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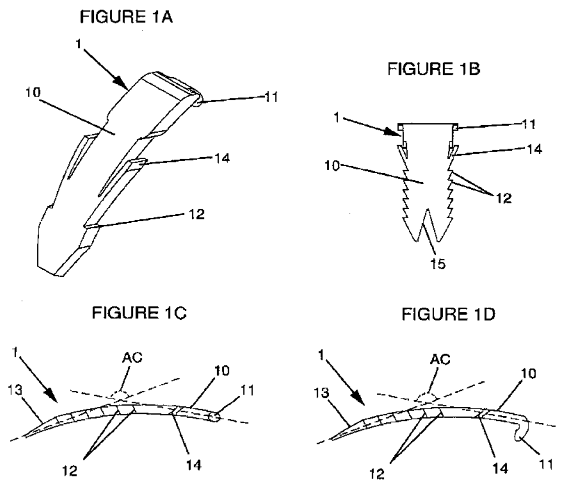
(54) Title: INTERSOMATIC CAGE, INTERVERTEBRAL PROSTHESIS, ANCHORING DEVICE AND IMPLANTATION INSTRUMENTS



(57) Abstract: An intersomatic cage, an intervertebral prosthesis, an anchoring device and an instrument for implantation of the cage or the prosthesis and the anchoring device are provided, as well as a system and a method for implanting spinal implants and anchoring devices in vertebrae. An intersomatic cage or an intervertebral prosthesis fit closely to the anchoring device (1), which includes a body (10) of elongated shape on a longitudinal axis, of curved shape describing, along the longitudinal axis, an arc whose dimensions and radius of curvature are designed in such a manner that the anchoring device (1) may be implanted in the vertebral plate of a vertebra by presenting its longitudinal axis substantially along the plane of the intervertebral space, where the anchoring device (1) is inserted, by means of the instrument, through a slot located in at least one peripheral wall of the cage (2A, 2B) or on at least one plate of the intervertebral disc prosthesis (2C) to penetrate into at least one vertebral plate.

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Intersomatic cage, intervertebral prosthesis, anchoring device and implantation instruments

This present invention concerns the area of orthopaedic implants and more precisely of spinal implants, such as intervertebral prostheses and intersomatic cages. An intervertebral prosthesis is implanted between two adjacent vertebrae in order to maintain or restore a space between the vertebrae while also preserving good mobility. An intersomatic cage is implanted between two adjacent vertebrae to allow the insertion and the growth of grafts of bony tissue (or a substitute) in the disc space, in order to achieve an arthrodesis (fusion of two vertebrae). After insertion of the cage, the intervertebral space may be filled with self–adapting spongy bone or suitable bony substitutes. In particular, the invention concerns, among other aspects, intervertebral prostheses and intersomatic cages for intervertebral fusion grafting, and more precisely their attachment to the vertebrae by a bony anchoring device and their implantation in the disc space using implantation instruments.

A problem in this area concerns the stability of the intervertebral prostheses or of the intersomatic cages in the disc space after they have been implanted there, at least before the growth of the graft on either side of the cage and fusion with the vertebrae in the case of the intersomatic cages. More generally, this problem concerns the fixation of a spinal implant (cage or prosthesis) onto the vertebrae. For example, there exists a risk that the prosthesis or the cage will move within the intervertebral space under the effect of the stresses exerted upon it when the patient moves or that the implant will not remain firmly fixed to vertebrae. The spinal implants (prosthesis or cage) must therefore not only have a shape that prevents it from pivoting but also have resources to prevent it from moving within the intervertebral space or in relation to the vertebrae.

From previous designs, we know of solutions that consist of equipping the top and bottom surfaces of the prostheses or cages with notches so as to prevent movement. However, this type of solution is not perfect and the prosthesis or the cage still may move. We are also familiar, from previous designs, with solutions that consist of equipping the prosthesis or the cage with a bony anchoring device which is used to soundly attach the prosthesis or the cage to the vertebral plates of the vertebrae between which it is implanted. This type of bony anchoring device proves to be effective for securing the prosthesis or the cage. However, this type of solution presents problems during implantation.

Access to the intervertebral spaces or to the edges of (or area around) the intervertebral spaces is often particularly difficult because of the dimensions involved, and in particular due to the presence of blood vessels and nerves at the edges of the intervertebral space. The bony anchoring devices must penetrate into the vertebrae to a sufficient depth to secure the device. As a consequence, these bony anchoring devices are generally implanted along an approach axis that is more–or–less perpendicular to the plane of the intervertebral space or at least on a substantially oblique axis in relation to the plane of the intervertebral space. Other types of bony anchoring devices fit onto a plate that is substantially parallel to the axis of the vertebral column and extending the prosthesis or the cage on one of the faces of the vertebrae. These different types of device therefore require the surgeons to make large incisions, inducing prejudice and considerable risks for the patient. In addition, this type of bony anchoring device is not easy to implant since it requires that there is sufficient space at the edges of the intervertebral space to allow the implantation of the device, which unfortunately is not always the case, depending on the vertebrae in question. Furthermore, depending on the bony anchoring devices, such as screws for example, a large space has to be cleared around the intervertebral space for allowing passage of a tool for the fixation of the bony anchoring device. Moreover, some bony anchoring devices have to be screwed or impacted into the vertebrae at a certain distance form the intervertebral space and generally along an approach axis substantially parallel to the plane of the intervertebral space and they require a large area to be cleared at the edges of the intervertebral space.

In this context, it is useful to provide an anchoring device (which may be referenced below simply as a "device") for spinal implants, such as an intersomatic cage or an intervertebral disc prosthesis which does not necessitate having more space at the edges of the intervertebral space than necessary for the implantation of the implant itself. A bony anchoring device the least invasive for its implantation as possible is thus desirable.

Some embodiments of this present invention have a purpose of overcoming certain drawbacks of some previous designs by providing an anchoring device that is implanted solidly and at a sufficient depth in the vertebral plates to retain the spinal implant against these vertebrae, while being the least invasive as possible for its implantation. For example, the implantation of the device may be on an approach axis that is substantially along the plane of the intervertebral space or that forms an oblique axis (in particular if it's intended to be implanted on the edges of the space) but without requiring much space around the intervertebral space to be cleared.

Various or all aspects of this purpose may be achieved by an anchoring device for anchoring a spinal implant in at least one vertebra, comprising a body of elongated shape on a longitudinal axis extending between a penetration end and an abutment end, characterised in that the body has a curved shape describing, along the longitudinal axis, an arc whose dimensions and radius of curvature are designed in such a manner that the anchoring device is implantable in a surface of a vertebra by being inserted, without deformation, through at least one orifice or receptacle located on the spinal implant and traversing at least one portion of the implant, the shape, dimensions and orientation of the orifice or receptacle being arranged to allow the passage of the anchoring device without deformation despite its curvature, so that the anchoring device penetrates into at least one vertebral surface and secures the spinal implant on or along this vertebral surface.

According to another feature of some embodiments, the circular arc described by the body has dimensions and a radius of curvature that are designed in such a manner that the anchoring device is implantable in a vertebral plate on an approach axis forming an angle of approximately 90° with the vertical axis of the vertebral column.

According to another feature of some embodiments, the curved and elongated body includes at least one curved plate.

According to another feature of some embodiments, the penetration end includes a chamfer or a bevel to facilitate the penetration of the device into the vertebrae.

According to another feature of some embodiments, the body is equipped with notches that are orientated so as to oppose the withdrawal of the device after it has been implanted in a vertebra.

According to another feature of some embodiments, the abutment end of the body includes at least one stop element that is intended to mate with at least one surface of the cage or of the prosthesis which the device is intended to secure.

According to another feature of some embodiments, the stop element includes a projecting lug on at least one face of the anchoring device.

According to another feature of some embodiments, the stop element includes two projecting lugs on the sides of the body.

According to another feature of some embodiments, the body includes, on at least one of its sides, a flexible lug orientated toward the abutment end and forming a stop element to oppose the withdrawal of the anchoring device.

Some embodiments of this present invention have a purpose of overcoming certain drawbacks of some previous designs by providing intersomatic cage that is easily implantable without requiring too much space to be cleared around the intervertebral space.

Various or all aspects of this purpose can be achieved by an intersomatic cage that includes a wall forming a cavity intended to receive a graft of bony tissue or a substitute, characterised in that the peripheral wall includes at least one orifice traversing at least a portion of the cage, the shape, dimensions and orientation of the orifice being adapted to the dimensions and radius of curvature of an anchoring device according to an embodiment of the present invention, so as to allow the passage of this anchoring device, without deformation despite its curvature, through this orifice, so as to orientate the anchoring device in the direction of a vertebral surface of one of the vertebrae between which the cage is intended to be implanted, the dimensions and radius of curvature of the anchoring device being designed in such a manner that the anchoring device is implantable in the surface of the vertebra by being inserted through the orifice.

According to another feature of some embodiments, at the peripheral surface of the wall, the orifice includes at least one stop element surface intended to mate with at least one stop element of the anchoring device.

According to another feature of some embodiments, the stop element surface includes two recesses located on either side of the orifice and intended to accommodate two projecting lugs on the sides of the body of the anchoring device.

According to another feature of some embodiments, the stop element surface includes a peripheral surface of the wall intended to accommodate a projecting lug on at least one face of the body of the anchoring device.

According to another feature of some embodiments, at the bottom or top surface of the wall, the orifice includes at least one stop element surface intended to mate with at least one flexible lug of the anchoring device, orientated toward its the abutment end, where this stop opposes the withdrawal of the anchoring device from the orifice.

According to another feature of some embodiments, the peripheral wall includes at least one attachment resource intended to mate with a gripper end of an instrument for implantation of the cage.

According to another feature of some embodiments, at least one of the top and bottom surfaces of the wall includes notches that prevent movement of the cage between the vertebrae between which it is intended to be implanted.

According to another feature of some embodiments, the mean planes passing through the top and bottom surfaces of the cage form an angle that imposes a lordosis on the vertebrae between which the cage is intended to be implanted.

According to another feature of some embodiments, the mean planes passing through the top and bottom surfaces of the cage are more or less parallel to each other.

According to another feature of some embodiments, the peripheral wall includes two orifices each of which is orientated toward one of the top and bottom surfaces, so as to allow anchoring of the anchoring device in each of the vertebrae between which the cage is intended to be implanted.

According to another feature of some embodiments, the peripheral wall includes at least two orifices located alongside each other, with each of these defining one possible axis of insertion of the anchoring device in the cage and, indirectly, one possible axis of insertion of the cage between the vertebrae.

According to another feature of some embodiments, the peripheral wall includes at least one chamfer on at least one peripheral portion of at least one of its top and bottom surfaces, so as to facilitate the insertion of the cage between the vertebrae.

Some embodiments of this present invention have a purpose of overcoming certain drawbacks of some previous designs by providing an intervertebral prosthesis that is easily implantable without requiring too much space to be cleared around the intervertebral space.

Various or all aspects of this purpose can be achieved by an intervertebral disc prosthesis which include at least a first plate and a second plate that are hinged to each by means of at least one curved surface, characterised in that at least one of the plates includes at least one orifice traversing at least a portion of at least one of the plates, the shape, dimensions and orientation of the orifice being adapted to the dimensions and radius of curvature of an anchoring device according to an embodiment of the present invention, so as to allow the passage of this anchoring device, without deformation despite its curvature, through this orifice, so as to orientate the anchoring device in the direction of a vertebral surface of one of the vertebrae between which the prosthesis is intended to be implanted, the dimensions and radius of curvature of the anchoring device being designed in such a manner that the anchoring device is implantable in the surface of the vertebra by being inserted through the orifice.

According to another feature of some embodiments, the orifice includes, at a peripheral surface of the plate, at least one stop element surface intended to mate with at least one stop element of the anchoring device.

According to another feature of some embodiments, the stop element surface includes two recesses located on either side of the orifice and intended to accommodate two projecting lugs on the sides of the body of the anchoring device.

According to another feature of some embodiments, the stop element surface includes a peripheral surface of the plate that is intended to accommodate a projecting lug on at least one face of the body of the anchoring device.

According to another feature of some embodiments, at the bottom or top surface of the plate, the orifice includes at least one stop element surface intended to mate with at least one flexible lug of the anchoring device, orientated toward its the abutment end, where this arrangement opposes the withdrawal of the anchoring device from the orifice.

According to another feature of some embodiments, at least one of the plates includes at least one attachment resource intended to mate with a gripper end of instrument for the implantation of the prosthesis.

According to another feature of some embodiments, at least one of the top and bottom surfaces of at least one of the plates includes notches that prevent movement of the prosthesis between the vertebrae between which it is intended to be implanted.

According to another feature of some embodiments, the mean planes passing through the top and bottom surfaces of at least one of the plates of the prosthesis form an angle that imposes a lordosis on the vertebrae between which the prosthesis is intended to be implanted.

According to another feature of some embodiments, the mean planes passing through the top and bottom surfaces of at least one of the plates of the prosthesis are more or less parallel to each other.

According to another feature of some embodiments, each of the plates includes an orifice, each of which is orientated toward one of the top and bottom surfaces, so as to allow the securing of each of the plates by the anchoring of an anchoring device in each of the vertebrae between which the prosthesis is intended to be implanted.

According to another feature of some embodiments, the prosthesis includes a mobile core with a surface which is more or less plane, fitting onto a surface that is more or less plane of one of the plates and a curved surface that is complementary to the curved surface of the other plate.

According to another feature of some embodiments, the core includes mating resources that are complementary to resources on at least one of the plates so as to limit the movement of the core in rotation and/or in linear movement in relation to this plate.

Some embodiments of this present invention have a purpose of overcoming certain drawbacks of some previous designs by providing an instrument for the implantation of a spinal implant (an intersomatic cage or an intervertebral disc prosthesis) between the vertebrae and/or for the implantation of an anchoring device in at least one of these vertebrae. Various or all aspects of this purpose can be achieved by an instrument for the implantation of a spinal implant between two adjacent vertebrae, and for the implantation of an anchoring device in at least one of these vertebrae, where this instrument firstly includes at least one impactor with a head whose shape and dimensions are designed to push the anchoring device and secondly at least one guide of elongated shape on a longitudinal axis extending between a first end, called the gripping end, of the cage or of the prosthesis, and a second end, called the push end, where the gripping end includes at least one gripping resource intended to mate with a resource for attachment of the spinal implant, characterised in that the guide includes a head whose shape and dimensions are designed to at least partially accommodate the head of the impactor and which includes at least one guidance surface having a radius of curvature that is substantially identical to the radius of curvature of an anchoring device according to an embodiment of the invention, so as to guide this anchoring device through a orifice of a spinal implant including an intersomatic cage according to the an embodiment of the invention or an intervertebral disc prosthesis according to the an embodiment of the invention, for impacting the anchoring device into a vertebral surface of one of the vertebrae between which the spinal implant is intended to be implanted.

According to another feature of some embodiments, the head of the guide includes a cavity whose shape and dimensions are designed to receive the anchoring device and, at least partially, the head of the impactor, where the guidance surface includes at least two curved grooves each located on either side of this cavity so as to guide the anchoring device on the two sides of its body, with the head of the impactor penetrating into the cavity from one end to the other of these grooves.

According to another feature of some embodiments, the impactor includes a rod which slides in relation to the guide when it is operated by means of the handle.

According to another feature of some embodiments, the impactor includes at least one stop element which limits the penetration of the head of the impactor within the head of the guide.

According to another feature of some embodiments, the gripping resource protrudes beyond the head of the guide at the gripping end, so as to allow the gripping of the cage or of the prosthesis with one end of the guidance surface opening onto the orifice in the cage or of the prosthesis thus held, and the other end of the guidance surface remaining accessible for the insertion of the anchoring device.

