

Description

This invention relates to concrete forms which yield patterned or very smooth concrete surfaces and to a process for making a concrete form used in making a patterned concrete surface.

US-A-4,730,805 discloses a form for forming concrete which utilizes a support and at least two layers of fabric over the support. The support can have lugs to space the fabric from the support and the fabric layers and the lugs assist in draining water away from the curing concrete. The support may have drainage holes for removal of excess water and air. The fabric is bonded to the support and is stiff and immovable relative to the support.

US-A-4,856,754 discloses a concrete form using double-woven fabrics on a support plate with holes to provide water drainage. One woven fabric is adhered to the plate and the other woven fabric is sewn to the first.

The invention as claimed in claims 1, 8 and 9 solves the problem of how to make a concrete form for the production of concrete with a high quality surface.

The concrete form of claim 1 is especially suitable for making concrete with a patterned surface and has a grid with interconnected spacing members which form holes in the grid and at least a portion of which rest against the support. The concrete form of claim 9 is especially suitable for making concrete with a very smooth surface and either comprises a grid having very small holes or the grid is omitted.

Preferred embodiments of the invention are the subject matter of the subclaims.

Examples of the invention are described in detail in the accompanying drawings, in which

Fig. 1 is a representation of the form of this invention, in partial section, with grid and porous fabric.

Fig. 2 is a cross section of the form from Fig. 1.

Fig. 3 is a cross section of a form having the porous fabric under uniform tension over the grid.

Concrete which is cast using a concrete form takes the surface of the form. The wet concrete is poured into or against the concrete form and, upon setting and removal of the form, the newly-exposed concrete surface is a reverse impression of the inner surface of the form. In the case of wooden forms, the concrete takes on the appearance of wood grain; and in the case of forms involving seamed form members, the concrete shows any seams which have not been masked.

Air is often added to a concrete mix and water is often added in excess to that amount required for hydration. Such air and water are useful to render the mix flowable and to facilitate handling and pouring. The water, if left undrained, results in concrete having a weakened surface and, the air, if not removed, results in surface pores as large as 0.1 to 3 centimeters, which pores leave an uneven surface open to the ef-

fects of dirt and erosion by freeze-thaw cycles of water.

It is often desirable to achieve a smooth, unblemished, concrete finish; and it would often be even more desirable to achieve a patterned surface with some aesthetic appeal. Finishing or smoothing operations on concrete surfaces are difficult and expensive; and patterning requires substantial time and effort. It has now been discovered that smooth and patterned concrete surfaces can be made without finishing operations. Moreover, it has been discovered that such smooth and patterned surfaces have qualities which are improved over concrete surfaces of the prior art.

This invention results in concrete having a surface with patterns constituted by convexities or raised areas. In a special embodiment, it also results in concrete with a completely smooth surface. This invention comprises a concrete form which utilizes a support, a grid, and a porous fabric.

Referring to Fig. 1, concrete form 10 includes support 11 which can be of any material which has been traditionally used as a material for concrete forms. Support 11 must have enough strength to support the weight of the wet concrete before curing. The support can be of wood or it can be of metal or plastic; and, while it should be relatively smooth, for use in making concrete with a patterned surface, the smoothness is not critical.

Grid 12 can be of any noncompressible material such as wire screening or plastic netting. The grid can have holes of any regular or irregular shape or size, defined by interconnecting spacing members 14 and 15. Any shape -- round, square, triangular, or irregular -- can be used; and it is preferable that the area of the holes should be greater than about 0.25 square centimeters and less than about 2500 square centimeters. Different sizes of holes can be used in a given application for any desired purpose. The area of the holes can be large enough that there is opportunity for fabric 13 to be pressed through the holes by wet concrete to contact support 11, or the holes can be so small and fabric 13 can be drawn so taut that the fabric is not deformed enough by pressure of the concrete mix to reach the surface of support 11. The grid 12 should have a thickness of from about 0.2 to 50 millimeters. The limits of the thickness are a matter of convenience and practicality. The thickness should be great enough to permit flow of water and air from the body of wet concrete and not so thick that there is excess distance between the support and porous fabric 13 juxtaposed with grid 12. Grid 12 can be made in such a way that interconnecting spacing members 14 and 15, either lie in the same plane, or lie on top of one another by being woven or not. It is preferred that the grid be composed of interconnected spacing members in which crossing elements are woven such that the crossing elements lie atop one

another at points of intersection.

