

(19) World Intellectual Property  
Organization  
International Bureau



(43) International Publication Date  
31 December 2003 (31.12.2003)

PCT

(10) International Publication Number  
**WO 2004/000145 A1**

(51) International Patent Classification<sup>7</sup>: **A61B 17/58**,  
17/60, A61F 2/00, 2/32, 2/34, 2/36, 2/38

(21) International Application Number:  
PCT/US2003/020003

(22) International Filing Date: 24 June 2003 (24.06.2003)

(25) Filing Language: English

(26) Publication Language: English

(30) Priority Data:  
10/178,875 24 June 2002 (24.06.2002) US

(63) Related by continuation (CON) or continuation-in-part  
(CIP) to earlier application:  
US 10/178,875 (CIP)  
Filed on 24 June 2002 (24.06.2002)

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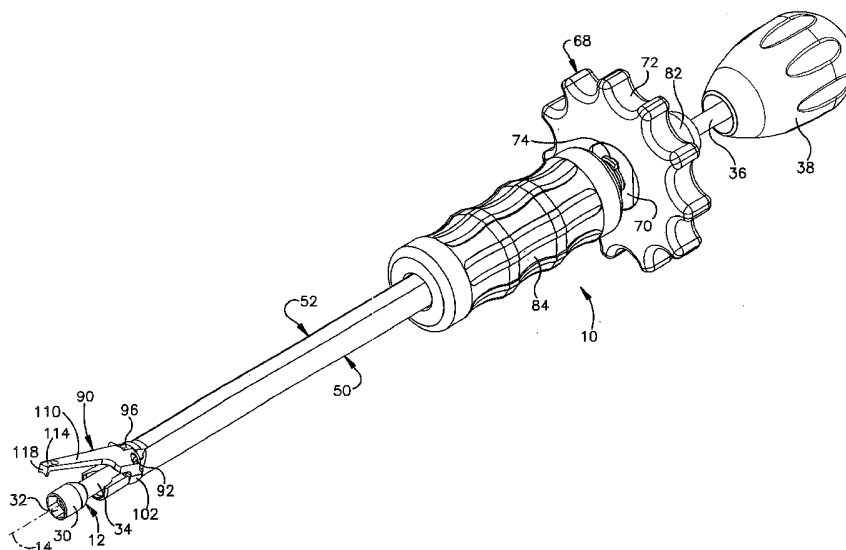
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(81) Designated States (national): AE, AG, AL, AM, AT, AU,  
AZ, BA, BB, BG, BR, BY, BZ, CA, CH, CN, CO, CR, CU,  
CZ, DE, DK, DM, DZ, EC, EE, ES, FI, GB, GD, GE, GH,  
GM, HR, HU, ID, IL, IN, IS, JP, KE, KG, KP, KR, KZ, LC,  
LK, LR, LS, LT, LU, LV, MA, MD, MG, MK, MN, MW,  
MX, MZ, NI, NO, NZ, OM, PH, PL, PT, RO, RU, SC, SD,  
SE, SG, SK, SL, TJ, TM, TN, TR, TT, TZ, UA, UG, US,  
UZ, VC, VN, YU, ZA, ZM, ZW.

(84) Designated States (regional): ARIPO patent (GH, GM,  
KE, LS, MW, MZ, SD, SL, SZ, TZ, UG, ZM, ZW),  
Eurasian patent (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM),  
European patent (AT, BE, BG, CH, CY, CZ, DE, DK, EE,  
ES, FI, FR, GB, GR, HU, IE, IT, LU, MC, NL, PT, RO,

[Continued on next page]

(54) Title: SURGICAL INSTRUMENT FOR MOVING VERTEBRAE



(57) Abstract: A surgical instrument (10) extendable through a cannula for moving a first bone portion relative to a second bone portion includes a first portion (30) having a longitudinal axis engageable with a first member (18) connected with to the first bone portion. A second portion is engageable with a second member connected with the second bone portion. The second portion is movable relative to the first portion from a first position toward a second position to move the first and second bone portions away from each other. An actuator (52) connected with the second portion moves the second portion relative to the first portion in a direction extending transverse to the longitudinal axis.

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SE, SI, SK, TR), OAPI patent (BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW, ML, MR, NE, SN, TD, TG).

— *before the expiration of the time limit for amending the claims and to be republished in the event of receipt of amendments*

**Declaration under Rule 4.17:**

— *of inventorship (Rule 4.17(iv)) for US only*

**Published:**

— *with international search report*

*For two-letter codes and other abbreviations, refer to the "Guidance Notes on Codes and Abbreviations" appearing at the beginning of each regular issue of the PCT Gazette.*

**SURGICAL INSTRUMENT FOR MOVING VERTEBRAE**

**Related Applications**

This application is a continuation-in-part of copending application serial number 10/178,875, filed June 24, 2002.

**Technical Field**

The present invention relates to a surgical instrument which is used to move bone portions, such as vertebrae of a spinal column, relative to each other. More specifically, the present invention relates to a surgical instrument extendable through a cannula for compressing and/or distracting vertebrae of a spinal column.

**Background of the Invention**

It is known to retain vertebrae of a spinal column in a desired spatial relationship with a longitudinal member extendable along the spinal column. Fasteners

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connect the longitudinal member to the vertebrae. Clamping members, which threadably engage the fasteners, clamp the longitudinal member to the fasteners. Once the longitudinal member is loosely connected with the vertebrae, a surgical instrument is used to move the vertebrae into a desired spatial relationship by compressing or distracting the vertebrae. The clamping members are tightened to clamp the longitudinal member to the fasteners to retain the vertebrae in the desired spatial relationship.

It is also known to connect fasteners and a longitudinal member to vertebrae during a surgical procedure performed through a cannula. The cannula is inserted into a body of a patient to create a working space adjacent the vertebrae. The fasteners and longitudinal member are then connected to the vertebrae to retain the vertebrae in a desired spatial relationship.

#### **Summary of the Invention**

The present invention is a surgical instrument extendable through a cannula for moving a first bone portion relative to a second bone portion, such as first and second vertebrae of a spinal column. The instrument includes a first portion having a

longitudinal axis engageable with a first member, such as a clamping member, connected with the first bone portion. A second portion is engageable with a second member, such as a fastener or a longitudinal member connected with the second bone portion. An actuator connected with the second portion moves the second portion relative to the first portion in a direction extending transverse to the longitudinal axis to move the first and second bone portions relative to each other.

#### **Brief Description of the Drawings**

The foregoing and other features of the present invention will become apparent to one skilled in the art to which the present invention relates upon consideration of the following description of the invention with reference to the accompanying drawings, wherein:

Fig. 1 is a perspective view of a surgical instrument constructed in accordance with a first embodiment;

Fig. 2 is an exploded perspective view of the surgical instrument of Fig. 1;

Fig. 3 is an enlarged perspective view of an end of the surgical instrument of Fig. 1 showing a jaw portion in a first position;

Fig. 4 is an enlarged side view of a portion of the surgical instrument showing a controller of the surgical instrument;

Fig. 5 is a schematic perspective view showing the surgical instrument of Fig. 1 extending through a cannula to move bone portions relative to each other;

Fig. 6 is a perspective view of a surgical instrument constructed in accordance with a second embodiment;

Fig. 7 is an enlarged perspective view of an end of the surgical instrument of Fig. 6;

Fig. 8 is a schematic perspective view showing the surgical instrument of Fig. 6 extending through a cannula to move bone portions relative to each other;

Fig. 9 is a perspective view of an apparatus constructed in accordance with a third embodiment;

Fig. 10 is an exploded perspective view of the surgical instrument of Fig. 9;

Fig. 11 is a schematic perspective view showing the surgical instrument of Fig. 9 extending through a cannula to move bone portions relative to each other;

Fig. 12 is a perspective view of a surgical instrument constructed in accordance with a fourth embodiment;

Fig. 13 is a schematic perspective view showing the instrument of Fig. 12 extending through a cannula to move bone portions relative to each other;

Fig. 14 is a perspective view of a surgical instrument constructed in accordance with a fifth embodiment;

Fig. 15 is an enlarged perspective view of an end of the surgical instrument of Fig. 14 showing a jaw portion spaced from a driving portion;

Fig. 16 is an exploded perspective view of the surgical instrument of Fig. 14;

Fig. 17 is an enlarged perspective view of a housing of the instrument of Fig. 14;

Fig. 18 is an enlarged exploded view of a portion of the instrument of Fig. 14 showing a control lever connected to a housing and an actuator;

Fig. 19 is a cross-sectional view of the instrument of Fig. 14 showing the instrument in a position for distracting vertebrae;

Fig. 20 is a cross-sectional view of the instrument of Fig. 14 showing the instrument in a position for compressing vertebrae; and

Fig. 21 is a schematic perspective view showing the instrument of Fig. 14 extending through a cannula to move bone portions relative to each other.

### Description of the Invention

The present invention is directed to a surgical instrument extendable through a cannula for moving bone portions, such as vertebrae of a spinal column, relative to each other. Figs. 1-5 illustrate a surgical instrument 10 constructed according to a first embodiment. The surgical instrument 10 (Figs. 1 and 2) includes a driving portion 12 having a longitudinal axis 14. The driving portion 12 is engageable with a clamping member or nut 16, one of which is shown in Fig. 5.

The clamping members 16 (Fig. 5) threadably engage fastener members 18 connected with first and second bone portions, such as vertebrae 20 and 21 of a spinal column. The clamping members 16 clamp a longitudinal member, such as a plate 22, extending between the vertebrae 20 and 21 to the fasteners 18. The fasteners 18 extend through openings 24 in the



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plate 22. The fasteners 18 also extend through washers 26 that permit polyaxial positioning of the fasteners relative to the plate 22, as known in the art.

The plate 22 and the washers 26 are clamped between the nuts 16 and intermediate portions 28 of the fasteners to retain the vertebrae 20 and 21 in a desired spatial relationship. The longitudinal member 22 and the fasteners 18 are connected to the vertebrae 20 and 21 during a surgical procedure performed through a cannula 29. It is contemplated that the instrument 10 could be used with any spine construct in which a nut is used to clamp a longitudinal member to a fastener.

The driving portion 12 (Figs. 3 and 5) of the instrument 10 has an end 30 with a recess 32 for receiving the nut (not shown) connected with the vertebra 20. The recess 32 has wrenching flats 33 for applying torque to the nut. The driving portion 12 is rotatable about the longitudinal axis 14 to rotate the nut relative to the fastener 18. Accordingly, the driving portion 12 can be rotated to loosen the nut on the fastener 18 and permit movement of the plate 22 connected with the vertebra 21 relative to the

fastener 18 connected with the vertebra 20. The nut can also be rotated to tighten the nut and clamp the plate 22 to the fastener 18.

The driving portion 12 (Figs. 1 and 2) has a longitudinally extending shaft 34 extending between the end 30 and an opposite end 36 of the driving portion. A handle 38 is connected to the end 36 of the driving portion 12. The handle 38 may threadably engage the shaft 36 to connect the handle with the driving portion 12. It is contemplated that the handle 38 may be connected to the end 36 in any suitable manner. The handle 38 is grasped by a surgeon to manually rotate the driving portion 12 about the longitudinal axis 14 to rotate the nut relative to the fastener 18.

The shaft 34 (Fig. 2) of the driving portion 12 extends through a longitudinal passage 44 defined by a longitudinally extending base portion 50 and a longitudinally extending actuator 52. The driving portion 12 is axially movable relative to the base portion 50 and the actuator 52. The driving portion 12 also rotates about the longitudinal axis 14 relative to the base portion 50 and the actuator 52.

The base portion 50 has a generally C-shaped cross-section defining a longitudinal slot 54. The

actuator 52 is located in the slot 54. A pair of longitudinally extending grooves 58 are located on either side of the slot 54. Longitudinally extending projections 60 on opposite sides of the actuator 52, one of which is shown in Fig. 2, extend into the grooves 58. The grooves 58 in the base portion 50 guide movement of the actuator 52 relative to the base portion in opposite directions extending parallel to the longitudinal axis 14.

The base portion 50 has a threaded end portion 66 (Figs. 2 and 4). A control wheel 68 threadably engages the end portion 66 on the base portion 50. The control wheel 68 moves the actuator 52 relative to the base portion 50 as the control wheel moves axially relative to the base portion. The control wheel 68 (Fig. 2) has a hub 70 threadably engaging the base portion 50. A grip 72 has a splined connection with the hub 70 so that the hub and grip rotate together relative to the base portion 50. It is contemplated that the hub 70 and grip 72 may be connected together in any suitable manner or be formed as one piece.

Radially extending projections 74 and 76 on the actuator 52 (Figs. 2 and 4) extend through the slot 54 in the base portion 50 adjacent the threaded end

portion 66. The projections 74 and 76 engage opposite sides of the control wheel 68. The projections 74 and 76 are formed as one piece with the actuator 52, however, it is contemplated that the projections could be welded to the actuator.

The control wheel 68 rotates about the longitudinal axis 14 relative to the base portion 50 and the actuator 52. Upon rotation of the control wheel 68 relative to the base portion 50, the control wheel moves axially relative to the base portion. Rotation of the control wheel 68 in one direction moves the control wheel and the actuator 52 away from the handle 38. The control wheel 68 applies force to the projection 74 to move the actuator 52 away from the handle 38. Rotation of the control wheel 68 in the opposite direction moves the control wheel toward the handle 38. The control wheel 68 applies force to the projection 76 to move the actuator 52 toward the handle 38.

A limit member 80 threadably engages the end portion 66 of the base portion 50 with the projection 74 between the limit member and the control wheel 68. The projection 74 on the actuator 52 engages the limit member 80 to limit movement of the

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actuator 52 away from the handle 38 relative to the base portion 50. A limit member 82 threadably engages the end portion 66 of the base portion 50 with the projection 76 located between the limit member 82 and the control wheel 68. The projection 76 on the actuator 52 engages the limit member 82 to limit movement of the actuator toward the handle 38 relative to the base portion 50.

A hand grip 84 (Figs. 1 and 2) is connected to the base portion 50 and engages the limit member 80. It is contemplated that the grip may be threaded onto the end portion 66. The grip 84 may be connected to the base portion 50 in any suitable manner. A surgeon can grasp the grip 84 while manipulating the driving portion 12 or moving the control wheel 68.

A jaw portion 90 (Figs. 1-3) is pivotally connected to the actuator 52 by a pivot pin 92. The jaw portion 90 has a recess 94 that receives an end 96 of the actuator 52. The pivot pin 92 extends through openings 98 in the jaw portion 90, one of which is shown in Fig. 2, and through an opening 100 in the end 96 of the actuator 52.

The jaw portion 90 is pivotable relative to the actuator 52 between a first position adjacent the

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driving portion 12, as shown in Fig. 3, and a second position spaced from the driving portion, as shown in Fig. 1. The jaw portion 90 extends at an angle of approximately 45° to the axis 14 when in the second position. The jaw portion 90 is movable relative to the driving portion 12 in a direction extending transverse to the longitudinal axis 14. Upon movement of the actuator 52 toward the handle 38, the jaw portion 90 pivots away from the driving portion 12. The jaw portion 90 moves toward the driving portion 12 when the actuator 52 moves away from the handle 38.

