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(54) **Method and device for the production of a panel having partially embedded elements and a panel produced using said method**

(57) The present invention relates to a method for forming a panel that has rows of partially embedded elements (4), wherein the elements (4) are laid in rows separated by a spacer on the bottom of a mould (1), and the assembly is subsequently covered with a mortar (7), said mortar (7) setting to yield the panel. The invention

is characterized in that at at least one longitudinal side of a row of elements as the spacer a hollow flexible hose (2) is used, and the mortar (7) is applied in a state of the hollow hose (2) where it is in close contact with the longitudinal sides of the elements, and the mortar (7) is subsequently set.

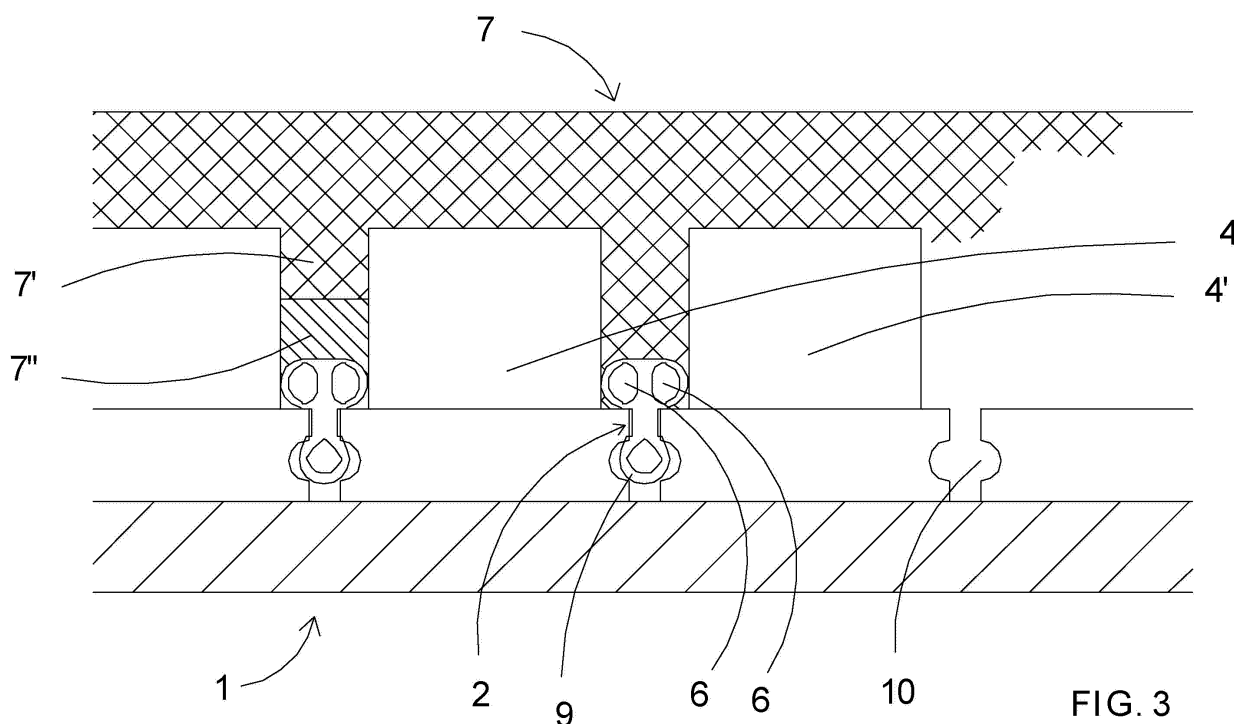


FIG. 3

Description

[0001] The present invention relates to a method for forming a panel which has rows of partially embedded elements, wherein the elements each have a pair of longitudinal sides which are parallel relative to each other and two head ends, wherein the head ends of adjacent elements of a row butt up with one another, and wherein each partially embedded element has a front view side and protrudes from the panel and has a second side opposite to the front view side which is embedded in the panel, wherein the elements are laid into parallel rows with their front view side on the bottom of a mould while a spacer in the form of a hollow flexible hose is in a second state during which it exerts a lower force on the elements than during a first state of the hollow hose controlling the alignment of the elements and wherein the hollow hose is in close contact with the longitudinal sides of the elements, and in said first state the spacer and the second sides of the elements are covered with a mortar, wherein said mortar sets to yield the panel, after which the panel is taken out of the mould.

[0002] Such a method is known from NL6811503, wherein a pneumatic tube is applied which is used as a spacer between rows of stones and which, under application of pressure, exerts a double function: Firstly, any stones that were not aligned are aligned. Secondly, thanks to the fluid pressure, the hose seals against the stones as a result of which it is prevented that mortar reaches the upper side of the mould and could smear the front view side of the stones.

[0003] A disadvantage of the known method is that it is sensitive to changes in the pressure, and calamities such as a falling away of the fluid pressure.

[0004] The object of the present invention is to provide a method according to the preamble which remedies the problem to a large extent and in an economical way.

[0005] To this end, the method according to the invention is characterized in that as the hollow hose, a hollow hose is used of which at least that part of the wall defining the lumen and facing a row of elements is made of an elastomer, and that the hollow hose is shaped such that in a state of rest and in the absence of elements it has a cross section which is dictated by the elastomer and which is broader than the hollow hose in the first state, wherein for laying the elements the hollow hose is brought into the second state by means of a vacuum pump, the hollow hose is brought from the second state into the first state by means of a change in pressure as a result of which it comes in close contact with the longitudinal sides of the elements, and following the application of the mortar, this is subsequently set to yield the panel.

[0006] In this way the alignment and sealing force exerted on the elements is predominantly or entirely provided by the force exerted by the elastomer. This provides a high degree of reliability since a possible falling away of the super-atmospheric pressure in the lumen of the

hollow hose will not result in loss of sealing, as a consequence of which mortar could reach the upper side of the mould. Calamities, such as a leakage of the hose or a power failure, do therefore not affect untroubled setting. With the method according to the invention a falling away of the (under)pressure supplied by the vacuum pump has no consequences for setting. It only hinders the placement of the elements. Furthermore, it has been found that the use of vacuum facilitates the removal from the mould. Placing the elements is easier as well. It has been found that irregularities in thickness per element, and those between the various elements, may effectively be compensated for. Both the distance over which a force can be exerted as well as the strength of the force exerted on the elements by the hollow hose are sufficient. As a result, less to no panels have to be rejected because of mortar penetrating beyond the spacer. Furthermore, a major advantage of the invention is that the method permits a quick and effective alignment of elements over large distances (lengths of rows), and allows the hollow hose to effectively function as a sealing. With the method according to the invention it is possible to provide a panel that is provided with an opening for a window or door. Hereby, also aesthetically unattractive joints, known from panels arranged adjacently according to the state of the art, are avoided. Such outer wall panels preferably have the height necessary for closing one floor level. The mortar may be any mass capable of setting, for instance concrete mortar and, if desired, may contain any possible addition such as reinforcing fibers etc. The medium in the hollow hose may be any fluid, such as water or advantageously air. When in the present application "head ends of adjacent elements of a row butt up with one another" is mentioned, this can mean butt up directly as well as butt up indirectly, that is to say having a spacer. Such a spacer will generally have the same length as the head end and be placed perpendicular to the hollow hose. In any case, such a spacer has to be of such dimensions that unset mortar does not pass in unacceptable quantities. The spacers are, for instance, fashioned from hardwood or plastic. The pressure in the lumen can be changed, and the pressure for the alignment of any unaligned elements and the pressure in the lumen for the application of the mortar, may be the same or different. For reaching the utmost strength, reinforcement elements can be included in the mortar, such as wire mesh (for instance of steel) or glass fibre mats. Such reinforcement elements are in themselves known in the art.

