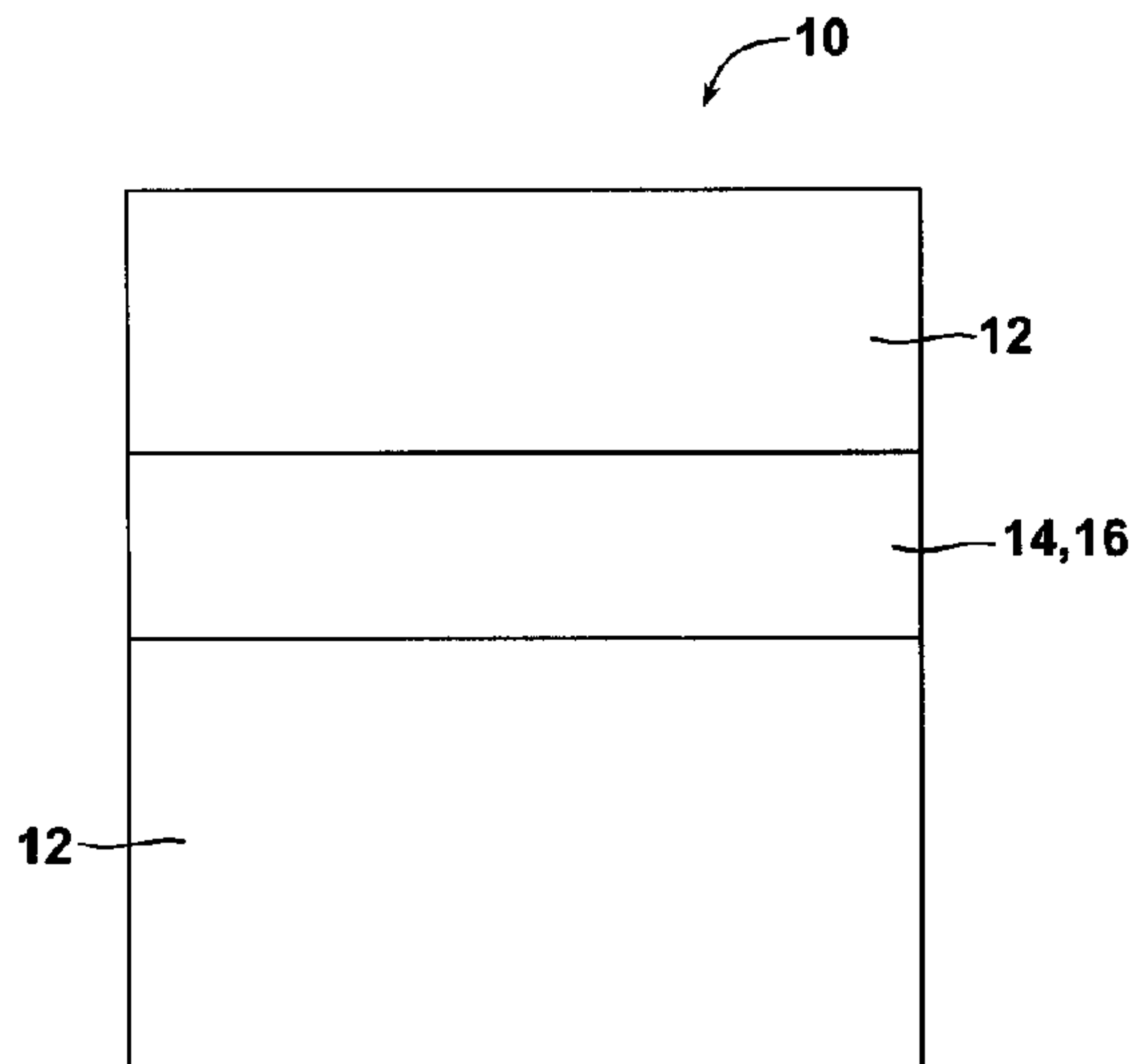




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 (54) Title: FLEXIBLE LAMINATED HIP AND RIDGE SHINGLE



(57) **Abrégé/Abstract:**

A laminated asphalt shingle including a base layer, a first decorative layer, and a second decorative layer is provided. The first decorative layer may be affixed to the base layer and to the second decorative layer by a flexible adhesive that permits the first decorative layer to move relative to both the base layer and the second decorative layer without debonding. The relative movement of the shingle layers permits the shingle to be folded over the ridge line of a roof without de-bonding or breaking the layers. Additionally, the relative movement of the layers when the shingle is installed over a ridge creates opposing transverse edges in which each layer is offset from the other layers as a result of the shingle bending about a different radius of curvature, thereby providing a dimensional appearance along the transverse edges.

**ABSTRACT**

A laminated asphalt shingle including a base layer, a first decorative layer, and a second decorative layer is provided. The first decorative layer may be affixed to the base layer and to the second decorative layer by a flexible adhesive that permits the first decorative layer to move relative to both the base layer and the second decorative layer without de-bonding. The relative movement of the shingle layers permits the shingle to be folded over the ridge line of a roof without de-bonding or breaking the layers. Additionally, the relative movement of the layers when the shingle is installed over a ridge creates opposing transverse edges in which each layer is offset from the other layers as a result of the shingle bending about a different radius of curvature, thereby providing a dimensional appearance along the transverse edges.

**FLEXIBLE LAMINATED HIP AND RIDGE SHINGLE****[0001]****TECHNICAL FIELD AND INDUSTRIAL****APPLICABILITY**

**[0002]** The present invention relates generally to roofing shingles, and more particularly, to a flexible laminating adhesive for use with a multi-layered shingled product that permits the shingle product to be bent, such as over an apex of a roof, without cracking or breaking. In addition, flexible adhesive provides flexibility at temperatures lower than or equal to about 40°F.

**BACKGROUND**

**[0003]** Roofs are typically formed so as to present at least two non-parallel planes that meet at a peak, usually the uppermost point of the roof. This peak is typically referred to as the ridge. Roofs can also be formed to present other non-parallel planes that are often formed at the ends of the ridge to form other diagonally-extending plane intersections similar to the ridge, but are referred to as hips. Whereas, the covering of the planar portions of a roof typically involve the laying of shingles in overlapping, transversely parallel courses from the bottom roof edge to the ridge or hip, the ridges and hips require a different technique to cover the intersection of the two or more roof planes. A conventional technique for covering the ridges and hips is to cut the shingles into appropriate width and to bend the cut shingle over

the ridge or hip so as to overlap the shingles placed on the opposing roof planes, and then starting at one end of the ridge or hip and overlap the cut shingles along the length of the ridge or hip.

**[0004]** Asphalt composite shingles are one of the most commonly used roofing products. These asphalt composite shingles typically incorporate a base material made from a fiberglass mat, or other suitable reinforcement member, such as an organic felt material. This reinforcing base material serves as a matrix to support an asphalt coating and gives the shingle strength. The asphalt coating is formulated for the particular service application and has a long-term ability to resist weathering and provide stability for the structure under extreme temperature conditions. An outer layer of granules is applied to the asphalt coating to form an outer surface that the asphalt coating from direct sunlight. This outer layer of granules also offers resistance to fire. Utilizing differently colored granules provides a variety in the surface appearance of the shingle to establish color variations.

**[0005]** Conventional laminated shingles, for example, as well as hip and ridge shingles, are generally multilayered and the separate, individual layers are held together with an adhesive material. One problem associated with conventional adhesives is that the adhesive can be too strong for a particular application. For instance, hip and ridge shingles are often formed of multiple layers or chips adhered to a base sheet in order to achieve a dimensional appearance when attached to a roof. However, when placing these multi-layered shingles along ridge or hip lines of a roof using conventional adhesives, a problem may occur when bending the shingle over the ridge or hip. In particular, because the thickest areas of the shingle include two or three layers of material, bending the shingle to cover the ridge or hip often results in a crack along the outer layer of the dimensional composite shingle, which compromises the integrity of the ridge or hip covering. Furthermore, if the adhesive holding the various layers together is too aggressive, the layers providing the dimensional appearance of the shingle may tear apart or otherwise cause the shingle to fail.

