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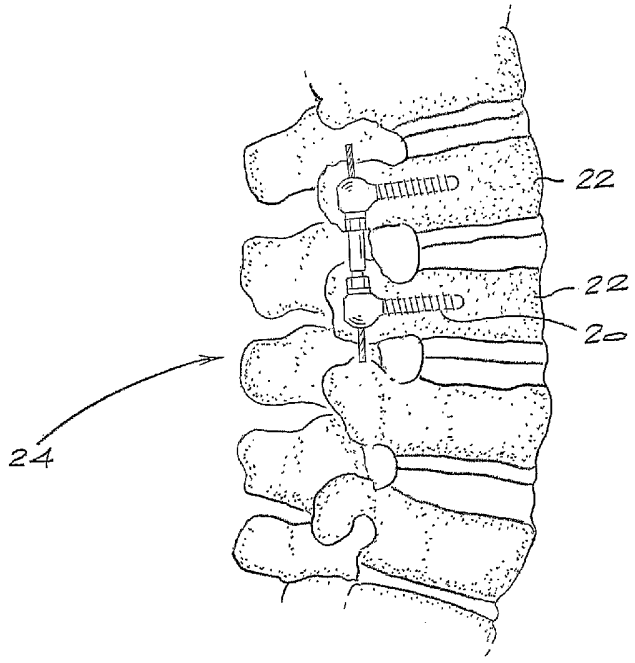
(54) **Title:** DYNAMIC SPINAL STABILISATION DEVICE



(57) **Abstract:** The invention concerns a posterior dynamic spinal stabilisation device (10) which can be used to stabilise a spinal section, typically in the lumbar region. The device includes pedicle screws (12) which can be screwed into holes reamed in respective spinal vertebrae. A flexible cable (14) connects the protruding heads (26) of the screws to one another with a spacing structure (16) between the screw heads. The spacing structure is used to set the distance between the screw heads and is of adjustable, preferably telescopically adjustable, length.

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"DYNAMIC SPINAL STABILISATION DEVICE"

BACKGROUND TO THE INVENTION

THIS invention relates to a posterior dynamic spinal stabilisation device.

Devices of the type with which the present invention is concerned are used to re-stabilise a spinal joint, typically in the lumbar region, without involving intervertebral discs or facet joints. A typical example of a known device is that available under the trade mark Dynesys®. This known device makes use of pedicle screws, one or more spacers and a flexible cord. The pedicle screws are engaged in spaced apart holes formed in neighbouring lumbar vertebrae. One or more tubular spacers are located between the outer ends of the pedicle screws with the bore(s) of the spacer(s) aligned with eyes at those outer ends. The cord is passed through the eyes and through the bore(s) of the spacer(s) and is anchored to the heads of the screws by clamping fasteners screwed into bores intersecting the eyes so as to clamp the cord. Such clamping is carried out after the cord has been appropriately tensioned using a separate tensioning tool. Ends of the cord which extend beyond the pedicle screws are trimmed off and the surgical wound is closed and allowed to heal.

The above procedure, which is carried out posteriorly, serves to stabilise the spinal segment under consideration while the flexibility of the cord and limited flexibility of the spacer(s) still allow some motion to take place. In essence the cord, being anchored to the vertebrae, acts in the manner of a stabilising ligament. In addition the procedure can distract the spinal segment in order to decompress the spinal disc(s), *inter alia* in the treatment of indications such as degenerative disc disease, disc herniation and spinal stenosis. The level of distraction is a function *inter alia* of the length of the spacer(s) between the pedicle screws.

Drawbacks of the known Dynesus® device are the relative difficulty of the cord tensioning operation, which must be carried out in a limited space, and possible loss of cord tension with passage of time possibly as a result of stretching of the cord between the clamping points. It will also be understood that the spacer(s) must either have, or be trimmed to, exactly the right length for each application.

It has also been reported that the cords, because of the material of which they are made, can be a potential cause of infection at the stabilisation site.

The present invention seeks to provide an alternative posterior dynamic spinal stabilisation device.

SUMMARY OF THE INVENTION

According to the present invention there is provided a posterior dynamic spinal stabilisation device comprising pedicle screws engagable with respective spinal vertebrae, tie means for connecting protruding heads of the screws to one another and spacing means, located between the screw heads, for setting the distance between the screw heads, the spacing means being of adjustable length for selective setting of the distance between the screw heads.

