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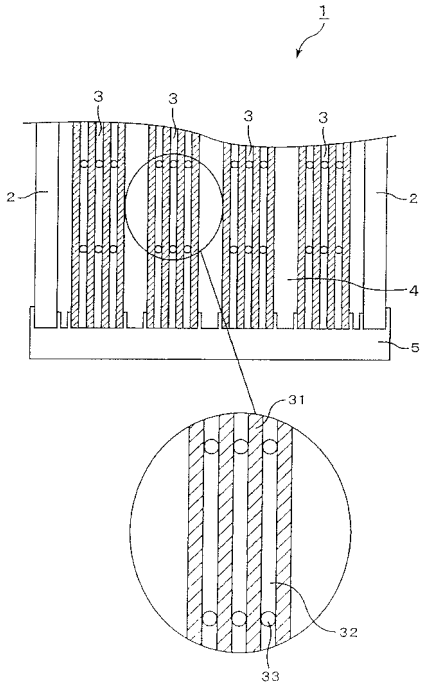
(54) PANEL BLOCK

(57) The present invention has its object to provide a panel block that is installed in an opening of a building and thereby can exert sufficient daylighting properties and heat insulation properties as high as those of a wall material.

The present invention relates to a panel block to be installed in an opening of a building, the panel block having a structure in which at least two daylighting heat insulating materials between two hard resin plates or two glass plates face one another via a gas layer with a thickness of 1 to 12 mm, the daylighting heat insulating material having a structure in which a plurality of substrate films face one another via a gas layer with a thickness of 1 to 5 mm, and a thickness of the entire panel block being 100 mm or more, and a visible light transmission of the entire panel block being 15% or more.

[Fig. 1]



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Description

TECHNICAL FIELD

[0001] The present invention relates to a panel block that is installed in an opening of a building and thereby can exert sufficient daylighting properties (properties of taking enough light) and heat insulation properties as high as those of a wall material.

BACKGROUND ART

[0002] Sufficient daylighting properties may be mentioned as conditions for a comfortable residence. In order to achieve high daylighting properties, it is desirable to increase the size of an opening (window) as much as possible. However, the size of an opening in the conventional building has restriction mainly in terms of skeleton strength and heat insulation properties.
With respect to skeleton strength, there has been proposed, in recent years, a construction method such as steel frame construction, in which pillars maintain skeleton strength and walls do not contribute to strength maintenance. By adopting such construction, it is possible to provide a big opening without impairing skeleton strength.

[0003] In reality, there have not been proposed effective means for solving the problems of heat insulation properties. From the viewpoint of energy saving, attempts have been made in buildings in recent years to achieve high heat insulation effects (effects of insulating the buildings with the external world) and ultimately increase the efficiency of air conditioning. It is necessary to air-condition each room independently in order to increase the efficiency of air conditioning. Various window materials having high heat insulation properties are proposed to attain the purpose (for example, Patent Document 1). However, the conventional window materials have difficulty in exerting high heat insulation effect in comparison with wall materials, etc. According to the "Shouenerugi Gijyutsu Senryaku Houkokusyo (Report on energy-saving technology strategy)" (June 12, 2002, Ministry of Economy, Trade and Industry), 45% of the total energy consumption loses from openings such as a window.
Window materials having sufficient daylighting properties and heat insulation properties as high as those of wall materials (heat transmission coefficient: not more than 0.4 to 0.5 kW/m^2) have been demanded.

Patent Document 1: Japanese Kokai Publication 2003-026453 (JP-A 2003-026453)

DISCLOSURE OF THE INVENTION

PROBLEMS TO BE SOLVED BY THE INTENTION

[0004] In view of the above state of the art, the present invention has its object to provide a panel block that is installed in an opening of a building and thereby can exert sufficient daylighting properties and heat insulation properties as high as those of a wall material.

MEANS FOR SOLVING THE PROBLEMS

[0005] The first present invention is a panel block to be installed in an opening of a building, the panel block having a structure in which at least two daylighting heat insulating materials between two hard resin plates or two glass plates one another via a gas layer with a thickness of 1 to 17 mm, the daylighting heat insulating material having a structure in which a plurality of substrate films face one another via a gas layer with a thickness of 0.4 to 17 mm, and a thickness of the entire panel block being 70 mm or more, and a visible light transmission of the entire panel block being 15% or more.
The second present invention is a panel block to be installed in an opening of a building, the panel block having a structure in which at least two daylighting heat insulating materials per one hard resin plate or one glass plate face one another via a gas layer with a thickness of 1 to 17 mm, the daylighting heat insulating material having a structure in which a plurality of substrate films face one another via a gas layer with a thickness of 0.4 to 17 mm, and a thickness of the entire panel block being 70 mm or more, and a visible light transmission of the entire panel block being 15% or more.
Hereinafter, the present invention will be described in further detail.

[0006] The present inventors have found that daylighting heat insulating materials having a structure in which a plurality of resin films face one another via an air layer with a thickness of 100 μm to 3 mm are extremely lightweight and exert high heat insulation properties, and filed a patent application (Japanese Kokai Publication 2006-291608 (JP-A 2006-291608)). However, a wall material of a general building has a thickness of 100 mm or more. When the daylighting heat insulating material disclosed in Japanese Kokai Publication 2006-291608 (JP-A 2006-291608) is allowed to have a thickness of 100 mm or more, high heat insulation properties are obtained, but most daylighting properties are lost.

[0007] The present inventors have found that a panel block (the first present invention) having a structure in which at least two daylighting heat insulating materials face one another via a gas layer with a thickness of 1 to 17 mm and these are held between two hard resin plates or two glass plates, or a panel block (the second present invention) having a structure in which at least two daylighting heat insulating materials per one hard resin or one glass plate face one another therevia has high daylighting properties and can exert heat insulation properties as high as those of a wall material. The present inventors thus competed the invention.

[0008] The panel block of the present invention (hereinafter, the technical feature(s) common to the first present invention and the second present invention is also referred to as the technical feature(s) of "the present invention") has at least one hard resin plate or one glass plate, and at least two daylighting heat insulating materials.

The hard resin plate or glass plate gives sufficient strength necessary for the panel block of the present invention.

The hard resin plate is not particularly limited, and examples thereof include a polycarbonate plate, an acrylic plate, and the like.

The glass plate is not particularly limited, and examples thereof include a float glass plate, a figured glass plate, a frosted glass plate, or reinforced glasses of these glasses, which have been conventionally used for buildings.

[0009] Utilizable as the hard resin plate or glass plate is a hard resin plate or glass plate on the surface of which processing, such as embossing, has been performed and which have a high all light transmittance and a high haze value. When such a hard resin plate or glass plate is used, image reflection on the surface is suppressed and inner members are less likely to be viewed and the design is also favourable while these plates take sunlight.

[0010] When one sheet of the hard resin plate or glass plate is used (the second present invention), it is desirable to disposed the hard resin plate or glass plate on the indoor side taking shock resistance and durability into consideration.

