

(12)

EUROPEAN PATENT APPLICATION

(21) Application number: **85300153.5**

(51) Int. Cl.⁴: **B 27 D 1/08**

(22) Date of filing: **09.01.85**

(30) Priority: **13.01.84 GB 8400881**
17.07.84 GB 8418221

(43) Date of publication of application:
24.07.85 Bulletin 85/30

(84) Designated Contracting States:
AT BE CH DE FR GB IT LI LU NL SE

(71) Applicant: **George, William Rodney**
The Pavilion Thames Road
Goring on Thames Oxfordshire RG6 9AL(GB)

(72) Inventor: **George, William Rodney**
The Pavilion Thames Road
Goring on Thames Oxfordshire RG6 9AL(GB)

(74) Representative: **Crawford, Andrew Birkby et al,**
A.A. THORNTON & CO. Northumberland House 303-306
High Holborn
London WC1V 7LE(GB)

(54) Structural members and apparatus and method for the production thereof.

(57) The present invention relates to laminated rings which may be used as load bearing members, for example as load bearing members in items of furniture. The rings are formed from a number of laminate layers, and each laminate layer is made up of a number of sections. Each section is specially cut in order to produce a ring whose walls are angled.

The invention also relates to a method of producing the laminated rings and to a tool designed to produce the laminated rings.

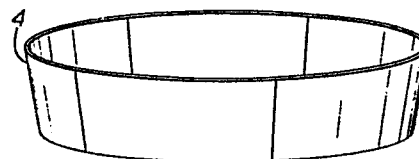


FIG. 4.

- 1 -

Structural Members and Apparatus
and Method for the production thereof

This invention relates to structural members, and particularly to structural members in the form of continuous rings of laminated construction.

This invention also relates to a method of
5 producing the laminated structural members, and also to apparatus for manufacturing a type of structural member in accordance with this invention.

It should be noted that the word "ring" as used in the context of the present invention does not
10 limit the structural members to annular configurations, but is used to denote the idea of a continuous member, which may be of any general shape, such as square or triangular, or even an irregularly shaped member, which includes at least an arcuate portion.

15 It has been proposed to use rings formed from layers of laminate as load-bearing members for furniture. The forces applied to the rings are generally perpendicular to the surface of the laminate and previously such rings were expensive to produce.

20 The present invention provides a continuous structural member comprising a plurality of laminate layers wherein each layer comprises a plurality of sections, and wherein at least a portion of the member is arcuate.

25 As an example, such structural members can be

- 2 -

used as the major load-bearing members in articles of furniture, supporting and bracing the four legs of a chair, for instance, or the legs and table top of a table.

5 The present invention preferably also provides a structural member manufactured from laminate layers, each layer being cut out of wood such that the grain of the wood, which lays along the plane of the laminate, is at an angle less than 90° to the grain of the wood in
10 the previous and succeeding laminate layers.

It has previously been suggested in order to provide extra strength in known wooden laminated constructions, that each succeeding laminate layer be arranged so that the grain of the wood in the plane of
15 the laminate runs at an angle of 90° to the grain of the wood in a preceding laminate layer.

However, in the present invention where a certain amount of flexibility in the laminate layer is required so that a continuous ring may be produced, the
20 above method of providing extra strength would reduce the flexibility of the laminated structure required to produce a ring.

It has been found, however, that if each laminate layer in the ring is cut from wood such that
25 the grain which lies along the plane of the laminate is at an angle less than 90° to the grain of the wood in the previous and succeeding laminate layers, the resulting ring has increased structural strength without reduction in the flexibility of the laminate construction
30 necessary to allow formation of the ring.

Preferably, the preferred angle between the grains in succeeding layers of the ring is not more than 10° .

In order to produce a laminated ring it is
35 necessary to clamp the laminates together during a bonding

- 3 -

process. The clamping force must include at least a component transverse to the central axis of the ring.

The present invention further provides a method of manufacturing a continuous laminated structural member, comprising the steps of forming a first layer by placing at least one preformed section in a chamber of a tool, forming at least one further layer over said first layer, the or each further layer comprising at least one preformed section, and applying pressure to the layers using the tool to force them into engagement with each other, thereby facilitating bonding of the layers to each other to form a continuous laminated structural member.