The spacing means is conveniently telescopically adjustable in length. It may for instance include an externally threaded tube through which the tie means extends and at least one nut threadable on one end of the tube to define, in combination with the tube, a spacing means of telescopic construction and adjustable length. There may be a single nut threadable on one end of the tube and arranged to bear on one of the screw heads and a fixed abutment at the other end of the tube and arranged to bear on the other of the screw heads. To facilitate rotational movement in the device, the screw heads will typically have curved surfaces and the nut and

abutment have correspondingly curved surfaces arranged to bear on the curved surfaces of the screw heads.

In an alternative configuration there may be a single nut threadable on one end of the tube and a fixed abutment at the other end of the tube, and washers which are located between the nut and one of the screw heads and between the abutment and the other of the screw heads respectively. In this case, rotational movement is facilitated by the fact that the screw heads have curved surfaces and the washers have correspondingly curved surfaces arranged to bear on the curved surfaces of the screw heads, and the fact that the nut and the abutment have curved surfaces arranged to bear on correspondingly curved surfaces of the washers.

In a preferred construction, each screw has an outer end, a hollow screw head which has a curved external surface and which locates on the outer end and transverse, alignable passages through the screw head and outer end to receive the tie means.

Other features of the invention are described below and set forth in the appended claims.

BRIEF DESCRIPTION OF THE DRAWINGS

The invention will now be described in more detail, by way of example only, with reference to the accompanying drawings in which:

Figure 1 shows a perspective view of a posterior dynamic spinal stabilisation device according to the present invention;

Figure 2 shows a cross-sectional view of the device seen in Figure 1;

Figure 3 shows a perspective view of another embodiment of posterior dynamic spinal stabilisation device according to the invention;

Figure 4 shows a cross-sectional view of the device seen in Figure 3; and

Figure 5 illustrates the manner in which the device of Figure 4 is installed in a spinal segment in use.

DESCRIPTION OF THE ILLUSTRATED EMBODIMENTS

A first embodiment of posterior dynamic spinal stabilisation device 10 is illustrated in Figures 1 and 2. The device 10 includes first and second, identical pedicle screws 12, a tie means 14 and a spacing structure 16. The tie means 14 may be in the form of a cable as illustrated or, for instance, in the form of a slender, resilient rod.

As is conventional, the pedicle screws 12 have threaded screw portions 18 which can be screwed into holes 20 reamed posteriorly in respective spinal vertebrae 22 in a spinal segment 24 requiring stabilisation, as shown in Figure 5. Each screw 12 also has a hollow, generally spherical head 26 which locates, through a Morse taper configuration, on the outer end 27of the screw 12 such that passages 28 and 29 extending through the head 26 and end 27 are in diametrical alignment with one another.

A threaded hole 30 intersects each passage 29 as illustrated. The mouth of the hole is located centrally along a slot 32 in the end 27 which can be engaged by a screwdriver or other appropriate tool for the purposes of screwing the screw 12 into a hole 20.

The cable 14 in the illustrated embodiment is of twisted strand type and is made of stainless steel or other appropriate non-allergenic and corrosion-

proof material. As illustrated, the cable passes through the passages 28 and 29 and can be clamped relative to the screw heads 26 by grub screws 34 screwed into the holes 30 so as to press against the cable inside the passages 29.

The spacing structure 16 includes an externally threaded tube 36 which is located between the screw heads 26. The cable 14 passes through the tube. The tube has a length less than the desired spacing of the screw heads 26 and carries an abutment 38 and an internally threaded, elongate nut 40. End surfaces 42, 44 of the abutment and nut are spherically concave with each surface having a curvature matching the curvature of a screw head 26.

Referring to Figure 2, the abutment 38 is positioned at the end of the tube 36 such that its end surface 42 can bear against the surface of the relevant screw head 26. In order to establish a selected distance between the screw heads, and accordingly to distract the vertebrae by a desired amount, the nut 40 is threaded along the tube in a direction away from the abutment 38, such that the end surface 44 is located beyond the other end of the tube and bears against the other screw head 26. It will be understood that the threaded nature of the connection between the nut and the tube provides a substantial mechanical advantage to facilitate the distraction of the vertebrae. It will also be noted that the abutment 38 and nut 40 have portions 46, 48 which are hexagonal in cross-section for engagement by a spanner or the like to facilitate rotation and the distraction process.

