the fastener.

Brief Description of the Drawings

[0009] Figure 1 is a perspective view illustrating an example of a rotary tool in accordance with aspects of the present disclosure.

[0010] Figure 2 is an end view of the rotary tool shown in Figure 1 with an end cap removed.

[0011] Figure 3 is a side view illustrating an example of a hammer and hammer support system in accordance with aspects of the present disclosure.

[0012] Figure 4 is a section view of the hammer and hammer support system shown in Figure 3.

5 [0013] Figure 5 is a close-up perspective view illustrating portions of the hammer and hammer support system shown in Figures 3 and 4.

[0014] Figure 6 is a section view illustrating portions of the hammer and hammer support system shown in Figures 3-5.

10 [0015] Figure 7 is a top view of an example of a hammer receiver of the hammer support system shown in Figures 3-5.

[0016] Figure 8 is a top view of the hammer receiver of Figure 7, further illustrating examples of a hammer and self-aligning support members received therein.

[0017] Figure 9 is a top view of the self-aligning support members shown in Figure 8.

15 [0018] Figure 10 is a perspective view illustrating examples of some components of a self-aligning support member.

[0019] Figure 11 is a perspective view illustrating further aspects of a self-aligning support member.

20 [0020] Figure 12 is a front view illustrating an example of a nut retainer of the hammer support system shown in Figures 3 and 4.

[0021] Figure 13 is a section view illustrating an example of a fastener of the hammer support system shown in Figures 3 and 4.

25 [0022] Figures 14A-14F conceptually illustrate examples of alternative arrangements for self-aligning support members in accordance with aspects of the present disclosure.

[0023] Figures 15A-15D illustrate an example of rotatable plates including a hammer support system for another example rotary tool in accordance with aspects of the present disclosure.

5 [0024] Figure 16A is a side view conceptually illustrating an example of a rotary tool employing rotatable plates such as those shown in Figures 15A-15D.

[0025] Figure 16B is a top view illustrating examples of selected hammers and hammer support systems shown in Figure 16A.

[0026] Figure 17 is a side view illustrating aspects of another example of a hammer and hammer support system in accordance with the present disclosure.

10 [0027] Figure 18 is a close up view of portions of the hammer and hammer support system shown in Figure 17.

[0028] Figure 19 is a sectional view of an example a hammer receiver in accordance with the hammer support system shown in Figures 17 and 18.

15 [0029] Figure 20 is a perspective view of an example of a bottom plate in accordance with the hammer support system shown in Figures 17-19.

[0030] Figure 21 is a perspective view of an example wedge part in accordance with the hammer support system shown in Figures 17 and 18.

[0031] Figure 22 is a side view illustrating aspects of another example of a hammer and hammer support system in accordance with the present disclosure.

20 [0032] Figure 23 is a perspective view of a self-aligning support member in accordance with the hammer support system shown in Figure 22.

[0033] Figure 24 is a perspective view of another self-aligning support member in accordance with the hammer support system shown in Figure 22.

Detailed Description

25 [0034] In the following Detailed Description, reference is made to the accompanying drawings, which form a part hereof, and in which is shown by way of illustration specific embodiments in which the invention may be practiced. In this

regard, directional terminology, such as top, bottom, front, back, etc., is used with reference to the orientation of the Figure(s) being described. Because components of embodiments can be positioned in a number of different orientations, the directional terminology is used for purposes of illustration and is in no way limiting.

5 It is to be understood that other embodiments may be utilized and structural or logical changes may be made without departing from the scope of the present invention. The following detailed description, therefore, is not to be taken in a limiting sense.

[0035] Figures 1 and 2 illustrate an example of a rotary tool 100, such as a grinder
10 or material reduction machine in accordance with aspects of the present disclosure. The rotary tool 100 includes a rotatable member 10. In the example shown in Figure 1, the rotatable member 10 is a rotary drum 12 that has a generally cylindrical drum skin 20, and first and second end caps 22, 24 positioned at opposite ends of the drum skin 20. Each of the end caps 22, 24 includes a stub shaft 28 (the end cap 22 is not
15 shown in Figure 2). In some examples, the end caps 22,24 are bolted to the end of the drum 20 and bearings are attached to them. In other embodiments, a cylindrical through shaft or a shaft with a non-circular cross-section, such as a hexagon shape is received by the end caps 22,24.

[0036] The drum skin 20 defines a plurality of hammer receiving apertures 30, with
20 a hammer 40 received therein. Each of the receiving apertures 30 has first and second sides 32, 34. The hammer 40 also has a first (leading) side 42 and a second (trailing) side 44. Typical known grinders use rectangular wedging components to hold the hammer in position. However, known wedging arrangements include
25 several surfaces that need to be in alignment, parallel to one another, to satisfactorily wedge the hammer in place. Such surfaces in prior art devices are rarely truly parallel, complicating perfect alignment of the wedge parts and thus the desired secure clamping of the hammer in the hammer receiving apertures.

[0037] In certain disclosed embodiments, a hammer support system 110 is provided that includes a first self-aligning support member 112 positioned between the first
30 side 32 of the receiving aperture 30 and the first side 42 of the hammer 40. A second self-aligning support member 114 is positioned between the second side 34 of the receiving aperture 30 and the second side 44 of the hammer 40.

[0038] In the example shown in Figures 1 and 2, the receiving apertures 30 are arranged in pairs, such that each receiving aperture 30 has a corresponding receiving aperture 30 located on the opposite side of the drum skin 20. The hammer 40 extends through the drum 12 such that opposite ends 40a, 40b of the hammer 40 project from the receiving apertures 30. In the illustrated embodiment, the leading sides 42 of the hammers 40 have a cutter 46 attached thereto.

[0039] Figures 3 and 4 illustrate a hammer support system including one of the hammers 40 removed from the drum 10 shown in Figure 1, and further illustrate an example of the hammer support system 110. The hammer support system 110 includes a hammer receiver 120 that has first and second alignment openings 122, 124. In the illustrated examples, the first alignment opening 122 is positioned on the first 42, or leading side of the hammer 40, and the second alignment opening 124 is positioned on the second 44, or trailing side of the hammer 40. A sleeve 116 is attached to the hammer receiver 120, and the hammer 40 is received in the sleeve 116. As noted above, the embodiment shown in Figure 1 includes hammers 40 that extend through the drum. As shown in Figure 3, one end 116a of the sleeve 116 is connected to one hammer receiver 120 with the first end 40a of the hammer 40 extending therefrom, and the opposite end 116b of the sleeve 116 is connected to another hammer receiver 120 that is situated in a receiving aperture 30 on the opposite side of the drum 12, with the second end 40b of the hammer 40 extending therefrom. Each end 40a, 40b of the hammer 40 has a cutter 46 attached to its leading side 42. In some embodiments, the cutter 46 is attached to the hammer 40 with a bolt 48 and nut 49.

[0040] The first self-aligning support member 112 is received in the first alignment opening 122 and the second self-aligning support member 114 is received in the second alignment opening 124. Figure 5 is a perspective view showing the first end 40a of the hammer 40 extending from the hammer receiver 120. In Figure 5, the hammer receiver 120 is transparent to show the first and second self-aligning support members 112, 114 received therein.

[0041] Figure 7 is a top view of an example of the hammer receiver 120. The first alignment opening 122 of the illustrated hammer receiver 120 has a first alignment surface 126 that is curved. The top view of Figure 8 shows the first and second self-

aligning support members 112,114 situated respectively in the first and second alignment openings 122,124 of the hammer receiver 120, and Figure 9 shows the first and second self-aligning support members 112,114 with the sleeve 116 therebetween.

5 [0042] In some embodiments, the first self-aligning support member 112 includes a first wedge part 130 having a second alignment surface 132 that is curved, and a second wedge part 134 that is configured to interact with the first wedge part 130. Figure 6 is a sectional view showing the hammer 40 and the hammer support system 110 with portions of the hammer receiver 120 removed to better illustrate the first
10 and second wedge parts 130,134, among other things. A fastener 140 draws down the first wedge part 130 against the second wedge part 134 such that the curved surface 132 of the first wedge part 130 engages the first curved alignment surface 126 so as to pivot into alignment relative to one another and thus self-align the first and second wedge parts 130,134 as the first wedge part 130 is drawn down by the
15 fastener 140. Thus, the first alignment surface 126 of the first alignment opening 122 matingly contacts the second alignment surface 132 to self-align the support member 112. The first alignment surface 126 and the second alignment surface 132 may have any curved or arcuate (e.g., semicircular, etc.) profile that allows the two to match/mate and thereby be able to pivotally self-align when drawn into contact
20 with one another

[0043] In some examples, such as that shown in Figures 6 and 10, the curved surface 132 of the first wedge part 130 defines a projection line 150 extending generally parallel with a longitudinal axis of the hammer 40. In other words, the outer surface 132 of the first wedge part 130 extends parallel to the hammer 40 as
25 shown in Figure 6. The first wedge part 130 further includes a planar surface 152 that is angled relative to the projection line 150 of the curved surface 132. In other words, the planar surface 152 does not extend parallel to the projection line 150. The second wedge part 134 has a planar surface 154 that is configured to mate with the planar surface 152 of the first wedge part 130. The second wedge part 134 also
30 has a second side 156 that is configured to mate with the first side 42 of the hammer 40.

[0044] As noted above, the second self-aligning support member 114 is received in the second alignment opening 124 of the hammer receiver 120. A fastener 141 holds the second self-aligning support member 114 in place in the second alignment opening 124. In some examples, the second self-aligning support member 114 has a third alignment surface 160, and the second alignment opening 124 has fourth alignment surface 128 that contacts the third alignment surface 160. In the illustrated example, the third alignment surface 160 of the second self-aligning support member 114 is curved and defines a projection line 170 extending generally parallel with the longitudinal axis of the hammer 40 and the projection line 150 of the curved surface 132. The second self-aligning support member 114 further has a planar surface 162 that extends generally parallel with the projection line 170 of the curved alignment surface 160. This planar surface 162 is configured to mate with the second side 44 of the hammer 40.

[0045] Thus, the fastener 140 is configured to engage the first wedge part 130 to wedge the first wedge part 130 between the curved alignment surface 126 of the first alignment opening 122 and the planar surface 154 of the second wedge part 134, which wedges the second side 156 of the second wedge part 134 against the first side 42 of the hammer 40. This wedges the second side 44 of the hammer 40 against the planar side 162 of the second self-aligning support member 114, which wedges the curved surface 160 of the second self-aligning support member 114 against the curved surface 128 of the second alignment opening 122 to fasten the hammer 40 within the receiving aperture 30.

[0046] In certain embodiments, the fastener 140 that engages the first and second wedge parts 130,134 includes a bolt 142 and a nut 144. The bolt 142 extends through openings 136,138 in the first and second wedge parts 130,134, respectively, as well as through an opening 174 in a bottom plate 172 of the hammer receiver 120 and is threadably received by the nut 144. As best seen in Figure 6 and the bottom perspective view of Figure 11, the opening 138 of the second wedge part 134 through which the bolt 142 extends is elongated. This allows the second wedge part 134 to move laterally (side-to-side as illustrated in Figure 6) as the first and second wedge parts 130,134 engage one another as they are drawn down by the fastener 140

and wedge the hammer 40 between the first and second self-aligning support members 112,114.

[0047] In some embodiments, the curved alignment surfaces 132, 160 of the first and second self-aligning support members 112,114 are radiused such that the first
 5 wedge part 130 and the second self-aligning support member 114 are partially cylindrical. The curved surface 126 of the first alignment opening 122 and the curved surface 132 of the first wedge part are correspondingly shaped, so that when they contact one another the planar surfaces 152,154 of the first and second wedge parts 130,134 are aligned and more fully contact one another. Similarly, when the
 10 curved surface 160 of the second self-aligning support member 114 contacts the curved alignment surface 128 of the second alignment opening 124, the planar surface 162 of the second self-aligning support member 114 aligns with and more fully contacts the planar second side 44 of the hammer 40.

[0048] In certain embodiments, the fasteners 140 and 141 further include nut
 15 retainers 180. Thus, the nut 144 is situated in the nut retainer 180, which engages the bottom plate 172 of the hammer receiver 120 when the bolt 142 is tightened within the nut 144. As shown in Figures 10-13, for example, the nut 144 is T-shaped and is received in a correspondingly shaped opening 182 in the nut retainer 180. In other examples, the nut 144 is not T-shaped (i.e., the nut top and bottom
 20 surfaces are generally parallel to one another) and the opening 182 is a correspondingly sized slot. The opening 182 in the nut retainer 180 extends to a flat side 184 that is situated against the sleeve 116 and welded thereto, which prevents the nut retainer 180, and thus the nut 144 situated therein, from turning as the bolt 142 is turned. Further, since the nut 144 is a loose part, it can easily be replaced if
 25 necessary, such as if the threads of the nut 144 were damaged.

[0049] Figures 14A-14F are simplified top views of the hammer 40, hammer receiver 120, and first and second self-aligning support members 112, 114 situated in the first and second alignment openings 122,124, respectively, conceptually illustrating various arrangements for curved alignment surfaces used in alternative
 30 embodiments. In Figures 14A-14F, the first or leading side 42 of the hammer 40 is on the left as shown in the drawings, and the second or trailing side 44 is on the right.

[0050] Figure 14A illustrates an arrangement essentially as shown in Figure 8 discussed above, with the first and second wedge parts 130,134 of the first self-aligning support member positioned in the first alignment opening 122 such that the curved surface 132 and the curved alignment surface 126 are positioned opposite the planar surface 156 of the second wedge part 134 that contacts the first side 42 of the hammer 40. The planar surface 162 of the second self-aligning support member 114 contacts the planar second side 44 of the hammer 40, with the curved surface 160 contacting the curved alignment surface 128.

[0051] In Figure 14B, the first and second wedge parts 130,134 are configured such that the second wedge part 134 defines the first curved alignment surface 126, which is contacted by the curved surface 132 of the first wedge part 130. Thus, the first wedge part 130 in Figure 14B is reversed from its position shown in Figure 14A, such that the curved surfaces 126, 132 are situated closer to the first side 42 of the hammer 40.

[0052] In the arrangement shown in Figure 14C, the first side 42 of the hammer 40 defines the first curved alignment surface 126. The curved surface 132 of the first wedge part 130 is positioned adjacent the first side 42 of the hammer 40 such that the curved surface 132 contacts the first curved alignment surface 126 defined by the first side 42 of the hammer 40.

[0053] The second self-aligning support member 114 is the same in the examples shown in Figures 14A-14C. In Figure 14D, the first self-aligning support member 112 is as shown in Figure 14A, with the second self-aligning support member 114 configured such that the second curved alignment surface 128 is defined by the second side 44 of the hammer 40, which is contacted by the curved surface 160 of the second self-aligning support member 114.

[0054] Figures 14E and 14F illustrate example arrangements where the second self-aligning support member 114 is as shown in Figure 14D. In Figure 14E, the first self-aligning support member 112 is arranged as shown in Figure 14B, and in Figure 14F, the first self-aligning support member 112 is arranged as shown in Figure 14C.

[0055] Figures 15A-15D illustrate aspects of other embodiments. Referring to Figure 15A, the illustrated rotary tool 100' includes a rotatable member 10 in the form of a rotatable plate or disc 13. A hammer receiving aperture 30 is defined by the disc 13, with a hammer 40 received therein. As with examples disclosed herein
 5 above, a hammer support system 110 is provided that includes a first self-aligning support member 112 positioned between the first side 32 of the receiving aperture 30 and the first side 42 of the hammer 40. A second self-aligning support member 114 is positioned between the second side 34 of the receiving aperture 30 and the second side 44 of the hammer 40.

10 [0056] The hammer support system illustrated in Figures 15A-15D is similar to that shown in Figures 3-13 and described in conjunction therein, though the hammer 40 shown in Figures 15A-15D does not extend through the rotatable member 10. The hammer 40 is received in the receiving aperture 30 and held therein by the hammer support system 110, which includes a hammer receiver 120 that has first and second
 15 alignment openings 122, 124. A sleeve 116 is attached to the hammer receiver 120, and the hammer 40 is received in the sleeve 116. The first self-aligning support member 112 is received in the first alignment opening 122 and the second self-aligning support member 114 is received in the second alignment opening 124. As with the examples disclosed previously, the first self-aligning support member 122
 20 includes a wedge arrangement 130,134 for clamping the hammer 40 within the receiving aperture 30. The wedge arrangement includes a fastener (such as the fastener 140 shown in Figure 13) for drawing down a first component 130 of the wedge arrangement to clamp the hammer 40 within the receiving aperture 30. The wedge arrangement also includes a curved interface 126,132 for self-aligning the
 25 wedge arrangement as the component is drawn down by the fastener 140.

[0057] Figures 15B-15D illustrate further examples respectively having two, three and four hammers 40 and hammer support systems 110 received by the plate or disc 13. Figure 16 conceptually illustrates an example rotary tool 10' employing the rotatable plates 13, which are stacked onto a central shaft 28 that extends through a
 30 central opening 190 in each of the plates 13 in a spaced-apart manner. In some embodiments, a retention pin 192 passes through a retention opening 194 (see Figure 15C, for example) in each hammer 40 as a means of redundant retention. For

simplicity of illustration, only three of the plates 13 are shown having a hammer 40 and cutter 46 attached thereto. The hammers 40 and associated hammer retention systems 110 could be in any of many configurations, such as any of the configurations shown in Figures 15A-15D.

5 [0058] Figure 16A further illustrates examples of two hammer arrangements 40-1 and 40-2, in which the hammers 40-1, 40-2 are off-set relative to the plate 13. The hammer 40-1 is off-set to the left of the corresponding plate 13 and the hammer 40-2 is off-set to the right of the corresponding plate 13 as illustrated in Figure 16A. Figure 16B is a top view of the example hammers 40, 40-1, 40-2 shown in Figure
10 16A. As disclosed herein above, the hammers 40, 40-1, 40-2 are held in the receiving apertures 30 by corresponding hammer retention systems 110, 110-1, 110-2. The modified hammer retention systems 110-1, 110-2 shown in Figure 16B include the wedge arrangement having the curved alignment surfaces described herein, and are further configured such that the first and second self-aligning support
15 members 112, 114 include extended portions 198 to receive the hammers 40-1, 40-2 in an off-set manner.

[0059] Figures 17-21 illustrate various aspects of an example of an alternative hammer support system 110a, in which self-aligning support members 112a, 114a are situated at an angle relative to the longitudinal axis of the hammer 40. In the
20 example shown in Figures 17-21, the first and second self-aligning support members 112a, 114a situated on the first and second sides 42, 44 of the hammer 40 have the same structure. Each of the first and second self-aligning support members 112a, 114a include a single wedge part 130a that is received in respective alignment openings 122a, 124a in a hammer receiver 120a.

