(19) Europäisches Patentamt
European Patent Office
Office européen des brevets

(11) **EP 2 903 543 B1**

(12) **EUROPEAN PATENT SPECIFICATION**

(45) Date of publication and mention of the grant of the patent:
20.11.2019 Bulletin 2019/47

(21) Application number: **13843504.5**

(22) Date of filing: **02.10.2013**

(51) Int Cl.:
A61B 17/70 *(2006.01)* ***A61B 17/64*** *(2006.01)*
A61H 1/00 *(2006.01)*

(86) International application number:
PCT/US2013/063002

(87) International publication number:
WO 2014/055612 (10.04.2014 Gazette 2014/15)

(54) APPARATUS FOR ALIGNING A SPINE

VORRICHTUNG ZUM AUSRICHTEN DER WIRBELSÄULE

APPAREIL D'ALIGNEMENT D'UNE COLONNE VERTÉBRALE

(84) Designated Contracting States:
AL AT BE BG CH CY CZ DE DK EE ES FI FR GB GR HR HU IE IS IT LI LT LU LV MC MK MT NL NO PL PT RO RS SE SI SK SM TR

(30) Priority: **04.10.2012 US 201213644365**

(43) Date of publication of application:
12.08.2015 Bulletin 2015/33

(73) Proprietor: **Suddaby, Loubert S.**
Orchard Park, NY 14127 (US)

(72) Inventor: **Suddaby, Loubert S.**
Orchard Park, NY 14127 (US)

(74) Representative: **Reichert & Lindner Partnerschaft Patentanwälte**
Bismarckplatz 8
93047 Regensburg (DE)

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Description

FIELD OF THE INVENTION

[0001] The field of the invention pertains to the field of surgical devices, particularly to orthopedic surgical device, and more particularly to corrective devices related to the spine.

BACKGROUND OF THE INVENTION

[0002] Scoliosis is a disorder that causes an abnormal curve of the spine, or backbone. Patients with scoliosis develop abnormal curves to either side of the body's median line (lateral curve) and the bones of the spine twist on each other like a corkscrew. Scoliosis is about two times more common in girls than boys. It can be seen at any age, but it is most common in those over 10 years old.

[0003] Often, the cause of scoliosis is unknown and is described based on the age when scoliosis develops. If the person is less than 3 years old, it is called infantile idiopathic scoliosis. Scoliosis that develops between 3 and 10 years of age is called juvenile idiopathic scoliosis, and people that are over 10 years old have adolescent idiopathic scoliosis.

[0004] In functional scoliosis, the spine is normal, but an abnormal curve develops because of a problem somewhere else in the body. This could be caused by one leg being shorter than the other or by muscle spasms in the back. In the neuromuscular form, there is a problem during the formation of the bones of the spine. Either the bones of the spine fail to form completely or they fail to separate from each other. This type of scoliosis may develop in people with other disorders including birth defects, muscular dystrophy, cerebral palsy, and Marfan's disease. This type of scoliosis is often much more severe and needs more aggressive treatment than other forms of scoliosis. Degenerative scoliosis occurs in older adults. It is caused by changes in the spine due to arthritis. Weakening of the normal ligaments and other soft tissues of the spine combined with abnormal bone spurs can lead to an abnormal curvature of the spine.

[0005] Adolescent idiopathic scoliosis is the most common form of scoliosis. If the angle of the spinal curve (Cobb's angle) is small when first diagnosed, it can be observed and followed with routine X-rays and measurements. If the curve stays below 25 degrees, no other treatment is usually needed. If the curve is between 25-40 degrees, a brace may be recommended. If the curve is greater than 40 degrees, then surgery may be recommended. Braces are not designed to correct the curve. They are used to help slow or stop the curve from getting worse.

[0006] Spinal fusion is one surgical procedure that may be used to alleviate scoliosis. In this procedure, bone is grafted to the vertebrae to form a rigid column. The rigidity of the column will prevent the curve from worsening. However, the rigid column reduces the range of motion available to the patient.

[0007] Modern surgical procedures attempt to address sagittal imbalance and rotational defects unresolved by the earlier rod systems. They primarily involve a combination of rods, screws, hooks, cables and/or wires fixing the spine and applying forces to the spine to correct the spinal curvature. An example of the use of screws and cables is seen in U.S. Patent Application Publication No. 2006/0195090 to Suddaby ("Suddaby"). Suddaby discloses a system for improving the alignment of a spine by placing a series of screws or pins into the posterior or lateral side of the bodies of individual vertebrae. Hollow spacers are placed between the pins and a cable is extended through the heads of the pins and the spacers and is attached to an expansion sleeve. Tension is applied to the cable by pulling it through the expansion sleeve and then applying tension to the cable to pull the attached pins into an improved alignment. One of a plurality of nodules at the end of the cable is then placed into the passage of the expansion sleeve thereby holding the cable in the new "tensioned" position. The tension discourages movement of the spine.

[0008] U.S. Patent No. 6,551,320 to Lieberman ("Lieberman") discloses an apparatus for aligning a spine that includes a plurality of anchors screwed into adjacent vertebral bodies. A cable or series of cables is strung through or around the anchors and then pulled. The tension applied to the cable(s) is used to pull the spine into a desired alignment. U.S. Patent Application Publication No. 2009/0112262 to Pool, et al. ("Pool") discloses a system in which at least one anchor is screwed or otherwise embedded into an upper vertebra and one or more anchors are similarly placed in lower vertebra(ae). A cable is extended between the anchors and force applied to the cable by a magnetic adjustment device to align the spine. In some cases a second anchor-cable arrangement can be used on the opposite side of the spine.

[0009] Finally, U.S. Patent No. 5,782,831 to Sherman, et al. ("Sherman") discloses a system for reducing a displaced vertebra between adjacent vertebrae. The Sherman patent describes a system in which two anchors are screwed into the vertebrae on either side of the displaced vertebra with a rod attached between the anchors. A third anchor is screwed into the displaced vertebra and attached to a cable. A cable tightening device, such as a come-along type device is used to pull the displaced vertebra into alignment after which it is attached to the support rod. However, the attachment of a bar across three adjacent vertebrae prevents pulling a curved spine into a more proper alignment.

[0010] In attempting to solve spinal alignment and displacement problems, the prior art relies on multiple vertebral anchors and the application of alignment force through complicated force applicators and cable systems. Often such corrective systems fail to provide complete correction of spinal alignment as full recuperation requires either too much force to correct the curve or sudden, rapid stretching of spinal neural elements result-

ing in permanent neurological damage.

[0011] What is needed then is an apparatus for aligning the spine that possesses few parts and is easy to implant while enabling a gradual restoration of the of spinal alignment over a determined period of time so that large and/or sudden forces are not applied to the curved spine. By applying reduced corrective forces over a longer period of time, complications such as bone fracture and nerve damage can be reduced or avoided.

SUMMARY OF THE INVENTION

[0012] The present invention broadly comprises an assembly for performing a gradual lateral spinal alignment of a spine, the spine to be realigned having a lateral curve, the lateral curve having a convex side and an opposite concave side. The assembly comprises a hollow bone screw having internal threads and an open proximal end and an open distal end, a second screw threadably inserted into the hollow bone screw, a toggle bolt that includes a shaft having a distal end and a proximal end, wherein the distal end supports a pivotal attachment, and a toggle wing pivotably attached to the pivotal attachment. The assembly also includes a rigid stabilizing rod, the stabilizing rod having two ends and defining a first orifice and a second orifice, such that the axis of the second orifice is perpendicular to the axis of the first orifice and the second orifice is surrounded by an externally threaded annular lip, a cable having a first end and a second end, the first end attached to the proximal end of the toggle bolt and extending through second orifice, and a tube enclosing at least part of the length of the cable and having a first end threadably attached to the externally threaded annular lip, such that one end of the toggle bolt is extended through the distal end of the hollow screw.

[0013] A method, not claimed herein, but provided for illustrative purposes, of gradually laterally aligning a spine having a lateral curve using a spinal alignment assembly the spinal alignment assembly including a hollow bone screw having internal threads and an open proximal end and an open distal end, a second screw threadably inserted into the hollow bone screw; a toggle bolt that includes a shaft having a distal end, a middle section, and a proximal end, wherein the distal end supports a pivotal attachment, and a toggle wing pivotably attached to the pivotal attachment. The assembly also includes a rigid stabilizing rod, the stabilizing rod having two ends and defining a first orifice and a second orifice, wherein the axis of the second orifice is perpendicular to the axis of the first orifice and the second orifice is surrounded by an externally threaded annular lip, a cable having a first end and a second end, the first end attached to the proximal end of the toggle bolt and extending the second orifice, and a tube enclosing at least part of the length of the cable and having a first end threadably attached to the externally threaded annular lip and a second set screw threadably inserted into the tube, such that one end of the toggle bolt is extended through the distal end of the hollow screw. The gradual alignment method comprises the steps of screwing the hollow bone screw into a body of a vertebra of the spine; removing the second inner screw from the hollow bone screw; extending the toggle bolt through the hollow bone screw; placing the stabilizing rod on the hollow bone screw between the spine and the receiver; deploying the toggle wing on a convex side of the lateral curve; aligning the stabilizing rod laterally and longitudinally along the concave side of the lateral curve of the spine; enclosing at least part of the length of the cable in the tube such that the second end of the cable extends out of the back of a user; threadably attaching the tube to the receiver; attaching a cable tightening device at or near the second end of the cable; pulling the cable so as to pull the toggle bolt and the vertebra toward the concave side of the lateral curve; and tightening the second set screw to the cable to hold the pulled toggle bolt in the pulled position.

[0014] One object of the invention is to provide a device for aligning a lateral curve in a spine using a minimum amount of vertebral drilling sites.

[0015] A second object of the invention is to a spinal alignment assembly that can be used on either side of the spinal column.