According to another feature of some embodiments, the attachment resource is a recess and the gripping resource is one end of a rod which slides in a body of the guide when it is operated by a handle in order to enter and leave the recess of the cage or of the prosthesis.

According to another feature of some embodiments, the rod includes a threaded end fitting onto a tapping in the recess so as to secure the cage or the prosthesis when the rod is operated by the handle.

According to another feature of some embodiments, the attachment resource is a recess and the gripping resource is the end of a curved rod, called a spatula, whose radius of curvature is more or less identical to a radius of curvature of the cage whose peripheral wall describes a circular arc, with the recess being located on a return part extending one end of the circular arc described by the wall of the cage in the direction of the centre of the circle of which the circular arc described by the wall forms part and the spatula fitting closely onto the shape of the cage between this return part and the other end of the circular arc described by the wall of the cage at which point a second gripping resource is located.

According to another feature of some embodiments, the second gripping resource is located at the base of the spatula, but on the side opposite to that carrying the spatula, and includes a second recess intended to accommodate a latch mounted on a rod of the guide, where this rod pivots when it is operated by a handle, between at least one position at which the latch fits into the second recess and a position at which the latch exits from the second recess and thus frees the cage.

According to another feature of some embodiments, the head of the guide is curved or bent more or less along the radius of curvature of the circular arc described by the cage.

According to another feature of some embodiments, the head of the impactor has a shape that is more or less curved or bent so as to confer upon it a radius of curvature that is compatible with its passage in the head of the guide, where this head of the impactor is mounted on an axis of rotation that allows it to pivot in order to pass the curvature or the bend in the head of the guide.

Some embodiments of this present invention have a purpose of overcoming certain drawbacks of some previous designs by providing a system for the implantation of a spinal implant between vertebrae. Various or all aspects of this purpose can be achieved by a system for the implantation of a spinal implant between two adjacent vertebrae, comprising at least one spinal implant and at least one anchoring device for anchoring the implant in at least one vertebra, characterized in that:

- the spinal implant includes an intersomatic cage according to an embodiment of the invention or an intervertebral disc prosthesis according to an embodiment of the invention; and
- the anchoring device includes an anchoring device according to an embodiment of the invention.

According to another feature of some embodiments, the system comprises an instrument according to an embodiment of the invention.

Some embodiments of this present invention have a purpose of overcoming certain drawbacks of some previous designs by providing a method for the implantation of a spinal implant (an intersomatic cage or an intervertebral disc prosthesis) between the vertebrae.

Various or all aspects of this purpose can be achieved by a method of inserting a spinal implant comprising:

- providing an anchoring device in accordance with the invention;
- providing a spinal implant including an intersomatic cage in accordance with an embodiment of the invention or including an intervertebral disc prosthesis in accordance with an embodiment of the invention;
- providing an implantation instrument in accordance with an embodiment of the invention;
- gripping the spinal implant with the gripping device of the implantation instrument ;
- inserting the spinal implant in an intervertebral space between adjacent vertebrae of a spinal column;
- presenting the anchoring device with the longitudinal axis of the anchoring device along an approach axis that is substantially along a plane of the intervertebral space;
- using the impactor of the implantation instrument, inserting the anchoring device through the guide head of the implantation instrument and through

the orifice in the implant, with the anchoring device traversing at least a portion of the implant ; and

- using the impactor of the implantation instrument, implanting the penetration end of the anchoring device in one of the adjacent vertebrae.

Other particular features and advantages of various embodiments of this present invention will appear more clearly on reading the description that follows, provided with reference to the appended drawings, in which:

- figure 1A represents a view in perspective of an anchoring device according to an embodiment of the invention, figure 1B represents a view from above of an anchoring device according to another embodiment of the invention, and figures 1C and 1D represent views in profile of anchoring devices according to two different embodiments of the invention,

- figures 2A, 2B and 2D respectively represent a view in perspective, a view from above and a view in profile of an intersomatic cage according to an embodiment of the invention, figure 2C represents a view in section of this intersomatic cage on section plane 2C–2C represented in figure 2B and figure 2E represents a view in section of this intersomatic cage on section plane 2E–2E represented in figure 2D,

- figures 3A and 3B respectively represent a view in perspective from the front and a view from above of an intersomatic cage according to an embodiment of the invention, figure 3C represents a view in section of this intersomatic cage on section plane 3C–3C represented in figure 3B and figure 3D represents a view in section of this intersomatic cage on section plane 3D–3D represented in figure 3B,

- figures 4A and 4B respectively represent a view in perspective from the front and a view from above of an intersomatic cage according to an embodiment of the invention, figure 4C represents a view in section of this intersomatic cage on section plane 4C–4C represented in figure 4B, and figure 4D represents a view in section of this intersomatic cage on section plane 4D–4D represented in figure 4B,

- figures 5A and 5B respectively represent a view in perspective and a view from the front of a head for the implantation guide of an anchoring device according to an embodiment of the invention, figures 5C and 5D respectively represent a view in perspective and a view in profile of a guidance element for an anchoring device according to an embodiment of the invention and figure 5E represents a view from the front of the head of the guide equipped with two guidance elements according to an embodiment of the invention,

- figure 6A represents a view in perspective of an implantation guide and of an impactor according to an embodiment of the invention, figures 6B, 6C and 6D respectively represent a view from above, a view in section on section plane 6C–6C represented in figure 6B and a view in section on section plane 6D–6D represented in figure 6C of an implantation guide according to an embodiment of the invention and figure 6E represents a view in profile of an impactor according to an embodiment of the invention,

- figures 7A and 7C represent views from above of an assembly according to an embodiment of the invention, of an implantation guide, of an impactor, of a cage and of an anchoring device, respectively, ready to be impacted and impacted, figures 7B and 7D represent views in section of this assembly along section plane 7B–7B represented in figure 7A and section plane 7D–7D represented in figure 7C, respectively,

- figures 8A and 8B represent views in perspective of an intersomatic cage equipped with an anchoring device according to an embodiment of the invention and figure 8C represents a view in perspective of the end of an implantation guide carrying an intersomatic cage according to an embodiment of the invention,

- figures 9A and 9B respectively represent a view in perspective and a view from above, of the end of an implantation guide carrying an intersomatic cage equipped with an anchoring device according to an embodiment of the invention and figure 9C represents a view in section on section plane 9C–9C represented in figure 9B,

- figures 10A, 10B and 10C respectively represent a view in perspective, a view from above and a view in section along axis 10C–10C of figure 10B, of an embodiment of a braced intersomatic cage and figures 10D, 10E and 10F respectively represent a view in perspective, a view from below and a view in section along axis 10F–10F of figure 10E, of another embodiment of a braced intersomatic cage,

- figures 11A and 11B respectively represent a view in perspective and a view in profile of an embodiment of an intervertebral prosthesis equipped with anchoring devices, and figures 11C and 11D respectively represent a view in perspective and a view in profile of another embodiment of an intervertebral prosthesis equipped with anchoring devices.

This present invention concerns, among other aspects, an anchoring device (1) that is substantially curved and usable for spinal implants such as intersomatic cages (2A, 2B) or intervertebral disc prostheses (2C). In various embodiments, the anchoring device (1) can be rigid and fit an orifice or receptacle (20) located on the cage (2A, 2B) or the prosthesis (2C) that it secures. Generally, the orifice or receptacle can be tailored as a slot for receiving the anchoring device (1), but those of skill in the art will recognize that the invention makes provision for several shapes of the anchoring device and the orifice or receptacle (in the extend definition used herein) and that the terms "orifice," "receptacle," and "slot" used herein should not be construed as limiting the scope of the invention. This present invention also concerns, among other aspects, intersomatic cages (2A, 2B) and intervertebral disc prostheses (2C), which in various embodiments may have a slot (20) or other orifice or receptacles adapted to receive the anchoring device (1). This present invention also concerns, among other aspects, an instrument for the implantation of a cage (2A, 2B) or of a prosthesis (2C) and for implantation of an anchoring device to secure the cage (2A, 2B) or the prosthesis (2C). In various embodiments, the instrument is designed for the anchoring device (1) so as to secure the latter in the vertebrae and also to the intersomatic cages (2A, 2B) or to the intervertebral disc prostheses (2C), which include at least one means (24) of retaining or attaching an implantation instrument so as to allow them to be gripped or otherwise engaged by the instrument. This attachment device may include at least one recess (24) that accommodates at least one gripping resource (321) of the instrument, as shown in the figures and described below in greater detail. However, this attachment resource (24) may also include a portion projecting on the outside of the cage or of the prosthesis and that is inserted into a recess of a gripping resource (not shown). In addition, in certain implementation variants, this attachment resource (24) may be formed at least in part by different surfaces of the cage (2A, 2B) or of the prosthesis (2C), with the gripping resources (321) of the instrument then having a shape that is complementary to these surfaces so as to allow gripping of the cage or of the prosthesis.

Various embodiments allow a reduction in the dimensions of the device and of the associated instrument, so as to allow implantation of the anchoring device on an approach axis that is substantially along the plane of the intervertebral space (disc space). The reduction of dimensions is particularly advantageous, even when the anchoring device is intended for an implantation along an oblique axis, as described below. Various embodiments of the invention ease implantation of the anchoring device (1) by using an orifice (20) in the spinal implant (2A, 2B, 2C) traversing at least one portion of the implant, with the dimensions and radius of curvature of the anchoring device being designed in such a manner that the anchoring device (1) is implantable in a surface of a vertebra by being inserted, without deformation, through the orifice (20), the shape, dimensions and orientation of the orifice (20) being arranged for allowing the passage of the anchoring device (1) without deformation despite its curvature, so that the anchoring device (1) penetrates into at least one vertebral surface and secure the spinal implant on this vertebral surface. Thus these embodiments of the invention use an anchoring device with a curved body that is adapted to freely pass through a receiving orifice of the spinal implant it's intended to fix. Thus, the free passage of the curved anchoring device through the orifice, without deformation despite its curved shape, facilitates its implantation in the vertebrae. Accordingly, in various embodiments the anchoring device can be substantially rigid.

The anchoring device (1) also may include a body (10) of elongated shape along a longitudinal axis extending between a first end and a second end. In this present description, the first end is called the penetration end and the second end is called the abutment end. The body (10) of the anchoring device (1) of various embodiments may have a curved shape that, along the longitudinal axis, describes an arc, for example a circular arc or an elliptic arc, whose dimensions and radius (or radii) of curvature are designed in such a manner that the anchoring device (1) is implantable in the vertebral plate of a vertebra by presenting the longitudinal axis of the device (1) approximately along the plane of the intervertebral space. Various implementation variants may feature a differing radius (or radii) of curvature of the anchoring device (1). The device also may have several different radii of curvature on different portions of the body (10), or may have a radius of curvature that varies along the body (10). Thus, this body may, for example, have a shape of a circular arc or of an elliptic arc, but may also describe a more complex curvature, such as if several circular arcs, having the same radius of curvature or different radii of curvature, were end to end or if several elliptic arcs, having the same radius of curvature or different radii of curvature, were end to end, or even any combination thereof, or even a radius of curvature that is a function of position along the body. In the present description, the terms "arc," "circular arc," and "radius of curvature" correspond to all these possibilities.

Accordingly, some embodiments of this present invention provide different implementation variants regarding the radius (or radii) of curvature of the anchoring device (1). For example, depending on the use of the device (1), and in particular of the vertebrae between which the cage or the prosthesis is to be implanted, the device (1) preferably may have a radius of curvature that is greater or smaller in dimension in various places. For example, the radius (or radii) can vary in size depending on the intended use. Depending on the radius of curvature of the anchoring device (1), the axes passing respectively through the penetration end and through the abutment end of the device (1) form an angle (AC), as may be seen particularly in figures 1C and 1D. This angle (AC) typically will be in the range of 90° to 180°, inclusively, although it may also be chosen to be less than 90°. Preferably, the angle (AC) will be between 110° and 160°, which in many circumstances will facilitate the implantation of the device better than an angle (AC) outside this range. Depending on the securing arrangement desired, an angle (AC) may be chosen that is more or less open. For example, if it is desired to secure the cage or the prosthesis by flattening it solidly against the vertebral plates, an angle (AC) can be chosen that ranges from 120° to 180°, while if instead it is desired to secure the cage or the prosthesis so as to prevent its movement in the plane of the disc space, an angle (AC) can be chosen that is between 90° and 150°. Different implementation variants may provide different angles for the anchoring device (1) to secure the cage or the prosthesis. In one of the preferred embodiments, angle (AC) may have an mutually accommodating value, such as close to 135°, for example, for securing the device by both flattening the cage or the prosthesis against a vertebral plate and inhibiting the movement of the cage or the prosthesis in the plane of the disc space.

In addition, depending on the embodiment of the cage or of the prosthesis, it is possible to choose different angles for the device, in particular to promote secure fixing despite a natural or pathological lordosis or one imposed by the prosthesis. The anchoring device (1) may be inserted through a slot (20) located on at least one peripheral wall of the cage (2A, 2B) or on at least one plate of the intervertebral disc prosthesis (2C) and traversing at least one portion of this cage (2A, 2B) or of this prosthesis (2C). This slot (20) may extend from a peripheral surface of the wall (25) of the cage (2A, 2B) or of the plate of the prosthesis (2C) up to a top or bottom surface of this cage (2A, 2B) or of this plate, with an orientation designed for the radius of curvature of the anchoring device (1), so as to orientate the latter in the direction of the vertebral plate of one of the vertebrae between which the cage (2A, 2B) or the prosthesis is implanted. By means of this orientation of the slot (20), the anchoring device (1) may penetrate into at least one vertebral plate and secure the cage (2A, 2B) or the prosthesis (2C) against this vertebral plate. Depending on the radius of curvature and the angle (AC) of the anchoring device (1), the thickness and the orientation of the slot (20) may vary in accordance with the various embodiments.

Some embodiments of this present invention therefore provide an intersomatic cage (2A, 2B) that includes a peripheral wall (25) forming a cavity (23) that receives a graft of bony tissue or a substitute. Such a cage may include a cavity (23) in its centre, formed by its wall (25), as shown in the figures, but it may also, in other implementation variants, consist of a block that does not have a cavity inside it, such cage being, for example, used at least in pairs, so as to form a cavity between the cages as is known from the previous designs. In an implementation variant represented in figure 10A, the intersomatic cage (2A) includes a brace (27) traversing its cavity (23) from side to side, which may be configured strengthen the wall (25) of the cage (2A). This brace (27) may have different forms and orientations and may, for example, be orientated along the insertion axis of the cage (2A) between the vertebrae. In various embodiments, the brace (27) may have a height that is less than that of the rest of the cage. This smaller height of the brace (27) in relation to the rest of the cage may allow the cage to hug any shape irregularities of the vertebral plates. Thus, as illustrated, for example, in figures 10A to 10C, the top and bottom surfaces of the brace (27) are located lower and higher than the top and bottom surfaces, respectively, of the cage (2A). Thus, if the vertebral plates of the two adjacent vertebrae have bumps, the cage will follow the shape of these plates and generally provide better stability. In this implementation example represented in figures 10A to 10C, the brace is not equipped with notches since it will not be in contact with the vertebral plates. However, the brace (27) may nevertheless be equipped with notches (22), even in this case, for example, so as to enhance stability of the cage when the osseous graft has grown around the cage. In the implementation example of figures 10D to 10F, the bottom surface of the brace (27) is located at the same level as the bottom surface of the rest of the cage (2A) but the top surface of the brace (27) is located lower than the top surface of the rest of the cage (2A), as may be seen particularly in figure 10E. In this implementation example, the bottom surface of the brace (27) is equipped with notches (22) adding to the notches present on the rest of the cage in order to oppose the movement of the latter. In a variant, this brace may not include notches. In a variant, this type of cage may also be used in an inverse configuration in relation to this example. Thus, in this variant, the brace (27) will have a top surface at the same level as the top surface of the rest of the cage and a bottom surface located higher than the rest of the cage. All of these possible variants of the brace may naturally be combined with the other variants concerning the other characteristics of the cage.

