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(54) WALL PANEL AND METHOD FOR PRODUCING THE SAME

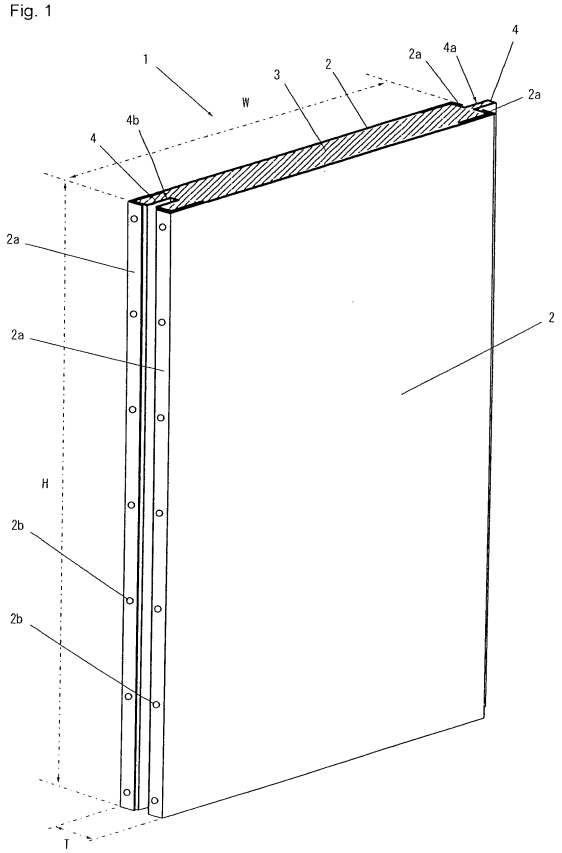
(57) [PROBLEMS]

To provide an easy-to-work wall panel exhibiting sufficient fire resistance and heat resistance in which the amount of material of a mounting board is reduced and joint of panels is facilitated, and a method for producing it.

[MEANS FOR SOLVING PROBLEMS]

The wall panel (1) has an interior material (3) between a pair of mounting boards (2, 2), wherein the mounting board (2) has a portion (2a) formed by folding the opposite ends inward, and a joint metal (4) provided with a protrusion (4a) or a recess (4b) and a shoulder portion (4c) continuous to the protrusion (4a) or the recess (4b). Wall panels (1, 1) are jointed together by coupling the folded portion (2a) and the shoulder portion (4c) and fitting the protrusion (4a) to the recess (4b), and the joint metal (4) is divided substantially at the center of the protrusion (4a) or the recess (4b) into the front side and the back side.

Fig. 1



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Description

Technical Field

[0001] The present invention relates to a wall panel for use in accommodation spaces of a ship and the like, and a method for producing the same. More specifically, the present invention relates to a wall panel whose features reside in a structure of joining one panel to another panel, and a method for producing the same.

Background Art

[0002] A wall panel of a type as shown in Figures 9 to 11, for example, is used in accommodation spaces of a ship and the like. Figure 9 shows wall panels joined in a flat-plate joint system; Figure 10 shows wall panels joined in an H-shaped joint system; and Figure 11 shows wall panels joined in a jointless system.

[0003] Figure 9(A) is a horizontal cross sectional view of a wall panel; Figure 9(B) shows a state of the wall panel before being joined to another panel; Figure 9(C) shows a state of the wall panel after being joined to another panel; and Figure 9(D) shows another example of wall panels joined in a flat-plate joint system in the prior art. A wall panel 91 shown in Figure 9(A) comprises a mounting board 92 whose opposite ends are inwardly bent, a mounting board 93 whose opposite ends are inwardly bent and having a recess 93a formed therein for inserting a flat-plate joint 95, and rock wool 94 filled in between the mounting board 92 and the mounting board 93. The rock wool 94 is bonded to the mounting boards 92 and 93 by adhesive. As shown in Figure 9(B), the recesses 93a of the wall panels 91 are aligned to each other, the flat-plate joint 95 is inserted in both of the recesses 93a and the ends of the wall panels 91 are butted against each other into the state shown in Figure 9(C). Such wall panels are disclosed in Non-Patent Document 1, for example.

[Non-Patent Document 1]

http: //www.sba.fi/ products/ 01-01-01_JMC_ 1_25_B-0.htm

[0004] A wall panel 96 shown in Figure 9(D) comprises a pair of mounting boards 91 whose opposite ends are inwardly bent, a joint metal 97 having a substantially concave shape and bonded to each of the opposite ends of the mounting board 91, and rock wool 94 filled in between the mounting boards 91. The rock wool 94 is bonded to the mounting boards 91 and the joint metal 97 by adhesive. The flat-plate joint 95 is inserted in the recess of the joint metal 97, so that the wall panels 96 are joined together. A similar wall panel to the wall panel 96 shown in Figure 9(D) is disclosed in Patent Document 1, for example.

[Patent Document 1] Japanese Patent Laid-Open No. S60-35688

[0005] Figure 10(A) is a horizontal cross sectional view of a wall panel; Figure 10(B) shows a state of the wall panel before being joined to another panel; and Figure 10(C) shows a state of the wall panel after being joined to another panel. A wall panel 101 shown in Figure 10 (A) comprises a pair of mounting boards 102 whose opposite ends are inwardly bent and having a recess 102a formed therein for inserting an H-shaped joint 104, and rock wool 103 filled in between the mounting boards 102. The rock wool 103 is bonded to the mounting boards 102 by adhesive. As shown in Figure 10(B), the recesses 102a of the wall panels 101 are aligned to each other, the H-shaped joint 104 is inserted in both of the recesses 102a and the ends of the wall panels 101 are butted against each other into the state shown in Figure 10(C). Such wall panels are disclosed in Non-Patent Document 2, for example.

[Non-Patent Document 2]

http: //www.sba.fi/ products/ 01-02-01_JMC_ 1_33_B-15.htm

[0006] Figure 11(A) is a horizontal cross sectional view of a wall panel; Figure 11(B) shows a state of the wall panel before being joined to another panel; Figure 11(C) shows a state of the wall panel after being joined to another panel; and Figure 11(D) shows another example of wall panels using no joint in the prior art. A wall panel 111 shown in Figure 11(A) comprises a pair of mounting boards 112 whose one end is inwardly bent to form a step and whose other end is inwardly folded back; a metal fitting 113 having a substantially U-shape and attached to the folded-back portion of the mounting board 112; and rock wool 114 that is filled in between the mounting board 112 and the metal fitting 113. When the folded portions and the folded-back portions of the mounting boards 112 are properly aligned and oriented so as to assemble mounting boards 112, a protrusion 111a and a recess 111b are formed, as shown in Figure 11(A). At this time, the metal fitting 113 is pinched by the folded-back portions of the mounting boards 112, and the rock wool 114 is bonded to the decorative steel plate 112 and the metal fitting 113 by adhesive. As shown in Figure 11 (B), the protrusion 111a of one wall panel 111 is faced to the recess 111b of another wall panel 111, the protrusion 111a of the one wall panel 111 is inserted into the recess 111b of the other wall panel 111 and the ends of the wall panel 111 are butted against each other into the state shown in Figure 11(C). Such wall panels are disclosed in Non-Patent Document 3, for example.

[Non-Patent Document 3]

http: // sungmlgc.en.ec21.com/ product_ detail.jsp? group_id=G C00723122&product_id=CA00723124& product_nm=Marine_fire_wa ll_panel

[0007] A wall panel 115 shown in Figure 11(D) comprises a pair of mounting boards 116 whose one end is inwardly bent to form a step and whose other end is inwardly folded back; and rock wool 117 filled in between the mounting boards 116. The mounting board 116 itself is shaped to also serve as for the metal fitting 113 shown in Figure 11(A). The rock wool 117 is bonded to the mounting board 116 by adhesive. The protrusion 116a

of one wall panel 116 is faced to the recess 116b of another wall panel 116, the protrusion 116a of the one wall panel 116 is inserted into the recess 116b of the other wall panel 116 and the ends of the wall panels 116 are butted against each other, so that the wall panels 116 are joined together. Such wall panels are disclosed in Non-Patent Document 4, for example.

[Non-Patent Document 4]

http://www.waskorea.co.kr/wall_panel.html

[0008] In addition, other wall panels in a jointless system have been disclosed, including those having a metal fitting of a substantially convex shape or a substantially concave shape connected to opposite ends of the panels, as shown in Patent Documents 2 and 3. Any of the wall panels disclosed in the Patent Documents has a metal fitting of a substantially convex shape or a substantially concave shape secured to either an end or a back surface of a flat mounting board.

[Patent Document 2] Japanese Patent Laid-Open No. H04-353140, Figure 4 and Figure 5

[Patent Document 3] Japanese Patent Laid-Open No. H07-217064, Figure 3

Disclosure of the Invention

Problems to be Solved by the Invention

[0009] When the above described various wall panels are generally used to divide a room, mounting boards with a high unit price (for example, decorative steel plates and the like) are used because both sides of the wall panels serve as walls of the divided rooms. Therefore, in order to reduce the cost of the wall panels, it is necessary to minimize the use of mounting boards with a high unit price. In addition, when used in accommodation spaces of a ship, the wall panels are required to be fire resistant and heat resistant, and therefore a structure of joining one wall panel to another wall panel should not be ignored.

[0010] In the case of the wall panel 91 shown in Figure 9(A) and the wall panel 101 shown in Figure 10(A), the mounting boards 93 and 102 are shaped to form the recesses 93a and 102a, respectively, and therefore use a larger amount of decorative steel plate than the mounting board 92, which increases cost thereof. For example, for the wall panels 91 and 101 having a width of 600 mm, the mounting board 92 only needs a decorative steel plate of a width of about 619 mm, while the mounting boards 93 and 102 need a decorative steel plate of a width of about 702 mm. In addition, shaping the opposite ends of the mounting boards 93 and 102 makes it difficult to maintain planarity of the mounting boards 93 and 102. In particular, it is difficult to control the accuracy in shaping, and a gap may sometimes be left in the butted portion on the back side when the opposite ends are butted against each other. This often causes problems in terms of appearance and fire resistance. Moreover, the flat-plate joint 95 or the H-shaped joint 104 itself used to join the wall panels 91 and 101 leads to increased cost, and also causes another problem of difficulty in transportation and attachment of the joints. In the case of the wall panel 96 shown in Figure 9(D), less amount of decorative steel plate is used. However, the use of the flat-plate joint 95 causes the above described problems, and it is difficult to maintain the accuracy of the butted portion in the wall panels 96 due to the wall panel 96 and the joint metal 97 not mechanically bonded to each other.

