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Brantigan

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[54] **SURGICAL PROSTHETIC IMPLANT FOR VERTEBRAE**

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[21] Appl. No.: **673,474**

[22] Filed: **Mar. 22, 1991**

[51] **Int. Cl.**[5] **A61F 2/44**

[52] **U.S. Cl.** **623/17**; 606/60; 606/61

[58] **Field of Search** 623/17; 606/60, 61

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Primary Examiner—Randall L. Green
Assistant Examiner—Dinh Nguyen

[57] **ABSTRACT**

Surgical prosthetic modular implants used singularly or stacked together are provided to support and fuse together adjacent vertebrae or to totally or partially replace one or more vertebrae in a vertebral column. The implants are rigid annular plugs, dimensionally similar to normal vertebral bodies, have simplified oval or hemi-oval shapes with ridged faces to engage adjacent vertebral bodies to resist displacement and allow bone ingrowth and fusion and to interdigitate with the ridges of an adjacent plug for modular stacking to allow variability of ultimate implant height. The implants can be provided in sets of different thicknesses and are internally grooved to receive an upstanding connecting bar to bind together the individual stacked implants into a stable unit. The annular implants have ample spaces to allow ingrowth of blood capillaries and packing of bone graft and are preferably made of a radiolucent material, preferably biocompatible carbon fiber reinforced polymers or are alternately made of traditional orthopaedic implant materials such as nickel, chromium, cobalt, stainless steel or titanium.

14 Claims, 3 Drawing Sheets

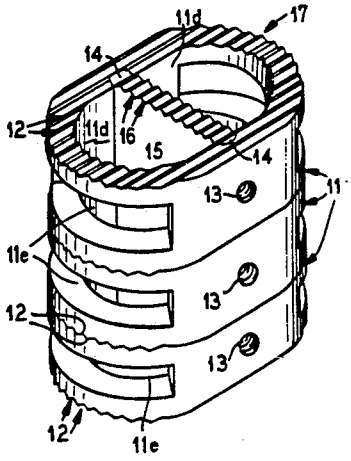
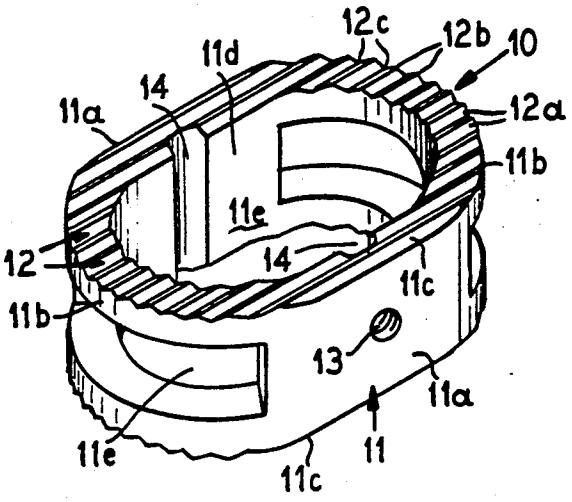


FIG. 1



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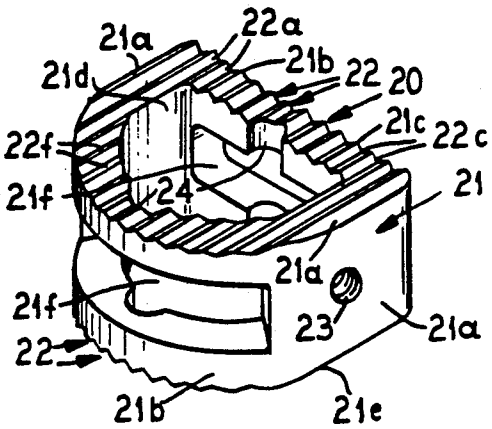

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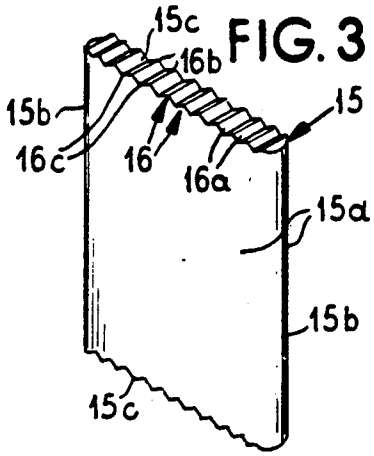

