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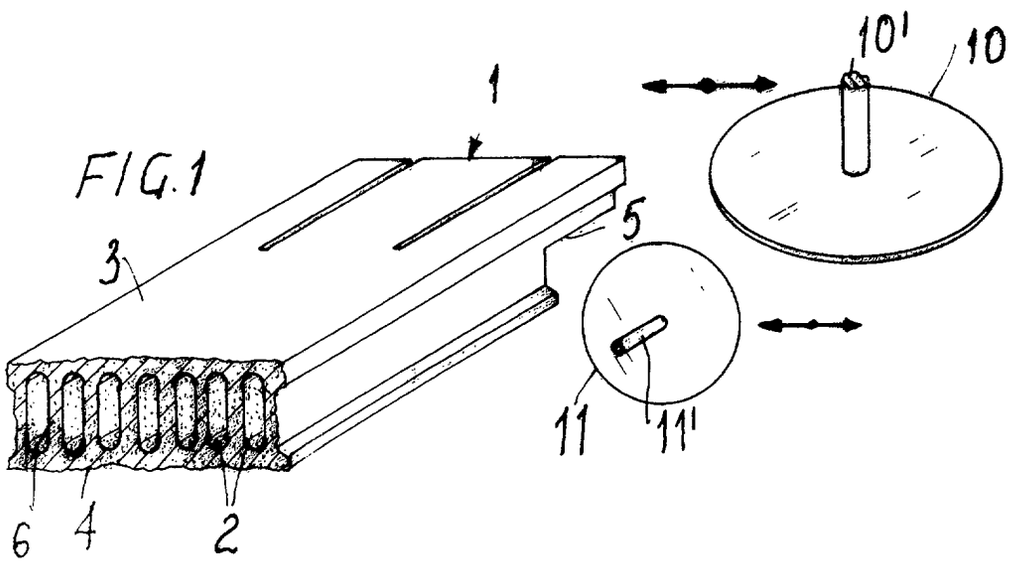
(54) Method of producing a precast slab or beam made of standard or precompressed concrete

(57) Method of producing a precast hollow slab or beam member made of standard or precompressed concrete comprising the following steps in sequence: continuous casting by means of a forming machine on a steel track on which suitably arranged pre-compression rods have already been laid and tensioned, setting and hardening of the casting, thereby obtaining a compact article, releasing the tensioning of the rods and subsequent pre-compression of the article, and carrying out two mutually inclined cuts at least at one end of said article.

FIG.1



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Description

[0001] The present invention relates to a method of producing a precast slab or beam made of standard or pre-compressed concrete and to a slab or beam thus obtained, particularly for the construction of hollow or suspended floors in general.

[0002] At present the production of floors by means of precast hollow concrete slabs placed next to one another or by means of other types of beam members produced with the same technology and by using finishing machines or extruders has been widely used in the residential and industrial building fields worldwide.

[0003] Such a success and the ever greater employment of precast members obtained by using the well-known hollow slabs is due to specific advantages concerning their production technology and way of use, such as:

- a continuous cycle production technology, which is quite suitable for being automatised, has a great potential and uses highly resistant concretes and thus it is little labour intensive and very cost-effective;
- minimum labour intensive even at the building site, since minimum casting and auxiliary reinforcements are required onsite to obtain a finished or suspended floor;
- economic convenience in comparison with any other floor structural component having equal static performances, the more so when the structure comprises spans, overloads or large heights between floors;
- simplicity and speed of laying as three or four workers can lay 500-600 m^2 of floor per day.
- by being self-bearing no stays or supporting structures are required, and it is possible to load the floor immediately after the same has been laid even without supplementary auxiliary structural castings;
- remarkable rigidity, i.e. their very limited resilient and viscous strain;
- very good durability and resistance to carbonatisation, apart from being highly fireproof;
- very good finishing of their lower surface so that, when needed, only painting with no smoothing or plastering is required.