The inner wall of the structural member is preferably formed to lie at an angle to the central axis. That is, the inner wall can be formed at any angle between horizontal and vertical.

In order to facilitate manufacture of rings in which the inner wall is generally at an angle to the central axis, the present invention further provides a tool for manufacturing continuous laminated structural members, said tool comprising first and second inter-engaging members which have angled cooperating faces, said first and second members being movable relative to each other such that a force is applied between the cooperating faces in a direction transverse to the direction of movement of said members, the magnitude of said force being altered by the relative movement between said members.

The members are preferably rigid and non-expandable.

Preferably, one and/or both of the members includes means for accelerating the bonding process occurring between the respective laminate layers. The

- 4 -

accelerating means conveniently may be heating means in the form of hot water tubes, or electrical heating means.

Features and advantages of the present invention will become apparent from the following description of embodiments thereof, given by way of example with reference to the accompanying drawings, in which:-

Figure 1 is a cut away section of a structural member according to the present invention;

10 Figure 2 is a cut away section of another structural member according to the present invention;

Figure 3 is a cut away section of yet another structural member according to the present invention;

15 Figures 4, 5, 6 show perspective views of the structural members of Figures 1, 2 and 3 respectively;

Figures 7, 8 and 9 show top plan views of single laminate sections which are used in the structural members of Figures 4, 5 and 6 respectively;

20 Figures 10, 11, 12 and 13 show top views of structural members according to the present invention, illustrating the variety of shapes of structural member which can be produced;

Figure 14 illustrates a way laminate sections are cut from wood at an angle to the grain;

25 Figure 15 shows a perspective view of a part of a tool in accordance with the present invention which can be used to manufacture certain types of the structural members according to this invention;

30 Figure 16 shows an exploded perspective view of a basic form of the tool for manufacturing certain types of structural members;

Figure 17 is a cross-sectional perspective view of part of the tool shown in Figure 16.

35 A structural member is manufactured by placing a number of single sections of laminate together in one

- 5 -

layer to conform to the general shape of the required structural member. Another layer of laminate is then formed in exactly the same way, except that the join where an end of a laminate section abuts against an end of another laminate section of the same layer is staggered with respect to the joins in the previous layer. The number of layers required is built up in this way until the structural member is complete.

Figures 1 to 6 show three differently shaped structural members. Figure 1 shows a cut away view of a generally annular structural member having a wall, made of laminated layers, wherein the walls of the member are angled outwards with respect to the central axis of the structural member, in this case at an angle of 7° . The complete article is shown in Figure 4.

In the generally annular structural member of Figures 2 and 5, the wall is shaped such that the lower part 1 of the wall is at an angle of, for example, 7° , but the top part 2 of the wall is radiussed to increase the angle. Figures 3 and 6 show a generally annular structural member where the walls are angled outwards and are generally S shaped in cross-sectional view.

It will be appreciated that the walls can be given any angle in between the horizontal and vertical planes, and generally any shape to fit the requirements for the structural member.

The structural members according to this invention are each manufactured from layers of material, each layer comprising a plurality of laminate sections, which are cut in the desired shape from a flat piece of the laminate material.

Figure 7 shows a single laminate section for use in the structural member of Figure 1. It is generally

- 6 -

planar and arcuate with two ends which are cut so that the desired angle will be formed when the laminate section is incorporated into the generally annular structural member shown in Figures 1 and 4.

5 Figure 8 shows a single laminate section for use in the structural member of Figures 2 and 5. Again, the laminate section is arcuate so that it can be made to form part of a ring and the ends are shaped so that the finally produced annulus will be radiussed outwardly.

10 Figure 9 shows a single laminate section for use in the structural member of Figures 6 and 3.

 It will be noted that as the structural member walls are angled out with respect to the axis of the member, so that the radius of the top edge of the ring is larger than the radius of the bottom edge, each veneer section is pre-cut to have a different top and bottom radius, the difference in radius determining the angle of the ends of each veneer section.