[0011] The wall panels 111, 115 shown in Figures 11 (A) and (D) use less amount of decorative steel plate than the wall panel 101 shown in Figure 10(A) (they need a decorative steel plate of a width of about 650 mm for a wall panel having a width of 600 mm). However, the folded portions formed on the ends may complicate shaping and increase cost. Furthermore, in addition to the problem of difficulty in controlling the accuracy in shaping the folded portions, bulges are formed on the bent portions, which hinders the plates from being flat at the end portions. This may impair the appearance.

[0012] The wall panels described in Patent Documents 2 and 3 use flat mounting boards to result in the minimum amount of decorative steel plate used. However, they have a problem of poor appearance when a metal fitting of a substantially convex shape or a substantially concave shape is secured with a threaded screw or bolt. And they also have a problem of poor resistance to fire and heat when the metal fitting is secured by adhesive, which may readily detach the mounting board at a high temperature.

[0013] The present invention has been made in view of the above problems, and it is an object of the present invention is to provide an easy-to-work wall panel exhibiting sufficient fire resistance and heat resistance in which the amount of material of a mounting board is reduced and joint of panels is facilitated, and a method for producing the same.

Means for Solving the Problems

[0014] According to the present invention, a wall panel having an interior material between a pair of mounting boards is provided, which is **characterized in that** the mounting board has a folded portion formed by folding the opposite ends inward, and a joint metal provided with a protrusion or a recess and a shoulder portion continuous to the protrusion or the recess, and the wall panels are configured to be jointed together by coupling the folded portion and the shoulder portion and fitting the protrusion to the recess, and the protrusion and the recess are divided substantially at the center thereof into a front side and a back side.

[0015] An end of the protrusion or the recess may be smoothly continuous to an extended portion of the protrusion or the recess, or an end of the protrusion or the recess may be continuous from an extended portion of the protrusion or the recess in a tapered shape, or the extended portion of the protrusion or the recess may be

continuous from the shoulder portion in a tapered shape.

[0016] Preferably, coupling means other than adhesive is used on at least one of the front side and the back side of the folded portion and the shoulder portion, and may be used at all of the folded portions and the shoulder portions. The coupling means may be, for example, clinching, welding, screw, threaded screw or bolt.

[0017] In addition, according to the present invention, a method for producing a wall panel having an interior material between a pair of mounting boards is provided, which is **characterized in that** it includes: a first step for forming a folded portion by folding opposite ends of the mounting board inward, and forming a joint metal having a shape of a metal fitting that includes a protrusion or a recess and a shoulder portion continuous to the protrusion or the recess and is divided substantially at the center thereof; a second step for producing a pair of joined members by coupling the folded portion and the shoulder portion; a third step for providing an interior material to the joined members; and a fourth step for integrally bonding the pair of joined members together.

[0018] Furthermore, the fourth step may include: a step for applying an adhesive to an inner surface of the mounting board of the joined member or a surface of the interior material; a step for facing the insides of the joined members to each other and bringing the insides into contact with each other; and a step for adjusting the positions of the joined members for lamination.

Advantages of the Invention

[0019] According to the above described wall panel and the method for producing the same of the present invention, the opposite ends of a mounting board are simply folded. As a result, the mounting board is easy to work with, the material amount of the mounting board used is reduced, and thus cost reduction can be achieved even when a material with a high unit price is used for the mounting board. Moreover, when the wall panel is joined to another wall panel by fitting a protrusion of a joint metal into a recess of a joint metal, a joint is not necessary to join the wall panels together. Therefore cost reduction can be achieved and, at the same time, transportation and attachment of the joints are facilitated. In addition, when a folded portion of a mounting board and a shoulder portion of a joint metal are coupled together even with coupling means other than adhesive, the coupled portion cannot be seen from the outside to improve the appearance. Furthermore, when a refractory material or a heat-resistance material is used for the interior material, the use of coupling means other than adhesive can prevent the mounting board and the joint metal from being detached even when the wall panels are exposed to a high temperature.

[0020] Furthermore, the joint metal divided substantially at the center thereof allows easy access to all of the coupled portions (the folded portions of the mounting board and the shoulder portions of the joint metal) from inside and outside, and allows easy coupling work even when coupling means other than adhesive is used. In addition, a gap is formed at the divided portion of the joint metal, which facilitates the fitting of the protrusion into the recess, and also allows any manufacturing tolerance and assembly tolerance to be accommodated within the gap at the divided portion.

Best Mode for Carrying Out the Invention

[0021] Now, embodiments of the present invention will be described below with reference to Figures 4 to 8. Figure 1 is a perspective view of a wall panel showing a reference embodiment that uses a joint metal different from that of a wall panel of the present invention, and Figure 2 shows cross sectional views of a joint portion between wall panels of the reference embodiment, with Figure 2(A) showing the wall panels before being joined, and Figure 2(B) showing the wall panels after being joined. Figure 3 shows views of a method for producing a wall panel of the reference embodiment shown in Figures 1 and 2.

[0022] As shown in Figures 1 and 2, a wall panel of the reference embodiment is a wall panel 1 having an interior material 3 between a pair of mounting boards 2, 2, and the mounting board 2 includes folded portions 2a formed by folding the opposite ends inward, and a joint metal 4 having a protrusion 4a or a recess 4b and shoulder portions 4c continuous to the protrusion 4a or the recess 4b, so that the wall panels 1, 1 are joined together by coupling the folded portions 2a and the shoulder portions 4c and fitting the protrusion 4a into the recess 4b.

[0023] The mounting board 2 may be formed of various materials depending on the application of the wall panel 1, and is a decorative steel plate when the wall panel is used in accommodation spaces of a ship, for example. As shown in Figure 1, each mounting board 2 has opposite ends folded inward, as viewed in the direction of its width (W) in its in-use position. The folded portion 2a may have any width necessary for coupling the folded portion 2a with the joint metal 4, and a width on the order of 4 to 10 mm may be sufficient for a wall panel of a width (W) of 600 mm x a height (H) of 2200 mm x a thickness (T) of 25 mm when clinching is used as coupling means, for example. Therefore, the amount of the material can be reduced in the production of the mounting board 2. In addition, the folded portions 2a can be formed by simply folding the opposite ends of the mounting board 2 inward to approximately 90 degrees, so that an easy-to-work wall panel is provided and there may be less effect on the planarity of the exposed portion of the mounting board 2. In the case where the mounting board 2 is coupled to the joint metal 4 by means of screw, threaded screw, bolt, or the like, a coupling hole may be provided in advance in the folded portion 2a.

[0024] The interior material 3 may be formed of various materials depending on the application of the wall panel 1, and may be rock wool when the wall panels are re-

quired to be fire resistant and heat resistant, such as those used in accommodation spaces of a ship, for example. In Figure 1, although the interior material 3 is shown to fill the entire inner space of the mounting board 2 and joint metal 4, the entire inner space may not necessarily be filled with the interior material 3. The interior material 3 may be discretely located in the space between the mounting boards 2, or no interior material 3 may be used to fill the small inside space of the joint metal 4.

[0025] There are two types of the joint metal 4: one having the protrusion 4a, and the other having the recess 4b. As shown in Figure 1, the joint metal 4 having the protrusion 4a is typically coupled to one end of the mounting board 2, while the joint metal 4 having the recess 4b is coupled to the other end of the mounting board 2. The joint metals 4 may be formed of an iron plate with a lower unit price. The protrusion 4a and the shoulder portion 4c shown in Figure 2(A) have a width Th and a width Ts, respectively, that are preferably set to satisfy a condition of $Th/Ts \geq 3/4$, and are most preferably set to satisfy a condition of approximately $Th/Ts = 1$. For example, for the wall panel 1 having a thickness (T) of 25 mm, it is preferred to set the widths (Th, Ts) = (9 mm, 8 mm), and for the wall panel 1 having a thickness (T) of 50 mm, it is preferred to set the widths (Th, Ts) = (34 mm, 8 mm) or (18 mm, 16 mm). The thickness of the mounting board 2 is ignored in the settings of the width Ts of the shoulder portion 4c.

[0026] Given the plate material folded to 90 degrees, the lower limit of the range of settings for both the width Th of the protrusion 4a and the width Ts of the shoulder portion 4c shown in Figure 2(A) is preferably about 4 mm. Therefore, for the wall panel 1 having a thickness (T) of 25 mm, setting the width Ts of the shoulder portion 4c to 4 mm dictates 17 mm for the width Th of the protrusion 4a. Meanwhile, setting the width Th of the protrusion 4a to 4 mm dictates 10.5 mm for the width Ts of the shoulder portion 4c. More specifically, for the wall panel 1 having a thickness (T) of 25 mm, the widths can be set within ranges of $4 \text{ mm} \leq Ts \leq 10.5 \text{ mm}$ and $4 \text{ mm} \leq Th \leq 17$ mm, respectively. In addition, for the wall panel 1 having a thickness (T) of 50 mm, setting the width Ts of the shoulder portion 4c to 4 mm dictates 42 mm for the width Th of the protrusion 4a. Meanwhile, setting the width Th of the protrusion 4a to 4 mm dictates 23 mm for the width Ts of the shoulder portion 4c. More specifically, for the wall panel 1 having a thickness (T) of 50 mm, the widths can be set within ranges of $4 \text{ mm} \leq Ts \leq 23 \text{ mm}$ and $4 \text{ mm} \leq Th \leq 42$ mm, respectively. The width of the recess 4b is determined by the width Th of the protrusion 4a to fit into the recess 4b.

