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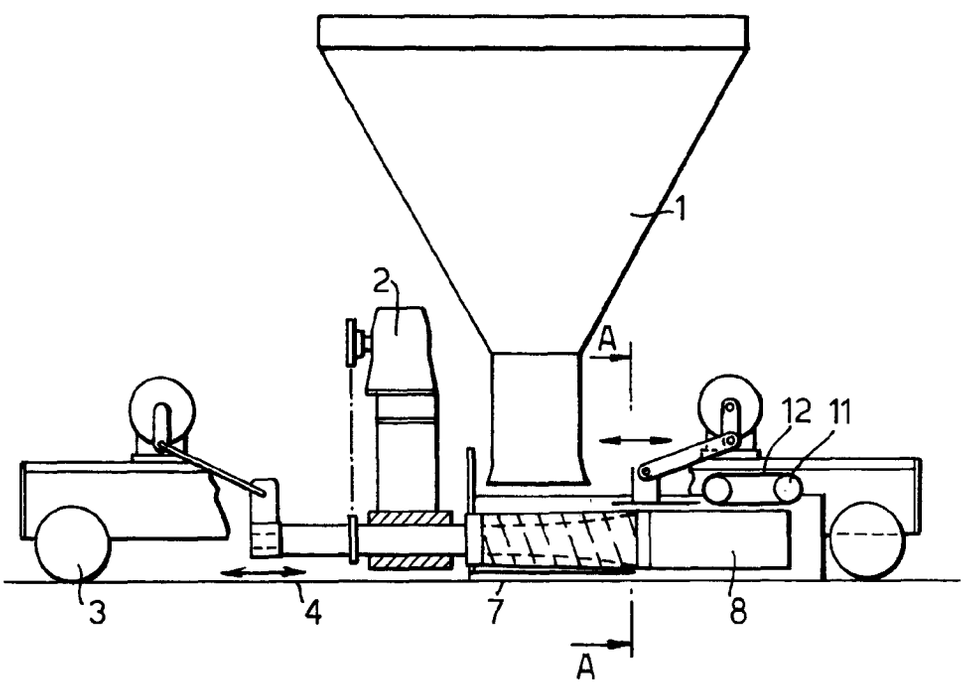
(54) Method and apparatus for casting concrete products

(57) A method and apparatus for casting concrete products by means of continuous slide casting so that concrete is extruded onto a bed (4), into a space between the bed and a mold, by means of a feeding member or members of a slide casting device travelling along the bed, the mass is compacted, and recesses are pressed onto the surface of the product by means of a roller and/or an endless belt (12) provided with protrusions. The recesses are at least partly discontinuous in the direction of the casting, and they are pressed into the upper surface of the slab at the latest during the compacting implemented following the feeding member or members, before the mix has been fully compacted.

Fig.1.



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Description

This invention concerns a method for casting concrete products by means of continuous slide casting so that concrete mix is extruded onto a bed, into a space between the bed and a mold, by means of a feeding member or members of a slide casting device travelling along the bed, the mix is compacted, and recesses are pressed into the surface of the product by means of a roller and/or endless belt provided with protrusions, said recesses being at least partly discontinuous in the direction of the casting. The invention also concerns a slide casting apparatus for casting concrete products, the surface of said products being provided with recesses, whereby said apparatus comprises a mold consisting of a cover portion and side walls, a feeding container and at least one feeding member for feeding concrete into the mold, at least one compacting member and a driving mechanism for driving the feeding and compacting members and for transporting the slide casting apparatus along the bed, whereby at least one wall or one portion or extension of a wall of the mold is formed by a roller supported on a shaft transversal to the travelling direction of the apparatus and/or by an endless belt going around transversal shafts, the outer surface of the roller or belt being provided with protrusions that are at least partly discontinuous in the direction of the casting.

With concrete products manufactured by slide casting methods known in the art, the surface is usually rather smooth. And, the smoothness of the surface is a desirable feature in general when the product to be cast functions as a visible part of a construction. However, in the construction technology constructions are often used, in which an entity is built up by an element manufactured in a factory and by a portion to be joined to it and produced on the site.

The desired functioning of this kind of concrete constructions requires that the bond between the element and the portion manufactured on the site is as firm as possible. For ensuring that, it is preferable to produce dowel patterns, in other words recesses into the surface of the element. These recesses are then filled by the portion to be cast on the site, that grips to the element manufactured in the factory. In order to prevent the mutual sliding of the parts of the construction, the patterns must be discontinuous as well parallel to the direction of the casting and in the transverse direction thereto, e. g. square or rectangular recesses. Also continuous transversal recesses can be used. A suitable depth of the dowels is e.g. from 1 to 20 mm.

