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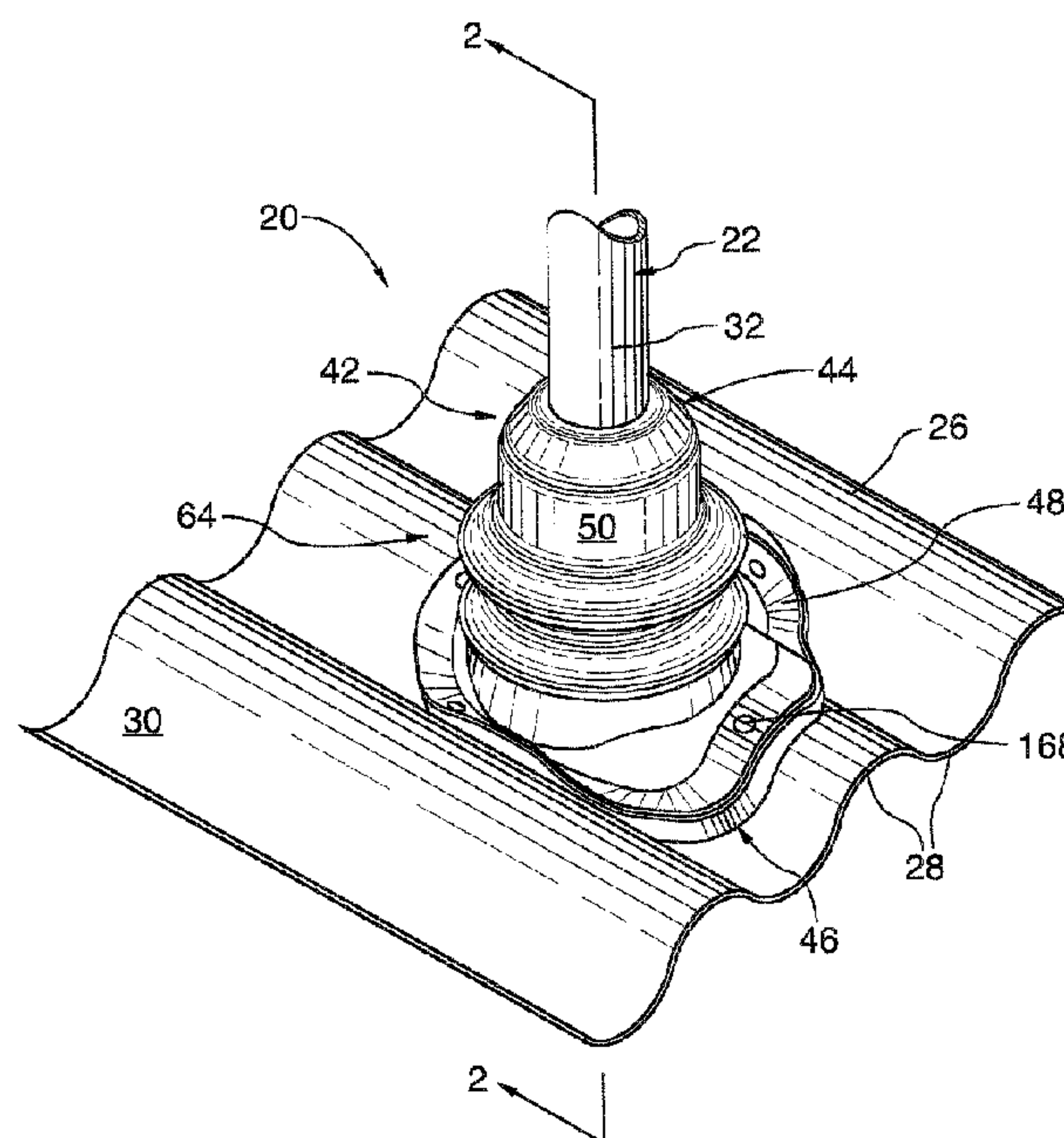
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(54) Title: ROOF FLASHING ASSEMBLY



(57) **Abrégé/Abstract:**

The present invention relates to a roof flashing assembly for use on a sloped roof surface having an elongate projection extending substantially upwardly therefrom in skewed relation thereto. The roof flashing assembly has a resilient, flexible, sleeve sized to fit over, and surround, the projection. The sleeve has a base portion, a neck portion and a passageway defined therebetween for receiving the projection therethrough. A bellows tube is formed on the neck portion to permit the sleeve to flex adaptively to accommodate for the skewed orientation of the projection relative to the sloped roof surface. The roof flashing assembly also includes a grommet which is positionable in surrounding relation with the projection. The grommet has three beveled lip members, which frictionally sealingly engage the exterior surface of the projection when urged in abutting relation therewith. An annular gasket positionable below the base portion of the sleeve, is also provided. The gasket frictionally sealingly engages the external surface of the projection. When urged in abutting relation with the sloped roof surface, flexible ring seal members formed on the underside of the gasket create a watertight seal with the roof surface. During installation, anchoring means are used to secure the sleeve and the gasket to the sloped roof surface.

ABSTRACT

The present invention relates to a roof flashing assembly for use on a sloped roof surface having an elongate projection extending substantially upwardly therefrom in skewed relation thereto. The roof flashing assembly has a resilient, flexible, sleeve sized to fit over, and surround, the projection. The sleeve has a base portion, a neck portion and a passageway defined therebetween for receiving the projection therethrough. A bellows tube is formed on the neck portion to permit the sleeve to flex adaptively to accommodate for the skewed orientation of the projection relative to the sloped roof surface. The roof flashing assembly also includes a grommet which is positionable in surrounding relation with the projection. The grommet has three beveled lip members, which frictionally sealingly engage the exterior surface of the projection when urged in abutting relation therewith. An annular gasket positionable below the base portion of the sleeve, is also provided. The gasket frictionally sealingly engages the external surface of the projection. When urged in abutting relation with the sloped roof surface, flexible ring seal members formed on the underside of the gasket create a watertight seal with the roof surface. During installation, anchoring means are used to secure the sleeve and the gasket to the sloped roof surface.

ROOF FLASHING ASSEMBLY

FIELD OF THE INVENTION

[001] The present invention relates to a roof flashing assembly used to provide watertight and weather resistant seals between a sloped roof surface and an upwardly projecting member such as a pipe or vent stack.

BACKGROUND OF THE INVENTION

[002] Roof flashing is conventionally used to provide a waterproof and weather resistant seal around pipes, vent stacks and other elongate members projecting through roofs. Roof flashing is generally constructed from sheet metal, flexible moulded rubber or other synthetic material formed in an appropriate shape to surround such projecting members, and is normally made to extend slightly above the level of the roof, to limit the penetration of precipitation therebelow.

[003] Roof leaks result in costly repairs for building owners and roofers. In northern climates condensation and leaks at roof protrusions caused by roof flashing products are the most common reason for roofing failure. It is believed that condensation problems alone are responsible for as much as 80 percent of all roof leaks.

[004] In some known prior art roof flashing assemblies, an air space is created between the outer surface of the elongate member and the interior surface of the flashing member. This air space is often in liquid communication with the interior environment of the structure lying below the roof. This allows moisture in warm air from within the structure to collect, condense and freeze within the flashing during the winter months. The ice thus formed melts during the spring and eventually leaks into the structure.

[005] In an attempt to alleviate water infiltration into the interior of a building due to condensation, insulation is typically applied to the inside surface of the flashing.

Despite the availability of insulated roof flashings, many installers elect, because of cost, to use non-insulated flashings. However, even when insulation is used, it has been found that condensation problems tend to persist to an unacceptable degree.

5 **[006]** Insulation of the flashing assembly by itself does not deal with the gap between the vent pipe (or the roof protrusion) and the inside diameter of the flashing sleeve. Although there often is vapor barrier, insulation material and flashing to protect from leakage and condensation, it has been found that condensation may still result if the flashing assembly does not have a base seal.

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15 **[007]** Base seals have been used in some known roof flashing assemblies. An example of such a roofing flashing assembly is found in Canadian Patent No. 2,292,716, open to public inspection on July 8 2000, and granted on January 14, 2003 to Ken Thaler. This patent describes a roof flashing assembly for use on a substantially planar, upper roof surface with an elongate member projecting upwardly therefrom. The roof flashing assembly has a hollow, rigid body member mounted in surrounding relation to the elongate member. The body member has a base portion and a boss portion extending axially therefrom. A passageway defined in the boss portion is adapted to receive the elongate member therethrough. The
20 roof flashing assembly further includes an annular grommet located at the top end of the passageway to keep moisture out. A resilient base seal provided at the opposite end of the passageway prevents moisture trapped therein from penetrating below the level of the roof surface. The roof flashing assembly is rigidly sealingly mounted to the roof surface by conventional mounting means which
25 include the use of fasteners in combination with bitumen, and alternatively, embedding the base portion in a layer of air-hardening liquid plastic. This type of roof flashing assembly is generally well suited for substantially planar, non-sloped roof surfaces.

30 **[008]** However, corrugated metal roof decks, particularly sloping metal roofs, such as ButlerTM roofs, present further challenges. Roof flashing assemblies for such roofs must be designed to accommodate roof protrusions and work in conjunction with any configuration of corrugation. Although metal vent stack

flashings may be used on some sloping roof applications, flexible roof flashing assemblies are often preferred because they are more adaptable to different roof slopes and roof deck profiles.

5 **[009]** Flexible roof flashing assemblies made with resilient deformable material having a lower portion contoured or deformable to complement the roof deck surface, have been previously used. An example is described in U.S. Patent No. 4,664,390 issued May 12, 1987 to David Houseman. This patent discloses a roof flashing device having an apertured base of resilient deformable material and
10 a sleeve of resilient material integral with the base and projecting from one side. The base in use is superimposed on the surface and the elongated conduit extends through the aperture and through the sleeve. The base has a marginal edge portion to be positioned in use so that it extends in a direction inclined in the direction of the longitudinal ridges and/or valleys. The marginal edge portion is
15 contoured along its length in a direction normal to the plane of the base, so that in a free state the length of the marginal edge portion measured along the contours is greater than the linear length. This device however does not appear to address the problem of condensation forming within the space defined between the interior surface of the sleeve and the elongated conduit.

20 **[0010]** A further challenge is that metal roof decking is subject to expansion and contraction from temperature change and may expand or contract up to 1 1/4 inches. This expansion and contraction in the area of apertures made for roof protrusions will be a source of condensation problems in sloped roof deck
25 applications.

[0011] Accordingly, it would be advantageous to have a roof flashing assembly, which could be simply and readily adapted to different roof decking profiles on sloped roof surfaces. Furthermore, it would be desirable to have a roof flashing
30 assembly with a base seal adapted to form a seal about the roof protrusion while maintaining sealing contact with the sloped roof surface despite distortions in the roof decking caused by thermal expansion and contraction effects.

SUMMARY OF THE INVENTION

[0012] According to one aspect of the invention, there is provided a roof flashing assembly for use on a sloped roof surface. The sloped roof surface has an elongate projection extending substantially upwardly therefrom in skewed relation thereto. The projection has at least one sidewall defining an external surface. The roof flashing assembly has a resilient, flexible, sleeve sized to fit over, and surround, the at least one sidewall of the projection. The sleeve has a base portion for location adjacent to the roof surface, an upstanding neck portion joined thereto and a passageway defined between the base portion and the neck portion for receiving the projection therethrough. The neck portion having a proximal end adjacent to the base portion, a distal end opposite the proximal end, and bellows means disposed between the proximal and distal ends in substantially coaxial relation with the passageway. The bellows means permits the sleeve to flex adaptively to accommodate for the skewed orientation of the projection relative to the sloped roof surface. The roof flashing assembly further includes a resilient upper sealing means positionable adjacent to the distal end of the neck portion in surrounding relation with the projection for frictionally sealingly engaging the external surface of the projection. The roof flashing assembly also includes a resilient lower sealing means positionable below the base portion in surrounding relation with the projection for sealingly engaging the external surface of the projection. The lower sealing means is sized and configured to frictionally sealingly engage the roof surface when urged in abutting relation therewith. Additionally, the roof flashing assembly has anchoring means for securing the sleeve and the sealing means to the sloped roof surface.

