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ABSTRACT

The present invention provides a panel member (10) for a panel structure (100). The panel member (10) may be formed from sheet material, such as sheet metal, and defines an outer panelling surface (11) extending between first (12) and second (13) opposite edge regions of the panel member. The first edge region (12) defines a slot (15) adjacent an inner surface of the panel member, which slot is substantially co-extensive with that first edge region (12). The slot (15) is adapted to receive a coupling member (30) with which the panel member (10) can be coupled to a second opposite panel (10) or a support. The slot (15) includes retaining means (16) for engagement with complementary fastening means (33) on the coupling member (30) to create a positive connection with the coupling member and retain the coupling member in the slot. The second edge region (13) of the panel member is formed with geometry (18) complementary to the first edge region (12) such that adjoining first and second edge regions (12,13) of adjacent panel members overlap and nest next to each other so as to minimise interruption between the outer panelling surfaces (11) of the adjacent panel members.

The invention also provides a paneling system incorporating the panel members and a method of fabricating those panel members.

AUSTRALIA
Patents Act 1990

ORIGINAL
COMPLETE SPECIFICATION
STANDARD PATENT

Invention Title: **PANELLING**

Applicant: **OFINAC PTY LTD**

The following statement is a full description of this invention, including the best method of performing it known to me:

PANELLING

This invention relates generally to panelling and to processes of fabricating panelling. More particularly, the invention relates to panel members and panel structures utilising such members which can be combined to form extended panels for use in such applications as acoustic panelling, fire walls, duct silencers and lay-in ceilings and walls.

Acoustic panels are generally constructed by joining together two separate panel members in spaced apart and opposed face-to-face relation such that the panel members form opposite, outer walls of a hollow panel structure which can be left hollow or filled with an acoustic deadening material as required. Each individual panel is furthermore typically configured to be matingly interconnected with an adjacent panel at an adjoining edge region thereof. Panels for other applications are typically of similar construction.

The fabrication of acoustic and other panelling usually involves time consuming construction methods, both in respect of forming the individual panel members and also in respect of the assembly of the panel structures from their component parts. Much of the assembly time is involved in methods of securely fastening the two side panels together, which typically involves a combination of extensive pop riveting, spot welding and metal crimping.

The fabrication of the individual panel members is generally carried out by roll forming of sheet metal, although other methods, such as brake pressing are also used. These procedures can be relatively time consuming. Accordingly, it would be desirable to provide a new panel structure and a method of fabricating panel members for use in acoustic and other panelling applications which can provide simplicity, speed and economy in both fabrication and assembly.

According to one aspect of the present invention there is provided a panel member for a panel structure. The panel member may be formed from sheet

material, such as sheet metal, and defines an outer panelling surface extending between first and second opposite edge regions of the panel member. The first edge region defines a slot adjacent an inner surface of the panel member, which slot is substantially co-extensive with that first edge region. The slot is adapted to receive a coupling member with which the panel member can be coupled to a second opposite panel or a support. The slot includes retaining means for engagement with complementary fastening means on the coupling member to create a positive connection with the coupling member and retain the coupling member in the slot. The second edge region of the panel member is formed with geometry complementary to the first edge region such that adjoining first and second edge regions of adjacent panel members overlap and nest next to each other so as to minimise interruption between the outer panelling surfaces of the adjacent panel members.

According to another aspect of the invention there is provided a panel structure comprising a pair of first and second panel members as described above arranged spaced apart and in opposed relationship such that the first edge regions of the panel members are located opposite each other and the second edge regions of the panel members are located opposite each other. The panel structure includes a channel member for coupling the panel members together at the opposite first edge regions. The channel member preferably has a generally "square U"-shaped geometry with a pair of projections interconnected by a base. Each of the projections is received within a respective slot formed at the first edge region of each panel member and fastening means provided at each channel member projection engages with each slot fastening means. The interconnected first edge regions of the panel members combine to form a female mating edge of the panel structure. The opposite second edge regions are joined together to form a male mating edge of the panel structure. The male mating edge of the panel structure is thereby able to nest within the female mating edge of an adjacent panel structure to provide smooth transition between panelling surfaces of the adjacent panel structures.