[0027] The cross sectional shape of the protrusion 4a and recess 4b is not limited to a squared U-shape, and may have a U-shape, a bottomless trapezoid (trapezoid without a lower base), or a V-shape. In addition, in Figure 1, both of the joint metal 4 having the protrusion 4a and the joint metal 4 having the recess 4b have a length along the entire height of the wall panel 1, while in the case where the wall panels are not required to be fire resistant and heat resistant to a greater extent, the joint metal 4 having the protrusion 4a or the recess 4b may have a smaller length, or may be discretely located as far as the joint can be achieved. In the case of the wall panel 1 that is to be fitted to another wall panel 1 only on one end side of the panel, the joint metal 4 having the protrusion 4a or the recess 4b may be coupled on one end of the mounting board 2, and the other end may be provided with a flat metal fitting.

[0028] The shoulder portion 4c of the joint metal 4 is formed to have an L-shaped cross section, as shown in Figures 1 and 2. In such a case, one surface of the shoulder portion 4c will be in contact with the folded portion 2a of the mounting board 2, and the other surface will be in contact with the back surface of the mounting board 2, which facilitates the alignment of the mounting board 2 in the production of the wall panel 1. The shoulder portion 4c may, of course, be formed into a flat shape having a surface that is in contact only with the folded portion 2a of the mounting board 2. Alternatively, the shoulder portion 4c may be partly continuous to the protrusion 4a or the recess 4b (at the portion necessary for the coupling to the folded portion 2a). When the mounting board 2 is coupled to the joint metal 4 by means of screw, threaded screw, bolt, or the like, a coupling hole may be provided in advance in the shoulder portion 4c.

[0029] The mounting board 2 (folded portions 2a) is preferably coupled to the joint metal 4 (shoulder portions 4c) using means other than adhesive, such as clinching, welding, screw, threaded screw, bolt, and the like. As shown in Figure 1, the coupled portion 2b is discretely located in the direction of the height (H) of the folded portion 2a. The term "clinching" as used herein means a "technique for jointing thin plates together by stacking the two thin plates and pressing the thin plates together into a cylindrical die". For example, clinching may be performed on plates at intervals of 300 mm. The reason for the use of coupling means other than adhesive is that, the adhesive is melted or evaporated when the wall panel 1 is exposed to a high temperature, and consequently the wall panel 1 may be broken. The above described mechanical or physical coupling means may prevents the wall panel 1 from decoupling and breaking as long as the wall panel 1 is not exposed to a temperature so high that the parts are melted. When the coupling means, such as clinching and welding, that requires the use of a tool on the inside and outside of the coupled portion 2b is used, the coupling means other than adhesive is used only on one of the front side and back side of the wall panel 1 due to production constraints, and coupling means, such as adhesive, screw, and threaded screw, that does not necessarily requires the use of a tool on both sides of the coupled portion is used on the other side.

[0030] The above described wall panel 1 is, as shown in Figure 2, configured so that the wall panels 1, 1 are joined together by fitting the protrusion 4a into the recess 4b, which means that the wall panel 1 of the reference

embodiment is in the jointless system. Such a jointless system eliminates the use of a joint that is a separate member from the wall member, which allows a cost reduction, and facilitates transportation and attachment of the joints. In addition, as shown in Figure 2(A), the width Th of the protrusion 4a or the recess 4b can be sufficiently secured to increase the strength of the fitted portion of the wall panel 1 and reduce the plastic deformation of the fitted portion that may occur in transportation or attachment of the joints. Moreover, as shown in Figure 2 (B), plane-to-plane contact of two planes, i.e. the folded portion 2a of the mounting board 2 and a side surface of the protrusion 4a or the recess 4b, can serve to reduce deformation or noise caused by vibration even when the wall panel 1 is installed at a place where vibration occurs, such as an accommodation space of a ship.

[0031] Next, a method for producing the wall panel 1 of the reference embodiment shown in Figures 1 and 2 will be described below with reference to Figure 3. Figure 3(A) shows a first step, Figure 3(B) shows a second step, Figure 3(C) shows a third step, and Figure 3(D) shows a fourth step.

[0032] In the first step shown in Figure 3(A), the folded portions 2a are formed by folding the opposite ends of the mounting board 2 in the direction of the width inward, and the joint metal 4 is formed to have the protrusion 4a or the recess 4b and the shoulder portions 4c. That is, the first step includes machining and shaping the mounting board 2 and the joint metal 4.

[0033] In the second step shown in Figure 3(B), a joined member 5 is produced by coupling the folded portion 2a and the shoulder portion 4c. At this time, coupling means other than adhesive is used. Specifically, clinching or welding as coupling means may be used at this step, because a tool can be placed on both of the inside and outside of the coupled portion.

[0034] In the third step shown in Figure 3(C), the interior material 3 is provided in the joined member 5. Although Figure 3(C) shows the case where the interior material 3, such as rock wool, is filled in the entire inside of the joined member 5, the interior material 3 may be discretely located. The interior material 3 is preferably fixedly attached to the mounting board 2 or the joint metal 4 by adhesive or the like. For example, an adhesive may be applied to the inner surface of the mounting board 2 or the joint metal 4, so that the rock wool that is compacted into blocks is adhesively secured to the inner surface of the mounting board 2 or the joint metal 4.

[0035] In the fourth step shown in Figure 3(D), the joined member 5 provided with the interior material 3 is covered with another mounting board 2 produced in the first step for integration, so as to complete the wall panel 1. At this time, because no tool can be inserted into the inside of the joined member 5, an adhesive is used for bonding as in the prior art, or coupling means, such as screw, threaded screw, and bolt, is used to be able to couple the folded portion 2a with the shoulder portion 4c only from the outside. In the case where an adhesive is used even only on one side, there remains the problem of fire resistance or heat resistance as in the case of the prior art. However, it can be said that coupling means other than adhesive used at least on the other side can enhance the fire resistance or heat resistance of the entire wall panel 1. Depending on the situation where the wall panel 1 is used, the surface with the coupling means other than adhesive may be faced to the side where more fire or heat resistance is required.

[0036] Next, a first embodiment of a wall panel according to the present invention will be described below with reference to Figures 4 to 6. Figure 4 is a perspective view of a wall panel showing a first embodiment of the present invention, and Figures 5 are cross sectional views showing a joint portion between wall panels of the first embodiment, with Figure 5(A) showing the state before joint, and Figure 5(B) showing the state after joint. The mounting board 2 is the same as that in the reference embodiment, and therefore will not be described below.

[0037] A wall panel 6 of the first embodiment shown in Figure 4 uses a joint metal 7 in such a shape as the joint metal 4 of the reference embodiment, divided substantially at the center of the protrusion 4a and recess 4b into a front side and a back side. Therefore, the joint metals 7 of the first embodiment are arranged at four locations on the opposite end sides, the front surface and the back surface, as viewed in the direction of the width (W) of the wall panel 6. A pair of joint metals 7, 7 on one end side together forms a protrusion 7a, and another pair of joint metals 7, 7 on the other end side together forms a recess 7b. The protrusion 7a and the recess 7b are each continuous to a shoulder portion 7c that has an L-shaped cross section, as similar to the joint metal 4.

[0038] As shown in Figure 5, the protrusion 7a and the recess 7b each have an end 7d that is smoothly continuous to an extended portion 7e, and the ends 7d that are faced to each other in the direction of the thickness (T) of the wall panel 6 have a gap C therebetween. The width Tt of the portion that forms the protrusion 7a and the width Ts of the shoulder portion 4c of the joint metal 7 shown in Figure 5(A) are preferably set to satisfy a condition of $Tt/Ts \geq 3/8$, respectively, and most suitably approximately $Tt/Ts = 1/2$. For example, for the wall panel 6 having a thickness (T) of 25 mm, it is preferred to use the setting; (Tt, Ts, C) = (4 mm, 8 mm, 1 mm), and for the wall panel 6 having a thickness (T) of 50 mm, it is preferred to use the setting; (Tt, Ts, C) = (4 mm, 8 mm, 26 mm) or (8 mm, 16 mm, 2 mm). The thickness of the mounting board 2 is ignored in the settings of the width Ts of the shoulder portion 7c.

[0039] In the first embodiment, the same size of the mounting boards 2 and the joint metals 7 can be used regardless of the thickness (T) of the wall panel 6, and the widths of the interior material 3 and the gap C can be adjusted to easily accommodate different sizes. The gap C at the joint metal 7 facilitates the insertion of the protrusion 7a into the recess 7b and also accommodates any manufacturing tolerance or assembly tolerance

when the protrusion 7a is fitted into the recess 7b so as to transition from the state shown in Figure 5(A) to that shown in Figure 5(B). In order to enhance fire resistance and heat resistance, it is preferable to provide the interior material 3 in the protrusion 7a and the recess 7b as shown in Figure 5. However, these spaces may be left unfilled with the interior material 3.

[0040] Given the plate material folded to 90 degrees, the lower limit of the range of settings for both the width Tt of the portion that forms the protrusion 7a and the width Ts of the shoulder portion 7c of the joint metal 7 shown in Figure 5(A) is preferably about 4 mm. The gap C is preferably set to at least 1 mm taking its effect into account. Therefore, for the wall panel 6 having a thickness (T) of 25 mm, setting the width Ts of the shoulder 7c to 4 mm and the gap C to 1 mm dictates 8 mm for the width Tt of the portion that forms the protrusion 7a. Meanwhile, setting the width Tt of the portion that forms the protrusion 7a to 4 mm and the gap C to 1 mm dictates 8 mm for the width Ts of the shoulder portion 4c. More specifically, for the wall panel 6 having a thickness (T) of 25 mm, the widths can be set within ranges of 4 mm $\leq$ Ts $\leq$ 8 mm and 4 mm $\leq$ Tt $\leq$ 8 mm, respectively. At this time, setting both of the width Ts and the width Tt to 4 mm maximizes the gap C (9 mm). Therefore, the gap C can be set within a range of 1 mm $\leq$ C $\leq$ 9 mm. In addition, for the wall panel 6 having a thickness (T) of 50 mm, setting the width Ts of the shoulder portion 7c to 4 mm and the gap C to 1 mm dictates 20.5 mm for the width Tt of the portion that forms the protrusion 7a. Meanwhile, setting the width Tt of the portion that forms the protrusion 7a to 4 mm and the gap C to 1 mm dictates 20.5 mm for the width Ts of the shoulder portion 4c. More specifically, for the wall panel 6 having a thickness (T) of 50 mm, the widths can be set within ranges of 4 mm $\leq$ Ts $\leq$ 20.5 mm and 4 mm $\leq$ Tt $\leq$ 20.5 mm, respectively. At this time, setting both of the width Ts and the width Tt to 4 mm maximizes the gap C (34 mm). Therefore, the gap C can be set within a range of 1 mm $\leq$ C $\leq$ 34 mm. The width of the portion that forms the recess 7b is determined by the width Tt of the portion that forms the protrusion 7a to fit into the recess 7b.