25 [0060] As with earlier-disclosed examples, the first alignment opening 122a has a curved alignment surface 126a and the second alignment opening 124a has a curved alignment surface 128a. In the example shown in Figure 19, the curved alignment surfaces 126a, 126b are angled relative to the longitudinal axis of the hammer 40, which is represented by a vertical dashed line 210 extending vertically in Figure 19.
30 The angle of the alignment surfaces 126a, 126b is indicated by a dashed line 212 that extends at an angle as compared to the line 210. In other words, the alignment surfaces 126a, 126b are not parallel to the axis of the hammer 40.

[0061] The first and second self-aligning support members 112a, 114a each include a first wedge part 130a that has a curved surface 132a and a planar surface 152a opposite the curved surface 132a that is configured to mate with sides of the hammer 40. As best shown in Figures 18 and 21, the curved surface 132a of the first wedge part 130a and the planar surface 152a are not parallel to one another. As shown in Figure 18, the planar surface 152 is configured to mate with the side of the hammer 40. Each of the wedge parts 130a of the first and second self-aligning support members 112a, 114a defines a projection line 150a that is angled relative to the planar surface 152a. The angle of the projection line 150a relative to vertical is about the same as the angle of the curved alignment surfaces 126a, 128a as indicated by the line 212.

[0062] Figure 20 shows an example bottom plate 172a of the hammer receiver 120a. In the examples shown in Figures 3-7, the bottom plate 172 of the hammer receiver 120 has a generally planar top surface. The bottom plate 172 shown in Figure 20 includes tabs 220 that extend upwardly from the bottom plate 172 to form a surface situated at approximately a right angle relative to the projection line 212 and generally parallel with a bottom surface 222 of the wedge part 130a.

[0063] Figure 17 illustrates the hammer support system 110a with the hammer receiver 120 removed in the upper portion of the drawing to show the position of the wedge parts 130a of the first and second self-aligning hammer supports. The hammer support system 110a shown in the lower part of Figure 17 is identical to that illustrated at the upper part of the drawing. Referring to the first self-aligning support member 112a shown on the left side of the upper portion of Figure 17, the wedge part 130a is inserted into the alignment opening 122a of the hammer receiver 120a such that planar surface 152a thereof is situated against the first side 42 of the hammer 40. A fastener 140 including a bolt 142 threadably received in a nut 142 is tightened to draw the wedge part 130 of the first self-aligning support member 112a down against one of the tabs 220 of the bottom plate 172a. The curved surface 126a of the first alignment opening 122a and the curved surface 132a of the first self-aligning support member 112a contact one another to self-align the wedge part 130a. Note that the bolt 142 is angled relative to the axis of the hammer 40, such that the bolt extends generally parallel to the projection lines 212 and 150a. As with earlier-

disclosed examples, the nut 144 may be received in a nut retainer 180 fasted to the sleeve 116. The nut retainer is not shown in Figures 17-21 for clarity.

[0064] The wedge part 130a of the second self-aligning support member 114a is then situated in the second alignment opening 124a such that the planar surface 152a thereof contacts the second side 44 of the hammer 40, and the curved surface 132a contacts the curved alignment surface 128a of the second alignment opening 124a. The hammer receiver 120a is sized such that when the wedge part 130a of the second self-aligning support member 114a is received in the second alignment opening 124a, the wedge part 130a does not extend to all the way to the tab 220 below the second alignment opening 124a. As the fastener 140 of the second self-aligning member 114a is tightened, the wedge part 130a is drawn downward so that the wedge part 130a is wedged between the side 44 of the hammer 40 and the second alignment surface 128a, pushing the first side 42 of the hammer tighter against the wedge part 130a of the first self-aligning support member 112a. In the example shown in Figures 17-21, the hammer receiver 120a is sized such that, even when tightened, the fastener 140 for the second self-aligning support member 114a does not draw the wedge part 130a thereof against the bottom plate 172, as shown in Figures 17 and 18.

[0065] Figures 22-24 illustrate an example of another hammer support system 110b in which self-aligning support members include planar surfaces that mate with sides of the hammer 40, and curved alignment surfaces that extend at an angle to (i.e. not parallel to) the planar surfaces. Similarly to the example shown in 17-21, the hammer support system 110b shown in Figures 22-24 has self-aligning support members 112b, 114b that are situated at an angle relative to the longitudinal axis of the hammer 40. In the system 110b, however, the first and second self-aligning support members 112b, 114b situated on the first and second sides 42, 44 of the hammer 40, respectively, have different structures.

[0066] The first and second self-aligning support members 112b, 114b are received in respective alignment openings 122b, 124b in a hammer receiver 120b. The hammer receiver 120b is configured similarly to the hammer receiver 120a shown in Figure 19, and the bottom plate 172b of the hammer receiver 120b is also similar to

the bottom plate 172a shown in Figure 20. These items are therefore not discussed in detail regarding the hammer retention system 110b.

[0067] Referring to Figure 23, the first self-aligning support member 112b includes a first wedge part 130b having a curved surface 132b defining a projection line 150b, and a planar surface 152b that is angled relative to the projection line 150b of the curved surface 132b. The first self-aligning support member 112b further includes a second wedge part 134b with a planar surface 154b that is configured to mate with the planar surface 152b of the first wedge part 130b. The second wedge part 134b further includes a second side 156b that mates with the first side 42 of the hammer 40. As best shown in Figure 22, the projection line 150b is angled, or not parallel to, the vertical longitudinal axis of the hammer 40.

[0068] An example of the second self-aligning support member 114b is illustrated in Figure 24. The second self-aligning support member 114b has a planar surface 162b configured to mate with the second side 44 of the hammer 40. Opposite the planar surface 162b is a curved alignment surface 160b that is configured to contact the second curved alignment surface of the hammer receiver 120b. The curved alignment surface 160b defines a projection line 170b that, as best shown in Figure 22, is angled (not parallel to) the longitudinal axis of the hammer 40. In other words, the projection line 170b is not parallel to the planar surface 162b of the second self-aligning support member 114b. As with the earlier-disclosed embodiments, the curved surfaces 132b and 160b contact the respective curved alignment surfaces of the hammer receiver 120b to pivot relative to one another and thereby self-align the first and second self-aligning support members 112b, 114b as the respective fasteners 140 are tightened.

[0069] Various modifications and alterations of this disclosure may become apparent to those skilled in the art without departing from the scope and spirit of this disclosure, and it should be understood that the scope of this disclosure is not to be unduly limited to the illustrative examples set forth herein.

What is claimed is:

1. A rotary tool, comprising:
a rotatable member including a receiving aperture having a first side and a
second side;
5 a hammer positioned in the receiving aperture having a first side and a
second side;
a first self-aligning support member positioned between the first side of the
receiving aperture and the first side of the hammer; and
a second self-aligning support member positioned between the second side of
10 the receiving aperture and the second side of the hammer.
2. The rotary tool of claim 1, further comprising:
a hammer receiver including a first alignment opening;
wherein the first self-aligning support member is received in the first
alignment opening.
- 15 3. The rotary tool of claim 2, wherein:
the first alignment opening has a first curved alignment surface;
the first self-aligning support member has a second curved alignment
surface; and
the first and second alignment surfaces matingly contact one another.
- 20 4. The rotary tool of claim 3, wherein the first alignment surface is
situated between the first self-aligning support member and the hammer.
5. The rotary tool of claim 2, wherein:
the first alignment opening has a first alignment surface;
the first side of the hammer has a second alignment surface; and
25 the first and second alignment surfaces contact one another.
6. The rotary tool of claim 2, wherein:
the first alignment opening has a curved alignment surface;

the first self-aligning support member includes a first wedge part having a curved surface defining a projection line, and a planar surface that is angled relative to the projection line of the curved surface, and a second wedge part having a planar surface configured to mate with the planar surface of the first wedge part and a second side configured to mate with the first side of the hammer; and the curved surface of the first alignment opening and the curved surface of the first self-aligning support member pivot into alignment relative to each other when brought into contact one another.

10 7. The rotary tool of claim 6, wherein:
the projection line extends generally parallel with a longitudinal axis of the hammer.

8. The rotary tool of claim 2, wherein:
the first alignment opening has a curved alignment surface;
15 the first self-aligning support member includes a first wedge part having a curved surface defining a projection line, and a planar surface opposite the curved surface configured to mate with the first side of the hammer; and
the curved surface of the first alignment opening and the curved surface of
20 the first self-aligning support member pivot into alignment relative to each other when brought into contact with one another.

9. The rotary tool of claim 3, wherein:
the second self-aligning support member is positioned between the second side of the receiving aperture and the second side of the hammer, the
25 second self-aligning support member having a third alignment surface;
the hammer receiver includes a second alignment opening having a fourth alignment surface;
the second self-aligning support member being received in the second
30 alignment opening; and
the third and fourth alignment surfaces contact one another.

10. The rotary tool of claim 9, wherein:

the first and second alignment openings each have a curved alignment surface;

the first self-aligning support member includes a first wedge part having a

5 curved surface defining a projection line extending generally parallel with a longitudinal axis of the hammer and a planar surface that is angled relative to the projection line of the curved surface, and a second wedge part having a planar surface configured to mate with the planar surface of the first wedge part and a second side

10 configured to mate with the first side of the hammer;

the second self-aligning support member includes a curved surface defining a

projection line extending generally parallel with the longitudinal axis of the hammer and a planar surface extending generally parallel with the projection line of the curved surface, the planar surface of the

15 second self-aligning support member being configured to mate with the second side of the hammer;

the curved surface of the first alignment opening and the curved surface of the first self-aligning support member contact one another; and

the curved surface of the second alignment opening and the curved surface of the second self-aligning support member contact one another.

20

11. The rotary tool of claim 10, further comprising:

a fastener configured to engage the first wedge part to wedge the first wedge part between the curved alignment surface of the first alignment

opening and the planar surface of the second wedge part, which

25 wedges the second side of the second wedge part against the first side of the hammer, which wedges the second side of the hammer against the planar side of the second self-aligning support member, which

wedges the curved surface of the second self-aligning support

member against the curved surface of the second alignment opening.

30 12. The rotary tool of claim 11, wherein the fastener includes:

a bolt extending through openings in the first and second wedge parts,
 wherein the bolt defines an axis extending generally parallel to a
 longitudinal axis of the hammer.

13. The rotary tool of claim 1, wherein the rotatable member is a drum
 5 configured to rotate about an axis.

14. The rotary tool of claim 1, wherein the rotatable member is a plate
 configured to rotate about an axis.

15. The rotary tool of claim 1, further comprising a cutter attached to the
 hammer.

10 16. The rotary tool of claim 1, wherein at least one of the first and second
 self-aligning support members includes a wedge arrangement for clamping the
 hammer within the receiving aperture, the wedge arrangement including a fastener
 for drawing down a component of the wedge arrangement to clamp the hammer
 within the receiving aperture, the wedge arrangement also including a curved
 15 interface for self-aligning the wedge arrangement as the component is drawn down
 by the fastener.

17. A hammer support system, comprising:
 a hammer receiver including a first alignment opening having a first curved
 alignment surface;
 20 a first wedge part having a curved surface;
 a second wedge part configured to interact with the first wedge part; and
 a fastener for drawing down the first wedge part against the second wedge
 part such that the curved surface of the first wedge part engages the
 first curved alignment surface to self-align the first and second wedge
 25 parts as the first wedge part is drawn down by the fastener.

18. The hammer support system of claim 17, wherein:
 the curved surfaced of the first wedge part defines a projection line;

the first wedge part includes a planar surface that is angled relative to the projection line;

the second wedge part includes a planar surface configured to mate with the planar surface of the first wedge part.

5 19. The hammer support system of claim 17, further comprising a second self-aligning support member, which includes:

a curved surface defining a projection line extending generally parallel with a longitudinal axis of the hammer;

10 a planar surface extending generally parallel with the projection line of the curved surface,

the planar surface of the second self-aligning support member being configured to mate with the second side of the hammer; and

the curved surface of the second alignment opening and the curved surface of the second self-aligning support member contact one another.

15 20. A method of fastening a hammer in a rotary tool, comprising:

providing a hammer receiver including a first alignment opening having a first curved alignment surface;

situating a hammer in the hammer receiver;

20 tightening a fastener so as to draw down a first wedge part against a second wedge part such that a curved surface of the first wedge part engages the first curved alignment surface to self-align the first and second wedge parts as the first wedge part is drawn down, and such that a second side of the second wedge part mates with a first side of the hammer to fasten the hammer in the hammer receiver.