[0011] The desirable lower limit of the thickness of the hard resin plate or glass plate is 30 μm, and the desirable upper limit thereof is 10 mm. When the thickness of the hard resin plate or glass plate is less than 30 μm, a panel block to be obtained may be low in strength and poor in handleability. When it exceeds 10 mm, a panel block to be obtained may be heavy and poor in handleability. The more desirable lower limit of the thickness of the hard resin plate or glass plate is 50 μm, and the more desirable upper limit thereof is 5 mm.

[0012] The daylighting heat insulating material has a structure in which a plurality of substrate films face one another via a gas layer with a thickness of 0.4 to 17 mm.

The daylighting heat insulating material may have a structure in which a gas layer is held between two substrate films. As long as the below-mentioned visible light transmission is satisfied, the daylighting heat insulating material preferably has a structure in which gas layers are held between three or more substrate films. The daylighting heat insulating material having a plurality of gas layers can exert high heat insulation effect. The temperature difference between substrate films in the daylighting heat insulating material having a plurality of gas layers is small, and it is possible to prevent dew condensation. Thereby, it is possible to reduce the quantity of a drying agent necessary in installing a frame member that is employed upon end professing of a panel, such as a glass and a heat insulating material, which is conventionally used for an opening; or alternatively, it is possible not to utilize the drying agent.

It is to be noted that the total number of the substrate films used for the daylighting heat insulting materials in the entire panel block is desirably 30 or less. When it exceeds 30, the below-mentioned visible light transmission may not be satisfied.

[0013] The present inventors have found that high heat insulation effect can be exerted especially when the thickness of a gas layer of the daylighting heat insulating material is set to the specific range. Heat transmission coefficient is related to the thickness of a gas layer, the total thickness of the daylighting heat insulating material, and the number of layers.

As long as the total thickness of the gas layers relative to a predetermined total thickness of the daylighting heat insulating material exceeds a specified level and the thickness of a gas layer is enough not to cause convection, the heat transmission coefficient exhibits the minimum value as the number of layers increases. This is caused by the effect of reduction in radiation heat based on Stefan-Boltzmann's law. When the daylighting heat insulating material has a structure that satisfies the conditions, the heat transmission coefficient will decrease with the increase in the total thickness of the daylighting heat insulating material.

It has been verified that high heat insulation affect is obtained particularly when the lower limit of the thickness of the gas layer of each daylighting heat insulating material is 0.4 mm, the upper limit thereof is 17 mm, and the number of layers of the substrate films in the entire panel block is 10 to 29. In this case, the panel block of the present invention can exert heat insulation properties as high as those of a wall while visible light transmission is maintained at 15% or more. More desirably, the lower limit of the thickness of the gas layer of the daylighting heat insulating material is 0.9 mm, the upper limit thereof is 15 mm, and the number of layers of the substrate films in the entire panel block is 15 to 25.

[0014] The peripheral portion of the gas layer may be sealed. With the structure, internal condensation can be prevented. The gas layer may be connected to other gas layers via the substrate films, or the panel block may have a structure in which gas can move between gas layers. That is, an unwoven fabric, and a perforated film having a hole of about 5 mmφ may also be used as a substrate.

[0015] The gas layer is desirably divided into a plurality of cells. When the gas layer is divided into a plurality of cells,

it is possible to improve the strength of the entire daylighting heat insulating material. In the present invention, a resin spacer plays a role in dividing cells. The desirable lower limit of the size of each cell of a gas layer is 4 cm^2, and the desirable upper limit thereof is 1800 cm^2. When it is less than 4 cm^2, the visible light transmission of a daylighting heat insulating material to be obtained may be poor, or the heat insulation properties may be deteriorated. When it exceeds 1800 cm^2, the strength of a daylighting heat insulating material to be obtained may be poor. The desirable lower limit of the size of cell of a gas layer is 25 cm^2, and the desirable upper limit thereof is 1000 cm^2.

[0016] The gas of the gas layer is not particularly limited, and examples thereof include air, carbon dioxide, and the like. Gases such as an aroma gas (a gas that exerts aromatic effect), and a gas that colored with smoke may be filed into the gas layer. When such gas is filled thereinto, it is possible to impart various functions to the panel block of the present invention.

[0017] A liquid may be loaded into the gas layer in order to improve the design.

The liquid is not particularly limited, and desirable examples thereof include colored waster, and the like. The colored water, etc. can improve the design of the panel block of the present invention.

When the above liquid or gases other than air is loaded into the gas layer, it is necessary to fully seal the gas layer into which the above liquid has been loaded.

[0018] When the above liquid is loaded into the gas layer, the liquid may be loaded so as to fill the entire space of the gas layer, or may be loaded into a portion of the gas layer, for example, some of the cells of the gas layer.

[0019] A solid may be loaded into the gas layer in order to improve the design.

The solid is not particularly limited, and examples thereof include: materials used for displays, such as color beads, dolls, stuffed dolls, textiles and clothing, wires made of paper, dry flowers, and living flowers to which a humidity controlling agent has been applied; materials for improving the interior properties of living space, such as pictures and calligraphic works; light emitters such as light and a lamp; and the like.

[0020] When the solid is loaded into the gas layer, the solid may be loaded so as to fill the entire space of the gas layer, or may be loaded into a portion of the gas layer, for example, some of the cells of the gas layer, When the solid is loaded into the gas layer, a portion of the solid may be fixed with wires, piano wires, glass fibers, etc. or may be attached to the gas layer to be fixed.

[0021] The combination of the liquid and solid may be loaded into the gas layer. In the gas layer, the solid may be allowed to float in the liquid, or the solid may be submerged in the liquid.

[0022] When the liquid or solid is loaded into the gas layer, the substrate film preferably has strength sufficient to bear its self weight.

[0023] The substrate film that forms the daylighting heat insulating material is not particularly limited, and a resin film is desirable because of its lightness in weight.

The resin film is not particularly limited as long as it excels in transparency, and examples thereof include a resin film made of polyethylene terephthalate, polybutylene terephthalate, polycarbonate, polyethylene, acrylic resin, vinyl chloride, polyvinyl alcohol, triacetate cellulose, fluorine-containing resin, and the like.

Polycarbonate and vinyl chloride are desirable among these because of their self-extinguishing properties and their resultant suitability as building materials. It is desirable to use a hard-coated resin film in order to improve scratch resistance of the resin film. Such a hard coat material is not particularly limited, and examples thereof include acrylic resin, and the like. As the hard-coated resin film, a resin film which has a two-layer structure in which an acrylic resin layer is formed on the surface of a polycarbonate film may be suitable used. In the case where a resin film is laminated on other substrate films, polybutylene terephthalate, for example, may be suitably used.

[0024] As the substrate films, some or all of the substrate films may be films for imparting various functions, such as films for improving their design, and optical adjustment films for adjusting visibility. In accordance with the purpose, an advertisement logo, a seal for partial sticking, or the like may be stuck to the substrate film.