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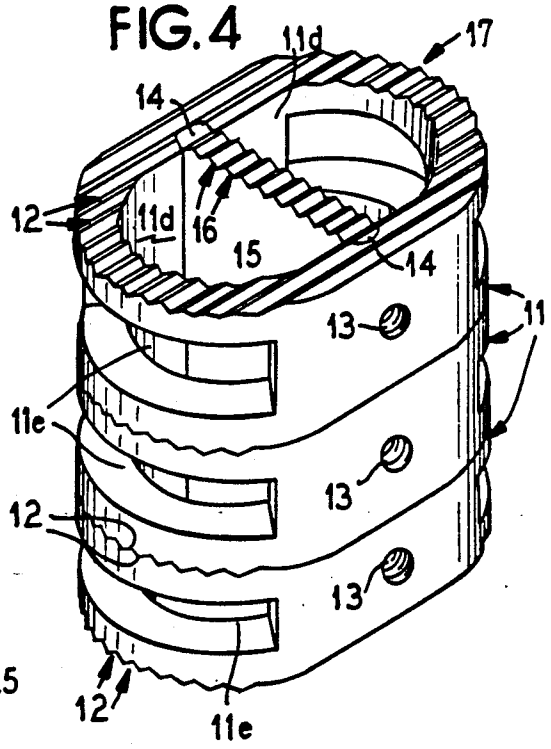

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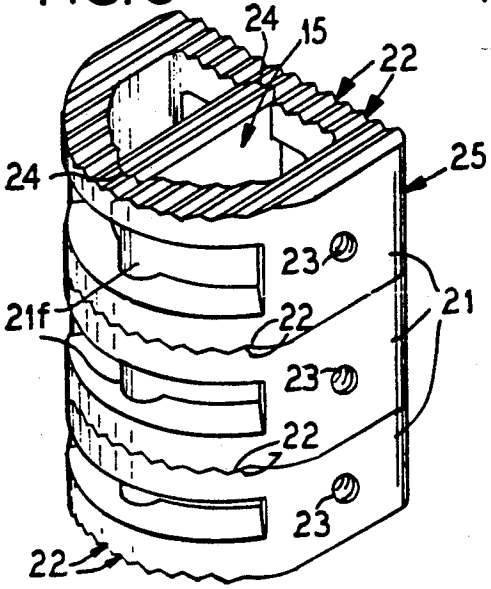

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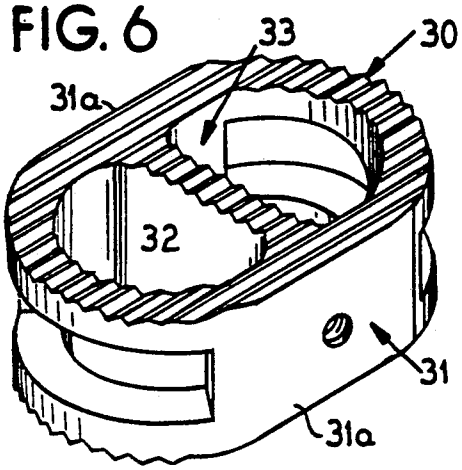

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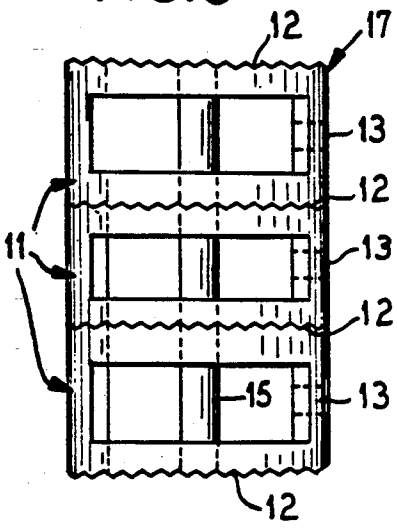

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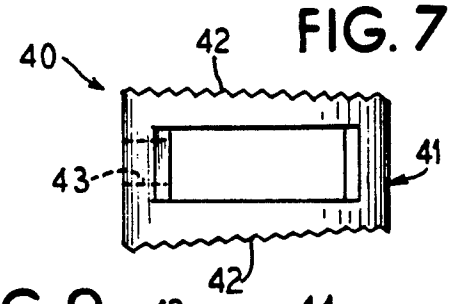