The jaw portion 90 has lobes 102 (Figs. 2 and 3) that extend on opposite sides of the axis 14 into cavities 104 in the base portion 50. Upon movement of the actuator 52 toward the handle 38 relative to the base portion 50, the lobes 102 engage surfaces 106 on the base portion defining the cavities 104 to pivot the jaw portion 90 away from the driving portion 12. Upon movement of the actuator 52 away from the handle 38 relative to the base portion 50, the lobes 102 engage surfaces 108 defining the cavities 104 to pivot the jaw portion 90 toward the driving portion 12.

The jaw portion 90 (Figs. 1-3) has a surface 110 facing away from the axis 14. The jaw portion 90 has a

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recess 114. The surface 110 is engageable with the plate 22, the nut 16, or the fastener 18 connected with the vertebra 21 (Fig. 5). Alternatively, the recess 114 can receive the nut 16 or fastener 18 connected with the vertebra 21 when moving the vertebrae 20 and 21 away from each other. The jaw portion 90 (Figs. 1-3) includes an extension 118 that extends toward the longitudinal axis 14. The extension 118 engages the plate 22, the nut 16, or the fastener 18 connected with the vertebra 21 to move the vertebrae 20 and 21 toward each other.

When the surgical instrument 10 is used to move vertebrae 20 and 21 away from each other or distract the vertebrae, the instrument is inserted through the cannula 29, as seen in Fig. 5. The cannula 29 has a radially expandable portion 124 defining a working space adjacent the vertebrae 20 and 21 in a body of a patient, as known in art. The instrument 10 extends through the cannula 29 with the driving portion 12 in engagement with the nut (not shown) connected with the vertebra 20. The jaw portion 90 extends into one of the openings 24 in the plate 22. Alternatively, the recess 114 in the jaw portion 90 could receive the nut 16 or the fastener 18 connected with the

vertebra 21. The driving portion 12 is rotated about the longitudinal axis 14 to loosen the nut on the fastener 18 connected to the vertebra 20. The plate 22, the nut 16, and the fastener 18 connected with the vertebra 21 can move relative to the nut (not shown) and the fastener 18 connected to the vertebra 20 and the vertebrae can move relative to each other.

The control wheel 68 is rotated about the longitudinal axis 14 to move the control wheel axially toward the handle 38. The control wheel 68 engages the projection 76 to move the actuator 52 in the direction extending parallel to the longitudinal axis 14 toward the handle 38. The lobes 102 on the jaw portion 90 engage the surfaces 106 on the base portion 50 to pivot the jaw portion about the pivot pin 92 away from the driving portion 12. The jaw portion 90 moves in a direction transverse to the longitudinal axis 14 and engages the plate 22, the nut 16, or the fastener 18 connected with the vertebra 21. As the jaw portion 90 continues to move away from the driving portion 12, the vertebrae 20 and 21 are moved away from each other. When the vertebrae 20 and 21 have been moved to a desired spatial relationship, the driving portion 12 is rotated about the longitudinal axis 14 to clamp the



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plate 22 between the nut (not shown) and the fastener 18 and retain the vertebrae in the desired spatial relationship.

When the surgical instrument 10 is used to move vertebrae 20 and 21 toward each other or compress the vertebrae, the instrument is inserted through the cannula 29. The instrument 10 extends through the cannula 29 with the driving portion 12 in engagement with the nut (not shown) connected with the vertebra 20. The jaw portion 90 is spaced from the driving portion 12 and extends into the opening 24 in the plate 22 through which the fastener 18 connected with the vertebra 21 extends. Alternatively, the extension 118 of the jaw portion 90 could engage an end of the plate 22, the nut 16, or the fastener 18 connected with the vertebra 21. The driving portion 12 is rotated about the longitudinal axis 14 to loosen the nut on the fastener 18 connected to the vertebra 20. The plate 22, the nut 16, and the fastener 18 connected with the vertebra 21 can move relative to the nut (not shown) and the fastener 18 connected to the vertebra 20 and the vertebrae can move relative to each other.

The control wheel 68 is rotated about the longitudinal axis 14 to move the control wheel axially

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away from the handle 38. The control wheel 68 engages the projection 74 to move the actuator 52 in the direction extending parallel to the longitudinal axis 14 away from the handle 38. The lobes 102 on the jaw portion 90 engage the surfaces 108 on the base portion 50 to pivot the jaw portion about the pivot pin 92 toward the driving portion 12. The jaw portion 90 moves in a direction transverse to the longitudinal axis 14 and engages the plate 22, the nut 16, or the fastener 18 connected with the vertebra 21. As the jaw portion 90 continues to move toward the driving portion 12, the vertebrae 20 and 21 move toward each other. When the vertebrae 20 and 21 have been moved to a desired spatial relationship, the driving portion 12 is rotated about the longitudinal axis 14 to clamp the plate 22 between the nut (not shown) and the fastener 18 and retain the vertebrae 20 and 21 in the desired spatial relationship.

A surgical instrument 210 constructed according to a second embodiment is illustrated in Figs. 6-8. In the embodiment illustrated in Figs. 1-5, the driving portion 12 and the jaw portion 90 are for use with a clamping nut 16 and plate 22 connected with bone portions. In the second embodiment, illustrated in

Figs. 6-8, the driving portion and the jaw portion are for use with top-loading screws and a rod connected with bone portions. Since the second embodiment illustrated in Figs. 6-8 is generally similar to the embodiment illustrated in Figs. 1-5, similar numerals will be utilized to designate similar components and only the jaw portion and the driving portion will be described in detail.

The instrument 210 (Figs. 6 and 7) includes a driving portion 212. The driving portion 212 has an end 230 with wrenching flats 232 (Fig. 7). The end 230 extends into a recess 234 (Fig. 8) in a clamping member or screw 236 connected with a vertebra 20 to apply torque to the clamping screw.

The clamping screws 236 (Fig. 8) threadably engage fastener housings 238 to clamp a longitudinal member, such as a rod 240, extending between vertebrae 20 and 21 to the housings. The clamping screws 236 also clamp fasteners 242 connected to the vertebrae 20 and 21 to the housings 238. The fasteners 242 are positionable in any one of a plurality of angular positions relative to the housings 238, as known in the art. The longitudinal member 240, the housings 238, and the fasteners 242 are connected to the vertebrae 20

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and 21 during a surgical procedure performed through the cannula 29. It is contemplated that the instrument 210 could be used with any spine construct in which a clamping screw is used to clamp a rod to a fastener.

A jaw portion 290 is pivotally connected to an actuator 52 by a pivot pin 92. The jaw portion 290 is pivotable relative to the actuator between a first position adjacent the driving portion 212 and a second position spaced from the driving portion, as shown in Fig. 7. The jaw portion 290 extends at an angle of approximately  $45^\circ$  to the axis 14 when in the second position. Upon movement of the actuator 52 toward a handle 38, relative to a base portion 50, the jaw portion 290 pivots away from the driving portion 212. The jaw portion 290 moves toward the driving portion 212 when the actuator 52 moves away from the handle 38.

The jaw portion 290 (Figs. 6 and 7) includes a recess 292 defined by a pair of legs 294. The jaw portion 290 receives the rod 240 between the legs 294, as shown in Fig. 8. The legs 294 (Figs. 6 and 7) have rounded portions 296 extending away from the driving portion 212 for engaging the housing 238 connected with

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the vertebra 21 when the surgical instrument 210 is used to move the vertebrae 20 and 21 away from each other. The rounded portions 296 maintain a single point of contact with the housing 238 to permit movement of the vertebrae 20 and 21 away from each other. The legs 294 have extensions 298 that extend toward the driving portion 212. The extensions 298 engage the housing 238 connected with the vertebra 21 when the surgical instrument 210 is used to move the vertebrae 20 and 21 toward each other.

When the surgical instrument 210 is used to move vertebrae 20 and 21 away from each other or distract the vertebrae, the instrument 210 is inserted through the cannula 29 (Fig. 8). The instrument 210 is inserted so that the driving portion 212 extends into the recess 234 in the clamping screw 236 connected with the vertebra 20. The rod 240 is received in the recess 292 between the legs 294 of the jaw portion 290. The driving portion 212 is rotated about the longitudinal axis 14 to loosen the screw 236. The rod 240, the housing 238, and the fastener 242 connected with the vertebra 21 can move relative to the clamping screw 236 and the fastener 242 connected with

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the vertebra 20 and the vertebrae can move relative to each other.

The control wheel 68 is rotated about the longitudinal axis 14 to move the actuator 52 in a direction extending parallel to the axis 14 toward the handle 38 relative to the base portion 50. The lobes 102 on the jaw portion 290 engage the surfaces 106 on the base portion 50 to pivot the jaw portion relative to the actuator 52 in a direction transverse to the axis 14 away from the driving portion 212. The rounded portions 296 of the jaw portion 290 move into engagement with the housing 238 connected with the vertebra 21 to move the vertebrae 20 and 21 away from each other. When the vertebrae 20 and 21 have been moved to a desired spatial relationship, the driving portion 212 is rotated to clamp the rod 240 to the housing 238 and the fastener 242 connected with the vertebra 20 to retain the vertebrae in the desired spatial relationship.

When the instrument 210 is used to move the vertebrae 20 and 21 toward each other or compress the vertebrae, the instrument is inserted through the cannula 29. The jaw portion 290 is spaced from the driving portion 212 with the extensions 298 engaging

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the housing 238 connected with vertebra 21. The driving portion 212 is inserted into the recess 234 in the clamping screw 236 connected with the vertebra 20. The driving portion 212 is rotated about the longitudinal axis 14 to loosen the screw 236. The rod 240, the housing 238, and the fastener 242 connected with the vertebra 21 can move relative to the clamping screw 236 and the fastener 242 connected with the vertebra 20 and the vertebrae can move relative to each other.

The control wheel 68 is rotated about the longitudinal axis 14 to move the actuator 52 in a direction extending parallel to the longitudinal axis away from the handle 38 relative to the base portion 50. The lobes 102 on the jaw portion 290 engage the surfaces 108 on the base portion 50 to pivot the jaw portion toward the driving portion 212 transverse to the axis 14. The extensions 298 on the jaw portion 290 engage the housing 238 connected with the vertebra 21 and move the vertebrae 20 and 21 toward each other. Once the vertebrae 20 and 21 have been moved into a desired spatial relationship, the driving portion 212 is rotated about the longitudinal axis 14 to tighten the screw 236 and clamp the rod 240 to the

housing 238 and the fastener 242 to retain the vertebrae in the desired spatial relationship.

A surgical instrument 310 constructed according to a third embodiment is illustrated in Figs. 9-11. The surgical instrument 310 has a driving portion 312 with a longitudinal axis 314. The driving portion 312 is engageable with a clamping member or nut (not shown) threaded onto a fastener 18 connected to a vertebra 20. The driving portion 312 (Figs. 9 and 10) has an end 330 with a recess 332 for receiving the nut. The recess 332 has wrenching flats 333 (Fig. 10) for applying torque to the nut.

A longitudinally extending shaft 334 of the driving portion 312 extends between the end 330 and an opposite end 336. The end 336 of the shaft 334 is threadably connected to a connector member 338. It is contemplated that the connector member 338 could be connected to the driving portion 312 in any suitable manner. The connector member 338 has wrenching flats 340 for receiving torque from a ratcheting handle 342. The ratcheting handle 342 has an opening 344 for receiving the connector member 338 to apply torque to the connector member. The ratcheting handle 342 may have any suitable construction.



The shaft 334 extends through a passage 350 defined by a base portion 358 and an actuator 360. The base portion 358 has a pair of axially spaced straps 362 for retaining the driving portion 312 in the passage 350. The actuator 360 is movable relative to the base portion 358 in directions extending parallel to the axis 314.

A control lever 380 has a recess 382 defined by a pair of legs 384. The recess 382 receives an end 386 of the base portion 358. The control lever is pivotally connected to the base portion 358 by a pivot pin 388. The pivot pin 388 extends through openings 390 in the base portion 358 and through openings 392 in the legs 384 of the control lever 380.

The recess 382 in the control lever 380 also receives an end 394 of the actuator 360. The control lever 380 is pivotally connected to the actuator 360 by a pivot pin 396. The pivot pin 396 extends through an oval-shaped opening 398 in the actuator 360. Accordingly, the pivot pin 396 can move in the opening 398. The pivot pin 396 also extends through openings 400 in the legs 384 of the control lever 380.

A jaw portion 410 (Figs. 9 and 10) is pivotally connected to the base portion 358. The jaw portion 410

(Fig. 10) has a recess 412 defined by a pair of legs 414. The recess 412 receives an end 416 of the base portion 358. A pivot pin 418 extends through openings 420 in the end 416 of the base portion 358 and through openings 422 in the legs 414 of the jaw portion 410.

The recess 412 in the jaw portion 410 also receives an end 426 of the actuator 360. The jaw portion 410 is pivotally connected to the actuator 360 by a pivot pin 428. The pivot pin 428 extends through oval-shaped openings 430, one of which is shown in Fig. 10, in the legs 414 of the jaw portion 410. Accordingly, the pivot pin 428 can move in the openings 430. The pivot pin 428 also extends through an opening 432 in the end 426 of the actuator 360.

Upon pivoting the control lever 380 relative to the base portion 358 toward the handle 342, the actuator 360 moves in a direction extending parallel to the longitudinal axis 314 toward the handle 342. The jaw portion 410 pivots relative to the base portion 358 and the actuator 360. The jaw portion 410 moves transverse to the axis 314 away from the driving portion 312. Upon pivoting the control lever 380 relative to the base portion 358 away from the

handle 342, the actuator 360 moves in a direction extending parallel to the longitudinal axis 314 away from the handle 342. The jaw portion 410 pivots relative to the base portion 358 and the actuator 360. The jaw portion 410 moves transverse to the axis 314 toward the driving portion 312.

When the instrument 310 is used to move vertebrae 20 and 21 (Fig. 11) away from each other or distract the vertebrae, the instrument is inserted through the cannula 29. The instrument 310 is inserted so that the driving portion 312 engages the nut (not shown) connected with the vertebra 20. The jaw portion 410 extends into the opening 24 in the plate 22 connected with the vertebra 21. Alternatively, the jaw portion 410 could engage the nut 16 or fastener 18 connected with the vertebra 21. The driving portion 312 is rotated about the longitudinal axis 314 to loosen the nut 16 to permit movement of the vertebrae 20 and 21 relative to each other.

The control lever 380 is pivoted relative to the base portion 358 and the actuator 360 toward the handle 342. The actuator 360 moves in the direction extending parallel to the longitudinal axis 314 toward the handle 342. The jaw portion 410 pivots relative to

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the base portion 358 and the actuator 360 and away from the driving portion 312. The jaw portion 410 engages the plate 22, the nut 16, or the fastener 18 connected with the vertebra 21 to move the vertebrae 20 and 21 away from each other into a desired spatial relationship. The driving portion 312 is rotated about the axis 314 to tighten the nut (not shown) on the fastener 18 and clamp the plate 22 to the fastener to retain the vertebrae 20 and 21 in the desired spatial relationship.

When the instrument 310 is used to move the vertebrae 20 and 21 toward each other or compress the vertebrae, the instrument is inserted through the cannula 29 with the driving portion 312 engaging the nut (not shown) connected with the vertebra 20. The jaw portion 410 is spaced from the driving portion 312 and extends into the opening 24 in the plate 22 through which the fastener 18 connected with the vertebra 21 extends. Alternatively, the jaw portion 410 could engage the end of the plate 22, the nut 16, or fastener 18 connected to the vertebra 21. The driving portion 312 is rotated about the longitudinal axis 314 to loosen the nut (not shown) on the fastener 18

connected with the vertebra 20 to permit movement of the vertebrae 20 and 21 relative to each other.

