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(71) Applicant: **Nieuweboer, Niels Pieter Gerard**
**1508 EN Zaandam (NL)**

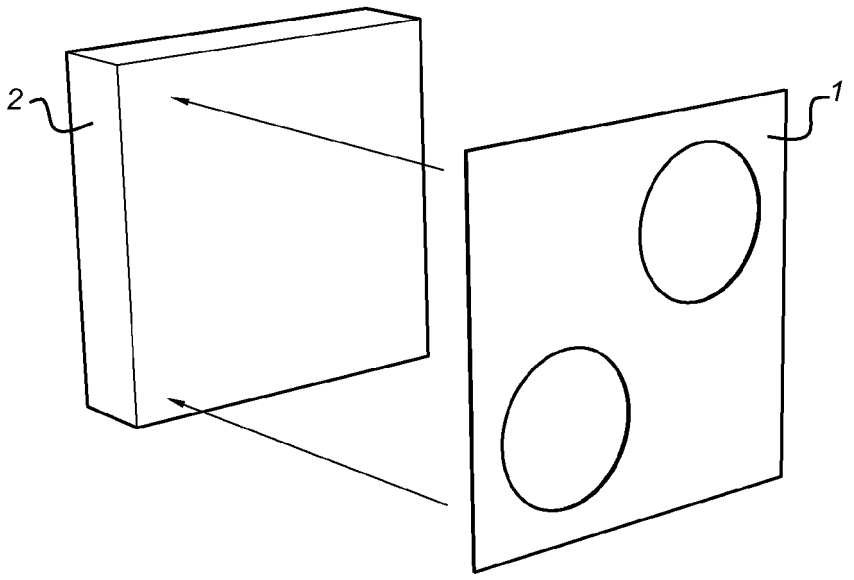
(72) Inventor: **Nieuweboer, Niels Pieter Gerard**
**1508 EN Zaandam (NL)**

(74) Representative: **Dekker-Garms, Alwine Emilie**
**RaTIO I/P**
**Pieter Zeemanstraat 57**
**5621 CR Eindhoven (NL)**

## (54) Method for manufacturing a variety of esthetic concrete surfaces using metal molds and a magnetic substrate

(57) In a method for manufacturing a concrete product having a colored, washed out, cured, engraved, or otherwise treated surface, the concrete is poured horizontally or vertically using a metallic mold (2), wherein a magnetic substrate (1) used alone or in combination with other active composites or substrates is placed against the mold (2) in order to obtain the desired concrete surface. At least one face of the substrate (1) is made of a magnetic sheet. The exact nature of the second face of the substrate (1) depends on whether or not it is desired to print an active composite such as a color or a retarder on that face of the substrate (1). It is possible for the substrate (1) to be provided with a cut design, a composition applied through lamination, and/or a printed colored design, for example.

*Fig. 1*




EP 2 789 439 A1

## Description

**[0001]** The present invention relates to a method for obtaining a variety of esthetic concrete surfaces that can be applied in any industrial setting where concrete is casted using a metallic mold or frame. Esthetic concrete surfaces include colored, washed out, cured, engraved, hydrophobic, and other treated surfaces, along with a mix of two or more of these treatments. The concrete can be casted horizontally or vertically using metallic molds of various sizes.

**[0002]** Several methods exist for obtaining esthetic concrete surfaces. The first group of methods consists in manually applying an active substance (for example paint or composites that have hydrophobic properties) on top of the hardened concrete. The main disadvantage of these methods is their high cost and divergent quality levels linked to the manual application of the active substance. The present invention relates to a method that enables the treatment of concrete surfaces at the time of the pouring of the concrete, based on the use of a magnetic substrate on which or against which active substances are deposited in an industrial way. This method enables both the consistent quality of the concrete surface treatment and cost efficient industrial use.

**[0003]** A second group of methods consists in mixing an active substance into the concrete mass made of water, cement, stones and sand during the concrete fabrication process. For example, pigments can be mixed in the concrete mass to obtain concrete with a uniform color. These methods require that pigments be mixed in either the entire mass of a concrete element or that they be used on a thick layer of a precasted concrete element. Such methods are not economical since a lot more active substances are used than those that are strictly needed to react with the visible layer of the concrete. In addition, only one active substance can be mixed in the concrete mass. Therefore, for example, colored patterns and photographs cannot be imprinted onto the concrete with these methods. The present invention enables the treatment of only the visible layer of a concrete element, which limits the amount of active substances needed. In addition, the present invention enables the treatment of the concrete surface with different active substances deposited next to one another -for example different colors printed according to a pattern.

**[0004]** A third group of methods consists in applying an active substance (for example a concrete retarder or a coloring composite) on a flat mold or on a formwork on which the concrete is then poured. Some of these methods also use a water soluble adhesive that is deposited against the mold or formwork. JP 2006256057, JP 9239717, US 5534214, and EP 0425670 for example disclose the coloration of concrete based on the application of a coloring composite on a formwork or flat mold. US 5520298 and JP 2008155473 detail the content of composites used to obtain patterned concrete surfaces. These methods are attached with two main difficulties: (1) the labor intensive process and divergent quality levels linked to the manual application of the active substances, and (2) the fact that several active substances of different types (for example retarders of different strengths or different colors) cannot be accurately deposited next to one another. The present invention enables the treatment of concrete surfaces simultaneously with several active substances of one type (for example different strengths of retarders) or of different types (for instance, a concrete retarder along with different colors). In addition, the application of the active substances is performed industrially, which ensures the consistent thickness of the substances deposited against the concrete surface.