[0004] However, the drawback exists that, in use, the slabs are borne by upturned T or L load resisting girders at their respective ends and the girders necessarily extend downwards with respect to the floor and are also partly visible at the lower surface thereof, thus interrupting the continuity of the floor, which is often undesirable from the aesthetic and architectural points of view, owing to the greater overall encumbrance given by the floor plus the beam thicknesses.

[0005] In order to partly obviate this drawback, steel lattice girders have already been proposed, having a plank thickness of approximately 5 mm. Even this solution, however proved, to be unsatisfactory both because the steel plank is still visible at the lower surface of the floor and above all, because the steel plank is poorly fireproof.

[0006] The main object of the present invention is to provide an improvement to the conventional industrial manufacturing method of producing a hollow slab or a precast girder made of standard or pre-compressed concrete which, whilst keeping all the economic and industrial advantages of the conventional production technology, allows floors with lower surface with no discontinuities both between adjacent floor slabs and between one or more floor supporting precast girders and the floor itself to be obtained.

[0007] Another object of the present invention is to provide a novel precast hollow slab and/or girder for the production of floors, which is suitable for overcoming the above listed limitations and drawbacks by using precast hollow slabs or girders obtained by conventional production technology.

[0008] A still further object of the present invention is to provide a method of producing precast concrete hollow slabs or girder members which is relatively easy and quick to carry out, so as to be competitive and cost-effective also from the economic viewpoint.

[0009] These and other objects which will be better apparent in the following description are accomplished by a method of producing a standard or precast pre-compressed concrete hollow slab or girder member, according to the present invention, comprising the following production steps in sequence :

- continuous casting on a steel track, on which suitably arranged and tensioned precompression rods have already been laid, by means of at least one forming machine,
- setting and hardening of the casting, thereby obtaining a compact article;
- release of the said tensioned rods and consequent compression of the article,
- transverse cutting of the said article to obtain hollow girder sections or slabs for floors,

and characterised in that it comprises

- making two butting inclined cuts at at least one end of each girder section or slab or portion thereof in order to obtain an end bearing shoulder.

[0010] Advantageously, the end butting cuts are carried out simultaneously, in order to minimise slab working times.

[0011] The present invention is described in greater detail below, with reference to two currently preferred embodiments thereof, given by way of not limiting examples, with reference to the accompanying drawings showing hollow slabs and in which :

Figure 1 shows a diagrammatic perspective view of a hollow slab portion and of a sawing machine with two cutting disks used to carry out the butting end cuts, the said sawing disks being arranged with their axes of rotation normal to one another;

Figure 2 shows a perspective view of a hollow slab according to the present invention provided with end "chair" shoulders for bearing onto a precast beam with no lower protrusions;

Figure 3 shows a perspective view of a hollow slab that is similar to that shown in Fig. 2 with an end "chair" shoulder obtained by using a cutting wire;

Figure 4 is a partial perspective view of a support pillar for a horizontally resting upturned T-beam for bearing the butted ends of two abutting hollow slabs without solution of continuity both at lower and upper surfaces of the floor formed by the slabs;

Figure 5 shows a diagrammatic perspective view of two hollow slabs having "dovetail" shaped end butts for resting onto a horizontal steel girder; and

Figure 6 shows a detail of Fig. 5 on an enlarged scale of a "dovetail shaped" butted end of a hollow slab or girder on a steel lattice beam provided with a fireproof coating and flush with the lower surface.

[0012] In the various Figures of the drawings the same or similar components are indicated by the same reference numerals.

[0013] With reference first to Figures 1 to 4, it will be noted that a hollow pre-compressed concrete slab 1 has a number of inner cavities 2 that extend longitudinally and parallel to the slab between an upper slab 3 and a lower slab 4 thereof and having in the shown Example, an elongated light in the sense of the height of the slab.

[0014] Each slab 1 is provided with a respective "chair" shoulder or upturned step 5 that is formed on the same side as its lower surface 4 and obtained by two butting cuts made along two inclined cutting planes (e. g. typically at a 90° angle): one of which is perpendicular to, and the other is parallel with the lying planes of the upper surface 3 and lower surface 4 of the slab. The height of the shoulders 5 can range from a few centimetres to 25 cm or more, whereas their depth can even be smaller than their height.

