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(71) Applicant: **Grobelny, Mieczyslaw**
60-687 Poznan (PL)

(72) Inventor: **Grobelny, Mieczyslaw**
60-687 Poznan (PL)

(74) Representative: **Kondrat, Mariusz**
Kondrat & Partners
Al. Niepodleglosci 223 lok.1
02-087 Warszawa (PL)

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(54) **CONCRETE PANEL, ESPECIALLY FOR COMPOSITE FLOORS, AND A COMPOSITE FLOOR**

(57) The invention relates to a concrete panel, especially for composite floors, characterised in that it has a longitudinal reinforcement in the form of a steel truss arranged axially symmetrically, a fibre reinforcement and a bonding layer on the top surface of the concrete panel, wherein the height of the concrete panel is in the range of 100 to 500 mm and the width of the concrete panel is

in the range of 20 to 90 cm. The invention relates also to a composite floor made of thin prefabricated concrete panels having a longitudinal reinforcement in the form of a steel truss arranged axially symmetrically, and a fibre reinforcement, wherein the height of the concrete panel is in the range of 100 to 500 mm and the width of the concrete panel is in the range of 20 to 90 cm.

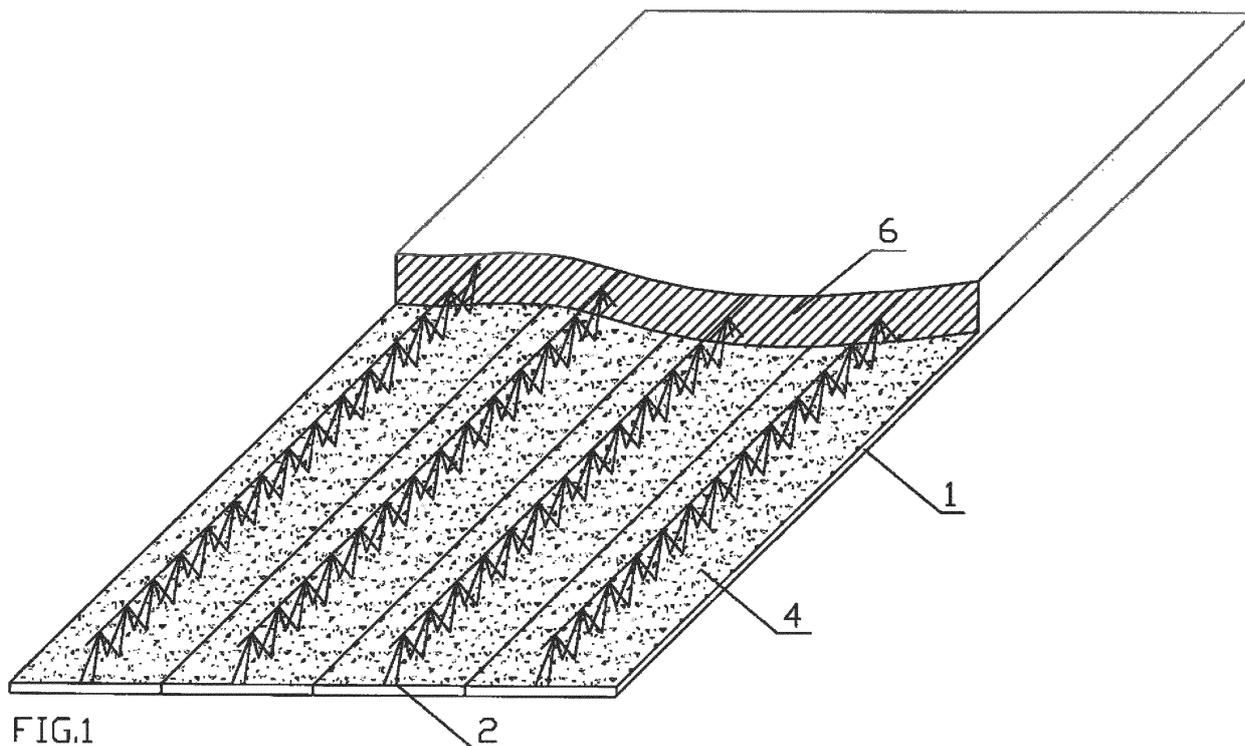


FIG.1

Description

[0001] The object of the invention is a concrete panel, especially for composite floors, and a composite floor. The solutions according to the invention are widely applicable in the construction industry.

[0002] From Polish Patent Application number P. 173278, a solution for composite beam and block floor is known, wherein the floor consists of a thin high-dimensional prefabricated reinforced concrete slab equipped with a reinforcement protruding above the top surface thereof, in the form of prefabricated trusses, extending in parallel to the span of the floor, and of reversed prefabricated reinforced concrete hollow core roof slabs, arranged between these trusses, equipped with outwardly protruding longitudinal and transverse reinforcement. The spaces between the hollow core roof slabs are filled with concrete, wherein the concrete in the spaces extending along the floor constitutes, together with the upper part of the hollow core roof slabs, supporting ribs of the structure. The whole structure is reinforced with a support reinforcement arranged in the supporting ribs of the structure.

