(19) Europäisches Patentamt
European Patent Office
Office européen des brevets

(11) EP 2 133 483 A1

(12) **EUROPEAN PATENT APPLICATION**
published in accordance with Art. 153(4) EPC

(43) Date of publication:
16.12.2009 Bulletin 2009/51

(21) Application number: **07767447.1**

(22) Date of filing: **18.06.2007**

(51) Int Cl.:
E04B 1/74 *(2006.01)*

(86) International application number:
PCT/JP2007/062639

(87) International publication number:
WO 2008/114467 (25.09.2008 Gazette 2008/39)

(84) Designated Contracting States:
AT BE BG CH CY CZ DE DK EE ES FI FR GB GR HU IE IS IT LI LT LU LV MC MT NL PL PT RO SE SI SK TR

(30) Priority: **16.03.2007 JP 2007068673**

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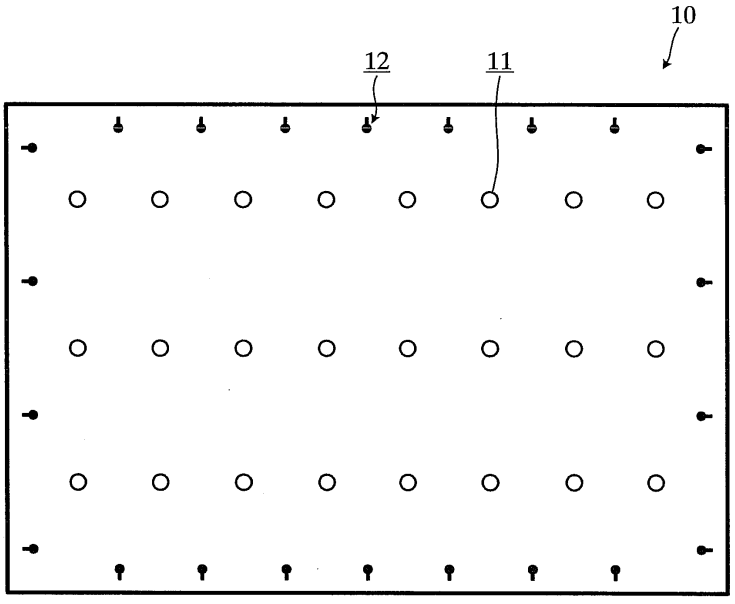
(54) **ROOF INSULATION SHEET AND ROOF USING SAME**

(57) There is provided a roof structure which protects a roof itself from direct sunlight by a simple structure by laying or stretching a roof blocking sheet above an existing roof, economically and effectively prevents the roof from being heated to a high temperature by naturally cooling it, and reduces a sound of rain. The roof blocking sheet is composed of a sheet material which has heat blocking characteristics and blocks light and rain and to which a plurality of through holes with a diameter of 80 to 150 [mm] are disposed, wherein the opening rate of the overall through holes is set to 3% to 8% as well as the sheet material has a thickness of 0.2 to 2.0 [mm]. The roof blocking sheet is laid to the roof with a space of about 50 to 90 [mm].

FIG.1



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Description

Technical Field

[0001] The present invention relates to a roof blocking sheet for effectively reducing transmission of solar heat as well as blocking sound of rain and the like by being laid or stretched to a roof a building and to a roof structural view using the roof blocking sheet. In particular, the present invention relates to a roof blocking sheet capable of reducing a room temperature by preventing a roof forming member from being heated to a high temperature by direct sunlight and optimally acting as a countermeasure for energy saving and global warming prevention as well as reducing sound of rain and a roof using the roof blocking sheet.

Background Art

[0002] Since the roofs of a house, a building, a factory, a warehouse or the like are conventionally impinged with direct sunlight, they are heated to a high temperature by the direct sunlight, and thus rooms are also heated to a high temperature by the heat of the sunlight transmitted thereinto. In particular, the temperatures of metal roofs such as a steel roof deck, a galvanized iron roof and the like are outstandingly increased. When a room temperature increases, since an air conditioner and the like operate for a long time, an amount of power consumption increases, and global warming is promoted thereby.

[0003] To cope with the high temperature, there is conventionally employed a countermeasure for blocking the heat transmitted from a roof by improving the ventilation in the space under the roof. Further, a heat insulation structure is employed to a roof itself to prevent an increase of room temperature by blocking the heat from the roof. However, the conventional method of improving ventilation in the space under the roof has a problem in that the structure of a building is made complex and a construction cost becomes expensive. Further, when a fan and the like are used for ventilation, a problem arises in that a running cost is required and a maintenance is necessary.

[0004] In contrast, the method of providing the roof with the heat insulation structure is disadvantageous in that a roof structure itself is made complex and a construction cost is increased by a heat insulating material built in the roof. Further, there is also a problem in that when an existing roof is provided with the heat insulation structure, a construction cost increases because the overall roof must be rebuilt.

[0005] Accordingly, any of the above methods has a problem in structure when it is applied to, for example, a factory, a large store building, a warehouse, a garage, and the like, and in particular, when it is applied to a metal roof making use of a low profile standing seam and a steel roof deck, the metal roof is outstandingly heated by direct sunlight and a room is adversely affected by the heat. Thus, the effect of the methods is limited.

[0006] Further, there is also a method of applying a heat resistant paint onto a roof so that the amount of heat absorbed by the roof is reduced by causing the roof to reflect light and the like. However, since the heat resistant paint reflects light, a problem arises in that reflected light reaches a building, a road and the like in the vicinity and increases the temperature thereof and eyes are dazzled by the reflected light. When the heat resistant paint is applied to the roof, it must be applied to an area at least 1.5 times larger than a flat area because the surface area of the roof is ordinarily larger than the flat area, from which a problem arises in that a painting cost is expensive. Further, there is also a problem in that although a heat blocking effect can be obtained just after the paint is applied, it is deteriorated as the front surface of the roof gets soiled and thus the roof absorbs a larger amount of heat.

[0007] Accordingly, there is strongly required to develop a relatively simple method of effectively lowering the room temperature of a building at low cost without deteriorating a performance and adversely affecting the environment. Power consumption can be reduced by preventing an increase of temperature of a building due to solar heat, which positively contributes to prevention of global warming.

[0008] Further, when the rain falls on the metal roof, since the rain directly impinges on a roof surface depending on a roof structure, a sound of rain becomes large. Thus, an outdoor environment may adversely affect a room because the sound of rain is transmitted to the room and the like. Accordingly, in a region in which strong rail falls frequently, there is a strong requirement for reducing a sound of rain in a room even if the rain falls so that a job can be quietly carried out in the room.

[0009] An object of the present invention, which was made in view of the above circumstances, is to provide a roof blocking sheet for suppressing an increase of temperature of a roof or naturally cooling the roof as well as blocking the rain and the like and to provide a roof structure for protecting an existing roof itself from direct sunlight by a simple arrangement by laying or stretching the roof blocking sheet to the existing roof as well as preventing the roof (room) from being heated to a high temperature by naturally cooling it economically as well as effectively.

[0010] Further, an object of the present invention is to provide a roof having a noise insulation effect for greatly suppressing the transmission of a sound of rain when strong rain falls.

Disclosure of the Invention

[0011] The present invention relates to a roof blocking sheet, and the above objects of the present invention can be effectively achieved by that a plurality of through holes with a diameter of 80 to 150 [mm] are disposed to a sheet material having heat blocking characteristics and rain and light blocking characteristics, wherein the opening

rate of the overall through holes is set to 3% to 8% and the sheet material has a thickness of 0.2 to 2.0 [mm]. The objects can be more effectively achieved by that metal eyelets or holes are formed to an edge surface of the sheet material or that the sheet material comprises polyethylene resin.

[0012] Further, the present invention relates to a roof blocking sheet, and the above objects of the present invention can be effectively achieved by that a roof blocking sheet, which comprises a sheet material which has a heat blocking characteristics and rain and a light blocking characteristics and to which a plurality of through holes with a diameter of 80 to 150 [mm] are disposed, is laid or stretched to a steel roof deck through hooks with a space of 50 to 90 [mm], wherein the opening rate of the overall through holes to the sheet material is set to 3% to 8%, and the thickness of the sheet material is set to 0.2 to 2.0 [mm].

[0013] The above objects of the present invention can be more effectively achieved by that the steel roof deck is a seam type steel roof deck or a bolted steel roof deck or that the hooks are engaged with the projections of the apexes of the seam type steel roof deck.

Brief Description of the Drawings

[0014] In the accompanying drawings:

FIG. 1 is a plan view showing an example of a roof blocking sheet according to the present invention;
FIG. 2 is a view showing an example of arrangement of a roof blocking sheet (one sheet) laid or stretched to a roof;
FIG. 3 is a detailed view of the part (B) of FIG. 2;
FIG. 4 is a detailed view of the part (C) of FIG. 2;
FIG. 5 is a view showing an example of arrangement of the roof blocking sheets (three sheets) laid or stretched to a roof;
FIGs. 6A and 6B are a structure showing an example of the roof blocking sheet attached to a seam type steel roof deck;
FIGs. 7A and 7B are a structure showing another example of the roof blocking sheet attached to the seam type steel roof deck;
FIG. 8 is a structure showing an example of the roof blocking sheet attached to a bolted steel roof deck;
FIG. 9 is a structure showing an example of the roof blocking sheet attached to a bolted steel roof deck;
FIG. 10 is a structure showing an example of the roof blocking sheet attached to a bolted steel roof deck;
FIG. 11 is a schematic view showing an operation (flow of heat and wind) of the roof of the present invention;
FIGs. 12A and 12B are schematic views showing the operation (heat blocking) of the roof of the present invention in comparison with that of a conventional roof;
FIG. 13 is a characteristics graph showing an advantage of the present invention;
FIG. 14 is a table showing an example of data measured to confirm the advantage (heat blocking) of the present invention;
FIG. 15 is a graph showing an example of temperature characteristics of a conventional roof;
FIG. 16 is a graph showing an example of temperature
characteristics of the roof of the present invention;
FIG. 17 is a perspective view showing another example of the roof blocking sheet (frame member structure) of the present invention;
FIG. 18 is a view showing an example of the roof blocking sheet of FIG. 17 disposed on a roof; and
FIG. 19 is a plan view showing still another example of the roof blocking sheet (structure of a frame member) of the present invention.