In some embodiments of this present invention, the wall (25) of the cage (2A, 2B) includes at least one slot (20) having a width that allows the passage of this anchoring device (1) despite its curvature. For allowing the passage, this slot (20) may have a width (the height of the aperture described by the slot) substantially larger than the height of the anchoring device (1). This slot (20) traverses the cage (2A, 2B) between a peripheral surface of the wall (25) and a top or bottom surface of the cage (2A, 2B), with an orientation that is designed for the radius of curvature of the anchoring device (1), so as to orientate the latter in the direction of the vertebral plate of one of the vertebrae between which the cage (2A, 2B) is implanted.

Some embodiments of this present invention provide an intervertebral disc prosthesis (2C). The prosthesis (2C) includes at least one first plate (51) and one second plate (52) that articulate along a curved surface. In an embodiment, particularly visible in figures 11A and 11B, the prosthesis (2C) includes only two plates (51, 52), each of which has a curved surface. These curved surfaces of the two plates (51, 52) are complementary and fit together to allow an articulation of plates (51, 52) by rotation about an axis that is more–or–less perpendicular to the plane of the plates and/or by sloping the plates in relation to each other. In another embodiment that is particularly visible in figures 11C and 11D, the prosthesis (2C) includes two plates (51, 52) and a central core (53), which is mobile in relation to at least one of the plates (51, 52). In an embodiment, this core (53) includes a surface that is substantially plane, fitting onto a surface that is substantially plane of one of the plates (51, 52) and a curved surface fitting onto a complementary curved surface of the other plate (52, 51). The curved surface allows an articulation as described previously (inclination and/or rotation) and the plane surface allows a linear movement of the core in relation to the plate that includes the plane surface and/or a rotation of the core in relation to this plate, about an axis that is more–or–less perpendicular to the plane of the plates. In addition, according to the embodiments employed, the core (53) may include complementary mating resources (530) on at least one of the plates (51, 52) so as to limit the movement of the core (53) in rotation and/or in linear movement in relation to this plate. In some embodiments of the present invention, at least one of the plates (51, 52) of the prosthesis (2C) includes at least one slot (20) having a width that that allows the passage of this anchoring device (1) despite its curvature. This slot (20) may have a width (the height of the aperture described by the slot) substantially larger than the height of the anchoring device (1). Similar to some embodiments having an intersomatic cage (2A, 2B) discussed above, the intervertebral prosthesis (2C) may have one or more slots (20) that traverse the plate (51, 52) and orient the anchoring device (1) in the direction of the vertebral plate of one of the vertebrae between which the prosthesis (2C) is implanted. In some embodiments, the dimensions and orientation of the slot(s) (20) may be adapted, respectively, to the dimensions and to the radius of curvature of the anchoring device (1).

In a preferred embodiment of the invention, the width of the slot (20) will be slightly greater than the thickness of the anchoring device (1), sufficiently to allow the passage of the latter within the slot, but by sufficiently little to enhance retention of the cage (2A, 2B) or of the prosthesis (2C) by the anchoring device (1), without excessive play of the latter within the slot

(20). In various embodiments, the curvature of the device (1) along the abutment end may be configured to interfere (cooperate) with the slot (20) sufficiently to enhance the retention of the cage (2A, 2B) or of the prosthesis (2C) by the anchoring device (1). In certain embodiments of the invention, the length of the slot (20) may be substantially to the same as the width of the device (1) so that the latter has little or no play once inserted into the slot (20). The length of the anchoring device (1) may be designed for the depth of the slot (20) to be traversed and to the depth to which it must penetrate to the vertebral plates.

Thus, the anchoring device (1), by means of its radius of curvature and the orientation of the slot (20) in which it is inserted, may be implanted on an approach axis that is substantially along the plane of the intervertebral space, meaning the plane along which the cage (2A, 2B) or the prosthesis (2C) is implanted, which facilitates the approach of all of the elements of the intervertebral prosthesis or cage and the anchoring device to the edges of the intervertebral space. In an embodiment, the arc described by the body (10) has dimensions and a radius of curvature that are designed in such a manner that the anchoring device (1) is implantable in a vertebral plate on an approach axis forming an angle with the vertical axis of the vertebral column of between 40° and 140°, and preferably an angle of approximately 90°. This angle may vary for a given anchoring device (1) depending on the dimensions at the edges of the vertebrae, and may also vary from one anchoring device (1) to another depending on the radius of curvature of the device (1) used and the angle (AC) formed between its abutment and penetration ends.

In an embodiment of the invention, the curved and elongated body (10) includes at least one curved plate, as may be seen particularly in figure 1 (A to D). This plate may be substantially rectangular as shown in the figures, but may naturally have various shapes without moving outside the spirit of the invention. Likewise, in other implementation variants, the body (10) may include a curved rod, with the slot (20) then having a shape to suit the section of this rod, but the invention naturally allows other embodiments, in particular regarding the shape of the body (10). In other implementation variants (not shown), the body (10) of this anchoring device (1) may include two plates (or two rods), generally parallel to each other, and connected together at the abutment end by an inward–curving part that fits onto a rod present at the centre of the slot (20) in the cage or the prosthesis, for example as the flat anchor shown and described in applications FR 2827156 (or WO03/005939) and FR 2879436 (or WO 2006/120505), which may be incorporated herein by reference.

The penetration end of the anchoring device (1) penetrates into the vertebral plate of one of the vertebrae between which the cage (or the prosthesis) is to be implanted. In an embodiment of the invention, the penetration end includes a chamfer (13) or a bevel to facilitate the penetration of the device (1) into the vertebra, as may be seen particularly in figures 1C and 1D. In an implementation variant, this penetration end may also include an indentation (15), in the form of a V–shaped notch, for example, as shown in figure 1B, to facilitate the penetration of the penetration end into the vertebral plates. The abutment end is butted up against a surface of the cage or of the prosthesis that the device secures, so as to hold the latter against the vertebral plate, preferably firmly and tightly.

In different implementation variants of the anchoring device (1), the abutment end of the body (10) includes at least one stop element (11) that mates with at least one surface of the cage (2A, 2B) or of the prosthesis (2C) that the device (1) secures. In a complementary manner, in different implementation variants of the cage (2A, 2B) or of the prosthesis (2C), at the level of the peripheral surface of the wall (25), the slot (20) includes at least one stop element surface (21) that mates with at least one stop element (11) of the anchoring device (1). In an embodiment, particularly visible in figures 1A and 1D, the stop element (11) includes a projecting lug on at least one face of the anchoring device (1). In the example shown, this stop element consists simply of a lug orientated toward the interior of the circle of which the arc described by the body (10) forms part, but the lug may adopt different orientations. The cage (2A, 2B) or the prosthesis (2C) may then simply include, below the slot (20), a contact surface for this stop element (11). The stop element surface (21) of the cage (2A, 2B) or of the prosthesis (2C) may then include a peripheral surface of the wall (25) or of the plate (51, 52) to accommodate this projecting lug on at least one face of the body (10) of the anchoring device (1). In another embodiment that is particularly visible in figures 1B and 1C, the stop element (11) includes two projecting lugs on the sides of the body (10). These two lugs may consist of two latches click–fitted in the slot. In this embodiment, the stop element surface (21) of the cage (2A, 2B) or of the prosthesis (2C) may include, for example, two recesses (21) located on either side of the slot (20) to accommodate two projecting lugs on the sides of the body (10) of the anchoring device (1). These two recesses may, for example, have a shape and dimensions to suit the click–fitting of the lugs of the anchoring device (1). In addition, as may be seen particularly in figures 11A and 11C, the periphery of the plates form an opening at the level of the slot for the insertion of the device and the edge located between this opening and the periphery of the plate forms a sort of rod onto which the stop element (11) of the anchoring device (1) may fit. Thus, the stop element (11) of the device (1) may consist of a curved portion that click–fits on the edge of the plate. Thus, the device (1) may be removable (in many embodiments) and may be implanted in the vertebrae and fitted onto the plates of the prosthesis after the implantation of the latter between the vertebrae. This embodiment allows adjustment, where appropriate, of the position of the prosthesis between the vertebrae before definitive securing.

In certain embodiments of the invention, the body (10) includes, on at least one of its sides, one or more flexible lugs (14) orientated toward the abutment end and forming a stop element to oppose the withdrawal of the anchoring device (1). As may be seen particularly in figures 1A and 1B, this flexible lug (14) may be present on the two lateral sides of the body (10), but it may naturally be located on a single face of the body, such as the top or bottom face, for example. This (or these) flexible lug(s) (14) are used to secure the anchoring device (1) in relation to the cage (2A, 2B) or the prosthesis (2C), by means of their orientation in the direction of the abutment end. When the device (1) is inserted into the slot (20), the lugs (14) fold up because of their flexibility, thus allowing the passage of the device (1) in the slot even if the width of the body (10) is substantially the same as the length of the slot (20), as mentioned previously, as a result, for example, of the recesses in the body (10) provided for the folding over of these lugs (14) or by means of the shape of the body (10) in relation to the slot (20). The position of these flexible lugs (14) on the body (10) may also be arranged so that they emerge at the other side of the slot (20), along the bottom or top surface of the wall (25) of the cage (2A, 2B) or at the bottom or top surface of the plate (51, 52) of the prosthesis (2C). In this embodiment, at the bottom or top surface of the wall (25), the slot (20) may include at least one stop element surface that mates with these lugs. On the other hand, the position of these flexible lugs (14) on the body (10) may also be arranged so that they do not emerge from the slot (20), which may then have at least one recess allowing the lugs (14) to unfold and oppose the withdrawal of the anchoring device (1).

In certain embodiments of the invention, the body (10) is equipped with notches (12) that are orientated so as to oppose the withdrawal of the device (1) after it has been implanted in a vertebra. As may be seen particularly in figures 1A and 1B, the number, the dimension and the shape of these notches (12) may vary according to the implementation variants, without moving outside the spirit of the invention.

Depending on the embodiments, the cage (2A, 2B) may have different shapes. The description that follows gives some non-limiting implementation variants with reference to the appended figures, but the cage (2A, 2B) and the prosthesis (2C) may of course have other shapes without moving outside the spirit of the invention. For example, the cage (2A) represented in figure 2 (A to E) is substantially annular, with a periphery that is substantially circular, except at the location of the slot (20) for insertion of the anchoring device (1), at which point it will be held by an implantation instrument (3, 4). The shape of the cage (2A, 2B) or of the prosthesis (2C) may vary, of course, and the shape of the end of the said instrument (3, 4) in contact with the cage (2A, 2B) or the prosthesis (2C) may vary as a consequence, according to some of the embodiments. The cage (2A, 2B) and the prosthesis (2C) may, for example, have different shapes, which preferably have a slot (20) designed for the insertion of the device (1), and attachment resources (24) adapted to mate with one end of an implantation instrument. Depending on the embodiments, these attachment resources (24) may be associated with a particular shape of the cage (2A, 2B) or of the prosthesis (2C) close to these attachment resources (24) to allow a good fit with the instrument or may even have such particular shapes fitting onto complementary shapes of the instrument. For example, the instrument may include a contact surface fitting closely onto the shape of the prosthesis (2C) close to the recess (24) and/or of the slot (20). Likewise, as mentioned previously, the cage (2A, 2B) may include a cavity (23) at its centre or not, to the extent that it is common to implant several intersomatic cages (2A, 2B) in a given intervertebral space (on condition that the dimensions allow it). The cages thus implanted are generally used to enclose bony tissue (a graft) which will grow within the intervertebral space and allow a fusion (arthrodesis) of the two vertebrae between which it is implanted. It is also common to use a substitute instead of an osseous graft. In any event, the aim of the cage (2A, 2B) is to restore or maintain a space between the vertebrae. Before the growth of the graft and the fusion of the vertebrae, the cage (2A, 2B) should remain correctly in position in the disc space, and various embodiments of this present invention facilitate its immobilisation.

Before the implantation of the anchoring device (1) used to maintain the cage (2A, 2B) in position, there may be a risk that the cage (2A, 2B) will move within the disc space. In certain embodiments, at least one of the top and bottom surfaces of the wall (25) will include notches (22) that prevent movement of the cage (2A, 2B) between the vertebrae between which it is implanted. Likewise, at least one of the plates (51, 52) of the prosthesis (2C) may be fitted, on its surface in contact with the vertebrae, with stabilisation resources, such as notches or fins or any type of structure that may be used to prevent its movement between the vertebrae, so as to enhance stability of the prosthesis before it is secured by the anchoring device (1). Thus, at least one of the top and bottom surfaces of at least one of the plates (51, 52) may include notches (22) that prevent movement of the prosthesis (2C) between the vertebrae between which it is implanted. According to various embodiments, these notches (22) or other stabilisation resources may have different orientations, so as to prevent movement of the cage (2A, 2B) or of the prosthesis (2C) in one or more directions. For example, the notches (22) may be substantially parallel to each other and all orientated perpendicularly to the axis of insertion of the cage (2A, 2B) or of the prosthesis (2C), but on the other hand the notches (22) may have different orientations on different portions of the cage (2A, 2B) or of the prosthesis (2C), so as to prevent movement in any direction.

In some situations, in particular depending on the vertebrae between which the cage (2A, 2B) or the prosthesis (2C) must be implanted, it is desirable that the cage (2A, 2B) or the prosthesis (2C) allow the imposition of a lordosis or kyphosis in addition to maintaining the space between the vertebrae. Certain embodiments therefore provide that the mean planes passing along the top and bottom surfaces of the cage (2A, 2B) form an angle (A1) that imposes a lordosis on the vertebrae between which the cage (2A, 2B) is implanted. For example, figure 2B represents a view from above of a cage (2A) according to an embodiment of the invention. This cage is implanted substantially along axis 2C–2C representing, in figure 2B, the plane of the view in section of figure 2C. Figure 2C shows that the mean planes (28) of the bottom and top surfaces of the cage (2A) form an angle (A1) which imposes a lordosis along axis 2C–2C. On the other hand, in certain embodiments, the mean planes passing along the top and bottom surfaces of the cage (2A, 2B) may be substantially parallel to each other. Likewise, the prostheses (2C) may include plates whose top and bottom surfaces are substantially parallel to each other but may include plates whose top and bottom surfaces form an angle that may, for example, impose a lordosis or a kyphosis. Thus, in certain embodiments, the mean plane passing along the top and bottom surface of at least one of the plates (51,

52) of the prosthesis (2C) forms an angle (A1) that imposes a lordosis on the vertebrae between which the prosthesis (2C) is implanted, for example as described in application FR 2869528 (or WO 2005/104996) and even in application FR 2879436 (or WO 2006/120505), which may be incorporated herein by reference. In other embodiments, the mean planes passing along the top and bottom surfaces of at least one of the plates (51, 52) of the prosthesis (2C) are substantially parallel to each other. In the case of prostheses that include a mobile central core (53) whose movement is limited by mating resources (530), the lordosis may be obtained by a core (53) that at rest is moved off–centre by means of these mating resources (530) and/or the mating resources (531) of the plate.