It will be understood that nature of the nut/tube combination making up the structure 16 enables its length to be adjusted telescopically.

A locking nut 49 may be provided on the tube 36, inwardly of the nut 40, to lock that nut at the correct longitudinal position on the tube.

The cable 14 may be anchored to the respective pedicle screws by tightening down the grub screws 34, as described above, before the length

of the spacing structure 16 is set. Accordingly as the length of the spacing structure is increased to the desired value the cord is placed under tension. It will however be understood that it would also be possible to set the desired length of the spacing structure before anchoring the cord.

In use, the interaction of the end surfaces 42, 44 of the abutment 38 and nut 40 with the spherical surfaces of the screw heads 26 allows for some rotational movement in the spinal segment 24 while the device as a whole provides stabilisation to that segment even though the spacing structure 16 is itself rigid after installation.

Figures 3 and 4 illustrate another embodiment of the invention which allows for some rotational movement in the spinal segment. In these Figures, components corresponding to components seen in Figures 1 and 2 are designated by the same reference numerals.

The embodiment of Figures 3 and 4 differs from that of Figures 1 and 2 primarily in the inclusion of pairs of annular, spherically domed washers 50. These are located on the cable 14 beyond the ends of the tube 36, i.e. between the abutment 38 and nut 40 and the respective screw heads 26. Thus the abutment 38 and nut 40 do not bear directly on the screw heads as in the first embodiment. A limited degree of rotational movement is allowed by the interactions between the abutment, associated washer 50 and associated screw head 26 on the one hand and between the nut, associated washer 50 and associated screw head 26 on the other hand.

It will be noted that the washers 50, abutment 38 and nut 40 are formed with laterally projecting flanges 52 which, by abutment with one another, limit the amount of articulation which take place.

It will also be noted that the outer surfaces of the abutment 38 and nut 40 have concave curvatures matching the convex curvatures on the inner surfaces of the washers 50. This facilitates rotational movement of the abutment, nut and washers relative to one another.

Both of the embodiments described above have a single threaded nut which is adjustable on the tube 36, but it will be understood that suitable telescopic adjustability of the length of the structure 16 could be obtained in each case with two nuts, one at each end of the tube. So, for instance, in the embodiment of Figures 1 and 2, the abutment 38 could be replaced by a threaded nut which will bear against the adjacent screw head 26. Both this nut and the nut 40 may then be adjusted rotationally on the tube 36 in order to adjust the overall length of the structure 16 and accordingly the degree to which the vertebrae are distracted.

CLAIMS

1.
A posterior dynamic spinal stabilisation device comprising pedicle screws engagable with respective spinal vertebrae, tie means for connecting protruding heads of the screws to one another and spacing means, located between the screw heads, for setting the distance between the screw heads, the spacing means being of adjustable length for selective setting of the distance between the screw heads.

2.
A device according to claim 1 wherein the spacing means is telescopically adjustable in length.

3.
A device according to claim 2 wherein the spacing means includes an externally threaded tube through which the tie means extends and at least one nut threadable on one end of the tube to define, in combination with the tube, a spacing means of telescopic construction and adjustable length.

4.
A device according to claim 3 comprising a single nut threadable on one end of the tube and arranged to bear on one of the screw heads and a fixed abutment at the other end of the tube and arranged to bear on the other of the screw heads.

5.
A device according to claim 4 wherein the screw heads have curved surfaces and the nut and abutment have correspondingly curved surfaces arranged to bear on the curved surfaces of the screw heads.

6.

A device according to claim 3 comprising a single nut threadable on one end of the tube and a fixed abutment at the other end of the tube, and washers which are located between the nut and one of the screw heads and between the abutment and the other of the screw heads respectively.

7.

A device according to claim 6 wherein the screw heads have curved surfaces and the washers have correspondingly curved surfaces arranged to bear on the curved surfaces of the screw heads.

8.

A device according to claim 7 wherein the nut and the abutment have curved surfaces arranged to bear on correspondingly curved surfaces of the washers.

9.

A device according to any one of the preceding claims wherein each screw has an outer end, a hollow screw head which has a curved external surface and which locates on the outer end and transverse, alignable passages through the screw head and outer end to receive the tie means.

