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(54) **A self-supporting panel for roofs, walls and floors**

(57) A panel (100) for roofs, walls, and floors of buildings is disclosed comprising: a lower plate (1), an upper plate (2), a filling material (4) arranged between said lower plate (1) and said upper plate (2), at least one stiffening section (3) fixed to the panel and at least one tubular

section for connection and alignment, in such manner to make the self-supporting panel stand by itself, resting on its ends, without the need for additional intermediate supports, and at least one tubular section for connection and alignment (8).

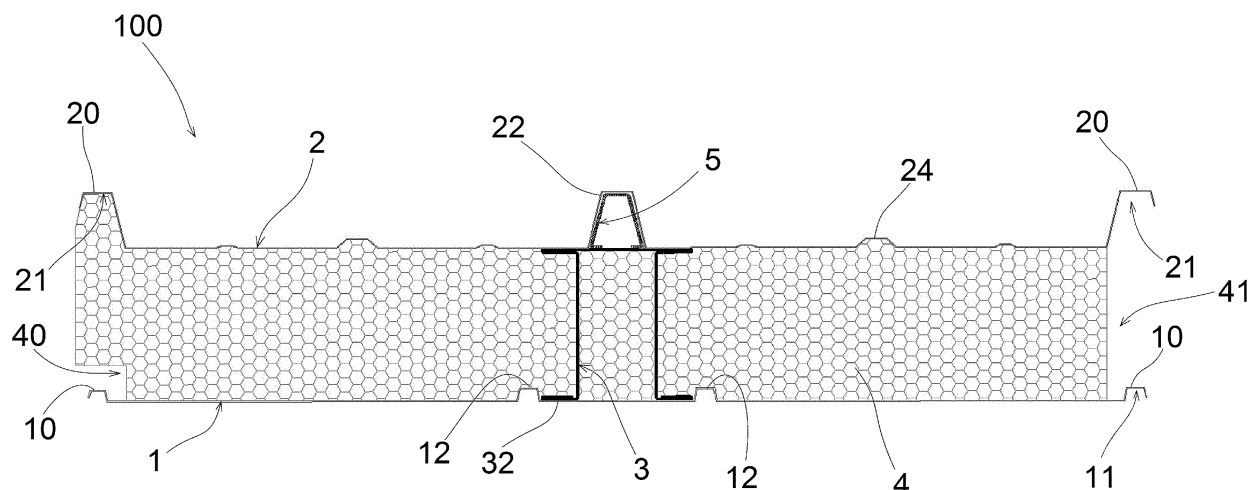


FIG. 1

Description

[0001] The present patent application relates to a self-supporting panel for roofs, walls and/or floors in industrial and civil buildings. In particular, said panel has been designed to cover high distances between two beams, including distances higher than 15 meters.

[0002] The panels for roofs, walls and floors of buildings according to the prior art are not self-supporting, although they are reinforced with a core. In fact, said panels must be mounted on supporting structures (such as roofs, walls or floors of buildings) that have already been installed. Said supporting structures must create a network wherein the distances between the support elements of the panels must be very limited, since panels are not provided with sufficient stiffness to be laid on distant supports without bending under the action of their own weight and/or overload.

[0003] The purpose of the present invention is to eliminate the drawbacks of the prior art by providing a panel for roofs, walls and floors of buildings that is of self-supporting type and does not require the provision of support elements at a close distance.

[0004] Another purpose of the present invention is to provide such a panel for roofs, walls and floors of buildings that is versatile, practical, inexpensive, easy to make and install, safe, with multiple functions to receive technical installations.

[0005] These purposes are achieved according to the invention, with the panel for roofs, walls and floors of buildings, the characteristics of which are listed in the independent claim 1.

[0006] Advantageous embodiments appear from the dependent claims.

[0007] The panel for roofs, walls and/or floors of buildings according to the invention comprises: a lower plate, an upper plate, a filling material (arranged between lower plate and upper plate), and at least one stiffening section internally and externally fixed to the panel, in such way to make the self-supporting panel stand while resting on its ends, without the need of additional intermediate supports.

[0008] Another novelty of the invention consists in the use, on the side of the internal sheet-metal element (intrados), of a tubular element or section suitably perforated or slotted that acts both as mechanical connection between the stiffening sections and as channel for passage of cables and/or pipes of electrical and technological installations in general, concealing them from sight and protecting them from accidental direct contact, thus optimizing results in terms of aesthetics, cost and safety.

[0009] The advantages of the self-supporting panel of the invention appear evident when compared to the known panels that are not self-supporting.

[0010] Further characteristics of the invention will appear clearer from the detailed description below, which refers to merely illustrative, not limiting, embodiments, illustrated in the attached drawings, wherein:

Fig. 1 is a cross-sectional view of a first embodiment of the self-supporting panel of the invention;

Fig. 2 is an exploded perspective view of some elements of the panel of Fig. 1;

Fig. 3 is cross-sectional view of a variant of the self-supporting panel of Fig. 1;

Fig. 4 is a perspective view of a second embodiment of the self-supporting panel of the invention,

Fig. 5 is a cross-sectional view of a roof for buildings obtained by assembling multiple self-supporting panels of Fig. 1;

Fig. 6 is cross-sectional view showing the assembly of two self-supporting panels of Fig. 1;

Fig. 7 is a perspective view of the roof of Fig. 5 showing the passage of electric cables, pipes and technological installations;

Figs. 7A, 7B, 7C, 7D are respectively enlarged views of the details contained in the ellipses A, B, C and D of Fig. 7;

Fig. 8 is a cross-sectional view of a third embodiment of a panel used to cover walls of buildings;

Fig. 9 is a cross-sectional view of a wall for buildings obtained with the self-supporting panels of Fig. 8;

Fig. 10 is a cross-sectional view of a fourth embodiment of a panel used for floors of buildings; and

Fig. 11 is a cross-sectional view of a floor obtained with the self-supporting panels of Fig. 10.

[0011] The self-supporting panel of the invention is disclosed with reference to the aforementioned figures.

[0012] Figs. 1 and 2 illustrate a first embodiment of the self-supporting panel that is generally indicated with reference numeral (100). Although the figures illustrate a rectangular panel, the panel of the invention can have different shapes.

[0013] Hereinafter, the terms "upper" and "lower" refer to the disposition of the panel as shown in the figures, it being understood that the self-supporting panel can be disposed in any position, e.g. in vertical or oblique position.

[0014] The self-supporting panel (100) comprises a lower plate (1), an upper plate (2), at least one stiffening section (3) disposed between lower plate and upper plate and a filling material (4) disposed between lower plate and upper plate. Optionally, the panel (100) can comprise a centering section (5).

[0015] The lower and upper plates are advantageously made of sheet metal; however said plates can be made of a different material, such as hard plastics. Preferably, the lower and upper plates are fretted or corrugated in order to have higher stiffness and resistance to bending.

[0016] Referring to Fig. 2, the lower plate (1) comprises two end ribs (10) that protrude upwards at the ends of the lower plate and define two downward-facing grooves (11). The end ribs (10) have a trapezoidal or tapered shape in cross-section for coupling of said panels.

[0017] Moreover, the lower plate (1) comprises two intermediate ribs (12) disposed in central position at a close

distance.