[0015] As known in the art, a hollow slab made of standard or pre-compressed concrete is prevailingly obtained according to two production methods. Production is carried out in factory on steel tracks typically 120-150 cm long , onto which a predetermined number of continuous reinforcements or steel pre-compression rods are suitably distributed throughout the width of the track, and jacktensioned by means of suitable jacktensioning devices designed to systematically control the rod tension and lengthening .

[0016] Continuous casting of concrete is then carried out onto the steel track on which reinforcements and/or the steel pre-compression rods have been suitably arranged and tensioned. In order to form the concrete casting a vibratory finishing method is adopted involving the use of one or more suitable vibratory finishing machines through which concrete is fed into moving sections and hypervibrated by means of banks of vibrators operating at different vibration frequencies.

[0017] Usually, concrete casting is carried out in one or two subsequent or simultaneous steps, i.e. for forming the lower surface 4 of the slab, the ribs 6 between adjacent cavities 2 and the upper surface 3 of the slab.

[0018] Concrete casting can also be carried out according to an extrusion method in which use is made of at least one forming machine into which concrete is forced, e.g. by means of metering screws, to become compacted to obtain a finished slab cross-section in one step.

[0019] Very high quality concretes are needed, consistent in so far as both their granulometry and cement and water dosing are concerned in order to guarantee first of all prompt shape stability for obtaining cavities 2, and high initial mechanical strength, whereby allowing pre-compression and formwork removal, when required, to be carried out in short time intervals and optimum adherence to the reinforcements (comprising, as it is known, pre-stressed rods and possible loose reinforcements provided in the casting) to be obtained.

[0020] Immediately after casting, while the concrete is still fresh, notches and/or openings are formed according to design, for locating possible vertical ducts .

[0021] After forming, the cast concrete is left to rest for setting and hardening, so that a compact article is obtained. In order to obtain an accelerated setting or hardening, the casting is usually covered with waterproof sheets throughout its length and heated up homogeneously until the concrete has reached a required strength for the pre-stressed reinforcements to be released, and subsequently for formwork removal. Resistance is experimentally determined by breaking samples subjected to the same vibrating and thermal treatment. In general, when the concrete is subjected to a compression test at the twenty-eighth day, its cubic strength should be greater than 55 Mpa.

[0022] In the most common case of hollow slabs, a routine strength control is carried out on the concrete, as known by the skilled person in the art, before releasing the tensioned rods and thus before pre-compressing the hardened article.

[0023] Once the hardening has been completed, the article is cross-cut by abrasive or diamond disks 10, 11 into specified lengths for article sections designed to form a floor whereby separating the various elements or hollow slabs 1. Then, after each slab 1 has been transferred onto a testing and processing bench, two "chair" shaped shoulders 5 are cut by carrying out two cuts at 90° one with respect to the other at the leading and trailing ends of each slab 1 (see Fig. 1), e.g. by using a butting machine (e.g. of any known type) provided with two cutting disks 10 and 11 arranged to rotate about rotation axes 10' and 11' normal to, or otherwise inclined

one with respect to the other . In this way, according to the present invention, hollow slabs 1 having a T-shaped or L-shaped longitudinal section are obtained for making floors with upper and lower flat surfaces with no continuity solution at the upturned T or L shaped load resisting girders 7 (Fig. 4).

[0024] Figure 3 shows an alternative method of obtaining end "chair"-shaped shoulders 5, i.e. through wire cutting by means of cutting wire 9 instead of disks 10, 11, to obtain in general "chair" shaped end shoulders 5 having rounded corners and edges.

[0025] When required by design calculation, during construction, suitable reinforcements may be provided and positioned at the ends to be cut for obtaining a "chair" support. Said reinforcements can comprise stirrups inserted into the longitudinal partition walls between the cavities 2 before casting by means of a forming machine or else manually inserted and embedded in the cavities, or alternatively, immediately after forming, when the concrete is still fresh, or else immediately after setting when the concrete is still fresh, or after hardening and formwork removal from the hollow slab, before the manufactured article is delivered to the building site.