 The structural members need not be annular in shape but can be formed in any shape required. Figures 20 12 to 14 show top views of some of the structural members which can be formed in accordance with the present invention. Other shapes may also be formed.

 Figure 10 shows a structural member of generally 25 triangular shape, with curved corners.

 Figure 11 shows a structural member of generally square shape, with curved corners.

 Figure 12 shows a structural member of generally rectangular shape, with curved corners.

30 It will be noted that the corners of the structural members in each case have some curvature to them. This is because they are manufactured from a plurality of laminate sections, which are not so flexible as to allow for extremely sharp corners.

35 It will be appreciated that the walls can be of

- 7 -

any cross-sectional shape, as previously described.

Such structural members can find use as structural members in furniture. For example, the generally square structural member could find use as
5 the major supporting member which braces together the four legs of a chair.

In order to provide extra strength to the structural members according to this invention, without diminuation in the flexibility required in order to
10 shape the structural member, the single laminate sections can be cut as shown in Figure 14.

Figure 14 shows a flat sheet of laminate material 8 from which two bow-shaped laminate sections 10 and 11 are to be cut. Arrows 9 representing the
15 direction in which the grain of the wood of the flat sheet 8 runs. The tangents to the mid-portions of laminate sections 10 and 11 are indicated by arrows 13 and 12 respectively.

Laminate section 10 is cut so that the tangent
20 13 is directed at an angle $+A$ to the grain of the wood. Angle A is preferably not more than 10° . Laminate section 11 is cut so that the tangent 12 is directed at angle $-A$ to the grain of the wood, i.e. the same angle but in a different direction.

25 If these two laminate sections are used in separate succeeding layers of a structural member so that they overlap each other, the different angles at which the grain lies in each case, will add extra strength to the finished structural member, without reduction in the
30 flexibility of the laminate layers.

It should be noted that, although the description refers to wooden laminate sections, structural members according to the present invention can also be manufactured from laminate sections of plastics material.
35 Certain types of plastics are known which have a grain,

- 8 -

and laminate sections can be cut from these materials at different angles to the grain, as described above.

In cases where the structural members are not annular in shape but are other shapes, such as
5 rectangular or triangular with rounded corners, it is preferable that the rounded corners are not formed in each layer from complete laminate sections, but that two laminate sections in each layer form a join in the region of the rounded corner. By using two laminate
10 sections to form a corner, the two laminate sections can be of complementary shapes, and the join can be adjusted in position without affecting the finished shape of the structural member. If only a single laminate section is used to form a corner the shape of the section is
15 likely to be such that it will be difficult to adjust the position of the joins with adjacent laminate sections without affecting the entire shape of the structural member.

An embodiment of a tool which can be used to
20 manufacture structural members wherein the inner wall is angled with respect to the central axis of the ring is described in the following description with reference to Figures 15, 16 and 17 of the drawings.

A method for producing such rings is also
25 described.

The method and apparatus to be described have been designed to produce laminated rings from layers of wooden or plastics veneer with the rings being formed as frusto-conical sections.

30 The rings are designed to have parallel inner and outer surfaces each sloping at about 7° with respect to the axis of the cone although any other angle may be produced, and the outer surface of the ring need not necessarily be parallel to the inner surface.

35 Turning now to the drawings, Figure 15 shows

- 9 -

an outer annular clamping member 14 in the form of a cast aluminium member which has an angled inner face 15. The angle of the face 15 determines the angle to the outer surface of a laminated ring to be produced which in this case is 7° .

As shown in Figure 16, a cooperating cast aluminium clamping member 16 having an angled outer face 17 is arranged to be received within the circumference of the member 14; the angle of the outer face 17 being the same as the angle of the inner face 15. The relative diameters of the member 14 and 16 are chosen having regard to the thickness of the laminated ring to be produced and which will be framed between the faces 15 and 17.

With the above arrangement, when the outer member 14 is clamped in position e.g. as shown by the bolts 18 in Figure 17 and the member 16 is moved axially of the member 14, the force applied by the angled faces 15, 17 to laminates inserted therebetween may be altered. As shown in Figure 17 either or both of the members 14, 16 may be provided with heating means for accelerating bonding together of the laminates. In this instance the heating means may be hot water-filled tubes or ducts 19.