One concrete product, in which the dowels are especially important, is the so called shell slab. The shell slab acts as a mold, onto which a concrete layer will be cast, the thickness of the layer corresponding to the required total thickness of the concrete slab. The shell slab remains as a part of the construction and the load bearing capacity requires a strong bond between the different portions. When using a hollow-core slab as a joint construction, the dowels are of the same importance.

Earlier the required dowel recesses have been made in general so that the product has not been cast by slide casting but cast into a stationary mold, the bottom of which is provided with protrusions. The recesses in the lower surface of the slab are formed by these protrusions. One drawback of this method is, however, that the other surface of the slab, that is the upper surface of it during the casting must be separately smoothened in order to make the visible surface of the slab smooth. This means additional work when casting the slab.

Patent publication FI 61652 discloses also a device by means of which recesses are formed onto the sides of the slab by using two successive wheels, by the teeth of which recesses are pressed into the side of the slab. As the concrete is compressed between these two wheels, the second wheel must be slightly smaller than the first one, and, additionally, the speeds of the wheels must be synchronized by means of a special slide coupling taking into account the changed dimensions of the slab. Thus, the device is rather complicated and difficult to make function properly under all circumstances.

Publication EP 592 183 describes a method and a device, by which the compacted surface layer is first fully compacted but, prior to the setting, is replasticized again by vibrating, and recesses are pressed into the replasticized surface by means of a roller or endless belt provided with protrusions.

The method in accordance with the present invention is characterized in that the discontinuous recesses are pressed into the upper surface of the product at the latest during the compacting implemented following the feeding member or members, before the mix has been fully compacted. The apparatus in accordance with the present invention is characterized in that the roller and/or belt provided with protrusions is arranged against the upper surface of the product and supported onto a horizontal shaft or around horizontal rollers, and forms a compacting upper wall of the mold or a portion or extension of a compacting upper wall of the mold, and that the roller and/or belt is adapted to fully compact the mix for the first time.

In this connection, "fully compacting" means that after that, the concrete mix requires no further mechanical compacting.

The method in accordance with the invention is applicable when forming dowel recesses onto the upper surface of a concrete slab being horizontal during the casting. Thereby a smooth steel plate can be used as the lower surface of the mold and the visible surface of the slab will be totally smooth.

According to the invention, the dowel recesses are formed by pressing, that is without removing any material. The slide casting method requires the use of rather dry concrete mix, because the product must have a stable form after the mold. Pressing of separate, successive recesses requires that the concrete mass is displaced by the recesses and the mix in the surface is

pushed between the successive recesses. This procedure might break the cast product, in case the surface portion thereof has already been compacted. Especially it has been difficult to press recesses into the upper surface of a hollow-core slab, because the hollow-core slab can in this phase easily collapse and the mass of the upper surface falls inside the hollow core when the mass is pressed from above. For this reason, in the method of the present invention, the right timing is essential for the pressing of the recesses.

In addition to forming dowels into a shell slab, the invention is also applicable for other concrete products manufactured by slide casting, like hollow-core slabs, beams and pillars. The invention can also be used for casting facade elements, to create recesses into the visible surface of the same for achieving an architectural effect.

The recesses are made by means of a roller or an endless belt immediately in connection with the compacting. The roller or belt placed after the surface compacting vibrator beam or float forms the recesses during or by the effect of the plasticizing caused by the surface compaction beam.

With the belt device, no separate compacting element is required. The pressure caused by the surface compaction beam remains under the belt and the concrete is workable. The method is applicable to the production of both hollow-core slabs and massive slabs.

The invention and its details will now be described in more detail in the following, with reference to the enclosed drawings, wherein

Figure 1 illustrates schematically one embodiment of the apparatus in accordance with the invention as a side section,

Figure 2 shows section A -A of figure 1, the belt cover being partly cut off for clarity,

Figures from 3 to 5 show top views and sections of three embodiments of a product manufactured by means of the apparatus in accordance with the invention,

Figure 6 shows a side view of another embodiment of the apparatus in accordance with the invention,

Figures from 7a to 7c show an enlarged perspective view of a detail of the equipment of figure 6, and the product to be cast in three different stages, and

Figures from 8 to 10 show top views and sections of three further embodiments of the product manufactured by means of the apparatus in accordance with the present invention.