**[0005]** A fourth group of methods consists in obtaining a relief or structure in the concrete surface by using either a formwork or a transfer sheet on which a structure or design has been laminated. For example, JP 2000135709 discloses a method to apply a relief onto a concrete surface by using a plastic formwork that is laminated to a steel plate. EP 0634256 and UK 2457063 disclose methods to apply a structure onto a concrete surface by using a membrane on which the structure is laminated. These methods are attached with the following main limitations: (1) they are focused solely on obtaining a relief; therefore they do not incorporate the use of both relief and a variety of other treatments (for example the use of different retarders or of a colored image), (2) because potential motives are visible only due to relief, the range of graphical images that can be placed and can be visible on the concrete is limited. In comparison, the present invention enables not only the application of a relief on the concrete surface, but also makes it possible to combine relief with the application of different substances such as various colors and retarders with different strengths. In addition, the range of graphic elements that can be imprinted onto the concrete surface is virtually unlimited.

**[0006]** A fifth group of methods consists in applying an active substance on a substrate that comes in contact with the freshly poured concrete. For example, EP 1569777 discloses how a non-porous fair-face concrete surface can be obtained based on the use of a cellulose-based membrane that is covered with a plastic coating and that has received an electrical treatment. EP 1177081 discloses the creation of a patterned concrete surface with the aid of a retarder and a release agent applied on a membrane that is plastic, cellulose, or metal based. DE 102006014900 discloses the application of colors on a concrete surface based on the use of an intermediate carrier made at least partly of paper or metal. Each of these patent publications consider solely a single esthetic effect of concrete: a smooth surface without holes in EP 1569777, washed out surfaces in EP 1177081, and only colors in DE 102006014900. In contrast, the present invention enables to obtain not only these single effects, but also a combination of these effects (for example, a smooth surface mixed with colors

and washed out areas). In addition, by applying the same method, the present invention enables additional treatments of concrete surfaces such as the waterproofing, protection against pollution, treatment against CO2, and other treatments.

**[0007]** In the fourth group of methods, only EP 1569777 specifies the nature of the substrate that can be employed. EP 1177081 and DE 102006014900 disclose only in broad terms the nature of the material on top of which the active substances can be deposited. Yet, the nature of this material is key to: (1) the practical and successful use of such a material during the concrete pouring process, (2) to determine which substances can be deposited on such a material, and (3) offering an affordable substrate relative to the price of a concrete. EP 1569777 relies on a cellulose-based membrane covered with a plastic coating. This type of membrane, along with cellulose-based substrates wherein two layers of kraft paper are glued together by an inside bitumen layer, are in effect the only membranes that are commonly used in the concrete industry. Yet, because they are cellulose-based, these membranes present a number of disadvantages: (1) they do not hold on the vertical molds that are used for in situ projects, which makes their use extremely difficult for in situ casting, (2) they risk damaging in contact with humidity, which makes their use very difficult in both in situ situations and in factories that work with open doors, (3) they demonstrate a very strong curling effect, which implies that there is a risk that the fresh concrete will flow under the membrane, and (4) they do not completely adhere to the surface of the concrete mold, which leads to the risk of air bubbles forming under the membrane, resulting in folds and damages in the concrete surface.

**[0008]** The present invention is based on the use of a specific type of substrate whereby one side of the substrate is magnetic and the other side is or is not printable according to the use made of the substrate. Since molds used in the concrete industry are mostly metallic, a magnetic substrate is highly convenient: it can adhere completely to the metallic mold, which prevents both any curling effect and the formation of air bubbles under the substrate. In addition, when used with a hydrophobic face made for example of plastic or silicone, the substrate is fully resistant to humidity.

**[0009]** Individual magnetic blocks are commonly used in the concrete industry. For instance, JP 2005297497 discloses how magnets can be employed to hold a partitioning plate between two metallic molds, and JP 20001135709 discloses how magnet blocks can be used to hold a plastic formwork that has been laminated against a metallic mold. Yet, these patent publications do not envision the use of a magnetic substrate positioned in a metallic mold as an instrument to create esthetic concrete surfaces.

**[0010]** Compared to existing methods, the present invention is innovative mainly in that it:

(1) identifies a type of substrate that adheres well to metallic molds used either vertically or horizontally in both factory and in situ environments; and
(2) identifies ways of using the substrate that enable to apply in an industrial manner, at the concrete pouring stage, substances that impact the esthetic properties of the concrete; and
(3) identifies ways of using the substrate that enable to obtain either a single, or a mix of esthetic effects; and
(4) identifies a method that enables the application of a variety of substances against the freshly poured concrete.

**[0011]** The invention therefore opens the door to producing in an industrial way a wide variety of high quality esthetic concrete surfaces, produced not only in the factory, but also in situ.

