



(51) International Patent Classification:

E04F 13/14 (2006.01) *E04F 15/08* (2006.01)
E04F 15/02 (2006.01) *E04F 15/06* (2006.01)

(21) International Application Number:

PCT/EP2009/067622

(22) International Filing Date:

21 December 2009 (21.12.2009)

(25) Filing Language:

English

(26) Publication Language:

English

(30) Priority Data:

MO2008A000330 24 December 2008 (24.12.2008) IT

(72) Inventor; and

(71) Applicant : PAGANELLI, Mariano [IT/IT]; Via Del Giglio N. 67, I-41100 Modena (IT).

(74) Agent: GUARESCHI, Antonella; c/o Ing. Dallaglio S.r.l., Via Mazzini N. 2, I-43121 Parma (IT).

(81) Designated States (unless otherwise indicated, for every

kind of national protection available): AE, AG, AL, AM, AO, AT, AU, AZ, BA, BB, BG, BH, BR, BW, BY, BZ, CA, CH, CL, CN, CO, CR, CU, CZ, DE, DK, DM, DO,

DZ, EC, EE, EG, ES, FI, GB, GD, GE, GH, GM, GT, HN, HR, HU, ID, IL, IN, IS, JP, KE, KG, KM, KN, KP, KR, KZ, LA, LC, LK, LR, LS, LT, LU, LY, MA, MD, ME, MG, MK, MN, MW, MX, MY, MZ, NA, NG, NI, NO, NZ, OM, PE, PG, PH, PL, PT, RO, RS, RU, SC, SD, SE, SG, SK, SL, SM, ST, SV, SY, TJ, TM, TN, TR, TT, TZ, UA, UG, US, UZ, VC, VN, ZA, ZM, ZW.

(84) Designated States (unless otherwise indicated, for every

kind of regional protection available): ARIPO (BW, GH, GM, KE, LS, MW, MZ, NA, SD, SL, SZ, TZ, UG, ZM, ZW), Eurasian (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), European (AT, BE, BG, CH, CY, CZ, DE, DK, EE, ES, FI, FR, GB, GR, HR, HU, IE, IS, IT, LT, LU, LV, MC, MK, MT, NL, NO, PL, PT, RO, SE, SI, SK, SM, TR), OAPI (BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW, ML, MR, NE, SN, TD, TG).

Declarations under Rule 4.17:

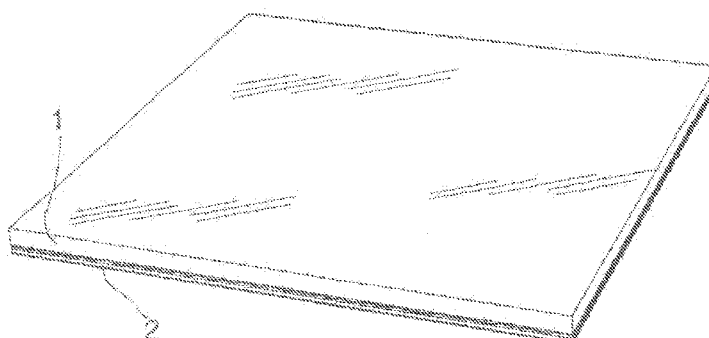
— of inventorship (Rule 4.17(iv))

Published:

— with international search report (Art. 21(3))

(54) Title: A PROCESS FOR REALISING HIGH-RESISTANCE SLABS OR TILES, DESTINED FOR COVERING INTERNAL OR EXTERNAL FLOORS OR WALLS

Fig. 1



(57) Abstract: The process for realizing high-resistance slabs or tiles, destined for covering internal or external floors or walls comprises following stages: arranging a slab or tile exhibiting an in-view surface; arranging at least a slim support slab or support plate having a characteristic of possessing a thermal expansion coefficient which is greater than a thermal expansion coefficient of the slab or tile, the slim support slab or support plate exhibiting good properties of tenacity and resistance to easy breakage thereof; gluing under heating the slab or tile onto the slim support slab or support plate, or vice versa, using a suitable glue for adhering to surfaces thereof to be glued; leaving an assembly thus obtained to cool down to an ambient temperature such that owing to a different thermal expansion coefficient (contraction), the slim support slab or support plate induces on the slab or tile, to which it is solidly glued, a state of compression starting from a lower surface thereof which is opposite the in-view surface.