The slide casting machine illustrated by the figures 1 and 2 comprises a feeding hopper 1 and a driving mechanism 2. The machine moves on wheels 3 along a bed 4. A mold is formed by side walls 5 and a top plate 6. For forming of hollow cores, the machine has parallel feed screws 7 and as an extension of those hollow core mandrels 8. The top plate 6 travels back and forth moved by a crankshaft 9 in the direction of travel of the machine. Also the side walls can be moved by a crankshaft 10. All this is known in the art.

Immediately after the top plate 6 there is arranged an endless belt 12 travelling around two horizontal rollers 11, said belt pressing the upper surface of the slab. The material of the belts is e.g. steel or rubber, and the belt is provided with protrusions that correspond to the recesses to be formed into the slab.

When casting the concrete slab, the feed screws 7 feed concrete from the feeding hopper 1 to the bed 4. The driving mechanism 2 rotates the feed screws 7 and, at the same time, the machine moves on the bed on its wheels 3 (in figure 1 from right to left). When the feed screws push the machine away from the cast product, the rollers 11 within the belt 12 roll along the belt and the belt moves together with the machine forward, along the upper surface of the slab to be cast.

The protrusions of the belts press recesses corresponding to the protrusions into the upper surface of the slab. The pressing of the recesses is implemented during the compacting process, and it is started before the slab has been compacted into its final compactness.

Instead of the belt 12, also a roller can be used, the surface of which is provided with protrusions for pressing recesses.

Figures 3a and 3b show a top view and a longitudinal section of a cast slab with a continuous transverse grooving on the upper surface of the same.

Figures 4a and 4b show a top view and a diagonal section of a slab with a continuous diagonal grooving on the upper surface of the same.

Figures 5a and 5b show a top view and a cross section of a cast slab with discontinuous recesses of different forms.

The invention is applicable, besides to hollow-core slabs, also to massive slabs. In that case no feed screws 7 and no hollow core mandrels 8 are used. The concrete feeding and compacting can be implemented by using e.g. a feeding hopper moving back and forth, described in international publication WO 95/29799, and a grinding top plate movable back and forth in the direction of the casting. A roller or endless belt provided with protrusions is placed immediately following the grinding top plate.

When using the above mentioned oscillating and compacting feeding hopper, it is possible to form into the upper surface of the slab longitudinal, continuous grooves by using a suitably designed edge of the hopper and a grinding top plate provided with ridges. This kind of longitudinal grooves can, in addition, be formed like swallow tails, so that their bottom is wider than the base or upper part thereof. In that way the joint construction can be provided with a best possible bond. This kind of a bond can be further improved according to the invention, by providing the longitudinal grooves with transverse extensions by means of a roller or endless belt.

Figure 6 shows an apparatus according to the in-

vention, whereby both an endless belt and a roller are used. The concrete mass is fed by using an oscillating and compacting hopper 1. A grinding top plate 6 moving back and forth in the direction of the casting, the lower surface thereof being provided with longitudinal ridges, is arranged after said oscillating and compacting hopper. The lower portion of the ridges is wider than the base thereof, whereby the upper surface of the slab to be cast will be provided with swallow tail formed grooves (see figure 7b). After the top plate there is an endless belt 12 or mat, also provided with longitudinal ridges 14. Between these there are in addition extensions or transversal ridges 15 (see Figure 7a). The longitudinal ridges 14 of the belt support the longitudinal grooves of the slab, and the transversal ridges 15 press transversal grooves into the slab (see figure 7c). Finally, the roller 13 presses additional recesses (figure 7d) into the slab. In the embodiment of figure 6, the final compacting is implemented by the belt 12 and the roller 13 both provided with protrusions.

Figures 8a, 8b and 8c illustrate a slab provided with longitudinal grooves having a semicircular cross section. The grooves are in the transversal direction partially discontinuous so that they are provided with transversal extensions on the sides. The slab can be either massive (figure 8a) or a hollow-core slab (figure 8b). The axial grooves can be made by means of a suitable design of the nozzle edge. The transversal extensions of the grooves are formed by means of protrusions of the roller or belt.

Figures 9a, 9b and 9c illustrate a slab provided with longitudinal grooves having a rectangular cross section, said grooves being provided with transversal extensions made by a roller or belt.

