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(54) **EXPANSION TOOL FOR ADJUSTABLE SPINAL IMPLANT**

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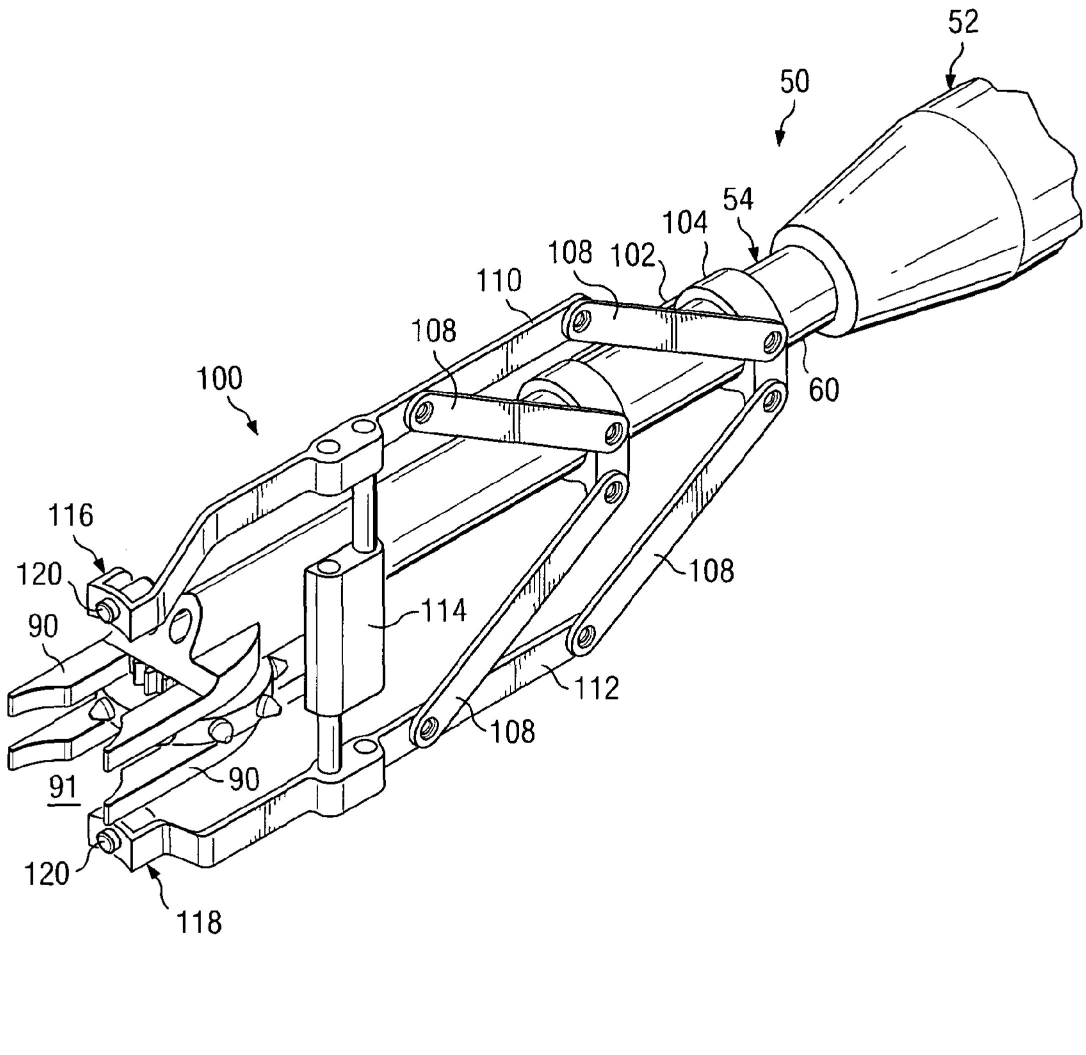
(57) **ABSTRACT**

A vertebral implant assembly having a tubular body and a pair of endplate assemblies is installed between two vertebral endplates using an apparatus comprising an axle having a proximal end and a distal end, a set of gears connected to the proximal end of the axle, and an engager device connected to the set of gears and adapted to rotate the tubular body when the axle is rotated. As the tubular body is rotated, the vertebral implant assembly expands.



