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(54) **Stairway and method for making it**

Treppe und Verfahren zu ihrer Herstellung

Escalier et méthode pour sa réalisation

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Description

[0001] The present disclosure refers to a stairway and to a method for making it.

[0002] In the building field, the need to provide a connection between different floors or levels of a same building arises very frequently; such a need is usually met by making one or more flights of stairs.

[0003] Sometimes the space available for making a stairway is reduced and therefore it is necessary for different sections of a same stairway to have orientations different from each other, in order to contain the dimensions in plan view of the stairway within a stairwell of limited size.

[0004] The recognized need to take up less room than the conventional stairways has led, e.g., to the introduction of the so-called spiral stairways. Historically, the first uses of spiral stairways were recorded for access to the top of towers, minarets, monumental columns or pillars.

[0005] Over the centuries, stairway construction techniques have evolved in the direction of rapidity and inexpensiveness of design, making and installation.

[0006] In the known art, the making of a concrete stairway requires on-site making of one or more formworks for the entire stairway. Formworks are hand-made with wooden boards or sheet metal and must be suitably supported to extend between the floors to be connected. Subsequently, concrete casting into the formworks occurs and, once concrete has set, formwork removal and stairway finishing are carried out. Therefore, the formworks compose a casing into which fluid-state concrete is cast. After setting, the casting has achieved a mechanical strength such as to ensure absorption of stresses to which the structure is subjected, and formwork dismantling ensues.

[0007] Such a making mode is very toilsome, complex and expensive, requiring skilled labour and long times for the making. Even the subsequent disposal of the formworks represents a problem, due to the fact that, usually, wood mixed up with plastics sheets is present in the formworks.

[0008] Moreover, there is the need to make a stairway having an intrados with a curved and well-jointed surface, because this is an aesthetical requirement much sought-after by customers.

[0009] The above-described making mode entails very large dimensional tolerances, which prove to be substantially incompatible with said need. To solve this drawback, a phase of finishing the stairway is resorted to in order to make the intrados surface free from asperities, steps and anomalous curvatures; this phase is very difficult and toilsome, as well as not always satisfactory from the standpoint of the final result.

[0010] Modular stairways of concrete, wood or other materials are also found in the known art. Such stairways consist of sectional prefabricated modules, each corresponding to a step, which are assembled together usually by screws and bolts or with other assembling modes. The modules are all identical to each other and are mass-produced. Examples of such modular stairways are disclosed by Austrian patent No. AT 385 074, which discloses the preamble of claim 1 and the preamble of claim 14, and also by German patent No. DE 336 074, German patent No. DE 809 483, United States patent No. US 6,112,480, international patent application No. WO 02/100149.

[0011] The making of a modular stairway is faster and simpler than a making entirely on-site as described above.

[0012] However, the inventor of the subject of the present disclosure has noticed that the fact of having to use modules identical to each other and of predetermined shape seriously limits the possibility of making a custom stairway for a stairwell of specific size, all the more so when space is limited and it is necessary to make a curved or spiral stairway. In fact, the designer's freedom is strongly limited, or even cancelled, by having to use modules that are identical and of standard shape and dimensions already preset by others, i.e. by the makers of the modules themselves.

[0013] Moreover, due also to the large dimensional tolerances linked to module making, jointing between modules proves to be rough, therefore it is very difficult to make a stairway having an intrados with a curved and well-jointed surface without resorting to subsequent toilsome finishing phases.

[0014] Therefore, in order to obviate at least one of the drawbacks mentioned above with reference to the known art and/or achieve further advantages, the inventor has provided a method for making a stairway according to claim 1, and a stairway according to claim 14.

[0015] Secondary features of the subject of the present disclosure are set forth in the corresponding dependent claims.

[0016] The subject of the present disclosure provides some relevant advantages.

[0017] The method which is the subject of the present disclosure is useful to render the making of a stairway more effective and cheaper.

[0018] In fact, the method envisages the making of a substantially modular stairway, wherein the modules, each corresponding to a step, are formworks which are shaped each depending on the end stairway to be obtained, and moreover they are "disposable" formworks, i.e. they are intended to remain included in the stairway following the casting of a filler material (which is, e.g., concrete). This allows a greater quickness in making the stairway, as the assembling of a plurality of individual prefabricated formworks is much easier than the on-site construction of a formwork for the entire stairway. Moreover, the method is useful to reach a higher precision of making, because the formworks can be suitably shaped so that the respective external surfaces basically correspond to the faces of the respective steps. Thus, the formworks may be accurately custom-made to obtain precise jointings between different steps.

[0019] Basically, with respect to the conventional methods based on concrete casting, the jointing between adjacent steps is remarkably improved and, for instance, in some embodiments, it is easier to obtain an intrados with a curved and well-jointed surface.

[0020] In particular, a design phase which includes a phase of custom computing the dimensions and shape of each of said formworks, on the basis of the dimensions of a stairway installation site, is provided. The shaping of the individual formworks is based on such a design phase.

[0021] Basically, it is possible to make a custom stairway, comprising a plurality of steps all different from each other and made in a precise way thanks to the exact dimensioning of the required individual formworks and to their subsequent production on the base of the exact dimensioning; in an embodiment, the production is carried out, e.g., by milling with a numerical-control milling machine.

[0022] Moreover, according to some embodiments of the present disclosure, the modular stairway is made with light-weight hollow formworks; accordingly, the transporting and assembling phases are less burdensome than other known methods.

[0023] A major contribution to the formwork lightness feature is attained, as in some embodiments the formwork is obtained from a block of wood-concrete. In fact, wood-concrete comprises wood chips mixed with a concrete matrix; as a result it is lighter in weight than solid blocks of concrete. By using this material, it is possible to reach a weight of the finished stairway that is about one-half the weight of a stairway made with conventional methods.

[0024] In other embodiments the formworks are obtained from polystyrene blocks, thereby attaining an even more marked reduction of the weight of the finished stairway. In addition, polystyrene is particularly easy to work.

[0025] Therefore, the method is particularly suitable for all those applications for which it is advisable to minimize constraint reactions from the supporting walls (e.g. in the refurbishing of old buildings) by lightening the load on the floor slabs.

[0026] In some embodiments, formwork shaping is carried out by material-removal manufacturing.

[0027] To be more specific, in some embodiments the manufacturing is carried out by milling from blocks of material; milling allows to reach high accuracy, which would not be achievable by using the usual moulding/casting methods. Milling further allows a rather rapid making of the formworks.

[0028] This mode is particularly indicated for shaping wood-concrete blocks, which can be milled without particular difficulty, and also for blocks of polystyrene or of other workable material.

[0029] In other embodiments, formwork shaping is carried out by laser cutting or by hydrojet cutting.

[0030] These modes, that allow to obtain high manufacturing accuracy too, are particularly suitable for shaping polystyrene blocks, but can anyhow be applied also to blocks of wood-concrete or of other workable material.

[0031] The polystyrene blocks might also be shaped otherwise, e.g. by hot-wire cutting.

[0032] In case polystyrene blocks are used, the strenght of the obtained formwork may be enhanced, after the shaping phase, by coating the surface of the formwork with a hardening resin, e.g. a polyurethane resin, or with fiberglass.

[0033] Basically, in such embodiments, the phase of manufacturing each formwork is carried out by selective removal of material from an initial solid block, in order to obtain a formwork having the desired dimensions and shapes, inclusive of recesses in the formwork body and recess openings to the outside; it is therefore a three-dimensional shaping.

[0034] Such shaping is carried out by using, e.g., a numerical-control machine tool, which is managed by a computer. To obtain maximum versatility of use, the machine tool is of the type having five or more axes.

[0035] In principle, it is possible to use blocks of other materials and/or other machine tools, which allow to machine the block by selectively removing material therefrom to obtain a formwork in the desired shape. The material will be selected among those allowing to obtain a formwork having a mechanical strenght adequate to the stairway to be made. Moreover, it will be appreciated that, since the formworks are "disposable", the method that is the subject of the present invention allows to get rid of the formwork disassembling phase, which instead is necessary with other stairway making methods. In some embodiments, the method provides a phase of assembling in which the joining between adjacent formworks is obtained by connecting means making a tongue-and-groove coupling between two adjacent formworks. This allows a very rapid and simple assembling, providing no screwing steps or more complex connecting methods.

[0036] In some embodiments, a phase of arranging reinforcements in the formworks before proceeding with casting the filler material is provided, so that the structural strength of the stairway be enhanced by the reinforcements themselves, which e.g. are metal bars. In some embodiments, the stairway is produced using fire-resistant, sound-absorbing and ecological materials.

[0037] Therefore, it will be better appreciated how the method of the present disclosure also allows to reduce noise due to treading on the steps.

[0038] Moreover, the method enables the use of a renewable material such as wood in the wood-concrete blocks.

[0039] The design phase provides, e.g., the adoption of antiseismic criteria in computing the dimensions and shape of the entire stairway and the individual steps.