TITLE: A PROCESS FOR REALISING HIGH-RESISTANCE SLABS OR TILES,
DESTINED FOR COVERING INTERNAL OR EXTERNAL FLOORS OR WALLS

DESCRIPTION

BACKGROUND OF THE INVENTION.

The invention relates to a process for realizing high-resistance slabs or tiles, destined for covering internal or external floors or walls.

SUMMARY of the INVENTION.

Specifically, though not exclusively, it is usefully applied in the sector of
5 ceramic tiles which have been triumphant in the market for floorings and coverings in residential buildings and public spaces thanks to their characteristics of durability and hygiene, naturally apart from the infinite possibilities of decoration they afford.

Modern known tiles are characterized by a high level of mechanical and
10 chemical resistance, as well as resistance to surface abrasion, and are also easy to clean. For these reasons they have become very widely used.

However, ceramic material is intrinsically fragile, so that ceramic tiles, though exhibiting very high load value qualities, are by their nature not very resistant to impacts, as the mechanism propagating the rupture thereof
15 is typical of hard-but-fragile materials: when subjected to a stress they rapidly reach breaking limit, even where the strain is very small.

For this reason ceramic tiles have to be cemented onto a very rigid support which prevents them from deforming. The prior art for installation of tiles comprises laying them on a floor which must be as rigid as possible.
20 According to the dictates of modern laying, the floor must be reinforced with an iron mesh such as to make it even more rigid. In this way those minimum deformations which lead to the breaking of the tiles are prevented, even following impacts or intense loads.

In raised flooring, the tiles are cemented onto a rigid support of several centimeters' thickness, which prevents flexion thereof.

In the prior art, then, ceramic tiles, in order to guarantee good results, must be cemented on a very rigid substrate. The substrates normally used in the prior art for dry laying, when thin, are not sufficiently rigid, so do not
5 guarantee resistance to breakage in case of impact. In order to guarantee resistance to impact, thicknesses of greater than 5mm are required.

The laying or recasting of a floor according to the prior art are therefore complex and expensive operations.

10 In recent years, however, laminate floors have become common on the market. Laminate floors do not require special precautions and can be easily laid even by inexperienced people and without the need for special technological tools. On the back of the success of these material which are laid without adhesive even on pre-existing floors, a strong demand for a
15 ceramic tile floor which can be laid in the same way has been established, i.e. without being cemented to the floor or platform and which can be installed even by inexpert personnel.

There exist prior-art realizations which comprise pre-mounting of the ceramic tile by cementing to supports of various types, for example plastic,
20 (see WO 2005/052279 A1 - Della Pepa), polyurethane (see WO 2006/042148 A2 - Mohawk), masonite (see US 2007251172 A1- Edge Flooring), or sheet metal (see WO 2008/056382 A1 - Planium), and ceramic (see WO2004090257 A1 – System).

In document WO 2008/056382 A1 - (Planium), reference is made to the
25 use of a metal sheet, with the sole aim of creating an anchoring between adjacent tiles.

Other systems propose reinforcement with a thick natural stone slab (13-17mm) (patent EP1329568A1 – Bresciana Graniti) or a ceramic tile (patent

JP 2005002646) using however rather complex manufacturing characteristics and methods.

All of these known systems have been shown to have limitations in their practical use in the field of civil construction due to poor resistance to impact in the flooring, essentially due to the intrinsic fragility of the ceramic tile. In particular the prior art exhibits the unsolved problem, not only for ceramic tiles, but especially in the case thereof, of not enabling realization of dry-laid ceramic floors provided with sufficient resistance to impacts.

The present invention obviates the above-mentioned drawbacks in the prior art by solving the problem of fragility of the ceramic material as set out in the claims.