[0018] The upper plate (2) comprises two end ribs (20) that protrude upwards at the ends of the upper plate and define two downward-facing end grooves (21). The end ribs (20) of the upper plate have a trapezoidal or tapered shape in cross-section for coupling to other panels.

[0019] The upper plate (2) may comprise a central rib (22) that protrudes upwards and creates a central downward-facing groove (23).

[0020] The upper plate (2) comprises other intermediate ribs (24) that protrude upwards, disposed between central rib (22) and end ribs (20). The central rib (22) has substantially the same height as the end rib. Instead, the intermediate ribs (24) have a much lower height than the central rib (22).

[0021] The ribs (10, 12) of the lower plate (1) and the ribs (20, 22, 24) of the upper plate (2) extend for the entire length (longitudinal dimension) of the plates.

[0022] The stiffening section (3) is preferably made of steel; however it can be made of another material. The stiffening section (3) gives the panel (100) high stiffness and suitable mechanical resistance to make it self-supporting, e.g. the panel can stand by itself, resting on its ends and covering large distance without the need of additional intermediate supports.

[0023] The length and thickness of the stiffening section (3) are chosen according to the stiffness to be given to the panel. The stiffening section (3) can extend for the entire length (longitudinal dimension) of the panel (100).

[0024] The stiffening section (3) has a substantially "Ω" (omega) shape. The stiffening section (3) comprises two lateral walls (30) connected by a connection wall (31) provided with two folded edges that protrude externally with respect to the lateral walls (30). Each lateral wall (30) of the stiffening section ends with folded wings (32) that protrude outwards in parallel direction to the connection wall (31).

[0025] The distance between the ends of the two wings (32) is advantageously the same as the distance between two intermediate ribs (12) of the lower plate.

[0026] The connection wall (31) of the stiffening section is intended to be fixed to the upper plate (2), in central position, under the central rib (22) of the upper plate.

[0027] The wings (32) of the stiffening section are intended to be fixed to the lower plate (1), in central position, between the two intermediate ribs (12) of the lower plate acting as stop for the wings (31) and consequently as centering for the stiffening section (3).

[0028] In order to make the panel (100), the stiffening section (3) is inserted between the lower plate (1) and the upper plate (2) and filling material (4) is foamed between the lower plate and the upper plate in order to embed the stiffening section (3).

[0029] Alternatively, a core is disposed between the lower plate (1) and the upper plate (2), with an empty space without filling material, said stiffening section (3) being inserted in said empty space.

[0030] Referring to Fig. 7, the assembly of all elements

of the panel (100) is guaranteed by the joint fixing of the stiffening section (3) with the upper and lower plates (1, 2) and by a tubular lower section for connection and alignment (8) disposed at 90° with respect to the stiffening section (3) and fixed to the lower plate (1) and the stiffening section (3), for instance by means of screws.

[0031] Going back to Figs. 1 and 2, the centering section (5) has a trapezoidal shape in cross-section, complementary to the shape of the central groove (23) of the upper plate. In this way, the centering section (5) can be easily inserted into the central groove (23) of the upper plate. The centering section (5) is provided with base walls (50) that are fixed to the connection wall (31) of the stiffening section. Consequently, the centering section (5) is adapted to guide and center the stiffening section (3) in the panel.

[0032] The filling material (4) is advantageously a thermal-insulation and/or sound-absorbent material, such as for example expanded material or glass wool or rock wool.

[0033] The filling material (4) is arranged between the two plates (1, 2) in such way to fill only one end groove (21) of the upper plate (left side in Fig. 1), leaving without material the other end groove (21) of the upper plate (right side in Fig. 1).

[0034] The two end ribs (10) of the lower plate are not covered by filling material in order to allow for coupling between panels. In view of the above, the panel (100) is provided with a first empty space (40) only above one end rib (10) of the lower plate (left side in Fig. 1) and a second empty space (41) extending from the end rib (10) of the lower plate to the end groove (21) of the upper plate (right side in Fig. 1).

[0035] Hereinafter elements that are identical or corresponding to the ones described above are indicated with the same reference numbers, omitting their detailed description.

[0036] Fig. 3 shows a variant of the self-supporting panel (100) without the centering section (5). In such a case, the connection wall (31) of the stiffening section (3) comprises an upward-protruding rib (33) that is inserted into the central groove (23) of the upper plate, thus acting as centering for the stiffening section (3) with respect to the upper plate (2).

[0037] Although Figs. 1 - 3 show an embodiment of the invention wherein the stiffening section (3) is arranged between the two plates (1, 2), according to the present invention the stiffening section can be also disposed externally, above the upper plate (2) or under the lower plate (1).

[0038] Fig. 4 shows a second embodiment of the self-supporting panel of the invention, generally referred to with numeral (200). In such a case, the stiffening section (3) is arranged above the upper plate (1), and not between the lower plate (1) and the upper plate (2). The upper plate (1) is provided with a plurality of upward-protruding ribs (25).

[0039] The stiffening section (3) is arranged above a

rib (25) of the upper plate. The stiffening section (3) comprises a plurality of U-bolts (35) fixed between the two lateral walls (30) of the stiffening section. The U-bolts (35) are fixed to the rib (25) of the upper plate by means of screws and allow for joint connection with the lower tubular section for connection and perfect alignment.

[0040] At least one tubular section for connection and alignment (8) is fixed under the lower plate (1). The tubular section for connection and alignment (8) is disposed at 90° with respect to the stiffening section (3).

[0041] Although Fig. 4 shows an embodiment of the invention wherein the stiffening section is fixed on the upper plate (2), the stiffening section (3) can be likewise fixed to the lower plate (1).

[0042] Fig. 5 shows a roof (6) comprising a plurality of self-supporting panels (100) connected side-by side.

[0043] As shown in Fig. 6, the connection of two self-supporting panels (100) is made by inserting the end ribs (20, 10) of the upper and lower plates of a first panel (right panel of Fig. 6) inside the end grooves (21, 11) of the upper and lower plates of a second panel (left panel of Fig. 6). It must be noted that this operation is made possible by the empty space (40) of the first panel that receives the end rib (10) of the lower plate of the second panel and by the empty space (41) of the second panel that receives the end groove (20) of the upper plate of the first panel.

[0044] Figs. 7, 7A, 7B, 7C and 7D describe a variant of the roof (6) with housings for passage of electrical cables (7) and pipes or ducts (9).

[0045] Fig. 7C shows a solution wherein a housing is obtained between the two lateral walls (30) of the stiffening section (3) for passage of at least one pipe or duct (9) surrounded by the filling material (4). Said duct (9) can be used for electrical cables and/or pipes longitudinally crossing the entire panel (100).

[0046] Fig. 7A shows a solution wherein an empty space or chamber (35) is obtained between the two lateral walls (30) of the stiffening section (3) for electrical cables (7) and/or pipes arranged above the lower plate (1).

[0047] As shown in Fig. 7B, the lower plate (1) comprises holes or slots (15) in communication with holes or slots (80) of the tubular section for connection and alignment (8) acting as support for the entire panel (100) to support it on an upper beam. The tubular section for connection and alignment (8) is fixed to the lower plate (1) by means of fixing systems and accessories and extends along the transversal direction of the panels. In view of the above, the electrical cables (7) of the empty space (35) of the stiffening section are inserted into the tubular section for connection and alignment (8) passing through the slots (15, 80) of the lower plate and the tubular section for connection and alignment. Therefore, the electrical cables (7) come out from the end of the tubular section for connection and alignment (8), as shown in Fig. 7D.