[0007] With the measure "shaped such that in a state of rest and in the absence of elements it has a cross section dictated by the elastomer" is meant that if one takes a cross section of the hose, that is to say a piece of hose having a length of for instance 1 cm, the shape of this piece of hose is not substantively determined by gravity. This allows on the one hand a proper sealing against the elements, and on the other hand that the hollow hose can be kept in a certain shape without maintaining a pressure in the lumen of the hollow hose. The

number of shapes in a state of rest is a discrete number and is usually 1 but may optionally also be 2, as will be explained in more detail later, when describing an embodiment.

[0008] When in the present application "a lower force" is mentioned, this obviously also comprises no force. This is even preferred to that extent that the distance between adjacent hollow hose parts is larger than the width (height when the outer wall panel stands upright) of the elements. A change in pressure can be a change from a higher pressure to a lower pressure or the other way around, but also a change wherein the pressure in the lumen at the first state and the second state is the same but had to undergo a change to achieve the transition. This will be further elucidated in the description of a working example.

[0009] NL6912313 discloses that the elements are aligned by letting a stretched elastic string go to a state of rest. A disadvantage of the known method is that it is hardly capable of compensating deviations in the thickness of the elements (i.e. in the finished state of the panel, at vertical arrangement, the height of an element). The known method is more suitable for forming panels having tiles as elements than having more irregularly shaped elements such as, for instance, stone strips, such as half bricks (a lying brick cut in half in a longitudinal and vertical plane). Bricks have a variation in thickness of more or less 2 mm (NEN 2489).

[0010] To carry out the method according to the invention reliably, it is preferred that in the absence of a difference in pressure between the lumen and the atmosphere the hollow hose is in the first state.

[0011] Thus, the alignment and sealing force is entirely provided by the elastomer. In such a case, the proper sealing is also guaranteed in case of a calamity during setting, such as power failure or leakage of the hose, which could otherwise result in a change of pressure in the hollow hose and thereby allow the passage of yet unset mortar.

[0012] For an optimal alignment wherein adjacent rows affect one another minimally, it is preferable that the hollow hose is held in place.

[0013] Holding it in place relative to the mould can be done using any method, for instance by means of glueing. It goes without saying that in case of more spacers, preferably the majority thereof and preferably all spacers, are held in place relative to the mould.

[0014] Preferably, the hollow hose is held in place over the length for which it functions as a spacer, because the hollow hose is connected with the bottom of the mould over the length of a row.

[0015] Thus, it can be avoided to a large extent that deviations in the dimensions of one or more elements of one row affect the alignment of elements of an adjacent row. It goes without saying that in case of more spacers preferably the majority thereof and preferably all spacers are connected with the bottom of the mould. When "is connected with the bottom of the mould over the length

of a row" is mentioned, being connected may be continuously or continually but then comprises, apart from two places located at or beyond the ends of the row of elements, at at least 1 place between these two places connected with the bottom of the mould. Within the scope of the present invention, the term "connected" means that a movement of the hollow hose transversely to the longitudinal direction of the hollow hose is counteracted at the location of the row of elements, and thus is not restricted to being irremovably connected.

[0016] Advantageously, this occurs because a hollow hose is used which has a bulging foot, the bulge being received in and retained by a groove in the bottom of the mould.

[0017] The bulge can have any shape, such as a branched shape.

[0018] A practical embodiment is characterized in that a flexible hollow hose is used which has a wall provided with flexing grooves in the longitudinal direction of the hollow hose.

[0019] The use of flexing grooves can promote that the hollow hose is brought into a defined second state in a predictable manner. Thereby it can be ensured that there will be no places in the lumen having a pressure that differs from the pressure elsewhere in the lumen. Furthermore, the presence of flexing grooves facilitates the reliable and ready removal from the set panel out of the mould.

[0020] Advantageously, a flexible hollow hose is used whose lumen, at a side opposite to a row of elements, is provided with a vertically oriented rigid wall.

[0021] Thus, it can be promoted that the elements are not subjected to a vertical movement, and a well-defined joint depth is provided.

[0022] According to a preferred embodiment a flexible hose is used, wherein the flexible hollow hose has two lumina which are separated by the vertically oriented rigid wall.

[0023] With such a hose, the lumina will be on the same height above the bottom of the mould, and in general the hollow hose will have a (vertically) mirror symmetrical cross section. This contributes to providing a force that is directed sideways and to a well-defined joint depth. A rigid wall can be accomplished by fashioning this wall from another material such as a mixture of elastomer and a component that affords rigidity (such as non-stretchable fibers) and/or by providing a hollow hose having a relatively thick vertically oriented wall.

[0024] According to an important embodiment, a thixotropic mortar is used as the mortar.

[0025] By using a thixotropic mortar an (in motion) thin mortar can be used which properly fills the space between the elements (but above the hollow hose), while any leaking through of the mortar between the head ends of elements and between an element and the hollow hose is avoided.

[0026] Preferably, the mortar is applied to the hollow flexible hose by means of spraying or pressure spraying.

[0027] Thus, the mortar is brought into the grooves between the elements with force and/or under pressure which ensures a proper filling of the grooves. It is not a problem if mortar also ends up on the elements.

[0028] The present method is highly suitable for providing lightweight construction panels, wherein, prior to the setting thereof, a plate of expanded polymer is applied on the mortar, and a second mortar is applied onto the plate of expanded polymer.

[0029] The first mortar and the second mortar can have identical or different compositions. Preferably, the second mortar is a finishing mortar.

[0030] In the present application with the term "expanded polymer" any polymer rigid foam is meant, irrespective of how this is formed.

[0031] The expanded polymer is for instance PUR-foam, and preferably polystyrene.

[0032] An important embodiment of the method is that, where the outer wall panel has a frame opening, wherein a profile is used which defines a frame opening and which is provided with an anchoring member at the circumferential side facing away from the frame opening, the profile is sealingly placed on the mould, the anchoring member of the profile is embedded in mortar.

[0033] Preferably, the anchoring member is a strip that runs along the outer circumference of the profile.

[0034] Such a strip has a width of for instance at least 5 mm, preferably at least 1 cm and more preferably at least 2 cm. Thus, not only a proper anchoring is ensured, but an effective barrier against penetration of moisture is provided as well. In the present application with the term outer circumference, any circumference of a profile is meant on which an anchoring member can be present that can be anchored in the mortar or the second mortar, thus including a side circumference.

[0035] Although a frame, after placing the profile on the mould, including after manufacture of the wall panel, could be mounted in the profile, it is strongly preferred that at least one profile forms part of the frame, and the frame is integrated with the wall panel by embedding and setting.

[0036] Thus, manufacturing is further simplified. The profile may be a profile that is connected to the frame in a detachable way, it may be a profile that is irremovably connected to the frame or the frame forms the profile. If there is more than one profile, this applies to the profiles independent of each other.

