(12) INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(19) World Intellectual Property Organization
International Bureau

(43) International Publication Date
19 April 2007 (19.04.2007)

PCT

(10) International Publication Number
WO 2007/042031 A2

(51) International Patent Classification:
*E06B 3/74* (2006.01) *E04B 2/74* (2006.01)

(21) International Application Number:
PCT/DK2006/000555

(22) International Filing Date: 5 October 2006 (05.10.2006)

(25) Filing Language: English

(26) Publication Language: English

(30) Priority Data:
PA 2005 01402 7 October 2005 (07.10.2005) DK

(71) Applicant *(for all designated States except US)*: **VKR HOLDING A/S** [DK/DK]; Tobaksvejen 10, 2860 Søborg, DK-2860 Denmark (DK).

(72) Inventor; and
(75) Inventor/Applicant *(for US only)*: **CHRISTENSEN, Jørn, Bjerg** [DK/DK]; Østertorp 58, Gjellerup, DK-7400 Herning (DK).

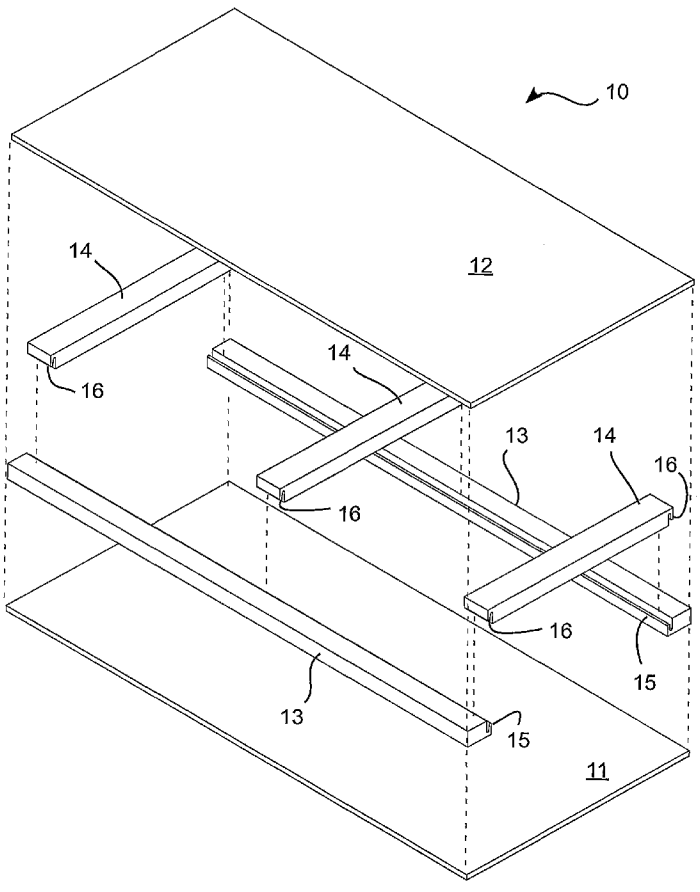
(74) Agent: **ZACCO DENMARK A/S**; Hans Bekkevolds Allé 7, DK-1900 Hellerup (DK).

(81) Designated States *(unless otherwise indicated, for every kind of national protection available)*: AE, AG, AL, AM, AT, AU, AZ, BA, BB, BG, BR, BW, BY, BZ, CA, CH, CN, CO, CR, CU, CZ, DE, DK, DM, DZ, EC, EE, EG, ES, FI, GB, GD, GE, GH, GM, HN, HR, HU, ID, IL, IN, IS, JP, KE, KG, KM, KN, KP, KR, KZ, LA, LC, LK, LR, LS, LT, LU, LV, LY, MA, MD, MG, MK, MN, MW, MX, MY, MZ, NA, NG, NI, NO, NZ, OM, PG, PH, PL, PT, RO, RS, RU, SC, SD, SE, SG, SK, SL, SM, SV, SY, TJ, TM, TN, TR, TT, TZ, UA, UG, US, UZ, VC, VN, ZA, ZM, ZW.

(84) Designated States *(unless otherwise indicated, for every kind of regional protection available)*: ARIPO (BW, GH, GM, KE, LS, MW, MZ, NA, SD, SL, SZ, TZ, UG, ZM, ZW), Eurasian (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), European (AT, BE, BG, CH, CY, CZ, DE, DK, EE, ES, FI, FR, GB, GR, HU, IE, IS, IT, LT, LU, LV, MC, NL, PL, PT, RO, SE, SI, SK, TR), OAPI (BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW, ML, MR, NE, SN, TD, TG).

*[Continued on next page]*

(54) Title: A PANEL ELEMENT AND A METHOD OF MANUFACTURING A PANEL ELEMENT




(57) Abstract: A panel element (10, 20, 30), such as a door, comprising a frame of the kind comprising a number of interconnected frame elements (13, 14, 21, 22, 31, 32), a number of said frame elements being formed with at least one connection element (15, 16, 23, 24, 33, 34) and at least one sheet element (11, 12) fastened to the frame. The connection elements are furthermore of a form such that two corresponding connection elements are connectable during assembly by relative motion towards each other along a direction vector which is arranged at an angle θ to the normal vector of the panel element, said angle θ being between 0° and 60°. In this way, a strong and tight connection is established between frame elements. In addition, the form of the connection elements provides for a quick method of assembly.

WO 2007/042031 A2

**Published:**

— *without international search report and to be republished upon receipt of that report*

*For two-letter codes and other abbreviations, refer to the "Guidance Notes on Codes and Abbreviations" appearing at the beginning of each regular issue of the PCT Gazette.*

# A panel element and a method of manufacturing a panel element

The current invention relates to a panel element, such as a door. The panel element comprises a frame of the kind comprising a number of interconnected frame elements and at least one sheet element fastened to the frame. A number of said frame elements are furthermore formed with at least one connection element, said connection elements being connectable to corresponding connection elements of other frame elements. The current invention also relates to a method of assembling a panel element of this kind.

Panel elements of this kind are often used as doors. Therefore, in the following, the examples will be of doors. However, the scope of the invention should not be limited to doors, but should extend to other panel elements which can make use of the teachings of the current invention.

GB 2293853 discloses an example of such a panel element, in this case a door, wherein the frame elements are brought into contact with each other and then fastened together by a staple. The staples however do not result in a very strong connection between the frame elements since the actual connection is only a point connection. In addition, in doors of this kind, the connection between the frame elements is often not very tight, and a gap can result between the frame elements. In this case, for example water and/or cold air can seep into the door. This can lead to poor thermal properties and/or to the destruction of the door.