[0041] Next, a method for producing the wall panel 6 of the first embodiment shown in Figures 4 and 5 will be described below with reference to Figure 6. Figure 6(A) shows a first step, Figure 6(B) shows a second step, Figure 6(C) shows a third step, Figure 6(D) shows an applying step in a fourth step, Figure 6(E) shows a position adjusting step in the fourth step, and Figure 6(F) shows a completed product.

[0042] In the first step shown in Figure 6(A), the folded portions 2a are formed by folding the opposite ends of the mounting board 2 in the direction of the width inward, and the joint metal 7 is formed in such a shape as a metal fitting having the protrusion 7a or recess 7b and the shoulder portions 7c, divided substantially at the center thereof. That is, the first step includes machining and shaping the mounting board 2 and the joint metal 7.

[0043] In the second step shown in Figure 6(B), the folded portion 2a and the shoulder portion 7c are coupled to form a pair of joined members 8, 8. At this time, coupling means other than adhesive is used. Specifically, clinching or welding as coupling means may be used, because a tool can be placed on both of the inside and outside of the coupled portion.

[0044] In the third step shown in Figure 6(C), the interior material 3 is provided in the joined member 8. For example, the interior material 3 may be divided into the interior material 3a provided in the gap at the protrusion 7a, the interior material 3b provided in the two gaps at the recess 7b, and the interior material 3c provided in the space between the protrusion 7a and the recess 7b, which is to be sandwiched by the mounting boards 2. One of the joined members 8 may be provided with three interior materials 3a, 3b and 3c, and the other of the joined members 8 may be provided with one interior material 3b. The interior material 3a and 3b provided in the gaps at the protrusion 7a and recess 7b may be omitted, or the interior material 3c may be discretely located. The interior material 3 is preferably fixedly attached to the mounting board 2 or the joint metal 7 by adhesive or the like. For example, an adhesive may be applied to the inner surface of the mounting board 2 or the joint metal 7, and the rock wool that is compacted into blocks may be adhesively secured to the inner surface of the mounting board 2 or the joint metal 4. The adhesive may be applied to the surface of the interior material 3.

[0045] In the fourth step shown in Figures 6(D) to 6(F), the pair of joined members 8 provided with the interior materials 3a, 3b and 3c are integrally bonded to complete the wall panel 6. The fourth step includes: a step for applying an adhesive to the inner surfaces of the mounting board 2 and the joint metal 7 included in one of the joined members 8 (the upper joined member 8 of Figure 6); a step for facing the insides of the joined members 8 to each other and bringing the insides into contact with each other in the direction shown by arrows (see Figure 6(D)); and a step for adjusting the position for integrally bonding the joined members 8, 8 together in the direction shown by arrows (see Figure 6(E)).

[0046] According to the above described production method, the pair of joined members 8, 8 that form the front side and back side of the wall panel 6 can be separately produced. This facilitates the use of coupling means other than adhesive at all of the coupled portions 2b at the mounting board 2 and the joint metal 7, and allows the use of coupling means, such as clinching and welding, that requires the use of a tool on inside and outside of the joint portion. In addition, the position of the pair of joined members 8, 8 that form the front side and the back side of the wall panel 6 can be adjusted using pressurizing means, such as press, which enables an accurate and easy determination of the end surface of the wall panel 6. Although the adhesive 9 is used to bond the joined members 8, any breakage of the wall panel 6 can be prevented even if the wall panel 6 is exposed to

a high temperature that melts or evaporates the adhesive 9, because the protrusion 7a is fitted into the recess 7b and coupling means other than adhesive is used at each coupled portion, providing better fire resistance and heat resistance of the wall panel6.

[0047] Next, with reference to Figures 7 and 8, several variations of the above described first embodiment will be described below. Figure 7 is a cross sectional view of a wall panel showing variations of the first embodiment, with Figure 7(A) showing a second embodiment, Figure 7(B) showing a third embodiment, and Figure 7(C) showing a fourth embodiment. Figure 8 is a cross sectional view of the joint portion of a wall panel showing variations of the first embodiment, with Figure 8(A) showing a fifth embodiment, Figure 8(B) showing a sixth embodiment, and Figure 8(C) showing a seventh embodiment.

[0048] The variations shown in Figure 7 have distinct shapes in ends of the wall panel 6 and the shoulder portion 7c. The second embodiment shown in Figure 7(A) has a flat cross section in the shoulder portion 7c of the joint metal 7, instead of an L-shaped cross section. The third embodiment shown in Figure 7(B) includes the protrusion 7a at one end of a wall panel, and the other end of the wall panel is flat without the recess 7b. In such a case, the metal fitting 9 having an L-shaped cross section is coupled to the folded portion 2a of the mounting board 2, for example, instead of the joint metal 7 having the recess 7b. In addition, the shoulder portion 7 of the joint metal 7 has a flat shape. The fourth embodiment shown in Figure 7(C) includes the recess 7b at one end of a wall panel, and the other end of the wall panel is flat without the protrusion 7a. In such a case, the metal fitting 9 having a flat shape is coupled to the folded portion 2a of the mounting board 2, for example, instead of the joint metal 7 having the protrusion 7a. In addition, the shoulder portion 7c of the joint metal 7 has an L-shaped cross section. The combination of the shape of the end of the wall panel 6 and the shape of the shoulder portion 7c is not limited to those shown in the figures. For example, the protrusion 7a may be provided to both ends, or the recess 7b may be provided to both ends.

[0049] The variations shown in Figure 8 have distinct shapes in ends of the joint metal 7. The fifth embodiment shown in Figure 8(A) includes the end 7d, the extended portion 7e, and the shoulder portions 7c of the protrusion 7a and recess 7b that are continuous to each other at the angle of about 90 degrees. The sixth embodiment shown in Figure 8(B) includes the end 7d of the protrusion 7a and recess 7b that are continuous from the extended portion 7e in a tapered shape. The term "tapered" as used herein means that the angle between an end 7d and an extended portion 7e is within a range of 0 to 90 degrees, and that the end 7d is continuous to the extended portion 7e so that the gap formed between the ends 7d, which are faced in the direction of the thickness of the wall panel 6, gradually tapers from the connected portion between the end 7d and the extended portion 7e. As shown in the figures, the recess 7b has substantially the same shape as that of the protrusion 7a, so that the protrusion 7a can be fitted into the recess 7b. The seventh embodiment shown in Figure 8(C) includes the extended portions 7e of the protrusion 7a and recess 7b that are continuous from the shoulder portions 7c in a tapered shape, which means that the seventh embodiment does not have the end 7d.

[0050] The present invention is not limited to the above described embodiments, and needless to say, various modification can be added without departing from the spirit of the present invention. For example, the protrusion 7a and the recess 7b may be provided at an upper end and a lower end, and the interior material 3 may include a sound insulating material.

Brief Description of the Drawing

[0051]

Figure 1 is a perspective view of a wall panel showing a reference embodiment that uses a joint metal different from that of a wall panel of the present invention;

Figure 2 is a cross sectional view showing a joint portion between wall panels of the reference embodiment, with Figure 2(A) showing the state before joint, and Figure 2(B) showing the state after joint;

Figure 3 is a view showing a method for producing a wall panel of the reference embodiment shown in Figures 1 and 2, with Figure 3(A) showing a first step, Figure 3(B) showing a second step, Figure 3(C) showing a third step, and Figure 3(D) showing a fourth step;

Figure 4 is a perspective view of a wall panel showing a first embodiment of the present invention;

Figure 5 is a cross sectional view showing a joint portion between wall panels of the first embodiment, with Figure 5(A) showing the state before joint, and Figure 5(B) showing the state after joint;

Figure 6 is a view showing a method for producing a wall panel of the first embodiment shown in Figures 4 and 5, with Figure 6(A) showing a first step, Figure 6(B) showing a second step, Figure 6(C) showing a third step, Figure 6(D) showing an applying step in a fourth step, Figure 6(E) showing a position adjusting step in the fourth step, and Figure 6(F) showing a completed product;

Figure 7 is a cross sectional view of a wall panel showing variations of the first embodiment, with Figure 7(A) showing a second embodiment, Figure 7 (B) showing a third embodiment, and Figure 7(C) showing a fourth embodiment;

Figure 8 is a cross sectional view of a joint portion of a wall panel showing variations of the first embodiment, with Figure 8(A) showing a fifth embodiment, Figure 8(B) showing a sixth embodiment, and Figure 8(C) showing a seventh embodiment;

Figure 9 is a view showing a wall panel that uses a

flat-plate joint, with Figure 9(A) showing a horizontal cross sectional view of the wall panel, Figure 9(B) showing a state before the wall panels are joined together, Figure 9(C) showing a state after the wall panels are joined together, and Figure 9(D) showing another example in the prior art that uses a flat-plate joint;

Figure 10 is a view showing a wall panel that uses an H-shaped joint, with Figure 10(A) showing a horizontal cross sectional view of the wall panel, Figure 10(B) showing a state before the wall panels are joined together, and Figure 10(C) showing a state after the wall panels are joined together; and

Figure 11 is a view showing a wall panel that use no joint, with Figure 11(A) showing a horizontal cross sectional view of the wall panel, Figure 11(B) showing a state before the wall panels are joined together, Figure 11(C) showing a state after the wall panels are joined together, and Figure 11(D) showing another example in the prior art that uses no joint.

Claims

1. A wall panel having an interior material between a pair of mounting boards, **characterized in that**
the mounting board has a folded portion formed by folding the opposite ends inward, and a joint metal provided with a protrusion or a recess and a shoulder portion continuous to the protrusion or the recess,
the wall panels are configured to be jointed together by coupling the folded portion and the shoulder portion and fitting the protrusion to the recess, and
the protrusion and the recess are divided substantially at the center thereof into a front side and a back side.

2. The wall panel according to claim 1, **characterized in that**
an end of the protrusion or the recess is smoothly continuous to an extended portion of the protrusion or the recess.