**[0006]** Thus, there exists a need in the art for an adhesive that will permit a multilayer shingle product to bend over the ridge or hip of a roof without failing, that does not pose any

additional health or safety issues, is cost effective, and where the performance of the adhesive is sustainable over time.

### SUMMARY

**[0007]** In accordance with embodiments of the present invention, an adhesive composition that includes a base asphalt, a linear copolymer, and an oil is provided. In some exemplary embodiments, the adhesive composition also contains a radial copolymer and/or one or more fillers. The base asphalt used in the inventive adhesive composition may be a viscosity graded asphalt, such as AC-10 or AC-20, or a paving graded asphalt, such as PG58 or PG64. The linear copolymer has an A-B di-block or A-B-A tri-block structure where blocks A and B may individually represent (1) styrene and butadiene or (2) styrene and isoprene. The oil is a petroleum-based oil that both "softens" the asphalt in the composition and reduces the viscosity of the adhesive composition. In some exemplary embodiments, the adhesive composition also contains a radial copolymer having an (A-B)<sub>n</sub> radial structure, where n is an integer of at least 4, or a tri-block (A-B-A) radial structure having from 4-8 arms. The inventive adhesive composition permits a multilayered shingle to have a degree of flexibility, such as to permit the shingle to be bent over the ridge line or hip of a roof.

**[0008]** In other embodiments to shingles for use as a hip and ridge shingle that includes a base layer having a first length dimension and a first width dimension and a first decorative layer having a second length dimension and a second width dimension are provided. Each of the base layer and the first decorative layer are separate layers that are both bent over a ridge such that the first decorative layer bends about a different radius of curvature than the base layer. The first decorative layer is affixed to the base layer by a flexible adhesive that allows the first decorative layer to move relative to the base layer without cracking or breaking the first decorative layer. In the shingle, at least one of the second length dimension and second width dimension is the same as or smaller than the corresponding first length dimension and the first width dimension. In exemplary embodiments, a second decorative layer is affixed to the first decorative layer by the flexible adhesive. Similar to the first layer, the adhesive permits the second decorative layer to move relative to said first decorative layer without cracking or breaking either the first or second decorative layer. The second decorative layer may have a length and/or width dimension that is the same as or smaller than the corresponding length and width dimension of the first decorative

layer. The adhesive composition includes a base asphalt, a linear copolymer, an oil, and optionally, a radial copolymer and/or one or more fillers. Additionally, the adhesive possesses sufficient flexibility and shear to permit a multilayered hip and ridge shingle to be bent over the ridge or hip of a roof without cracking or breaking, even at temperatures lower than or equal to about 40°F.

**[0009]** In yet other embodiments, hip and ridge shingles for covering a ridge line of a roof that includes (1) a base layer having a first length dimension and a first width dimension and (2) a first decorative layer having a second length dimension and a second width dimension where at least one of the second length and width dimensions is smaller than the corresponding first length and width dimensions are provided. The first decorative layer is affixed to the base layer by a flexible adhesive that allows a limited movement of the first decorative layer relative to the base layer to permit the first decorative layer to bend about a different radius of curvature than the base member when the hip and ridge shingle is bent over a ridge line. The hip and ridge shingle may also include a second decorative member affixed to the first decorative member by the flexible adhesive to allow a limited movement of the second decorative layer relative to the first decorative layer, thus allowing the second decorative layer to bend at a different radius of curvature than the first decorative layer. Additionally, each of the base layer, the first decorative layer, and the second decorative layer have opposing transverse edges that are offset when the hip and ridge shingle is installed on a ridge line or a hip of a roof.

**[0009a]** In yet other embodiments, a roof assembly that includes a first planar roof portion and a second planar roof portion opposed to the first planar roof portion. The first planar roof portion intersects the second opposed planar roof portion to form a ridge line or a hip of the roof assembly. A hip and ridge shingle includes a base layer and a first decorative layer affixed to the base layer by a flexible adhesive, the flexible adhesive comprising a hydrocarbonaceous material, an oil, and at least one copolymer. Each of the base layer and the first decorative layer are separate layers that are both bent over the ridge line or the hip such that the first decorative layer bends about a different radius of curvature than the base layer. The flexible adhesive allows movement of the first decorative layer relative to the base layer.

**[0010]** It is an advantage of the present inventions that the adhesive composition is flexible such that the layers of a multilayer shingle can be bent over the ridge or hip of a roof with out breaking or cracking.

**[0011]** It is a further advantage of the present inventions that the adhesive provides for more flexibility at lower temperatures, such as temperatures lower than or equal to about 40°F.

**[0012]** It is also an advantage of the present inventions that the decorative layers of a laminated asphalt composite shingle are secured by a flexible adhesive that permits the

decorative layers to shift transversely to allow the respective decorative layers to bend at different radii of curvature when the shingle is placed over a roof ridge or hip.

**[0013]** It is a further advantage of the present inventions that the respective decorative layers of a laminated asphalt composite shingle can bend at respective radii of curvature so that the decorative layers will not crack along the bend line.

**[0014]** It is yet another advantage of the present inventions that the adhesive composition does not pose any safety or health issues to workers involved in their manufacture and/or application.

**[0015]** It is also an advantage of the present inventions that the asphaltic adhesive is useful in winter applications and in colder climates.

**[0016]** It is an advantage of the present inventions that the individual layers of the shingle will bend at a radius of curvature that accommodates the thickness of the shingle being bent to cover the ridge or hip of a roof.

**[0017]** It is yet another advantage of the present inventions that the exposed portion of the hip and ridge shingle is positioned on the decorative layers of a previously laid hip and ridge single when affixed to a ridge or hip of a roof, thereby providing a three dimensional, aesthetically pleasing appearance.

**[0018]** It is a further advantage of the present inventions that the slipping of the individual decorative layers of a laminated composite shingle when bent to cover a ridge or hip of a roof results in an exposure of the underlying layer along the longitudinal length of the shingle.

**[0019]** The foregoing and other objects, features, and advantages of the inventions will appear more fully hereinafter from a consideration of the detailed description that follows.

**BRIEF DESCRIPTION OF THE DRAWINGS**

[0020] The advantages of this invention will be apparent upon consideration of the following detailed disclosure of the invention, especially when taken in conjunction with the accompanying drawings wherein:

[0021] FIG. 1 is a schematic top plan view of an embodiment of a hip and ridge shingle formed according to the principles of the instant invention, the shingle being shown in a flat orientation with the decorative layers being representatively placed on a central portion of the shingle;

[0022] FIG. 2 is a schematic end elevational view of the hip and ridge shingle depicted in FIG. 1;

[0023] FIG. 3 is a schematic front elevational view of the hip and ridge shingle depicted in FIG. 1; and

[0024] FIG. 4 is a schematic top plan view of an embodiment of a hip and ridge shingle formed according to the principles of the instant invention, the shingle being shown in a flat orientation with the decorative layers being representatively placed on a central portion of the shingle;

[0025] FIG. 5 is a schematic end elevational view of the hip and ridge shingle depicted in FIG. 4;

[0026] FIG. 6 is a schematic top plan view of a base shingle containing three separate hip and ridge shingles with perforations therebetween to facilitate separation of the hip and ridge shingles from the base shingle; and

[0027] FIG. 7 is a schematic front elevational view of the hip and ridge shingle being bent to form a ridge or hip cover, the slippage of the individual layers being seen along the sides of the bent shingle.

**DETAILED DESCRIPTION**

[0028] Unless defined otherwise, all technical and scientific terms used herein have the same meaning as commonly understood by one of ordinary skill in the art to which the

invention belongs. The terms “adhesive”, “inventive adhesive”, “adhesive composition”, “laminating adhesive”, and “laminating adhesive composition” may interchangeably be used herein. In addition, the terms “cap shingle”, “cap”, or “hip and ridge shingle” may be used interchangeably herein.

**[0029]** The present inventions relate, at least in part, to a flexible adhesive composition for use with hip and ridge shingles (cap shingle) that includes a base asphalt, a linear copolymer, an oil, and, optionally, a radial copolymer and/or one or more fillers. The adhesive possesses sufficient flexibility and shear to permit a multilayered hip and ridge shingle to be bent over the ridge or hip of a roof without cracking or breaking. In addition, the adhesive provides for more flexibility at lower temperatures, such as temperatures lower than or equal to about 40°F.