If a stronger and/or tighter connection is desired, the techniques from frame doors are often used. These techniques are shown in for example US 6,487,827 and EP 0023807. In these two documents doors are disclosed in which the frame elements have corresponding male and female connection elements which are pressed into each other. In this way, a much stronger and tighter connection can be established.

One problem with the above mentioned frame type doors is that the frame elements are connected by motion of the frame elements towards each other along a direction which is parallel to the plane of the door. This means that the frame must be assembled first, then the panels glued on, and then structure is pressed. This adds an extra step to the assembly method. This results in a long and expensive process.

Another problem with the above mentioned frame type doors is that the connection between two frame elements is established with a male part on a first connection element and a female part on a second connection element. This means that two tool setups are required, one for making the male part and one for making the female part. In the case where a frame element is connected to more than one other frame element, the frame element must go to both tool setups.

A first aspect of the current invention is therefore to provide a door which can be assembled quickly and with few steps.

A second aspect of the current invention is to provide a door as mentioned in the opening paragraph which requires reduced tooling.

A third aspect of the current invention is to provide a door where the connections between frame elements are strong and tight.

The current invention seeks to solve the above mentioned aspects in part by providing connection elements which are of a form such that two corresponding connection elements are connectable during assembly by relative motion towards each other along a direction vector which is arranged at an angle $\theta$ to the normal vector of the panel element, said angle $\theta$ being between $0^\circ$ and $60^\circ$. In this way a strong and tight connection is established between inter-

connected frame elements. In addition, the connections are quick and easy to assemble.

In a preferred embodiment, the angle θ can be essentially 0°. This provides for a simpler assembly jig and a simpler method of assembly. Furthermore, in another preferred embodiment, essentially all of said frame elements can be assembled along the same direction vector.

Another advantage of the above construction is that the directions of the forces which are required during assembly are limited to forces which are along a single direction vector. This reduces the demands made to the assembly jig. In contrast, a frame door according to the prior art requires forces during assembly in at least two directions which are orthogonal to each other.

In a preferred embodiment, the connection elements can be made in the form of flanges arranged on the sides of frame elements. Advantageously, at least a part of the flanges can be essentially perpendicular to the plane of the panel element. In this way, it is easy to assemble the frame elements in a vertical direction.

Two interconnected frame elements can furthermore be connected together with oppositely facing flanges. In this way, a strong and tight connection is established.

By making the flanges of two interconnected frame elements essentially identical, the costs and the logistics of the manufacturing process can be reduced.

In addition, at least a part of the flange can be tapered. This makes assembly even easier since the frame elements will better align themselves without there being a need for very high accuracy.

The panel element according to the invention can be assembled in a method which comprises the steps of: placing a first set of frame elements on a first sheet element, placing a second set of frame elements on said first sheet element in a direction perpendicular to the plane of said first sheet element, whereby a number of frame elements of said second set of frame elements interconnect with a number of frame elements of said first set of frame elements, and fastening a second sheet element to the first and second set of frame elements. This method results in a fast and simple process.

In a preferred embodiment, the panel element can be arranged in a press and pressed at the end of the assembling process. This can increase the strength of the connections between the elements of the panel element.

In order to form the connection elements, a profile can be cut into at least one side of the connectable frame elements before the frame elements are assembled. In this way, the connection elements can be arranged in a custom manner, allowing for many different forms of panel elements to be produced.

The invention will now be described in more detail with reference to the attached figures which show example embodiments of panel elements according to the current invention.

Figure 1 shows a front view of a first embodiment of a door.

Figure 2 shows a perspective exploded view of the first embodiment.

Figure 3 shows a cross section view through one of the corners of the door shown in figures 1 and 2 and according to the section line shown in figure 1.

Figure 4 shows a front view of a second embodiment of a door.

Figure 5 shows a perspective exploded view of the second embodiment.

Figure 6 shows a front view of a third embodiment of a door.

Figure 7 shows a perspective exploded view of the third embodiment.

Figures 8-10 show three different embodiments of connection elements according to the invention.

Figure 11 shows another type of connection element according to the invention.

Figure 12 shows another type of connection element which is assembled at an angle to the panel's normal vector.

Figures 1-3 show some different views of a first embodiment 10 of a panel element according to the current invention. In this case, the panel element is a door.

The door 10 comprises a first sheet element 11, a second sheet element 12, two vertical frame elements 13 and three horizontal frame elements 14. As can be seen in figure 2 and 3, the frame elements 13,14 are cut with a profile 15 along at least one side. This profile forms a connection element 15,16 which can be connected to a corresponding connection element 16,15 of another frame element 14,13. Note that the second sheet element 12 has been hidden in Figure 1 so that the inner details of the door 10 can be seen.

Figure 3 shows a section view through one corner of the door thereby showing more details of the two interconnected frame elements. The connection element 15 comprises a tapered flange 17 arranged on one side of the vertical frame element 13. The tapered flange 17 is essentially perpendicular to

the plane of the door 10 and extends in an upwards direction (as defined by figure 3). A corresponding connection element 16 is arranged on the end of the horizontal frame element. This connection element 16 comprises a tapered flange 18 which is essentially perpendicular to the plane of the door 10 and extends in a downwards direction (as defined by figure 3). The two connection elements 15,16 are identical and can therefore be inserted into each other as shown by figure 3.

The flanges 17,18 are formed by cutting a profile into the side of the frame element 13,14 with a cutting element. The profile is cut along a direction which is essentially parallel to the side of the frame element 13,14. The person skilled in the art should be easily able to cut a profile into a frame element as shown in the figures, therefore more details of the cutting operation won't be provided here.

As can be seen in figure 3, the cross section through the connection elements 15,16 show that the profile of a connection element 15,16 is in the form of a hook which can be connected with a corresponding hook facing the opposite way.

In the current embodiment 10, the connection elements 15,16 of all the frame elements 13,14 are the same and are cut using the same cutting element. In this way, the cost of tooling is greatly reduced. In addition, the logistics of the manufacturing process are reduced since all the profiles of all the connection elements are identical. The resulting joint is also quite strong, since both connection elements are equally strong.

Figure 2 shows details of how the door is assembled. In a first step, the first sheet element 11 is arranged on a table or other support surface (not shown). Glue is applied to the first sheet element 11 on the upwardly facing side. The glue could be applied in a separate machine before the sheet is

arranged on the support surface. The glue could also be applied once the first sheet has been arranged on the support surface.