[0026] When the formwork is removed, the hollow slabs 1 are provided with a smooth lower surface in contact with a metal formwork (track) and rough sides and upper surface so that when the slabs are laid in position side-by-side, concrete joints cast between adjacent slabs become effectively integral with the slabs..

[0027] Figures 5 and 6 show hollow slabs provided with "dovetail" end shoulders 5a, i.e. having support delimiting walls that are mutually inclined at an angle smaller than 90° for use with steel lattice beams 8, preferably provided with a fire-proof coating on their lower surface. The "dove-tail" cut ensures a better adherence of the coating 8a under metal plate 8; such a coating preferably comprising an insulating and fireproof mortar.

[0028] As better shown in Figures 4 and 5, a hollow slab 1 according to the present invention can be used for obtaining a floor supported by both precast reinforced concrete load resistant beams 7 and steel lattice girders 8 or by well known semi-precast beams provided with protruding stirrups (not shown in the drawings) that need to be completed by casting onsite, e.g. steel lattice girders 8.

[0029] The invention as described above is susceptible to several modifications and variations within the protection scope as defined by the claims.

[0030] The disclosure of Italian patent application no. VR2001A000067 from which priority date of 15 June 2001 is claimed, is incorporated herein by reference.

Claims

1. Method of producing a precast hollow slab or beam member made of standard or pre-compressed concrete comprising the following steps in sequence:

   - continuous casting by means of at least one forming machine on a steel track on which suitably arranged pre-compression rods have already been laid and tensioned,
   - setting and hardening of the casting, thereby obtaining a compact article,
   - releasing said tensioned compression rods and consequent compression of the article,

   and **characterised in that** it comprises

   - carrying out two mutually inclined cuts at least at one end of said article .

2. Method as claimed in Claim 1, **characterised in that** it comprises cross-cutting the said article into sections of beam members or hollow slabs before slabs before obtaining the said two inclined cuts.

3. Method as claimed in Claim 2, **characterised in that** said two inclined cuts are made at at least one or more intermediate position of the length of the said article .

4. Method as claimed in Claim 3, **characterised in that** the said butting inclined cuts are carried out simultaneously.

5. Method as claimed in any preceding Claim, **characterised in that** the said inclined cuts extend one heightwise and the other lengthwise with respect to a respective slab or beam, with a penetration depth which is different from one cut to another.

6. Method as claimed in any preceding claim 2 to 5, **characterised in that** after having been cross-cut, each slab is transferred onto a laying bench in order to carry out said inclined cuts.

7. Method as claimed in any preceding claim, **characterised in that** the said inclined cuts are carried out by means of a butting machine having two disks rotating about axes of rotation which are inclined to one another.

8. Method as claimed in any claim 1 to 6, **characterised in that** the said inclined cuts are carried out by a cutting wire.

9. Method as claimed in claim 8, **characterised in that** the said cutting wire is driven by moving pulleys controlled so as to follow the profile of the cut.

10. Method as claimed in any preceding claim, **characterised in that** the said inclined cuts are mutually inclined at substantially 90°.

11. Method as claimed in claim 8 or 9, **characterised in that** the said inclined cuts are carried out in such a way as to obtain profiles having rounded corners and edges.

12. Method as claimed in any preceding claim, **characterised in that** it comprises inserting reinforcements into a portion of the article to be obtained or already obtained close to the portion where said inclined cuts are to be made.