[0016] A third object of the invention is to provide a device of spinal alignment in which corrective alignment is achieved gradually to avoid potential neurological and muscular damage. By gradually is meant over a period of several weeks to several months depending on the severity of the lateral curve.

BRIEF DESCRIPTION OF THE SEVERAL VIEWS OF THE DRAWINGS

[0017] The nature and mode of the operation of the present invention will now be more fully described in the following detailed description of the invention taken with the accompanying drawing Figures, in which:

Figure 1 is a stylized drawing of person with a spine afflicted with scoliosis;

Figure 2 is a rear view of a full body brace used by scoliosis patients;

Figure 2A is a rear view of a lighter brace used by scoliosis patients;

Figure 3 is a cross section of a hollow bone screw having an outer shell and an inner screw threadably inserted therein;

Figure 4 demonstrates the inner screw as separated from the outer shell leaving a lumen as a hollow space along the length of the outer shell;

Figure 4A depicts the outer shell with the inner screw removed leaving a lumen as a hollow space along the length of the outer shell;

Figure 5A is a top view of stabilizing rod of the assembly of the present invention;

Figure 5B is a side view of the stabilizing rod showing

the receiver formed into the peak that defines a screw hole;

Figure 5C is a cross section view taken along line 5C-5C in Figure 5B;

Figure 6 is side perspective exploded view of the assembly of the present invention attached to a vertebra in the spinal column of the spine to be aligned;

Figure 7 is a side perspective view of the assembly showing a pulling tool attached to the end of the pulling cable;

Figure 8 is a top or posterior view of a laterally curved spinal column with the alignment assembly in place;

Figure 9 a top or posterior view showing the assembly holding the spinal column in place after a pulling procedure;

Figure 10 shows spinal column moved to a straighter position relative to the axis after a succeeding pulling procedure;

Figure 10A shows the assembly with the pulling tool removed and the tube set screw screwed into the tube aperture to hold the cable in place between pulling procedures;

Figure 11 is the same posterior view showing the results of the final pulling procedure in which the lateral curve of the spinal column is significantly reduced if not eliminated;

Figure 12 is a posterior view showing spinal column after the final pulling procedure; and,

Figure 12A is a cross section view similar to Figure 5C showing he set screw holding the cable in place to maintain tension of the assembly after the final pulling procedure.

DETAILED DESCRIPTION OF EMBODIMENTS OF THE INVENTION

[0018] At the outset, it should be appreciated that like drawing numbers on different drawing views identify identical structural elements of the invention. It also should be appreciated that figure proportions and angles are not always to scale in order to clearly portray the attributes of the present invention.

[0019] While the present invention is described with respect to what is presently considered to be the preferred embodiments, it is understood that the invention is not limited to the disclosed embodiments. The present invention is intended to cover various modifications and equivalent arrangements included within the scope of the appended claims.

[0020] Furthermore, it is understood that this invention is not limited to the particular methodology, materials and modifications described and as such may, of course, vary. It is also understood that the terminology used herein is for the purpose of describing particular aspects only, and is not intended to limit the scope of the present invention, which is limited only by the appended claims.

[0021] Unless defined otherwise, all technical and scientific terms used herein have the same meaning as commonly understood to one of ordinary skill in the art to which this invention belongs. Although any methods, devices or materials similar or equivalent to those described herein can be used in the practice or testing of the invention, the preferred methods, devices, and materials are now described.

[0022] Adverting to the drawings, Figure 1 is a stylized view of a person **P** with a spine afflicted with scoliosis. Spinal column **1** is shown to have two lateral curves - upper curve **2** and lower curve **3.** Often the presence of one lateral curve will generate the formation of a second curve to compensate for the reduced spinal support of the body caused by one lateral curve. Figures 2 and 2A depict two different types of braces **4** and **5,** respectively, used to prevent further deterioration of spinal alignment. In some cases, braces such as braces **4** and **5** may improve the condition, but they rarely enable the wearer to achieve a full recovery to a correct spinal alignment.

[0023] Figure 3 is a cross section of hollow bone screw **20.** Outer screw shell **22** is externally threaded with threads **22a** to enable it to be screwed into the body of a vertebra as described below. Inner screw **24** is also externally threaded with threads **24a** to threadably connect with internal threads **22b** of outer screw shell **22.** Preferably cap **24b** is attached to the proximal end of inner screw **24.** Figures 4 and 4A demonstrate how inner screw **24** can be separated from outer shell **22** leaving lumen **26** as a hollow space along the length of outer shell **22.**

[0024] Figure 5A is a top view of stabilizing rod **30** ("rod **30**"). Preferably the ends 30a of rod **30** are curved to provide the advantage of being able to move more easily along the spine and longitudinal muscles along the spine. Receiver complex **32** ("receiver **32**") extends from the surface of rod **30** to form a peak which defines screw hole **34.** Figure 5B is a side view of rod **30** showing receiver **32** formed into the peak that defines screw hole **34** (not seen in Figure 5B). Also seen is aperture **36,** defined by part of one side of receiver **32,** and set screw **37** set into the same side of receiver **32.**

[0025] Figure 5C is a cross section view taken along line 5C-5C in Figure 5B. Set screw **37** is shown set into receiver **32.** It can be seen that aperture **36** and set screw **37** have parallel longitudinal -axes and both of these axes are substantially perpendicular to the axis **34a** of screw hole **34.** Annular lip **38** surrounds aperture **36** and set screw **37** and is externally threaded.

[0026] Figure 6 is side perspective exploded view of assembly **10** attached to a vertebra **80** in the spinal column of the spine to be aligned. Initially, hollow screw **20** is extended into screw hole **34** and is screwed into body **80** of the target vertebra until the distal end point **25** emerges slightly from the distal side, which preferably is at or near the peak of the convex curve of the laterally curved spinal column **1.** Inner screw **24** is then removed from outer shell **22** thereby opening lumen **26.** Toggle bolt **40** having shaft **41** with a distal end and a proximal end (not seen in Figure 6) and deployable wings **42** is

guided through lumen **26** from the proximal side of vertebra **80** until it extends past distal end point **25** at the distal end hollow screw **20.** Preferably, toggle bolt **40** includes pivot attachment **44** to which wings **42** are attached. Wings **42** are deployed (opened out) as shown in Figure 6 and pulled against the convex side of vertebra **80.** Cable **46,** attached to the proximal end of shaft **41,** extends out the proximal end of lumen **26** and guided into screw hole **34** and up aperture **36.** This perpendicular turn is preferably guided by curved wall **36b** of aperture **36.** Persons of skill in the art will recognize that cable **46** may be threaded from distal end point **25** toward the proximal end of lumen **26** with wings **46** deployed at distal end point **25.** In addition, equivalent devices having expanded or expandable components positioned similarly to wings **46** may be used in place of toggle bolt **40** as long as they provide satisfactory support for pulling cable **46** as described below.

[0027] Cable **46** is guided through tube **50** which extends posteriorly through back **B.** Lip **52** at one end of tube **50** included internal threads **52a** to enable tube **50** to be threadably attached to annular lip **38.** Set screw **54** is screwed into threaded tube aperture **50a** to hold cable **46** in place.

[0028] Figure 7 is a side perspective view of assembly **10** showing pulling tool **60** attached to the end of cable **46.** Cable **46** has sufficient length to extend from the proximal end of the toggle bolt shaft to outside the back to be attached to pulling tool **60.** Examples of pulling tools are winch or reel-type devices, come-along, pliers, or other suitable devices that are able to repeatedly apply a pulling force to cable **46** which pulls the convex apex of laterally curved spinal column **1** at the point where toggle wing **42** contacts vertebral body **80.** Tube **50** is threadably attached to annular lip **38.** It will be understood that other vertebra are positioned above and below target vertebra **80.** Because rod **30** is placed along the concave curve of the spine, it is possible that it will not contact vertebra **80** during some or all of the alignment process as is shown in Figure 7. The perpendicular turn allows the force vectors on cable **46** to be directed out of back **B** so that the lungs and surrounding viscera can be avoided.

[0029] Figure 8 is a top or posterior view of laterally curved spinal column **1** with alignment assembly **10** in place as shown in Figure 7. Axis **A** represents what the longitudinal axis of spinal column **1** would be when straightened to the ideal anatomical position. Toggle bolt **40** is depicted with deployed wings **42** contacting vertebra **80.** Vertebral discs **70** are shown alternately placed within spinal column **1** between each vertebra. The attachment of tube **50** to annular lip **38** is depicted in cut out form to show cable **46** extending from toggle bolt **40** through lumen **26** and aperture **36** into tube **50.** In a preferred practice, tube **50** would be attached to annular lip **38.** The further or distal end of cable **46** is attached to pulling tool **60.** Rod **30** is placed laterally and longitudinally along spinal column **1.** It can be seen that because rod **30** is preferably on the concave side of the lateral spinal curve, it may not contact curved spinal column **1** where cable **46** emerges from spinal column **1** on the concave or proximal side.

[0030] During the pulling procedure, set screw **54** is loosened or removed from tube aperture **50a.** Pulling tool **60** applies pulling force across spinal column **1** onto wings **42.** This pulls spinal column **1** against stabilizing rod **30** forcing wings **42** and consequently vertebra **80** toward rod **30** thereby reducing the lateral curve. After sufficient movement, tube set screw **54** is threaded into tube aperture **50a** to hold the pulled cable and spinal column in the new straighter position. After a period of time to allow muscles and nerves and spinal column **1** to adjust to the new position, the pulling procedure is repeated with spinal column **1** again being pulled against rod **30** to an even straighter position relative to axis **A.** Figure 9 shows assembly **10** after a pulling procedure with tube **50** attached to rod **30** at annular lip **38** (not shown in Figure 9). By following the sequence of pulling, tightening, and waiting, spinal column **1** is gradually brought closer to proper alignment. By gradual or gradually is meant that alignment may be achieved of a period of as little as one or two days to as long as 6 months, although in mild cases of scoliosis 5-15 minutes to one day may be possible. Normally, an alignment period may range from a week to about three months, but persons of skill in the art will recognize that the length of the alignment period will depend on such factors as the severity of the lateral curve, the age of the patient, and the strength of the surrounding neuromuscular structure as well as other factors.