[0037] According to a preferred embodiment thereof, the frame is provided with a window, and the totality of frame, window and at least one profile is placed on the mould before the anchoring member is embedded in mortar, and more preferably the profile is placed sealingly against the elements on the mould and against the spacers before the anchoring member is embedded in the mortar or, alternatively, the profile is placed sealingly against a dummy body which is placed on the spacers, which dummy body is placed sealingly against the elements before the anchoring member is embedded in the

mortar.

[0038] The present invention also relates to a panel produced using the method according to the invention.

[0039] More in general, the invention relates to an outer wall panel having a width of at least 4 metres and a height of at least 2 metres, and which has rows of elements that are partially embedded in set mortar and can be produced by means of the method according to the invention.

[0040] Such outer wall panels according to the invention have a width of at least 4 metres, preferably at least 5 metres and more preferably at least 6 metres. According to an important embodiment the outer wall panels are sandwich panels which have a core of expanded polymer, such as polystyrene.

[0041] According to a preferred embodiment, such an outer wall panel comprises at least one opening selected from a door opening and a window opening.

[0042] Finally, the invention relates to an apparatus suitable for using the methods according to the invention, said device comprising a mould whose bottom is provided with at least one hollow hose, and which apparatus moreover comprises a vacuum pump for lowering the pressure in the lumen of the hollow hose.

[0043] According to a preferred embodiment, the bottom of the mould is provided with parallel grooves, and the hollow hose comprises a bulging foot, the bulge being received in and retained by a groove in the bottom of the mould.

[0044] The present invention will now be illustrated by the drawing in which

fig. 1 shows a top plan view on a mould according to the invention;

fig. 2 shows a top plan view on an alternative mould according to the invention, wherein the mould is partially covered with elements;

fig. 3 shows a vertical cross section of a detail of the mould of fig. 2;

fig. 4a and 4b show a cross section of a hollow hose suitable for applying the method according to the invention, in two states; and

fig. 5a-f show, in a vertical cross section, various phases of a method for manufacturing an outer wall panel provided with a frame.

[0045] Figure 1 shows a top plan view of a bare mould 1 according to the invention. The mould 1 is provided with hollow hoses 2 which are connected to a vacuum pump 3. In figure 2, which shows an alternative mould according to the invention, lengthwise sawn through half bricks 4 are also shown, which have been placed with their front view side (the side) on the bottom of the mould 1. The half bricks 4 are placed within upright walls 5 in a row against hollow hoses 2, which are fitted on the bottom of the mould 1. Herewith the hollow hoses 2 are in a state (designated in the description as second state) in which they exert little to no force transversely to the longitudinal

direction of the hollow hoses 2, in a plane parallel to the bottom of the mould 1. For that purpose, the hollow hoses 2 in the illustrated embodiment are connected to a vacuum pump 3. By lowering the pressure in the lumen 6 (fig. 3, 4) of the hollow hoses 2, the hollow hoses 2 become narrower, and thus the ability of the hollow hoses 2 to exert a force on the half bricks 4 (elements) is reduced. A hollow hose 2 can have more than 1 lumen 6. By using upright walls 5 on the mould 1, with that mould 1 a large number of wall panels having different dimensions can be formed, by using other upright walls 5 as casing.

[0046] A hollow hose 2 is either operatively sealed near one end (not shown) or connected to the vacuum pump 3 with both ends (fig. 1 and 2).

[0047] A hollow hose 2 can be brought into a state (designated in the description as first state) in which it pushes against the row of bricks 4. Herewith, two objectives are achieved: 1) Any bricks 4 not aligned will as yet be aligned; and 2) The hollow hose 2, whose height is lower than the height with which the bricks 4 extend above the bottom (fig. 3), prevents that mortar 7 can reach the bottom of the mould 1, as will be explained hereinafter. If desired, according to a possible embodiment of the method, the mortar 7 can be applied twice, wherein firstly a thin but highly thixotropic mortar 7" is used for properly filling the space directly above the hollow hose 2 without leaving air bubbles, after which - preferably before the mortar 7" is set - an additional mortar 7' is applied, which does not have to be thixotropic. Additionally, or alternatively, to using a highly thixotropic mortar 7", it may also suffice to use 1 single mortar 7 if the mortar 7 is thrown on the bricks 4 and hollow hose 2, for instance by means of a spraying technique, preferably in the form of drops. A spraying technique is preferred since this allows a relatively thick mortar 7 to be introduced effectively in the joints between the bricks 4.

[0048] For a quick and effective transformation from the first state into the second state, it is preferred that there is more than 1 hollow hose 2, because the length of the hollow hose, and thus the length over which the fluid (usually air) has to be discharged from the lumen 6, is very large compared to the cross section of the lumen 6. In such a case a collecting pipe 8 can be provided (fig. 2), which preferably has a larger internal cross section than the hollow hose 2.

[0049] Fig. 3 shows a vertical cross section of a detail of fig. 2. Shown are the bottom of the mould 1, two bricks 4, 4', the hollow hose 2 and mortar 7. The hollow hose 2 has a bulging foot 9, which is received in a groove 10 in the bottom of the mould 1. Although the hollow hose 2 may be fashioned from a flexible plastic such as polyethylene, it is strongly preferred to use a hollow hose 2 fashioned from elastomer. It can in fact be shaped such that it is resilient and can be in a state of rest having a defined shape. In the present application with "a state of rest", a state is meant in which the hollow hose 2 has a self-assumed shape and strives to maintain this shape. Gen-

erally, a hose 2 can only be in one state of rest, but a larger number of such states is possible (in that case this number is usually 2, wherein the hollow hose 2 can pass, with some force - more specifically, by a change in pressure in the lumen - from one state into the other state (flip-flop)). When such a hollow hose having two states of rest is used, the pressure in the lumen 6 in the first and second state can be, but is not necessarily, the same. It is highly preferred that the first state is between the (broadest) state of rest and the second state, or coincides with the (broadest) state of rest. Particularly in the first case, it is in fact achieved that the hollow hose 2 exerts a force (by the inherent elastomeric character of the hollow hose 2) without the need to actively maintain a pressure in the lumen 6 of the hollow hose 2. This saves energy and helps to avoid a loss of products, for instance as a result of a falling away of pressure in the lumen 6 when the hollow hose springs a leak or when the vacuum source fails. Nevertheless, one can opt to maintain a pressure in the first state that is higher than the atmospheric pressure, in order to ensure a perfect sealing.

[0050] The width of the lumen (in a plane parallel to that of the bottom of the mould 1, and perpendicular to the longitudinal direction of the hollow hose) co-determines to what extent the hollow hose 2 can allow for deviations of the dimensions of the elements 4. The width will normally be at least equal to the maximum variation to be accommodated for by the hollow hose 2.

[0051] In fig. 4a a cross section of a hollow hose 2 in the state of rest is shown. The hollow hose 2 has a bulging foot 9, which can be slid into a groove 10 in the bottom of a mould 1. Once it is in place, there is no more need to remove the hollow hose 2. In the illustrated embodiment the hollow hose 2 has two lumina 6, which are separated by a rigid vertical partition wall 11. The rigid nature of this vertical partition wall 11 avoids, during a change of the pressure in the lumina 6, a vertical movement of parts of the hose that are in contact with the half bricks 4, and thus also that the half bricks 4 are lifted. In this way, also a proper sealing against the upright walls 5 of the mould 1 can be ensured. Both lumina 6 of the hollow hose 2 are provided with three longitudinal grooves, two at the inside 12, 12' and one at the outside 13. These ensure that, when lowering the pressure in the lumina 6 using the vacuum pump 3, the walls of the hollow hose 2, intended for having contact with the bricks 4 and which define the lumina 6, bend at that place. Thus, the hollow hose 2 passes into in the second state which is shown in fig. 4b.