10.

A device according to claim 9 wherein the screw head locates on the outer end in a Morse taper configuration.

11.

A device according to claim 9 or claim 10 wherein the outer end is shaped for engagement by a screwdriver for the purposes of rotating the screw.

12.

A device according to any one of claims 9 to 11 comprising clamping means for clamping the tie means in the passage through the outer end.

13.

A device according to claim 12 comprising an axial, threaded hole in the outer end of the screw and intersecting the passage through the outer end, and the clamping means comprises a grub screw threadable in this hole to engage the tie means in the passage.

14.

A device according to any one of the preceding claims wherein the tie means is a flexible, stainless steel cable of twisted strand construction.

Fig.1

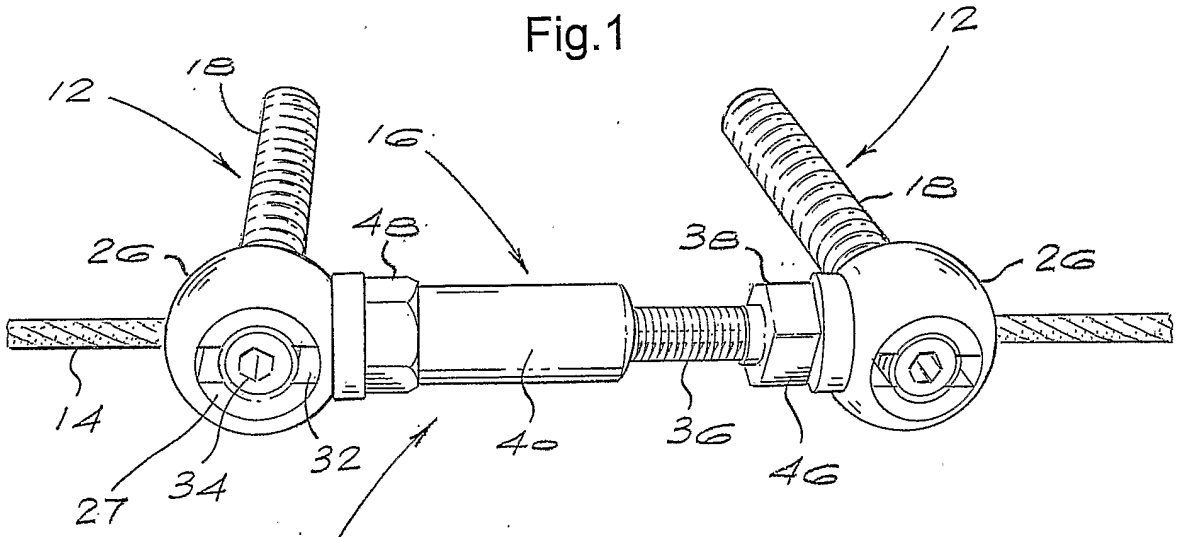
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Fig.2