Porous fabric 13 can be woven or nonwoven and can be made from natural or synthetic materials. The preferred material is thermo-bonded polyolefin fabric having a basis weight of about 20 to 600 grams per square meter. Pores in the fabric should be at least 10 microns and less than about 300 microns, that is, of a size to permit passage of water and air but to prevent passage of substantially all solid particles in a concrete mix. It is preferred that the fabric have pore sizes from about 15 to 200 microns in diameter. The fabric can be of any convenient thickness; but it must be adequate to withstand the high pressures brought against it by the wet concrete. It is preferred that the fabric should be at least 0.5 millimeter thick.

Referring to Fig. 2, concrete form 10 is made by affixing grid 12 against support 11 which has been established to have the shape desired in a final concrete article, and then juxtaposing porous fabric 13 with the grid. The grid 12 need not be closely affixed to support 11 but it must be affixed to the degree required to assure that it will remain in place during use of the form. Likewise, porous fabric 13 need not be closely affixed to grid 12; but merely juxtaposed therewith. For forms wherein the intended concrete article has a patterned surface, the fabric 13 can be effectively juxtaposed by use of staples or small nails placed periodically at relatively large distances at the edge or backside of the form. It has been determined that the fabric should not be closely attached to the grid. By the word "juxtaposed" is meant that fabric 13 should be placed against grid 12; but that the surface of one should not be bound to the surface of the other.

As porous fabric 13 is juxtaposed with grid 12, both against support 11; and, as concrete is poured into the form, the concrete presses porous fabric 13 into the holes in grid 12 and against support 11, causing depressions 16 along with channels 17. As a result of pressing into the fabric 13 to make depressions 16, the concrete will form one convexity for each depression 16. When the grid is made in such a way that the depressions form a pattern of any kind, whether regular or irregular, the concrete will form a mating pattern of convexities. Water and air will pass through porous fabric 13, into channels 17, and away from the concrete.

As one particular embodiment, and looking to Fig. 3 for detail, when porous fabric 13 is held with continuous, uniform, force such that it is stretched uniformly over grid 12, a completely smooth concrete surface can be made. Making a completely smooth concrete surface is difficult due to the difficulty in holding fabric 13 without wrinkles during the concrete pouring process. This is because support 11 and fabric 13 may shrink or expand due to changes in temperature or humidity. It has been determined that as little as 1/2% of shrinkage or expansion in either the support or the fabric is enough to cause wrinkles in

the fabric and consequent irregularities in the concrete surface. It should be pointed out that, in the case where patterned concrete surfaces are being made by this invention, the effects of shrinkage and expansion are taken up in the depressions. However, when completely smooth concrete surfaces are desired, the grid must be so small that no depressions form. That is, for completely smooth concrete surfaces, the grid should have interconnected spacing members forming holes less than 0.25 cm². Continuous, uniform, force is applied to fabric 13 by connecting elastic or resilient members 18 to edges of fabric 13 by means of grippers 19. Members 18 can be springs or they can be made from rubber or some other elastomer. Members 18 are brought over risers 20 and attached to anchor 21. Of course, any arrangement of members is acceptable which results in tension applied to fabric 13. A multitude of members 18 can be attached to fabric 13, thereby assuring continuous, uniform, tension over the expanse of fabric. It has been determined that a tension of 0.2 to 3.0 kg/lineal cm is adequate for the practice of this invention. It should be understood that the tension can be applied in any manner which is effective to yield the proper result.

When a completely smooth support 11 is used, there is no need for any grid in the making of concrete with a completely smooth surface, so long as fabric 13 is stretched over the support at a uniform tension, as described above.

As an added benefit, the form of this invention can be dismantled sooner after pouring the concrete than forms of the prior art. A post-curing of concrete using the form of this invention can be accomplished by removing the support and grid after only a day or two and leaving the fabric on the concrete to prevent premature drying. In fact, the fabric can be sprayed with water to enhance the post-curing treatment.

Description of the Preferred Embodiments

As a test, a wooden form was made using small pieces of wood for a panel 2 by 2.5 meters. A concrete panel made using that form had an uneven surface appearance which mirrored the grain and seams of the wood; and the concrete surface included small cavities caused by air bubbles which could not escape from the form. Moreover, before each subsequent use, the form had to be repaired, cleaned, and sprayed with release oil.