Figures 10a, 10b and 10c illustrate a slab with a swallow tail formed cross section of the grooves. Also this kind of grooves can be provided with transversal extensions.

Claims

1. A method for casting concrete products by means of continuous slide casting so that concrete mix is extruded onto a bed (4), into a space between the bed and a mold, by means of a feeding member or members of a slide casting device travelling along the bed (4), the mix is compacted, and recesses are pressed into the surface of the product by means of a roller (13) and/or endless belt (12) provided with protrusions, said recesses being at least partly discontinuous in the direction of the casting, **characterized** in that the discontinuous recesses are pressed into the upper surface of the product at the latest during the compacting implemented following the feeding member or members, before the mix has been fully compacted.

2. A slide casting apparatus for casting concrete products, the surface of said products being provided with recesses, whereby said apparatus comprises a mold consisting of a cover portion (6) and side walls (5), a feeding container (1) and at least one feeding member for feeding concrete into the mold, at least one compacting member and a driving mechanism (2) for driving the feeding and compacting members and for transporting the slide casting apparatus along the bed, whereby at least one wall or one portion or extension of a wall of the mold is formed by a roller (13) supported on a shaft transversal to the travelling direction ofthe apparatus and/or by an endless belt (12) going around transversal shafts, the outer surface of the roller or belt being provided with protrusions that are at least partly discontinuous in the direction of the casting, **characterized** in that the roller (13) and/or belt (12) provided with protrusions is arranged against the upper surface of the product and supported onto a horizontal shaft or around horizontal rollers (11), and forms a compacting upper wall of the mold or a portion or extension of a compacting upper wall of the mold, and that the roller and/or belt is adapted to fully compact the mix for the first time.

3. A slide casting apparatus according to claim 3, provided with feeding screws (7) for feeding the mix into the mold, and with compacting members (8) as extensions of the feeding screws, for compacting the mix, **characterized** in that roller (13) and/or belt (12) provided with protrusions is arranged at least partly above the compacting members (8).

Fig.1.

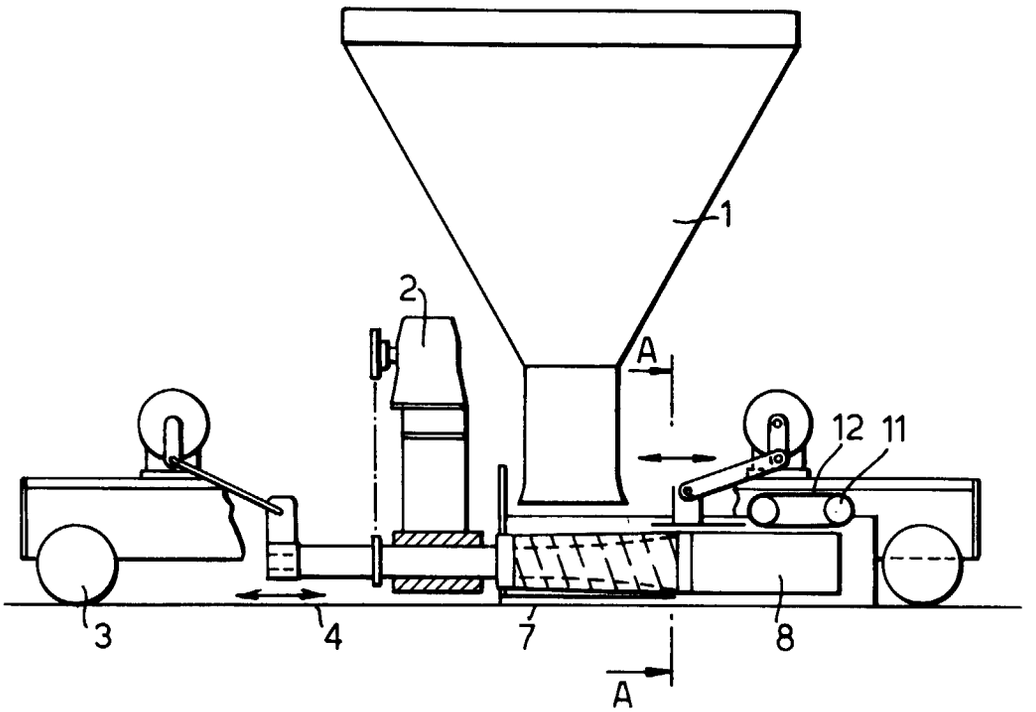


Fig.2.