The control lever 380 is pivoted relative to the base portion 358 and the actuator 360 away from the handle 342. The actuator 360 moves in a direction extending parallel to the longitudinal axis 314 away from the handle 342. The jaw portion 410 pivots relative to the base portion 358 transverse to the axis 314 and toward the driving portion 312. The jaw portion 410 engages the plate 22, the nut 16, or the fastener 18 connected with the vertebra 21 to move the vertebrae 20 and 21 toward each other into a desired spatial relationship. The driving portion 312 is rotated about the longitudinal axis 314 to tighten the nut (not shown) on the fastener 18 and clamp the plate 22 to the fastener to retain the vertebrae 20 and 21 in the desired spatial relationship.

The instrument 310 is shown with a driving portion 312 and a jaw portion 410 for use with a nut 16 and a plate 22. It is contemplated that the instrument 310 could have a driving portion and a jaw portion similar to the driving portion 212 and the jaw portion 290 described in connection with the second embodiment, illustrated in Figs. 6-8. The

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instrument 310 could then be used to move vertebrae relative to each other that are connected to a spine construct having a clamping screw and rod.

A surgical instrument 510 constructed according to a fourth embodiment is illustrated in Figs. 12 and 13. The surgical instrument 510 includes a driving portion 512 having a longitudinal axis 514. The driving portion 512 is engageable with a clamping member or nut 16, one of which is shown in Fig. 13.

The driving portion 512 (Fig. 12) has an end 530 with a recess 532 for receiving the nut (not shown) connected with the vertebra 20. The recess 532 has wrenching flats 533 for applying torque to the nut. The driving portion 512 is rotatable about the longitudinal axis 514 to rotate the nut relative to the fastener 18. Accordingly, the driving portion 512 can be rotated to loosen the nut on the fastener 18 and permit movement of the plate 22 connected with the vertebra 21 relative to the fastener 18 connected with the vertebra 20. The driving portion 512 can also be rotated to tighten the nut and clamp the plate 22 to the fastener 18.

The driving portion 512 has a longitudinally extending shaft 534 extending between the end 530 and

an opposite end 536. A handle 538 is connected to the end 536 of the driving portion 512. The handle 538 may threadably engage the shaft 536 to connect the handle with the driving portion 512. However, the handle 538 may be connected to the end 536 in any suitable manner. The handle 538 may be grasped by a surgeon to manually rotate the driving portion 512 about the longitudinal axis 514 to rotate the nut relative to the fastener 18.

The shaft 534 of the driving portion 512 extends through a longitudinal passage 544 defined by a longitudinally extending base portion 550 and a longitudinally extending actuator 552. The driving portion 512 is axially movable relative to the base portion 550 and the actuator 552. The driving portion 512 also rotates about the longitudinal axis 514 relative to the base portion 550 and the actuator 552.

The base portion 550 has a C-shaped cross-section defining a longitudinal slot in which the actuator 552 is located. A pair of longitudinally extending grooves (not shown) are located on either side of the slot, similar to the embodiment illustrated in Figs. 1 and 2. Longitudinally extending projections (not shown) on the actuator 552 extend into the grooves. The grooves in

the base portion 550 guide movement of the actuator 552 relative to the base portion in a direction extending parallel to the longitudinal axis 514.

A control lever 560 has a recess 562 defined by a pair of legs 564. The recess 562 receives an end 566 of the base portion 550. The legs 564 have rounded ends or lobes 568, one of which is shown in Fig. 12, that extend into cavities 570 in the end 566 of the base portion 550 on opposite sides of the axis 514.

The recess 562 in the control lever 560 also receives an end 580 of the actuator 552. The control lever 560 is pivotally connected to the actuator 552 by a pivot pin 582. The pivot pin 582 extends through an opening in the actuator 552 and through openings in the legs 564 of the control lever 560.

A jaw portion 590 is pivotally connected to the actuator 552 by a pivot pin 592. The jaw portion 590 has a recess (not shown) that receives an end of the actuator 552. The pivot pin 592 extends through openings in the jaw portion 590 and through an opening in the end of the actuator 552.

The jaw portion 590 is pivotable between a first position adjacent the driving portion 512 and a second position spaced from the driving portion and extending



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at an angle of approximately 45° to the axis 514. The jaw portion 590 is movable relative to the driving portion 512 transverse to the longitudinal axis 514. Upon movement of the actuator 552 toward the handle 538, the jaw portion 590 pivots away from the driving portion 512. The jaw portion 590 moves toward the driving portion 512 when the actuator 552 moves away from the handle 538.

The jaw portion 590 has lobes 602, one of which is shown in Figs. 12 and 13, that extend into cavities 604 in the base portion 550 on opposite sides of the axis 514. Upon movement of the actuator 552 toward the handle 538 relative to the base portion 550, the lobes 602 engage surfaces 606 on the base portion defining the cavities 604 to pivot the jaw portion 590 away from the driving portion 512. Upon movement of the actuator 552 away from the handle 538 relative to the base portion 550, the lobes 602 engage surfaces 608 defining the cavities 604 to pivot the jaw portion 590 toward the driving portion 512.

The jaw portion 590 has a surface 610 facing away from the axis 514. The surface 610 has a recess 614. The surface 610 is engageable with the plate 22, the nut 16, or the fastener 18 connected with the

vertebra 21. Alternatively, the recess 614 can receive the nut 16 or fastener 18 connected with the vertebra 21 when moving the vertebrae 20 and 21 away from each other. The jaw portion 590 includes an extension 618 that extends toward the axis 514. The extension 618 engages the plate 22, the nut 16, or the fastener 18 connected with the vertebra 21 to move the vertebrae 20 and 21 toward each other.

Upon pivoting of the control lever 560 relative to the base portion 550 and the actuator 552 toward the handle 538, the actuator 552 moves in a direction extending parallel to the longitudinal axis 514 toward the handle 538. The jaw portion 590 pivots relative to the actuator 552 and away from the driving portion 512. Upon pivoting the control lever 560 relative to the base portion 550 and the actuator 552 away from the handle 538, the actuator 552 moves in a direction extending parallel to the longitudinal axis 514 away from the handle 538. The jaw portion 590 pivots relative to the actuator 552 and toward the driving portion 512.

When the instrument 510 is used to move vertebrae 20 and 21 (Fig. 13) away from each other or distract the vertebrae, the instrument is inserted

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through the cannula 29. The instrument 510 is inserted so that the driving portion 512 engages the nut (not shown) connected with the vertebra 20. The jaw portion 590 extends into the opening 24 in the plate 22 through which the fastener 18 connected with the vertebra 20 extends. Alternatively, the jaw portion 590 could engage the nut 16 or fastener 18 connected with the vertebra 21. The driving portion 512 is rotated about the longitudinal axis 514 to loosen the nut to permit movement of the vertebrae 20 and 21 relative to each other.

The control lever 560 is pivoted relative to the actuator 552 toward the handle 538. The actuator 552 moves in the direction parallel to the longitudinal axis 514 toward the handle 538. The jaw portion 590 pivots relative to the base portion 550 and the actuator 552 transverse to the axis 514 and away from the driving portion 512. The jaw portion 590 engages the plate 22, the nut 16, or the fastener 18 connected with the vertebra 21 to move the vertebrae 20 and 21 away from each other into a desired spatial relationship. The driving portion 512 is rotated about the axis 514 to tighten the nut (not shown) on the fastener 18 and clamp the plate 22 to the fastener to

retain the vertebrae 20 and 21 in the desired spatial relationship.

When the instrument 510 is used to move the vertebrae 20 and 21 toward each other or compress the vertebrae, the instrument is inserted through the cannula 29 with the driving portion 512 engaging the nut (not shown) connected with the vertebra 20. The jaw portion 590 is spaced from the driving portion 512 and extends into the opening 24 in the plate 22 through which the fastener 18 connected with the vertebra 21 extends. Alternatively, the jaw portion 590 could engage the end of the plate 22, the nut 16, or the fastener 18 connected with the vertebra 21. The driving portion 512 is rotated about the longitudinal axis 514 to loosen the nut 16 relative to the fastener 18 to permit movement of the vertebrae 20 and 21 relative to each other.

The control lever 560 is pivoted relative to the actuator 552 away from the handle 538. The actuator 552 moves in a direction extending parallel to the longitudinal axis 514 away from the handle 538. The jaw portion 590 pivots relative to the actuator 552 transverse to the axis 514 and toward the driving portion 512. The jaw portion 590 engages the plate 22,

the nut 16, or the fastener 18 connected with the vertebra 21 to move the vertebrae 20 and 21 toward each other into a desired spatial relationship. The driving portion 512 is rotated about the longitudinal axis 514 to tighten the nut (not shown) on the fastener 18 connected with the vertebra 20 and clamp the plate 22 to the fastener to retain the vertebrae 20 and 21 in the desired spatial relationship.

The instrument 510 is shown with a driving portion 512 and a jaw portion 590 for use with a nut 16 and a plate 22. It is contemplated that the instrument 510 could have a driving portion and a jaw portion similar to the driving portion 212 and the jaw portion 290 described in connection with the second embodiment, illustrated in Figs. 6-8. The instrument 510 could then be used to move vertebrae relative to each other that are connected to a spine construct having a clamping screw and rod.

A surgical instrument 710 constructed according to a fifth embodiment is illustrated in Figs. 14-21. The surgical instrument 710 (Fig. 16) includes a driving portion 712 with a longitudinal axis 714. The driving portion 712 (Fig. 15) has an end 730 with wrenching flats 732. The end 730 (Fig. 21) extends into a recess

(not shown) in a clamping member or cap screw 736 connected with a vertebra 20 to apply torque to the clamping member.

The clamping members 736 threadably engage fastener housings 738 to clamp a longitudinal member, such as a rod 740, extending between vertebrae 20 and 21 to the housings. The clamping members 736 also clamp fasteners 742 connected to the vertebrae 20 and 21 to the housings 738. The fasteners 742 are positionable in any one of a plurality of angular positions relative to the housings 738, as known in the art. The longitudinal member 740, the housings 738, and the fasteners 742 are connected to the vertebrae during a surgical procedure performed through the cannula 29. It is contemplated that the instrument 710 could be used with any spine construct in which a clamping screw is used to clamp a rod to a fastener.

A longitudinally extending shaft 744 (Figs. 14 and 16) of the driving portion 712 extends between the end 730 and an opposite end 746. The end 746 of the shaft 744 is connected to a handle 748. The handle 748 may threadably engage the shaft 744 to connect the handle with the driving portion 712. It is contemplated that the handle 748 may be connected to

the end 746 in any suitable manner. The handle 748 is grasped by a surgeon to manually rotate the driving portion 712 about the longitudinal axis 714 to rotate the clamping member 736 relative to the housing 738.

The shaft 744 (Fig. 16) extends through a passage 750 defined by a base portion 758 and an actuator 760. The driving portion 712 is axially movable relative to the base portion 758 and the actuator 760. The driving portion 712 also rotates about the longitudinal axis 714 relative to the base portion 758 and the actuator 760.

The base portion 758 (Fig. 16) has a generally C-shaped cross-section defining a longitudinal slot 762. The actuator 760 is located in the slot 762. A pair of longitudinally extending grooves 764 are located on either side of the slot 762. Longitudinally extending projections 766, one of which is shown in Fig. 16, on opposite sides of the actuator 760 extend into the grooves 764. The grooves 764 in the base portion 758 guide movement of the actuator 760 relative to the base portion in proximal and distal directions extending parallel to the longitudinal axis 714.

The base portion 758 (Fig. 16) has an end 768 with a generally rectangular cross-section. The end 768

includes a pair of rectangular recesses 770 on opposite sides of the slot 762. The end 768 of the base portion 758 also includes a pair of threaded openings (not shown) for receiving screws (not shown) to connect the base portion 758 to a housing 774. It is contemplated that the base portion 758 and the housing 774 may be connected together in any suitable manner or be formed as one piece.

The housing 774 (Figs. 16-18) includes a channel 776 defined by a bottom wall 778 and two side walls 780 and 782 extending generally parallel to each other. A pair of rectangular projections 784 (Figs. 14 and 16) extend from the side walls 780 and 782 toward each other. The projections 784 are received in the recesses 770 in base portion 758 to prevent relative movement between the housing 774 and the base portion 758. The bottom wall 778 of the housing 774 has a pair of openings 786 (Fig. 19) through which the screws (not shown) extend to connect the housing to the base portion 758.

The housing 774 (Fig. 17) includes a block portion 788 at an axial end 790 of the housing between the side walls 780 and 782. The block portion 788 has an axially extending opening 792 through which the



driving portion 712 extends. An opening 794 (Fig. 19) extending transverse to the axis 714 intersects the opening 792. The opening 794 may receive a ball plunger (not shown) that frictionally engages the driving portion 712.

The side wall 780 (Fig. 17) has a slot 796 at the end portion 790 of the housing 774. The slot 796 has a first distal circular end portion 798 and a second proximal circular end portion 800. The slot 796 has an intermediate portion 801 interconnecting the end portions 798 and 800. The intermediate portion 801 has a width smaller than the diameter of the end portions 798 and 800.

The side wall 782 has a slot 802 aligned with the slot 796. A longitudinally extending rail 804 extends into the slot 802. The rail 804 defines a distal circular end portion 806 of the slot 802. The rail 804 also defines a proximal circular end portion 808 of the slot 802.

A control lever 816 (Figs. 14 and 16) is pivotally connected to the housing 774 by a pivot connection 818. The pivot connection 818 extends into a cylindrical recess 820 and through an opening 822 in the control lever 816. The pivot connection 818 also extends

through the slots 796 and 802 in the housing 774. The pivot connection 818 is operable to be moved between the ends 798 and 800 of the slot 796 and the ends 806 and 808 of the slot 802. When the pivot connection 818 is in the ends 798 and 806, as shown in Fig. 19, the instrument 710 is in a position for distracting vertebrae when the lever 816 is pivoted toward the housing 774. When the pivot connection 818 is in the ends 800 and 808, as shown in Fig. 20, the instrument 710 is in a position for compressing vertebrae when the lever 816 is pivoted toward the housing 774.

The control lever 816 (Fig. 18) includes an opening 826 for receiving the hand of a surgeon for operating the surgical instrument 710. The control lever 816 has a pair of legs 828 defining a recess 830 between the legs. A pivot pin 832 extends through openings 834 in the legs 828 to pivotally connect a link 836 to the control lever 816. The link 836 extends into the recess 830 defined by the legs 828.

The pivot connection 818 (Fig. 18) includes a button 840 that extends into the recess 820. A screw 842 extends into the opening 822 and threadably engages the button 840. The button 840 has a head 844,

a cylindrical intermediate portion 846, and a cylindrical end portion 848. The intermediate portion 846 extends between the head 844 and the end portion 848.