[0013] In an additional feature of that aspect of the invention, the upper sealing means includes a grommet having an aperture defined therein. The aperture is sized and shaped to permit close-fitting frictional sealing engagement between the grommet and the exterior surface of the projection. In a further feature, the grommet is an annular grommet has a circumferential wall defining an interior grommet surface, and circumferential lip means extending radially inward from the interior grommet surface. The interior grommet surface and the circumferential lip

means co-operate one with the other to define the grommet aperture. In a yet another feature, the circumferential lip means includes at least one beveled lip member terminating with a free edge. The free edge of the at least one beveled lip member is urged to bear against the exterior surface of the projection in frictional sealing engagement therewith when the roof flashing assembly is operatively connected to the roof surface. In still a further feature, the circumferential lip means includes three, vertically spaced, beveled lip members.

[0014] In another additional feature, the lower sealing means includes an annular gasket formed about a longitudinal gasket axis. The annular gasket has an outer flange portion surrounding an inner body portion. The outer flange portion has an upper surface for abutting the base portion and a lower surface dimensioned and adapted for sealingly engaging the roof surface when the roof flashing assembly is operatively connected to the roof surface. The inner body portion has proximal edges joined to the outer flange portion and opposed distal edges. The distal edges define an aperture of the gasket through which the projection is received. The distal edges are urged to bear against the exterior surface of the projection in frictional sealing engagement therewith when the roof flashing assembly is operatively connected to the roof surface. In a further feature, the inner body portion includes a circumferential channel disposed between the proximal edges and the distal edges thereof. Additionally, the channel has a substantially curved profile.

[0015] In a further additional feature, the outer flange portion has at least one resilient ring seal member downwardly depending from its lower surface. The at least one ring seal member has a generally triangular profile when viewed in cross-section. Additionally, the at least one ring seal member tapers downwardly from the lower surface of the outer flange portion to terminate at a free edge. The free edge of the at least one ring seal member is urged to bear against the roof surface in frictional sealing engagement therewith when the roof flashing assembly is operatively connected thereto. In another feature, the generally triangular profile of the at least one ring seal member is defined by an inner face and an outer face. The outer face is disposed substantially perpendicular to the

longitudinal gasket axis; and the inner face is disposed askew of the longitudinal gasket axis. In still a further feature, the outer flange portion has a plurality of concentrically mounted, resilient ring seal members downwardly depending from its lower surface. The plurality of ring seal members have diameters of outwardly increasing magnitude.

BRIEF DESCRIPTION OF THE DRAWINGS

[0016] The present invention may be further understood by reference to the following detailed description of the embodiments of the invention, taken in conjunction with the accompanying drawings, in which:

[0017] Figure 1 is a perspective view of a roof flashing assembly according to a preferred embodiment of the present invention, showing the roof flashing assembly operatively mounted onto a sloped, corrugated roof surface;

[0018] Figure 2 of the drawings is a cross-sectional view of the roof flashing assembly shown in Figure 1 taken along section '2-2' of Figure 1;

[0019] Figure 3 is an exploded, perspective view of the roof flashing assembly of Figure 1 showing a sleeve, a lower sealing means and a hold-down ring;

[0020] Figure 4 is a cross-sectional view of the sleeve shown in Figure 3 taken along section '4-4' of Figure 3;

[0021] Figure 5 is an enlarged, partial cut away, perspective view of the uppermost portion of the sleeve shown in Figure 3;

[0022] Figure 6 is a partial cut away, perspective view of the lower sealing means shown in Figure 3;

[0023] Figure 7 is a bottom plan view of the lower sealing means shown in Figure 3;

[0024] Figure 8 is a cross-sectional view of the lower sealing means shown in Figure 3 taken along section '8-8' of Figure 3;

5 **[0025]** Figure 9 is a cross-sectional view of an alternative embodiment of a lower sealing means to that shown in Figure 7; and

10 **[0026]** Figure 10 is a perspective view of a roof flashing assembly similar to that depicted in Figure 3, shown operatively mounted onto a sloped, substantially planar, roof surface.

[0027] Figure 11 is a perspective view of an alternative embodiment to the lower seal shown in Figure 7.

15 **[0028]** Figure 12 is a bottom perspective view of an alternative embodiment to the lower seal shown in Figure 11.

[0029] Figure 13 is a cross-sectional view of an embodiment of a lower sealing means to those shown in Figures 7 and 9.

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DETAILED DESCRIPTION OF A PREFERRED EMBODIMENT

25 **[0030]** The description, which follows, and the embodiments described therein, are provided by way of illustration of an example, or examples of particular embodiments of principles and aspects of the present invention. These examples are provided for the purposes of explanation, and not of limitation, of those principles and of the invention. In the description that follows, like parts are marked throughout the specification and the drawings with the same respective reference numerals.

30 **[0031]** Referring to Figures 1 and 2, a roof flashing assembly is generally designated with reference numeral 20. During installation, the roof flashing assembly 20 is operatively mounted in surrounding relation with an elongate

projection 22 and securely anchored to a sloped roof surface 26 of a building or structure (not shown) to prevent moisture from penetrating below the level of the sloped roof surface 26 and from ultimately seeping into the building.

5 **[0032]** As best seen in Figure 2, the projection 22 extends substantially upwardly through an opening 24 defined in the sloped roof surface 26. The sloped roof surface 26 has a plurality of corrugations 28 extending in a direction substantially parallel to the slope thereof thus forming a corrugated metal roof decking 30. The projection 22 is mounted askew of the corrugated roof decking 30. While in the preferred embodiment, the corrugations 28 have a generally sinusoidal profile; it will be appreciated that the roof flashing assembly 20 may be employed on sloped roof surfaces having other corrugated profiles.

15 **[0033]** The projection 22 may be a building vent, an exhaust stack, a support member for a roof mounted apparatus, or any like elongate member extending from the sloped roof surface 26. However, in the preferred embodiment, the projection 22 is a vertically oriented, pipe 32 of generally constant, substantially circular, cross-section. The pipe 32 has a radial sidewall 34, which defines an exterior pipe surface 36. As will be explained in greater detail below, the roof flashing assembly 20 is adapted to sealingly engage the sloped roof surface 26, and the exterior pipe surface 36 at various vertically spaced locations.

25 **[0034]** Referring to Figure 3, the roof flashing assembly 20 includes: a sleeve 42 sized to fit over, and surround, the side wall 34 of pipe 32; an upper sealing means 44 for maintaining sealing contact with the exterior pipe surface 36 at least one location along the pipe 32; a lower sealing means 46 for maintaining sealing contact with the sloped roof surface 26 and with the exterior pipe surface 36 at another location along the pipe 32; and anchoring means 48 for securing the sleeve 42 to the sloped roof surface 26.

30 **[0035]** Referring to Figures 3 and 4, the sleeve 42 has a resilient, flexible sleeve body 50 formed along a longitudinal sleeve axis 52. The sleeve body 50 has a base portion 54 and an upstanding neck portion 56 joined thereto. A passageway 58

extending longitudinally between the base portion 54 and the neck portion 56, is configured to receive pipe 32 therethrough when the sleeve 42 is fitted over the pipe 32.

5 **[0036]** The neck portion 56 has a proximal end 60 adjacent to the base portion 54 and an opposed free or distal end 62. Disposed between the proximal and distal ends 60 and 62 in substantially coaxial relation with the passageway 58, is a bellows means 64 in the nature of a bellows tube 66. The neck portion 56 includes an undulated peripheral wall 68 which has formed therein in a direction
10 substantially perpendicular to the longitudinal sleeve axis 52, a plurality of circumferential bulges 70 alternately disposed with a plurality of corresponding circumferential furrows 72. The plurality of circumferential bulges 70 and furrows 72 co-operate with each other to define concertinaed sides 74 of the bellows tube 66. As shown in Figure 2, the concertinaed sides 74 allow the sleeve body 50 to flex
15 (that is, to contract or expand) adaptively to accommodate to the sloped profile of roof surface 26 such that the base portion 54 can be positioned to abut the sloped roof surface 26 when the sleeve 42 is fitted over the pipe 32.

20 **[0037]** In the preferred embodiment, first and second circumferential bulges 76 and 78 define the bellows tube 66, and corresponding first and second circumferential furrows 80 and 82. However, a larger number of bulges and furrows may be used to define the bellows tube 66. Also, while it is preferable that the first and second circumferential bulges 76 and 78 be sized to have substantially the same diameters, this need not be the case in every application. For instance, the
25 bellows tube may be fabricated with circumferential bulges of increasingly larger diameter from the proximal end 60 to the distal end 62.

30 **[0038]** The neck portion 56 extends upwardly away from the bellows tube 66 to terminate at the distal end 62. Positioned adjacent to the distal end 62, and integrally formed therewith, is the upper sealing means 44. The upper sealing means 44 includes a resilient grommet 84 having an aperture 86 defined therein. The grommet aperture 86 is sized and shaped for close-fitting frictional sealing engagement with the exterior pipe surface 36.

[0039] In the preferred embodiment shown in Figures 4 and 5, the grommet 84 is substantially annular. It has a circumferential wall 88 defining an interior grommet surface 90, and circumferential sealing lip means 92 extending radially inward from the interior grommet surface 90. The interior grommet surface 90 and the circumferential sealing lip means 92 co-operate with each other to define the substantially circular grommet aperture 86. The circumferential sealing lip means 92 includes a plurality of longitudinally spaced, beveled lip members 94. Each beveled lip member 94 terminates with a free edge 96 which, as the sleeve 42 is being fitted onto the pipe 32, is urged into close-fitting, frictional sealing engagement with the exterior pipe surface 36 to thereby form a watertight seal therewith.

[0040] In the preferred embodiment, the plurality of beveled lip members 94 includes three beveled lip members 98, 100 and 102 for increased watertight sealing action between the sleeve 42 and the pipe 32. Preferably, the beveled lip members 98, 100 and 102 are sized to have similar internal diameters. However, in certain applications it may be desirable to have internal diameters of downwardly increasing magnitude.

[0041] Furthermore, while it is preferred that the upper sealing means 44 resiliently sealingly engage the exterior pipe surface 36 at a plurality of locations along the pipe 32 to increase sealing action between the sleeve 42 and the pipe 32, in an alternative embodiment, the upper sealing means could be adapted to form a seal at a single location along the pipe 32.

[0042] In the upper sealing means 44 described above, the grommet 84 is substantially annular with circumferential sealing lip means 92 conforming to the substantially circular cross-section of pipe 32. However, the grommet 84 need not be annular. For instance, where the pipe is provided with a non-circular cross-section, such as a square, rectangular or triangular cross-section, the grommet may be shaped accordingly and provided with peripheral sealing lip means sized and configured to resiliently sealingly engage the exterior pipe surface.

5 **[0043]** Other modifications to the upper sealing means 44 are also possible. In an alternative embodiment, the plurality of beveled lip members 94 may be replaced with a plurality of alternate seal members extending inwardly into the grommet aperture. These alternate seal members may be substantially semi-circular or rectangular in cross-section.