The result is obtained by the invention with the realization of a high-resistance tile able to resist much greater impacts than those usually withstandable by traditional ceramic tiles without having to resort to use of tiles having greater thickness.

BRIEF DESCRIPTION of the DRAWINGS.

Further characteristics and advantages of the present invention will better emerge from the detailed description that follows of some preferred though not exclusive embodiments of the invention, illustrated purely by way of non-limiting example in the accompanying figures of the drawings, in which:

Figure 1 is a schematic perspective view of a product made according to the invention;
figure 2 is a large-scale drawing of part of a schematic exploded section of the product of the invention as in figure 1.

DESCRIPTION of the PREFERRED EMBODIMENTS.

With reference to the accompanying figures, the process of the invention for realizing high-resistance slabs or tiles, destined for covering internal or external floors or walls comprises following main stages:

arranging a slab or tile 1 exhibiting an in-view surface (aesthetic surface);

5 arranging at least a slim support slab or support plate 2 having a characteristic of possessing a thermal expansion coefficient which is greater than a thermal expansion coefficient of the slab tile 1, the slim support slab or support plate 2 being characterized by having good properties of tenacity and resistance to easy breakage thereof;

10 gluing under heating the slab or tile 1 onto the slim support slab or support plate 2, or vice versa, using a suitable glue for adhering to surfaces thereof to be glued;

leaving an assembly thus obtained to cool down to an ambient temperature such that owing to a different thermal expansion coefficient (contraction),
15 the slim support slab or support plate 2 induces on the slab or tile 1, to which it is solidly glued, a state of compression starting from a lower surface thereof which is opposite the in-view surface.

The slab or tile 1 is made of a ceramic material or the like which can be glazed and decorated. Further it is preferably of small thickness, i.e. a few
20 millimeters, in comparison with the thickness normally used for floor tiles.

The at least a thin slab or support sheet 2 is preferably made of a metal or a metal alloy. In particular, it is advantageously made of galvanized iron and exhibits a slim thickness comprised between 0.1mm and 1mm, preferably between 0.3mm and 0.5mm.

25 The gluing under heating is performed at a temperature which is greater by a predetermined entity ΔT than a predetermined working and use temperature. The predetermined entity ΔT indicated is preferably at least 40°C and the gluing of the first slab or tile 1 on the thin support slab or

sheet 2, or vice versa, comprises spreading a layer of adhesive on at least one of the two surfaces to be glued followed by a pressing stage during which the first slab or tile 1 is pressed with a predetermined pressure against the slim support slab or sheet 2.

- 5 The first slab or tile 1 is a thin ceramic tile (a few millimeters thick), usually not greater than 4 to 5 mm, while the slim support slab or sheet 2 has a thickness preferably comprised between 0.25mm and 0.5mm.

An important condition is however that the material constituting the slim support slab or sheet 2, apart from being a non-fragile material, also has a
10 thermal expansion coefficient (contraction) and a modulus of elasticity which are decidedly higher than those of the slab or tile 1. Materials which can be used comprise galvanized iron, steel and aluminium alloys.

The glue used for solidly gluing under heating the slab or tile 1 on the slim support slab or sheet 2, or vice versa, is constituted by an acrylic resin, a
15 polyurethane resin, a polyester resin or an epoxy resin.

In this way, during cooling the support slab or sheet 2 will undergo a thermal contraction which is greater than that of the slab or tile 1, subjecting to compression the lower surface of the slab or tile 1 to which the support slab or sheet 2 is adherent by means of the glue.

- 20 The high modulus of elasticity of the material of the support slab or sheet 2 guarantees that the high level of compression becomes permanent in the coupling, preventing formation of cracking during impact stress on the lower surface of the tile, which would inevitably lead to the breakage of the piece.

- 25 The composite tile thus obtained is highly resistant and essentially characterized by the fact of comprising a slab or tile 1 exhibiting an in-view surface which is solidly constrained on a slim support slab or sheet 2 provided with good properties of tenacity and resistance to easy fracture

such as to be subjected to a state of compression, starting from the lower surface opposite the in-view surface, induced thereon by the slim support slab or sheet 2 which is strongly glued thereto. It is able to withstand an impact without cracking up to the point that the surface, when finally
5 cracking, does so due to compression, and a typical hertzian fracture forms. In other words, it dents but does not shatter into pieces.

