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(54) **ROOF FLASHING ASSEMBLY**

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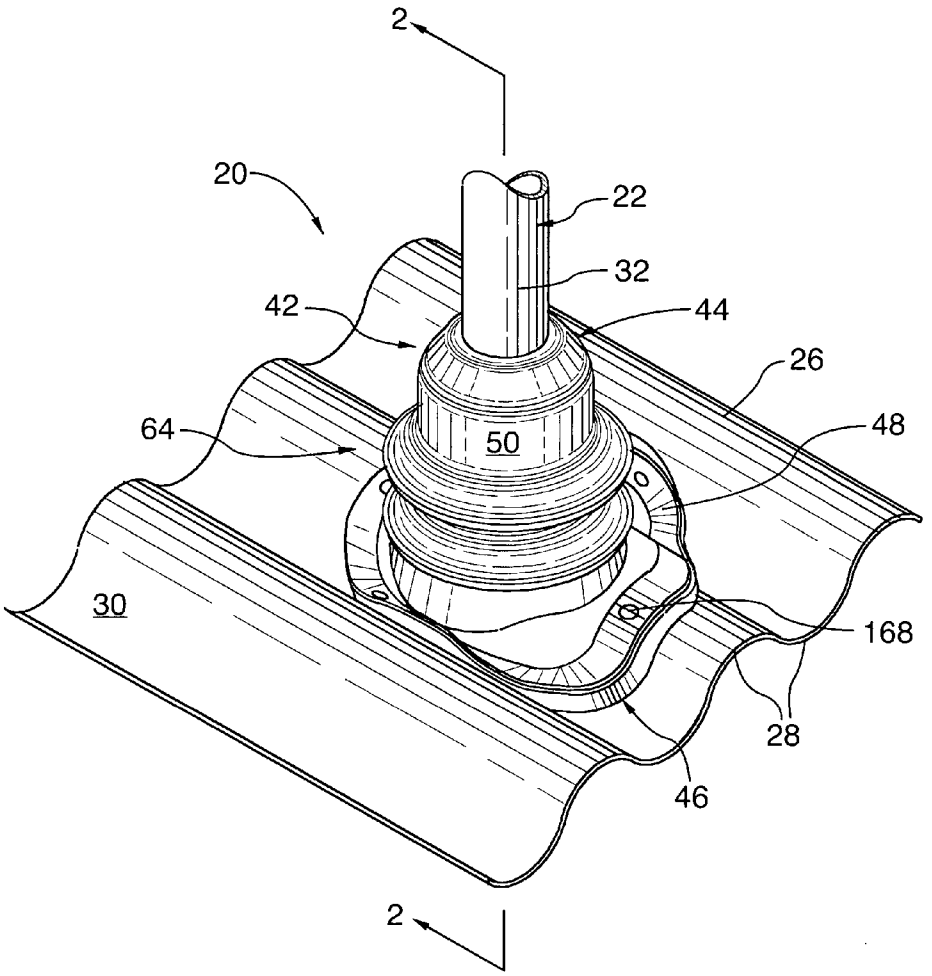
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(57) **ABSTRACT**

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.



