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Swann

(54) **STAND-ALONE SPINAL CAGE**

(71) Applicant: **Karl W. Swann**, San Antonio, TX (US)

(72) Inventor: **Karl W. Swann**, San Antonio, TX (US)

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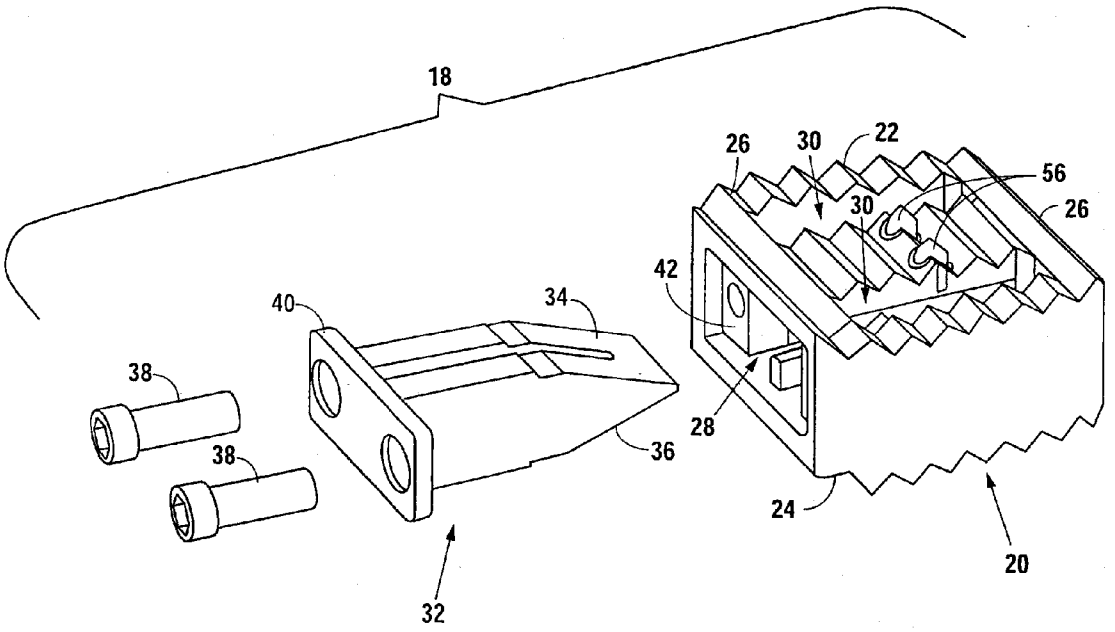
(57) **ABSTRACT**

A spinal cage device for fusion of spinal vertebrae comprising a cage body having a cavity defined by upper, lower, and side walls; a piston selectively insertable into the cavity through a side wall, the piston having at least one angled surface; at least one channel extending through at least one of the upper wall and the lower wall; at least one fastening member moveable within the at least one channel between a first disengaged position and a second engaged position; and wherein in second engaged position the at least one fastening member is held substantially stationary relative to the cage body by contact with the piston. According to one aspect of the invention, the device includes a locking means for supplementing fixation of the piston to the cage body.