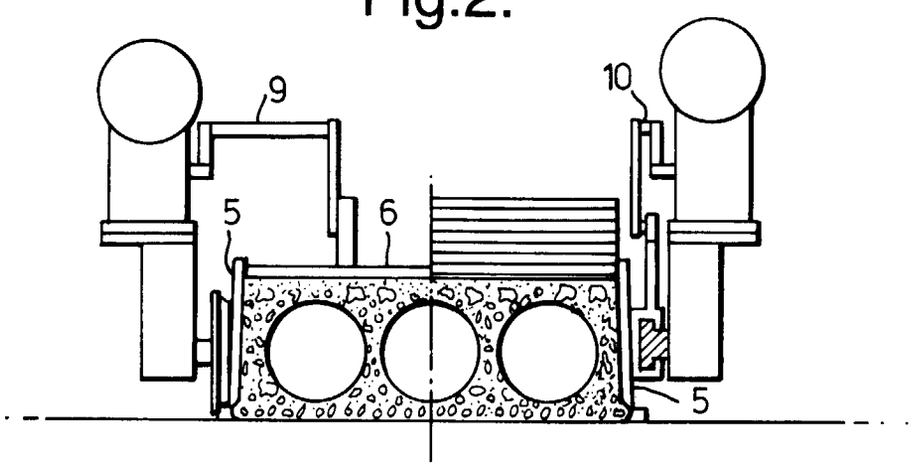


Fig.3a.

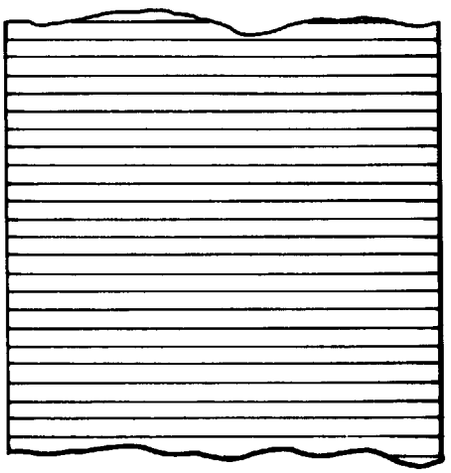


Fig.3b.

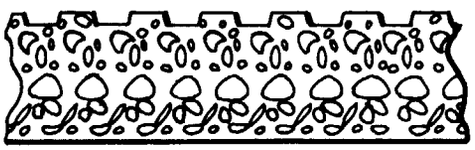


Fig.4a.

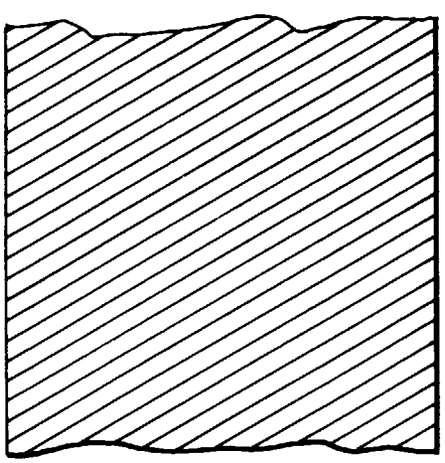


Fig.4b.

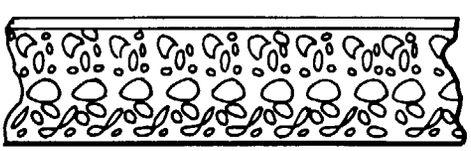


Fig.5a.

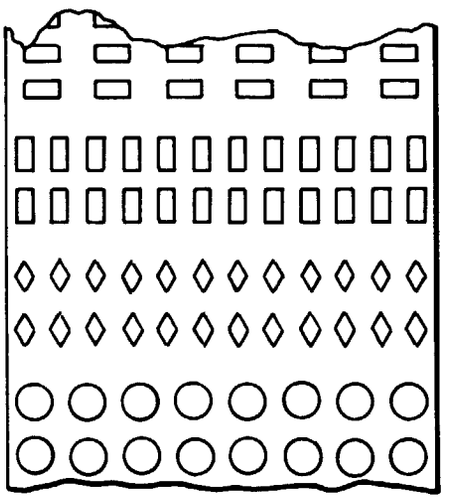


Fig.5b.

