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(54) Title: AN INSULATING PANEL

(57) Abstract: A fire resistant edge seal 100 for sealing a joint between adjacent panels 101, 102 is in the form of a sheet or tape and comprises a resin fabric prepreg backing layer 105 pre-bonded to a layer 106 of intumescent material. In a fire, phenolic resin in the prepreg bonds on to the foam on the foam surface at the panel edge. The prepreg cures to provide a thermal shield to the foam surface that it covers. The combination of a phenolic glass prepreg and an intumescent material provides substantially improved fire protection to the joints between adjacent panels.

"An insulating panel"

Introduction

The invention relates to an insulated panel of the type comprising an external sheet, an internal liner sheet and an insulating core between the external sheet and the liner sheet.

EP-A-1055513 and WO-A-00/73055 describe a composite honeycomb sandwich panel for use in aerospace applications comprising a honeycomb core structure with a first face and a second face located on opposite sides of the core structure. A face sheet is bonded to the faces of the core structure. The face sheet comprises a single ply sheet having an adhesive layer, a fire protection layer and a fiber layer between the adhesive and fire protection layers.

EP-A-0624462 also describes a composite sandwich panel with first and second honeycomb core layers.

There is a need for an improved panel which will facilitate a sealed joint between adjacent panels for improved fire resistance.

Statements of Invention

According to the invention there is provided a fire resistant edge seal for sealing a joint between adjacent panels or the like, the seal comprising a resin pre-impregnated fabric and a layer of intumescent material pre-bonded to the resin fabric. The resin is pre-impregnated into a woven or non-woven fabric. Such a resin pre-impregnated fabric may be referred to as a prepreg. This material combination is preferably placed on each edge of the panels to be joined with the prepreg face of the sealing material in direct contact with the foam surface at the panel edge. Hence after adjacent panels are

assembled together, the intumescent sides of the sealing materials are in contact with one another.

In a preferred embodiment of the invention the resin fabric prepreg is impregnated with a phenolic resin.

Preferably the fabric is of an inorganic fibre, ideally the fabric is of a glass fibre. In a preferred embodiment the fabric has a weight of from 75 to 1000g per square meter, preferably from 190 to 400g per square meter, most preferably approximately 290g per square meter.

In a preferred embodiment the fabric prepreg has a resin content of from 15 to 60% by weight, preferably from 40 to 50% by weight, most preferably approximately 46% by weight.

In one embodiment the layer of intumescent material is in the form of a sheet or tape. The sheet or tape may be preferably from 0.5 to 4mm thick, most preferably approximately 1mm in thickness.

Preferably the intumescent material is a mineral fibre based mat incorporating thermally activated exfoliating graphite.

The invention also provides an insulating panel comprising an external sheet, an internal sheet and an insulating core between the external and internal sheets, the panel having joint forming portions for connecting adjacent panels, the panel having a fire resistant edge seal of the invention extending along at least portion of a jointing edge thereof.

Preferably the seal extends along a jointing edge of the insulating core.

In one embodiment the insulating core has a joint forming portion on at least one side of the panel and the seal extends along the joint forming portion of the core. In this case the insulating core may have joint forming portions on both sides of the panel and the seal extends along both the joint forming portions of the core.

Brief Description of the Drawings

The invention will be more clearly understood from the following description thereof, given by way of example only, with reference to the accompanying drawings, in which:-

Fig. 1 is a perspective view of a seal according to the invention;

Fig. 2 is a side cross sectional view of portion of two adjacent panels according to the invention separated;

Fig. 3 is a cross sectional view of the panels joined together with some seals omitted; and

Fig. 4 is a cross sectional view of the panels joining together, in use.

Detailed Description

Referring to Fig. 1 there is illustrated a fire resistant edge seal 100 according to the invention for sealing a joint between panels such as adjacent panels 101, 102 illustrated in Figs. 2 to 4. The seal 100 is in this case in the form of a sheet or tape and comprises a resin fabric prepreg backing layer 105 and a layer 106 of intumescent material bonded to the fabric prepreg.