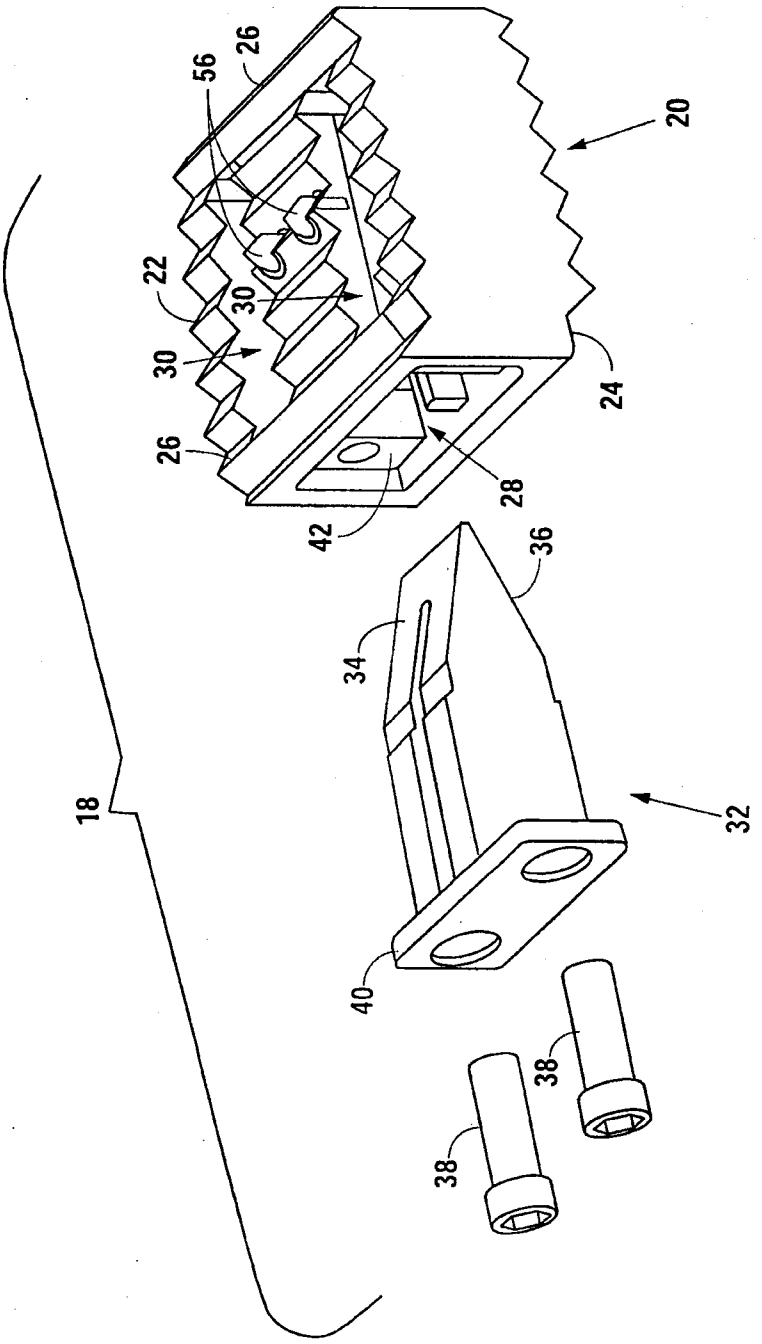


Fig. 1

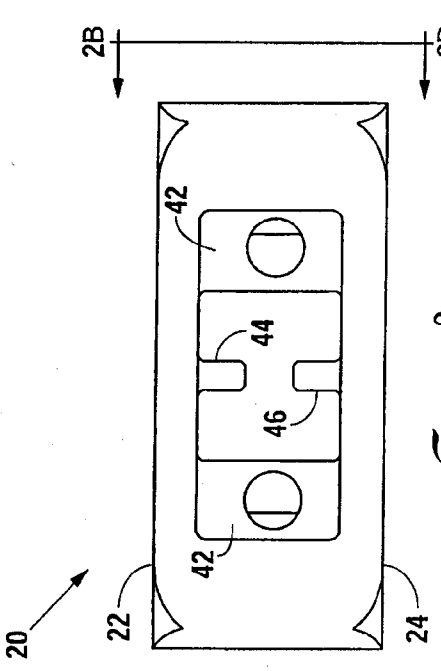


Fig. 2A

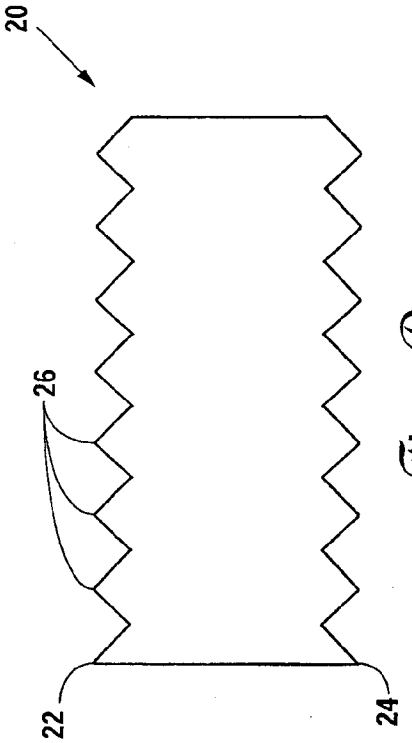


Fig. 2B

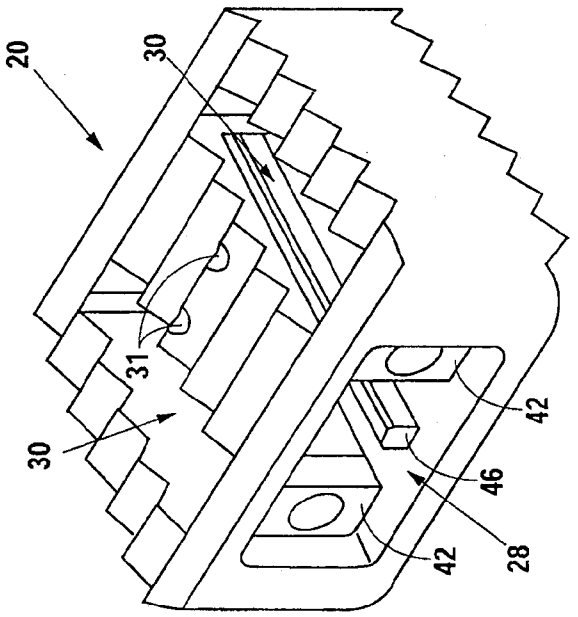


Fig. 2C

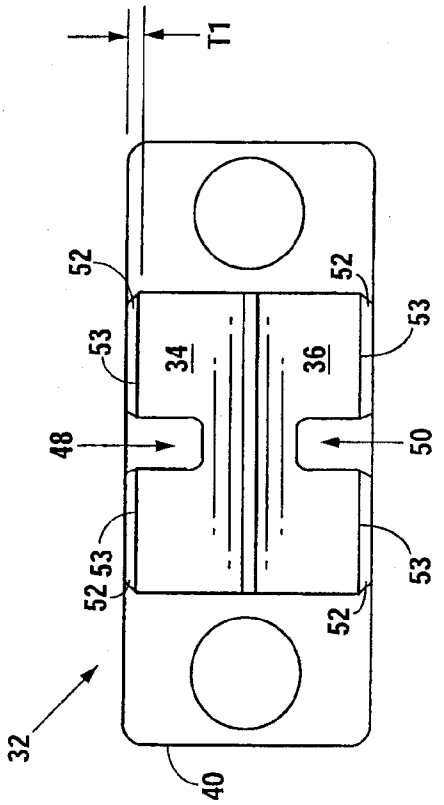


Fig. 3B

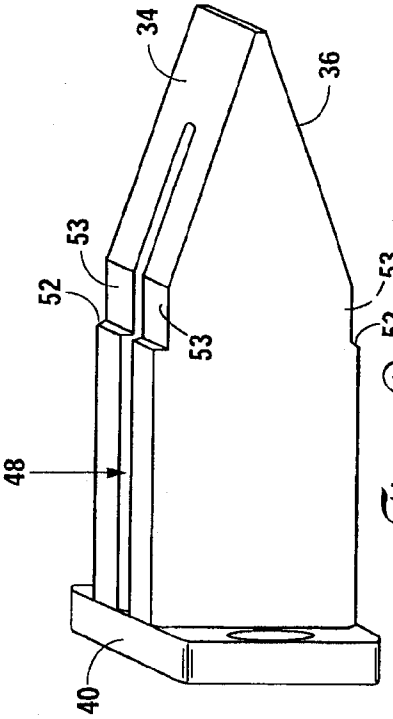


Fig. 3C

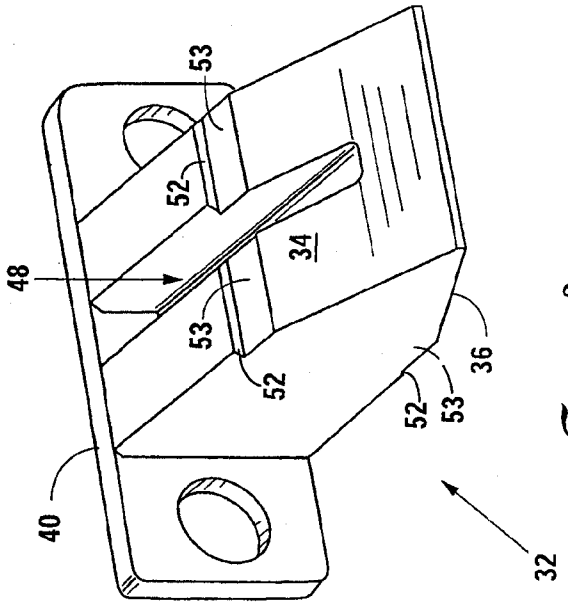


Fig. 3A

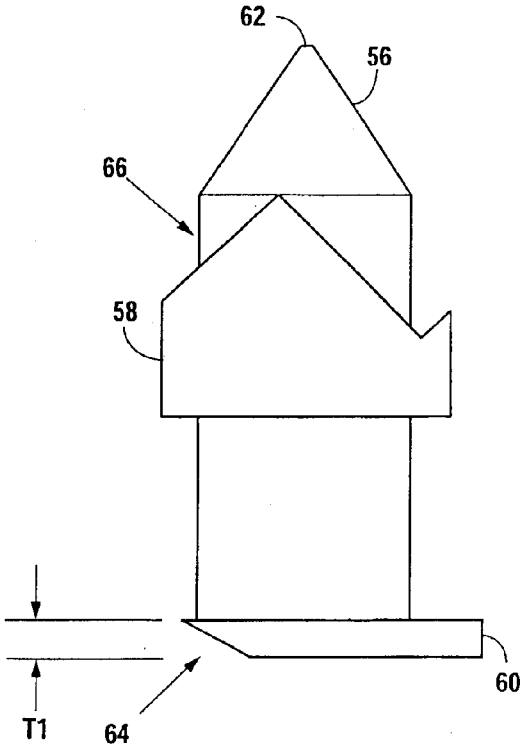


Fig. 4A

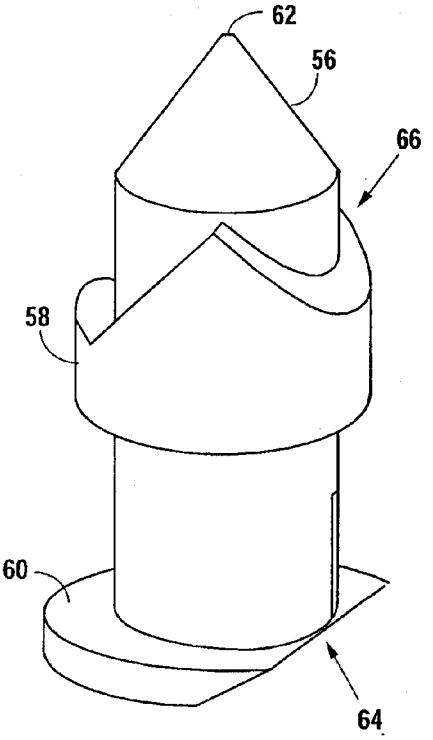


Fig. 4B

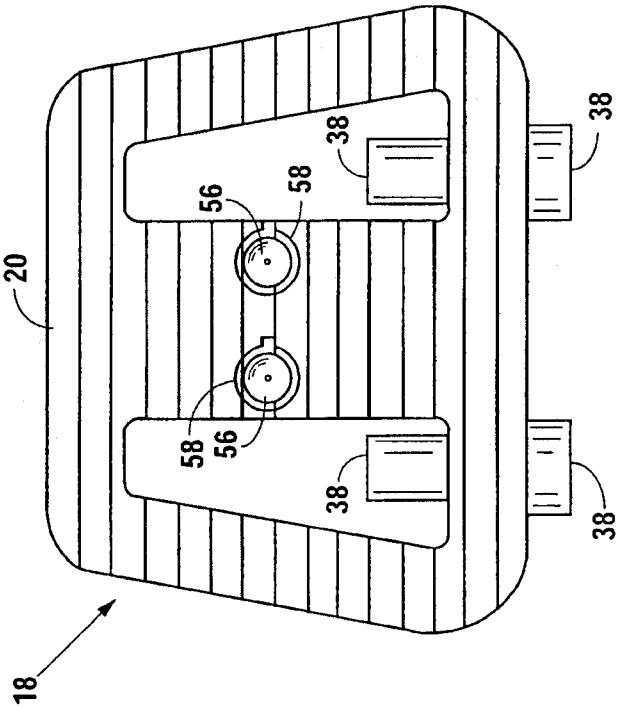


Fig. 5B