Best Mode for Carrying Out the Invention

[0015] In the present invention, a roof blocking sheet is laid or stretched to a roof with a space (about 50 to 90 [mm]) defined therebetween. The roof blocking sheet is composed of a sheet material which has a heat block characteristics (characteristics for reflecting heat without absorbing it) and a rain/light blocking characteristics and to which a plurality of through holes with a diameter of 80 to 150 [mm] are formed so that the overall through holes have an opening rate of 3 to 8% to the sheet material. The roof blocking sheet is excellent in durability and a heat resistance as well as blocks sun light and rain and causes a radiating (cooling) action by the reflection of the roof blocking sheet itself and the an airflow naturally generated in the space (gap) between the roof blocking sheet and a roof surface so that the roof blocking sheet can suppress an increase of temperature due to direct sunlight and can effectively prevent an increase of temperature in a room resulting from the direct sunlight.

[0016] Further, even if the rain falls, since almost of it reaches the roof surface after it impinges on the rain blocking sheet, almost of a sound of rain is blocked by the roof blocking sheet. Accordingly, the sound of rain on the roof can be greatly suppressed.

[0017] The roof blocking sheet can be simply laid or stretched to an existing metal roof (low profile standing seam and steel roof deck) directly or through hooks at a very low cost because it is not necessary to modify or rebuild the existing roof.

[0018] Embodiments of the present invention will be explained below with reference to the drawings.

[0019] FIG. 1 is a plan view of a roof blocking sheet 10 according to the present invention, and a sheet material of the roof blocking sheet 10 is composed of a polyethylene resin (92.0 to 97.0 wt% of polyethylene, 1.0 to 3.0 wt% of an organic additive of amine, phenol or the like, pigment, 0.5 to 5.0 wt% of an inorganic additive of pigment, calcium carbonate or the like) having a heat blocking characteristics and a rain/light blocking characteris-

tics and is formed to a rectangular sheet shape with a lateral width of about 3 to 8 [m], a longitudinal length (depth) of about 1.5 to 6 [m], and a thickness of about 0.2 to 2.0 [mm] (preferably 0.4 to 0.8 [mm]). The overall surface of the roof blocking sheet 10 has a plurality of circular through holes 11 with a diameter of about 80 to 150 [mm] (preferably 100 to 120 [mm]) regularly (in a lattice shape) formed thereto at a predetermined pitch, and brass metal eyelets 12 are disposed to the peripheral edge portion of the roof blocking sheet 10 at a predetermined pitch so that they are used when the roof blocking sheet is laid or stretched to a roof.

[0020] The opening rate of the overall through holes 11 to the roof blocking sheet 10 is set to about 3 to 8% and preferably 4 to 6%. Although the opening rate of the overall through holes 11 to the sheet is determined by the diameter and the number of the through holes 11, it is set to about 3 to 8% and preferably 4 to 6% from the relationship between the heat reflection effect of the roof blocking sheet 10 and natural cooling carried out by an airflow generated through the space between the roof blocking sheet 10a and the roof surface. When the opening rate is less than 3%, the natural cooling carried out by the airflow becomes ostracized, whereas when the opening rate is more than 8%, the heat reflection effect is deteriorated as well as a light/rain blocking effect is also deteriorated.

[0021] Note that, in the embodiment, although the through holes 11 of the roof blocking sheet 10 are formed to the circular shape, they may be formed to a rectangular shape, a triangular shape, a polygonal shape as long as the opening rate is set to 3 to 8%. Further, the material of the roof blocking sheet 10 is preferably the polyethylene resin, various types of a fabric sheet, a vinyl sheet, a rubber sheet or the like may be also used. That is, any materials may be used as long as they have heat blocking characteristics, light resistance, heat resistance, and durability blocks, and can block rain and withstands wind, rain, snow or the like.

[0022] Further, the metal eyelets 12 are fixedly attached to a steel roof deck of a metal roof, seam type steel roof deck. A seam type steel roof deck can be fixed with screws or bolts and nuts using the metal eyelets 12. However, the metal eyelets 12 are not always necessary in a bolted steel roof deck, because it is possible to use the bolted steel roof deck by folding an edge and clamping it by a fixing member such as an angle member and the like. Further, holes may be used in place of the metal eyelets as long as they can be fixed by screws or bolts and nuts.

[0023] In the present invention, the roof blocking sheet 10 is laid or stretched to an existing metal roof, for example, a roof composed of a seam type steel roof deck and a bolted steel roof deck or to a roof to which low profile standing seams are disposed. The height of the seam type steel roof deck and the bolted steel roof deck from a roof surface is set to about 50 to 90 [mm], by which an airflow space is formed between them and the roof blocking sheet 10. When a height is low as in the low profile standing seam, the roof blocking sheet 10 is laid or stretched through high hooks so that a space (gap) of about 50 to 90 [mm] is formed between the roof blocking sheet 10 and a roof surface.

[0024] A metal roof ordinarily has an inclination of 0° or more to 30° or less. When the roof blocking sheet 10 is laid or stretched, the edge (peripheral edge portion) thereof may be reinforced with an edge reinforcing member such as a polyethylene rope and the like. The edge reinforcing member has a diameter of about 2.0 to 6.0 [mm] and preferably 3.0 to 5.0 [mm]. Although polypropylene is ordinarily used as the rope of the edge reinforcing member, it is preferable to use the same polyethylene as that used to the roof blocking sheet 10 from a view point of recycle.

[0025] FIG. 2 shows an example in which the roof blocking sheet 10 is laid or stretched to a metal roof 20, wherein the part (A) of FIG. 2 is a plan view, the part (B) of FIG. 2 is a front elevational view (the detail of which is shown in FIG. 3), and the part (C) of FIG. 2 is a side elevational view (the detail of which is shown in FIG. 4). The roof 20 is composed of a lot of seal type or bolted type steel roof decks 21, steel tight frames 24A and 24B are disposed on the upper and lower portions of the roof 20, and the separated distance L1 from an edge surface portion of the roof 20 to the roof blocking sheet 10 is set to about 500 [mm] or more. A reason why the separated distance L1 is provided resides in that heat is more radiated by an air flow by separating the edge surface portion of the roof from the roof blocking sheet 10 than entirely covered the roof therewith. It is effective to cover about 70 to 90% of a roof area with the roof blocking sheet 10.

[0026] The roof blocking sheet 10 is fixed to the apexes of the steel roof deck 21 by bolt and nuts (or screws) 23 through hooks 23. At the time, although the metal eyelets 12 are used to the seam type steel roof deck, a roof blocking sheet with no metal eyelet 12 is used to the bolted steel roof deck, and the edge portion of the roof blocking sheet is folded and fixed using the fixing member such as the angle member and the like, the detail of which will be explained later.

[0027] Further, FIG. 5 shows an example in which four roof blocking sheets 10A1, 10A2 to 10C are laid or stretched to the metal the roof 20, in which the part (A) of FIG. 5 is a plan view, the part (B) of FIG. 5 is a front elevational view, and the part (C) of FIG. 5 is a side elevational view. It is the same as the case of FIG. 2 that the steel tight frames 24A and 24B are disposed on the upper and lower portions of the roof 20, and the separated distance L1 from an edge surface portion of the roof to the roof blocking sheet 10 is set to about 500 [mm] or more. A roof blocking sheet 10A1 and a roof blocking sheet 10A2 are an example in which a separated distance L3 therebetween is set to "0". The separated distance L2 between the roof blocking sheets 10A1, 10A2 and the roof blocking sheet 10B, 10C is set to about 0 to 500 [mm], and the separated distance L3 between the roof

blocking sheet 10B and the roof blocking sheet 10C is set to about 0 to 500 [mm] . These separated distances L1 to L3 are determined in consideration of the convenience of construction of the roof blocking sheets and the heat block effect of the roof blocking sheets. It is effective to cover about 70 to 90% of a roof area with the roof blocking sheet 10A1, 10A2 to 10C.

[0028] When a plurality of roof blocking sheets are laid or stretched as in FIG. 5, they are fixed to the apexes of the steel roof deck 21 by the bolts and nuts (or screws) 23 through the hooks 22. At the time, although the metal eyelets 12 are used in the seam type steel roof deck likewise, the roof blocking sheet with no metal eyelet 12 is used in the bolted steel roof deck, and the edge portions thereof are folded and fixed using the fixing member such as the angle member and the like.

[0029] Note that even the seam type steel roof deck may be fixed by folding the edge portion thereof using the fixing member such as the angle member and the like without using the metal eyelets, the detail of which will be explained next.

[0030] FIGs. 6A and 6B show an example in which a trapezoidal quadrangular pyramid shaped hook 221 is fixed to the apex of a seam type steel roof deck 21A, a square root/round head bolt 222 is passed through the hole of the apex of the hook 221 and the metal eyelet 12 of the roof blocking sheet 10, and both the ends of the bolt 222 are tightened and fixed with nuts 223A and 223B, thereby the roof blocking sheet 10 is attached to the roof 20. A groove 224 is formed to the bottom of the hook 221 and engaged with a rail-shaped projection 211 formed to the apex of the seam type steel roof deck 21A so that the hook 221 is fixed to the seam type steel roof deck 21A by the engagement of the groove 224 with the projection 211. A space (height: about 50 to 90 [mm]) is formed using the tall hook 221 so that a space, in which airflows are generated, is formed between the roof blocking sheet 10 and the seam type steel roof deck 21A.