In addition, in certain embodiments, the peripheral wall (25) of the cage (2A, 2B) may include at least one chamfer (250) on at least one peripheral portion of at least one of its top and bottom surfaces, so as to facilitate the insertion of the cage (2A, 2B) between the vertebrae. As may be seen particularly in figure 2B, this chamfer (250) of the cage (2A) may be located substantially in the axis (2C–2C, figure 2B) of implantation of the prosthesis. In addition, as may be seen particularly in figure 2D, this chamfer (250) may be present on the two bottom and top surfaces of the cage (2A). This chamfer (250) or bevelled profile facilitates the implantation of the cage (2A, 2B) by according it a height that is somewhat less on its attacking edge (that is inserted first) than on the rest of the cage. Likewise, the plates of the prosthesis (2C) may include, on the periphery of their surface in contact with the vertebrae, at least one chamfer to facilitate the insertion of the prosthesis (2C) in the disc space.

In certain embodiments, the peripheral wall (25) of the cage (2A, 2B) includes two superimposed slots (20) each of which is orientated toward one of the top and bottom surfaces, so as to allow anchoring of the anchoring device (1) in each of the vertebrae between which the cage (2A, 2B) is implanted. Likewise, each of the plates (51, 52) may include a slot (20), each of which may be orientated toward one of the top and bottom surfaces, so as to allow the securing of each of the plates (51, 52) by the anchoring of an anchoring device (1) in each of the vertebrae between which the prosthesis (2C) is implanted. In other embodiments, the cage (2A, 2B) may have only single slot (20). In some embodiments, only one plate (51, 52) of the prosthesis (2C) has a slot and the other plate has none.

In certain embodiments, the cage (2A, 2B) may be implantable on an axis located substantially along the plane of the intervertebral space but which is oblique in relation to the vertical axis of the vertebral column so as, for example, to allow the implantation between the vertebrae at the point at which blood vessels pass, preventing frontal access to the intervertebral space. In this case, the cage (2A) should be implanted on an axis of implantation that is oblique in relation to the antero–posterior axis of the vertebral column (the sagittal axis) meaning the axis in which a lordosis may have to be imposed. As shown in figure 3B, the axis of insertion of the anchoring device (1) is orientated along axis 3C–3C, representing the section plane of figure 3C and the cage (2A) is implanted on this axis, but because of the possible dimensions of the access to the intervertebral space, the antero–posterior axis of the vertebrae may be orientated along axis 3D–3D in relation to the cage, which may thus be implanted obliquely. As may be seen particularly in figure 3A, and by comparison with figures 3C and 3D, cage (2A) may allow the imposition of a lordosis by means of an angle (A1, figure 3A) of inclination between its top and bottom surfaces, but the axis of inclination of the mean planes (28) passing along its top and bottom surfaces is orientated along axis 3D–3D and not along axis 3C–3C. The cage therefore imposes a larger lordosis along axis 3D–3D than along axis 3C–3C in order that it may be implanted along oblique axis 3C–3C in relation to axis 3D–3D corresponding to the antero–posterior axis of the vertebrae (the sagittal axis). Thus, a cage according to this particular embodiment may be implanted obliquely and allow the imposition of a lordosis that is aligned correctly with respect to the vertebral column.

In other embodiments, the peripheral wall (25) may include at least two slots (20) located alongside each other, with each of these defining one possible axis of insertion of the anchoring device (1) in the cage (2A, 2B) and, indirectly, one possible axis of insertion of the cage (2A, 2B) between the vertebrae. For example, as may be seen particularly in figure 4A and 4B, the cage (2A) includes 2 superimposed slots (20) each of which is orientated toward one of the top and bottom surfaces of the cage on a first axis (4C–4C, figure 4B) located alongside 2 superimposed slots (20) each of which is orientated toward one of the top and bottom surfaces of the cage on a second axis (4D–4D, figure 4B). In this implementation variant, the cage (2A) may be implanted along axis 4C–4C or along axis 4D–4D but the inclination of the mean planes passing along the top and bottom surfaces of the cage is orientated along axis 4C–4C, as may be seen by comparison with figures 4C and 4D. This type of cage may therefore be implanted obliquely (along axis 4D–4D) or frontally (along axis 4C–4C). In a relatively similar manner, the plates (51, 52) of the prostheses represented in figures 11A to 11D include several slots (20) each. In the examples shown, these slots are located on the edges of the plates, but either centred in relation to the antero–posterior axis of the prosthesis, or moved off–centre. These slots then define two possible axes of insertion of the osseous anchoring device (1), namely either on the antero–posterior axis, or on an oblique axis. In addition, the attachment resources (24) of the prosthesis (2C) are located close to each of these slots, so as to allow gripping of the prosthesis during the impacting of the device (1) in the vertebrae. Thus, these attachment resources (24) also define two possible axes of insertion of the prosthesis (2C) between the vertebrae by the instrument, namely either an antero–posterior axis, or an oblique axis. After appreciating this disclosure, those of skill in the art will appreciate that the invention allows many variants regarding the position and the shape of these attachment resources (24) and of the slots (20). It will be noted in passing that in figures 11A and 11B, for example, the devices (1) of the two anchoring plates do not have the same orientation as each other, which may be explained by a different orientation of their slot (20). Naturally, these figures are simply illustrative, and in no way limiting, since it is possible to envisage any type of combination of orientations and of shapes and of position slots (20) on the plates after appreciating this disclosure.

In other embodiments, the intersomatic cage may be of the transforaminal type, meaning implanted through the foramen. This type of cage, which is described, for example, in patent application FR 2 897 259 (or U.S. Patent App. Ser. No. 11,378,165 or WO2007/093900) each submitted by the present applicant and which may be incorporated herein by reference, is particularly advantageous because it is relatively small and may therefore be implanted by the transforaminal route. This type of intersomatic cage for an intervertebral fusion graft may comprise a body generally defining an arc (in particular a circular arc), the body comprising a lateral concave surface; a lateral convex surface; a substantially transverse upper surface; a substantially transverse lower surface; an end wall at a first longitudinal extremity of the body and an incurvate return part at a second longitudinal extremity of the body opposite the end wall. The end wall comprises an end hole configured to receive a retaining end of a rod of an implantation instrument and oriented substantially tangential to the arc defined by the body; In various embodiments of this present invention, the cage (2B) is in the shape of a circular arc, as may be seen particularly in figures 8A and 8B, and includes at least one slot (20) of shape, dimension and orientation to suit the insertion of a curved anchoring device (1) according to the different embodiments of this present invention. As may be seen particularly in figure 8A, the wall (25) of the cage may form a cavity (23), internal or not, as for the cages (2A) described previously. In addition, as may be seen particularly in figure 8A, the wall (25) may include at least one lateral opening (26) that allows the growth of the graft through the cage (2B). Although these lateral openings have not been represented in the other figures with reference to the cages (2A) described previously, after appreciating this disclosure those of skill in the art will recognize that these too may also include such openings (26), where appropriate. This type of cage (2B) has an arcuate peripheral wall (25), for example describing a circular arc. The radius of curvature of the cage (2B) and the dimensions of the latter may naturally vary according to the embodiments, and according to the vertebrae between which they must be implanted. The wall (25) in an arc of the cage (2B) is extended, at one of its ends, by a return part extending in the direction of the inside of the curve described by the wall (25). In certain embodiments, as may be seen particularly in figures 8B and 8C, this return part may include a chamfer (250) to facilitate its implantation between the vertebrae. Like for the first implementation variants of intersomatic cages (2A), these transforaminal implementation variants of the intersomatic cages (2B) may be equipped with notches (22) on at least one part of at least one of their bottom or top surfaces. Whatever the type of cage (2A, 2B), these notches (22) may have different orientations and present a pattern that is linear or circular, or any other type of pattern, and the lines or circles described by the notches may either cross each other or not. For example, as may be seen particularly in figures 8B and 8C, the notches (22) may describe a pattern of chevrons or of circular arcs. The different embodiments of the anchoring device (1) described previously with reference to the previous embodiments of intersomatic cages (2A) may naturally be adapted to these transforaminal implementation variants of the cage (2B) and vice versa. Likewise, the different embodiments concerning the slots (20) may be adapted to this type of transforaminal cage (2B) and vice versa, on condition that the dimensions allow it or are adapted to allow it.

In some embodiments, the intersomatic cages (2A, 2B) or the intervertebral prostheses (2C) will be implanted by means of a special instrument (3, 4) that is used to implant them between the vertebrae and that may be used to implant the anchoring devices (1) in the vertebral plates. In these embodiments, the peripheral wall (25) of the cages (2A, 2B) or at least one of the plates (51, 52) may include at least one attachment resource (24) that mates with a gripper end of an instrument (3, 4) for implantation of the cage (2A, 2B) or of the prosthesis (2C). As mentioned previously, this attachment resource (24) may include at least one recess (24) that receives the end of a gripping resource (321). As may be seen particularly in figure 3A, the cage may include two recesses (24) each located on one side of the slot, to facilitate gripping of the cage, but the recesses of course may be located in other places, preferably for these recesses to facilitate the gripping of the cage (2A, 2B) or of the prosthesis (2C) by a complementary instrument. As may be seen particularly in figure 4A, a slot (20) in the cage may be associated with a single recess (24) but it is possible to provide several recesses (24) around the slots (20), even when the cage (2A, 2B) includes several slots (20) as in this implementation example. These different variants concerning the number and the position of the attachment resources (24) and of the slot (20) described here naturally apply equally well to the cages (2A, 2B) and to the prostheses (2C).

Various embodiments of the present invention therefore also concern an instrument (3, 4) for the implantation of an intersomatic cage (2A, 2B) or of an intervertebral disc prosthesis (2C) between the vertebrae and for the implantation of an anchoring device (1) in at least one of these vertebrae. The instrument may include an impactor (4) that includes a head (40) whose shape and dimensions are designed to push on the anchoring device (1). The instrument may also include a guide (3) of elongated shape on a longitudinal axis extending between a first end, called the gripping end of the cage or of the prosthesis, and a second end, called the push end. The gripping end includes at least one gripping resource (321) that mates with at least one means (24) of attaching the cage (2A, 2B) or the prosthesis (2C). Depending on the embodiments, the push end may include a handle (33) that is used to push the guide holding the cage (2A, 2B) or the prosthesis (2C) in order to insert the latter into the intervertebral space. This handle may also consist of a stop element on which the surgeon may tap, by means of a tool of known type for example, in order to introduce the cage or the prosthesis between the vertebrae. After appreciating this disclosure those of skill in the art will recognize that the different elements of the instrument (3, 4) described here may be present whatever the embodiment of the cage (2A, 2B) or of the prosthesis (2C), unless it is expressly specified in this present description that a particular element concerns only one type of cage described previously or a single type of prosthesis.

The guide (3) of the instrument may include a head (30) whose shape and dimensions are designed to at least partially accommodate the head (40) of the impactor, and includes at least one guidance surface (31) having a radius of curvature that is substantially the same as the radius of curvature of the anchoring device (1). This curved surface (31) may guide this anchoring device (1) through the slot (20) of an intersomatic cage (2A, 2B) or of an intervertebral prosthesis (2C), for the impacting of the anchoring device (1) into a vertebral plate of one of the vertebrae between which the cage (2A, 2B) or the prosthesis (2C) is implanted.

The guide (3) may include an elongated body (32) that allows an approach to the intervertebral space without needing a lot of space. The impactor (4) also may include an elongated body (42), which slides in relation to the body (32) of the guide (3). In certain embodiments, the impactor (4) includes a handle (41) which is used to cause the body (42) of the impactor to slide in relation to the guide (3). This handle may also play the role of a stop element on which the surgeon may tap, by means of a tool of known type for example, in order to cause the anchoring device (1) to penetrate into a vertebral plate. In addition, in certain embodiments, the impactor (4) may include at least one stop element (43) which limits the penetration of the head (40) of the impactor (4) within the head (30) of the guide (3). In certain variants, the position of this stop element may be adjustable along the body (42) of the impactor (4), for use in adjusting the penetration of the impactor to the size of the head (30) of the guide (3) and to the size of the anchoring device (1) employed. For example, as mentioned previously, the anchoring device (1) may have a length that is variable to suit the circumstances and the head (30) of the guide, and in particular the curved guidance surface (31) will also be of a size designed for this length of the anchoring device (1).

Depending on the embodiments, the body (32) of the guide (3) may have two rods or tubes (32), as shown in figure 6B, but the guide (3) may have a single rod or a single tube, even if the guide includes several gripping resources (321), preferably allowing these resources (321) to secure the cage or the prosthesis. As may be seen particularly in figure 6D, in certain embodiments, the gripping resources (321) may consist of rods (321) fitted freely within the tubes (32) constituting the body of the guide (3). In some embodiments, these rods may not be within the body (32). In different embodiments, the gripping resource (321) may comprise one end of a rod which slides in a body (32) of the guide (3) when it is operated by a handle (33) so as to enter and leave the recess (24) of the cage (2A). In these implementation variants, these gripping resources (321) may include threads at their ends so as to be screwed within the recess (24) of the cage (2A, 2B), which may include a tapping. In certain implementation variants, the rod (321) may therefore include a threaded end fitting into a tapping in the recess (24) in order to secure the cage (2A) when the rod is operated by the handle (33). In other variants, the rod may have dimensions that are adjusted to penetrate exactly into the recess, and allow the retention of the cage by this exact adjustment. These different variants of the rod (321) and of the recess (24) naturally may also be applied to prostheses (2C). For example, the prostheses represented in figures 11A to 11D include plates (51, 52) that include recesses (24) to accommodate these gripping resources (321). In the examples of implementation represented, the gripping resources (321) may be located close to the top and bottom surfaces of the head (30) of the guide (3) so that these resources (321) allow the correct gripping of two plates (51, 52) of the prosthesis (2C). Various embodiments of the invention allow other methods of implementation of the attachment resources (24) and of the gripping resources (321), for example as mentioned previously. In addition, in the implementation example of the prosthesis (2C) of figures 11C and 11D that includes two plates (51, 52) and a core (53), the attachment resources (24) may also include attachment resources located on the core, so that the latter is also retained by the instrument. For example, the surface of the head (30) of the guide facing the prosthesis (2C) may have a shape that is complementary to the two plates and to the core assembly, so as to hug the shape of the prosthesis and keep the elements of the prosthesis stable.

In the embodiments represented in figures 6 (A to E) and 7 (A to D), the body (32) includes a guidance plate (34) that is used to guide the impactor (4). In these embodiments, the plate (34) includes a groove that guides the impactor on the axis of the body (32) of the guide. In other possible embodiments, as represented in figure 9A, for example, the body (42) of the impactor (4) may be mounted to slide within the body (32) of the guide, but the invention naturally allows other implementation variants, preferably allowing the impactor (4) to be guided in relation to the head (30) and to slide in relation to the guide (3).