**[0012]** The present invention is based on the use of a substrate with one face made of a magnetic sheet. The exact nature of the second face of the substrate depends on whether or not an active composite has to be printed on that face of the substrate. Magnetic substrates can be found in sheets or in rolls of various sizes. The magnetic face of the substrate can also be found in various thicknesses and magnetic strengths. It is important to identify substrates with a sufficient magnetic force to ensure the full adherence of the substrate to the metallic mold employed to cast the concrete. The smaller the metallic mold, the lower the magnetic strength needed. Similarly, a smaller magnetic strength is needed in horizontal than in vertical molds. The molds considered in this invention include, but are not limited to, blocks, tiles, slabs, panels manufactured in the factory on in situ.

**[0013]** A first approach to producing esthetic concrete surfaces with a magnetic substrate consists in using this substrate as a stencil alone. In this approach, the substrate does not need to have a printable face. However, it is preferable to have a substrate face that is covered with a hydrophobic material such as a plastic in order to enable the optimal curing of the concrete. Due to the hydrophobic material, the water mixed with the cement and other materials cannot evaporate, which enables the cement to react with water in an optimal way. This optimized curing process leads to concrete with very small capillary pores, no big holes, and a smooth surface.

**[0014]** Various industrial techniques such as laser cutting, press cutting, and automated knife cutting can be employed to cut designs in the sheets or rolls of substrate. Designs to be cut are recorded in digital files and then sent to the cutting machines. A large variety of original designs can be cut with these machines.

**[0015]** Once cut, the magnetic substrate can be employed as a stencil to engrave designs into the concrete surface. The designs become visible due to the contrast between (1) the surfaces in contact with the substrate and (2) the surfaces that are in contact either directly with the metallic mold or with an active composite deposited

on the mold, or with another substrate covered with an active composite and placed between the metallic mold and the magnetic substrate.

**[0016]** In this invention, a variety of existing active composites can be applied by brushing or spraying directly onto the metallic mold. Alternatively, these active composites can be deposited on a substrate using established methods such as laminating, print screening, or ink jet printing for example, as described in EP 1177081 and DE 102006014900. The common feature of these composites is that they modify the appearance or the properties of the concrete surface when they enter in contact with freshly poured concrete. Examples of relevant composites include but are not limited to:

(1) retarder agents that retard the reaction of the cement with the water, thereby enabling the exposing of the concrete aggregates;
(2) composites that incorporates inks and dyes that can be transferred onto the concrete surface, thereby coloring the concrete surface;
(3) hydrophobic substances that get absorbed in and close the pores of the concrete surface, thereby protecting the concrete surface against humidity, pollution, and dirt; and
(4) composites that incorporate nano-titiaandioxidecistaline which have a photocatalystic effect, thereby both protecting the concrete surface and having a positive effect on pollution in the area around the concrete.

**[0017]** The present invention will now be explained in greater detail with reference to the figures, in which equal or similar parts are indicated by the same reference signs, and in which:

figure 1 diagrammatically shows a metallic mold and a magnetic substrate in which designs have been cut;
figure 2 illustrates an application of concrete retarder with the metallic mold and the magnetic substrate as shown in figure 1;
figure 3 illustrates an application of an intermediate carrier covered with color with the metallic mold and the magnetic substrate as shown in figure 1;
figure 4 diagrammatically shows a metallic mold and a magnetic substrate which has been laminated with a hydrophobic composite;
figure 5 diagrammatically shows a metallic mold and a magnetic substrate on which a colored design has been printed;
figure 6 diagrammatically shows a metallic mold and a magnetic substrate in which designs have been cut and on which a colored design has been printed; and figure 7 illustrates an application of concrete retarder with the metallic mold and the magnetic substrate as shown in figure 6.

**[0018]** Three examples of applications are described below to illustrate how the cut magnetic substrate used as a stencil can be employed to create different types of esthetic concrete surfaces.

*Application 1: Cut magnetic substrate against freshly poured concrete*

**[0019]** In this application, as shown in figure 1, a magnetic substrate 1 in which designs (rounds) have been cut and with a side containing a plastic-based material is positioned on a metallic mold 2. The concrete is then poured against the mold 2 covered with the magnetic substrate 1. Once the concrete has hardened, the mold 2 is extracted from the concrete 1. Due to its magnetic strength, the substrate 1 continues to adhere to the mold 2.

**[0020]** The parts of the hardened concrete surface that have been in contact with the substrate 1 are smooth, with extremely fine pores and virtually no cavity. In contrast, the parts of the hardened concrete surface that were in contact with the mold 2 (the round surfaces in figure 1) are rougher, with greater pores and more cavities. In addition, the parts of the concrete surface that were in direct contact with the mold 2 differ in height from the parts of the concrete surface that where in contact with the substrate 1. A relief between the two surfaces has appeared. Because of this relief and of the different appearance of the concrete surfaces, the designs cut in the substrate 1 become visible on the concrete surface. As implied in this application, membranes of different thicknesses can be employed to modify the deepness of relief visible on the concrete surface.