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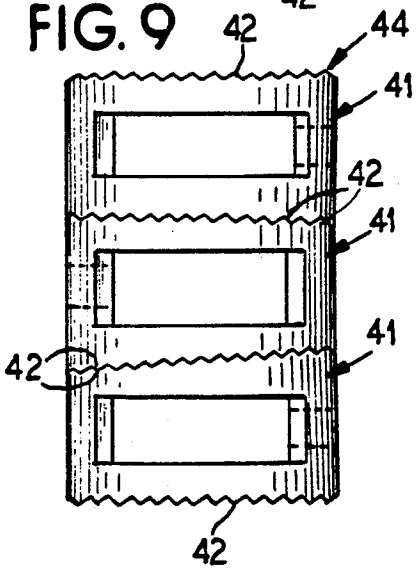

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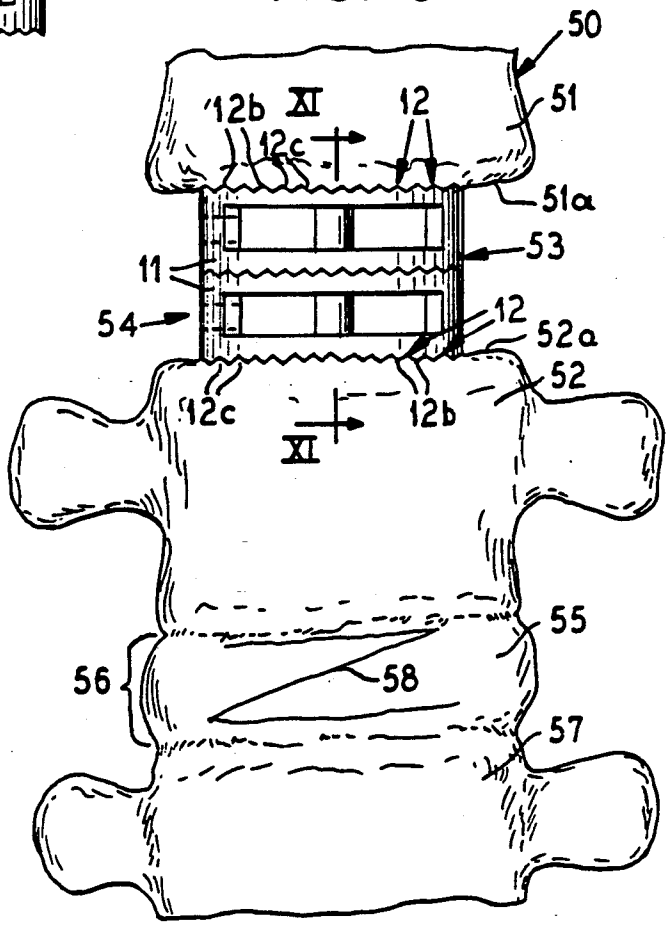

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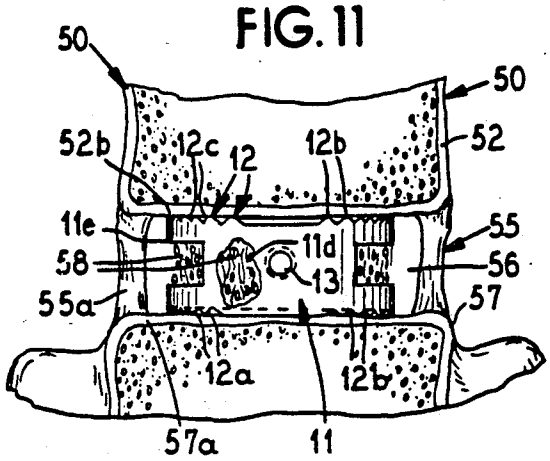