As may be seen particularly in figure 5A, the head (30) of the guide (3) includes a cavity (300) whose shape and dimensions are designed to receive the anchoring device (1) and, at least partially, the head (40) of the impactor (4). Various embodiments of the invention naturally allow different embodiments of the head (30) and the examples given here are only by way of illustration. The head (30) of the guide may include at least one passage (320) through which the gripping resource (321) of the cage or of the prosthesis will be inserted in order to hold the cage or the prosthesis at the end of the guide (3). In the embodiment represented in figures 5A and 5B, this head includes two identical passages on either side of the cavity (300), since this embodiment of the head (30) is designed to be mounted on a guide (3) that has two gripping resources (321). After appreciating this disclosure those of skill in the art will recognize that the invention will allow the use of only one gripping resource (321) or, on the other hand, an increase in their number by reducing their size and by distributing them differently around the cavity, for example, with the provision of complementary recesses on the cages to be implanted. In addition, a given instrument (3, 4) may serve for the implantation of different types of cages (2A, 2B) or prostheses (2C), preferably with the gripping resources (321) of the guide (3) and the attachment resources (24) of the cages (2A, 2B) or of the prostheses (2C) being designed to be complementary. For example, the instrument that includes a head (30) as represented in figure 5E, may serve for the implantation of the cage (2A) of figure 4A, even though one of the gripping resources (321) of the guide (3) will not be used in this case. Inside the cavity (300) of the head (30) of the guide (3) there may be at least one curved guidance surface (31) of the anchoring device (1). In the embodiments illustrated here by way of example, this guidance surface (31) may include at least two curved grooves (31) each located on either side of this cavity (300) to guide the anchoring device (1) on both sides of its body (10). The head (40) of the impactor (4) is then designed to penetrate into the cavity (300) from one end to the other of these grooves (31), so as to push the anchoring device (1) from one end to the other of these grooves (31). In the embodiment represented in figure 5 (A to E), the cavity (300) of the head (30) may receive two guidance elements (310) (particularly visible in figures 5C and 5D), with each including the guidance grooves (31) and each located on one side of the cavity (300), as may be seen particularly in figure 5E. In this implementation example, the guidance elements (310) are assembled with the head (30) by inserting it into the cavity (300) which may include securing resources that are used to immobilise these guidance elements (310). In other examples of implementation such as, for example, the head (30) of the guide (3) represented in figures 8C and 9 (A to C), the head (30) will be made with of the guidance grooves (31) directly on the inside of the cavity (300). In this case, the head may be made in two assembled parts in order to facilitate the machining of the curved grooves (31).

In certain embodiments, as shown in figures 3A, 4A and 5A, the recess (24) of the cages (2A) may be created close to the slot (20), and the passage (320) for the gripping resources (321) may be close to the cavity (300) so as to allow correct gripping of the cage close to the site at which the anchoring device (1) is likely to apply pressure on the cage under the action of the impactor (4). The resource (24) for attachment of the prostheses (2C) may naturally be made in the same way.

As may be seen particularly in figures 6C and 9B, the gripping resource (321) may protrude beyond the head (30) of the guide (3) at the position of the gripping end. As may be seen particularly in figures 7A and 7B or in figures 9A and 9C, the guide may allows the gripping of the cage (2A, 2B) with one end of the guidance surface (31) ending in the slot (20) in the cage (2A, 2B) thus held, and the other end of the guidance surface (31) remaining accessible for the insertion of the anchoring device (1). In these embodiments, the anchoring device (1) may be inserted in the head (30) after the cage (2A, 2B) has been mounted on the gripping resources (321), but other embodiments, which may be less advantageous but less costly to implement, may require insertion of the anchoring device (1) prior to the mounting of the cage (2A, 2B). These variants also may apply to the prostheses (2C) which may be designed in the same way and may therefore be implanted with the same instrument as that described for these cages (2A, 2B).

In the case of the transforaminal cages (2B), the instrument may allow the cage to be held over virtually the whole of its length, which may facilitate the insertion of the cage (2B) into the intervertebral space and protect it from damage. In this embodiment of the cage (2B), the gripping resource (321) may be the end of a curved rod, such as a spatula, which may have a radius of curvature substantially identical to a radius of curvature of the cage (2B) having a peripheral wall (25) describing an arc. In this embodiment, the recess (24) may be located on the return part extending one end of the circular arc described by the wall (25) of the cage (2B) in the direction of the centre of the circle of which the circular arc described by the wall (25) forms part. The spatula may hug the shape of the cage (2B) between this return part and the other end of the circular arc described by the wall (25) of the cage (2B). At this other end of the wall (25), the cage (2B) advantageously may include a second gripping resource to hold the cage (2B). In certain embodiments of the transforaminal cage, this second gripping resource may be located at the base of the spatula, but on the side opposite to that carrying the spatula. This second gripping resource may include a second recess (241) to accommodate a latch (341) mounted on a rod (340) of the guide (3). As explained previously for the body (32) of the guide and the body (42) of the impactor or the gripping resources (321), this rod (340) may be mounted freely within the body (32) of the guide or on the outside, preferably so that it is guided in relation to the head (30). This rod (340) may be operated by a handle and may pivot between at least one position at which the latch (341) engages the second recess (241), and a position at which the latch (341) exits from the second recess (241) and thus frees the cage (2B).

In certain embodiments of the implantation instrument (3, 4), particularly suitable for the transforaminal cages whose insertion must be accomplished along an arc or an oblique axis in relation to the antero–posterior axis of the vertebrae, the head (30) of the guide (3) may be curved or bent substantially along the radius of curvature of the arc described by the cage (2B). Thus, the bent instrument allows easier passage through the foramens, although it may be used in another context. In this bent embodiment of the head (30) of the guide (3), the head (40) of the impactor (4) may have a shape that is more or less curved or bent so that it has a radius of curvature compatible with its passage in the head (30) of the guide (3). In addition, in a particularly advantageous variant, this head (40) of the impactor (4) may be mounted on an axis (425) of rotation mounted on the body (42) of the impactor. This axis (425) allows the head (40) of the impactor to pivot in order to pass the curvature or the bend in the head (30) of the guide (3), as may be seen particularly in figure 9B. In another implementation variant, the impactor (4) may be straight and designed to be inserted in the head (30) on an oblique axis, substantially parallel to axis 9C–9C of figure 9B for example, with the head (30) then having an opening of sufficient size to allow the introduction of the head (40) of the impactor (4).

The present invention allows several combinations between the embodiments described herein. In particular, the present invention also concerns, among other aspects, a system for the implantation of a spinal implant between two adjacent vertebrae. In some embodiments, such a system comprises at least one spinal implant (2A, 2B, 2C) and at least one anchoring device (1) for anchoring the implant in at least one vertebra. In particular, the spinal implant (2A, 2B, 2C) includes an intersomatic cage (2A, 2B) according to an embodiment of the invention or an intervertebral disc prosthesis (2C) according to an embodiment of the invention and the anchoring device (1) includes an anchoring device (1) according to an embodiment of the invention. In some embodiments, such system also comprises an instrument (3, 4) according to an embodiment of the invention.

The present invention also concerns, among other aspects, a method of inserting a spinal implant. In some embodiments, this method comprises the following steps:

- providing an anchoring device (1) in accordance with an embodiment of the invention;
- providing a spinal implant (2A, 2B, 2C), such as an intersomatic cage (2A, 2B) in accordance with an embodiment of the invention or an intervertebral disc prosthesis in accordance with an embodiment of the invention;
- providing an implantation instrument (3, 4) in accordance with an embodiment of the invention;
- gripping the spinal implant (2A, 2B, 2C) with the gripping device of the implantation instrument (3, 4);
- inserting the spinal implant (2A, 2B, 2C) in an intervertebral space between adjacent vertebrae of a spinal column;
- using the impactor of the implantation instrument, inserting the anchoring device (1) through the guide head of the implantation instrument (3, 4) and through the orifice (20) in the implant, with the anchoring device (1) traversing at least a portion of the implant (2A, 2B, 2C); and
- using the impactor of the implantation instrument, implanting the penetration end of the anchoring device (1) in one of the adjacent vertebrae.

In some embodiments, this method may also comprise the step of presenting the anchoring device (1) with the longitudinal axis of the anchoring device along an approach axis that is substantially along a plane of the intervertebral space. In some variants, depending on the location of the orifice (20) in the spinal implant, the method may comprise a step of orienting the anchoring device along an approach axis which is oblique in relation to the plane of the intervertebral space. In some embodiments, a curved anchoring device according to the invention can be used so as to avoid the surgeon to clear too much space around the intervertebral space. For example, some intersomatic cages or intervertebral disc prostheses are known to include a wall or flange extending outside the intervertebral space, placed against a peripheral surface of at least one of the adjacent vertebrae. The prosthesis or the cage lies substantially in the plane of the intervertebral space and may comprise such a wall or flange extending substantially parallel to the axis of the spine (thus orthogonal to the plane of the space). Such wall or flange normally requires that the surgeon clear a vertebral surface surrounding the intervertebral space so as to implant the anchoring device orthogonally to the spine, and additionally to clear an access to this surface of the vertebra for use of a tool for anchoring the anchoring device. The anchoring device, because of its curvature, can be used with an oblique axis of approach and can be impacted in the vertebrae through an orifice (20) arranged in the wall of the cage or of the prosthesis, such orifice being adapted to the anchoring device (1) as described previously, but with an orientation adapted to the oblique axis of approach of the anchoring device. Thus, the surgeon only has to clear the vertebral surface on which the wall or flange is intended to be abutted and does not have to clear more tissue for the passage of a tool because the anchoring device will be implanted along an oblique axis. This use of the anchoring device reduces the invasiveness of the implantation, because the surgeon does not need, for the insertion of the anchoring device, to clear more space around the intervertebral space than necessary for the implantation of the implant itself.

After appreciating this disclosure those of skill in the art will recognize that this present invention allows embodiments in many other specific forms without moving outside the scope of the invention. As a consequence, these present embodiments must be considered to be illustrations only, but of the attached claims, and the invention should not be limited to the details may be modified within the area defined by the scope given above.

CLAIMS

1. An anchoring device (1) for anchoring a spinal implant (2A, 2B, 2C) in at least one vertebra, comprising a body (10) of elongated shape on a longitudinal axis extending between a penetration end and an abutment end, characterised in that the body (10) has a curved shape describing, along the longitudinal axis, an arc whose dimensions and radius of curvature are designed in such a manner that the anchoring device (1) is implantable in a surface of a vertebra by being inserted, without deformation, through at least one orifice (20) located on the spinal implant and traversing at least one portion of the implant, the shape, dimensions and orientation of the orifice (20) being arranged to allow the passage of the anchoring device (1) without deformation despite its curvature, so that the anchoring device (1) penetrates into at least one vertebral surface and secures the spinal implant on this vertebral surface.

2. An anchoring device (1) according to claim 1, characterised in that the circular arc described by the body (10) has dimensions and a radius of curvature that are designed in such a manner that the anchoring device (1) is implantable in a vertebral plate on an approach axis forming an angle of approximately 90° with the vertical axis of the vertebral column.

3. An anchoring device (1) according to one of claims 1 and 2, characterised in that the curved and elongated body (10) includes at least one curved plate.

4. An anchoring device (1) according to one of claims 1 to 3, characterised in that the penetration end includes a chamfer (13) or a bevel to facilitate the penetration of the device (1) into the vertebrae.

5. An anchoring device (1) according to one of claims 1 to 4, characterised in that the body (10) is equipped with notches (12) that are orientated so as to oppose the withdrawal of the device (1) after it has been implanted in a vertebra.

6. An anchoring device (1) according to one of claims 1 to 5, characterised in that the abutment end of the body (10) includes at least one stop element (11) that is intended to mate with at least one surface of the cage (2A, 2B) or of the prosthesis (2C) which the device (1) is intended to secure.

7. An anchoring device (1) according to claim 6, characterised in that the stop element (11) includes a projecting lug on at least one face of the anchoring device (1).

8. An anchoring device (1) according to claim 6, characterised in that the stop element (11) includes two projecting lugs on the sides of the body (10).

9. An anchoring device (1) according to one of claims 1 to 8, characterised in that the body (10) includes, on at least one of its sides, a flexible lug (14) orientated toward the abutment end and forming a stop element to oppose the withdrawal of the anchoring device (1).

10. An intersomatic cage (2A, 2B) that includes a wall (25) forming a cavity (23) intended to receive a graft of bony tissue or a substitute, characterised in that the peripheral wall (25) includes at least one orifice (20) traversing at least a portion of the cage (2A, 2B), the shape, dimensions and orientation of the orifice (20) being adapted to the dimensions and radius of curvature of an anchoring device (1) according to one of the preceding claims, so as to allow the passage of this anchoring device (1), without deformation despite its curvature, through this orifice (20), so as to orientate the anchoring device (1) in the direction of a vertebral surface of one of the vertebrae between which the cage (2A, 2B) is intended to be implanted, the dimensions and radius of curvature of the anchoring device (1) being designed in such a manner that the anchoring device (1) is implantable in the surface of the vertebra by being inserted through the orifice (20).

11. An intersomatic cage (2A, 2B) according to claim 10, characterised in that, at the peripheral surface of the wall (25), the orifice (20)

includes at least one stop element surface (21) intended to mate with at least one stop element (11) of the anchoring device (1).

12. An intersomatic cage (2A, 2B) according to claim 11, characterised in that the stop element surface (21) includes two recesses (21) located on either side of the orifice (20) and intended to accommodate two projecting lugs on the sides of the body (10) of the anchoring device (1).

13. An intersomatic cage (2A, 2B) according to claim 11, characterised in that the stop element surface (21) includes a peripheral surface of the wall (25) intended to accommodate a projecting lug on at least one face of the body (10) of the anchoring device (1).

14. An intersomatic cage (2A, 2B) according to one of claims 10 to 13, characterised in that, at the bottom or top surface of the wall (25), the orifice (20) includes at least one stop element surface (21) intended to mate with at least one flexible lug (14) of the anchoring device (1), orientated toward its the abutment end, where this stop opposes the withdrawal of the anchoring device (1) from the orifice (20).

15. An intersomatic cage (2A, 2B) according to one of claims 10 to 14, characterised in that the peripheral wall (25) includes at least one attachment resource (24) intended to mate with a gripper end of an instrument (3, 4) for implantation of the cage (2A, 2B).

16. An intersomatic cage (2A, 2B) according to one of claims 10 to 15, characterised in that at least one of the top and bottom surfaces of the wall (25) includes notches (22) that prevent movement of the cage (2A, 2B) between the vertebrae between which it is intended to be implanted.

17. An intersomatic cage (2A, 2B) according to one of claims 10 to 16, characterised in that the mean planes passing through the top and bottom surfaces of the cage (2A, 2B) form an angle (A1) that imposes a lordosis on the vertebrae between which the cage (2A, 2B) is intended to be implanted.

18. An intersomatic cage (2A, 2B) according to one of claims 10 to 16, characterised in that the mean planes passing through the top and bottom surfaces of the cage (2A, 2B) are more or less parallel to each other.

19. An intersomatic cage (2A, 2B) according to one of claims 10 to 18, characterised in that the peripheral wall (25) includes two orifices (20) each of which is orientated toward one of the top and bottom surfaces, so as to allow anchoring of the anchoring device (1) in each of the vertebrae between which the cage (2A, 2B) is intended to be implanted.

20. An intersomatic cage (2A, 2B) according to one of claims 10 to 19, characterised in that the peripheral wall (25) includes at least two orifices (20) located alongside each other, with each of these defining one possible axis of insertion of the anchoring device (1) in the cage (2A, 2B) and, indirectly, one possible axis of insertion of the cage (2A, 2B) between the vertebrae.

21. An intersomatic cage (2A, 2B) according to one of claims 10 to 20, characterised in that the peripheral wall (25) includes at least one chamfer (250) on at least one peripheral portion of at least one of its top and bottom surfaces, so as to facilitate the insertion of the cage (2A, 2B) between the vertebrae.

22. An intervertebral disc prosthesis (2C) which include at least a first plate (51) and a second plate (52) that are hinged to each by means of at least one curved surface, characterised in that at least one of the plates (51, 52) includes at least one orifice (20) traversing at least a portion of said plate (51, 52), the shape, dimensions and orientation of the orifice (20) being adapted to the dimensions and radius of curvature of an anchoring device (1) according to one of claims 1 to 9, so as to allow the passage of this anchoring device (1), without deformation despite its curvature, through this orifice (20), so as to orientate the anchoring device (1) in the direction of a vertebral surface of one of the vertebrae between which the prosthesis (2C) is intended to be implanted, the dimensions and radius of curvature of the

anchoring device (1) being designed in such a manner that the anchoring device (1) is implantable in the surface of the vertebra by being inserted through the orifice (20).

