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

(19) World Intellectual Property Organization
International Bureau

(43) International Publication Date
24 September 2015 (24.09.2015)

WIPO | PCT

(10) International Publication Number
WO 2015/140715 A1

(51) International Patent Classification:
E04B 1/16 (2006.01) *B26D 3/00* (2006.01)
E04C 2/20 (2006.01)

(21) International Application Number:
PCT/IB2015/051954

(22) International Filing Date:
17 March 2015 (17.03.2015)

(25) Filing Language: Italian

(26) Publication Language: English

(30) Priority Data:
MI2014A000447 18 March 2014 (18.03.2014) IT

(72) Inventor; and
(71) Applicant : FANTINI, Valentino [IT/IT]; Via Torriane 11/a, I-28013 Gattico (no) (IT).

(74) Agent: OTTAZZO, Marco; c/o Barzanò & Zanardo Milano S.p.A., Via Borgonuovo, 10, I-20121 Milano (IT).

(81) Designated States (*unless otherwise indicated, for every kind of national protection available*): AE, AG, AL, AM, AO, AT, AU, AZ, BA, BB, BG, BH, BN, BR, BW, BY, BZ, CA, CH, CL, CN, CO, CR, CU, CZ, DE, DK, DM, DO, DZ, EC, EE, EG, ES, FI, GB, GD, GE, GH, GM, GT, HN, HR, HU, ID, IL, IN, IR, IS, JP, KE, KG, KN, KP, KR, KZ, LA, LC, LK, LR, LS, LU, LY, MA, MD, ME, MG, MK, MN, MW, MX, MY, MZ, NA, NG, NI, NO, NZ, OM, PA, PE, PG, PH, PL, PT, QA, RO, RS, RU, RW, SA, SC, SD, SE, SG, SK, SL, SM, ST, SV, SY, TH, 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, LR, LS, MW, MZ, NA, RW, SD, SL, ST, SZ, TZ, UG, ZM, ZW), Eurasian (AM, AZ, BY, KG, KZ, RU, TJ, TM), European (AL, AT, BE, BG, CH, CY, CZ, DE, DK, EE, ES, FI, FR, GB, GR, HR, HU, IE, IS, IT, LT, LU, LV, MC, MK, MT, NL, NO, PL, PT, RO, RS, SE, SI, SK, SM, TR), OAPI (BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW, KM, ML, MR, NE, SN, TD, TG).

Published:
— *with international search report (Art. 21(3))*

(54) Title: METHOD FOR PRODUCING A SLAB OF INSULATING MATERIAL FOR USE IN BUILDINGS, TAILORED-MODULE SYSTEM COMPRISING SUCH A SLAB AND METHOD FOR MAKING A COMPOSITE WALL USING SUCH A SLAB

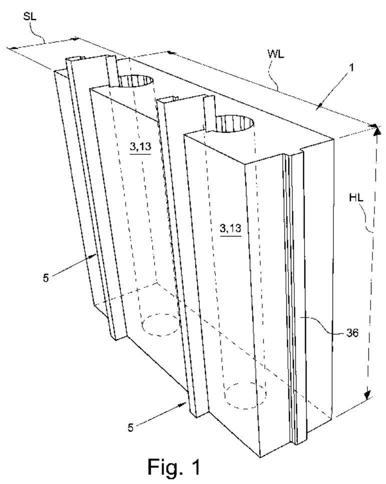

Fig. 1

(57) Abstract: The invention describes a method for producing a slab (1) made of insulating material for use in building. The slab (1) comprises a plurality of passing channels (3) that pass from one side of the slab (1) to the other in a direction substantially parallel to the two major faces of the slab (1) itself. In order to make a composite wall one or more slabs (1) are erected, then jets of concrete are cast into the channels (3), possibly after having inserted iron reinforcement cages (11) for reinforced concrete into the channels (3). Then the concrete jets are allowed to solidify, so as to obtain a pillar (13) within each channel (3).

WO 2015/140715 A1

METHOD FOR PRODUCING A SLAB OF INSULATING MATERIAL FOR USE IN BUILDINGS, TAILORED-MODULE SYSTEM COMPRISING SUCH A SLAB AND METHOD FOR MAKING A COMPOSITE WALL USING SUCH A SLAB

The present invention concerns a slab made of insulating material for use in building, able to be used in particular to make external and internal walls of buildings, partition walls and retaining walls. The invention also concerns a tailored-module system comprising the aforementioned slab, as well as a method for making a composite wall made of alternative materials to conventional ones made of solid cement or of bricks.

In order to make walls or partition walls of buildings that are lighter and capable of providing greater thermal and sound insulation, prefabricated modular systems are currently known for making mixed structures of concrete and alternative material to those in use in conventional building. An example of these known systems is described in document EP 0 163 117 A1 and foresees the construction of a wall by putting together a plurality of blocks or "bricks" made of foamed plastic material. The assembled blocks form vertical channels that run through the inside of the wall for its entire height and are configured to be filled with concrete jets. The latter, once set, forms a series of pillars that give the wall the necessary structural strength. The authors of the present invention have observed that such a prefabricated system still has some drawbacks. The construction of such a wall requires that a relatively large number of blocks be laid down, and therefore needs a long and expensive manual work step. The numerous separating surfaces between the blocks constitute an equally large number of potential, if not actual, routes for infiltration of external humidity. In order to be able to make their complex shape at acceptable costs, the blocks must be obtained from a mould, making it relatively expensive, for example, to adapt the interaxial distance between the pillars from one installation to another.

Further prefabricated modular systems for making mixed structures of concrete and insulating materials are described, for example, in documents WO 2011/060118 A2, US 5 645 542 A and DE 102 51 286 A1. Typically, the slabs made of insulating material of known systems are manufactured through direct moulding. Manufacturing through direct moulding, however, imposes some shape and size constraints, not allowing panels of all shapes and sizes to be made.