As a practice of the present invention, the same form was used as the support; and a grid with holes 15 by 15 centimeters was attached to the support by means of small nails. Porous fabric was placed over the grid by means of elastic members as shown in Fig. 3. The tension on the fabric was about 0.05 kg/lineal centimeter. The porous fabric was a thermo-bonded polypropylene sheet material with a basis weight of

about 290 grams/square meter sold under the trade-name "Typar" by Du Pont de Nemours S.A., Luxembourg.

Concrete made using the form of this invention exhibited a uniform dark color and no surface porosity. Concrete made using the wood form only, without the benefit of this invention, exhibited a nonuniform lighter color and easily visible pores or surface cavities ranging in size from 1 to 15 millimeters or more. The surface of the concrete made using the form of this invention was determined to have a hardness 30% higher than the surface of the concrete made using the wood form. The surface hardness was measured by means of a Schmidt-Hammer tester.

The surface of the concrete using the form of this invention exhibited a regular pattern of slight bulges the same size as the holes of the grid.

Concrete walls made in the same manner, with the same form and with the same porous fabric, but with grids having holes of 9 by 9, 5 by 5, and 2 by 2 centimeters, gave the same high quality concrete with the same high quality surfaces as were made in the test first described above.

When the same wood support was used with a grid of 5 by 5 centimeters and a thermo-bonded polypropylene fabric of basis weight 136 grams/square meter, the same high quality concrete was made with the same high quality surface, except that the depressions for the fabric were more pronounced which resulted in bulges (convexities) in the surface of the concrete which were more pronounced.

A grid with holes of 5 by 5 millimeters was used in the form as described above with the fabric having a basis weight of 136 grams/square meter and with a tension of 1 kg/lineal centimeter applied as shown in Fig. 3. The holes in the grid were small enough and the tension was continuous and uniform and great enough that the surface of the resulting concrete was almost completely smooth, with only a barely detectable pattern from the grid.

In a further test, fabric having a basis weight of 290 grams/square meter was used, and was fixed on a flat, smooth plywood form without any grid, but with 1.5 kg/lineal centimeter tension applied in both directions.

The resulting concrete was absolutely flat, free of fold marks and of the same quality described above.

Another test was conducted using the same conditions as in the above test; but, on the surface of fabric to be against the concrete, a transferable printing was applied using an ink with a base of glycol ethers and alcohols. The ink dissolved in the concrete and the printing was transferred from the fabric to the concrete at the same time that the concrete was made. This test shows the preparation of fully acceptable decorative concrete panels made in a single step, instead of making the panel, finishing the concrete, and then painting it.

Claims

1. A concrete form (10) for making a patterned surface comprising:
 - a support (11);
 - a grid (12), having interconnected spacing members (14,15) which form holes in the grid (12) and at least a portion of which rest against the support (11),
 - a porous fabric (13) adjacent to the grid (12) and set apart from the support (11) by the grid (12);
 - characterized
 - in that the holes of the grid (12) have an individual area of at least 0.25 cm² to create the patterned concrete surface;
 - in that the porous fabric (13) is juxtaposed with, but not attached to, the grid (12) and
 - in that fabric stretching means (18 to 21) are provided to continuously stretch the porous fabric (13) uniformly over the grid (12) throughout the concrete making process.
2. The concrete form of claim 1 wherein the holes of the grid (12) have an individual area of less than 2500 cm².
3. The concrete form of claim 1 wherein the grid has a thickness of from 0.2 to 15 millimeters.
4. The concrete form of claim 1 wherein the porous fabric (13) is nonwoven.
5. The concrete form of claim 4 wherein the nonwoven fabric (13) has pores of a size to permit passage of water and air but to prevent passage of substantially all solid particles in a concrete mix.
6. The concrete form of claim 4 wherein the nonwoven fabric (13) has pores 15 to 200 microns in average diameter.
7. The concrete form of claim 4 wherein the nonwoven fabric (13) is thermo-bonded polyolefin.
8. A process for making a concrete form (10) used in making a patterned concrete surface comprising the steps of:
 - establishing a support (11) having the shape desired for a concrete article to be made;
 - affixing a grid (12) to the support (11) wherein the grid (12) has interconnected spacing members (14,15) which form holes in the grid (12) and at least a portion of which rest against the support (11);
 - providing a porous fabric (13) adjacent to the grid (12);



about 290 grams/square meter sold under the trade-name "Tytar" by Du Pont de Nemours S.A., Luxembourg.