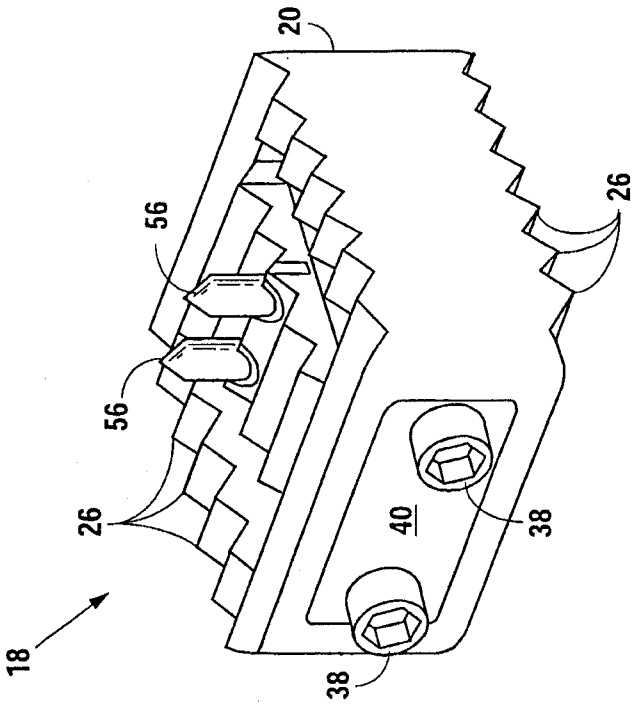


Fig. 5A

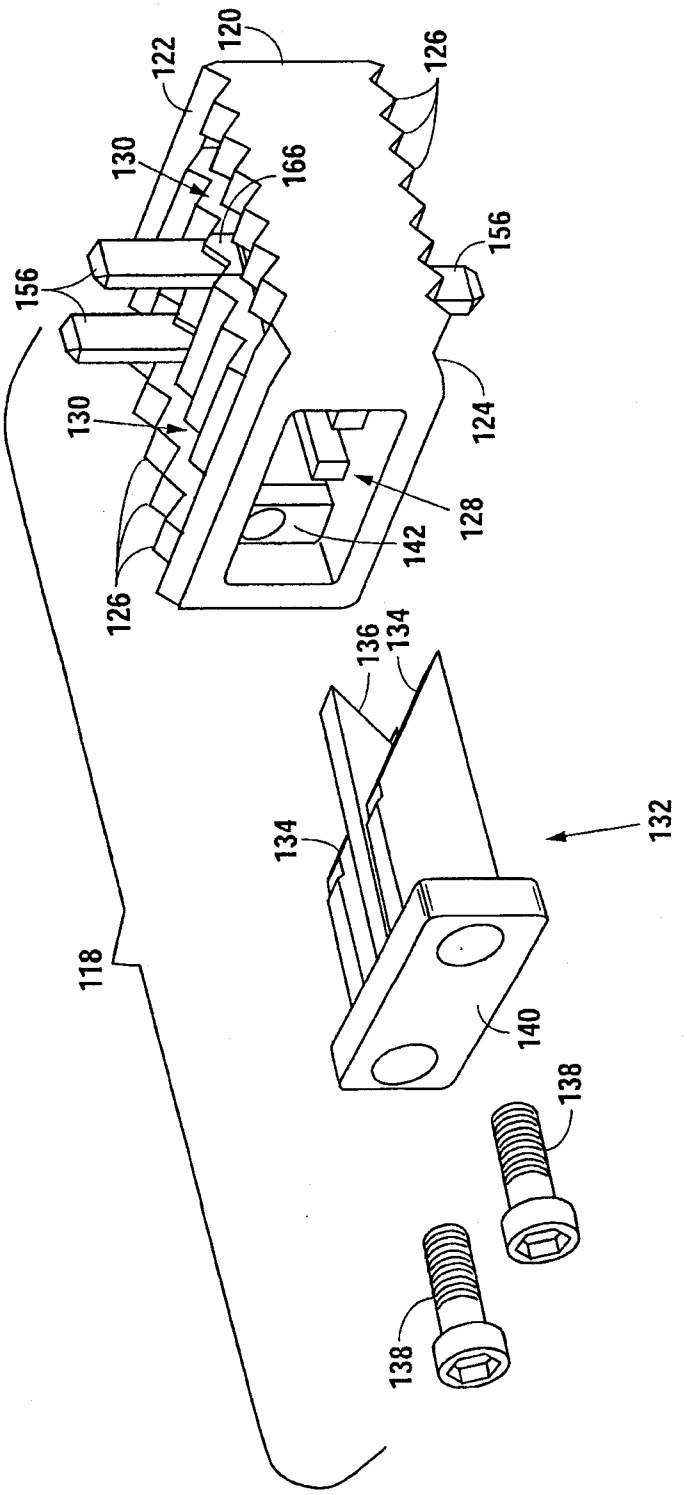

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Fig. 6

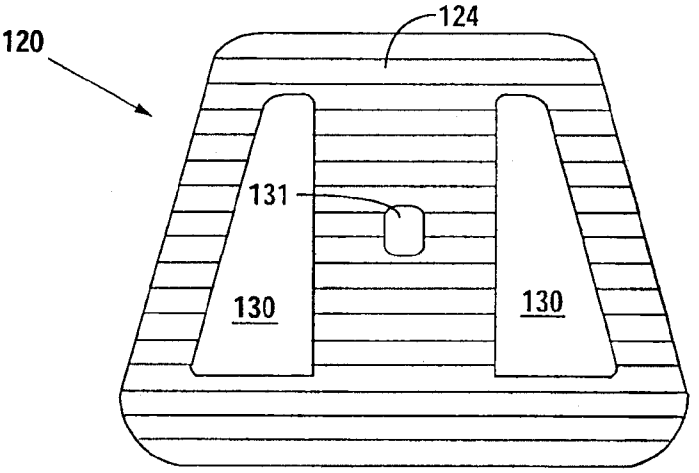

Fig. 7A

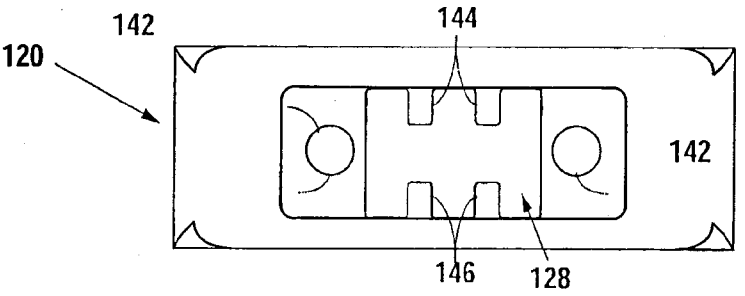

Fig. 7B

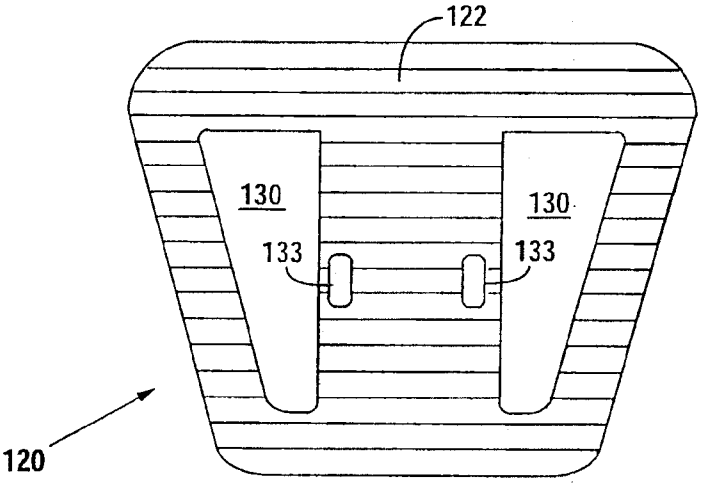

Fig. 7C

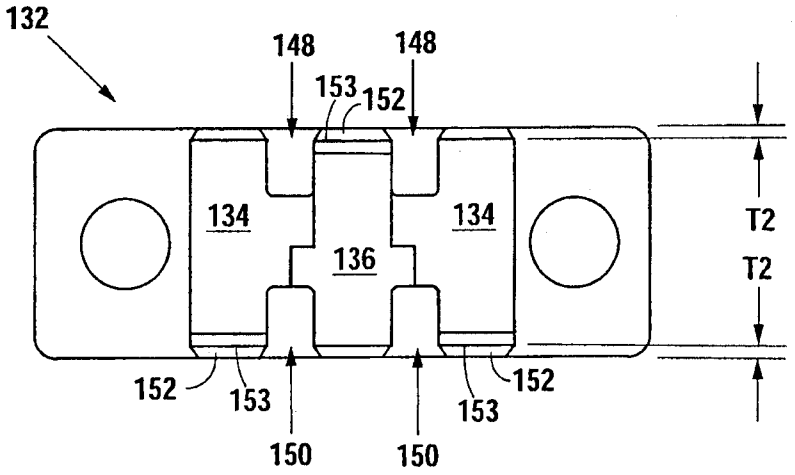
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Fig. 8A

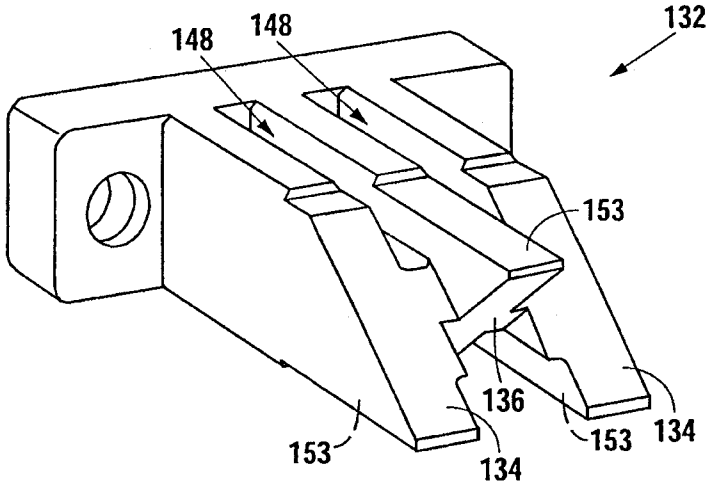
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Fig. 8B