3. The wall panel according to claim 1, **characterized in that**
an end of the protrusion or the recess is continuous from an extended portion of the protrusion or the recess in a tapered shape.

4. The wall panel according to claim 1, **characterized in that**
the extended portion of the protrusion or the recess is continuous from the shoulder portion in a tapered shape.

5. The wall panel according to claim 1, **characterized in that**
coupling means other than adhesive is used on at least one of the front side and the back side of the folded portion and the shoulder portion.

6. The wall panel according to claim 1, **characterized in that**
all of the coupling means used in the folded portion and the shoulder portion are those other than adhesive.

7. The wall panel according to claim 1, **characterized in that**
coupling means used in the folded portion and the shoulder portion is one of clinching, welding, screw, threaded screw, and bolt.

8. A method for producing a wall panel having an interior material between a pair of mounting boards, **characterized in that** the method comprises:

   a first step for forming a folded portion by folding opposite ends of the mounting board inward, and forming a joint metal having a shape of a metal fitting that includes a protrusion or a recess and a shoulder portion continuous to the protrusion or the recess and is divided substantially at the center thereof;
   a second step for producing a pair of joined members by coupling the folded portion and the shoulder portion;
   a third step for providing an interior material to the joined members; and
   a fourth step for integrally bonding the pair of joined members together.

9. The method for producing a wall panel according to claim 8, **characterized in that**
the fourth step further comprises:

   a step for applying an adhesive to an inner surface of the mounting board of the joined member or a surface of the interior material;
   a step for facing the insides of the joined members to each other and bringing the insides into contact with each other; and
   a step for adjusting the positions of the joined members for lamination.

Fig. 1

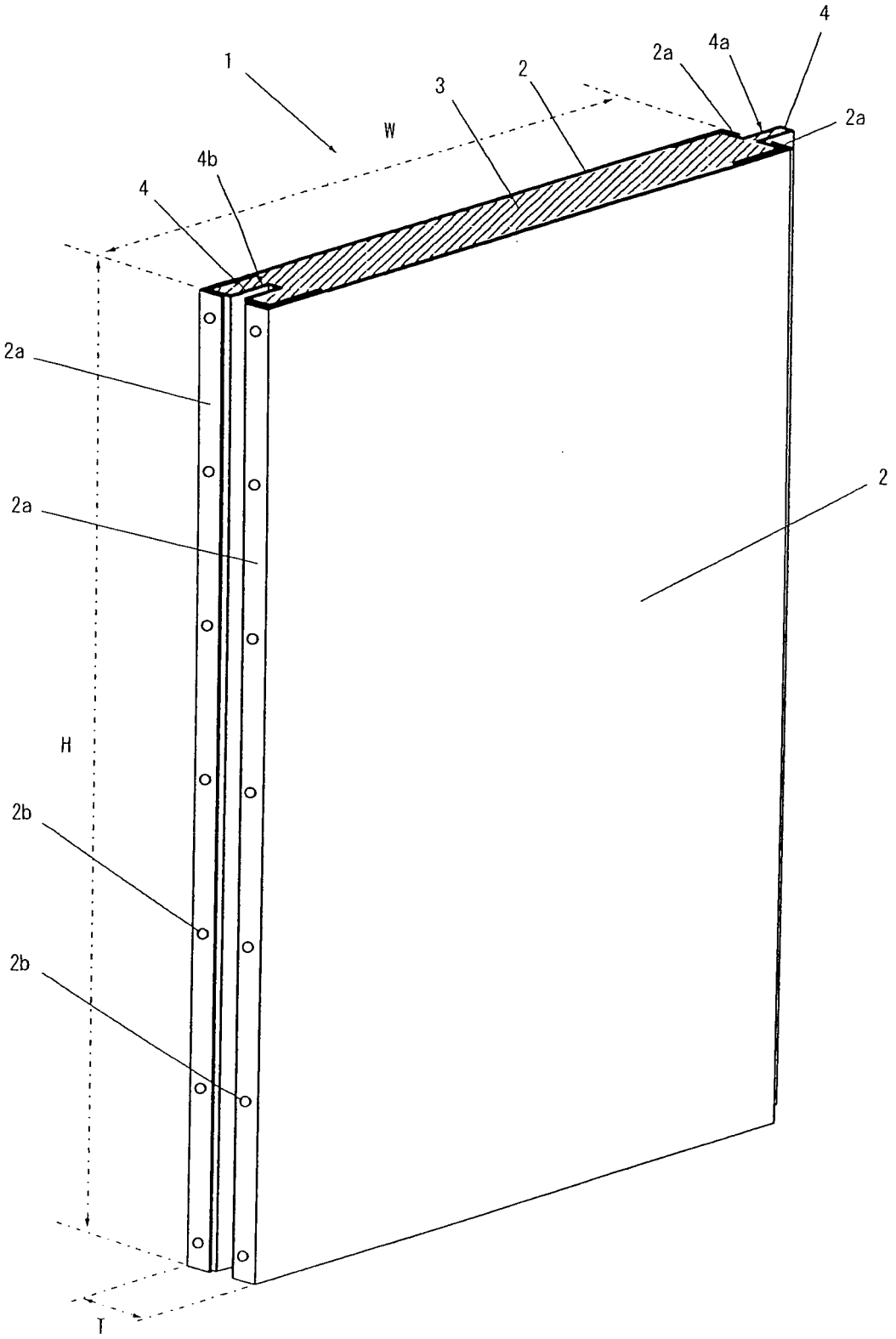
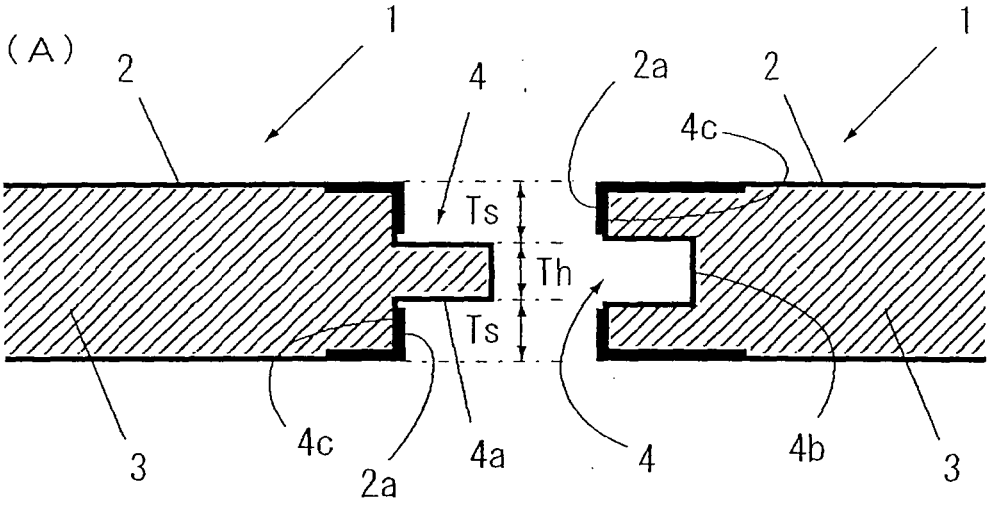