Concrete made using the form of this invention exhibited a uniform dark color and no surface porosity. Concrete made using the wood form only, without the benefit of this invention, exhibited a nonuniform lighter color and easily visible pores or surface cavities ranging in size from 1 to 15 millimeters or more. The surface of the concrete made using the form of this invention was determined to have a hardness 30% higher than the surface of the concrete made using the wood form. The surface hardness was measured by means of a Schmidt-Hammer tester.

The surface of the concrete using the form of this invention exhibited a regular pattern of slight bulges the same size as the holes of the grid.

Concrete walls made in the same manner, with the same form and with the same porous fabric, but with grids having holes of 9 by 9, 5 by 5, and 2 by 2 centimeters, gave the same high quality concrete with the same high quality surfaces as were made in the test first described above.

When the same wood support was used with a grid of 5 by 5 centimeters and a thermo-bonded polypropylene fabric of basis weight 136 grams/square meter, the same high quality concrete was made with the same high quality surface, except that the depressions for the fabric were more pronounced which resulted in bulges (convexities) in the surface of the concrete which were more pronounced.

A grid with holes of 5 by 5 millimeters was used in the form as described above with the fabric having a basis weight of 136 grams/square meter and with a tension of 1 kg/lineal centimeter applied as shown in Fig. 3. The holes in the grid were small enough and the tension was continuous and uniform and great enough that the surface of the resulting concrete was almost completely smooth, with only a barely detectable pattern from the grid.

In a further test, fabric having a basis weight of 290 grams/square meter was used, and was fixed on a flat, smooth plywood form without any grid, but with 1.5 kg/lineal centimeter tension applied in both directions.

The resulting concrete was absolutely flat, free of fold marks and of the same quality described above.

Another test was conducted using the same conditions as in the above test; but, on the surface of fabric to be against the concrete, a transferable printing was applied using an ink with a base of glycol ethers and alcohols. The ink dissolved in the concrete and the printing was transferred from the fabric to the concrete at the same time that the concrete was made. This test shows the preparation of fully acceptable decorative concrete panels made in a single step, instead of making the panel, finishing the concrete, and then painting it.

Claims

1. A concrete form (10) for making a patterned surface comprising:
 - a support (11);
 - a grid (12), having interconnected spacing members (14,15) which form holes in the grid (12) and at least a portion of which rest against the support (11),
 - a porous fabric (13) adjacent to the grid (12) and set apart from the support (11) by the grid (12);
 - characterized
 - in that the holes of the grid (12) have an individual area of at least 0.25 cm² to create the patterned concrete surface;
 - in that the porous fabric (13) is juxtaposed with, but not attached to, the grid (12) and
 - in that fabric stretching means (18 to 21) are provided to continuously stretch the porous fabric (13) uniformly over the grid (12) throughout the concrete making process.
2. The concrete form of claim 1 wherein the holes of the grid (12) have an individual area of less than 2500 cm².
3. The concrete form of claim 1 wherein the grid has a thickness of from 0.2 to 15 millimeters.
4. The concrete form of claim 1 wherein the porous fabric (13) is nonwoven.
5. The concrete form of claim 4 wherein the nonwoven fabric (13) has pores of a size to permit passage of water and air but to prevent passage of substantially all solid particles in a concrete mix.
6. The concrete form of claim 4 wherein the nonwoven fabric (13) has pores 15 to 200 microns in average diameter.
7. The concrete form of claim 4 wherein the nonwoven fabric (13) is thermo-bonded polyolefin.
8. A process for making a concrete form (10) used in making a patterned concrete surface comprising the steps of:
 - establishing a support (11) having the shape desired for a concrete article to be made;
 - affixing a grid (12) to the support (11) wherein the grid (12) has interconnected spacing members (14,15) which form holes in the grid (12) and at least a portion of which rest against the support (11);
 - providing a porous fabric (13) adjacent to the grid (12);



characterized
in that the holes have an individual area of
at least 0.25 cm² to create the patterned concrete
surface;

in that the porous fabric is juxtaposed but
not attached to the grid (12) and

in that the porous fabric (13) is stretched
continuously and uniformly over the grid (12)
throughout the concrete making process.