[0048] The tubular section for connection and alignment (8) supports the lower plate (1) because it is

screwed onto the wings (31) of the stiffening elements. Therefore, the tubular section for connection and alignment (8) acts both as mechanical connection between the stiffening sections (3) and as channel for cables and/or pipes of electrical and technical installations in general, concealing them from sight and protecting them from accidental direct contact, thus optimizing the result in terms of aesthetics and safety.

[0049] Fig. 8 shows a third embodiment (300) of a panel for walls of buildings. In such a case, the upper plate (2) is substantially identical to the lower plate (1). In fact, the upper plate (2) comprises two downward-facing end ribs (10) and two downward-facing intermediate ribs (12). In view of the above, the ribs (10, 12) of the lower plate (1) and the upper plate (2) are faced towards the inside of the panel and do not interfere with the wall whereon the panel is positioned.

[0050] The upper wall (31) of the stiffening section (3) is disposed between the two intermediate ribs (12) of the upper plate (2), in such a way to be centered with respect to the upper plate (2).

[0051] It must be noted that one side of the panel is provided with the first empty space (40) in the end rib (10) of the lower plate, whereas the other side of the panel is provided with the second empty space (41) between the two end ribs (10) of the lower plate and the upper plate.

[0052] Fig. 9 shows a wall (T) comprising a plurality of panels (300) connected side-by side. In such a case, the end rib (10) of the lower plate of a first panel is inserted into the end groove (11) of the lower plate of a second panel and simultaneously the end rib (10) of the upper plate of the second panel is inserted into the end groove (11) of the lower plate of the first panel.

[0053] One or more tubular section for connection and alignment (8) are fixed to the lower plate (1) and disposed at 90° with respect to the stiffening sections (3).

[0054] Fig. 10 shows a fourth embodiment (400) of a panel for floors of buildings. In such a case, the upper plate (2) is corrugated with saw-toothed profile. The upper plate is provided with a plurality of upward-facing ribs (26) separated by grooves (27) open towards the top. The grooves (27) substantially have the same shape as the ribs.

[0055] In such a case the stiffening section (3) is turned upside down with respect to the previous examples. In fact, the connection wall (33) of the stiffening profile is fixed to the lower plate (1) between the intermediate ribs (12), whereas the wings (32) of the stiffening section are fixed to the upper plate (2) under two ribs (26) separated by a groove (27).

[0056] The upper plate (2) is provided with two end grooves (28) defining downward-facing end ribs (29). Therefore, in order to connect two panels (400), the end ribs (10) of the lower plate of a first panel are inserted into the end grooves (11) of the lower plate of a second panel and the end rib (29) of the upper plate of the first panel is inserted into the end groove (20) of the upper

plate of the second panel.

[0057] Fig. 11 shows a floor (S) comprising panels (400) connected side-by side. In such a case, a concrete layer (CS) is laid on the upper surface of the upper plate (2) in such manner to fill the the grooves (27) and cover the ribs (26).

[0058] It must be noted that the various types of self-supporting panels (100; 200; 300; 400) can be produced in the factory as elements with width equal to the maximum size for road transportation (approx. 2.5 m), thus optimizing and reducing assembly costs and time with respect to the panels that are currently available on the market (1 m max. width). Moreover, the above simplifies the operations that must be carried out on the building site to install the panels, with a significant reduction of costs.

[0059] In addition, the present invention makes it possible to build panels (100; 200; 300; 400) with different load-bearing capacity according to the general characteristics of the building (for example, the distance between panel supports and loads to withstand), by simply changing the dimensional features (height, thickness of sections and shells and thickness of insulation material in particular, or type of material) of the stiffening section (3). This makes it possible to obtain the desired load-bearing capacity, without wasting money for overdimensioned elements with respect to the real needs.

[0060] Numerous variations and modifications can be made to the present embodiments of the invention, within the reach of an expert of the field, while still falling within the scope of the invention described in the enclosed claims.

Claims

1. A panel (100; 200; 300; 400) for roofs, walls and/or floors of buildings, comprising:

- a lower plate (1),
- an upper plate (2),
- a filling material (4) disposed between lower plate (1) and upper plate (2),

characterized in that it also comprises

- at least one self-supporting stiffening section (3) fixed to the panel, in order to make the self-supporting panel stand by itself, resting on its ends, without the need for additional intermediate supports; and
- a tubular section for connection and alignment (8) disposed at 90° with respect to the self-supporting stiffening section (3) is fixed to the lower plate (1) of the panel.

2. The panel (100; 200; 300; 400) of claim 1, **characterized in that** said stiffening section (3) is made of

steel.

3. The panel (100; 200; 300; 400) of claim 1 or 2, **characterized in that** said stiffening section (3) extends for the entire length of the panel.
4. The panel (100; 200; 300; 400) of any one of the preceding claims, **characterized in that** said stiffening section (3) has a substantially "Ω" (omega) shape and comprises two lateral walls (30) connected by a connection wall (32) that protrudes externally with respect to the lateral walls (30), wherein each lateral wall (30) of the stiffening section ends with wings (32) that protrude outwards in parallel direction to the connection wall (31).
5. The panel (100; 200; 300; 400) of any one of the preceding claims, **characterized in that** said lower plate (1) and said upper plate (2) are made of sheet steel.
6. The panel (100; 200; 300; 400) of any one of the preceding claims, **characterized in that** said lower plate (1) and said upper plate (2) are fretted or corrugated.
7. The panel (100; 200; 300; 400) of any one of the preceding claims, **characterized in that** said lower plate (1) and said upper plate (2) comprise end ribs (10; 20; 29) that define end grooves (11; 21; 28) adapted to receive the end ribs (10; 20; 29) of the adjacent panel in order to connect two panels.
8. The panel (100; 200; 300; 400) of any one of the preceding claims, **characterized in that** said filling material (4) is a thermal-insulation and/or sound-absorbent material.
9. The panel (100; 300; 400) of any one of the preceding claims, **characterized in that** said stiffening section (3) is arranged between said lower plate (1) and upper plate (2).
10. The panel (100; 300) of claim 9, **characterized in that** said lower plate (1) comprises intermediate ribs (12) spaced by a distance equal to the distance between the ends of the two wings (32) of the supporting section in such manner to act as centering for the supporting section on the lower plate.
11. The panel (100) of any one of the preceding claims, **characterized in that** said upper plate (2) comprises a central rib (22) that protrudes upwards and defines a central groove (23) and said panel comprises centering means (33; 5) that engage in said central groove (23) of the upper plate to center said stiffening section (2) with respect to the upper plate.