A first set of frame elements, in this case the vertical frame elements 13, are then arranged on the first sheet element 11. Due to the glue, the frame elements are all placed on the sheet element in a direction which is perpendicular to the plane of the sheet element.

The vertical frame elements are all arranged with their connection elements 15 facing upwards. The second set of frame elements 14, in this case the horizontal frame elements 14, are then placed on the sheet element 11. The horizontal frame elements 14 are arranged with their connection elements 16 pointing downwards. In this way, the downwardly facing flanges 18 of the horizontal frame elements are engaged with the upwardly facing flanges 17 of the vertical frame elements 13. In case a stronger connection is desired, glue could also be applied to the connection elements 15,16 of the vertical 13 and/or the horizontal 14 frame elements.

Once the horizontal frame elements 14 have been arranged in place, the second sheet element 12 is fastened to the frame elements 13,14. As before, glue is used to fasten the second sheet element to the frame elements 13,14. The glue could again, either be applied directly to the frame elements 13,14 or it could be applied to the second sheet element 12 before it is arranged on the frame elements 13,14.

The entire structure is then placed in a press and pressed, thereby securely fastening all the elements 11,12,13,14 together.

The assembled door can then be further processed, for example the outline of the door can be machined, openings for windows, locks and other hardware, can be created and so on.

Due to the tapered shape of the flanges, the frame elements will align themselves with respect to each other and are therefore easy to assemble without requiring very high accuracy.

Before assembling the door, connection elements 15,16 are cut into the frame elements 13,14 as previously described. The arrangement of the connection elements 15,16 can be chosen dependent on the desired door type.

The door 10 shown in figures 1-3 is just one example embodiment of a panel element according to the current invention. Figures 4-5 and figures 6-7 show two other example embodiments 20,30 of a panel element according to the invention.

The second embodiment 20 of a door shown in figures 4 and 5 is very similar to the first embodiment 10 of a door shown in figures 1-3, therefore the same reference numerals will be used for the same elements. As in figure 1, the second sheet element 12 has been hidden in figure 4 in order to show the internal details of the door.

The second embodiment 20 comprises a first sheet element 11, a second sheet element 12, two vertical frame elements 13, a set of horizontal frame elements 14,21 and an additional vertical frame element 22 in the lower section of the door 20. The addition vertical frame element 22 increases the strength of the lower section of the door 20. As can be seen from figure 5, the two lower horizontal frame elements 21 comprise an extra upwardly facing connection element 23 in the form of a profile cut along their inwardly facing sides. These two connection elements 23 connect with the downwardly facing connection elements 24 cut into the ends of the additional vertical frame element 22.

The method of assembling the door 20 shown in figures 4 and 5 is almost identical to that of the method described with respect to the first embodiment 10, with the one change that an extra step is needed for placing the additional vertical frame member 22 in place. As before, the two vertical frame elements 13 are arranged on the first sheet element first, followed by the three horizontal frame elements 14,21, finally followed by the additional vertical frame element 22. As before, all the frame elements 13,14,21,22 are put in place via movement which proceeds along a direction which is perpendicular to the plane of the door 20.

As can be seen from the second embodiment 20 of a panel element according to the current invention, the frame elements can be arranged with connection elements on many different sides, thereby allowing the frame of the panel element to be customized for many different purposes.

Figures 6 and 7 show a third embodiment 30 of a panel element according to the current invention. As before, the third embodiment 30 shows a door which is very similar to the ones shown in figures 1-3 and figures 4-5. Therefore the same reference numerals will be used for the same items.

The door 30 comprises a first sheet element 11, a second sheet element 12, two vertical frame elements 13, three horizontal frame elements 14,31 and an additional horizontal frame element 32. The additional horizontal frame element 32 is connected with the lowermost horizontal frame element 31 in order to increase the strength of the lower most section of the door.

The method of assembling, as shown in figure 7, is very similar to the one described above. The only difference being that an extra step is required for arranging the additional horizontal frame element 32 in place.

As can be seen from figure 7, the lowermost horizontal frame element 31 has an extra upwardly facing connection element 33 on its inwardly facing side. This upwardly facing connection element 33 connects with a corresponding downwardly facing connection element 34 on the additional horizontal frame element 32.

It should be mentioned that the above described embodiments are very simple embodiments of doors. However, it should be obvious to the person skilled in the art that panel elements, such as the above described doors, could furthermore comprises other elements such as window panes, insulating elements, etc...

Furthermore, as mentioned previously, the above described embodiments have all been doors. However, other panel elements such as windows, wall elements, partitions, flooring, etc, could also be imagined according to the invention.

It should also be noted, that the above three embodiments described one particular profile of the connection element. However, the connection element could be formed in many different ways. Figures 8-10 show cross section views of three different embodiments of connection elements 40,50,60. These connection elements are all formed such that two interconnecting elements are identical. In this case, only one tool setup is required to form the connection elements.

Figure 11 shows a top view of another example 70 of a set of corresponding connection elements where a first connection element 71 is a female part and a second connection element 72 is a male part. Connections of this type can also be assembled in a direction which is perpendicular to the plane of the door. Two different tool setups are required for this type of connection.

Figure 12 shows a cross section view of two frame elements 81,82 with another type of connection element 83,84. In this case, the direction of assembly is at an angle θ to the normal vector of the panel element. The connection elements are therefore arranged at an angle.

It should also be obvious to the person skilled in the art, that the frame members are not limited to horizontal or vertical frame elements. Other frame elements could also be imagined. For example, frame elements could be imagined which are arranged at an angle, for example 45 degrees.

It should also be obvious to the person skilled in the art, that there is no limitation as to the number of frame elements which are connected together. For example, in the first embodiment 10, there are two sets of frame elements, one vertical set and one horizontal set. In the second embodiment 20 there are three sets of frame elements, a first set of vertical elements, a first set of horizontal elements and a second set of vertical elements. Other embodiments could also be imagined where more than two or three sets of frame elements are connected together.

It should furthermore be obvious to the person skilled in the art, that the method of assembling the doors as described above is just one example of a method within the scope of the invention. Other methods could also be imagined which are within the scope of the teaching of the current invention. For example, the door could be assembled in a number of different working stations. Or the door could be assembled in a different order than that described above.

Claims:

1. A panel element (10,20,30), such as a door, said panel element comprising:
   - a frame of the kind comprising a number of interconnected frame elements (13,14;21,22; 31,32), a number of said frame elements being formed with at least one connection element (15,16;23,24;33,34), said connection elements being connectable to corresponding connection elements (16,15;24,23;34,33) of other frame elements (14,13;22,21;32,31), and
   - at least one sheet element (11,12) fastened to the frame,

   **characterized** in that said connection elements are of a form such that two corresponding connection elements are connectable during assembly by relative motion towards each other along a direction vector which is arranged at an angle θ to the normal vector of the panel element, said angle θ being between 0° and 60°.