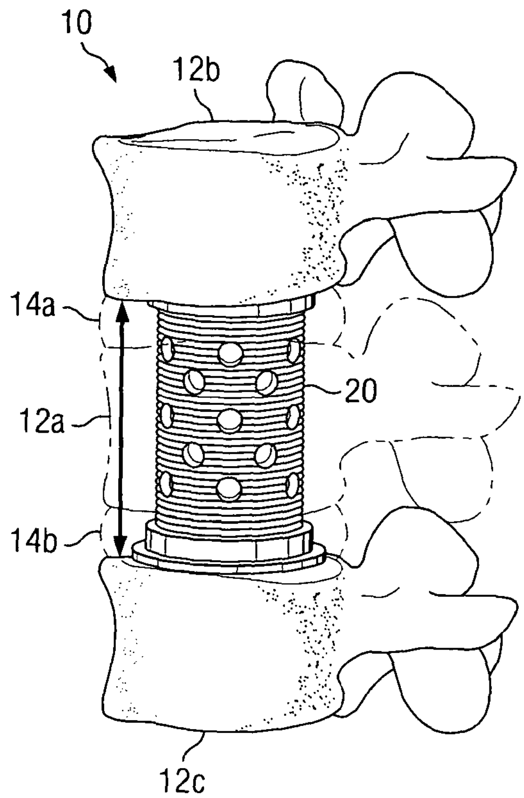

10
12b
14a
12a
20
14b
12c

Fig. 1

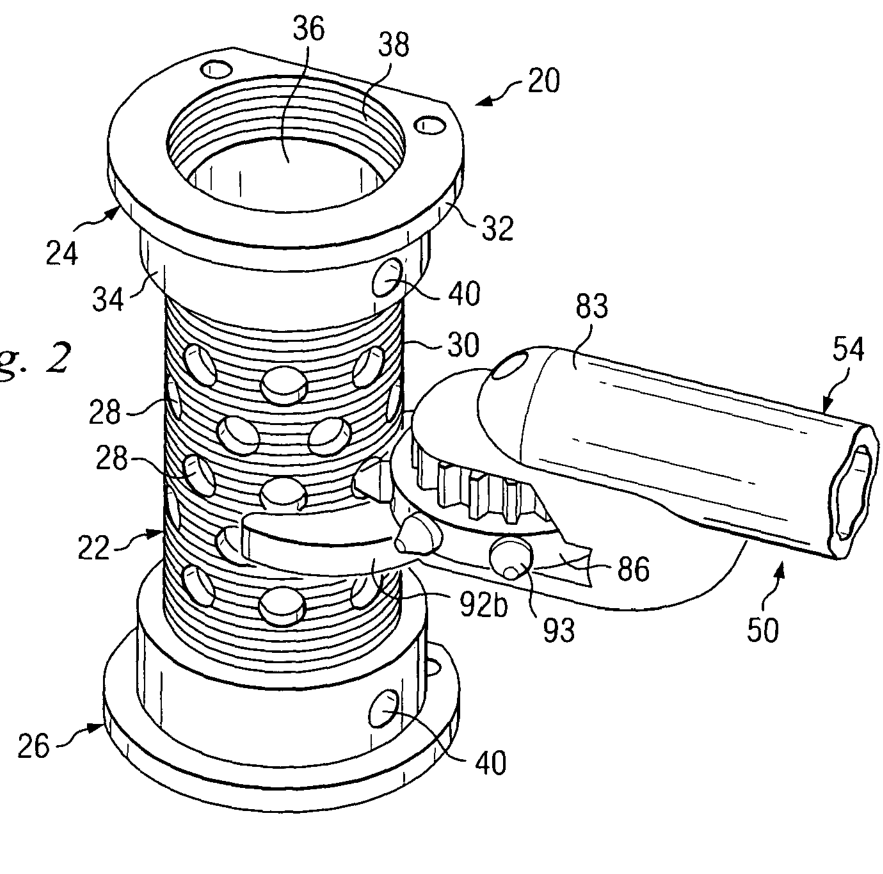

36
38
20
24
32
34
40
83
30
54
28
28
22
86
92b
93
50
26
40

Fig. 2

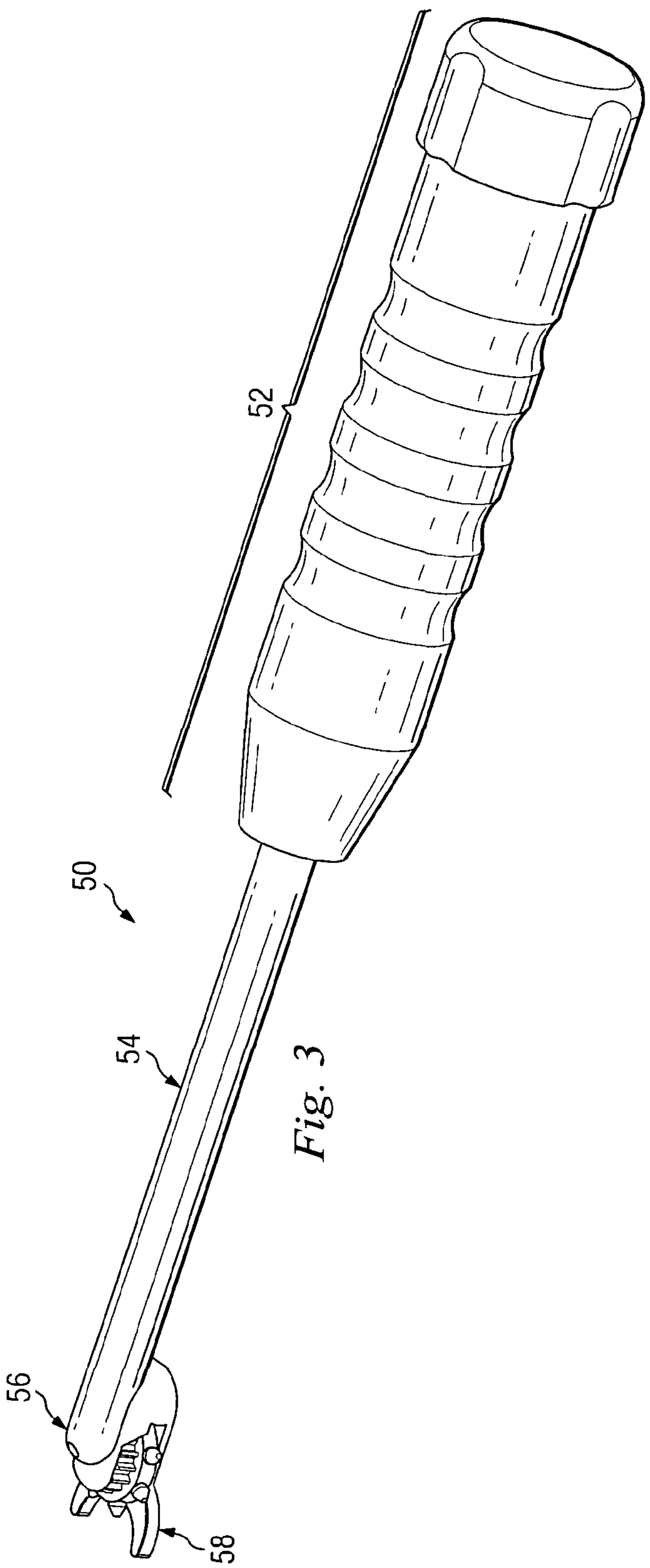


Fig. 3

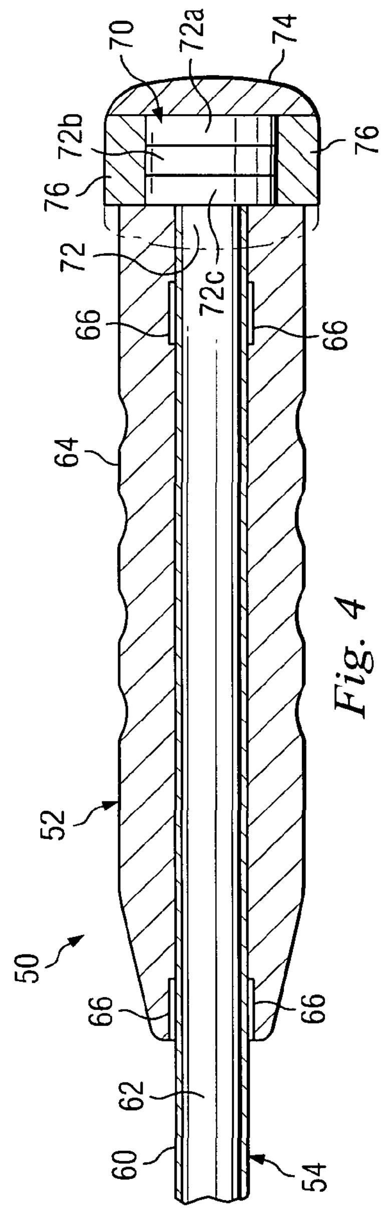


Fig. 4

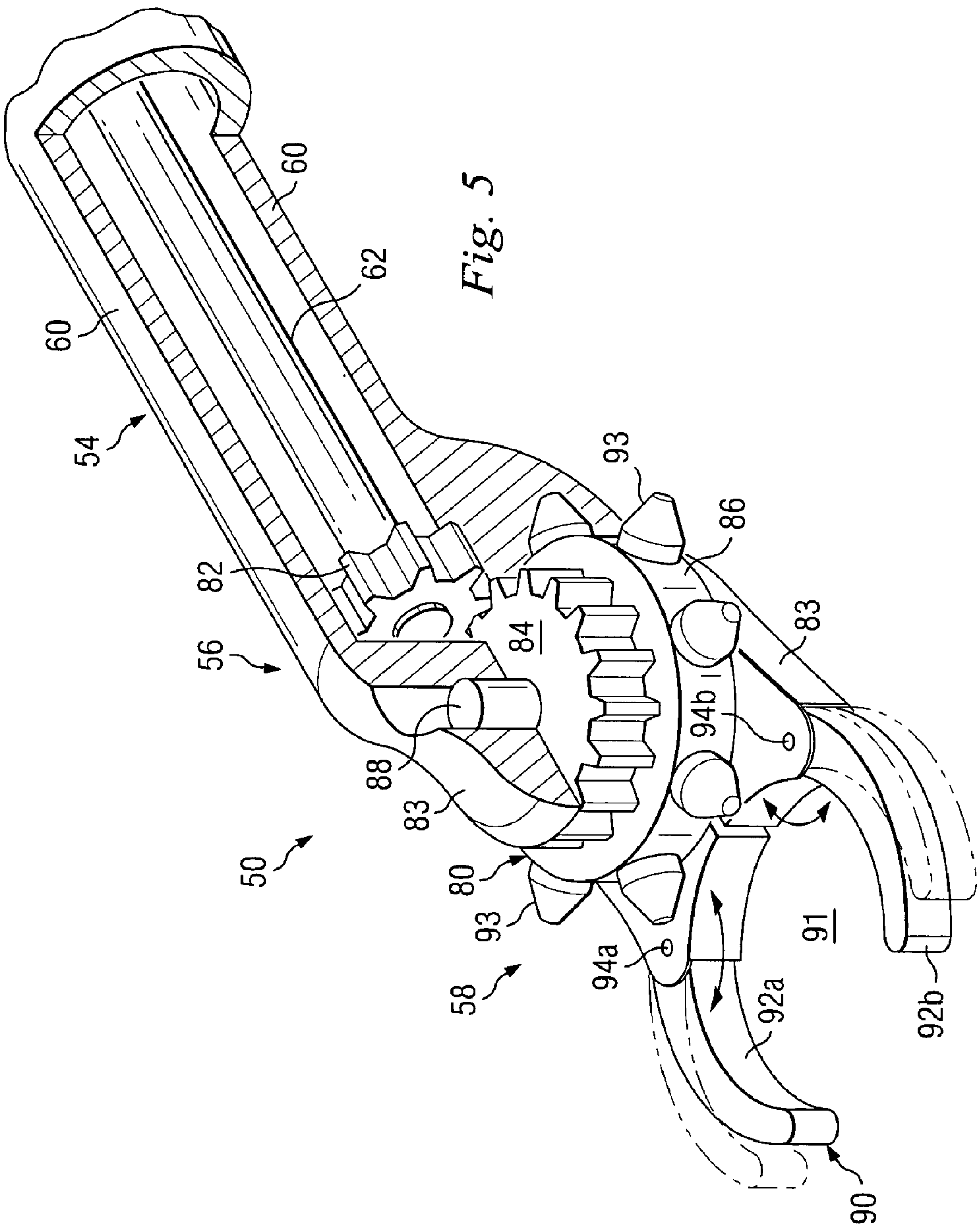


Fig. 5

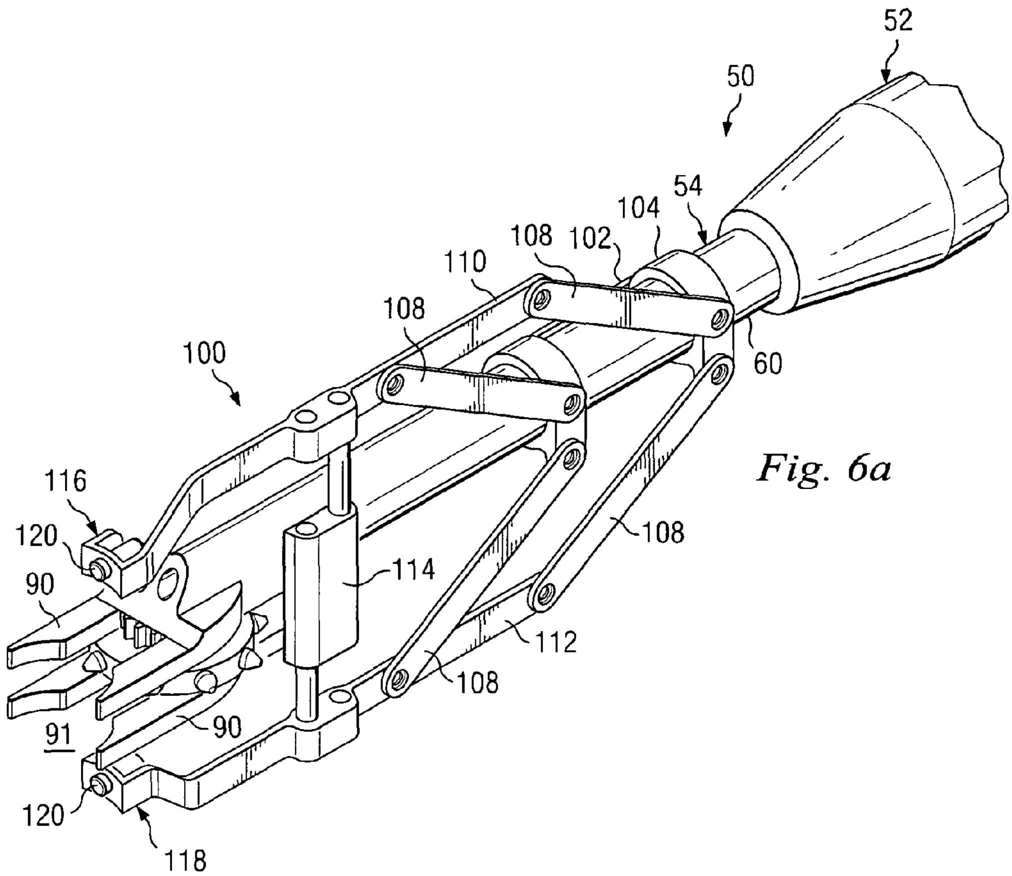

52
50
54
104
108
102
110
108
60
100
116
120
90
114
108
112
108
90
91
120
118

Fig. 6a

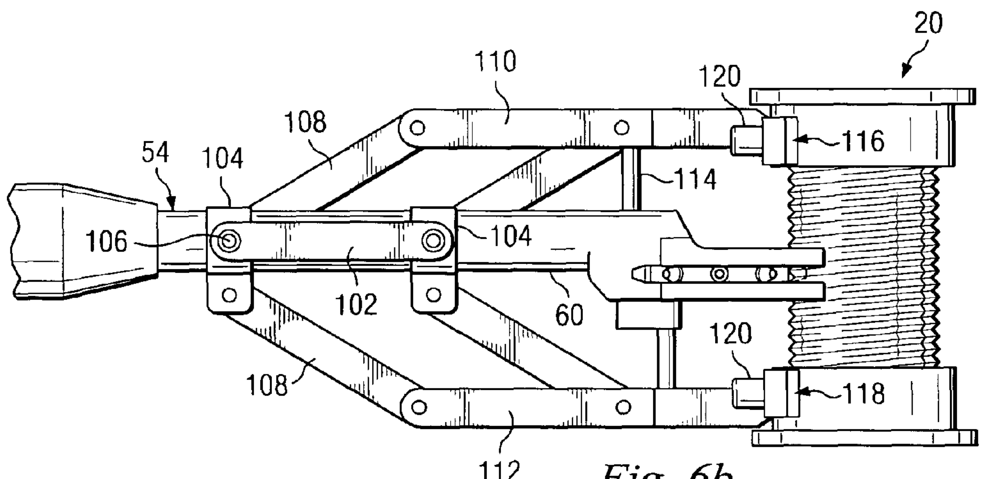

20
110
120
108
116
54
104
114
106
104
102
60
120
108
118
112

Fig. 6b

EXPANSION TOOL FOR ADJUSTABLE SPINAL IMPLANT

CROSS REFERENCE

[0001] This application claims the benefit of U.S. Provisional Application No. 60/412,730 filed on Sep. 23, 2002.

FIELD OF THE INVENTION

[0002] The present invention concerns medical procedures and instruments used during surgery. More particularly, a novel apparatus and method is provided for adjusting an adjustable vertebral implant.

BACKGROUND

[0003] A variety of spinal injuries and deformities can occur due to trauma, disease or congenital effects. For example, one type of spinal deformity, a kyphosis, involves a prolapse of the vertebral column towards the front of the body, often caused by the destruction of the vertebral body itself. This destruction can be in the form of a trauma type injury, such as a fracture or burst injury to the vertebral body, or a non-traumatic deformity caused by a tumor or a degeneration of the bone in the vertebral body.

[0004] Treatment of a kyphosis in the thoracic or lumbar spine appears now to be best achieved through an anterior approach, particularly in order to avoid some of the more severe complications associated with support or replacement of a damaged vertebral body. In most treatments of a kyphosis, a high degree of anterior reconstruction of the spine is required, most frequently involving total removal of the damaged vertebral body. In a typical anterior approach, partial or total ablation of the vertebral body and the two adjacent vertebral discs is carried out. Following this vertebrectomy, a vertebral implant assembly may be used to restore the vertebral column to the correct orientation.