A purpose of the present invention is to avoid the aforementioned drawbacks of the state of the art, and in particular to provide a tailored-module system and a method for making walls, partition walls or other parts of buildings, made of thermally insulating materials that are lighter than concrete or known bricks, which are quicker and simpler to apply with respect to modular systems that are currently known.

Such a purpose is achieved with a method for producing a slab made of insulating material for use in building having the characteristics according to claim 1. Further characteristics of the invention are the object of the dependent claims.

The advantages that can be obtained with the present invention will become clearer, to the person skilled in the art, from the following detailed description of some particular non-limiting embodiments thereof, illustrated with reference to the following schematic figures.

Figures 1 and 2 respectively show a first and a second perspective view of a slab, with relative guides, of a tailored-module system according to a first embodiment of the invention;

figure 3 shows a perspective view of a mounting guide of the slab of figure 1;

figure 4 shows a perspective view of an instance of an example of mounting the tailored-module system of figure 1;

figure 5 shows a slab of a tailored-module system according to a second embodiment of the invention; and

figure 6 shows a perspective view of a machine for producing the slabs of figure 2.

Figures 1-4 and 6 relate to a tailored-module system for making walls, partition walls and other parts of buildings according to a particular embodiment of the invention. Such a tailored-module system comprises one or more slabs 1, each of which comprises a plurality of passing channels 3 that pass from one side of the slab to the other in a direction substantially parallel to the two major faces of the slab itself (figure 1). The slab is advantageously made of one or more thermally insulating materials, like for example a foamed polymeric material, wood or wood fibre, rock wool, mineralised wood.

Particularly advantageous materials for properties of thermal and acoustic insulation, mechanical strength and suitability for containing jets of concrete, i.e. steel/wood bars or beams with or without the presence of concrete, which will go to form the pillars 13, lightness and ease of processing and handling also on the worksite are foamed polystyrene (EPS) or extruded polystyrene foam (XPS).

Preferably, the slab is advantageously made of a material having a thermal conductivity, measured according to the standard EN 12667, of 0.3 W/(mK) or less, more preferably of 0.05 W/(mK) or less and even more preferably of 0.035 W/(mK) or less.

Advantageously, the slabs 1 have a height HL, in a direction parallel to that of the passing channels 3, of 0.5 metres or more, more preferably of 1 metre or more and even more preferably of 1.5-2 metres or more, so that a single slab 1 extends over the entire height of the wall that it is to be part of. For this purpose, the two smaller faces of the slab 1 onto which the channels 3 open preferably form flat surfaces, so as to be able to be formed also by simply cutting a slab and not necessarily through moulding or complicated milling processing.

As an example, the width WL of the slabs 1 can for example be of 0.3 metres or more, comprised between 0.9-2.4 metres, comprised between 1-1.4 metres, or even equal to 1.2 metres.

The slabs 1 can form part of a tailored-module system of prefabricated slabs that comprises different slabs the widths of which WL′, WL″ can be sub-multiples of the width WL of the slab 1. For example, the width can be WL′ = WL/2; WL″ = WL/4; WL‴ = WL/2,66667. For example, if the width is WL = 1.2 m, the sub-multiple widths of the slabs WL', WL", WL''' , WL can be equal to 5 cm, 10 cm, 15 cm, 0.3 m, 0.45 m, 0.6 m.

Again as an example, the slabs 1 can have a thickness SL of 0.15 metres or more, of 0.25 metres or more, of 0.30 metres or more, comprised between 0.25-1 metres or else comprised between 0.25-0.5 metres.

Preferably in the slabs 1 the ratio between the minimum dimension between height HL and width WL, and the thickness SL, is of 3 times or more, i.e. it is:

$$(\mathrm{Min}\ (HL,\ WL))/(SL) \geq 3$$

and more preferably it is of 4 or more or 5 times.

The passing channels 3 preferably extend rectilinearly and are of shape and size such as to be able to contain jets of concrete and possible iron reinforcement cages, or steel/wood bars or beams with or without the presence of concrete, and thus be able to be used as disposable formwork, as will be described in more detail hereafter. For this purpose each channel 3 preferably has a minimum passing section of 50 square centimetres (cm^2) or more, more preferably of 77-80 cm^2 or more and even more preferably of 175-180 cm^2 or more.

Preferably the passing channels are obtained by cutting, milling or perforating a full slab, for example with the hot wire method. Such processing also makes the production of small batches of slabs 1 economically advantageous, sufficient to make a single installation or project (like for example the construction of a new building or the restructuring, raising, seismic reinforcement of an old building) and make it possible to adapt the interaxial distance between the channels 3, and therefore between the pillars 13, with substantial freedom and fairly low costs based on the specific requirements of the project itself.

The hot wire method can be advantageously exploited in the following way: the cut 30, which is used by the hot wire to reach the inner area of the slab in which to cut a channel 3, preferably lies in a plane passing through the axis of the channel 3 and inclined according to a predetermined angle with respect to the major faces of the slab 1 (figure 2). The plane can be both perpendicular to the major faces of the slab 1, and oblique, for example for anti-seismic structures.

A metallic guide 5, in particular the central portion 50 of its cross section, is inserted into the cut 30. A portion of the mounting guide 5 projects outside of the slab 1 and preferably forms a resting area 52 that substantially lies in a plane parallel to the major faces of the slab 1. Possibly, an edge 54 of the guide portion that projects outside of the slab 1 bends so as to insert back into the slab 1, for example inside a further slit 34 that also runs longitudinally to the channel 3. Preferably another portion of the guide 5 reaches the channel 3 and an edge thereof 56 bends (for example in a U) so as to insert into a third slit 32 that extends longitudinally to the channel 3 and, starting from the inner wall thereof, penetrates into the material of the slab 1 without however reaching the outside. The couplings with the slits 30, 32 and 34 make it possible to very firmly fix the guide 5 to the slab 1 before casting the concrete in the channels 3, in particular preventing the cross sections of the guide from rotating with respect to the slab.