13. Method as claimed in Claim 11, **characterised in that** said reinforcements comprise stirrups or the like.

14. Hollow slab having a T-shaped longitudinal section when obtained by the method according to any preceding claim.

15. Hollow slab having an L-shaped longitudinal section when obtained by the method as claimed in any claim 1 to 13.

16. Precast beam member when obtained by the method as claimed in any claim 1 to 13.

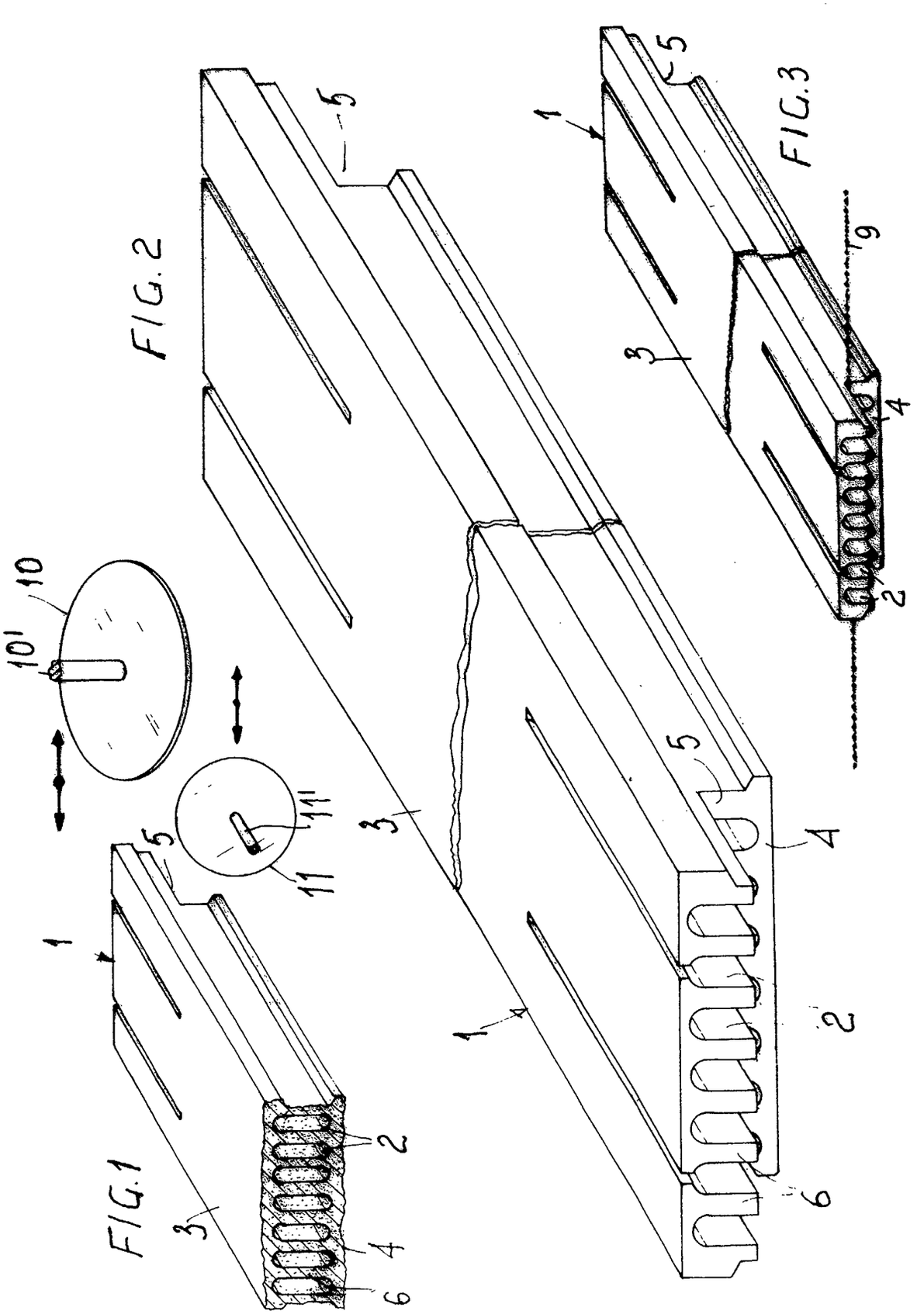
FIG.1
FIG.2
FIG.3
1
2
3
4
5
6
9
10
10'
11
11'