[0040] Other advantages, features and operation steps of the subject of the present disclosure will be made evident in the following detailed description of preferred embodiments thereof, given by way of example and not for limitative purposes. Reference will be made to the

figures of the annexed drawings, wherein:

- Figure 1 shows a top perspective view of a formwork according to the present disclosure;
- Figure 2 shows a front perspective view of the formwork according to Figure 1;
- Figure 3 shows a perspective view of a phase of manufacturing the formwork according to Figure 1;
- Figure 4 shows a top and side perspective view of a plurality of formworks according to the present disclosure, in a phase of assembling a stairway;
- Figure 5 shows a top and side perspective view of the formworks according to Figure 4, in an assembled configuration;
- Figure 6 shows a bottom perspective view of the formworks according to Figure 5, wherein a stairway intrados is visible;
- Figure 7 shows a top and side perspective view of a stairway in a making phase according to the present disclosure;
- Figure 8 shows a top perspective view of the stairway according to Figure 7, in another making phase;
- Figure 9 shows a perspective view of a detail of the stairway according to Figure 8; and
- Figure 10 shows a top and side perspective view of part of the stairway according to Figure 7 in still another making phase.

[0041] Referring initially to Figure 1 and Figure 2, a formwork according to the present disclosure is shown in two different views and is generally denoted by reference number 1.

[0042] As will be made apparent hereinafter, the formwork 1 is of the so-called "disposable" type, i.e. it remains permanently included in the end structure of a stairway 100. In other words, the formwork 1 is not removed subsequently to the making of the stairway, as it happens with formworks commonly used in the building field, but on the contrary the formwork 1 is an integral part of the stairway 100 and therefore carries out a structural function in the stairway 100 when the latter is completed.

[0043] In particular, each formwork 1 goes to form a respective step 110 of the stairway 100, therefore the formwork 1 has a shape that corresponds to the shape of the respective step 110.

[0044] The formwork 1 has a substantially prismatic shape. In the example shown, it has;

- a first face 1 a, or top face, corresponding to a treadable region 12 of the respective step 110,
- a second face 1b, or bottom face, opposite to the first face 1a and corresponding to an intrados portion 6 of the stairway 100,
- a third face 1c and a fourth face 1d, which are intended to face on respective adjacent formworks,
- a fifth face 1 e, corresponding to a riser face of the respective step 110,
- a sixth face 1f and a seventh face 1g, which are side faces corresponding to the bases of said prismatic shape.

[0045] In particular, the third face 1c is interposed between the first treadable face 1a and the second intrados face 1b, and is intended to face an adjacent formwork 1 placed at a higher height; the fourth face 1d is interposed between the second intrados face 1b and the fifth riser face 1e, and is intended to face an adjacent formwork 1 placed at a lower height.

[0046] Moreover, the first treadable face 1 a and the fifth riser face 1e are orthogonal to each other. In some embodiments of the present disclosure, the second intrados face 1b has a curved surface.

[0047] It has to be noted that by "substantially prismatic" shape it is meant that the formwork 1 has a shape resembling that of a prism, though it is not required that it be a geometric prism. E.g., the sixth face 1f and the seventh face 1g may be not parallel to each other and be of dimensions different from each other; the faces 1a, 1b, 1c, 1 d, 1 e, 1 f, 1g may have curved surfaces.

[0048] The formwork 1 is a hollow body, substantially it is a casing of suitable thickness (in the shown example the thickness is comprised between 2 and 8 cm), having an internal recess 2 which is open on one or more faces of the external surface of the formwork 1. In particular, the third face 1c and the fourth face 1d have respective access openings 23, 24 for accessing the internal recess 2; also the first treadable face 1 a has openings 21 for accessing to the internal recess 2. The fifth riser face 1e and the side faces 1f, 1g have continuous surfaces, in other words are devoid of access openings for accessing the internal recess 2.

[0049] In a variant embodiment (visible e.g. in the first base formworks 1 in Figures 4 and 5), the openings 21 of the first treadable face 1a and the openings 23 of the third face 1c are contiguous to each other; in other words, such openings 21, 23 extend to the edge 1 q between the first face 1 a and the third face 1 c, which edge 1 q is therefore interrupted at said openings 21, 23.

[0050] In the example, the formwork 1 comprises a partition 25, substantially parallel to the side faces 1f, 1g and arranged in an approximately intermediate position between said side faces 1f, 1g, partitioning the internal chamber 2 into two compartments; each compartment has access openings 21, 23, 24 on the corresponding faces 1a, 1c, 1d. Moreover, the partition 25 has a function of reinforcing the formwork 1.

[0051] Furthermore, the formwork 1 is provided with connecting means for allowing an assembling thereof with the adjacent formworks. In the example, the connecting means achieves a tongue-and-groove coupling, comprising male members 3 (e.g. pegs or tenons) and female members 4 (e.g., holes or mortises).

[0052] Such connecting means 3, 4 is arranged on the third faces 1c and on the fourth faces 1 d, e.g. at opposite parts of the faces themselves; for instance, it may be provided that each third face 1c and each fourth face 1d

be provided with a male member 3 and a female member 4, or it may be envisaged that each third face 1c be provided with at least two male members 3 and each fourth face 1 d be provided with at least two corresponding female members 4, or vice versa.

[0053] Basically, the joining between two adjacent formworks 1 is achieved by a tongue-and-groove joint coupling.

[0054] Each formwork 1 is obtained in the desired shapes and dimensions by three-dimensional shaping of a respective block 16 of material; in Figure 3 a shaping by milling is exemplarily shown.

[0055] In an embodiment, the blocks 16 are made of wood-concrete; in particular, they are made of a material comprising wood chips homogeneously distributed in a cement matrix, e.g. Portland cement, acting as a binder between the wood chips.

[0056] In the example, said wood-concrete comprises wood chips in an amount of 80% by weight and concrete in an amount of 20% by weight. In the example, the wood chips are pinewood chips and have dimensions in the order of 3-6 cm in length and a thickness of some millimetres.

[0057] Therefore, wood-concrete blocks 16 are provided, e.g. initially parallelepiped-shaped, that are machined by a milling machine 17 to obtain the formworks 1, which thereby are custom-made.

[0058] Starting from a wood-concrete block 16, the milling machine 17 machines and shapes such a block 16 to give it the shape and dimensions desired for the relevant formwork 1 and makes therein the internal recess 2 and the openings 21, 23, 24, leaving the partition 25.

[0059] By repeating the process for the other blocks 16, a plurality of wood-concrete formworks 1 is thus provided.

[0060] In the example, the phase of producing the formworks 1 by milling is carried out by using a milling machine 17 having five or more axes.

[0061] In particular, the milling machine 17 is of numerical-control type, it being controlled by a computer 18. Therefore, the milling machine 17, by being a numerical-control one, allows to make the formworks 1 in a very accurate way, and with a working contribution from a single unskilled operator.

[0062] In another embodiment the blocks 16 are made of polystyrene, e.g. EPS with a density of 35 kg/m^3.

[0063] The polystyrene blocks 16 are shaped by the milling machine 17 to obtain the formworks 1.

[0064] Alternatively, the shaping of the blocks 16 may be carried out by using a laser cutting machine, or a hydrojet cutting machine, also these being numerical control ones and operating on five or more axes. In case of polystyrene blocks 16, also a hot-wire cutting machine might be used.

[0065] In case polystyrene blocks 16 are used, the formwork 1 obtained following the shaping operation is subjected to a phase of coating with resin: the surface of the formwork 1 (both on the external faces 1 a, 1b, 1 c, 1 d, 1 e, 1 f, 1g, and in the internal recess 2) is coated with a hardening resin, which e.g. is distributed by spraying or brushing. This hardening resin is, e.g., a polyurethane resin and/or a fiberglass-containing resin. Thus, a formwork 1 of resin-coated polystyrene is obtained, i.e. a formwork having a polystyrene core coated by a layer of hardened resin which sensibly improves its mechanical resistance properties. The thickness of the resin layer is, e.g., of 1-2 mm; such thickness may be higher for bigger formworks 1, i.e. for those that are subjected to greater mechanical stresses. The thickness of the walls or faces of the polystyrene formwork is, e.g., of between 2 and 8 cm.

[0066] The phase of making the formworks 1 occurs in a workshop and the formworks 1 thus obtained are subsequently transported on the site where the stairway 100 is to be installed. Basically, the formworks 1 are prefabricated in the workshop and ready for use.

[0067] Prefabrication of the formworks 1 occurs on the basis of a design of the stairway 100.

[0068] The designing of the stairway 100 includes a phase of custom computing the dimensions and features of the stairway 100 itself, given the dimensions (encumbrance in plan view, difference in level between floors to be connected,...) of a stairwell or other installation site and the specifications required, e.g., by technical rules for building. In particular, the computing phase determines in a custom-made manner the dimensions and the shape of each step 110 and therefore of each formwork 1.

[0069] The shaping of each block 16 to obtain the respective formwork 1 is based on the dimensions and shape of the step 110 which have been determined in the design phase.