12. The panel (100) of any one of the preceding claims,
characterized in that it comprises:

- a chamber (35) to receive electrical cables (7)
 or pipes of the building, said chamber (35) being
 provided between the lateral walls (30) of said
 stiffening section (3) and defined by the lower
 plate (1) and/or by the walls of the stiffening sec-
 tion (3). 5
- a duct (9) disposed between the lateral walls
 (30) of said stiffening section (3) and surrounded
 by said filling material (4). 10

13. A roof (6) for buildings comprising a plurality of pan-
 els (100) according to claim 12, assembled side- by-
 side, **characterized in that** said tubular section for
 connection and alignment (8), which is fixed in trans-
 versal direction under said lower plates (1) of the
 panels, comprises slots (80) in communication with
 slots (15) of the lower plates for passage of said ca-
 bles or pipes contained in the chamber (35) . 15 20

14. A wall (T) for buildings comprising a plurality of pan-
 els (300) according to any one of claims 1 to 10,
 assembled side- by- side, wherein each panel (300) 25
 comprises a lower plate (1) with ribs (10, 12) that
 protrude towards the inside of the panel and an upper
 plate (2), substantially identical to the lower plate and
 provided with ribs (10, 12) that protrude towards the
 inside of the panel and a tubular section for connec-
 tion and alignment (8) . 30

15. A floor (S) for buildings comprising a plurality of pan-
 els (400) according to any one of claims 4 to 9, as-
 sembled side- by- side, wherein each panel (400) 35
 comprises an upper fretted plate (2), with saw-
 toothed profile, provided with a plurality of upward-
 protruding ribs (26) spaced with a plurality of grooves
 (27), said stiffening section (3) having the connection
 surface (33) connected to the lower plate and the
 two wings (32) connected to the upper plate under
 two ribs (26) spaced by a groove (27) and a tubular
 section for connection and alignment (8) . 40

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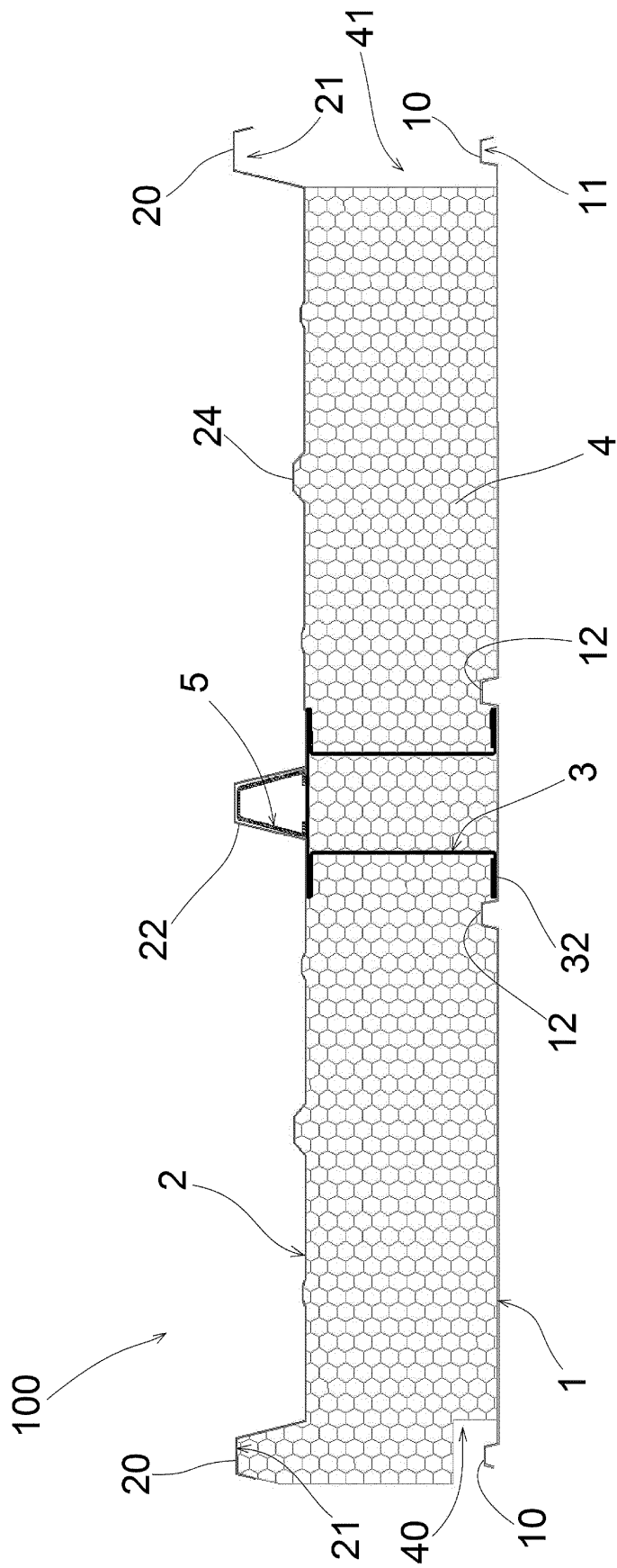
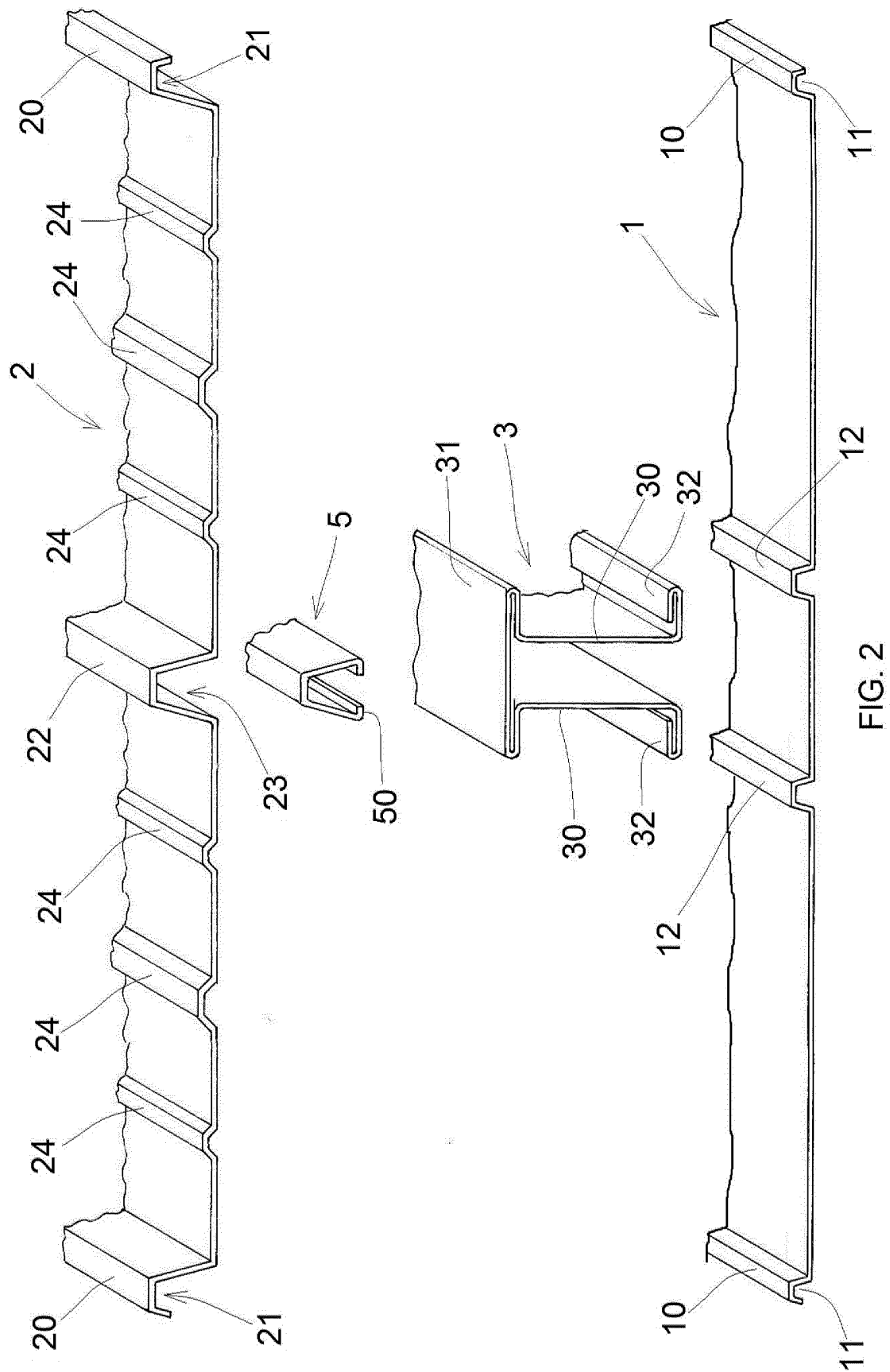
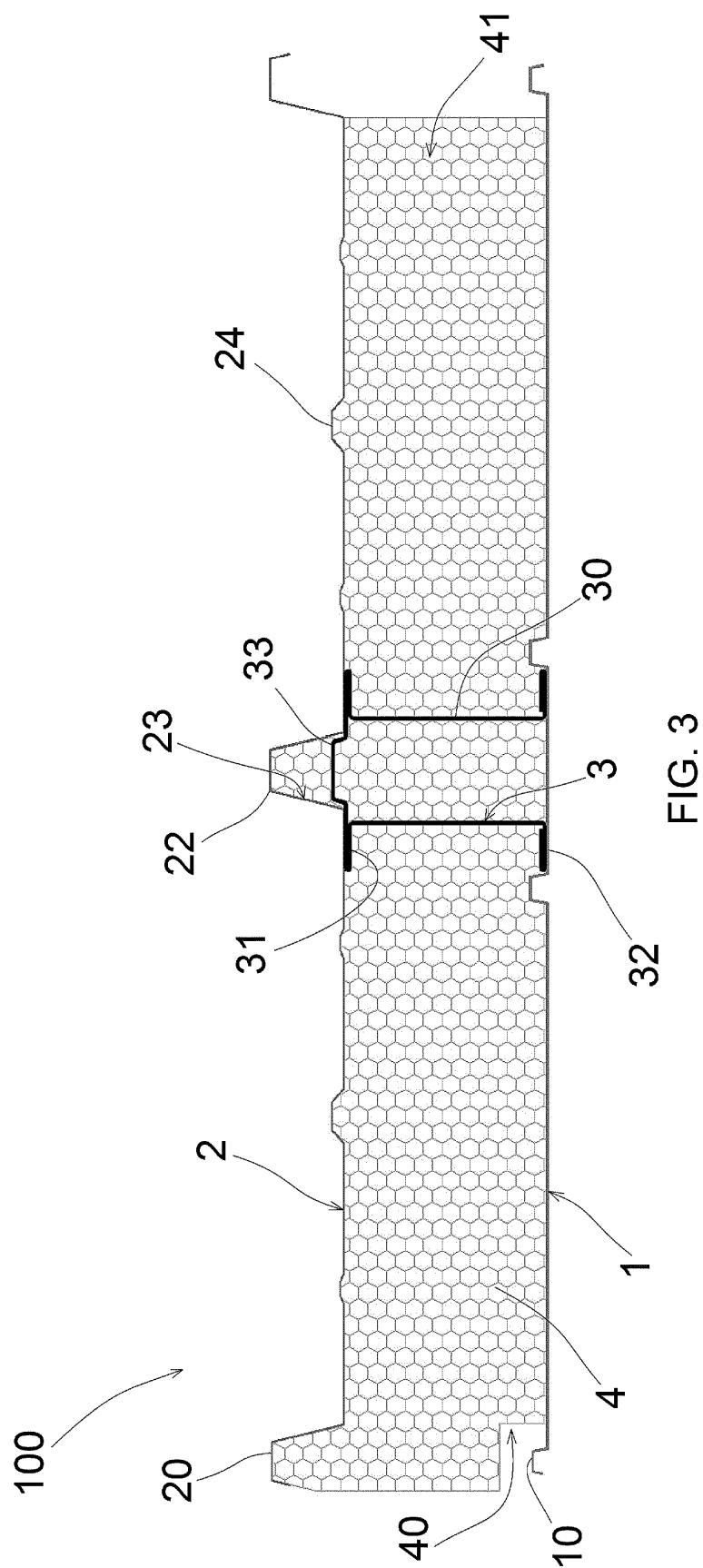