Thanks to such an arrangement, the guides 5 are embedded in the concrete of the future pillars 13 that will be cast in the holes 3, or at least rest directly against such pillars 13, and therefore discharging the forces that the guides 5 may be subjected to onto them instead of onto the material of the slab 1.

Preferably, on the smaller faces of the slab 1 parallel to the channels 3 couplings are formed, for example of the male/female type with longitudinal ribs 36 that insert into longitudinal throats 38, to couple and constrain an edge of a slab 1 to that of a second slab 1 analogous and adjacent to the first.

Each slab 1 can be grooved so as to obtain open grooves. Each slab 1 can thus be used to make horizontal structures for floors. The grooves are configured to receive the beam made of reinforced concrete of the floor of any width and pitch.

If in structural terms the load-bearing capacity of a single pillar 13 were not sufficient, it is possible to lengthen the section of such a pillar 13 creating dividing or load-bearing walls in the slab 1. In order to counteract the thrust of the concrete being cast, longitudinal grooves are made with respect to the development plane of the slab 1 and plastic connectors are inserted transversally. Such dividing or load-bearing walls can have any length and thickness with a maximum of 50 cm.

The slabs 1 are produced with the method and the machine shown in figure 6. Such a machine, indicated with overall reference numeral 100, comprises a work table or plane 102 to which a plurality of cutting devices 104 is fixed, like for example cutting dies, blades or punches. The work plane 102 can be a simple metallic plane, or a plane with rollers, idle or motorised, which promote the advancing of the semi-finished blocks or panels 106 described in greater detail hereafter.

Each cutting die 104 is preferably formed from one or more suitably shaped metal sheets. The cutting dies 104 that must cut the channels 3 can comprise a tubular portion 108 and a sustaining portion 110, which supports the tubular portion 108 keeping it in a predetermined position with respect to the work plane 102. The machine 100 can also comprise other cutting dies 112, 114 arranged to cut the longitudinal ribs 36 or the longitudinal throats 38 that run along the lateral edges of the slabs 1, and possibly trim such edges.

The machine 100 is advantageously provided with an advancing system, not shown, arranged to advance a semi-finished block or panel 106 of EPS, XPS or other foamed plastic material, along a predetermined direction F. The advancing system can for example comprise motorised wheels or rollers, pneumatic cylinders or drive chain systems.

The machine 100 can be used by heating the cutting dies, knives or punches 104, 112, 114 up to a temperature such as to melt the plastic material of the slabs 1. A semi-finished block or panel 106 is rested and slid on top of the work plane 102 according to a predetermined direction F, so that it hits the cutting dies 104, 112, 114 and the latter dig or cut into the block 106, with very fast, cost-effective and flexible machining, the channels 3, the ribs 36, the throats 38 and/or the grooves. Advantageously, the sustaining portions 110 cut the slits 30 that extend from a wall of a respective channel 3 up to one of the two major faces of the finished slab 1 and receive the metallic guides 5.

Advantageously, the position of the cutting dies 104, 112, 114 on the work plane 102 can be changed, in particular in directions parallel to the same work plane 102, thus varying the interaxial distance between the channels 3 that are formed. The costs for this processing change are practically negligible and this makes it possible to produce small batches of slabs 1, at very competitive costs, with the most suitable interaxial distance between the channels 3 for a specific project.

With respect to manufacturing with standard machinery, like for example hot wire pantographs for processing polystyrene, the method according to the present invention thus allows fast processing of the slabs 1 at very low cost. The semi-finished block or panel 106 runs in line in the machine 100 and meets the cutting dies, blades or punches 104, heated and pre-formed, which sublimate the EPS. In conventional pantographs, on the other hand, the panel is immobile and it is the standard tool that moves. The semi-finished block or panel 106 can have any length.

The machine 100 can produce even two slabs 1 simultaneously, with all of the channels 3, the ribs 36, the throats 38 and/or the grooves required, and therefore it has greater productivity than pantographs.

The machine 100 cannot be provided with programming, is simple to use and does not therefore require highly trained workers, or high programming and tuning costs. The machine 100 is of small dimensions, so as to be able to be transported on a normal truck and positioned even on the building yard. The investment for making a machine 100 is less (roughly 50%) with respect to that necessary for a pantograph and is considerably less (more than ten times less) with respect to what is required to fit out a plant for moulding slabs made of EPS.

An example of application and use of the tailored-module system described above will now be illustrated. On a floor, foundation or base P suitable floor guides 7, which can for example be rods or bars with L-shaped cross-section, and the fastening plates 9 to which to anchor the future load-bearing structure made of concrete or reinforced concrete inside the slabs 1 themselves, are fixed. The slabs 1, with the relative guides 5 already mounted, are applied referring to the floor guides 7 and plumbed referring for example to the guides 5. Advantageously, the slabs 1 were produced with a height HL equal to that of the entire wall to be made, thus making it faster and easier to make the wall and substantially reducing the manual application operations.

Preferably, on top of the modular slabs 1 suitable lintel modules 8 are arranged, having the function of structurally connecting the concrete casts of the different pillars 13 to each other or to the cast of a second floor, foundation or base that must be supported by the pillars 13 themselves.

The reinforcement cages 11 of the future pillars 13, i.e. the steel/wood bars or beams, are inserted from the top into the relative channels 5 and fixed to the fastening plates 9, after which the latter are filled with possible concrete casts, where foreseen. When the concrete has solidified, a composite wall is obtained, formed from the slabs 1 internally reinforced by a series of pillars 13 having the structural function both of supporting possible overlying structures, and of flexurally reinforcing the wall itself against possible knocking down. In order to reduce the risks of intrusion through the wall itself, the pillars 13 can be suitably close together and, by making them through cutting with hot wire, milling or drilling, the channels 3 can be positioned in the slabs 1 with the interaxial distance most suitable for each installation and very low costs.

The composite wall can be finished by fixing for example panels made of plasterboard, wood or other coatings, or suitably plastered, to the guides 5.