[0070] The design phase may also be made through known algorithms, typically via a software. E.g., CAD/CAM systems are used, which, in an embodiment, are directly integrated with the computer 18 controlling the milling machine 17 (or other machine tool for the three-dimensional shaping of the blocks 16), making the designing of the stairway 100 even more rapid.

[0071] Basically, an apparatus for making the formworks 1 is provided, comprising a computer 18 and a shaping machine tool 17. The computer 18 is configured for inputting data related to the dimensions of the installation site for the stairway 100 and is further configured for executing a custom computing software for each formwork 1 on the basis of the dimensions of the installation site. The shaping machine tool 17 is configured for shaping a plurality of blocks 16 on the basis of the results of the custom computing, to the obtainment of the plurality of formworks 1.

[0072] In particular, the apparatus includes storage means for storing the dimensions of the installation site and/or the results of the custom computing.

[0073] The stairway 100 may be designed with steps 110 all different from each other, therefore also the formworks 1 are made as unique pieces, different from each

other. In other words, the method allows a custom and individual making of a stairway 100, which therefore can be designed in the best way, to best be fitted in a stairwell of preset dimensions.

[0074] Figures 4 to 10 show subsequent phases of making the stairway 100.

Figure 4 shows a plurality of formworks 1 that are joined to each other in sequence, by a phase of on-site assembling in which the formworks 1 are arranged adjacent and aligned in a preset sequence along a direction 150 of ascent-descent of the stairway 100.

[0075] As mentioned, the formworks 1 may be, e.g., all different from each other; such a preset sequence of the formworks 1 is therefore that univocally determined in the design phase and allowing to obtain the stairway 100 in the design dimensions and features.

[0076] In particular, Figure 4 shows the assembling of a formwork 1 with another adjacent formwork, denoted by reference number 5, which has already been laid; thus, a stairway section 100 shown in Figure 5 is obtained.

[0077] In the assembling phase, a tongue-and-groove joint coupling is achieved between the male 3 and female 4 members on the fourth face 1d of the formwork 1 and the corresponding female 4 and male 3 members on the third face 1c of the adjacent formwork 5.

[0078] Thanks to the custom design phase, the dimensions of the fourth face 1d of the formwork 1 correspond to, and even match, the dimensions of the third face 1c of the adjacent formwork 5, as well as there is a correspondence between the connecting means 3, 4 of the formwork 1 and the connecting means 4, 3 of the adjacent formwork 5.

[0079] Moreover, the formworks 1, 5 are arranged so that the access openings 24 of the fourth face 1d of the formwork 1 be aligned with respective access openings 23 of the third face 1 c of the formwork 5; therefore, it is obtained a channel 29 (or, in the present case, two channels 29) extending through the recesses 2 of the formworks 1, 5 along the direction 150 of ascent-descent.

[0080] The assembling phase can also be carried out by hand, as it merely comprises a tongue-and-groove joint coupling and the formworks 1, 5 are rather lightweight. As the case may be, it may be necessary to assemble a simple scaffolding or other similar structure (not shown) to support the whole of the formworks 1, 5 during the assembling. The assembling phase proceeds by joining in sequence one formwork 1 after the other, until completing the skeleton 7 of the stairway 100, shown in Figure 7.

[0081] Basically, the stairway 100 is a modular stairway, whose modules are represented by the formworks 1; it has to be noted, however, that such modules in the example are all different from each other.

[0082] Therefore, a sequence of formworks 1, 5, adjacent to each other and connected via the connecting means 3, 4, is obtained, which are arranged to take up a stairwell (not shown in the figures as not strictly necessary to the present description) to act as vertical connection between an upper floor 13 and a lower floor 14.

[0083] The skeleton 7 of the stairway 100 has a step-shaped first treadable side 12, and a second intrados side 6 opposite to the first treadable side 12.

[0084] The second intrados side 6 is designed so as to have a continuous even surface; in other words, the second intrados side 6 is a curved surface that (within the limits of the tolerances for the making and joints) has no gaps, steps, and/or sudden variations of slope or curvature.

[0085] The surface of the second intrados side 6 is formed by the setting side-by-side of the second faces 1 b of the formworks 1, arranged side-by-side to each other and in sequence.

[0086] It has to be noted that the making method according to the present disclosure allows, thank to the designing and the custom making of the individual formworks 1, to obtain said intrados 6 with a curved, continuous and precisely and evenly jointed surface between adjacent formworks 1.

[0087] Figure 8 shows a phase of positioning a reinforcement 8 in the recesses 2 of the plurality of formworks 1.

[0088] In particular, the reinforcement 8 comprises longitudinal reinforcements or bars 10 which are arranged along said channel 29, i.e. substantially parallel to the direction 150 of ascent or descent of the stairway 100; the reinforcement 8 further comprises transversal reinforcements or bars 11 arranged substantially perpendicular to the longitudinal reinforcements 10 and substantially parallel to a treadable plane 12, i.e. parallel to the first faces 1 a of the formworks 1.

[0089] It has to be noted that the transversal bars 11 can, e.g., be positioned in the internal recess 2 by slipping them through suitable through holes (not shown) made in the side faces 1f, 1g and in the partition 25 of the respective formwork 1.

[0090] In the embodiment shown, the longitudinal reinforcements 10 extend for a stairway section 100 comprising a plurality of steps 110, even all of the steps 110; in other words, each longitudinal reinforcement 10 is common to a plurality of adjacent formworks 1, in order to strengthen the connection between the formworks 1 themselves.

[0091] Figure 9 shows in detail the positioning of the reinforcement 8 in the recesses 2. It has to be noted that the transversal reinforcements 11 are interconnected with the longitudinal reinforcements 10 by a phase of hooping which includes the use of hoops 15 surrounding and clasping the intersection regions between the longitudinal reinforcements 10 and the transversal reinforcements 11.

[0092] Moreover, the hooping is also made between the transversal reinforcements 11 of a formwork 1 and the transversal reinforcements 11a of an adjacent formwork; this is illustrated by way of example in Figure 9, in which hoops 15b are shown connecting a transversal bar 11 of the formwork 1 to a transversal bar 11 a of the

adjacent formwork 5 (not shown). This allows to strengthen the connection between the adjacent formworks 1,5.

[0093] The reinforcement 8 is made, e.g., by means of metal bars, as those customarily used in the building field to reinforce concrete.

[0094] Referring to Figure 10, it is illustrated a phase of filling the formworks 1 with a filler material, which in the example is concrete 40.

[0095] Basically, once the formworks 1 have been assembled and joined to each other, and the longitudinal reinforcement 10 and the transversal reinforcements 11 have been arranged in the internal recesses 2 and the hooping has been made between them, fluid-state concrete 40 is cast into the internal recesses 2, completely filling them. Concrete 40 is cast into the internal recesses 2 through the openings 21 on the first faces 1a of the formworks 1. The presence of the openings 23, 24 aligned to each other facilitates the homogeneous distribution of the concrete 40 in the recesses 2, also allowing the transit of concrete 40 from one formwork 1 to another one and the creation of a continuous structure involving all formworks 1.

[0096] E.g., the filling of each formwork 1 may be carried out by casting the concrete 40 through the openings 21 of the formwork 1 at the higher level (i.e. nearer to the top floor 13), so that the concrete 40 may flow down along the channels 29 and fill all of the underlying formworks 1. In this case the filling of each formwork 1 is carried out by a single casting operation of concrete 40.

[0097] Alternatively, the concrete 40 may be cast in sequence into each formwork 1, one after the other.

[0098] When the concrete 40 has dried up, the stairway 100 is structurally complete. Of course, finishing operations will be possible, like, e.g., laying of marble or stone slabs, or of wooden boards on the first treadable faces 1a, polishing of the surfaces in sight, plastering, painting.

[0099] From the present description it is evident that the formworks 1 remain permanently included in the structure of the stairway 100; in fact, the formworks 1 are disposable formworks, making up a skeleton 7 having both a load-bearing structural function for the stairway 100 and a containing function for the concrete 40. The concrete 40 turns the stairway 100 into a single body, carrying out the final locking of the formworks 1 to each other. The reinforcement 8 has a structural reinforcing function, among which that of enhancing joining solidity between the formworks 1.

[0100] Therefore, the stairway 100 has a plurality of steps 110, each comprising a respective formwork 1 and the filler material (in the example, concrete 40) which is permanently included in the formwork 1 itself.

[0101] Each step 110 has a treadable region 12 corresponding to the first face 1 a of the formwork 1, a riser 65 corresponding to the riser face 1 e of the formwork 1, an intrados 6 corresponding to the second face 1b of the formwork 1, and sides 66, 67 corresponding to the side faces 1f, 1g of the formwork 1.

[0102] In alternative embodiments, the formwork is designed and made so as to correspond to a plurality of consecutive steps 110 of the stairway 100, instead of to a single step 110. Basically, the overall number of distinct formworks to be made may be lower than the total number of steps 110, as two or more successive steps may be comprised in a single formwork. In pratice, in accordance with these variant embodiments, the wording "wherein each formwork (1, 5) has a shape corresponding to a respective step (110) of the stairway (100)" in claim 1 and in claim 17 is to be understood in the sense that the formwork has dimension corresponding to a plurality of subsequent steps of the final stairway. It follows that, in accordance with these variant embodiments, the number of steps that are made together with a single formwork is established during the designing and computing phase.