*Application 2: Cut magnetic substrate against mold sprayed with retarder*

**[0021]** In this application, as shown in figure 2, a magnetic substrate 1 with a side containing a plastic-based material, in which designs (rounds) have been cut, is positioned on a metallic mold 2 on which a concrete retarder 3 has been manually deposited. If selected properly, the substrate 1 has a magnetic force sufficient to fully adhere to the concrete mold 2 in spite of the layer of concrete retarder 3. As described in Application 1, the concrete is then poured, and the mold 2 extracted once the concrete has hardened. Afterwards, the concrete surface is washed with pressurized water. As a result, in the spaces where the concrete was in contact with the concrete retarder 3, the aggregates of the concrete are apparent. Therefore, the round designs cut in the substrate 1 become visible on the concrete surface due to the contrast between the washed out and the smooth surfaces of the concrete. This contrast is further accentuated by the difference in relief between the washed out and the smooth surfaces. In line with this application, other substances such as color composites can be deposited on the mold surfaces.

*Application 3: Cut magnetic substrate against substrate covered with color*

**[0022]** This application, as shown in figure 3, is based on the use of an intermediate carrier 4 on one side of which a composite containing color pigments has been deposited industrially by laminating or screen printing. This intermediate carrier 4 is placed against the concrete mold 2 and held in place due to the cut magnetic substrate 1 that is placed against it. The colored face of the intermediate carrier 4 is facing the magnetic side of the cut substrate 1. If selected properly, the cut substrate 1 has a magnetic force sufficient to fully adhere to the concrete mold 2 in spite of the intermediate carrier 4. As described in Application 1, the concrete is then poured, and the mold 2 extracted once the concrete has hardened. The pigments that were deposited on the intermediate carrier 4 color the concrete surfaces (the round designs in figure 3) that are in contact with that carrier 4. In contrast, the concrete surfaces that are contact with the magnetic substrate 1 are smooth and non-colored. As a result, colored designs become visible on the hardened concrete surface. In line with this application, other active composites such as concrete retarders can be deposited on the intermediate carrier 4.

**[0023]** A second approach to producing esthetic concrete surfaces with a magnetic substrate is based on depositing active substances directly on the magnetic substrate. The non-magnetic side of the substrate needs to be such that active substances can both adhere to it and be released when in contact with the freshly poured concrete. Plastic-based, paper-based, and silicone-based materials can be laminated onto the magnetic side of the substrate and can be covered with a variety of active composites. One advantage of plastic and silicone-based materials is that they stimulate an optimal curing of the concrete surface.

**[0024]** A variety of existing methods including, but not limited to, laminating, screen printing, and inkjet printing, can then be employed to deposit industrially the desired active composites on the plastic, cellulose-based, or silicone-based side of the substrate. A variety of active composites can be deposited on the non-magnetic side of the substrate. They include the same composites as those described in the approach above whereby the magnetic substrate is used as a stencil. A single active composite or several active composites can be deposited on the magnetic substrate. For instance, with techniques such as screen printing, it is possible to deposit colors next to retarders on the substrate.

**[0025]** The magnetic side of the substrate is placed against the concrete mold. Because of the perfect adherence of the magnetic substrate to the mold, the active substances that have been deposited on the substrate can be transferred consistently onto the concrete surface. The risk of marks of bubbles and other damages to the concrete surface usually associated with the use of cellulose-based transfer materials is virtually avoided due to the use of the magnetic substrate.

**[0026]** The two examples below illustrate how a magnetic substrate on which active composites are deposited industrially can be employed to create different types of esthetic concrete surfaces.

*Application 4: Hydrophobic composite laminated on substrate*

**[0027]** This application is based on the use of a magnetic substrate 1 with a side made of plastic. Through lamination, a composite containing a hydrophobic substance is deposited on the plastic side of the substrate 1. As shown in figure 4, the laminated substrate 1 is placed against the metallic mold 2. As described in Application 1, the concrete is then poured, and the mold 2 extracted once the concrete has hardened. The hydrophobic substance on the substrate 1 is such that it gets absorbed in the pores of the concrete during the concrete hardening process and closes these pores. As a result, the concrete surface becomes more resistant to pollution, humidity, and dirt, and therefore keeps longer the appearance of new concrete. In line with this application, other single active substances such as a retarder, a color, or nano-titiaandioxidecistaline can be applied to the concrete surface.

*Application 5: Colored design printed on magnetic substrate*

**[0028]** This application is based on the use of a magnetic substrate 1 with a side covered with a silicone-based material. One benefit of using a silicone-based material is that on the one hand the inks can be deposited on this material while on the other hand this material easily releases the printed inks under the suction force characteristic of the concrete forming process. Though inkjet printing, UV inks are deposited on the silicone-based material to represent a color photograph. UV inks are selected because they dry rapidly when placed in UV-based dryers, which enables the rapid printing of colored designs for example on rolls of the substrate 1. As shown in figure 5, the magnetic substrate 1 on which a colored design is printed is placed against the metallic mold 2. As described in Application 1, the concrete is then poured, and the mold 2 extracted once the concrete has hardened. The inks have then been absorbed into the concrete surface, which means that the photograph originally printed on the magnetic substrate 1 is now visible on the concrete surface, which shows for the rest no marks of folds or other defaults.

**[0029]** A third approach to producing esthetic concrete surfaces with a magnetic substrate consists in mixing the first and second approaches described above. Therefore, an active composite can first be deposited on the magnetic substrate which is then cut according to some design. This approach enables an optimal mix of esthetic surfaces produced in an industrial setting. This approach

is illustrated below with two examples.