Figure 5 relates to a slab 1′ according to a second embodiment of the invention. The slab 1′ is formed from many different materials: two outer panels 15 and 17 for example made of wood fibre, or hardboard, between which blocks 19, 19′, 19″ of rock wool are arranged. Between the blocks 19, 19′, 19″ some passing channels 3′ are formed. Clearly, the choice of materials can also be different, being able to make the outer panels 15, 17 for example of mineralised laminated wood, or other materials derived from wood, rock or glass wool or other mineral insulators, and the blocks 19, 19′, 19″ can for example be made of wood or derivatives thereof, or foamed plastic materials.

With respect to the system with bricks or blocks described in document EP 0 163 117 A1, the slabs 1 can be applied with much less manual operations; moreover, thanks to their relatively large size, the slabs 1, 1’ can be aligned and plumbed with greater ease and much greater precision; they reduce the number and overall extension of the slits through the layer of insulating material of the wall itself, thus increasing the impermeability thereof to air, humidity, to other atmospheric agents and to noise; they can be transported and moved much more easily on the building site, since the slabs are easier to hold, harness or bind, for example to be lifted with a hoist, with respect to an incoherent mass of insulating blocks in the form of bricks. The slabs 1 made of EPS, XPS or other similar light materials eliminate very many problems of worker safety when they are moved on the building site. Moreover, the composite wall described above, in particular if made of EPS, XPS or other foamed plastic materials, is much lighter, less expensive and provided with much better thermal and sound insulation with respect to conventional walls made of solid reinforced concrete or of bricks, since on large portions thereof the entire thickness of such a composite wall is substantially occupied by just EPS or another insulating material.

The slabs 1 are obtained from the cutting of blocks manufactured from EPS, XPS or other similar light and insulating materials. Such a processing procedure makes it possible to make any shape, size and interaxial distance of pillar (even round walls) and any size of panel without the typical constraints of moulding. The slabs 1 are not therefore manufactured in series and there is not a limited choice of types of panels, since such slabs 1 are made to size each time, adapting them to the architectural and structural design of the building. The cutting process also allows the insertion in the factory of accessories and personalisation, like for example home fittings, counterframes for doors and windows, shutter boxes, guides for rainscreens, plasterboard panels, etc., of any shape and size. It is also possible to make side panels for floors.

The embodiments described above can undergo different modifications and variations without however departing from the scope of protection of the present invention. For example, a slab according to the invention can comprise a layer of foamed plastic material, like for example EPS or XPS, on which a panel made of wood or a wood-derived material is glued or in any case coupled. Moreover, all of the details can be replaced by technically equivalent elements. For example, the materials used, as well as the sizes, can be whatever according to the technical requirements. It should be understood that an expression of the type "A *comprises* B, C, D" or "A *is formed from* B, C, D" also comprises and describes the particular case in which "A consists of B, C, D". The examples and lists of possible variants of the present application should be considered to be non-exhaustive lists.

CLAIMS

1) Method for producing a slab (1) made of insulating material for use in building, the method comprising the following steps:

- arranging a work plane (102) on a machine (100);
- arranging at least one cutting device (104), fixed to the work plane (102), and heating it up to a temperature such as to be able to melt the insulating material;
- running a semi-finished block or panel (106) made of insulating material over the work plane (102), according to a predetermined direction (F), so that said semi-finished block or panel (106) hits said at least one cutting device (104) and so that said at least one cutting device (104) digs or cuts into the semi-finished block or panel (106) one or more of the following elements:
  - a passing channel (3),
  - a longitudinal rib (36),
  - a longitudinal groove, or
  - a longitudinal throat (38) configured to couple and constrain an edge of a first slab (1) to that of a second slab (1) analogous and adjacent to said first slab (1).

2) Method according to claim 1, characterised in that the cutting device (104) is selected from the group consisting of:

- at least one hot wire,
- at least one cutting die,
- at least one blade,
- at least one punch.

3) Method according to claim 1 or 2, wherein the position of said at least one cutting device (104) on the work plane (102) is variable in a direction parallel to said work plane (102), so as to vary the interaxial distance between said one or more dug or cut elements in the semi-finished block or panel (106).

4) Slab (1) made of insulating material for use in building obtained with a method according to any one of claims 1 to 3, said slab (1) comprising a plurality of passing channels (3) that pass from one side of said slab (1) to the other in a direction inclined according to a predetermined angle with respect to the two larger faces of said slab (1), wherein:

- at least part of the passing channels (3) has a medium or minimum passage section of 50 square centimetres or more;
- the major faces of said slab (1) have a height (HL), according to the direction longitudinal to the passing channels (3), of 0.5 metres or more;
- the major faces of said slab (1) have a width (WL), according to a direction perpendicular or transverse to the passing channels (3), of 0.3 metres or more; and
- said slab (1) has a medium or minimum thickness of 0.15 metres or more, preferably of 0.25 metres or more.

5) Slab (1) according to claim 4, the insulating material of which is selected from the group consisting of:

- a foamed plastic material,
- foamed polystyrene (EPS),
- extruded polystyrene foam (XPS),

- a material having a thermal conductivity of 0.3 W/(mK) or less,
- a material having a thermal conductivity of 0.05 W/(mK) or less,
- rock or glass wool,
- wood or materials derived therefrom,
- hardboard or laminated wood,
- mineralised wood.

6) Tailored-module system for obtaining parts of buildings, such as for example walls or partition walls, comprising:

- one or more slabs (1) according to claim 4 and provided with slits (30), each of which extends longitudinally to a relative channel (3) and also extends from a wall of said channel (3) up to one of the two major faces of the slab (1); and
- one or more mounting guides (5) arranged both to allow the mounting of a covering panel on the slab (1), and to partially insert in the slit (30), preferably reaching the channel (3).