[0031] Figure 10 shows spinal column **1** moved to a straighter position relative to axis **A** after a succeeding pulling procedure. Rod **30** is shown closer to spinal column **1** as spinal column **1** is pulled straighter. It can also be seen that curved ends **30a** provide an advantage over straight ends in that it allows stabilizing rod **30** to move along spinal column **1** with less if any interference with elements of spinal column **1.** Figure 10A shows assembly **10** with pulling tool removed and tube set screw **54** screwed into tube aperture **50a** holding cable **46** in place between pulling procedures.

[0032] Figure 11 is the same posterior view showing the results of the final pulling procedure in which the lateral curve of spinal column **1** is significantly reduced if not eliminated. It can be seen that the middle section of stabilizing rod **30** is pulled close to vertebra **80** at the insertion point of hollow bone screw **20.**

[0033] Figure 12 is a posterior view showing spinal column **1** after the final pulling procedure. Tube **50** is removed through the back of the patient. Stabilizing rod **30** is left in place holding spinal column **1** in place against toggle bolt wings **42** with the holding force transmitted on cable **46** in lumen **26.**

[0034] Figure 12A is a cross section view similar to Figure 5C in which set screw **37** is shown screwed down into screw hole **34** to hold (fix) cable **46** in place under tension after the final pulling procedure. Set screw **37** is

screwed in place before set screw **54** is loosened to constantly maintain tension in cable **46** to enable assembly **10** to hold spinal column **1** in the final position. Set screw **37** may be tightened using appropriate conventional or arthroscopic instruments known to those skilled in the art. Thus, cable **46** is held in place under tension by its attachment to toggle bolt **40** at the distal end and by set screw **37** at the proximal end. After set screw **37** holds cable **46,** the remaining "tail" of cable **46** extending past set screw **37** can be cut close to or inside aperture **38.** In one embodiment, a cap may be placed over annular lip **38.**

[0035] Thus it is seen that the objects of the invention are efficiently obtained, although changes and modifications to the invention should be readily apparent to those having ordinary skill in the art, which changes would not depart from the scope of the invention as claimed.

Claims

1. An assembly (10) for a gradual lateral spinal alignment of a spine (1), comprising:

a hollow bone screw (20) having internal threads (22a) and an open proximal end and an open distal end;
a second screw (24) threadably inserted into said hollow bone screw (20);
a toggle bolt (40) including:

a shaft (41) having a distal end and a proximal end, wherein said distal end supports a pivotal attachment (44); and,
at least one toggle wing (42) pivotably attached to said pivotal attachment (44);

a rigid stabilizing rod (30), said stabilizing rod (30) having two ends (30a) and a receiver complex (32), said receiver complex (32) defining a screw hole (34) and an aperture (36), wherein the axis of said aperture (36) is substantially perpendicular to the axis (34a) of said screw hole (34) and said aperture (36) is surrounded by an externally threaded annular lip (38);
a cable (46) having a first end and a second end, said first end attached to said proximal end of said toggle bolt shaft (41) and extending through said aperture (36); and,
a tube (50) enclosing at least part of the length of said cable (46) and having a first end threadably attached to said externally threaded annular lip (38);
wherein one end of said toggle bolt (40) is extended through said distal end of said hollow screw (20).

2. The assembly (10) as recited in Claim 1 wherein said stabilizing rod (30) further comprises an internally threaded bore hole, said internally threaded bore hole having an axis substantially parallel to the axis of said aperture (36) and arranged to receive a first set screw (37).

3. The assembly (10) as recited in Claim 1 wherein said distal end of said hollow bone screw (20) extends transversely through the body of a vertebra (80) of said spine (1), said distal end extending to at least the convex side of said lateral curve (2, 3).

4. The assembly (10) as recited in Claim 1 wherein said stabilizing rod (30) is configured to lay laterally and longitudinally along said spine (1).

5. The assembly (10) as recited in Claim 4 wherein said stabilizing rod (30) extends longitudinally along said spine (1) on the concave side of said spine (1).

6. The assembly (10) as recited in Claim 1 wherein said two ends of said rigid stabilizing rod (30) are curved.

7. The assembly (10) as recited in Claim 1 wherein said tube (50) further comprises a second internally threaded tube aperture (50a) arranged to receive a second set screw (54).

8. The assembly (10) as recited in Claim 1 further comprising a cable pulling tool (60) releasably attached at or near said second end of said cable (46).

9. The assembly (10) as recited in Claim 1 wherein said cable (46) comprises sufficient length to extend from said proximal end of said toggle bolt (40) to outside the back of a user.

Patentansprüche

1. Anordnung (10) für eine graduelle seitliche spinale Ausrichtung einer Wirbelsäule (1), umfassend:

eine Hohlknochenschraube (20), die Innengewinde (22a) und ein offenes proximales Ende und ein offenes distales Ende aufweist;
eine zweite Schraube (24), die gewindemäßig in die Hohlknochenschraube (20) eingefügt ist;
einen Knebelbolzen (40), umfassend:

einen Schaft (41), der ein distales Ende und ein proximales Ende aufweist, wobei das distale Ende eine Schwenkanbringung (44) stützt; und
zumindest einen Knebelflügel (42), der schwenkbar an der Schwenkanbringung (44) angebracht ist;

eine steife Stabilisierungsstange (30), wobei die Stabilisierungsstange (30) zwei Enden (30a) und einen Aufnahmekomplex (32) aufweist, wobei der Aufnahmekomplex (32) ein Schraubenloch (34) und eine Öffnung (36) definiert, wobei die Achse der Öffnung (36) im Wesentlichen senkrecht zu der Achse (34a) des Schraubenloches (34) ist und die Öffnung (36) von einem außen gewundenen ringförmigen Rand (38) umgeben ist;
ein Kabel (46), das ein erstes Ende und ein zweites Ende aufweist, wobei das erste Ende an dem proximalen Ende des Knebelbolzenschaftes (41) angebracht ist und sich durch die Öffnung (36) erstreckt; und
eine Röhre (50), die zumindest einen Teil der Länge des Kabels (46) einschließt und ein erstes Ende aufweist, das gewindemäßig an dem außen gewundenen ringförmigen Rand (38) angebracht ist;
wobei sich ein Ende des Knebelbolzens (40) durch das distale Ende der Hohlschraube (20) erstreckt.

2. Anordnung (10) nach Anspruch 1, wobei die Stabilisierungsstange (30) ferner ein innen gewundenes Bohrloch umfasst, wobei das innen gewundene Bohrloch eine Achse aufweist, die im Wesentlichen parallel zu der Achse der Öffnung (36) ist und angeordnet ist, um eine erste Feststellschraube (37) aufzunehmen.

3. Anordnung (10) nach Anspruch 1, wobei sich das distale Ende der Hohlknochenschraube (20) quer durch den Körper eines Wirbels (80) der Wirbelsäule (1) erstreckt, wobei sich das distale Ende zumindest zu der konvexen Seite der seitlichen Kurve (2, 3) erstreckt.

4. Anordnung (10) nach Anspruch 1, wobei die Stabilisierungsstange (30) so konfiguriert ist, dass sie seitlich und längs entlang der Wirbelsäule (1) liegt.

5. Anordnung (10) nach Anspruch 4, wobei sich die Stabilisierungsstange (30) längs entlang der Wirbelsäule (1) auf der konkaven Seite der Wirbelsäule (1) erstreckt.

6. Anordnung (10) nach Anspruch 1, wobei die zwei Enden der steifen Stabilisierungsstange (30) gebogen sind.

7. Anordnung (10) nach Anspruch 1, wobei die Röhre (50) ferner eine zweite innen gewundene Röhrenöffnung (50a) umfasst, die angeordnet ist, um eine zweite Feststellschraube (54) aufzunehmen.

8. Anordnung (10) nach Anspruch 1, ferner umfassend ein Kabelziehwerkzeug (60), das lösbar an oder nahe dem zweiten Ende des Kabels (46) angebracht ist.

9. Anordnung (10) nach Anspruch 1, wobei das Kabel (46) ausreichend Länge umfasst, um sich von dem proximalen Ende des Knebelbolzens (40) nach außerhalb des Rückens eines Benutzers zu erstrecken.

Revendications

1. Ensemble (10) pour un alignement rachidien latéral graduel d'une colonne vertébrale (1), comprenant :

une vis à os creuse (20) ayant des filets internes (22a) et une extrémité proximale ouverte et une extrémité distale ouverte et,
une seconde vis (24) insérée par filets dans ladite vis à os creuse (20) ;
un boulon à ailettes (40) comprenant :

un arbre (41) ayant une extrémité distale et une extrémité proximale, dans lequel ladite extrémité distale supporte une attache pivotante (44) ; et
au moins une ailette (42) attachée en pivotement à ladite attache pivotante (44) ;

une tige stabilisatrice rigide (30), ladite tige stabilisatrice (30) ayant deux extrémités (30a) et un complexe récepteur (32), ledit complexe récepteur (32) définissant un trou de vis (34) et une ouverture (36), dans lequel l'axe de ladite ouverture (36) est sensiblement perpendiculaire à l'axe (34a) dudit trou de vis (34) et ladite ouverture (36) est entourée par une lèvre annulaire filetée en externe (38) ;
un câble (46) ayant une première extrémité et une seconde extrémité, ladite première extrémité étant attachée à ladite extrémité proximale dudit arbre (41) du boulon à ailettes et s'étendant à travers ladite ouverture (36) ; et,
un tube (50) enserrant au moins une partie de la longueur dudit câble (46) et ayant une première extrémité attachée par filets à ladite lèvre annulaire filetée en externe (38) ;
dans lequel une extrémité dudit boulon à ailettes (40) est étendue à travers ladite extrémité distale de ladite vis creuse (20).