FIG. 1





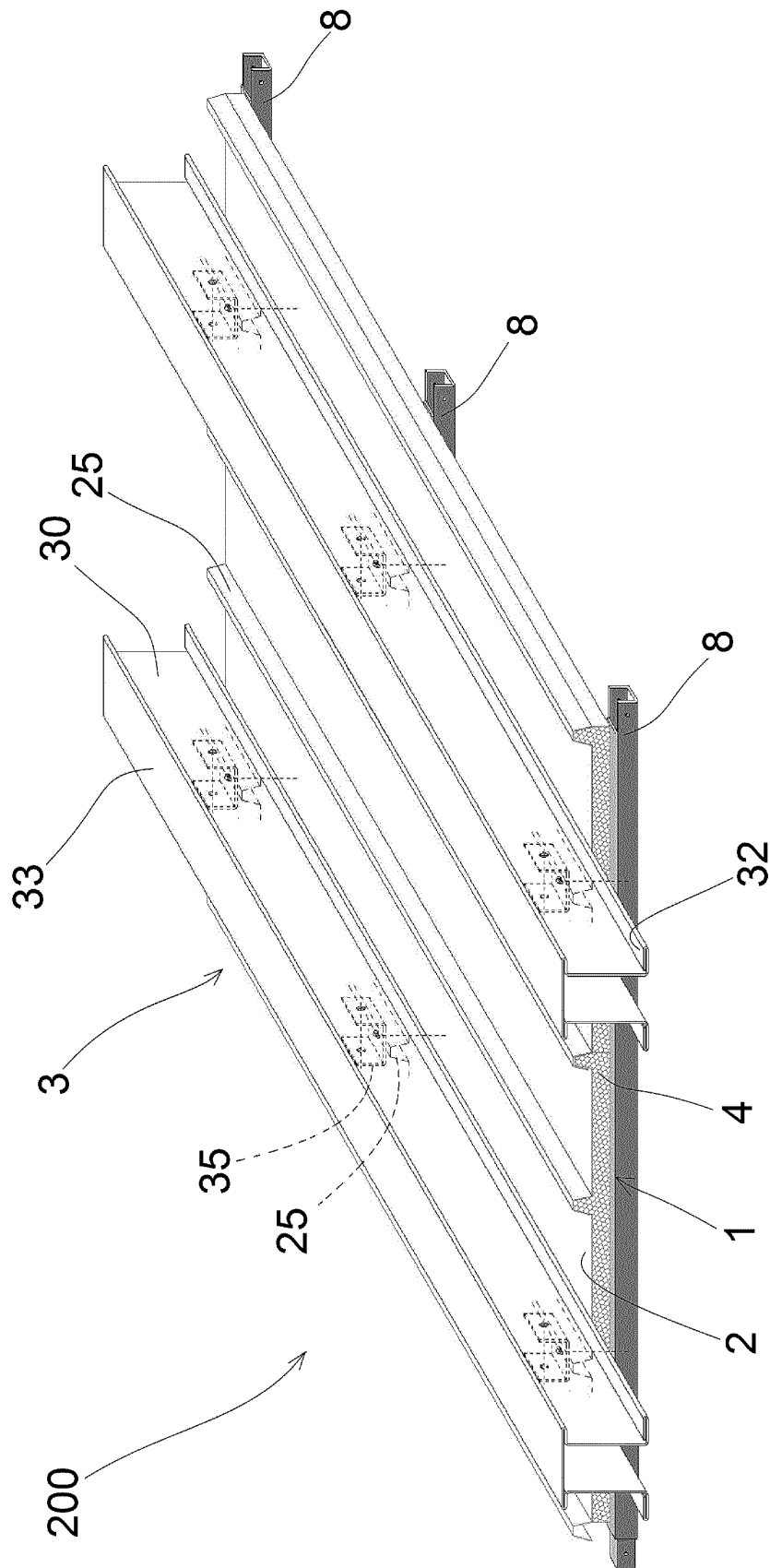
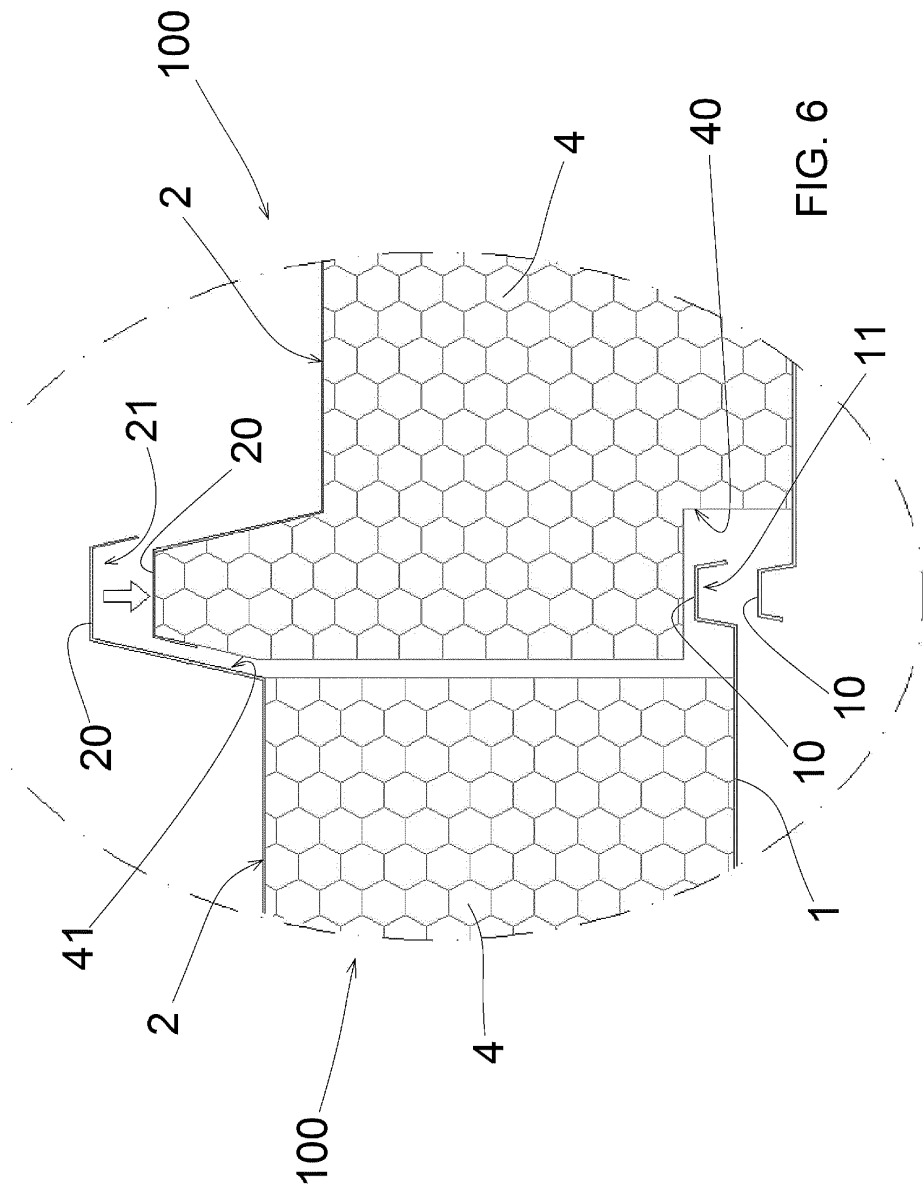