23. An intervertebral disc prosthesis (2C) according to claim 22, characterised in that the orifice (20) includes, at a peripheral surface of the plate (51, 52), at least one stop element surface (21) intended to mate with at least one stop element (11) of the anchoring device (1).

24. An intervertebral disc prosthesis (2C) according to claim 23, characterised in that the stop element surface (21) includes two recesses (21) located on either side of the orifice (20) and intended to accommodate two projecting lugs on the sides of the body (10) of the anchoring device (1).

25. An intervertebral disc prosthesis (2C) according to claim 23, characterised in that the stop element surface (21) includes a peripheral surface of the plate (51, 52) that is intended to accommodate a projecting lug on at least one face of the body (10) of the anchoring device (1).

26. An intervertebral disc prosthesis (2C) according to one of claims 22 to 25, characterised in that, at the bottom or top surface of the plate (51, 52), the orifice (20) includes at least one stop element surface (21) intended to mate with at least one flexible lug (14) of the anchoring device (1), orientated toward its the abutment end, where this arrangement opposes the withdrawal of the anchoring device (1) from the orifice (20).

27. An intervertebral disc prosthesis (2C) according to one of claims 22 to 26, characterised in that at least one of the plates (51, 52) includes at least one attachment resource (24) intended to mate with a gripper end of instrument (3, 4) for the implantation of the prosthesis (2C).

28. An intervertebral disc prosthesis (2C) according to one of claims 22 to 27, characterised in that at least one of the top and bottom surfaces of at least one of the plates (51, 52) includes notches (22) that prevent movement of the prosthesis (2C) between the vertebrae between which it is intended to be implanted.

29. An intervertebral disc prosthesis (2C) according to one of claims 22 to 28, characterised in that the mean planes passing through the top and bottom surfaces of at least one of the plates (51, 52) of the prosthesis (2C) form an angle (A1) that imposes a lordosis on the vertebrae between which the prosthesis (2C) is intended to be implanted.

30. An intervertebral disc prosthesis (2C) according to one of claims 22 to 29, characterised in that the mean planes passing through the top and bottom surfaces of at least one of the plates (51, 52) of the prosthesis (2C) are more or less parallel to each other.

31. An intervertebral disc prosthesis (2C) according to one of claims 22 to 30, characterised in that each of the plates (51, 52) includes a orifice (20), each of which is orientated toward one of the top and bottom surfaces, so as to allow the securing of each of the plates (51, 52) by the anchoring of an anchoring device (1) in each of the vertebrae between which the prosthesis (2C) is intended to be implanted.

32. An intervertebral disc prosthesis (2C) according to one of claims 22 to 31, characterised in that it includes a mobile core (53) with a surface which is more or less plane, fitting onto a surface that is more or less plane of one of the plates (51, 52) and a curved surface that is complementary to the curved surface of the other plate (52, 51).

33. An intervertebral disc prosthesis (2C) according to claim 32, characterised in that the core (53) includes mating resources (530) that are complementary to resources (531) on at least one of the plates (51, 52) so as to limit the movement of the core (53) in rotation and/or in linear movement in relation to this plate.

34. An instrument (3, 4) for the implantation of a spinal implant (2A, 2B, 2C) between two adjacent vertebrae, and for the implantation of an anchoring device (1) in at least one of these vertebrae, where this instrument firstly includes at least one impactor (4) with a head (40) whose shape and dimensions are designed to push the anchoring device (1) and secondly at

least one guide (3) of elongated shape on a longitudinal axis extending between a first end, called the gripping end, of the cage or of the prosthesis, and a second end, called the push end, where the gripping end includes at least one gripping resource (321) intended to mate with a resource (24) for attachment of the spinal implant (2A, 2B, 2C), characterised in that the guide (3) includes a head (30) whose shape and dimensions are designed to at least partially accommodate the head (40) of the impactor and which includes at least one guidance surface (31) having a radius of curvature that is substantially identical to the radius of curvature of an anchoring device (1) according to one of claims 1 to 9, so as to guide this anchoring device (1) through a orifice (20) of a spinal implant (2A, 2B, 2C) including an intersomatic cage (2A, 2B) according to the one of claims 10 to 21 or an intervertebral disc prosthesis (2C) according to the one of claims 22 to 33, for impacting the anchoring device (1) into a vertebral surface of one of the vertebrae between which the spinal implant (2A, 2B, 2C) is intended to be implanted.

35. An instrument (3, 4) according to claim 34, characterised in that the head (30) of the guide (3) includes a cavity (300) whose shape and dimensions are designed to receive the anchoring device (1) and, at least partially, the head (40) of the impactor (4), where the guidance surface (31) includes at least two curved grooves (31) each located on either side of this cavity (300) so as to guide the anchoring device (1) on the two sides of its body (10), with the head (40) of the impactor (4) penetrating into the cavity (300) from one end to the other of these grooves (31).

36. An instrument (3, 4) according to one of claims 34 and 35, characterised in that the impactor (4) includes a rod (42) which slides in relation to the guide (3) when it is operated by means of the handle (41).

37. An instrument (3, 4) according to one of claims 34 to 36, characterised in that the impactor (4) includes at least one stop element (43) which limits the penetration of the head (40) of the impactor (4) within the head (30) of the guide (3).

38. An instrument (3, 4) according to one of claims 34 to 37, characterised in that the gripping resource (321) protrudes beyond the head (30) of the guide (3) at the gripping end, so as to allow the gripping of the cage (2A, 2B) or of the prosthesis (2C) with one end of the guidance surface (31) opening onto the orifice (20) in the cage (2A, 2B) or of the prosthesis (2C) thus held, and the other end of the guidance surface (31) remaining accessible for the insertion of the anchoring device (1).

39. An instrument (3, 4) according to one of claims 34 to 38, characterised in that the attachment resource (24) is a recess and the gripping resource (321) is one end of a rod which slides in a body (32) of the guide (3) when it is operated by a handle (33) in order to enter and leave the recess (24) of the cage (2A) or of the prosthesis (2C).

40. An instrument (3, 4) according to one of claims 34 to 39, characterised in that the rod (321) includes a threaded end fitting onto a tapping in the recess (24) so as to secure the cage (2A) or the prosthesis (2C) when the rod is operated by the handle (33).

41. An instrument (3, 4) according to one of claims 34 to 38, characterised in that the attachment resource (24) is a recess and the gripping resource (321) is the end of a curved rod, called a spatula, whose radius of curvature is more or less identical to a radius of curvature of the cage (2B) whose peripheral wall (25) describes a circular arc, with the recess (24) being located on a return part extending one end of the circular arc described by the wall (25) of the cage (2B) in the direction of the centre of the circle of which the circular arc described by the wall (25) forms part and the spatula fitting closely onto the shape of the cage (2B) between this return part and the other end of the circular arc described by the wall (25) of the cage (2B) at which point a second gripping resource is located.

42. An instrument (3, 4) according to claim 41, characterised in that the second gripping resource is located at the base of the spatula, but on the side opposite to that carrying the spatula, and includes a second recess

(241) intended to accommodate a latch (341) mounted on a rod (340) of the guide (3), where this rod (340) pivots when it is operated by a handle, between at least one position at which the latch (341) fits into the second recess (241) and a position at which the latch (341) exits from the second recess (241) and thus frees the cage (2B).

43. An instrument (3, 4) according to one of claims 41 and 42, characterised in that the head (30) of the guide (3) is curved or bent more or less along the radius of curvature of the circular arc described by the cage (2B).

44. An instrument (3, 4) according to claim 43, characterised in that the head (40) of the impactor (4) has a shape that is more or less curved or bent so as to confer upon it a radius of curvature that is compatible with its passage in the head (30) of the guide (3), where this head (40) of the impactor is mounted on an axis (425) of rotation that allows it to pivot in order to pass the curvature or the bend in the head (30) of the guide (3).

45. A system for the implantation of a spinal implant between two adjacent vertebrae, comprising at least one spinal implant (2A, 2B, 2C) and at least one anchoring device (1) for anchoring the implant in at least one vertebra, characterized in that :

- the spinal implant (2A, 2B, 2C) includes an intersomatic cage (2A, 2B) according to one of claims 10 to 21 or an intervertebral disc prosthesis (2C) according to one of claims 22 to 33; and
- the anchoring device (1) includes an anchoring device (1) according to one of claims 1 to 9.

46. A system according to claim 45, characterized in that it comprises an instrument (3, 4) according to one of claims 34 to 44.

47. A method of inserting a spinal implant comprising:

- providing an anchoring device (1) in accordance with one of claims 1 to 9;
- providing a spinal implant (2A, 2B, 2C) including an intersomatic cage (2A, 2B) in accordance with one of claims 10 to 21 or including an intervertebral disc prosthesis in accordance with one of claims 22 to 33;

- providing an implantation instrument (3, 4) in accordance with one of claims 34 to 44;
- gripping the spinal implant (2A, 2B, 2C) with the gripping device of the implantation instrument (3, 4);
- inserting the spinal implant (2A, 2B, 2C) in an intervertebral space between adjacent vertebrae of a spinal column;
- presenting the anchoring device (1) with the longitudinal axis of the anchoring device along an approach axis that is substantially along a plane of the intervertebral space;
- using the impactor of the implantation instrument, inserting the anchoring device (1) through the guide head of the implantation instrument (3, 4) and through the orifice (20) in the implant, with the anchoring device (1) traversing at least a portion of the implant (2A, 2B, 2C); and
- using the impactor of the implantation instrument, implanting the penetration end of the anchoring device (1) in one of the adjacent vertebrae.