[0031] Further, FIGs. 7A and 7B show an example of a structure in which the roof blocking sheet 10 is attached to the apex of the seam type steel roof deck 21A likewise. In the structure, a groove 226 formed to the bottom of a trapezoidal quadrangular pyramid shaped hook 225 is engaged with the rail-shaped projection 211 formed to the apex of the seam type steel roof deck 21, and the hook 225 is fixed to the seam type steel roof deck 21A. A hexagonal tightening bolt 227 is extended to a lower portion of the hook 225, and the hook 225 can be more strongly fixed to the seam type steel roof deck 21A by tightening the hexagonal bolt 227 from both the sides thereof. Then, the square root/round head bolt 222 is passed through the hole of the apex of the hook 221 and the metal eyelet 12 of the roof blocking sheet 10, and both the end portions of the bolt 222 are tightened and fixed by the nuts 223A and 223B, thereby the roof blocking sheet 10 is attached to the seam type steel roof deck 21A. Since the tall hook 225 is used, a space is formed between the roof blocking sheet 10 and the seam type steel roof deck 21A(50 to 90 [mm]) so that an airflow is generated in the space.

[0032] Next, an example, in which the roof blocking sheet 10 is attached to a bolted steel roof deck 21B will be explained with reference to FIGs. 8 to 10. Since the projection 211 in the seam type steel roof deck 21A does not exist to the apex of the bolted steel roof deck 21B, a method of constructing the bolted steel roof deck 21B is different from that of the seam type steel roof deck 21A.

[0033] FIG. 8 shows an example in which the roof blocking sheet 10 is attached to anX-portion (midportion) of FIG. 2, and, first, a rectangular parallelepiped hook 230 with a rectangular cross section is fixed to the apex of the bolted steel roof deck 21B by a bolt and nut 231. Then, the roof blocking sheet 10 is placed on the upper surface of the hook 230, and the roof blocking sheet 10 is fixed by a screw 232. The roof blocking sheet 10 is attached to the bolted steel roof deck 21B by sequentially carrying out the above process at a predetermined pitch. Since the tall hook 230 is used, a space (50 to 90 [mm]) is also formed between the roof blocking sheet 10 and the bolted steel roof deck 21B also in this case so that an airflow is generated in the space.

[0034] FIGs. 9 and 10 show an example in which the roof blocking sheet 10 is attached to a Y-portion (end portion) of FIG. 2, and, first, a pipe-shaped hook 233 with a rectangular cross section is fixed to the apex of the bolted steel roof deck 21B by a bolt and nut 234. A reason why an end portion of the hook 233 is opened and inclined is to permit the bolt and nut 234 to be easily tightened with a tool from an upper side, and both the end portions of the hook 233 may be inclined or may be made flat.

[0035] After the hook 233 is fixed to the apex of the bolted steel roof deck 21B, a rectangular parallepiped hook 235 and a pipe shaped square member 236 are further disposed on the hook 233 in abutment therewith, the hook 235 and the square member 236 are fixed on the hook 233 by a bolt and nut, and the like, and the roof blocking sheet 10 is placed on the hook 235 and the square member 236. Then, an angle member 237 with an L-shaped cross section, which is engaged with the square member 236 is abutted against the roof blocking sheet 10, and the roof blocking sheet 10 is clamped between the square member 236 and the angle member 237 and fixed by a screw 238.

[0036] Note that the hook 233 is not necessarily formed to the pipe shape as long as it can fix the blocking sheet.

[0037] When the roof blocking sheet 10 according to the present invention is attached to the steel roof deck and laid or stretched to the roof as described above, the sunlight is reflected on the surface of the roof blocking sheet 10 as shown in a schematic view of FIG. 11 as well as ventilation is carried out by the airflow (wind) generated in the through holes 11 and in the space formed between the roof blocking sheet 10 and the steel roof deck. Accordingly, an outstanding heat blocking effect can be obtained by the roof blocking sheet 10.

[0038] That is, since the roof blocking sheet 10 has a

thin thickness of 0.2 to 2.0 [mm], the amount of heat accumulated in the sheet itself can be suppressed. Further, since the roof blocking sheet 10 is attached spaced apart from the roof surface about 50 to 90 mm and attached by the hook, the amount of heat transmission to the roof can be suppressed. Further, since the roof blocking sheet, the roof and the like are cooled by the heat radiation caused by the airflow, an increase of temperature thereof can be suppressed.

[0039] FIG. 12A shows a conventional roof to which the roof blocking sheet is not laid or stretched. In this case, a room temperature is increased by the solar heat transmitted into a room. In contrast, when the roof blocking sheet 10 is laid or stretched to the roof as shown in FIG. 12B, since solar heat is reflected on the roof blocking sheet 10 and the amount heat entering into the room is reduced, an increase of the room temperature can be suppressed or prevented.

[0040] When the temperature increases of a black roof, a silver roof, and white roof, which were disposed spaced apart about 30 cm from a lamp as a heat source of about 75°C, were measured after five minutes after the heat source was lit, the following result of differences was obtained. That is, the temperature of the black roof increased to 62.9°C, the temperature of the silver roof without blocking sheet increased to 40.9°C, the temperature of the silver roof with blocking sheet increased to 33.5°C, and the temperature of the white roof increased to 41.8°C.

[0041] Further, FIG. 13 is a graph showing experiment data of the temperature suppression effect of the present invention, wherein an outside temperature, the temperature on a steel roof deck with roof blocking sheet, the temperature on a steel roof deck without roof blocking sheet, the temperature under a roof with roof blocking sheet were measured in a 20 [m^2] prefabricated building with a steel roof deck as a time passed. As a result, before the roof blocking sheet was constructed (without roof blocking sheet), the temperature under the roof reached to 57.7 °C and the temperature on the steel roof deck increased up to 64°C although the outside temperature was almost unchanged. In contrast, after the roof blocking sheet was constructed (with roof blocking sheet), it could be confirmed that the temperature under the roof and the temperature on the steel roof deck were considerably reduced to 43°C and 48.6°C at the maximum respectively. The difference of the temperatures before and after the construction of the roof blocking sheet was 14.7°C under the roof and 15.8°C on the steel roof deck, and the temperature was reduced by at least an average of 11.5°C.

[0042] It is also apparent from the data of experiment of FIG. 13 that the temperature under the roof was reduced by 5°C to 15°C, which is equivalent to save electricity costs of at least 15% in terms of an amount of power consumption. Thus, it is apparent that the present invention has an outstanding advantage.

[0043] Further, when an effect of improvement of a room temperature is simulated using the housing heat load calculation program "SMASH" of a housing performance disclosure system certified by Japanese Government, the temperature under the roof and the room temperature have characteristics shown in FIG. 15 in a room environment shown in FIG. 14 when the roof blocking sheet is laid or stretched. Whereas, the temperature under the roof and the room temperature have characteristics shown in FIG. 16 when no roof blocking sheet is laid or stretched.

[0044] A space used in the experiment is arranged such that a living room portion has a size of "3.6 [m] × 1.8 [m] × 2.0 [m] " , the space under the roof has a size of "3.6 [m] × 1.8 [m] × 0.2 [m]", and a floor area has a size of 6.48 [m^2]. The number of times natural ventilation is set to a 1.0 time/hour, and when the roof blocking sheet is provided, the sunlight absorption rate of a roof member is "0", from which it can be also found that the present invention has the outstanding advantage.

[0045] Further, according to the roof sheet or the roof according to the present invention, even if rain falls, since all the rain does not impinges on a roof surface and is eased by the roof sheet, noise in a room is reduced. Accordingly, the present invention is particularly advantageous in a location where a lot of rain falls.

[0046] Note that the roof blocking sheet itself is directly laid or stretched to the roof in the above arrangement. However, it is also possible to make a relatively small blocking sheet member 40 in which a blocking sheet 42 described above is stretched in a rectangular frame member 41 composed of wood, synthetic resin, or metal as shown in FIG. 17 and to dispose and fix the blocking sheet member 40 on and to a roof 43 as shown in FIG. 18. Note that although the six blocking sheet members 40 are disposed on the roof 43 in FIG. 18, the number of them may be arbitrarily determined as long as 70 to 90% of a roof area is covered with the blocking sheet 42 and the frame member 41. Further, the opening rate of through holes 43 to the sheet 42 is set to about 3 to 8%.

[0047] The upper and lower positions of the blocking sheet 42 may be arbitrarily set to the frame member 41. That is, the blocking sheet member 40 may be stretched to the upper surface of the frame member 41, to the lower surface thereof, or to the midportion thereof as shown in FIG. 17.

[0048] FIG. 19 shows a different blocking sheet member 50, in which a plurality of strip-shaped blocking sheets 52 are stretched in a rectangular-shaped frame member 51, and slits 53 of about 5 to 20 [mm] are formed between adjacent blocking sheet 52 as through holes. The opening rate of the slits 53 in this case is set to about 5 to 15% to the blocking sheet 52 so that 70 to 90 % of a roof area is covered with the blocking sheet 52 and the frame member 51.

[0049] Note that although the above description is made as to the case in which the metal roof is exemplified as the roof and the roof blocking sheet is laid or stretched to the seam type steel roof deck and the bolted steel roof

deck, the present invention is not limited to the above roof, and it is sufficient to lay or stretch the roof blocking sheet so that an appropriate space is formed between the roof and the roof blocking sheet. Although a particularly outstanding advantage can be obtained when the roof blocking sheet is applied to the metal roof, the application thereof is not limited to the metal roof.

[0050] Although the above description shows an embodiment of the present invention, a change of design and a modification carried out by an ordinary means are included in the embodiment of the present invention.