The resin fabric prepreg 105 generally comprises an inorganic fibre, ideally glass fibre fabric impregnated with a resin, especially a phenolic resin. The resin content of the prepreg 105 is preferably 15 to 60%, most preferably 40 to 50%, and ideally about 45% by weight of resin. One such suitable prepreg product is code named SL201/01 from Primco Limited, Manchester, UK – a 7781 style glass fabric modified phenolic prepreg which has a thickness of approximately 0.3mm. In a fire, phenolic resin in the prepreg bonds on to the foam surface at the panel edge, polymerises and thermally degrades at elevated temperature to leave a hard char reinforced by glass fibres. Phenolic resins undergo condensation polymerisation which is endothermic initially. This endotherm helps keep foam beneath the prepreg at a lower temperature than it otherwise would be in a fire. The phenolic prepreg cures to provide a hard charred durable material that is effective in providing a thermal shield to the foam surface it covers.

The layer 106 of intumescent material is in the form of a sheet or tape and comprises a mineral fibre based mat incorporating activated exfoliating graphite. At high temperatures greater than typically 190ºC the mat expands by up to 20 times it's initial thickness to form a stable thermally insulating layer. One such material is 1mm thick Tecnofire 60853 from Technical Fibre Products, Kendal UK. It is a requirement that the sealing material is not much thicker than 3mm otherwise a noticeable gap would appear between assembled adjacent panels which would be judged as cosmetically unacceptable for their end use application in buildings.

In a fire situation, the metal liners of insulated panels expand causing distortion in the region of the joint We have found that the material combination of phenolic glass prepreg and intumescent sheet described above provides substantially improved fire protection to the joints between adjacent panels. When panel joints distort in a fire, the insulation foam at the edges of adjacent panels become exposed to flames. This results in thermal degradation of the said foam, and consequently the foam no longer acts as

an effective thermal insulating material. Individually, both the phenolic glass fabric prepreg and the intumescent sheet provide some fire protection to foam at the panel joints. However, this material combination provides synergistic benefits in providing fire protection to panel joints as measured in the standard fire test BS476 Part 22. Here, 3 individual panels of height 3000mm, width 1000mm and thickness 40-180mm are assembled together in a frame and mounted in a furnace. Temperature probes are placed on the unexposed external cladding not facing the furnace. The temperature rise of this unexposed external cladding is monitored. The time taken for the temperature to rise 180°C above ambient is noted. Generally, the temperature rise is quickest in the region of the panel joints as this is the region that foam thermally degrades first. Examples are provided below showing the improved thermal insulation performance provided by the material combination of phenolic glass fabric prepreg and intumescent sheet.

The fire resistant strip 100 is used for sealing along at least portion of a jointing edge of an insulating panel. The seal 100 preferably extends along a jointing edge of an insulating core of such a panel.

In the invention the prepreg is applied to the side edge of the foam core at a joint between adjacent panels. This is important in ensuring that the seal comprising the prepreg and intumescent tape has a cushioning effect when two composite panels comprising a foam core sandwiched between two metal (such as steel) panels are jointed together. In use, the prepreg will slowly polymerise at room temperature in the joint of the panel edges and become substantially rigid. But, in panel assembly, it is desirable that the prepreg is flexible and possibly tacky to aid initial adhesion of prepreg to metal.

The fire resistant panel edge seal may be factory applied as a tacky or dry product. The tacky panel edge seal typically has a low molecular weight phenolic resin which can age/polymerise at room temperature over several weeks to become a dry seal.

Such a tacky product may be useful in manufacture for adhering the edge seal to a liner. For example, it may be applied to a liner during manufacture before a foam resin rises and bonds to the prepreg. In general, such a tacky prepreg is preferred for ease of use in panel manufacture. However, a dry prepreg edge seal may also be used, for example in arrangements in which the panel edge profile is such that guide rollers may be used to position the seal and hold it in position until the rising foam firmly bonds to it.

It is envisaged that with the fire resistant edge seal applied to one face of a panel at a joint between adjacent panels the intumescent material will provide some protection to the edge without the seal applied. However, the most effective fire performance is achieved if the edge seal is applied to both panel edge faces at a joint.

Referring to Figs. 2 to 4 of the drawings, there is illustrated one such insulated panel according to the invention. The panel comprises a profiled external sheet 2, an internal liner sheet 3 and an insulating core 4 between the external sheet 2 and internal sheet 3. The sheets 2 and 3 are typically of steel material and the core 4 is of polyurethane or poyisocyanurate or phenolic foam material which fills the space between the sheets 2, 3. The panel 1 is typically used for roofing and/or cladding systems.