[0103] The subject of the present disclosure has hereto been described with reference to preferred embodiments thereof. It is understood that other embodiments might exist, all falling within the scope of the claims hereinafter.

Claims

1. A method for making a stairway (100), said method comprising the phases of:

- providing a plurality of formworks (1, 5), wherein each formwork (1, 5) has a shape corresponding to a respective step (110) of the stairway (100);
- joining said formworks (1, 5) in sequence;
- filling each of said formworks (1, 5) with a filler material (40), to the obtainment of a respective step (110) comprising said formwork (1, 5) and said filler material (40) permanently included in said formwork (1, 5),

characterised in that

the phase of providing a plurality of formworks comprises the following phases:

- a design phase which includes a custom computing of the dimensions and shape of each of said formworks (1, 5) on the basis of the dimensions of an installation site of the stairway (100);
- a phase of prearranging a plurality of blocks (16);
- a phase of shaping each of said blocks (16) to the obtainment of said plurality of formworks (1, 5), wherein said phase of shaping each of said blocks (16) is based on said design phase.

2. The method according to claim 1, wherein said formworks (1, 5) are joined by a phase of on-site assembling, wherein said formworks (1, 5) are arranged adjacent and aligned in a preset sequence along a direction (150) of ascent-descent of said stairway

(100), each formwork (1, 5) comprising a first face (1a) corresponding to a treadable region (12) of the respective step (110) and a second face (1b) opposite to the first face (1a) and having a curved surface, said design phase being such that in said assembling phase the second faces (1b) of the adjacent formworks (1, 5) are arranged side-by-side to each other, to form a continuous even surface (6).

3. The method according to claim 1 or 2, wherein said phase of joining the formworks (1, 5) provides a joining between adjacent formworks (1, 5) by connecting means (3, 4) adapted to make a tongue-and-groove coupling between two adjacent formworks (1, 5).

4. The method according to claim 1, 2 or 3, wherein said blocks (16) are made of wood-concrete or of polystyrene.

5. A method according to any one of the claims 1 to 4, wherein said phase of shaping each of said blocks (16) comprises a material-removal manufacturing.

6. The method according to claim 5, wherein said phase of shaping each of said blocks (16) is carried out by a milling machine (17) or by a laser cutting machine or a hydrojet cutting machine.

7. The method according to any one of the claims 4 to 6, wherein said blocks (16) are made of polystyrene and wherein the phase of shaping the block (16) is followed by a phase of coating the respective formwork (1, 5) by a hardening resin.

8. The method according to any one of the claims 1 to 7, wherein each of said formworks (1, 5) has a substantially prismatic shape having an internal recess (2), and wherein each of said formworks (1, 5) has a third face (1c) and a fourth face (1d) which are intended to face respective adjacent formworks (5, 1), said third face (1c) and fourth face (1d) having access openings (23, 24) for accessing said internal recess (2).

9. The method according to claims 2 and 8, wherein during said assembling phase the formworks (1, 5) are arranged so that the access openings (23, 24) of said third face (1 c) and fourth face (1 d) of adjacent formworks (1, 5) be aligned to each other to form a channel (29) extending along said direction (150) of ascent-descent.

10. The method according to claim 9, comprising a phase of positioning a reinforcement (8) into said internal recesses (2), said reinforcement (8) comprising longitudinal reinforcements (10) arranged along said channel (29).

11. The method according to claim 10, wherein said reinforcement (8) comprises transversal reinforcements (11) that are substantially parallel to a first treadable face (1a) of the respective formwork (1, 5) and substantially perpendicular to said longitudinal reinforcements (10).

12. The method according to claim 11, comprising a phase of hooping by hoops (15b) between transversal reinforcements (11) of adjacent formworks (1, 5).

13. The method according to any one of claims 8 to 12, wherein the phase of filling said formworks (1, 5) includes a phase of concrete casting (40) into said internal recesses (2).

14. A stairway (100) including a plurality of steps (110), wherein each step (110) comprises a formwork (1, 5) and a filler material (40) permanently included in said formwork (1, 5),
characterised in that
said stairway (100) has a first treadable side (12) and a second intrados side (6) opposite to said first treadable side (12), said second intrados side (6) being a continuous even surface, wherein each of said formworks (1, 5) has a first treadable face (1a) and a second face (1b) opposite to the first treadable face (1a) and corresponding to a respective portion of said second intrados side (6), said continuous even surface (6) being formed by the arrangement side-by-side of said second faces (1 b) of the formworks (1, 5).

15. The stairway (100) according to claim 14, wherein said intrados side (6) has a curved surface, the second face (1b) of each formwork (1, 5) having a respective curved surface.

16. The stairway (100) according to claim 14 or 15, wherein said formworks (1, 5) are made of wood-concrete or of polystyrene.

17. The stairway (100) according to claim 16, wherein said formworks (1, 5) comprise a core of polystyrene and an external coating of polyurethane resin or of fiberglass.

Patentansprüche

1. Verfahren zum Herstellen einer Treppe (100), wobei das Verfahren die Arbeitsschritte enthält:

- Bereitstellen einer Mehrzahl von Schalungen (1, 5), wobei jede Schalung (1, 5) eine Form hat, die einer jeweiligen Stufe (110) der Treppe (100) entspricht;
- Zusammenfügen der Schalungen (1, 5) der

Reihe nach;
- Füllen jeder der Schalungen (1, 5) mit einem Füllmaterial (40) für das Erhalten einer jeweiligen Stufe (110), die die Schalung (1, 5) und das Füllmaterial (40) enthält, das dauerhaft in der Schalung (1, 5) enthalten ist,
dadurch gekennzeichnet,
dass der Arbeitsschritt des Bereitstellens einer Mehrzahl von Schalungen (1, 5) die folgenden Arbeitsschritte enthält:
- einen Gestaltungsarbeitsschritt, der eine individuelle Berechnung der Dimensionen und Form jeder der Schalungen (1, 5) auf der Basis der Dimensionen eines Installationsortes der Treppe (100) enthält;
- einen Arbeitsschritt des Vorab-Anordnens einer Mehrzahl von Blöcken (16);
- einen Arbeitsschritt des Formens jedes der Blöcke (16) für das Erhalten der Mehrzahl von Schalungen (1, 5), wobei der Arbeitsschritt des Formens jedes der Blöcke (16) auf dem Gestaltungsarbeitsschritt basiert.

2. Verfahren nach Anspruch 1, wobei die Schalungen (1, 5) durch einen Arbeitsschritt der Vor-Ort-Montage verbunden werden, wobei die Schalungen (1, 5) in einer vorgegebenen Reihenfolge längs einer Richtung (150) des Aufstiegs-Abstiegs benachbart und ausgerichtet angeordnet werden, wobei jede Schalung eine erste Fläche (1a), die einem Trittbereich (12) der jeweiligen Stufe (110) entspricht, und eine zweite Fläche (1b) enthält, die entgegengesetzt zu der ersten Fläche (1a) ist und eine gekrümmte Oberfläche hat, wobei der Gestaltungsarbeitsschritt so ist, dass in dem Montagearbeitsschritt die zweiten Flächen (1b) der benachbarten Schalungen (1, 5) Seite-an-Seite zueinander angeordnet werden, um eine durchgehende gleichmäßige Oberfläche (6) zu bilden.

3. Verfahren nach Anspruch 1 oder 2, wobei der Arbeitsschritt des Zusammenfügens der Schalungen (1, 5) ein Zusammenfügen zwischen benachbarten Schalungen (1, 5) durch Verbindungseinrichtungen (3, 4) bereitstellt, die ausgelegt sind, eine Nut-und-Feder-Kopplung zwischen zwei benachbarten Schalungen (1, 5) zu ergeben.

4. Verfahren nach Anspruch 1, 2 oder 3, wobei die Blöcke (16) aus Holzbeton oder aus Polystyrol bestehen.

5. Verfahren nach einem der Ansprüche 1 bis 4, wobei der Arbeitsschritt des Formens jedes der Blöcke (16) eine Produktionstechnik der Materialentfernung enthält.

6. Verfahren nach Anspruch 5, wobei der Arbeitsschritt des Formens jedes der Blöcke (16) durch eine Fräsmaschine (17) oder durch eine Laserschneidmaschine oder eine Wasserstrahlschneidmaschine durchgeführt wird.

7. Verfahren nach einem der Ansprüche 4 bis 6, wobei die Blöcke (16) aus Polystyrol bestehen und wobei auf den Arbeitsschritt des Formens des Blocks (16) ein Arbeitsschritt des Beschichtens der jeweiligen Schalung (1, 5) durch ein härtendes Harz folgt.

