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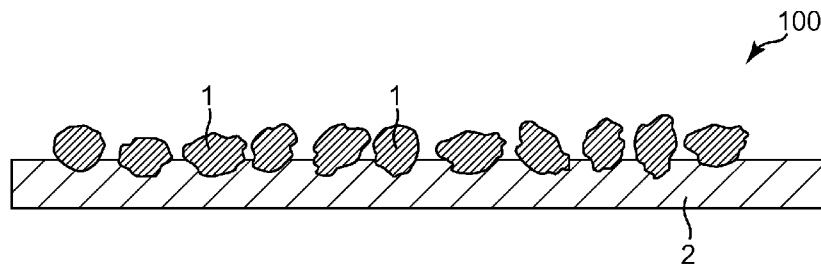


FIG. 1A

(57) Abstract: Problem: To provide a sealing material that can sufficiently secure water stopping performance over a long period of time in a joining section between two members. Resolution Means: A sealing material interposed between two members that seals a gap between the two members, wherein the sealing material is provided with a base material having gap filling conformability and deformation resistant characteristics, and water absorbing resin particles fixed at a fixed amount of not less than 2.5 g/m² onto at least a portion of the base material.



SEALING MATERIAL

FIELD OF THE DISCLOSURE

The present disclosure relates to a sealing material interposed between two members that seals a gap between the two members.

BACKGROUND ART

Heretofore, sealing material such as a gasket, packing, or the like has been used to secure sealing performance and water stopping performance in a joining section between two members by embedding into a gap between two members, and various raw materials that have been used as such include silicon rubber or other rubber based material, urethane foam or other foam material, polytetrafluoroethylene or other resin material, and the like.

For example, Patent Document 1 discloses a packing used in a joint portion of a tube connected by a flange. Further, Patent Document 2 discloses a front defroster nozzle of an automobile where a sealing member that is an annular packing made of a foam body is interposed in a joining section between a lower cylindrical body and an upper cylindrical body. Moreover, Patent Document 3 discloses use of a gasket made of resin in a construction of a door mirror placement part of a vehicle. Furthermore, Patent Document 4 discloses preventing rain water from penetration indoors by a primary or secondary gasket in a waterproof construction of an outer wall joint. Further, Patent Document 5 discloses use of packing to keep a joining section in a water tight state in a watertight testing device for a joining section of a tube.

PRIOR ART DOCUMENTS

Patent Documents

Patent Document 1: Japanese Unexamined Patent Application Publication No. H09-96388A

Patent Document 2: Japanese Unexamined Patent Application Publication No. 2010-188791A

Patent Document 3: Japanese Unexamined Patent Application Publication No. H10-315860A

Patent Document 4: Japanese Unexamined Patent Application Publication No. H06-26117A

Patent Document 5: Japanese Unexamined Patent Application Publication No. H09-280996A

SUMMARY OF THE DISCLOSURE

Problems to be Solved by the Disclosure

Securing sufficient sealing performance and water stopping performance is desired by embedding sealing material interposed between two members into the gap between the members. Particularly, securing sufficient water stopping performance in gaps between members over a long period of time in a joining section between housing members and in a joining section between vehicle members is desired.

However, with conventional sealing material, even if sufficient water stopping performance is secured at the time of joining, the water stopping performance may decrease as small gaps may appear due to deformation of the sealing material over time or due to deformation by an external force such as a

load or the like during use and leaks may occur from these gaps.

Means to Solve the Problem

The sealing material according to one embodiment of the present disclosure is a sealing material interposed between two members that seals a gap between the two members, wherein the sealing material is provided with a base material having gap filling conformability and deformation resistant characteristics and water absorbing resin particles fixed at a fixed amount of not less than 2.5 g/m^2 onto at least a portion of the base material.

With this type of embodiment, even if a small gap occurs between the sealing material and the member, leakage from such gap can be sufficiently prevented. Therefore, by using the above sealing material, water stopping performance over a long period of time in a joining section between two members can be sufficiently secured.

In the sealing material according to a different embodiment, the base material may be a sheet-like base material, and the water absorbing resin particles may be fixed to at least one side of the sheet-like material.

The sealing material according to this embodiment may further provide an adhesive layer provided on the other side of the sheet-like base material. Further, the sealing material according to this embodiment may have the water absorbing resin particles fixed to both main surfaces of the sheet-like base material.

In the sealing material according to a different embodiment, an average particle diameter of the water absorbing resin particles may be 800 micrometers or less.

In the sealing material according to a different embodiment, the water absorbing resin particles may have water absorbing properties of 250 (g/g 30 min) or more.

In the sealing material according to a different embodiment, the water absorbing resin particles may be fixed onto the base material by a binder resin.

In the sealing material according to a different embodiment, the base material may be a base material made of a foam body. Further, in this embodiment, the Asker C hardness of the foam body may be 50 or less.

In the sealing material according to a different embodiment, the base material may be a base material made of a rubber-like elastic body.

EFFECT OF THE DISCLOSURE

According to one aspect of the present disclosure, a sealing material is provided that can sufficiently secure water stopping performance over a long period of time in a joining section between two members.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1A is a cross-sectional view schematically illustrating one aspect of the sealing material.

FIG. 1B is a cross-sectional view schematically illustrating another aspect of the sealing material.

FIG. 2A is a cross-sectional view schematically illustrating another aspect of the sealing material.

FIG. 2B is a cross-sectional view schematically illustrating another aspect of the sealing material.

FIG. 3A is a cross-sectional perspective view schematically illustrating the sealing material according to a modified example.

FIG. 3B is also a cross-sectional view schematically illustrating another aspect of the sealing material.

FIG. 3C is also a cross-sectional view schematically illustrating another aspect of the sealing material.

FIG. 3D is also a cross-sectional view schematically illustrating another aspect of the sealing material.

FIG. 4 is a perspective view schematically illustrating one aspect of use of the sealing material.

FIG. 5A is a perspective view schematically illustrating another aspect of use of the sealing material.

FIG. 5B is a perspective view schematically illustrating another aspect of use of the sealing material.

FIG. 6 is a perspective view schematically illustrating a water stopping performance test in the working examples.

DETAILED DESCRIPTION

Embodiments of the present disclosure will be described in detail hereinafter with reference to drawings at certain times.

The sealing material according to this embodiment is a sealing material interposed between two members that seals a gap between the two members and is provided with a base material and water absorbing resin particles fixed at a fixed amount of not less than 2.5 grams/square meter onto at least a portion of the base material.

With the sealing material according to this embodiment, even if a small gap occurs between the sealing material and the member, leakage from such gap can be sufficiently prevented. Therefore, the sealing material according to this embodiment can sufficiently secure water stopping performance over a long period of time in a joining section between two members.

The above effect is considered to be achieved for the following reasons. That is, when a gap occurs between the sealing material and a member and water begins to penetrate into the gap, the water absorbing resin particles absorb the water and swell, and the gap is blocked by the swollen water absorbing resin particles thereby preventing further penetration of the water. Further, after water penetration has stopped and a dry atmosphere has returned, the moisture absorbed in the water absorbing resin particles dries naturally and returns to its pre-absorption state, and thus is understood to be able to withstand repeated water penetration.

Because the sealing material according to this embodiment can sufficiently secure water stopping performance over a long period of time in a joining section between two members, the sealing material can be suitably used for securing water stopping performance in a joining section between

housing members and in a joining section between vehicle members, and the like.

The base material positioned in the gap between two members is not particularly restricted. As the base material, base materials used conventionally, for example, in gaskets or as packing materials may be used by appropriate selection according to applied use of the sealing material.

The shape of the base material is also not particularly restricted and may be, for example, a sheet-like base material, a rectangular shaped base material, or a base material having a three-dimensional shape along the gap between the two members. The shape of the base material can be appropriately selected according to the shape of the joining section of the members.

The base material may be a base material made of, for example, a foam body. As the foam body, any foam body that can be used as a gasket or packing material may be used without particular restriction.

Examples of the foam body include polyolefin based foams such as polyethylene foams, polypropylene foams, ethylene-propylene copolymer based foams, ethylene-vinyl acetate copolymer based foams; polyester based foams such as polyethylene terephthalate based foams, polyethylene naphthalate based foams, polybutylene terephthalate based foams; polyvinyl chloride foams; polystyrene foams; phenolic resin foams; isocyanurate foams; vinyl acetate foams; polyphenylene sulfide-based foams; polyamide based foams; polyimide foams; polyurethane foams, and the like.