**[0030]** The laminating adhesive composition contains, as one component, a base asphalt or other hydrocarbonaceous material. As used herein, the term “asphalt” is meant to include any of a variety of materials that are solid or semi-solid materials at room temperature that gradually liquefy when heated and are formed predominantly of naturally occurring bitumens obtained as residue in petroleum refining. The base asphalt used in the inventive adhesive composition is desirably a viscosity graded asphalt or an AC-10 paving grade asphalt such as PG58-22, which is commercially available British Petroleum™ and Conoco Philips™ and/or an AC-20 paving grade asphalt such as PG64-22, which is also commercially available from British Petroleum™ and Conoco Philips™. The base asphalt may be generally present in the adhesive composition in an amount from about 79.0% to about 90.5% by weight of the composition. In exemplary embodiments, the base asphalt may be present in the adhesive composition in an amount from about 81% to about 88% by weight of the composition. As used herein, and unless defined otherwise, the phrase “% by weight” is meant to denote % by weight of the total adhesive composition.

[0031] As discussed above, the adhesive composition contains a linear copolymer, and, optionally, a radial copolymer, each of which is described in detail below. The copolymers are thermoplastic and are selected for their ability to impart strength to the adhesive at colder temperatures and to provide sufficient flexibility and/or shear. As with conventional thermoplastic organic polymers, the copolymers used in the inventive adhesive can be processed (*i.e.*, melted and extruded) and can be repeatedly heated and cooled with no substantial loss in their properties, including elastomeric properties. Accordingly, the copolymers used herein substantially retain their properties when subjected to heating and cooling cycles. One particular advantageous feature is the ability of the copolymers to retain strength upon cooling the copolymers, which gives both strength and flexibility to the adhesive at colder temperatures.

[0032] The adhesive composition contains a linear copolymer having an A-B di-block or A-B-A tri-block structure. In particular, the linear copolymer has a di-block content greater than 50%. Blocks A and B may individually represent (1) styrene and butadiene or (2) styrene and isoprene. Either block, A or B, may include more than one monomer. Additionally, each block segment may include 100 or more monomer units. The linear copolymer may have a styrene content of less than 50%, from about 20% to about 40% styrene, or from about 20% to about 35% styrene. In some embodiments, the linear copolymer has a styrene/butadiene ratio of 33/67. In some examples the linear copolymer have styrene or polystyrene as the A block or end block units. Suitable copolymers include styrene-butadiene block copolymers and styrene-isoprene block copolymers. Specific, non-limiting examples include D1118K, a styrene-butadiene-styrene di-block copolymer, and D1113K, and D1119K, styrene-isoprene-styrene linear polymers with a high-di-block content (all are commercially available from Kraton<sup>®</sup>). In some examples, the linear copolymer is a styrene-butadiene di-block copolymer, such as D1118K, commercially available from Kraton<sup>®</sup>. The linear di-block copolymer may be present in the inventive adhesive composition in an amount from about 2.5% to about 11.0% by weight of the composition. In some embodiments, the linear copolymer is present in the adhesive composition in an amount from about 2.5% to about 6.5% by weight of the composition. In some exemplary

embodiments, the linear copolymer may be present in the adhesive composition in a greater amount, such as, for example, from about 10.0-14.0% by weight of the composition, or from 11.0-12.0% by weight.

**[0033]** Optionally, the adhesive composition may contain a radial copolymer. The radial copolymer may have an (A-B)<sub>n</sub> radial structure, where n is an integer of at least 4, or from 4-20, or a tri-block (A-B-A) radial structure having from 4-8 arms. Block copolymers are well known and are described in numerous patents, including, for example, U.S. Patent No. 4,738,884 to Algrim, *et al.*, U.S. Patent No. 4,824,880 to Algrim, *et al.*, and U.S. Patent No. 6,759,454 to Stephens, *et al.* Similar to the linear copolymer, block A and/or B in the radial copolymer may include more than one monomer and each block segment may include 100 or more monomer units. Additionally, blocks A and B may individually represent (1) styrene and butadiene or (2) styrene and isoprene. It is desirable that the radial polymer have styrene or polystyrene as the A block or end block units. The radial copolymer may have a styrene content of less than 50%, from about 20% to to about 40% styrene, or from about 20% to about 35% styrene. In some examples, the styrene/butadiene ratio is 31/69.

**[0034]** Exemplary radial copolymers include D4158K (includes 33% oil), D1184K, D1116K, and D1144K, all of which are styrene-butadiene-styrene (SBS) radial copolymers (commercially available from Kraton®), and D1124K and D1126P, both of which are styrene-isoprene radial copolymers (commercially available from Kraton®). In some embodiments, the radial copolymer is a styrene-butadiene radial copolymer, such as D4158K or D1184K (commercially available from Kraton®). The radial copolymer may be present in the adhesive composition in an amount from 0% to about 9.0% by weight of the composition. In exemplary embodiments, the radial copolymer may be present in the adhesive composition in an amount from about 3.5% to about 7.0% by weight of the composition.

**[0035]** When both a linear and a radial copolymer are present in the inventive adhesive, the total amount of the radial copolymer and the linear copolymer present in the adhesive composition may range from about 6.5% to about 14.0 %, or from about 8.0% to about 11.0% of the total composition. Additionally, the ratio of radial copolymer to linear

copolymer present in the adhesive composition may range from 6:3 to 2:6 (radial copolymer:linear copolymer). In some examples, the ratio of radial copolymer to linear copolymer present in the adhesive composition is 5:4.

[0036] Another component present in the adhesive composition is an oil. The oil can be any oil recognized in the art to enhance the “softness” of the asphalt in the adhesive composition. The oil also aids in reducing the viscosity of the adhesive composition. In general, the oil is added in an amount necessary to achieve a desired viscosity for the adhesive composition, and to improve flexibility and low temperature bonding. The viscosity of the adhesive composition desirably does not exceed approximately 1500 cps as measured by a Brookfield LVF Viscometer using spindle number 7 at 350 °F. The oil utilized in the adhesive composition may be a petroleum-based oil or other naphthenic or paraffinic oils identified by one of ordinary skill in the art. One particularly useful oil is Hydrolene SP-125, a severely solvent modified heavy petroleum oil commercially available from Sunoco, Inc. (CAS No. 63741-88-4). The oil, in combination with the selected copolymers, acts to give the flexibility and shear so that the adhesive can be used in conjunction with hip and ridge shingles, even at colder temperatures. The oils and copolymer(s) permit the adhesive to flex and/or shear so that the layers of the hip and ridge shingle “slide” over each other upon bending and remain laminated together, without cracking or breaking the dimensional elements adhering to the base of the shingle. The oil may be present in the adhesive composition in a total amount from about 2.0% to about 7.0% of the total adhesive composition, or from about 4.0% to about 6.0%. It is to be appreciated that a portion of the total oil content may be derived from another component of the adhesive composition, such as, for example, an oil-containing copolymer.

[0037] In some exemplary embodiments, fillers may be added to any of the adhesive roofing sealant compositions. For example, up to about 30% by weight of a filler may be used. Suitable fillers include, but are not limited to, limestone (calcium carbonate), dolomite (calcium magnesium carbonate), wollastonite, talc, silica, and others known to those skilled in the art. The filler may have a median particle size from about 5 microns to about 50 microns, or from about 10 microns to about 30 microns.

**[0038]** One adhesive composition is set forth in Table 1.

[0039]

**Table 1**

<b>Components of Roofing Shingle Adhesive Composition</b>	<b>% By Weight of Composition</b>	<b>Alternate % By Weight of Composition</b>
PG64-22 <sup>(1)</sup>	79.0-86.0	82.0-84.0
Kraton 1111 <sup>(2)</sup>	10.0-14.0	11.0-12.0
Hydrolene SP-125 <sup>(3)</sup>	4.0-7.0	5.0-6.0

- (1) performance grade asphalt (commercially available from British Petroleum and Conoco Philips)
- (2) styrene-isoprene-styrene tri-block copolymer (commercially available from Kraton<sup>®</sup>)
- (4) petroleum-based oil (commercially available from Sunoco, Inc.)

[0040] A second adhesive composition is set forth in Table 2.