Using the above apparatus a laminated ring would be produced as follows:-

Pre-glued sections are placed against the face 15, and the components of the laminated ring are built up. The advantage of this method is that the sections which make up the two or more layers of the ring can be so cut that, for example, three pieces can comprise one layer. Although a single section could comprise one layer, each piece is cut to incorporate the top and bottom circumference of the finished product required, and results in a bow shaped component. The ends of each piece

are cut to correspond with the degree of angle required in the ring, in relation to the angle of the wall of the product for which it will be used. For example an ornamental tube incorporating the rings as structural members can be made with the wall having an outward slant of 7° , and this will be required in the ring. When the sections of each layer are laid in place, they are forced outwards to take up the shape of the product. The section has a natural resilience, or spring tension to take up its original flat shape. When all the components which make up each layer have been put in place, the spring tension acts to keep the components in place, thus allowing the following layer to be put in place, and so on, until all the layers are completed.

15 The member 17 is in the form of a plug, with corresponding dimensions for the required internal top and bottom circumference and width. Because the ring is tapered inwards from the top downwards, the plug can be pushed downwards into the outer member 14, with the laminates in position, causing an even pressure to be applied to all the glued surfaces. The more pressure applied, the tighter the fit. The pressure can be applied in any manner, such as weight, toggle clamps, screw locking clamps or hydraulic pressure.

25 In order to speed up the gluing or bonding process, heat can be applied by casting piping into the aluminium forming rings, so that hot water, steam or other heated liquid can be circulated round the clamping rings. The rings can be electrically heated, and Radio Frequency gluing can be applied, as well as any other form of causing an acceleration of the curing of the glue.

30 The shape of the finished product need not only be round. By using part of a circumference, it is possible to make up shapes which are for example in a generality triangular, square, rectangular, hexagonal,

35

- 11 -

and so on. The forming tools do not need to be annular in shape, but can be triangular, square, or generally any shape which is required for the finished structural member. The forming tools can be so shaped
5 to allow for solid sections to be incorporated in the gluing process.

It should also be appreciated that the angle of the cooperating faces of the tool can vary from point to point on the faces so that rings can be
10 produced which flare out at an increasing angle, for instance, as in the ring shown in Figure 5.

Claims:

1. A continuous structural member comprising a plurality of laminate layers wherein each layer comprises a plurality of sections and wherein at least a portion of the member is arcuate.
2. A structural member in accordance with claim 1, wherein grain of the sections in the plane of any one layer runs at an angle of less than 90° to the grain of the section in adjacent layers.
3. A structural member in accordance with claim 2, wherein said angle of the grain of the sections, in a layer is not more than 10° with respect to the grains in adjacent layers.
4. A structural member in accordance with any preceding claim, wherein each section is cut from a flat piece of laminate material, in such a shape so that when the structural member is formed from the sections, the desired shape of the structural member is achieved.
5. A structural member according to any preceding claim, wherein said member has an inner continuous surface and an outer continuous surface, and the inner surface is angled with respect to the central axis of the member.

6. A tool for manufacturing continuous laminated structural members, said tool comprising first and second inter-engaging members which have angled cooperating faces, said first and second members being movable relative to each other such that a force is applied between the cooperating faces in a direction transverse to the direction of movement of said members, the magnitude of said force being altered by the relative movement between said members.

7. A tool in accordance with claim 5, wherein said first member is in the form of a plug having a continuous outer wall which is angled with respect to the central axis of the plug and said second member is in the form of a ring having a continuous inner wall which is angled with respect to the central axis of the ring, and wherein the dimensions of said first member and second member are such that the outer wall of said first member corresponds with the inner wall of said second member to form said cooperating faces.

8. A tool in accordance with any of claims 6 or 7, wherein piping is provided in the first and/or second member, whereby to facilitate heating of the first and/or second members by heating fluid.

9. A tool in accordance with any of claims 6 to 8, wherein said second member is fixed in position and said first member is moved in a direction parallel with its axis by the application of external force, whereby varying the force applied between said cooperating faces in a direction transverse to the axis.