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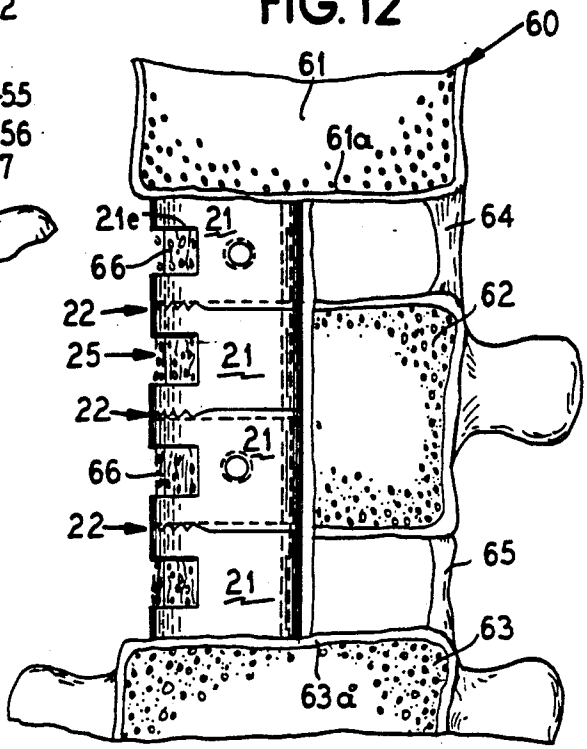

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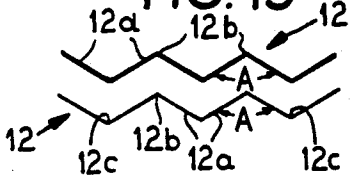

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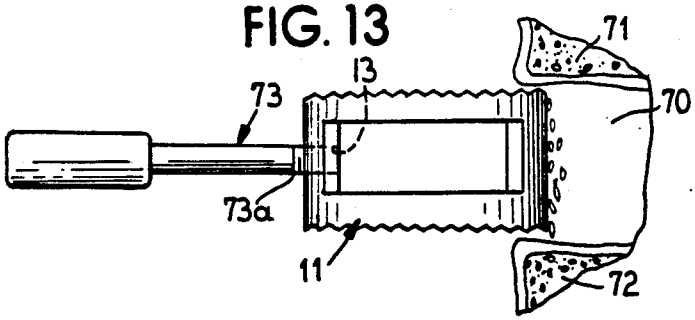
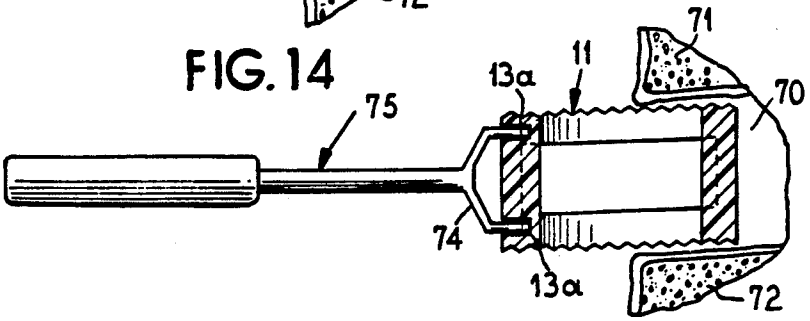


FIG. 14



SURGICAL PROSTHETIC IMPLANT FOR VERTEBRAE

BACKGROUND OF THE INVENTION

1. Field of the Invention

This invention relates to inert rigid vertebral prosthetic devices and methods for implanting the devices between adjacent vertebrae to treat or prevent back or neck pain in patients with ruptured or degenerated intervertebral discs and for replacing vertebral bodies damaged by fracture, tumor or degenerative process. Specifically, the invention deals with ring-like prosthetic plugs or discs used singly or stacked together between vertebrae to form support sturts in the spinal column and having rigid surfaces facilitating anchoring and providing valleys for bone ingrowth from adjoining vertebrae. The rings are bottomed on the opposing end faces of adjoining vertebrae, are preferably oval shaped with medial-lateral and anterior-posterior dimensions in the same ratio as normal vertebral bodies, are supplied in different heights to be used individually to replace a single damaged intervertebral disc, have ridges to bite into the vertebrae or to interdigitate to be securely stacked together to the exact height required at the time of surgery, have slots and hollow areas for packing bone graft material, tool receiving means, and are preferably radiolucent to allow visualization of the bone healing postoperatively.