[0052] Fig. 5a shows in a vertical cross section a detail of a mould 1 provided with spacers in the form of hollow hoses 2. In fig. 5b the mould 1 illustrated in fig. 5a is provided with bricks 4. On parts of the hollow hoses designated by 2' a dummy body A is placed. Instead of a dummy body A, the mould 1 could have been formed like the dummy body 1, but this would have negatively affected the flexibility of the mould 1, which would then be suitable for less types of wall panels. Indeed, now, each

time a dummy body A of choice can be used. In the embodiment illustrated here, the dummy body A has the shape of a plate. The bricks 4 are placed butting up against the plate A (as can be seen partially in fig. 2). In the embodiment illustrated here, the upper side of the dummy body A is at the same height as the non-front view side (in fig. 5b the upper side) of the bricks 4. A frame 14 is laid sealingly on the elements 4. The term "sealingly" will be defined hereinafter. The frame 14 has a frame construction 15, double glazing 16 as well as a first intrados profile 17 and a second intrados profile 18. More specifically, the first intrados profile 17 is laid sealingly on the bricks 4. In an alternative embodiment, the dummy body A can also be shaped such that the first intrados profile protrudes beyond the non-front view side (thus lower than illustrated here). To prevent that the frame 14 is displaced, the dummy body A, as shown in fig. 5b-f, can have a suitably adapted shape in order to butt up against the frame 14. In the scope of the present invention, the term "sealingly" means that openings whose size would allow mortar or second mortar to flow from a location outside the profile to a location inside the profile, are not allowable. The maximum allowable size of the openings (that is to say, cracks resulting from poor butting up between the profile and the bricks 4 and possibly the dummy body A) depends on the viscosity and thixotropic properties of the mortar or second mortar used, and will generally be less than 2 mm, such as less than 1,5 mm and for instance ca. 1 mm. In the present application, with an intrados profile a casing is meant which comprises one or more intrados. By using the preferred embodiment of the method according to the invention described here, there is no need to place the intrados afterwards, because the intrados profiles 17, 18 are integrated in the outer wall panel. The intrados 17, 18 are for instance made of wood, or plastic such as PVC. It goes without saying that the intrados profile 17 also has to be placed sealingly in a direction parallel to the hollow hose parts 2' on the bricks 4. In other embodiments this may also be done differently, such as against hollow hoses 2'.

[0053] The profiles 17, 18 each have an anchoring strip 19 respectively 20, along the outer circumference thereof. Here it is 1 cm wide and made of plastic.

[0054] Following placement of the frame 14, mortar 7 is applied to the hollow hose 2 between the bricks 4, wherein the first anchoring strip 19 is embedded in the mortar 7. Before the mortar 7 is set, plates (preferably interconnected) of polystyrene 22 are placed on the unset mortar 7, after which a second mortar 23 is applied on the polystyrene 22, wherein the second anchoring strip 20 is embedded in the second mortar 23. Hereinafter, the yet unset mortar 7, 23 is left to set, to obtain an outer wall panel that is finished to a large extent.

[0055] To remove air bubbles captured under the polystyrene 22, an underpressure may be applied. This is, for instance, possible by covering the totality of the mould and panel with a PVC foil, and subjecting the space under

the foil to an underpressure. For that matter, it is noted that, although the presence of bubbles may not be desirable, especially the large bubbles are disadvantageous, and especially the large bubbles, should they even occur, can be removed properly with the underpressure technique described above. The air can escape between adjacent polystyrene plates or between holes that have been provided in the polystyrene plates for this purpose. These holes can be made, for instance, by using, optionally hot, needles. Another advantageous method to prevent air from getting trapped under the hard foam in the method according to the invention, is using strips of hard foam having a width of 50 cm or less, such as 40 cm or less. Advantageously, plates are cut to strips and the strips are placed with a cut face (thus, transverse to the original surface of the plate) on the first mortar.

[0056] In the embodiment illustrated in fig. 5c and further, the frame 14 has a fire-resistant strip 21 along the outer circumference thereof of, for instance, rock wool. In case of a fire it will protect the expanded polymer 22.

[0057] Plywood plates having a thickness of 18 mm were glued on a steel mould of 13 x 3,5 m. Onto these plywood plates, in the longitudinal direction of the mould, elongated plywood profiled strips (width 57 mm) were screwed, having interspaces of 5,5 mm. Thus, a groove was formed in which the hose was fitted. These elongated plates had a top layer (Betonplex, Pont-Meyer, Utrecht, The Netherlands) that does not adhere to concrete. The grooves were on a centre-to-centre distance of 6,25 cm relative to one another. The hose fitted in the grooves had a profile as specified in fig. 4. The hose was produced by the company Vizo (Zeewolde, The Netherlands) from neoprene. When the (double) lumen of this hose was subjected to an underpressure, it had a width of 11 mm, and in the absence of the underpressure its width was 17 mm.

[0058] Halve bricks (dimensions 207 x 50 x 40 mm) were placed between the hoses, with the head ends against one another. During placement the hose was subject to an underpressure, which was generated by a vacuum pump (CSL10, Rietschle-Thomas, Weesp, The Netherlands).

[0059] The half bricks were confined by a rectangular wooden casing with dimensions of 1,5 x 3 m. After placement of the half bricks, the underpressure in the hose was lifted. Hereby the half bricks were aligned, and the hose fitted closely against the half bricks. For manufacturing a panel having a window, dummy bodies were screwed onto the plywood plates, which dummy bodies were placed such that the window frame at the inner circumference thereof fell exactly over the dummy bodies. In this way, the window frame was held in position during the subsequent operations. Since the dummy bodies can be removed and/or moved, many types of panels can be produced using this one mould.

[0060] A thixotropic mortar (type 391, Beamix, Eindhoven, The Netherlands) was prepared according to the instructions of the manufacturer and pressure sprayed

into the joints between the bricks. Subsequently, a low-shrinkage casting mortar (type TM5203 (Tillman, Megchelen, The Netherlands) was applied onto the half bricks and the thixotropic mortar (which may still be unset). As reinforcement mats hot galvanized wire mesh Casanet (wire thickness 2,05 mm; maze 50 x 50 mm; Van Rooy en Co, Rotterdam, The Netherlands) was used. This was pushed into the mortar layer having a thickness of 2 cm, which subsequently was levelled. Instead of wire mesh, however, for instance also woven glass fibre mats can be used, such as those available as Glasgitter wFs1 GW545 (Romar-Voss, Roggel, The Netherlands).

[0061] Subsequently, polystyrene plates having a thickness of 200 mm (EPS 150 SE, Unidek, Gemert, The Netherlands) were placed on the casting mortar that had not yet set, wherein care was taken not to trap too much air under the polystyrene plates. The plates were properly pressed by walking over them.

[0062] Subsequently, a layer of self-levelling casting mortar Beamix ABS340 (Beamix, Eindhoven, The Netherlands), prepared according to the instructions of the manufacturer, was applied onto the polystyrene plates.