EXAMPLE n° 1

An example of this invention relates to the application to the lower surface of the ceramic slab or tile of a galvanized steel sheet having a modulus of
10 elasticity of 200 Gpa and being 0.5mm thick, using as a glue a polyurethane resin in a heated die at 70°C. The die is used to maintain the ceramic tile and the galvanized steel sheet positioned in relation to one another. Once the resin has completed hardening the product can be extracted from the die and subsequent cooling thereof to ambient
15 temperature of 20-30°C leads to a state of compression of the lower surface which enormously increases resistance to impacts thereof.

Example N°2

By way of instance, consider the following example in order to provide a quantification of the results achievable with the process of the invention
20 applied to a normal vitrified stoneware tile, format 60x60cm having a thickness of 12mm, water absorbance of 0.012%, a thermal expansion coefficient $\alpha_{(20-100)} = 7.5 \times 10^{-6} \text{ K}^{-1}$ and fracture strength 55 MPa. A tile of this type, when not glued to the floor, if struck by a steel ball weighing 510 grams from a height of 100mm shatters into many shards. If the same tile is
25 glued to the floor using a high-resistance glue (Mapei Kerabond) it can withstand an impact by the same ball from a height of 800 mm (Certifications et classements des produits du bâtiment – Revetements de sol ceramiques – Cahiers du CSTB, cahier 3503 annexe 6 choc lourd –

Janvier 2005). Beyond this height, the tile glued to the floor begins to dent, but does not break into fragments.

The same type of tile is glued under heating at 50°C with a heat-fusible reactive polyurethane resin applied by roller on the lower surface of the tile
5 to a 0.5mm-thick galvanized iron sheet with a thermal expansion coefficient of $\alpha_{(20-100)} = 12.5 \times 10^{-6} \text{ K}^{-1}$ and a modulus of elasticity of 190Mpa. The product is then left to cool. The increase in thickness of the whole product with respect to the original tile is 1.5mm. This product, which constitutes the basis of the invention, is rested on a rigid reinforced-
10 cement flooring without any adhesive. The invention can withstand an impact of the above-mentioned steel ball of the weight of 510 grams from a height of 800mm striking the center of the tile. Beyond this height the surface of the product begins to dent. The behavior is entirely similar to that of the tile glued to the cement flooring.

15 EXAMPLE N°3

By way of example of application of the invention, consider the use of a ceramic slab or tile 1 having a 60x60cm format with a thickness of only 3mm made of unglazed vitrified stoneware. This tile has a water absorption of 0.01%, a thermal expansion coefficient of $\alpha_{(20-100)} = 7.2 \times 10^{-6} \text{ K}^{-1}$ and a
20 fracture strength of 60Mpa. When rested on the floor, it shatters if struck by the steel ball weighing 510 grams which falls from a height of 50 millimeters. If the tile is glued according to the present invention on the floor using a high-resistance adhesive it can withstand an impact of a steel ball weighing 510 grams falling from a height of 800mm. If the ball falls
25 from greater heights the tile dents, i.e. is damaged by crushing.

The same type of tile is then, according to the process of the present invention, glued under heating at a temperature of 50°C on an AISI 430 stainless steel sheet having a thermal expansion coefficient of $\alpha_{(20-100)} = 10$

$\times 10^{-6} \text{ K}^{-1}$, a modulus of elasticity of 200 Mpa, a fracture strength of 50Mpa, and a thickness of 0.4mm. The glue used is a fast-acting bicomponent epoxy adhesive having a thickness of 0.4 mm. The cooling stage follows. The product obtained has a total thickness of 3.8mm, greater
5 than that of the original tile 1 by only 0.8 mm and is constituted by a high-resistance tile characterized in that it comprises a slab or a tile 1 exhibiting an in-view surface which is solidly constrained on a slim support slab or support plate 2 provided with good properties of tenacity and resistance to easy breakage thereof, in such a way as to be subjected to a state of
10 compression, starting from a lower surface opposite the in-view surface, which state of compression is induced by the slim support slab or support plate 2 which is solidly glued thereto.