The profiled external sheet 2 and internal lining sheet 3 have profiled joint-forming portions for connecting adjacent panels, on assembly as illustrated.

The profiled external sheet 2 has an external male projecting part 10 and an internal recess part 11 on one side for engagement, on assembly, with a corresponding external recess part 12 and projecting inner male part 13 respectively on the opposite side of the panel. An internal weather seal 20 is placed in the internal recess 11 for sealing engagement, on assembly, with the internal male projecting part 13 of the external

skin 2 of an adjacent panel. The seal 20 is of an elastomeric material which, in this case, is shaped to substantially conform to the shape of the recess, on assembly.

It will be noted that the internal recess 11 is of generally channel-shape having a base web 11a which is substantially flat with rounded corners. Similarly, a front nose portion 13a of the inner male part 13 is substantially flat, also with rounded corners for effective sealing engagement with the seal 20, on assembly. The seal 20, on assembly is deformed evenly into a flattened shape as illustrated, providing a highly effective seal.

To provide a substantially uniform outer gap g between the external sheets 2 of adjacent panels, on assembly, the external male projecting part 10 extends towards an inwardly inclined wall 25 defining the outer recess 12 of the external sheet 2 of an adjacent panel 2. A minimum gap g^1 of typically 1.5mm is defined between the male part 10 and the wall 25.

An outwardly diverging wall 10b extends at an angle α of from 70 to 80°, ideally approximately 75° to define, together with the inclined wall 25, the fixed gap g. The inclined wall 25 extends at an angle β which is also from 70 to 80°, ideally approximately 75°. The engagement of the portion 10a of the male part 10 against the inclined wall 25, on assembly, acts as a stop limiting the engagement between the nose 13a and wall 11a thus controlling the sealing engagement. This engagement between the portion 10a and the inclined wall 25 also ensures that the gap g is uniform which provides an excellent aesthetic finish when a plurality of panels are joined side to side either vertically or horizontally to provide, for example a wall cladding.

It will be noted that on assembly, the external male projecting part 10 of the external sheet 2 extends over the external recess 13 of an adjacent external sheet 2 to define a hidden recess 26 housing the head 27 of a fastener 28. As will be particularly apparent

from Fig. 4, the fastener 28 extends through the external sheet 2, the foam core 4 and the internal sheet 3 for fixing a panel to a support.

The male projecting part 10 does not engage the inclined wall 25 defining the outer recess 13 but is spaced-apart therefrom by an amount of about 3mm, on assembly to facilitate expansion and contraction of the panels in use.

It will be noted that the inclined wall 25 has a step portion 50 to occlude the connection between adjacent panels whilst still providing an externally visible and architecturally attractive fixed gap g between adjacent panels, on assembly.

The internal lining sheet 3 has an inner recess part 30 and an outer male projecting part 31 on one side, and a corresponding inner projecting male part 32 and an outer recess part 33 respectively on the opposite side of the panel, for interengagement on assembly of adjacent panels, as illustrated.

The internal lining sheet 3 includes a dimple 33 to accommodate an internal seal 35 which is typically glue gun-applied, on-site. The seal 35 is of a fire resistant and/or food-safe material such as butyl rubber.

The fire resistant seal strip 100 is applied along the exposed face of the foam core 4 on preferably both side edges of the panel.

The profiles of the male parts 31, 32 and recess parts 30, 33 are arranged to overlap on assembly to receive a fixing pin 40 to ensure the integrity of the joint for fire rating, as required. The fixing pin 40 also extends, in this case through the profile of at least one of the external sheets 2 to further strengthen the joint.

In use, the panels may be overlapped either vertically or horizontally. Typically an end bearer is used to start a panel assembly, the end bearer having a head part for

engagement in a female recess 11 of the external sheet 2 of a first panel. The other side of the first panel is then fixed in place by a fastener 28. This side of the first panel is then engaged with the mating side of a second panel, as illustrated so that the head 27 of the fastener 28 is hidden, the seal 20 is engaged, the gap g between the panels is substantially uniform and the fire resistant seal strip 100 is engaged between the faces of the insulating core of adjacent panels. Construction is continued in this way. After on-site construction, fixing pins 40 may be inserted, as illustrated and an internal seal 35 is applied to ensure the integrity of the joint for fire resistance application on/or environments in which the inner wall requires washing, for example in the food applications.