10 **[0044]** While in the preferred embodiment, the grommet 82 is integrally formed with the neck portion 56 of the sleeve 42, it will be appreciated that in an alternate embodiment the grommet could be molded as a separate part so as to be detachable from the neck portion 56. The grommet could be mounted to the neck portion 56 using known attachment means, such as tongue and groove type arrangements. The separate grommet could be fabricated from a homogeneous elastomeric material such as rubber, neoprene, polyurethane, or any like material exhibiting suitable sealing ability.

15 **[0045]** Referring to Figure 4, the base portion 54 joins the neck portion 56 at the proximal end 60 thereof. The base portion 54 includes a peripheral flange 104, which flares radially outward in a direction generally transverse of the longitudinal sleeve axis 52. The peripheral flange 104 is resilient and flexible to allow the base portion 54 to conform to the non-planar profile of the corrugated roof decking 30. In addition, as explained in greater detail below, the peripheral flange 104 has a lower face 106 to which the anchoring means 48 may be fastened to thereby allow the sleeve to be secured onto the sloped roof surface 26.

25 **[0046]** In the preferred embodiment, the sleeve 42 is fabricated from ethylene propylene diene monomer (EPDM) and the base portion 54 is integrally molded with the neck portion 56 for ease of manufacture. However, the sleeve 42 need not be of unitary construction. In an alternate embodiment, the neck and base portions may be fabricated separately from different materials. It will be further appreciated
30 that materials other than EPDM exhibiting the requisite characteristics of resilience, flexibility, durability, waterproofing and resistance to the effects of thermal expansion and contraction could also be used to fabricate the sleeve.

[0047] With reference to Figures 3, 6 and 8, the lower sealing means 46 includes a resilient gasket 108. The gasket 108 has a gasket aperture 110 defined therein for receiving therethrough the pipe 32. As will be explained in greater detail below, the gasket aperture 110 is sized and configured such that the innermost edges of gasket 108 defining the aperture 110, are urged into close-fitting frictional sealing engagement with the exterior pipe surface 36 at a location along the pipe 32 adjacent the base portion 54.

[0048] In the preferred embodiment, the gasket 108 is an annular gasket formed about a longitudinal gasket axis 111, with a substantially circular aperture (see Figure 8). The gasket 108 has an inner body portion 112 surrounded by an outer flange portion 114, which extends about the periphery of the gasket 108. The inner body portion 112 has proximal edges 116 joined to the outer flange portion 114, and opposed distal edges 118. The distal edges 118 define the innermost edges of gasket 108 that are urged to resiliently sealingly engage the exterior pipe surface 36 when the sleeve 42 is operatively mounted to the pipe 32. The inner body portion 112 also includes a resilient, circumferential pocket or channel 120 positionable in substantial alignment with the passageway 58. As can be seen in Figure 8, the base 121 of the channel 120 extends below the lowermost point of the outer flange portion 114. When the roof flashing assembly 20 is installed, the base 121 is urged against the edges of the sloped roof surface 26 defining the opening 24.

[0049] The channel 120 is defined by a downwardly concave surface 122, which spans between the proximal and distal edges 116 and 118 of the inner body portion 112. When viewed in cross-section, the channel 120 has a substantially semi-circular or parabolic profile (see Figure 8). However, the profile of the channel 120 is subject to change over time as the gasket 108 adaptively expands or contracts in response to expansion or contraction of the metal corrugated roof decking 30 caused by changes in the ambient temperature. The gasket's ability to responsively expand or contract tends to ensure that the distal edges 118 of the inner body portion 112 remain in constant sealing engagement with the exterior pipe surface 36.

[0050] The channel 120, however, need not have a curved profile. It can be configured to have any desired profile suitable. For instance, the channel could have a square, rectangular, triangular or trapezoidal profile.

5 **[0051]** In the preferred embodiment, an annular gasket is used to conform to the substantially circular cross-section of the pipe 32. However, it will be appreciated that non-annular gaskets could be employed in instances where the projection has a non-circular cross-section.

10 **[0052]** Referring to Figures 6 and 8, the inner body portion 112 is joined to the outer flange portion 114 along its proximal edges 116. The outer flange portion 114 has an upper surface 124 and an opposed lower surface 126. At its outermost edges, the outer flange portion 114 has an abutting wall 128 extending along its periphery. The abutting wall 128 stands proud of the upper surface 124. The
15 abutting wall 128 defines guiding means 130 for aligning the gasket 108 with the base portion 54 of the sleeve 42 during installation of the roof flashing assembly. The base portion 54 has outermost edges 132 which define a base portion footprint 134 (see Figure 4). The area on the upper surface 124 bounded by the abutting wall 128 is sized slightly larger than the base portion footprint 134 such
20 that when the sleeve 42 is operatively connected to the lower sealing means 46, the outermost edges 132 of the base portion 54 are urged into snug, close-fitting contact with the abutting wall 128, thereby aligning the sleeve 42 with the gasket 108 (see Figure 2).

25 **[0053]** In the preferred embodiment, the abutting wall 128 extends continuously along the periphery of the upper surface 124. However, in an alternative embodiment, the single continuous abutting wall 128 could be replaced with several aligning tabs positioned along the periphery of the upper surface 124. Further modifications to the guiding means are also possible. For instance, the
30 alignment arrangement described above could be reversed. The outermost edges of the upper surface could define an upper surface footprint and the base portion could have a downwardly depending wall extending about its periphery. The area bound by the downwardly depending wall of the base portion could be slightly

larger than the upper surface footprint such that the outermost edges of the upper surface are urged into close-fitting contact with the downwardly depending wall of the base portion.

5 **[0054]** Referring to Figures 7 and 8, a plurality of concentrically mounted, resilient, ring seal members 136, 138, 140, 142, 144 and 146 (collectively designated with reference number 148) depend downwardly from the lower surface 126 of the outer flange portion 114. The ring seal members 148 have diameters of outwardly increasing magnitude. As will be explained in greater detail below, the
10 ring seal members 148 are sized and configured to maintain sealing contact with the slope roof surface 26 when the roof flashing assembly 20 is operatively connected thereto.

15 **[0055]** The ring seal members 148 each have proximal edges 150 joined to the lower surface 126 and opposed free or distal edges 152. When viewed in cross-section, the ring seal members 148 each have a generally triangular profile with each ring seal member tapering downwardly from its respective proximal edges 150 to its respective distal edges 152. An inner face 154 and an outer face 156 define the triangular profile of each ring seal member. In the preferred embodiment
20 shown in Figure 7, the outer faces 156 of the ring seal members 148 are disposed substantially perpendicular to the longitudinal gasket axis 111 whereas the inner faces 154 thereof have a substantially skewed orientation relative to the longitudinal gasket axis 111. With their inner and outer faces 154 and 156 oriented in this manner, the ring seal members 148 have a tendency to flex outwardly when urged
25 against the sloped roof surface 26 during installation of the roof flashing assembly 20, as shown in Figure 2. The outwardly flexed ring seal members 148 frictionally engage the sloped roof surface 26 to provide enhanced watertight sealing action therewith. The flex in the ring seal members 148 allows the latter to deform adaptively in response to expansion and contraction of the metal corrugated roof
30 decking 30 caused by changes in the ambient temperature.

[0056] Referring to Figures 11 and 12, the lower sealing means 190 may include a notched portion 192, which permits outward drainage of any trapped water

between the lower seal and the roof deck. Water may penetrate past the outer ring 194 and freeze in certain weather conditions. Freezing may lead to further deformation of lower sealing means 190, which may in turn cause water penetration to the second seal ring 196. The notch 192 permits outward drainage of any trapped water. The notch interrupts the two outer seal rings 194 and 196 and is approximately 1/2" X 1/2" in dimension. In the installed position the notched portion 192 is always situate on the downward or the low point of the roof flashing assembly, namely facing the soffit of the sloped roof.

[0057] Other orientations of the outer and inner faces of the ring seal members are possible. For instance, in an alternative embodiment shown in Figure 9, a gasket 158 generally similar to gasket 108 is provided with a plurality of ring seal members collectively designated with reference numeral 160. The ring seal members 160 each have a generally triangular profile defined by an inner face 162 and an outer face 164 thereof. In this embodiment, however, both the inner and outer faces 162 and 164 have substantially skewed orientations relative to the longitudinal gasket axis 111.

[0058] In another alternative embodiment shown in Figure 13, a gasket 198, generally similar to gasket 108 or gasket 158, is provided with a plurality of ring seal members collectively designated with reference numeral 200. The ring seal members 200 each have a generally triangular profile defined by an inner face 202 and an outer face 204 thereof. In this embodiment, a substantially flat base region 206 separates the ring seal members. This ring seal configuration permits, in an installed position, greater flattening of the lower seal member onto the roof deck.

[0059] In the preferred embodiment, the gasket 108 has six ring seal members 136, 138, 140, 142, 144 and 146. However, it will be appreciated that the gasket 108 can be provided with fewer ring seal members, such as four or five ring seal members. In a further alternative, a single ring seal member may be used. Conversely, a gasket having more than six ring seal members could be employed to similar advantage.

[0060] Preferably, the gasket 108 is molded from EPDM, the same material used to fabricate the sleeve 42. However, the gasket could be molded from other suitable materials.

5 **[0061]** Referring to Figures 2 and 3, the anchoring means 48 includes a generally planar hold-down ring 166 and a plurality of fasteners 168 for securing the hold-down ring 166 to the sloped roof surface 26. The hold-down ring 166 has a central aperture 172 defined therein sized to receive the sleeve 42 therethrough during installation of the roof flashing assembly 20. A plurality of relatively smaller
10 openings 174 are also formed in the hold-down ring 166 to accommodate the fasteners 168. The hold-down rings 166 have a footprint defined by its innermost edges 178 and its outermost edges 180. The footprint of the hold-down ring 166 corresponds generally to the width of the peripheral flange 104 of the base portion 54. The hold-down ring 166 is deformable to adaptively conform to the non-planar
15 profile of the metal corrugated roof decking 30 when placed in abutting relation thereto. Preferably, the hold-down ring 166 is made of cast aluminum. However, other suitable corrosion-resistant materials could also be used. Preferably, the fasteners 168 are lock rivets, but other fasteners such as bolts, screws and the like could also be used.

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[0062] With reference to Figure 2, a typical installation of the roof flashing apparatus 20 is now described. The gasket 108 is fitted over the pipe 32 and urged in abutting relation with the sloped roof surface 26. The gasket 108 is pressed down onto the corrugations 28 to conform to the profile of the corrugated metal roof
25 decking 30. The base 121 of the channel 120 is urged against the edges of the sloped roof surface 26 defining the opening 24. Care is taken to ensure that the inner body portion 112 frictionally sealingly engages the exterior pipe surface 32 along the distal edges 118. To facilitate installation, a non-petroleum based lubricant may be applied on either the distal edges 118 of the inner body portion
30 112 or on the exterior pipe surface 32.

[0063] Subsequently, the sleeve 42 is fitted over the pipe 32 and aligned with the gasket 108 by urging the outermost edges 132 of the base portion 54 to frictionally

sealingly engage the abutting wall 128 of the gasket 108. During the alignment step, the bellows tube 66 flexes adaptively to allow the sleeve 42 to conform to the generally skewed orientation of the pipe 32 relative to the sloped roof surface 26. In addition, the free edges 96 of the beveled lip members 98, 99 and 100 are urged
5 into frictional sealing engagement with the exterior pipe surface 36 at various locations along the pipe 32.