[0051] The roof blocking sheet of the present invention is a sheet formed by regularly disposing or dispersing the through holes thereto and having heat, light, and rain blocking characteristics. The roof blocking sheet can be easily laid or stretched to the metal roof and is excellent in durability and heat resistance. When the roof blocking sheet is laid or stretched to a roof with a space defined therebetween, it causes a radiating action due to the reflection of heat made the sheet and to a naturally generated airflow, thereby an increase of heat can be suppressed so that a temperature can be effectively prevented from being increased by direct sunlight.

[0052] Further, a roof, to which the roof blocking sheet is laid or stretched, has a space between the upper surface of the roof and the roof blocking sheet, a hot airflow made by direct sunlight is eased or suppressed by an airflow naturally formed by the through holes formed to the roof blocking sheet so that the roof can be prevented from being heated to a high temperature by the direct sunlight radiated to the upper surface of the roof. A wind (air) causes an action for cooling the roof by ventilating the space formed between the upper surface of the roof and the roof blocking sheet and by entering into and going out also from the through holes. As a result, the roof blocking sheet can be prevented from floating up and from being broken by fluttering as well as is effective to discharge the rain water and the like stored thereto. When a wind blows, since the flow rate thereof is faster on the sheet upper surface than on the lower surface thereof, lifting power is produced by airflows. However, since the holes are formed to the area of 3 to 8% of the sheet, the lifting power is cancelled, thereby lifting up and fluttering of the sheet can be suppressed.

[0053] Since the operation/working effect of the present invention is achieved neither artificially nor mechanically and is achieved naturally, the present invention has also an economical effect of not requiring a running cost.

[0054] Further, although the roof of the present invention employs the flammable polyethylene resin as the roof blocking sheet, since its thickness is 0.2 to 2.0 [mm], when it is laid or stretched to a roof with an inclination of 0 to 30°, the heat transmission function of the sheet attenuates or disappears to thereby suppress an increase of temperature. As a result, the roof blocking sheet acts as an inflammable material and satisfies the regulation of building standards.

Claims

1. A roof blocking sheet, **characterized by** comprising a 0.2 to 2.0 [mm] thick sheet material having heat blocking characteristics as well as rain and light blocking characteristics and a plurality of through holes with a diameter of 80 to 150 [mm] disposed thereto, wherein the opening rate of the overall through holes is set to 3% to 8%.

2. A roof blocking sheet according to claim 1, wherein metal eyelets or holes are formed to an edge surface of the sheet material.

3. A roof blocking sheet according to claim 1 or 2, wherein the sheet material comprises polyethylene resin.

4. A blocking sheet member in which a 0.2 to 2.0 [mm] thick sheet material having heat blocking characteristics as well as rain and light blocking characteristics is stretched in a rectangular frame member comprising wood, synthetic resin, or metal, wherein a plurality of through holes with a diameter of 80 to 150 [mm] are disposed to the sheet material such that the opening rate of the overall through holes is set to 3% to 8%.

5. A roof **characterized in that** a plurality of roof blocking sheet members, in each of which a 0.2 to 2.0 [mm] thick sheet material having heat blocking characteristics as well as rain and light blocking characteristics is stretched in a rectangular frame member comprising wood, synthetic resin, or metal, is laid or stretched to a steel roof deck in the range of 70% to 90% thereof with a space of 50 to 90 [mm] formed from the front surface of the roof, wherein a plurality of through holes with a diameter of 80 to 150 [mm] are disposed to the sheet material such that the opening rate of the overall through holes is set to 3% to 8%.

6. A blocking sheet member in which a plurality of 0.2 to 2.0 [mm] thick strip-shaped sheet materials having heat blocking characteristics as well as rain and light blocking characteristics are stretched in a rectangular frame member comprising wood, synthetic resin, or metal, wherein the sheet materials have slits, and the opening rate of the overall slits is set to 5% to 15%.

7. A roof **characterized in that** a blocking sheet member, in which a plurality of 0.2 to 2.0 [mm] thick strip-shaped sheet materials having heat blocking characteristics as well as rain and light blocking characteristics are stretched in a rectangular frame member comprising wood, synthetic resin, or metal, is laid or stretched to a steel roof deck in the range of 70% to

90% thereof with a space of 50 to 90 [mm] formed from the front surface of the roof, wherein the sheet materials have slits, and the opening rate of the overall slits is set to 5% to 15%.

8. A roof, **characterized in that** a roof blocking sheet, which comprises a 0.2 to 2.0 [mm] thick sheet material having heat blocking characteristics as well as rain and light blocking characteristics and a plurality of through holes with a diameter of 80 to 150 [mm] disposed thereto, is laid or stretched to a steel roof deck in the range of 70% to 90% thereof with a space of 50 to 90 [mm] formed from the front surface of the roof, wherein the opening rate of the overall through holes is set to 3% to 8%.

9. A roof according to claim 8, wherein the steel roof deck is a seam type steel roof deck, and the roof blocking sheet is attached through hooks.

10. A roof according to claim 8, wherein the steel roof deck is a bolted steel roof deck, and the roof blocking sheet is attached through hooks.

11. A roof according to claim 9, wherein the hooks are engaged with the projections of the apexes of the seam type steel roof deck.

12. A roof, **characterized in that** a roof blocking sheet, which comprises a 0.2 to 2.0 [mm] thick and elastic sheet material having heat blocking characteristics as well as rain and light blocking characteristics and a plurality of through holes with a diameter of 80 to 150 [mm] disposed thereto, is laid or stretched to a low profile standing seam through hooks in the range of 70% to 90% thereof with a space of 50 to 90 [mm] formed from the front surface of the roof, wherein the opening rate of the overall through holes is set to 3% to 8%.