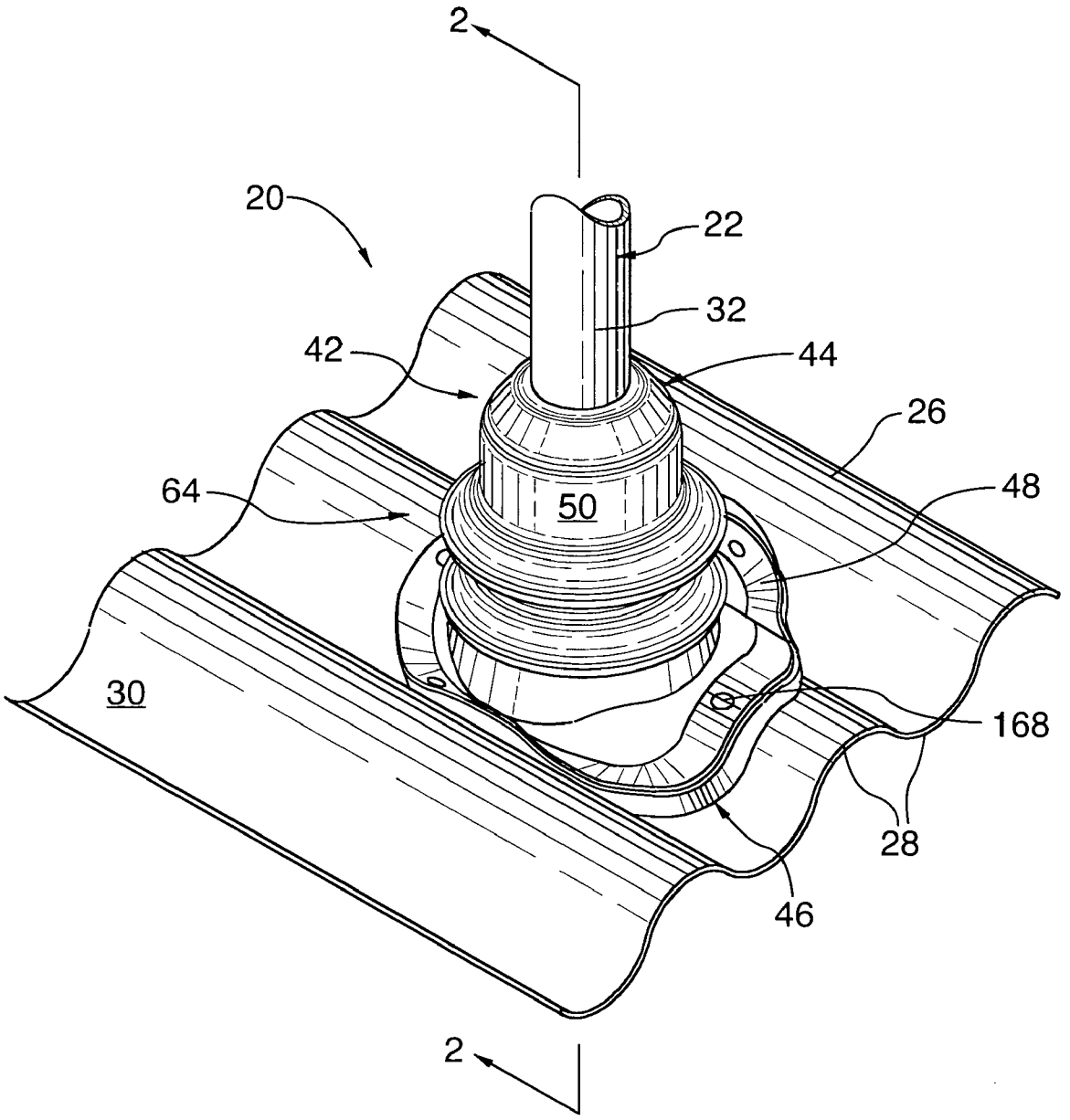


FIG 1

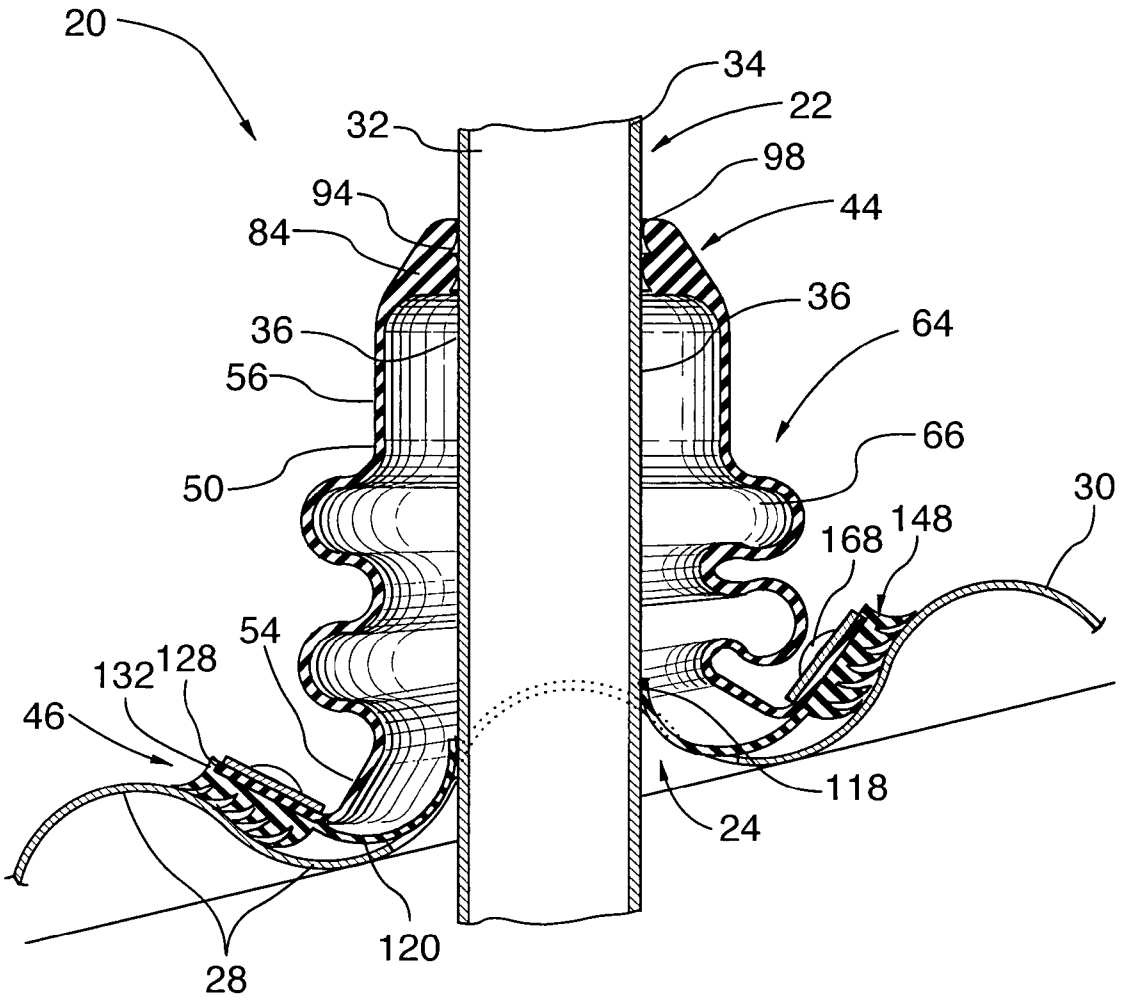

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FIG.2

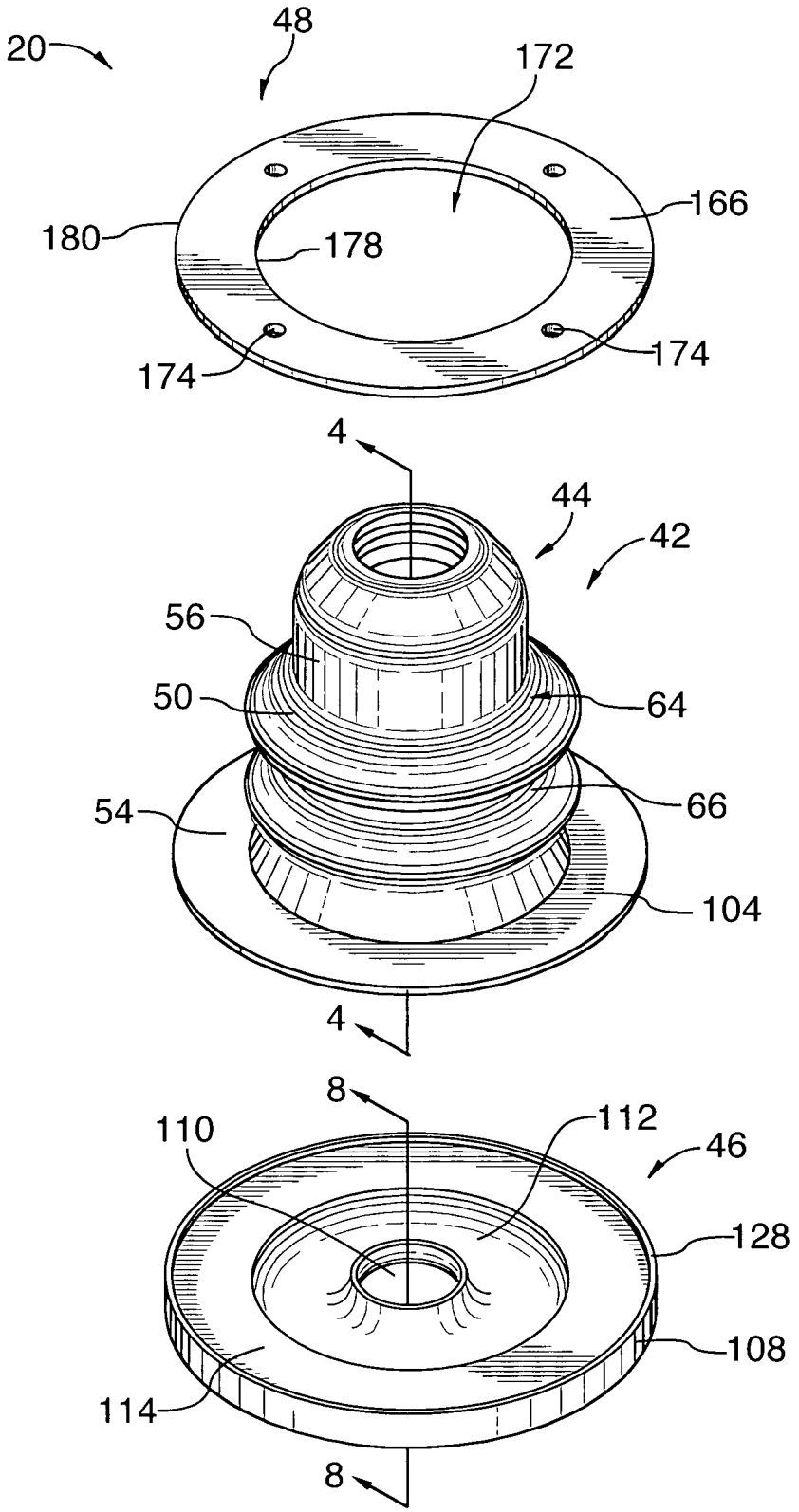

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FIG.3

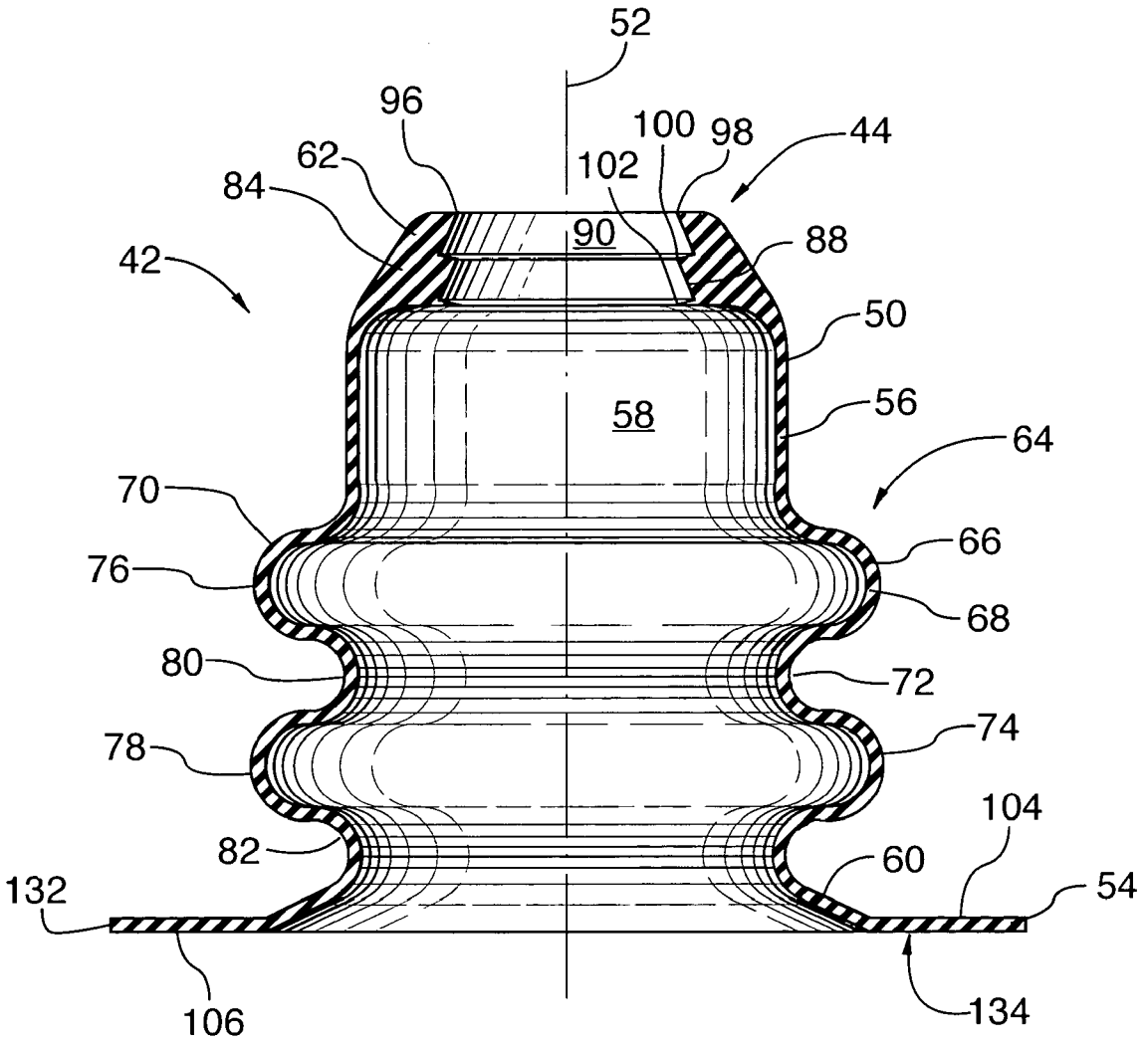

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FIG.4

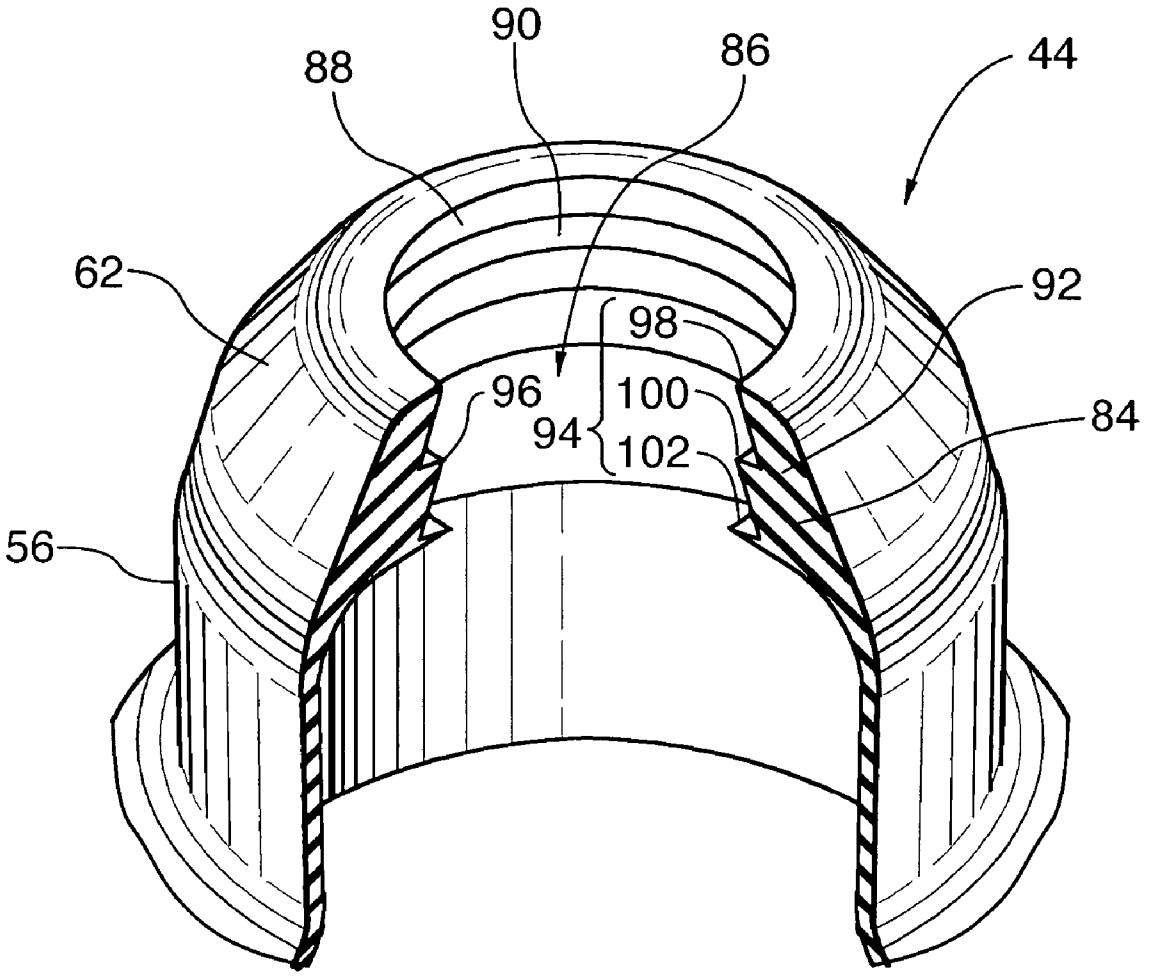


FIG.5

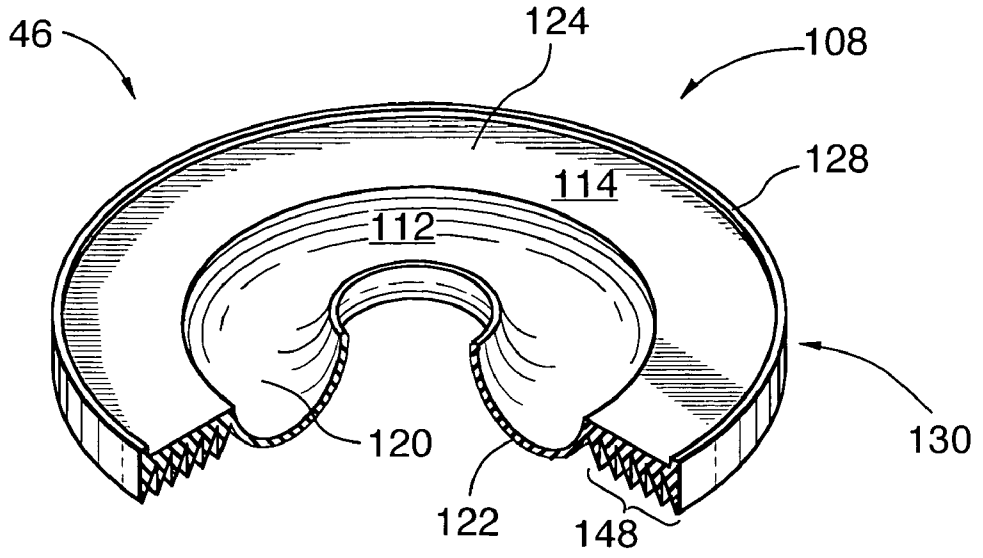

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FIG.6

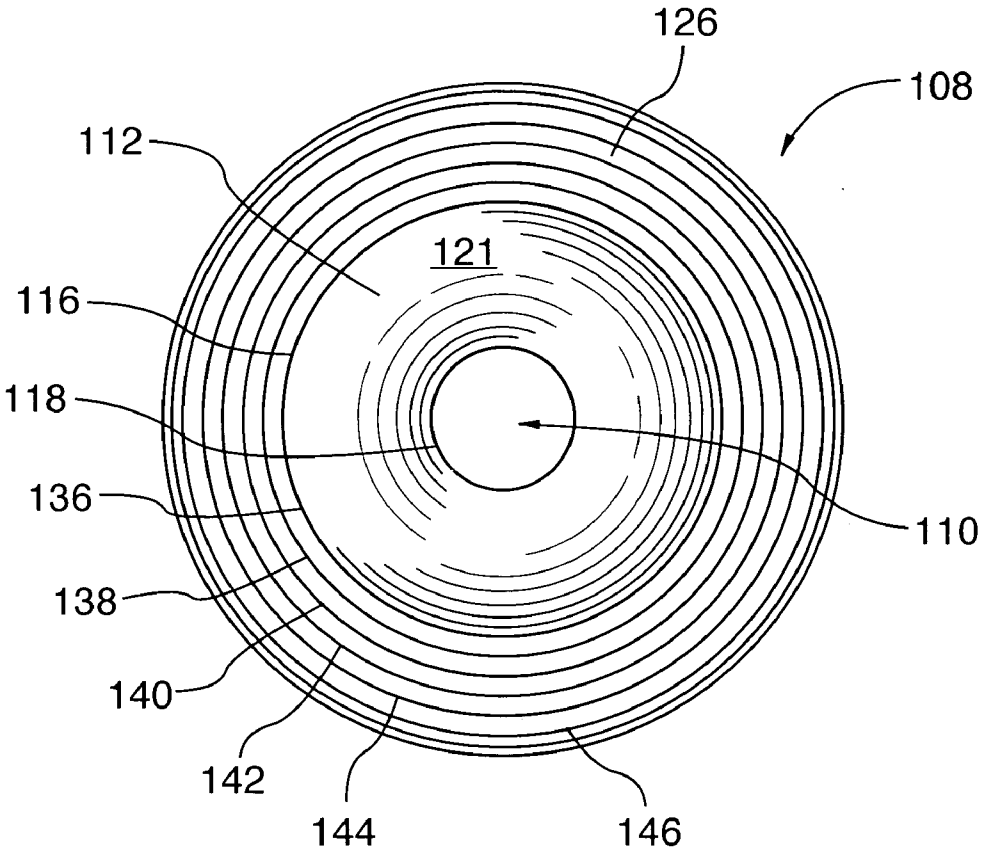

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FIG.7

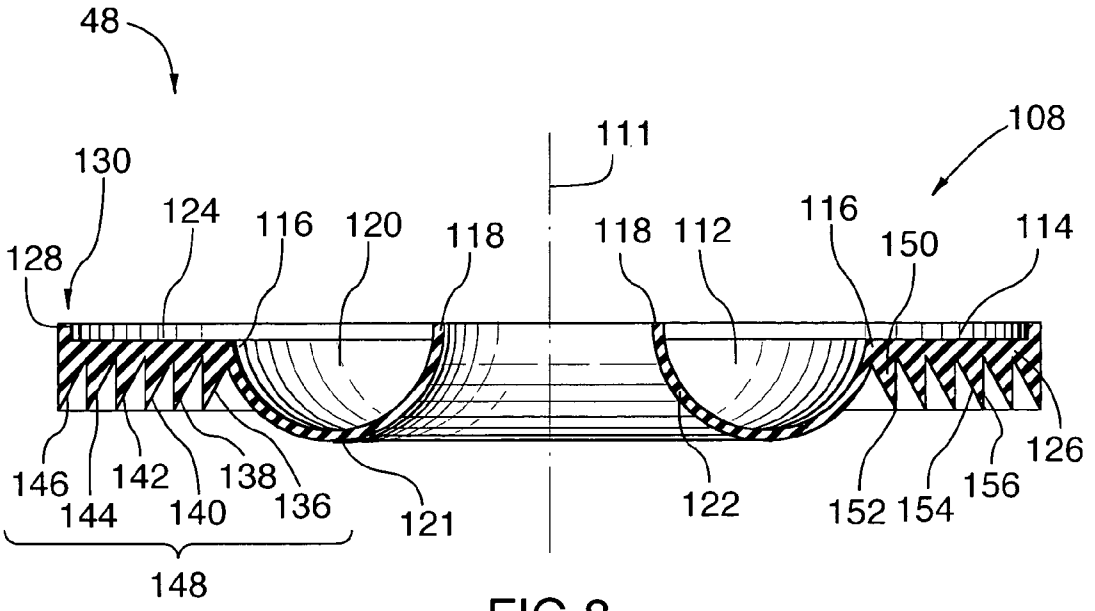

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FIG.8

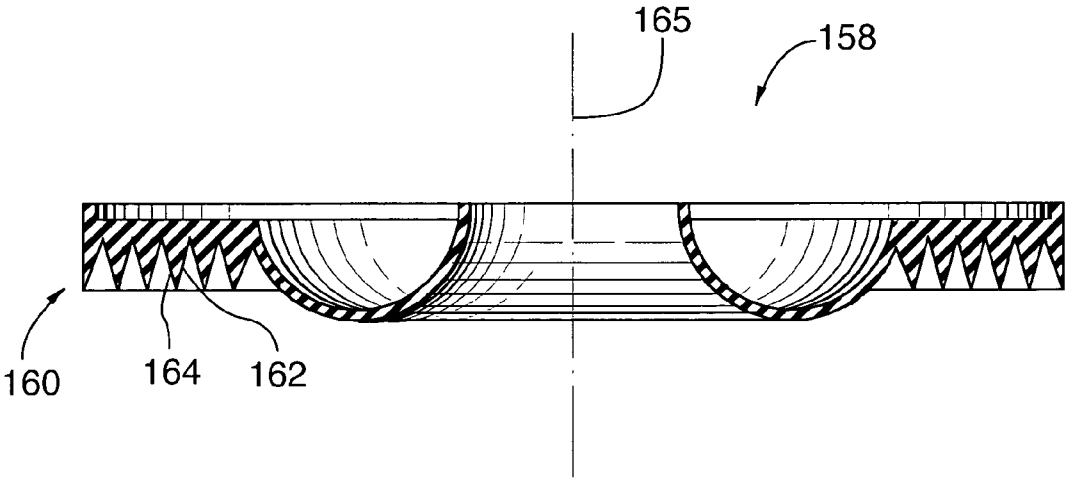

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FIG.9

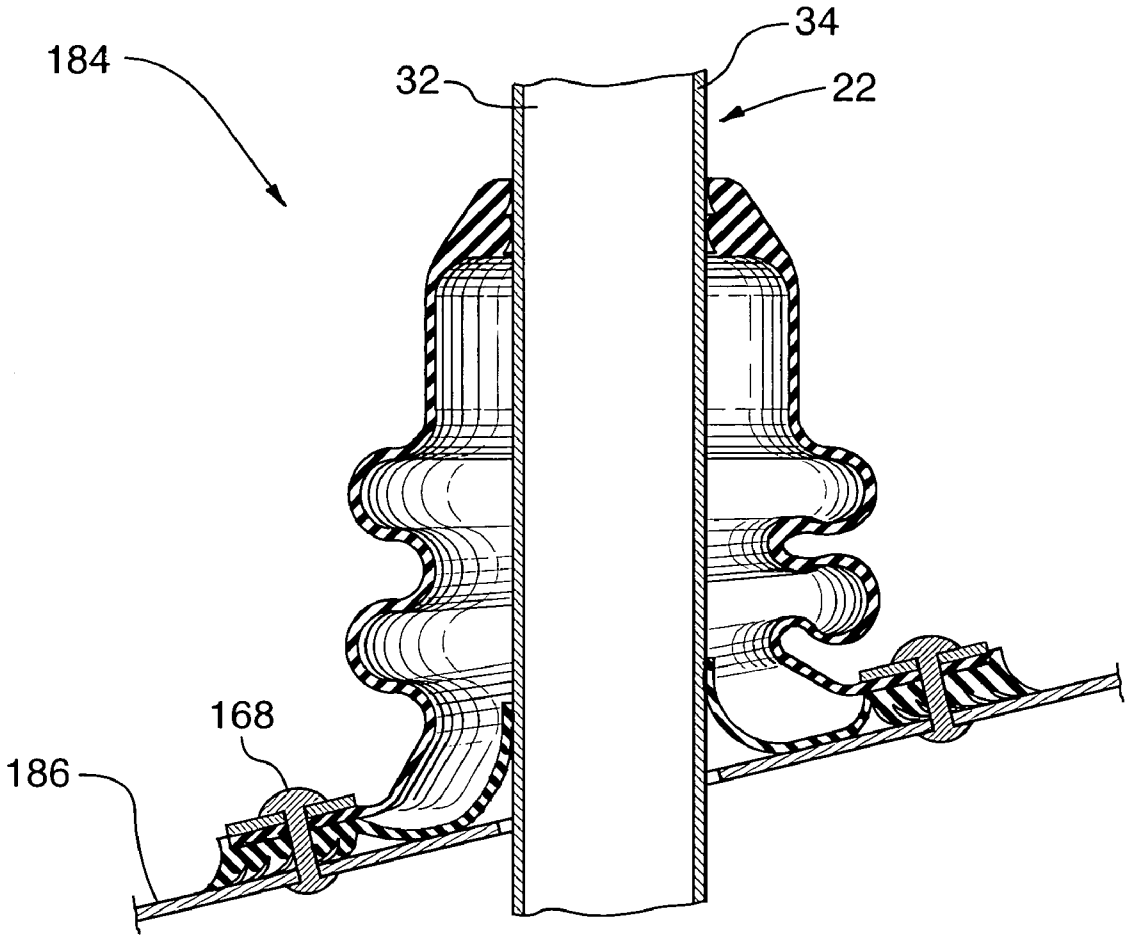


FIG.10

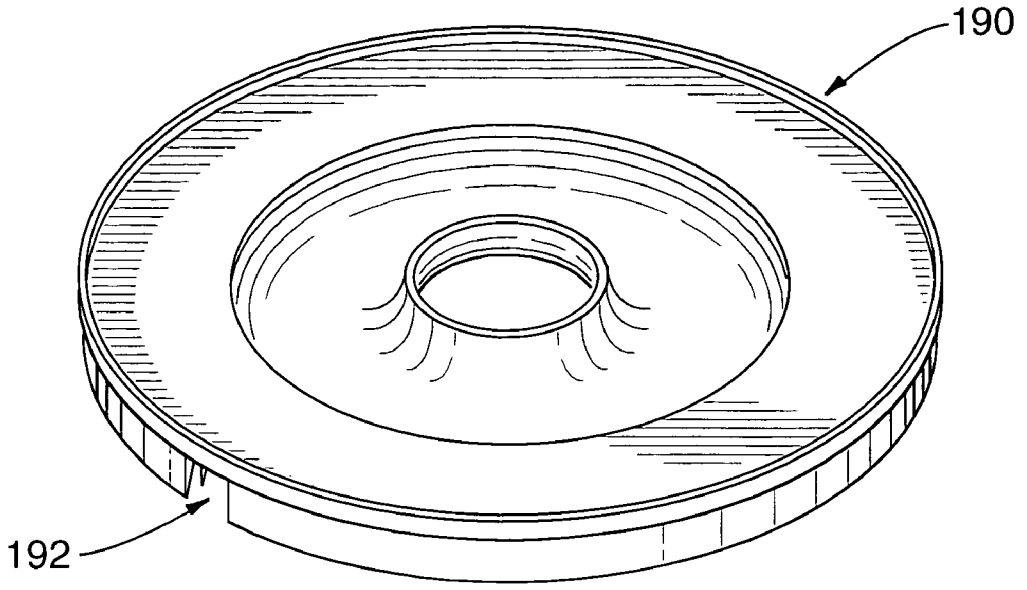


FIG.11

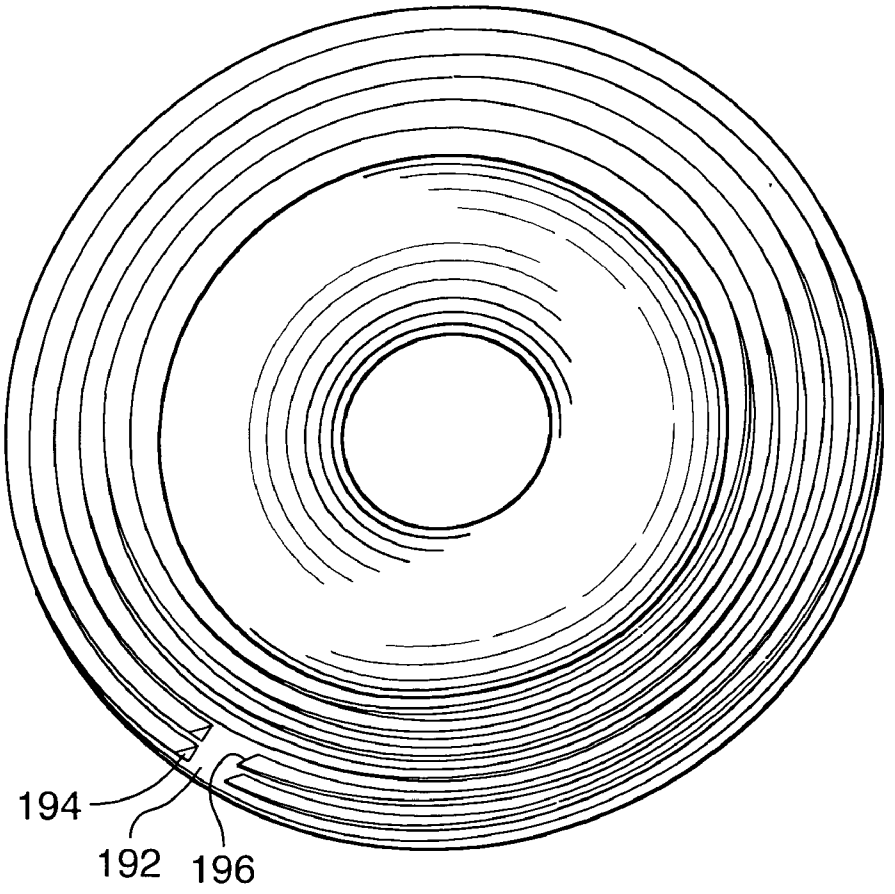


FIG.12