According to a further aspect of the present invention there is provided a panelling system including:

a plurality of panel members, each panel member being as described above, with the panel members adapted to be arranged spaced in pairs, spaced apart and in opposed relationship such that the outer panelling surface of each panel member faces away from the other panel member of the pair and such that the first edge regions of the paired panel members are located opposite each other and the second edge regions of the paired panel members are located opposite each other;

a channel member for coupling the paired panel members together at their opposite first edge regions, the channel member being of a generally U-shaped configuration having a pair of projections upstanding from a base interconnecting the upstanding projections, each of the projections being adapted to be received within a respective slot at the first edge region of each panel member and having fastening means adapted to engage with the retaining means of each slot; and

wherein the interconnected first edge regions of the panel members combine to form a female mating edge of a panel structure and wherein the opposite second edge regions of the panel members can be joined together to form a male mating edge of the panel structure, the male mating edge being configured to nest within the female mating edge of an adjacent panel structure to provide a close fit and a smooth transition between the outer panelling surfaces of the two panel structures.

In yet another aspect of the invention there is provided a method of fabricating each of the components of the panel structure. For instance, the invention provides a method of fabricating a panel member for a panelling system including the step of roll forming opposite edge regions of a sheet of metal in a sequence of discrete forming stages wherein a first edge region of the sheet is progressively folded back through approximately 180° to form a slot adjacent an inner surface of the panel member, said slot being adapted to receive and retainingly engage a coupling member in positive connection therewith, and

wherein a second opposite edge region of the sheet is progressively deformed to a configuration or geometry complementary to the first edge region such that adjoining first and second edge regions of adjacent panel members overlap and nest next to each other to provide a close fit and minimise interruption between outer panelling surfaces of the adjacent panel members.

In a preferred form of the invention the panel members and the channel section will be roll formed from a suitable sheet metal such as galvanised steel, stainless steel or aluminium, although other sheet materials are also suitable. The thickness of the sheet

material will depend upon the material used. Galvanised steel of between 0.6 and 1.2 mm gauge is preferred.

In a preferred embodiment of the invention, the first and second panel members will be substantially identical and each formed from a single piece of sheet material. The first edge region of the panel member is preferably formed in a succession of roll forming stages wherein an edge portion of the sheet is progressively folded back through approximately 180 degrees thereby forming a slot adjacent an inner surface of the panel member extending along the first edge region.

The folded portion of the first edge region preferably includes a raised portion in the form of a ridge or similar extending along its length and defining a recess within the slot. Preferably this will be located toward the open end of the slot. This recess is configured and situated to receive an appropriately located and dimensioned bead in a projection of the channel member as described further below. Such inter-engaging beads and recesses are examples of the complementary retaining/fastening means referred to previously.

The edge of the folded portion at the open end of the slot is preferably angled inward away from the slot at an angle preferably greater than 45 degrees and more preferably about 80 degrees. This angled edge provides an added degree of stiffness to the edge region and also facilitates the insertion of the channel member into the slot. The first edge region of the second panel member is typically a mirror image of the first edge region of the first panel member.

The channel member is preferably of the same material as the panel members. It is generally of a "square U"-shaped configuration with the base and the two projections of the member each being substantially planar. Preferably the two projections of the channel member will be at 90 degrees to the base. Preferably the channel member will include along each projection a raised

portion or bead which protrudes such that in use it locates into the respective recess extending along the slot.

The dimensions of the channel member will vary depending upon the dimensions of the panel members and the desired width of the overall panel structure. By varying the width of the channel member base, the width of the overall panel structure will also vary. The length of the channel member projections will be such that they extend well into the slots and preferably beyond the recess formed for engagement with the channel members.