9. A concrete form (10) for making concrete having
a smooth surface comprising
a support (11) with a smooth surface and
a porous fabric (13) adjacent to the
smooth surface of the support (11);

characterized by

the porous fabric (13) being juxtaposed
with but not attached to the smooth surface of
the support (11); and

fabric stretching means (18 to 21) by which
the porous fabric (13) is continuously stretched
over the support (11) at a uniform tension of 0.2
to 3 kg/lineal cm throughout the concrete making
process.

10. The concrete form of claim 9 wherein there is a
grid (12) positioned between the support (11) and
the porous fabric (13) and wherein the grid (12)
has interconnected spacing members (14,15)
forming holes in the grid (12) with an individual
area of less than 0.25 cm².

Patentansprüche

1. Betonschalung (10) zur Herstellung einer gemusterten Oberfläche, mit
einer Halterung (11);
einem Gitter (12) mit untereinander verbundenen Abstandselementen (14,15), die Leerräume in dem Gitter (12) bilden und von denen sich wenigstens ein Teil an der Halterung (11) abstützt;
einer porösen Bahn (13), die an dem Gitter (12) anliegt und durch das Gitter (12) von der Halterung (11) getrennt wird;
dadurch gekennzeichnet,
daß die Leerräume des Gitters (12) einzelne Flächen von wenigstens 0,25 cm² aufweisen, um die gemusterte Betonoberfläche zu erzeugen;
daß die poröse Bahn (13) an dem Gitter (12) anliegt, jedoch nicht daran befestigt ist und
daß Bahnstreckeinrichtungen (18 bis 21) vorgesehen sind, um die poröse Bahn (13) kontinuierlich und gleichförmig über das Gitter (12) während des Betonherstellungsvorganges zu strecken.

2. Betonschalung nach Anspruch 1, wobei die Leerräume des Gitters (12) einzelne Flächen von weniger als 2500 cm² haben.

3. Betonschalung nach Anspruch 1, wobei das Gitter eine Dicke von 0,2 bis 15 Millimeter hat.

4. Betonschalung nach Anspruch 1, wobei die poröse Bahn (13) ein Vliesstoff ist.

5. Betonschalung nach Anspruch 4, wobei die Vliesstoffbahn (13) Poren einer Größe hat, die den Durchtritt von Wasser und Luft ermöglichen, jedoch den Durchtritt von im wesentlichen allen Feststoffteilchen in einer Betonmischung verhindern.

6. Betonschalung nach Anspruch 4, wobei die Vliesstoffbahn (13) Poren mit einem Durchschnittsdurchmesser von 15 bis 200 Mikrometer hat.

7. Betonschalung nach Anspruch 4, wobei die Vliesstoffbahn (13) thermogebundenes Polyolefin ist.

8. Verfahren zur Herstellung einer Betonschalung (10) zur Verwendung bei der Herstellung einer gemusterten Betonoberfläche, indem
eine Halterung (11) eingerichtet wird, die die gewünschte Form eines herzustellenden Beton-Gegenstandes hat;

ein Gitter (12) an der Halterung (10) befestigt wird, wobei das Gitter (12) untereinander verbundene Abstandselemente (14,15) aufweist, die Leerräume in dem Gitter (12) bilden und von denen sich wenigstens ein Teil gegen die Halterung (11) abstützt;

eine poröse Bahn (13) bei dem Gitter (12) vorgesehen wird;

dadurch gekennzeichnet,

daß die Leerräume einzelne Flächen von wenigstens 0,25 cm² haben, um die gemusterte Betonoberfläche zu erzeugen;

daß die poröse Bahn an dem Gitter (12) anliegt, jedoch nicht daran befestigt ist und

daß die poröse Bahn (13) während des Betonherstellungsvorganges kontinuierlich und gleichförmig über das Gitter (12) gestreckt wird.

9. Betonschalung (10) zur Herstellung von Beton mit einer glatten Oberfläche, mit
einer Halterung (11), die eine glatte Oberfläche hat, und
einer porösen Bahn (13) an der glatten Oberfläche der Halterung (11),
gekennzeichnet
dadurch, daß die poröse Bahn (13) an der Halterung (11) anliegt, jedoch nicht an ihr befestigt ist und



durch Bahnstreckeinrichtungen (18 bis 21), durch die die poröse Bahn (13) während des Betonherstellungsvorgangs kontinuierlich mit einer gleichförmigen Spannung von 0,2 bis 3 N/Längen-Zentimeter über die Halterung (11) gestreckt wird.

