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# (54) LANDING DOOR OF ELEVATOR

(57) An elevator landing door has a reinforcement member (2) provided on a back of a door panel (1) for enhancing rigidity. The elevator landing door has an adhesive (3) for bonding the door panel (1) and the reinforcement member (2) together and a thermally-expanding agent (4) interposed between the door panel (1) and the reinforcement member (2). Upon exposure to intense heat stemming from occurrence of fire or the like, the thermally-expanding agent (4) inflates, thereby separating the door panel (1) from the reinforcement member (2). Hence, there can be prevented deformation of the door panel (1), which would otherwise be caused by a difference between the door panel (1) and the reinforcement member (2) in terms of coefficient of thermal expansion. As a result, the entrance of the elevator can be sealed by the door panel (1) without fail, thereby preventing intrusion of smoke and flame into a car compartment or a hoistway.

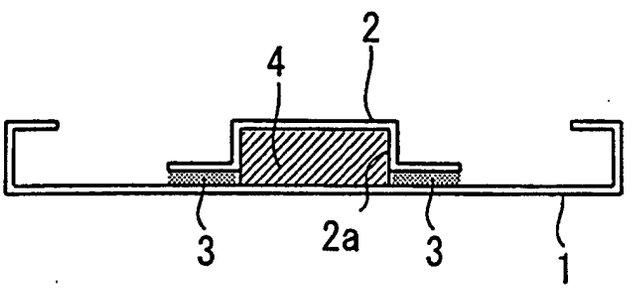


Fig. 2

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## Description

### THCHNICAL FIELD

**[0001]** The invention relates to a landing entrance door for use in an elevator.

### BACKGROUND ART

**[0002]** There has hitherto been known an elevator landing entrance door, wherein a reinforcement member is provided on a back of a door panel in order to enhance the rigidity of the landing entrance door. The construction of a conventional elevator landing entrance door will be described by reference to Figs. 6 through 10.

**[0003]** Fig. 6 is a front view showing an entrance located at an elevator hall. At the entrance, a hall floor 16 and a hoistway through which an elevator car is caused to ascend or descend are partitioned from each other by means of a landing entrance door consisting of two door panels 11. A frame is formed around the entrance from entrance pillars 14.

**[0004]** Fig. 7 is a schematic diagram showing a cross section of the entrance when viewed from the right side in Fig. 6. The door panels 11 are fitted to grooves of a door sill 15 provided at a lower part of the entrance and can move in the direction perpendicular to the drawing sheet of Fig. 7.

**[0005]** Fig. 8 is a perspective view showing a back of the door panels 11; that is, the surfaces of the door panels 11 facing a hoistway. As shown in Fig. 8, a reinforcement member 12 is fixed on the surfaces of the door panels 11 opposite decorated surfaces thereof, for enhancing the rigidity of the door panels 11. Fig. 9 is a cross-sectional view of the door panels taken along dashed line II-II' shown in Fig. 8. As shown in Fig. 9, the door panels 11 and the reinforcement member 12 are bonded together by means of a metal adhesive 13. A non-thermoplastic adhesive is generally used as the metal adhesive 13. As mentioned above, the door panels 11 and the reinforcement member 12 are fixedly integrated together at the entrance of a conventional elevator landing entrance door, thereby enhancing the rigidity of the door panels.

**[0006]** According to the above-described conventional technique, the rigidity of the door panels 11 can be enhanced by the reinforcement member 12. However, in the event of fire, there arises a problem of the door panels 11 being deformed with intense heat in the event of fire or the like.

**[0007]** Fig. 10 is a schematic view showing the door panels 11 when they have become deformed with intense heat from the state shown in Fig. 7. As shown in Fig. 10, when fire has arisen in a building equipped with an elevator, the door panels 11 are heated from the hall floor 16 of the elevator, whereby the door panels 11 and the reinforcement member 12 become thermally expanded. At this time, the extent to which the door panels 11 are thermally expanded and that to which the reinforcement member 12 is thermally expanded differ from each other, for reasons of a difference in thermal conductivity or geometry between the door panels 11 and the reinforcement member 12. However, the door panels 11 and the reinforcement member 12 are completely integrated together with the metal adhesive 13. Hence, warpage eventually arises in the door panels 11.