As the foam body, a foam body is used having an Type E durometer hardness (JISK6253 published in 2012, ISO7619) of 50 or less in one embodiment, and of 40 or less in another embodiment. When the Type E durometer hardness of the foam body is 50 or less, the sealing material more easily achieves gap filling conformability and deformation resistant characteristics which enables the sealing material to be applied to broad uses.

In one embodiment the Type E durometer hardness of the foam body is 5 or greater, and in another embodiment, is 10 or greater. When the Type E durometer hardness of the foam body is 5 or greater there is less deformation over time of the sealing material making it less susceptible to gaps between the sealing material and the member, and thereby having a tendency to further improve the water stopping performance of the sealing material.

The base material may be a base material made of, for example, a rubber-like elastic body. As the rubber-like elastic body, any rubber-like elastic body that can be used as a gasket or packing material may be used without particular restriction. Examples of the rubber-like elastic body include chloroprene rubber, butyl rubber, ethylene-propylene-diene rubber, ethylpropylene butyl rubber, polybutadiene rubber, polyisoprene rubber, polyisobutylene rubber, styrene-butadiene rubber, nitrile rubber, fluoro rubber, silicone rubber, urethane rubber, and the like.

Further, the base material may be a base material made of foam rubber-like elastic body. Examples of foam a suitable rubber-like elastic body include foamed ethylene-propylene-diene rubber, foamed chloroprene rubber, foamed ethylpropylene butyl rubber, foamed nitrile rubber, natural foam rubber, foamed silicone rubber, foamed styrene-butadiene rubber, foamed polybutadiene, foamed polyisoprene, foamed polyisobutylene, foamed fluoro rubber, and foamed polyurethane, and the like.

The base material may be made of a material other than a foam rubber-like elastic body. For example, the base material may be made from resin material such as polyester resins, polyurethane resins,

phenolic resins, polyamide resins, fluorine resins, polyacetal resins, polyolefin resins, and the like.

The water absorbing resin particles may be anything that swells by absorbing and retaining water when coming into contact with water, and may be particles that include known water absorbing resins, the composition of such being not particularly restricted.

Examples of the water absorbing resin particles include particles that contain a water absorbing resin such as sodium polyacrylate, acrylic acid-vinyl alcohol copolymer, crosslinked sodium polyacrylate, starch-acrylic acid graft copolymers, isobutylene-maleic anhydride copolymers and saponified products thereof, polyaspartic acid, and the like.

The water absorbing resin particles are preferably particles having an average particle diameter of 800 micrometers (μm) or less, and more preferably 500 micrometers or less as determined by the Microtrac method (measured by Micro-track MT3000 series provided by Nikkiso Co., Ltd (Shibuya-ku Tokyo, Japan). When the average particle diameter of the water absorbing resin particles exceeds 800 micrometers, there is a tendency to drop off from the base material which may lead to a decrease in storage stability and product reliability.

The lower limit of the average particle diameter of the water absorbing resin particles is not particularly restricted. Note that, in one aspect, partially embedding the water absorbing resin particles into the base material enables the water absorbing resin particles to be fixed to the base material. In this type of aspect, completely burying the water absorbing resin particles into the base material may prevent the water absorbing resin particles from absorbing water. In other words, in this aspect, it is desired that the water absorbing resin particles be partially embedded into the base material and are fixed to the base material with the remaining portion protruding above the base material. The average particle diameter of the water absorbing resin particles may be 10 micrometers or greater, and this type of water absorbing resin particle can easily fix onto the base material with the desired aspect described above. Further, from a perspective of more easily fixing onto the base material, the average particle diameter of the water absorbing resin particles may be 20 micrometers or greater.

Note that, in this specification, the average particle diameter of the water absorbing resin particles indicates the average particle diameter of the water absorbing resin particles in a dry state, and the average particle diameter is defined as a particle diameter where, when used as a boundary in a particle size distribution obtained by the Microtrac method provided by Nikkiso Co., Ltd, the distribution area of the particle diameter on the large side is equivalent to the distribution area of the particle diameter on the small side.

In one embodiment the water absorbing resin particles are particles having water absorbing properties of 250 (g/g 30 min) or greater. In another embodiment, the water absorbing properties of the water absorbing resin particles are 300 (g/g 30 min) or greater, and in a further embodiment 350 (g/g 30 min) or greater. With the water absorbing resin particles having this type of water absorbing properties, sufficient water stopping performance can be maintained even with the occurrence of larger gaps thereby enabling a more suitable sealing material to be obtained as a sealing material to be applied to a joining section between housing members, a joining section between vehicle members, and the like.

Although the upper limit concerning the water absorbing properties of the water absorbing resin particles is not intended to be necessarily limited, the water absorbing properties are such that swelling

does not occur under a use environment, and may be, for example, 1000 (g/g 30 min) or less or 800 (g/g 30 min) or less.

In this specification, the water absorbing properties of the water absorbing resin particles indicate a value measured in compliance with JIS K 7223. Note that a water absorbing property of the water absorbing resin particles of "250 (g/g 30 min) or more" means 250 g of water or more is absorbed in 30 min per 1 g of water absorbing resin particles.

The water absorbing resin particles are fixed on at least a portion of the base material, and the fixed amount is 2.5 grams/square meter or greater. When the fixed amount is less than 2.5 grams/square meter, sufficient water stopping performance may not be obtained.

In one embodiment the fixed amount of the water absorbing resin particles is 3.0 grams/square meter or more, and in another embodiment 4.0 grams/square meter or more. With this type of fixed amount, the water stopping performance can be sufficiently maintained even when gaps between the sealing material and the member become large. Therefore, the sealing material having the water absorbing resin particles fixed in this type of fixed amount can be particularly suited for applying to a joining section between housing members, a joining section between vehicle members, and the like.

Although the upper limit of the fixed amount of the water absorbing resin particles is not particularly limited, the fixed amount of the water absorbing resin particles may be, for example, 100 grams/square meter or less. At 100 grams/square meter or less tackiness that occurs by absorbing moisture in the air is suppressed and handling is favorable. Furthermore, the fixed amount of the water absorbing resin particles may be 50 grams/square meter or less or 40 grams/square meter or less.

Note that, in this specification, the fixed amount of the water absorbing resin particles indicates a fixed amount of water absorbing resin particles fixed on the surface of the base material, in other words a fixed amount of water absorbing resin particles fixed so that at least a portion is positioned outside the base material. The fixed amount of the water absorbing resin particles does not include, for example, a fixed amount of the water absorbing resin particles that are embedded so as to be completely buried in the base material.

The water absorbing resin particles are fixed onto the surface of the base material, but the aspect of fixation is not particularly restricted. For example, embedding a portion of the water absorbing resin particles into the base material enables the water absorbing resin particles to be fixed on to the base material. With the sealing material having the water absorbing resin particles fixed by embedding in this manner, because a portion of the water absorbing resin particles are exposed on the surface of the base material, water absorption by the water absorbing resin particles proceeds rapidly, thereby obtaining excellent water stopping performance.

When the water absorbing resin particles are fixed to the base material by embedding, it is desirable that 40% or more of the volume of the water absorbing resin particles are embedded into the base material. Further, 50% or more of the volume of the water absorbing resin particles may be embedded into the base material. A low degree of embedding into the base material brings about a tendency for the water absorbing resin particles to drop off which may lead to a decrease in storage stability and product reliability.

In one embodiment, the water absorbing resin particles are embedded into the base material

such that 10% or more of the volume of the water absorbing resin particles protrude outside the base material. In another embodiment 20% of the volume of the water absorbing resin particles or more protrude outside the base material. Embedding in this manner further improves the water absorption rate by the water absorbing resin particles thereby tending to further improve the water stopping performance.

Note that, examples of methods for embedding the water absorbing resin particles into the base material include methods where the base material raw materials are extrusion molded and the water absorbing resin particles are adhered to the surface prior to hardening, methods where the water absorbing resin particles are distributed on the surface of a soft base material and then embedded under applied pressure, and the like.

Furthermore, the water absorbing resin particles may be fixed onto the base material by a binder resin. Compared to fixing by only embedding into the base material, fixing using a binder resin allows the water absorbing resin particles to be more stably fixed onto the base material and enables a stable water stopping performance to be maintained over a long period of time.