[0005] One implant that may be used is disclosed in U.S. Pat. No. 6,344,057 to Rabbe et al. ("Rabbe patent"), which is hereby incorporated by reference. The implant disclosed in the Rabbe patent is an adjustable vertebral implant assembly configured to span the void created by the removed vertebral body and discs. The assembly includes a thin-walled tubular body which defines a hollow interior and further includes endplates with end surfaces configured to engage the tubular body between the adjacent vertebrae. In some embodiments, the end surfaces defines a bore through the endplate.

[0006] Current surgical spinal reconstruction techniques can use a plurality of wrenches to expand or otherwise manipulate rotationally adjustable implants, such as the assembly disclosed in the Rabbe patent. However, a wrench requires lateral translation which, in the confined area of the wound, can require an enlarged wound and increased labor and time. It must also relocate and reattach to the implant after each turn, which is both difficult and time consuming.

SUMMARY

[0007] The present invention provides an apparatus for installing a vertebral implant assembly, having a tubular body and a pair of endplate assemblies, between two vertebral endplates. The apparatus comprises an axle having a proximal end and a distal end, a set of gears connected to the proximal end of the axle, and an engager device connected to the set of gears and adapted to rotate the tubular body when the axle is rotated, wherein the rotation of the tubular body expands the vertebral implant assembly.

[0008] In one embodiment, the apparatus further comprises a plurality of gears selectively engaged with the axle.

[0009] In another embodiment, the engager device comprises a toothed section configured to engage apertures on the vertebral implant assembly.

[0010] In another embodiment, the engager device comprises a positioning mechanism for at least partially surrounding the vertebral implant assembly.

[0011] In another embodiment, the apparatus further comprises a holding instrument to resist movement of the vertebral implant assembly during expansion.

BRIEF DESCRIPTION OF THE DRAWINGS

[0012] **FIG. 1** is an perspective view of a destroyed vertebral body within a vertebral column (in shadow) and a vertebral implant assembly according to one embodiment of the present invention positioned within the vertebral column.

[0013] **FIG. 2 a** perspective view of a vertebral implant assembly coupled with a portion of an expansion apparatus according to one embodiment of the present invention.

[0014] **FIG. 3** is a perspective view of an expansion apparatus according to an embodiment of the present invention.

[0015] **FIG. 4** is a cross-sectional view of a portion of the expansion apparatus of **FIG. 3**.

[0016] **FIG. 5** is a partial cross-section of a portion of the expansion apparatus of **FIG. 3**.

[0017] **FIGS. 6*a*** and **6*b*** are perspective views of a holding instrument used with the expansion apparatus of **FIG. 3**.

DETAILED DESCRIPTION

[0018] Referring to **FIG. 1, a** vertebral column **10** includes a damaged vertebra **12*a*** (shown in phantom) extending between a vertebra **12*b*** and a vertebra **12*c***. An intervertebral disc **14*a*** (shown in phantom) extends between vertebrae **12*a*** and **12*b*,** and an intervertebral disc **14*b*** (shown in phantom) extends between vertebrae **12*a*** and **12*c***. In a surgical excision, the vertebra **12*a*** can be removed together with discs **14*a*** and **14*b*** creating a void between the two intact vertebra **12*b*** and **12*c***. This procedure may be performed using an anterior, anterolateral, or other approach known to one skilled in the art. A vertebral implant assembly **20** as described in the Rabbe patent can then be provided to fill the void between the two intact vertebrae **12*b*** and **12*c***.

[0019] Referring now to **FIG. 2**, the vertebral implant assembly **20** is shown as a turnbuckle in accordance with one embodiment of the present invention. The implant assembly **20** generally includes a threaded tubular body **22** extending between threaded endplate assemblies **24** and **26**. The threaded tubular body **22** is provided with a plurality of apertures **28** that may be used for installation of the assembly **20** and that may also provide an avenue for bone or tissue ingrowth to further enhance the stability of the replacement assembly after implantation. In the present embodiment, the opposite ends of the tubular body **22** are formed into external threads **30**. The threads **30** may extend from each opposite end over most or all of the length of the tubular body **22** and may be configured to threadedly engage endplate assemblies **24** and **26**.

[**0020**] The endplate assembly **24** may include a flange **32**, which may cover a substantial load-bearing area of the endplates of the adjacent intact vertebral bodies. A cylinder **34** may be integrally formed with flange **32** to extend toward the threaded tubularl body **22** when the endplate assembly **24** is placed within the excised vertebral space. The cylinder **34** and flange **32** define a bore **36** there through. The inside surface of the bore **36** is provided with internal threads **38** which are configured to mate with the external threads **30** of the tubular body **22**. In one embodiment, the threads **38** extend along the entire length of the cylinder **34** and into the flange **32**. Endplate assembly **26** may be configured similar or identical to endplate assembly **24** and therefore will not be described in detail. The endplate assemblies **24** and **26** may further include one or more apertures **40** configured to engage a holding instrument (as described below for **FIGS. 6***a* and **6***b*).

[**0021**] In one specific embodiment, the external threads **30** on the threaded tubular body **22** may be cut in opposite directions (e.g., right handed and left handed) so that the endplates can be drawn together or apart by rotating only the body. Thus, as the body is rotated in one direction, the threads **30** at each of the ends engage the internal threads **38** of each of the end caps **24** and **26** in the proper direction to draw the end caps together. Alternatively, the handedness of the threads **30** can be the same at each end so that it is necessary to individually thread each end cap in opposite directions onto the tubular body **22**. The disadvantage of this arrangement is that it is more difficult to adjust the height of the total assembly **20** while maintaining the proper orientation of each of the endplate assemblies **24** and **26**. An advantage is that in situ the assembly is unable to unthread itself. Further details of the assembly **20** and its operation are described in the embodiments shown in the Rabbe patent.