FIG.1

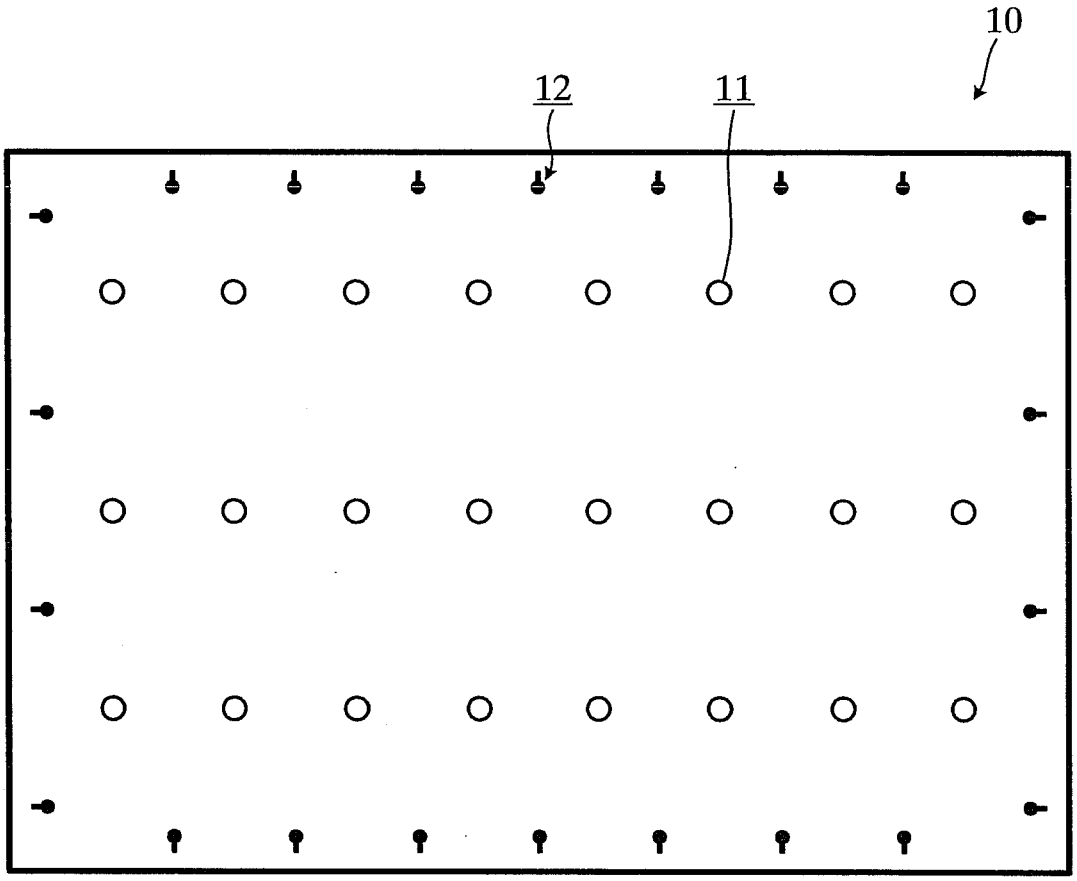


FIG.2

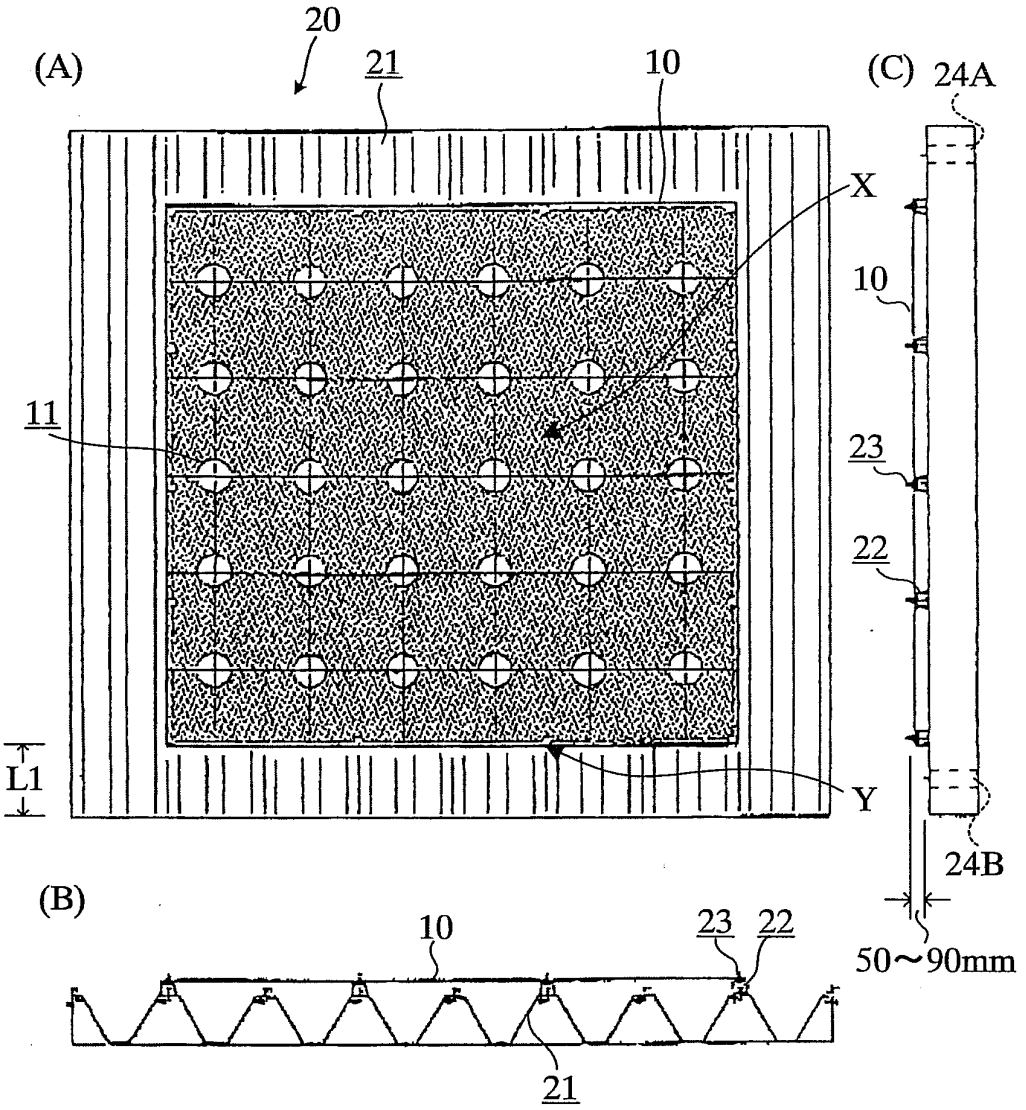

20
(A)
21
10
(C)
24A
X
10
11
23
22
L1
Y
24B
(B)
10
23
22
50～90mm
21

FIG.3

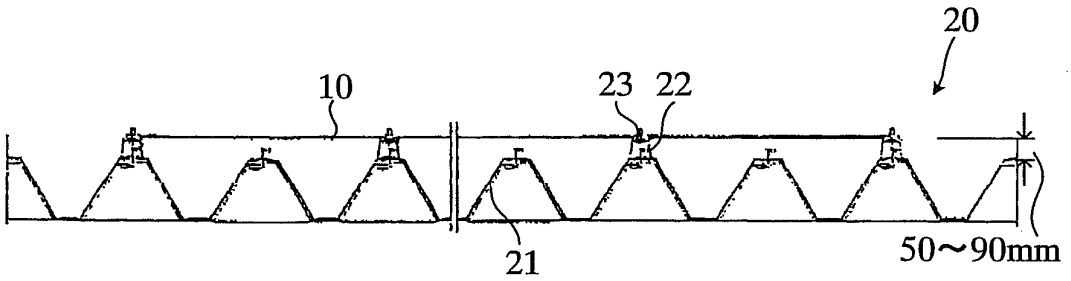

20
10
23
22
21
50～90mm

FIG.4

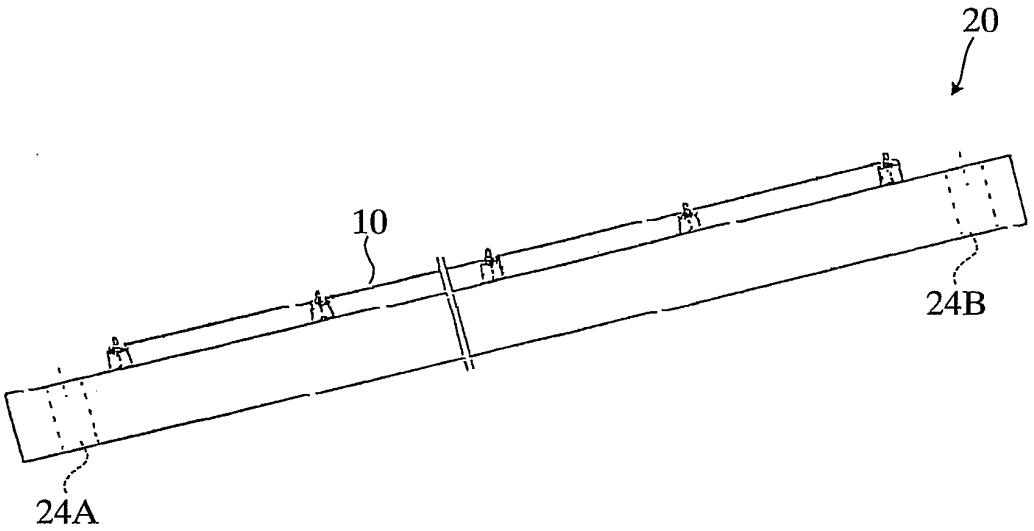
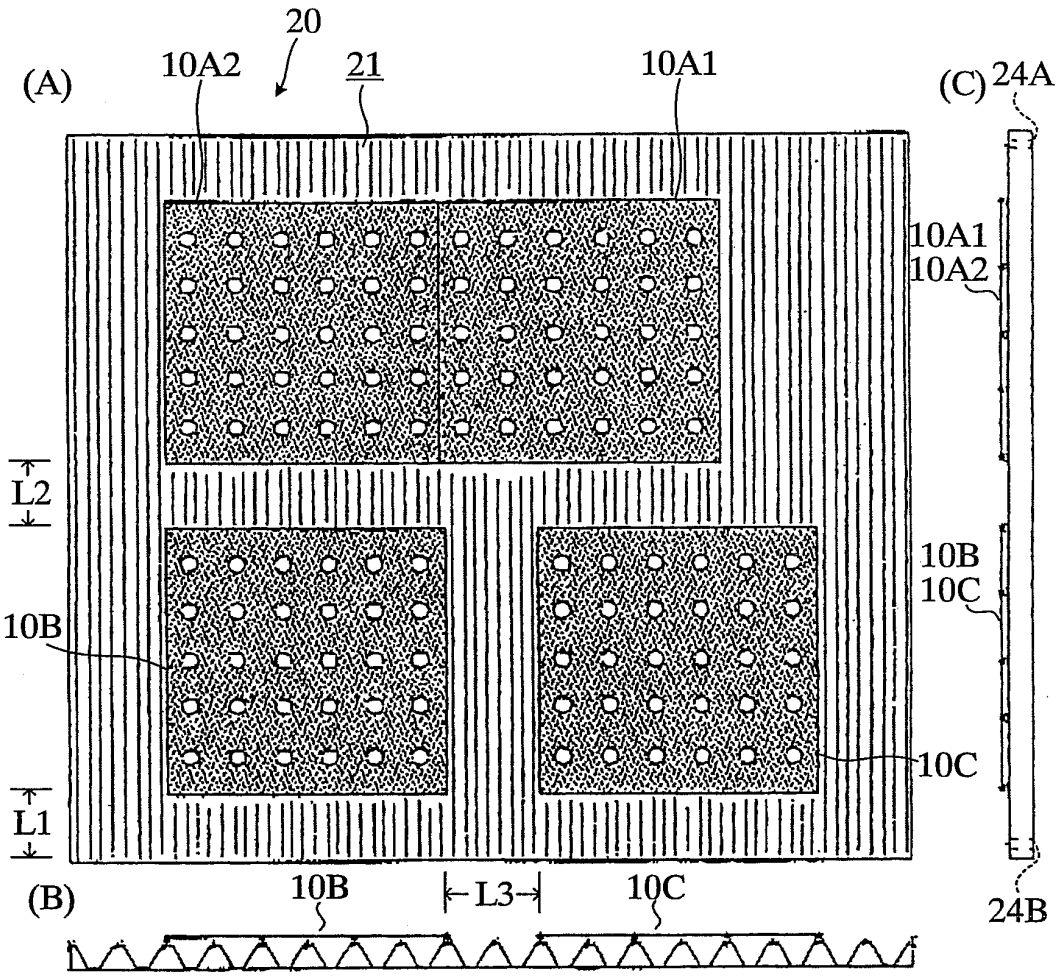

20
10
24B
24A

FIG.5


20
(A)
10A2
21
10A1
(C)
24A
10A1
10A2
L2
10B
10B
10C
10C
L1
(B)
10B
L3
10C
24B

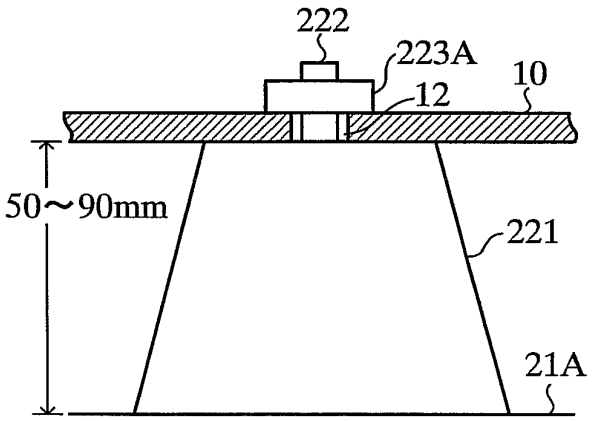


FIG.6(A)