[0064] Once the sleeve 42 has been properly positioned on the gasket 108, the hold-down ring 166 is placed onto the peripheral flange 104 of the base portion 54.
10 Openings 182 are then drilled into the peripheral flange 104 and the fasteners 168 are secured to the metal corrugated roof decking 30 thereby anchoring the sleeve 42 and gasket 108 thereto. As the fasteners 168 are being secured the hold-down ring 166 is urged to bear against the peripheral flange 104 and the gasket 108 causing the ring seal members 148 to flex outwardly and frictionally sealingly
15 engage the sloped roof surface 26.

[0065] While in the preferred embodiment the roof flashing assembly 20 is installed on the sloped roof surface 26, which has a non-planar corrugated profile, it will be appreciated that the roof flashing assembly 20 may be used to similar
20 advantage on a sloped roof surface having a generally planar profile. Referring to Figure 10, a roof flashing assembly 184 similar to the roof flashing assembly 20 previously described, is operatively mounted to a sloped roof surface 186. The sloped roof surface 186 has a generally planar profile.

[0066] Although the above description and accompanying drawings relate to
25 specific preferred embodiments of the present invention as presently contemplated by the inventor, it will be understood that various changes, modifications and adaptations may be made without departing from the spirit of the invention.

THE EMBODIMENTS OF THE INVENTION IN WHICH AN EXCLUSIVE PROPERTY OR PRIVILEGE IS CLAIMED ARE DEFINED AS FOLLOWS:

1. A roof flashing assembly for use on a sloped roof surface having an elongate projection extending substantially upwardly therefrom in skewed relation thereto, the projection having at least one side wall defining an external surface, the roof flashing assembly comprising:
a resilient, flexible, sleeve sized to fit over, and surround, the at least one side wall of the projection; the sleeve having a base portion for location adjacent to the roof surface, an upstanding neck portion joined thereto and a passageway defined between the base portion and the neck portion for receiving the projection therethrough;
the neck portion having a proximal end adjacent to the base portion, a distal end opposite the proximal end, and bellows means disposed between the proximal and distal ends in substantially coaxial relation with the passageway; the bellows means permitting the sleeve to flex adaptively to accommodate for the skewed orientation of the projection relative to the sloped roof surface;
a resilient upper sealing means positionable adjacent to the distal end of the neck portion in surrounding relation with the projection for frictionally sealingly engaging the external surface of the projection;
a resilient lower sealing means positionable below the base portion in surrounding relation with the projection for sealingly engaging the external surface of the projection, the lower sealing means being sized and configured to frictionally sealingly engage the roof surface when urged in abutting relation therewith; and
anchoring means for securing the sleeve and the sealing means to the sloped roof surface.
2. The roof flashing assembly of claim 1 wherein the upper sealing means includes a grommet having an aperture defined therein, the aperture being sized and shaped to permit close-fitting frictional sealing engagement between the grommet and the exterior surface of the projection.

3. The roof flashing assembly of claim 2 wherein the grommet is an annular grommet having a circumferential wall defining an interior grommet surface, and circumferential lip means extending radially inward from the interior grommet surface; the interior grommet surface and the circumferential lip means co-operating one with the other to define the grommet aperture.
4. The roof flashing assembly of claim 3 wherein the circumferential lip means includes at least one beveled lip member terminating with a free edge; the free edge of the at least one beveled lip member being urged to bear against the exterior surface of the projection in frictional sealing engagement therewith when the roof flashing assembly is operatively connected to the roof surface.
5. The roof flashing assembly of claim 4 wherein the circumferential lip means includes three, vertically spaced, beveled lip members.
6. The roof flashing assembly of claim 5 wherein the beveled lip members have internal diameters of equal size.
7. The roof flashing assembly of claim 2 wherein the shape of the grommet aperture is chosen from the group consisting of: (a) substantially circular; (b) substantially triangular; (c) substantially square; and (d) substantially rectangular.
8. The roof flashing assembly of claim 1 wherein the upper sealing means is integrally formed with the neck portion of the sleeve.
9. The roof flashing assembly of claim 8 wherein the upper sealing means is fabricated from EPDM.

10. The roof flashing assembly of claim 1 wherein the grommet is releasably detachable from the distal end of the neck portion.
11. The roof flashing assembly of claim 10 wherein the grommet is fabricated from a homogeneous elastomeric material.
12. The roof flashing assembly of claim 11 wherein the homogeneous elastomeric material is chosen from the group consisting of: (a) rubber; (b) neoprene; and (c) polyurethane.
13. The roof flashing assembly of claim 1 wherein:
the sleeve is formed along a longitudinal sleeve axis; and
the neck portion has an undulated wall extending about its periphery, the undulated wall having formed therein in a direction substantially perpendicular to the longitudinal sleeve axis at least one circumferential bulge alternately disposed with at least one circumferential furrow, the at least one circumferential bulge and the at least one circumferential furrow defining the bellows means.
14. The roof flashing assembly of claim 13 wherein the undulated wall of the neck portion has formed therein first and second circumferential bulges alternately disposed with first and second circumferential furrows.
15. The roof flashing assembly of claim 14 wherein the first and second bulges each have an internal diameter, the internal diameter of the first bulge being equal to the internal diameter of the second bulge.
16. The roof flashing assembly of claim 1 wherein:
the lower sealing means includes an annular gasket formed about a longitudinal gasket axis, the annular gasket having an outer flange portion surrounding an inner body portion;
the outer flange portion having an upper surface for abutting the base portion and a lower surface dimensioned and adapted for sealingly

engaging the roof surface when the roof flashing assembly is operatively connected to the roof surface;

the inner body portion having proximal edges joined to the outer flange portion and opposed distal edges, the distal edges defining an aperture of the gasket through which the projection is received, the distal edges being urged to bear against the exterior surface of the projection in frictional sealing engagement therewith when the roof flashing assembly is operatively connected to the roof surface.

17. The roof flashing assembly of claim 16 wherein the inner body portion further includes a circumferential channel disposed between the proximal edges and the distal edges thereof.
18. The roof flashing assembly of claim 17 wherein the channel has a substantially curved profile.
19. The roof flashing assembly of claim 18 wherein the profile of the channel is substantially semi-circular.
20. The roof flashing assembly of claim 18 wherein the profile of the channel is substantially parabolic.
21. The roof flashing assembly of claim 17 wherein the channel is defined by a downwardly concave surface extending between the proximal and distal edges of the inner body portion.
22. The roof flashing assembly of claim 16 wherein the outer flange portion has at least one resilient ring seal member downwardly depending from its lower surface, the at least one ring seal member having a generally triangular profile when viewed in cross-section.
23. The roof flashing assembly of claim 22 wherein the at least one ring seal member tapers downwardly from the lower surface of the outer flange

portion to terminate at a free edge, the free edge of the at least one ring seal member being urged to bear against the roof surface in frictional sealing engagement therewith when the roof flashing assembly is operatively connected thereto.

24. The roof flashing assembly of claim 23 wherein the inner body portion further includes a circumferential channel disposed between the proximal edges and the distal edges thereof, the channel having a base, the base of the channel extending downwardly beyond the free edge of the at least one ring seal member.
25. The roof flashing assembly of claim 22 wherein:
the generally triangular profile of the at least one ring seal member is defined by an inner face and an outer face;
the outer face being disposed substantially perpendicular to the longitudinal gasket axis; and
the inner face being disposed askew of the longitudinal gasket axis.
26. The roof flashing assembly of claim 22 wherein:
the generally triangular profile of the at least one ring seal member is defined by an inner face and an outer face;
both the inner and outer faces being disposed askew of the longitudinal gasket axis.
27. The roof flashing assembly of claim 22 wherein the outer flange portion has a plurality of concentrically mounted, resilient ring seal members downwardly depending from its lower surface, the plurality of ring seal members having diameters of outwardly increasing magnitude.
28. The roof flashing assembly of claim 27 wherein the outer flange portion has six ring seal members.

29. The roof flashing assembly of claim 16 further including means for aligning the annular gasket with the base portion of the sleeve.
30. The roof flashing assembly of claim 29 wherein:
the base portion has an outwardly flaring peripheral flange, the peripheral flange having outermost edges; and
the aligning means is defined by an abutting wall extending along the periphery of the outer flange portion and standing proud of the upper surface thereof, the abutting wall being sized to permit close-fitting frictional engagement with the outermost edges of the peripheral flange when the roof flashing assembly is operatively mounted to the roof surface.
31. The roof flashing assembly of claim 16 wherein the gasket is fabricated from EPDM.
32. The roof flashing assembly of claim 1 wherein the anchoring means includes a hold-down ring and a plurality of fasteners for attaching the hold-down ring to the roof surface.
33. The roof flashing assembly of claim 32 wherein the hold-down ring is deformable to adapt to a non-planar profile of the roof surface.
34. The roof flashing assembly of claim 33 wherein the hold-down ring is cast aluminum.
35. The roof flashing assembly of claim 1 wherein the sleeve is fabricated from EPDM.