*Application 6: Color design printed on cut magnetic substrate*

**[0030]** In this example, a colored design (a flower and grass) is printed on the substrate 1 according to the method described in Application 4. Then other designs (rounds) are press cut or laser cut into the substrate 1. As shown in figure 6, the substrate 1 is then applied against the metallic mold 2. As described in Application 1, the concrete is then poured, and the mold 2 extracted once the concrete has hardened. The hardened concrete then shows: (1) smooth surfaces covered with a colored design -the colored flower and grass-, (2) non-colored and rougher surfaces shaped according to the designs cut in the substrate 1 (rounds), (3) a relief between the colored and the non-colored surfaces. In line with this application, other active substances -such as retarders- can be deposited on the magnetic substrate 1.

*Application 7: Color design printed on cut magnetic substrate against mold covered with retarder*

**[0031]** As shown in figure 7, the same magnetic substrate 1 as in Application 6 is used in Application 7. However, in this application, the mold 2 is first sprayed with a concrete retarder 3 before the substrate 1 is placed against the mold 2. The concrete is then poured as described in previous applications. Once the concrete has hardened, the concrete surface is washed with water as explained in Application 2. The concrete element then shows the following surfaces: (1) smooth surfaces covered with a colored design -the colored flower and grass-, (2) non-colored and washed out surfaces shaped according to the designs cut in the substrate 1 (rounds), (3) a relief between the washed out and the colored surfaces. In line with this application, other active substances can be deposited on the magnetic substrate 1 and, directly or through the use of an intermediate carrier 4, on the metallic mold 2.

**[0032]** It will be clear to a person skilled in the art that the scope of the present invention is not limited to the examples discussed in the foregoing, but that several amendments and modifications thereof are possible without deviating from the scope of the present invention as defined in the attached claims. While the present invention has been illustrated and described in detail in the figures and the description, such illustration and description are to be considered illustrative or exemplary only, and not restrictive. The present invention is not limited to the disclosed embodiments.

**[0033]** Variations to the disclosed embodiments can be understood and effected by a person skilled in the art in practicing the claimed invention, from a study of the figures, the description and the attached claims. In the claims, the word "comprising" does not exclude other steps or elements, and the indefinite article "a" or "an" does not exclude a plurality. The mere fact that certain measures are recited in mutually different dependent claims does not indicate that a combination of these measures cannot be used to advantage. Any reference signs in the claims should not be construed as limiting the scope of the present invention.

## Claims

1. Method for manufacturing a concrete product having a colored, washed out, cured, engraved, or otherwise treated surface, wherein the concrete is poured horizontally or vertically using a metallic mold (2), and wherein a magnetic substrate (1) used alone or in combination with other active composites or substrates is placed against the mold (2) in order to obtain the desired concrete surface.

2. Method according to claim 1, wherein the substrate (1) is made of a magnetic layer on one side while the rest of the substrate (1) is made of another material.

3. Method according to claim 1 or 2, wherein an active composite is directly deposited on one face of the magnetic substrate (1), and wherein the magnetic substrate (1) is placed on one side directly against the mold (2) and on the other side against the freshly poured concrete.

4. Method according to claim 3, wherein the active composite is deposited on the substrate (1) with techniques including laminating, print screening and ink jet printing for example.

5. Method according to claim 1 or 2, wherein designs are cut in the substrate (1), and wherein the cut substrate (1) is placed on one side on top of another non-magnetic substrate (4) covered with an active composite and placed against the mold (2), and on the other side against the freshly poured concrete.

6. Method according to claim 1 or 2, wherein designs are cut in the substrate (1), and wherein the cut substrate (1) is placed on one side on top of an active substance (3) that has been deposited directly on the mold (2), and on the other side against the freshly poured concrete.

7. Method according to any of claims 1 to 4, wherein designs are cut in the substrate (1), and an active composite is deposited on one side of the substrate (1), and wherein the substrate (1) is placed directly against a metal mold (2) on one side and against the freshly poured concrete on the other side.

8. Method according to any of claims 1 to 4, wherein

designs are cut in the substrate (1), and an active composite is deposited on one side of the substrate (1), and wherein the substrate (1) is placed on one side on top of another non-magnetic substrate (4) covered with an active composite and placed against the mold (2), and on the other side against the freshly poured concrete.

**9.** Method according any of claims 1 to 4, wherein designs are cut in the substrate (1), and an active composite is deposited on one side of the substrate (1), and wherein the substrate (1) is placed on one side on top of an active substance (3) that has been deposited directly on the mold (2), and on the other side against the freshly poured concrete.

**10.** Method according to any of claims 1 to 9, wherein an active composite is used which incorporates at least one of a concrete retarding substance (3), a concrete coloring substance, a hydrophobic substance, a photocatalystic substance.

**11.** Method according to claim 10, wherein the active composite incorporates other substances that, upon contact with freshly poured concrete, modify the concrete surface.

**12.** Method according to claim 1 or 2, wherein designs are cut in the substrate (1) and the substrate (1) is placed directly against a metal mold (2) on one side and against the freshly poured concrete on the other side.