**[0008]** For this reason, as shown in Fig. 10, clearance existing between the entrance pillars 14 and the door panels 11 becomes larger at the entrance. Further, clearance existing between the door panels 11 also becomes larger. By way of the clearance, smoke and flame stemming from fire enters the hoistway of the elevator and a hoisting machine, thereby making it impossible to maintain the fire resistance of the elevator. There also arises a probability of fire spreading to other floors of abuilding as a result of smoke and fire entering the hoistway.

**[0009]** Accordingly, the invention aims at providing an elevator landing door which can prevent occurrence of warpage and deformation of door panels which would otherwise be caused with intense heat and prevent leakage of smoke and flame even if fire has arisen in a building.

### DISCLOSURE OF THE INVENTION

**[0010]** The invention is directed toward an elevator landing door having a reinforcement member for enhancing rigidity and comprising a door panel, a reinforcement member provided on a back of the door panel, an adhesive for bonding the door panel and the reinforcement member together, and a thermally-expanding agent interposed between the door panel and the reinforcement member. When the door panel is heated by fire or the like, the thermally-expanding agent interposed between the door panel and the reinforcement member inflates, thereby separating the reinforcement member from the door panel. Therefore, even if a difference exists between the door panel and the reinforcement member in terms of coefficient of thermal expansion or geometry, no warpage or deformation arises in the door panel. Accordingly, there can be prevented intrusion of flame and smoke into ahoistway by way of an entrance of the elevator, which would otherwise be caused when the landing door panel is heated during fire, thus enhancing the fire protection performance and safety of the elevator landing door.

**[0011]** The invention is directed toward the thus-improved elevator landing door, wherein the thermally-expanding agent is formed from inorganic material. Use of inorganic material for the thermally-expanding agent prevents generation of smoke or flame on the back of the door panel and enhances the fire protection performance of the elevator landing door.

**[0012]** The invention is directed toward the thus-improved elevator landing door, wherein the door panel

and the reinforcement member are connected together by a joint piece. Even when the thermally-expanding agent has inflated as a result of occurrence of fire, thereby separating the reinforcement member from the door panel, the reinforcement member remains connected to the door panel with the joint piece. Hence, falling of the reinforcement member into the hoistway can be prevented.

**[0013]** The invention is directed toward the thus-improved elevator landing door, wherein a recessed section into which the thermally-expanding agent is to be inserted is formed in the reinforcement member. The recessed section is formed in the reinforcement member, whereby the thermally-expanding member is enclosed by the reinforcement member and the door panel. Hence, force can be applied, without fail, in a direction in which the reinforcement member is separated by means of volume expansion of the thermally-expanding member.

**[0014]** The invention is directed toward the thus-improved elevator landing door, wherein the adhesive is formed from a thermoplastic adhesive. Since the thermoplastic adhesive becomes soft in the event of fire, the door panel and the reinforcement member can be reliably separated from each other by means of an increase in the volume of the thermally-expanding material.

## BRIEF DESCRIPTION OF THE DRAWINGS

**[0015]**

Fig. 1 is a perspective view showing an elevator landing door according to a first embodiment of the invention;

Fig. 2 is a horizontal cross-sectional view showing the elevator landing door of the first embodiment;

Fig. 3 is a horizontal cross-sectional view showing that the elevator landing door of the first embodiment is heated;

Fig. 4 is a horizontal cross-sectional view showing an elevator landing door according to a second embodiment of the invention;

Fig. 5 is a horizontal cross-sectional view showing that the elevator landing door of the second embodiment is heated;

Fig. 6 is a schematic view showing the front appearance of a conventional elevator landing door;

Fig. 7 is a side cross-sectional view showing a side surface of the conventional elevator landing door;

Fig. 8 is a perspective view showing the conventional elevator landing door;

Fig. 9 is a horizontal cross-sectional view showing the conventional elevator landing door; and

Fig. 10 is a side cross-sectional view showing that the conventional elevator landing door is heated and that door panels become resultantly warped.

## DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

**[0016]** The invention will be described in more detail by reference to the accompanying drawings.

**[0017]** Fig. 1 is a perspective view showing an elevator landing door according to a first embodiment of the invention. Fig. 2 is a view showing a cross section of the landing door taken along a dashed line I-I' shown in Fig. 1. As shown in Figs. 1 and 2, a reinforcement member 2 is provided on the back of a door panel 1, and the reinforcement member 2 and the door panel 1 are bonded together with an adhesive 3. Here, according to the invention, a thermoplastic adhesive is used as the adhesive 3.