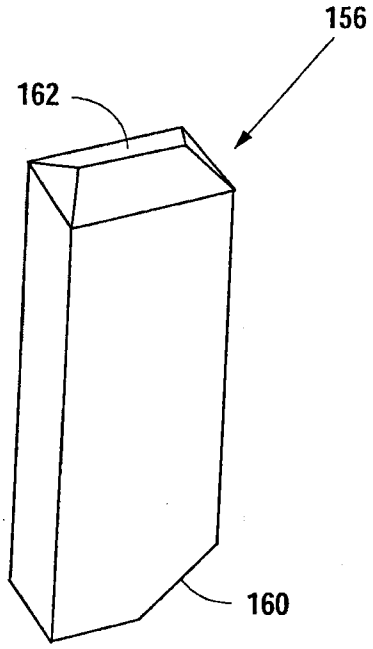

Fig. 9A

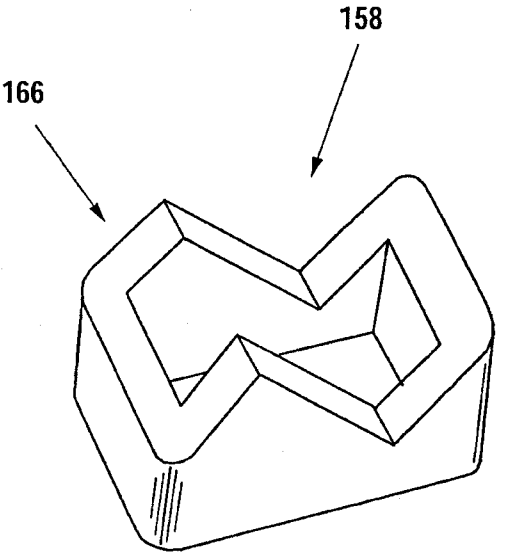

Fig. 9B

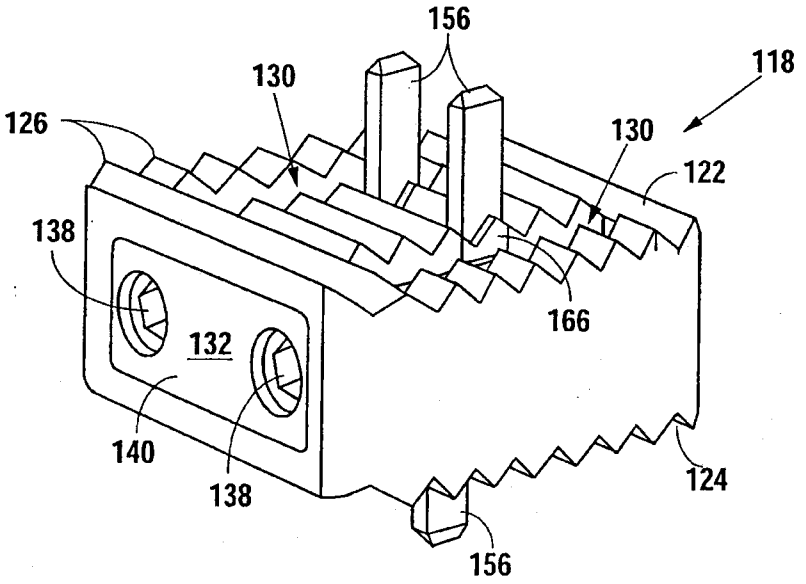

Fig. 10

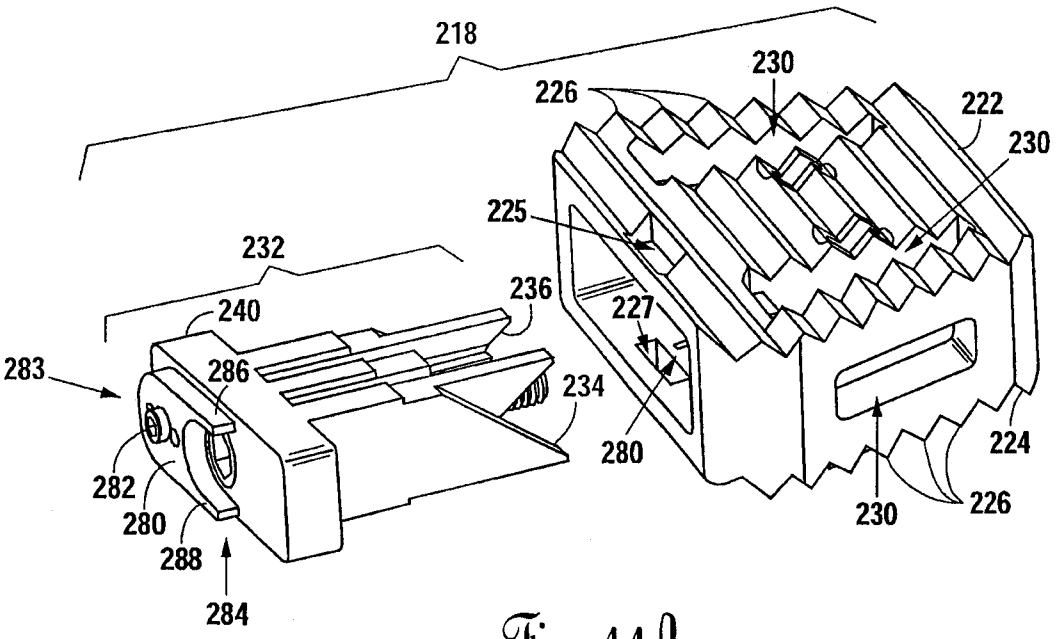

Fig. 11A

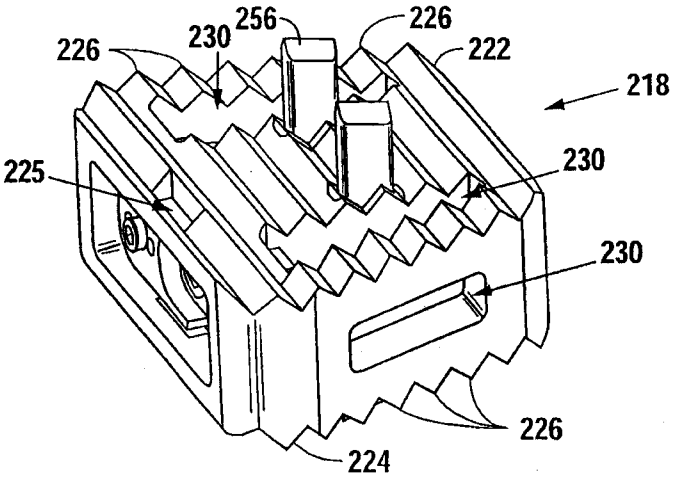

Fig. 11B

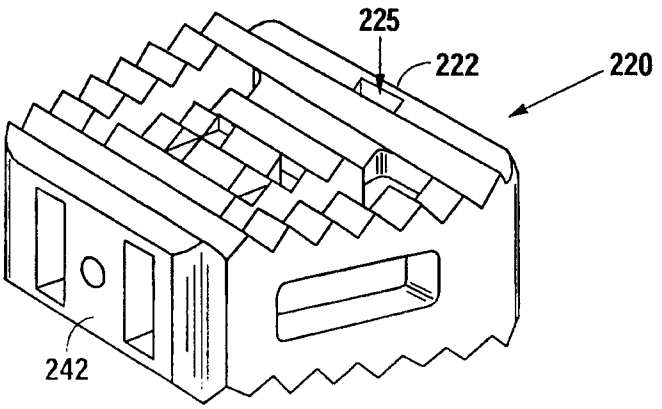

Fig. 12A

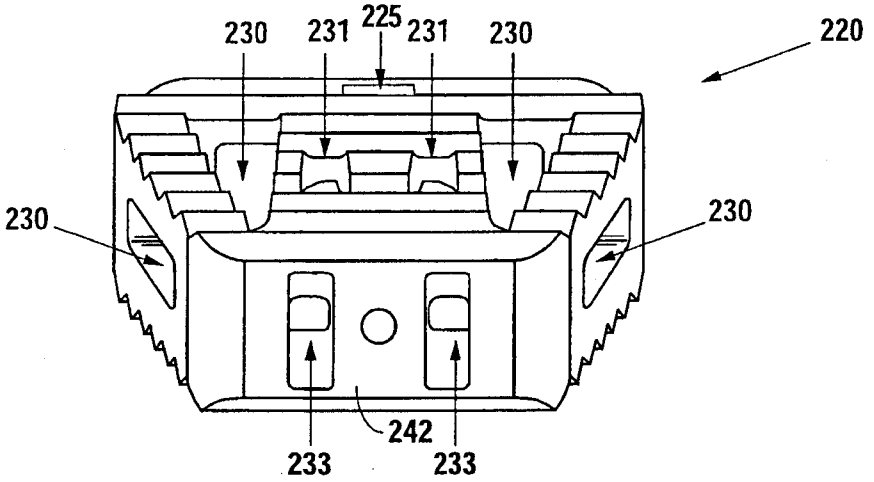

Fig. 12B

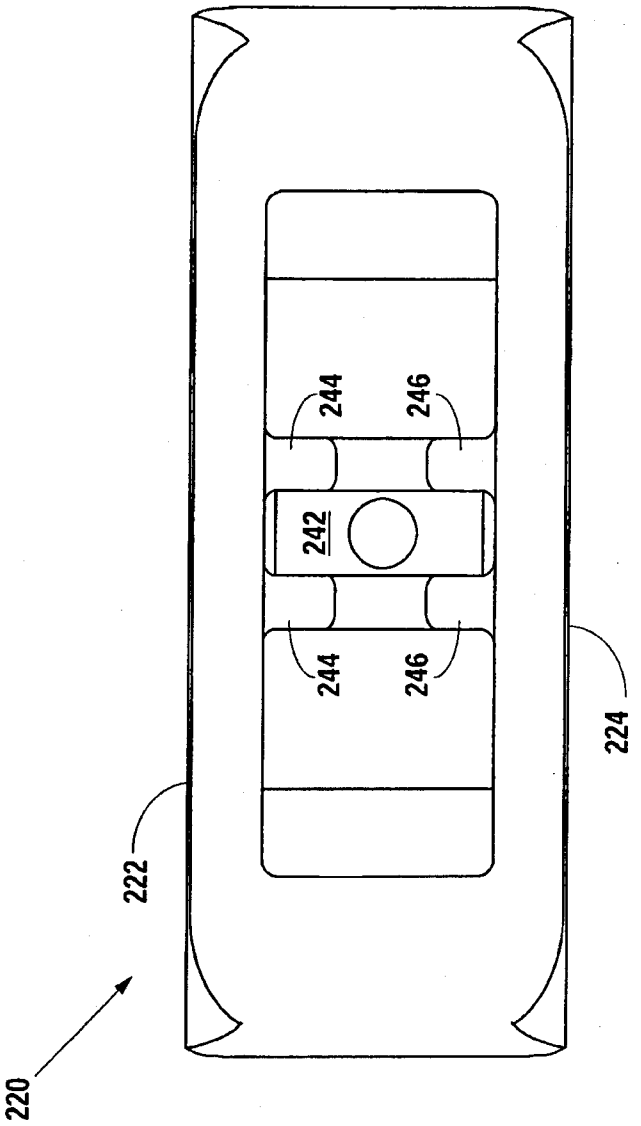

Fig. 12C

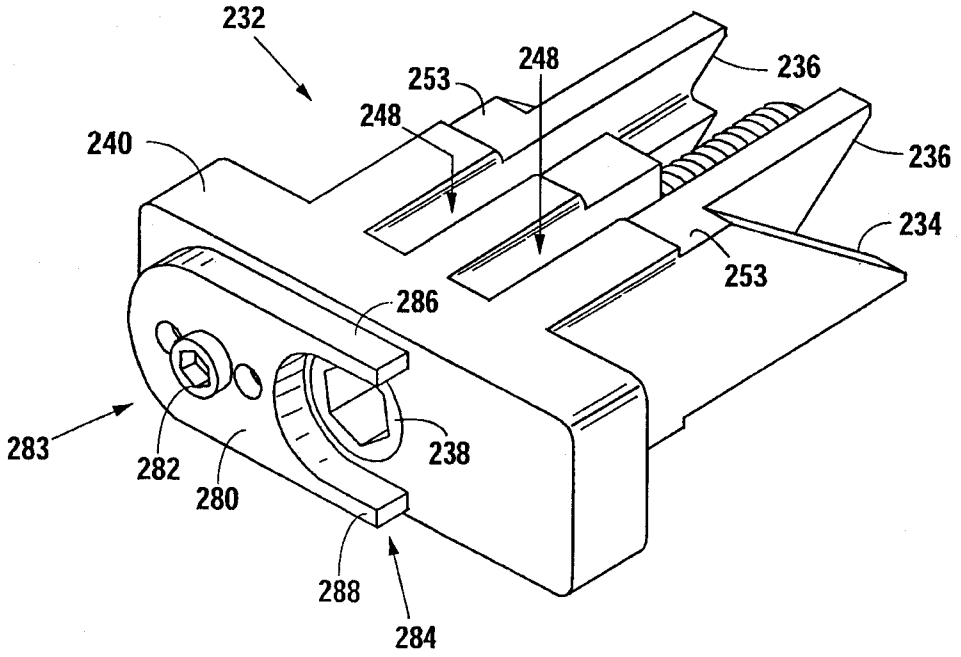

Fig. 13A

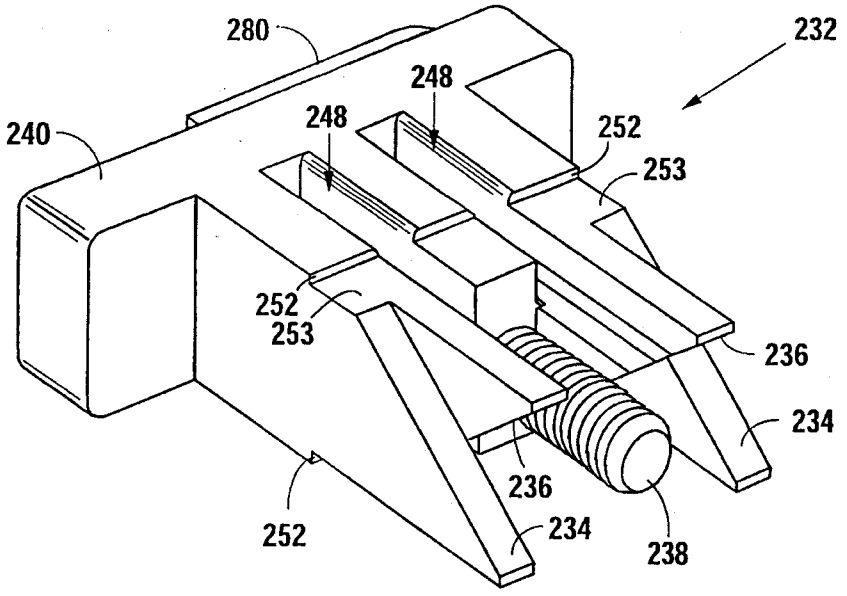

Fig. 13B

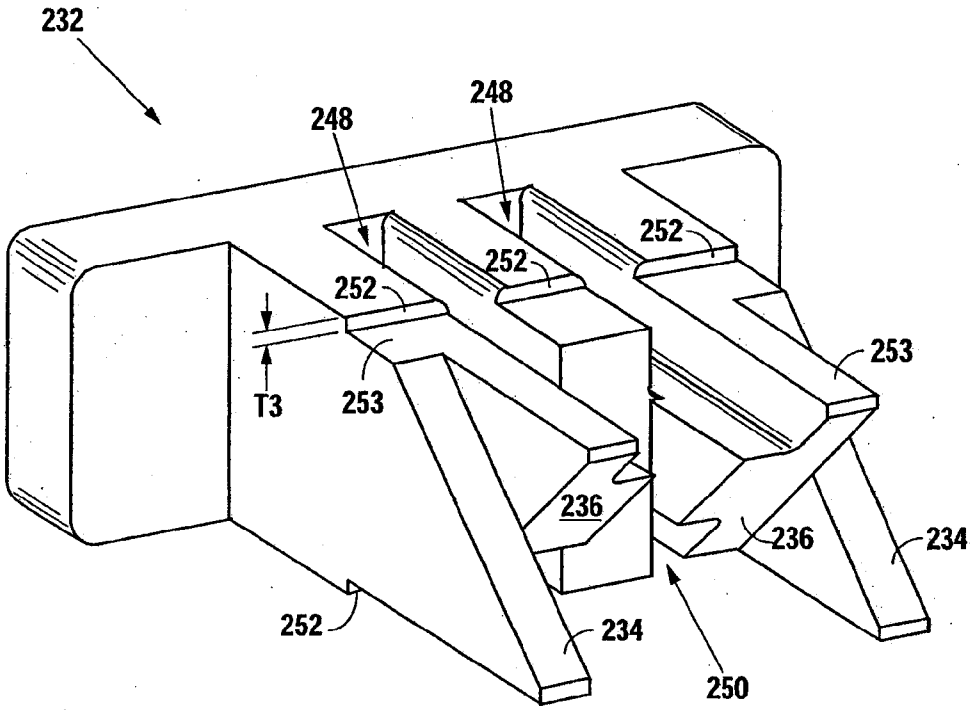

Fig. 13C

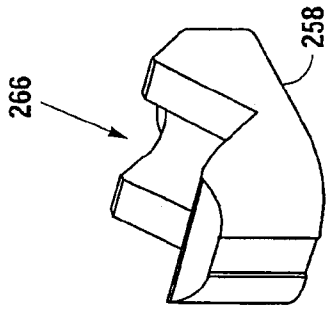

Fig. 14D

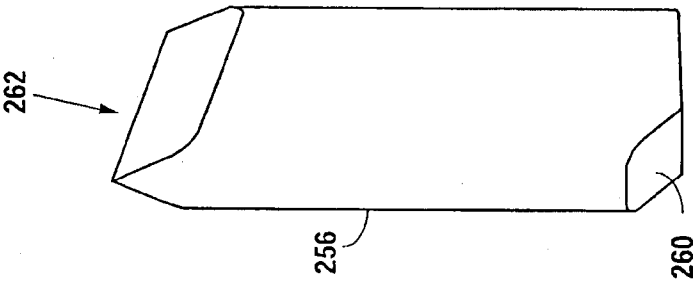

Fig. 14C

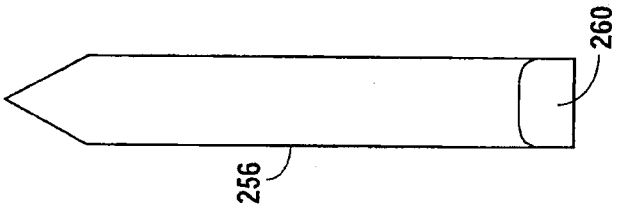

Fig. 14B

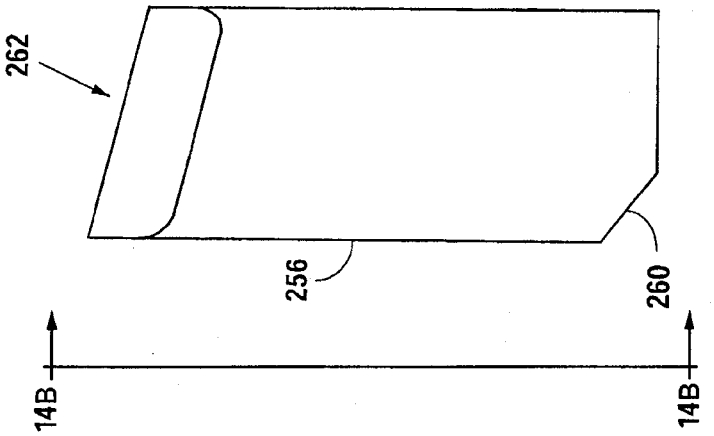

Fig. 14A

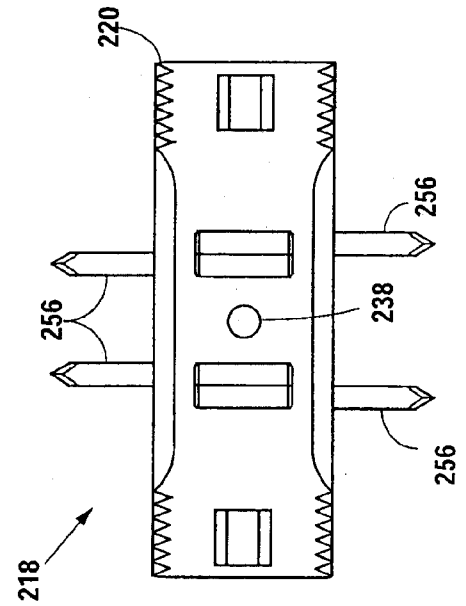

Fig. 15B

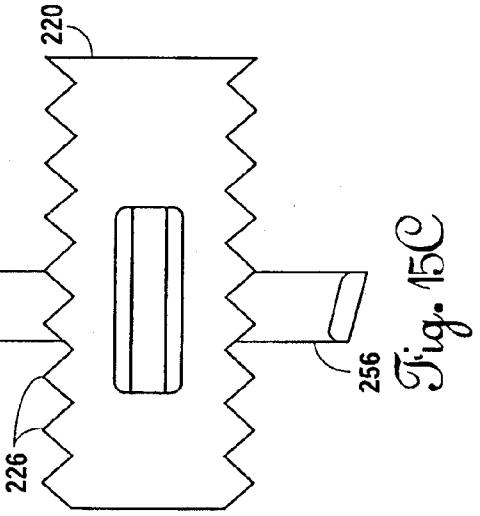

Fig. 15C

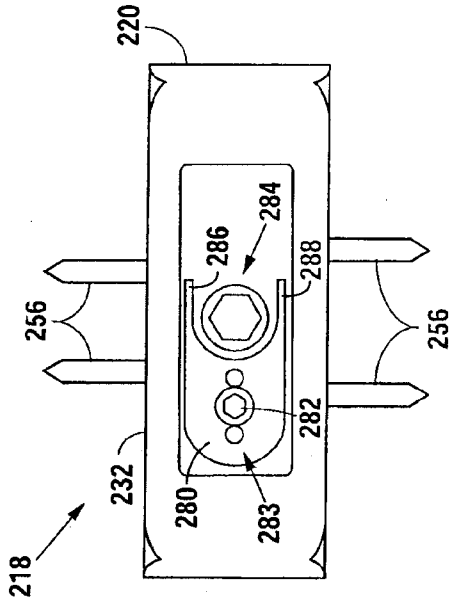

Fig. 15D

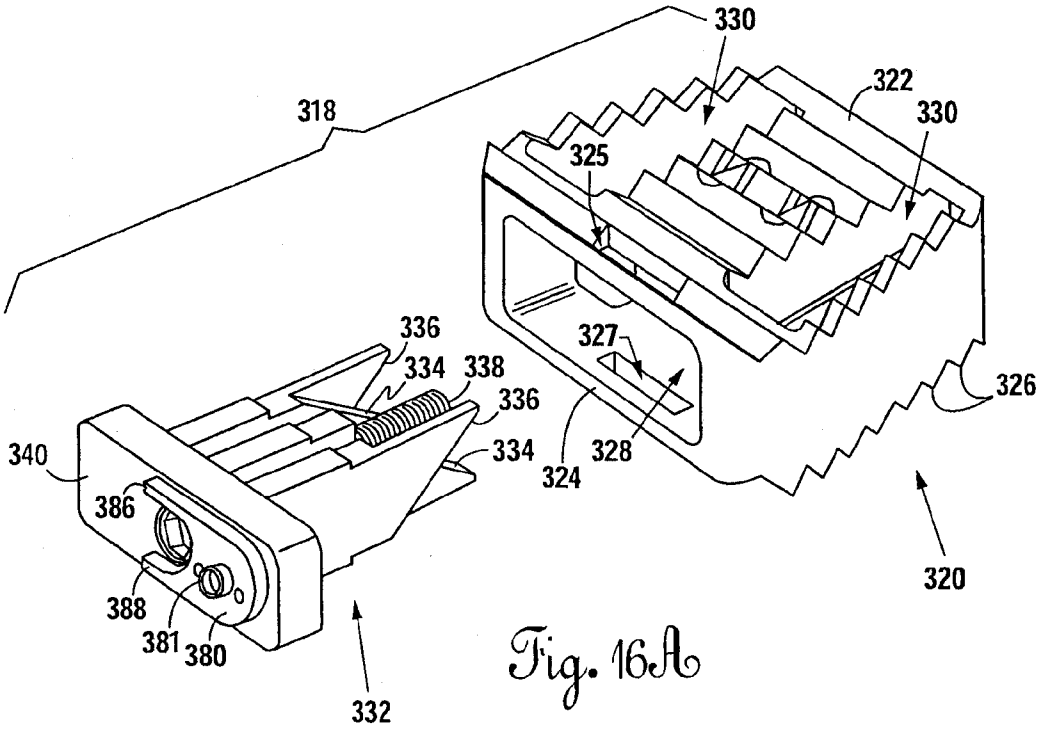

Fig. 16A

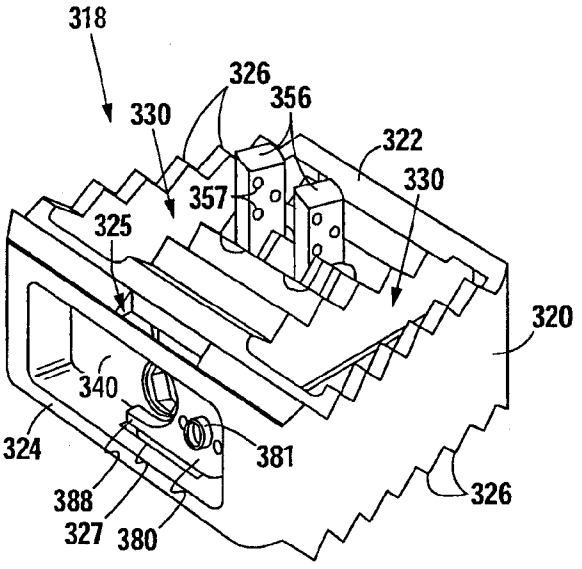

Fig. 16B

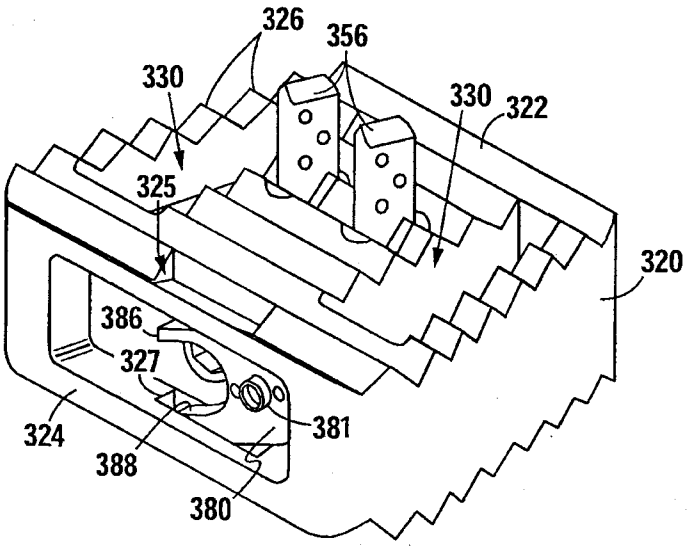

Fig. 16C

STAND-ALONE SPINAL CAGE

CROSS REFERENCE TO RELATED APPLICATIONS

[0001] This continuation patent application claims the benefit of and incorporates herein by reference, U.S. patent application Ser. No. 13/022,305, filed Feb. 7, 2011; and U.S. Provisional Application Ser. No. 61/302,088, filed Feb. 6, 2010.