[0025] The thickness of the substrate film is not particularly limited. The desirable lower limit thereof is 10 μm, and the desirable upper limit thereof is 300 μm. When it is less than 10 μm, the strength of a daylighting heat insulating material to be obtained may be deteriorated. When it exceeds 300 μm, the daylighting heat insulating material may be unnecessarily thick to have the same heat insulation effect. The more desirable lower limit thereof is 20 μm, and the more desirable upper limit thereof is 250 μm. When the daylighting heat insulating material needs strength only on the surface, thicker substrate films may be used only for surface films.

[0026] The daylighting heat insulating material desirably has spacers between substrate films. The spacers are employed for maintenance of the gas layers (maintenance of the interval between substrate films), sealing of the periphery of the gas layers, division of the gas layers, or the like.

[0027] The spacer is not particularly limited. The spacer is desirably transparent in order to secure the visible light transmission of the daylighting heat insulating material, and desirably has high heat insulation properties in order not to inhibit the insulation efficiency of the daylighting heat insulating material. The spacer is not particularly limited, and suitable examples thereof include a hollow body (including a foamed body), an FRP, an acrylic resin having self adherence, and the like.

[0028] The shape of the spacer is not particularly limited, and may be a particle shape, a linear shape, or the like. The shape of the spacer may improve the design of a daylighting heat insulating material to be obtained. In the presence of a plurality of the gas layers, the spacers that specify each of the gas layers may be of the same shape or different shapes. For example, the spacers may be lattice-shaped as a whole in such a manner that the spacers that define adjacent gas layers are mutually perpendicular.

[0029] The thickness of the daylighting heat insulating material is not particularly limited. The desirable lower limit thereof is 3.5 mm, and the desirable upper limit thereof is 100 mm. When it is less than 3.5 mm, it may be impossible to exert heat insulation properties as high as those of a wall while keeping the visible light transmission at 15%. When it exceeds 100 mm, the thickness of a gas layer is large. Therefore, cut precision may be deteriorated, or the strength as a panel may be reduced, resulting in poor handleability.

[0030] Taking into consideration the construction efficiency of the panel block of the present invention, it is desirable to provide a frame member (hereinafter, also referred to as a "peripheral frame member of a daylighting heat insulating material") to the periphery of the daylighting heat insulating material for giving rigidity. Especially when a thin, lightweight substrate film is selected as the substrate film, the strength of the daylighting heat insulating material is insufficient. Thus, it is effective to provide the peripheral frame member of a daylighting heat insulating material.

[0031] The peripheral frame member of the daylighting heat insulating material having a U-shaped square cross suction may be fitted to the daylighting heat insulating material, or may be fixed with an adhesive, a sealing material, a double-sided tape, etc. When a simple fittable airtight frame is employed as the peripheral frame member of the daylighting heat insulating material, it may be easier to fix the frame member to the periphery of the daylighting heat insulating material. In order to secure the flatness and right angles of the daylighting heat insulating material, corner members are separately prepared and are fitted to the corners of the daylighting heat insulating material; thereby, it is easier to construct the panel block.

[0032] In order to further facilitate the construction of the panel block, jigs for inserting the daylighting heat insulating material in the frame member of the panel block may be used. The jigs are not particularly limited as long as they facilitate the insertion of the daylighting heat insulating material, and there may be mentioned, for example, a U-shaped jig whose three sides are fixed. The daylighting heat insulating material is inserted in the U-shaped jig whose three sides are fixed, this is inserted in the frame member of the panel block, and thereafter the jig is removed; this method facilitates the construction of the panel block.

[0033] In the panel block of the present invention, the daylighting heat insulating materials face one another via a gas layer with a thickness of 1 to 17 mm.

The panel block of the present invention is required to have a thickness of 70 mm or more for applications of a daylighting block having heat insulation properties as high as those of a wall material. In addition to this, the panel block of the present invention is required to have sufficient daylighting properties and heat insulation properties as high as those of a wall material. In order to achieve such performance, it is important to reduce, in the entire panel block, the number of substrate films to be used for a daylighting heat insulating material as much as possible to the extent that it does not impair heat insulation properties.

As a result of wholehearted investigation, the present inventors have found that high heat insulation properties can be attained with the minimum number of substrate films when two or more daylighting heat insulating materials are disposed to face one another via a gas layer with a predetermined thickness.

[0034] The lower limit of the thickness of the gas layer between the daylighting heat insulating materials is 1 mm, and the upper limit thereof is 17 mm. When it is less than 1 mm, the number of substrate films to be used for the daylighting heat insulating materials in the entire panel block increase when the thickness of the panel block is 100 mm or more; thus, it is impossible to secure daylighting properties. When it exceeds 17 mm, the panel block cannot achieve heat insulation properties as high as those of a will. The desirable lower limit thereof is 1.5 mm, and the desirable upper limit thereof is 15 mm.

[0035] The method for fixing the hard resin plate or glass plate to the daylighting heat insulating material is not particularly limited, and examples thereof include a method for connecting and fixing them with a connecting member made of resin or metal.

[0036] The lower limit of the thickness of the panel block of the present invention is 70 mm, and the upper limit thereof is 200 mm. When the thickness of the panel block of the present invention is less than 70 mm, it is impossible to achieve heat insulation properties as high as those of a wall. When the thickness of the panel block of the present invention exceeds 200 mm, it is impossible to secure daylighting properties. The panel block protrudes indoor from a frame of an opening when it exceeds 200 mm, likely resulting in poor appearance and narrower living space. The desirable lower limit thereof is 75 mm, and the desirable upper limit thereof is 150 mm.

[0037] The lower limit of visible light transmission of the panel block of the present invention is 15%. When it is less than 15%, it is impossible to obtain sufficient daylighting. The desirable lower limit of visible light transmission is 20%, and the more desirable lower limit thereof is 25%.

[0038] The weight of the panel block of the present invention is not particularly limited, and the desirable upper limit

thereof is 20 kg in terms of the installation efficiency of the panel block.

[0039] Tig. 1 schematically illustrates an of the structure of a panel block of the present invention.

A panel block 1 of Fig. 1 is provided with two hard resin plates 2 or two glass plates 2, four daylighting heat insulating materials 3, and a connecting member 5 for holding these. Two hard resin plates 2 or two glass plates 2 are disposed on the outermost part of the panel block 1. Four daylighting heat insulating materials 3 face one another via a gas layer 4. Each of the daylighting heat insulating materials 3 has the structure in which substrate films 31 face one another via a gas layer 32. The gas layer 32 is secured by spacers 33 provided in the substrate films 31.

[0040] The entire panel block of the present invention is desirably integrated by a frame member. The integration makes it possible to exert high installation efficiency. When the frame member is a fittable frame member, it is possible to exert higher installation efficiency. When the panel block of the present invention is fittable due to the below-mentioned airtight frame, it is possible to improve the installation efficiency of the panel block.

[0041] The material of the frame member is not particularly limited. When metal such as aluminum is used because of its design, it is desirable to give a structure in which only the surface is made of metal and the central portion is made of plastic in order to minimize the reduction in heat insulation properties.

Furthermore, it is possible to improve the design by changing the size and shape of the panel block.