**[0018]** A thermally-expanding agent 4 is interposed between the door panel 1 and the reinforcement member 2. The thermally-expanding agent 4 is formed from an expanded material having a large bulk modulus and which, preferably, is an inorganic material. A recessed section 2a is formed in the surface of the reinforcement member 2 facing the doorpanel 1, bymeans of bending. The thermally-expanding agent 4 is inserted into the recessed section 2a.

**[0019]** Fig. 3 shows a state in which the door panel 1 having such a construction has been heated by fire or the like. Fig. 3 is a view showing a cross section of the door panel 1 taken along a dashed line I-I' shown in Fig. 1. As shown in Fig. 3, when the door panel 1 is heated, the thermoplastic adhesive 3 becomes soft, and the bond strength existing between the door panel 1 and the reinforcement member 2 becomes weak. Meanwhile, the thermally-expanding agent 4 becomes expanded when heated,whereby the volume of the thermally-expanding agent is increased. As a result, the thermally-expanding agent 4 exerts force on the reinforcement member 2 and the door panel 1 in a direction in which the reinforcement member 2 and the door panel 1 are separated from each other. When the force that is exerted by the thermally-expanding agent 4 so as to separate the reinforcement member 2 from the door panel 1 has become greater than the bond strength exerted by the adhesive 3 between the reinforcement member 2 and the door panel 1, the reinforcement member 2 is separated from the door panel 1 in the manner as shown in Fig. 3. As a result of the door panel 1 having been separated from the reinforcement member 2, there can be prevented occurrence of warpage or deformation in the door panel 1, which would otherwise be caused by a difference between the reinforcement member 2 and the door panel 1 in terms of coefficient of thermal expansion or geometry.

**[0020]** Thereby, the plane characteristic of the door panel 1 is maintained at the same level as that achieved before the door panel 1 is heated, no clearance arises between the door panel 1 and an entrance of an elevator hall. Therefore, even in the case of an elevator in which a single entrance is opened and closed through use of

a plurality of door panels 1, no clearance arises between the door panels 1. Accordingly, there can be prevented intrusion of smoke or flame due to fire, which would otherwise arise from an entrance of an elevator hall toward a hoistway or a hoisting machine.

**[0021]** The thermally-expanding agent 4 is formed from an inorganic material, thereby preventing generation of smoke or fire, which would otherwise arise behind a door panel. Hence, the fire protection performance of the door panel can be enhanced.

**[0022]** Next, an elevator landing door according to a second embodiment of the invention will be described by reference to Figs. 4 and 5. As shown in Figs. 4 and 5, the elevator landing door of the second embodiment is realized by connecting the door panel 1 and the reinforcement member 2, both being described in connection with the first embodiment, through use of one joint piece 5 or a plurality of joint pieces.

**[0023]** Fig. 4 is a cross-sectional view showing the door panel 1 and the reinforcement member 2 before heating. As shown in Fig. 4, the joint pieces 5 to be used for connecting the reinforcement member 2 and the door panel 1 are formed from, e.g., a metal plate or wire or a plate or wire f ormed from inorganic material. One end of each joint piece is fastened to the reinforcement member 2, and the other end is fastened to the door panel 1. The elevator landing door is identical with that described in connection with the first embodiment, except for the joint pieces 5.

**[0024]** Fig. 5 shows that the elevator landing door of the second embodiment has become heated. When the landing door is heated in the same manner as in the case shown in Fig. 3, the thermally-expanding agent 4 inflates, thereby separating the reinforcement member 2 from the door panel 1. In the second embodiment, at this time, the reinforcement member 2 and the door panel 1 are connected together by the joint pieces 5. Hence, even when the bonding section formed from the adhesive 3 has been peeled, complete separation of the reinforcement member 2 from the door panel 1 is prevented. Accordingly, there can be prevented separation of the reinforcement member 2 from the panel 1 and falling of the separated reinforcement member 2 into a hoistway, which would otherwise be caused during fire, or infliction of damage to other members such as a communication cable or a car compartment, which would otherwise be caused by falling of the reinforcement member 2.

## INDUSTRIAL APPLICABILITY

**[0025]** As has been described, an elevator landing door of the invention prevents intrusion of fire and smoke into a hoistway by way of an entrance of an elevator, which would otherwise be caused when a door panel is heated in the event of fire or the like. The elevator landing door is useful for a variety of elevators and lifts, as an elevator landing door whose fire protection performance and safety have been enhanced.

## Claims

1. An elevator landing door comprising:

   a door panel;
   a reinforcement member provided on a back of the door panel; an adhesive to be used for bonding the door panel and the reinforcement member together; and
   a thermally-expanding agent interposed between the door panel and the reinforcement member.