25

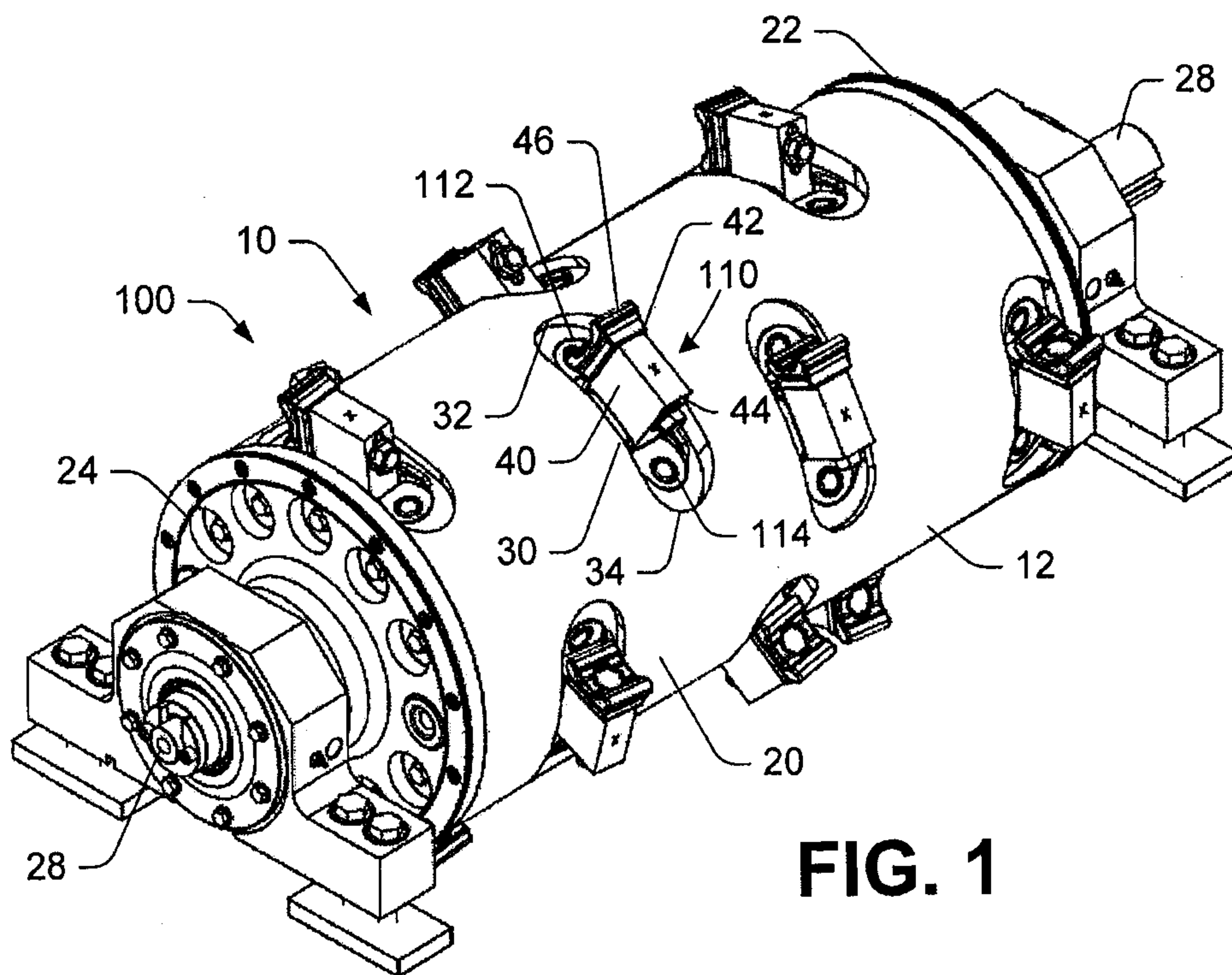


FIG. 1

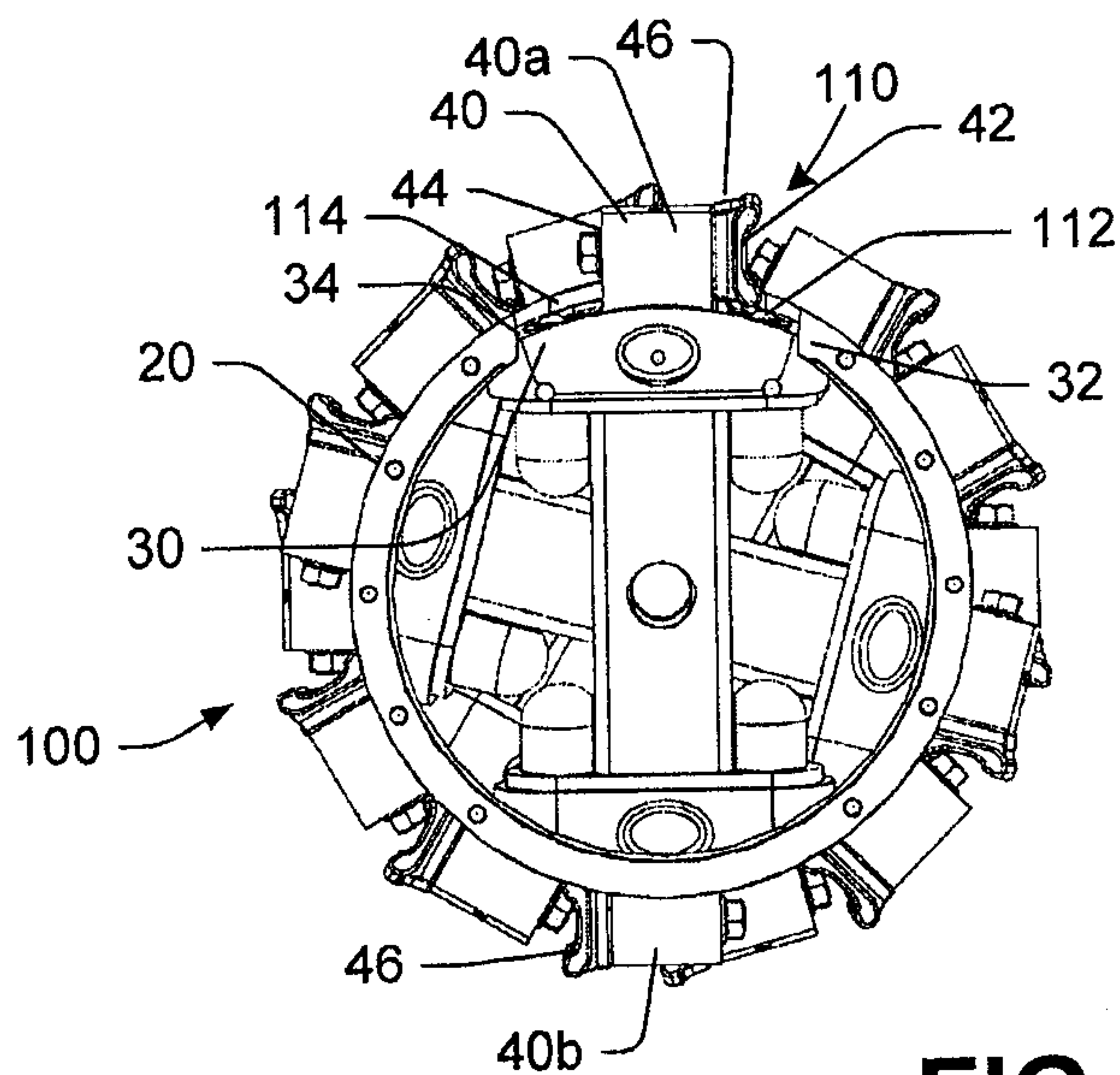
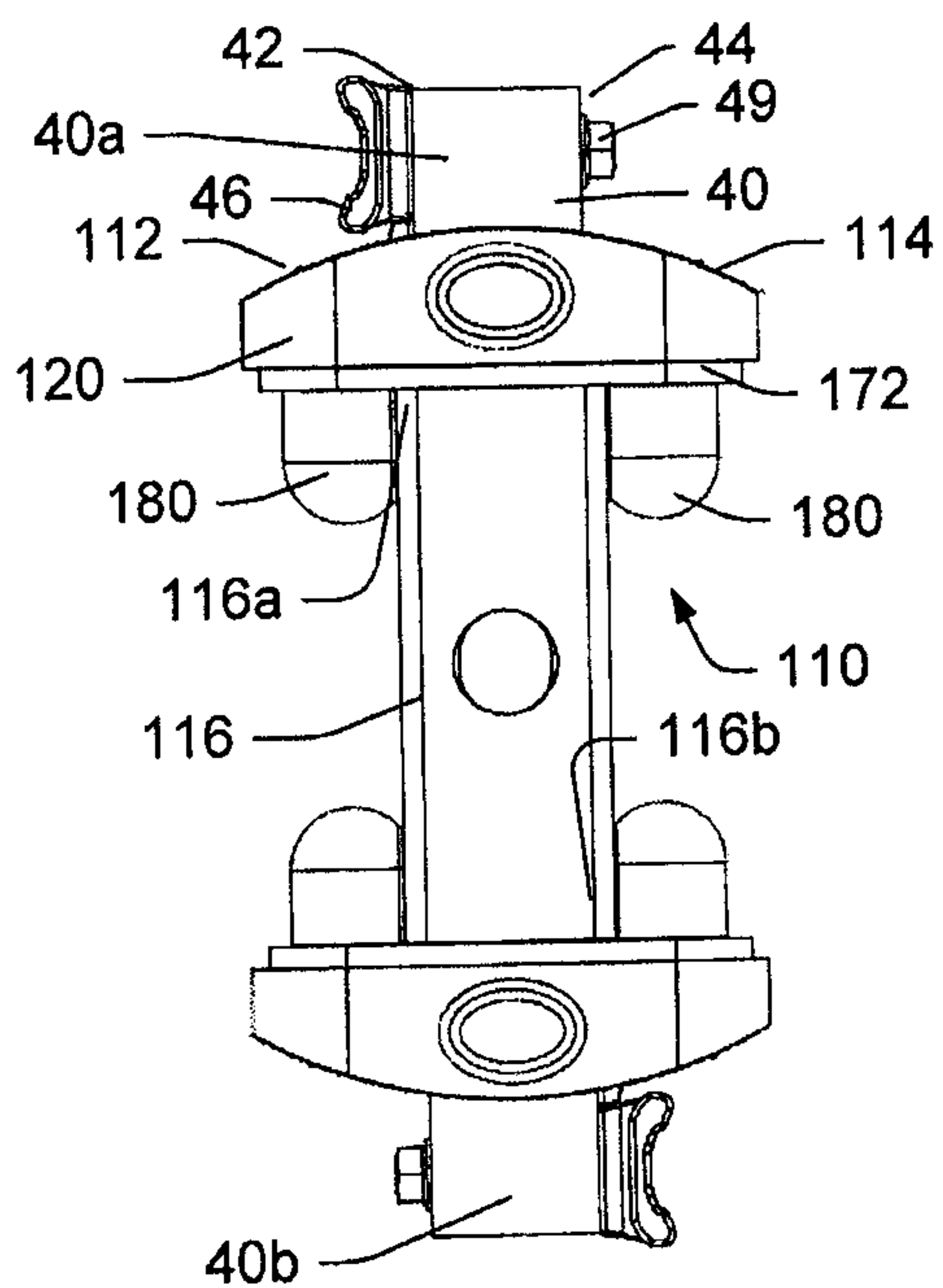
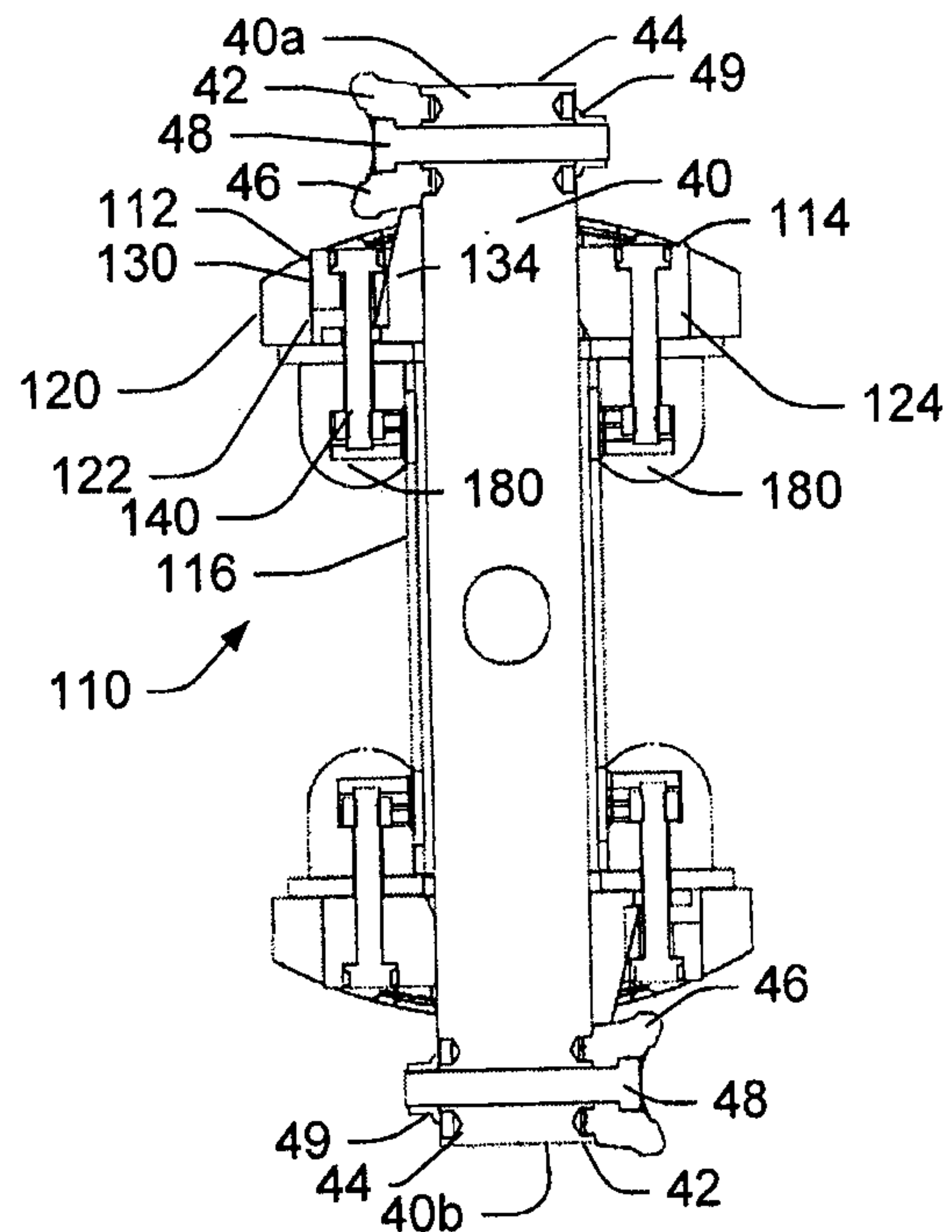
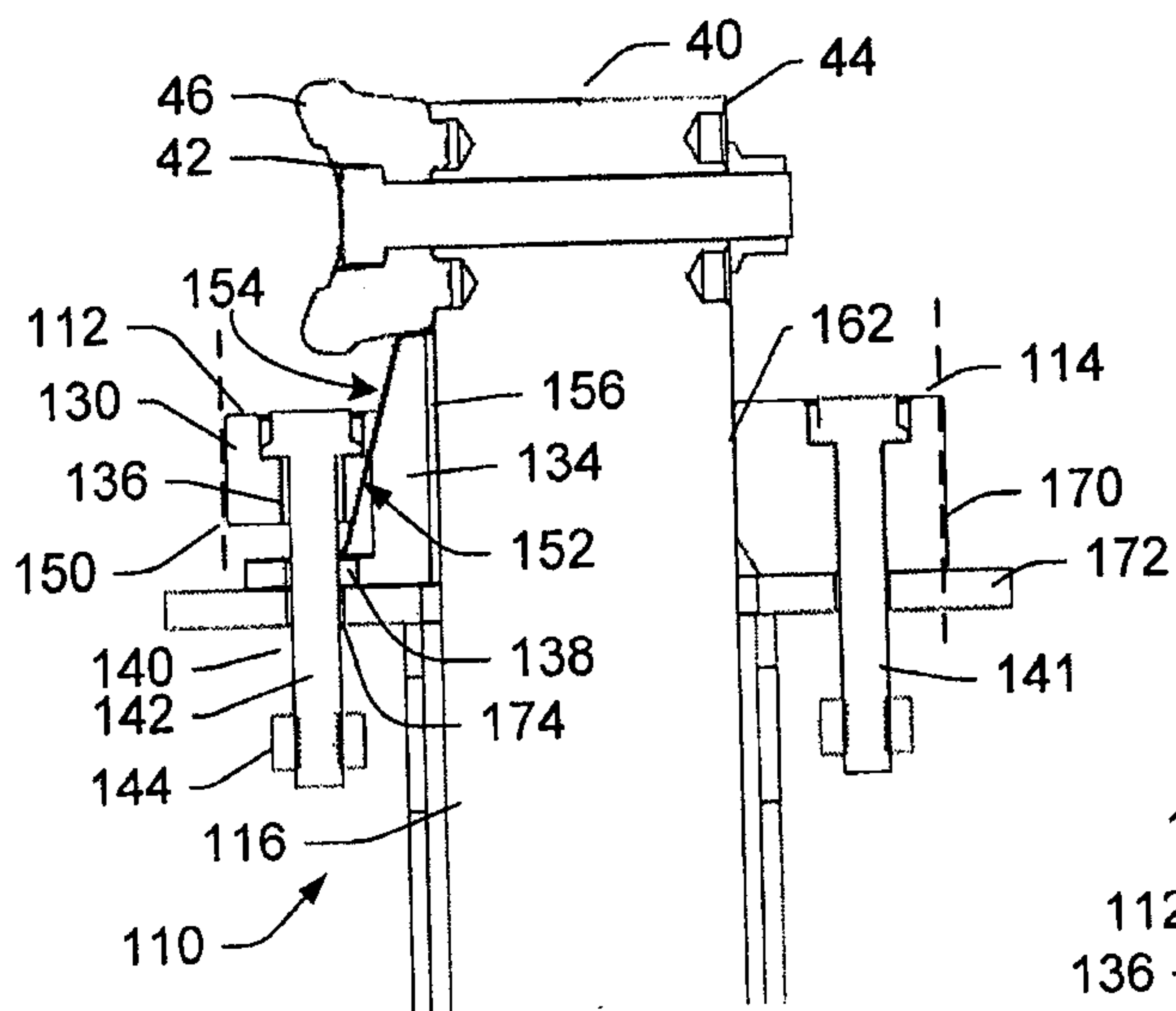
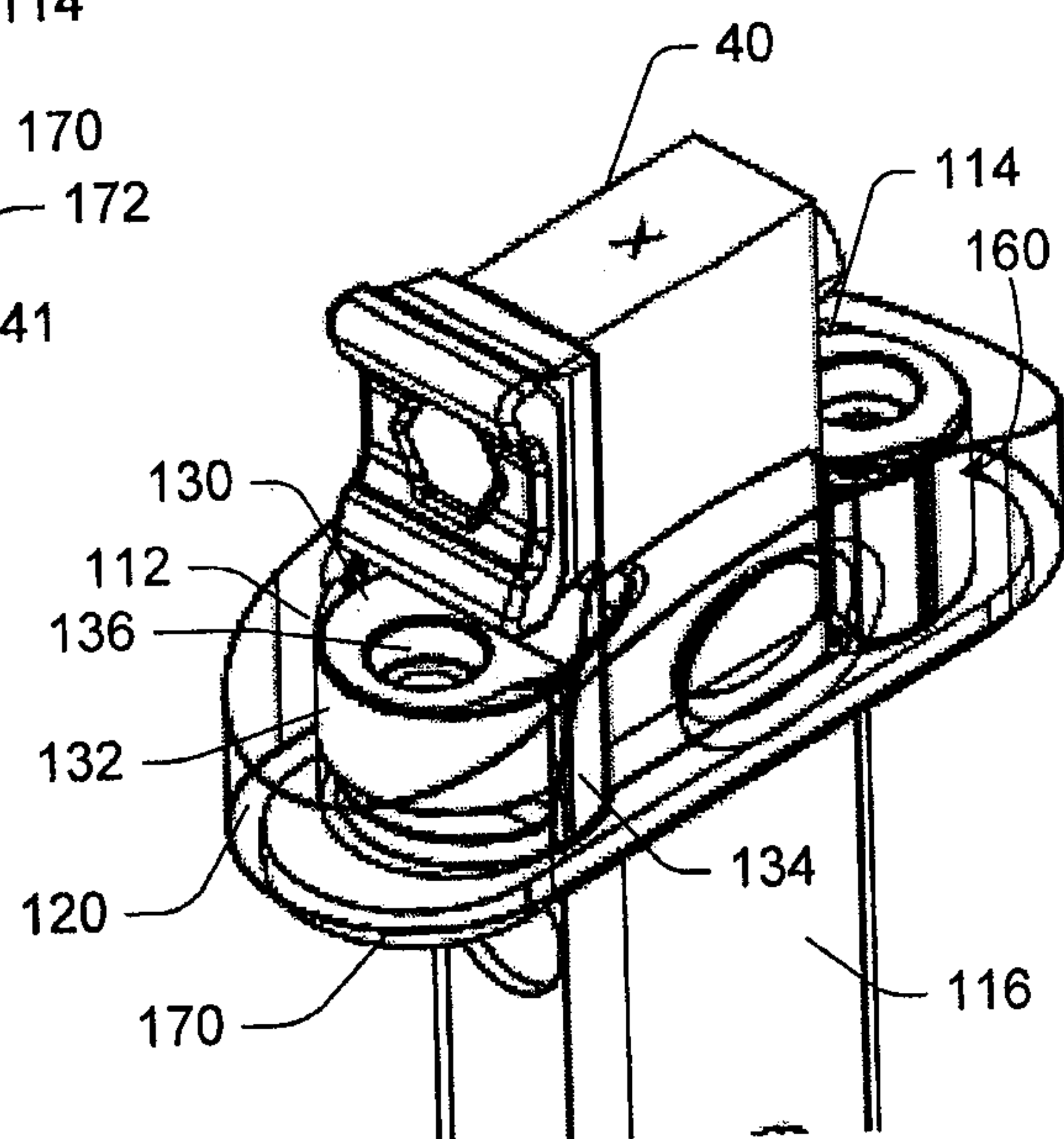