[0063] Advantageously, after the setting of the mortar of the first layer and prior to taking the panel out of the mould, first vacuum is applied to the hollow hose again, whereby it releases from the set mortar.

[0064] After 16 hours of setting the panel was de-cased by the taking away the wooden casing, and placing the totality of mould and panel in a vertical position. Subsequently, the panel was separated from the mould. After about 1 week of additional setting the panel had achieved the envisioned strength of construction.

Claims

1. A method for forming a panel which has rows of partially embedded elements, wherein the elements each have a pair of longitudinal sides which are parallel relative to each other and two head ends, wherein the head ends of adjacent elements of a row butt up with one another, and wherein each partially embedded element has a front view side and protrudes from the panel and has a second side opposite to the front view side which is embedded in the panel, wherein the elements are laid into parallel rows with their front view side on the bottom of a mould while a spacer in the form of a hollow flexible hose is in a second state during which it exerts a lower force on the elements than during a first state of the hollow hose controlling the alignment of the elements and wherein the hollow hose is in close contact with the longitudinal sides of the elements, and in said first state the spacer and the second sides of the elements are covered with a mortar, wherein said mortar sets to yield the panel, after which the panel is taken out of the mould, **characterized in that** as the hollow hose, a hollow hose is used of which at least

that part of the wall defining the lumen and facing a row of elements is made of an elastomer, and that the hollow hose is shaped such that in a state of rest and in the absence of elements it has a cross section which is dictated by the elastomer and which is broader than the hollow hose in the first state, wherein for laying the elements the hollow hose is brought into the second state by means of a vacuum pump, the hollow hose is brought from the second state into the first state by means of a change in pressure as a result of which it comes in close contact with the longitudinal sides of the elements, and following the application of the mortar, this is subsequently set to yield the panel.

2. The method according to claim 1, wherein in the absence of a difference in pressure between the lumen and the atmosphere the hollow hose is in the first state.

3. The method according to claim 1 or 2, wherein the hollow hose is held in place.

4. The method according to claim 3, wherein the hollow hose is held in place over the length for which it functions as a spacer, because the hollow hose is connected with the bottom of the mould over the length of a row.

5. The method according to claim 4, wherein a hollow hose is used which has a bulging foot, the bulge being received in and retained by a groove in the bottom of the mould.

6. The method according to any of the preceding claims, **characterized in that** a flexible hollow hose is used which has a wall provided with flexing grooves in the longitudinal direction of the hollow hose.

7. The method according to any of the preceding claims, **characterized in that** a flexible hollow hose is used whose lumen, at a side opposite to a row of elements, is provided with a vertically oriented rigid wall.

8. The method according to claim 7, wherein the flexible hollow hose has two lumina which are separated by the vertically oriented rigid wall.

9. The method according to any of the preceding claims, wherein a thixotropic mortar is used as the mortar.

10. The method for manufacturing an outer wall panel according to any of the preceding claims, which outer wall panel has a frame opening, wherein a profile is used which defines a frame opening and which is

provided with an anchoring member at the circumferential side facing away from the frame opening, the profile is sealingly placed on the mould, the anchoring member of the profile is embedded in mortar.

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11. The method according to claim 10, wherein the profile is placed sealingly against the elements on the mould and against the spacers before the anchoring member is embedded in the mortar.

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12. The method according to claim 10, wherein the profile is placed sealingly against a dummy body which is placed on the spacers, which dummy body is placed sealingly against the elements before the anchoring member is embedded in the mortar.

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13. A panel produced using the method according to any of the preceding claims.

14. An outer wall panel having a width of at least 4 metres and a height of at least 2 metres, and which has rows of elements that are partially embedded in set mortar and can be produced by means of the method according to any of the claims 10 to 12.

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15. The outer wall panel according to claim 14, wherein the outer wall panel is a sandwich outer wall panel which comprises a core layer of expanded polymer, said core layer being not transected by reinforcement elements which connect the layers lying at opposite sides of the core layer.

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16. The outer wall panel according to claim 14 or 15, wherein the outer wall panel comprises at least one opening selected from a door opening and a window opening.

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17. An apparatus suitable for applying the method according to any of the claims 1 to 12, which apparatus comprises a mould whose bottom is provided with at least one hollow hose, and which device moreover comprises a vacuum pump for lowering the pressure in the lumen of the hollow hose.

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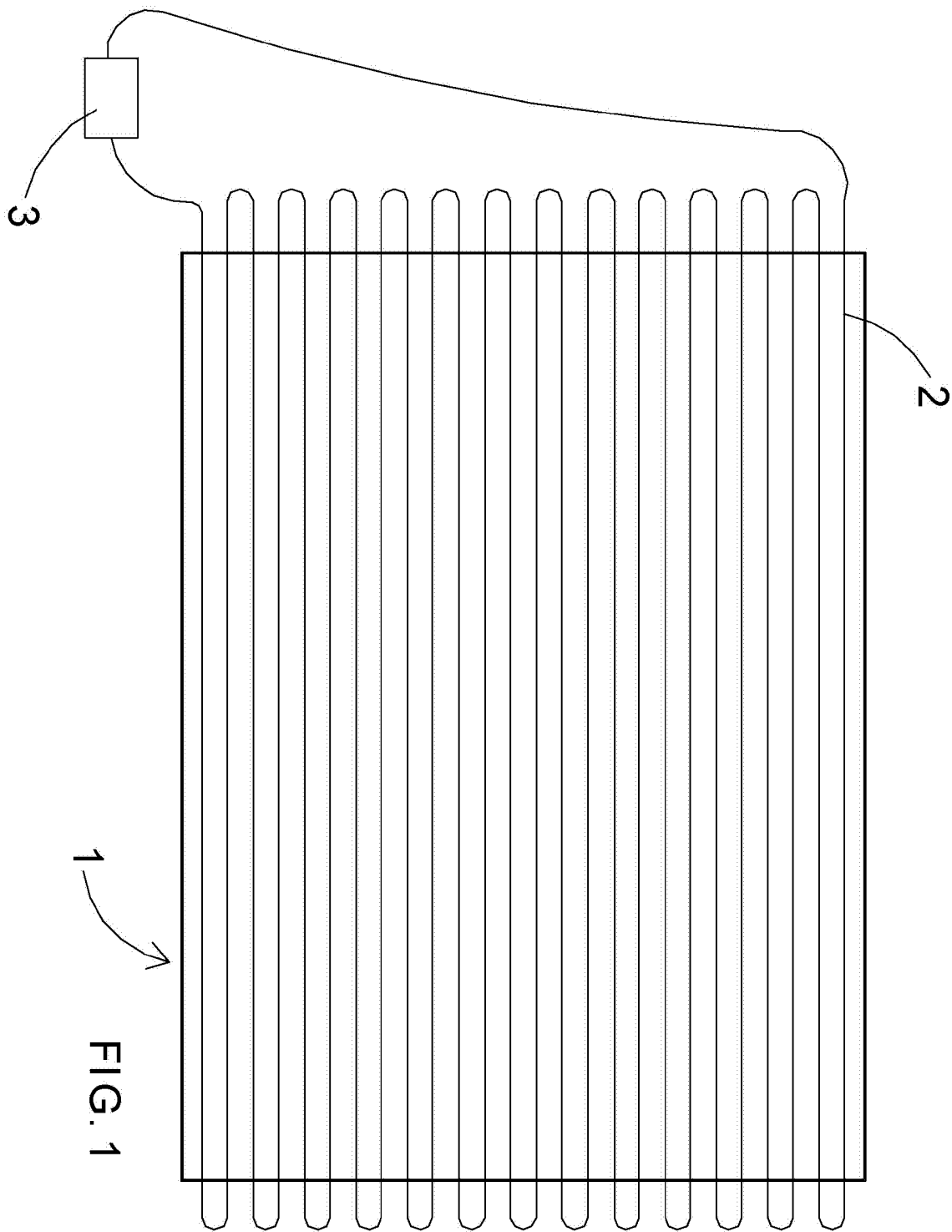
18. The apparatus according to claim 17, wherein the bottom of the mould is provided with parallel grooves, and the hollow hose comprises a bulging foot, the bulge being received in and retained by a groove in the bottom of the mould.