When assembled, the combination of the first and second panel members and connecting channel member combine to form at one edge of the panel structure, a large channel being the female mating edge formed from the base of the channel member and the respective folded portions of the panel members. This channel opening is designed to receive the male mating edge of another panel structure. Further panel structures can be added, edge to edge to create the desired width of panel.

Accordingly, the male mating edge of the panel structure is configured to provide a close fit with the female mating edge formed in the first edge region. Preferably the second edge region of each of the two panel members will have a generally stepped configuration wherein there are two steps parallel to the outer panelling surface thereby giving a three level structure consisting of the outer panelling surface, an intermediate level and an inner level. In a more preferred form, the sheet material of the inner level is formed with an indentation such that when a pair of panel members are combined to assemble the panel structure the respective indentations can be aligned to locate the panel members in the proper position with respect to each other.

The respective second edge regions of the two panel members are dimensioned such that when the two panel members are joined together, the external width of the panel at the intermediate level is such that it is receivable

into the female mating edge of the panel structure. Preferably, the external width at the intermediate level step is only slightly less than the internal width of the channel of the female mating edge such that a friction fit is obtained. The closeness of the fit between the male and female mating edges of the panel structures ensures good thermal and acoustic integrity between adjoining panel structures.

The width of the panel structure at the male mating edge can be increased either by altering either or both of the step heights between the inner and intermediate levels or by inserting a spacer of appropriate width between the respective inner levels. This spacer may be of "square U" shaped channel. Any variation in the dimensions of the male mating edge must be matched by corresponding variation in the channel member connecting the respective first edge regions of the two panel members.

In a preferred configuration the length of the intermediate level is slightly less than the distance between the opening of the female mating edge and the ridge which extends along folded portion of the respective first edge regions.

A preferred method of fabricating the panel members is by roll formation in a continuous process. As the person skilled will appreciate roll forming apparatus is normally custom designed to produce the particular section required. The preferred method of fabrication produces the desired profile in a series of 9 steps in which the two ends of the sheet are simultaneously and progressively rolled into the desired profile. By this simple one step procedure, the panel member according to the invention, is able to be produced at a rate of approximately 10 seconds/per metre.

As the person skilled in the art will appreciate, the roll forming process involves a flat coil being fed into the roll forming machine whereby it passes through the various stages of roll forming. The number of stages ensure that the desired shape and stability in the material flow is obtained. After the material has

passed through the roll forming stage the machine is set to cut the material to the required predetermined length.

The panel members can be produced in any length required. Typically, this will be in the order of up to about 5.5 metres, however, longer lengths can be produced if necessary. The panels may also be formed by other means such as brake pressing and may be fabricated in other than a single sheet.

In one preferred application, the panel structures of the invention are used to provide sound proofing. In such an application, the hollow panel structure will preferably include a sound absorbent material such as wool or other material as is known in the art. To assist its acoustic properties, the wall section may be perforated. Preferably the perforations will be made in the sheet material prior to it being roll formed. In that case the perforations will be restricted to the panelling surface intermediate the two edge regions of the sheet.

Acoustic panelling is but one of many useful applications of the panels of the invention. Other applications utilising the composite panel structure include fire walls where the cavity between the panel member is filled with a suitable fireproof material. The cavity may also be filled with other materials, such as concrete, depending on the application.

In a further alternative application, the panel members can also be usefully utilised singly where it is not necessary to have a hollow two sided structure. For example, the wall members can be used to form "lay-in" ceiling or wall panels. In such an application, channel members as described above may be attached to a roof rafter or cross beam or similar support member by conventional means. This provides a channel member which extends down below or out from the support member. All panel members can then be fitted to the channel member in an analogous manner to that described above in relation to the composite structure. In such an application, the first edge region of a panel member is fitted over the lower (in a ceiling application) projection of

the channel member. The second edge region of another panel is then fitted or nested inside the first edge region of the first panel member and the first edge region of the second panel member fitted around a suitably positioned second channel.