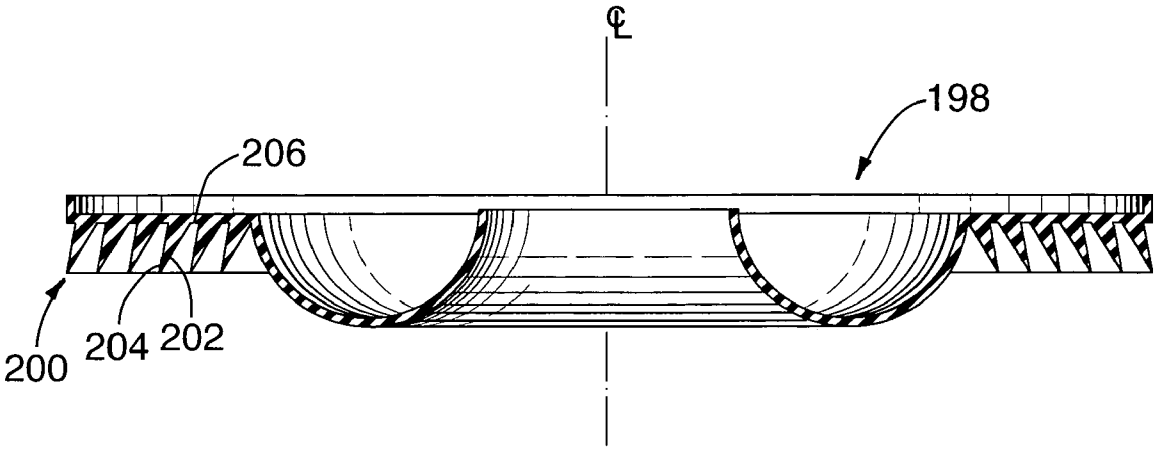


FIG.13

ROOF FLASHING ASSEMBLY

FIELD OF THE INVENTION

[0001] 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

[0002] 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.

[0003] 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.

[0004] 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.

[0005] 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.

[0006] 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.

[0007] 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 Jul. 8 2000, and granted on Jan. 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 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 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.

[0008] However, corrugated metal roof decks, particularly sloping metal roofs, such as Butler™ 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.

[0009] 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. Pat. 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 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 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.