The intermediate portion 846 has an outer diameter smaller than the outer diameter of the end portion 848. The outer diameter of the intermediation portion 846 is also smaller than the width of the intermediate portion 801 of the slot 796 in the housing 774. The outer diameter of the end portion 848 of the button 840 is smaller than the diameter of the end portions 798 and 800 of the slot 796. The outer diameter of the end portion 848 is larger than the width of the intermediate portion 801 of the slot 796. Accordingly, when the intermediate portion 846 of the button 840 is in the slot 796, the button can slide along the slot. When the end portion 848 is in the slot 796, the button 840 is prevented from moving relative to the housing.

The end portion 848 of the button 840 has an axial opening 850 into which the screw 842 extends. The end portion 848 also includes a threaded opening (not shown) which the screw 842 threadably engages. A radially extending surface (not shown) extends between

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the threaded opening and a cylindrical surface 856 defining the opening 850.

A coil spring 860 extends around a shaft 862 of the screw 842. The spring 860 engages a surface (not shown) in the opening 850 of the button 840 and also engages a surface (not shown) in the recess 820 of the control lever 816. The button 840 extends through the slot 796 in the housing 774. A head 866 of the screw 842 extends into the slot 802 in the housing 774. The head 866 has a diameter smaller than the end portions 806 and 808 of the slot 802. The diameter of the head 866 is larger than the distance between the rail 804 and the wall defining the slot 802.

The spring 860 biases the pivot connection 818 to a position in which the large diameter end portion 848 of the button 840 extends into one of the circular end portions 798 or 800 of the slot 796 and the head 866 of the screw 842 extends into one of the circular end portions 806 or 808 of the slot 802. The button 840 is manually pressed to compress the spring 860 and align the intermediate portion 846 with the slot 796 in the housing 774. The head 866 of the screw 842 also moves out of engagement with the rail 804 of the housing 774. Accordingly, the pivot connection 818 may slide along

the slots 796 and 802 to position the pivot connection 818 in one of the ends 798 or 800 of the slot 796 and one of the ends 806 and 808 of the slot 802.

When the pivot connection 818 is in the ends 798 and 806 of the slots 796 and 802 in the housing 774, the instrument 710 is in a position to operate the instrument for distraction to move vertebrae 20 and 21 away from each other. When the pivot connection 818 is in the ends 800 and 808 of the slots 796 and 802, the instrument 710 is in a position to operate the instrument for compression or move vertebrae 20 and 21 toward each other.

The link 836 (Fig. 18) has an end 880 that extends into the recess 830 in the control lever 816. The end 880 includes an opening 882 through which the pivot pin 832 extends to pivotally connect the control lever 816 to the link 836. The link 836 has a recess 886 defined by a pair of legs 888. The recess 886 receives an extension 890 on the actuator 760. A pivot pin 891 extends through openings 892 in the legs 888 and through an opening 894 in the extension 890 of the actuator 760 to pivotally connect the link 836 to the actuator ends 798. When

the pivot connection 818 is located in the ends 798 and 806 of the slots 796 and 802, as shown in Fig. 19, the link 836 is in a position to move the actuator 760 in a proximal direction relative to the base portion 758 when the control lever 816 pivots toward the housing 774. When the pivot connection 818 is located in the ends 800 and 808 of the slots 796 and 802, as shown in Fig. 20, the link 836 is in a position to move the actuator 760 in a distal direction relative to the base portion 758 when the control lever 816 pivots toward the housing 774.

A jaw portion 900 (Figs. 14-16) is pivotally connected to the actuator 760 by a pivot pin 902. The jaw portion 900 has a recess 904 that receives an end 906 of the actuator 760 opposite from the extension 890. The pivot pin 902 extends through openings 908 in the jaw portion 900, one of which is shown in Fig. 16, and through an opening 910 in the end 906 of the actuator 760. The jaw portion 900 is pivotable relative to the actuator 760 between a first position adjacent the driving portion 712 and a second position spaced from the driving portion. Upon movement of the actuator 760 in the distal direction toward the handle 748 relative to the base portion 758,

the jaw portion 900 pivots away from the driving portion 712. The jaw portion 900 pivots toward the driving portion 712 when the actuator 760 moves in a distal direction away from the handle 748 relative to the base portion 758.

The jaw portion 900 has a pair of lobes 914 that extend on opposite sides of the axis 714 into cavities 916 in the base portion 758. Upon movement of the actuator 760 in the proximal direction relative to the base portion 758, the lobes 914 engage first surfaces on the base portion defining the cavities 916 to pivot the jaw portion 900 away from the driving portion 712. Upon movement of the actuator 760 in a distal direction relative to the base portion 758, the lobes 914 engage second surfaces defining the cavities 916 to pivot the jaw portion 900 toward the driving portion 712.

The jaw portion 900 includes a recess 918 defined by a pair of legs 920. The legs 920 extend at an angle from an intermediate portion 922. The jaw portion 900 receives the rod 740 between the legs 920. The legs 920 have surfaces facing away from the driving portion 712 that engage the housing 738 connected with the vertebra 21 when the surgical instrument 710 is

used to moved the vertebrae away from each other. The legs 916 have surfaces facing the driving portion 712 that engage the housing 738 connected with the vertebra 21 when the surgical instrument 710 is used to move the vertebrae 20 and 21 toward each other.

When the surgical instrument 710 is used to move vertebrae away from each other or distract the vertebrae, the pivot connection 818 is moved into the ends 798 and 806 of the slots 796 and 802 in the housing 774, as shown in Fig. 19. The instrument 710 is inserted through the cannula 29. The instrument 710 is inserted so that the driving portion 712 extends into the recess in the cap screw 736 connected with the vertebra 20. The rod 740 is received in the recess 918 between the legs 920 of the jaw portion 900. The driving portion 712 is rotated about the longitudinal axis 714 to loosen the cap screw 736. The rod 740, the housing 738, and the fastener 742 connected with the vertebra 21 can move relative to the clamping screw 736 and the fastener 742 connected with the vertebra 20 and the vertebrae can move relative to each other.

The control lever 816 is pivoted toward the housing 774 to move the actuator 760 in a distal direction extending parallel to the axis 714 relative



to the base portion 758. The lobes 914 on the jaw portion 900 engage surfaces on the base portion 758 to pivot the jaw portion relative to the actuator 760 in a direction extending transverse to the axis 714 and away from the driving portion 712. The legs 920 of the jaw portion 900 move into engagement with the housing 738 connected with the vertebra 21 to move the vertebrae 20 and 21 away from each other. When the vertebrae 20 and 21 have been moved to a desired spatial relationship, the driving portion 712 is rotated to clamp the rod 740 to the housing 738 and the fastener 742 connected with the vertebra 20 to retain the vertebrae in the desired spatial relationship.

When the instrument 710 is used to move the vertebrae 20 and 21 toward each other or compress the vertebrae, the instrument 710 is inserted through the cannula 29. The pivot connection 818 is moved to the ends 800 and 808 of the slots 796 and 802 in the housing 774, as shown in Fig. 20. The jaw portion 900 is spaced from the driving portion 712 with the legs 920 engaging the housing 738 connected with the vertebra 21. The driving portion 712 is inserted into the recess in the cap screw 736 connected with the vertebra 20. The driving portion 712 is rotated about

the longitudinal axis 714 to loosen the screw 736. The rod 740, the housing 738, and the fastener 742 connected with the vertebra 21 can move relative to the clamping screw 736 and the fastener 742 connected with the vertebra 20 and the vertebrae can move relative to each other.

The control lever 816 is pivoted about the pivot connection 818 toward the housing 774 to move the actuator 760 in the proximal direction extending parallel to the longitudinal axis 714 relative to the base portion 758. The lobes 914 on the jaw portion 900 engage surfaces on the base portion 758 to pivot the jaw portion toward the driving portion 712 and transverse to the axis 714. The legs 920 on the jaw portion 900 engage the housing 738 connected with the vertebra 21 and move the vertebrae 20 and 21 toward each other. Once the vertebrae 20 and 21 have been moved into a desired spatial relationship, the driving portion 712 is rotated about the longitudinal axis 714 to tighten the screw 736 and clamp the rod 740 to the housing 738 and the fasteners 742 to retain the vertebrae in the desired spatial relationship.

Although the instruments 10, 210, 310, 510, and 710 are shown moving adjacent vertebrae 20 and 21

relative to each other, it is contemplated that the instruments could be used to move vertebrae that are not adjacent to each other. Furthermore, it is contemplated that the instruments 10, 210, 310, 510, and 710 could be used with any cannula.

From the above description of the invention, those skilled in the art will perceive improvements, changes and modifications. Such improvements, changes and modifications within the skill of the art are intended to be covered by the appended claims.

Having described the invention, the following is claimed:

1. A surgical instrument extendable through a cannula for moving a first bone portion relative to a second bone portion, said surgical instrument comprising:

a first portion having a longitudinal axis engageable with a first member connected with the first bone portion;

a second portion engageable with a second member connected with the second bone portion, said second portion being movable relative to said first portion; and

an actuator connected with said second portion for moving said second portion relative to said first portion in a direction extending transverse to said longitudinal axis to move the first and second bone portions relative to each other.

2. A surgical instrument as set forth in claim 1 wherein said second portion is pivotally connected to said actuator.

3. A surgical instrument as set forth in claim 2 wherein said second portion is pivotally connected to a third portion, said actuator being movable relative to said third portion to move said second portion relative to said first portion.

4. A surgical instrument as set forth in claim 3 further including a control lever pivotally connected to said actuator for moving said actuator in a direction extending parallel to said longitudinal axis to move said second portion relative to said first portion.

5. A surgical instrument as set forth in claim 4 wherein said control lever is pivotally connected to said third portion, said control lever pivoting relative to said actuator and said third portion to move said second portion relative to said first portion.

6. A surgical instrument as set forth in claim 2 wherein said second portion engages a third portion, said actuator being movable relative to said third portion to move said second portion into engagement with said third portion and relative to said first portion.

7. A surgical instrument as set forth in claim 6 wherein said third portion includes a cavity into which a lobe on said second portion extends, said lobe engaging said third portion to pivot said second portion relative to said actuator.

8. A surgical instrument as set forth in claim 1 wherein said actuator is movable in a direction extending parallel to said longitudinal axis to move said second portion relative to said first portion.

9. A surgical instrument as set forth in claim 1 wherein said actuator at least partially defines a passage through which said first portion extends.

10. A surgical instrument as set forth in claim 9 further including a third portion at least partially defining said passage through which said first portion extends, said actuator being movable relative to said third portion to move said second portion relative to said first portion.

11. A surgical instrument as set forth in claim 10 wherein said first portion is axially movable relative to said third portion.

12. A surgical instrument as set forth in claim 1 wherein said first portion is rotatable about said longitudinal axis of said first portion.

13. A surgical instrument as set forth in claim 12 wherein said first portion includes a ratcheting handle for rotating said first portion about said longitudinal axis.

14. A surgical instrument as set forth in claim 12 wherein said first portion has an end engageable with a clamping member threadably engaging a fastener connected to the first bone portion which clamps a longitudinal member extending between the first and second bone portions to the fastener, said first portion being rotatable about said longitudinal axis to rotate the clamping member relative to the fastener.

15. A surgical instrument as set forth in claim 1 further including a controller for moving said actuator relative to said first portion to move said second portion relative to said first portion, said controller being rotatable about said longitudinal axis.

16. A surgical instrument as set forth in claim 15 wherein said controller engages said actuator and is axially movable relative to said first portion, said controller moving said actuator in a direction extending parallel to said longitudinal axis.



17. A surgical instrument as set forth in claim 16 wherein said controller threadably engages a third portion, said controller and said actuator being movable relative to said third portion.

18. A surgical instrument as set forth in claim 1 wherein said second portion is movable away from said first portion to move the first and second bone portions away from each other, said second portion being movable toward said first portion to move the first and second bone portions toward each other.

19. A surgical instrument as set forth in claim 18 further including a control lever pivotally connected to a third portion for moving said actuator relative to said third portion to move said second portion relative to said first portion.

20. A surgical instrument as set forth in claim 19 wherein said control lever is pivotable in a first direction relative to said third portion to move said second portion away from said first portion to move the first and second bone portions away from each other, said control lever being pivotable in said first

direction relative to said third portion to move said second portion toward said first portion to move the vertebrae toward each other.

21. A surgical instrument as set forth in claim 20 wherein said control lever is pivotally connected to said third portion by a pivot connection, said pivot connection being movable relative to said third portion between first and second positions, said control lever being pivotable in said first direction relative to said third portion to move said second portion away from said first portion when said pivot connection is in said first position, said control lever being pivotable in said first direction relative to said third portion to move said second portion toward said first portion when said pivot connection is in said second position.

22. A surgical instrument as set forth in claim 21 further including a link pivotally connected to said control lever, said link being pivotally connected to said actuator.

23. A surgical instrument as set forth in claim 1 wherein said second portion includes a cavity for engaging the second member connected to the second bone portion.

24. A surgical instrument as set forth in claim 1 wherein said second portion includes a recess for receiving a longitudinal member extending between the first and second bone portions and connected to one of the first and second bone portions.

25. A surgical instrument as set forth in claim 24 wherein said second portion includes a rounded portion engageable with the second member connected to the second bone portion to maintain a single point of contact with the second member connected to the second bone portion as said second portion moves relative to said first portion.

26. A surgical instrument extendable through a cannula for moving a first bone portion away from a second bone portion comprising:

a first portion engageable with a first member connected with the first bone portion;

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a second portion engageable with a second member connected with the second bone portion, said second portion being movable relative to said first portion from a first position toward a second position to move the first and second bone portions away from each other; and

an actuator connected with said second portion for moving said second portion relative to said first portion to move the first and second bone portions away from each other.

27. A surgical instrument as set forth in claim 26 wherein said second portion is pivotally connected to said actuator.

28. A surgical instrument as set forth in claim 27 wherein said second portion is pivotally connected to a third portion, said actuator being movable relative to said third portion to move said second portion relative to said first portion.

29. A surgical instrument as set forth in claim 28 further including a control lever pivotally connected to said actuator and pivotally connected to said third portion for moving said actuator in a direction extending parallel to a longitudinal axis of said first portion.

30. A surgical instrument as set forth in claim 27 wherein said second portion includes a lobe extending into a cavity in a third portion, said actuator being movable relative to said third portion to move said lobe into engagement with said third portion to pivot said second portion relative to said actuator and move said second portion relative to said first portion.

31. A surgical instrument as set forth in claim 26 wherein said actuator is movable in a direction extending parallel to a longitudinal axis of said first portion to move said second portion relative to said first portion.

32. A surgical instrument as set forth in claim 26 wherein said actuator and a third portion define a passage through which said first portion extends, said actuator being movable relative to said third portion to move said second portion relative to said first portion.

33. A surgical instrument as set forth in claim 32 wherein said first portion is axially movable relative to said third portion.

34. A surgical instrument as set forth in claim 33 wherein said first portion is rotatable about a longitudinal axis of said first portion, said first portion having an end engageable with a clamping member threadably engaging a fastener connected to the first bone portion which clamps a longitudinal member to the fastener.

35. A surgical instrument as set forth in claim 26 further including a controller for moving said actuator relative to said first portion to move said second portion relative to said first portion, said controller being rotatable about a longitudinal axis of said first portion.

36. A surgical instrument as set forth in claim 35 wherein said controller engages said actuator and is axially movable relative to said first portion, said controller moving said actuator in a direction extending parallel to a longitudinal axis of said first portion.