FIG. 2

**FIG. 3****FIG. 4****FIG. 6****FIG. 5**

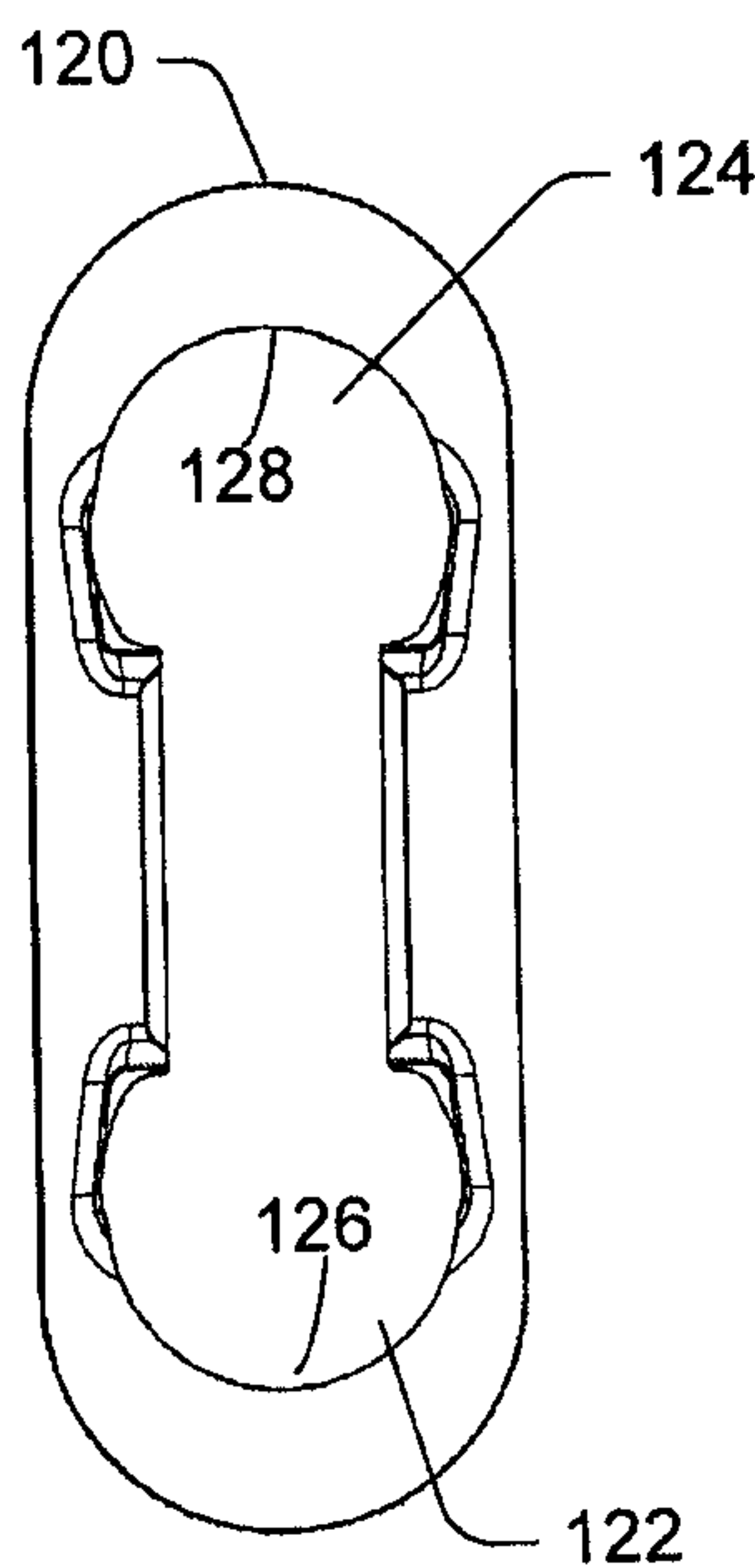


FIG. 7

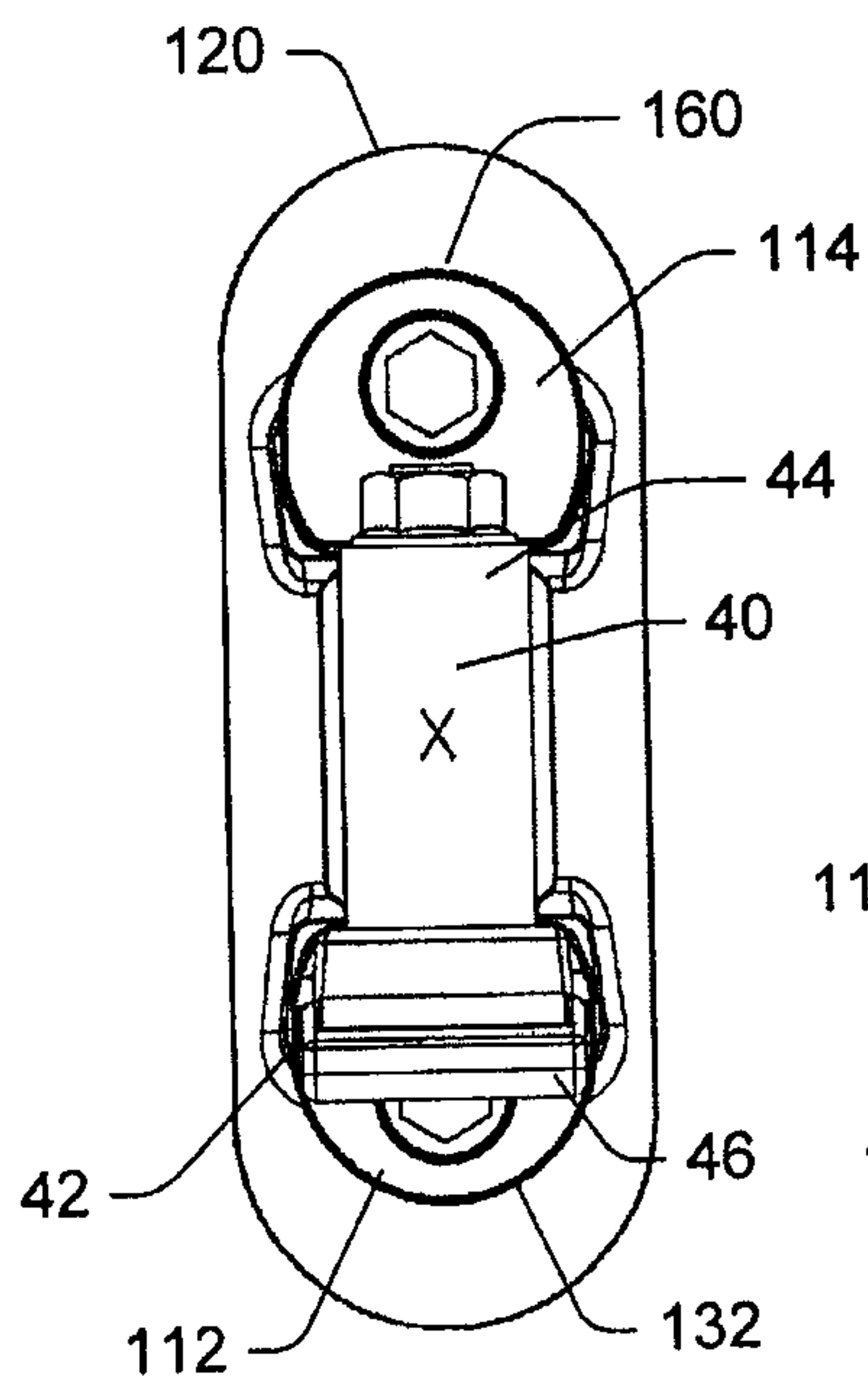


FIG. 8

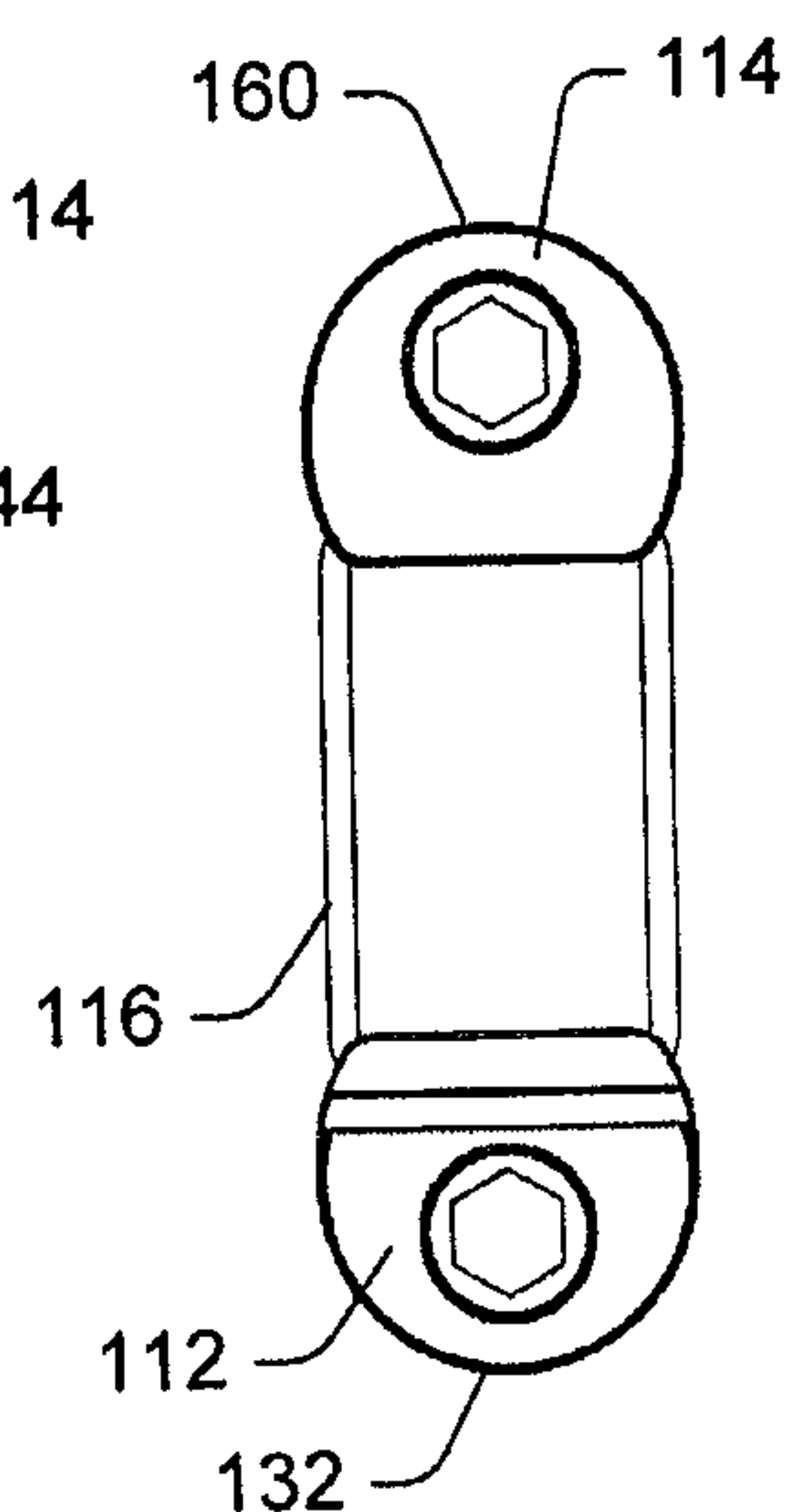


FIG. 9

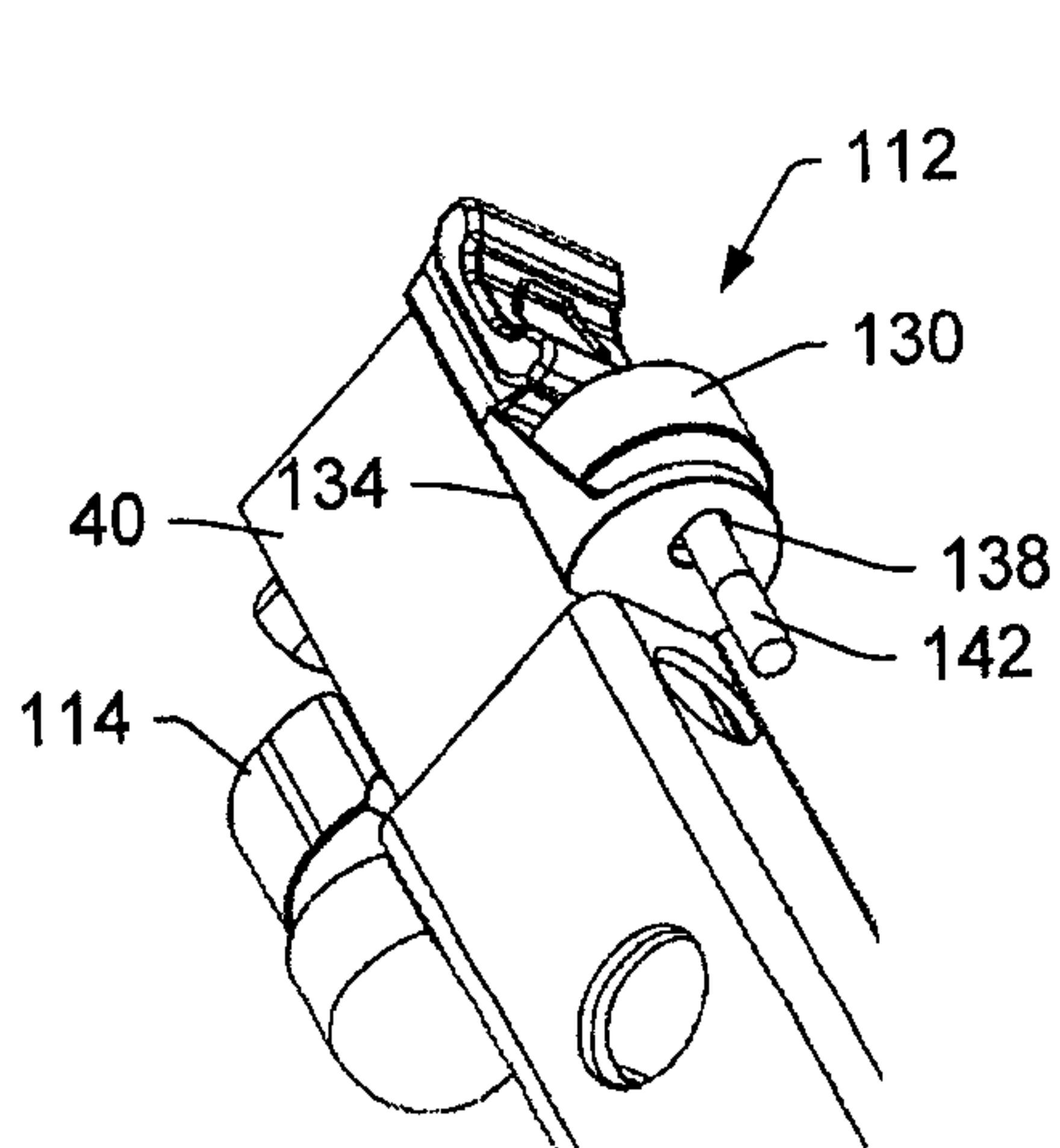


FIG. 11