Any binder resin may be used without particular restriction so long as the water absorbing resin particles can be fixed on to the base material. Examples of the binder resin include polyurethane resins, polyester resins, acrylic resins, phenol resins, and the like.

If the binder resin is a resin that has water absorbing properties, the water absorbing resin particles may be buried inside the binder resin. Meanwhile, if the binder resin is a resin with non-water absorbing properties, it is desirable that at least a portion of the water absorbing resin particles protrude from the layer of the binder resin.

A polyurethane resin, for example, can be suitably applied as the binder resin. Because polyurethane resins have water absorbing properties, the water absorbing resin particles can be fixed onto the base material without preventing penetration of the water into the water absorbing resin particles even if the water absorbing particles are buried inside or beneath the binder resin.

Examples of polyurethane resins include moisture curing types that cure by reacting with moisture in the air in a single solution polyurethane resin, block types that cure when heated, lacquer types where a film is formed by evaporation of a solvent, two part polyurethane resins where a main agent polyol is blended with a curing agent polyisocyanate at the time of use and which is moisture curing at room temperature, and the like. Examples of polyols include acrylic polyols having a hydroxyl group in the molecule, polyester polyols, polyether polyols, polyurethane polyols, and the like. Examples of isocyanates used in polyisocyanate prepolymers include Toluene diisocyanate(TDI) -based, Polymethylene polyphenyl polyisocyanate(MDI)-based, Isophorone diisocyanate (IPDI)-based, hexamethylene diisocyanate (HDI)-based, and the like.

Further, an adhesive agent may be used as the binder resin. In other words, the sealing material may be such that an adhesive agent, which is a binder resin, forms an adhesive layer on the base material and the water absorbing resin particles are fixed to the adhesive layer.

Examples of adhesive agents include acrylic-based adhesive agents, epoxy-based adhesive agents, urethane-based adhesive agents, silicone-based adhesive agents, and the like. Moreover, the adhesive agent may be a pressure sensitive adhesive (PSA), and examples of pressure sensitive adhesives include natural and synthetic rubber-based pressure sensitive adhesives, acrylic-based pressure sensitive

adhesives, silicone-based pressure sensitive adhesives, elastomer-based pressure sensitive adhesives, polyolefin-based pressure sensitive adhesives, and the like.

Furthermore, the binder resin may contain alcoholic compounds. Providing an alcoholic compound enables less degradation of water absorption rate under high humidity condition and more stable water stopping performance than the case without any alcoholic compound.

When the content of alcoholic compounds is less than 1% the effect of improvement of stability in humidity may not be sufficient.

The boiling points of the alcoholic compounds may be higher than 100 degrees C. By providing higher boiling point than 100 degrees C, the alcoholic compounds may not vaporize during the drying process of the binder solution etc. and therefore remain effective for resistance against humidity.

Examples of suitable alcoholic compounds include primary alcohol agents, such as 1-pentanol, 1-hexanol, 1-octanol, secondary alcohol agents, such as 2-heptanol, 2-octanol, tertiary alcohol agents, such as isobutyl alcohol, polyol agents, such as ethylene glycol, glycerin, ethylene glycol monobutyl ether, and the like. Further, these alcoholic compounds may have other functional groups.

The thickness of the resin layer formed by the binder resin may be 5 μm or greater, or may be 10 μm or greater. Providing the resin layer with a thickness of 5 μm or greater enables the water absorbing resin particles to fix onto the base material with sufficient retention.

In one embodiment the thickness of the resin layer formed by the binder resin is 400 micrometers or less, and in another embodiment is 200 micrometers or less. Providing the resin layer with a thickness of 400 micrometers or less enables the water absorbing resin particles to be firmly fixed onto the base material without losing the gap filling conformability and deformation resistant characteristics or pliability of the base material.

The sealing material may further have an adhesive layer provided on a portion of the base material, for example, in the opposite side of the water absorbing particle. The sealing material having this type of adhesive layer can be easily interposed between two members because the sealing material can be applied via the adhesive layer to one side of a joining member.

The adhesive layer may be a layer containing a known adhesive agent and can be appropriately selected from among known adhesive agents according to the material properties of the joining members, the material properties of the base material, and the like. Examples of adhesive agents that can be suitably used include acrylic-based adhesive agents, epoxy-based adhesive agents, urethane-based adhesive agents, silicone-based adhesive agents, and the like. Moreover, the adhesive agent may be a pressure sensitive adhesive (PSA), and examples of pressure sensitive adhesives include natural and synthetic rubber-based pressure sensitive adhesives, acrylic-based pressure sensitive adhesives, silicone-based pressure sensitive adhesives, elastomer-based pressure sensitive adhesives, polyolefin-based pressure sensitive adhesives, and the like.

Further, the adhesive layer may be formed by two-sided adhesive tape provided with an adhesive layer made of a pressure sensitive adhesive on both major surfaces. This type of adhesive layer can be easily formed by applying the two-sided adhesive tape onto the base material.

The thickness of the adhesive layer, although not particularly limited, may be the thickness that obtains the intended adhesiveness.

In the sealing material having the adhesive layer, the adhesive layer may contain the water absorbing resin particles. When the adhesive layer contains the water absorbing resin particles, the water stopping performance can be further improved in the contact surface between the member and the adhesive layer.

A plurality of aspects of the sealing material according to this embodiment will be explained below with reference to the drawings.

FIG. 1A is a cross-sectional view schematically illustrating one aspect of the sealing material. A sealing material 100 of FIG. 1A is provided with a sheet-like base material 2 and water absorbing resin particles 1 fixed onto one side surface of the sheet-like base material 2. In the sheet material 100, a portion of the water absorbing resin particles 1 are fixed by being embedded in the sheet-like base material 2.

In FIGS. 1A and 1B, configuring elements on the other surface side of the sheet-like base member 2 are not particularly illustrated, but the sealing material 100 may be provided with an adhesive layer on the other surface side of the sheet-like base material 2. Further, the sealing material 100 may have the water absorbing resin particles 1 also fixed to the other surface side of the sheet-like base material 2 (i.e., the water absorbing resin particles 1 fixed on both major surfaces of the sheet-like base material 2).

FIG. 1B is a cross-sectional view schematically illustrating another aspect of the sealing material. The sealing material 110 of FIG. 1B is provided with a sheet-like base material 2 and water absorbing resin particles 1 fixed by a binder resin 3 onto one surface side of the sheet-like base material 2.

With the sealing material 110, in one embodiment a resin having water absorbing properties is used as a binder resin 3. By covering the water absorbing resin particles 1 with the binder resin 3, the water absorbing resin particles 1 are firmly fixed onto the surface of the sheet-like base material 2. Further, when the binder resin 3 is a resin having water absorbing properties, sufficient water stopping performance can be obtained while covering the water absorbing resin particles 1 by the binder resin 3.

In FIG. 1B, configuring elements on the other major surface of the sheet-like base member 2 are not particularly illustrated, but the sealing material 110 may be provided with an adhesive layer on the other major surface of the sheet-like base material 2. Further, the sealing material 110 may have the water absorbing resin particles 1 also fixed to the other major surface of the sheet-like base material 2 (i.e., the water absorbing resin particles 1 fixed on both major surfaces of the sheet-like base material 2).

FIG. 2A is a cross-sectional view schematically illustrating another aspect of the sealing material. A sealing material 120 of FIG. 2A is provided with a sheet-like base material 12, water absorbing resin particles 11 fixed by a binder resin 13 onto one major surface of the sheet-like base material 12, and an adhesive layer 14 provided on the other major surface of the sheet-like base material 12. With the sealing material 120, the binder resin 13 may be a resin that does not have tack (for example, urethane resin or the like), or it may be a resin that functions as an adhesive agent.

FIG. 2B is a cross-sectional view schematically illustrating another aspect of the sealing material. A sealing material 130 of FIG. 2B is provided with the sheet-like base material 12, a first resin layer containing the water absorbing resin particles 11 and a first binder resin 13, provided on one major surface of the sheet-like base material, and a second resin layer containing the water absorbing resin

particles 11 and a second binder resin 14 on the second major surface.

With the sealing material 130, the first binder resin 13 and the second binder resin 14 may respectively be resins that do not have tack (for example, urethane resin or the like), or they may be resins that function as adhesive agents.