**Table 2**

<b>Components of Roofing Shingle Adhesive Composition</b>	<b>% By Weight of Composition</b>	<b>Alternate % By Weight of Composition</b>
PG58-22 <sup>(1)</sup>	79.5-88.5	81.0-86.0
Kraton 4158 <sup>(2)</sup>	5.55-8.55	6.3-7.8
Kraton 1118 <sup>(3)</sup>	4.6-7.6	5.6-7.6
Hydrolene SP-125 <sup>(4)</sup>	1.35-4.35	2.1-3.6

- (1) performance grade asphalt (commercially available from British Petroleum and Conoco Philips)
- (2) styrene-butadiene radial copolymer containing oil (commercially available from Kraton<sup>®</sup>)
- (3) styrene-butadiene di-block copolymer (commercially available from Kraton<sup>®</sup>)
- (4) petroleum-based oil (commercially available from Sunoco, Inc.)

[0041] A third adhesive composition is set forth in Table 3. The inventive adhesive compositions described herein can be reacted with elemental sulfur to vulcanize *in situ*. Table 3 depicts an exemplary composition containing a mixture of two linear copolymers (*i.e.*, di-block and tri-block styrene-butadiene copolymers). After dispersion in the base asphalt and oil, the copolymer blend may be crosslinked with sulfur. The addition of the

sulfur to polymer modified asphalts enhances dispersion stability and improves mechanical properties.

**Table 3**

<b>Components of Roofing Shingle Adhesive Composition</b>	<b>% By Weight of Composition</b>	<b>Alternate % By Weight of Composition</b>
PG64-22 <sup>(1)</sup>	79.7-89.4	82.3-86.4
Kraton 1101 <sup>(2)</sup>	4.0-8.0	6.0-7.0
Kraton 1118 <sup>(3)</sup>	2.5-5.0	2.5-3.5
Hydrolene SP-125 <sup>(4)</sup>	4.0-7.0	5.0-6.0
Elemental sulfur	0.1-0.3	0.1-0.2

- (1) performance grade asphalt (commercially available from British Petroleum and Conoco Philips)
- (2) styrene-butadiene-styrene linear tri-block copolymer (commercially available from Kraton<sup>®</sup>)
- (3) styrene-butadiene di-block copolymer (commercially available from Kraton<sup>®</sup>)
- (4) petroleum-based oil (commercially available from Sunoco, Inc.)

**[0042]** Conventional mixing or blending techniques may be used to make the adhesive composition. In at least one exemplary embodiment, the base asphalt is heated to a temperature of approximately 350 °F and the oil is blended into the molten asphalt. The linear copolymer is added to the molten asphalt/oil to form a mixture. If a radial copolymer is included in the composition, it may be added along with the linear copolymer. The mixture is then placed into a conventional milling apparatus where the polymers are sheared into smaller polymeric pieces. The mixture is ground in the milling apparatus for a period of time sufficient to mill (grind) the polymers to a size that is no longer visible to the naked eye under UV light. The adhesive composition is cooled for packaging and then melted for application to a shingle. It may be desirable to circulate and maintain the adhesive at an elevated temperature during processing and application to the shingles to aid in the prevention of phase separation.

**[0043]** Turning to FIGS. 1-3, a hip and ridge shingle according to at least one exemplary embodiment of the invention can best be seen. The laminated hip and ridge

shingle 10 may include a base layer 12. The base layer 12 may be formed in a conventional manner, and in some embodiments includes a reinforcement member, such as a fiberglass mat, on which asphalt and decorative granules are placed. As one example, chopped glass fibers may be dispersed into a water slurry which may contain surfactants, viscosity modifiers, or other chemical agents. The slurry containing the dispersed fibers is then deposited onto a moving screen where a substantial portion of the water is removed. Next, a binder (*e.g.*, a urea formaldehyde binder or a polycarboxylic acid based binder) is applied, and the resulting mat is dried to remove the remaining water and cure the binder. The mat, formed of an assembly of randomly oriented, dispersed individual glass filaments, may be dried in any conventional manner, such as by passing the mat through an oven. Asphalt may then be applied to the dried/cured mat in any known manner, such as by passing the mat through a bath containing an asphalt mix that may include molten asphalt, fillers, and optionally sulfur, to place a layer of asphalt on at least one side of the mat and fill in the interstices between the individual glass fibers. The asphalt-coated mat is then cut to the appropriate shape and size to form the base layer 12. The hot, asphalt-coated mat may also be passed beneath one or more granule applicators that apply protective surface granules to portions of the asphalt-coated mat prior to cutting into the desired shape.

**[0044]** A similarly constructed first decorative or dimensional layer 14 is positioned on and adhered to the base layer 12 to provide a desired aesthetic appearance. Optionally, a second decorative (dimensional) layer 16 may be affixed on the first decorative layer 14 to provide greater depth to the composite shingle 10 and an enhanced three dimensional aesthetic appearance, particularly when viewed from a distance. It is to be appreciated that although the drawings reflect two decorative layers 14, 16 that are positioned across the width of the base layer 12, one skilled in the art will recognize that the decorative layers 14, 16 can be placed in any appropriate arrangement or orientation on the base layer 12 to provide a desired aesthetic appearance. Accordingly, the principles of the present invention are not limited to the specific location, size of the layers, or positioning of the decorative layers 14, 16, or the bending of the shingle to form a ridge or hip cap, as described in greater detail

below, that requires the bending of all layers of the shingle irrespective of the location of the decorative layers 14, 16.

**[0045]** The respective layers 12, 14, 16 of the hip and ridge shingle 10 are adhered to one another via the flexible adhesive described in detail above. To form the hip and ridge shingle 10, the first decorative layer 14 is positioned at a desired location on the base layer 12 and affixed thereto with the inventive adhesive composition. The adhesive can be applied in a continuous or discontinuous fashion, such as in the form of beads or “dashes”. In at least one embodiment (not illustrated), the first decorative layer 14 may be the same size or substantially the same size as the base layer 12. In other embodiments, the first decorative layer 14 may have a width that is smaller than the width of the base layer 12, such as is shown in FIGS. 1-3. In general, the first decorative layer 14 has a length and a width dimension and at least one of the length and width dimensions is smaller than the length and/or width dimension of the base layer 12. Subsequent layers, such as, for example, the second decorative layer 16, may have a length and/or a width dimension that is the same as or smaller than that of the first decorative layer 14. For instance, the second decorative layer 16 may be affixed to the first decorative layer 14 such that the second layer 16 substantially covers the first decorative layer 14. As used herein, the phrase “substantially covers” is intended to denote that the second layer 16 completely covers or nearly completely covers the first decorative layer 14. In FIGS. 1-3, the first and second decorative layers have approximately the same length and width (*i.e.*, are substantially the same size). Also, it is to be appreciated that the addition of the first and/or second decorative layer provides areas of greater thickness on the base layer, which provides a dimension to the shingle and an aesthetic appearance when viewed from a distance.

**[0046]** In an alternate embodiment, the second decorative layer 16 may have a length and/or a width dimension that is smaller than that of the first decorative layer 14 to offset the second decorative layer 16 from the first decorative layer 14 with only a partial overlap of the second decorative layer 16 on the first decorative layer. As shown in FIGS. 4 and 5, the first decorative layer 14 is affixed to the base layer 12 with the adhesive composition. The first decorative layer 14 has a size in a width dimension that is less than a size in the width

dimension of the base layer 12. The second decorative layer 16, which has a size in the width dimension that is less than the width dimensions of both the first decorative layer 14 and the base layer 12, is affixed to the top surface of the second decorative layer 14 to form a hip and ridge shingle 10 in accordance with at least one embodiment of the invention. It is to be appreciated that any number of configurations of the arrangements of the first and second decorative layers 14, 16 on the base layer 12 and the sizes of the first and second decorative layers with respect to the base layer 12 are envisioned and are considered to be within the purview of the invention.