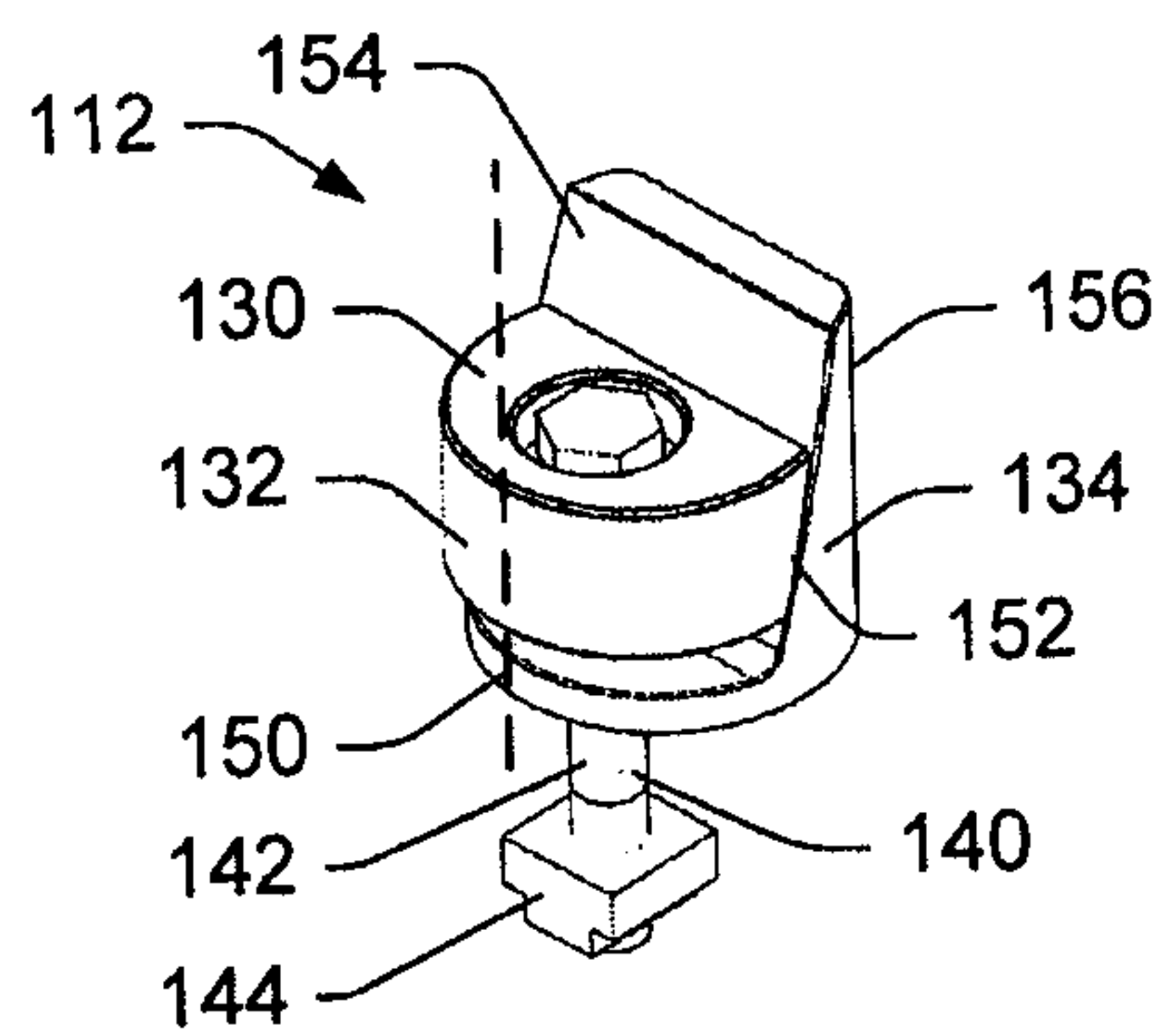


FIG. 10

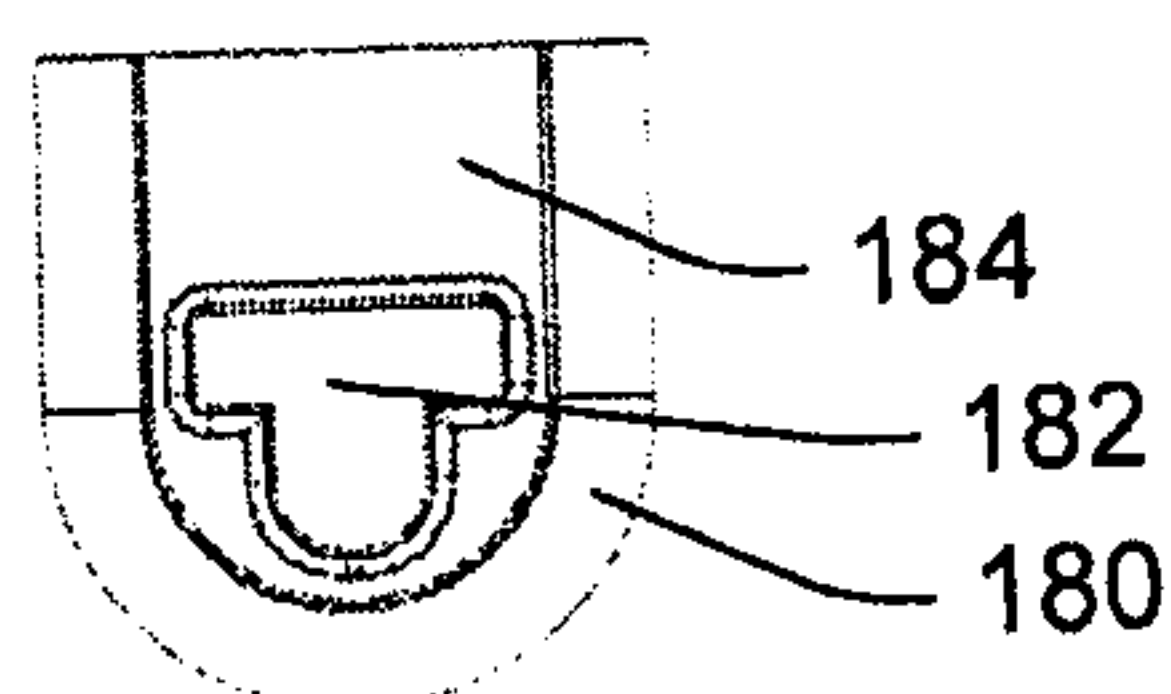


FIG. 12

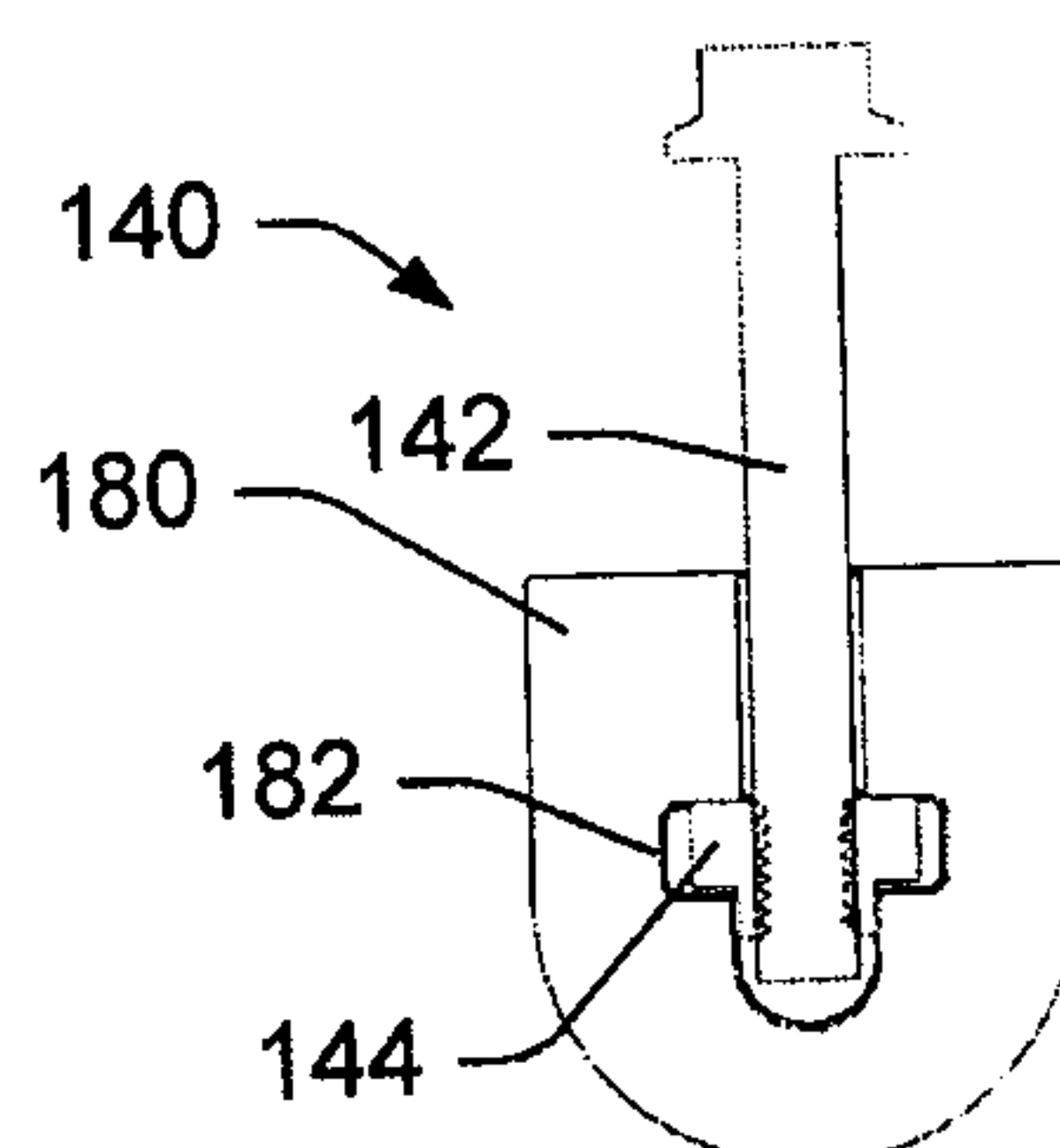
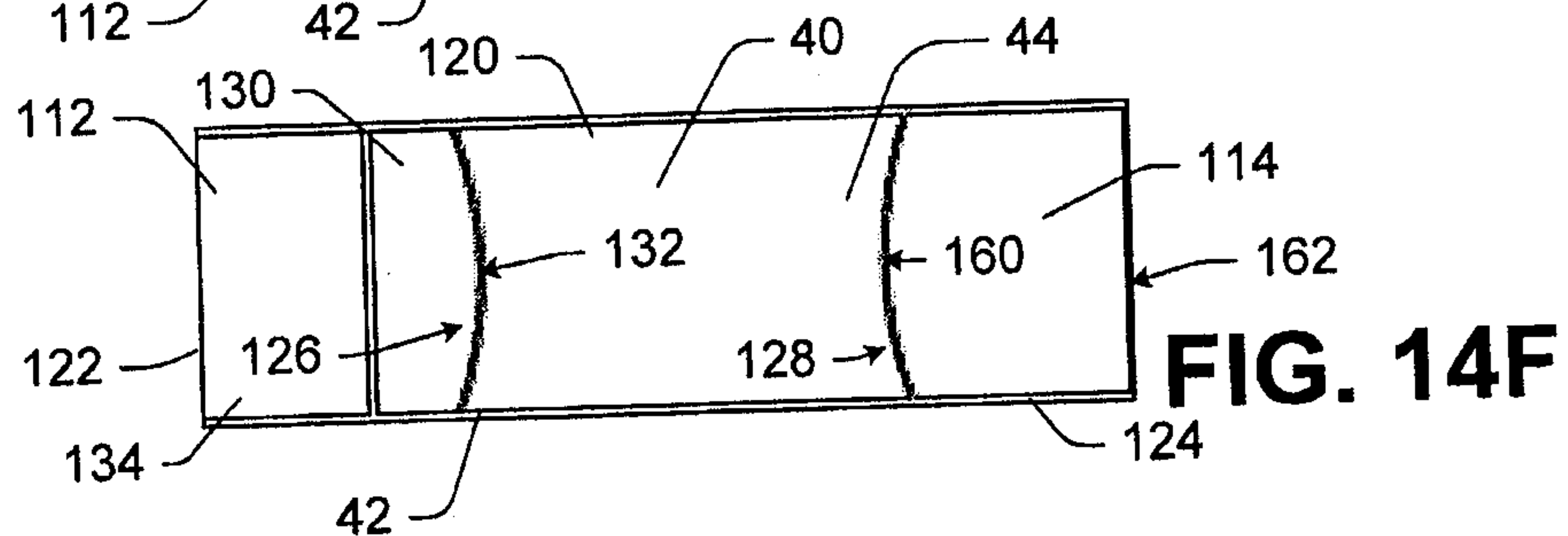
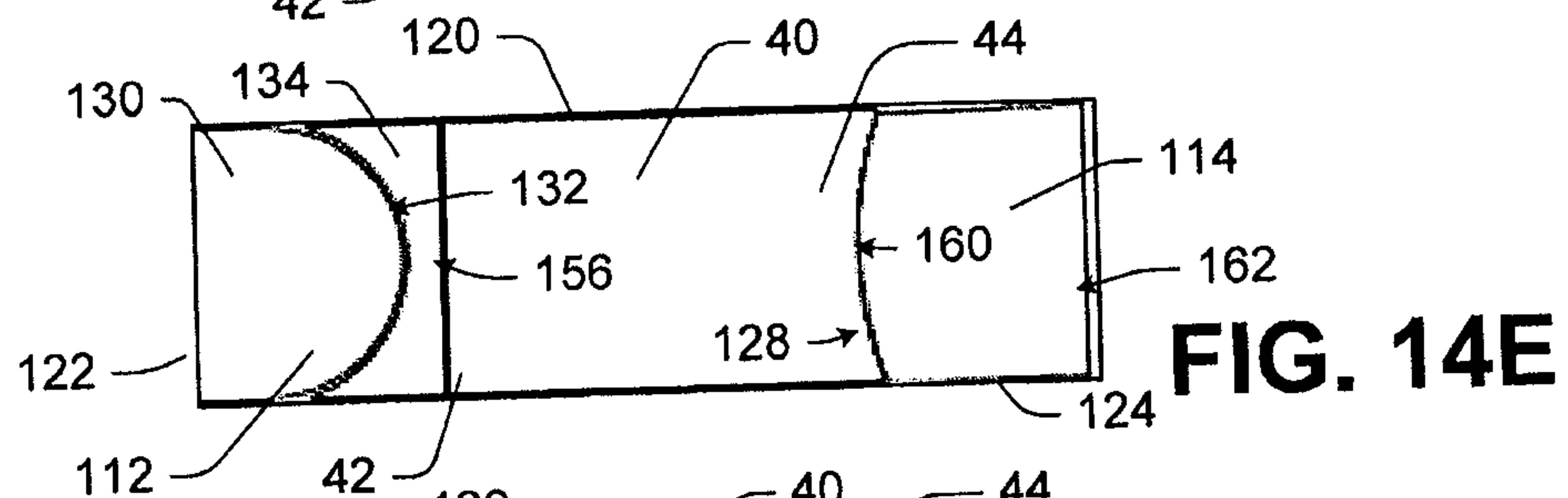
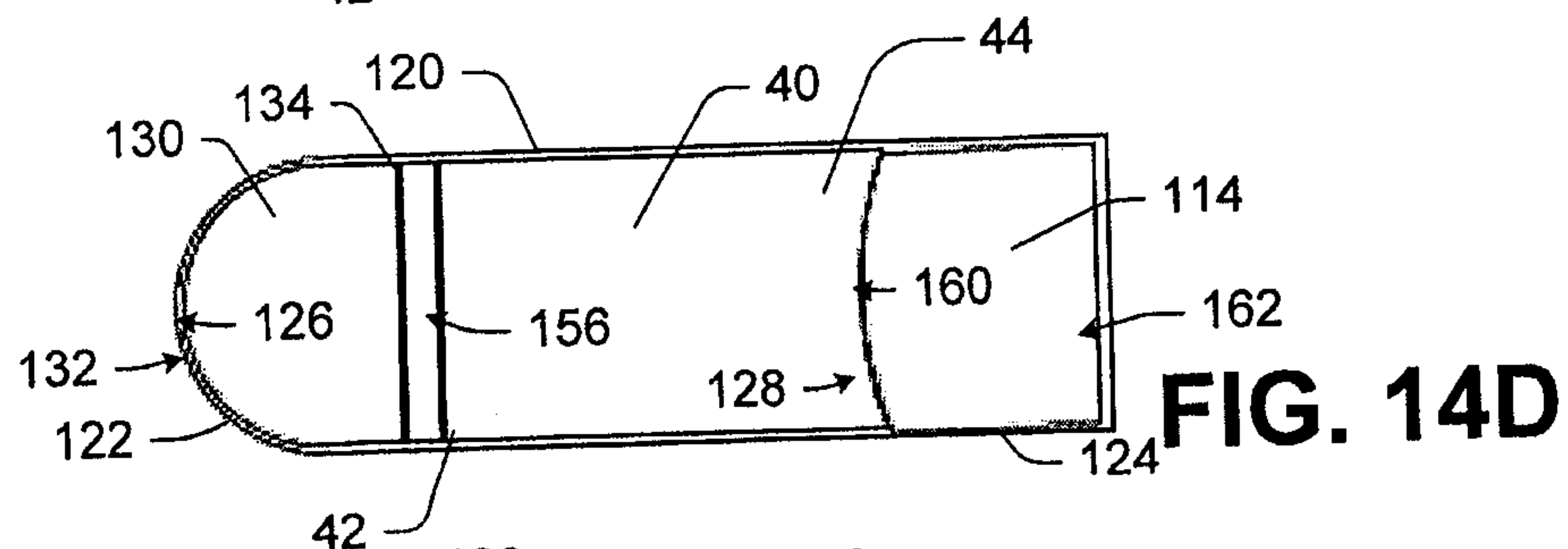