**13.** Method according to any of claims 1 to 12, wherein the substrate (1) is taken off the concrete surface at a minimum after the concrete mass has hardened.

**14.** Method according to any of claims 1 to 13, wherein pouring of the concrete takes place in the factory.

**15.** Method according to claims 1 to 13, wherein pouring of the concrete takes place in situ.

Fig. 1

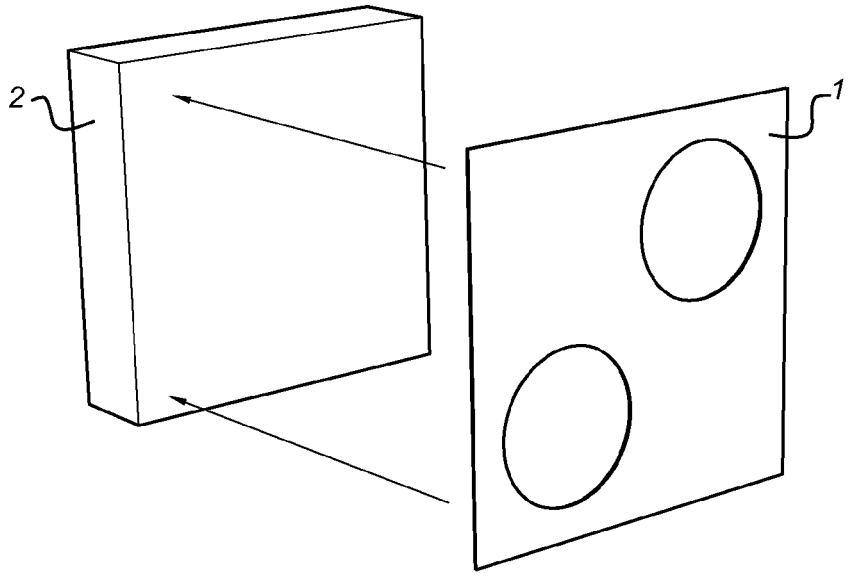



Fig. 2

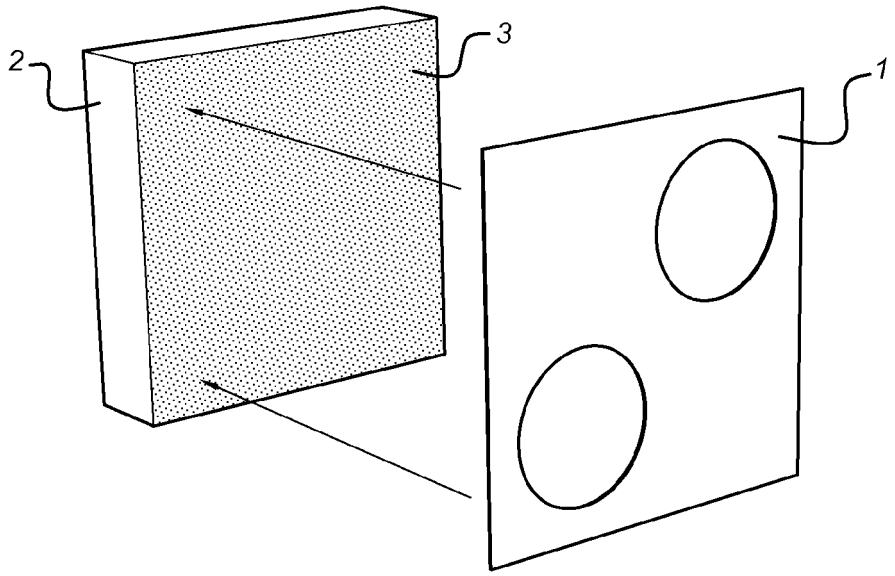


Fig. 3

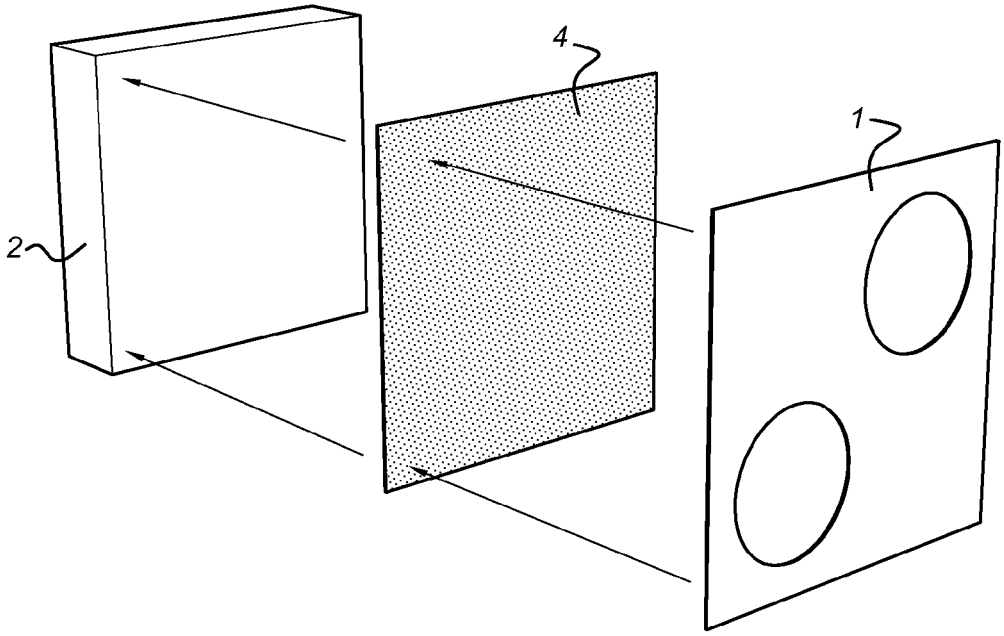



Fig. 4