In a further analogous application, the panel members can be used in combination with appropriately configured channel sections as duct silencers.

For a better understanding of the present invention, a preferred embodiment of the invention is hereafter described by way of illustrative example with reference to the accompanying drawings in which like reference characters designate like features and in which:

Figure 1 is a sectional end view of a panel member according to an embodiment of the present invention;

Figure 2 is a sectional end view of a panel structure according to an embodiment of the present invention;

Figure 3(a) to 3(i) is a series of sectional end views showing the progressive formation of a panel member according to the present invention.

Referring firstly to Fig. 1 of the drawings, the invention provides a panel member (10) for use in a panelling system. The panel member (10) is formed to any desired length and width from a substantially rigid sheet of metal such as galvanised steel having a thickness in the range of about 0.6 mm to about 1.2 mm. The panel member (10) has an outer panelling surface (11) extending between a first edge region (12) and an opposite second edge region (13). The first edge region includes a folded portion (14) which is folded back approximately 180° onto an inner side of the panel member (10) to define a slot (15). The slot includes an indentation or recess (16) located towards the open end of the slot (15). The recess (16) may extend along the length of the panel member (10). Furthermore, the free edge of the folded portion (14) is angled inwardly away from the slot to form a flange (17).

The second, opposite edge region (13) of the panel member (10) is formed in a stepped configuration and includes two steps substantially parallel with the outer panelling surface (11), namely an intermediate step (18) and an inner step (19). The geometry of the intermediate step (18) is complementary to the configuration of the first edge region (12) to the extent that at least a part of the first edge region (12) of an adjacent panel member (10) is adapted to neatly overlap and nest with the second edge region (13) at the intermediate step (18) so that the outer panelling surfaces (11) of the adjacent panel members are substantially co-planar with minimal interruption or discontinuity therebetween. The intermediate level step (18) is connected with the outer panelling surface (11) by a first face portion (21) which is disposed at an angle of about 60° to the outer surface. The intermediate level step (18) is connected to the inner level step by a second face portion (22) which is angled at approximately 80° to the intermediate level step. Furthermore, the inner level step (19) includes a V-shaped notch (23) approximately at a mid-point therealong.

Referring now to Fig. 2 of the drawings, there is illustrated a panel structure (100) according to the present invention. The panel structure (100) includes a first panel member (10) as illustrated in Fig. 1 paired with a second panel member (10'). The second panel member (10') is a mirror image of the first panel member (10) except in respect of its notch (23'). The V-shaped notch (23') in the second panel member (10') points inwardly whereas the notch (23) in the first panel member (10) points outwardly. The notches (23, 23') are therefore able to interengage in the manner shown in Fig. 2.

The panel structure (100) includes a channel member (30) interconnecting the first edge region (12,12') of the two panel members (10,10') which are arranged spaced apart and opposite one another. The channel member (30) has a generally "square" U-shaped cross-section and includes two projections (31) upstanding from a base (32) of the channel member. The base (32) is flat and the projections (31) extend substantially at right angles from the base and have

a length which is slightly less than the depth of each slot (15,15'). Each of the projections (31) includes a raised section or bead (33) which is adapted to be received in the recess (16) formed in the folded portions (14, 14') of the first edge regions (12,12'). The flanges (17,17') assist in the insertion of the projections (31) of the channel member (30) into the respective slots (15,15'). The recess retaining means (16,16') and the channel member beads (33) provide a positive snap fit between the channel member (30) and the panel members (10,10'). This snap fit provides a sufficiently positive connection to render unnecessary other extensive and time consuming securing methods such as pop riveting, spot welding and the like which would otherwise be required.