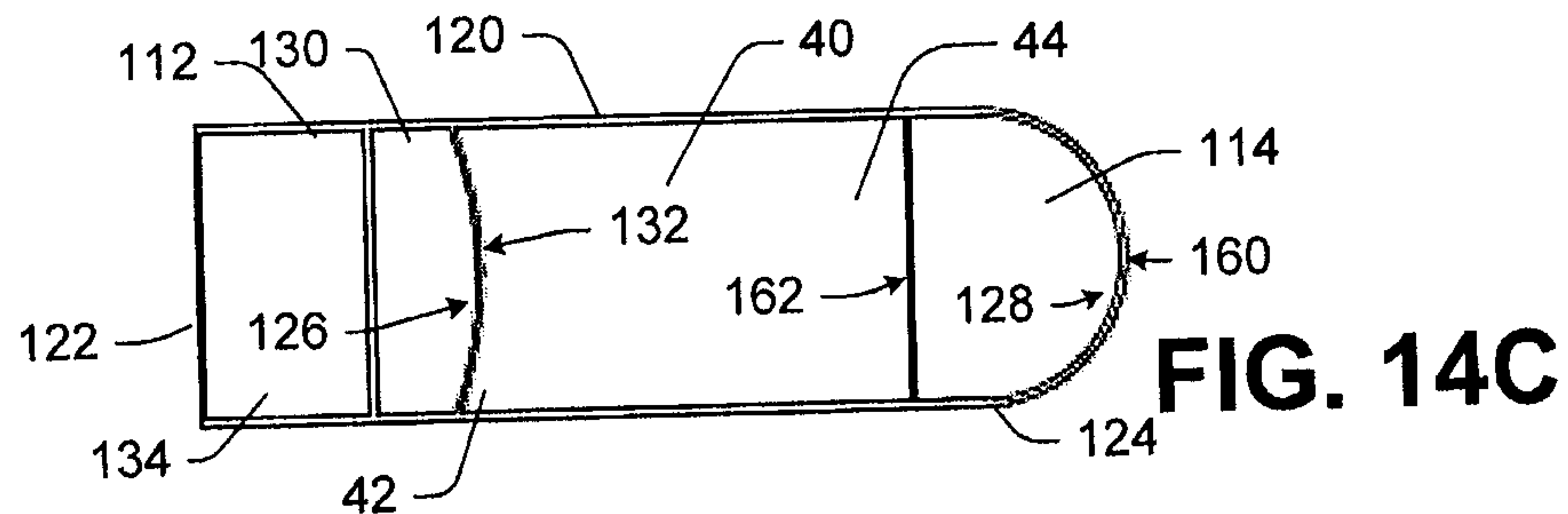
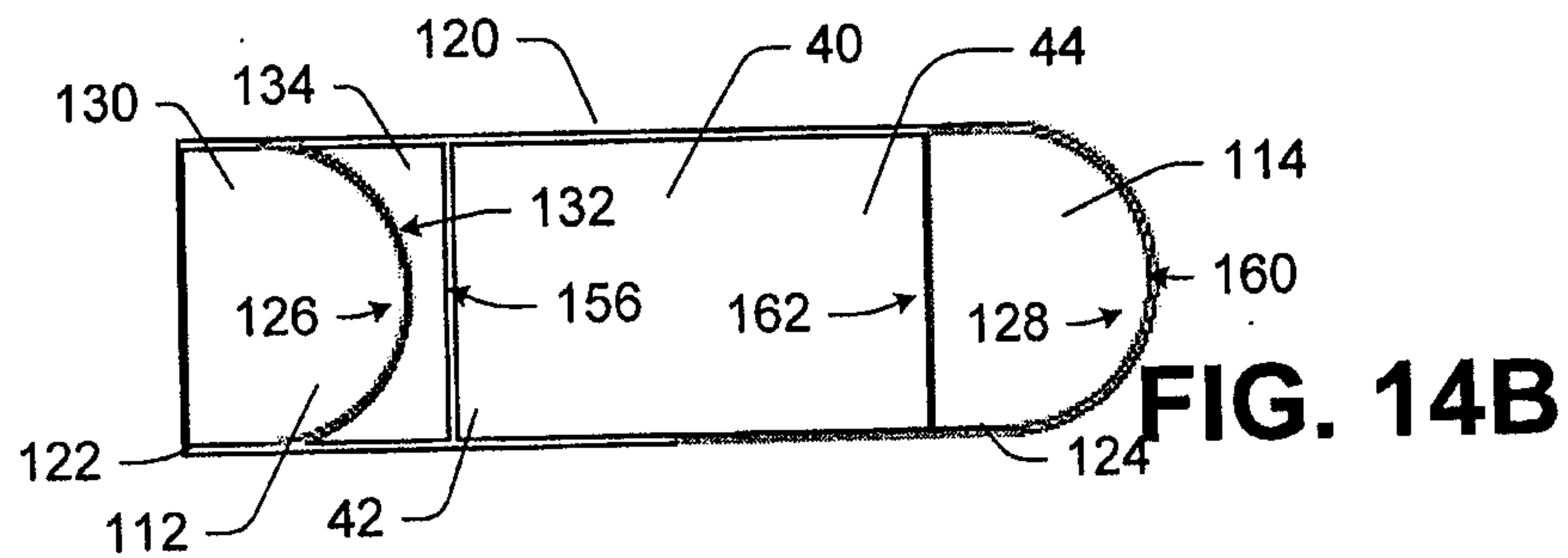
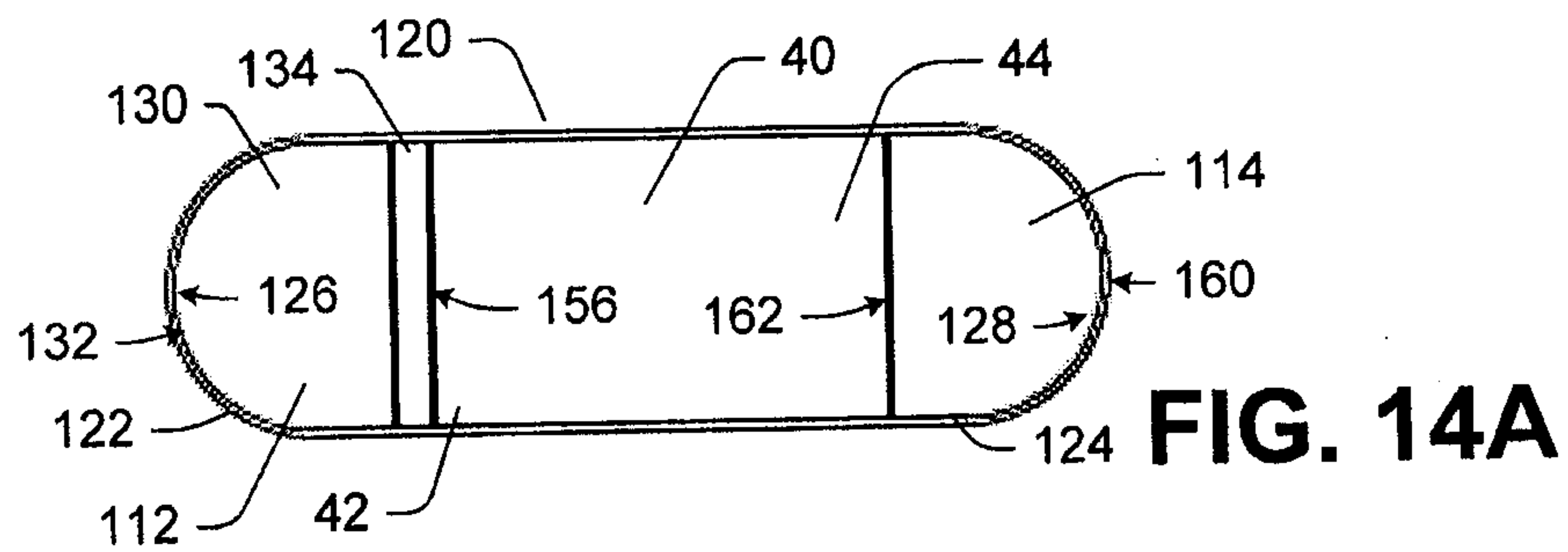
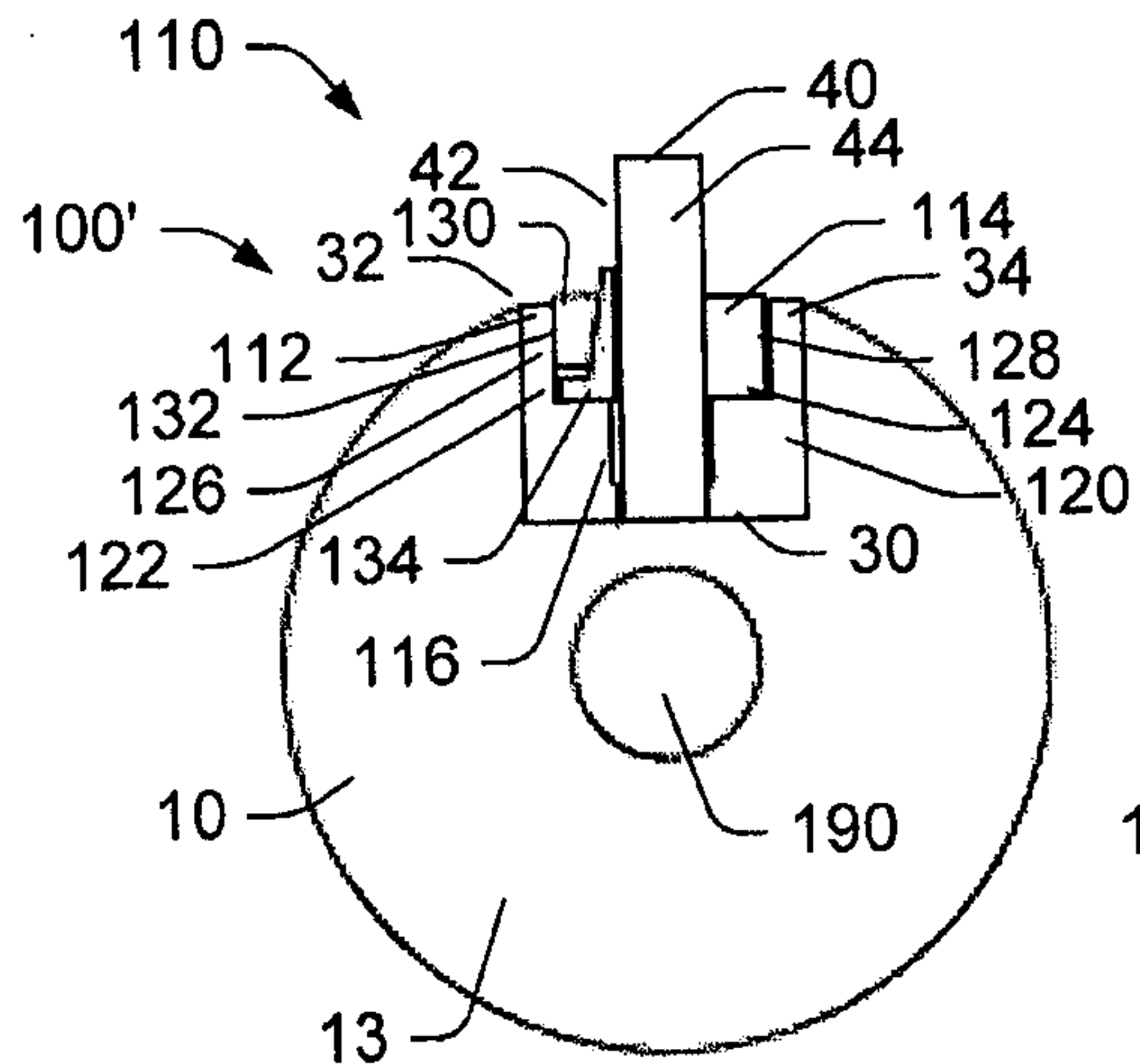
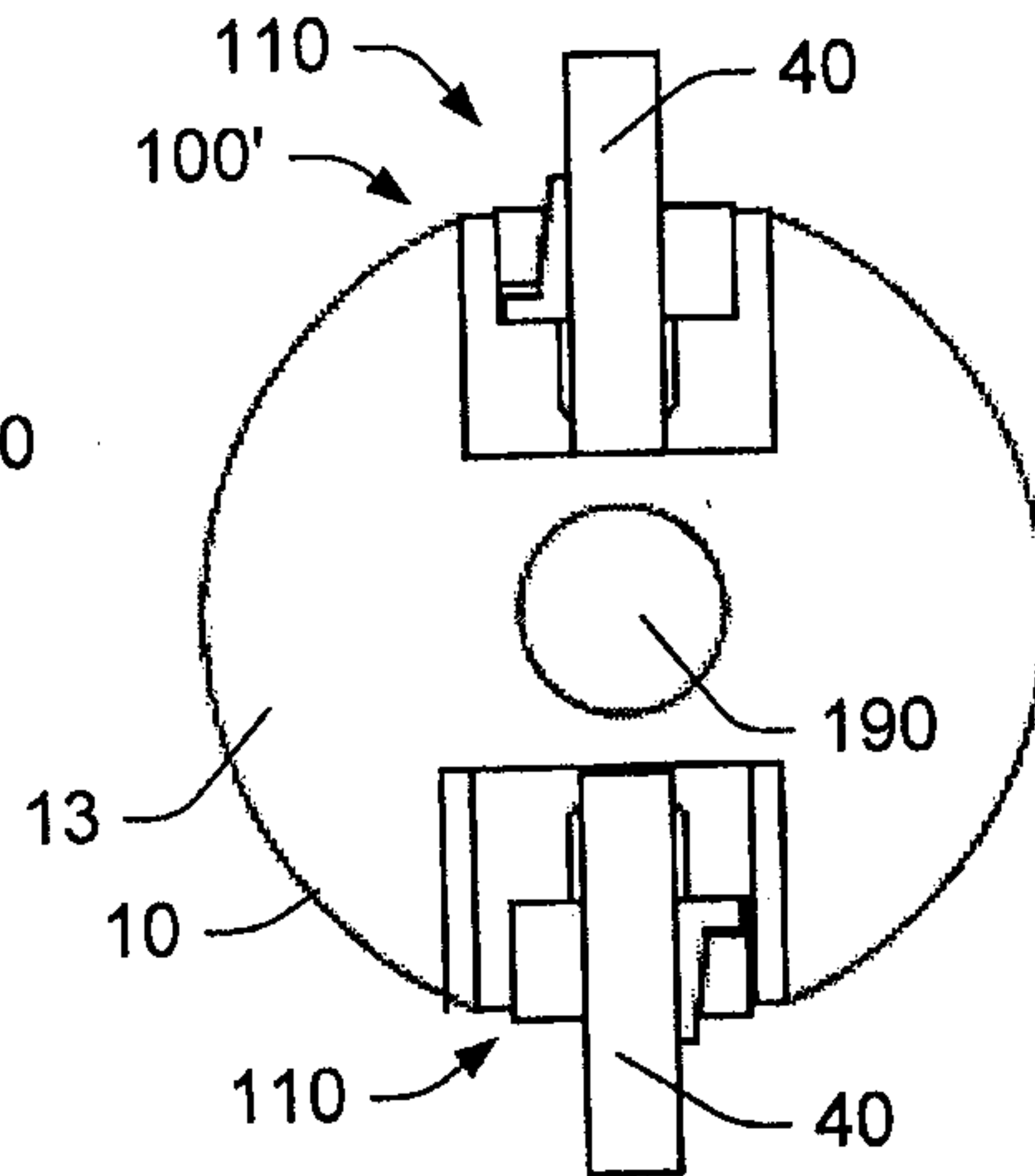
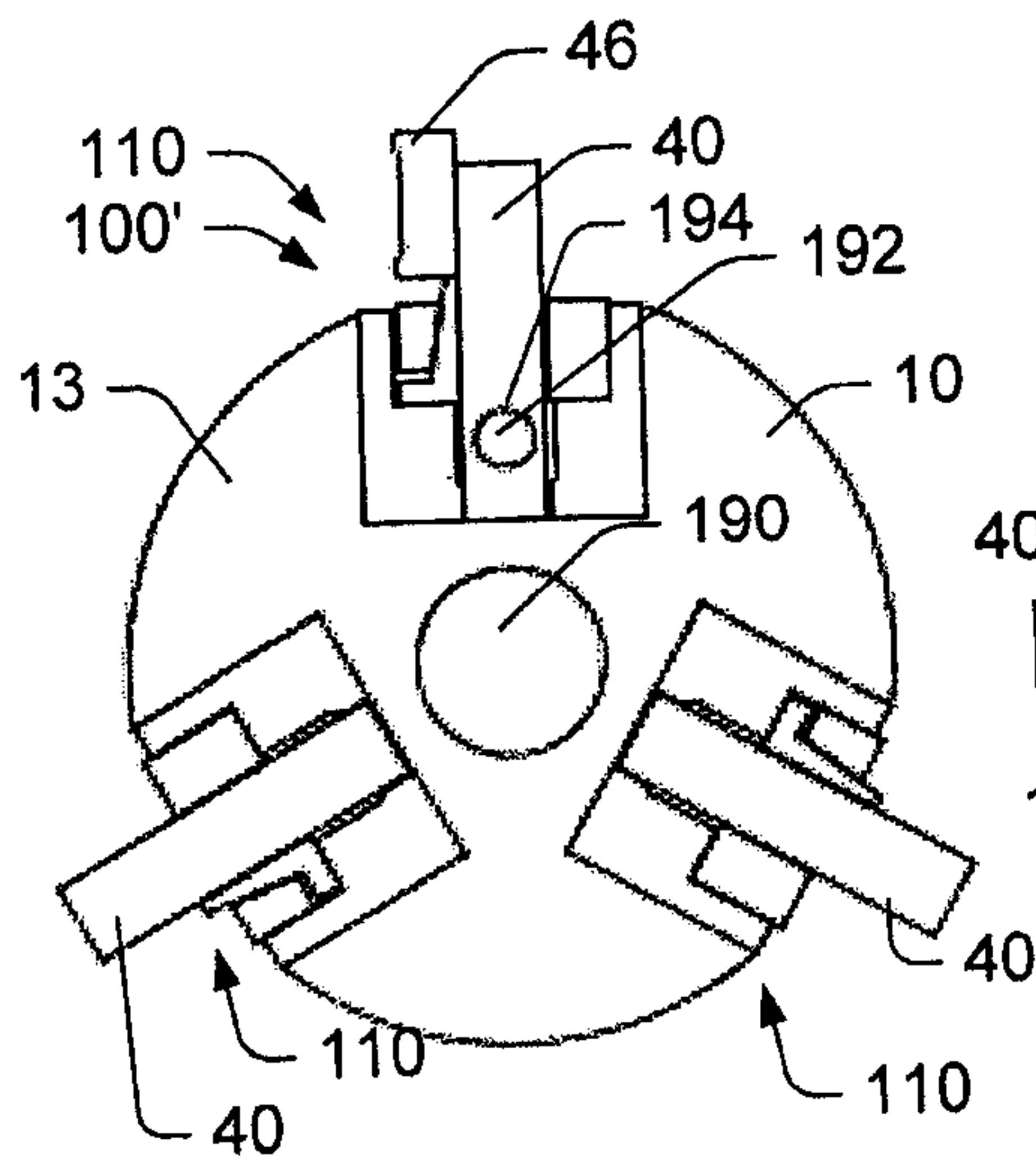
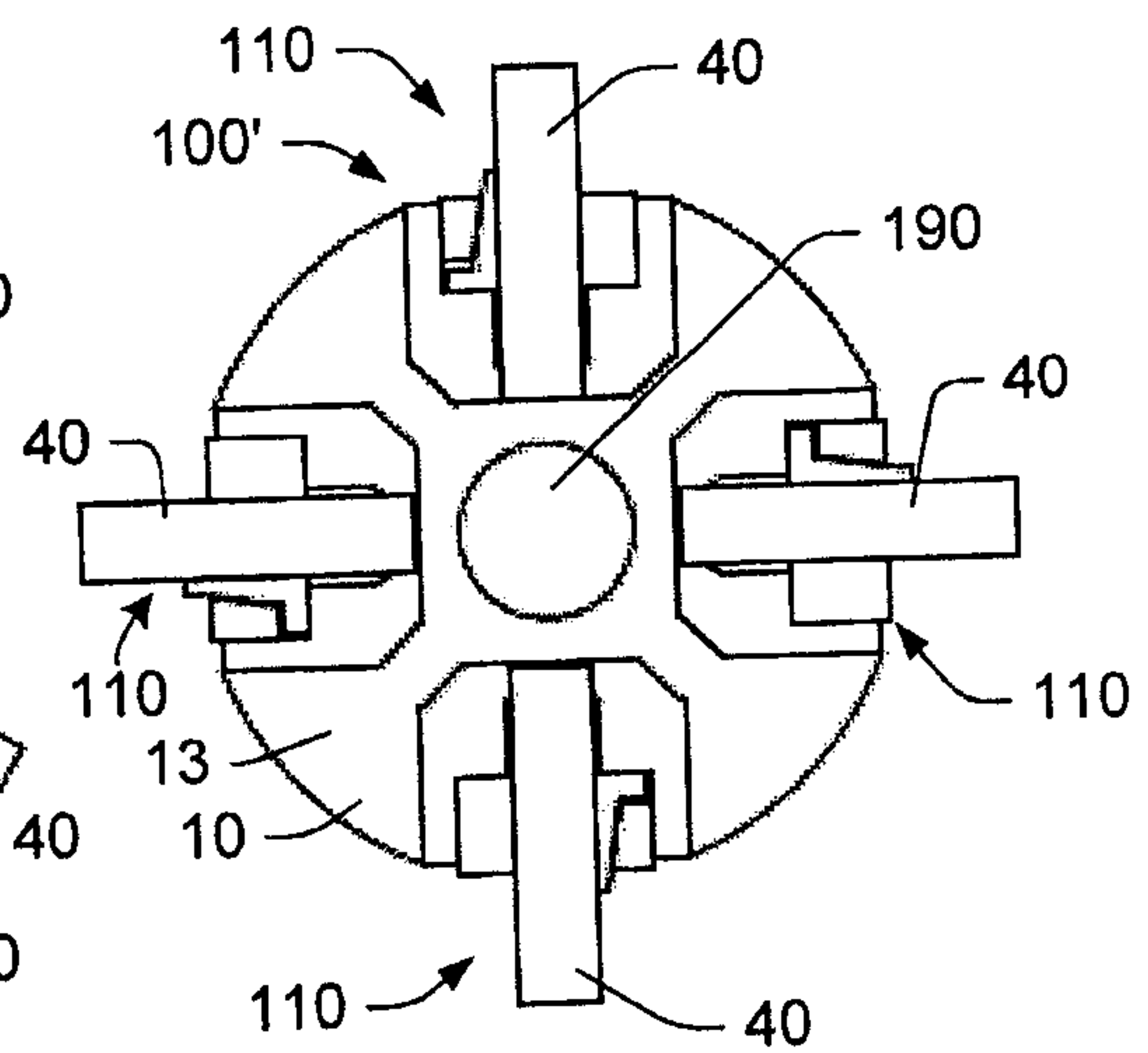