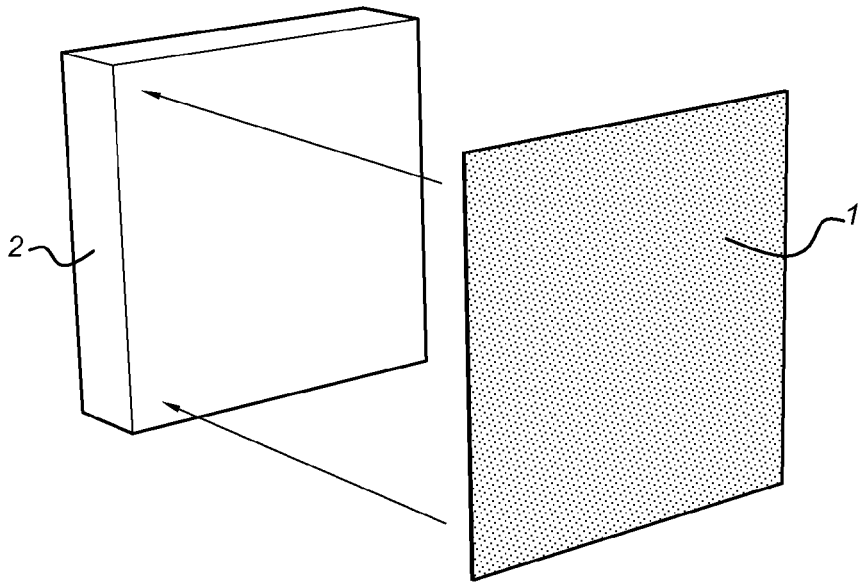


Fig. 5

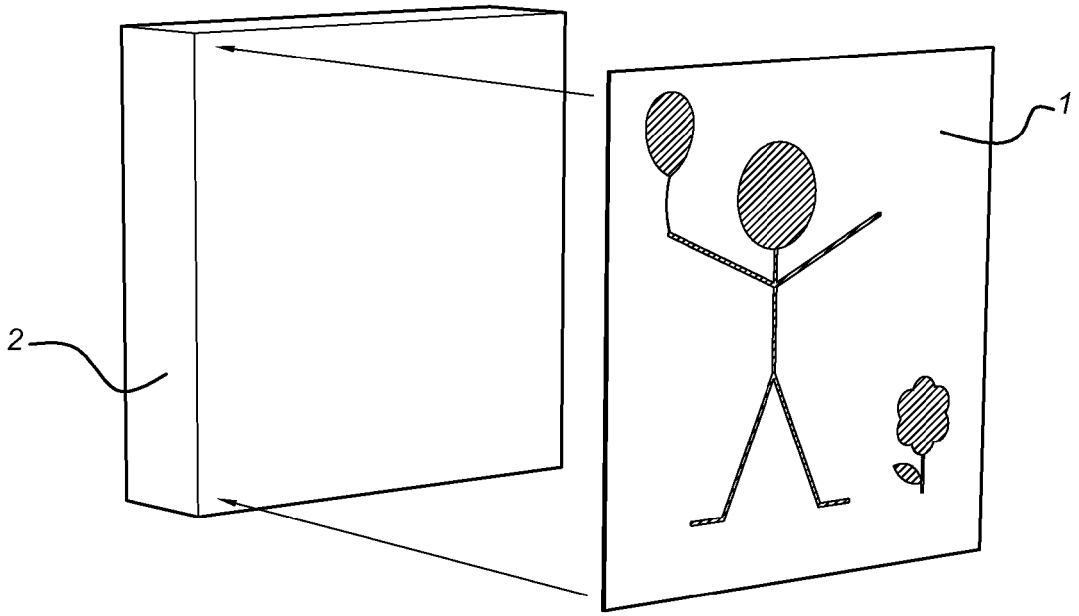



Fig. 6

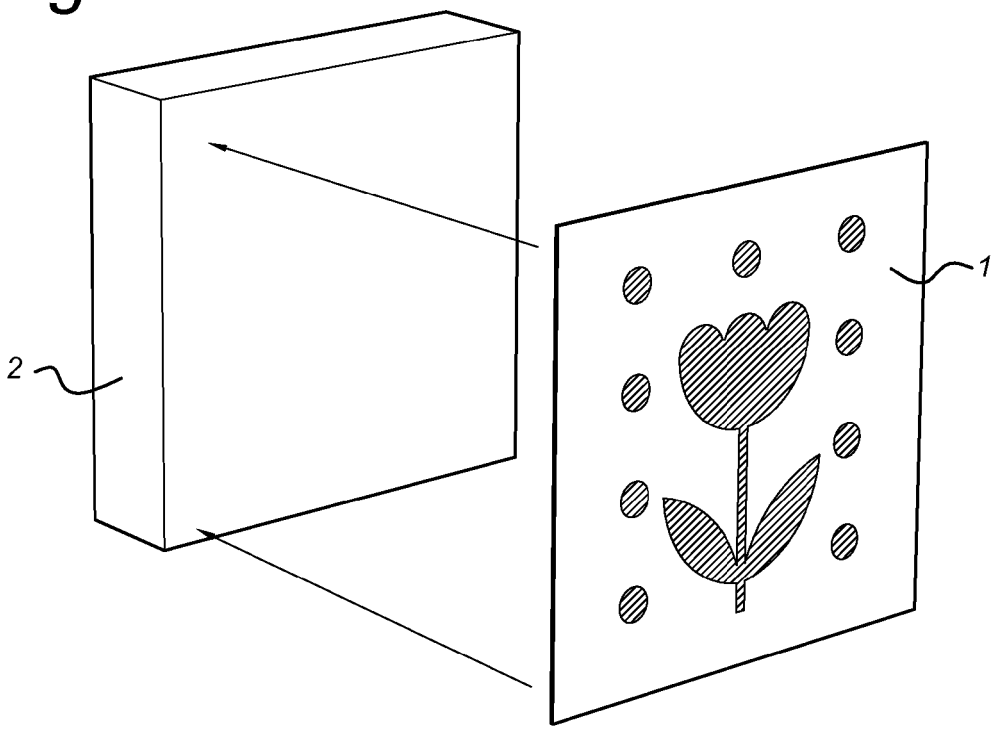
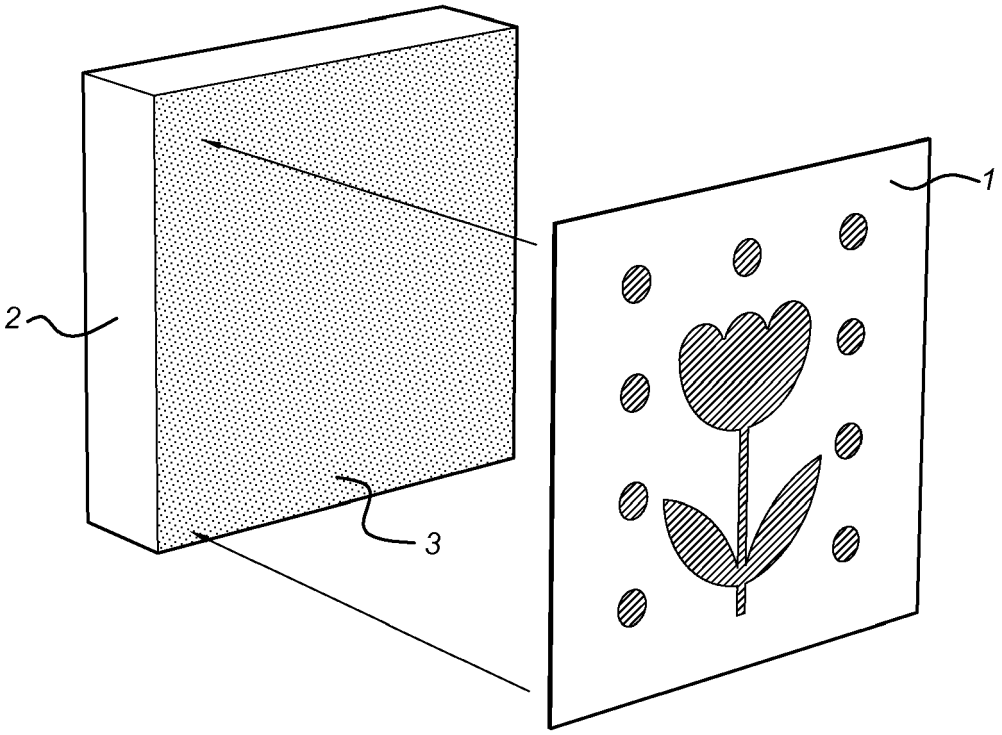


Fig. 7



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# EUROPEAN SEARCH REPORT

Application Number
EP 13 16 2900

## 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,D | JP 2005 297497 A (ASAHI CONCRETE WORKS) 27 October 2005 (2005-10-27) * abstract; figures 3,4 * | 1 | INV. B28B7/00 |
| X | FR 2 589 762 A1 (SAUVEPLANE FRANCOIS [FR]) 15 May 1987 (1987-05-15) * claims 1,2; figure 1 * | 1 | |
| A,D | JP 2000 135709 A (NAT HOUSE IND) 16 May 2000 (2000-05-16) * abstract; figures 1-3 * | 1 | |
| A | US 2009/173871 A1 (STOTT GALE J [US] ET AL) 9 July 2009 (2009-07-09) * * | 1 | |
| | | | TECHNICAL FIELDS SEARCHED (IPC) |
| | | | B28B |

The present search report has been drawn up for all claims

| Place of search | Date of completion of the search | Examiner |
|---|---|---|
| The Hague | 21 November 2013 | Boone, John |

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