2. A panel element (10;20;30) according to claim 1, **characterized** in that the angle θ is essentially 0°.

3. A panel element (10;20;30) according to claim 1 or 2, **characterized** in that essentially all of said frame elements (13,14;21,22;31,32) are assembled along the same direction vector.

4. A panel element (10;20;30) according to claim 1, 2 or 3 **characterized** in that at least one of said connection elements (15,16;23,24;33,34) is in the form of a flange (17,18) arranged on a side of a frame element (14,13;22,21;32,31).

5. A panel element (10;20;30) according to claim 4 **characterized** in that at least a part of said flange (17,18) is essentially perpendicular to the plane of the panel element.

6. A panel element (10;20;30) according to claim 4 or 5, **characterized** in that two interconnected frame elements (13,14;21,22;31,32) are connected together with oppositely facing connection elements (15,16;23,24;33,34).

7. A panel element (10;20;30) according to any one of claims 4-6 **characterized** in that at least a part of said flange (17,18) is tapered.

8. A panel element (10;20;30) according to any one of claims 1-7 **characterized** in that the connection elements (15,16;23,24;33,34) of two interconnected frame elements (13,14;21,22;31,32) are essentially identical.

9. A method of manufacturing a panel element (10;20;30), such as a door, comprising the steps of:
   - placing a first set of frame elements (13) on a first sheet element (11),
   - placing a second set of frame elements (14;21,31) on said first sheet element along a direction vector which is at an angle θ to the normal vector of said first sheet element, whereby a number of frame elements of said second set of frame elements interconnect with a number of frame elements of said first set of frame elements,
   - fastening a second sheet element (12) to the first and second set of frame elements.

10. A method of manufacturing a panel element (10;20;30), such as a door, according to claim 9 **characterized** in that a profile (15,16;23,24;33,34) is cut into at least one side of the connectable frame elements (13,14;21,22;31,32) before the frame elements are assembled.

11. A method of manufacturing a panel element (10;20;30), such as a door, according to claim 10, **characterized** in that the tool used to cut the profile (15,16;23,24;33,34) of two connectable frame elements (13,14;21,22;31,32) is the same.