8. Verfahren nach einem der Ansprüche 1 bis 7, wobei jede der Schalungen (1, 5) eine im wesentlichen prismatische Form mit einer inneren Aussparung (2) hat, und jede der Schalungen (1, 5) eine dritte Fläche (1c) und eine vierte Fläche (1d) hat, die dazu bestimmt sind, jeweils benachbarten Schalungen zugewandt zu sein, wobei die dritte Fläche (1c) und vierten Seite (1d) Zugangsöffnungen (23, 24) zum Zugang zu der inneren Aussparung (2) haben.

9. Verfahren nach den Ansprüchen 2 und 8, wobei während des Montagearbeitsschrittes die Schalungen (1, 5) so angeordnet sind, dass die Zugangsöffnungen (23, 24) der dritten Fläche (1c) und der vierten Fläche (1d) benachbarter Schalungen (1, 5) miteinander ausgerichtet sind, um einen Kanal (29) zu bilden, der sich entlang der genannten Richtung (150) des Aufstiegs-Abstiegs erstreckt.

10. Verfahren nach Anspruch 9, enthaltend einen Arbeitsschritt des Positionierens einer Verstärkung (8) in die inneren Aussparungen (2) hinein, wobei die Verstärkung (8) Längsverstärkungen (10) enthält, die entlang dem Kanal (29) angeordnet sind.

11. Verfahren nach Anspruch 10, wobei die Verstärkung (8) Querverstärkungen (11) enthält, die im Wesentlichen parallel zu einer ersten Trittfläche (1a) der jeweiligen Schalung (1, 5) und im Wesentlichen senkrecht zu den Längsverstärkungen (10) sind.

12. Verfahren nach Anspruch 11, enthaltend einen Arbeitsschritt des Umreifens mit Bändern (15b) zwischen Querverstärkungen (11) benachbarter Schalungen (1, 5).

13. Verfahren nach einem der Ansprüche 8 bis 12, wobei der Arbeitsschritt des Füllens der Schalungen (1, 5) einen Arbeitsschritt des Betongießens in die inneren Aussparungen (2) hinein enthält.

14. Treppe (100)die eine Mehrzahl von Stufen (110) enthält, wobei jede Stufe (110) eine Schalung (1, 5) und ein Füllmaterial (40) enthält, das dauerhaft der Schalung (1, 5) enthalten ist,
dadurch gekennzeichnet,
dass die Treppe (100) eine erste Trittseite (12) und

eine zweite Laibungsseite (6) entgegengesetzt zu ersten Trittseite (12) enthält, wobei die zweite Laibungsseite (6) eine durchgehende gleichmäßige Oberfläche ist, wobei jede der Schalungen (1, 5) eine erste Trittfläche (1a) und eine zweite Fläche (1b) entgegengesetzt zur ersten Trittfläche (1a) und entsprechend einem jeweiligen Teil der zweiten Laibungsseite (6) hat, wobei die durchgehende gleichmäßige Oberfläche (6) durch das Anordnen der zweiten Flächen (1b) der Schalungen (1, 5) Seite-an-Seite.

15. Treppe (100) nach Anspruch 14, wobei die Laibungsseite (6) eine gekrümmte Oberfläche hat, wobei die zweite Fläche von jeder Schalung (1, 5) eine entsprechend gekrümmte Oberfläche hat.

16. Treppe (100) nach Anspruch 14 oder 15, wobei die Schalungen (1, 5) aus Holzbeton oder aus Polystyrol bestehen.

17. Treppe (100) nach Anspruch 16, wobei die Schalungen (1, 5) einen Kern aus Polystyrol und eine äußere Beschichtung aus Polyurethanharz oder aus Fiberglas haben.

Revendications

1. Procédé pour fabriquer un escalier (100), ledit procédé comprenant les étapes consistant à :

- prévoir une pluralité de coffrages (1, 5), dans lequel chaque coffrage (1, 5) a une forme correspondant à une marche (110) respective de l'escalier (100) ;
- assembler lesdits coffrages (1, 5) en séquence ;
- remplir chacun desdits coffrages (1, 5) avec une matière de remplissage (40), jusqu'à l'obtention d'une marche (110) respective comprenant ledit coffrage (1, 5) et ladite matière de remplissage (40) incluse de manière permanente dans ledit coffrage (1, 5),

caractérisé en ce que :

l'étape consistant à prévoir une pluralité de coffrages comprend les étapes suivantes :

- une étape de conception qui comprend un calcul personnalisé des dimensions et de la forme de chacun desdits coffrages (1, 5) sur la base des dimensions d'un site d'installation de l'escalier (100) ;
- une étape consistant à pré-agencer une pluralité de blocs (16) ;
- une étape consistant à former chacun desdits blocs (16) jusqu'à l'obtention de ladite pluralité de coffrages (1, 5), dans lequel ladite étape consistant à former chacun desdits blocs (16) est basée sur ladite phase de conception.

2. Procédé selon la revendication 1, dans lequel lesdits coffrages (1, 5) sont assemblés par une étape d'assemblage sur site, dans lequel lesdits coffrages (1, 5) sont agencés de manière adjacente et alignés dans une séquence prédéterminée le long d'une direction (150) d'ascension-descente dudit escalier (100), chaque coffrage (1, 5) comprenant une première face (1 a) correspondant à une région de piétinement (12) de la marche (110) respective et une deuxième face (1b) opposée à la première face (1 a) et ayant une surface incurvée, ladite étape de conception étant telle que dans ladite étape d'assemblage, les secondes faces (1b) des coffrages (1, 5) adjacents sont agencées côte à côte, afin de former une surface régulière continue (6).

3. Procédé selon la revendication 1 ou 2, dans lequel ladite étape consistant à assembler les coffrages (1, 5) fournit un assemblage entre les coffrages (1, 5) adjacents par des moyens de raccordement (3, 4) adaptés pour réaliser un couplage à languette et rainure entre deux coffrages (1, 5) adjacents.

4. Procédé selon la revendication 1, 2 ou 3, dans lequel lesdits blocs (16) sont réalisés à partir de bois-béton ou de polystyrène.

5. Procédé selon l'une quelconque des revendications 1 à 4, dans lequel ladite étape consistant à former chacun desdits blocs (16) comprend une fabrication de retrait de matériau.

6. Procédé selon la revendication 5, dans lequel ladite étape consistant à former chacun desdits blocs (16) est réalisée par une machine de meulage (17) ou par une machine de découpe au laser ou une machine de découpe à hydrojet.

7. Procédé selon l'une quelconque des revendications 4 à 6, dans lequel lesdits blocs (16) sont réalisés à partir de polystyrène et dans lequel l'étape consistant à former le bloc (16) est suivie par une étape consistant à recouvrir le coffrage (1, 5) respectif par une résine de durcissement.

8. Procédé selon l'une quelconque des revendications 1 à 7, dans lequel chacun desdits coffrages (1, 5) a une forme sensiblement prismatique ayant un évidement interne (2), et dans lequel chacun desdits coffrages (1, 5) a une troisième face (1 c) et une quatrième face (1 d) qui sont prévues pour faire face aux coffrages (5, 1) adjacents respectifs, ladite troisième face (1c) et la quatrième face (1d) ayant des

ouvertures d'accès (23, 24) pour avoir accès audit évidement interne (2).

9. Procédé selon les revendications 2 et 8, dans lequel, pendant ladite étape d'assemblage, les coffrages (1, 5) sont agencés de sorte que les ouvertures d'accès (23, 24) de ladite troisième face (1c) et de la quatrième face (1d) des coffrages (1, 5) adjacents sont alignées entre elles afin de former un canal (29) s'étendant le long de ladite direction (150) d'ascension-descente.

10. Procédé selon la revendication 9, comprenant une étape consistant à positionner un renforcement (8) dans lesdits évidements internes (2), ledit renforcement (8) comprenant des renforcements longitudinaux (10) agencés le long dudit canal (29).

11. Procédé selon la revendication 10, dans lequel ledit renforcement (8) comprend des renforcements transversaux (11) qui sont sensiblement parallèles à une première face de piétinement (1 a) du coffrage (1, 5) respectif et sensiblement perpendiculaires auxdits renforcements longitudinaux (10).

12. Procédé selon la revendication 11, comprenant une étape consistant à cercler avec des cercles (15b) entre les renforcements transversaux (11) des coffrages (1, 5) adjacents.

13. Procédé selon l'une quelconque des revendications 8 à 12, dans lequel l'étape consistant à remplir lesdits coffrages (1, 5) comprend une étape consistant à couler du béton (40) dans lesdits évidements internes (2).

14. Escalier (100) comprenant une pluralité de marches (110), dans lequel chaque marche (110) comprend un coffrage (1, 5) et une matière de remplissage (40) incluse de manière permanente dans ledit coffrage (1, 5),
caractérisé en ce que
ledit escalier (100) a un premier côté de piétinement (12) et un second côté d'intrados (6) opposé audit premier côté de piétinement (12), ledit second côté d'intrados (6) étant une surface régulière continue, dans lequel chacun desdits coffrages (1, 5) a une première face de piétinement (1a) et une deuxième face (1b) opposée à la première face de piétinement (1 a) et correspondant à une partie respective dudit second côté d'intrados (6), ladite surface régulière continue (6) étant formée par l'agencement côte à côte desdites deuxièmes faces (1 b) des coffrages (1, 5).