[**0022**] The assembly **20** may be inserted into the vertebral column (as shown in **FIG. 1**) and then expanded to achieve the desired fit and alignment between the adjacent intact vertebrae. In one embodiment, expansion of the assembly can be achieved by rotating the tubular body **22** using an expander apparatus **50** as shown in **FIG. 3**.

[**0023**] Referring now to **FIG. 3**, in accordance with one embodiment of the present invention, the expander apparatus **50** includes a handle section **52**, an extension section **54**, a main gear box **56** and an engager **58**. The expander apparatus **50** may allow the assembly **20** to be adjusted without the use of lateral movement, thereby reducing the size of a patient's wound and decreasing the time and labor involved to complete the procedure.

[**0024**] Referring to both **FIG. 3** and **FIG. 4**, the handle section **52** can receive and enclose a portion of the extension section **54**. In the present embodiment, the extension section **54** may comprise an outer casing **60** through which an interior axle **62** may extend. The handle section **52** may include a handle **64** that receives, surrounds and rotationally engages the outer casing **60** of the extension section **54** through one or more bushings **66**. It is understood that in other embodiments, the rotational engagement of the outer casing **60** may be accomplished using ball bearing assemblies and/or the material comprising the handle **64**. Although not shown, in some embodiments, the handle **64** may be separated into two independent portions, with one portion being fixed to the outer casing **60** to secure and position the expander apparatus **50** during use, and the other portion being free to rotate for providing the rotational force discussed below.

[**0025**] In the present embodiment, the handle section **52** may further include a distally located selector gear box **70**. The selector gear box **70** may include a set or plurality of gears **72***a,* **72***b,* **72***c* configured to selectively engage with the distal end of the interior axle **62** of the extension section **54**. Each of the gears **72***a,* **72***b,* and **72***c* may be of a different size so that a user of the expander apparatus **50** may choose from a range of selectable gear ratios, enabling the user to achieve a desired speed or torque for adjusting the vertebral implant assembly **20**. The selector gear box **70** may be configured to engage with a cap member **74**. The cap member **74** can be both axially and rotationally movable about the handle **64** and can further include a gear selection member **76** which, as the cap member **74** is moved, can engage any of the different gears **72***a,* **72***b,* or **72***c* to create the desired gear ratio.

[**0026**] Although the present embodiment depicts three gears, it is understood that in other embodiments a fewer or a greater number of gears may be used. Further, any of a variety of gear train systems may be employed incorporating a variety of gear components such as a planetary gear systems, a layshaft, a clutch, a worm gear system, a bevel gear system, a rack and pinion system, or other gear based systems. In the present embodiment, the cap member **74** rotates or translates about the handle **64** to select a particular gear, but other gear selection mechanisms can also be used. In some embodiments, the selector gear box may not be located in the handle section **52**, but rather, may be included in the extension section **54** or elsewhere in the expander tool **50**.

[**0027**] Although not shown, in another embodiment, the selector gear box **70** may be omitted and the distal end of the axle **62** may be fixedly engaged with the gear selection cap **74** and/or a rotating portion of the handle section **52**. In this embodiment, the rotation of the axle **62** may be directly driven by rotation of the gear selection cap **74**. In still another embodiment, the axle **62** may be driven by a motor coupled to the axle **62** or to the selector gear box **70**.

[**0028**] Referring now to **FIG. 5**, while one end of the extension section **54** engages with the handle section **52**, the opposite end may engage with the main gear box **56**. The main gear box **56** may include a main gear/tooth assembly **80** and a secondary gear assembly **82**. The main gear/tooth assembly **80** can be partially enclosed and secured within a casing **83**, and can include a gear section **84** coaxially attached to a toothed section **86**. The casing **83** may include a pin **88** about which the main gear/tooth assembly **80** can rotate. In the present embodiment, the rotational axis of the pin **88** and the gear section **84** may be aligned perpendicular to the rotational axis of the axel **62**, although different embodiments may have different arrangements.

[**0029**] The secondary gear assembly **82** may be attached to the proximate end of the interior axle **62**, opposite from the end engaged with the selector gear box **70**, and may rotate about the axis of the axle **62**. The secondary gear assembly **82** may engage with the gear section **84** of the main gear/tooth assembly **80** causing any rotational force from the axle **62** to be transferred to the main gear/tooth assembly **80**.

[**0030**] Referring to **FIGS. 2 and 5**, the main gear box **56** can be further connected to the engager **58**. The casing **83** of the main gear box **56** may be attached to a positioning mechanism **90**, which in the embodiment of **FIG. 2** is shaped like a semi-circle with opposing arc portions **92***a* and **92***b*. The arc portions **92***a* and **92***b* can define a cross-section of an engagement area **91** into which the implant assembly **20** may be positioned. The positioning mechanism **90** is shaped to mate with the tubular body **22** of the implant assembly **20**, allowing the tubular body **22** to rotate while assisting in maintaining the general position and proximity of the engager **58** to the tubular body **22**.

[**0031**] As described above, the casing **83** may cover only a portion of the main gear/tooth assembly **80**. The other portion, which can include the tooth section **86**, may extend into the engagement area **91** of the engager **58**. The tooth section **86** may include a plurality of teeth **93** that are sized, spaced, and shaped to engage the apertures **28** on the tubular body **22** when the tubular body **22** is positioned in the engagement area **91**. With the endplate assemblies at least tentatively affixed to the adjacent vertebral endplates, the tubular body **22** can rotate as the tooth section **86** is rotated. Furthermore, the positioning mechanism **90** and the arrangement of the apertures **28** can minimize any translation of the tubular body **22**, ensuring that the next tooth **93** easily locates and engages the next aperture **28**, to thereby maintain the rotation. In the present embodiment, the teeth **93** are radially arranged on the tooth section **86** in a gear-like configuration. In other embodiments, a toothed belt or another gripping mechanism can be used to drive the rotation of the tubular body **22**.