FIGURE 1A

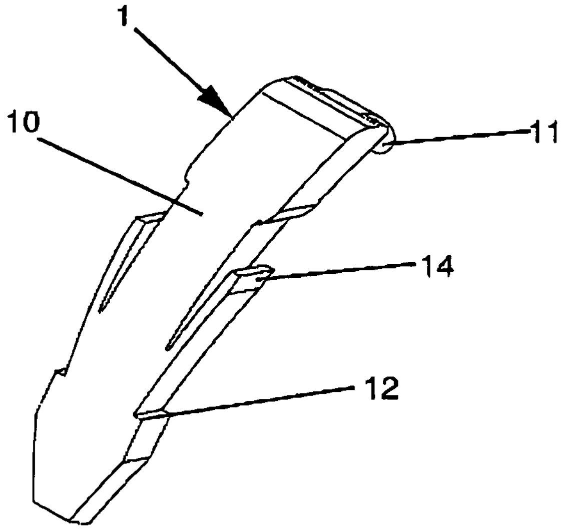

FIGURE 1B

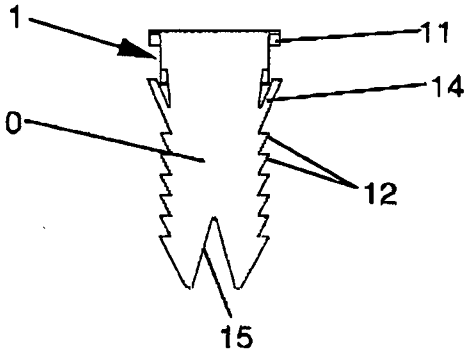

FIGURE 1C

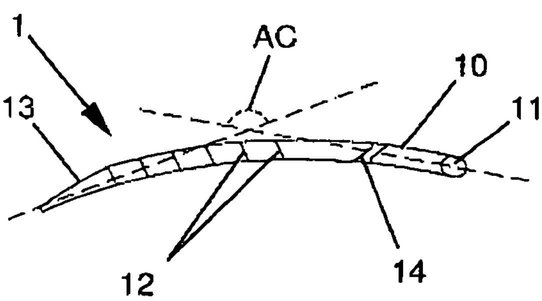

FIGURE 1D

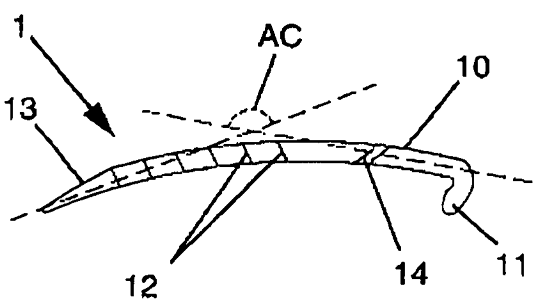

FIGURE 2A

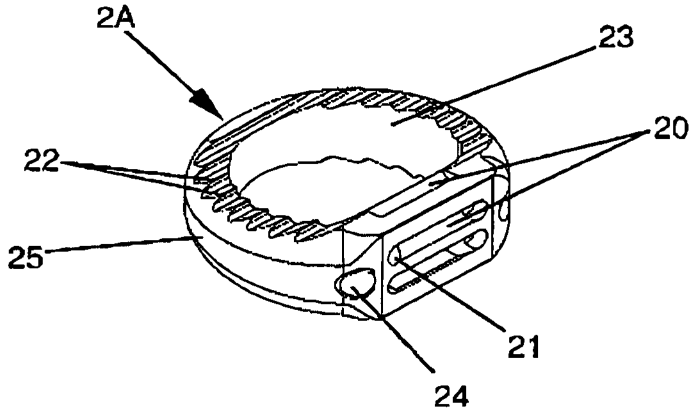

FIGURE 2B

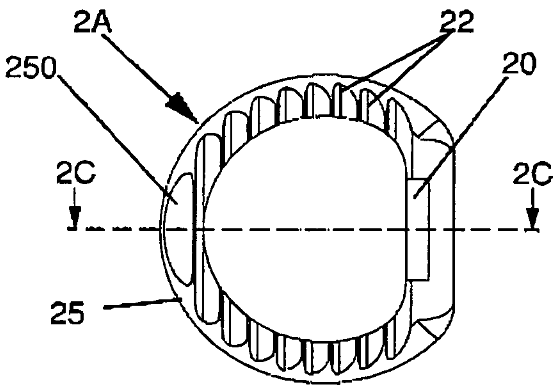

FIGURE 2C

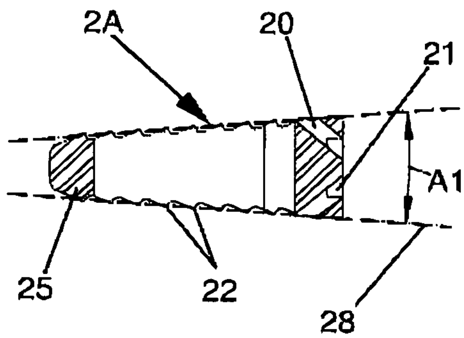

FIGURE 2D

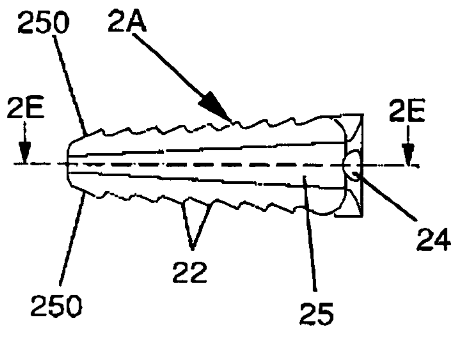

FIGURE 2E

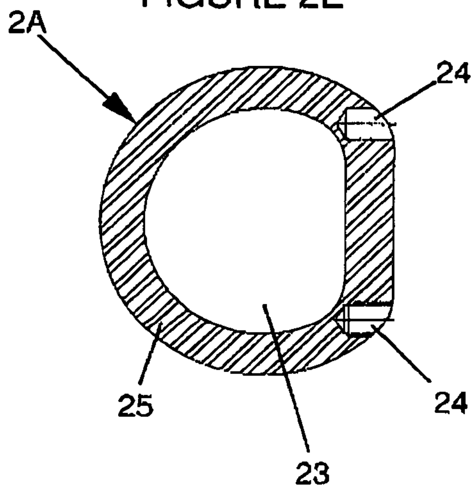

FIGURE 3A

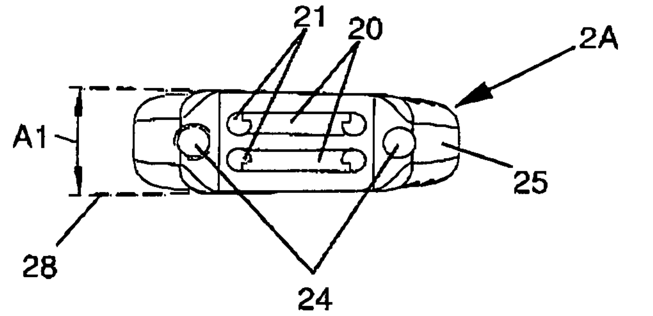

FIGURE 3B

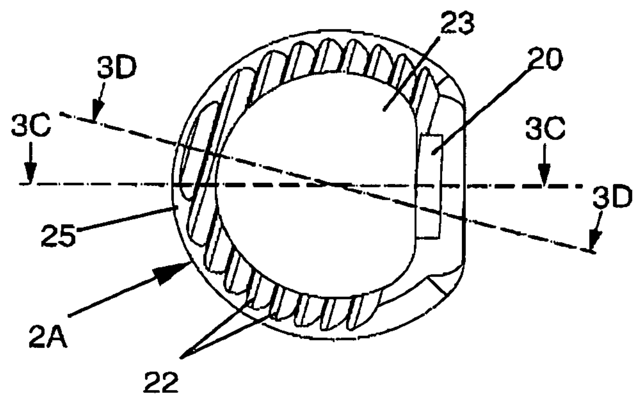

FIGURE 3C

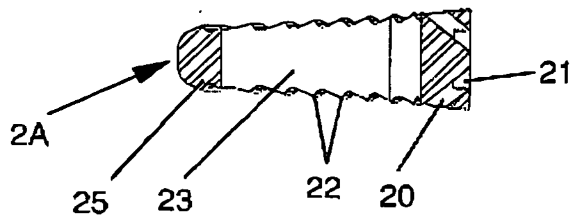

FIGURE 3D

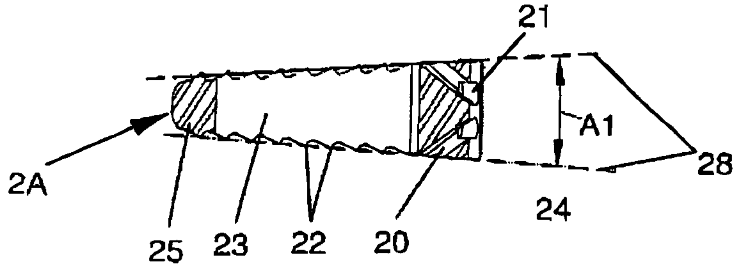

FIGURE 4A

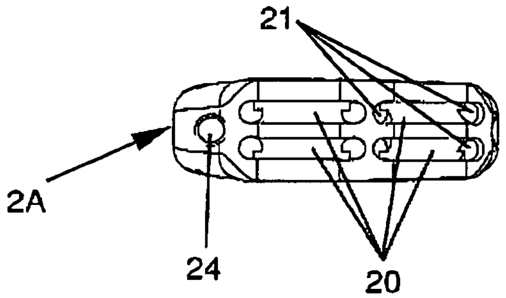

FIGURE 4B

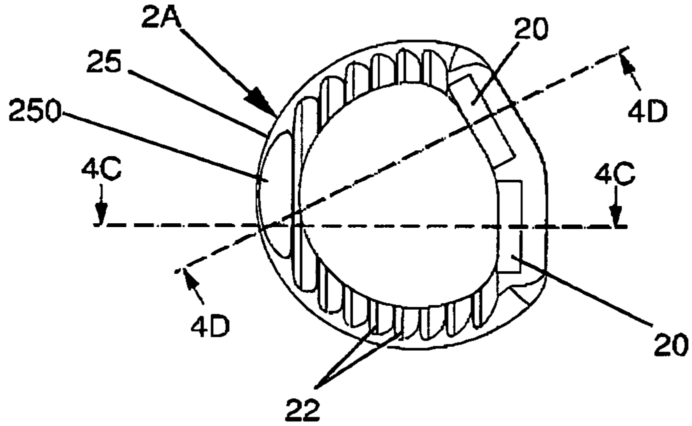

FIGURE 4C

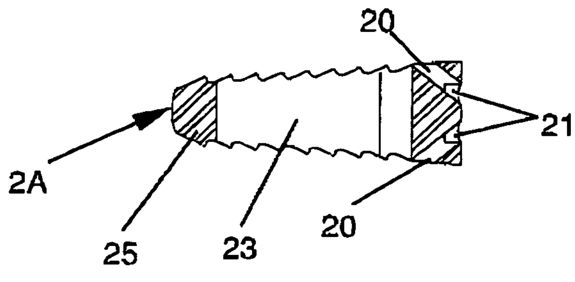

FIGURE 4D

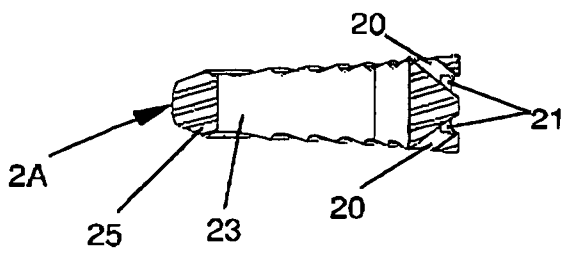

FIGURE 5A

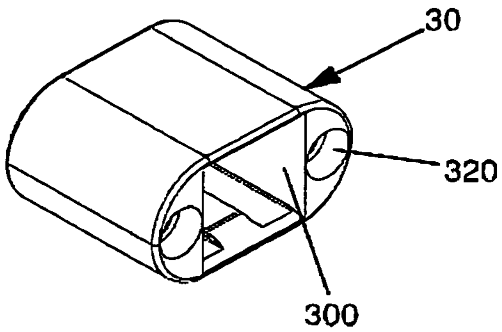

FIGURE 5B

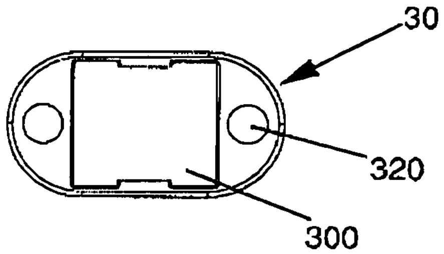

FIGURE 5C

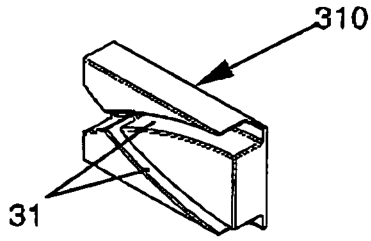

FIGURE 5D

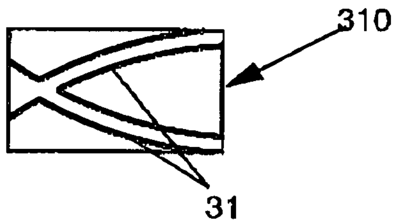

FIGURE 5E

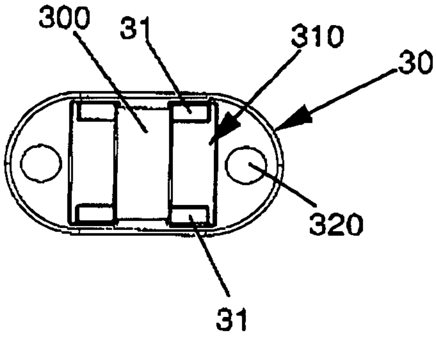

FIGURE 6A

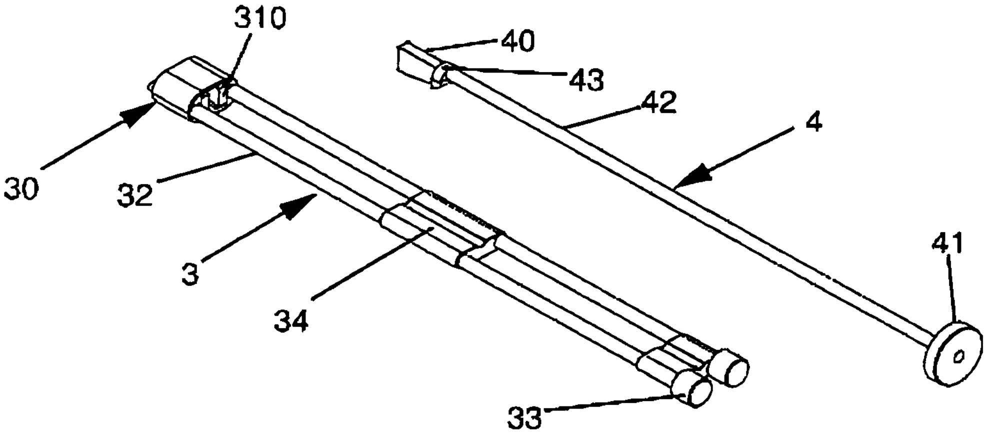

FIGURE 6B