[0047] The shingle may be advantageously formed in-line using conventional roofing machines and existing roofing lines. Initially, a base layer 12 is formed of a size large enough to accommodate several individual hip and ridge shingles. Turning to FIG. 6, a base shingle 40 formed of a base layer 12 including three separate hip and ridge shingles 10 can be seen. To form a hip and ridge shingle 10, a first decorative layer 14 and a second decorative layer 16 may be affixed to the base layer 12 in-line with the inventive adhesive being placed at each interface of the layers 12, 14, and 16. Perforations 15 separating the three separate shingles 10 may then be punched or otherwise formed into the base layer 12. In some embodiments, the perforations 15 may be punched prior to the application of the first and second decorative layers. The perforations 15 permit a worker to easily detach one hip and ridge shingle 10 from another at the jobsite without the need for any additional equipment. Alternatively, the shingle 40 may not include perforations (not illustrated). If no perforations are present, the worker must cut or otherwise similarly detach the individual hip and ridge shingles 10 from the base shingle 40. The distance between the perforations and the resulting final size of the shingle 10 is dependent on the end use of the shingle 10, and may include considerations such as the location where the shingle 10 will be used. For example, some regions of the United States use a smaller hip and ridge shingle than other regions. Generally, the perforations are about 12 inches or less from each other, thus forming shingles with a width of approximately 12 inches (or less). The length of the shingle 10 may also be about 12 inches or less, and may or may not form a square shape.

[0048] FIG. 7 schematically illustrates the use of the hip and ridge shingle 10. Although the placement of shingles on the opposing planar portions 31, 33 of the roof 30 which are overlapped by the hip and ridge shingle 10 have not been shown, one skilled in the art will understand that before the hip and ridge shingle 10 is folded over the ridge 35 of the roof 30, the ridge 35 (which could also be a hip) being formed by the intersection of the two opposing planar surfaces 31, 33 of the roof 30, the shingles on the planar portions 31, 33 are affixed to the roof 30 up to the ridge 35. The base shingle 40 starts in a flat orientation, such as is depicted in FIG. 7, for the ease of shipping and because the ridges and hips are formed at variable angles. For instance, one building may have a roof slope of 6:12, while another may have a 4:12 slope, thus resulting in the need for a ridge cap that can be mated to the roof.

[0049] In use, the shingle 10 is detached from the base shingle 40 and is folded over the top of the ridge line 35 and secured in place, typically by nailing or otherwise mechanically affixing the hip and ridge shingle 10 to the roof. Subsequent shingle pieces 10 are then placed in an overlapping arrangement, similar to the orientation of the courses of conventional shingles (*e.g.* three-tab shingles) on the planar portions of the roof 30, beginning at one end of the ridge 35 and continuing to the opposing or distal end of the ridge 35. In particular, a first hip and ridge shingle may be mechanically affixed to the roof, such as by nailing through the first and second decorative layers and the base layer. A subsequent hip and ridge shingle is then placed over the first shingle such that the exposed portion of the second hip and ridge shingle is positioned over the decorative layers of the first hip and ridge shingle. This process is repeated with additional hip and ridge shingles until the end of the ridge line or hip is reached. The exposed portion of each subsequent shingle is thus raised, thereby providing a three dimensional, aesthetically pleasing appearance to the ridge line or hip.

[0050] It is to be appreciated that if the topmost decorative layer 16 were required to bend at the radius of curvature corresponding to the base layer 12 in a conventional shingle, the cap 10 would be likely to crack or break because of the thickness of the shingle 10 and because of the use of rigid adhesives. However, due to the flexibility of the inventive adhesive, the respective layers can move relative to the adjacent layer to accommodate the

increasing radius of curvature, as is reflected in the offset edges 27 along the transverse sides of the cap 10. In the three-layer shingle 10 depicted in FIG. 7, the first decorative layer 14 is moved a distance of S1 relative to the base member 12 and the second decorative layer 16 is moved a distance S2 relative to the first decorative layer 14. The adhesive permits the relative movement and relaxes the stresses created by folding the shingle 10 over the ridge. An incidental benefit of this movement between the layers 12, 14, 16 is that the offset edges 27 along the transverse sides of the cap 10 provide an additional three dimensional depth to the cap 10.

**[0051]** The adhesive composition of the present invention provides numerous advantages, such as, for example, flexibility at temperatures lower than or equal to about 40 °F. In addition, it is envisioned that the hip and ridge shingle using the adhesive composition described herein can be manufactured in-line with conventional roofing machines on existing roofing lines. Incorporating the lamination of the decorative layers via the inventive adhesive in-line provides significant savings and an economic advantage. Further, the adhesive composition has little or no toxicity or safety issues, and, as a result, no additional safety precautions or equipment are needed to apply the adhesive to the layers forming the hip and ridge shingle.

**[0052]** The invention of this application has been described above both generically and with regard to specific embodiments. Therefore, it is to be understood that a wide variety of alternatives known to those of skill in the art can be selected within the generic disclosure. The invention is not otherwise limited, except for the recitation of the claims set forth below.

Having thus described the invention, what is claimed is:

1. A shingle for use as a hip and ridge shingle:  
a base layer having a first length dimension and a first width dimension; and  
a first decorative layer having a second length dimension and a second width dimension,  
and  
wherein each of the base layer and the first decorative layer are separate layers that are both bent over a ridge such that the first decorative layer bends about a different radius of curvature than the base layer,  
wherein said first decorative layer is affixed to said base layer by a flexible adhesive that allows a movement of said first decorative layer relative to said base layer without cracking or breaking said first decorative layer.
2. The shingle of claim 1, further comprising:  
a second decorative layer affixed to said first decorative layer by said flexible adhesive, said flexible adhesive permitting said second decorative layer to move relative to said first decorative layer without cracking or breaking said first or second decorative layer.
3. The shingle of claim 1, wherein at least one of said second length and width dimensions is the same as or smaller than the corresponding first length and width dimension.
4. The shingle of claim 1, wherein said flexible adhesive comprises:  
a hydrocarbonaceous material;  
a linear copolymer having an A-B di-block or an A-B-A tri-block structure; and  
an oil.
5. The shingle of claim 4, wherein said oil is selected from petroleum-based oils, naphthenic oils, paraffinic oils and combinations thereof.
6. The shingle of claim 4, further comprising a member selected from one or more fillers, a radial copolymer and combinations thereof, said radial copolymer being selected from a block

copolymer having an  $(A-B)_n$  radial structure where  $n$  is an integer of at least 4 and a block copolymer having a tri-block  $(A-B-A)$  radial structure having from 4-8 arms.

7. The shingle of claim 6, wherein said radial copolymer is selected from styrenebutadiene-styrene radial copolymers and styrene-isoprene radial copolymers, and wherein the copolymer forming said linear copolymer is selected from styrenebutadiene block copolymers and styrene-isoprene block copolymers.

8. The shingle of claim 4, wherein said adhesive provides flexibility at temperatures as less than or equal to about 40 °F.

9. A hip and ridge shingle for covering a ridge line or hip of a roof comprising:  
a base layer having a first length dimension and a first width dimension; and  
a first decorative layer having a second length dimension and a second width dimension,  
at least one of said second length and width dimensions being smaller than the corresponding first length and width dimensions,

wherein said first decorative layer is affixed to said base layer by a flexible adhesive that allows a limited movement of said first decorative layer relative to said base layer to permit said first decorative layer to bend about a different radius of curvature than said base member when said hip and ridge is bent over said ridge line or said hip.

10. The hip and ridge shingle of claim 9, further comprising:

a second decorative member affixed to said first decorative member by said flexible adhesive to allow a limited movement of said second decorative layer relative to said first decorative layer, thus allowing said second decorative layer to bend at a different radius of curvature than said first decorative layer.

11. The hip and ridge shingle of claim 9, wherein each of said base layer, said first decorative layer, and said second decorative layer have opposing transverse edges, the corresponding said transverse edges of said first decorative layer being offset relative to said base layer and relative

to said second decorative layer when said hip and ridge shingle is installed on said ridge line or said hip.

12. The hip and ridge shingle of claim 9, wherein said adhesive provides flexibility at temperatures less than or equal to about 40 °F.

13. The hip and ridge shingle of claim 12, wherein said flexible adhesive comprises:  
a hydrocarbonaceous material;  
a linear copolymer having an A-B di-block or an A-B-A tri-block structure; and  
an oil.

14. The hip and ridge shingle of claim 13, wherein said oil is selected from petroleum-based oils, naphthenic oils, paraffinic oils and combinations thereof.