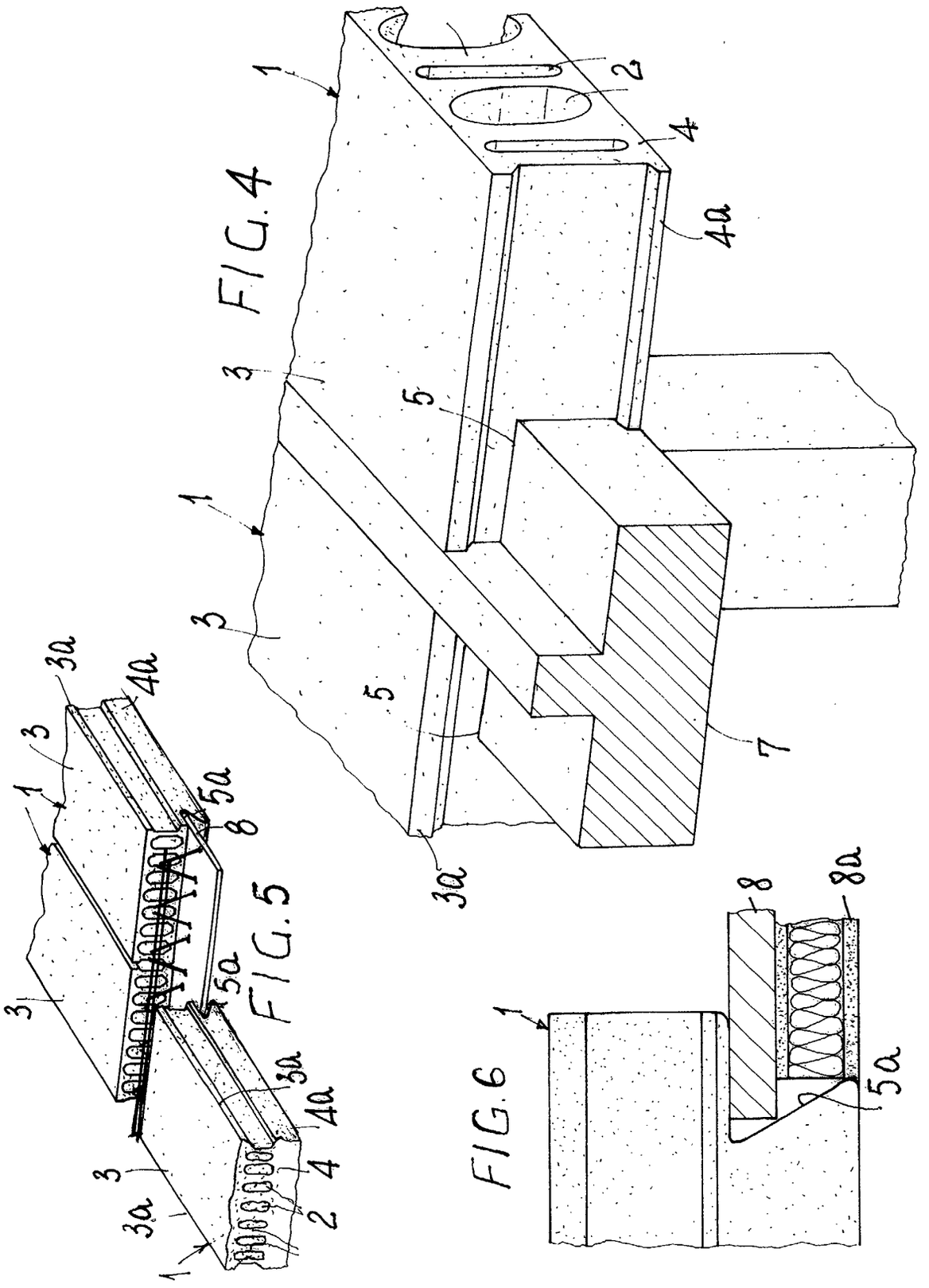

FIG. 4

FIG. 5

FIG. 6