After the interconnection of the panel members (10,10') with the channel member (30) at the first edge regions (12,12'), the panel members are placed in proper alignment by interengagement of the two V-shaped notches (23,23'). Then, in order to permanently secure the panel members and the channel member together, the first edge region of each panel member (10,10') is clinched across the slot (15,15') at either end of the channel member to prevent the channel member from sliding longitudinally in the slots. Furthermore, the top and bottom regions of the interengaged inner level steps (19,19') are also clinched.

As can be clearly seen in Fig. 2 of the drawings, once assembled the panel structure (100) has a relatively large channel forming a female mating edge (50) between the folded portions (14,14') of the first edge regions (12,12'), and a protruding nose forming a male mating edge (60) having parallel side wall portions formed by the intermediate level steps (18,18'). The external width of the male mating edge (60) is marginally less than the internal width of the opening in the female mating edge (50). Accordingly, a plurality of panel structures (100) can be combined in a planar array with the male mating edges (60) nesting within the female mating edges (50) of adjacent panel structures to

provide a substantially continuous outer panelling surface (11,11') across the panelling array.

Finally, Figs 3a to 3i illustrate the various stages of deformation of a sheet of metal during a nine stage 'cold' roll forming operation in which both of the opposite first and second edge regions (12,13) are continuously roll formed to provide a panel member (10) as shown in Fig. 1 at the end of the ninth and final roll forming stage.

It is to be understood that various modifications, alterations and/or additions may be introduced into the construction and arrangement of the parts specifically described and illustrated herein without departing from the spirit or ambit of the present invention.

THE CLAIMS DEFINING THE INVENTION ARE AS FOLLOWS:

1. A panel member for a panelling system, including:

an outer panelling surface extending between first and second opposite edge regions of the panel member;

the first edge region defining a slot adjacent an inner surface of the panel member, the slot being adapted to receive a coupling member by means of which the panel member can be coupled to another opposite panel member or support, the slot having retaining means for engagement with complementary fastening means on the coupling member to create a positive connection with the coupling member and retain the coupling member in the slot; and

the second edge region having a geometry complementary to the first edge region such that adjoining first and second edge regions of adjacent panel members may overlap and nest next to each other to minimise interruption between the outer panelling surfaces of the adjacent panel members.

2. A panel member as claimed in claim 1 wherein the panel member is formed from a relatively rigid sheet material and wherein the slot comprises a portion of the first edge region folded back upon itself through an angle of about 180°.

3. A panel member as claimed in claim 1 or claim 2 wherein the retaining means comprises an indentation or recess for receiving a complementarily shaped projection or bead on a coupling member.

4. A panel member as claimed in claim 3 wherein the recess in the slot extends longitudinally the length of the panel member transverse the depth of the slot.

5. A panel member as claimed in claim 3 or claim 4 wherein the recess or indentation is located proximate an open end of the slot.

6. A panel member as claimed in any one of claims 2 to 5 wherein a free end of the folded portion at an open end of the slot is angled inwardly away from the slot to form an inwardly angled flange.

7. A panel member as claimed in claim 7 wherein the flange is at an angle to the folded portion at greater than 45°.

8. A panel member as claimed in any one of the preceding claims wherein the second edge region has a stepped configuration and includes a first step level for overlapping with at least a part of the first edge region of an adjacent panel member such that the outer panelling surfaces of the adjacent panel members are substantially co-planar and in close fit.

9. A panel member as claimed in any one of the preceding claims wherein the panel member is fabricated from a sheet of metal selected from the group consisting of galvanised steel, stainless steel and aluminium.

10. A panel member as claimed in claim 9 wherein the sheet of metal is galvanised steel having a thickness in the range of about 0.6 mm to about 1.2 mm.