15. The hip and ridge shingle of claim 13, further comprising a member selected from one or more fillers, a radial copolymer and combinations thereof, said radial copolymer being selected from a block copolymer having an (A-B)<sub>n</sub> radial structure where n is an integer of at least 4 and a block copolymer having a tri-block (A-B-A) radial structure having from 4-8 arms.

16. A hip and ridge shingle for mounting on a roof to cover a ridge line or hip of said roof, comprising:

a base layer having a first length dimension and a first width dimension;  
a first decorative layer having a second length dimension and a second width dimension;  
a second decorative layer affixed to said first decorative layer to provide areas of greater thickness on said base member; and

a flexible adhesive securing said first decorative layer to said base layer and said first decorative layer to said second decorative layer such that said first layer is operable to move relative to both said base layer and said second decorative layer to permit each of said base layer, said first decorative layer and said second decorative layer to bend with a different radius of curvature when said hip and ridge shingle is applied to said roof over said ridge line or said hip.

17. The hip and ridge shingle of claim 16, wherein said flexible adhesive permits said first and second decorative layers to move relative to each other and said base layer said without cracking or breaking said first or second decorative layer.
18. The hip and ridge shingle of claim 16, wherein at least one of said second length and width dimensions is smaller than the corresponding first length and width dimensions, said first decorative layer being affixed to said base layer.
19. The hip and ridge shingle of claim 18, wherein each of said base layer, said first decorative layer, and said second decorative layer have opposing transverse edges, the corresponding said transverse edges of said first decorative layer being offset relative to said base layer and relative to said second decorative layer when said hip and ridge shingle is installed on said ridge line or said hip.
20. The hip and ridge shingle of claim 16, wherein said flexible adhesive comprises:  
a hydrocarbonaceous material;  
a linear copolymer having an A-B di-block or an A-B-A tri-block structure; and  
an oil.
21. The hip and ridge shingle of claim 20, wherein said oil is selected from petroleum-based oils, naphthenic oils, paraffinic oils and combinations thereof.
22. The hip and ridge shingle of claim 20, further comprising a member selected from one or more fillers, a radial copolymer and combinations thereof, said radial copolymer being selected from a block copolymer having an  $(A-B)_n$  radial structure where n is an integer of at least 4 and a block copolymer having a tri-block (A-B-A) radial structure having from 4-8 arms.
23. A roof assembly comprising:  
a first planar roof portion;  
a second planar roof portion opposed to the first planar roof portion, wherein the

first planar roof portion intersects the second opposed planar roof portion to form a ridge line or a hip of the roof assembly;

a hip and ridge shingle, comprising:

a base layer; and

a first decorative layer affixed to the base layer by a flexible adhesive, the flexible adhesive comprising a hydrocarbonaceous material, an oil, and at least one copolymer;

wherein each of the base layer and the first decorative layer are separate layers that are both bent over the ridge line or the hip such that the first decorative layer bends about a different radius of curvature than the base layer,

wherein the flexible adhesive allows movement of the first decorative layer relative to the base layer.

24. The roof assembly of claim 23 wherein the flexible adhesive has a viscosity that is less than or equal to about 1500 cps as measured by a Brookfield LVF Viscometer using spindle number 7 at 350 °F.

25. The roof assembly of claim 23 wherein the at least one copolymer includes at least one linear copolymer having an A-B di-block or an A-B-A tri-block structure, and a radial copolymer, the radial copolymer being selected from a block copolymer having an  $(AB)_n$  radial structure where n is an integer of at least 4 and a block copolymer having a tri-block (A-B-A) radial structure having from 4-8 arms, and wherein the oil is present in an amount between about 2.0 to about 7.0 weight%.

26. The roof assembly of claim 25, wherein the radial copolymer is selected from styrenebutadiene-styrene radial copolymers and styrene-isoprene radial copolymers, and wherein the copolymer forming the linear copolymer is selected from styrenebutadiene block copolymers and styrene-isoprene block copolymers.

27. The roof assembly of claim 25, wherein the ratio of radial copolymer to linear copolymer present in the adhesive ranges from 6:3 to 2:6.

28. The roof assembly of claim 23, wherein said oil is a paraffinic oil.

29. The roof assembly of claim 23, wherein the base layer has a first length and a first width and the first decorative layer has a second length and a second width, at least one of the second length and the second width being less than the corresponding first length and first width.

30. The roof assembly of claim 23 wherein the base layer includes a top side, a bottom side, a first reinforcement member coated with asphalt, and a first layer of granules applied to the asphalt coated first reinforcement member to form the top side of the base layer, and wherein the first decorative layer includes a top side, a bottom side, a second reinforcement member coated with asphalt, and a second layer of granules applied to the asphalt coated second reinforcement member to form the top side of the first decorative layer, wherein the bottom side of the first decorative layer is positioned onto the top side of the base layer and the flexible adhesive is applied between the bottom side of the first decorative layer and the top side of the base layer to affix the first decorative layer to the base layer.

31. The roof assembly of claim 30 wherein the asphalt coated onto the base layer and the asphalt coated onto the first decorative layer does not include the flexible adhesive.

32. The roof assembly of claim 30, wherein the hip and ridge shingle further comprises a second decorative layer having a top side, a bottom side, a third reinforcement member coated with asphalt, and a third layer of granules applied to the asphalt coated third reinforcement member to form the top side of the second decorative layer, wherein the bottom side of the second decorative layer is positioned onto the top side of the first decorative layer and the flexible adhesive is applied between the bottom side of the second decorative layer and the top side of the first layer to affix the second decorative layer to the first decorative layer.

33. The roof assembly of claim 32 wherein the second decorative layer is separate from the base layer and the first decorative layer, and the second decorative layer is bent over the ridge line or the hip of the roof assembly such that the second decorative layer bends about a different radius of curvature than the base layer or the first decorative layer.