37. A surgical instrument as set forth in claim 36 wherein said controller threadably engages a third portion, said controller and said actuator being movable relative to said third portion to move said second portion relative to said first portion.

38. A surgical instrument as set forth in claim 26 wherein said second portion is movable from said second position toward said first position to move the first and second bone portions toward each other.

39. A surgical instrument as set forth in claim 38 further including a control lever pivotally connected to a third portion for moving said actuator relative to said third portion to move said second portion relative to said first portion.

40. A surgical instrument as set forth in claim 39 wherein said control lever is pivotable in a first direction relative to said third portion to move said second portion away from said first portion to move the first and second bone portions away from each other, said control lever being pivotable in said first direction relative to said third portion to move said second portion toward said first portion to move the vertebrae toward each other.

41. A surgical instrument as set forth in claim 40 wherein said control lever is pivotally connected to said third portion by a pivot connection, said pivot connection being movable relative to said third portion between first and second positions, said control lever being pivotable in said first direction relative to said third portion to move said second portion away from said first portion when said pivot



connection is in said first position, said control lever being pivotable in said first direction relative to said third portion to move said second portion toward said first portion when said pivot connection is in said second position.

42. A surgical instrument as set forth in claim 41 further including a link pivotally connected to said control lever, said link being pivotally connected to said actuator.

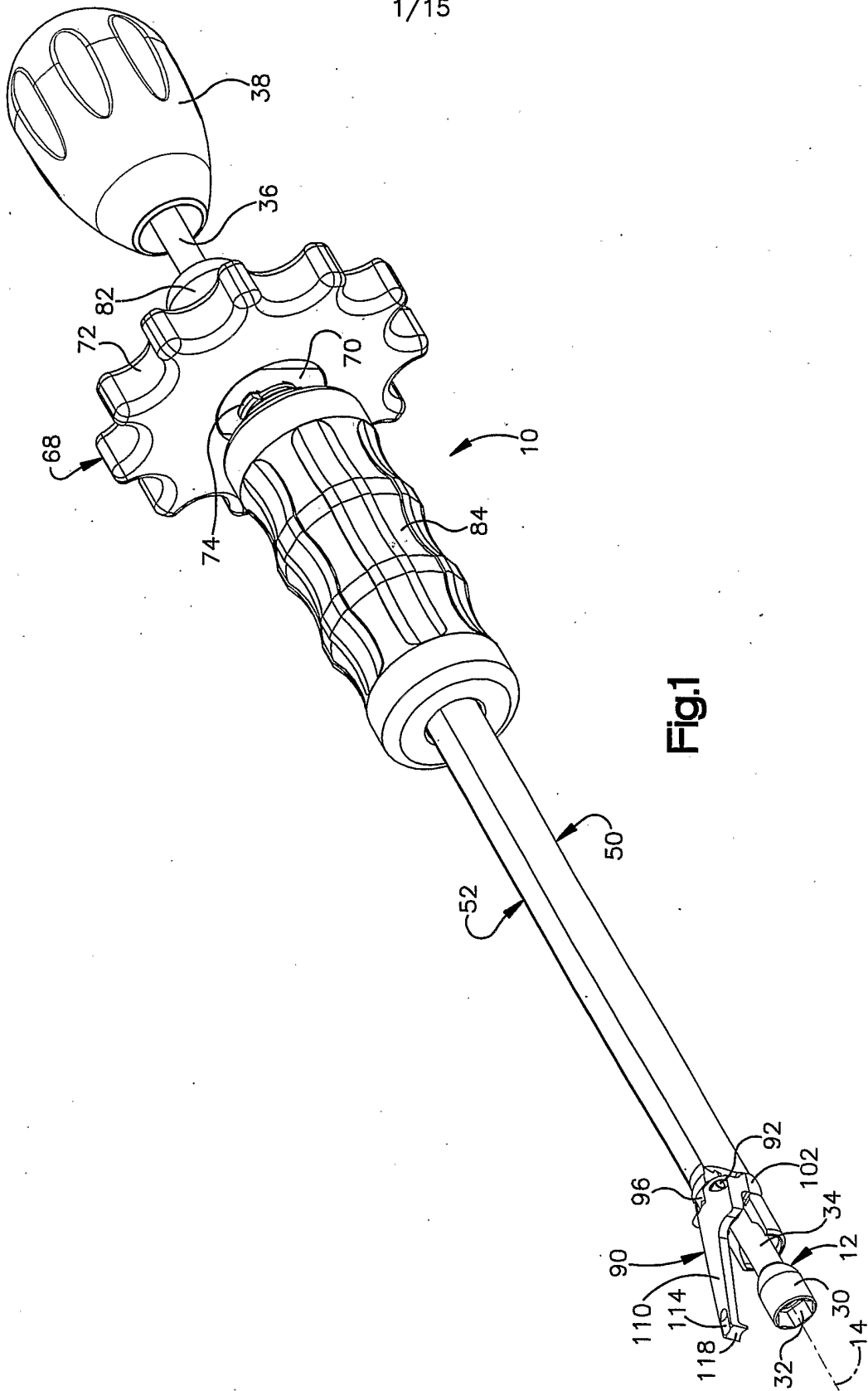


Fig.1

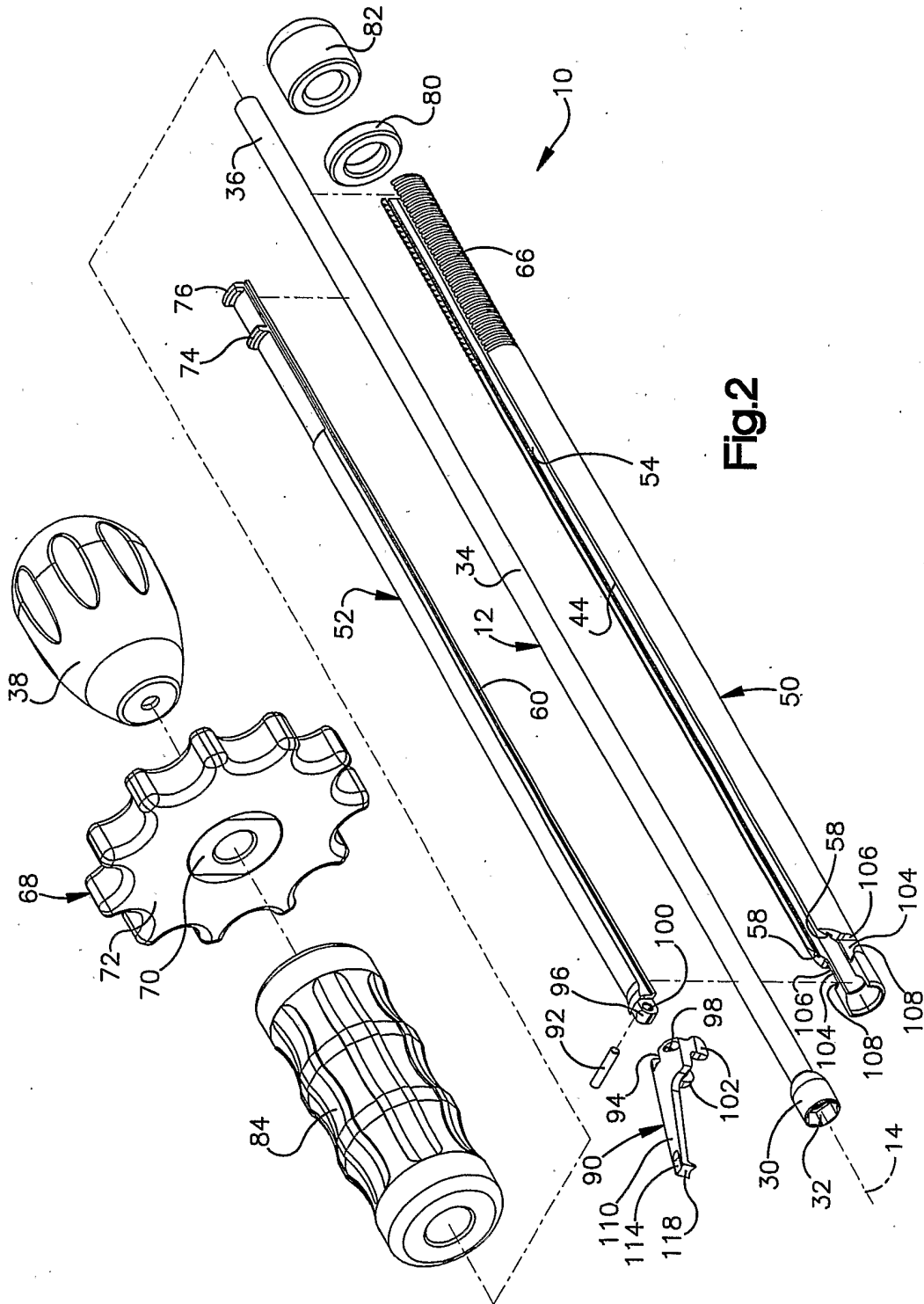
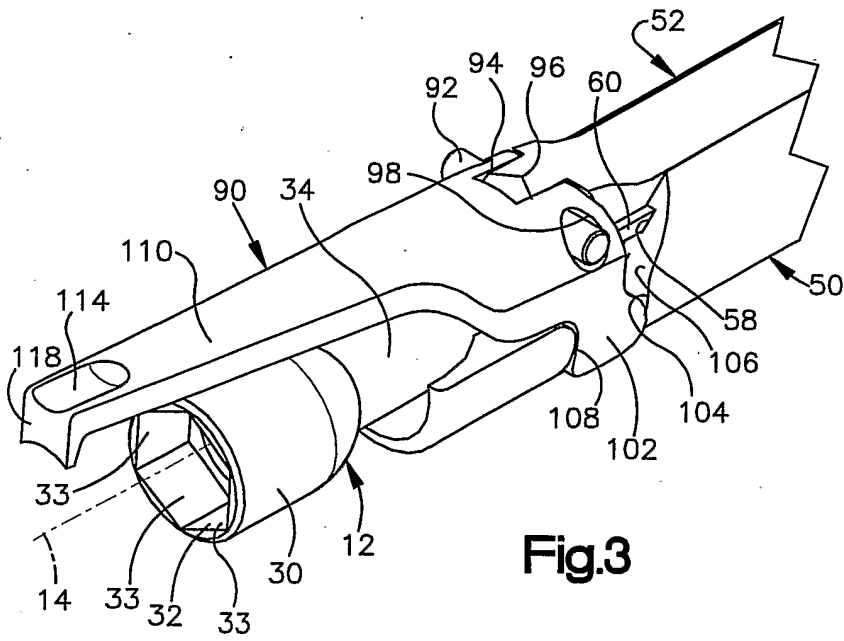