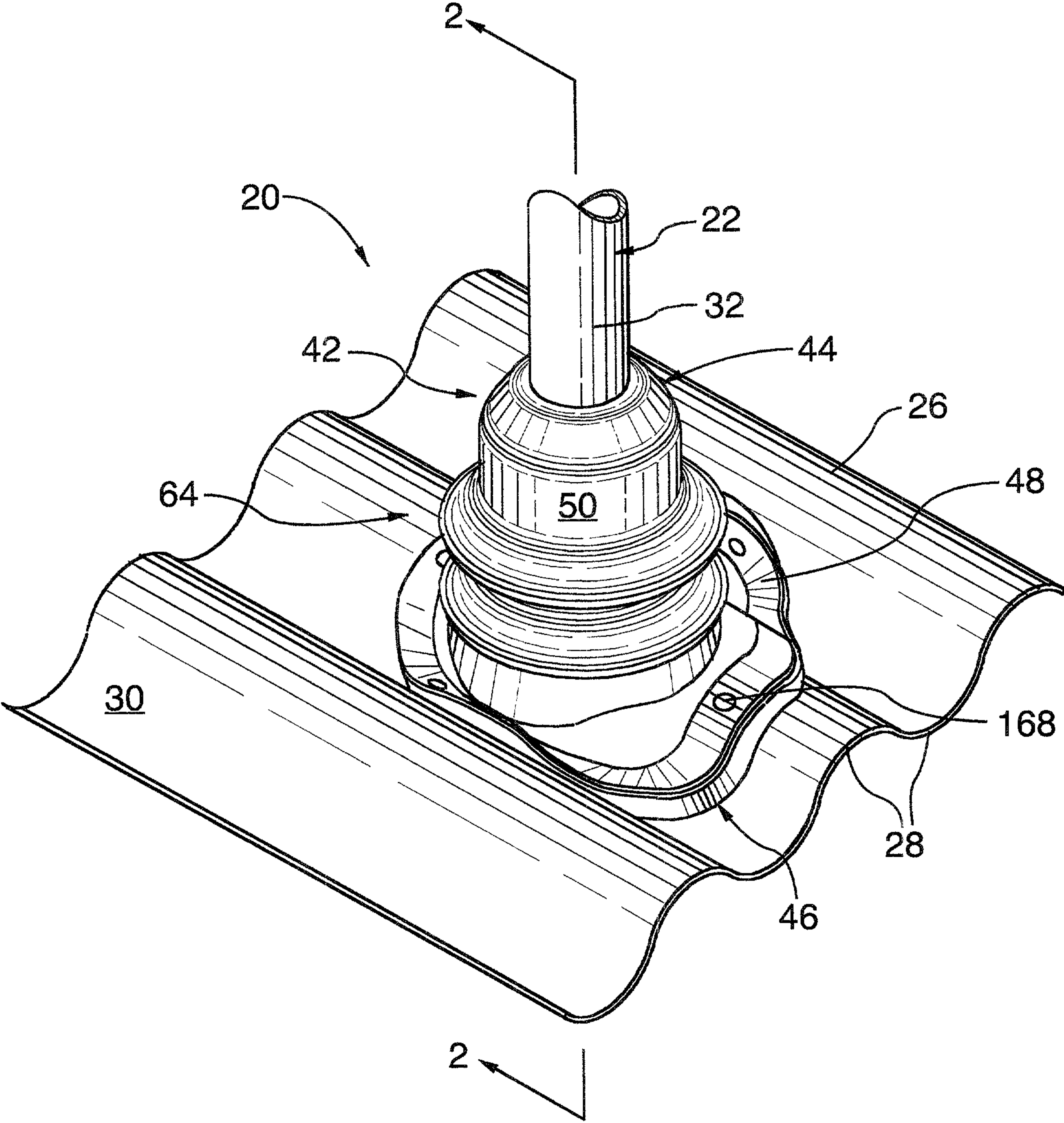


FIG 1

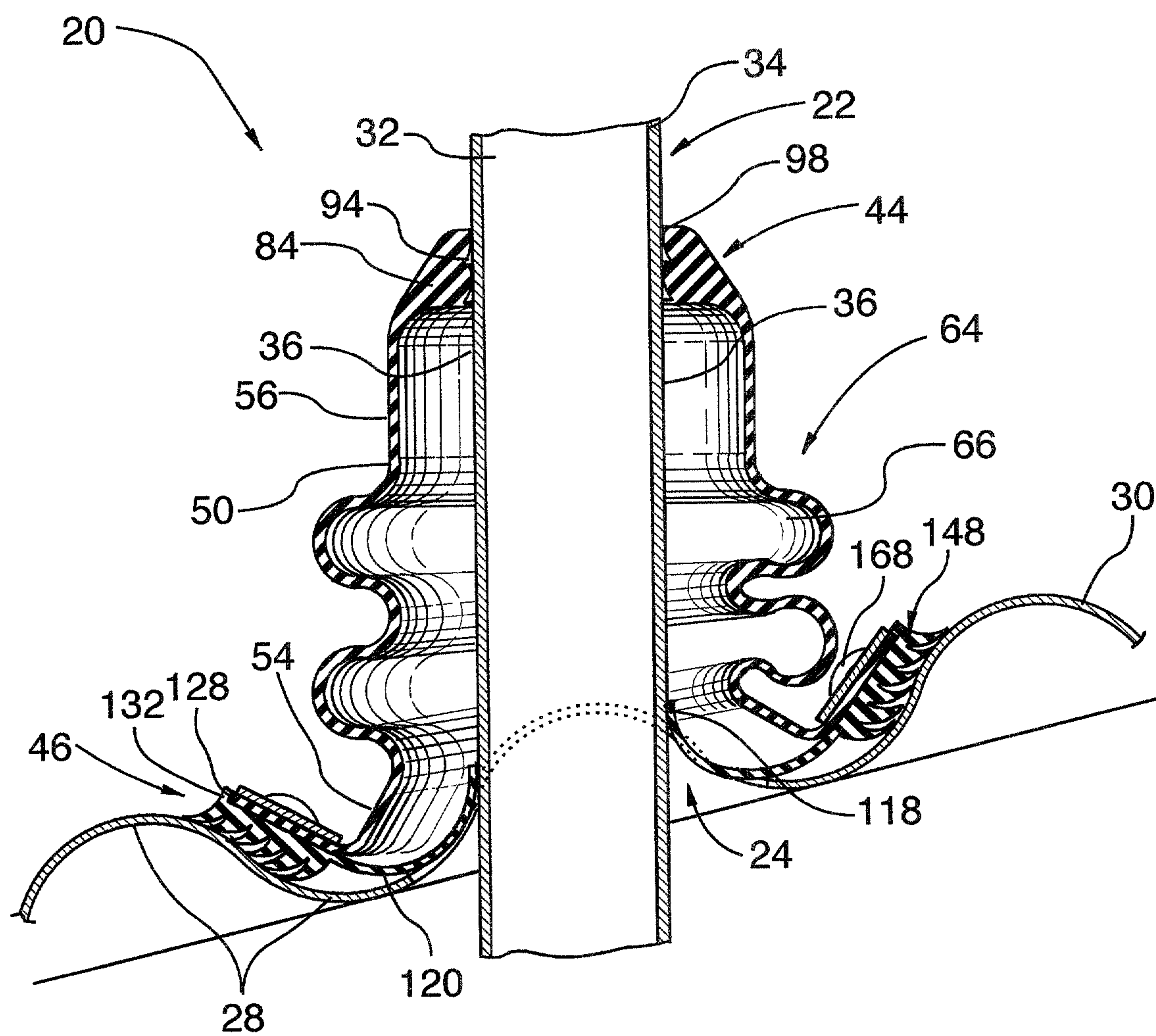


FIG.2

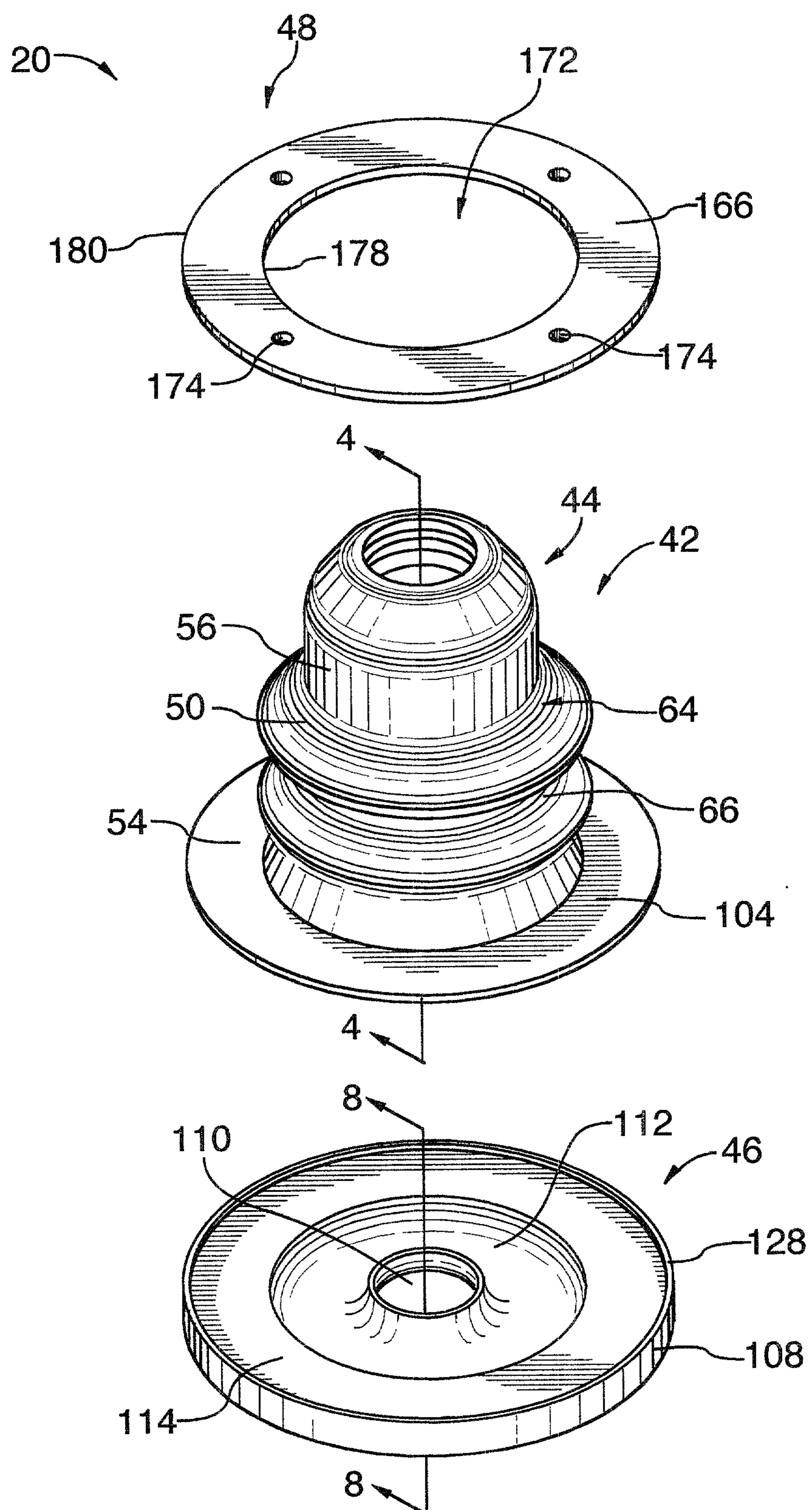


FIG. 3