[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 1¼ 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 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 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] **FIG. 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] **FIG. 2** of the drawings is a cross-sectional view of the roof flashing assembly shown in **FIG. 1** taken along section '**2-2**' of **FIG. 1**;

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

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

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

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

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

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

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

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

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

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

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

DETAILED DESCRIPTION OF A PREFERRED EMBODIMENT

[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.

[0031] Referring to **FIGS. 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.

[0032] As best seen in **FIG. 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.

[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.

[0034] Referring to **FIG. 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**.

[0035] Referring to **FIGS. 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**.

[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 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 **FIG. 2**, the concertinaed sides **74** allow the sleeve body **50** to flex (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**.

[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 bellows tube may be fabricated with circumferential bulges of increasingly larger diameter from the proximal end **60** to the distal end **62**.

[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 **FIGS. 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.

[**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.

[**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.

[**0045**] Referring to **FIG. 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**.

[**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 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 **FIGS. 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 **FIG. 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 **FIG. 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 **FIG. 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.

[**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.

[**0052**] Referring to **FIGS. 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 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 **FIG. 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 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 **FIG. 2**).

[**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 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.

[**0054**] Referring to **FIGS. 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 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.

[**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 shown in **FIG. 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 against the sloped roof surface **26** during installation of the roof flashing assembly **20**, as shown in **FIG. 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 decking **30** caused by changes in the ambient temperature.

[**0056**] Referring to **FIGS. 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 ½"×½" 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 **FIG. 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 **FIG. 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.

[**0061**] Referring to **FIGS. 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 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 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.

[**0062**] With reference to **FIG. 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 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 **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 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**. 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 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 advantage on a sloped roof surface having a generally planar profile. Referring to **FIG. 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 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.

Having described the invention, the following is claimed:

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.

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