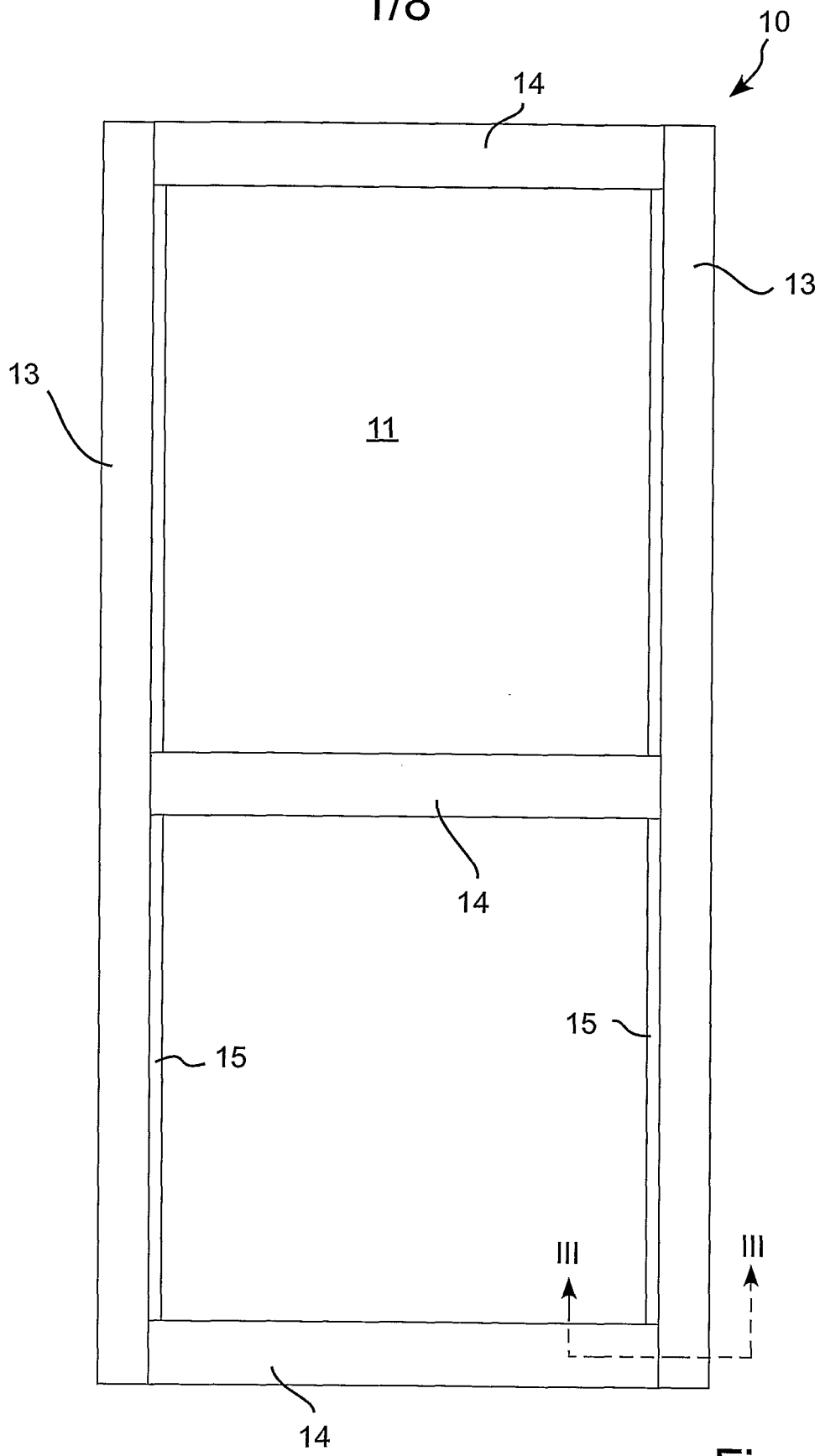



Fig. 1

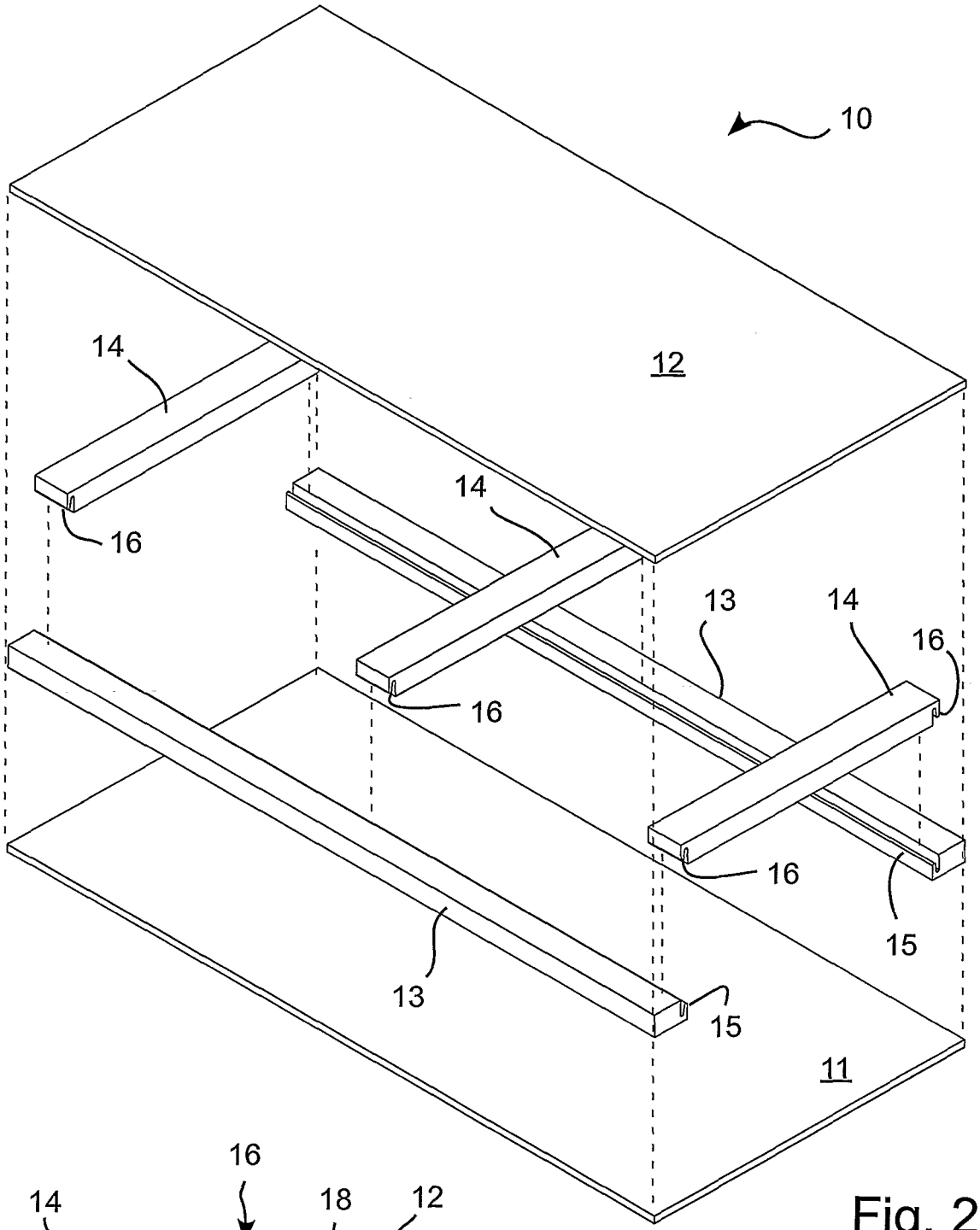



Fig. 2

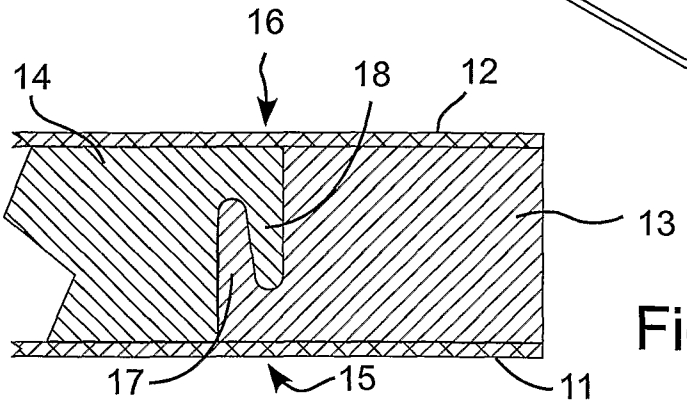



Fig. 3