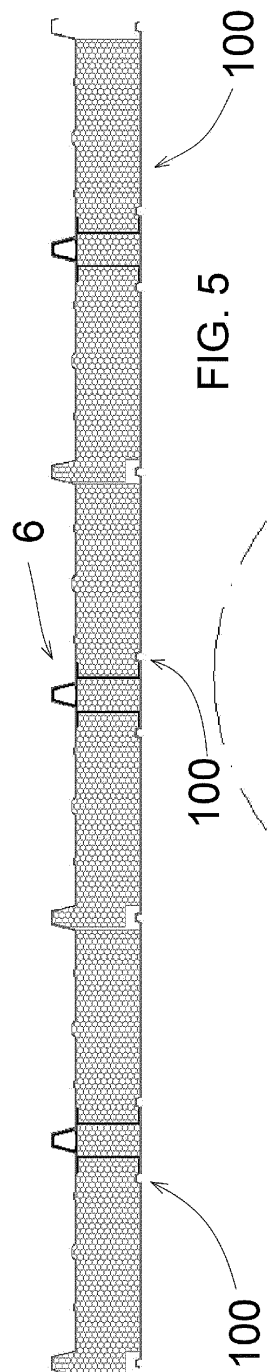
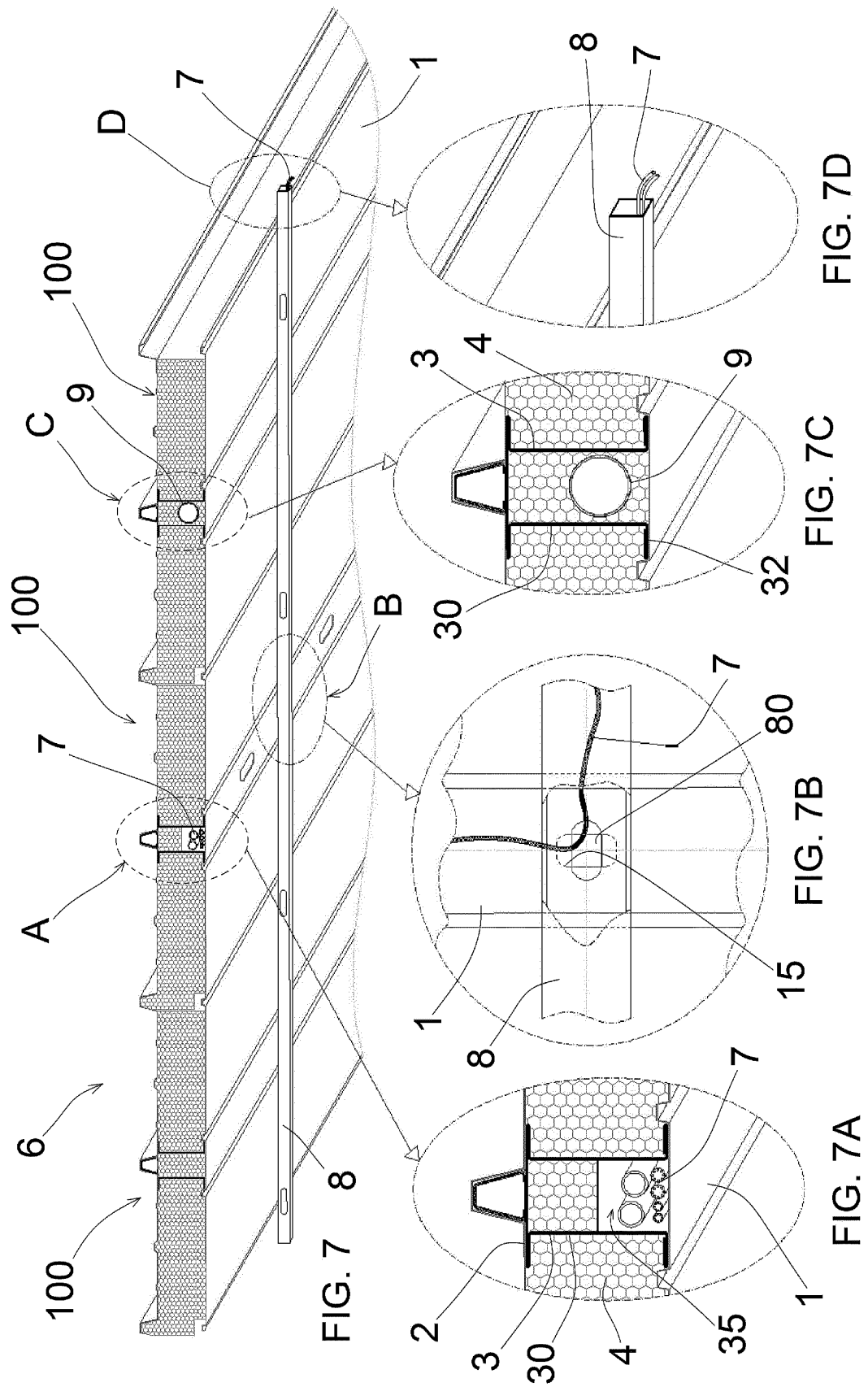