FIG. 3 is a cross-sectional perspective view schematically illustrating a modified example of the sealing material according to this embodiment. A sealing material 140 of FIG. 3A is provided with a sheet-like base material 22, a binder resin layer 21 containing water absorbing resin particles provided onto one major surface of the sheet-like base material 22, and an adhesive layer 23 provided on the other major surface of the sheet-like base material 22.

A sealing material 150 illustrated in FIG. 3B is provided with a base material 32 having a predetermined three-dimensional shape, a binder resin layer 31 containing water absorbing resin particles provided on the surface of a portion of the base material 32, and an adhesive layer 33 provided on another surface of the base material 32. The three-dimensional shape of the base material 32 is formed so that the gap between two members is filled and sealed by the sealing material 150 when the sealing material 150 is interposed between the two members.

A sealing material 160 illustrated in FIG. 3C is provided with a base material 42 in a rectangular shape and a binder resin layer 41 containing water absorbing resin particles provided on the entire surface of the base material 42. This type of sealing material 160 can be suitably used when either one of two joining members has unevenness in a joining section.

A sealing material 170 illustrated in FIG. 3D is provided with a base material 52 having a disk-like shape and binder resin layers 51a and 51b containing water absorbing resin particles provided on both major surfaces of the base material 52. The sealing material 170 can be produced, for example, by cutting the sheet-like base material provided with the binder resin layers 51a and 51b on both major surfaces into a disk-like shape.

FIG. 4 is a perspective view schematically illustrating one aspect of use of the sealing material according to this embodiment. In FIG. 4, the first major surface of the first member 65 and the side edge portion of the second member 66 are joined via a sealing material 180. The sealing material 180 has a first major surface 61 and a second major surface 63 and the second major surface 63 joins with the first major surface of the first member 65. The sealing material 180 is interposed between the first member 65 and the second member 66 so that the main first major surface 61 joins with the side edge portion of the second member 66.

Here, with members having a plate-like shape like the first member 65 and the second member 66, it is generally easy for the major surfaces to be formed flat without unevenness, but it is difficult for the side edge portion to be flattened to the same degree. On account of this, there is a tendency for a gap, caused by unevenness in the side edge portion of the second member, to easily occur between the second member 66 and the sealing material 180. Therefore, it is desirable that the sealing material 180 have water absorbing resin particles fixed in the first major surface 61 that contacts the side edge portion of the second member 66.

An adhesive layer, for example, may be provided on the second major surface 63 of the sealing material 180. In this case, the sealing material 180 is applied to the first member 65 via the adhesive

layer and then the second member 66 is joined onto the sealing material 180, and using this method, the sealing material 180 can be easily interposed between the first member 65 and the second member 66.

FIG. 5A is a perspective view schematically illustrating another aspect of use of the sealing material according to this embodiment. In FIG. 5A, a side edge portion of a first member 75 and a side edge portion of a second member 76 are joined via a sealing material 190. The sealing material 190 has a second joining surface 73 that joins with the first member 75, and a first joining surface 71 that joins with the second member 76.

The sealing material 190 has water absorbing resin particles fixed to at least one side of the first joining surface 71 and the second joining surface 73, and the water absorbing resin particles may be fixed to both sides of the first joining surface 71 and the second joining surface 73.

The sealing material 190 may have adhesiveness on at least one side of the first joining surface 71 and the second joining surface 73. In other words, at least one side of the first joining surface 71 and the second joining surface 73 may be a joining surface made of an adhesive layer. Applying this type of sealing material 190 to either of the first member 75 or the second member 76 via a joining surface having adhesiveness and then joining to the other member allows the sealing material 190 to be easily interposed between the first member 75 and the second member 76.

FIG. 5B is a perspective view schematically illustrating another aspect of use of the sealing material according to this embodiment. In FIG. 5B, a first major surface of a first member 85 and a first major surface of a second member 86 are joined via a sealing material 200. The sealing material 200 has a first major surface 81 and a second major surface 83, and the second major surface 83 joins with the first major surface of the first member 85. The sealing material 200 is interposed between the first member 85 and the second member 86 so that the first major surface 81 joins with the first major surface of the second member 86.

The sealing material 200 has water absorbing resin particles fixed to at least one side of the first major surface 81 and the second major surface 83, and the water absorbing resin particles may be fixed to both sides of the first major surface 81 and the second major surface 83.

The sealing material 200 may have adhesiveness on at least one side of the first major surface 81 and the second major surface 83. In other words, an adhesive layer may be provided on at least one side of the first major surface 81 and the second major surface 83. In this case, the sealing material 200 is applied to one of either the first member 85 or the second member 86 via the adhesive layer and then the other member is joined onto the sealing material 200, and using this method, the sealing material 200 can be easily interposed between the first member 85 and the second member 86.

Several embodiments of the present disclosure have been described above, but the present disclosure is not limited to the above mentioned embodiments. For example, one aspect of the present disclosure may be a joining method where a first member and a second member are joined via the above sealing material. Furthermore, another aspect of the present disclosure may be a manufacturing method of the sealing material wherein the water absorbing resin particles described above are fixed to a known gasket or packing material to obtain the sealing material.

Examples

The present disclosure is described more specifically below using working examples, but the present disclosure is not limited to the working examples.

Working Example 1

Sealing material was prepared by fixing water absorbing resin particles (made by Sanyo Chemical Industries, Ltd., "SANFRESH ST-500 MPSA" average particle diameter: 40 micrometers, water absorbency: 400 (g/g 30 min)) onto one surface of a sheet-like base material made of butyl rubber at a fixed amount of 3 grams/square meter using a urethane resin solution (made by Sakata Inx Corporation, "Lamiall Mark III" 18% solid content toluene methyl ethyl ketone / isopropyl alcohol mixed solution).

Specifically, 50 g of the water absorbing resin particles were added to 150 g of the urethane resin solution and dispersed to make a coating solution. The coating solution was coated onto the base material using a knife coater so as to produce a dry weight of the applied coating solution of 8 grams/square meter. The applied coating solution was allowed to dry (Dry Condition : 80 C, 10 minutes) to produce the sealing material.

Working Examples 2 to 4

Sealing material was prepared identically to working example 1 with the exception of modifying the fixed amount of the water absorbing resin particles to 4 grams/square meter, 5 grams/square meter, and 6 grams/square meter, respectively.

Comparative Example 1

The sealing material of comparative example 1 uses the sheet-like base material made of butyl rubber as is without fixing the water absorbing resin particles.

Comparative Examples 2 to 3

Sealing material was prepared identically to working example 1 with the exception of changing the fixed amount of the water absorbing resin particles to 1 grams/square meter and 2 grams/square meter, respectively.

Water Stopping Performance Test 1

FIG. 6 is a perspective view schematically illustrating a water stopping performance test in the working examples. The water stopping performance test was performed with a test device made by stacking a spacer 92 with a thickness H_1 onto a test plate 93, and installing a test tube 91 (thickness 1 mm, inner diameter 10 mm) above the spacer 92 with the sealing material 210 therebetween. Note that, the sealing material 210 was installed so that the surface where the water absorbing resin particles were fixed was positioned on the spacer 92 side. Because the spacer 92 has a structure where a portion of the disk plate is missing, a gap is formed in the test device surrounded by the test plate 93, the spacer 92, and the sealing material 210.

The water stopping performance of the sealing material was evaluated for when the thickness H_1 of the spacer is 0.1 mm and water was pooled in the test tube 91, in that, "A" represents when water was pooled in the test tube 91 up to a height of 100 mm from the test plate 93, and "B" represents when water leaked from the gap prior to water pooling up to a height of 100 mm.

The results after conducting the water stopping performance test 1 are indicated in Table 1 for the sealing materials of working examples 1 to 4 and comparative examples 1 to 3.

Table 1

	Working Example 1	Working Example 2	Working Example 3	Working Example 4	Comparative Example 1	Comparative Example 2	Comparative Example 3
Fixed Amount (grams/square meter)	3	4	5	6	0	1	2
Water Stopping Performance Test 1	A	A	A	A	B	B	B

Water Stopping Performance Test 2

0.3 mL of water was dripped, so as to spread to a diameter of approximately 20 mm, onto a surface where water absorbing resin particles of the sealing material were fixed. After standing for 30 seconds, the sealing material was stood up vertically, and the water stopping performance of the sealing material was evaluated, "B" representing dripping of the dripped water, and "A" representing when the dripped water was absorbed by the sealing material without dripping.