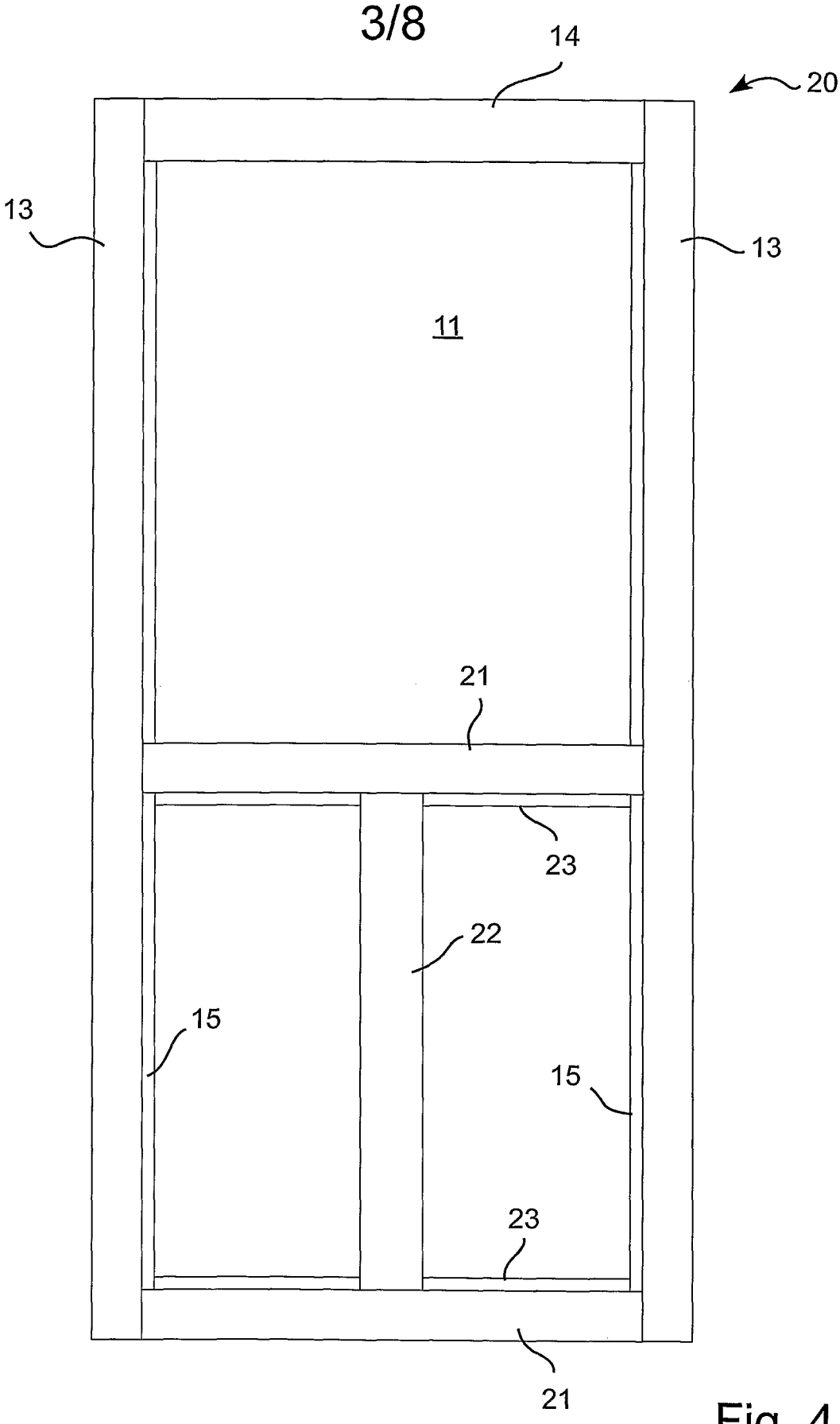



Fig. 4

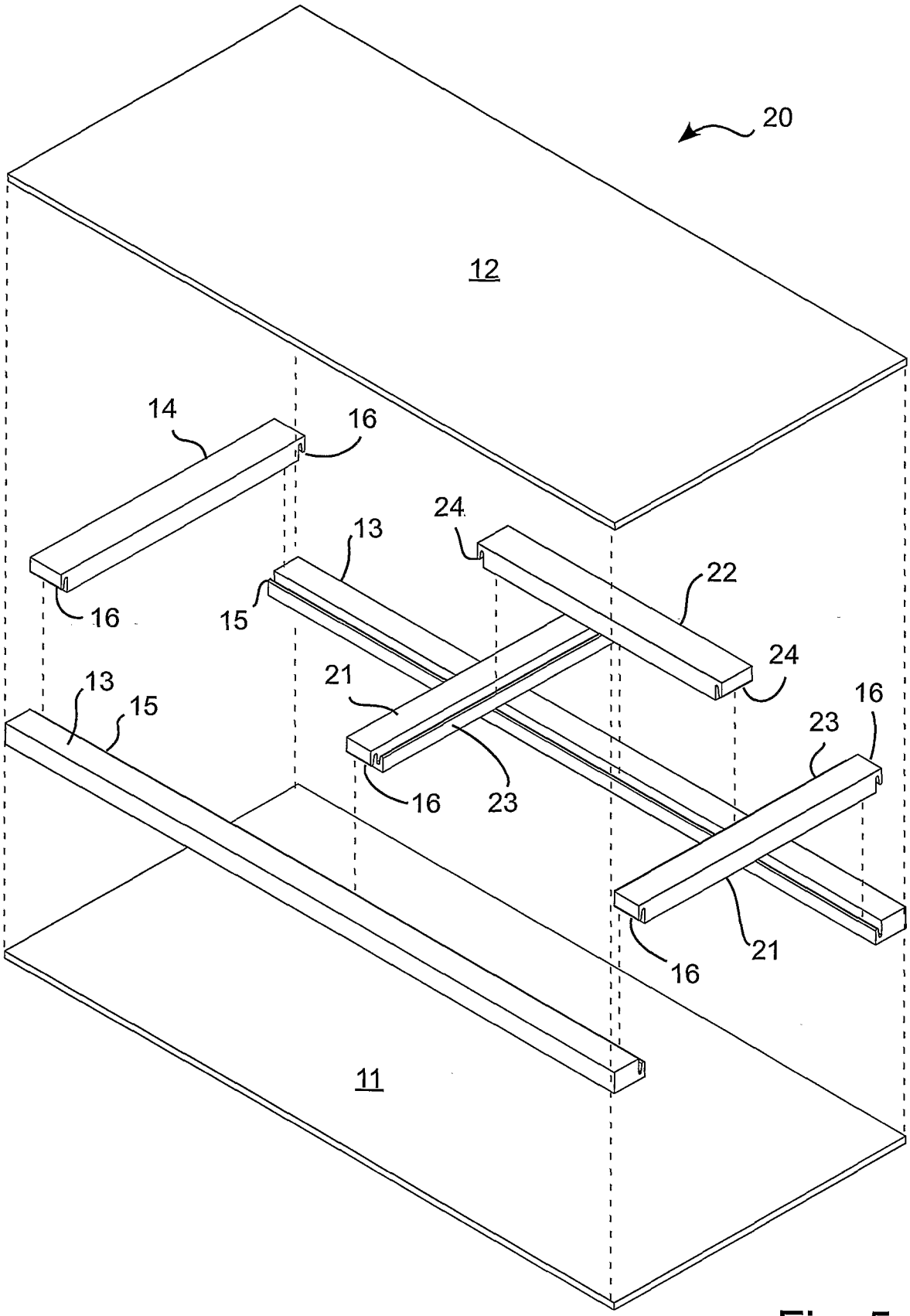



Fig. 5

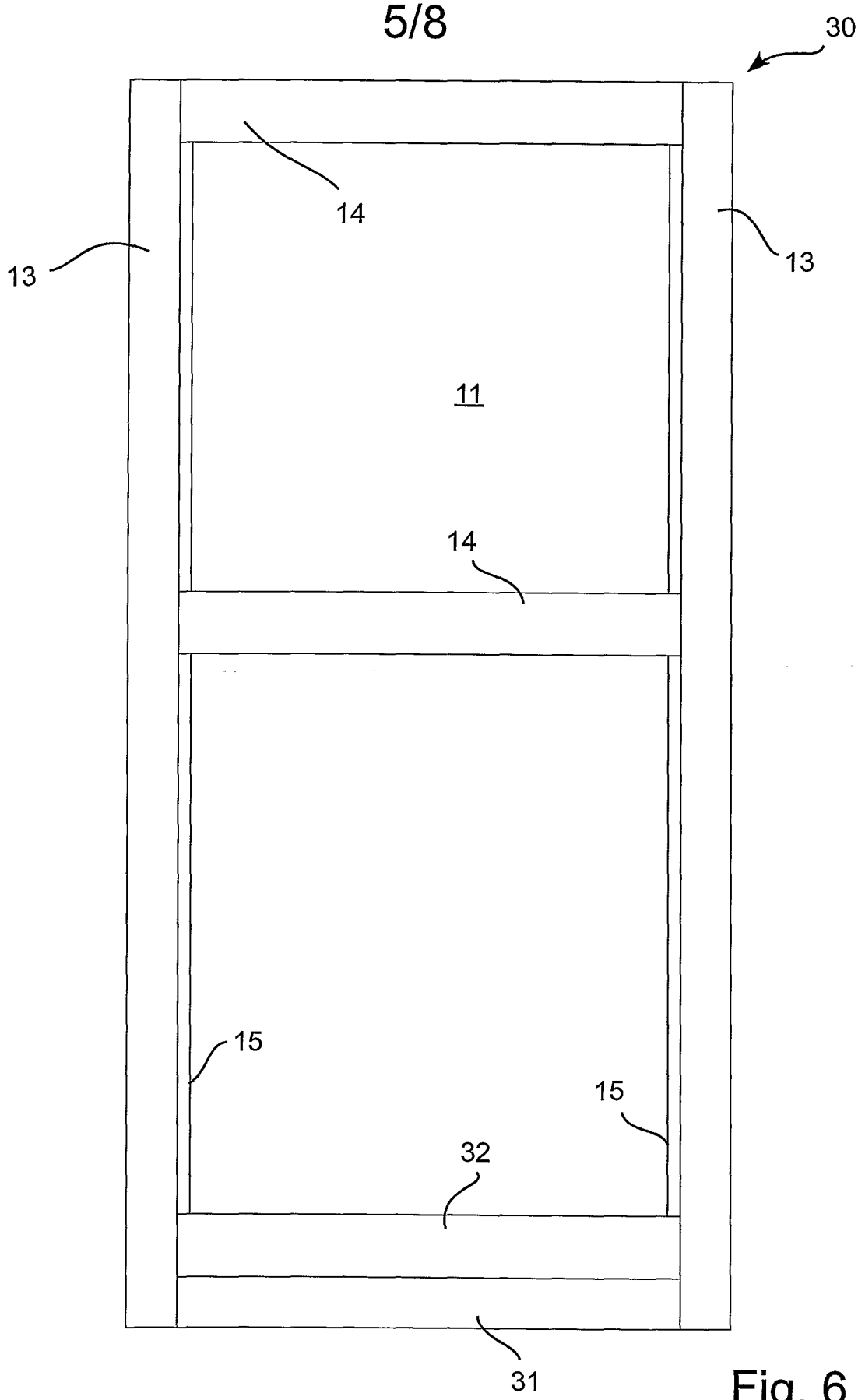



Fig. 6