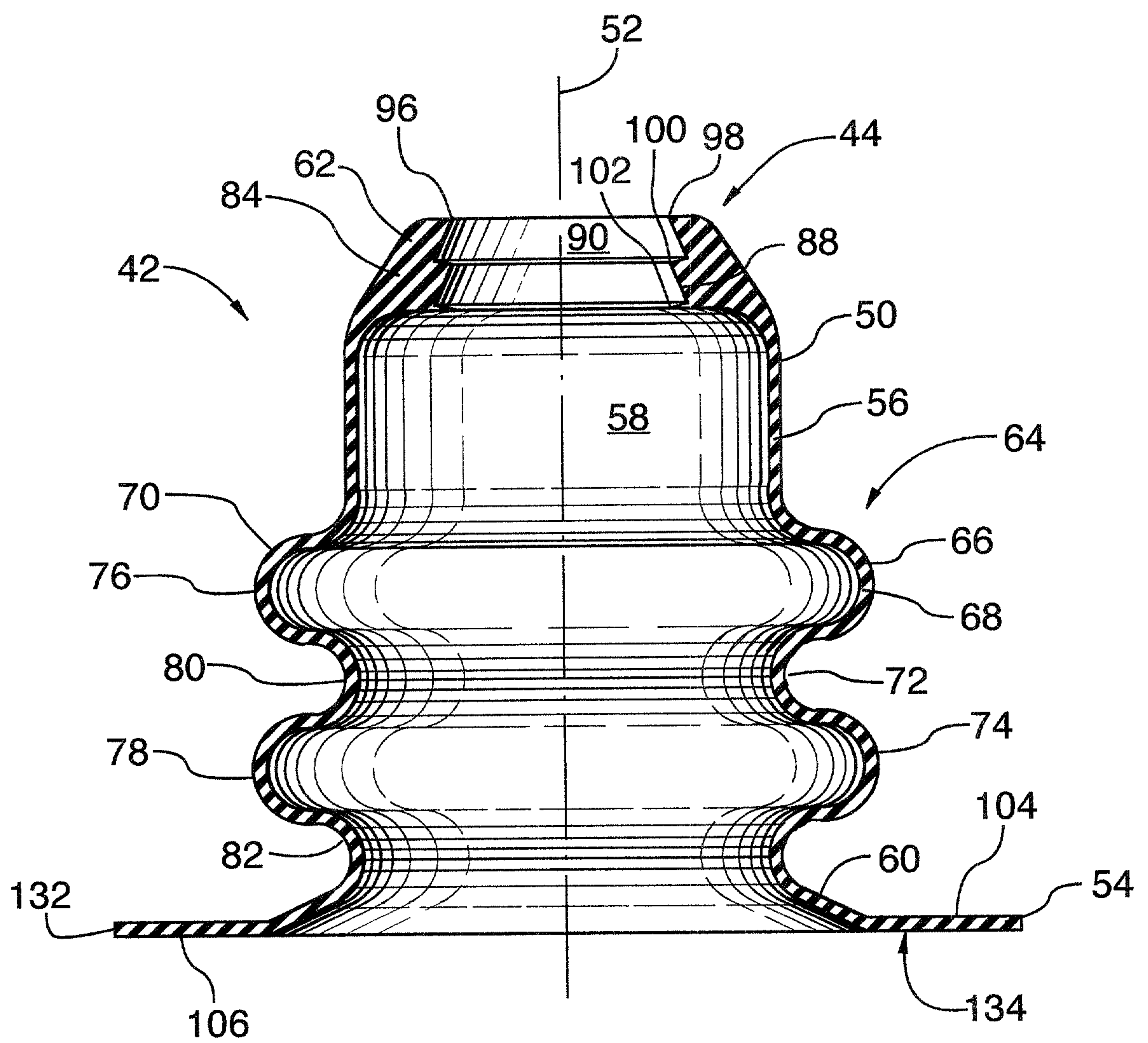


FIG.4

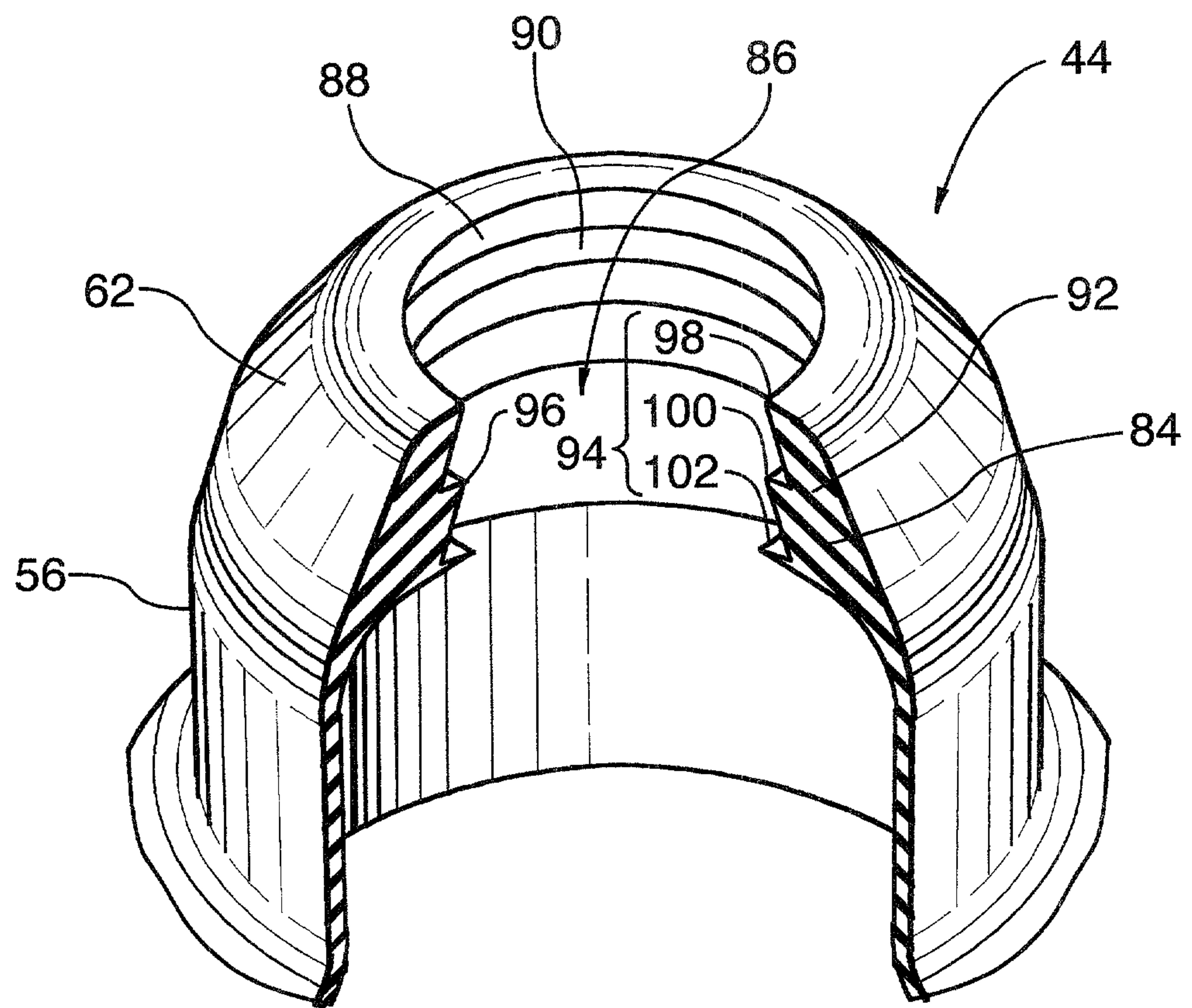


FIG.5

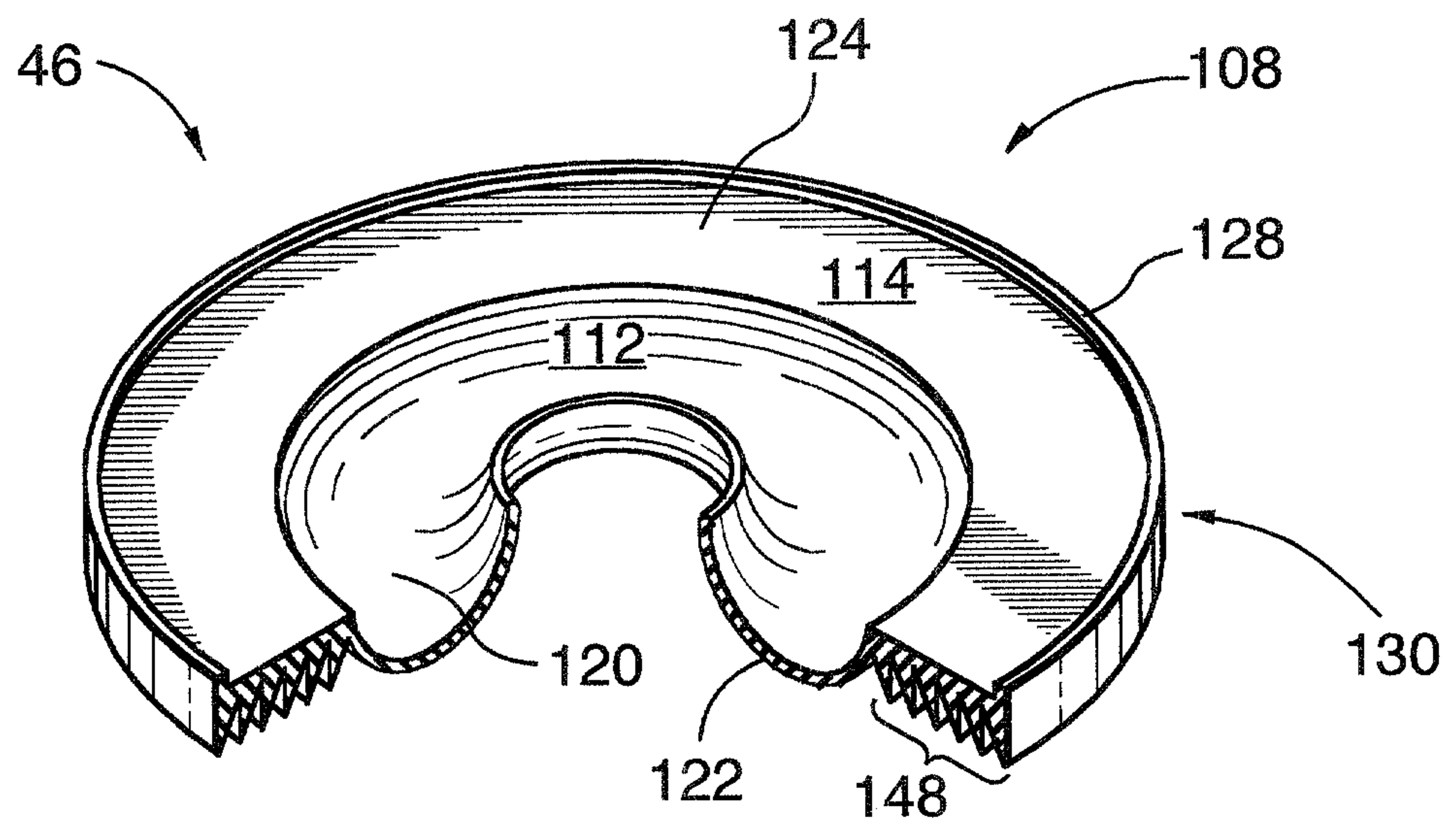


FIG. 6

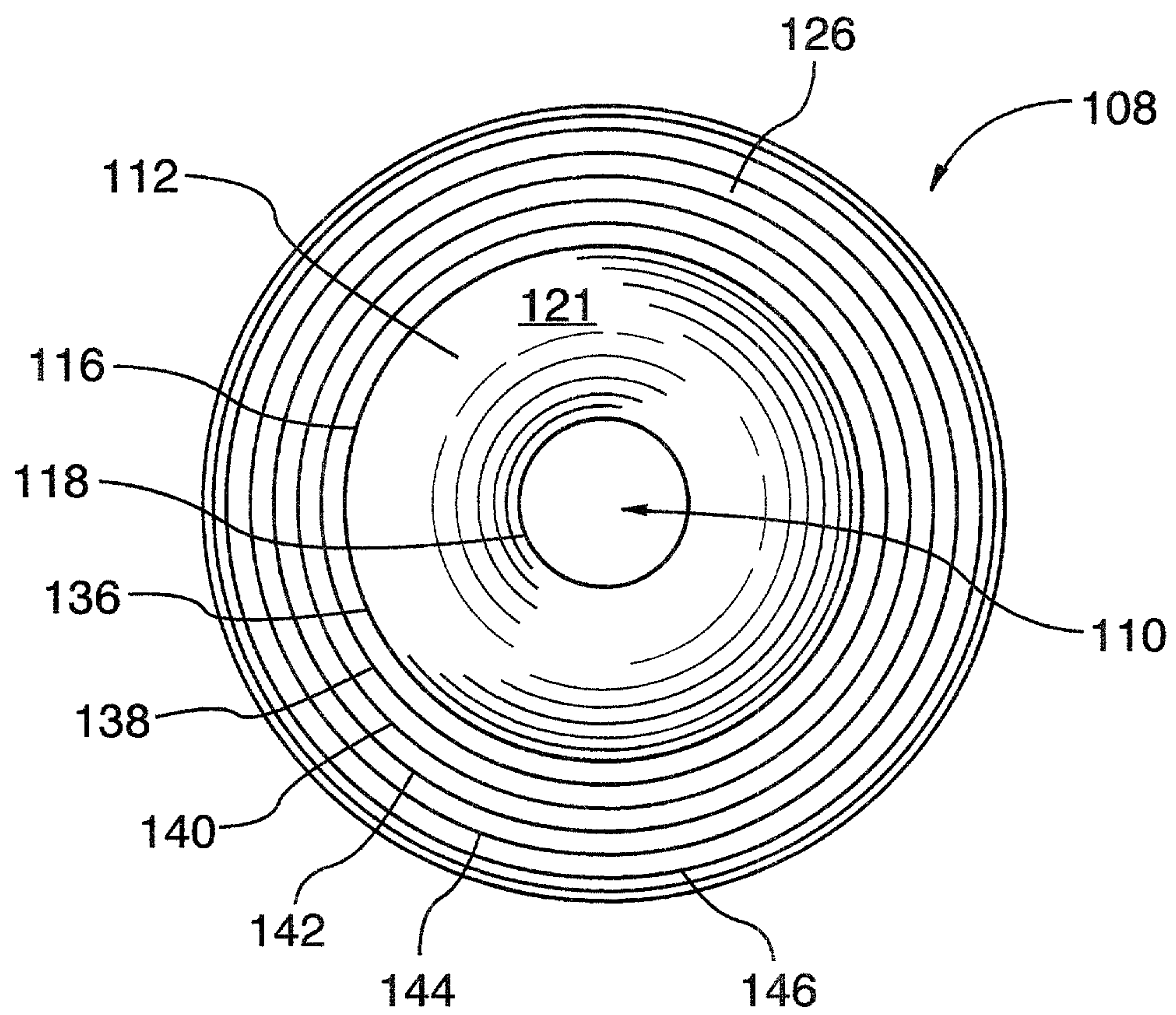