BACKGROUND OF THE INVENTION

[0002] 1. Field of the Invention

[0003] The present invention relates to a spinal cage device. More specifically, the present invention is a stand-alone spinal cage designed to obviate the need for an accompanying anterior spinal plating systems.

[0004] 2. Description of the Related Art

[0005] Traditional spinal cages are often implanted with anterior plating to prevent movement of the spinal cage over time. The present invention is a stand-alone spinal cage that obviates the need to use anterior spinal plating systems.

BRIEF SUMMARY OF THE INVENTION

[0006] The present invention is a spinal cage device for fusion of spinal vertebrae comprising a cage having a cavity defined by upper, lower, and side walls; a piston selectively insertable into the cavity through a side wall, the piston having at least one angled surface; at least one channel extending through at least one of the upper wall and the lower wall; at least one fastening member moveable within the at least one channel between a first disengaged position and a second engaged position; and wherein in second engaged position the at least one fastening member is held substantially stationary relative to the cage by contact with the piston. According to one aspect of the invention, the device includes a locking means for supplementing fixation of the piston to the cage by the internal screw(s). According to another aspect of the invention, the fastening members (e.g., nails or pins) of the device are porous to allow bone growth therethrough.

BRIEF DESCRIPTION OF THE DRAWINGS

[0007] FIG. **1** is an assembly view of a first embodiment of the invention.

[0008] FIG. **2**A is a front view of the first embodiment.

[0009] FIG. **2**B is side elevation through line **2**B-**2**B of FIG. **2**A.

[0010] FIG. **2**C is a rear isometric view of the first embodiment.

[0011] FIG. **3**A-**3**C depict various views of the piston of the first embodiment.

[0012] FIG. **4**A-**4**B shows a fastening member and bushing of the first embodiment.

[0013] FIG. **5**A and **5**B are a rear isometric and a top elevation view, of the first embodiment.

[0014] FIG. **6** is an assembly view of a second embodiment of the invention.

[0015] FIG. **7**A-**7**C are a bottom, rear elevation, and top elevation of the cage of the second embodiment.

[0016] FIG. **8**A and **8**B are a front elevation and a side isometric view of the piston of the second embodiment.

[0017] FIG. **9**A and **9**B depict a fastening member and bushing, respectively, of the second embodiment.

[0018] FIG. **10** is a rear isometric view of the second embodiment.

[0019] FIG. **11**A is an assembly view of a third embodiment of the invention.

[0020] FIG. **11**B is a rear isometric view of the third embodiment.