Fig. 2



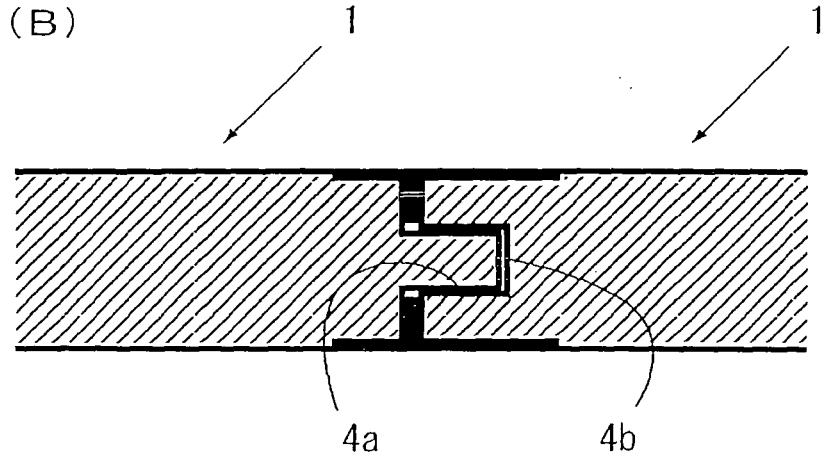


Fig. 3

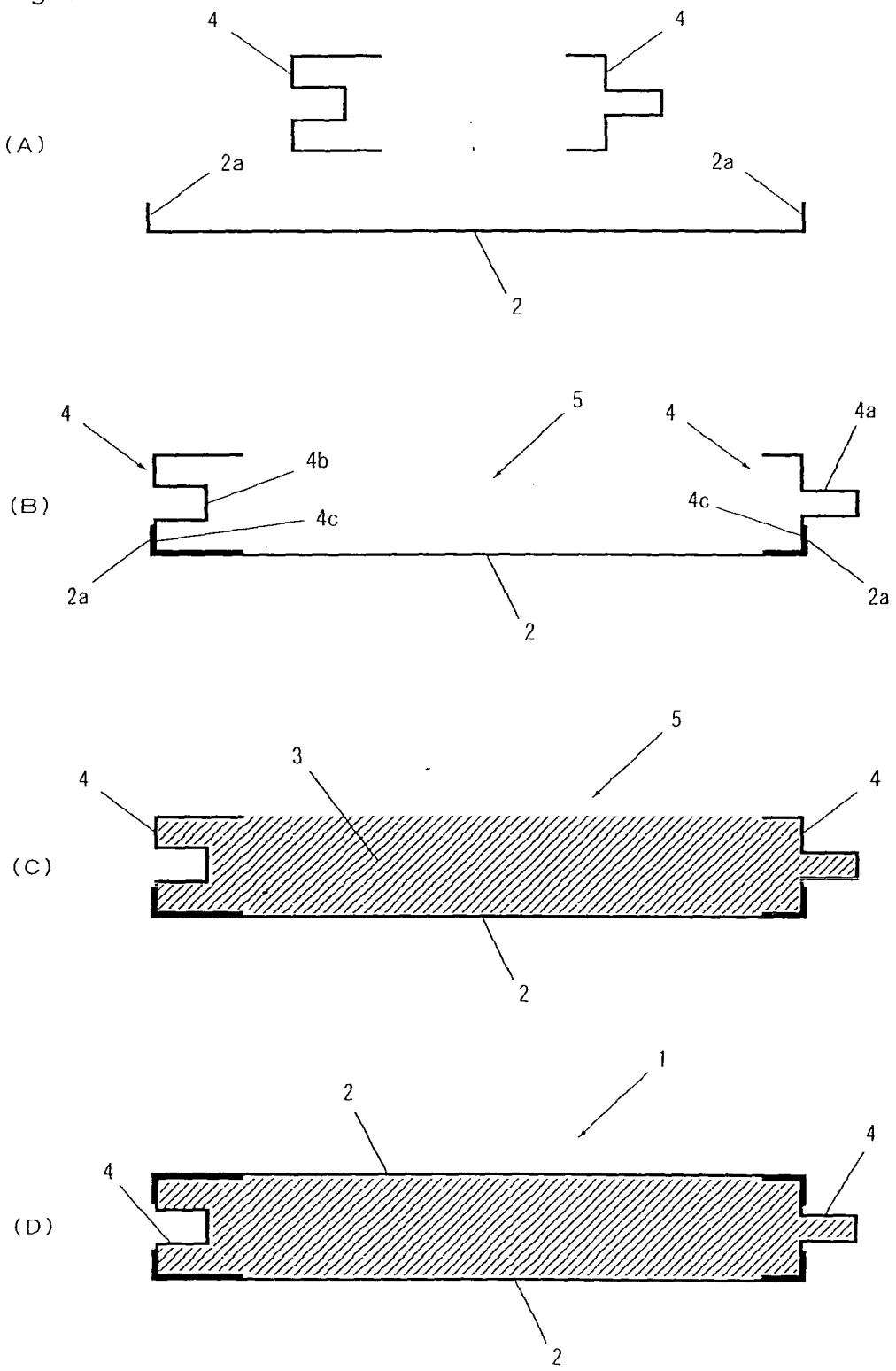


Fig. 4

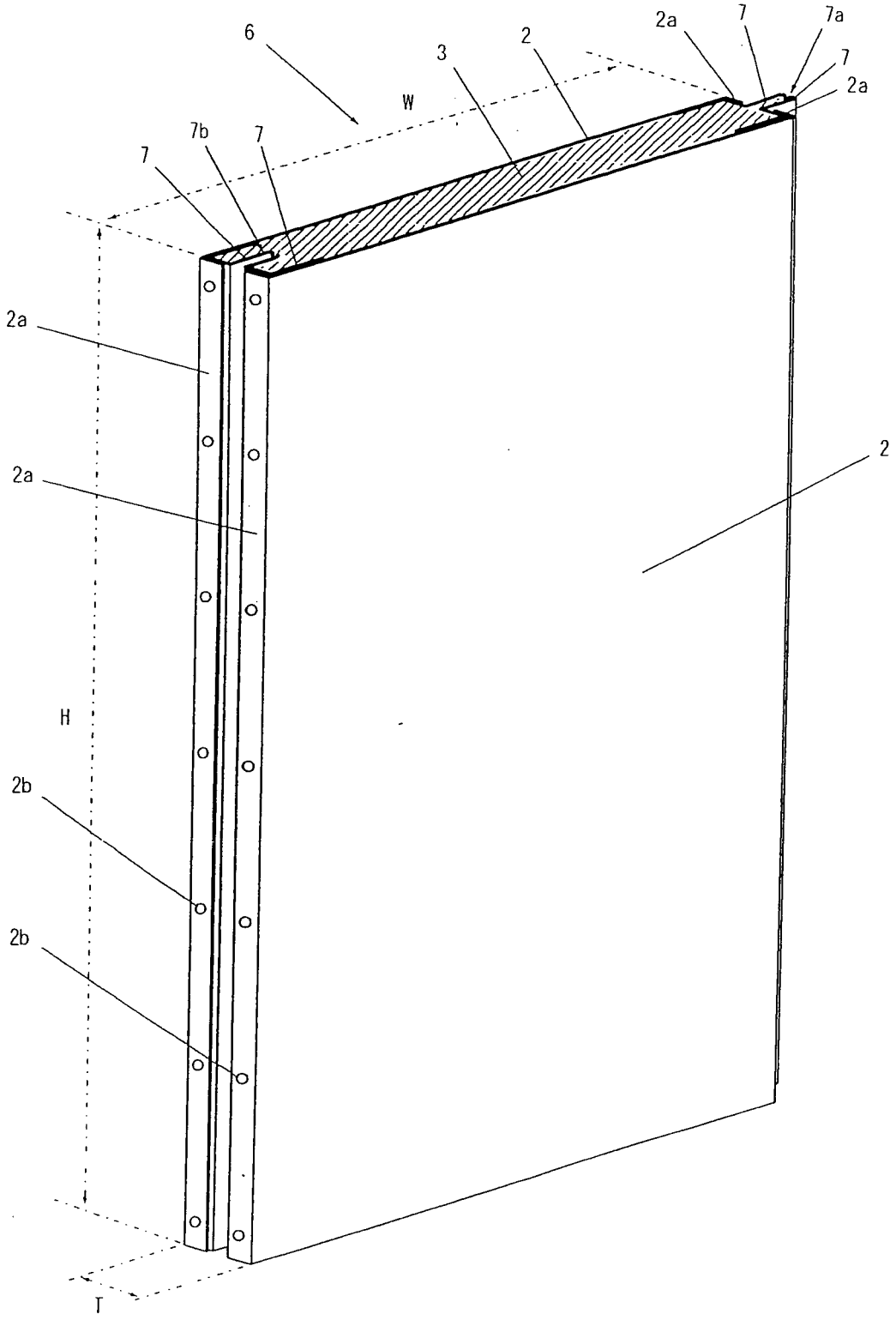
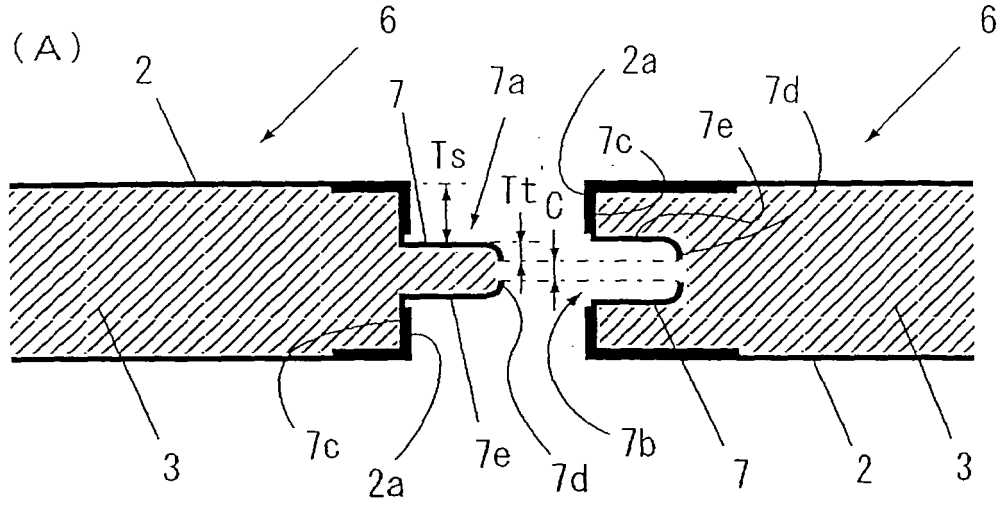