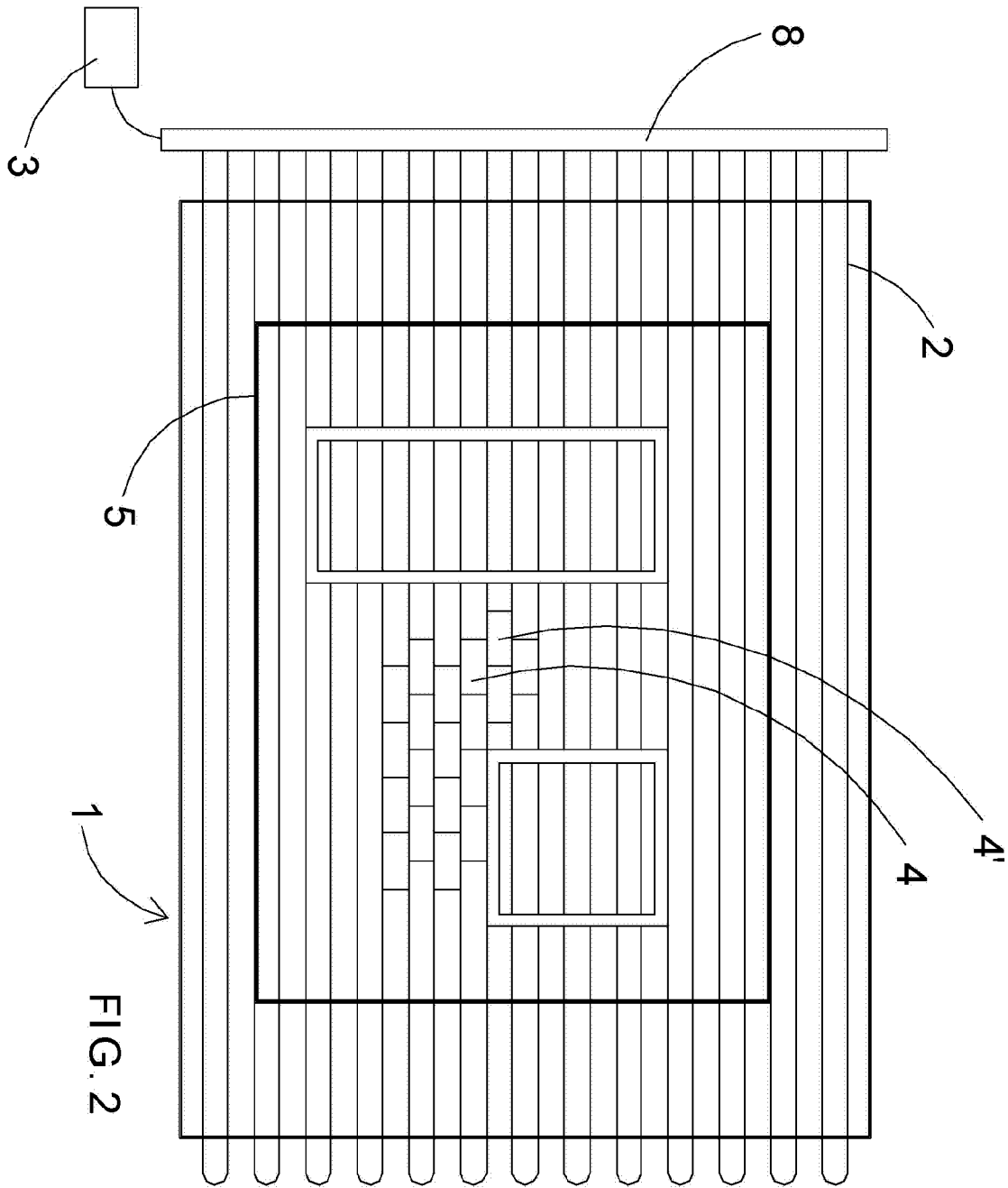
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