15. Escalier (100) selon la revendication 14, dans lequel ledit côté d'intrados (6) a une surface incurvée, la deuxième face (1b) de chaque coffrage (1, 5) ayant une surface incurvée respective.

16. Escalier (100) selon la revendication 14 ou 15, dans lequel lesdits coffrages (1, 5) sont réalisés à partir de bois-béton ou de polystyrène.

17. Escalier (100) selon la revendication 16, dans lequel lesdits coffrages (1, 5) comprennent un coeur de polystyrène et un revêtement extérieur de résine de polyuréthane ou de fibres de verre.

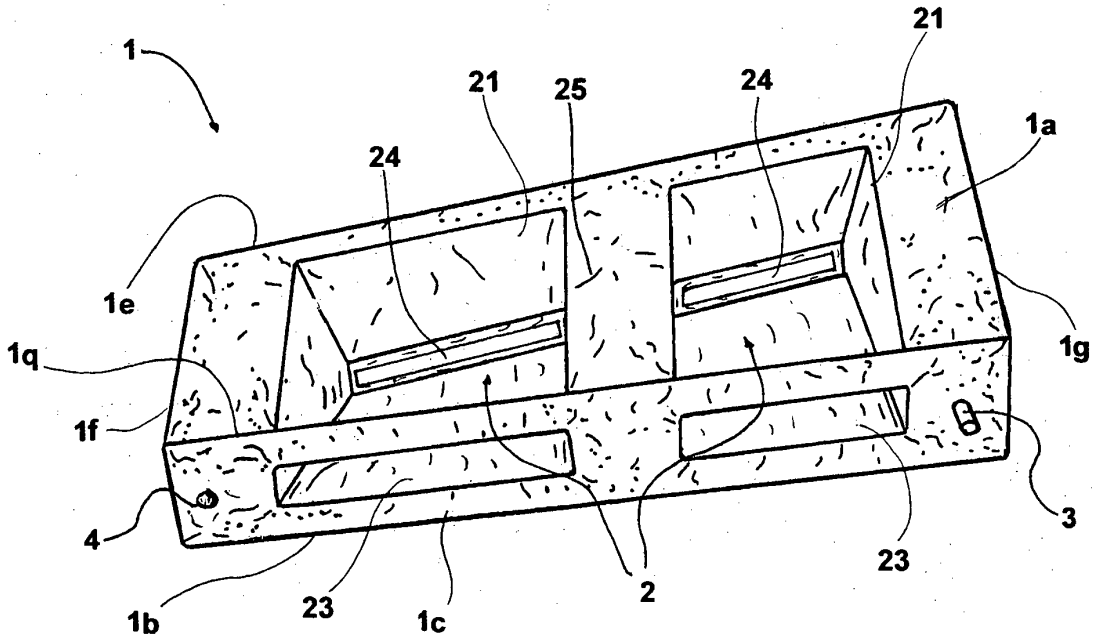
1
21
21
25
24
24
1a
1e
1g
1q
1f
4
3
23
2
1b
23
1c

FIG. 1

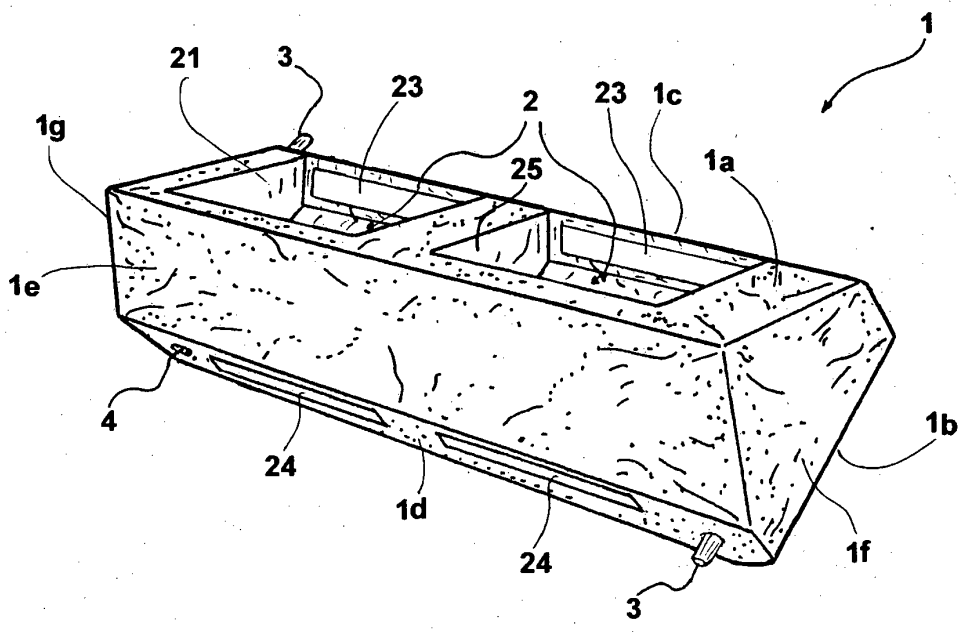
1
21
3
23
2
23
1c
1g
25
1a
1e
4
1b
24
1d
24
1f
3