FIG. 13



**FIG. 15A****FIG. 15B****FIG. 15C****FIG. 15D**

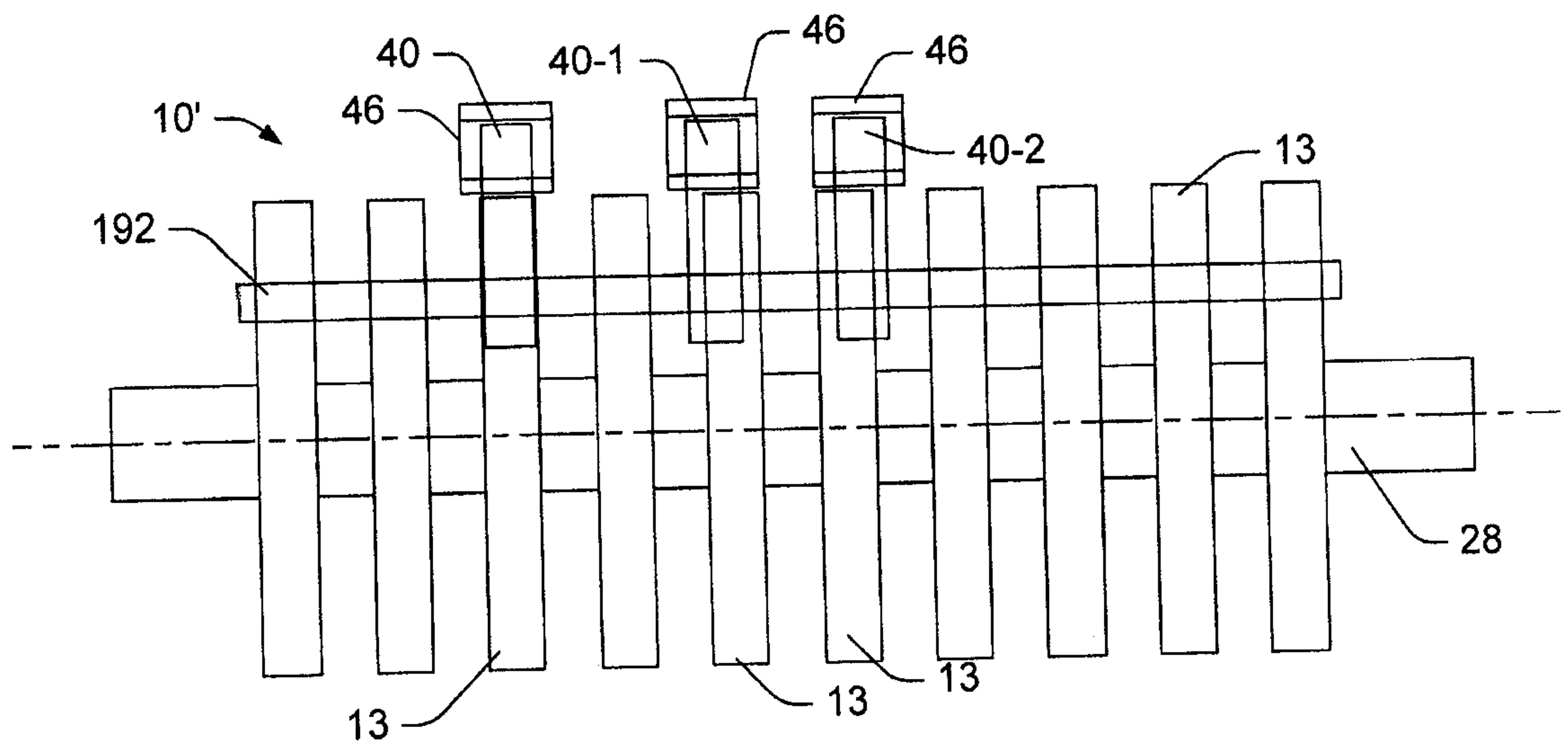


FIG. 16A

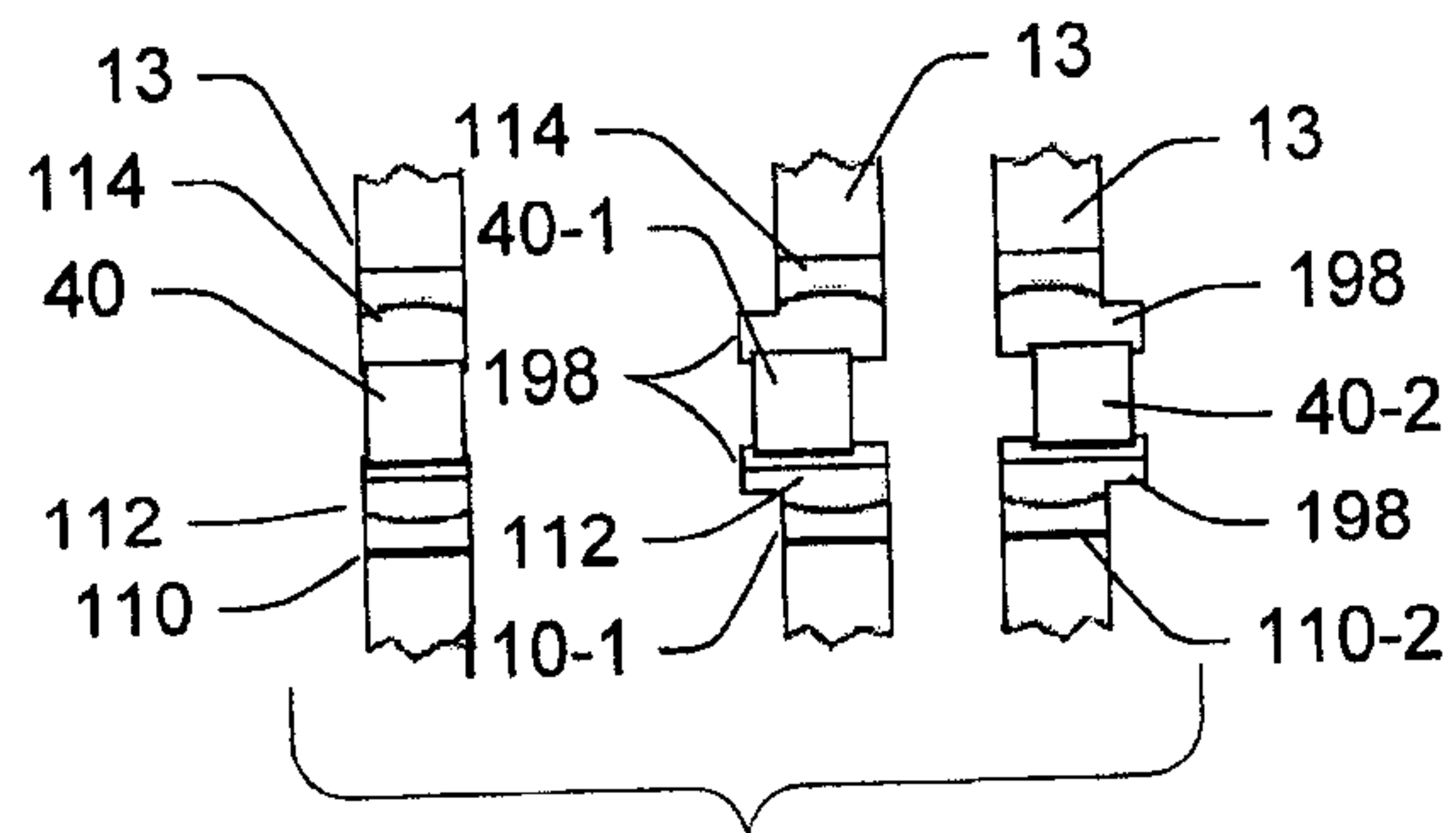
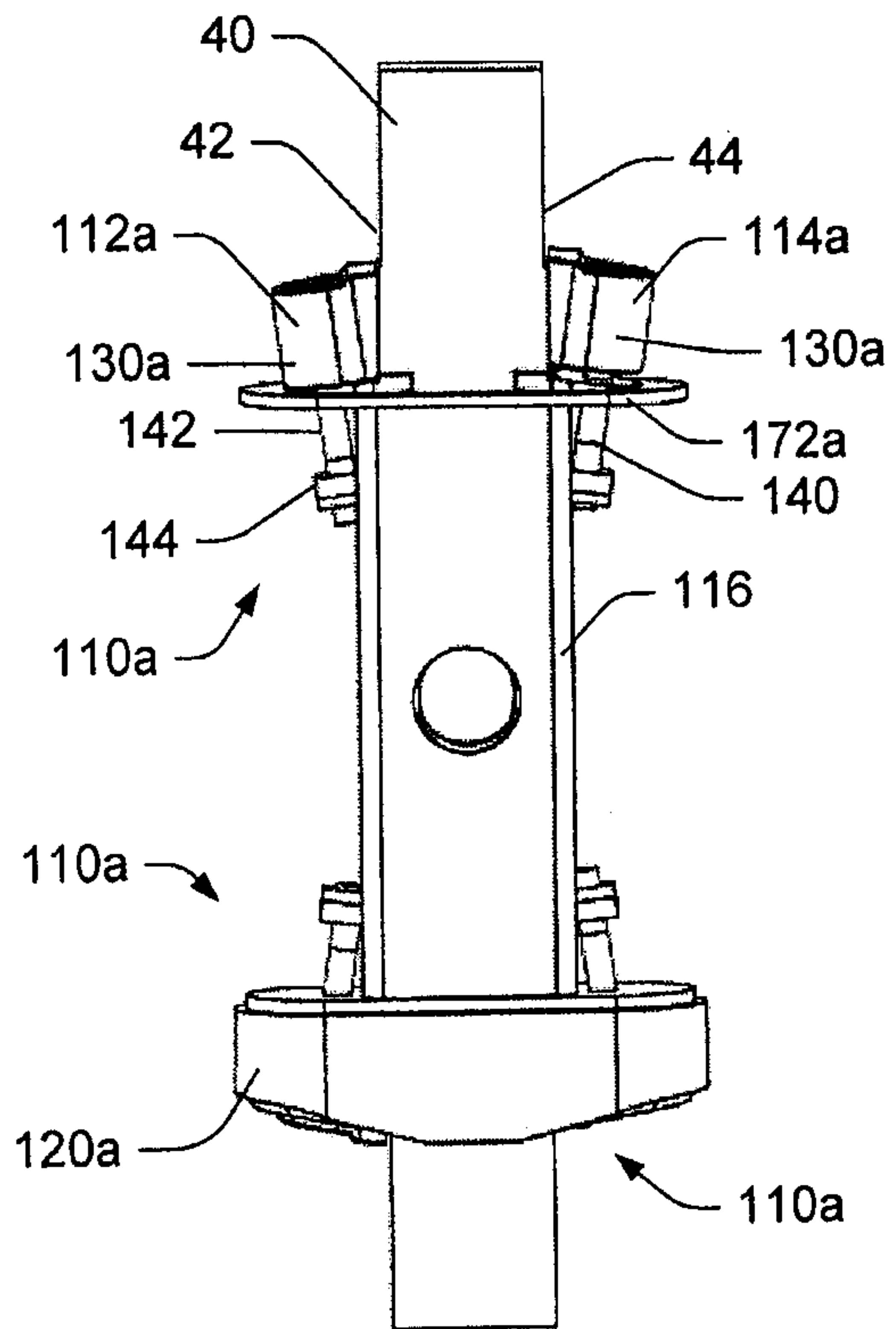
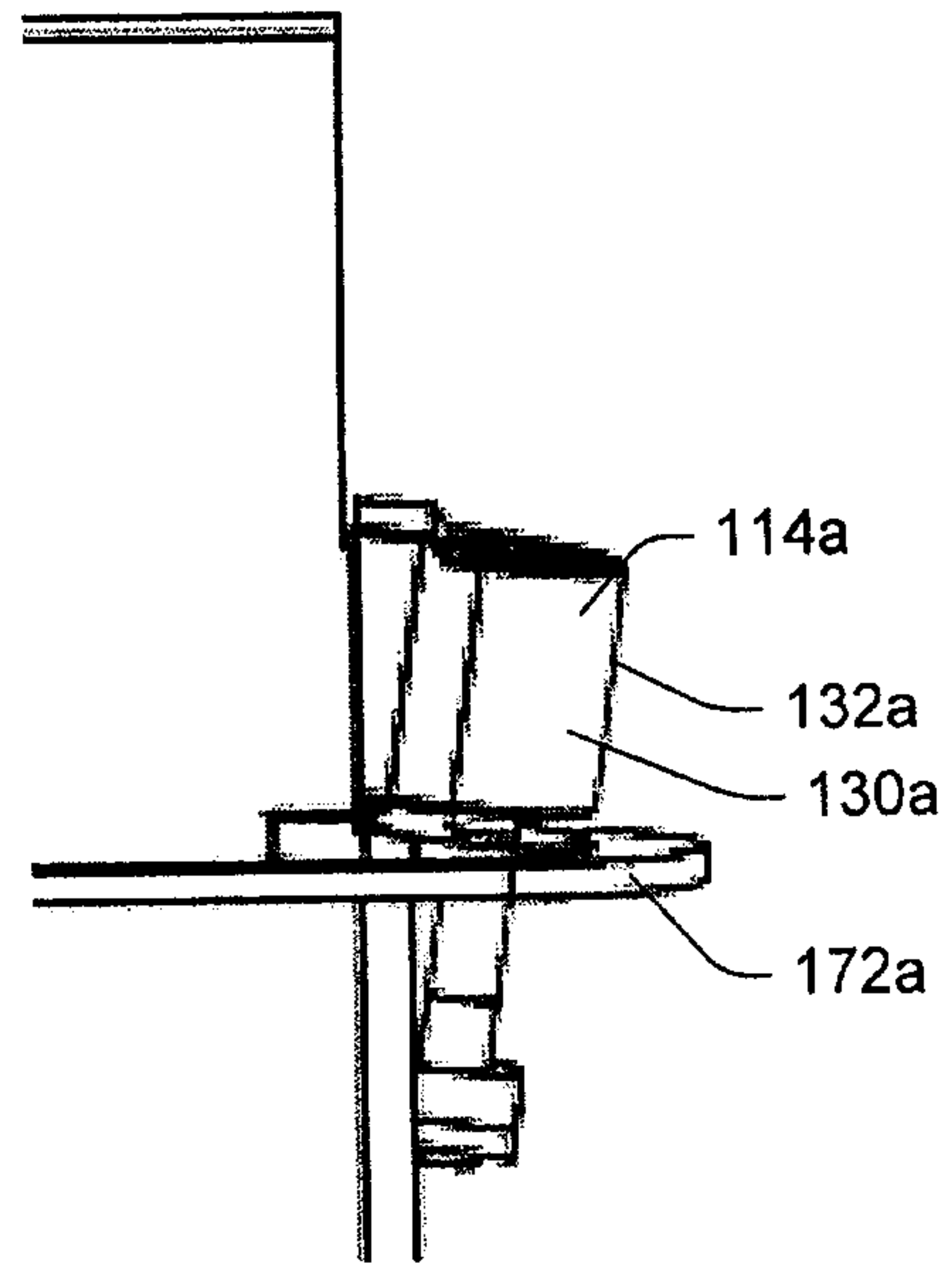
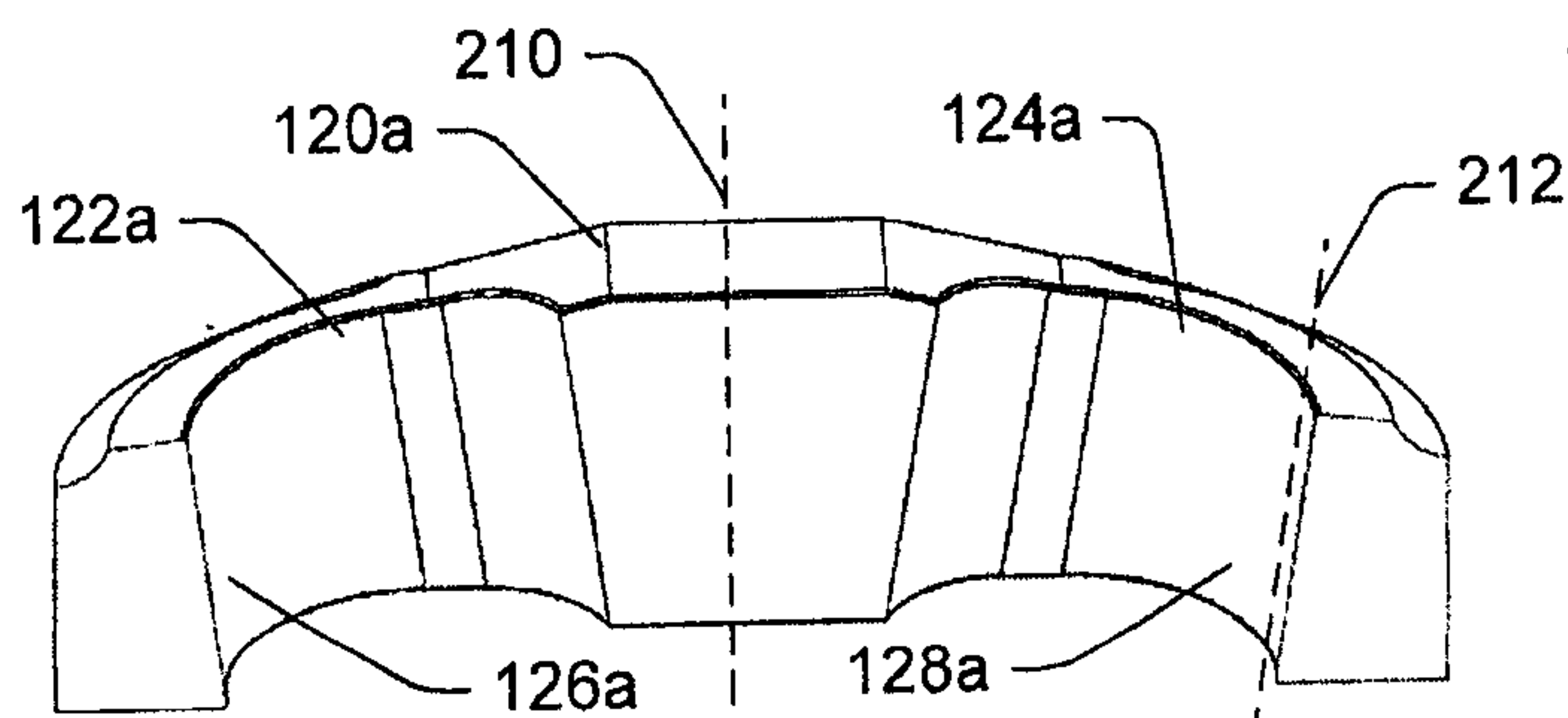
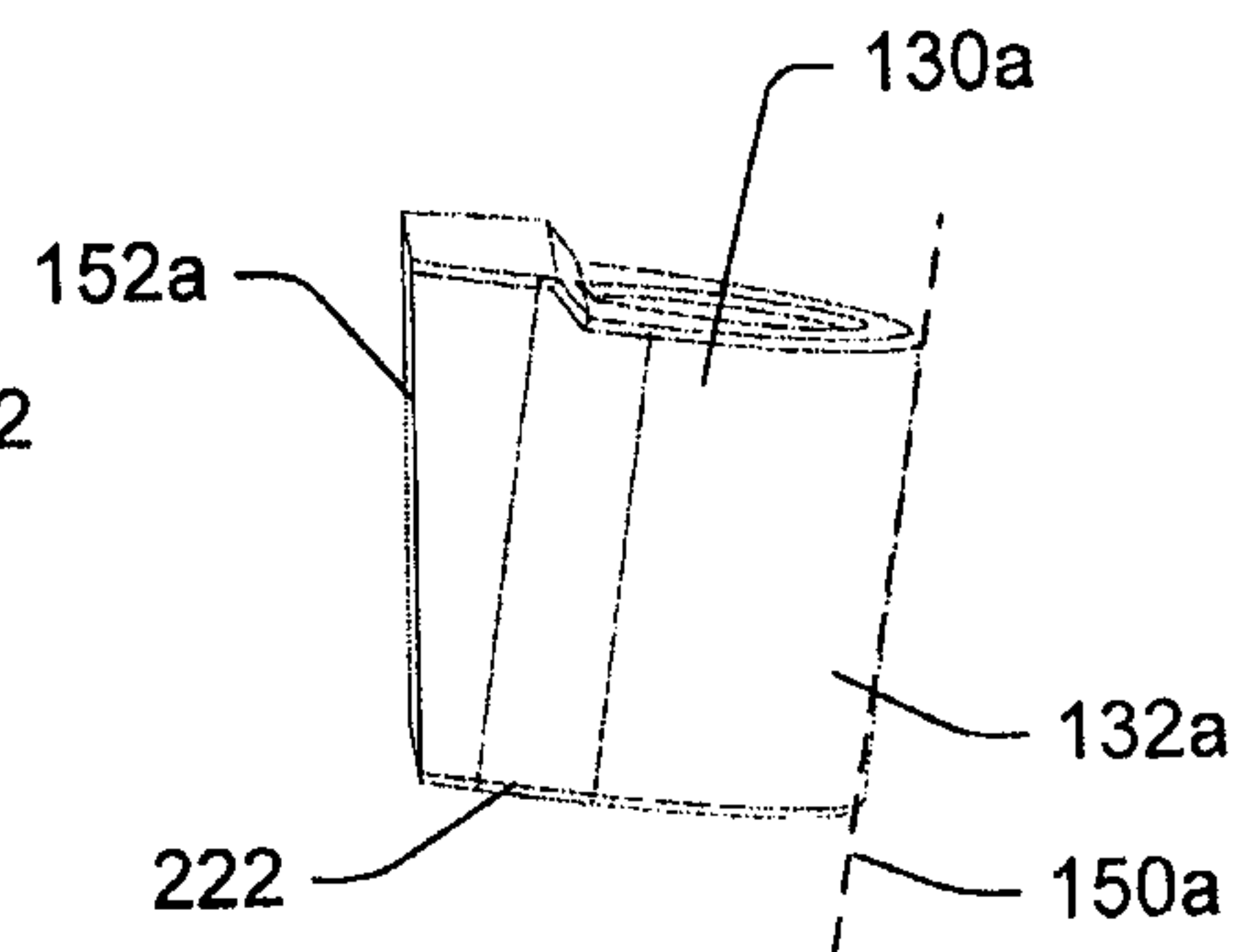
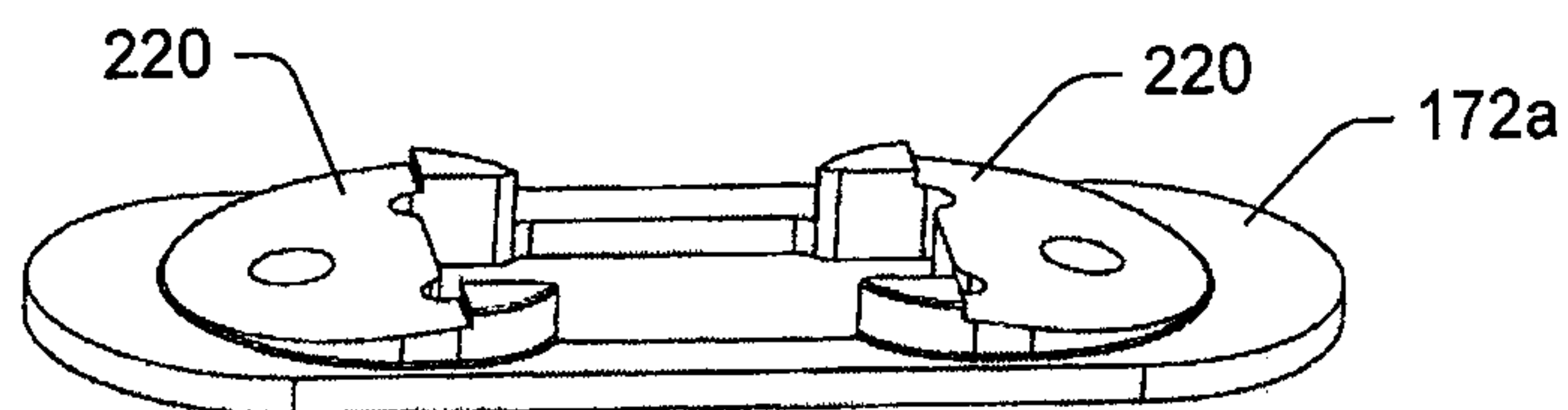
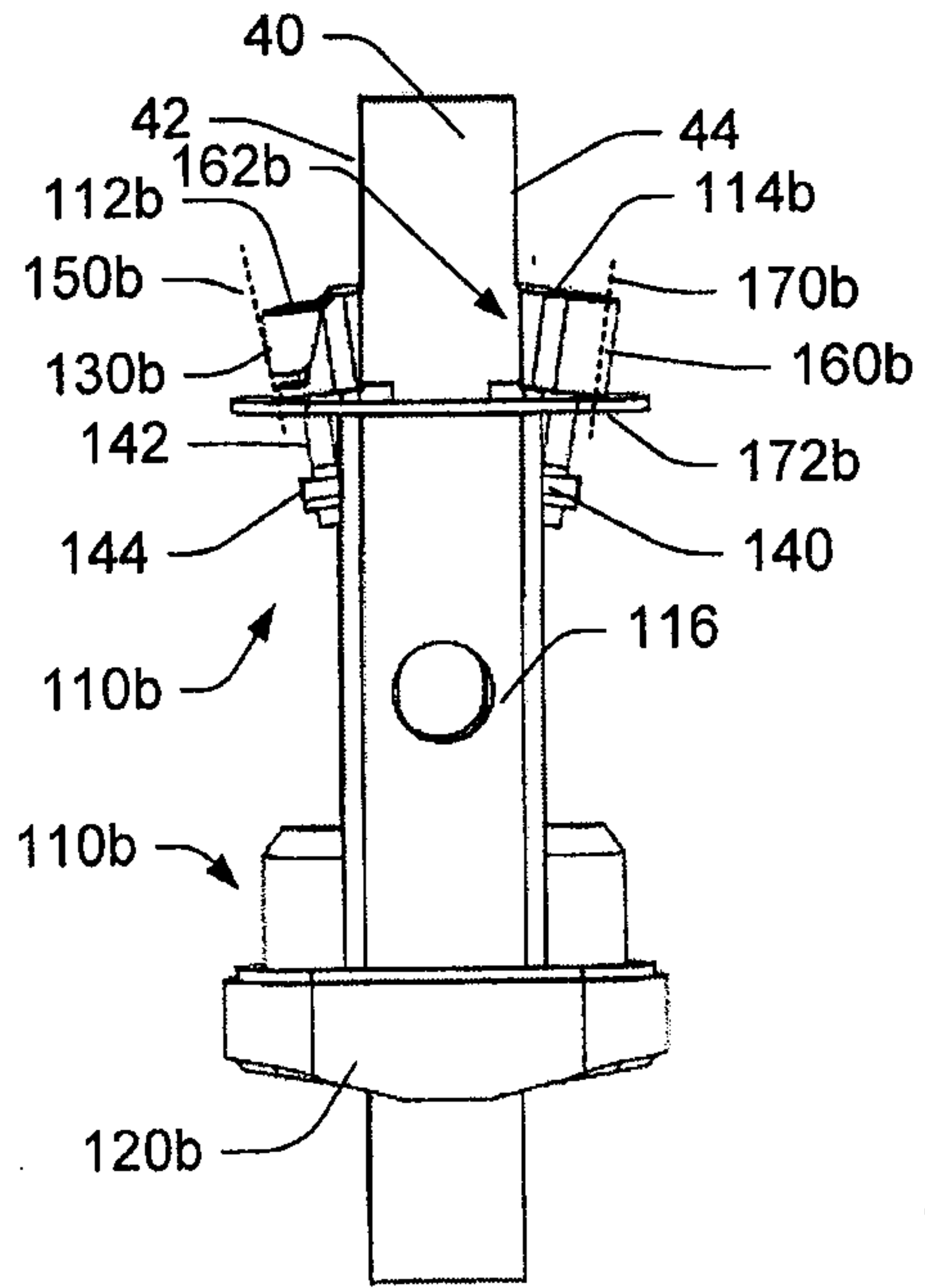
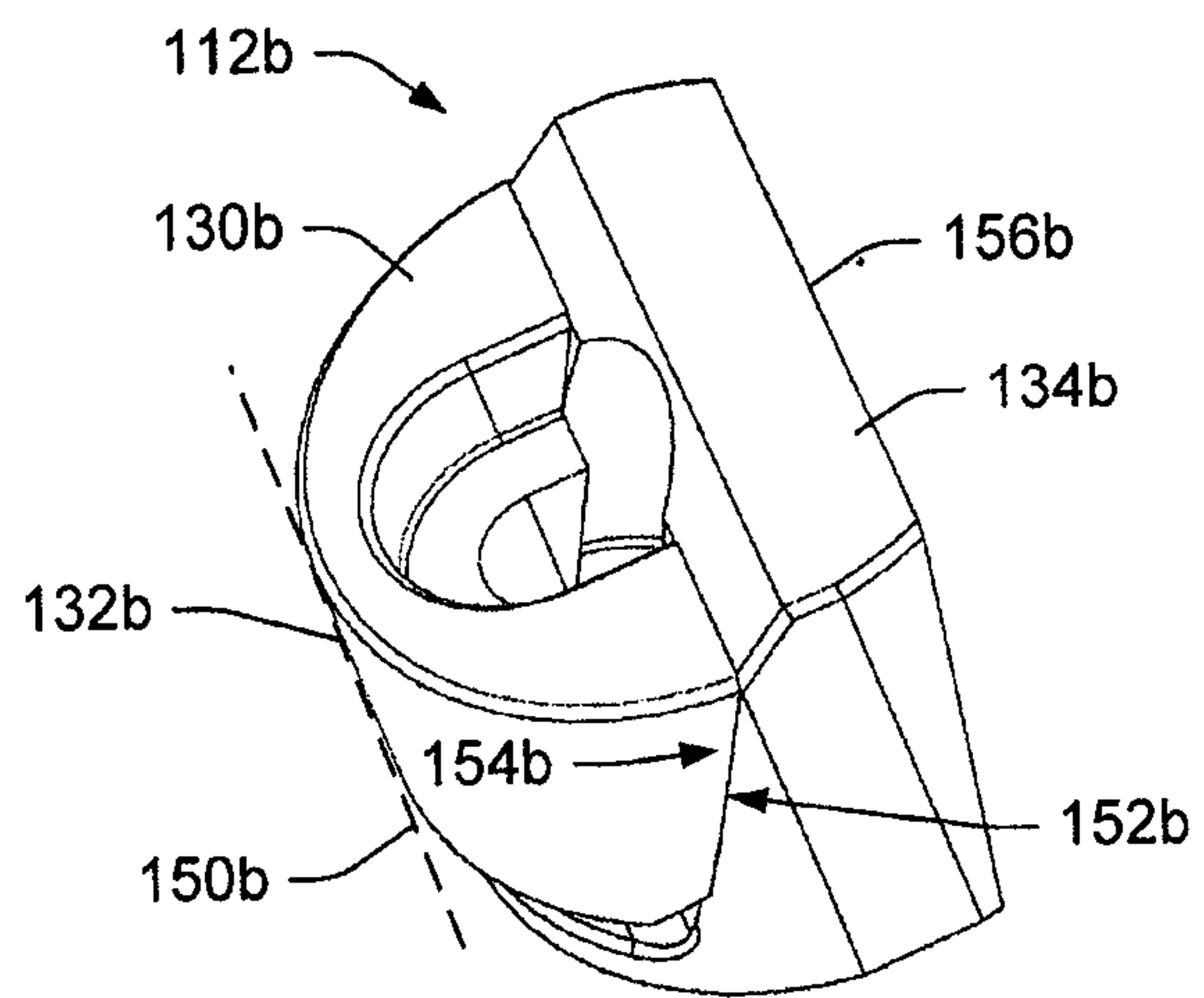
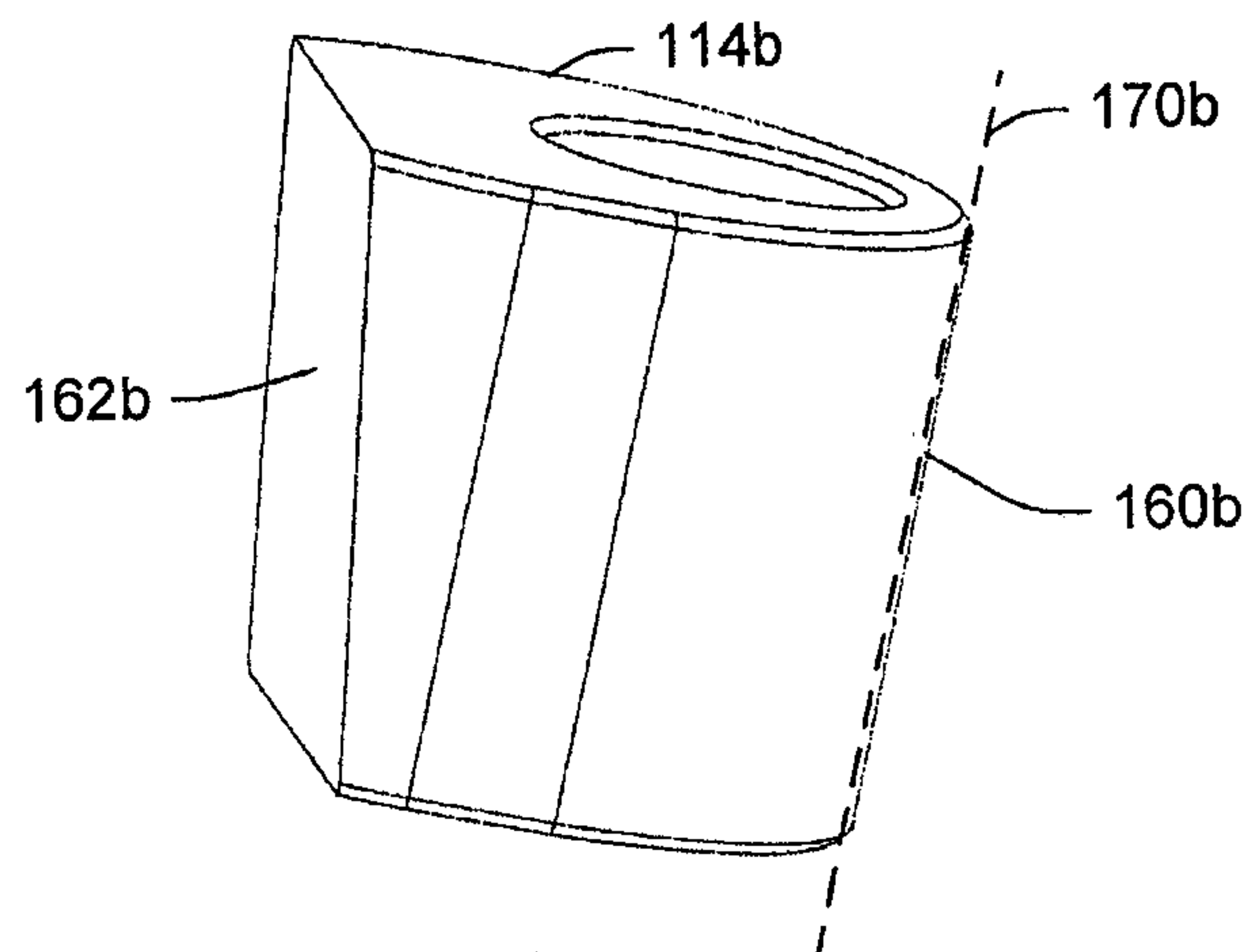