[0042] Fig. 5 schematically illustrates an example of a method for installing a panel block of the present invention.

In the method for installing the panel block illustrated in Fig. 5, a framework 16 for installing a panel block is provided inside the frame of the opening of a building, a little separately from an opening glass (about 5 to 100 mm considering the thickness of an opening sash and the depth of the frame of the opening of a building). The framework 16 may be made of metal, such as aluminum, and resin, and having a portion fittable into a frame member of the panel block. The panel block 1 is provided in the framework 16, fitted and fixed thereto. I t is to be noted that in the case where a material excellent in durability, such as glass, an acrylic plate, or a polycarbonate plate is used as the outermost part of the panel block of the present invention, it is possible not to use an opening glass.

When an opening glass is used, it is possible, as in the second present invention, not to use a hard plate of the outermost part on the side of the opening glass of a panel block to be provided. The reduction in the number of parts leads to cost reduction.

[0043] Fig. 6 schematically illustrates another example of a method for installing a panel block of the present invention.

In the method for installing the panel block illustrated in Fig. 6(a), the framework 16 as illustrated in Fig. 5 is not used, and a method for directly fitting panel blocks 1 into one another and installing the panel blocks 1 is employed. The method for fitting the panel blocks 1 into one another is not particularly limited, and there may be mentioned, for example, a method using a nail shape as illustrated in Fig. 6(b). In order to improve the design, a screening plate 17 for hiding fitting portions of the panel blocks 1 may be provided. In Fig. 6(a), the framework 16 is used in the periphery; however, it is possible not to use the framework 16 if the panel block 1 is directly fittable into the frame of the opening of a building. It is to be noted that in the case where a material excellent in durability, such as glass, an acrylic plate, or a polycarbonate plate is used as the outermost part of the panel block of the present invention, it is possible not to use an opening glass.

[0044] Fig. 7 schematically illustrates another example of a method for installing a panel block of the present invention.

In the method for installing the panel block illustrated in Fig. 7, a method for fitting a panel block 1 into an opening glass 18 with an airtight frame and thereby installing the panel block 1 is employed.

The airtight frame used herein refers to a frame member having fitting portions (a male portion and a female portion) and especially to a frame member in which the fitting portions have an airtight structure. One of the fitting portions is preliminarily mounted on the periphery of the panel block with a fixing agent, such as a double-sided tape, and the other fitting portion is disposed just next to the end of the opening glass; the pair of the fitting portions are fitted into one another. Thereby, the panel block is installed.

[0045] In Fig. 7, the panel block 1 is fitted into the opening glass 18 by an airtight frame 19. The airtight frame 19 is provided with a removable frame member 191 and a holding member 192. The frame member 191 is disposed in the periphery of the opening glass 18 as a sealing frame, for example, by the adhesive 20. The panel block 1 is disposed inside the sealing frame made of the frame member 191 so as to face the sealing frame. The holding member 192 is attached to the frame member 191. while keeping this state. Since the holding member 192 has a protruding panel block holding portion 193, the panel block 1 is securely fixed.

Upon removing the panel block 1, it is only necessary to remove the holding member 192 from the frame member 191.

[0046] The method for fixing the airtight frame to the opening glass is not particularly limited, and a method with the use of a double-sided tape is preferable because the method is of a dry type.

The method for fixing the panel block to an airtight frame is not particularly limited, and examples thereof include: a method with the use of a double-sided tape, an adhesive, etc.; a method with the use of a pin or a clip that was preliminarily provided in the frame member; and the like. Fixing the panel block to the airtight frame is advantageous in terms of easier installation, but it is not always necessary to fix it. When the panel block is not fixed, it is advantageously replaceable more easily.

[0047] When the panel block is fitted into an opening glass by using an airtight frame, it is easier to remove the panel

block from the opening glass without damaging the panel block, and the removed panel block can be attached to the opening glass again if necessary.

[0048] There may also be mentioned a installation method in which a hard plate, a daylighting heat insulating material, etc. are inserted or fitted into outside frame members of the panel block having rail grooves within the frame. In the case where the outside frame members of the panel block are divided into several members, the outside frame members may be integrated with rail grooves, or may be separate from rail grooves. In these cases, there many be employed a sequential connection method in which members are sequentially connected according to the procedure, that is, a method in which a panel is set to a first outside frame member of the block, and after attaching a second outside frame member of the block, another panel is set to the second outside frame member of the block.

[0049] The Panel block of the present invention has sufficient daylighting properties, and can exert heat insulation properties as high as those of a wall when installed in the conventional opening. When a glass plate, or a hard resin plate with sufficient weather resistance is used as the outermost panel on the indoor side, it is possible to use it instead of the conventional opening by improving the sealing properties of the fitting shape of the panel block. Either way, it is possible to increase the area of the opening and markedly improve the house design flexibility. When the panel block of the present invention is installed to the conventional opening, durability is secured by the opening glass.

EFFECTS OF THE INVENTION

[0050] According to the present invention, it is possible to provide a panel block that is installed in an opening of a building and thereby can exert sufficient daylighting properties and heat insulation properties as high as those of a wall material.

BEST MODE FOR CARRYING OUT THE INVENTION

[0051] The following examples illustrate the present invention in more detail. These examples are, however, by no means limitative of the scope of the invention.

(Example 1)

(1) Production of daylighting heat insulating material

[0052] Acrylic resin spacers with an external diameter of 1.8 mm were applied to films at an interval of 50 mm. Six polyethylene terephthalate films with a width of 1000 mm and a thickness of 250 μm were used as substrate films to produce a daylighting heat insulating material. The total thickness of the obtained daylighting heat insulating material was about 10 mm.
Fig. 2 is a front view of a daylighting heat insulating material obtained, and Fig. 3 is an A-A' cross-sectional view of Fig. 2. In Fig. 3, the numeral 14 is an acrylic resin spacer, and the numeral 15 is a polyethylene terephthalate film.

(2) Production of panel block

[0053] Four daylighting heat insulating materials produced in (1) were used. A 4-mm-thick figured acrylic plate was used as a hard plate on the outdoor side, and a 4-mm-thick figured glass was used as a hard plate on the indoor side. A daylighting heat insulating material 1 was installed at 2 mm from the 4-mm-thick figured acrylic plate, a daylighting heat insulating material 2 was further installed via a 10-mm-thick air layer, a daylighting heat insulating material 3 was further installed via a 10-mm-thick air layer, a daylighting heat insulating material 4 was further installed via a 10-mm-thick air layer, and a 4-mm-thick figured glass was further installed via a 2-mm-thick air layer.
The thickness of the air layer was defined by a resin spacer provided inside the frame member.

(Example 2)

(1) Production of daylighting heat insulating material

[0054] Acrylic resin spacers with an external diameter of 1.0 mm were applied to films at an interval of 50 mm. Two polyethylene terephthalate films (A4300-188 produced by Toyobo Cho., Ltd.) with a width of 1000 mm and a thickness of 188 μm and four polyethylene terephthalate films (A4300-125 produced by Toyobo Co., Ltd.) with a width of 1000 mm and a thickness of 125 μm were used as substrate films; and a daylighting heat insulating material was produced in such a manner that the 188-μm-thick polyethylene terephthalate films served as the outermost layers. The total

thickness of the obtained daylighting heat insulating material was about 6 mm.