Fig.2



**Fig.3**

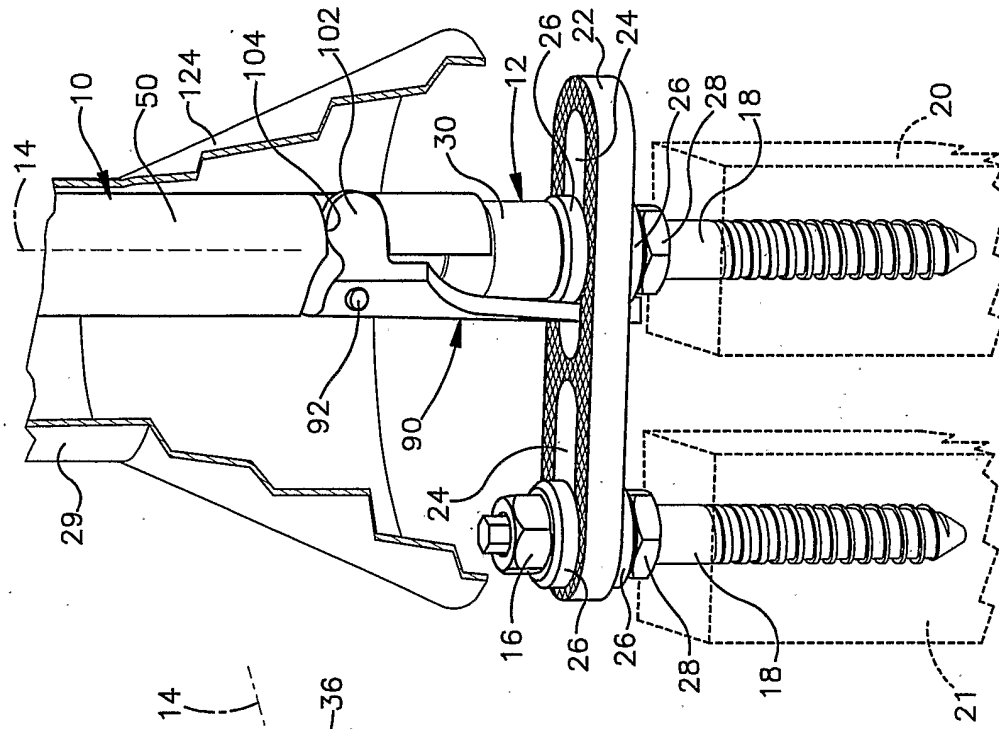


Fig.5

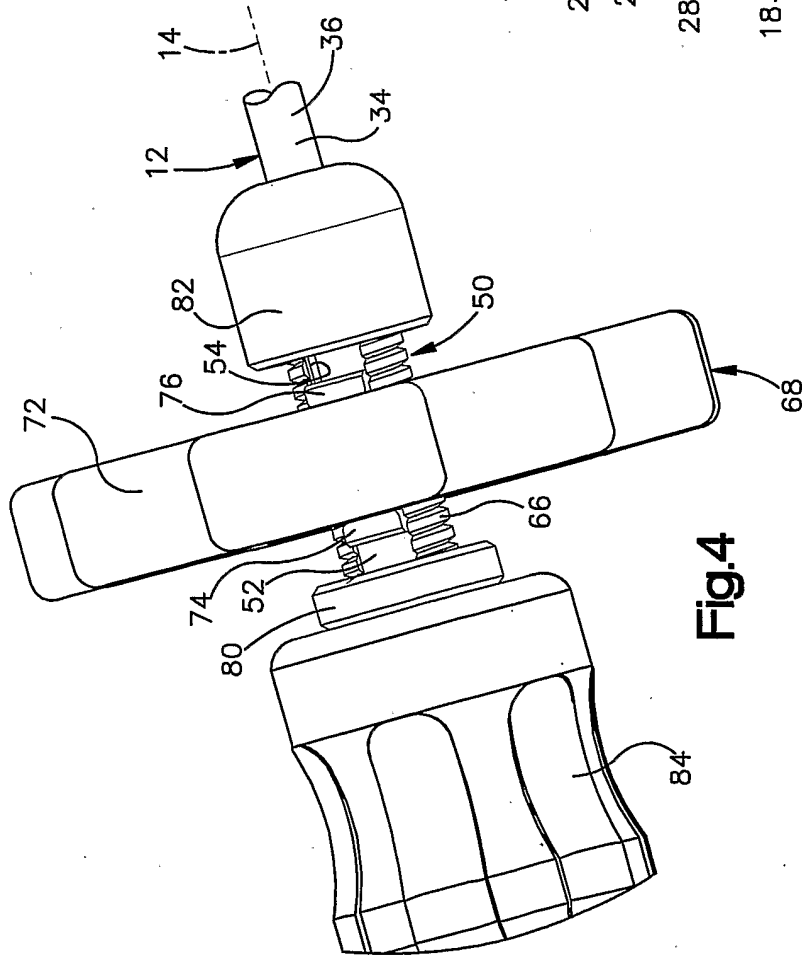
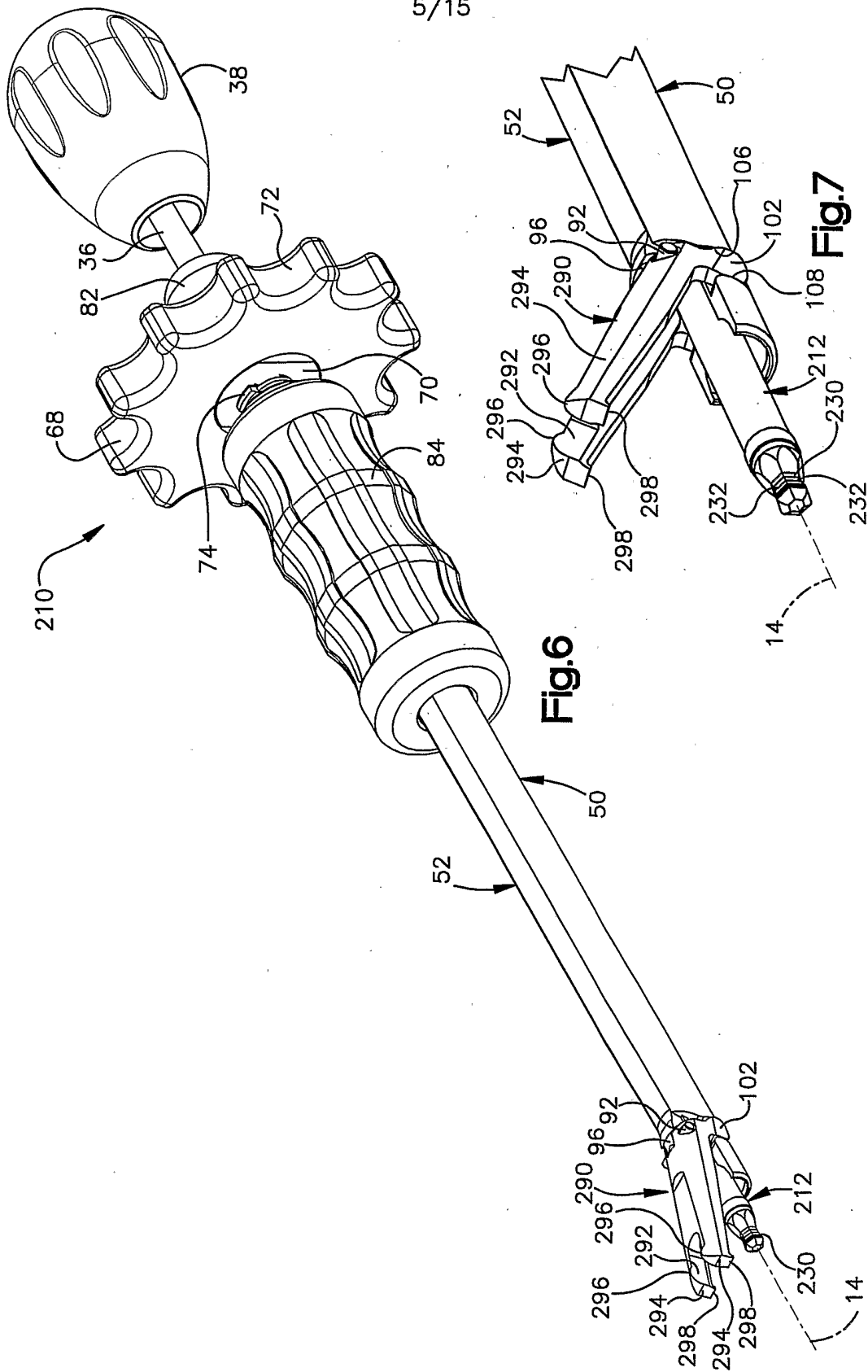
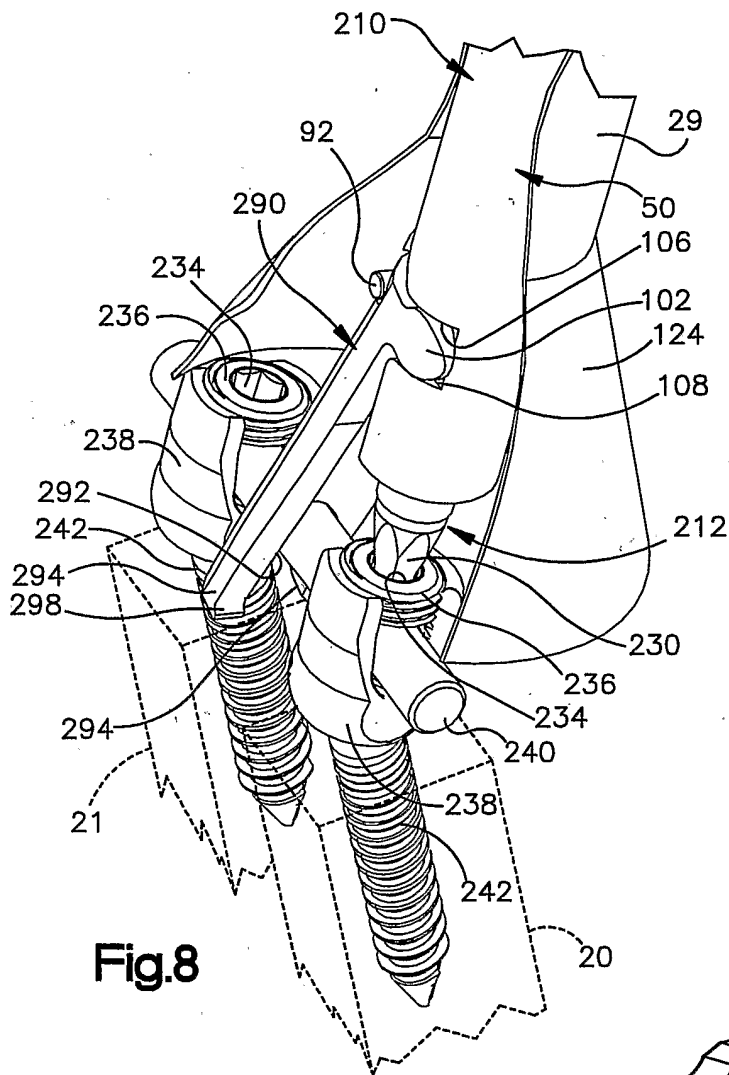
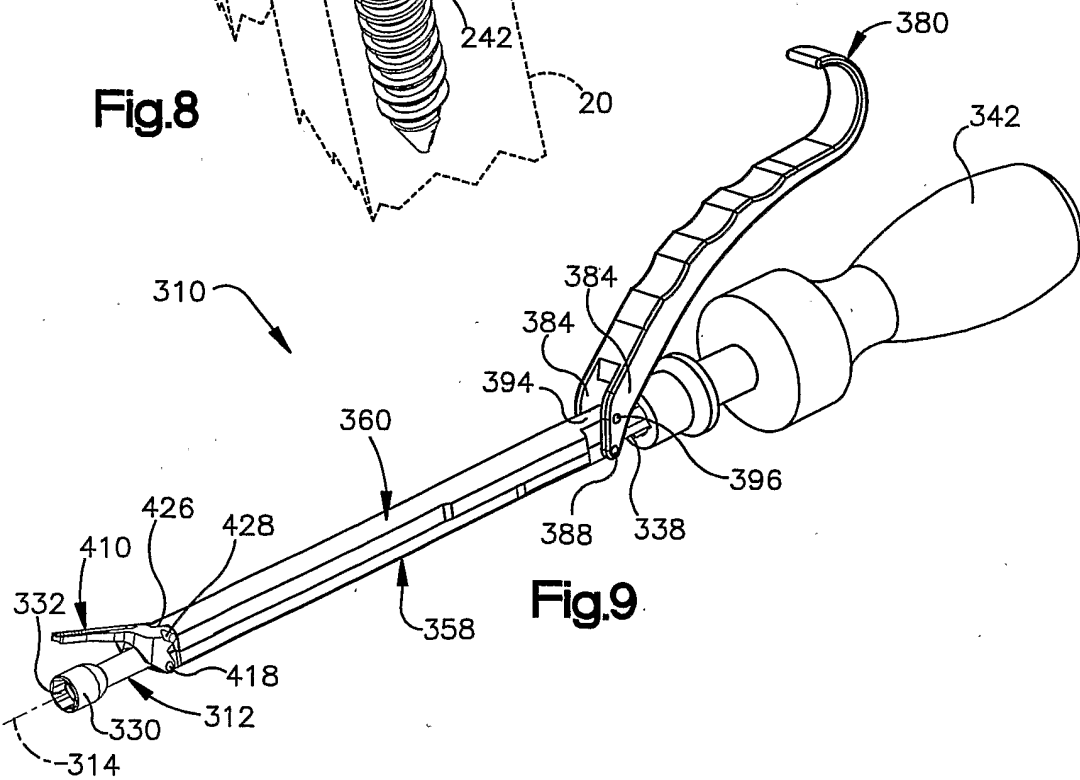