The invention provides an insulated panel with side edges which are arranged for highly efficient heat insulation, sound insulation, weather ingress and fire sealing.

It will be appreciated that the panels may be provided with opposite side edges or two different panels with a similar profile on both side edges may be provided.

Examples

a) Three panels were assembled and subjected to a test performed generally in accordance with BS476 Part 22 Clause 5 to determine fire resistance performance. The three panels each had a height of 3000mm, width 1000mm and thickness 100mm comprising 0.5mm thick steel external cladding and 0.4mm thick internal steel lining sheet sandwiched between a Polyisocyanurate foam core. The arrangement was that the internal lining sheets were exposed to the heating conditions of the test. In the joint between adjacent panels was a 2mm thick polyethylene foam seal on one panel edge and a 0.2mm PVC film on the adjacent panel edge.

The time taken for the temperature to rise 180ºC above ambient on the external steel cladding was 26mins.

b) Three panels were assembled and subjected to a test performed generally in accordance with BS476 Part 22 Clause 5 to determine fire resistance performance. The three panels each had a height of 3000mm, width 1000mm and thickness 100mm comprising 0.5mm thick steel external cladding and 0.4mm thick internal steel lining sheet sandwiched between a Polyisocyanurate foam core. The arrangement was that the internal lining sheets were exposed to the heating conditions of the test. In the joint between adjacent panels was a 2mm thick intumescent sheet seal on one panel edge and a 0.2mm PVC film on the adjacent panel edge.

The time taken for the temperature to rise 180ºC above ambient on the external steel cladding was 28mins.

c) Three panels were assembled and subjected to a test performed generally in accordance with BS476 Part 22 Clause 5 to determine fire resistance performance. The three panels each had a height of 3000mm, width 1000mm and thickness 100mm comprising 0.5mm thick steel external cladding and 0.4mm thick internal steel lining sheet sandwiched between a Polyisocyanurate foam core. The arrangement was that the internal lining sheets were exposed to the heating conditions of the test. In the joint between adjacent panels covering each foam edge was a 0.3mm thick phenolic woven glass fabric prepreg and a 1mm thick intumescent sheet seal.

The time taken for the temperature to rise 180ºC above ambient on the external steel cladding was 35mins.

The invention is not limited to the embodiments hereinbefore described which may be varied in construction and detail.

CLAIMS

1. A fire resistant edge seal for sealing a joint between adjacent panels or the like, the seal comprising a resin fabric prepreg and a layer of intumescent material bonded to the resin fabric prepreg.

2. A seal as claimed in claim 1 wherein the resin fabric prepreg is impregnated with a phenolic resin.

3. A seal as claimed in claim 1 or 2 wherein the fabric is of an inorganic fibre.

4. A seal as claimed in any of claims 1 to 3 wherein the fabric is of a glass fibre.

5. A seal as claimed in any preceding claim wherein the fabric is a non-woven fabric.

6. A seal as claimed in any of claims 1 to 4 wherein the fabric is a woven fabric.

7. A seal as claimed in any preceding claim wherein the fabric has a weight of from 75 to 1000g per square meter.

8. A seal as claimed in any preceding claim wherein the fabric has a weight of from 190 to 400g per square meter.

9. A seal as claimed in any preceding claim wherein the fabric has a weight of approximately 290g per square meter.

10. A seal as claimed in any preceding claim wherein the fabric prepreg has a resin content of from 15 to 60% by weight.

11. A seal as claimed in any preceding claim wherein the resin content of the fabric prepreg is from 40 to 50% by weight.

12. A seal as claimed in any preceding claim wherein the resin content of the fabric prepreg is approximately 46% by weight.

13. A seal as claimed in any preceding claim wherein the layer of intumescent material is in the form of a sheet or tape.

14. A seal as claimed in claim 13 wherein the sheet or tape has a thickness of from 0.5 to 4mm.

15. A seal as claimed in claim 13 or 14 wherein the sheet or tape has a thickness of approximately 1mm.

16. A seal as claimed in any preceding claim wherein the intumescent material is a mineral fibre based mat incorporating thermally activated exfoliating graphite.