2. Ensemble (10) selon la revendication 1, dans lequel ladite tige stabilisatrice (30) comprend en outre un trou d'alésage fileté en interne, ledit trou d'alésage fileté en interne ayant un axe sensiblement parallèle à l'axe de ladite ouverture (36) et agencé pour recevoir une première vis de pression (37).

3. Ensemble (10) selon la revendication 1, dans lequel ladite extrémité distale de ladite vis à os creuse (20) s'étend transversalement à travers le corps d'une vertèbre (80) de ladite colonne vertébrale (1), ladite extrémité distale s'étendant vers au moins le côté convexe de ladite courbe latérale (2, 3).

4. Ensemble (10) selon la revendication 1, dans lequel ladite tige stabilisatrice (30) est configurée pour reposer latéralement et longitudinalement le long de ladite colonne vertébrale (1).

5. Ensemble (10) selon la revendication 4, dans lequel ladite tige stabilisatrice (30) s'étend longitudinalement le long de ladite colonne vertébrale (1) sur le côté concave de ladite colonne vertébrale (1).

6. Ensemble (10) selon la revendication 1, dans lequel lesdites deux extrémités de ladite tige stabilisatrice rigide (30) sont incurvées.

7. Ensemble (10) selon la revendication 1, dans lequel ledit tube (50) comprend en outre une seconde ouverture de tube fileté en interne (50a) agencée pour recevoir une seconde vis de pression (54).

8. Ensemble (10) selon la revendication 1, comprenant en outre un outil de traction de câble (60) attaché avec faculté de libération à ladite seconde extrémité dudit câble (46) ou près de celle-ci.

9. Ensemble (10) selon la revendication 1, dans lequel ledit câble (46) comprend une longueur suffisante pour s'étendre de ladite extrémité proximale dudit boulon à ailettes (40) vers l'extérieur du dos d'un utilisateur.