The results after conducting the water stopping performance test 2 are indicated in Table 2 for the sealing materials of working examples 1 to 4 and comparative examples 1 to 3.

Table 2

	Working Example 1	Working Example 2	Working Example 3	Working Example 4	Comparative Example 1	Comparative Example 2	Comparative Example 3
Fixed Amount (grams/square meter)	3	4	5	6	0	1	2
Water Stopping Performance Test 2	A	A	A	A	B	B	B

Working Example 5

Sealing material was prepared identically to working example 2 with the exception of changing the base material to chloroprene rubber foam (made by Daiwabo Progress Co., Ltd., product name NV-M, Askers-C hardness 23) (fixed amount 4 grams/square meter).

Working Example 6

Sealing material was prepared identically to working example 2 with the exception of changing the base material to EPDM foam (made by INOAC Corporation, product name E-4388, Askers-C hardness 20) (fixed amount 4 grams/square meter).

Working Example 7

Sealing material was prepared identically to working example 2 with the exception of changing the base material to polyurethane foam (made by INOAC Corporation, product name ESH, Askers-C hardness 7) (fixed amount 4 grams/square meter).

Working Example 8

Sealing material was prepared identically to working example 2 with the exception of using polyester resin (made by Seiko Advance Ltd., product name PAL) instead of urethane resin as a binder resin (fixed amount 4 grams/square meter).

Working Example 9

Sealing material was prepared identically to working example 2 with the exception of using acrylic resin (made by Teikoku Printing Inks Mfg. Co., Ltd., product name NAN) instead of urethane resin as a binder resin (fixed amount 4 grams/square meter).

The results after conducting the water stopping performance test 2 are indicated in Table 3 for the sealing materials of working examples 5 to 9.

Table 3

	Working Example 5	Working Example 6	Working Example 7	Working Example 8	Working Example 9
Fixed Amount (grams/square meter)	4	4	4	4	4
Water Stopping Performance Test 2	A	A	A	A	A

Working Example 10

Sealing material was prepared identically to working example 1 with the exception of using the mixture of acrylic pressure sensitive adhesive (made by Soken Chemical & Engineering Co., Ltd.,

product name SK-Dyne 1811L) and ethylene glycol monobutyl ether (10% compared to binder resin) instead of urethane resin as a binder resin and changing the fixed amount to 12 grams/square meter.

Working Example 11

Sealing material was prepared identically to working example 1 with the exception of adding ethylene glycol monobutyl ether (30% compared to binder resin) to the binder resin and changing the fixed amount to 12 grams/square meter.

Working Example 12

Sealing material was prepared identically to working example 10 with the exception of changing the amount of ethylene glycol monobutyl ether to 5%.

Working Example 13

Sealing material was prepared identically to working example 10 with the exception of changing the amount of ethylene glycol monobutyl ether to 2%.

Working Example 14

Sealing material was prepared identically to working example 10 with the exception of using 1-octanol instead of ethylene glycol monobutyl ether as a high boiling point alcoholic compound.

Comparative Example 4

Sealing material was prepared identically to working example 10 with the exception of eliminating ethylene glycol monobutyl ether.

Water Stopping Performance Test 3

0.4 mL of water was dripped, so as to spread to a diameter of approximately 20 mm, onto a surface where water absorbing resin particles of the sealing material were fixed. The time required for water absorption to be complete was measured once a day. This was done until the time exceeded 30 seconds for the first time. The number of days it took for the time to exceed 30 seconds was recorded.

The results after conducting the water stopping performance test 3 are indicated in Table 4 for the sealing materials of working examples 10 to 14 and comparative example 4.

Table 4

	Working Example 10	Working Example 11	Working Example 12	Working Example 13	Working Example 14	Comparative Example 4
Amount of Alcohol	10%	30%	5%	2%	10%	-
Time Before Water Absorption	>30 days	>30 days	28 days	23 days	>30 days	4 days

Exceeded 30 Seconds in Water Stopping Performance Test 3						
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Reference Numerals

1, 11 Water absorbing resin particles

2 and 12 Base material

3, 13, and 14 Binder resin

21, 31, 41, 51a and 51b Binder resin layer

22, 32, 42, and 52 Base material

23 and 33 Adhesive layer

65, 66, 75, 76, 85 and 86 Member

91 Test tube

92 Spacer

100, 110, 120, 130, 140, 150, 160, 170, 180, 190, 200 and 210 sealing material

What is claimed is:

1. A sealing material interposed between two members that seals a gap between the two members, the sealing material comprising:
a base material having gap filling conformability and deformation resistant characteristics; and
water absorbing resin particles fixed at a fixed amount of not less than 2.5 grams/square meter on at least a portion of the base material.
2. The sealing material according to claim 1, wherein the base material is a sheet-like base material, and
the water absorbing resin particles are fixed onto at least one surface side of the sheet-like base material.
3. The sealing material according to claim 2, further comprising an adhesive layer provided on another surface of the sheet-like base material.
4. The sealing material according to claim 2, wherein the water absorbing resin particles are fixed onto both main surfaces of the sheet-like base material.
5. The sealing material according to any one of claims 1 to 4, wherein an average particle diameter of the water absorbing resin particles is 800 micrometers or less.
6. The sealing material according to any one of claims 1 to 5, wherein the water absorbing resin particles have water absorbing properties of 250 (g/g 30 min) or more.
7. The sealing material according to any one of claims 1 to 6, wherein the water absorbing resin particles are fixed onto the base material by a binder resin.
8. The sealing material according to any one of claims 1 to 6, wherein the water absorbing resin particles are fixed onto the base material by a binder resin and wherein a binder resin contains an alcoholic compound.
9. The sealing material according to any one of claims 1 to 7, wherein the base material is composed of a foam body.
10. The sealing material according to claim 8, wherein an Askers-C hardness of the foam body is not greater than 50.
11. The sealing material according to any one of claims 1 to 7, wherein the base material is composed of a rubber-like elastic body.