[**0032**] Referring more specifically to **FIG. 5**, in some embodiments, the positioning mechanism **90** is shaped more like a "C." In these embodiments, the positioning mechanism **90** also helps to prevent the engager **58** from accidentally disengaging from the replacement assembly **20**. In one embodiment, the opposing arc portions **92***a*, **92***b* are selectively pivotable about pins **94***a* and **94***b* with friction keeping the arc portions **92***a*, **92***b* either open or closed. In the open position, the tubular body **22** can be positioned in or removed from the engagement area **91**. In the closed position, the arc portions **92***a* and **92***b* aid in keeping the positioning mechanism **90** engaged to the tubular body **22** while the body rotates. It is understood, that other embodiments may use a clip, a spring, or some other means of engagement to selectively allow the positioning mechanism **90** to remain engaged.

[**0033**] In some embodiments, the positioning mechanism **90** may be configured to more securely maintain the desired position of implant assembly **20**. For example, the positioning mechanism **90** may extend laterally along the tubular body **22** to restrain the assembly **20** from pivoting about its longitudinal axis. Another example (e.g. **FIG. 6***a* and **6***b*) may include a second positioning mechanism **90** extending from the casing **83** in which case the assembly **20** can be held in position by arc positions both above and below the tooth section **86**.

[**0034**] Referring now to FIGS. **1**-**5**, in operation, once the implant assembly **20** is placed in position between the endplates of the two adjacent vertebrae **12***b* and **12***c* (as shown in **FIG. 1**), the expander apparatus **50** may be positioned within the surgical area proximate to the implant assembly **20**. It is understood, however, that in some instances the expander apparatus **50** can be used to facilitate the placement of the assembly **20** inside the vertebral column **10**. The expander apparatus **50** is positioned so that the engager **58** is engaged with the tubular body **22** of the implant assembly **20**. Specifically, at least one of the teeth **93** may engage one of the apertures **28**. The handle **60** can extend away from the vertebral column **10**, for example, in an anterior surgical approach, the handle may be positioned in the anterior area of the patient, within easy reach of the surgeon.

[**0035**] After the expander apparatus is in place, the surgeon can rotate or axially translate the cap member **74** to engage the appropriate gear **72***a*, **72***b*, **72***c* to achieve the desired gear ratio, although it is understood that in some embodiments the selector gear box **70** can be omitted. The surgeon can then turn either the handle **64** or the rotatably movable portion of the handle **64** around the axis of the interior axle **62** to expand (or contract, if necessary) the implant assembly **20**. Specifically, the rotation of the handle **64** or handle portion is transferred through the gear box **70** to rotate the axle **62**. The axle, in turn, rotates the secondary gear assembly **82**, which rotates the gear section **84**. The rotation of the gear section **84**, causes the fixedly attached tooth section **86** to rotate which, in turn moves the teeth **93**. With the endplate assemblies **24** and **26** held immovably in place by compression of the vertebral endplates, by structural features of the endplate assemblies **24** and **26**, or by mechanical means, the movement of the teeth **93** can cause the tubular body **20** to rotate which may cause the endplate assemblies **24** and **26** to move relative to one another, thereby expanding, contracting, or otherwise adjusting the implant assembly **20**.

[**0036**] Referring now to **FIGS. 6***a* and **6***b*, in this embodiment, a holding instrument **100** may be coupled to the expander apparatus **50** to hold the implant assembly **20** in position during the expansion, all the while minimizing backlash or lateral movement of the assembly **20**. The holding instrument can be attached to the extension section **54** by an attachment device **102** which may include one or more rings **104** configured for fastening to the outer casing **60**. The one or more rings **104** may be fixedly attached to the extension section with one or more fastening mechanisms **106** which can be, for example, screws. In one alternative embodiment, to avoid interference with the interior axle **62** running through the extension section **54**, the fastening mechanisms **106** may engage a protrusion (not shown) extending from the outer casing **60**.

[**0037**] A plurality of expansion members **108** may connect the attachment device **102** to a pair of alignment arms **110** and **112**. Each expansion member **108** may be a rigid bar pivotally connected at one end to the attachment device **102** and at the opposite end to one of the alignment arms **110** or **112**. In alternative embodiments, the expansion member may be a spring, an elastic member, or another mechanism capable of expanding with the alignment arms **110** and **112** as the implant **20** is expanded. An alignment member **114** may further extend between the alignment arms **110** and **112** and may be adjustable to maintain a relatively parallel alignment of the alignment arms. Each of the alignment arms **110** and **112** extend toward the engagement area **91** where the ends of each alignment arm **110** and **112** are configured with holding assemblies **116** and **118**, respectively. The holding assemblies **116** and **118** may be arc-shaped to accept the assembly **20** and may further include fasteners **120** for engaging the apertures **40** on the endplate assemblies **24** and **26** to maintain the assembly **20** in a generally rigid vertical position while the assembly **20** is expanded. The fasteners may be, for example, pins, screws, or clamps. In some embodiments, the holding assemblies **116** and **118** may fasten to the endplate assemblies **24** and **26** without engaging the apertures **40**.

[**0038**] Referring still to **FIGS.** **6***a* and **6***b*, in operation, once the implant assembly **20** is placed in position between the endplates of the two adjacent vertebrae **12***b* and **12***c* (as shown in **FIG. 1**), the expander apparatus **50** with the attached holding instrument **100** may be positioned within the surgical area proximate to the implant assembly **20**. It is understood, however, that in some instances the expander apparatus **50** and holding instrument **100** can be used to facilitate the placement of the assembly **20** inside the vertebral column **10**. The expander apparatus **50** is positioned so that the engager **58** is engaged with the tubular body **22** of the implant assembly **20**. Specifically, at least one of the teeth **93** may engage one of the apertures **28**. To further secure the implant assembly **20**, the pins **120** may be engaged with the apertures **40** on the endplate assemblies **24** and **26**. The handle **60** can extend away from the vertebral column **10**, for example, in an anterior surgical approach, the handle may be positioned in the anterior area of the patient, within easy reach of the surgeon.