17. A seal substantially as hereinbefore described with reference to the accompanying drawings.

18. An insulating panel comprising an external sheet, an internal sheet and an insulating core between the external and internal sheets, the panel having joint forming portions for connecting adjacent panels, the panel having a fire resistant edge seal as claimed in any preceding claim extending along at least portion of a jointing edge thereof.

19. An insulating panel as claimed in claim 18 wherein the seal extends along a jointing edge of the insulating core.

20. An insulating panel as claimed in claim 18 or 19 wherein the insulating core has a joint forming portion on at least one side of the panel and the seal extends along the joint forming portion of the core.

21. An insulating panel as claimed in claim 20 wherein the insulating core has joint forming portions on both sides of the panel and the seal extends along both the joint forming portions of the core.

22. An insulating panel substantially as hereinbefore described with reference to the accompanying drawings.

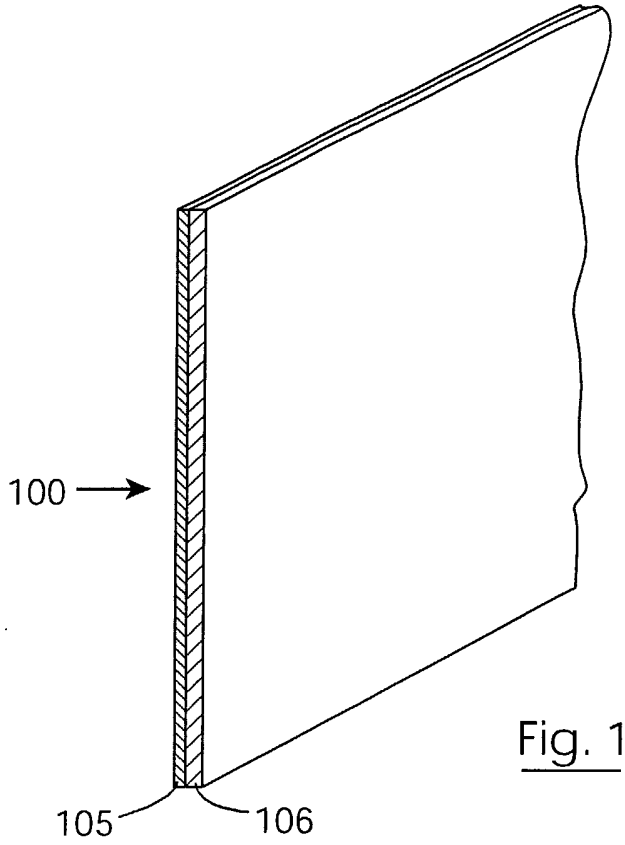

Fig. 1

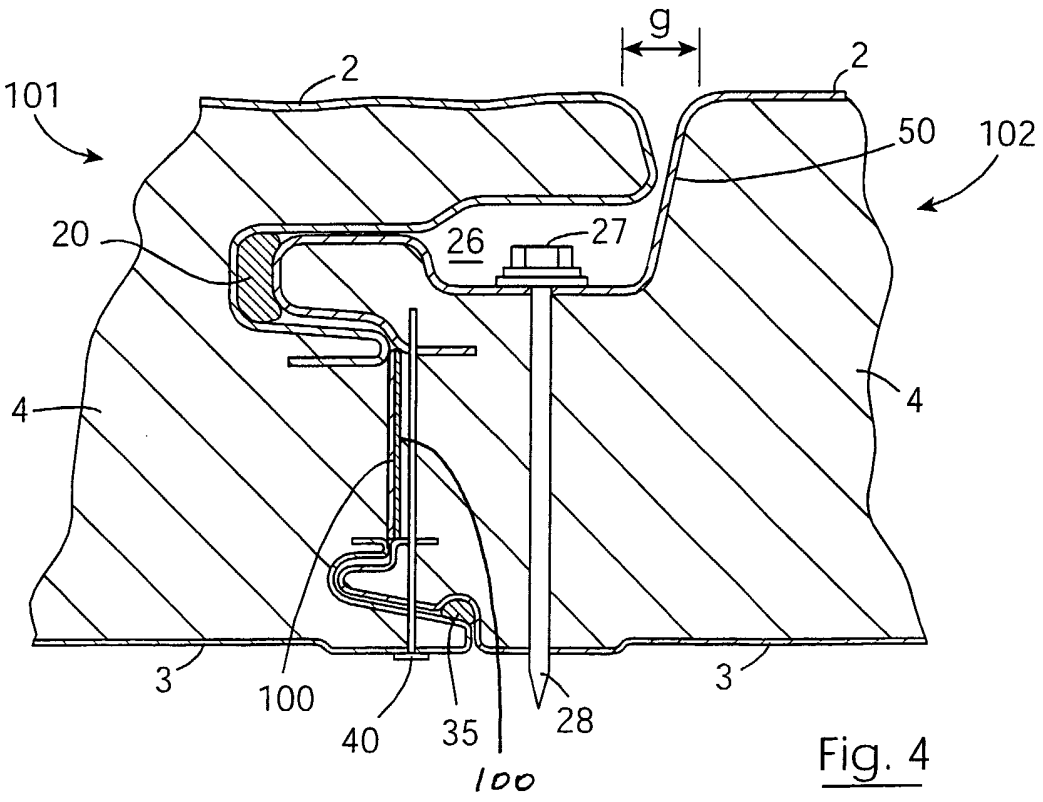

Fig. 4

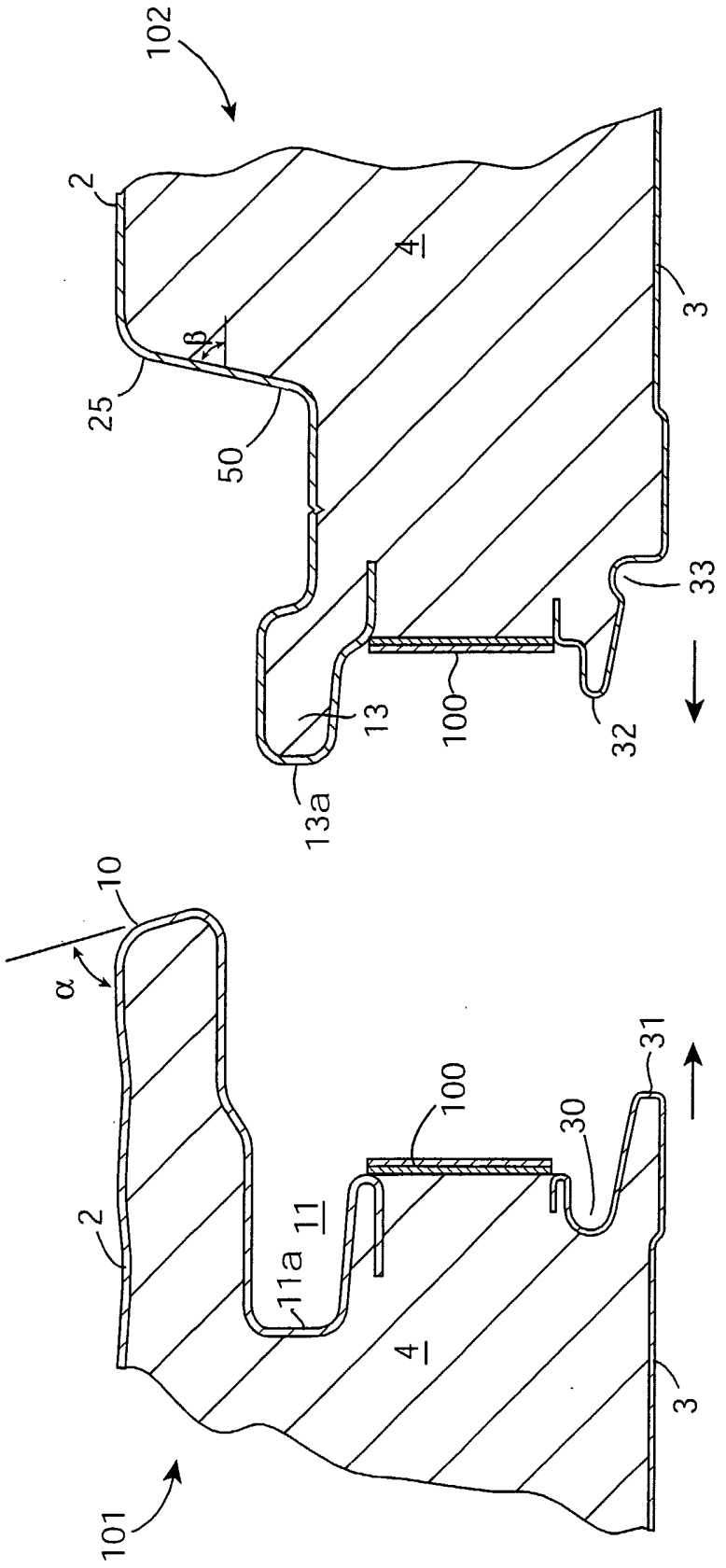

Fig. 2

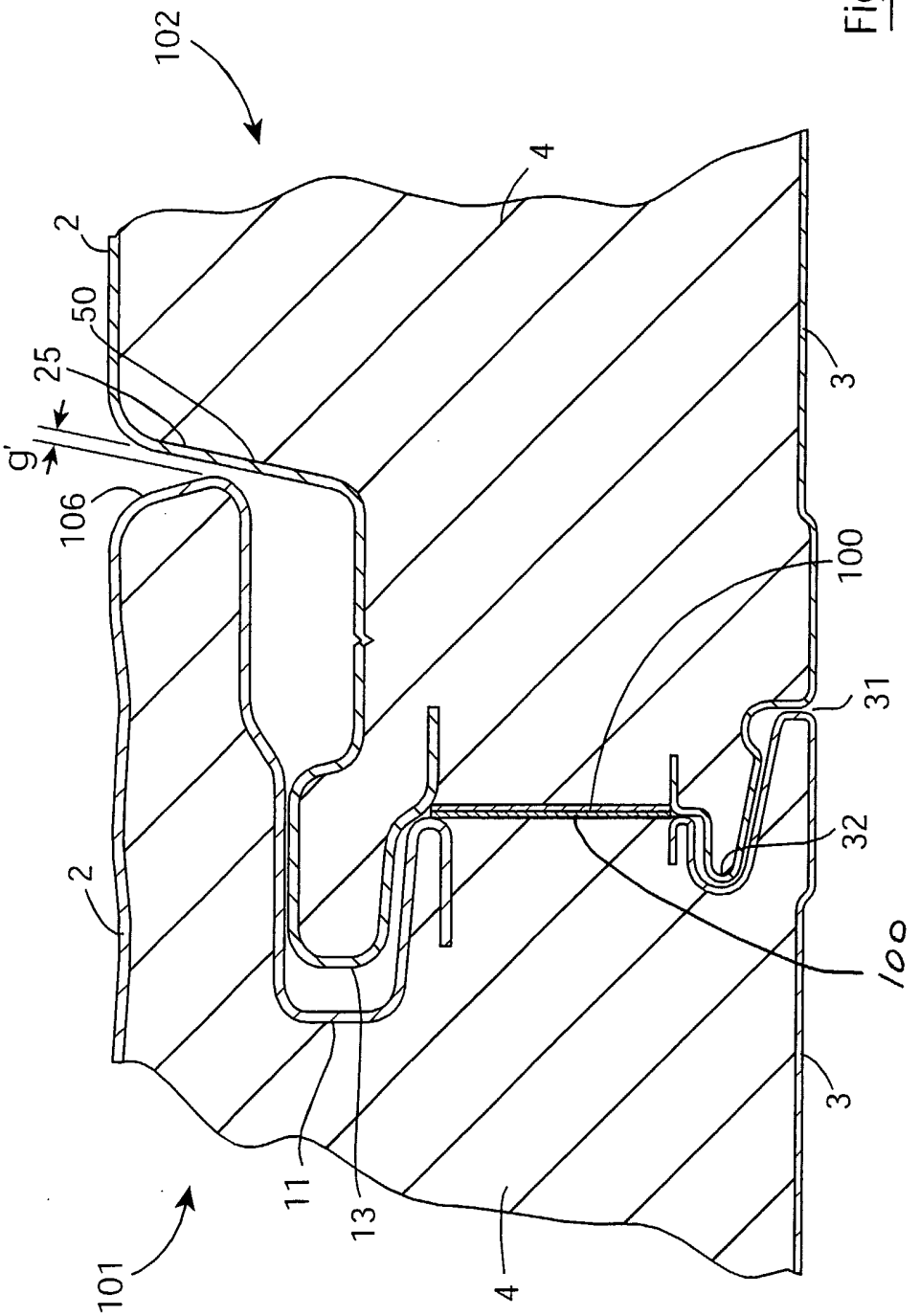

Fig. 3