Fig. 5



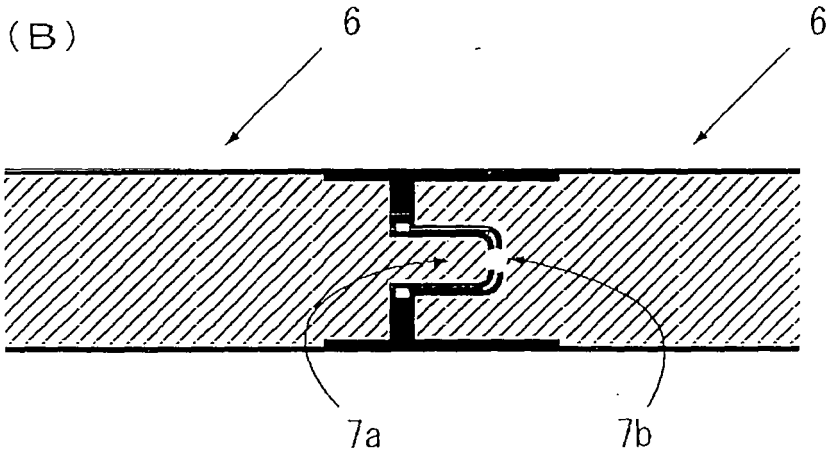


Fig. 6

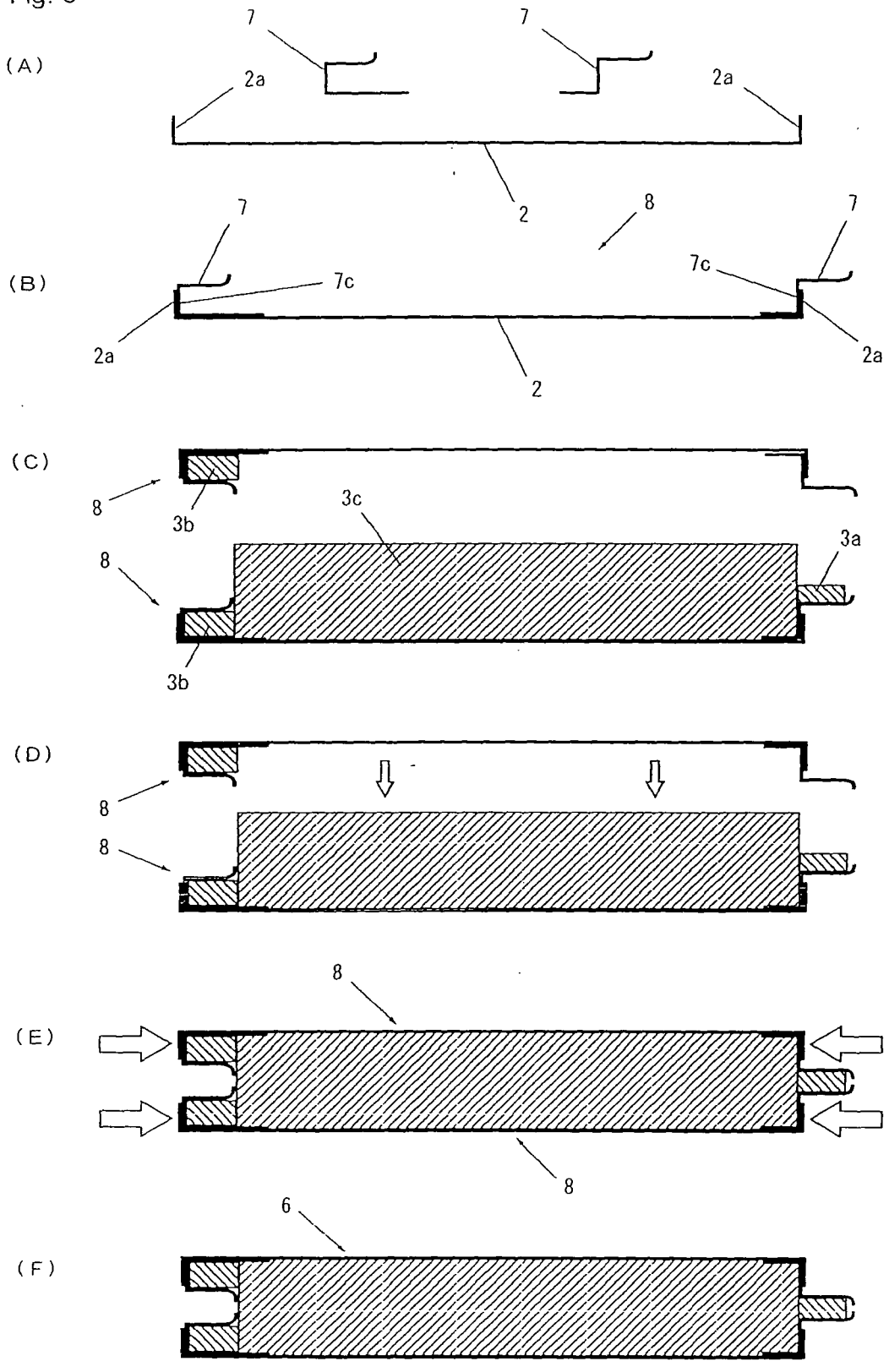


Fig. 7

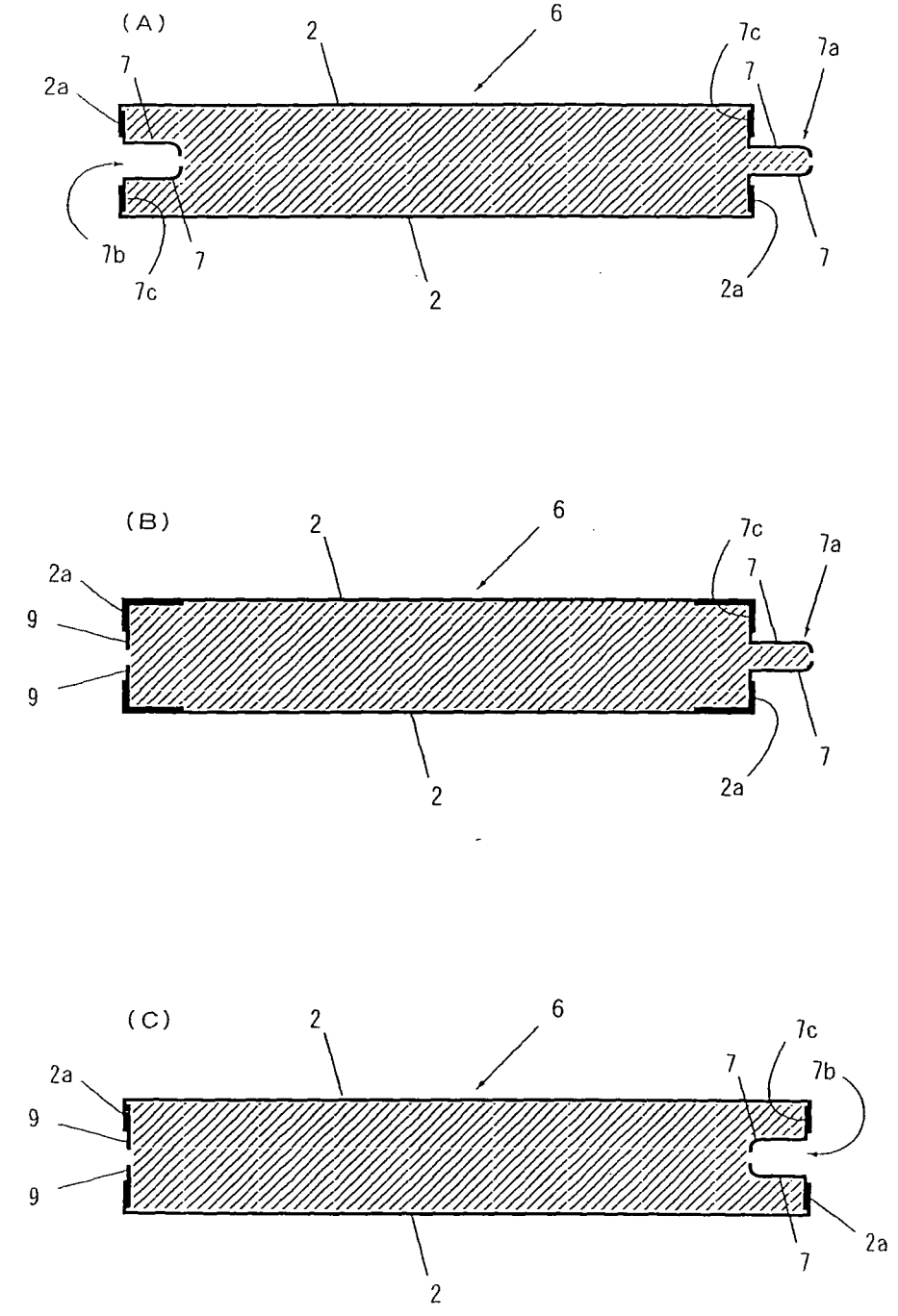

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Fig. 8

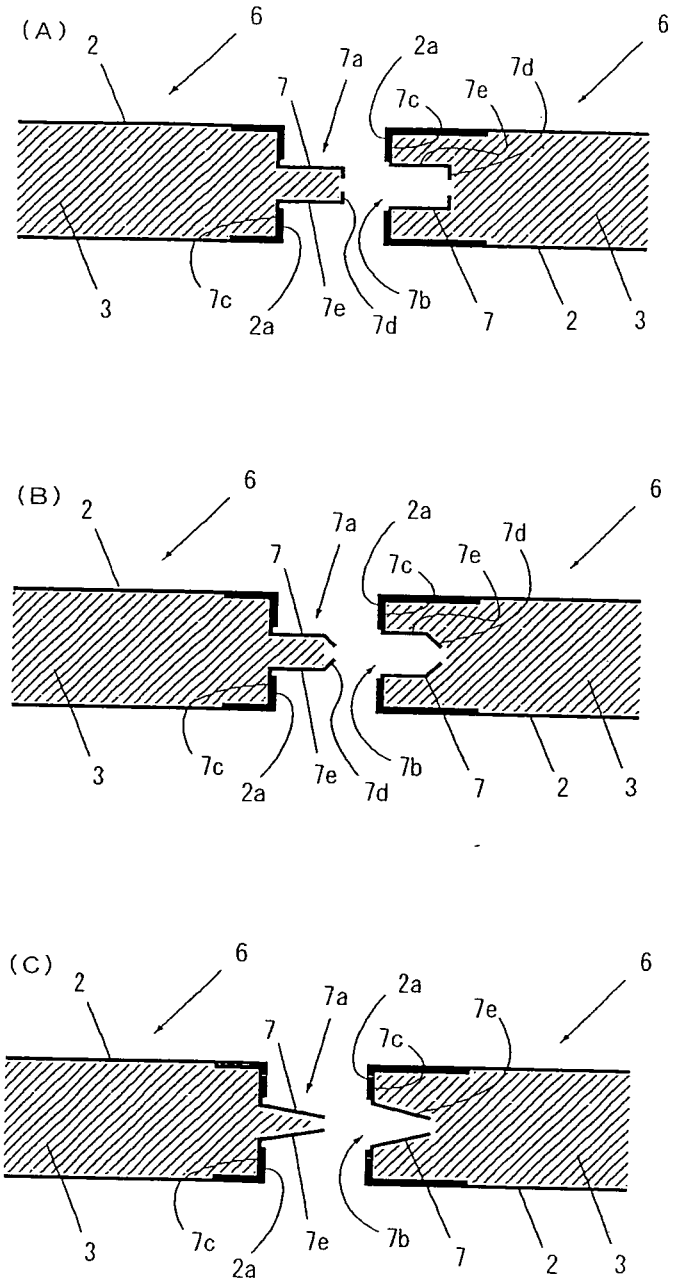
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Fig. 9

Prior Art (Wall panel in a flat-plate joint system)