[**0039**] After the expander apparatus is in place, the surgeon can rotate or axially translate the cap member **74** to engage the appropriate gear **72***a*, **72***b*, **72***c* to achieve the desired gear ratio. It is understood that in some embodiments the selector gear box **70** can be omitted. The surgeon can then rotate either the handle **64** or the rotatably movable portion of the handle **64** along the axis of the interior axle **62** to expand (or contract, if necessary) the implant assembly **20**. Specifically, the rotation of the handle **64** or handle portion is transferred through the gear box **70** to rotate the axle **62**. The axle, in turn, rotates the secondary gear assembly **82**, which rotates the gear section **84**. The rotation of the gear section **84**, causes the fixedly attached tooth section **86** to rotate which, in turn moves the teeth **93**.

[**0040**] With the endplate assemblies **24** and **26** held immovably in place by the holding instrument **100**, the movement of the teeth **93** can cause the tubular body **20** to rotate, which in turn can cause the endplate assemblies **24** and **26** to move relative to one another, thereby expanding (or contracting, if necessary) the implant assembly **20**. As the implant assembly **20** expands, the expansion members **108** may pivot to allow the alignment arms **110** and **112** to move apart while remaining in relatively parallel alignment. As the alignment arms **110** and **112** move, the alignment member **114** may adjust to further preserve the parallel alignment of the alignment arms **110** and **112**. After the implant assembly **20** has attained the desired height, the pins may be removed from the apertures **40**, disconnecting the holding instrument **100** from the implant assembly **20**.

[**0041**] Although only a few exemplary embodiments of this invention have been described in detail above, those skilled in the art will readily appreciate that many modifications are possible in the exemplary embodiments without materially departing from the novel teachings and advantages of this invention. Accordingly, all such modifications are intended to be included within the scope of this invention.

What is claimed is:

1. An apparatus for installing a vertebral implant assembly, having a tubular body and a pair of endplate assemblies, between two vertebral endplates, the apparatus comprising:

an axle having a proximal end and a distal end;

a set of gears connected to the proximal end of the axle; and

an engager device connected to the set of gears and adapted to rotate the tubular body when the axle is rotated,

wherein the rotation of the tubular body expands the vertebral implant assembly.

2. The apparatus of claim 1 further comprising

an outer casing and

a handle section connected to the distal end of the axle,

wherein the axle extends through the outer casing and at least partially into the handle.

3. The apparatus of claim 2 wherein the handle section is fixedly connected to the axle.

4. The apparatus of claim 2 wherein the handle section rotationally engages the outer casing.

5. The apparatus of claim 2 wherein the handle section comprises a first portion fixed to the outer casing and a second portion adapted to rotate the axle.

6. The apparatus of claim 2 further comprising a plurality of gears selectively engaged with the axle.

7. The apparatus of claim 6 further comprising a cap member movable about the handle section, wherein the cap member is adapted to select one or more of the plurality of gears to engage the axle.

8. The apparatus of claim 1 wherein the engager device comprises a toothed section configured to engage apertures on the vertebral implant assembly.

9. The apparatus of claim 1 wherein the engager device comprises a positioning mechanism for at least partially surrounding the vertebral implant assembly.

10. The apparatus of claim 9 wherein the positioning mechanism comprises a pair of selectively pivotable arc portions.

11. The apparatus of claim 8 wherein the set of gears comprises

a secondary gear assembly attached to the axle and

a gear section attached to the toothed section,

wherein the secondary gear assembly engages the gear section for translating rotation of the axle into rotation of the toothed section.

12. The apparatus of claim 1 further comprising:

an outer casing through which the axle extends, and

a holding instrument attached to the endplate assemblies of the vertebral implant assembly and further attached to the outer casing.

13. The apparatus of claim 11 wherein the holding instrument further comprises:

a pair of parallel alignment arms for the attachment to the endplate assemblies;

an attachment device for the attachment to the outer casing;

one or more expansion members extending between the attachment device and each alignment arm; and

an alignment member extending between the alignment arms for maintaining the parallel alignment of the alignment arms as the vertebral implant assembly expands.

14. A method for adjusting a vertebral implant assembly having a tubular body and a pair of endplate assemblies, the method comprising:

fixing the endplate assemblies to prevent rotation;

engaging an expander apparatus with the vertebral implant assembly, wherein the expander apparatus includes a set of gears connected between an axle and an implant engager device;

turning the axle; and

rotating the implant engager device, wherein rotating the engager device adjusts the vertebral implant assembly.

15. The method of claim 14 wherein the expander apparatus remains laterally fixed while adjusting the vertebral implant assembly.

16. The method of claim 14 further comprising:

moving the implant into a spinal column with the expander apparatus.

17. The method of claim 14 further comprising:

selecting from a plurality of gears to engage the axle, thereby adjusting the speed and torque of the rotating implant engager device.

18. The method of claim 17 further comprising:

moving a cap member about the handle to select from the plurality of gears.

19. The method of claim 14 wherein the implant engager device comprises a plurality of radially arranged teeth adapted to engage a plurality of radially arranged apertures on the tubular body and wherein the rotation of the implant engager device advances the teeth into the apertures and rotates the tubular body.

20. The method of claim 19 wherein the set of gears includes a first gear coupled to the axle and a second gear coupled to the implant engager and wherein the first gear is positioned perpendicular to and in contact with the second gear so that the rotation of the axle is translated into rotation of the implant engager device through the set of gears.

21. The method of claim 14 wherein fixing the endplate assemblies comprises attaching the endplate assemblies to a holding instrument fixedly attached to the expander apparatus and wherein the holding instrument prevents lateral movement of the vertebral implant assembly during the adjustment of the vertebral implant assembly.

* * * * *