[0003] In turn, from Polish Patent Application P. 402760, a steel and concrete beam for reinforcement of prefabricated construction units having a preferable ratio of mass per unit of their length is known. The beam according to this solution comprises a multi-rod openwork spatial reinforcement in the form of truss located inside a concrete block shaped in the form of a solid, where the spatial steel reinforcement truss is equipped, in the upper part, with a special concrete form shaped in such a way that between the lower and the upper surface of the prefabricated floor, a free space is created.

[0004] A solution of a single-sided stay-in-place formwork described in Patent Application P.403918 is also known. This document describes a method of making a single-sided profiled stay-in-place formwork, characterised in that the insulation element - stay-in-place formwork is shaped, from the concrete side, in particular through a system of grooves and indents, so that the concrete which fills it ensures good maintenance of the formwork, or the insulation element - stay-in-place formwork may comprise additional elements, shaped blocks or protrusions from its own or other material, so that the concrete which fills them ensures good maintenance of the formwork.

[0005] In practice, two alternative floor solutions are known and commonly used.

[0006] Beam and block floors are the most common solution. Support elements in this type of floors are reinforced concrete beams with spacing not exceeding 90 cm, most frequently spacing between the ribs is 40 - 60 cm. Between the beams, fills are placed, which can be constituted by hollow blocks made of ceramics, of concrete and gravel, of concrete and slag, of concrete and rubble, of lightweight concrete, of foamed polystyrene, of gypsum etc. The upper part of the beam and block

floor is a concrete slab made on site - concrete topping. It protects the hollow blocks against damage and is an underlay for the floor. The slab has a thickness of 3 - 7 cm. The total thickness of the floor is approx. 23 - 35 cm and it depends on the thickness of the slab and on the height of the hollow blocks.

[0007] Elements of the floor of this type are relatively light (prefabricated beam having a length of 6 m weighs approx. 80-90 kg, hollow block - 11-18 kg), therefore there is not any need to use special equipment. However, in case of floors having ribs made on site, formwork is necessary.

[0008] The greatest disadvantage of solution of this type is time and labour consumption resulting from the number of elements used in this floor. For example, per 100 m² of floor, approx. 700 elements, hollow blocks with dimensions of 25 x 50 cm and average weight of 15 kg, need to be placed (making a total of approx. 10 t of manually placed hollow blocks, in addition, it is necessary to previously arrange beams). Furthermore, the number of elements requiring to be arranged on the construction site makes the very process of installing this type of solution very dangerous.

[0009] These disadvantages seemed to be eliminated by a solution based on the use of filigree slabs.

[0010] Filigree is a stay-in-place formwork slab comprising longitudinal and transverse supporting reinforcement and sunken trusses allowing transport of slabs. During the installation of slabs on the construction site, reinforcement of floor tie beam is made and an additional reinforcement of floor in the form of basic reinforcement of the structure or additional reinforcements in connection places of slabs. Then, a layer of concrete topping is poured, and the arranged slabs function as a formwork.

[0011] Construction of the floor, using this type of slabs, is not particularly labour-intensive, but size of the slabs is a significant disadvantage. Size of this type of slabs is generally significant, which in turn requires the use of heavy equipment, both in the factory and on site. This feature also makes the transport of slabs very expensive, and their installation on the construction site requires the use of heavy equipment. Furthermore, slabs of this type are made to measure, and their production is preceded by the necessity to perform a number of structural calculations and to design an appropriate slab. Consequently, the use of this solution requires constant participation of the constructor, in the process of both design and production, and installation of the slab.

[0012] The primary objective of the inventions described in this document was to eliminate disadvantages of known solutions indicated above. The inventions make it possible to quickly obtain a durable floor without having to incur high time investment, as in the case of beam and block floors, or financial investment, as required by the transport and installation of filigree slabs. Furthermore, in the floor according to the invention, improved parameters of bearing capacity and sound insulation were obtained. On the other hand, thanks to the use of a bonding

layer, bonding of the concrete panel with a layer of concrete topping was improved.

[0013] The solutions according to the inventions combine features of known solutions, making appropriate innovative improvements.

[0014] The concrete panel, especially for composite floors, with dimensions in the range of 100 - 500 mm of height of 20 - 90 cm of width, was equipped with an appropriate reinforcement in the form of a steel truss sunken in the panel. The steel truss was sunken axially centrally over the entire length of the concrete panel. Wherein elements of this reinforcement, usually in the form of cross-braces, protrude above the top surface of the panel and extend in parallel to the span of the floor. These elements facilitate installation of panels on the construction site, and when flooded with a layer of concrete topping, reinforce its connection to the panel. The concrete panel may be also equipped with an additional longitudinal reinforcement in the form of composite rods or wires and prestressing steel cables. Additionally, the concrete panel was equipped with a fibre reinforcement, and on the top surface, with a bonding layer.