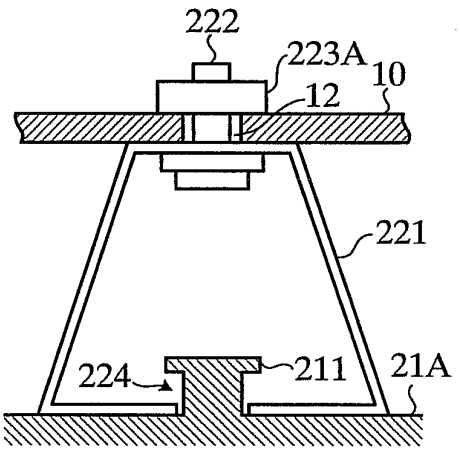


FIG.6(B)

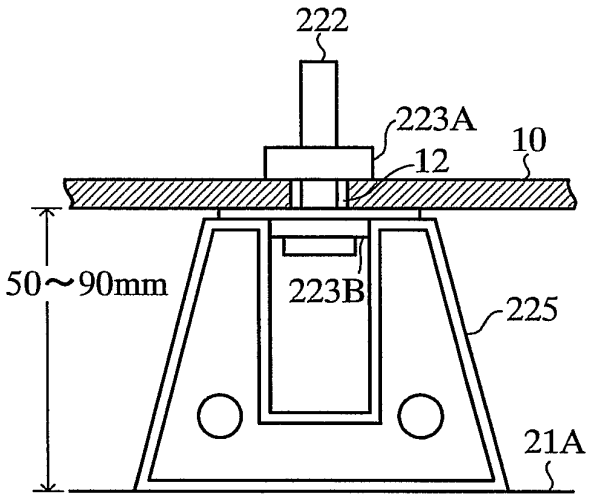


FIG.7(A)

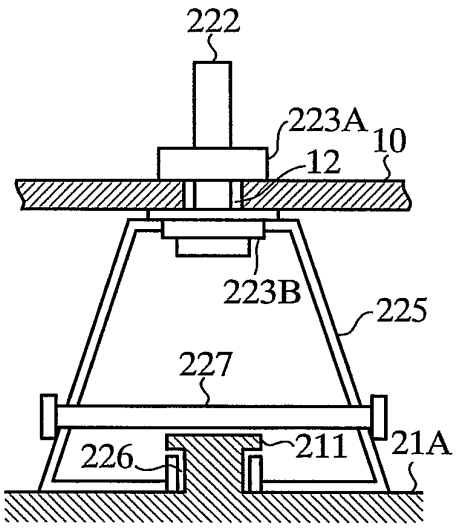


FIG.7(B)

FIG.8

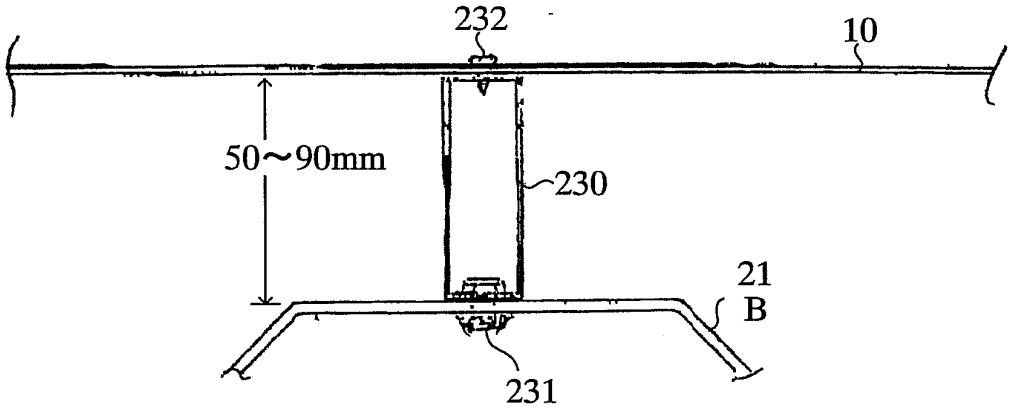


FIG.9

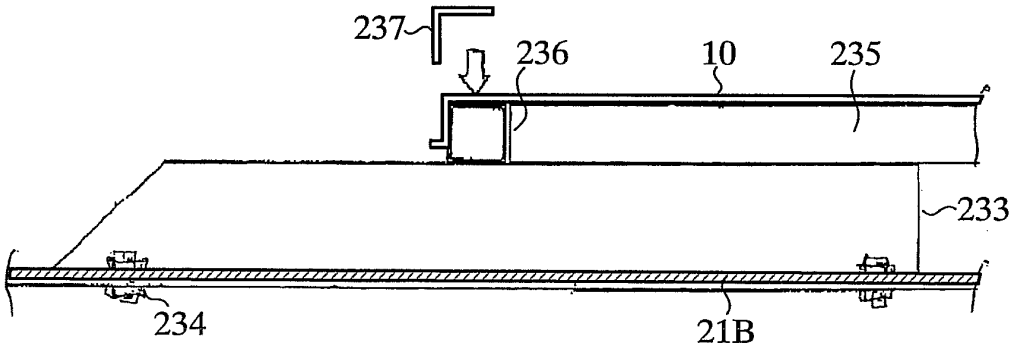


FIG.10

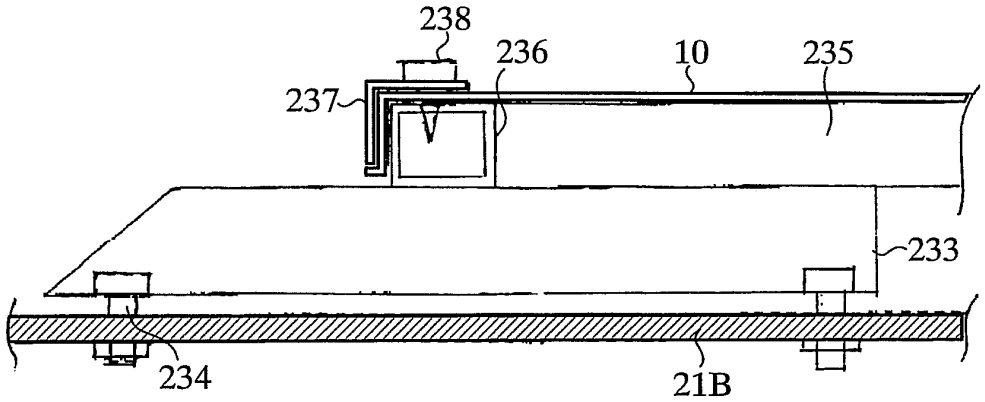
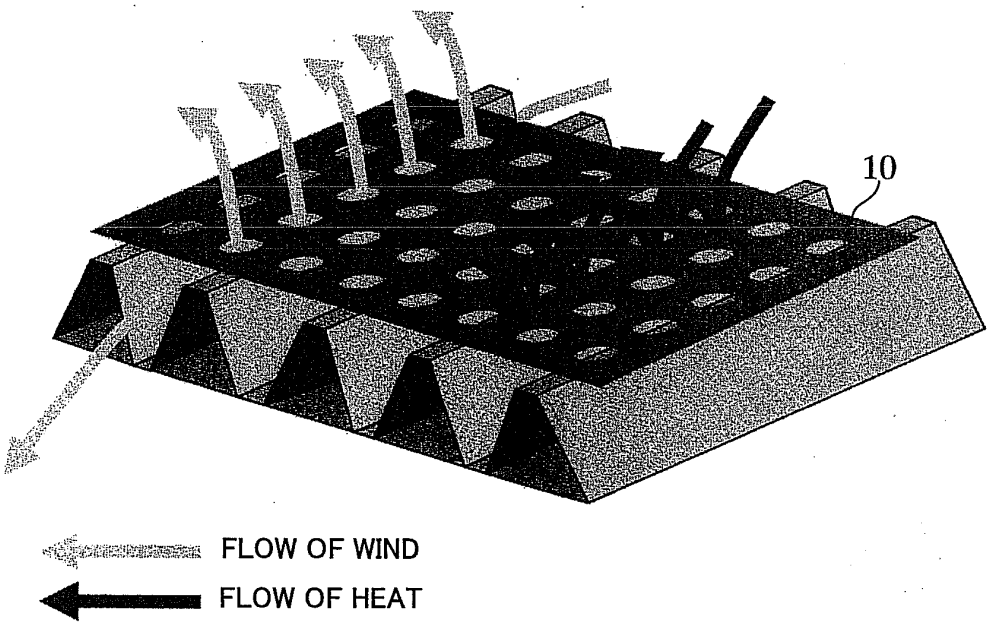


FIG.11



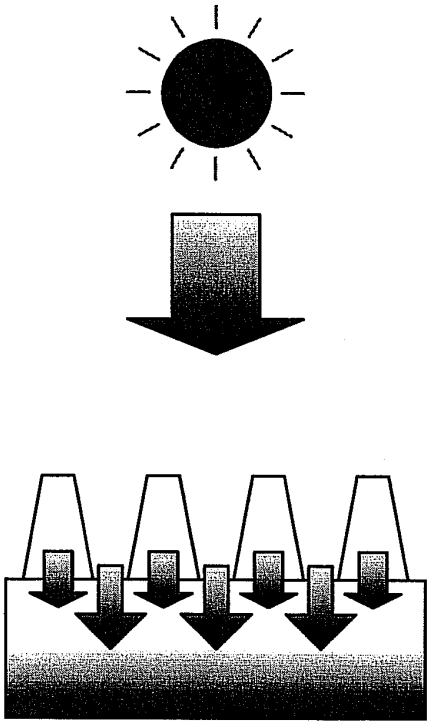


FIG.12(A)