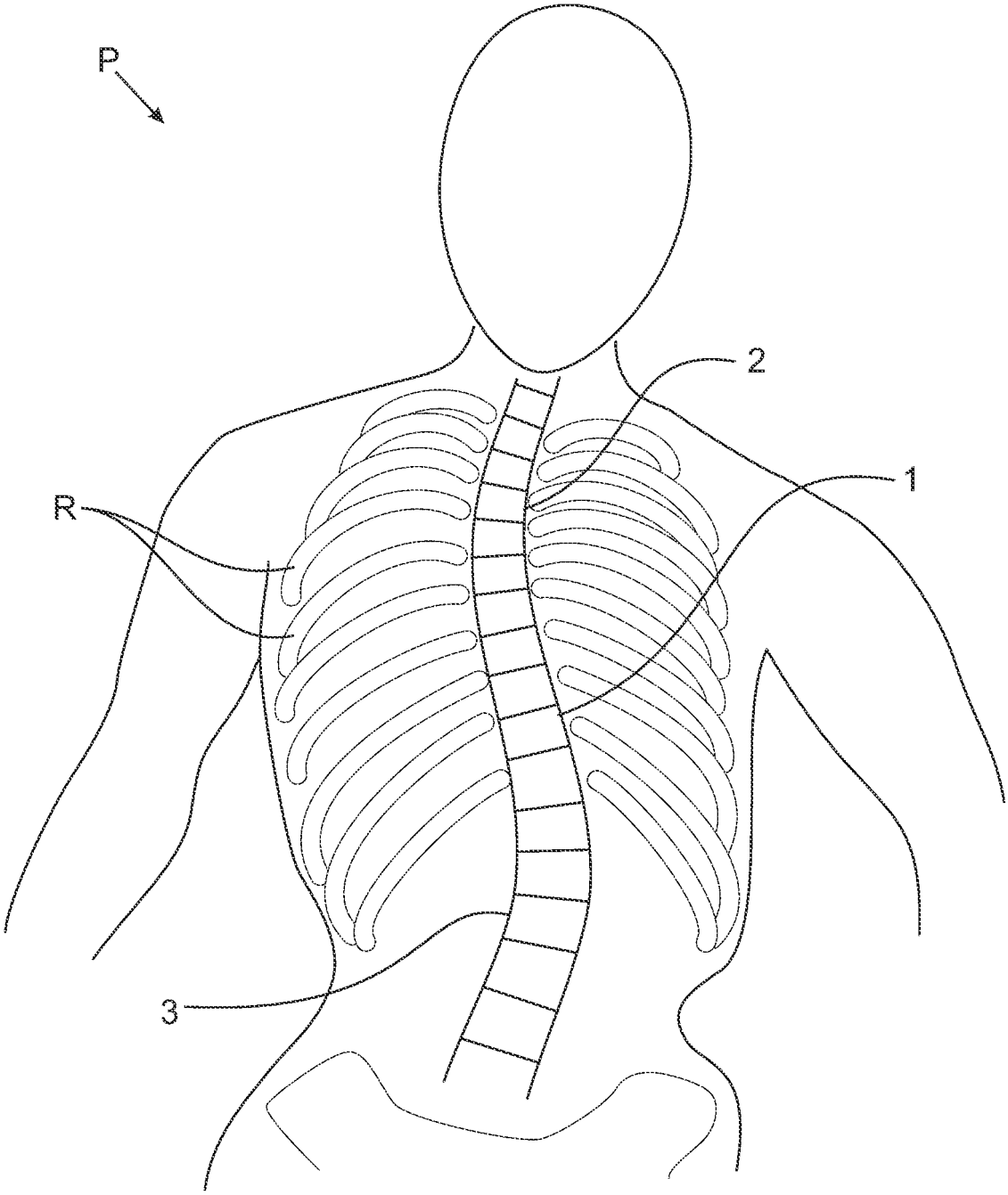

Fig. 1

Prior Art

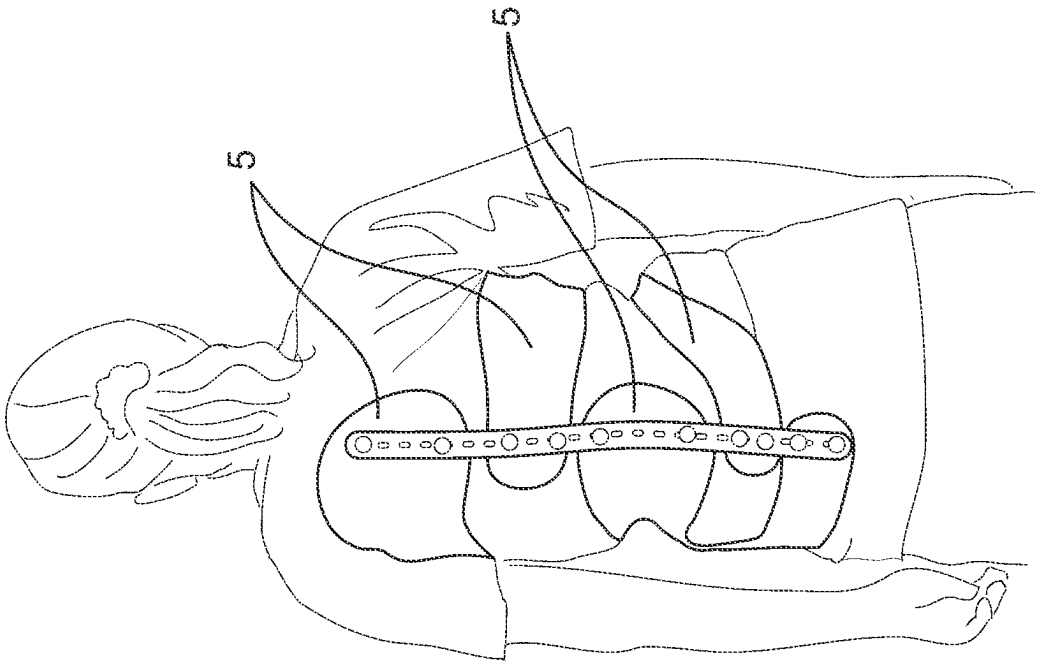

Fig. 2A

Prior Art

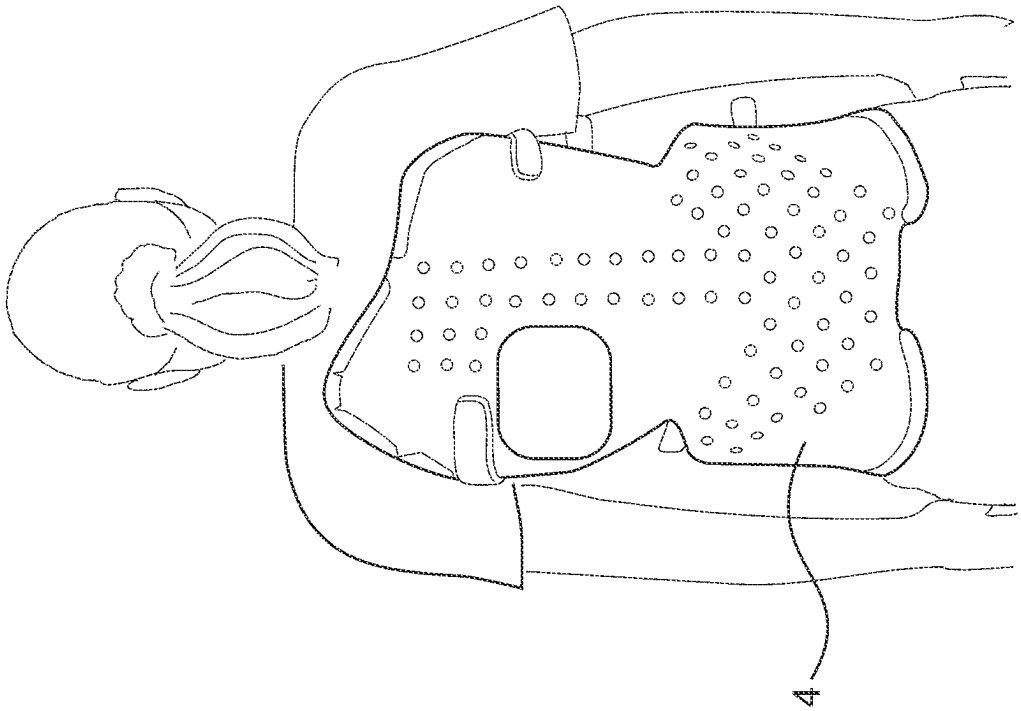

Fig. 2

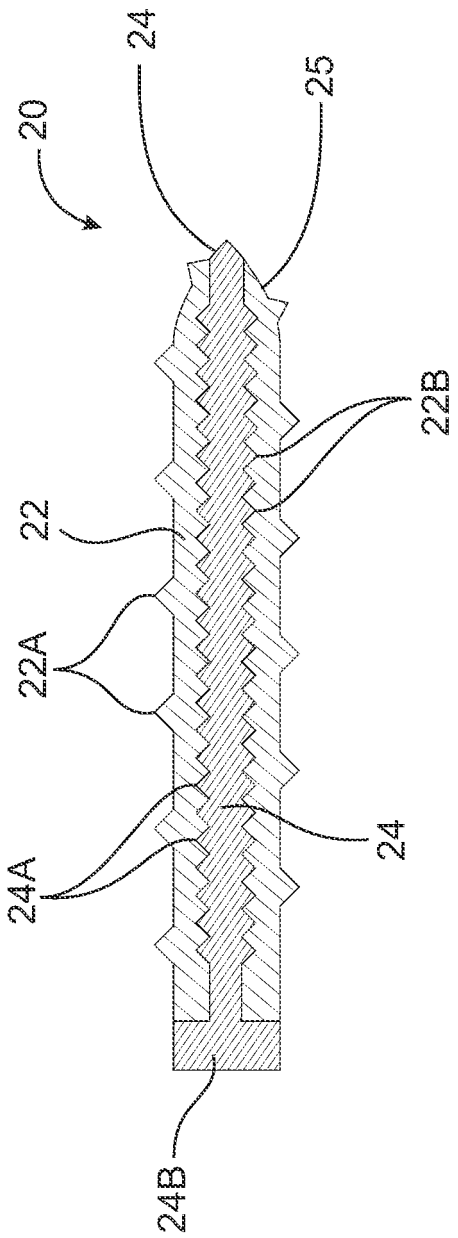

Fig. 3

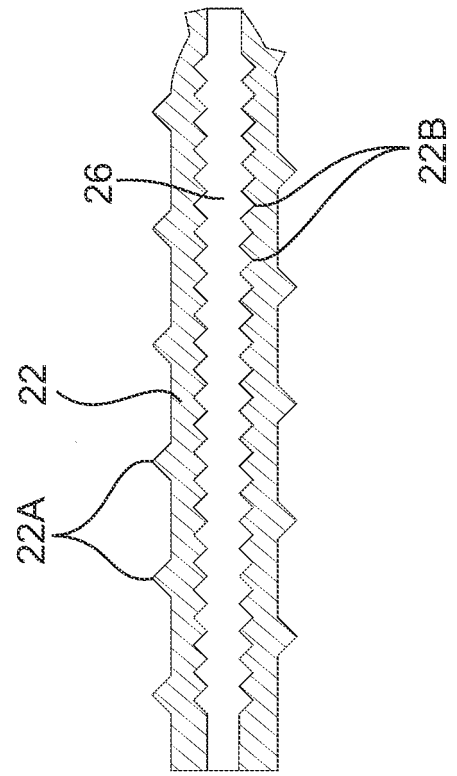

Fig. 4A

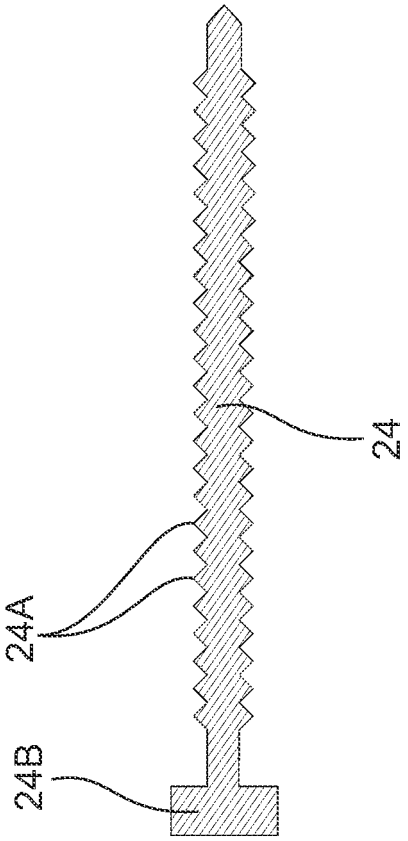