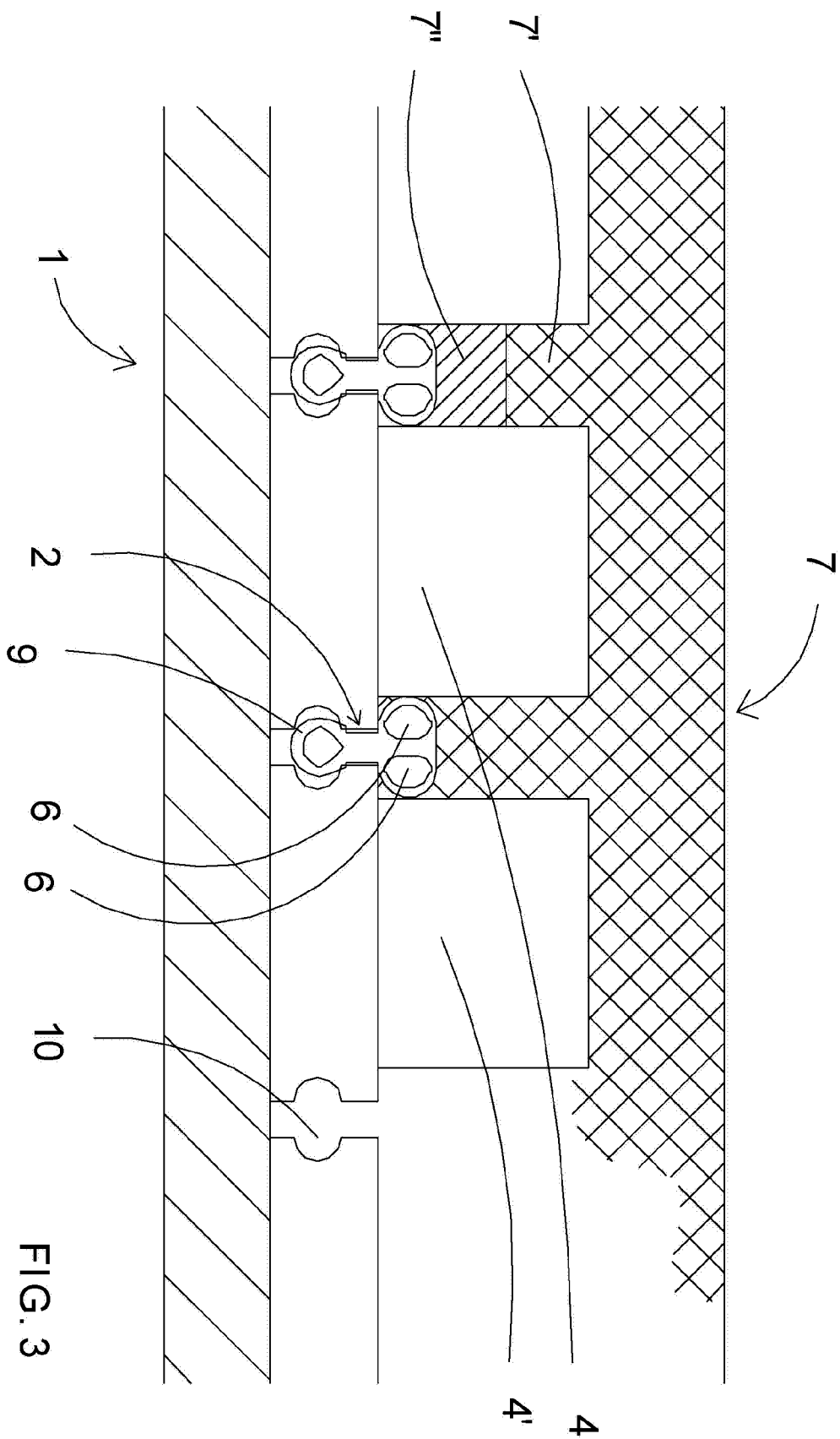
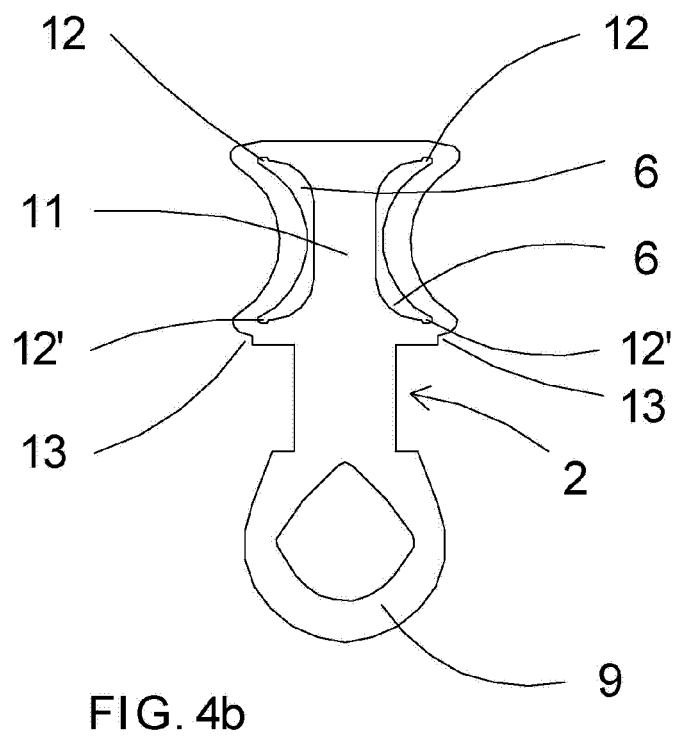
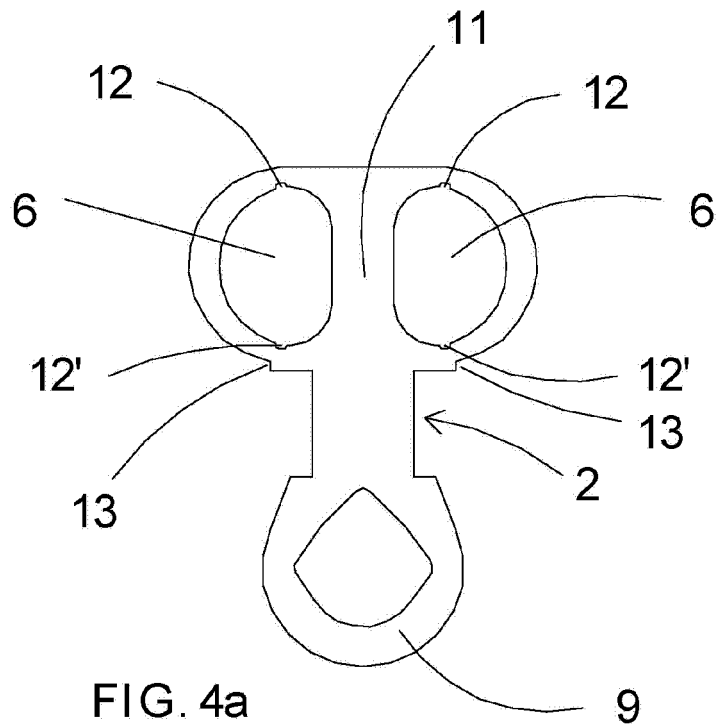