FIG. 2

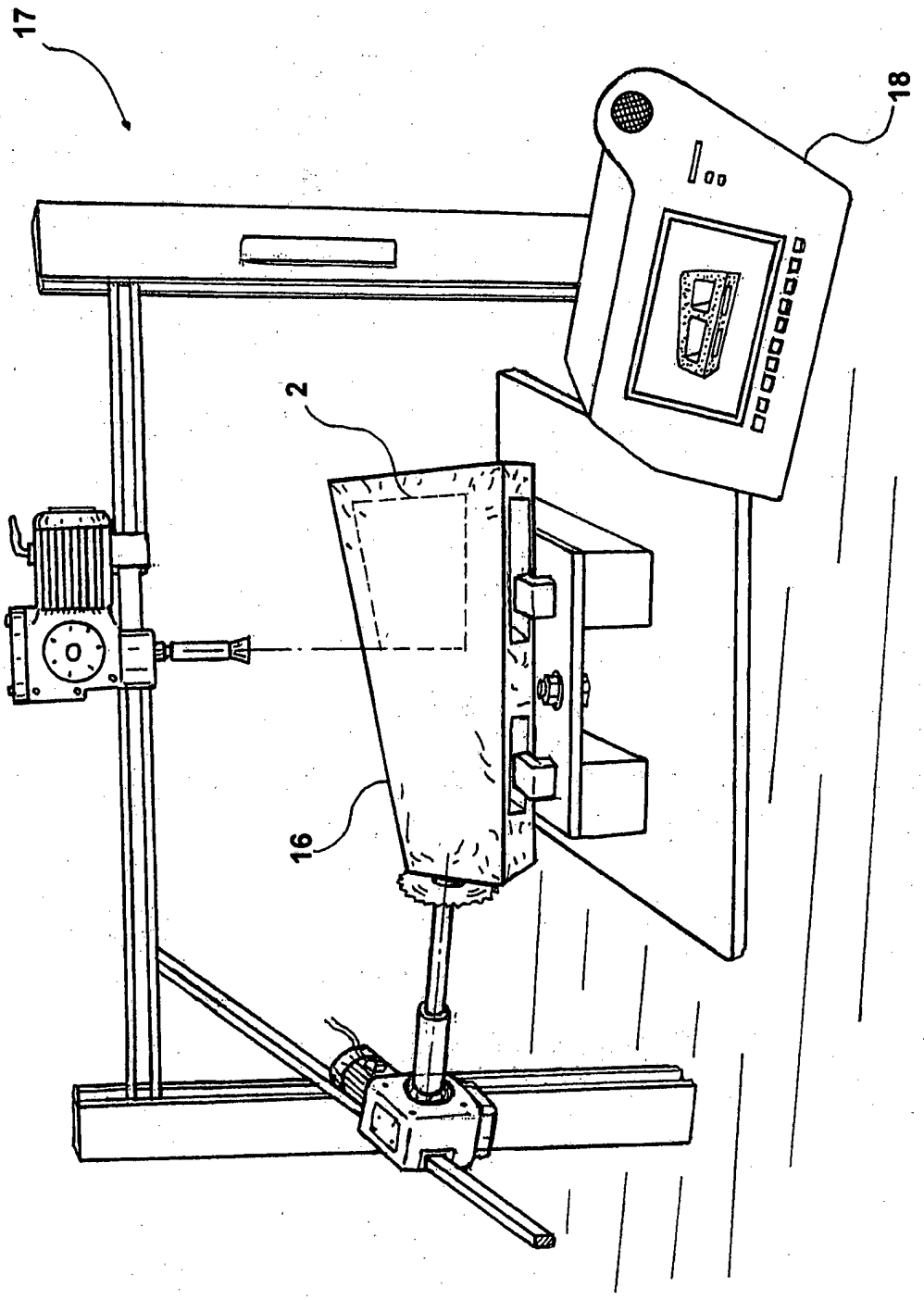

FIG. 3

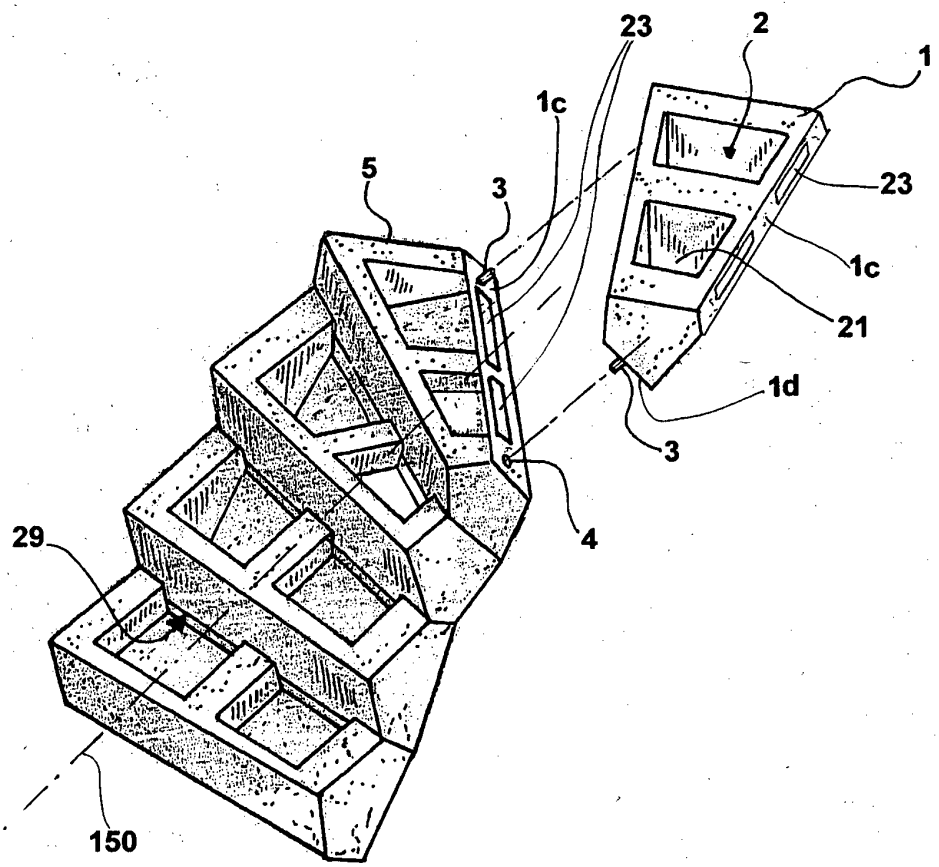

FIG. 4

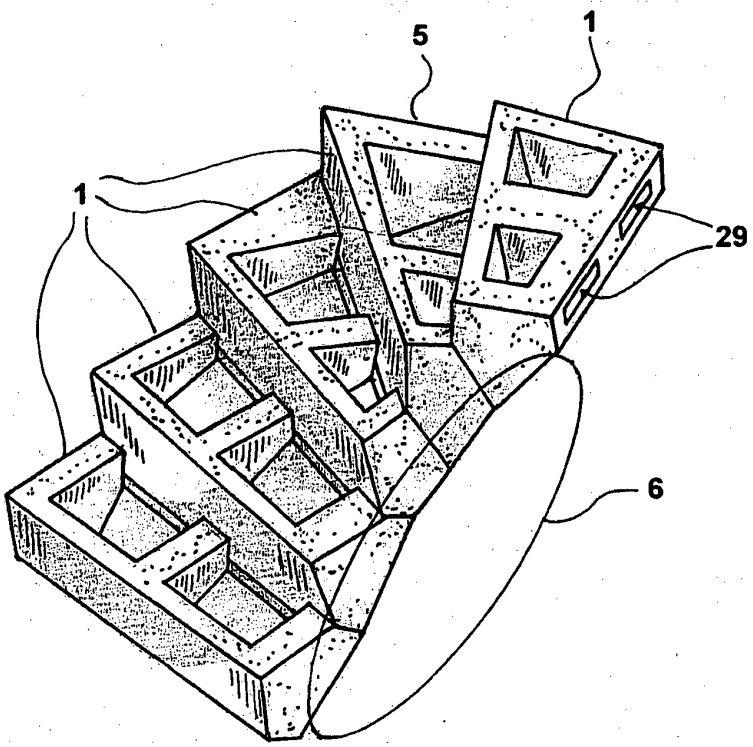

FIG. 5

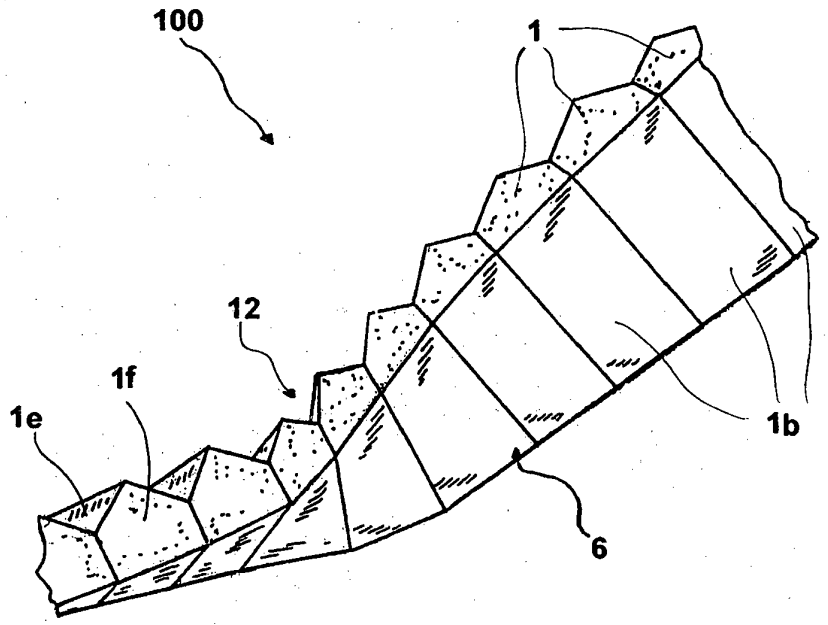

FIG. 6

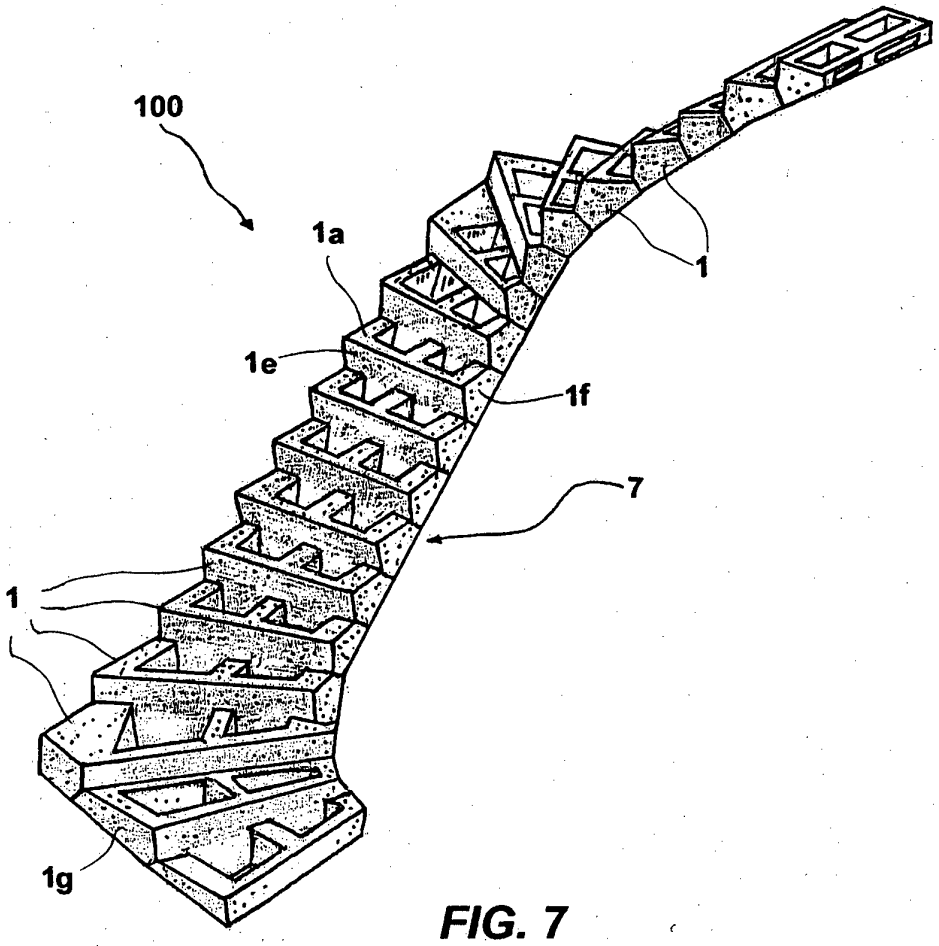

FIG. 7

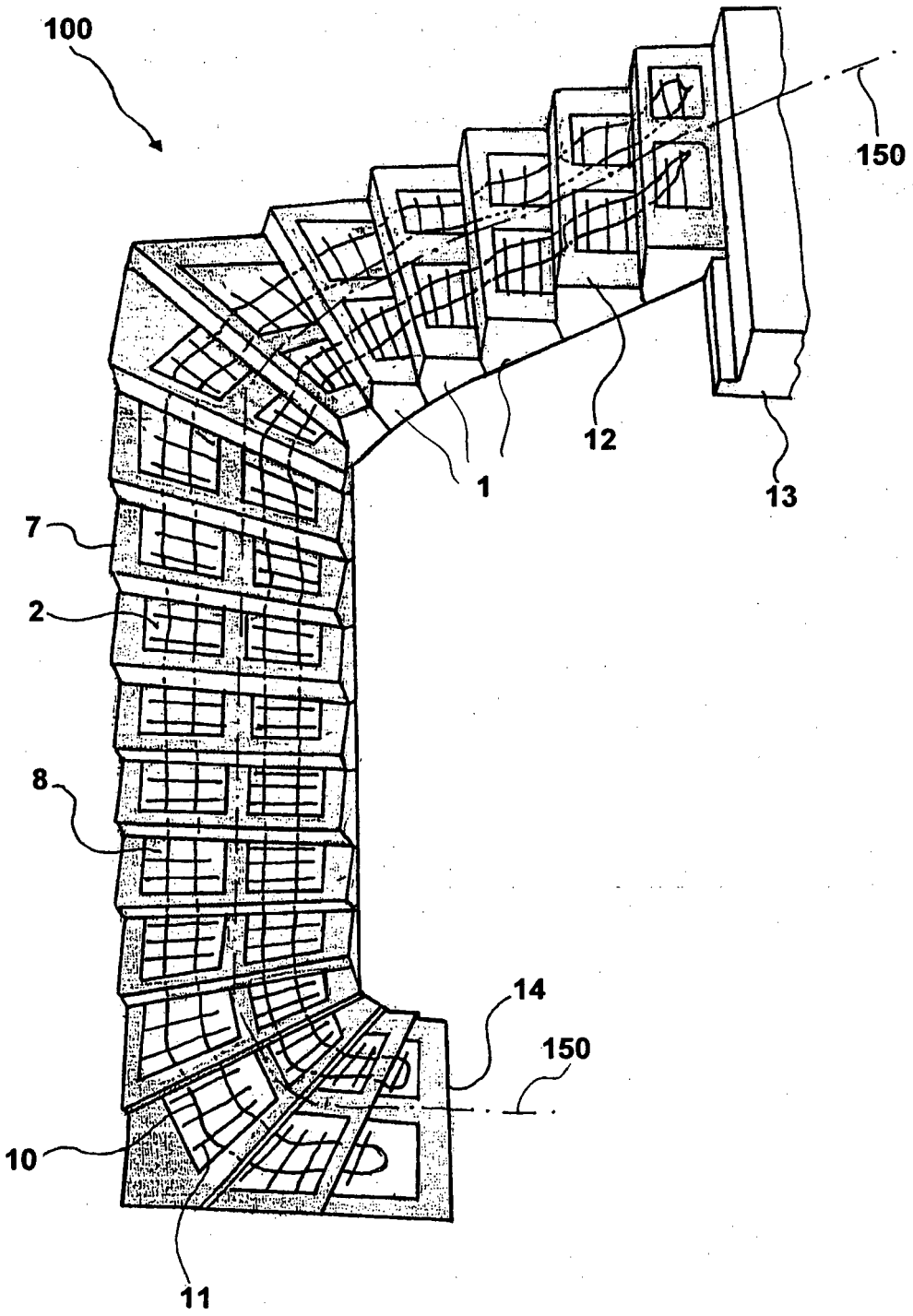