[0015] The composite floor according to the invention was created from fully prefabricated modular and light-weight concrete panels having predetermined sizes. Floor of this type requires individual designing for each room in which it is to be used. The solution according to the invention does not require the use of heavy equipment when producing and installing individual elements of the floor. Number of elements used in the construction of this type of floor was significantly reduced, which significantly reduced time of the floor installation. The concrete panels used in the floor according to the invention were reinforced with a longitudinal reinforcement and a fibre reinforcement.

[0016] The use of fibre reinforcement in place of previously used transverse reinforcement is an essential feature of the solution according to the invention. Such a solution not only significantly reduces the production cost for the floor but also improves the bearing capacity of the floor. An individual element obtained according to the invention is very thin, which allows for easy transport, handling and arranging of these elements in the floor on the walls of the building.

[0017] On the other hand, the use of fibre reinforcement in the form of fibres protruding above the top surface of the concrete panel further reinforces the connection between the concrete panel and the concrete topping.

[0018] An important variant of the composite floor according to the invention is also equipping the top surface of the concrete panel with a special bonding layer which will further reinforce the connection between the concrete panel and the concrete topping, which in turn will significantly improve the rigidity of the floor and will reduce deflections by many times.

[0019] Each floor consists of two layers - a lower extended one in which, in addition to the concrete, there is a reinforcement, most frequently in the form of steel rods,

and an upper compressed layer, most frequently made of concrete only.

[0020] The element connecting these two layers is a steel truss, and more precisely cross-braces, which not fully combine both layers. Any action aimed at improving the connection concrete-prefabricated unit will improve the bearing capacity. This problem is solved by the use of a bonding layer, as in the floor according to the invention.

[0021] The bonding layer also constitutes an important feature of the invention in the form of concrete panel, especially for composite floors. The bonding layer was obtained thanks to sinking crushed aggregate, e.g. in the form of basalt or granite grit or other, in the top surface of the concrete panel. Alternatively, the bonding layer can be obtained by providing the top surface of the panel with a rough structure obtained thanks to transverse ribs or grooves which are the result of the process of spiked connecting.

[0022] Additionally, the bonding layer can be also constituted by steel or polymeric fibres, protruding above the top surface of the concrete panel, which can also function as a fibre reinforcement. Improvement of bearing capacity of the panel, and especially bearing capacity on the wall, is obtained by a firm connection between the prefabricated unit and the concrete poured on site by means of the bonding layer. So-called rigidity of the floor increases as there is not any slip between the layers.

[0023] After flooding the panels, arranged on the construction site, with concrete, a monolith with a strong and reliable connection between the prefabricated unit and the concrete topping is achieved. Thereby, high parameters of sound insulation are also obtained, in addition to high bearing capacity.

[0024] The concrete panel according to the invention can be also used in the construction of other surfaces than the floor, such as e.g. retaining walls, foundations, etc. Structure of the concrete panel, its modularity and low weight make its applicability for the construction wide.

Reinforcement of the panel with a longitudinal reinforcement and a fibre reinforcement improves its bearing capacity, which in turn significantly improves properties of the panel used e.g. in the construction of retaining walls. In fact, the retaining wall transfers the pressure of the secured construction object onto the substrate, therefore parameters of bearing capacity thereof are extremely important. Thanks to the solutions used, the panels can form a retaining wall with exceptional strength and resistance to high static loads and environmental conditions. Wall made of concrete panels according to the invention is also simple, faster and cheaper to install than the traditional wall. Prefabricated units are set up quickly and easily, regardless of the weather.

[0025] In each of the envisaged variants of the invention, the concrete panel comprises a centrally located longitudinal steel truss and a fibre reinforcement. Wherein the fibre reinforcement may take the form of steel or plastic fibres, or steel or plastic mesh sunken in the panel.

Regardless of the type of the fibre reinforcement used, the top surface of the panel can additionally have a bonding layer in the form of sunken grains of crushed aggregate, or grooves obtained in the process of spiked connecting, or transverse ribs. The concrete panel can be also equipped with an additional longitudinal reinforcement in the form of rods or wires sunken in the panel along the steel truss. Therefore, one of the variants of the invention can be a panel comprising a steel truss, additional rods of longitudinal reinforcement and a fibre reinforcement, and a bonding layer. However, any other variants of the object according to the invention are also possible.

[0026] Also the composite floor according to the invention can be made of concrete panels having features of variants as indicated in the dependent claims. For example, it can be indicated that the floor can be made of concrete panels comprising longitudinally axially and centrally extending steel trusses and a fibre reinforcement in the form of fibres protruding above the top surface of the panel. In turn, a layer of concrete topping is applied onto this surface. The concrete panel according to this embodiment may have a height of 300 mm and a width of 50 cm.

[0027] Height of the concrete panel is the height of the prefabricated unit alone without the steel truss.