(2) Production of panel block

[0055] Four daylighting heat insulating materials produced in (1) were used. A 0.05-mm-thick acrylic plate (Acryplen #HBS027 produced by Mitsubishi Rayon Co., Ltd.) was used as a hard plate for outdoor side, and a 4-mm-thick figured glass (produced by Nippon Sheet Glass Co., Ltd.) was used as a hard plate for indoor side.
A daylighting heat insulating material 1 was installed without any gap from the 0.05-mm-thick figured acrylic plate, a daylighting heat insulating material 2 was further installed via a 14.5-mm-thick air layer, a daylighting heat insulating material 3 was further installed via a 14.5-mm-thick air layer, a daylighting heat insulating material 4 was further installed via a 14.5-mm-thick air layer, and a 4-mm-thick figured glass was further installed without any gap from the daylighting heat insulating material 4.
The thickness of the air layer was defined by a resin spacer provided inside the frame member.

(Example 3)

[0056] A panel block was produced in the same manner as in Example 2, except that a 0.05-mm-thick acrylic plate was not used.

(Comparative Example 1)

[0057] A panel block was produced in the same manner as in Example 1, except that a daylighting heat insulating material was not used.

(Evaluation)

[0058] The following revaluation was performed on the panel blocks produced in Example 1 and Comparative Example 1.
Table 1 shows the results.

(1) Measurement of heat transmission coefficient

[0059] The heat transmission coefficient was evaluated with a heat flow plate and a heat insulation box that has an opening with a width of 300 mm and a height of 1200 mm and in which a sheet rubber heater temperature-controllable by an automatic transformer was installed on a face opposite to a face of the opening. A sample having a size of 300 x 1200 mm was fastened to the opening, the heater was controlled so as to set the difference between the internal and external air temperatures to about 20°C, and the amount of heat that passed through the surface of the sample was measured in the steady state. The heat transmission coefficient was calculated from the amount of heat that passed and air temperature.
It is to be noted that the heat transmission coefficient was measured on a panel block alone and the entire sample including an opening glass.

(2) Measurement of all light transmittance

[0060] The all light transmittance (%) was measured by the method in conformity with JIS R 3106 by using a U-4100 type spectrophotometer (produced by Hitachi High-Technologies Corporation).
In this measurement, a small sample having a structure under the same conditions as in the installation was produced and measured.

[0061]

[Table 1]

	Example 1	Example 2	Example 3	Comparative Example 1
Samples	Panel block of the first present invention	Panel block of the first present invention	Panel block of the second present invention	absent
Structure of opening	Float glass: 6 mm /argon: 12 mm /heat reflecting glass: 6 mm	Float glass: 6 mm /argon: 12 mm /heat reflecting glass: 6 mm	Float glass: 6 mm /argon: 12 mm /heat reflecting glass: 6 mm	Float glass: 6 mm /argon: 12 mm /heat reflecting glass: 6 mm
Structure of panel block	Figured acrylic plate (4 mm)	Acrylic plate (0.05 mm)	-	-
	Air layer (2 mm)	-	-	-
	Daylighting heat insulating material (5 layers. 6 sheets, thickness: 10 mm)	Daylighting heat insulating material (5 layers, 6 sheets. thickness: 6 mm)	Daylighting heat insulating material (5 layers, 6 sheets, thickness: 6 mm)	-
	Air layer (10 mm)	Air layer (14.5 mm)	Air layer (14.5 mm)	-
	Daylighting heat insulating material (5 layers, 6 sheets, thickness: 10 mm)	Daylighting heat insulating material (5 layers, 6 sheets, thickness: 6 mm)	Daylighting heat insulating material (5 layers, 6 sheets, thickness: 6 mm)	-
	Air layer (10 mm)	Air layer (14.5 mm)	Air layer (14.5 mm)	-
	Daylighting heat insulating material (5 layers, 6 sheets. thickness: 10 mm)	Daylighting heat insulating material (5 layers, 6 sheets, thickness: 6 mm)	Daylighting heat insulating material (5 layers, 6 sheets. thickness: 6 mm)	-
	Air layer (10 mm)	Air layer (14.5 mm)	Air layer (14.5 mm)	-
	Daylighting heat insulating material (5 layers, 6 sheets, thickness: 10 mm)	Daylighting heat insulating material (5 layers, 6 sheets. thickness: 6 mm)	Daylighting heat insulating material (5 layers, 6 sheets. thickness: 6 mm)	-
	Air layer (2 mm)	-	-	-
	Figured glass (4 mm)	Figured glass (4 mm)	Figured glass (4 mm)	-

(continued)

		Example 1	Example 2	Example 3	Comparative Example 1
Thickness of gas layer between substrate films of daylighting heat insutating material (mm)		1.8	1.0	1.0	-
Thickness of gas layer between daylighting heat insulating materials (mm)		10	14.5	14.5	-
Thickness of entire panel block (mm)		82	86.05	86	-
Total number of substrate films (sheets)		24	24	24	-
Evaluation	Heat transmission coefficient of block alone (W/m^2K)	0.52	0.58	0.59	-
	Heat transmission coefficient of block and opening glass (W/m^2K)	0.40	0.47	0.48	1.70
	All light transmittance (%)	25	28	32	90

[0062] The panel block of Example 1 having a size of 350 × 350 mm was installed on the entire face of an opening (1820 × 2500 mm) having a pair glass of a 6-mm-thick float glass/12-mm-thick argon gas layer/6-mm-thick heat reflecting glass. The surface temperature was observed with thermography, and it was verified that the surface temperature was equivalent to the temperature of the peripheral wall (heat transmission coefficient: 0.4 W/m^2K). Fig. 4 is an image taken by camera in thermography using the panel block of Example 1.

INDUSTRIAL APPLICABILITY

[0063] According to the present invention, it is possible to provide a panel block that is installed in an opening of a building and thereby can exert sufficient daylighting properties and heat insulation properties as high as those of a wall material.

BRIEF DESCRIPTION OF THE DRAWINGS

[0064]

Fig. 1 schematically illustrates an example of the structure of a panel block of the present invention.
Fig. 2 is a front view of a daylighting heat insulating material produced in Examples.
Fig. 3 is an A-A' cross-sectional view of Fig. 2.
Fig. 4 is an image taken by camera in thermography using the panel block of Example 1 for evaluating heat insulation properties.
Tig. 5 schematically illustrates an example of a method for installing a panel block of the present invention.
Fig. 6 schematically illustrates an example of a method for installing a panel block of the present invention.
Fig. 7 schematically illustrates an example of a method for installing a panel block of the present invention.