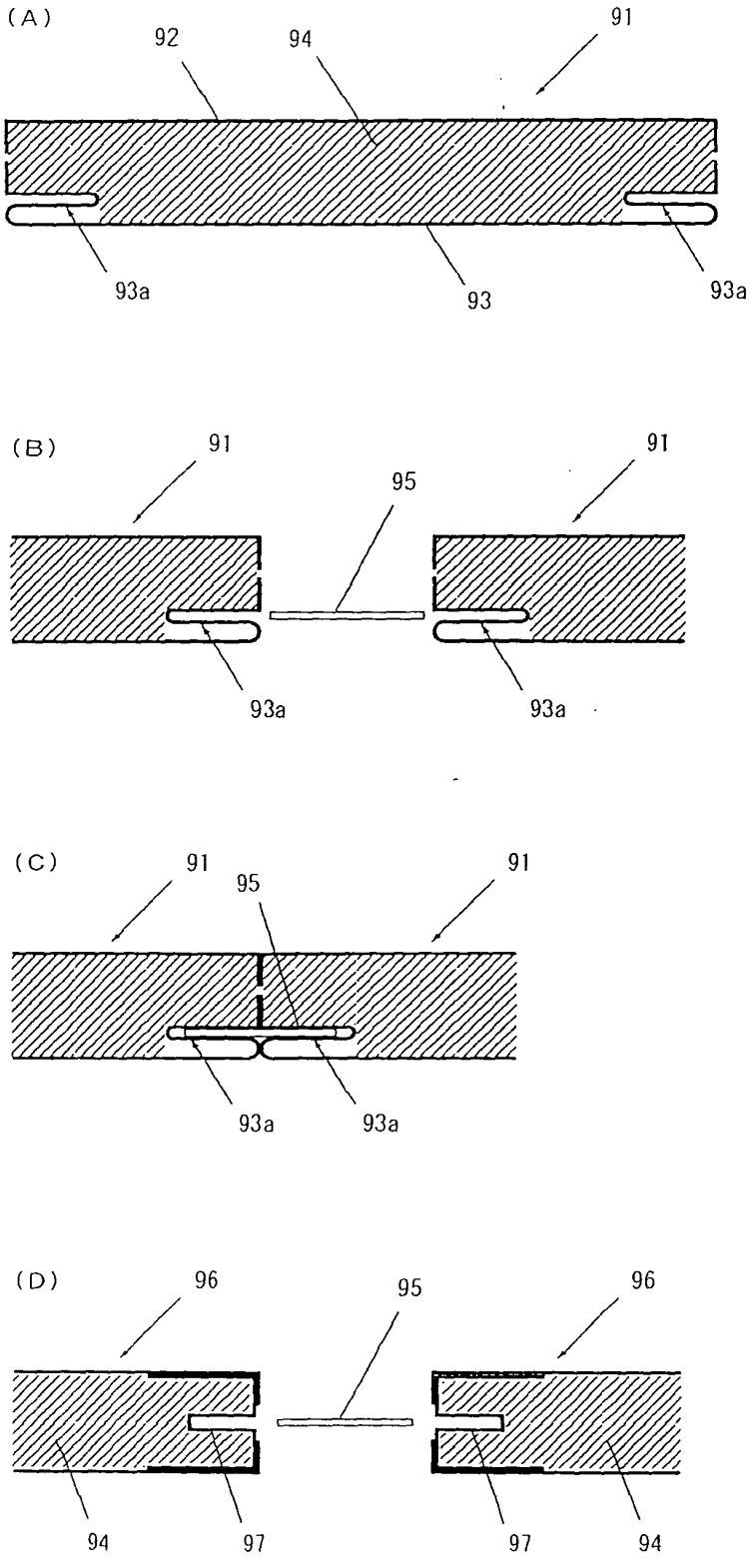
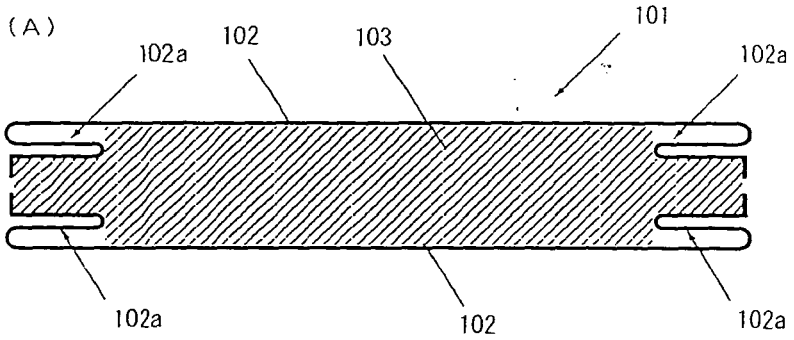
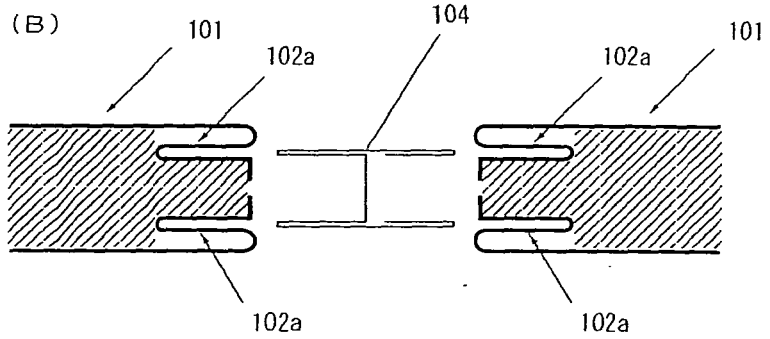


Fig. 10

Prior Art (Wall panel in a H-shaped joint system)





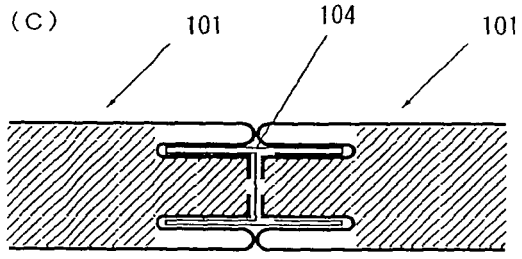
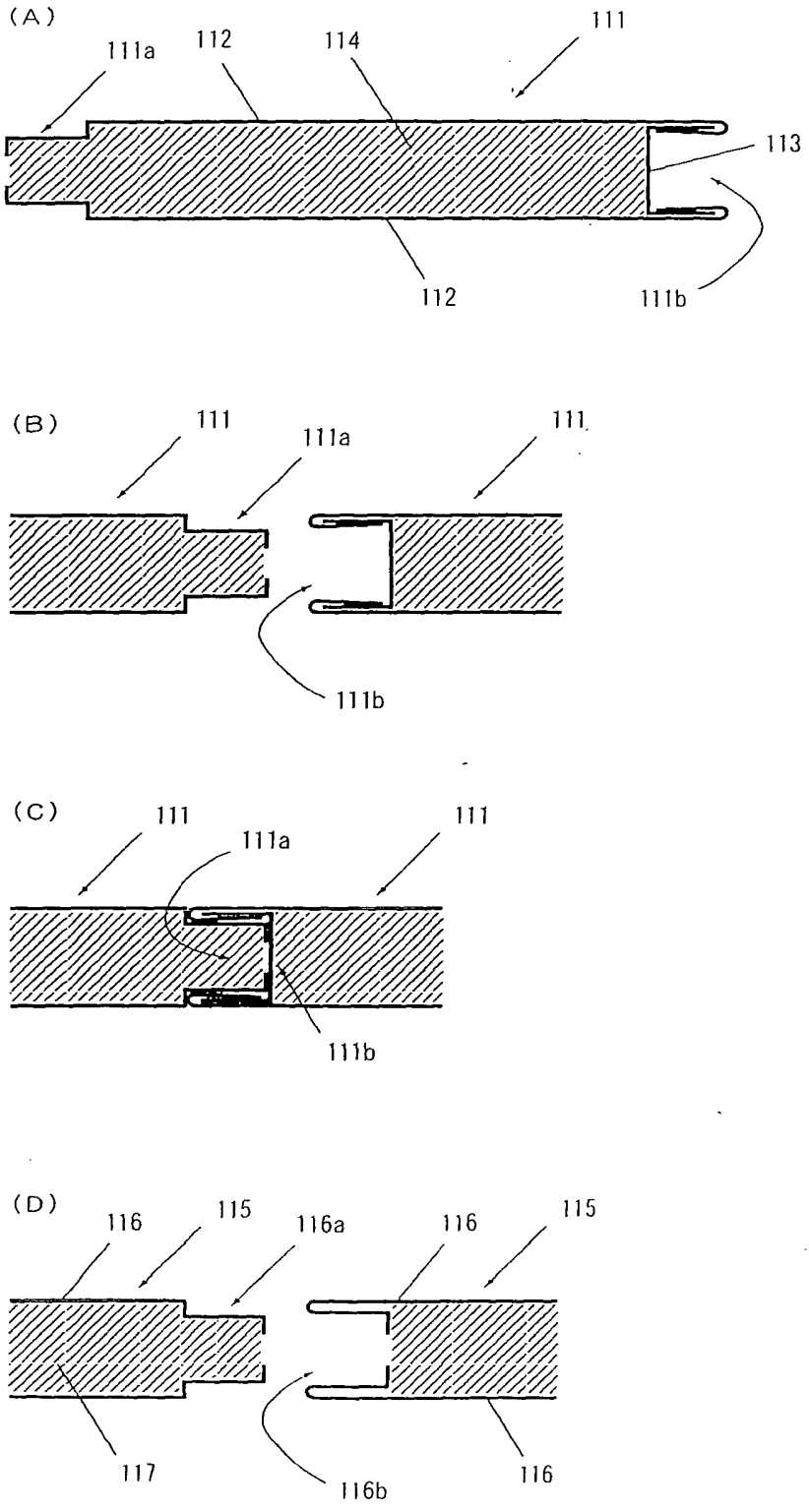


Fig. 11

Prior Art (Wall panel in a jointless system)



INTERNATIONAL SEARCH REPORT

International application No.
PCT/JP2007/073360

A. CLASSIFICATION OF SUBJECT MATTER
E04C2/30(2006.01)i, *B63B29/02*(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)
E04C2/00-2/54, B63B29/02, E04B2/56-2/96

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.
A	JP 2584464 Y2 (Nippon Light Metal Co., Ltd.), 05 November, 1998 (05.11.98), Figs. 1 to 6 (Family: none)	1-9
A	JP 3505527 B2 (Sumitomo Metal Steel Products Inc.), 08 March, 2004 (08.03.04), Figs. 1 to 4 (Family: none)	7
A	JP 3021342 B2 (Daido Kohan Kabushiki Kaisha), 15 March, 2000 (15.03.00), Figs. 2 to 4 (Family: none)	8,9

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

* Special categories of cited documents:
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"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
19 December, 2007 (19.12.07)	08 January, 2008 (08.01.08)
Name and mailing address of the ISA/ Japanese Patent Office Facsimile No.	Authorized officer Telephone No.

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- JP S6035688 B **[0004]**
- JP H04353140 B **[0008]**
- JP H07217064 B **[0008]**