FIG. 4





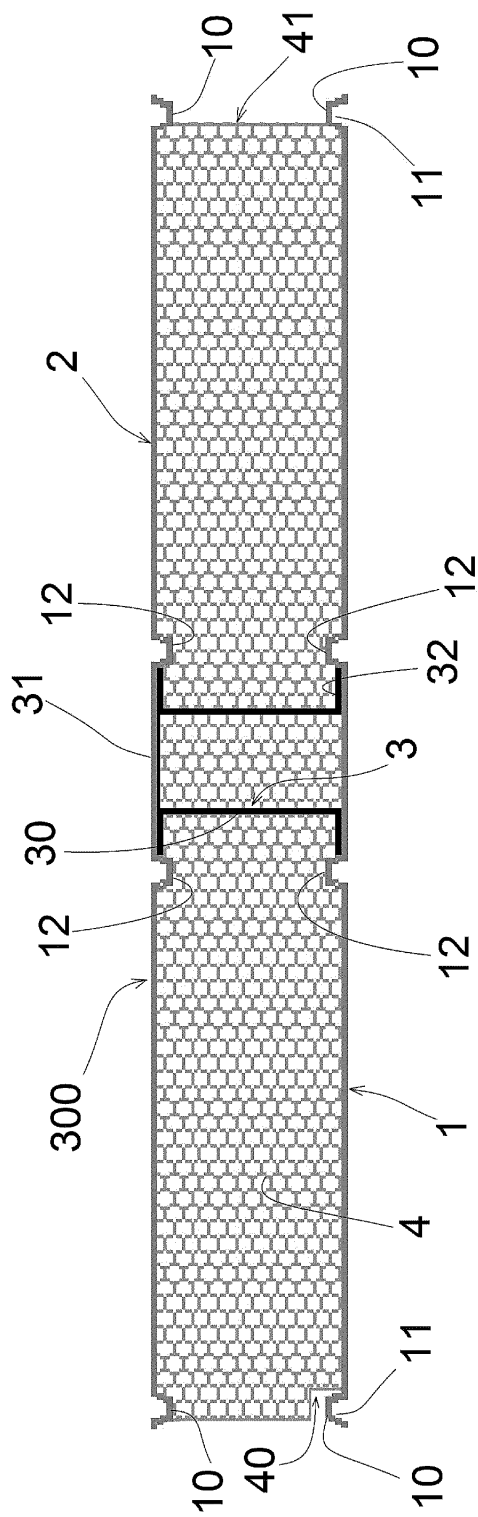


FIG. 8

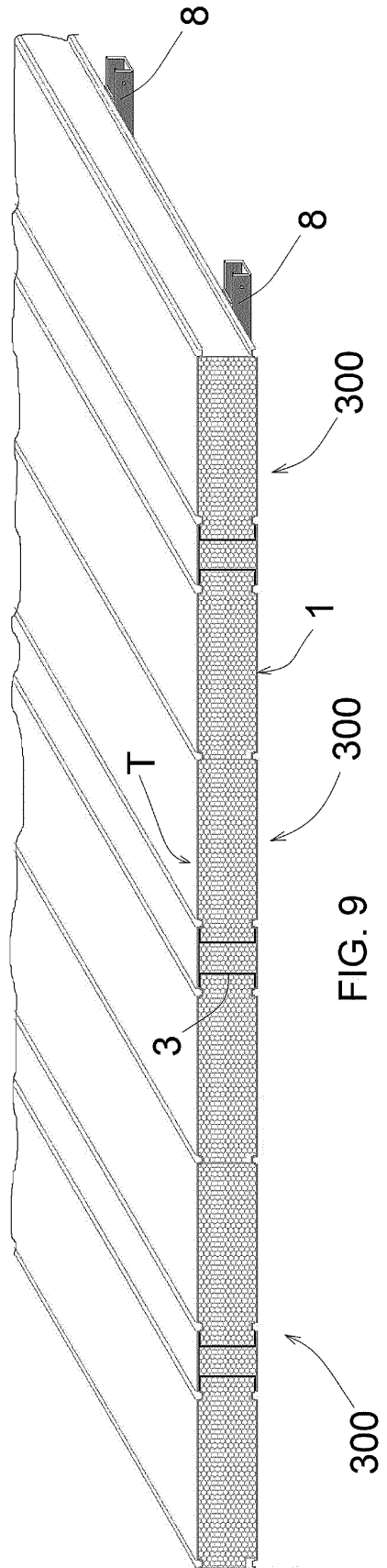
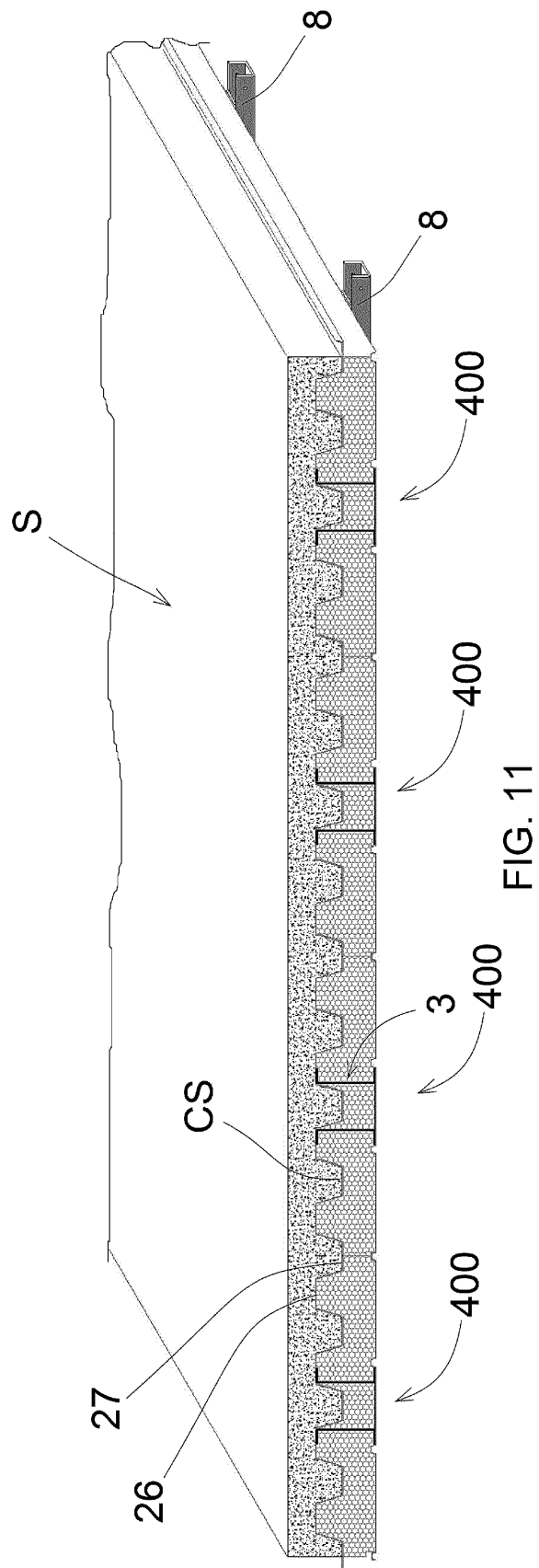
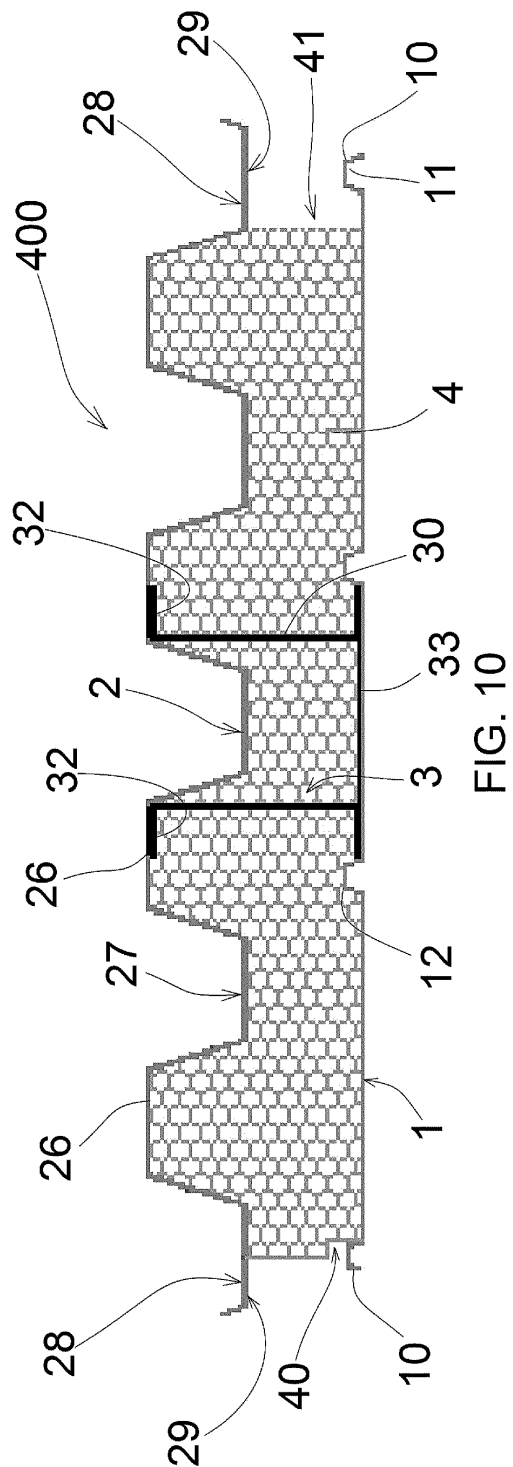


FIG. 9





EUROPEAN SEARCH REPORT

Application Number
EP 13 15 8710

DOCUMENTS CONSIDERED TO BE RELEVANT			
Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
Y	US 6 085 485 A (MURDOCK DOUGLAS G [CA]) 11 July 2000 (2000-07-11) * column 6, line 15 - column 9, line 43; figures 1-8 *	1-15	INV. E04C2/296 E04D3/35
Y	DE 299 21 554 U1 (VIESMANN HANS [DE]) 23 March 2000 (2000-03-23) * figure 6 *	1-15	
Y	EP 1 347 111 A1 (BREMET BREVETTI METECNO S P A [IT] METECNO IND S P A [IT]) 24 September 2003 (2003-09-24) * claim 1; figures 1,5,6 *	1-15	
A	WO 02/092932 A1 (PAROC GROUP OY AB [FI]; HESELIUS LARS [FI]; WILLMAN TARMO [FI]; LYNDER) 21 November 2002 (2002-11-21) * claim 1; figure 1b *	12	
The present search report has been drawn up for all claims			TECHNICAL FIELDS SEARCHED (IPC)
			E04C E04D E04B
Place of search		Date of completion of the search	Examiner
The Hague		2 July 2013	Mysliwetz, Wolfgang
CATEGORY OF CITED DOCUMENTS		T : theory or principle underlying the invention E : earlier patent document, but published on, or after the filing date D : document cited in the application L : document cited for other reasons & : member of the same patent family, corresponding document	
X : particularly relevant if taken alone Y : particularly relevant if combined with another document of the same category A : technological background O : non-written disclosure P : intermediate document			

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EPO FORM 1503 03.02 (P04C01)

**ANNEX TO THE EUROPEAN SEARCH REPORT
ON EUROPEAN PATENT APPLICATION NO.**

EP 13 15 8710

This annex lists the patent family members relating to the patent documents cited in the above-mentioned European search report.
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02-07-2013

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