FIG. 7

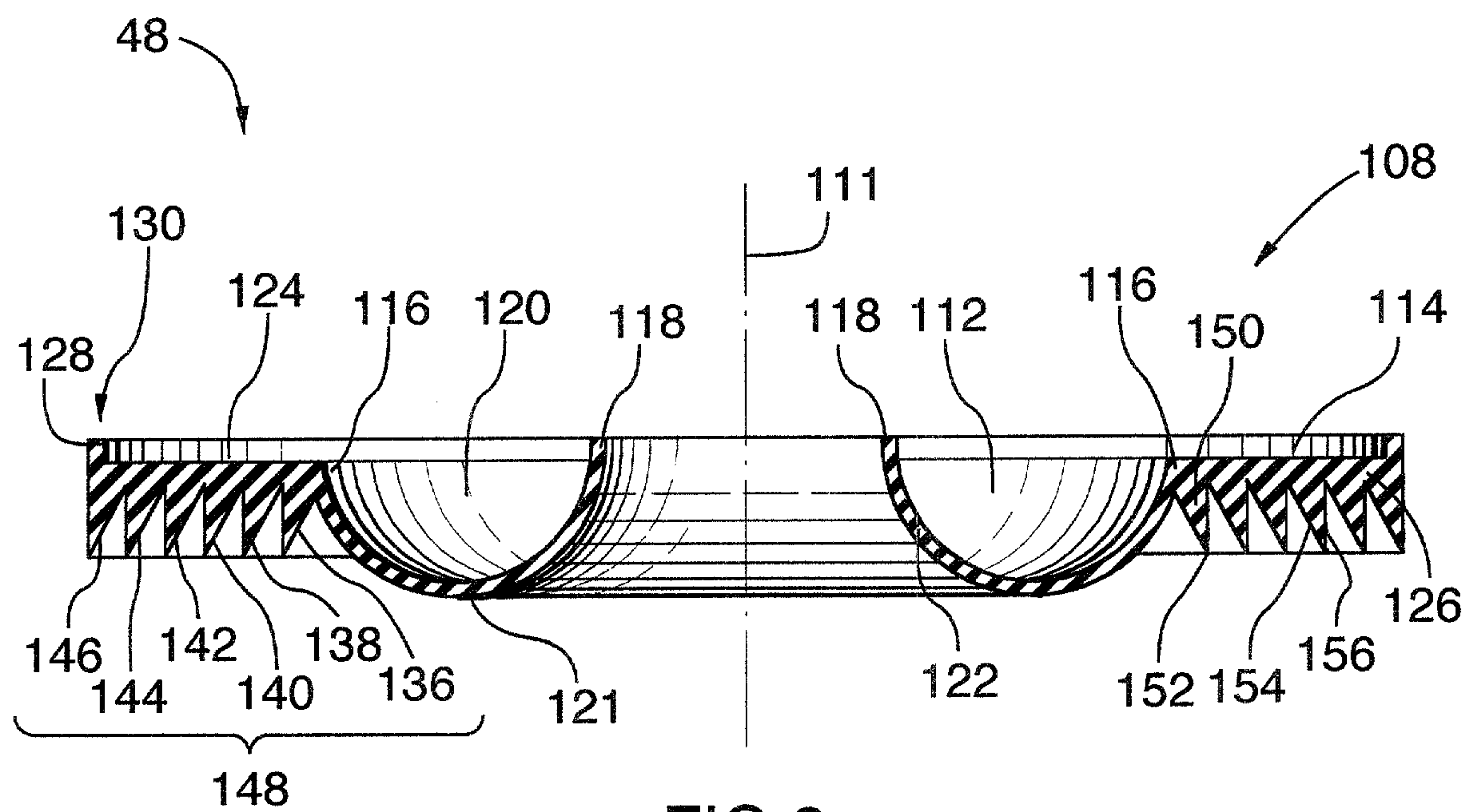


FIG. 8

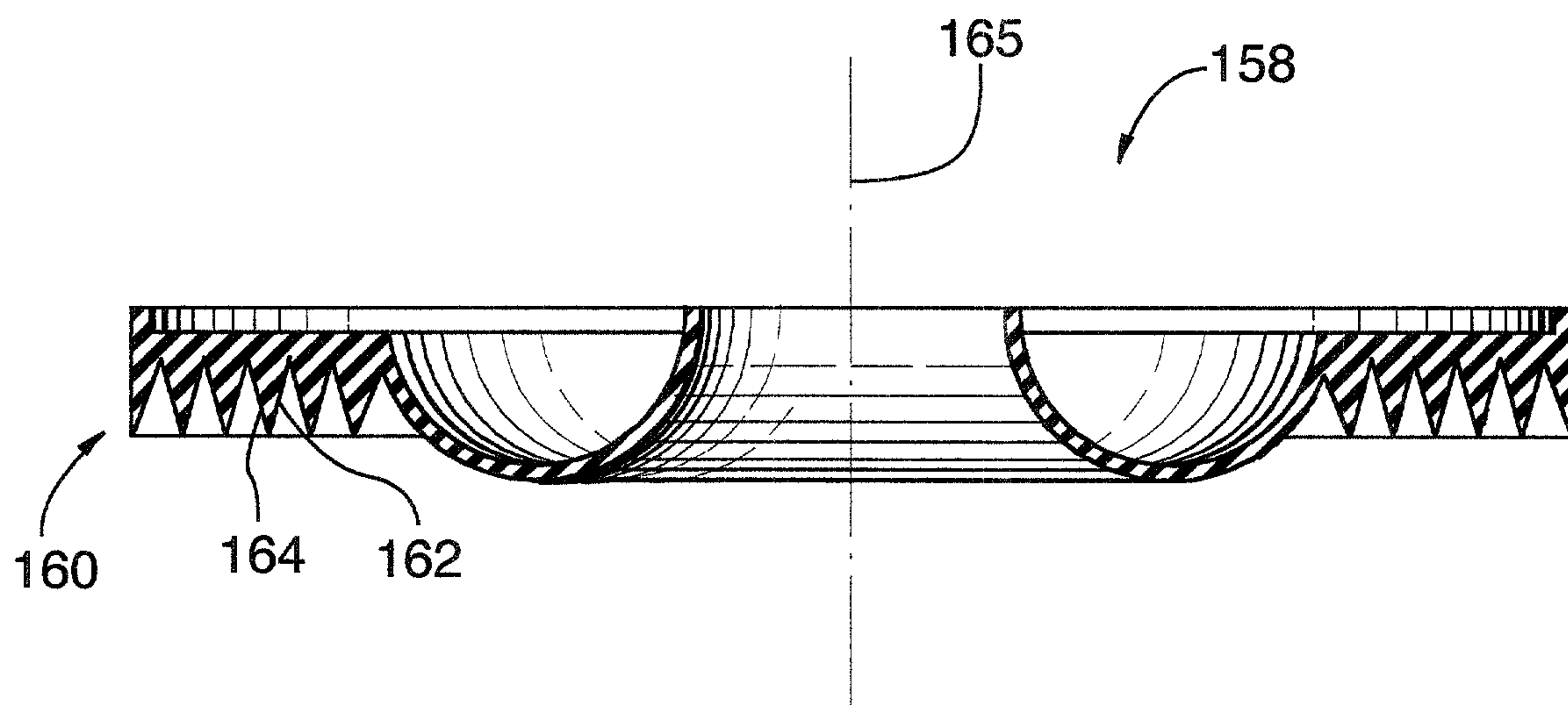


FIG. 9

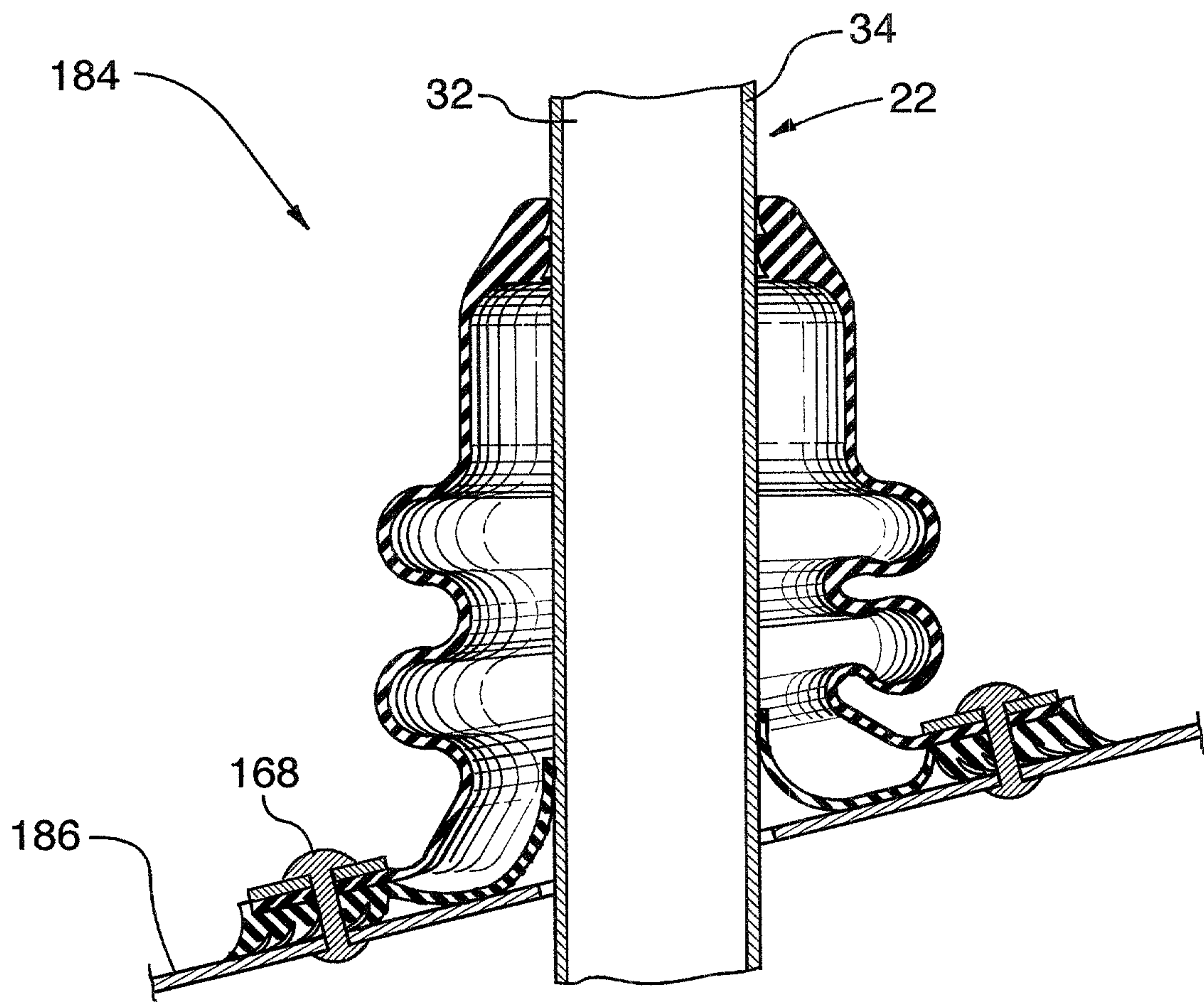