- 14 -

10. A method of manufacturing a continuous laminated structural member, comprising the steps of forming a first layer by placing a plurality of preformed sections in a chamber of a tool, forming at least one further layer over said first layer, the or each further layer comprising a plurality of preformed section, and applying pressure to the layers using the tool to force them into engagement with each other, thereby facilitating bonding of the layers to each other to form a continuous laminated structural member.

1/4

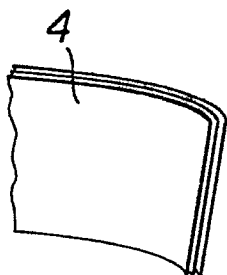


FIG. 1.

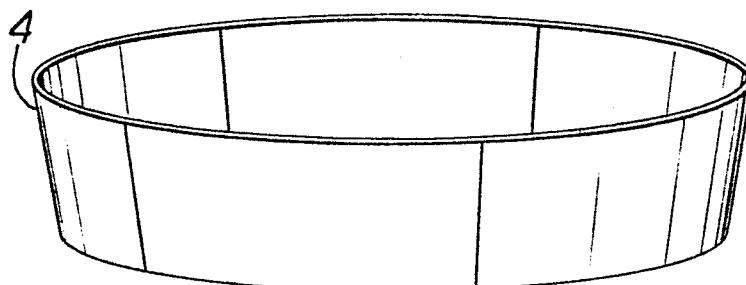


FIG. 4.

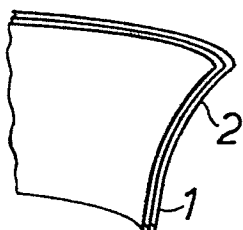


FIG. 2.

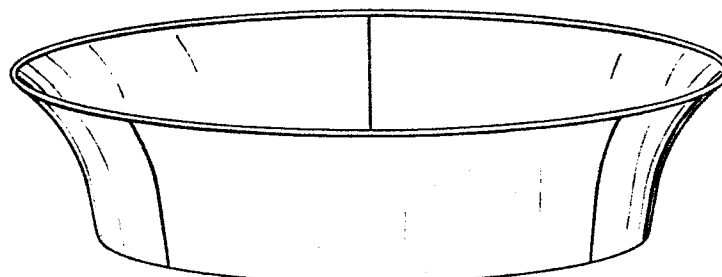


FIG. 5.

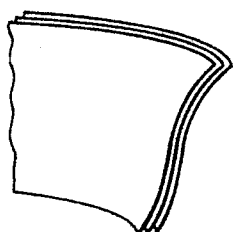


FIG. 3.