Fig.4





**Fig.8**



**Fig.9**

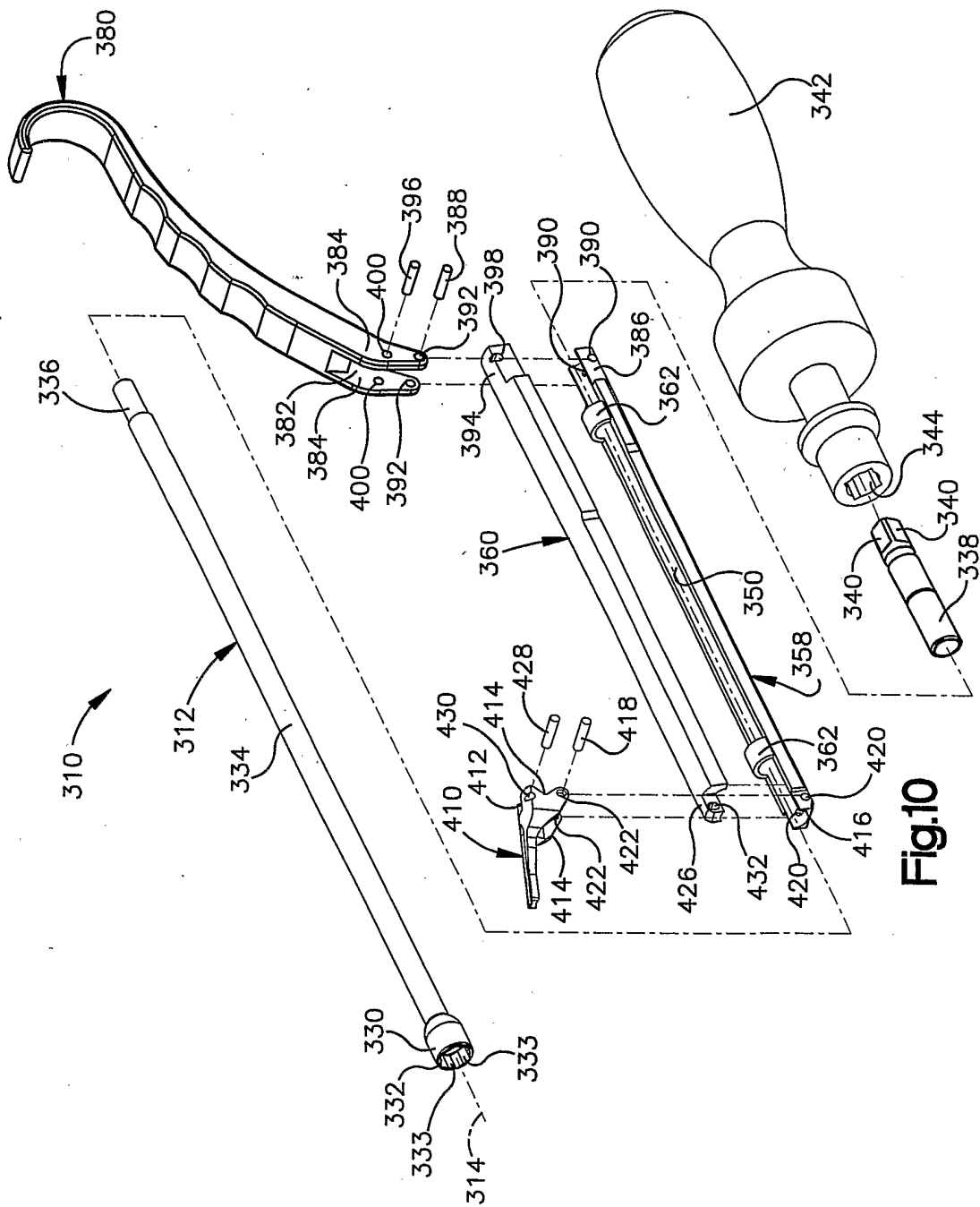


Fig.10



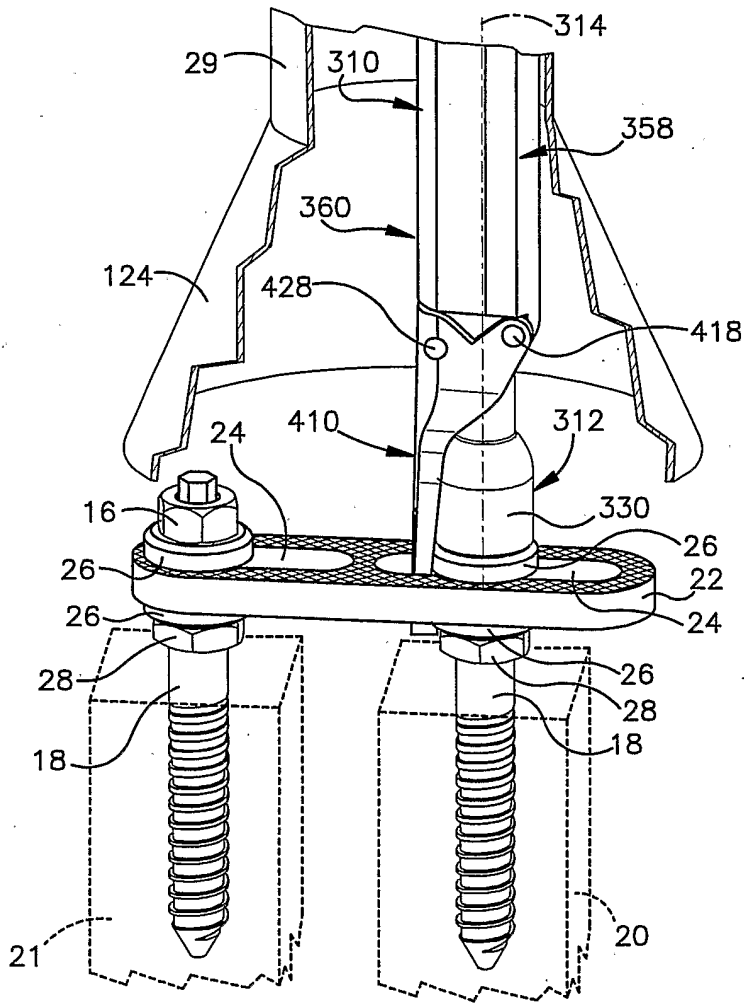


Fig.11

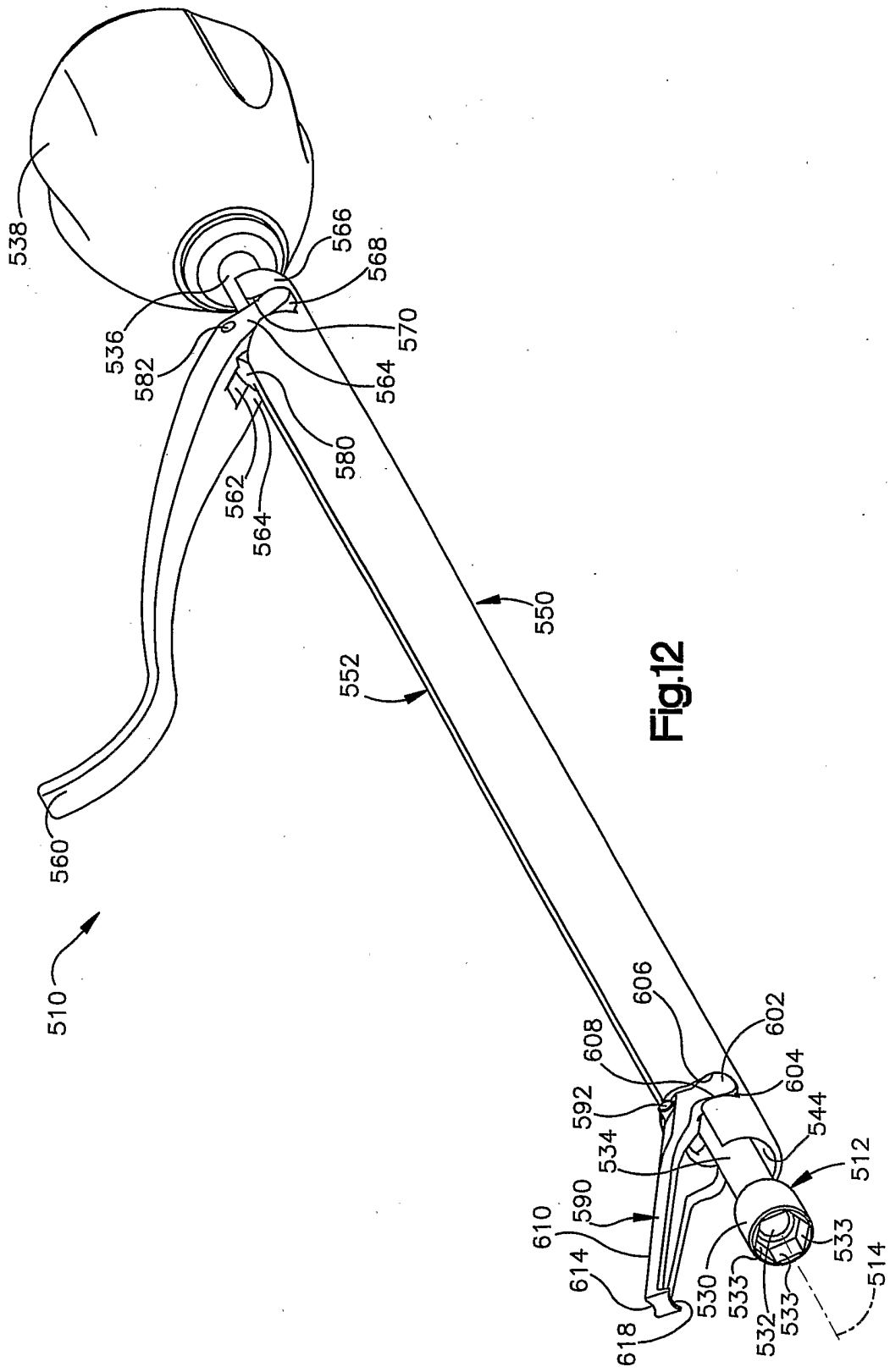


Fig.12

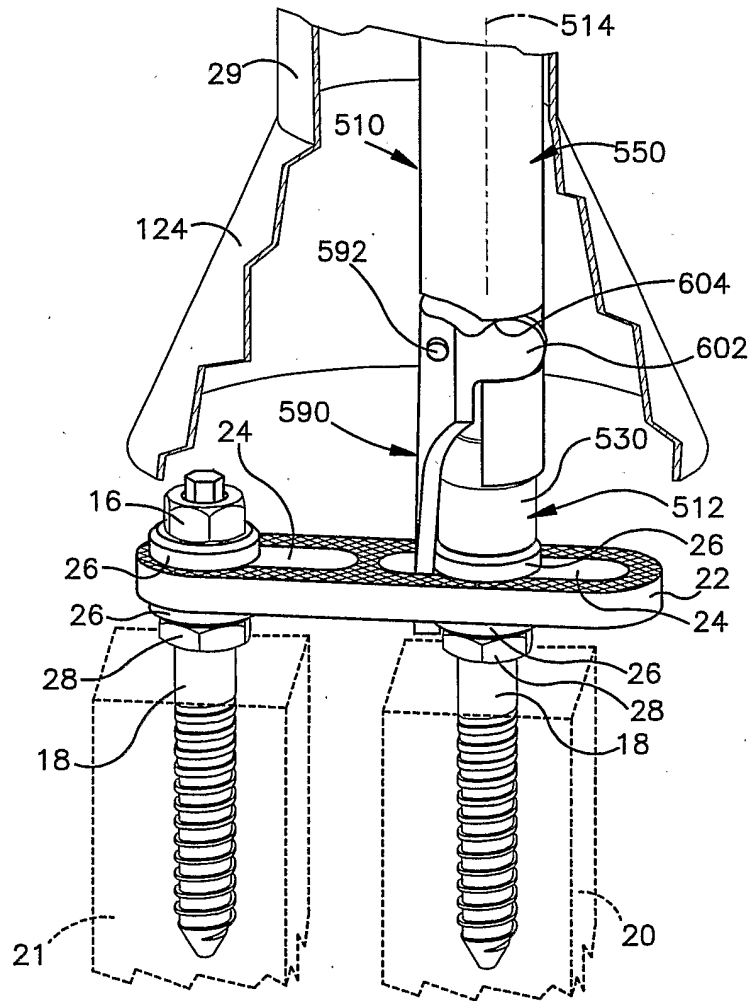


Fig.13

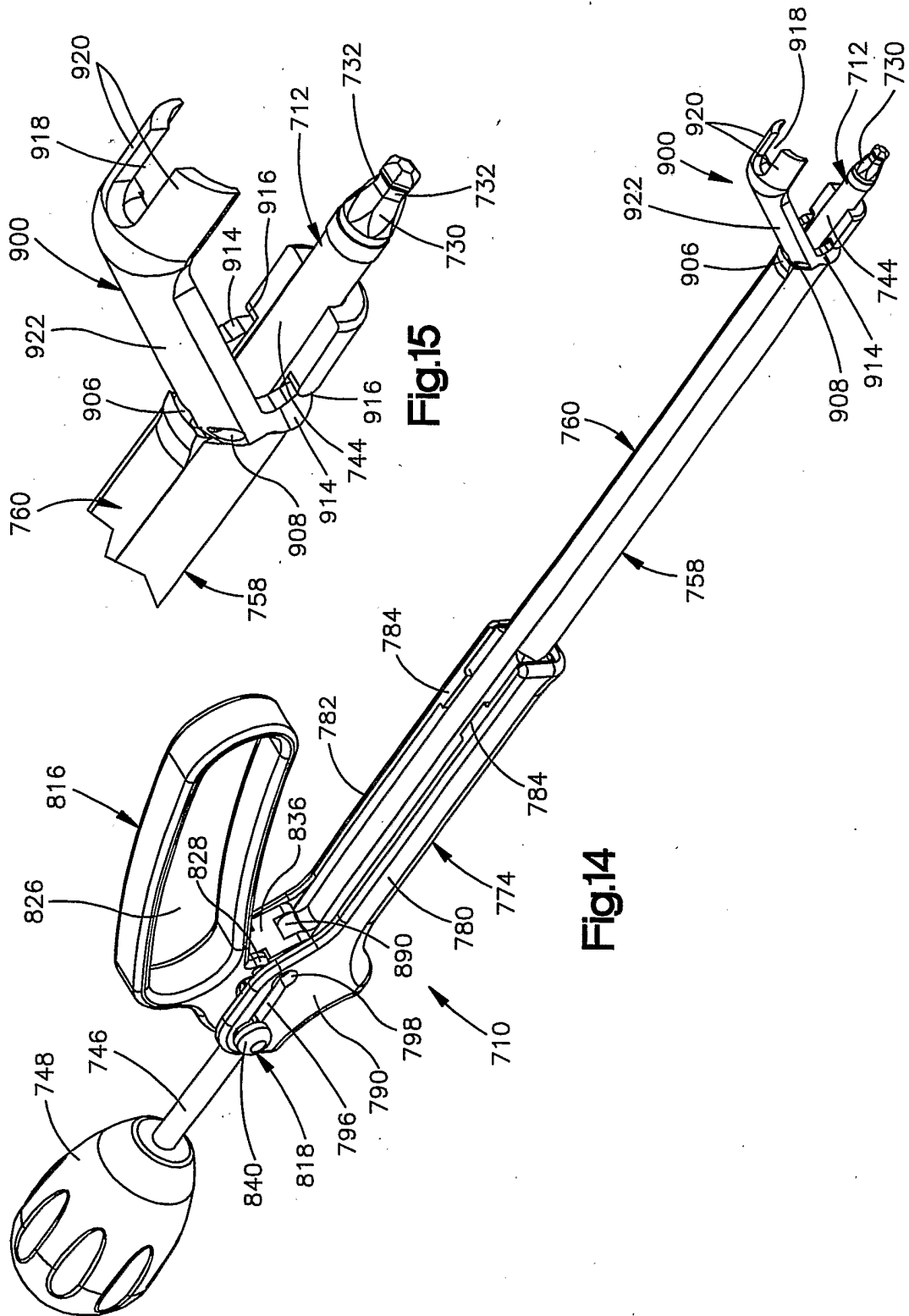


Fig.15

Fig.14

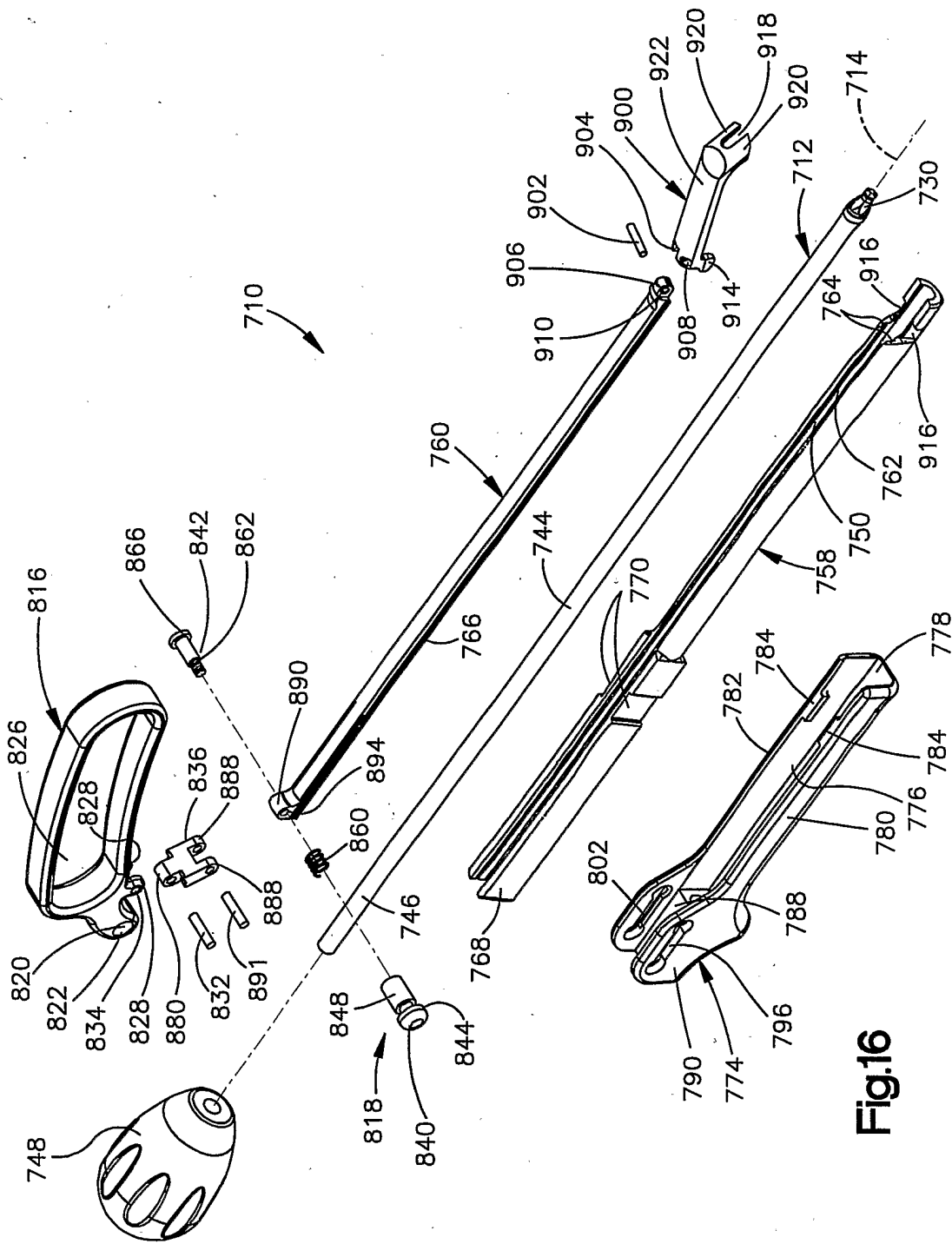


Fig.16

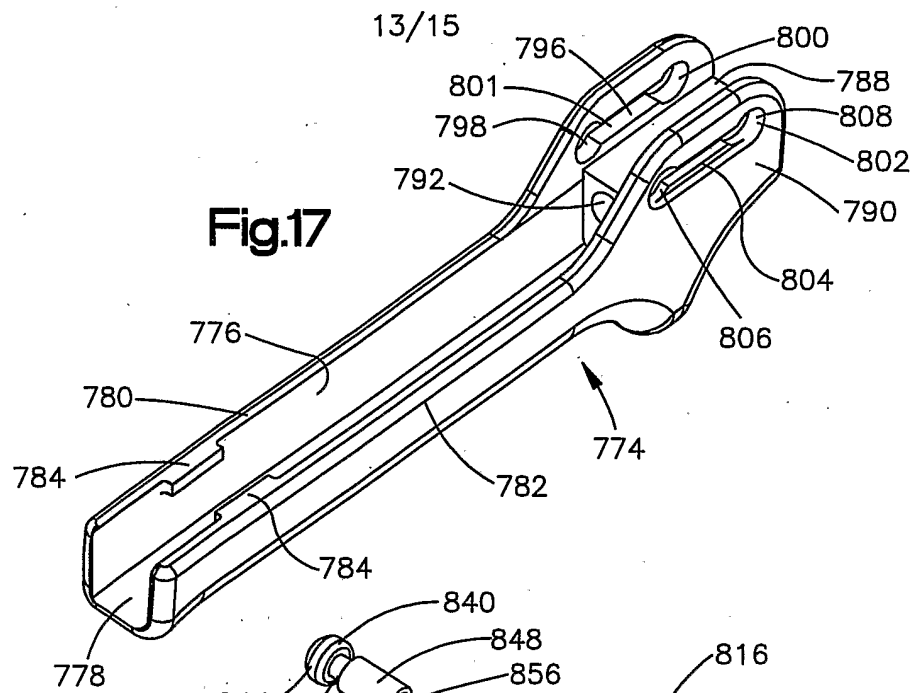


Fig.17

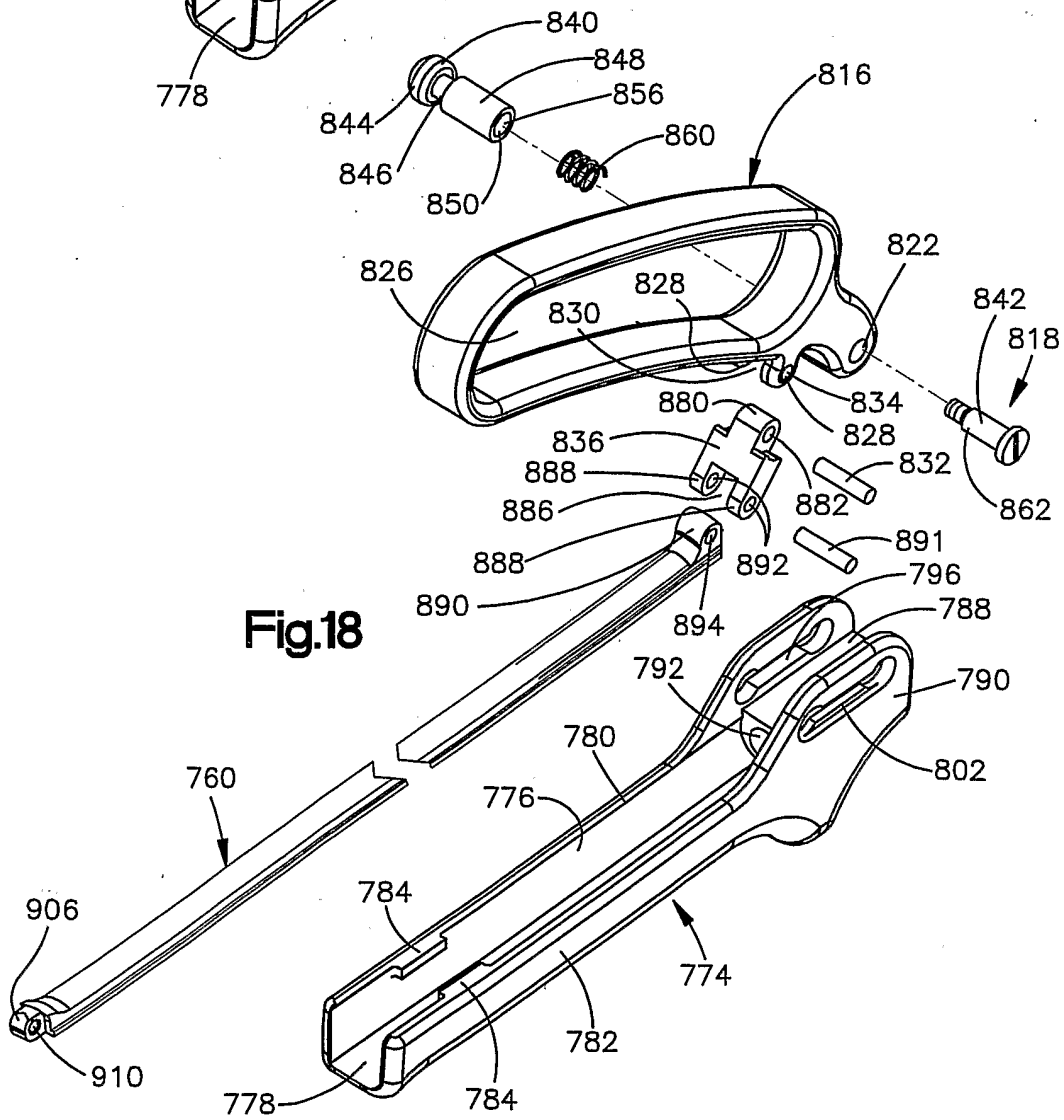
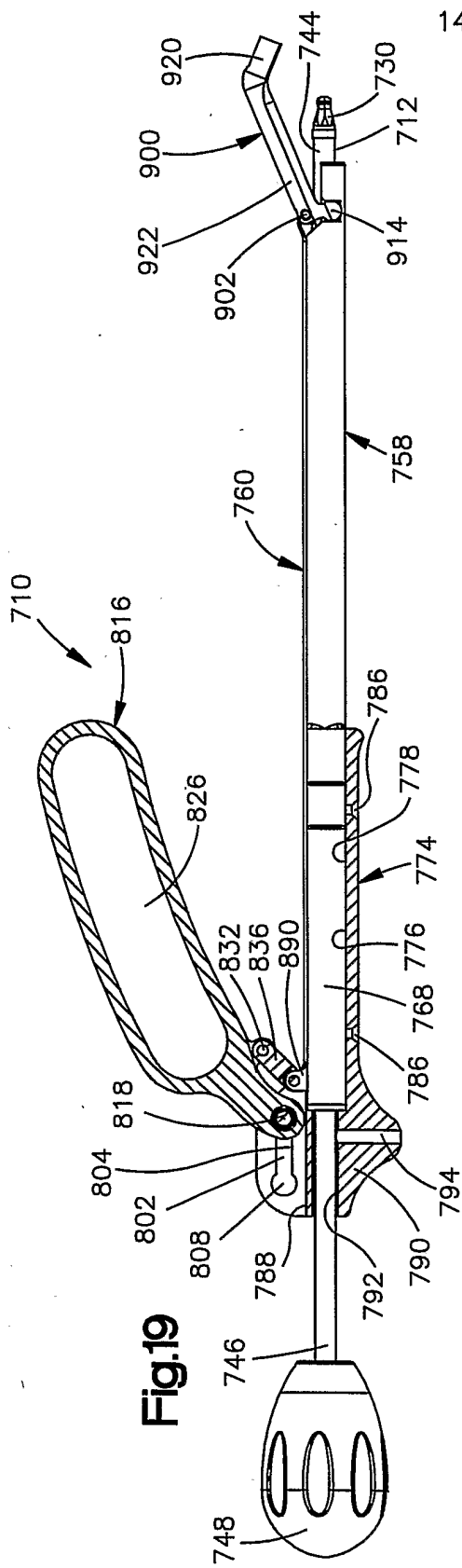
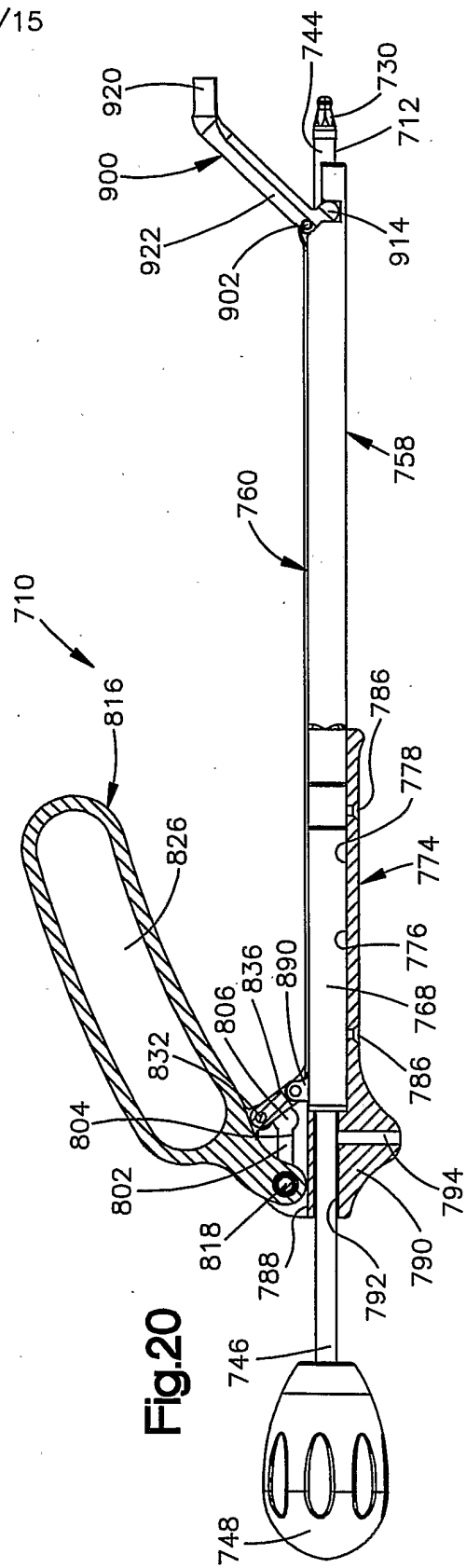


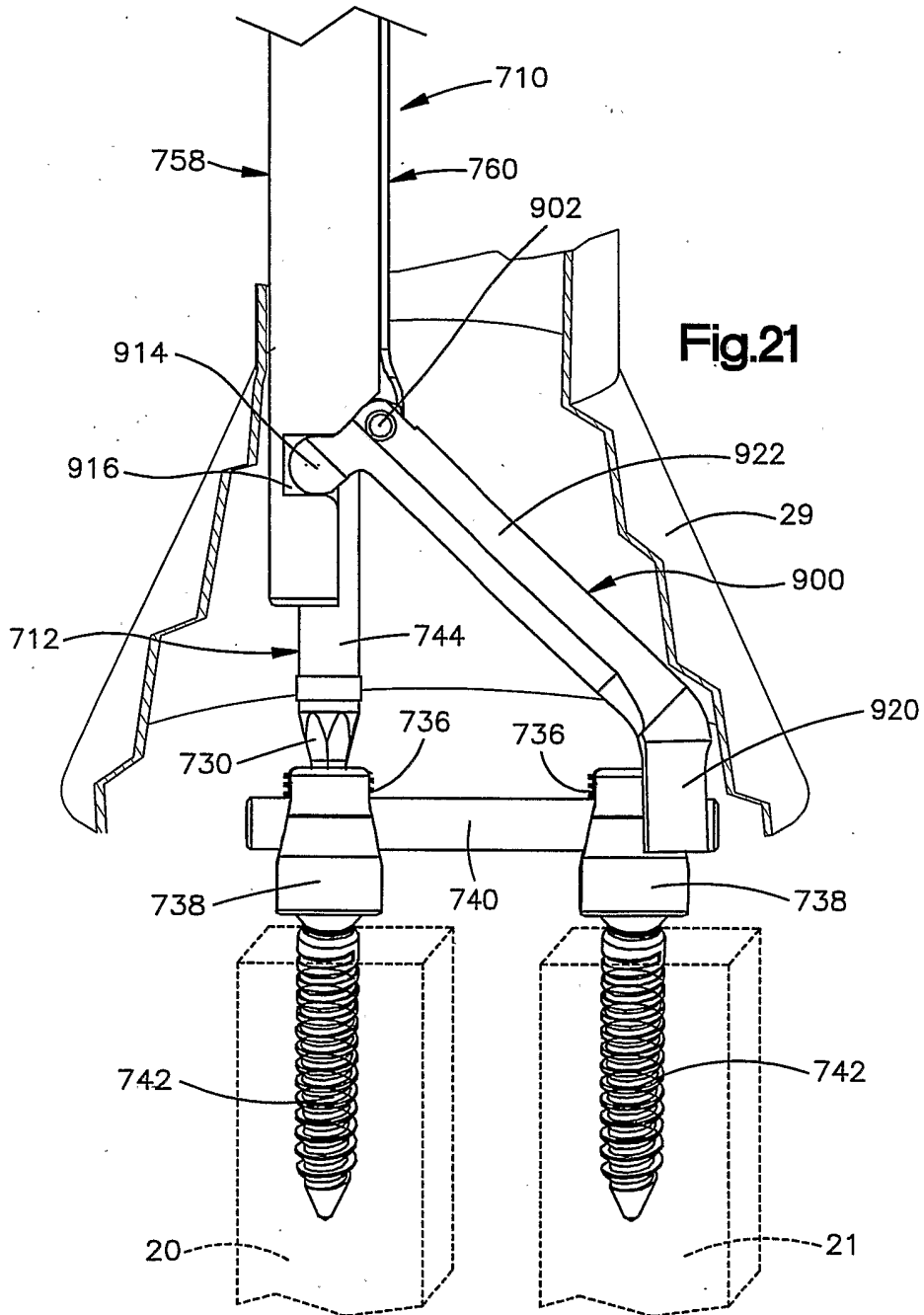
Fig.18



**Fig.19**



**Fig.20**

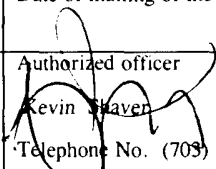




# INTERNATIONAL SEARCH REPORT

International application No.

PCT/US03/20003

<b>A. CLASSIFICATION OF SUBJECT MATTER</b>		
IPC(7) : A61B 17/58, 17/60; A61F 2/00, 2/32, 2/34, 2/36, 2/38		
US CL : 606/105		
According to International Patent Classification (IPC) or to both national classification and IPC		
<b>B. FIELDS SEARCHED</b>		
Minimum documentation searched (classification system followed by classification symbols) U.S. : 606/108, 105, 104, 99, 90, 53, 86		
Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched		
Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)		
<b>C. DOCUMENTS CONSIDERED TO BE RELEVANT</b>		
Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 6,261,296 B1 (AEBI et al) 17 July 2001 (17.07.2001), Figure 3, column 3, lines 66-67, column 4, lines 1-67 and column 5, lines 1-18.	1-3, 12-13, 18, 26-28, 38-40