2. The elevator landing door according to claim 1, wherein the thermally-expanding agent is an inorganic material.

3. The elevator landing door according to claim 1 or 2, further comprising:

   a joint piece for connecting the door panel and the reinforcement member together.

4. The elevator landing door according to any one of claims 1 through 3, wherein a recessed section into which the thermally-expanding agent is inserted is formed in the reinforcement member.

5. The elevator landing door according to any one of claims 1 through 4, wherein the adhesive is a thermoplastic adhesive.

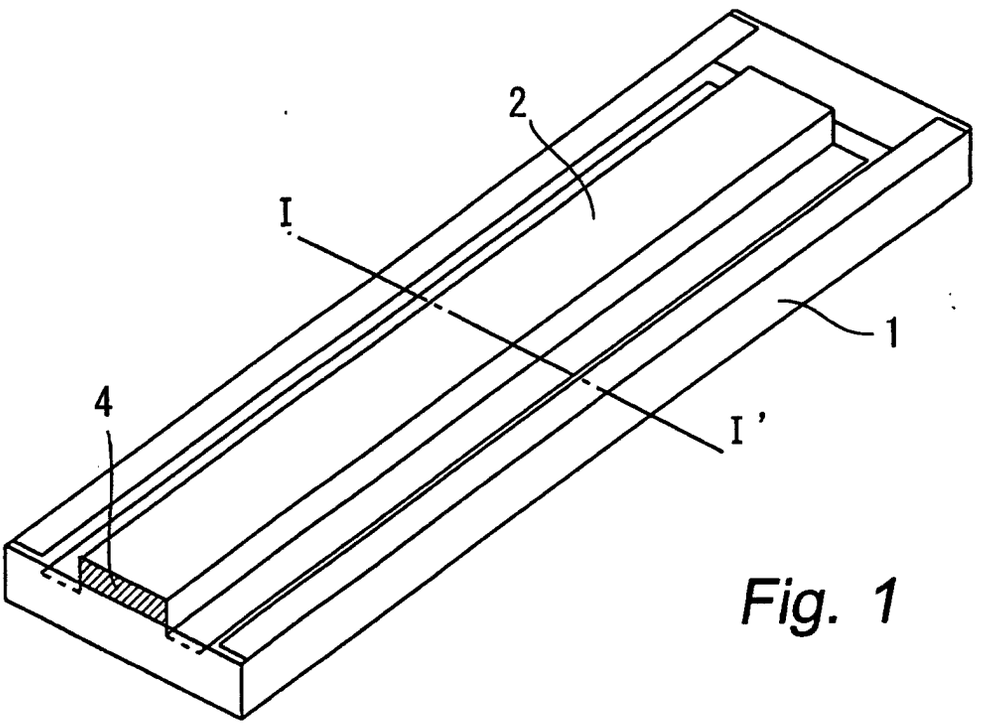


Fig. 1

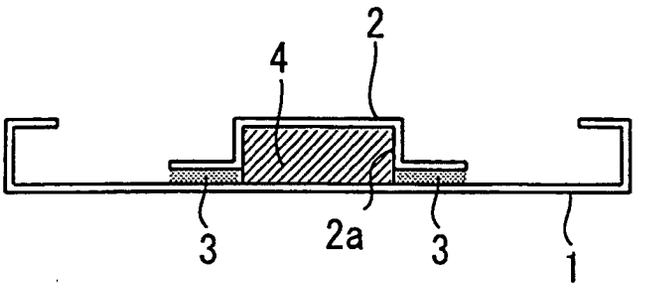