11. A panelling system including:

a plurality of panel members, each panel member being as claimed in any one of claims 1 to 10, with the panel members adapted to be arranged spaced in pairs, spaced apart and in opposed relationship such that the outer panelling surface of each panel member faces away from the other panel member of the pair and such that the first edge regions of the paired panel members are located opposite each other and the second edge regions of the paired panel members are located opposite each other;

a channel member for coupling the paired panel members together at their opposite first edge regions, the channel member being of a generally U-

shaped configuration having a pair of projections upstanding from a base interconnecting the upstanding projections, each of the projections being adapted to be received within a respective slot at the first edge region of each panel member and having fastening means adapted to engage with the retaining means of each slot; and

wherein the interconnected first edge regions of the panel members combine to form a female mating edge of a panel structure and wherein the opposite second edge regions of the panel members can be joined together to form a male mating edge of the panel structure, the male mating edge being configured to nest within the female mating edge of an adjacent panel structure to provide a close fit and a smooth transition between the outer panelling surfaces of the two panel structures.

12. A panelling system as claimed in claim 11 wherein the channel member has an approximately "square" U-shaped cross-section and wherein each of the projections of the channel member includes a bead for engagement with the retaining means in the slot of each respective panel member.

13. A panelling system as claimed in claim 11 or claim 12 wherein the respective second edge regions of the paired panel members have a generally stepped configuration including two steps substantially parallel to the outer panelling surface comprising an intermediate level step and an inner level step.

14. A panelling system as claimed in any one of claims 11 to 13 wherein the second edge region of each pair of panel members are adapted to engage to form the male mating edge when the panel members are combined in the panel structure.

15. A panelling system as claimed in claim 14 wherein the second edge regions of the pair of panel members are adapted to engage at the inner step level in the panel structure.

16. A method of fabricating a panel member for a panelling system including the step of:

roll forming opposite edge regions of a sheet of metal in a sequence of discrete forming stages wherein a first edge region of the sheet is progressively folded back through approximately 180° to form a slot adjacent an inner surface of the panel member, said slot being adapted to receive and retainingly engage a coupling member in positive connection therewith, and wherein a second opposite edge region of the sheet is progressively deformed to a configuration or geometry complementary to the first edge region such that adjoining first and second edge regions of adjacent panel members overlap and nest next to each other to provide a close fit and minimise interruption between outer panelling surfaces of the adjacent panel members.

17. A method as claimed in claim 16 wherein the sheet of metal is provided as a continuous sheet and the step of roll forming the sheet in discrete stages is a continuous roll forming process.

18. A method as claimed in claim 16 or claim 17 wherein the first and second opposite edge regions of the sheet are roll formed simultaneously.

19. A method as claimed in any one of claims 16 to 18 wherein the step of roll forming the opposite edge regions of the sheet is a 'cold' rolling operation which takes place in nine discrete forming stages.

20. A method as claimed in any one of claims 16 to 19 further including the step of providing an array of perforations across the surface of the sheet of metal prior to the step of roll forming the sheet.

21. A method as claimed in any one of claims 16 to 20 wherein the sheet of metal is selected from the group consisting of galvanised steel, stainless steel and aluminium.

22. A method as claimed in claim 21 wherein the sheet of metal is galvanised steel and has a thickness in the range of about 0.6 mm to about 1.2 mm.

23. A panel member substantially as herein described with reference to the accompanying drawings.

24. A panelling system substantially as herein described with reference to the accompanying drawings.

25. A method of fabricating a panel member for a panelling system substantially as herein described with reference to the accompanying drawings.