[0028] Arranging the above described concrete panels tightly in the floor on the walls of the building, and then flooding them with a layer of concrete topping, or reinforcing with an additional truss and flooding with a layer of concrete topping allows obtaining an extremely durable and strong composite floor.

[0029] Primary advantages of the inventions are:

- > standardisation and modularity of prefabricated units, which significantly improves the design work and allows production to the warehouse. The obtained panels are universal and can be used in many different buildings, which cannot be done in the case of filigree floor, where the slabs are produced based on individual projects.
- > better connection between the prefabricated unit and the layer of concrete topping poured on site, and consequently better parameters of bearing capacity of the floor.
- > reduction of the costs of producing the prefabricated unit by approx. 40% compared to the filigree slabs (transverse reinforcement is eliminated);
- > reduction of the costs of installation by approx. 60% compared to the beam and block floors (hollow blocks are eliminated).
- > longitudinal, transverse cutting, side notches and drilling of holes are possible to perform on site, which significantly simplifies the installation work. This work is performed without having to change design of the panel, and in the case of filigree floors, this is not possible. As a result, this significantly reduces the cost of producing the floor.

[0030] The essence of the solution according to the invention is a concrete panel, especially for composite floors, characterised in that it has a longitudinal reinforcement in the form of a steel truss arranged axially symmetrically, a fibre reinforcement and a bonding layer on the top surface of the concrete panel, wherein the height of the concrete panel is in the range of 100 to 500 mm and the width of the concrete panel is in the range of 20 to 90 cm.

[0031] Preferably, the panel according to the invention comprises an additional longitudinal reinforcement in the form of composite rods made of fibre glass or other polymer.

[0032] Preferably, the additional longitudinal reinforcement of the concrete panel is constituted by wires and/or prestressing steel cables.

[0033] Preferably, the fibre reinforcement of the concrete panel is constituted by steel or plastic microfibres.

[0034] Preferably, the fibre reinforcement is constituted by a mesh of artificial and/or composite fibres sunken in the plane of the concrete panel.

[0035] Preferably, the bonding layer is constituted by a heterogeneous top surface of the concrete panel having a rough structure with ribs and/or grooves.

[0036] Preferably, the bonding layer is constituted by elements in the form of crushed aggregate sunken in the top surface of the concrete panel and/or steel or polymeric fibres protruding above the surface of the concrete panel.

[0037] Preferably, the height of the concrete panel is in the range of 200 to 400 mm and the width is in the range of 40 to 70 cm.

[0038] Preferably, the height of the concrete panel is 200, and the width is 60 cm.

[0039] The essence of the solution according to the invention is also a composite floor the bottom surface of which is made of modules comprising steel trusses, and the top surface is constituted by a layer of concrete topping, characterised in that the modules are thin prefabricated concrete panels having a height of 100 to 500 mm and a width of 20 to 90 cm, having a fibre reinforcement and a longitudinal reinforcement in the form of a steel truss arranged axially symmetrically.

[0040] Preferably, the height of the concrete panel is in the range of 200 to 400 mm and the width is in the range of 40 to 70 cm.

[0041] Preferably, the height of the concrete panel is 200 mm, and its width is 60 cm.

[0042] Preferably, the panel comprises an additional longitudinal reinforcement in the form of composite rods made of fibre glass or other polymer.

[0043] Preferably, the additional longitudinal reinforcement is constituted by wires and/or prestressing steel cables.

[0044] Preferably, the fibre reinforcement is constituted by steel or plastic microfibres.

[0045] Preferably, the fibre reinforcement is constituted by a mesh of artificial and/or composite fibres sunken

in the plane of the concrete panel.

[0046] Preferably, the top surface of the concrete panel comprises a bonding layer connecting the concrete panel and the layer of concrete topping.

[0047] Preferably, the bonding layer is constituted by a heterogeneous top surface of the concrete panel having a rough structure with ribs and/or grooves.

[0048] Preferably, the bonding layer is constituted by elements in the form of crushed aggregate sunken in the top surface of the concrete panel and/or steel or polymeric fibres protruding above the surface of the concrete panel.

[0049] Preferably, the floor according to the invention has additional transverse reinforcements arranged during installation on site anywhere in the floor.

[0050] The objects of the invention are shown in an embodiment in the drawing, in which Fig. 1 shows a composite floor in cross-section, and Fig. 2 shows a concrete panel in cross-section with distinct elements of a steel truss and of fibres of a transverse reinforcement, Fig. 3 shows the concrete panel in cross-section with distinct elements of the steel truss, a fibre reinforcement, and grains of crushed aggregate, Fig. 4 shows the concrete panel in cross-section with distinct elements of the steel truss, the fibre reinforcement and grooves obtained in the process of spiked connecting, Fig. 5 shows a composite floor in cross-section with elements of the steel truss, the fibre reinforcement, a bonding layer and an additional longitudinal reinforcement.

[0051] A concrete panel 1, especially for composite floors, comprises a longitudinal reinforcement 2 in the form of a steel truss arranged axially symmetrically, a fibre reinforcement 3 and a bonding layer 4 on the top surface of the panel 1. The concrete panel 1 according to the invention can also comprise an additional longitudinal reinforcement 5 in the form of composite rods and/or prestressing wires.