Fig. 4

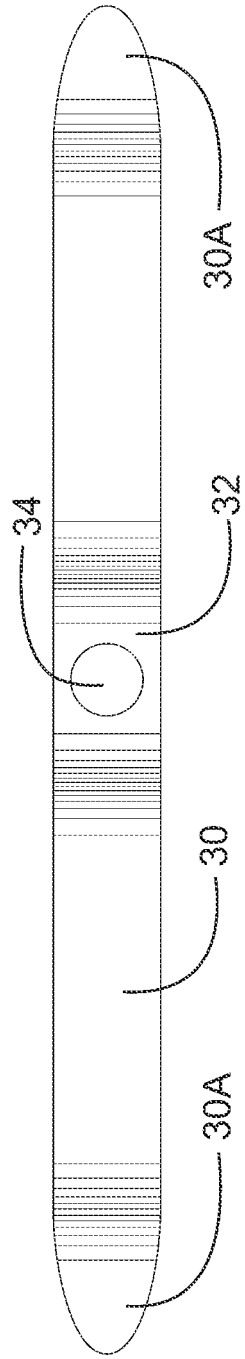

Fig. 5A

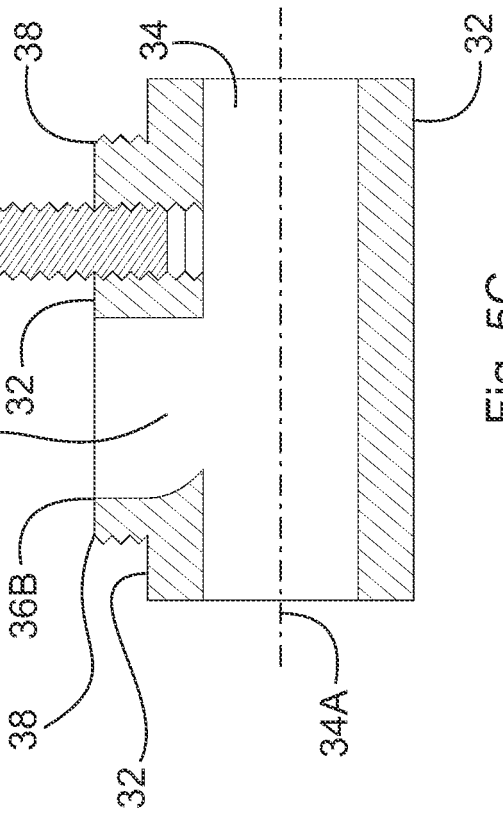

Fig. 5C

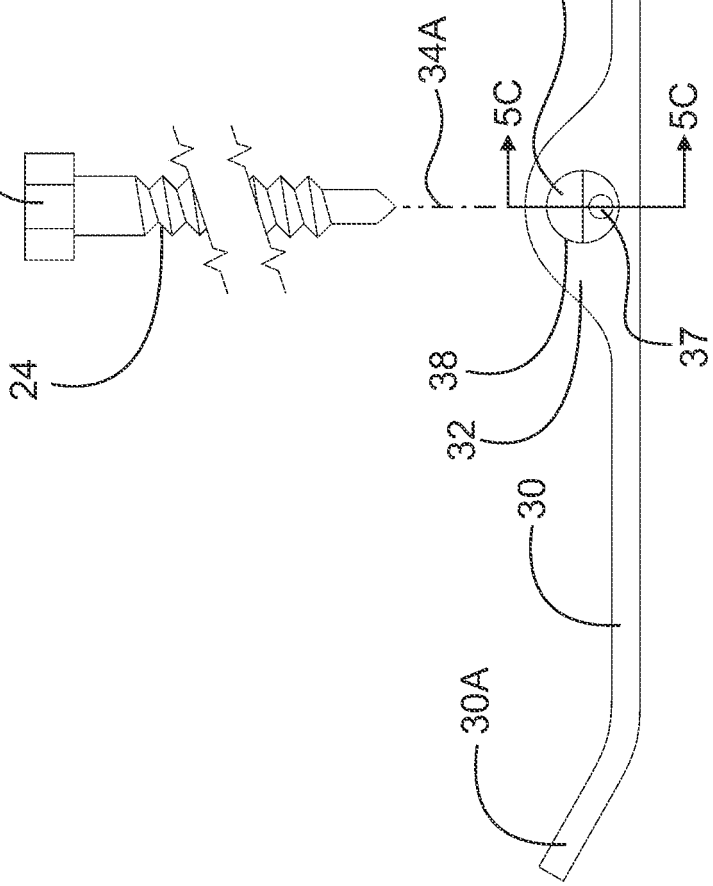

Fig. 5B

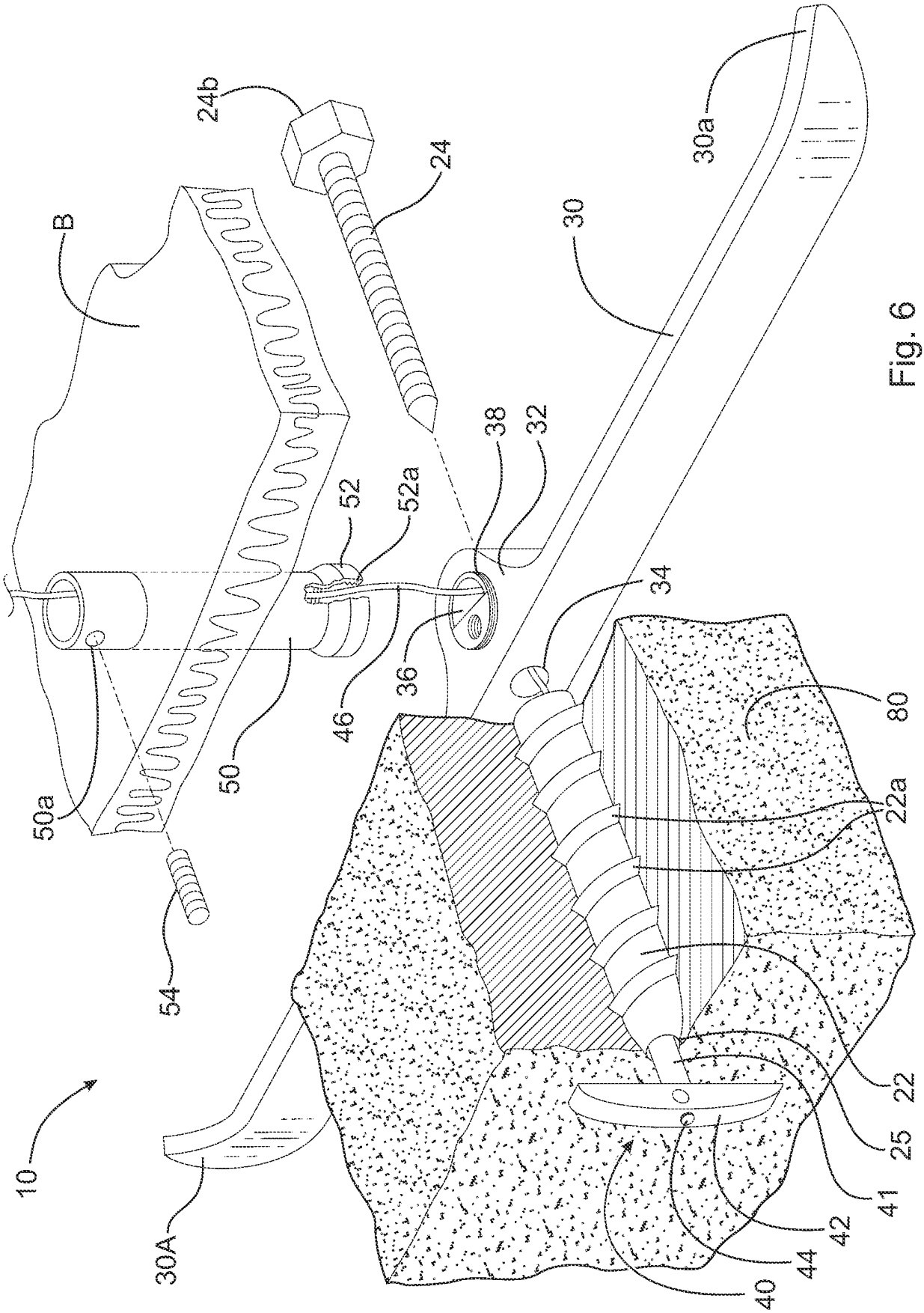
24b
24
30a
B
30
38
32
52
52a
34
36
46
50
80
50a
22a
54
10
22
25
41
42
44
40
30A