7) Method for making a composite wall, the method comprising the following operations:

- erecting one or more slabs (1) having the characteristics according to claim 4;
- casting jets of concrete, where foreseen, into the channels (3), possibly after having inserted iron reinforcement cages (11) for reinforced concrete, i.e. steel or wood bars or beams, into the channels (3);
- allowing the concrete jets to solidify so as to obtain a pillar (13) within each channel (3).

8) Method according to claim 7, comprising the following operations:

- using a tailored-module system having the characteristics according to claim 6;
- partially inserting a mounting guide (5) in one of the slits (30);
- casting a jet of concrete into the inner channel (3) closest to the mounting guide (5);
- allowing the concrete jet to solidify, so as to obtain a pillar (13) within the channel (3) and so that the guide (5) is at least partially embedded in the pillar (13), or in any case it can rest against it.

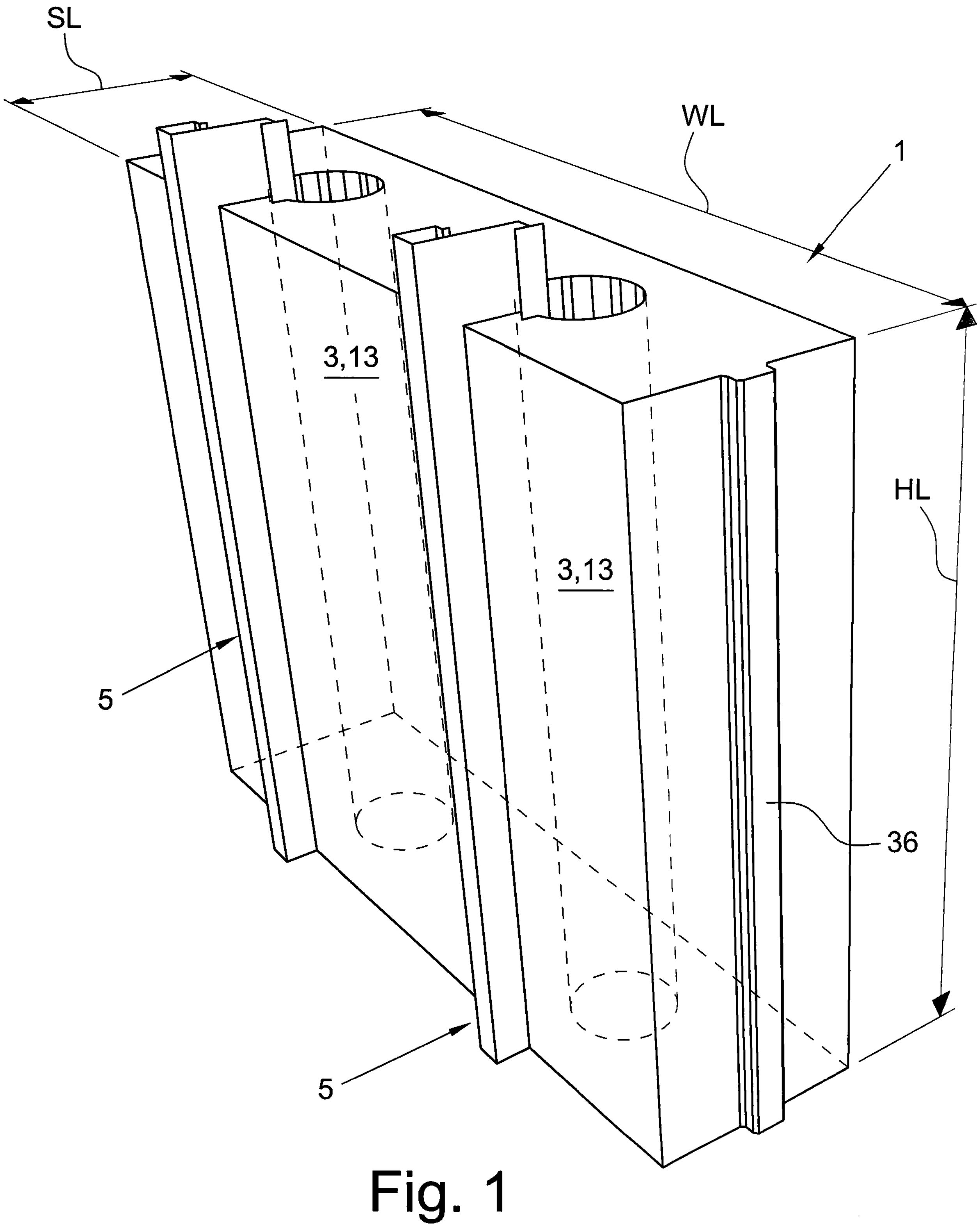

Fig. 1

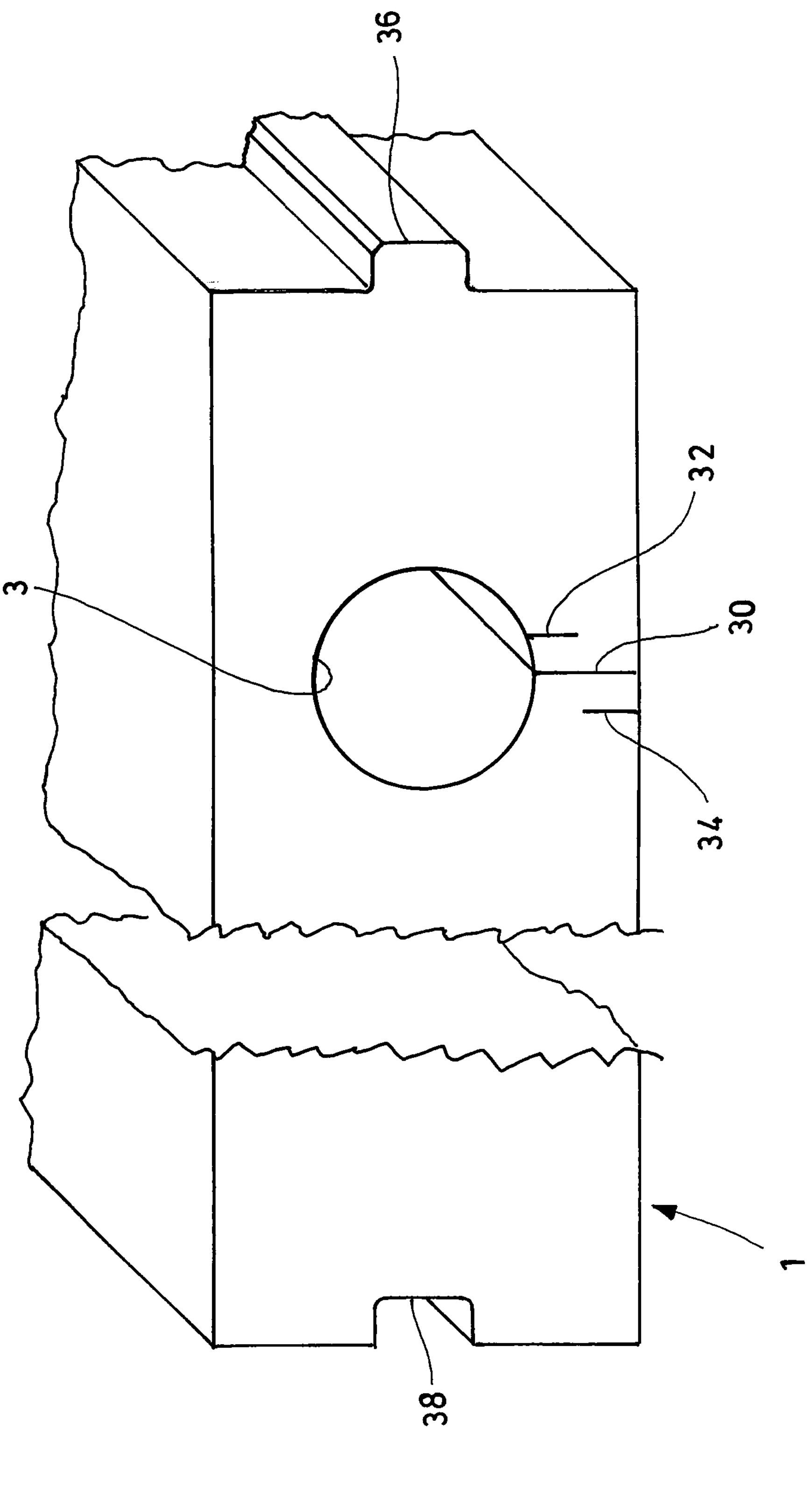

Fig.2

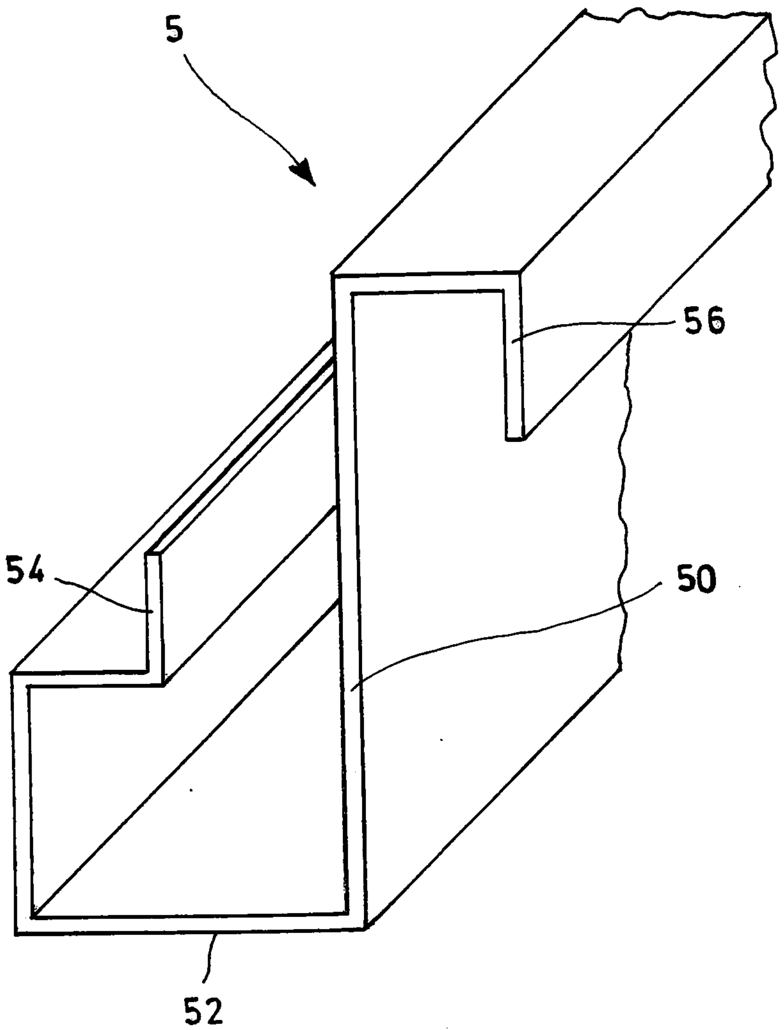

Fig.3

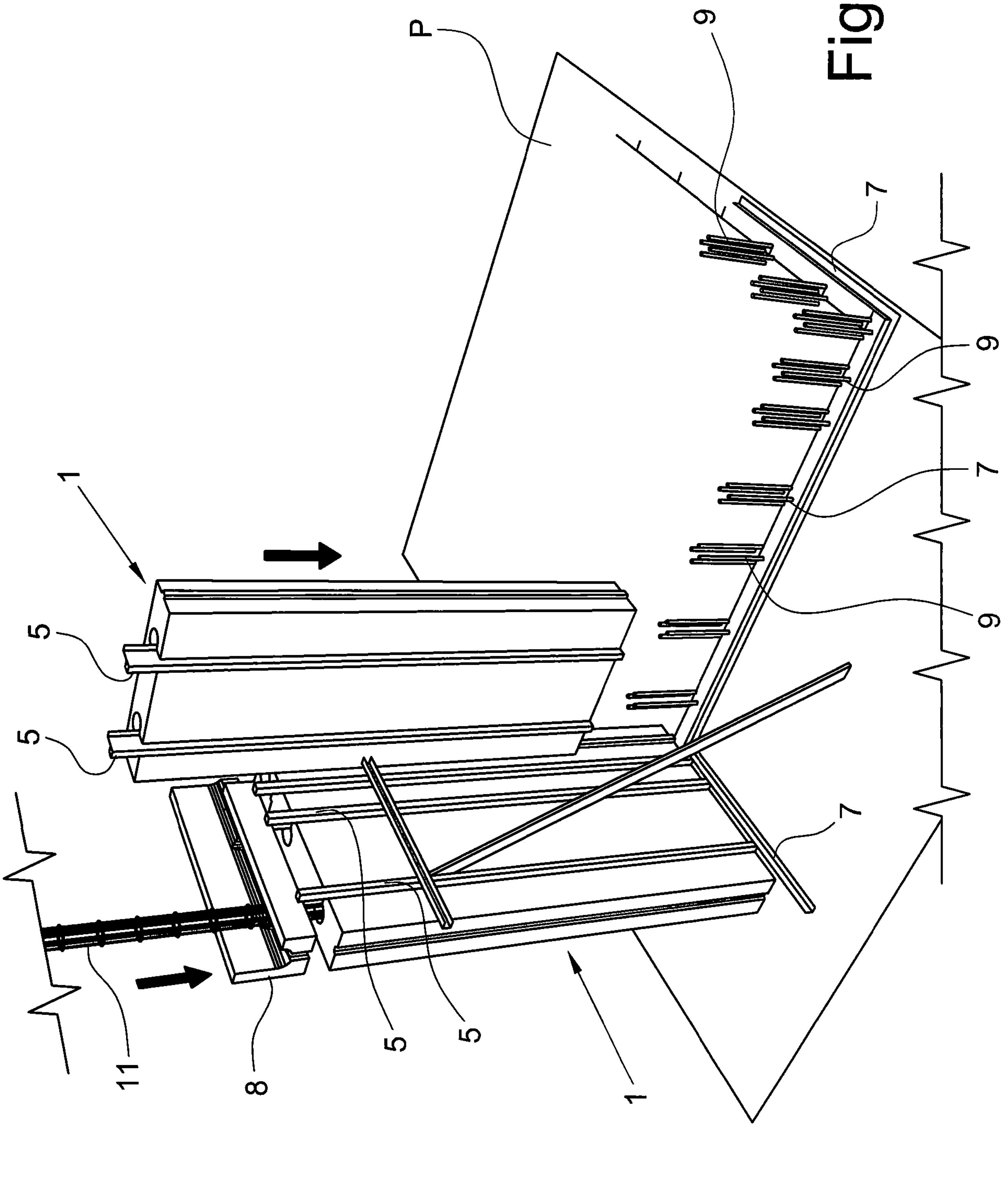

Fig. 4

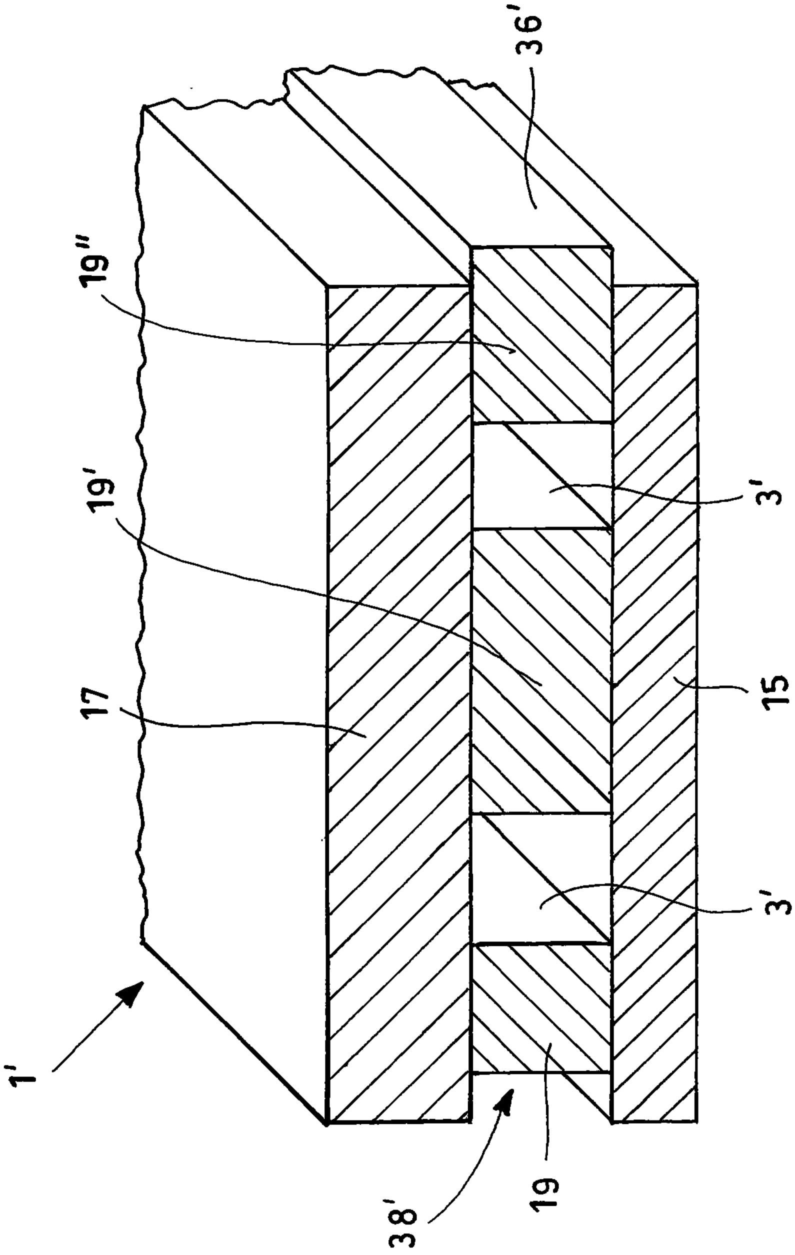

Fig.5

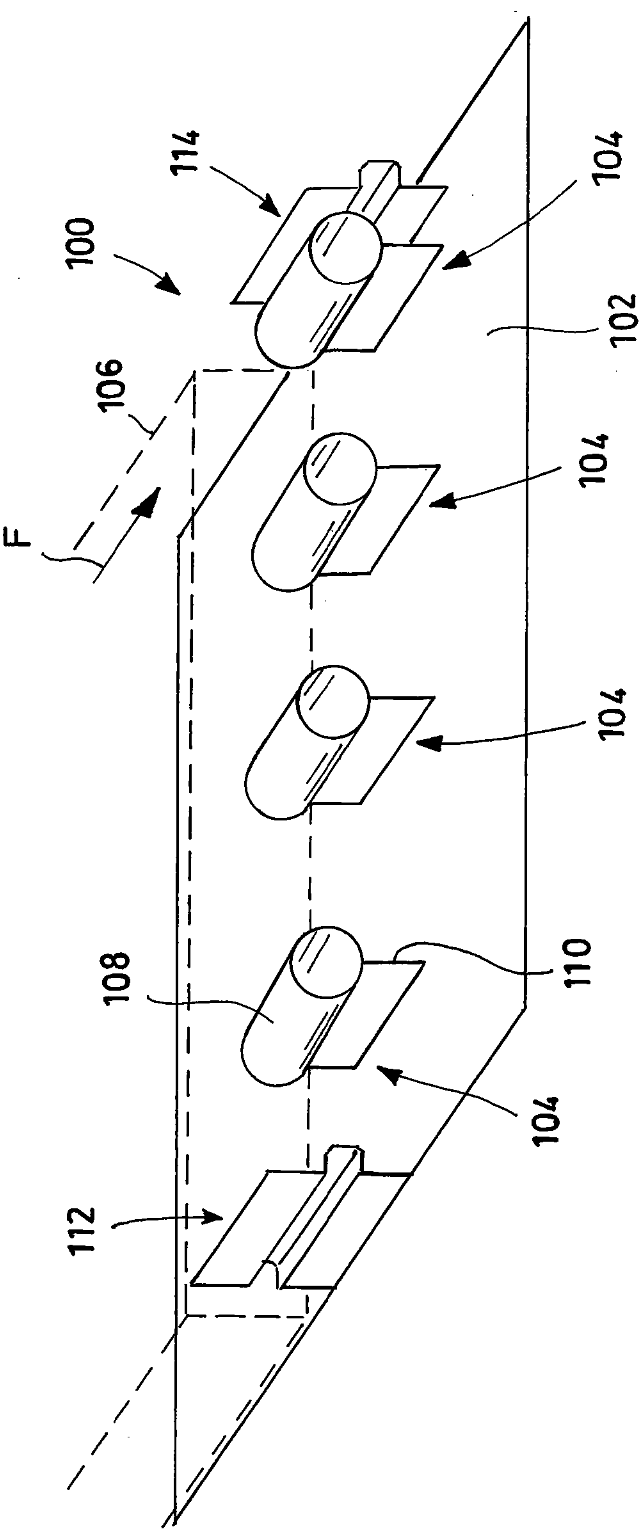

Fig.6

INTERNATIONAL SEARCH REPORT

International application No
PCT/IB2015/051954

A. CLASSIFICATION OF SUBJECT MATTER
INV. E04B1/16 E04C2/20
ADD. B26D3/00

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
E04B B26D E04C

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

EPO-Internal, WPI Data

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	WO 2011/060118 A2 (IGLOO PANELS LLC [US]; STEPHENS ROY [US] SOLID GREEN SYSTEMS LLC [US];) 19 May 2011 (2011-05-19) paragraph [0047] - paragraph [0053]; figures 1A, 1B -----	1-8