Simply rested on a reinforced concrete flooring without any glue, the product is able to withstand an impact with a steel ball weighing 510 grams
15 hitting the center of the tile falling from a height of 800 millimeters and only when the ball is dropped from greater heights does it begin to dent by force of crushing.

The product obtained, constituting a high-resistance tile, only resting on a floor, behaves as if it were solidly cemented to the actual floor.

20 With the invention ceramic floor laying can be done without fixing with glue or adhesive.

CLAIMS.

- 1). A process for realizing high-resistance slabs or tiles, destined for covering internal or external floors or walls, comprising following stages: arranging a slab or tile exhibiting an in-view surface;
- 5 arranging at least a slim support slab or support plate having a characteristic of possessing a thermal expansion coefficient which is greater than a thermal expansion coefficient of the first slab or tile, the slim support slab or support plate having good properties of tenacity and resistance to easy breakage thereof;
- 10 gluing under heating the slab or tile onto the slim support slab or support plate, or vice versa, using a suitable glue for adhering to surfaces thereof to be glued;
- leaving an assembly thus obtained to cool down to an ambient temperature such that owing to a different thermal expansion coefficient (contraction),
- 15 the slim support slab or support plate induces on the slab or tile, to which it is solidly glued, a state of compression starting from a lower surface thereof which is opposite the in-view surface.
- 2). The process of claim 1, wherein the slab or tile is made of a ceramic material or a like material.
- 20 3). The process of claim 2, wherein the at least a slim support slab or support plate is preferably made of a metal or a metal alloy.
- 4). The process of claim 1, 2, or 3, wherein the gluing under heating is performed at a higher temperature by a predetermined entity ΔT with respect to a normal in-situ temperature for the assembly once laid.
- 25 5). The process of claim 1, wherein the gluing under heating of the first slab or tile on the slim support slab or support plate, or vice versa, comprises a spreading of a layer of adhesive on at least a surface of the two surfaces to be glued, followed by a pressing stage, during which

pressing stage the first slab or tile is pressed, with a predetermined pressure, against the slim support slab or plate.

6). The process of claim 1, wherein the first slab or tile is a ceramic tile for floors or for coverings having a thickness of less than 4 mm.

5 7). The process of claim 3, wherein the slim support slab or support plate, preferably made of metal or a metal alloy, is made of steel and exhibits a thickness comprised between 0.25 mm and 0.5 mm.

8). The process of claim 7, wherein the slim support slab or support plate, preferably made of metal or a metal alloy, is made of galvanized iron and
10 exhibits a thickness comprised between 0.25 mm and 0.5 mm.

9). The process of claim 1, wherein the glue with which the first slab or tile is gluing under heating on the slim support slab or plate, or vice versa, is constituted by an acrylic resin, a polyurethane resin, a polyester resin or an epoxy resin.

15 10). A high-resistance slab or a tile, comprising a slab or a tile exhibiting an in-view surface which is solidly constrained on a slim support slab or support plate provided with good properties of tenacity and resistance to easy breakage thereof, in such a way as to be subjected to a state of compression, starting from a lower surface opposite an in-view surface of
20 the slab or tile, which state of compression is induced by the slim support slab or support plate which is solidly glued thereto.