FIG.10

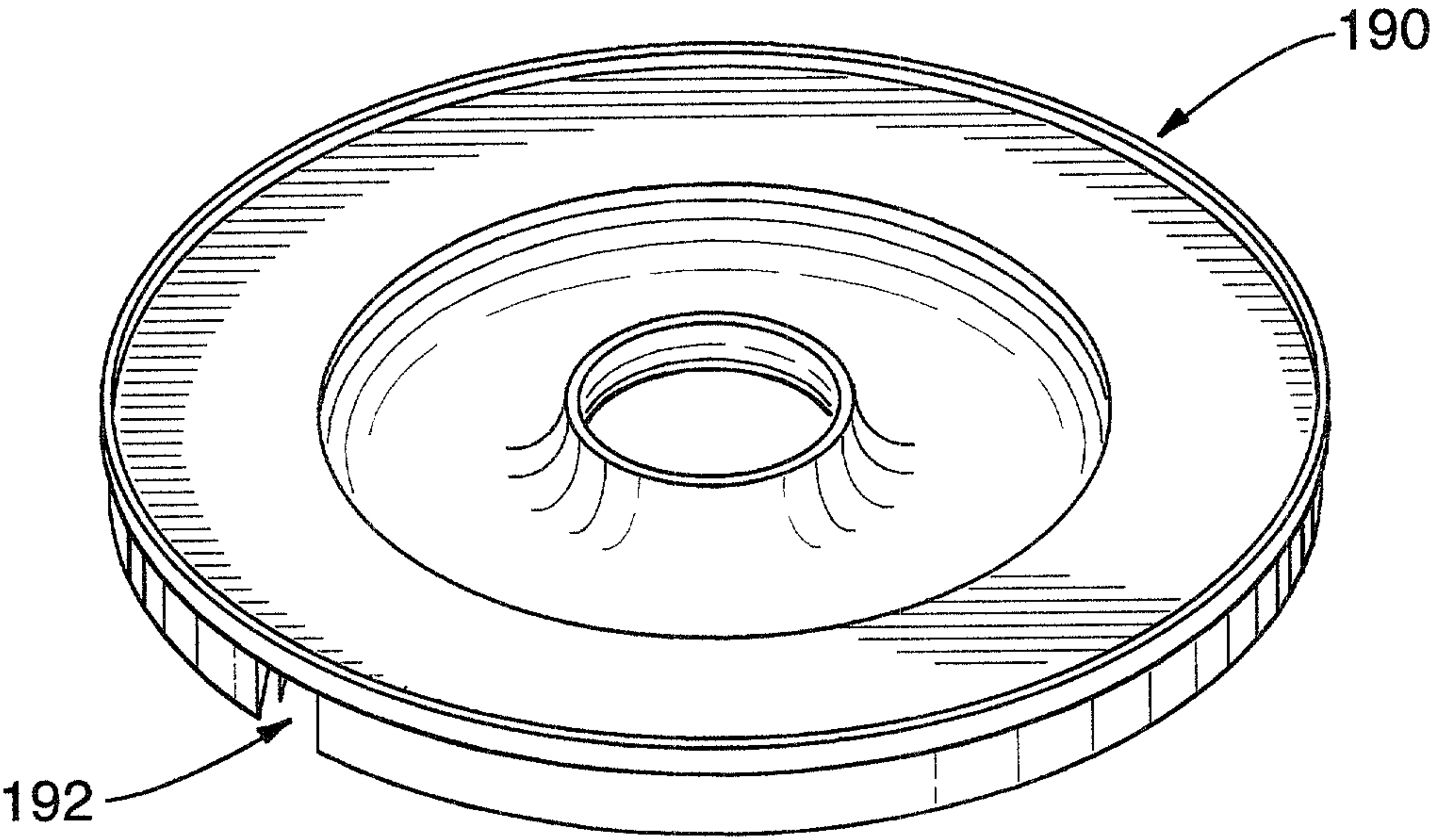


FIG.11

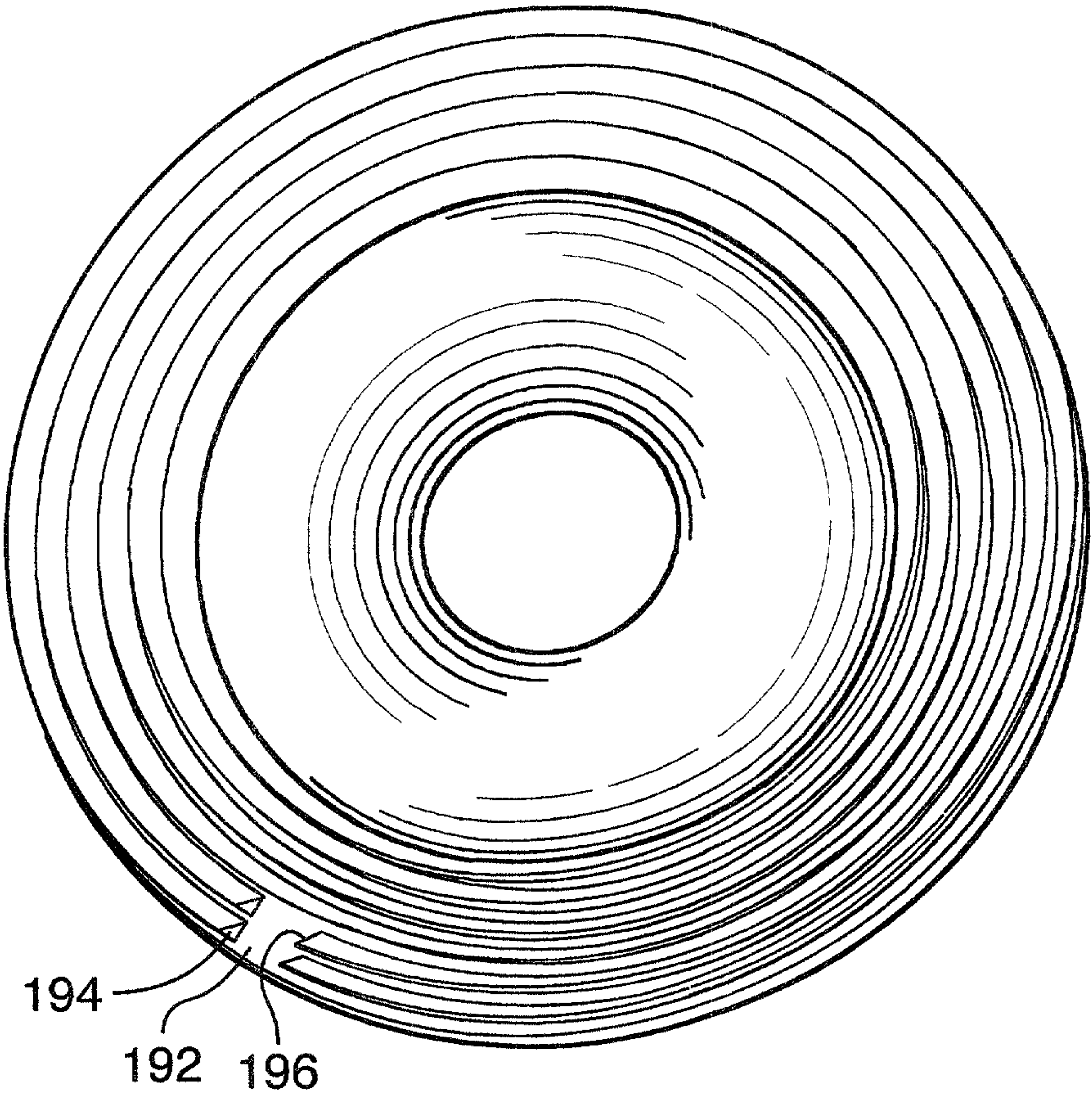


FIG.12

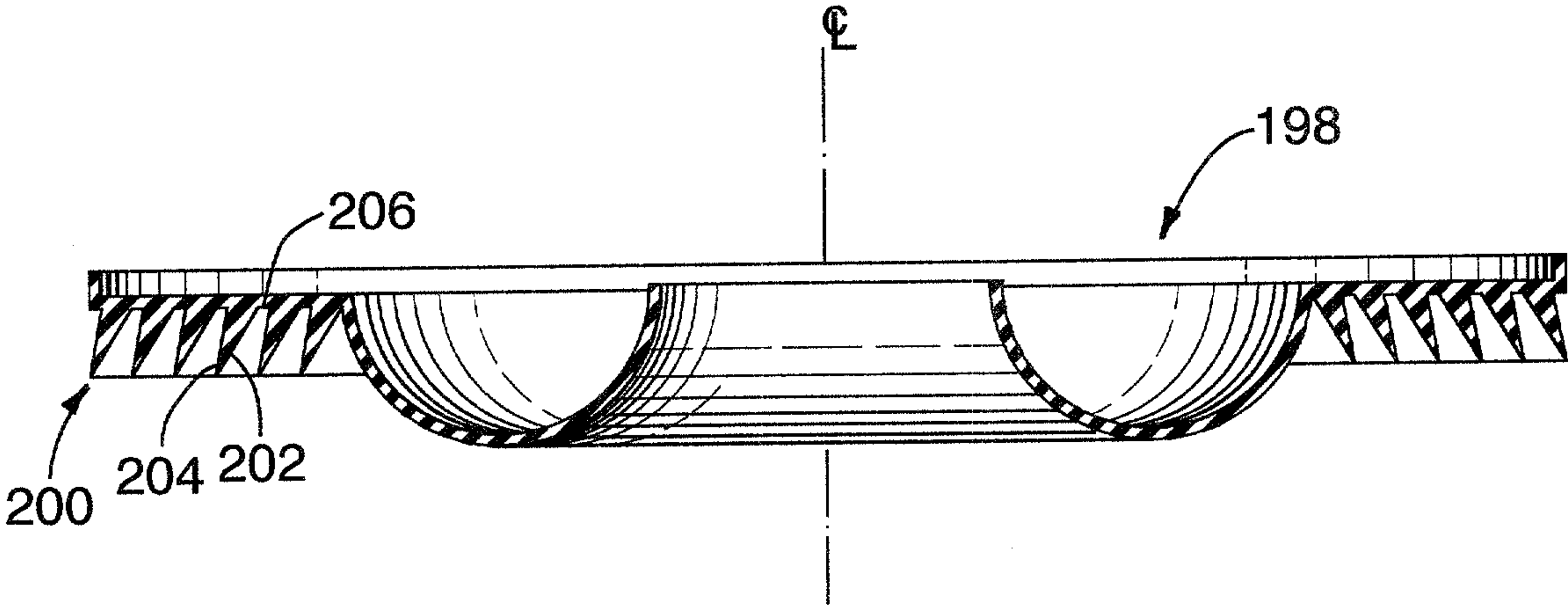


FIG.13