FIG. 8

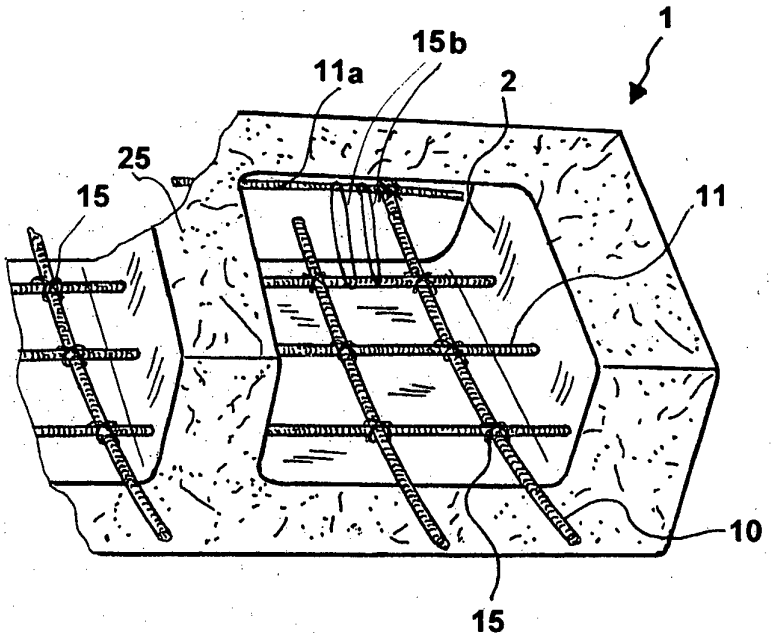
1
15b
11a
2
25
15
11
10
15

FIG. 9

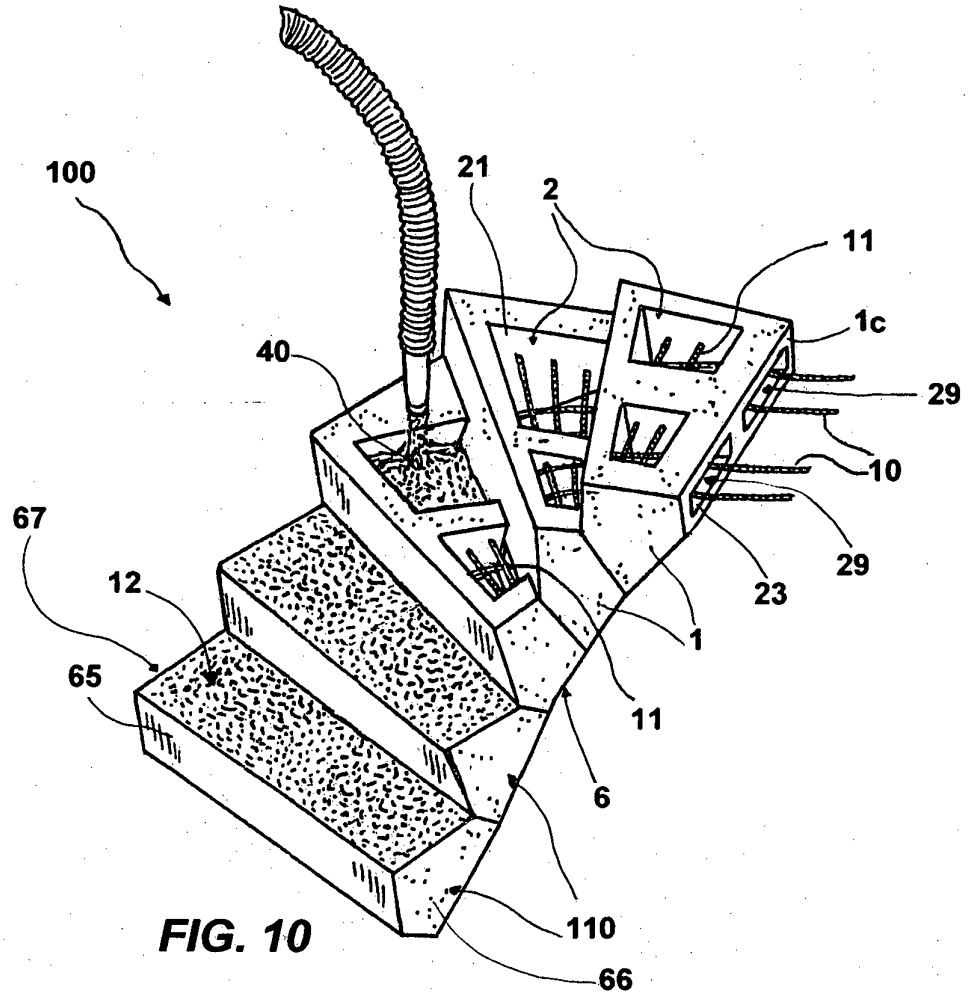
100
21
2
11
1c
40
29
10
67
12
29
23
1
65
11
6
110
66

FIG. 10

REFERENCES CITED IN THE DESCRIPTION

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