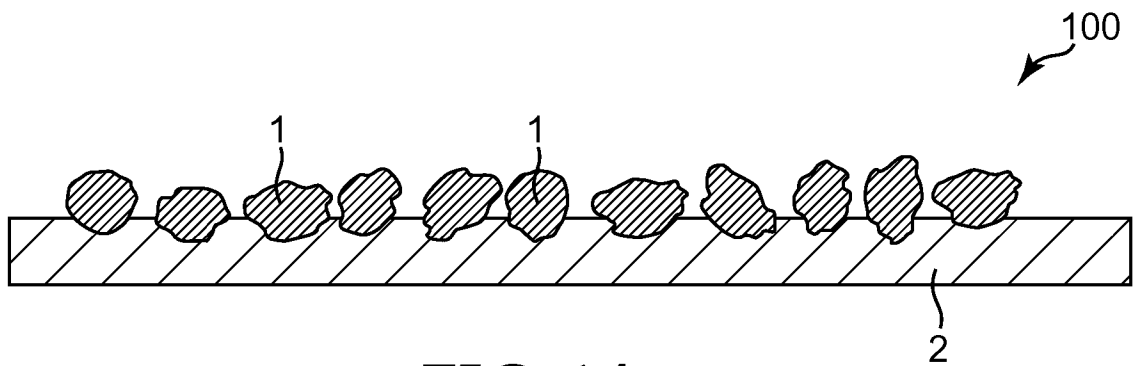


FIG. 1A

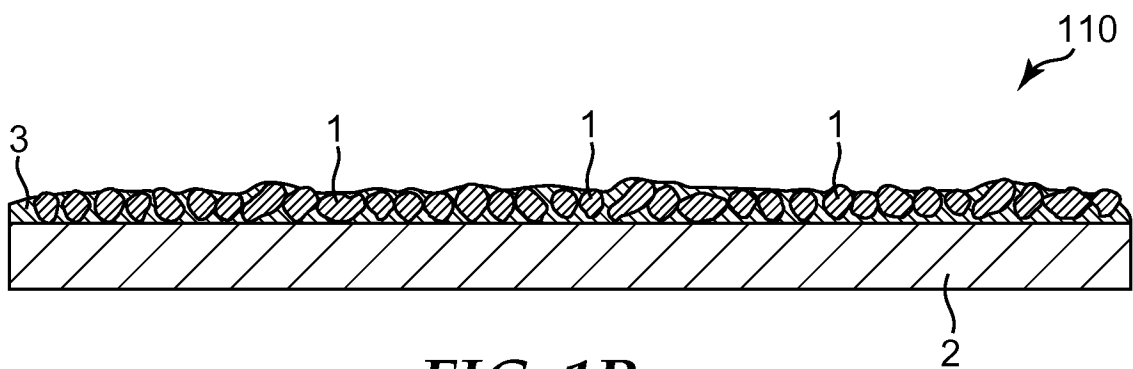
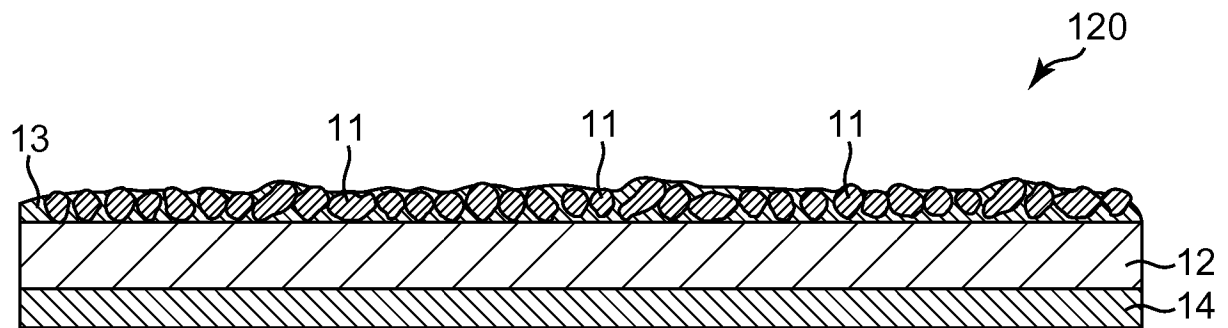
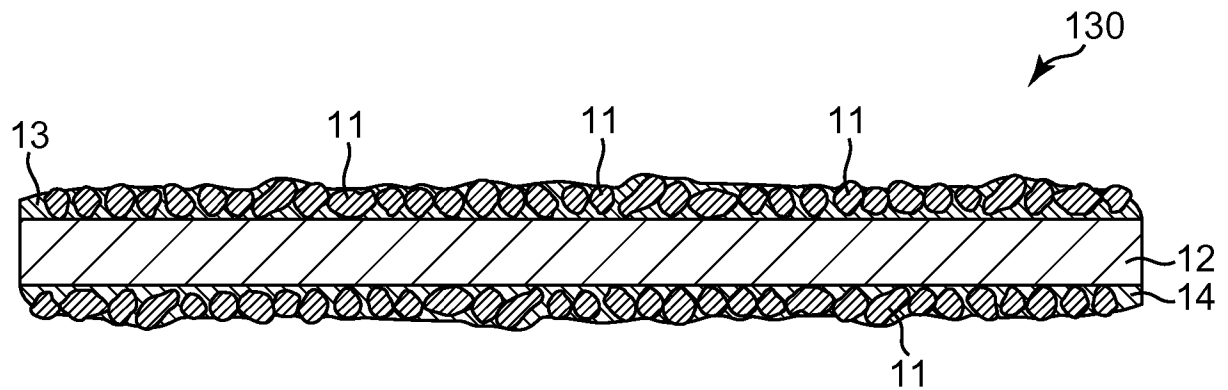
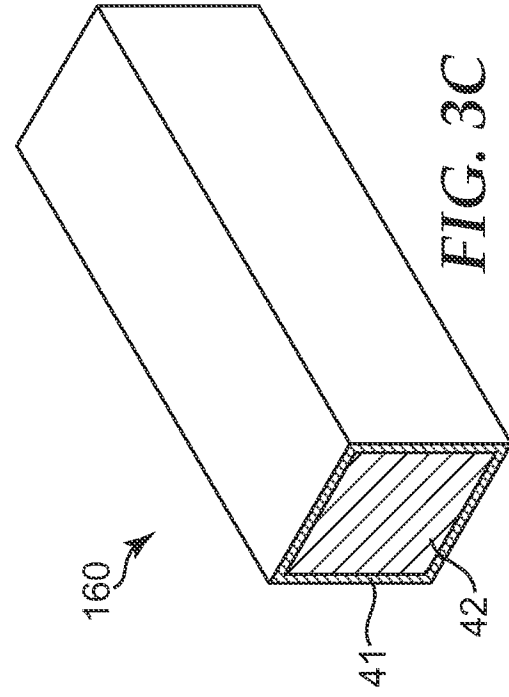
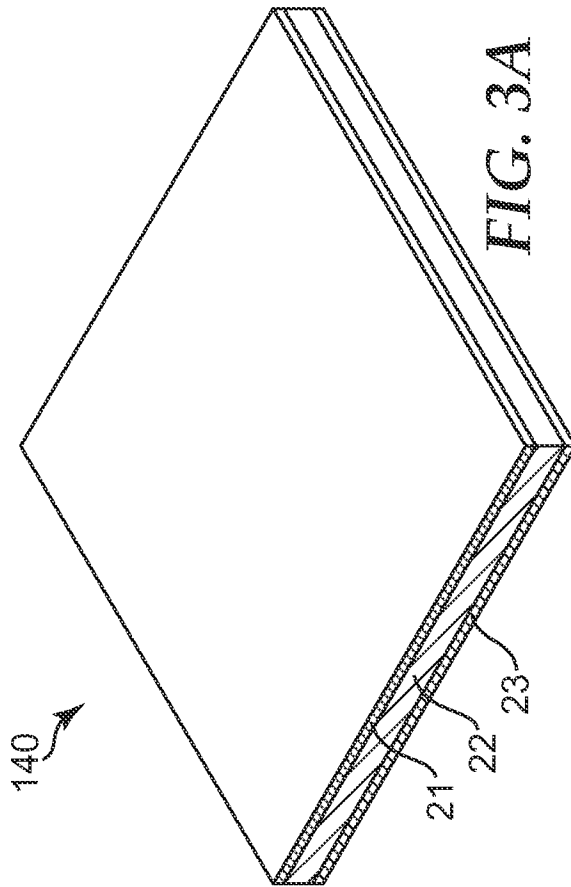
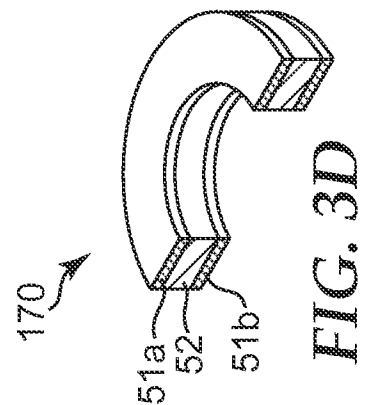
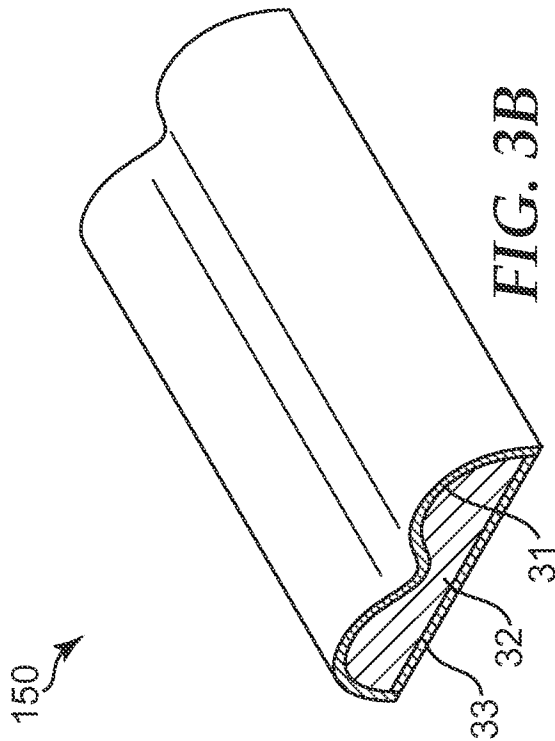