10. Betonschalung nach Anspruch 9,

wobei ein Gitter (12) zwischen der Halterung (11) und der porösen Bahn (13) angeordnet ist und wobei das Gitter (12) untereinander verbundene Abstandselemente (14, 15) aufweist, die Leerräume in dem Gitter (12) mit einzelnen Flächen von weniger als 0,25 cm² bilden.

Revendications

1. Coffrage pour béton (10) servant à produire une surface à motifs, comprenant:

- un support (11);
- une grille (12) présentant des organes d'espacement (14, 15) interconnectés, qui forment des trous dans la grille (12) et dont au moins une partie repose contre le support (11),
- un tissu poreux (13) adjacent à la grille (12) et écarté du support (11), par la grille (12);

caractérisé:

- en ce que les trous de la grille (12) présentent une aire individuelle inférieure à 0,25 cm² pour produire la surface de béton à motifs;
- en ce que le tissu poreux (13) est juxtaposé sur mais non-fixé à la grille (12) et
- en ce que des moyens d'étirement de tissu (18 à 21) sont prévus pour étirer de manière continue et uniforme le tissu poreux (13) sur la grille (12), durant tout le procédé de fabrication de béton.

2. Coffrage pour béton selon la revendication 1, dans lequel les trous de la grille (12) présentent une aire individuelle inférieure à 2500 cm².

3. Coffrage pour béton selon la revendication 1, dans lequel la grille présente une épaisseur allant de 0,2 à 15 mm.

4. Coffrage pour béton selon la revendication 1, dans lequel le tissu poreux (13) n'est pas tissé.

5. Coffrage pour béton selon la revendication 4, dans lequel le tissu non-tissé (13) présente des pores dotés d'une taille suffisante pour permettre le passage de l'eau et de l'air, mais qui empêche le passage de pratiquement toutes les particules solides présentes dans un mélange de béton.

6. Coffrage pour béton selon la revendication 4, dans lequel le tissu non-tissé (13) présente des pores dotés d'un diamètre moyen allant de 15 à 200 microns.

7. Coffrage pour béton selon la revendication 4, dans lequel le tissu non-tissé (13) est constitué de polyoléfine liée thermiquement.

8. Procédé de fabrication d'un coffrage pour béton (10) utilisé dans la fabrication d'une surface de béton à motifs, comprenant les étapes de:

- établissement d'un support (11) présentant la forme souhaitée, pour l'article en béton à produire;
- fixation d'une grille (12) au support (11), dans lequel la grille (12) présente des organes d'espacement (14, 15) interconnectés qui forment des trous dans la grille (12) et dont au moins une partie repose contre le support (11);
- disposition d'un tissu poreux (13) de manière adjacente à la grille (12);

caractérisé:

- en ce que les trous présentent une aire individuelle d'au moins 0,25 cm², pour produire la surface de béton à motifs;
- en ce que le tissu poreux est juxtaposé sur mais non-fixé à la grille (12) et
- en ce que le tissu poreux (13) est étiré de manière continue et uniforme sur la grille (12), durant tout le procédé de fabrication de béton.

9. Coffrage pour béton (10) servant à fabriquer du béton présentant une surface lisse, comprenant:

- un support (11) doté d'une surface lisse; et
- un tissu poreux (13) adjacent à la surface lisse du support (11);

caractérisé par:

- le tissu poreux (13), qui est juxtaposé sur mais non-fixé sur la surface lisse du support (11); et
- des moyens d'étirement de tissu (18 à 21), grâce auxquels le tissu poreux (13) est étiré de manière continue sur le support (11), selon une tension uniforme allant de 0,2 à 3 kg/cm linéaire, durant tout le procédé de fabrication de béton.

10. Coffrage pour béton selon la revendication 9, dans lequel il existe une grille (12) placée entre le support (11) et le tissu poreux (13) et dans lequel la grille (12) présente des organes d'espacement (14, 15) interconnectés formant des trous dans la grille (12), ces trous étant dotés d'une aire individuelle inférieure à 0,25 cm².