[0052] A composite floor according to the invention is made of thin, prefabricated concrete panels 1 which panels have the fibre reinforcement 3 and the longitudinal reinforcement 2 in the form of the steel truss arranged axially symmetrically. The concrete panels 1 can comprise the additional longitudinal reinforcement 5 in the form of composite rods and/or prestressing wires. Furthermore, in the composite floor, the bonding layer 4 can be applied which covers the top surface of the concrete panel 1 and connects the concrete panel 1 to a layer of concrete topping 6. The composite floor according to the invention can also have additional transverse reinforcements arranged during installation on site anywhere in the floor.

Claims

1. A concrete panel, especially for composite floors, **characterised in that** it has a longitudinal reinforcement (2) in the form of a steel truss arranged axially

symmetrically, a fibre reinforcement (3) and a bonding layer (4) on the top surface of the concrete panel (1), wherein the height of the concrete panel (1) is in the range of 100 to 500 mm and the width of the concrete panel (1) is in the range of 20 to 90 cm.

2. The panel according to claim 1, **characterised in that** it comprises an additional longitudinal reinforcement (5) in the form of composite rods made of fibre glass or other polymer.

3. The panel according to claim 1, **characterised in that** the additional longitudinal reinforcement (5) is constituted by wires and/or prestressing steel cables.

4. The panel according to claim 1, **characterised in that** the fibre reinforcement (3) is constituted by steel or plastic microfibres.

5. The panel according to claim 1 or 4, **characterised in that** the fibre reinforcement (3) is constituted by a mesh of artificial and/or composite fibres sunken in the plane of the panel.

6. The panel according to claim 1, **characterised in that** the bonding layer (4) is constituted by a heterogeneous top surface of the concrete panel (1) having a rough structure with ribs and/or grooves and/or bonding layer (4) is constituted by elements in the form of crushed aggregate sunken in the top surface of the concrete panel (1) and/or steel or polymeric fibres protruding above the surface of the concrete panel (1).

7. The panel according to claim 1, **characterised in that** its height is in the range of 200 to 400 mm, and the width is in the range of 40 to 70 cm, preferably its height is 200 mm, and the width is 60 cm.

8. A composite floor the bottom surface of which is made of modules comprising steel trusses, and the top surface is constituted by a layer of concrete topping, **characterised in that** the modules are thin prefabricated concrete panels (1) having a height in the range of 100 to 500 mm and a width in the range of 20 to 90 cm, having a fibre reinforcement (3) and a longitudinal reinforcement (2) in the form of a steel truss arranged axially symmetrically.

9. The composite floor according to claim 8, **characterised in that** the height of the concrete panel (1) is in the range of 200 to 400 mm, and the width is in the range of 40 to 70 cm, preferably the height of the concrete panel (1) is 200 mm, and its width is 60 cm.

10. The composite floor according to claim 8, **characterised in that** the concrete panel (1) comprises an

additional longitudinal reinforcement (5) in the form of composite rods made of fibre glass or other polymer.