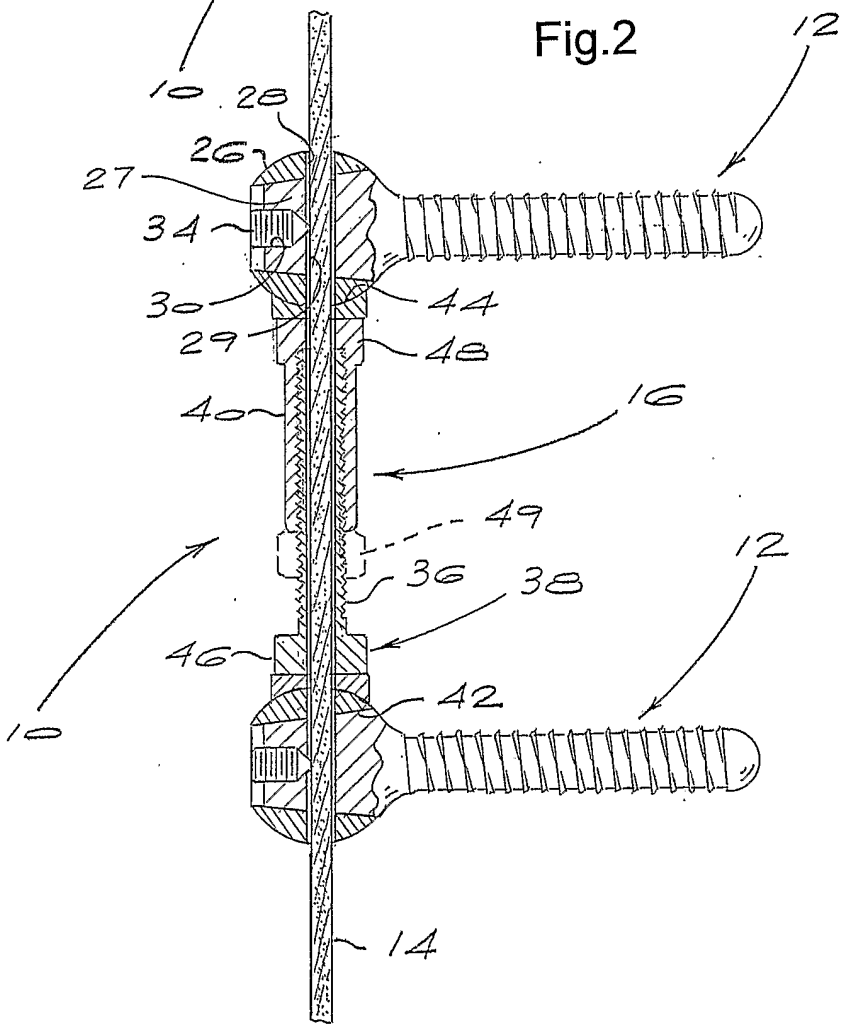
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Fig.3

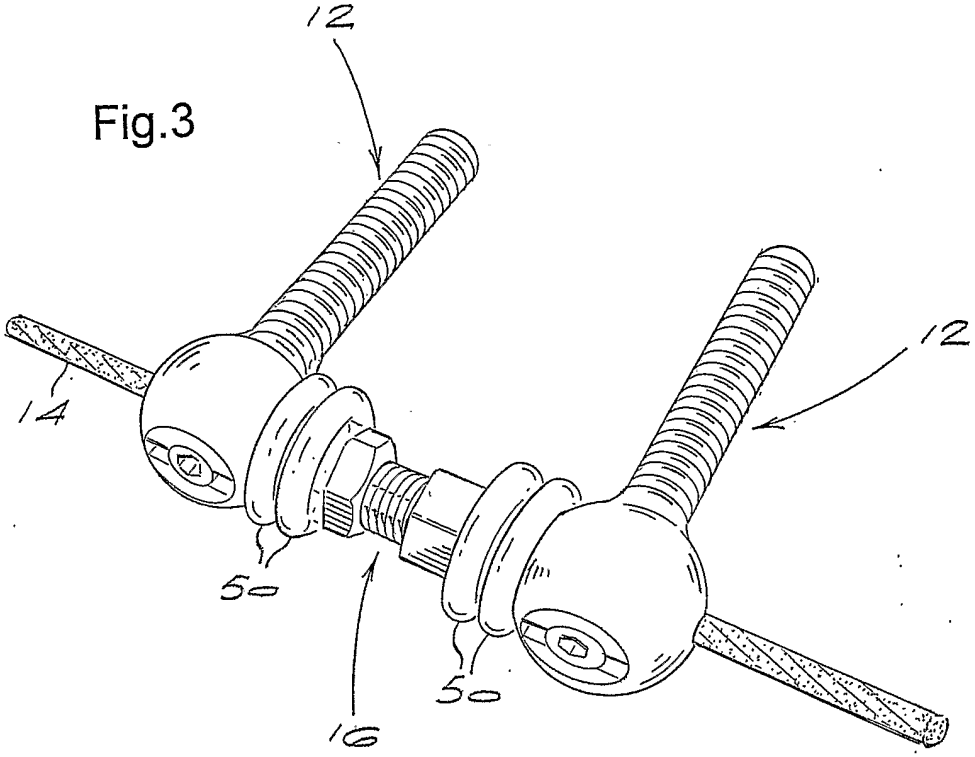
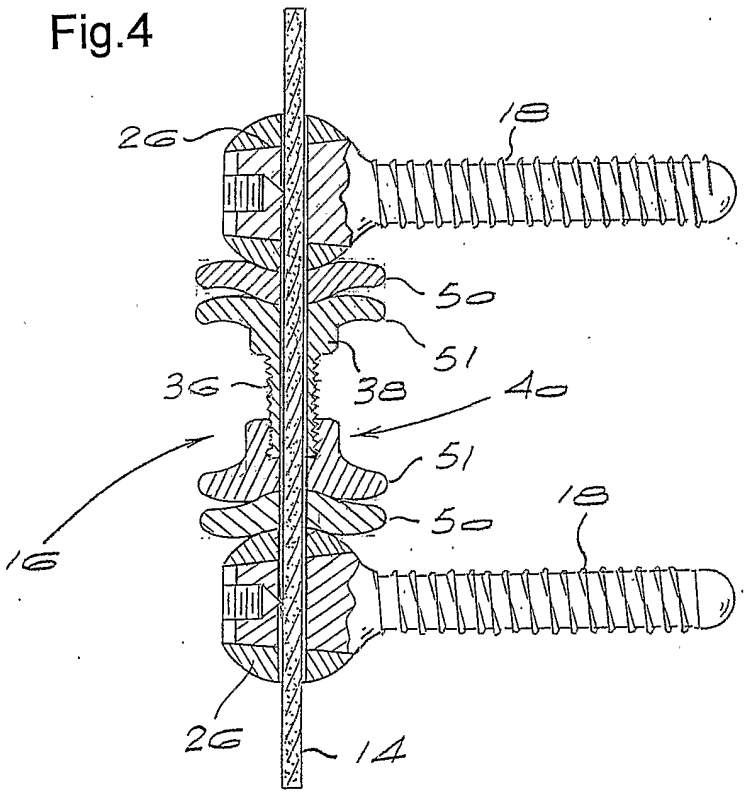