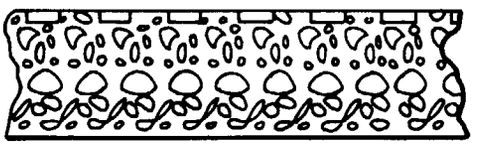


Fig.6.

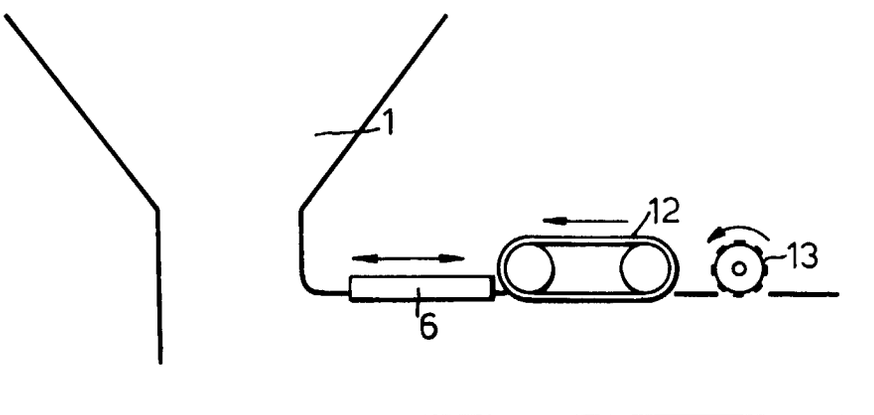


Fig.7a.

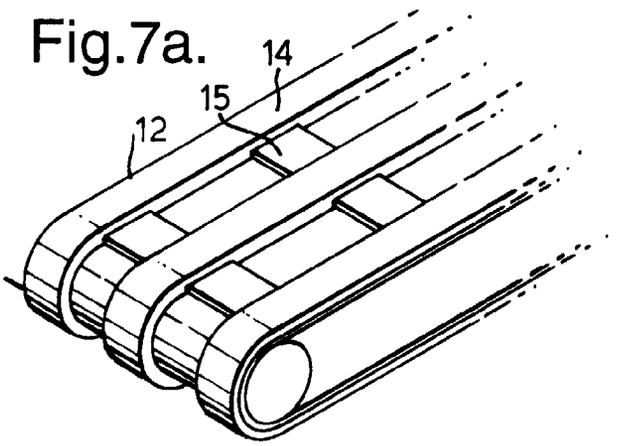


Fig.7b.

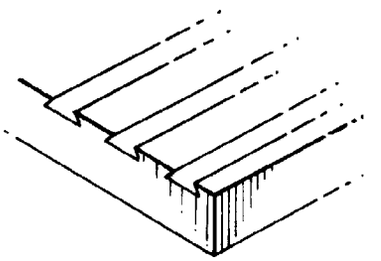


Fig.7c.

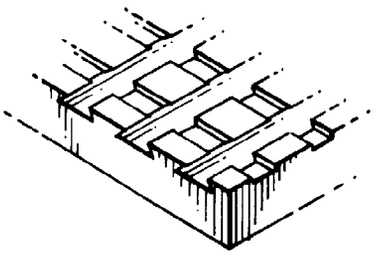


Fig.7d.

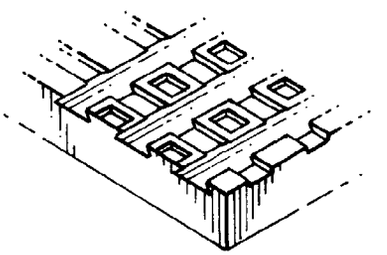


Fig.8c.

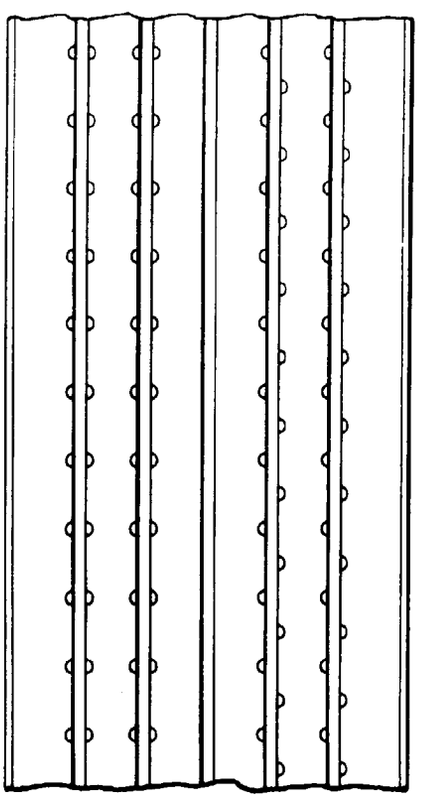


Fig.8a.