Fig. 2

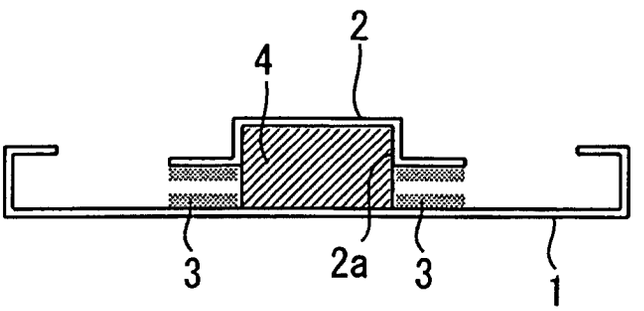


Fig. 3

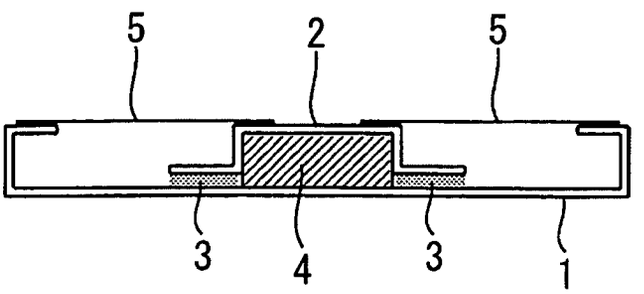


Fig. 4

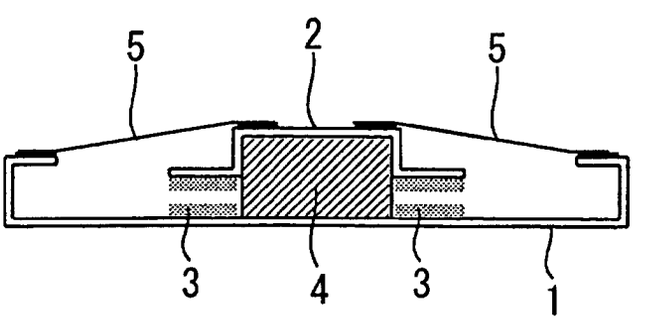


Fig. 5

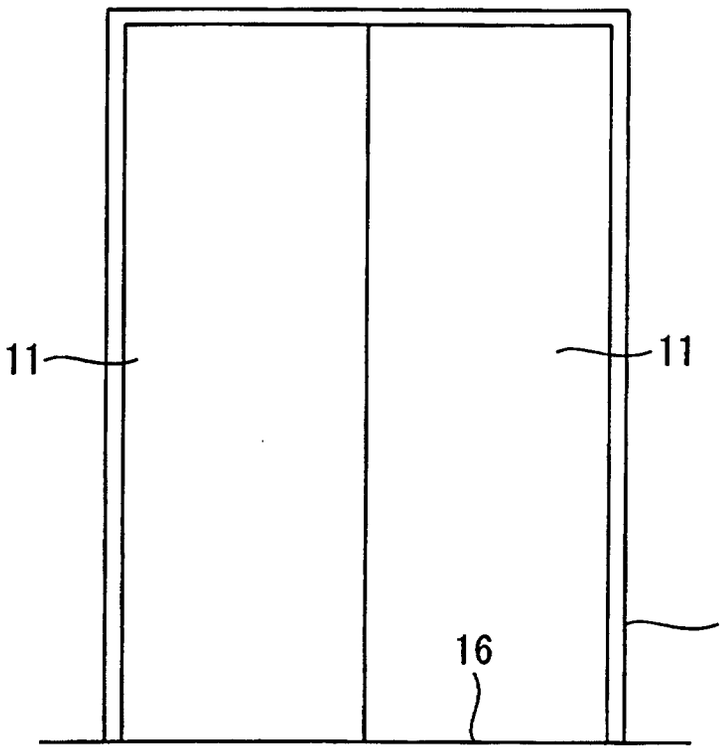


Fig. 6

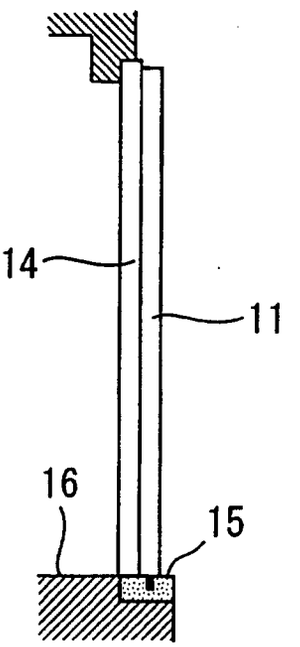


Fig. 7

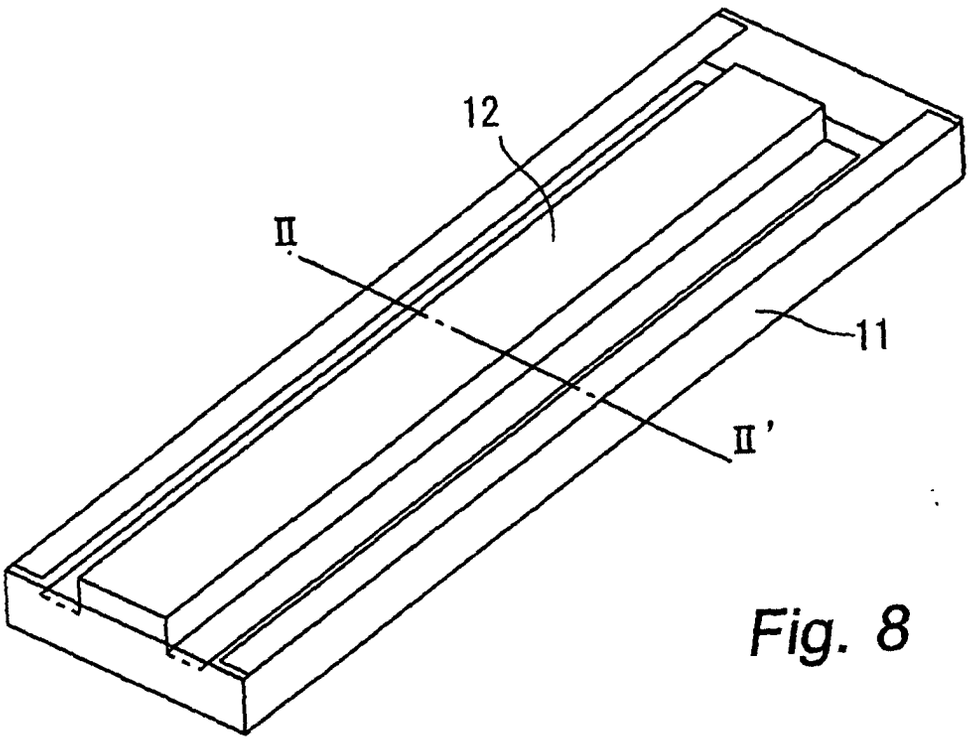


Fig. 8

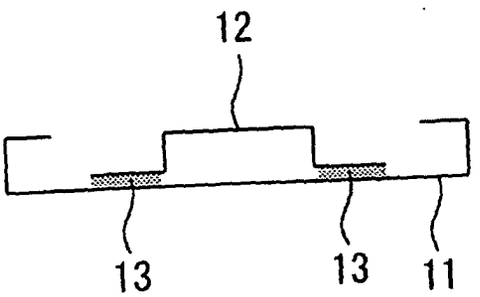


Fig. 9

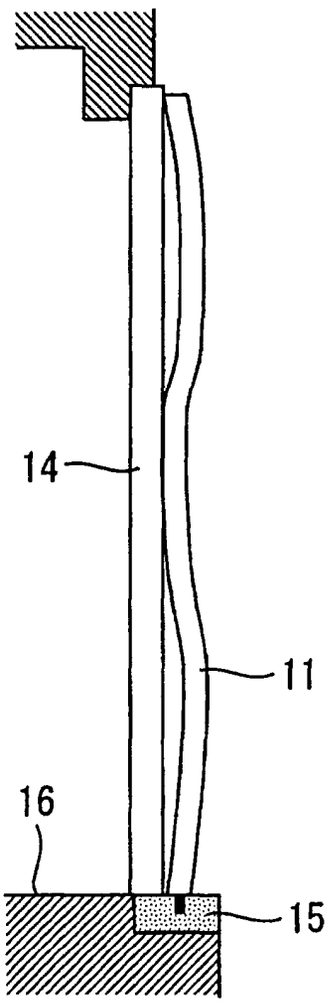


Fig. 10

## INTERNATIONAL SEARCH REPORT

International application No.
PCT/JP01/07072

A. CLASSIFICATION OF SUBJECT MATTER
Int.Cl[7] B66B13/30, E06B5/16

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)
Int.Cl[7] B66B13/00-B66B13/30, E06B5/16

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 | 1996-2002 |
| Kokai Jitsuyo Shinan Koho | 1971-2002 | Toroku Jitsuyo Shinan Koho | 1994-2002 |

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. |
|---|---|---|
| A | US 3981102 A (Dover Corp.), 21 September, 1976 (21.09.76), & CA 1008732 A | 1-5 |
| A | JP 2001-97657 A (Inventio AG.), 10 April, 2001 (10.04.01), & EP 1083290 A1 & CN 1287093 A & AU 5656800 A & BR 3999 A | 1-5 |
| A | JP 11-130366 A (Mitsubishi Electric Corp.), 18 May, 1999 (18.05.99), & NL 1008737 C & CN 1215691 A & US 5988321 A | 1-5 |

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| 01 May, 2002 (01.05.02) | 21 May, 2002 (21.05.02) |
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