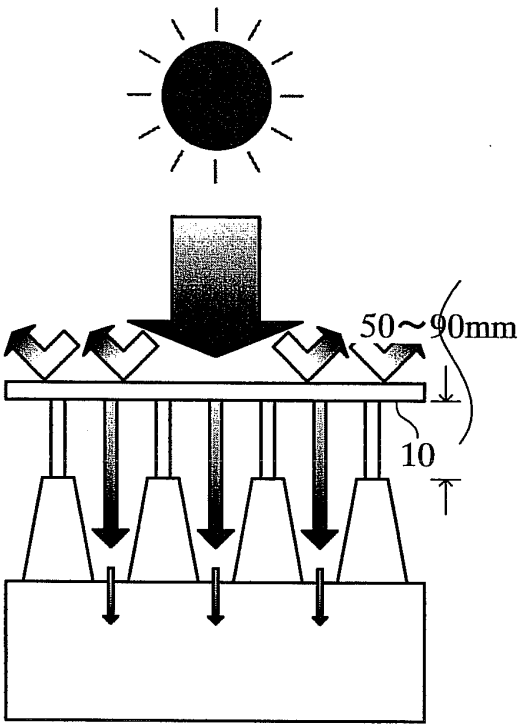


FIG.12(B)

FIG.13

TABLE SHOWING TRANSITION OF CHANGE OF TEMPERATURE

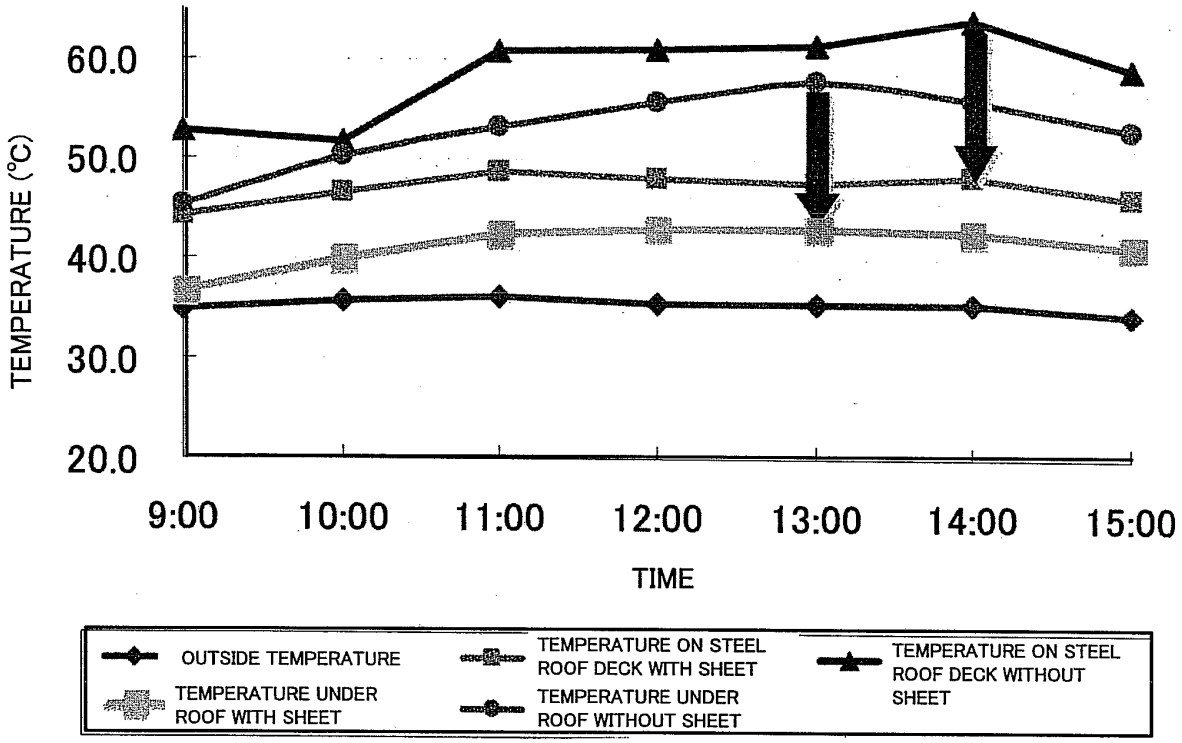


FIG.14

PORTION	MATERIAL (DETAILED NAME)	THICKNESS [mm]	THERMAL CONDUCTIVITY: λ [W/m²·K]	SMASH INPUT ITEM
ROOF	GALVANIZED STEEL SHEET	0.5	50	STEEL MATERIAL
	PEFF	4	0.024	HEAT KEEPING HARD URETHANE FOAM NO.1 OF TYPE 1
CEILING	GLASS WOOL	50	0.05	CORRESPONDING TO HOUSING GLASS WOOL 10K
	PLASTER BOARD	9.5	0.22	PLASTER BOARD
OUTSIDE WALL	IRON SHEET	0.35	50	STEEL MATERIAL
	FOAMED STYRENE	40	0.043	POLYSTYRENE FOAM NO.4 MADE BY BEAD METHOD
	IRON SHEET	0.35	50	STEEL MATERIAL
FLOOR	PLYWOOD	2.5	0.16	PLYWOOD
	CONCRETE PANEL	12	0.16	PLYWOOD
WINDOW	GLASS	3	1	FLOAT GLASS
DOOR	ALUMINUM SHEET	3	200	ALUMINUM ALLOY