FIG. 1B

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*FIG. 2A**FIG. 2B*



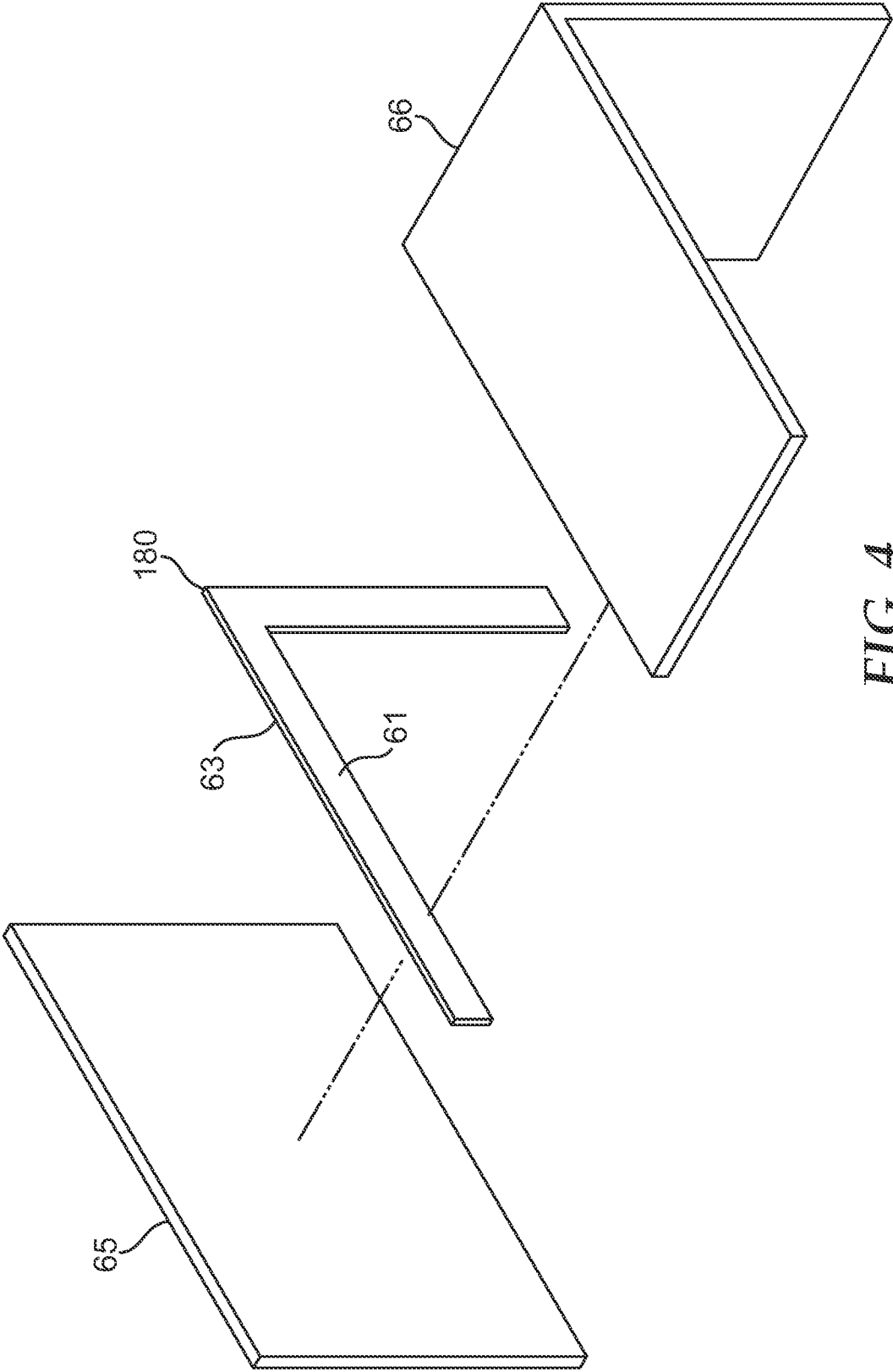


FIG. 4

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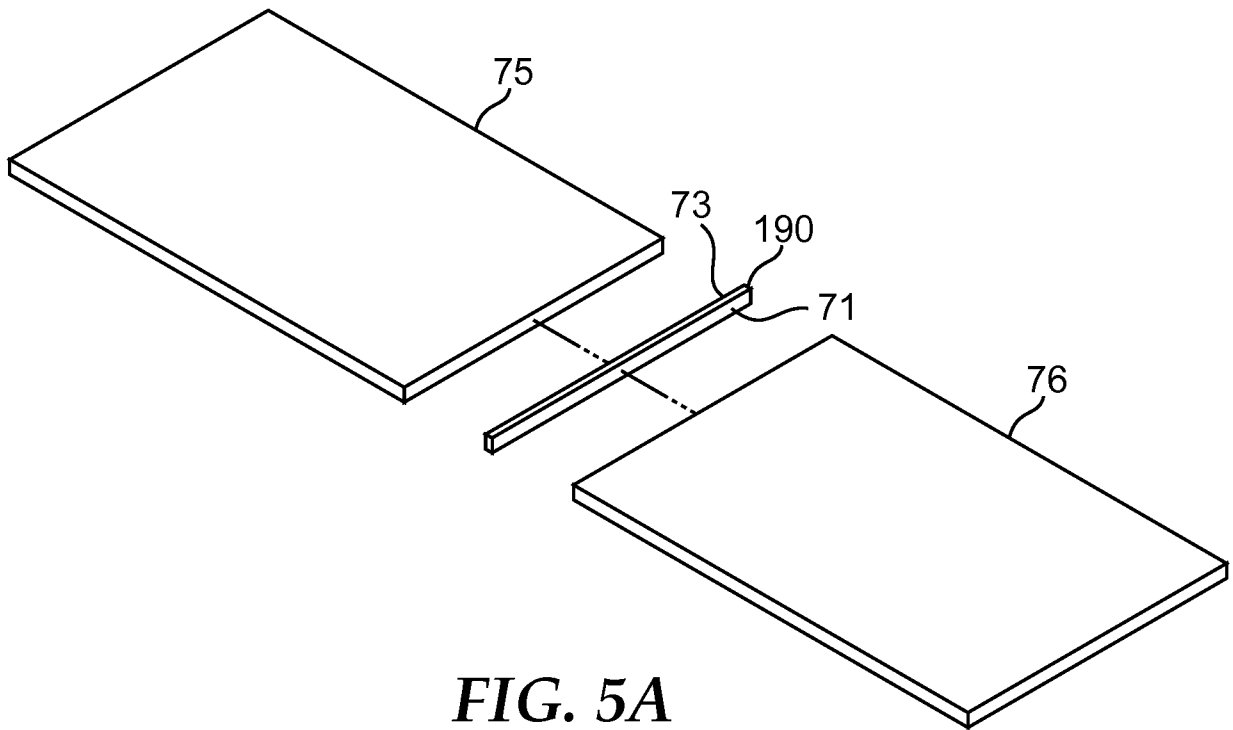