[0021] FIG. **12**A and **12**B are a front isometric and a front view of the cage of the third embodiment. FIG. **12**C is a side elevational view of the third embodiment of Applicant's invention.

[0022] FIG. **13**A and **13**B are rear and front isometric views, respectively, of the piston, locking plate, and piston screw of the third embodiment.

[0023] FIG. **13**C is a front isometric view of the piston of the third embodiment.

[0024] FIG. **14**A-**14**C are various views of the fastening member of the third embodiment.

[0025] FIG. **14**D is a bushing of the third embodiment.

[0026] FIG. **15**A-**15**C are rear, front, and side elevations, respectively, of the third embodiment in the engaged state.

[0027] FIG. **16**A is an assembly view of a fourth embodiment of the invention.

[0028] FIG. **16**B is a rear isometric view of the fourth embodiment in an engaged state. FIG. **16**C is a perspective view of a fourth embodiment of Applicant's device.

DETAILED DESCRIPTION OF THE INVENTION

[0029] The present invention may be used in the cervical, lumbar, or thoracic regions of the spine. Some components of the embodiment described herein, such as the cage bodies, are preferably made of biocompatible OXPEKK, a poly-ether-ketone-ketone sold under the registered trademark of Oxford Performance Materials, Inc., Enfeld, Conn., USA. Alternative embodiments contemplate fabrication from biocompatible PEEK (poly-ether-ether-ketone). OXPEKK has approximately one-and-a-half to two times the compressive strength of PEEK, and therefore may be suited for constructing the cage body.

[0030] In addition to the foregoing, it should be noted that, while the embodiments described herein are solid bodies, they may also be formed as porous bodies, as described in U.S. application Ser. No. 612/952,788 (filed Nov. 23, 2010), entitled "Spinal Cage Device" and incorporated by reference herein.

[0031] While the terms "upper," "lower," "front," "rear," and similar terms are used throughout this document, it should be expressly understood that such are simply terms of convenience only to aid in description of the invention, and the orientation of the invention disclosed herein after during implantation is primarily within the surgeon's discretion.

FIRST EMBODIMENT

[0032] A first embodiment **18** of the invention is shown in FIGS. **1**-**5**. FIG. **1** is an assembly view of the first embodiment **18**, which comprises a cage body **20** having upper and lower walls **22**, **24** with ridges **26**. Upper and lower walls **22**, **24** partially define a cavity **28** of the cage body **20**. Openings **30** through the upper and lower walls **22**, **24** provide access to the cavity **28** to allow for bone growth thereinto from adjacent vertebrae. A piston **32** having upper and lower angled surfaces **34**, **36** is insertable into the cavity **28** through a piston opening in the posterior sidewall of the cage body **20** to engage and drive nails **56**. Piston screws **38** may thereafter be

inserted through a piston faceplate **40** and secured to screw mounts **42** located in the cavity **28** near the posterior opening.

[0033] FIGS. **2**A-**2**C show the cage body **20** is greater detail. Upper and lower rails **44**, **46** extend along the length of, and protrude into the cavity **28** from, the upper and lower wails **22**, **24**, respectively. Screw mounts **42** are located near the posterior side of the cavity **28**. Openings **30** through the upper wall **22** and lower wall **24** provide access the cavity **28** to allow for bone growth thereinto from adjacent vertebrae. Cylindrical channels **31** are located between the two openings **30** and provide a cylindrical path through the upper wall **22** to the cavity **28**. A pair of cylindrical channels (not shown) is disposed through the lower wall in similar fashion and aligned with the upper channels **31**.

[0034] FIGS. **3**A-**3**C show the piston **32** of the first embodiment in greater detail. The piston **32** has upper and lower angled planar surfaces **34**, **36** approximately sixty degrees apart. Upper and lower grooves **48**, **50** are formed longitudinally along the piston **32** and extend between the faceplate **40** and the upper and lower angled planar surfaces **34**, **36**. The grooves **48**, **50** are alignable with, and during insertion guide the piston **32** along, upper and lower rails **44**, **46** (see FIG. **2**A), respectively, of the cage body **20**. Shoulders **52** are formed in the piston body having a thickness T1. Engagement surfaces **53** are located between the shoulders **52** and the angled surfaces **34**, **36**.

[0035] FIGS. **4**A and **4**B show a titanium nail **56** and bushing **58** of the first embodiment in greater detail. The nail **56** is generally cylindrical and has a nail head **60** of thickness Ti at a proximal end and tapers to a point **62** at the distal end. The nail head **60** has an angled portion **64** corresponding to the angled surfaces **34**, **36** of the piston **32** (see FIGS. **3**A-**3**C). The upper end **66** of the bushing **58** corresponds in shape to the upper wall **22** (see FIGS. **2**A-**2**C) such that, when assembled, the bushing **58** is flush with the ridges **26** of the upper surface of the cage body **20** (see, e.g., FIG. **5**A).

[0036] FIG. **5**A and FIG. **5**B are an isometric view and a top elevation view, respectively, of the first embodiment **18** with the nails **56** in a second engaged position. During implantation, the angled portions **60** of the nail heads **60** (see FIGS. **4**A-**4**B) are contacted by and become flush with the angled surfaces **34**, **36** of the piston **32** (see FIGS. **3**A-**3**C), which, as the piston **32** is inserted further into the cavity **28**, causes the nails **56** to move upwardly through the channels **31**. In this manner, engagement of the upper angled surface **34** with the nail head **60** causes movement of the piston **32** into the cavity **28** to drive the nail **56** into the adjacent vertebra above the embodiment **18**. Similarly, engagement of the lower angled surface **36** with nail heads causes movement of the piston **32** into the cavity **28** to drive lower nails (not shown) into the adjacent vertebra below the embodiment.

[0037] After complete insertion of the piston **32**, each nail head **60** becomes flush with the corresponding engagement surface **53** to prevent the nail **56** from receding back into the cavity **28**. This ensures fastening of the nail **56** to adjacent bone matter. The upper and lower rails **44**, **46** (see FIGS. **2**A, **2**C) occupy the upper and lower grooves **48**, **50**, respectively, to ensure proper alignment of the piston **32** within the cavity **28**. The ridged bushings **58** are fitted within the channels **31** in the annular space between the nail **56** and channel walls to facilitate slidable movement of the nail **56** therein. By threading the screws **38** through the faceplate **40** and the screw mounts **42**, the piston **32** is drawn into the cavity **28** and secured to the cage body **20**.

SECOND EMBODIMENT

[0038] A second embodiment **118** of the invention, shown in FIG. **6**-**10**, comprises a cage body **120** having upper and lower walls **122**, **124** with ridges **126**. Upper and lower walls **122**, **124** partially define a cavity **128** of the cage body **120**. Openings **130** through the upper and lower walls **122**, **124** provide access to the cavity **128** to allow for bone growth thereinto from adjacent vertebrae. A piston **132** having upper and lower angled planar surfaces **134**, **136** is insertable into the cavity **128** through a piston opening in the posterior wall of the cage body **120**. Screws **138** may thereafter be inserted through a piston faceplate **140** and secured to screw mounts **142** located in the cavity **128** proximal to the piston opening.

[0039] FIG. **7**A-**7**C show the cage body **120** of the second embodiment is greater detail. FIG. **7**A and **7**C are bottom and top elevations, respectively, of the cage body **120**. FIG. **7**B is a rear elevation of the cage body **120**. Upper and lower rails **144**, **146** extend along the length of, and protrude into the cavity **128** from, the upper and lower walls **122**, **124**, respectively. Screw mounts **142** are located near the rear side of the cavity **128**. Openings **130** through the upper and lower walls **122**, **144** provide access to the cavity **128** to allow for bone growth thereinto from adjacent vertebrae. As shown in FIG. **7**A, a channel **131** is located between the two openings **130** and provides a path through the lower wall **124** to the cavity. As shown in FIG. **7**B, two channels **133** are located between the two openings **130** and provide a path through the upper wall **122** to the cavity **128**.

[0040] FIG. **8**A and **8**B show the piston **132** of the second embodiment **118** in greater detail. The piston **132** has upper and lower angled surfaces **134**, **136** angled approximately sixty degrees apart. Upper and lower grooves **148**, **150** are formed longitudinally along the piston **132** from the faceplate **140** to the upper and lower angled surfaces **134**, **136**. Upper and lower grooves **148**, **150** are alignable with, and during insertion guide the piston **132** along, upper and lower rails **144**, **146** (see FIG. **7**B) of the cage body **120**. Shoulders **152** are formed in the piston body having a thickness T2. Engagement surfaces **153** are located between the shoulders **152** and the angled surfaces **134**, **136**.

[0041] FIGS. **9**A and **9**B show a titanium pin **156** and bushing **158**, respectively, of the second embodiment **118** in greater detail. Each pin **156** has an angled engagement surface **160** that corresponds to the angle of the upper and lower angled surfaces **134**, **136** of the piston **132** (see FIG. **8**B). Each pin **156** tapers to a wedge **162** at the distal end. The upper end **166** of the bushing **158** corresponds in shape to the upper wall **122** (see FIGS. **7**A-**7**C) such that, when assembled, the bushing **158** is flush with the ridges **126** of the upper surface of the cage body **120** (see, e.g., FIG. **10**).

[0042] FIG. **10** is a perspective view of the second embodiment **118** with the pins **156** in an engaged position. During implantation, the angled engagement surfaces **160** (see FIGS. **9**A-**9**B) of the pins **156** are contacted by and become flush with the upper and lower angled surfaces **134**, **136** of the piston **132**, which, as the piston **132** is inserted further into the cavity **128**, causes the pins **156** to move through the channels **131**, **133** to an engaged position. In this manner, engagement of the upper and lower angled surfaces **134**, **136** with the pins **156** causes movement of the piston **132** into the cavity **128** to drive the pins **156** into the adjacent vertebra. The piston screw heads are positioned anterior of the posterior surface of the faceplate **140**.