Fig. 6

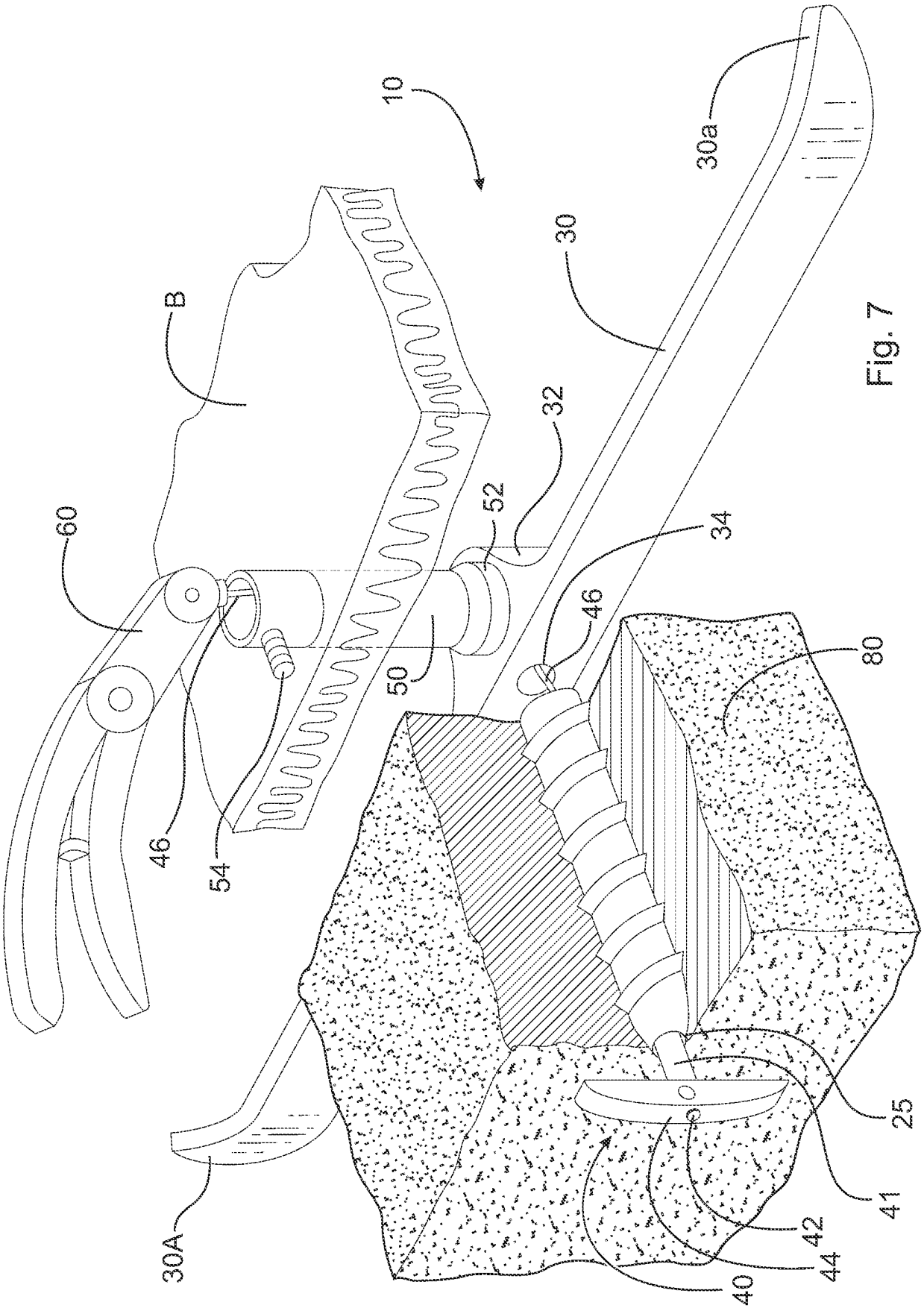

Fig. 7

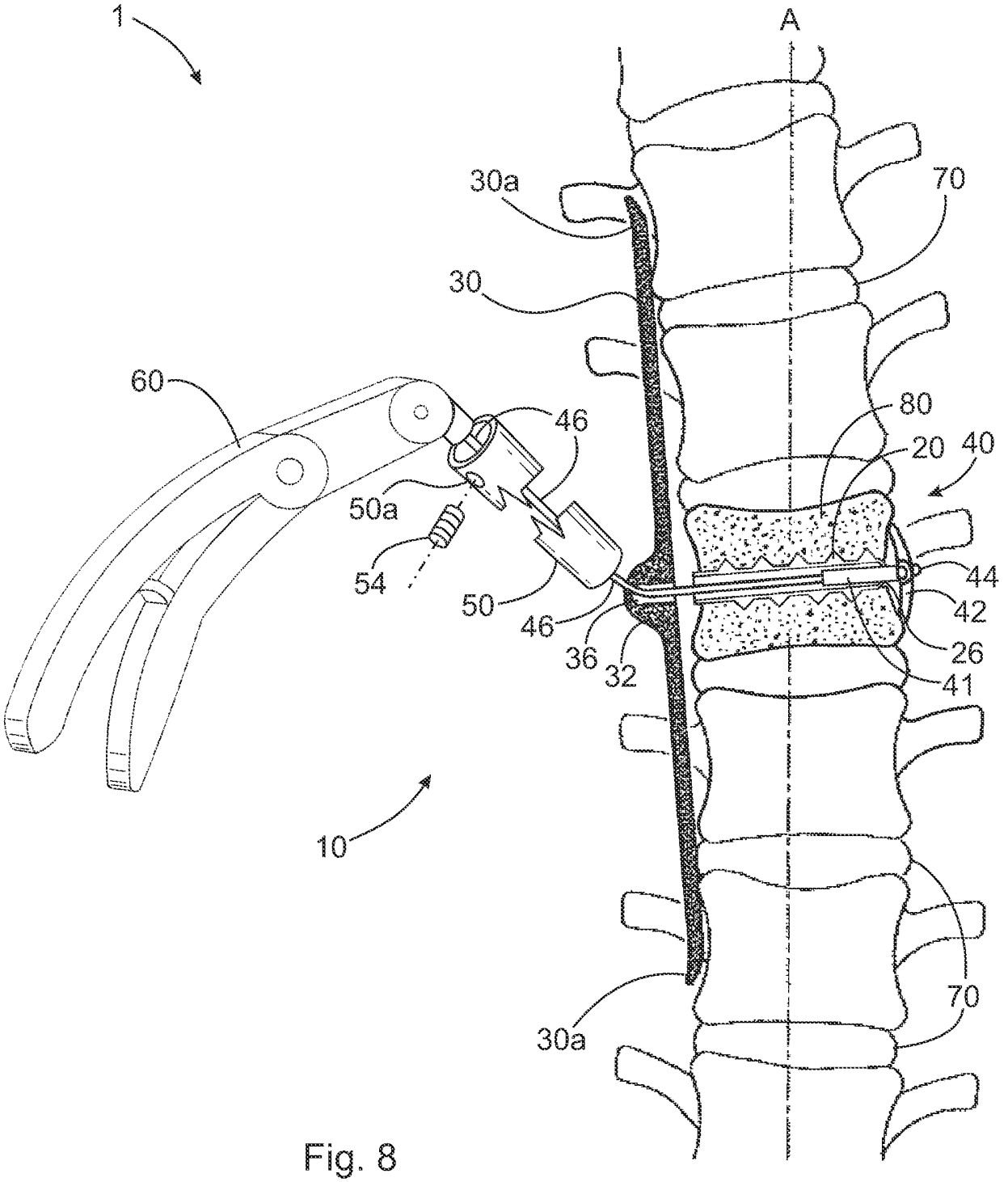

Fig. 8

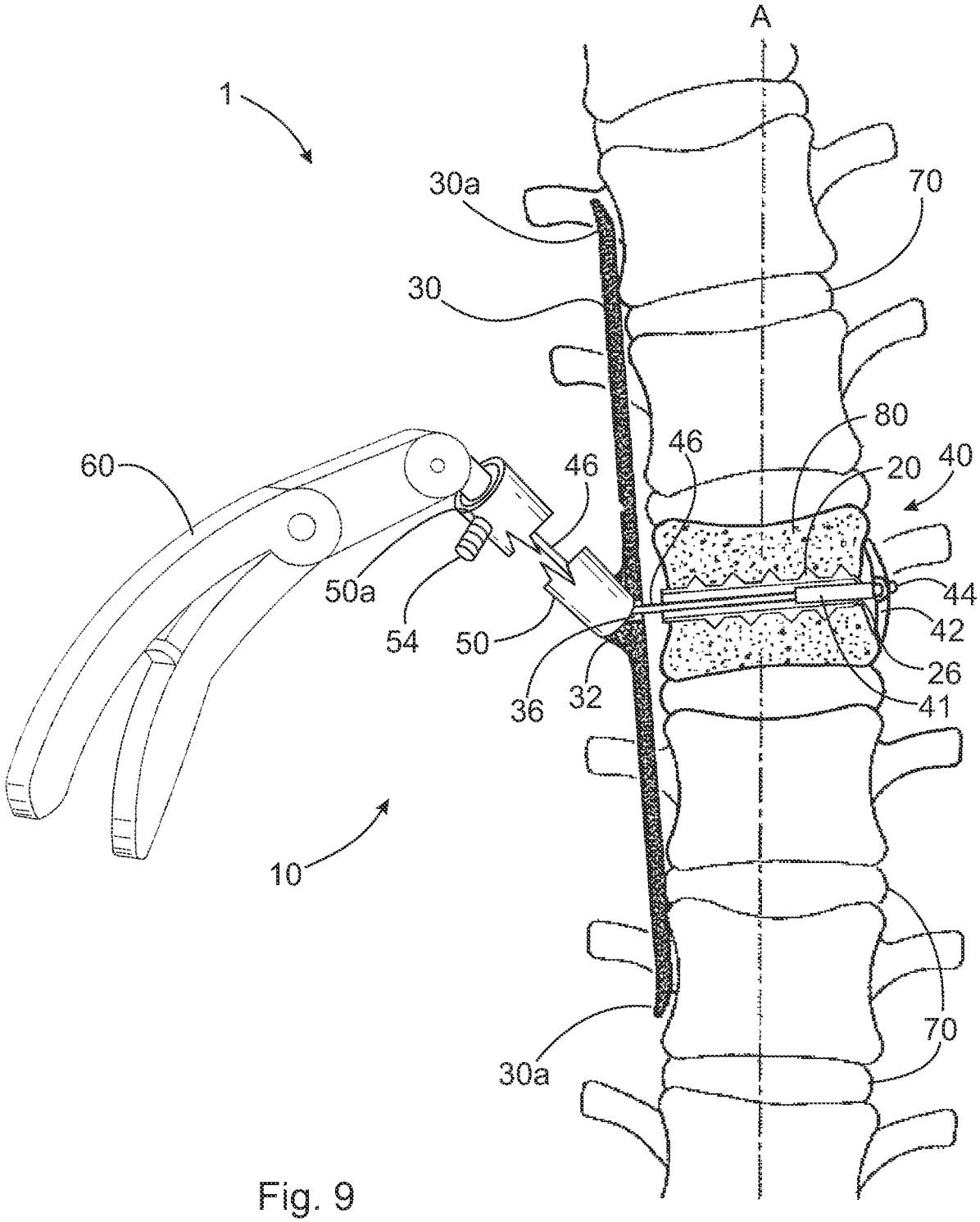

Fig. 9

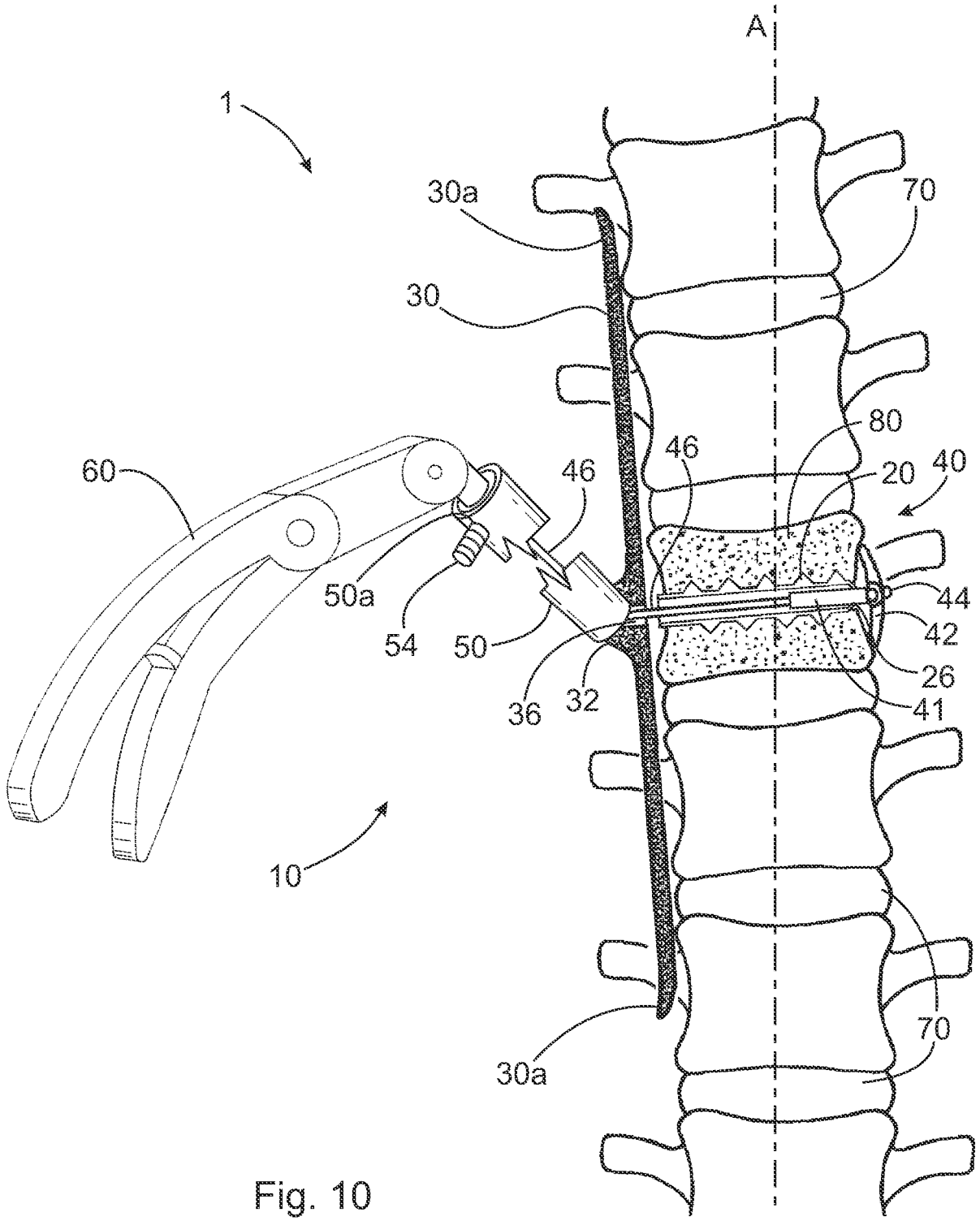

Fig. 10

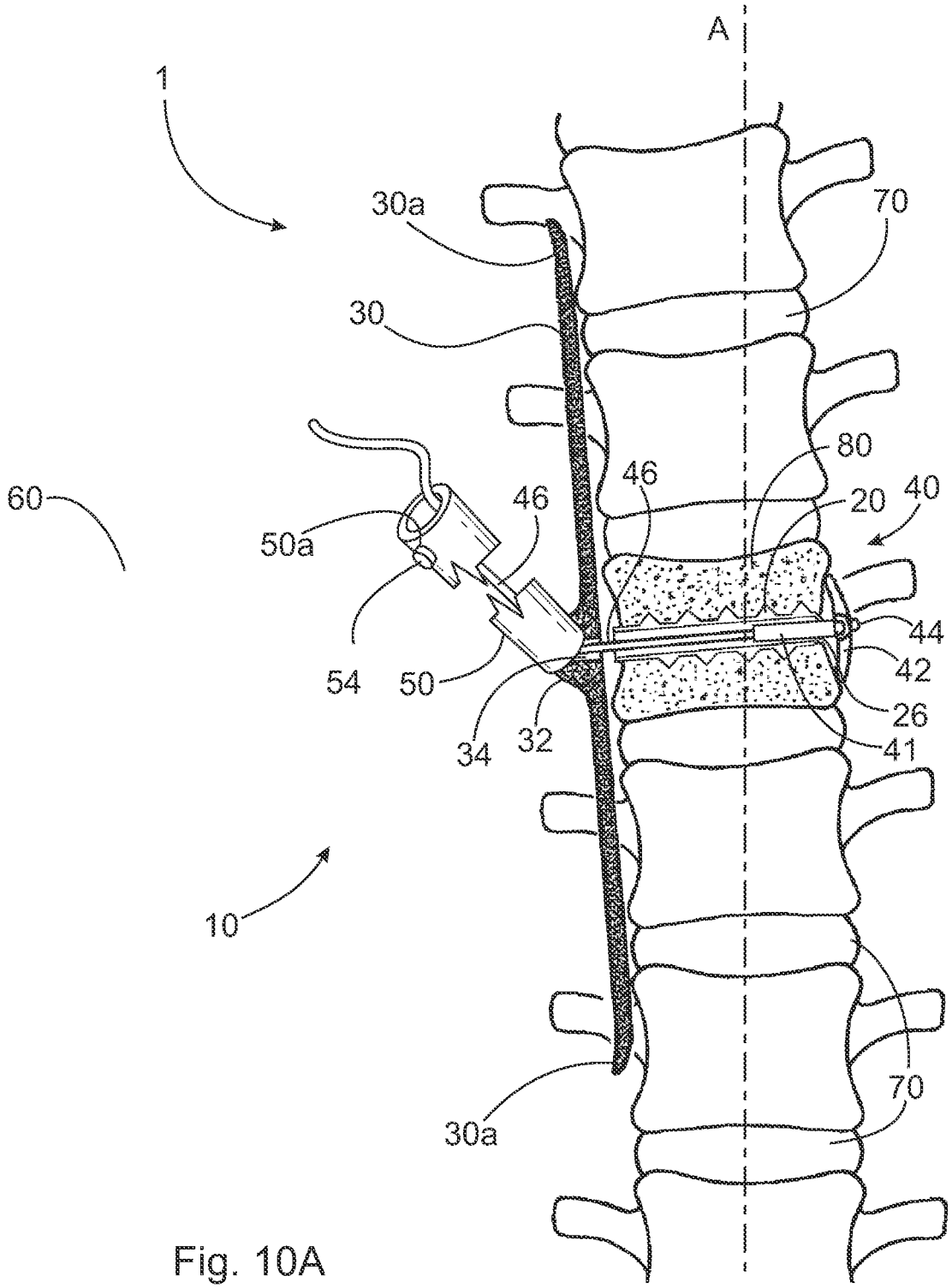