FIG. 5A

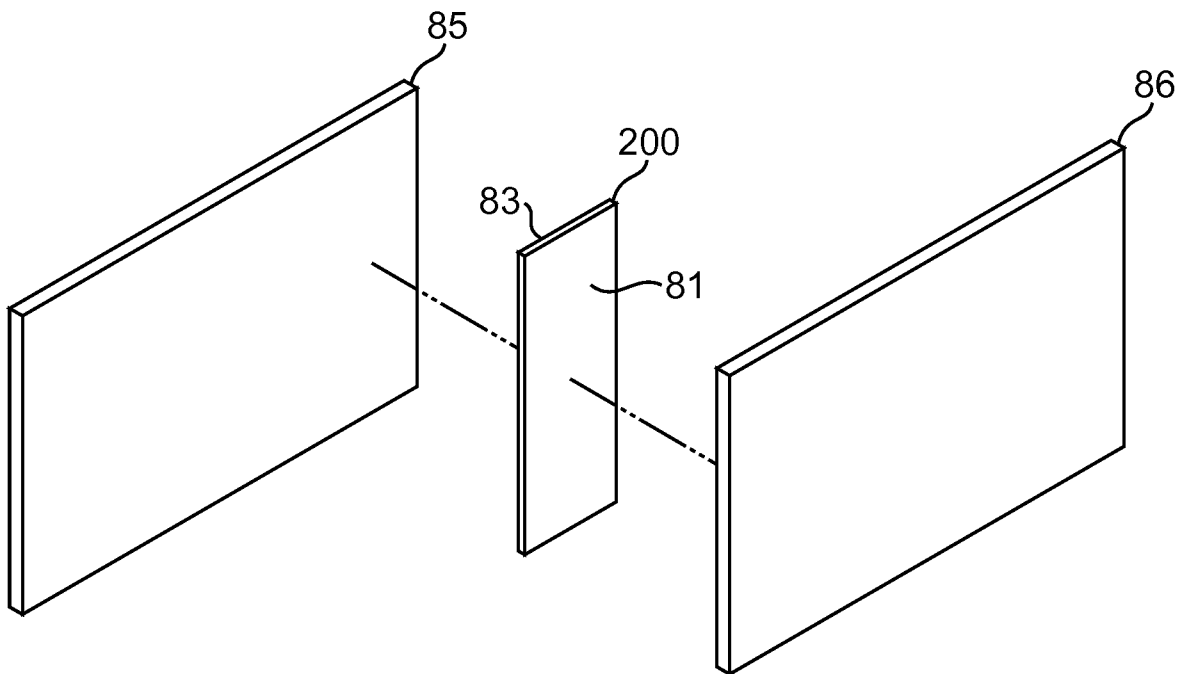


FIG. 5B

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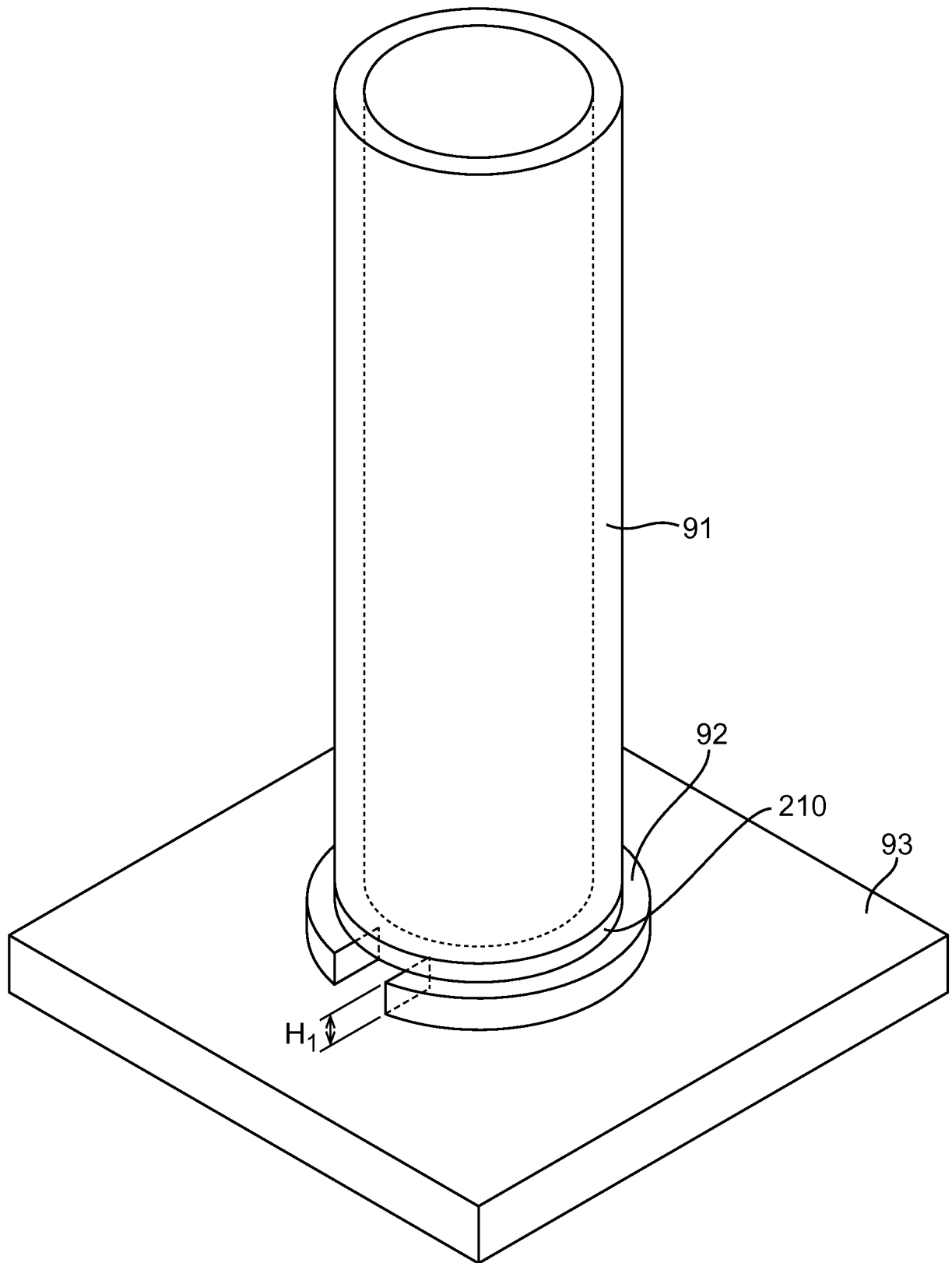


FIG. 6

INTERNATIONAL SEARCH REPORT

114/071783-17-04-2015

International application No.

PCT/US2014/071783

A. CLASSIFICATION OF SUBJECT MATTER

IPC(8) - B32B 1/00 (2015.01)

CPC - B32B 1/00 (2015.01)

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

IPC(8) - B22F 7/04; B23K 11/16, 35/22; B23P 17/00; B24D 3/02, 3/28, 11/00; B32B 1/00, 3/00 (2015.01)

CPC - B23K 35/22; B24D 18/0072; B29C 33/38, 33/424, 33/448, 33/505, 39/026, 39/36; B32B 1/00 (2015.01)

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched
USPC - 156/62.2, 241, 247, 331.5, 344, 702; 219/91.21 (keyword delimited)

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

PatBase, Google Patents, Google.

Search terms used: seal, base material, absorbent, resin particles, gap filling, sheet, particle diameter, deform, conform, layers

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	US 6,964,796 B1 (KOYAMA et al) 15 November 2005 (15.11.2005) entire document	1-5
A	US 2002/0001686 A1 (KASHIBA et al) 03 January 2002 (03.01.2002) entire document	1-5
A	US 2011/0155224 A1 (YANG et al) 30 June 2011 (30.06.2011) entire document	1-5

☐ Further documents are listed in the continuation of Box C.

* Special categories of cited documents:

"A" document defining the general state of the art which is not considered to be of particular relevance

"E" earlier application or patent but published on or after the international filing date

"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)

"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art

"&" document member of the same patent family

Date of the actual completion of the international search

03 March 2015

Date of mailing of the international search report

17 APR 2015

Name and mailing address of the ISA/US

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PCT OSP: 571-272-7774

INTERNATIONAL SEARCH REPORT

PCT/US2014/071783

PCT/US2014/071783

Box No. II Observations where certain claims were found unsearchable (Continuation of item 2 of first sheet)

This international search report has not been established in respect of certain claims under Article 17(2)(a) for the following reasons:

1. ☐ Claims Nos.:
because they relate to subject matter not required to be searched by this Authority, namely:
2. ☐ Claims Nos.:
because they relate to parts of the international application that do not comply with the prescribed requirements to such an extent that no meaningful international search can be carried out, specifically:
3. ☒ Claims Nos.: 6-11
because they are dependent claims and are not drafted in accordance with the second and third sentences of Rule 6.4(a).

Box No. III Observations where unity of invention is lacking (Continuation of item 3 of first sheet)

This International Searching Authority found multiple inventions in this international application, as follows:

1. ☐ As all required additional search fees were timely paid by the applicant, this international search report covers all searchable claims.
2. ☐ As all searchable claims could be searched without effort justifying additional fees, this Authority did not invite payment of additional fees.
3. ☐ As only some of the required additional search fees were timely paid by the applicant, this international search report covers only those claims for which fees were paid, specifically claims Nos.:
4. ☐ No required additional search fees were timely paid by the applicant. Consequently, this international search report is restricted to the invention first mentioned in the claims; it is covered by claims Nos.:

Remark on Protest

- ☐ The additional search fees were accompanied by the applicant's protest and, where applicable, the payment of a protest fee.
- ☐ The additional search fees were accompanied by the applicant's protest but the applicable protest fee was not paid within the time limit specified in the invitation.
- ☐ No protest accompanied the payment of additional search fees.