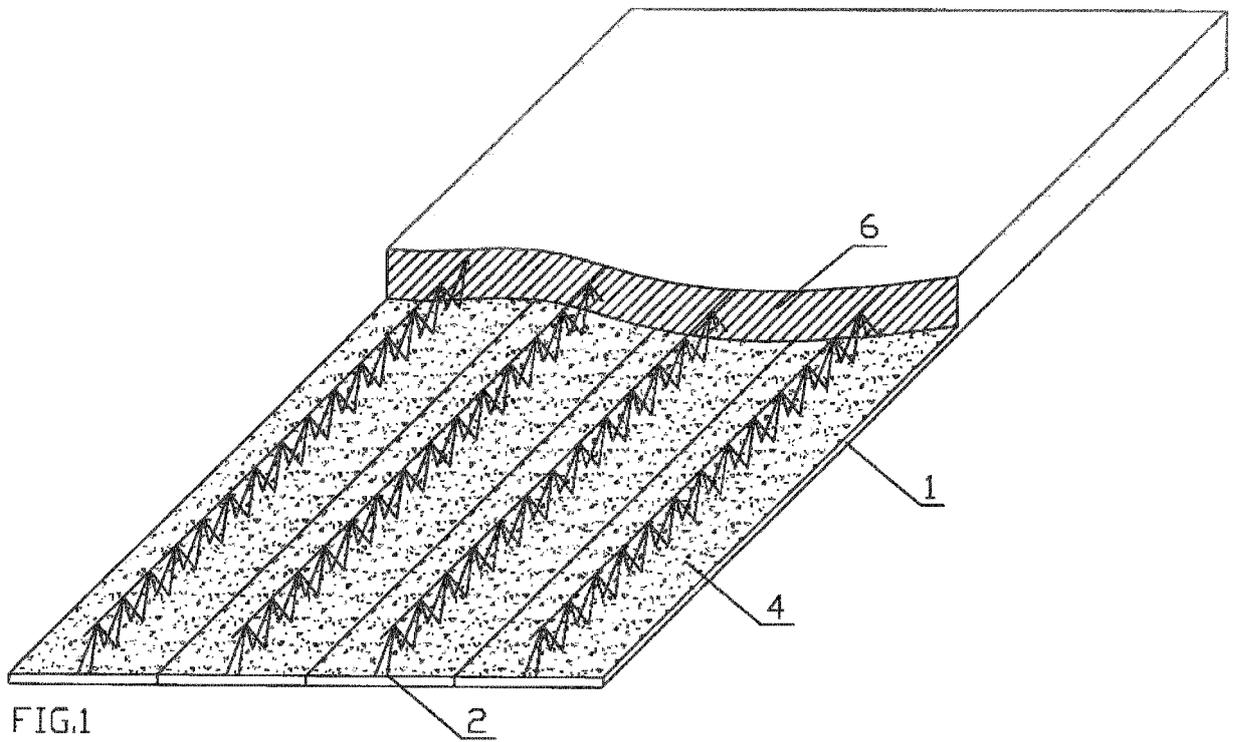
11. The composite floor according to claim 8, **characterised in that** the additional longitudinal reinforcement (5) is constituted by wires and/or prestressing steel cables. 5
12. The composite floor according to claim 8, **characterised in that** the fibre reinforcement (3) is constituted by steel or plastic microfibers and/or the fibre reinforcement (3) is constituted by a mesh of artificial and/or composite fibres sunken in the plane of the concrete panel (1). 10
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13. The composite floor according to claim 8, **characterised in that** the top surface of the concrete panel (1) comprises a bonding layer (4) connecting the concrete panel (1) and the layer of concrete topping (6). 20
14. The composite floor according to claim 13, **characterised in that** the bonding layer (4) is constituted by a heterogeneous top surface of the concrete panel (1) having a rough structure with ribs and/or grooves. 25
15. The composite floor according to claim 13, **characterised in that** the bonding layer (4) is constituted by elements in the form of crushed aggregate sunken in the top surface of the concrete panel (1) and/or steel or polymeric fibres protruding above the surface of the concrete panel (1). 30
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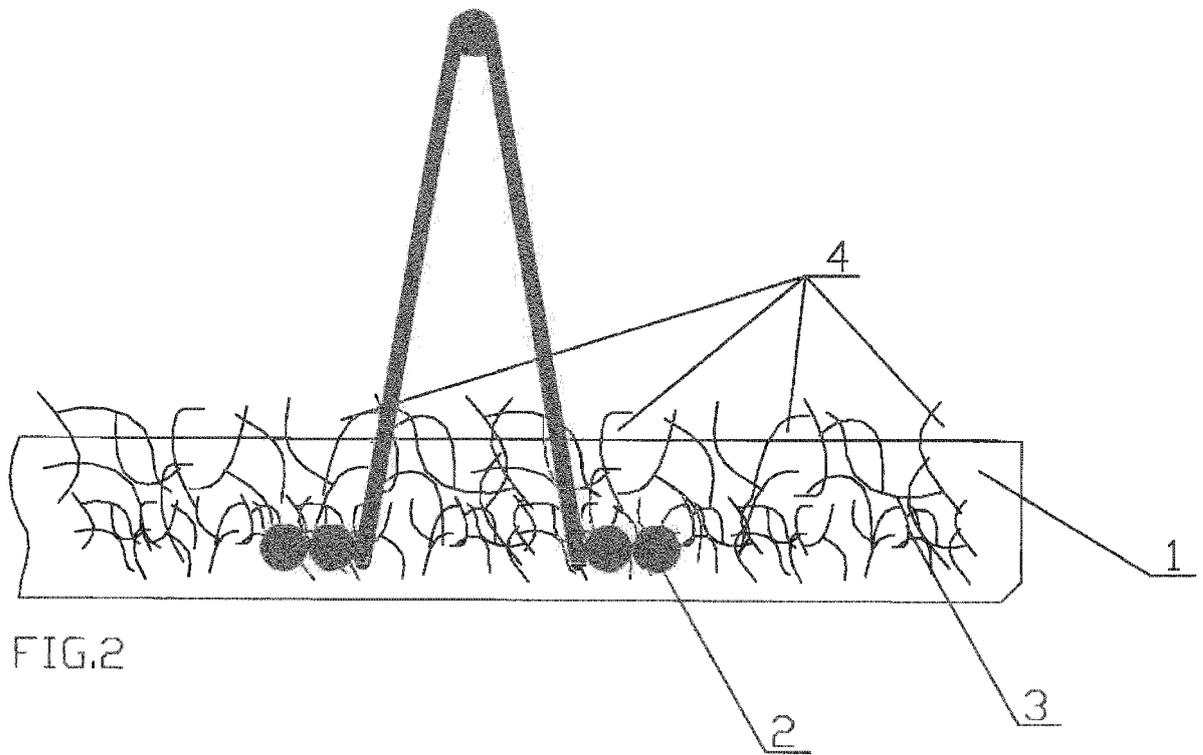