Fig. 10A

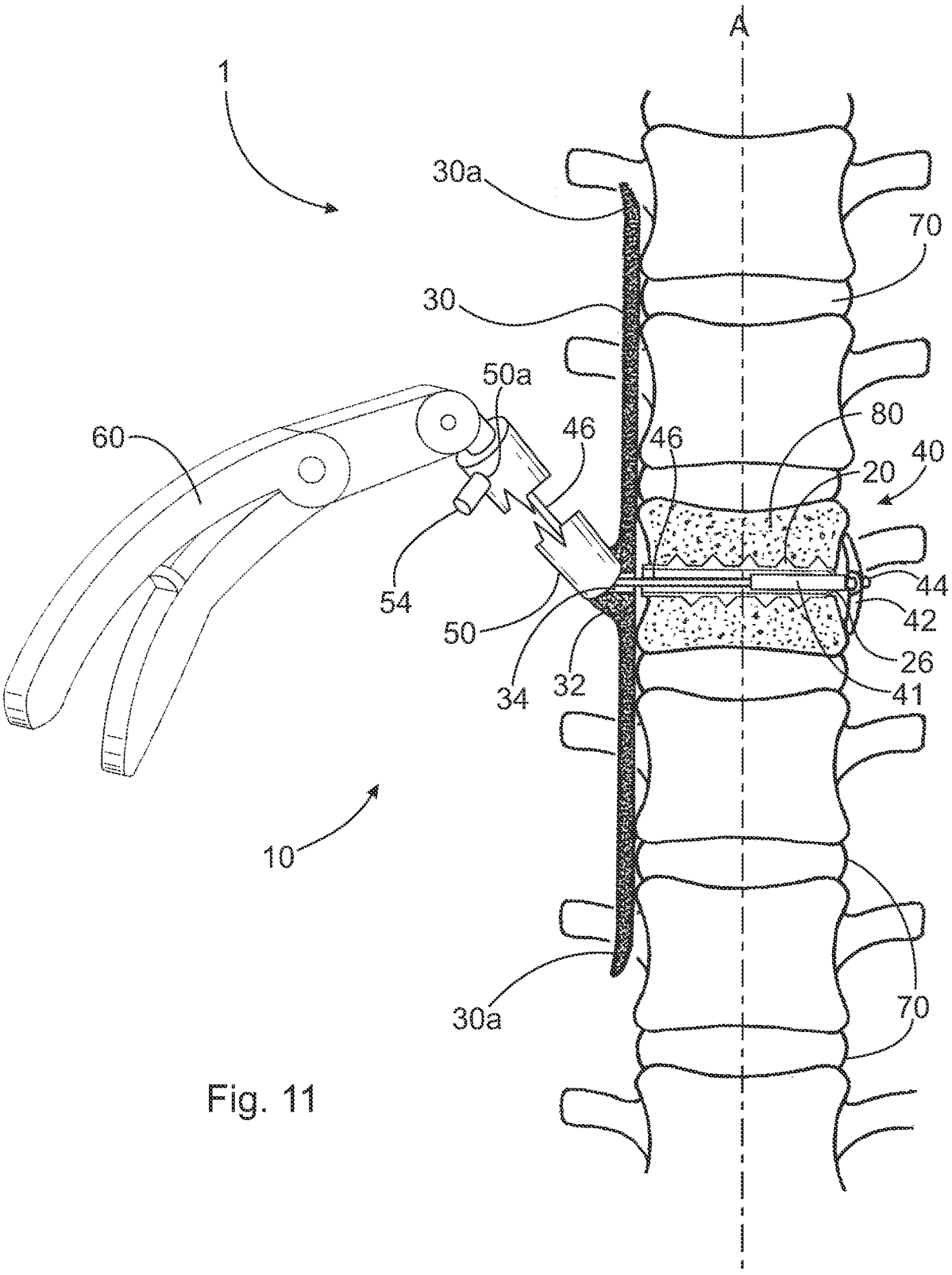

Fig. 11

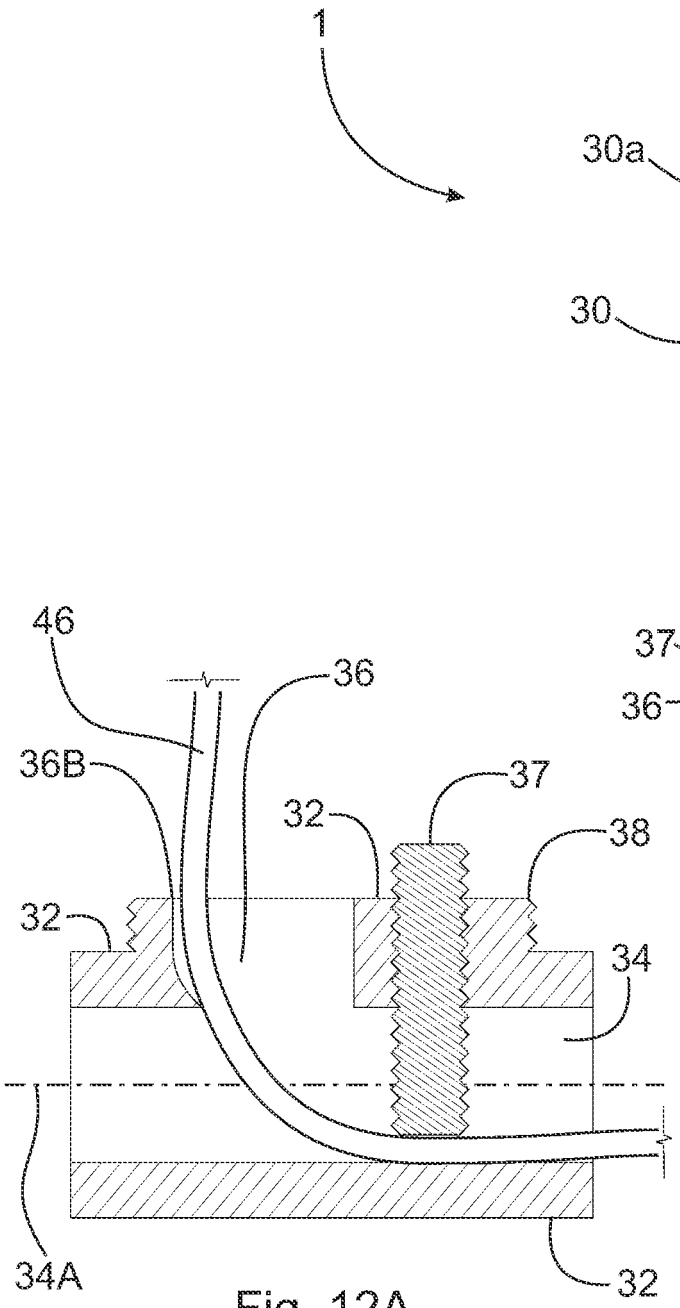

Fig. 12A

Fig. 12

REFERENCES CITED IN THE DESCRIPTION

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