[0043] After insertion of the piston **132** is complete, each engagement surface **160** is flush with the engagement surfaces **153** of the piston to prevent the pins **156** from receding back into the cavity **128** and ensuring fastening of the pins **156** with adjacent bone matter. The upper and lower rails **144**, **146** (see FIGS. **7**B) occupy the upper and lower grooves **148**, **150**, respectively, of the piston **132** to ensure proper alignment of the piston **132** within the cavity **128**. The ridged bushings **158** are fitted within the upper and lower channels **131**, **133** in the annular space between the pin **156** and channel wails to facilitate movement between disengaged and engaged positions.

THIRD EMBODIMENT

[0044] A third embodiment **218** of the invention, shown in FIG. **11**-**15**, comprises a cage body **220** having upper and lower walls **222**, **224** with ridges **226**. Upper and lower walls **222**, **224** partially define a cavity **228**. Openings **230** through the upper and lower wall **222**, **224** and sidewalls provide access to the cavity **228** to allow for bone growth thereinto from adjacent vertebrae. Upper and lower lock openings **225**, **227** are formed through the upper and lower walls, **222**, **224**, respectively proximal to a piston opening in the posterior wall of the cage body **220**.

[0045] A piston **232** having upper and lower angled surfaces **234**, **236** is insertable into the cavity **228** through the piston opening. A screw **238** may thereafter be inserted through a piston faceplate **240** and secured to a screw mount **242** located at the posterior of the cavity **228**. A locking plate **280** having a closed end **283** and an opened end **284** defined by upper and lower fingers **286**, **288** is rotatably attached to the faceplate **240** with a locking member screw **282**.

[0046] FIG. **12**A-**12**C show the cage body **220** in greater detail. A screw mount **242** is located near the front of the cavity **228**. Openings **230** through the upper wall **222** provide access to the cavity **228** to allow for bone growth thereinto from adjacent vertebrae. Rectangular channels **231**, **233** are located between the openings **230** and provide paths through the upper wall **222** and lower wall **224** to the cavity. As shown in FIG. **12**C, upper and lower rails **244**, **246** extend along the length of, and protrude into the cavity **228** from, the upper and lower walls **222**, **224**, respectively.

[0047] FIG. **13**A-**13**C show the piston **232**, piston screw **238**, and locking plate **280** of the third embodiment in greater detail. The piston **232** has upper and lower angled surfaces **234**, **236** angled approximately sixty degrees apart. Upper and lower grooves **248**, **250** are formed longitudinally along the piston **232** between the faceplate **240** and the upper and lower angled surfaces **234**, **236**. Upper and lower grooves **248**, **250** are alignable with, and during insertion guide the piston **232** along, upper and lower rails **244**, **246** (see FIG. **12**C) of the cage body **220**. Shoulders **252** are formed in the piston body having a thickness T3. Engagement surfaces **253** are located between the shoulders **252** and the upper and lower angled surfaces **234**, **236**.

[0048] FIGS. **14**A-**14**D show a titanium pin **256** and bushing **258**, respectively, of the third embodiment **218** in greater detail. Each pin **256** has an angled engagement surface **260** that corresponds to the angle of the upper and lower angled surfaces **234**, **236** of the piston **132** (see FIG. **13**C). Each pin **256** tapers to an angled wedge **262** at the distal end. The upper end **266** of the bushing **258** corresponds in shape to the ridged upper surface (see FIG. **7**A-**7**C) such that, when assembled, the bushing **258** is flush with the ridges **226** of the cage body **220** (see, e.g., FIG. **10**).

[0049] FIGS. **15**A-**15**C disclose rear, front, and side elevations, respectively of the third embodiment **218**. During implantation, the angled engagement surfaces **260** (see FIGS. **14**A-**14**C) are contacted by and become flush with the upper and lower angled surfaces **234**, **236** of the piston **232**, which, as the piston **232** is inserted further into the cavity **228**, causes the pins **256** to move upwardly through the channels **231**, **233** to an engaged position. In this manner, engagement of the upper and lower angled surfaces **234**, **236** with the pin **256** causes movement of the piston **232** into the cavity **228** to drive the pins **256** into the adjacent vertebra.

[0050] After insertion of the piston **232** is complete, each engagement surface **260** becomes flush with the engagement surface **253** to prevent the nail from receding back into the cavity **228** and ensuring fastening of the nail **256** with adjacent bone matter. The upper and lower rails **244**, **246** (see FIGS. **12**A, **12**C) occupy the upper and lower grooves **248**, **250**, respectively, to ensure proper alignment of the piston **232** within the cavity **228**. The ridged bushings **258** are fitted within the channels **231**, **233** in the annular space between the titanium pin **256** and channel walls to facilitate movement and retain the pins **256** in the channels **231**, **233**.

[0051] Operation of the locking plate for this embodiment is identical to operation of the locking mechanism described hereafter with reference to the fourth embodiment

FOURTH EMBODIMENT

[0052] A fourth embodiment comprises a cage body **320**, shown in FIGS. **16**A-**16**C, comprises upper and lower walls **322**, **324** with ridges **326**. Upper and lower walls **322**, **324** partially define a cavity **328**. Openings **330** through the upper wall **322** provide access to the cavity **328** to allow for bone growth thereinto from adjacent vertebrae. Upper and lower lock openings **325**, **327** are formed in the upper and lower walls **322**, **324**, respectively near the piston opening **328**.

[0053] A piston **332** having upper and lower angled surfaces **334**, **336** is insertable into the cavity **328**. A screw **338** may thereafter be inserted through a piston faceplate **340** and secured to a screw mount located in the cavity **328**. A locking plate **380** having a closed end **383** opened end **384** defined by upper and lower fingers **386**, **388** is rotatably attached to the faceplate **340** with a screw **382**. As shown in FIG. **16**B, the fastening members of the fourth embodiment **318** comprises porous blades **356** with lateral passages **357** therethrough to allow bone growth.

[0054] FIG. **16**B and FIG. **16**C, which both depict the piston in an engaged position within the cage body **320**, show the locking plate **380** in the unlocked and locked position, respectively. In the unlocked position, the screw **338** may be passed between the upper and lower fingers **386**, **388**, with the screw head accessible. Once the piston **382** is engaged with the cage body **320** to support the blades **356**, the locking plate **380** is rotated around the locking plate screw **381** so that the lower finger **386** extends into the lower lock opening **325** and upper finger **386** covers the head of the piston screw **382**. In this position, the locking plate **380** prevents "back out" of the piston screw **382** and piston **332**, which assures engagement of the blades **356** with the adjacent vertebrae.

[0055] Although the embodiments of the present invention disclose titanium fastening members, alternative embodiments include stainless steel fastening members.

[0056] For each of the above-described embodiments, the upper and lower walls are at least substantially parallel. In alternative embodiments, however, the upper and lower walls may be angled relative to one another to correspond to curvature of the spine (e.g., to correspond to a lordotic curvature) at the targeted region of implantation. In such case, the front and rear sides will be of differing heights.

[0057] In addition to the nail and/or pins described hereinabove, alternative embodiments of the present invention contemplate a fastening member with a blade- or knifelike appearance, such as the porous blades shown in FIG. **17** and FIG. **20**.

[0058] The present invention is described in terms of preferred illustrative embodiments of specifically described stand-alone spinal cages. Those skilled in the art will recognize that yet other alternative embodiments of such a device can be used in carrying out the present invention. Other aspects, features, and advantages of the present invention may be obtained from a study of this disclosure and the drawings, along with the appended claims.

1. A spinal cage device for fusion of spinal vertebrae comprising:

a cage body having upper, lower, and side walls that a define a cavity, said upper and lower walls having bone growth openings therethrough, said side walls including a posterior side wall with a piston opening therethrough and an anterior side wall;

a piston having a piston body with anterior and posterior ends, said piston body being insertable along a longitudinal axis into said cavity through said piston opening, wherein said piston body comprise at least two angled surfaces adjacent to said anterior end;

at least two fastening member channels extending through said upper and lower walls;

at least two fastening members moveable within said at least two fastening member channels between a first disengaged position and a second engaged position;

wherein in said second engaged position said at least two fastening members contact said piston body and are stationary relative to said cage body.

2. The spinal cage device of claim **1** wherein said fastening members comprises a generally cylindrical nail having a nail head with a proximal surface and a distal end, said nail head having an angled portion at least substantially corresponding to an angle of said at least two angled surfaces.

3. The spinal cage device of claim **1** further comprising:

at least one screw mount positioned in the cavity;

a faceplate connected to the posterior end of the piston body, said faceplate being insertable into the piston opening; and

at least one screw insertable through said faceplate and matable with said at least one screw mount.

4. The spinal cage device of claim **1** wherein the at least two angled surfaces adjacent to said anterior end of said piston comprise upper and lower angled surfaces, wherein said fastening member comprises an angled engagement surface corresponding to the angle of at least one of said upper and lower surfaces, said fastening member tapering to a wedge at its distal end.

5. The spinal cage device claim **1** wherein each of said upper and lower angled surfaces is longitudinally alignable with at least one of said fastening member channels.

6. The spinal cage device of claim **1** further comprising:

at least one lock opening proximal to said piston opening; and

a locking member rotatably-connected to said faceplate;

wherein in said second engaged position said locking member is rotatable to a locked position in which a portion of said locking member extends into said at least one lock opening and a portion of said locking member is positioned adjacent said screw.

7. The spinal cage device of claim **1** wherein said at least one fastening member is porous to allow home growth therethrough.

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