FIG.15

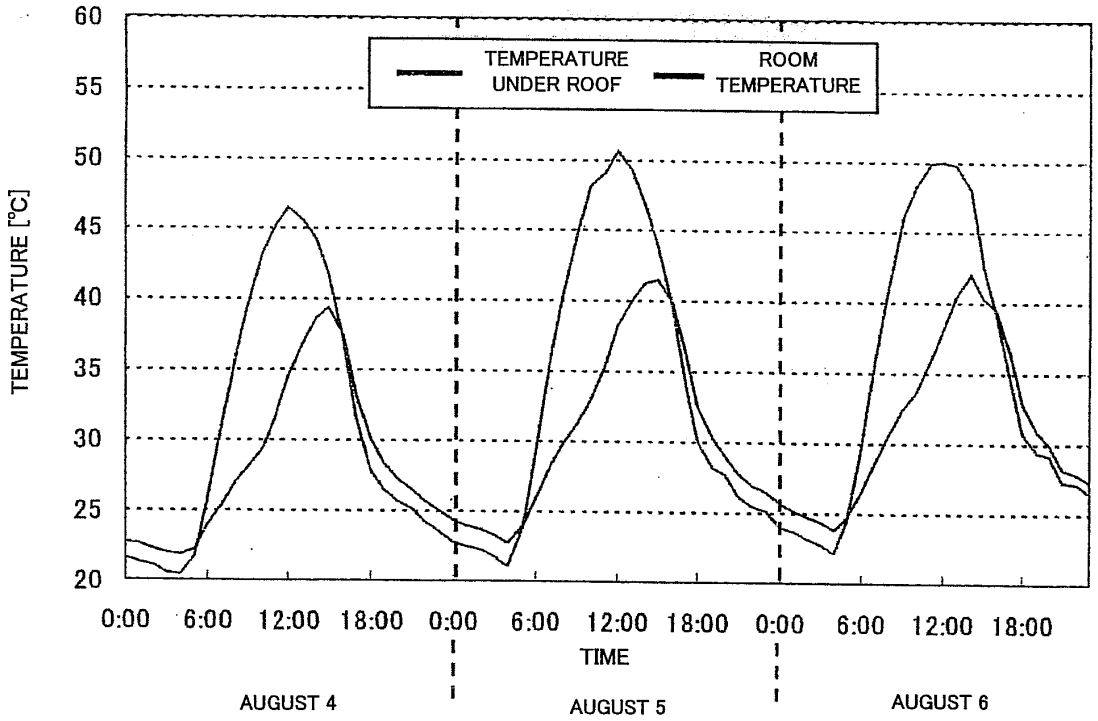


FIG.16

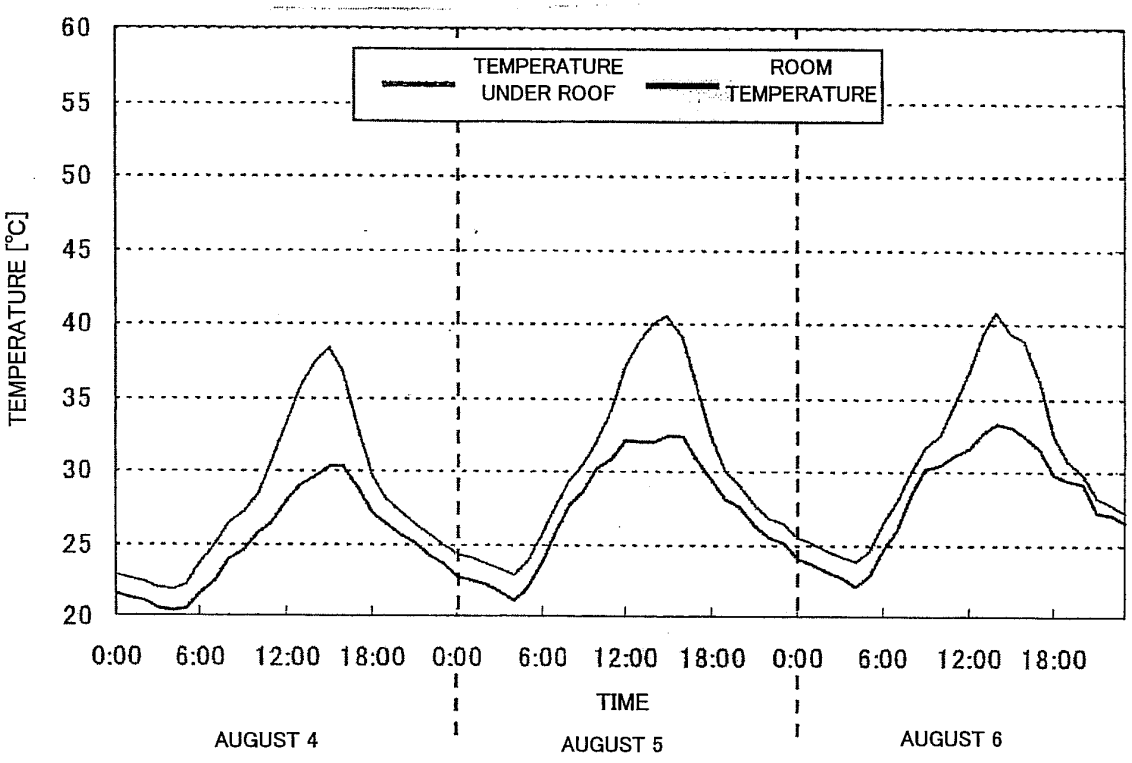

TEMPERATURE UNDER ROOF
ROOM TEMPERATURE
TEMPERATURE [°C]
60
55
50
45
40
35
30
25
20
0:00
6:00
12:00
18:00
0:00
6:00
12:00
18:00
0:00
6:00
12:00
18:00
TIME
AUGUST 4
AUGUST 5
AUGUST 6

FIG.17

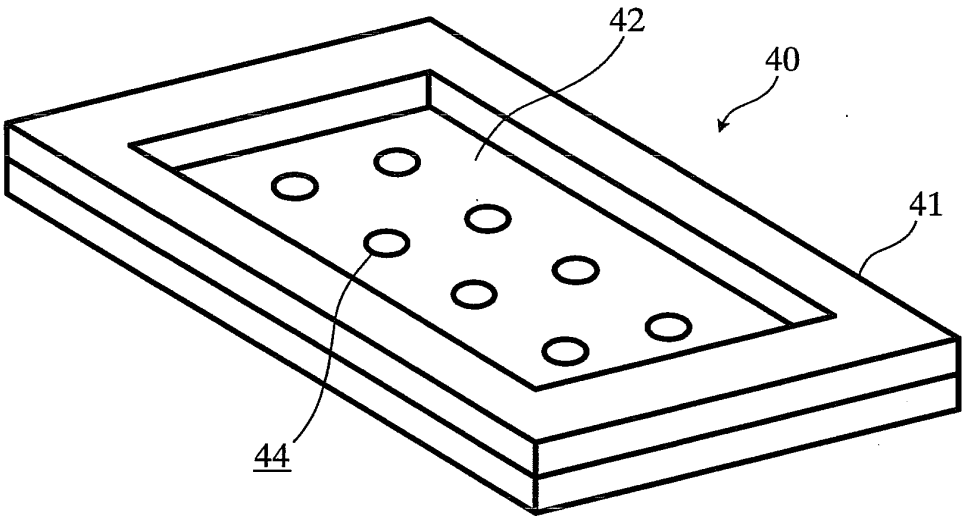

42
40
41
44

FIG.18

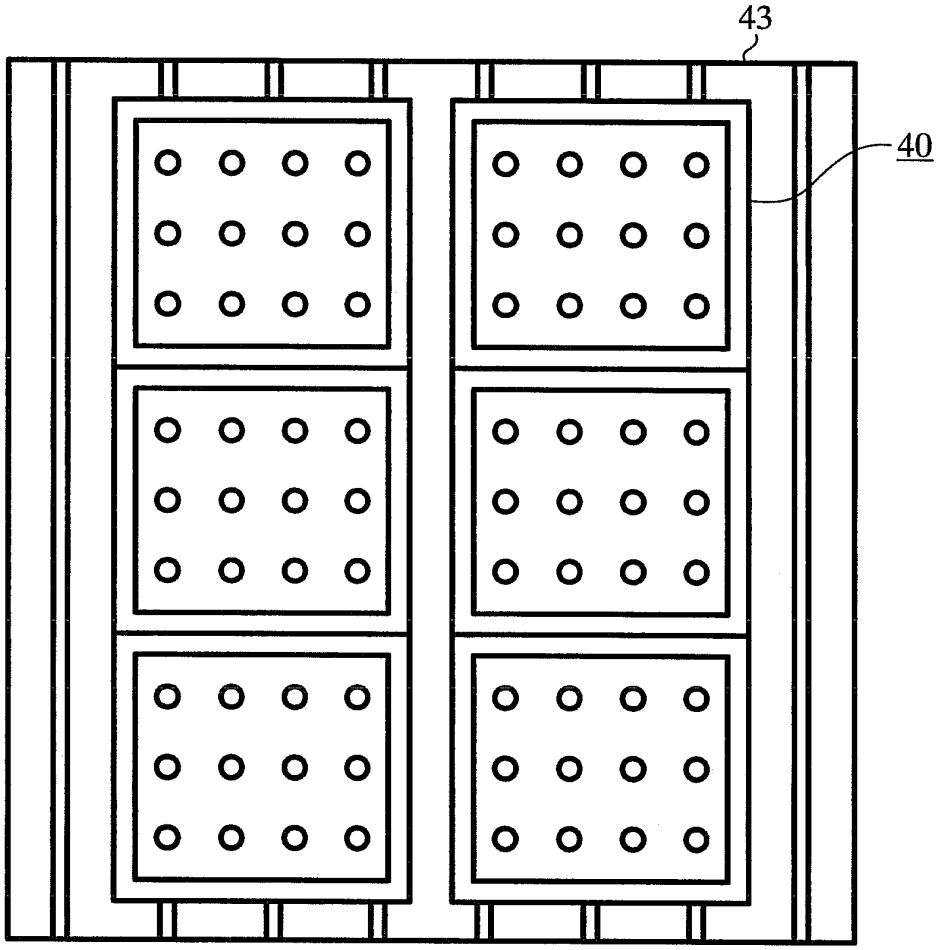
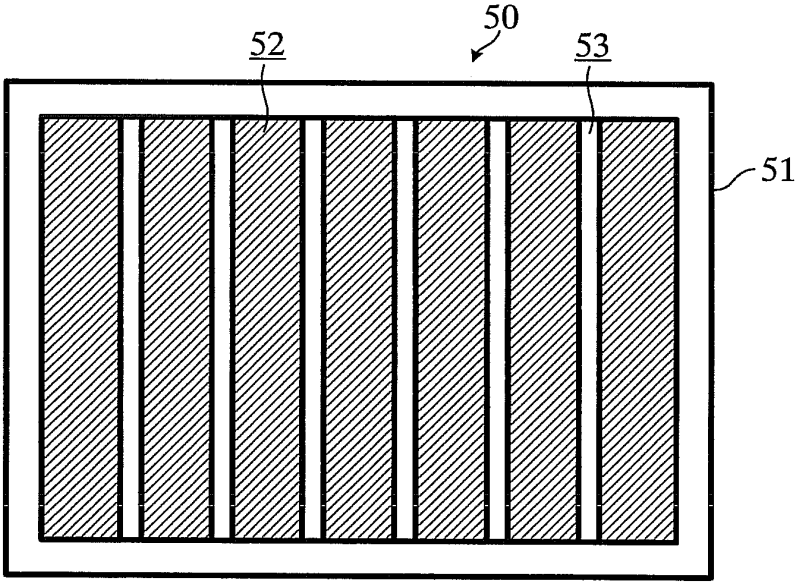


FIG.19



INTERNATIONAL SEARCH REPORT

International application No.
PCT/JP2007/062639

A. CLASSIFICATION OF SUBJECT MATTER
E04B1/74(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)
E04B1/74

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 1996-2007
Kokai Jitsuyo Shinan Koho 1971-2007 Toroku Jitsuyo Shinan Koho 1994-2007

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 3129324 U (Kabushiki Kaisha Sawaya), 15 February, 2007 (15.02.07), Par. Nos. [0007] to [0009]; Figs. 1 to 3 (Family: none)	1,2,12 3-11
Y	Microfilm of the specification and drawings annexed to the request of Japanese Utility Model Application No. 48102/1981(Laid-open No. 159924/1982) (Daiwa House Industry Co., Ltd.), 07 October, 1982 (07.10.82), Page 1, line 19 to page 3, line 11; Figs. 1, 2 (Family: none)	3,6,7,10

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

* Special categories of cited documents:
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"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	Date of mailing of the international search report
08 August, 2007 (08.08.07)	21 August, 2007 (21.08.07)
Name and mailing address of the ISA/ Japanese Patent Office Facsimile No.	Authorized officer Telephone No.

Form PCT/ISA/210 (second sheet) (April 2005)

INTERNATIONAL SEARCH REPORT

International application No.
PCT/JP2007/062639

C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	JP 2001-11983 A (Kabushiki Kaisha Mitsuboshi), 16 January, 2001 (16.01.01), Par. Nos. [0011] to [0017]; Fig. 3 (Family: none)	4-7
Y	JP 2004-36354 A (Takayuki YAMAKAWA), 05 February, 2004 (05.02.04), Par. Nos. [0007] to [0013]; Fig. 5 (Family: none)	5,7-11
Y	JP 60-73948 A (National House Industrial Co., Ltd.), 26 April, 1985 (26.04.85), Page 1, lower right column, line 7 to page 2, left column, line 11; Figs. 1 to 3 (Family: none)	6,7
Y	JP 2002-61338 A (Yodogawa Steel Works, Ltd.), 28 February, 2002 (28.02.02), Par. Nos. [0017] to [0018]; Figs. 1 to 6 (Family: none)	10

Form PCT/ISA/210 (continuation of second sheet) (April 2005)