Fig. 1

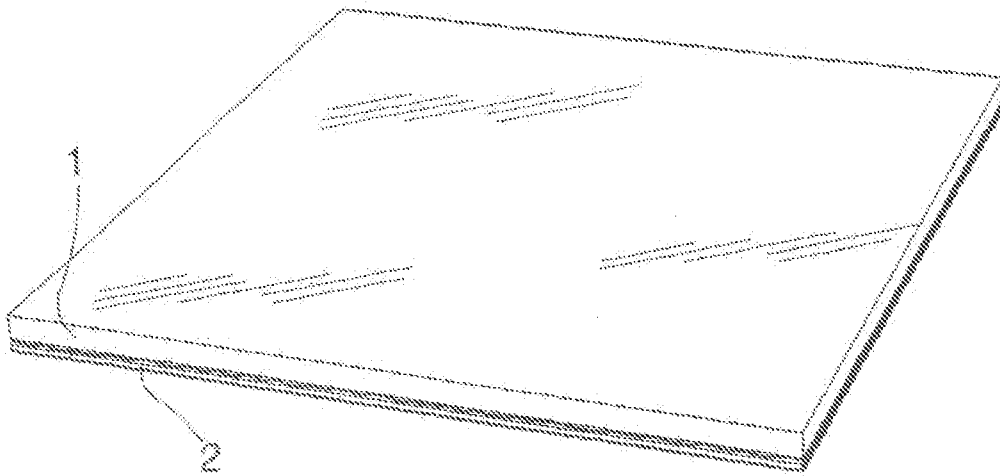
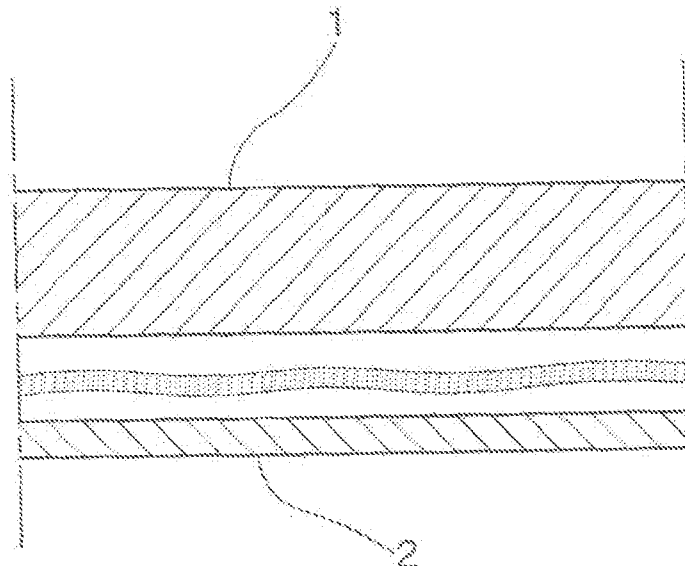


Fig. 2



INTERNATIONAL SEARCH REPORT

International application No

PCT/EP2009/067622

A. CLASSIFICATION OF SUBJECT MATTER

INV. E04F13/14 E04F15/02 E04F15/08 E04F15/06

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

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

E04F B32B E04C

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

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

EP0-Internal

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	WO 00/67999 A (CONGOLEUM CORP.) 16 November 2000 (2000-11-16)	1-5,7-10
A	page 7, line 5 - page 8, line 21; figures 1,1A	6
X	GB 774 049 A (INT. SIPOREX) 1 May 1957 (1957-05-01)	1-10
X	page 1, line 8 - page 2, line 5	
X	GB 2 306 389 A (MONTE MOSS) 7 May 1997 (1997-05-07)	1,4-5,10
A	page 2, line 24 - page 5, line 10; figures	3,7-9



Further documents are listed in the continuation of Box C.



See patent family annex.

* Special categories of cited documents :

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

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

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

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

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

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

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

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

"&" document member of the same patent family

Date of the actual completion of the international search

12 March 2010

Date of mailing of the international search report

19/03/2010

Name and mailing address of the ISA/

European Patent Office, P.B. 5818 Patentlaan 2
NL - 2280 HV Rijswijk
Tel. (+31-70) 340-2040,
Fax: (+31-70) 340-3016

Authorized officer

Righetti, Roberto

INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No

PCT/EP2009/067622

Patent document cited in search report		Publication date	Patent family member(s)	Publication date
WO 0067999	A	16-11-2000	AU 4996700 A CA 2373458 A1 US 6413618 B1	21-11-2000 16-11-2000 02-07-2002
GB 774049	A	01-05-1957	NONE	
GB 2306389	A	07-05-1997	ZA 9606990 A	24-02-1997