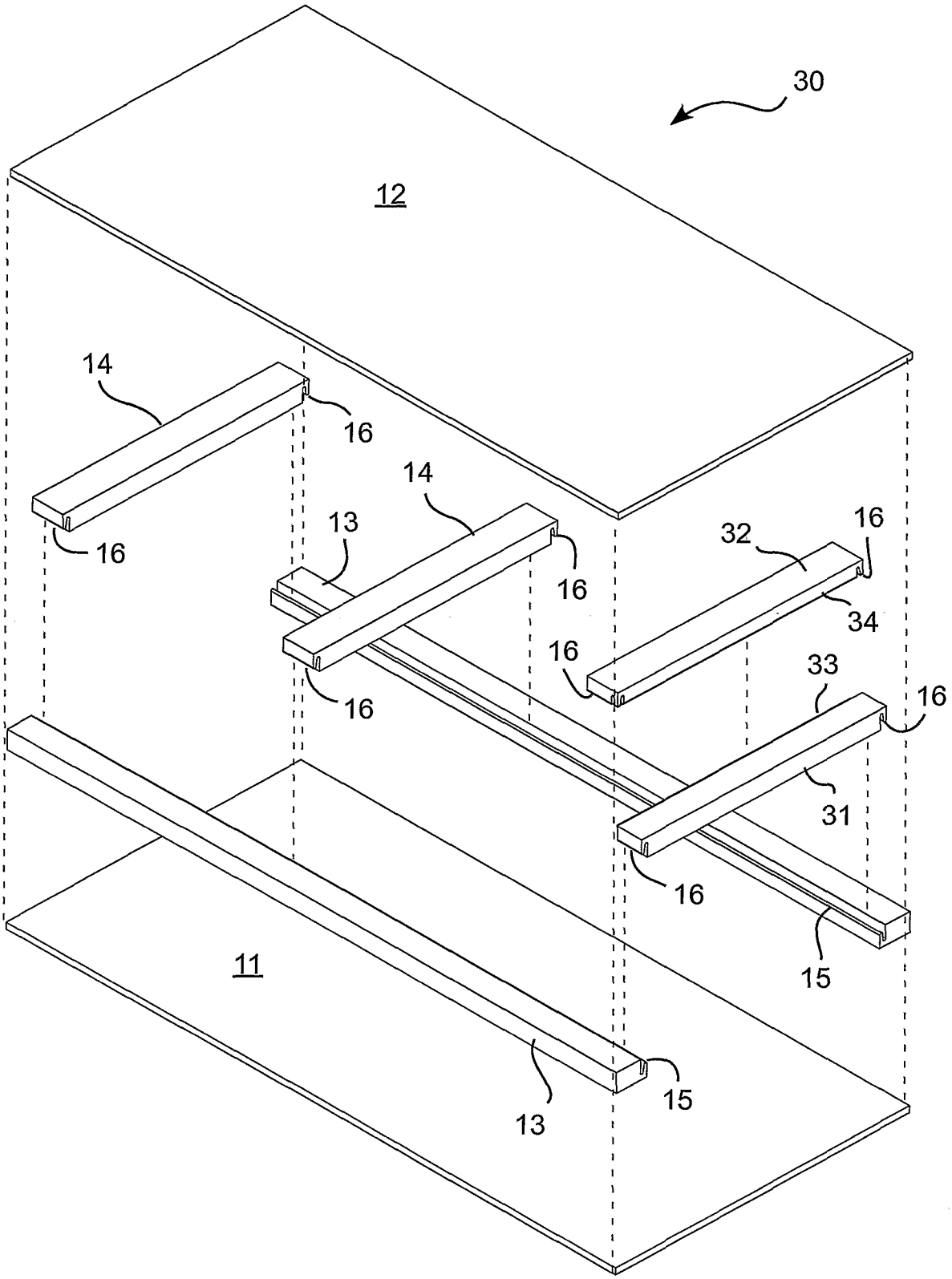



Fig. 7

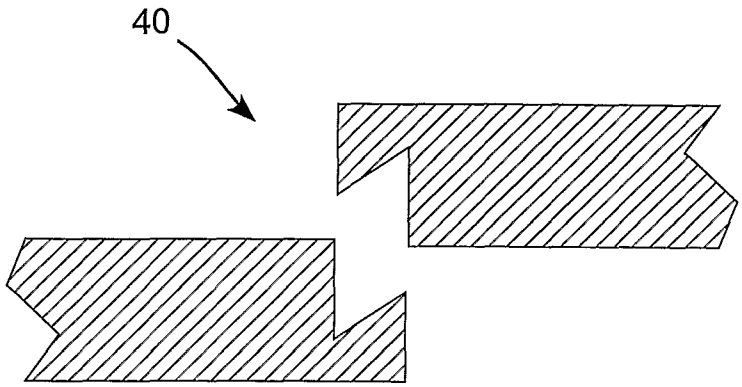



Fig. 8

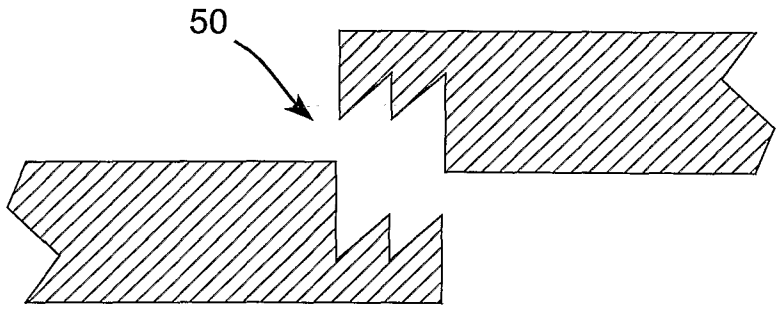



Fig. 9