2. Description of the Prior Art

While many types of vertebral prosthetic devices have been proposed, the success ratio has been very low and the surgical procedures have been very complicated and traumatic to the patient. The surgical implant devices and methods covered in my U.S. Pat. Nos. 4,743,256; 4,834,757 and 4,878,915 have greatly improved the success rate and have simplified the surgical techniques in interbody vertebral fusion. In the procedures covered by these patents, biologically acceptable but completely inert strut plugs are bottomed in channels or grooves of adjoining vertebrae and receive bone ingrowth which quickly fuses the structure to the bone and forms a living bone bridge across the fusion area.

The present invention now further improves this art of interbody fusion without cutting grooves or channels in the vertebrae and is especially well suited for anterior cervical and lumbar fusion. The invention provides ring-like prosthesis plugs or discs bottomed on end faces of adjoining vertebrae and constructed and arranged so that they can be used singly or stacked plurally to accommodate individual surgical requirements. The rings can replace excised discs and vertebrae and can also be mounted inside the fibrous disc column connecting adjoining vertebrae. The annular units are preferably oval or partial oval shaped preferably hemi-oval, to conform with vertebral disc shapes, have ridged or peaked surfaces for biting into the vertebrae on which they are seated and for receiving bone ingrowth in valleys between the peaks. When stacked, an interior connecting bar can be provided to lock the components in fixed relation and cooperate with interfitting ridges.

SUMMARY OF THE INVENTION

According to this invention, biologically acceptable, but inert rigid annular prosthesis units are provided to support and fuse with adjacent vertebrae in both the cervical, thoracic spine and lumbar portions of a human vertebral column. These ring-like prosthetic devices are

bottomed on the hard bone faces or end plates of adjacent vertebrae and are generally oval shaped to conform with the general outline perimeter of the vertebrae. They are also provided in partial (preferably hemi-oval) annular shape to accommodate those surgical procedures where only a portion of the vertebrae or disc is damaged. Two such hemi-oval rings can be used in the posterior lumbar area in side-by-side relation since the dural sac and nerve roots must be retracted to each side in turn as the implant is placed on the opposite side. In an anterior fusion since the entire front of the disc space is exposed, a single piece implant can be used making the oval an advantage in this area.

The periphery of the oval ring is grooved to accommodate ingrowth of blood capillaries and the open central portion of the ring is preferably packed with bone graft material to facilitate bone ingrowth. Bone graft can also be packed in the grooves.

Each of the oval implants is sized to match the height of an average disc and thus, can vary from 10 to 15 mm for the lumbar area and from 7–11 mm for the cervical area.

The oval shape simplifies the surgical procedure since it can be rotated or reversed and still fit the vertebrae. Further, the device stretches the disc tissue creating a tension which will cause the vertebrae to tightly grip the ring on which it is bottomed. If the disc columnar tissue is preserved, a cut, preferably "Z"-shaped, can be made in the columnar fibrous tissue, the interior pulpus material of the disc removed, and the ring implant inserted through the cut to be bottomed on the adjoining vertebrae and surrounded by the disc tissue.

To accommodate a myriad of different heights between vertebrae on which the prosthesis ring is to be bottomed, the rings can be supplied in sets of different heights to be stacked to the exact height required for a particular surgical implant. For example, in the cervical spine, cervical corpectomy is often required for cervical myelopathies in which large bone spurs cause spinal cord pressure. An average grafting height is 30 mm after corpectomy and this can be achieved by stacking, for example, three 10 mm high oval implants.

In the treatment of thora columbar fractures, hemicorpectomy is often done followed by grafting. Placement of stacked hemi-oval implants in the hemi-corpectomy area provides solid structural weight bearing. The re-sected vertebral bone is packed into the implant so that harvesting of additional bone grafting can be avoided.

In the treatment of vertebral tumors, the stacked oval implants can achieve solid bony fusion across the entire re-sected area providing a permanent mechanically secure repair with living tissue.

The invention now provides vertebral prosthetic implant devices suitable for anterior, posterior or lateral placement in any area of the spine requiring replacement of disc or vertebral body. Since the implants are intended to bottom out on adjacent vertebral end faces, which preferably have been prepared by flattening with a burr drill, removing cartilaginous material and stretching the annular fibrosis so that the vertebrae can tightly grip the plug, the plugs can be inserted either anteriorly, posteriorly or laterally into the vertebral column while mounted on the end of an insertion tool.

The ring devices have ridged surfaces providing multiple purposes of gripping the vertebrae to resist expul-

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