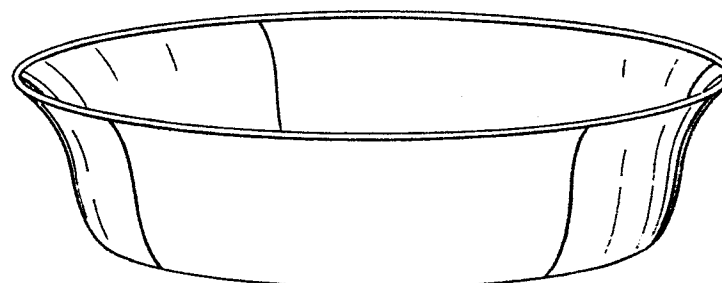
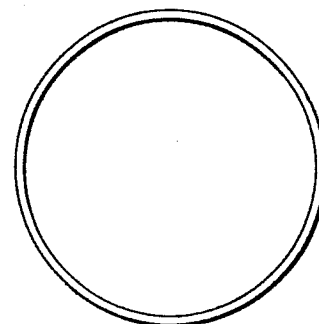
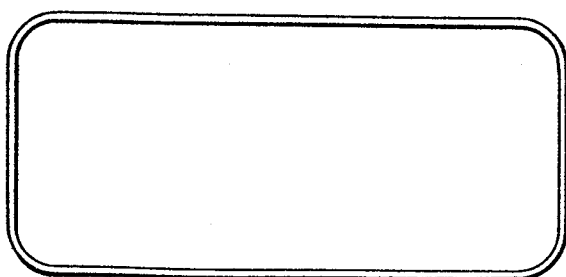
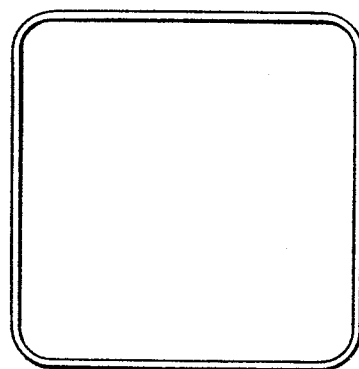
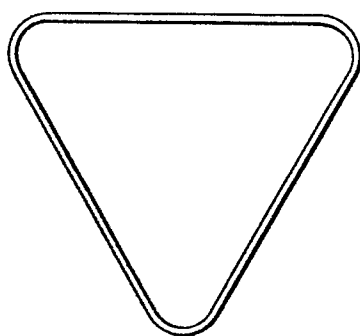
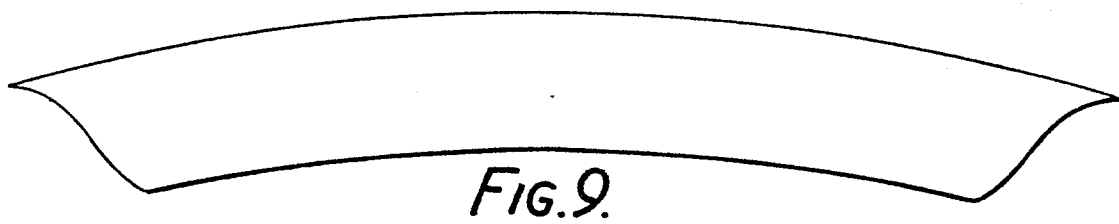
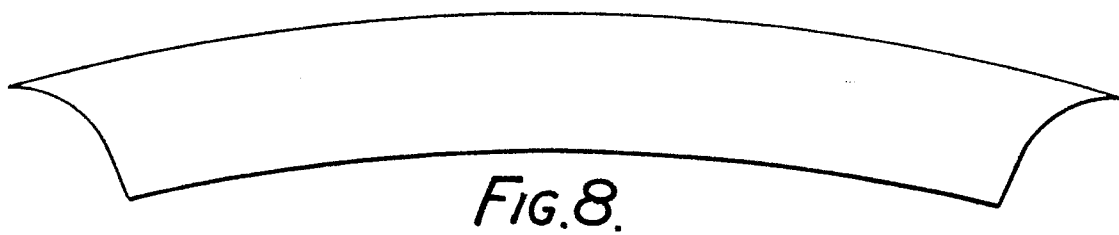
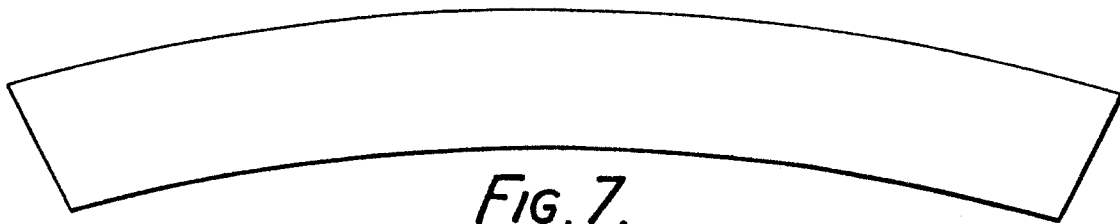


FIG. 6.