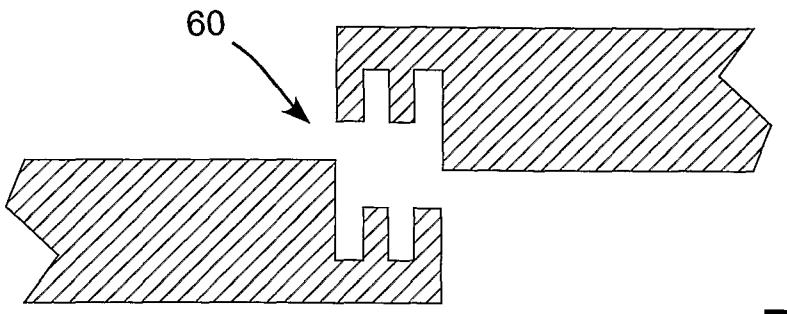



Fig. 10

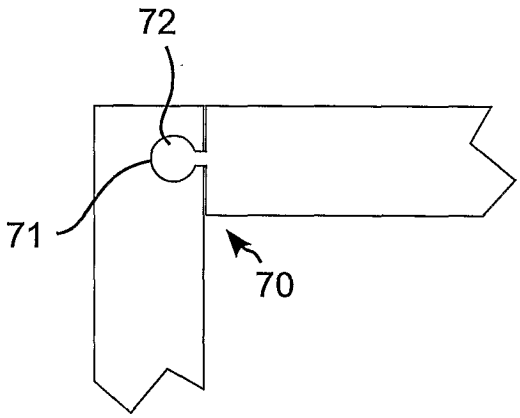



Fig. 11

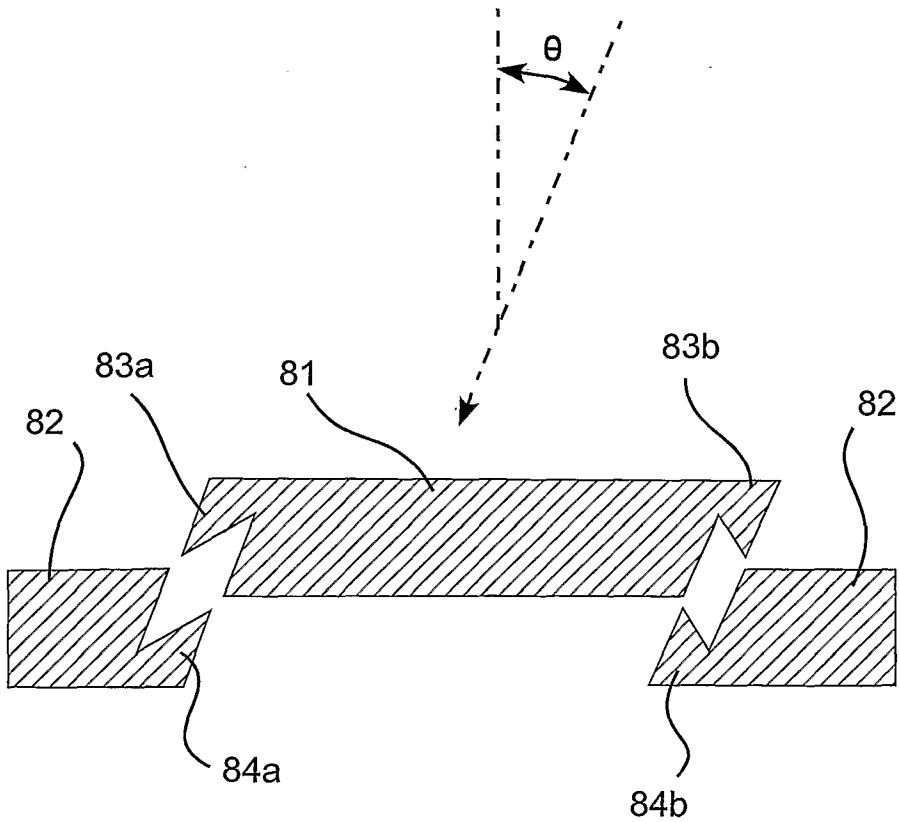



Fig. 12