FIG. 3



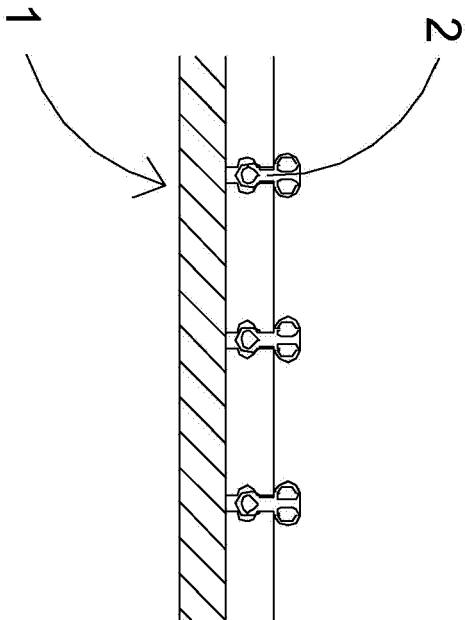


FIG. 5a

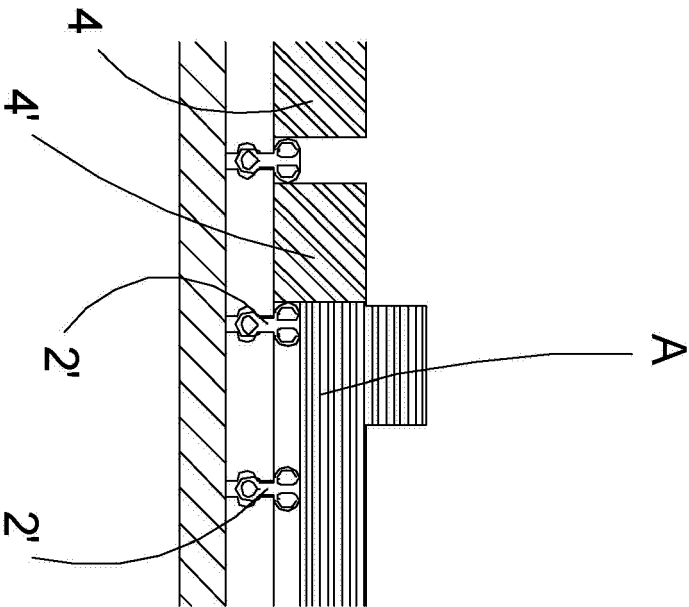
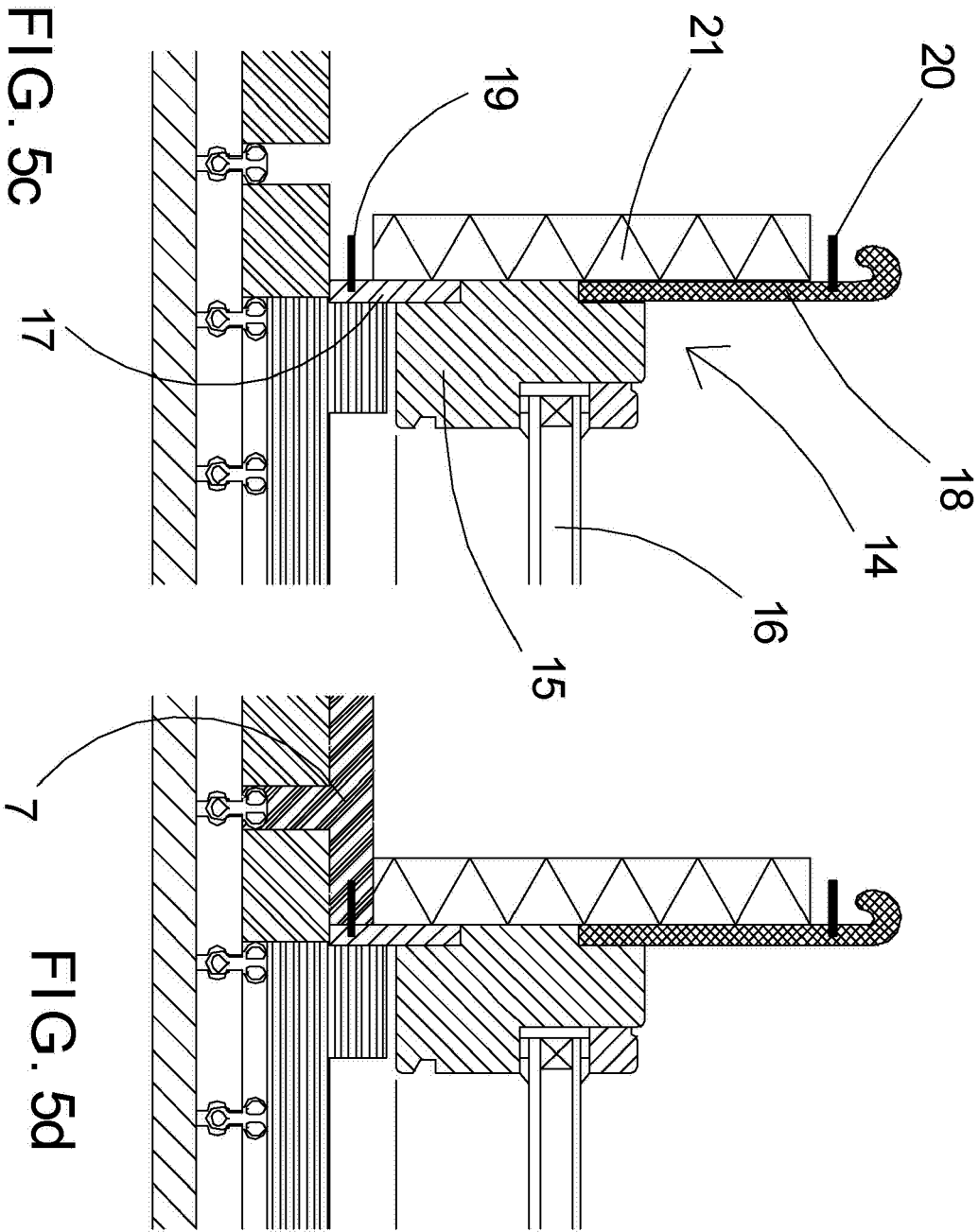


FIG. 5b



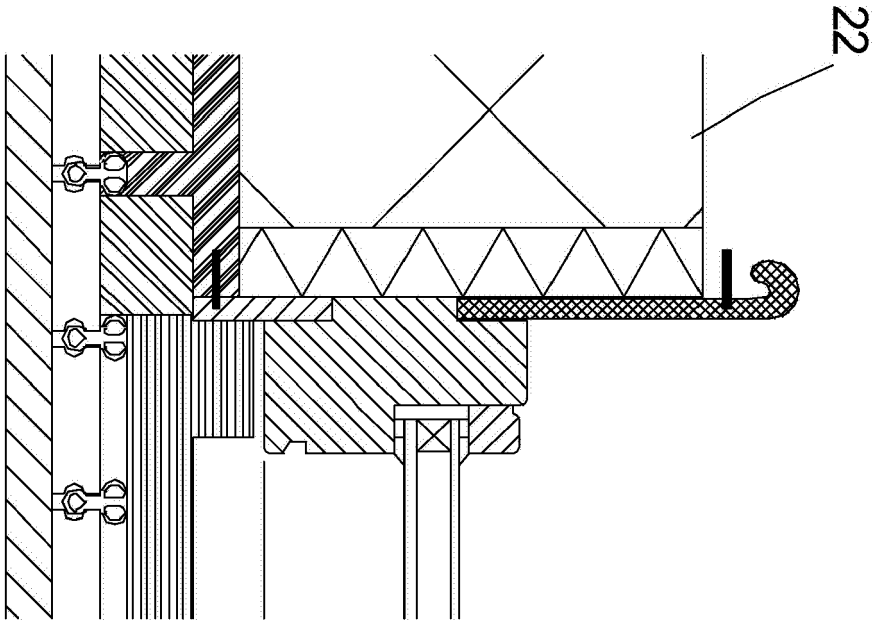


FIG. 5e

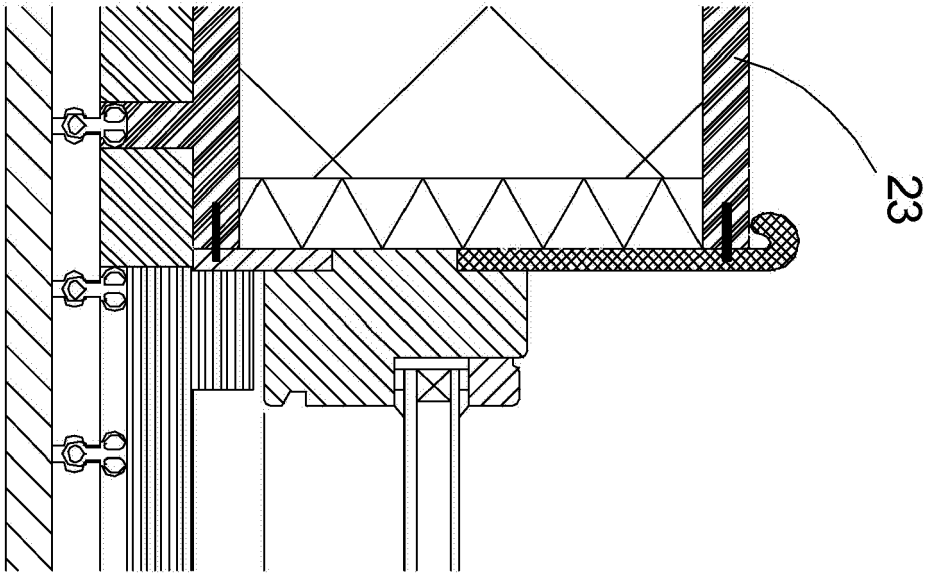


FIG. 5f

REFERENCES CITED IN THE DESCRIPTION

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