X	US 5 465 542 A (TERRY VERL O [US]) 14 November 1995 (1995-11-14) column 4, line 35 - column 7, line 11; figures 1, 2, 8, 9 -----	1-8
X	DE 102 51 286 A1 (WAHLS MANFRED [DE]) 19 May 2004 (2004-05-19) paragraph [0025] - paragraph [0029]; figures 1,2 -----	1-8

-/--

[X] Further documents are listed in the continuation of Box C.

[X] See patent family annex.

* Special categories of cited documents :

"A" document defining the general state of the art which is not considered to be of particular relevance

"E" earlier application or patent but published on or after the international filing date

"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)

"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art

"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
9 June 2015	18/06/2015

Name and mailing address of the ISA/	Authorized officer
European Patent Office, P.B. 5818 Patentlaan 2 NL - 2280 HV Rijswijk Tel. (+31-70) 340-2040, Fax: (+31-70) 340-3016	Galanti, Flavio

INTERNATIONAL SEARCH REPORT

International application No
PCT/IB2015/051954

C(Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 5 943 775 A (LANAHAN KENNETH P [US] ET AL) 31 August 1999 (1999-08-31) column 21, line 54 - column 24, line 17; figures 15,16 -----	1-3

INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No
PCT/IB2015/051954

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
WO 2011060118 A2	19-05-2011	CA 2818412 A1	19-05-2011
		US 2011113707 A1	19-05-2011
		WO 2011060118 A2	19-05-2011
US 5465542 A	14-11-1995	NONE	
DE 10251286 A1	19-05-2004	NONE	
US 5943775 A	31-08-1999	US 5943775 A	31-08-1999
		US 6167624 B1	02-01-2001