1/3

FIG. 1

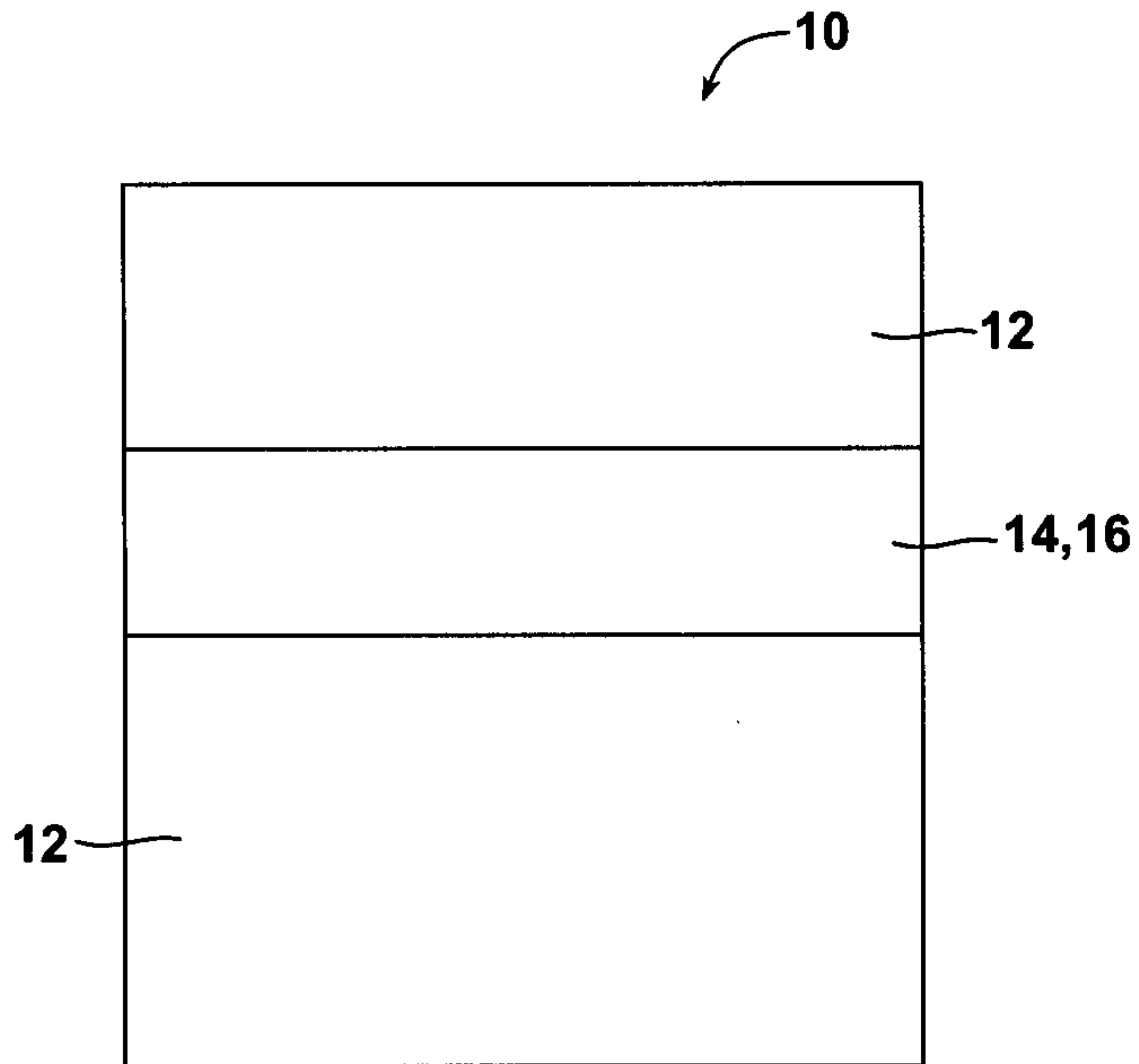


FIG. 2

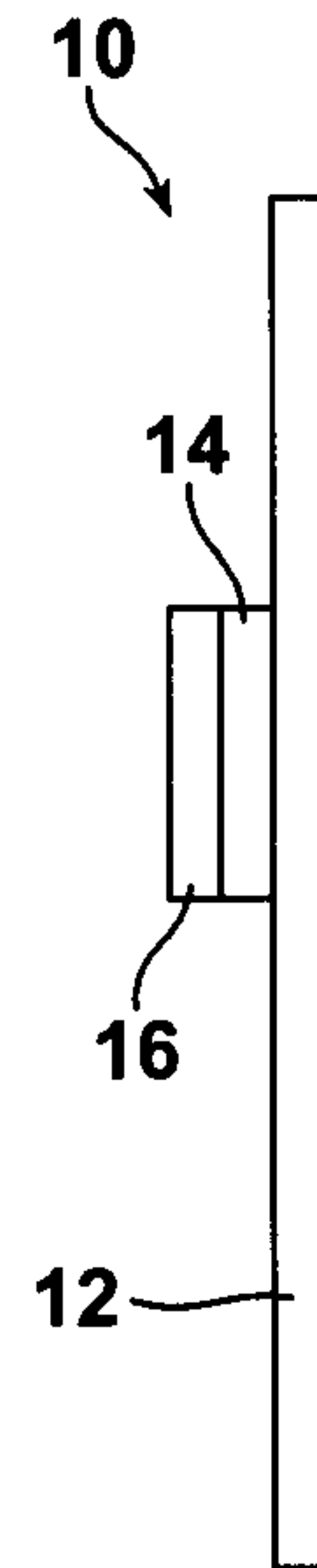
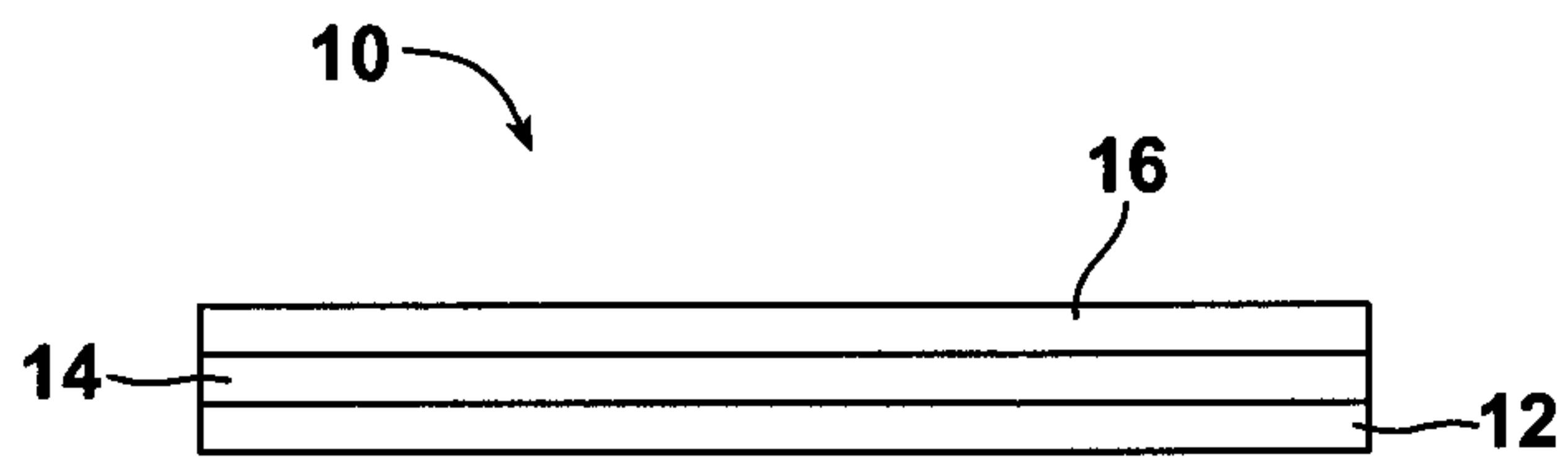