EXPLANATION OF SYMBOLS

[0065]

1	Panel block
2	Hard resin plate or glass plate
3	Daylighting heat insulating material
31	Substrate film
32	Gas layer
33	Spacer
4	Gas layer
5	Connecting member
14	Acrylic resin spacer
15	Polyethylene terephthalate film
16	Framework
17	Screening plate
18	Opening glass
19	Airtight frame
191	Frame member
192	Holding member
193	Panel block holding portion
20	Adhesive

Claims

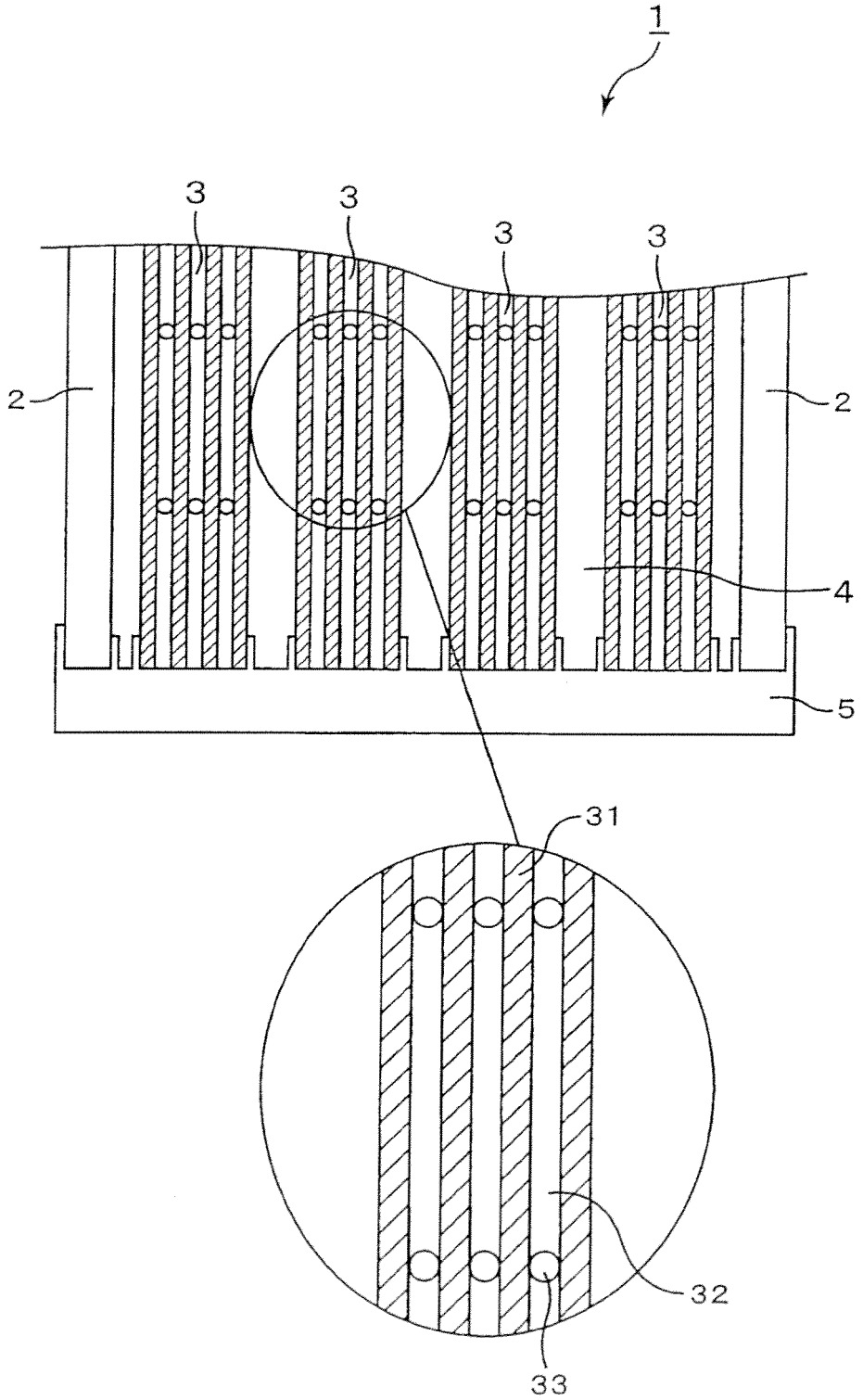
1. A panel block to be installed in an opening of a building,
the panel block having a structure in which at least two daylighting heat insulating materials between two hard resin plates or two glass plates face one another via a gas layer with a thickness of 1 to 17 mm,
said daylighting heat insulating material having a structure in which a plurality of substrate films face one another via a gas layer with a thickness of 0.4 to 17 mm, and
a thickness of the entire panel block being 70 mm or more, and a visible light transmission of the entire panel block being 15% or more.

2. A panel block to be installed in an opening of a building,
the panel block having a structure in which at least two daylighting heat insulating materials per one hard resin plate or one glass plate face one another via a gas layer with a thickness of 1 to 17 mm,
said daylighting heat insulating material having a structure in which a plurality of substrate films face one another via a gas layer with a thickness of 0.4 to 17 mm, and
a thickness of the entire panel block being 70 mm or more, and a visible light transmission of the entire panel block being 15% or more.

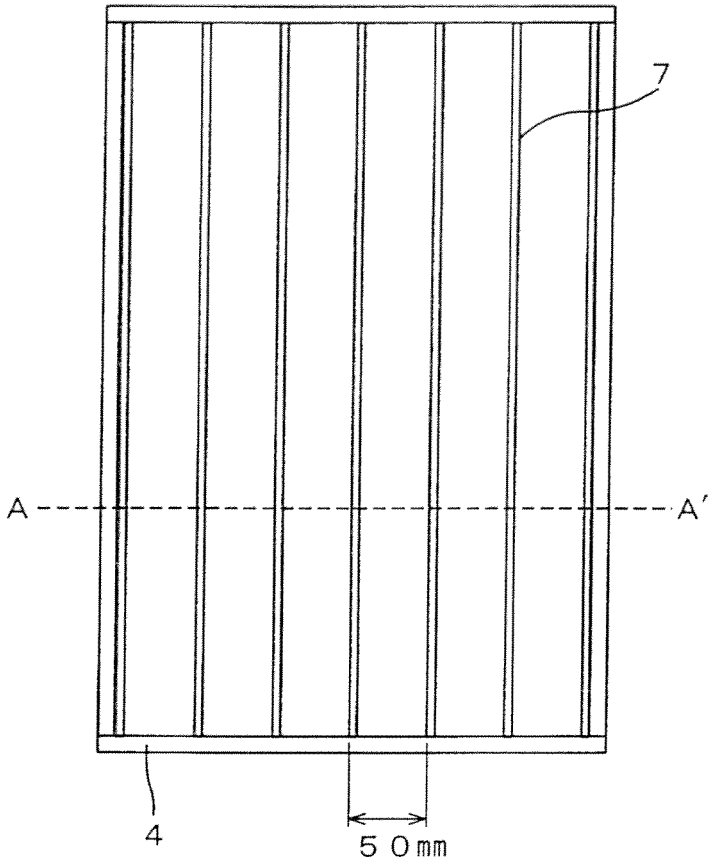
3. The panel block according to Claim 1 or 2,
which has a frame member fittable aground.