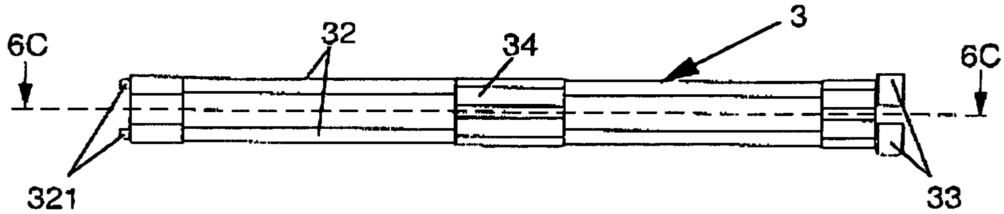

FIGURE 6C

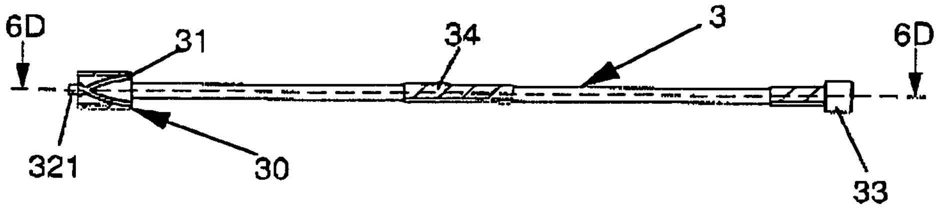

FIGURE 6D

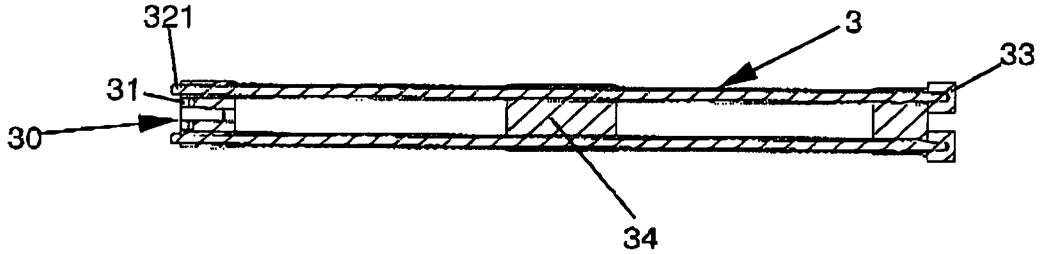

FIGURE 6E

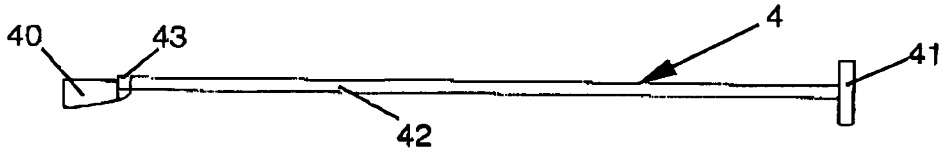

FIGURE 7A

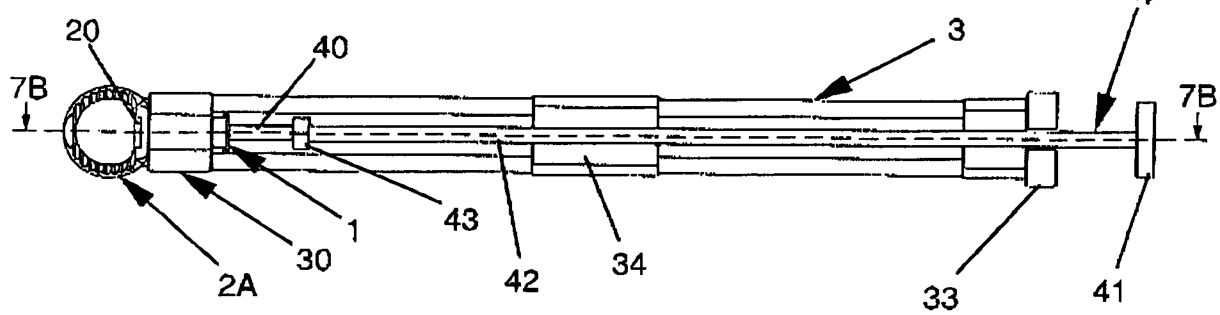

FIGURE 7B

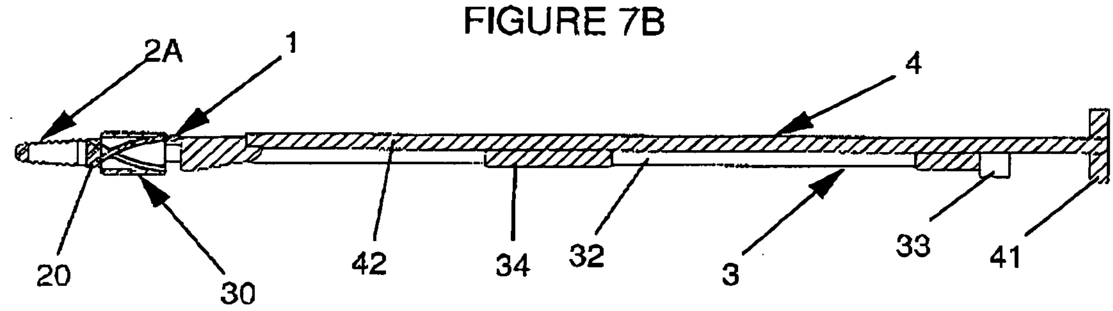

FIGURE 7C

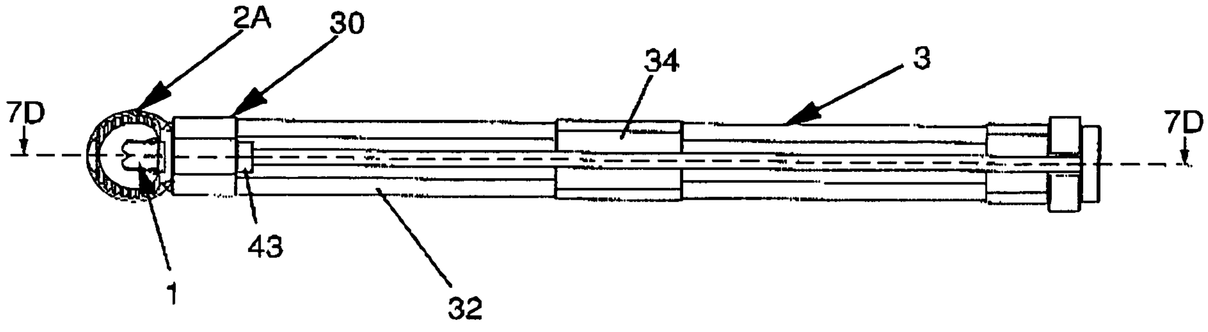

FIGURE 7D

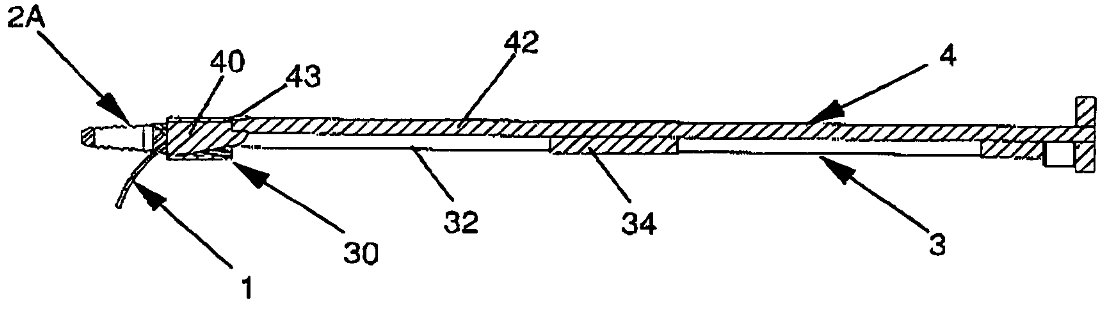

FIGURE 8A

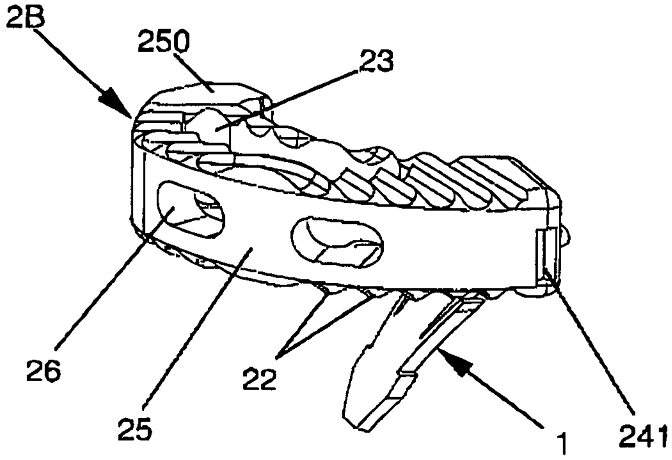

FIGURE 8B

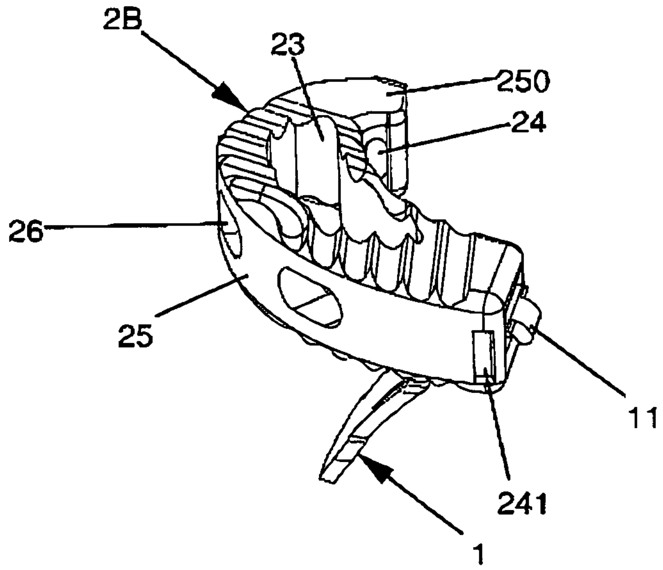

FIGURE 8C

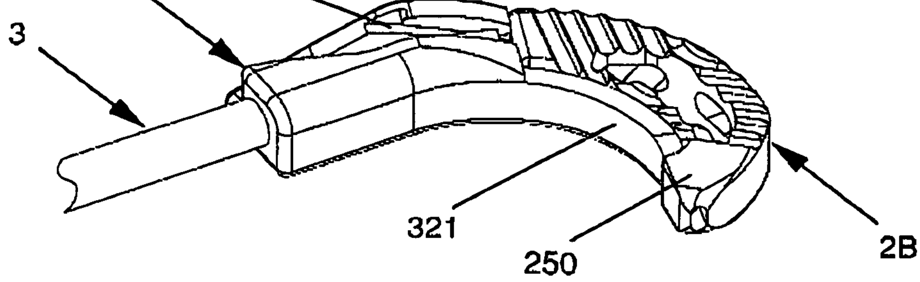

FIGURE 9A

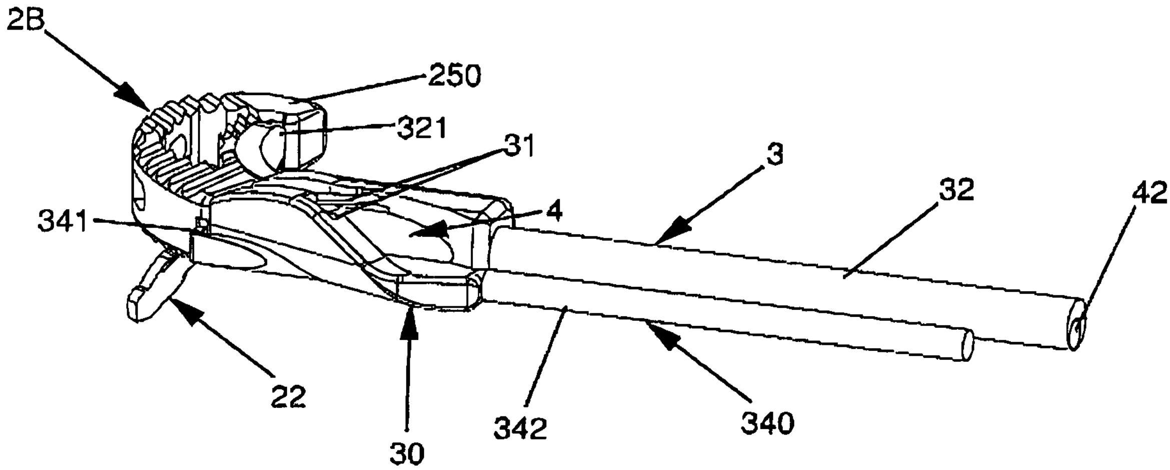

FIGURE 9B

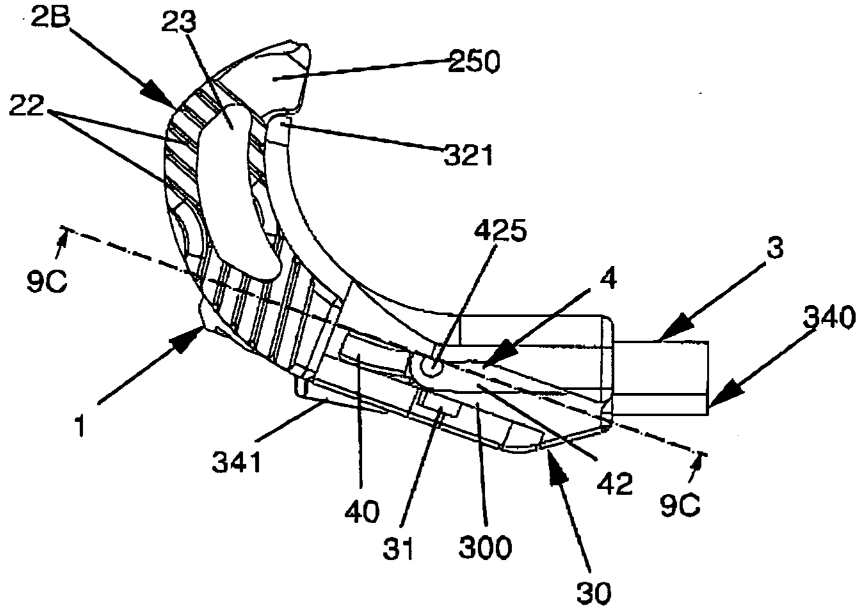

FIGURE 9C

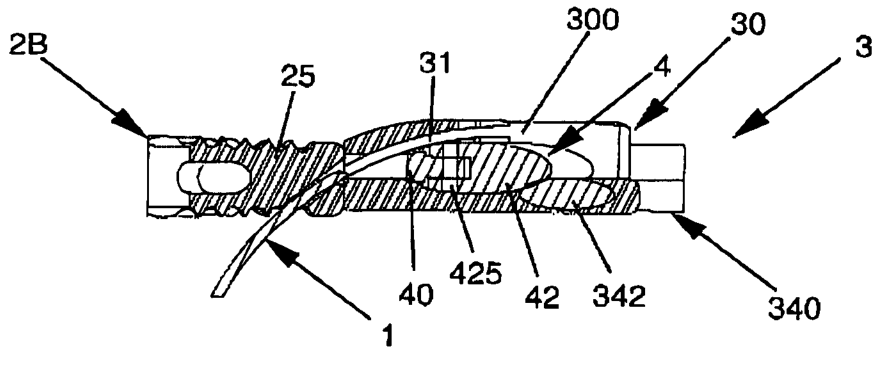

FIGURE 10A

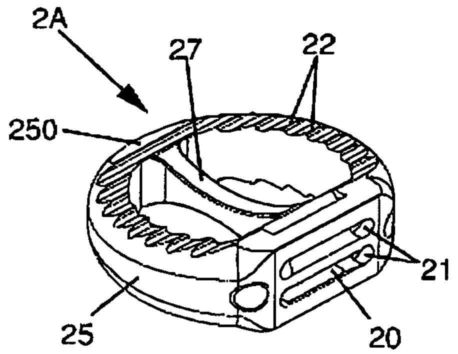

FIGURE 10D

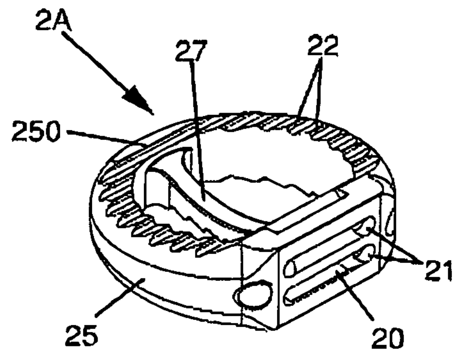

FIGURE 10B

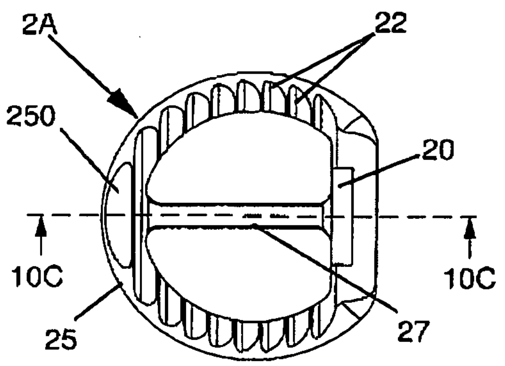

FIGURE 10E

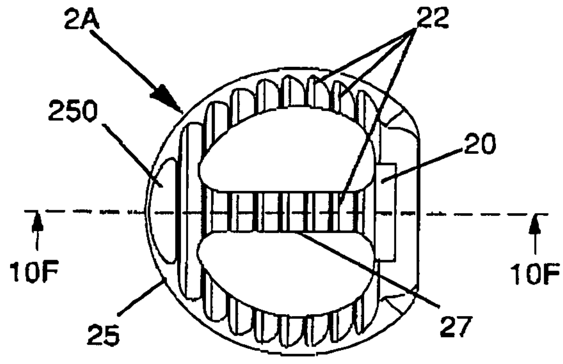

FIGURE 10C

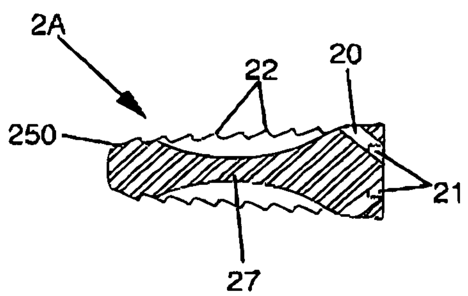

FIGURE 10F

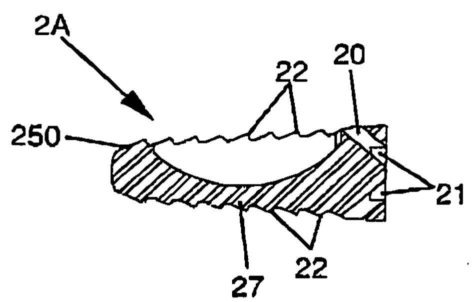

FIGURE 11A

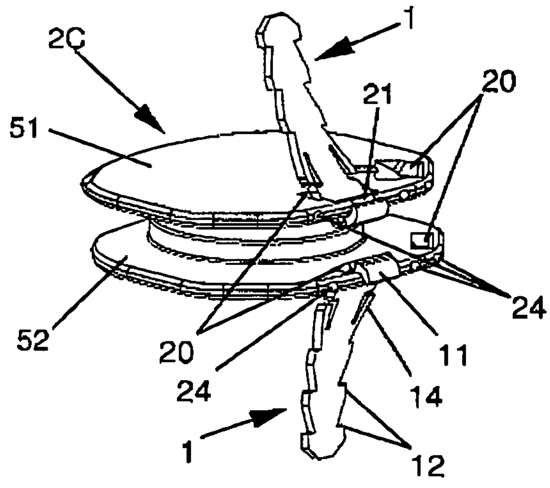

FIGURE 11C

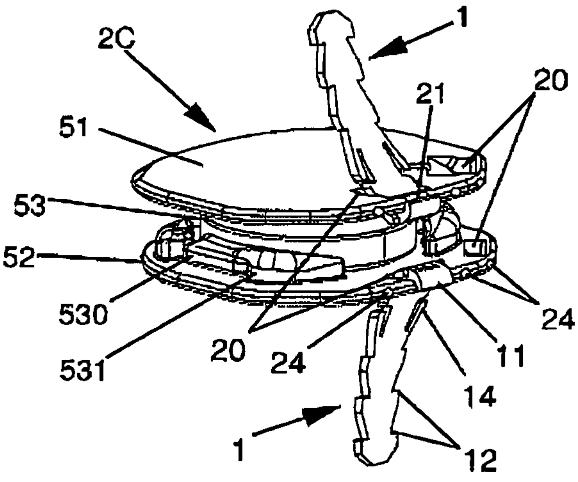

FIGURE 11B

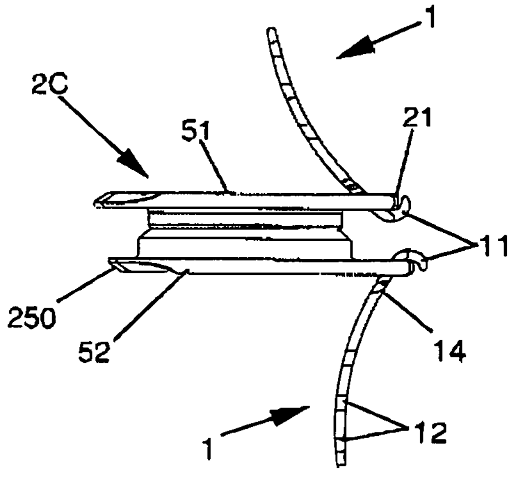

FIGURE 11D