FIG.2

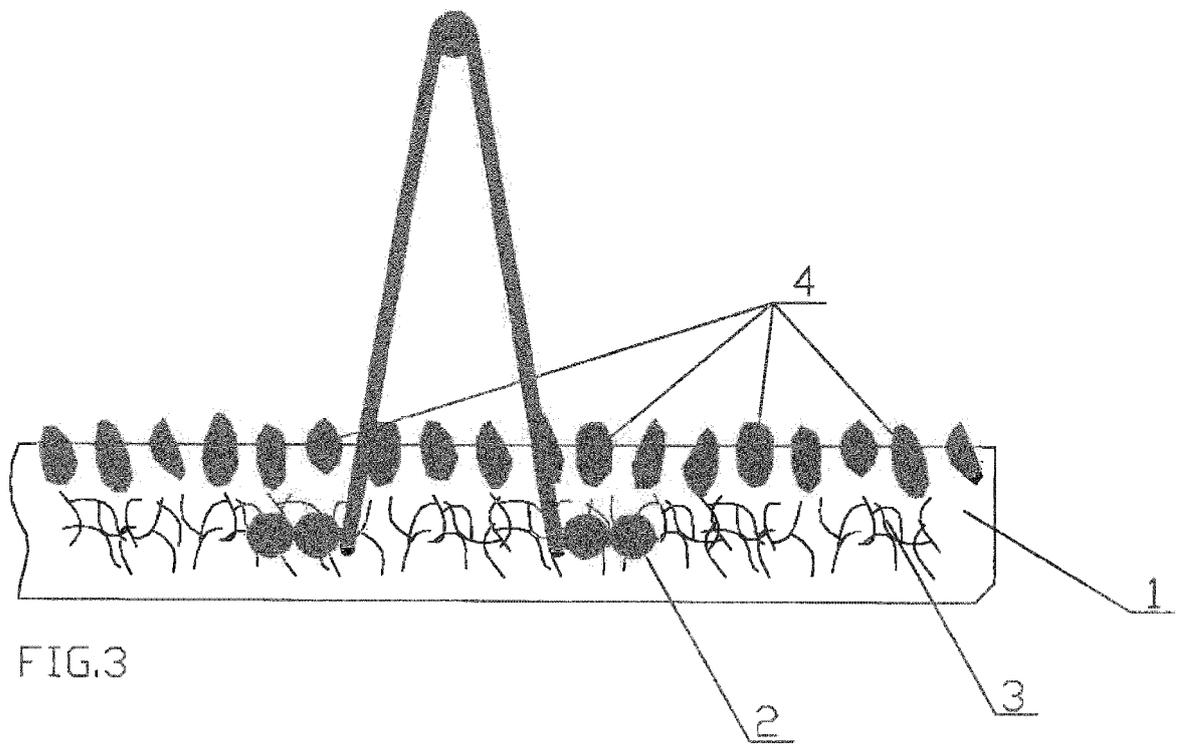


FIG.3

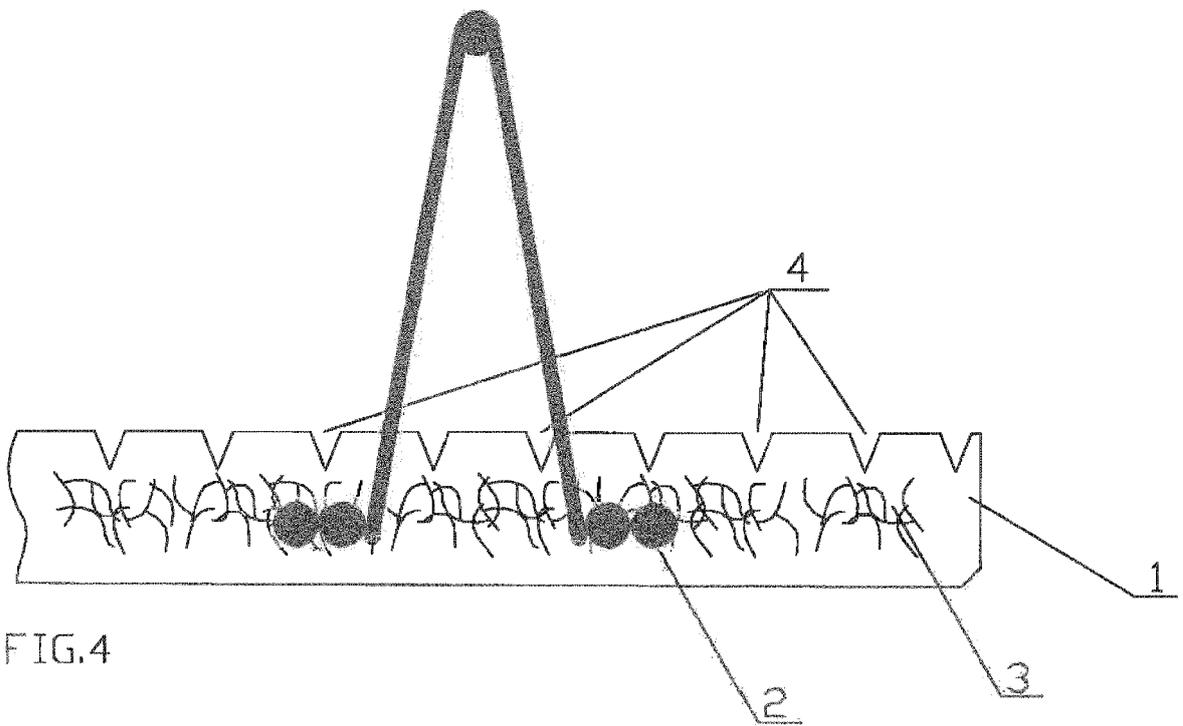
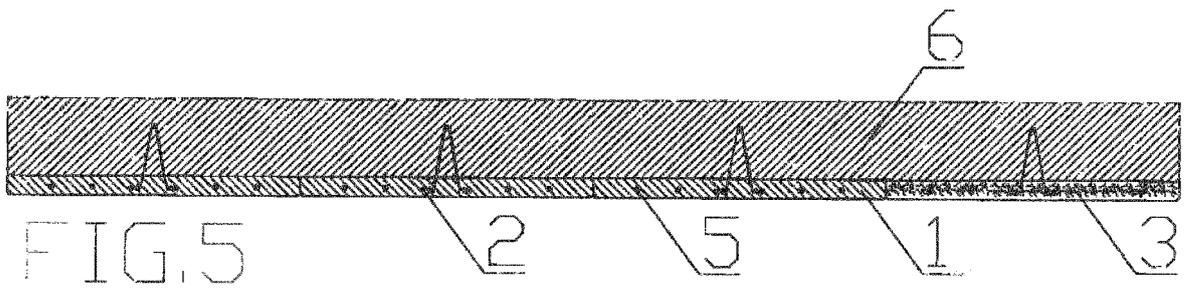


FIG.4





EUROPEAN SEARCH REPORT

Application Number
EP 16 17 8089

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DOCUMENTS CONSIDERED TO BE RELEVANT			
Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
X	GB 2 336 607 A (BIRCHWOOD OMNIA LIMITED [GB]) 27 October 1999 (1999-10-27)	1,4,12,13	INV. E04B5/04 E04B5/38
Y	* page 4, lines 6-28; figures 3,5,6 *	6,15	
A	-----	2	
Y	DE 26 58 622 A1 (HEINZ CARL) 29 June 1978 (1978-06-29)	6,15	
A	* page 8, paragraph 2; figure 1 *	1,8	
A	-----	1,8	
A	DE 36 40 985 A1 (KLAUS HUFNAGL GMBH [DE]) 16 June 1988 (1988-06-16)	1,8	TECHNICAL FIELDS SEARCHED (IPC) E04B
A	* the whole document *	1,8	
A	-----	1,8	
A	DE 102 14 967 A1 (SYSPRO GRUPPE BETONBAUTEILE E [DE]) 19 May 2004 (2004-05-19)	1,8	
A	* the whole document *	1,8	
A	-----	1,8	
A	DE 100 07 100 A1 (SYSPRO GRUPPE BETONBAUTEILE E [DE]) 23 August 2001 (2001-08-23)	1,8	
A	* the whole document *	1,8	

The present search report has been drawn up for all claims			
Place of search Munich		Date of completion of the search 3 November 2016	Examiner Stern, Claudio
CATEGORY OF CITED DOCUMENTS		T : theory or principle underlying the invention E : earlier patent document, but published on, or after the filing date D : document cited in the application L : document cited for other reasons	
X : particularly relevant if taken alone Y : particularly relevant if combined with another document of the same category A : technological background O : non-written disclosure P : intermediate document		& : member of the same patent family, corresponding document	

EPO FORM 1503 03/82 (P04/C01)

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

EP 16 17 8089

5 This annex lists the patent family members relating to the patent documents cited in the above-mentioned European search report.
The members are as contained in the European Patent Office EDP file on
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03-11-2016

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
GB 2336607 A	27-10-1999	NONE	
DE 2658622 A1	29-06-1978	NONE	
DE 3640985 A1	16-06-1988	NONE	
DE 10214967 A1	19-05-2004	NONE	
DE 10007100 A1	23-08-2001	DE 10007100 A1	23-08-2001
		DE 10066261 B4	21-09-2006

EPO FORM P0459

For more details about this annex : see Official Journal of the European Patent Office, No. 12/82

REFERENCES CITED IN THE DESCRIPTION

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Patent documents cited in the description

- PL P173278 [0002]
- PL P402760 [0003]
- PL P403918 [0004]