FIG. 16B

**FIG. 17****FIG. 18****FIG. 19****FIG. 21****FIG. 20**

**FIG. 22****FIG. 23****FIG. 24**

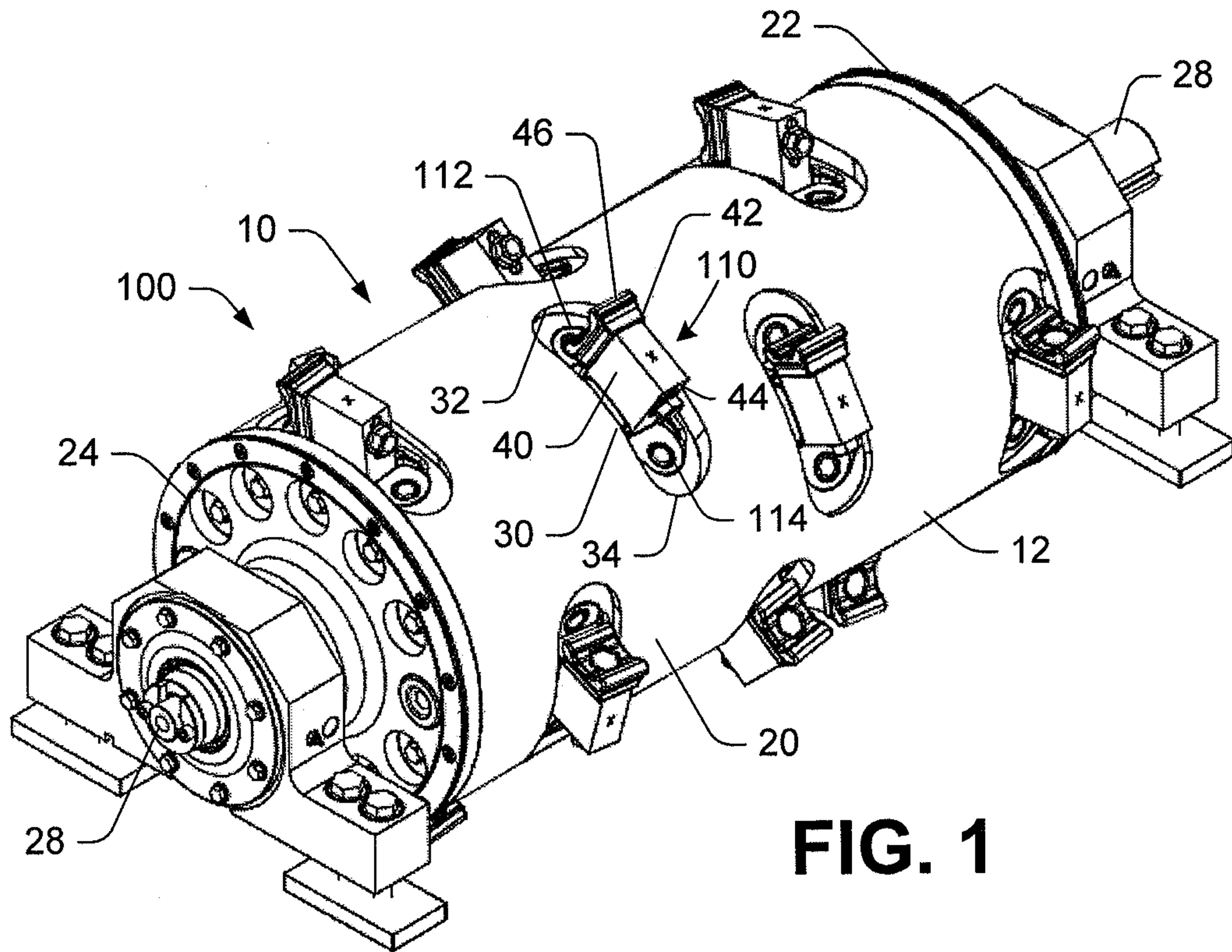


FIG. 1