2/4



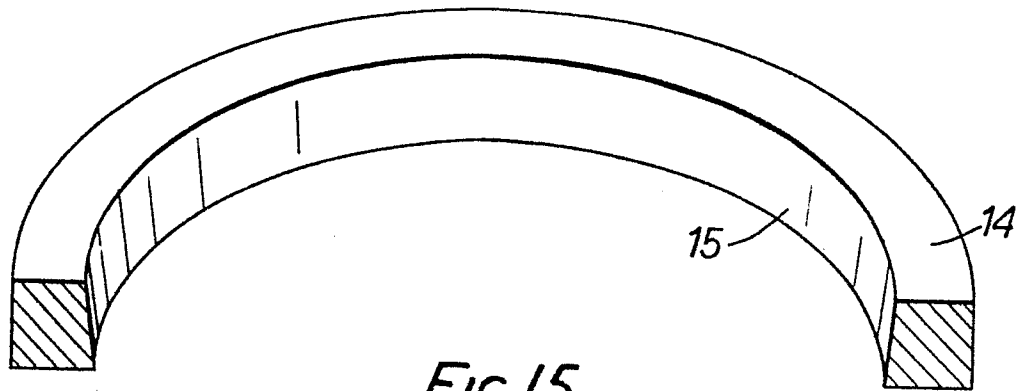


FIG. 15.

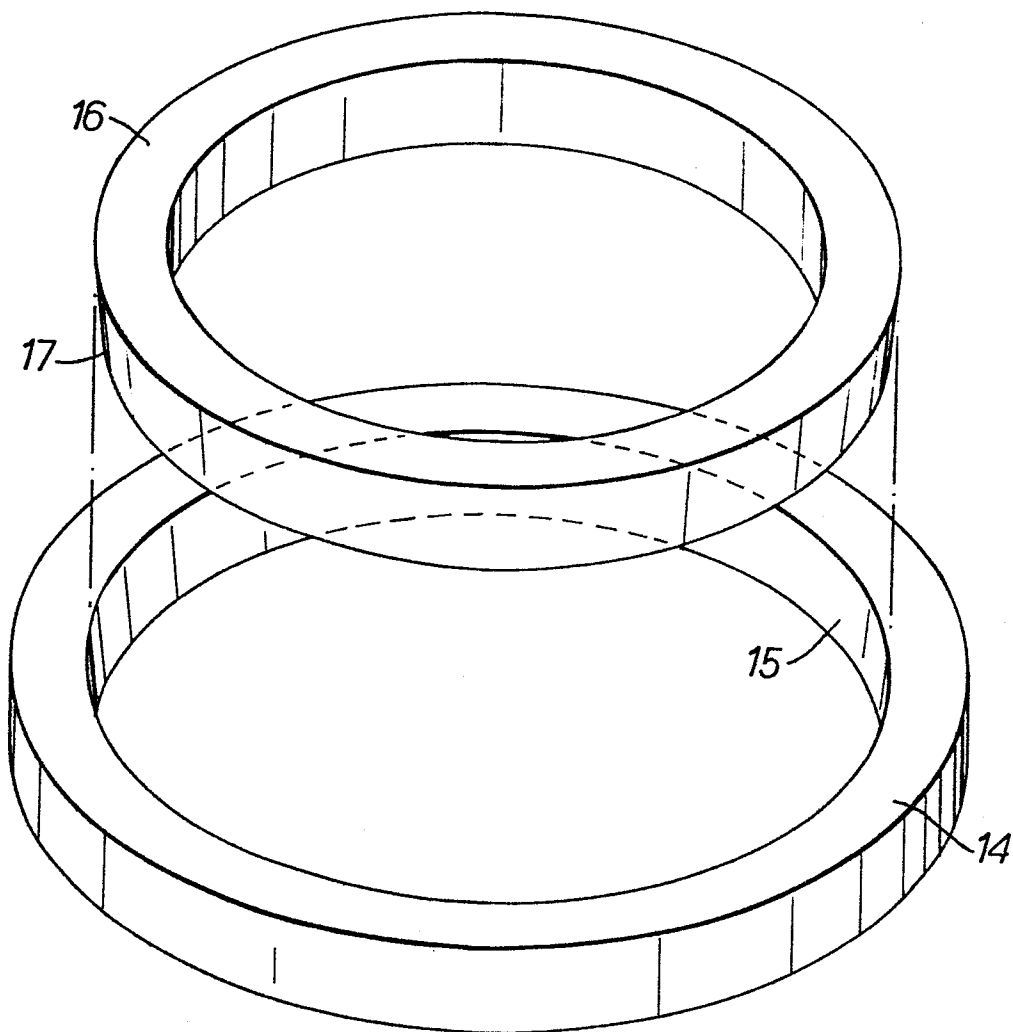


FIG. 16.