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David B Fitzpatrick

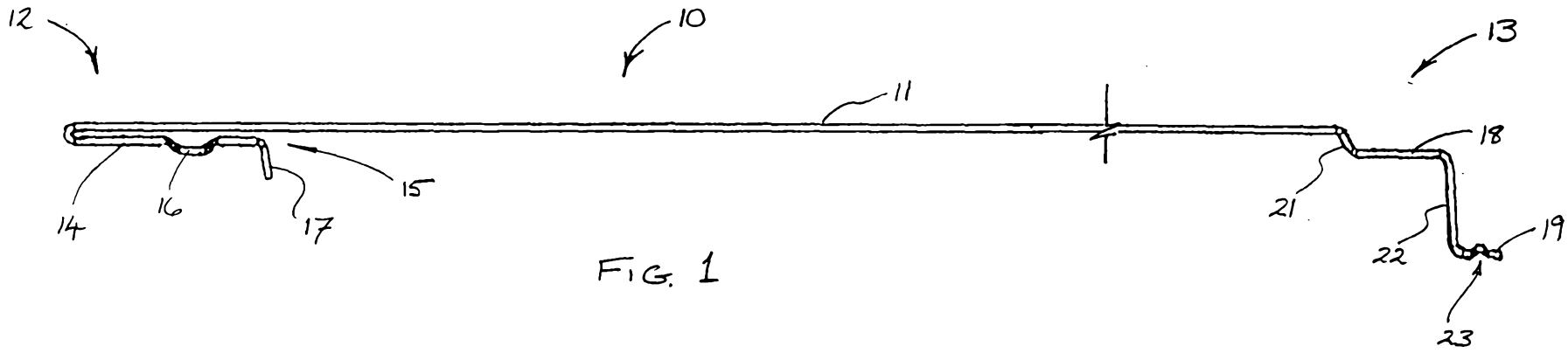
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FIG. 1

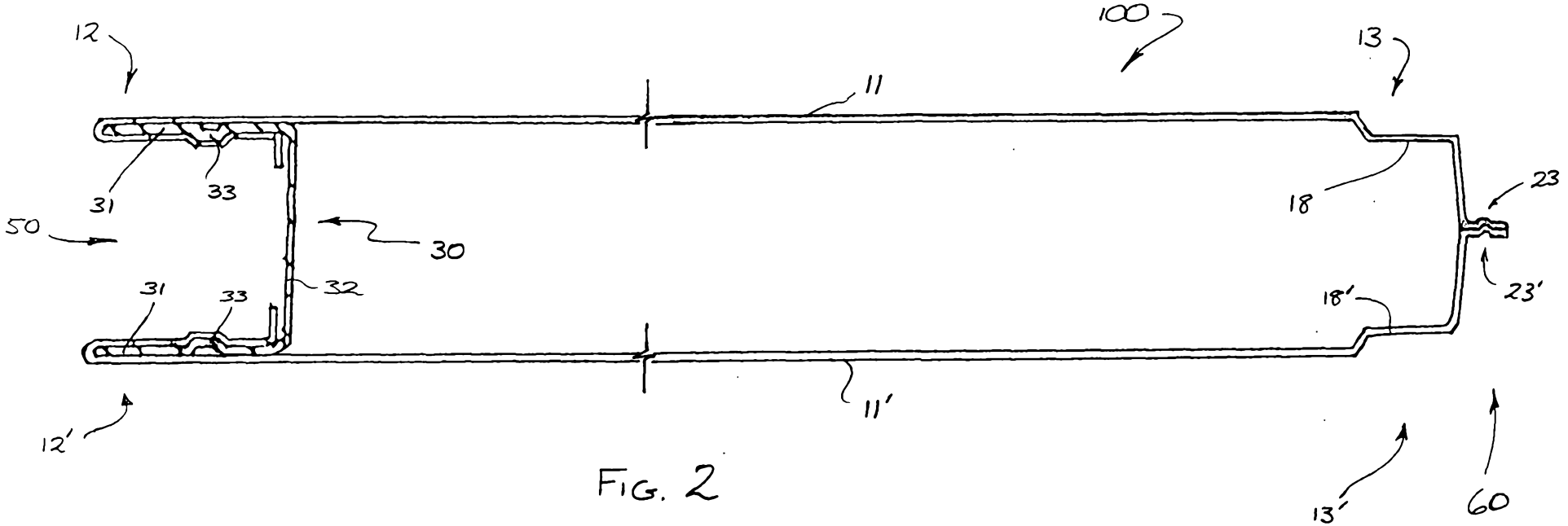
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FIG. 2