FIG. 3



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2/3

FIG. 4

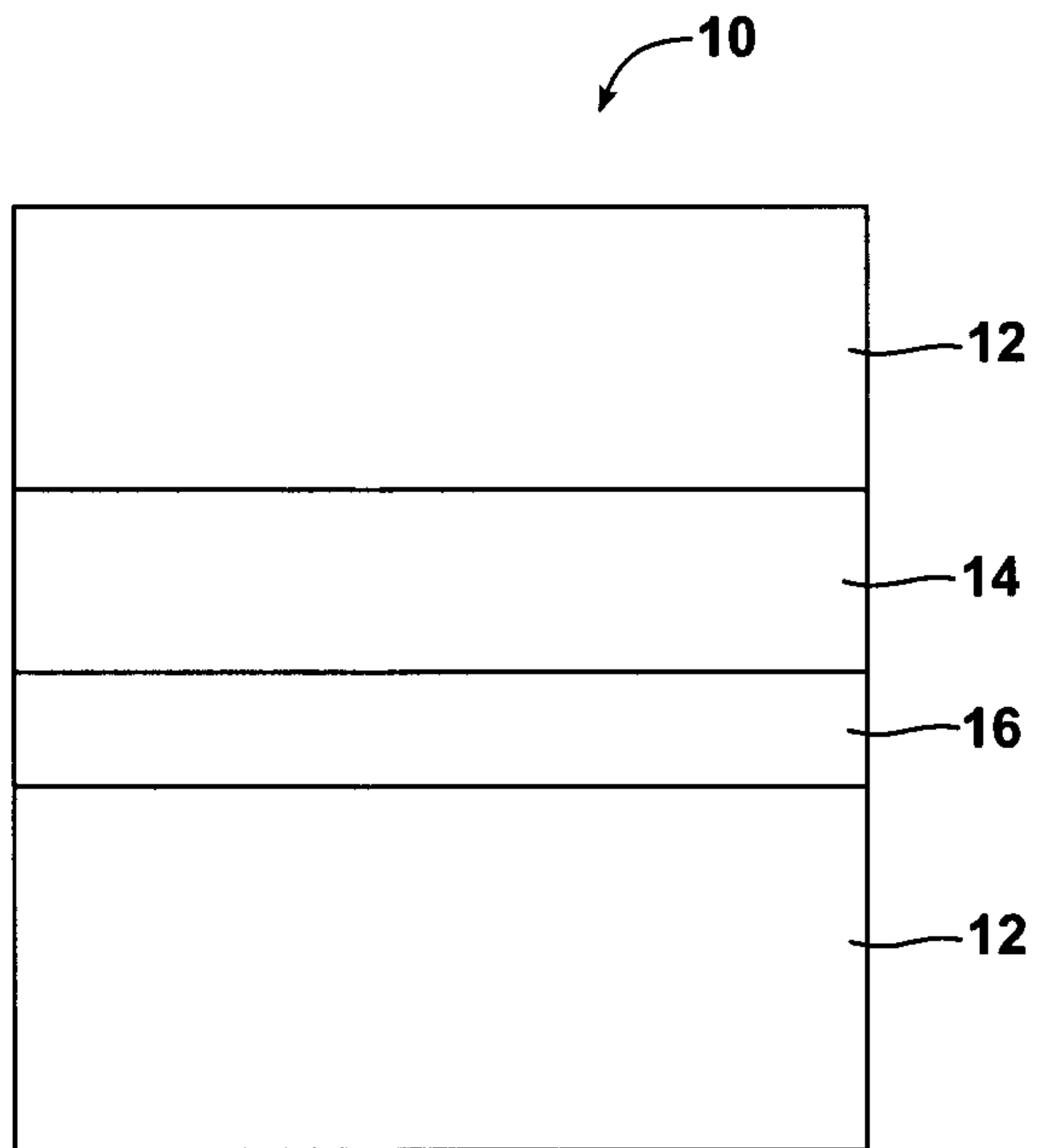
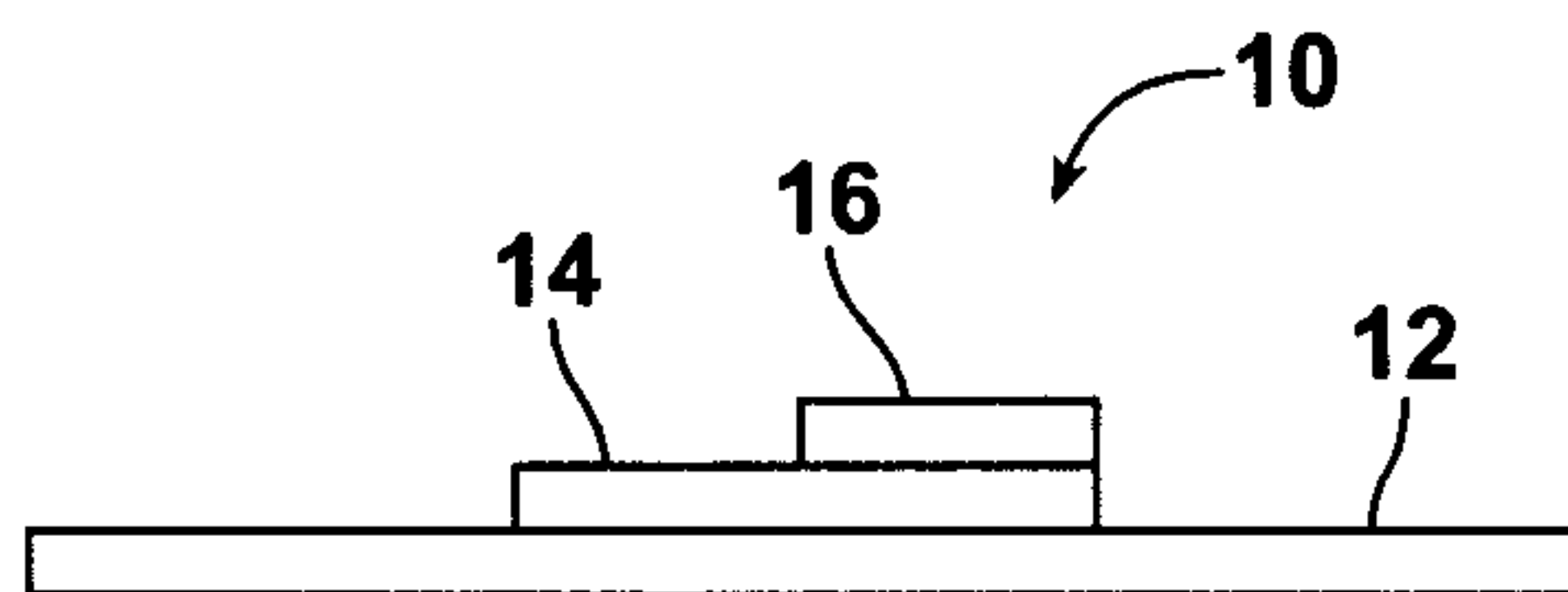
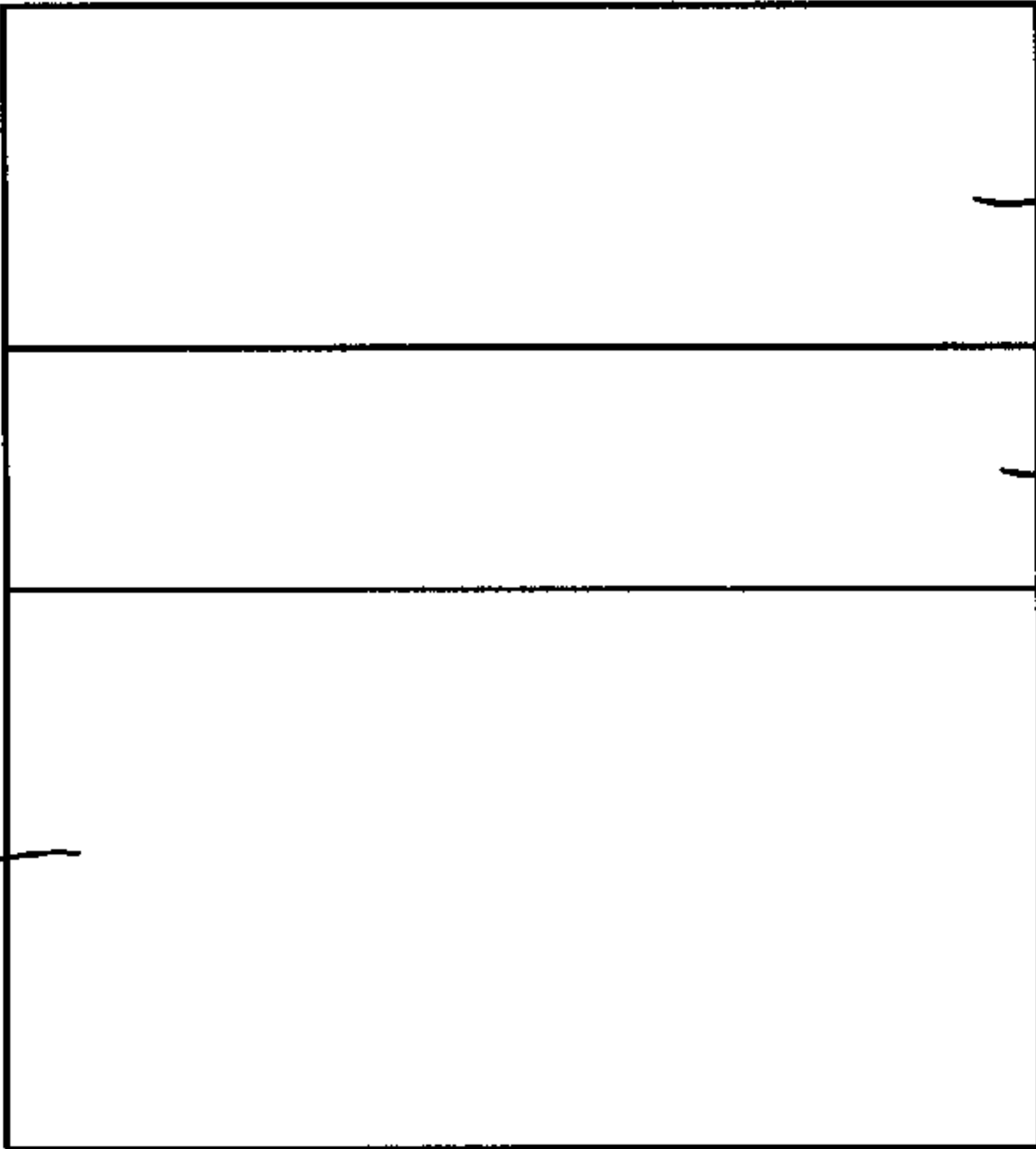



FIG. 5





**10**



**12**

**14,16**

**12**