Fig.4



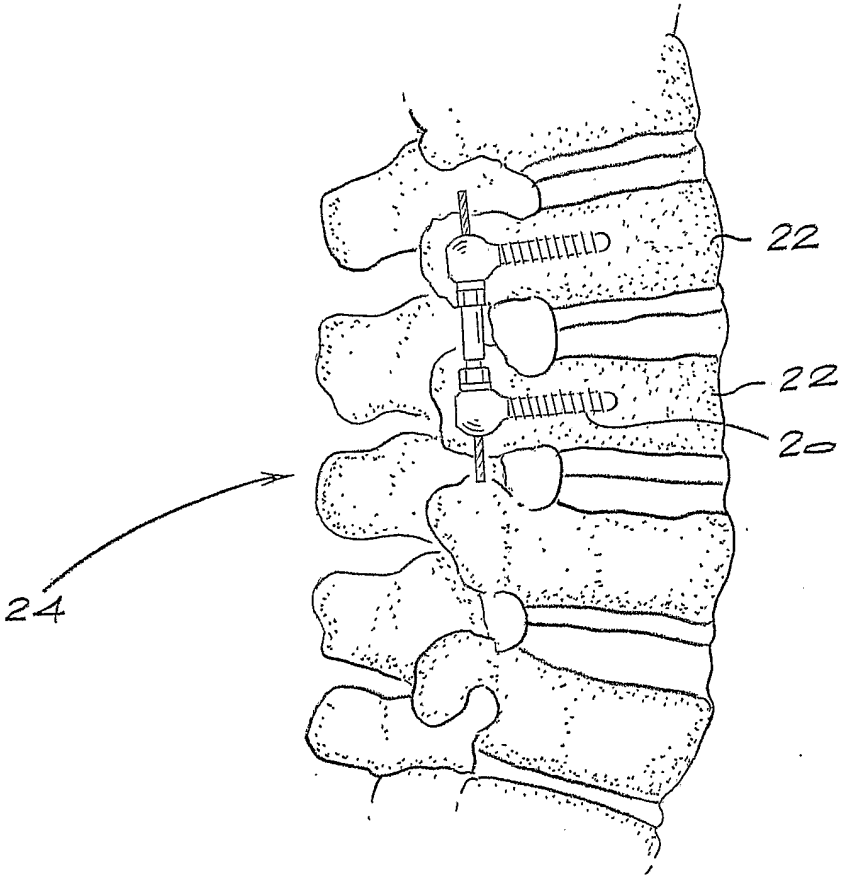


Fig.5