Fig.8b.

Fig.9a.

Fig.10a.

Fig.9b.

Fig.10b.

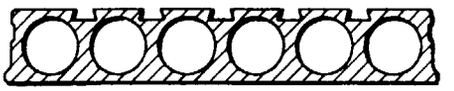


Fig.9c.

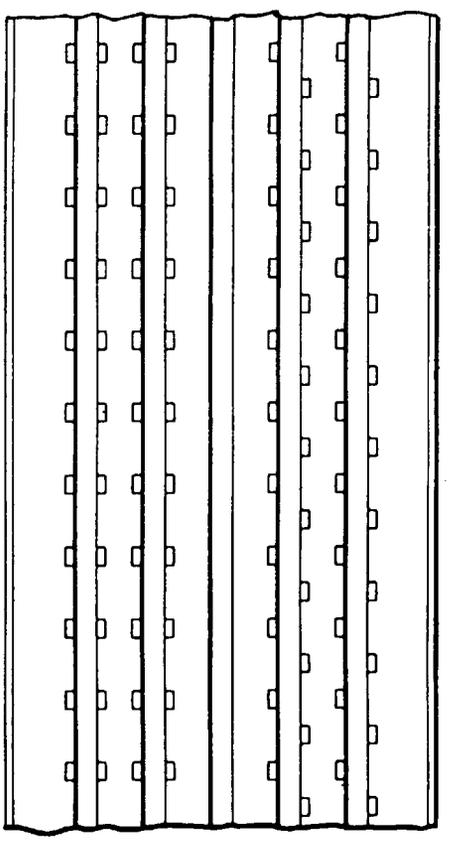
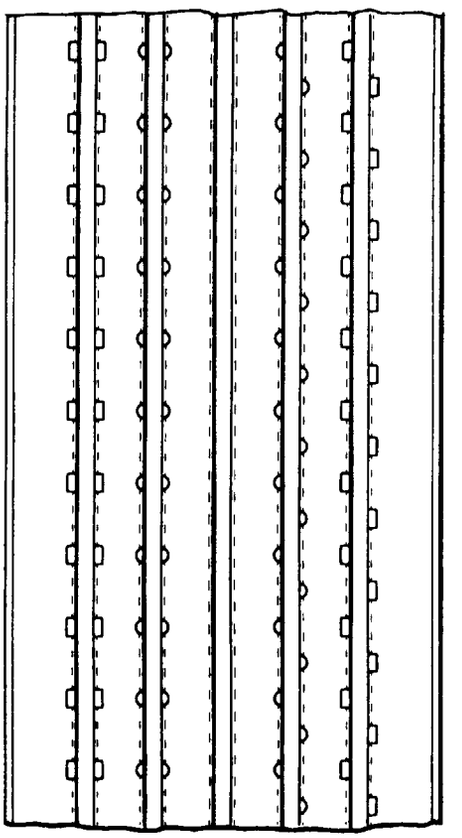


Fig.10c.



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EUROPEAN SEARCH REPORT

Application Number
EP 97 66 0132

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int.Cl.6)
Y	GB 1 506 722 A (HEWITT F) * the whole document * * page 2, line 111 - page 3, line 84 * * figures 1,4,5 *	1-3	B28B1/08 B28B1/29 B28B11/08
Y	FR 2 448 422 A (APPLIC CERAMIQUES ET) * the whole document * * page 1, line 18 - page 2, line 7 *	1-3	
Y	US 4 247 269 A (BEZHANOV TIGRAN V ET AL) * the whole document *	1-3	
A	FR 2 151 437 A (SARET) * the whole document * * page 4, line 37 - page 4, line 40 * * page 5, line 34 - page 6, line 9 * * figures 1,3,5 *	1-3	
A	FR 2 145 206 A (SPIROLL CORP LTD) * the whole document *	1-3	
A	GB 907 450 A (J. VINAS TARRES) * the whole document *	1-3	

TECHNICAL FIELDS SEARCHED (Int.Cl.6)
B28B

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
THE HAGUE	17 March 1998	Gourier, P

CATEGORY OF CITED DOCUMENTS

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