4. The panel block according to Claim 1 or 2,
which is fittable around with an airtight frame.

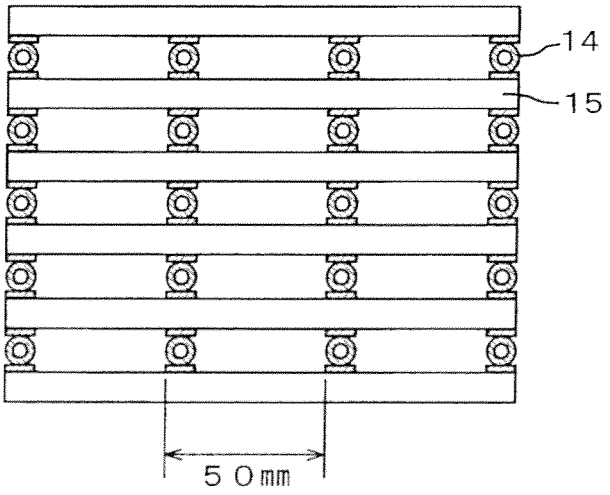
[Fig. 1]



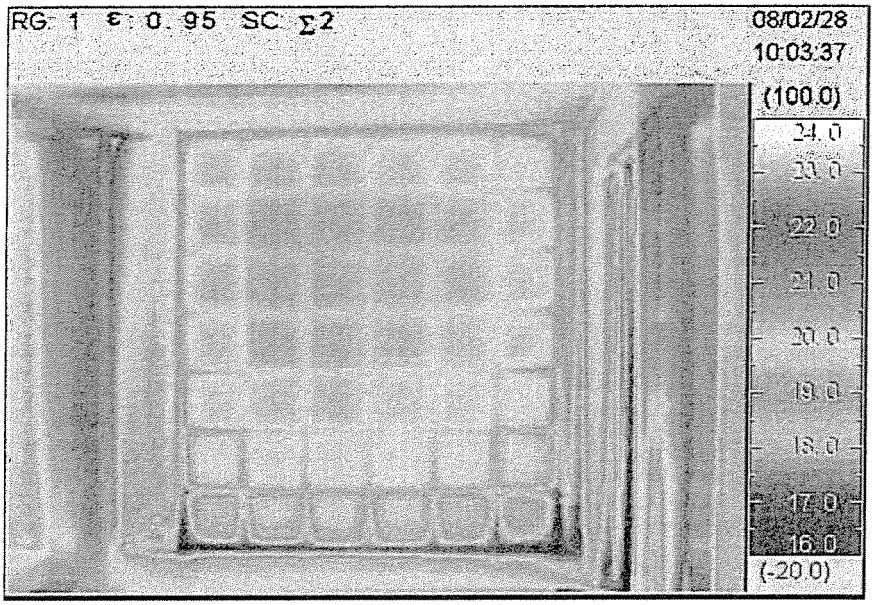
[Fig. 2]



[Fig. 3]



[Fig. 4]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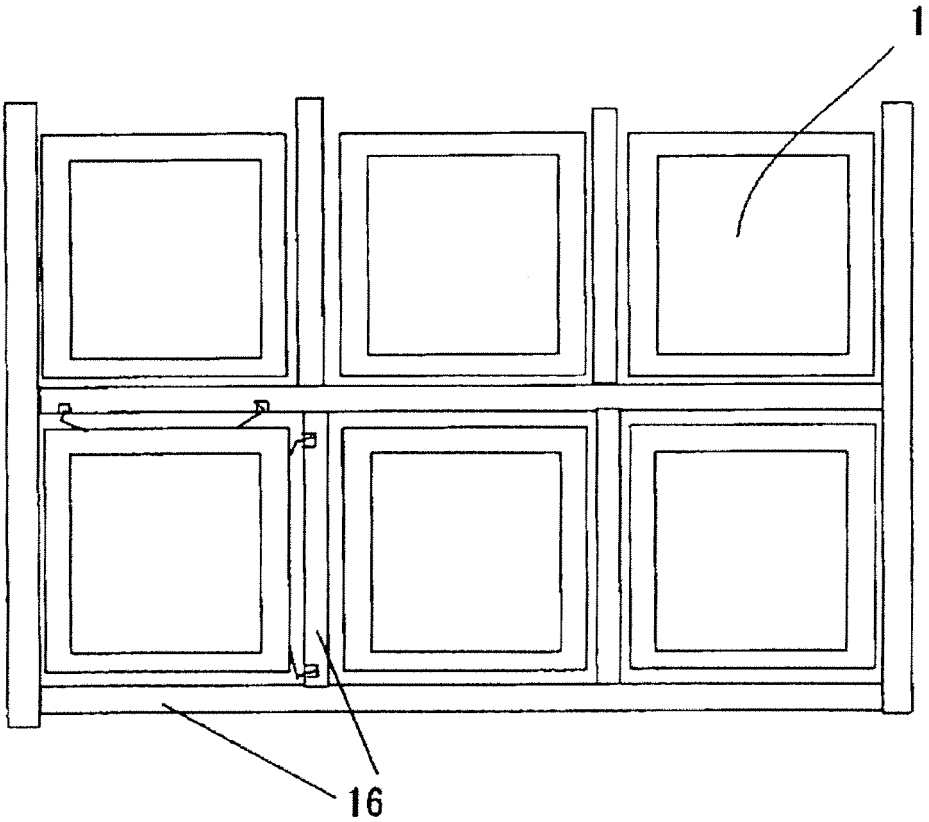
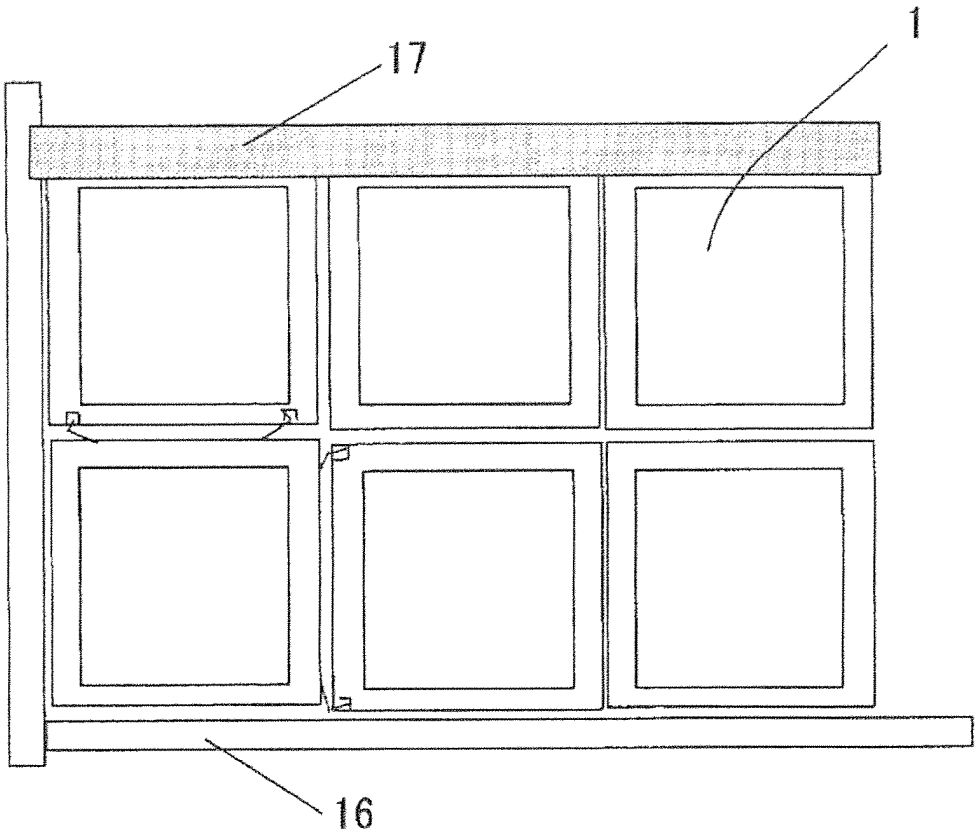
[Fig. 5]