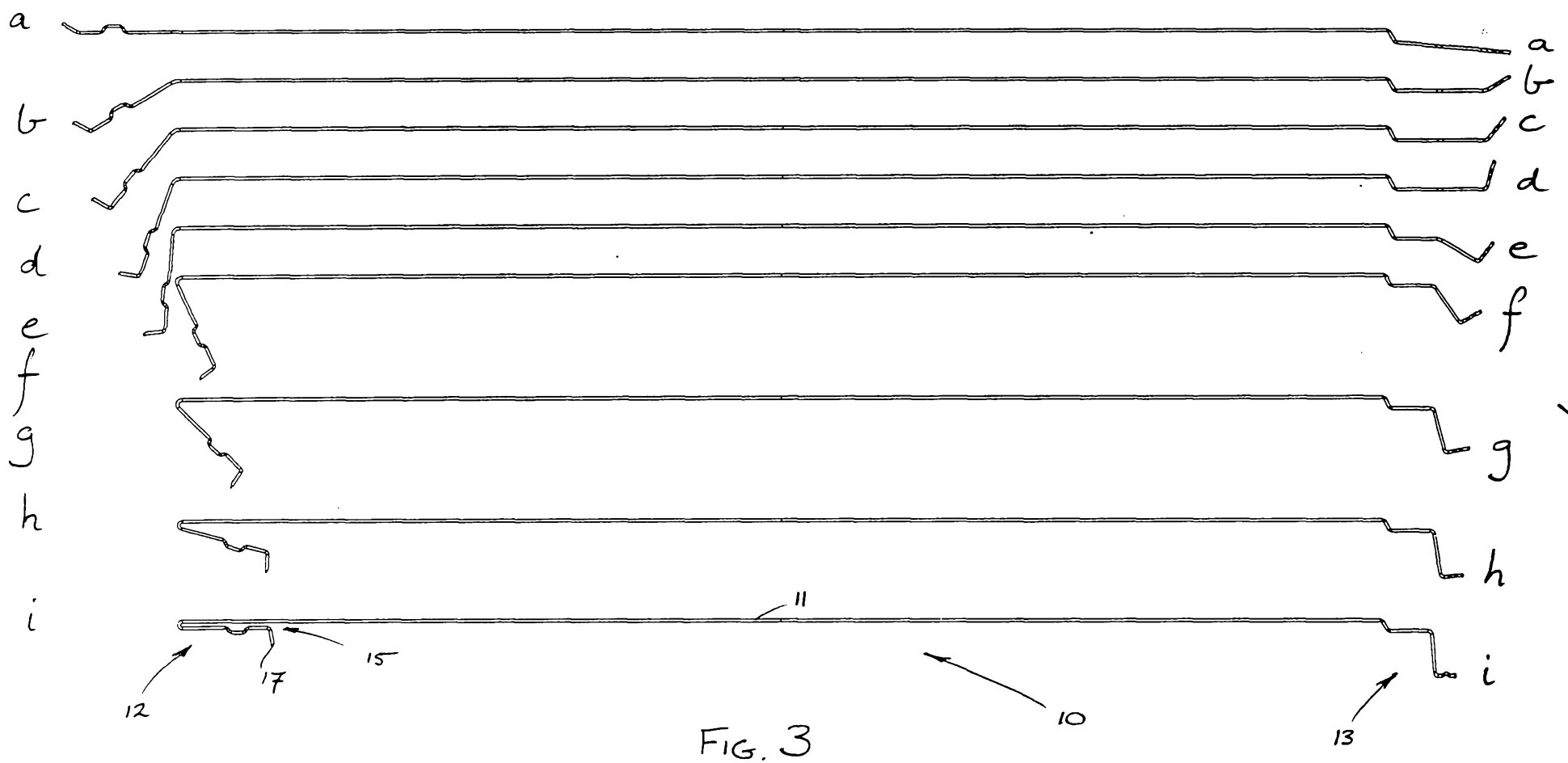

FIG. 3