X	US 6,287,307 B1 (ABBOUDI) 11 September 2001 (11.09.2001), Figure 1 and column 3, lines 18-33.	1-2, 12, 18, 26-27, 38
A	US 5,803,919 A (HART et al) 8 September 1998 (8.09.1998), Figure 1.	1-42
A	US 3,960,147 A (MURRAY) 1 June 1976 (1.06.1976), Figure 1 and column 2, lines 4-23.	1-42
<input type="checkbox"/> Further documents are listed in the continuation of Box C. <input type="checkbox"/> See patent family annex.		
* Special categories of cited documents:		
"A"	document defining the general state of the art which is not considered to be of particular relevance	"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention
"E"	earlier application or patent published on or after the international filing date	"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone
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"O"	document referring to an oral disclosure, use, exhibition or other means	"&" document member of the same patent family
"P"	document published prior to the international filing date but later than the priority date claimed	
Date of the actual completion of the international search		Date of mailing of the international search report
31 October 2003 (31.10.2003)		<b>03 DEC 2003</b>
Name and mailing address of the ISA/US Mail Stop PCT, Attn: ISA/US Commissioner for Patents P.O. Box 1450 Alexandria, Virginia 22313-1450 Facsimile No. (703)305-3230		Authorized officer  Telephone No. (703) 308-0858