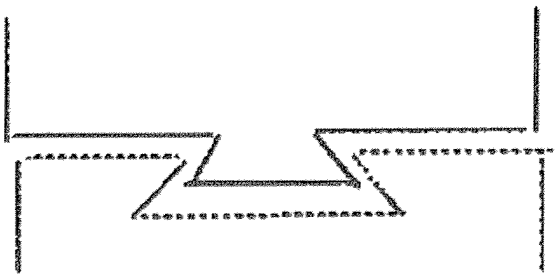

1
16

[Fig. 6]

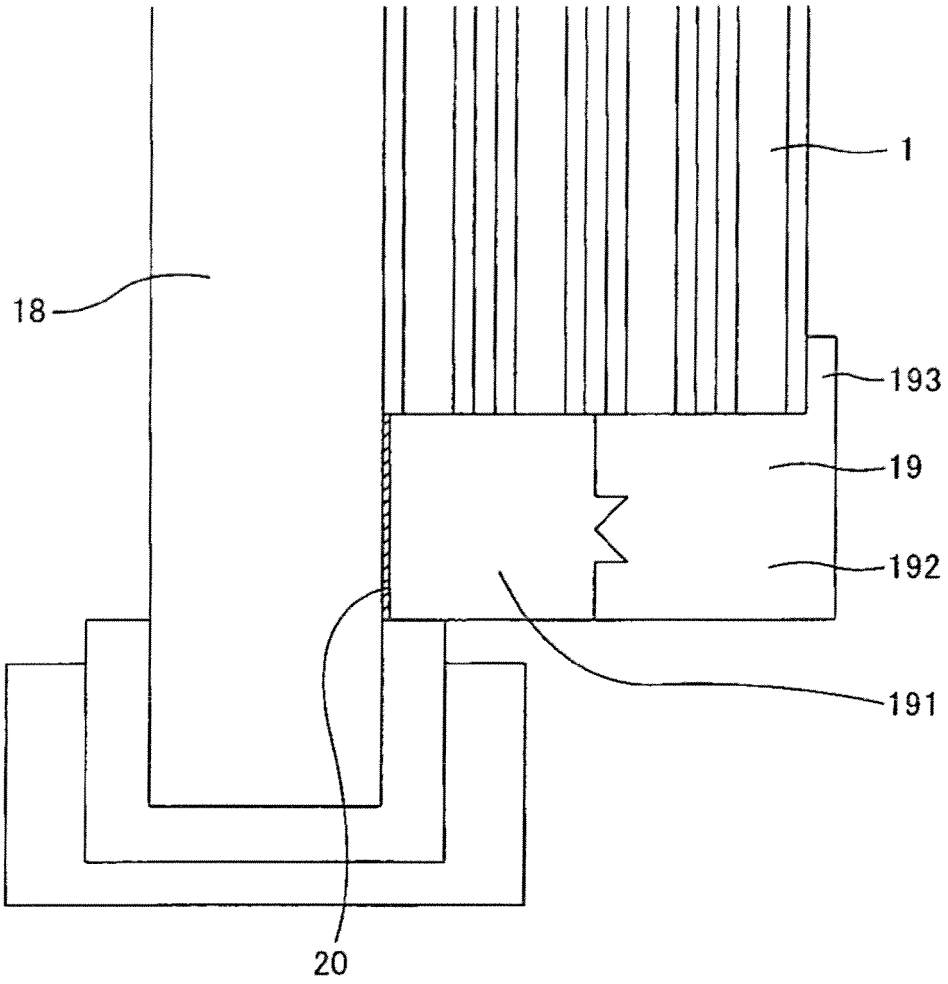
(a)



(b)



[Fig. 7]



INTERNATIONAL SEARCH REPORT

International application No.
PCT/JP2008/067035

A. CLASSIFICATION OF SUBJECT MATTER
E04B1/80(2006.01)i, *E04C2/54*(2006.01)i, *E06B5/00*(2006.01)i

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)
E04B1/80, E04C2/54, E06B5/00

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched
Jitsuyo Shinan Koho 1922-1996 Jitsuyo Shinan Toroku Koho 1996-2008
Kokai Jitsuyo Shinan Koho 1971-2008 Toroku Jitsuyo Shinan Koho 1994-2008

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

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X Y	JP 2005-220574 A (Sekisui Chemical Co., Ltd.), 18 August, 2005 (18.08.05), Par. Nos. [0017] to [0027], [0031] to [0037]; Figs. 1, 2 (Family: none)	1,3 2,4
Y	JP 2002-61464 A (Yugen Kaisha Kosumo Kenkyusho), 28 February, 2002 (28.02.02), Par. No. [0019]; Fig. 3 (Family: none)	2

☒ Further documents are listed in the continuation of Box C. ☐ See patent family annex.

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Date of the actual completion of the international search	Date of mailing of the international search report
01 October, 2008 (01.10.08)	14 October, 2008 (14.10.08)
Name and mailing address of the ISA/ Japanese Patent Office Facsimile No.	Authorized officer Telephone No.

Form PCT/ISA/210 (second sheet) (April 2007)

INTERNATIONAL SEARCH REPORT

International application No.
PCT/JP2008/067035

C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	Microfilm of the specification and drawings annexed to the request of Japanese Utility Model Application No. 65158/1981(Laid-open No. 178689/1982) (Kawaguchi Giken Co., Ltd.), 12 November, 1982 (12.11.82), Page 3, lines 5 to 18; Fig. 2 (Family: none)	4

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REFERENCES CITED IN THE DESCRIPTION

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Patent documents cited in the description

- JP 2003026453 A **[0003]**
- JP 2006291608 A **[0006]**

Non-patent literature cited in the description

- Shouenerugi Gijyutsu Senryaku Houkokusyo. Ministry of Economy, Trade and Industry, 12 June 2002 **[0003]**