



(11) Publication number : **0 592 183 A1**

(12) **EUROPEAN PATENT APPLICATION**

(21) Application number : **93307890.9**

(51) Int. Cl.⁵ : **B28B 1/08, B28B 1/29, B28B 3/12**

(22) Date of filing : **05.10.93**

(30) Priority : **05.10.92 FI 924486**

(43) Date of publication of application :
13.04.94 Bulletin 94/15

(84) Designated Contracting States :
BE DE FR GB IT NL

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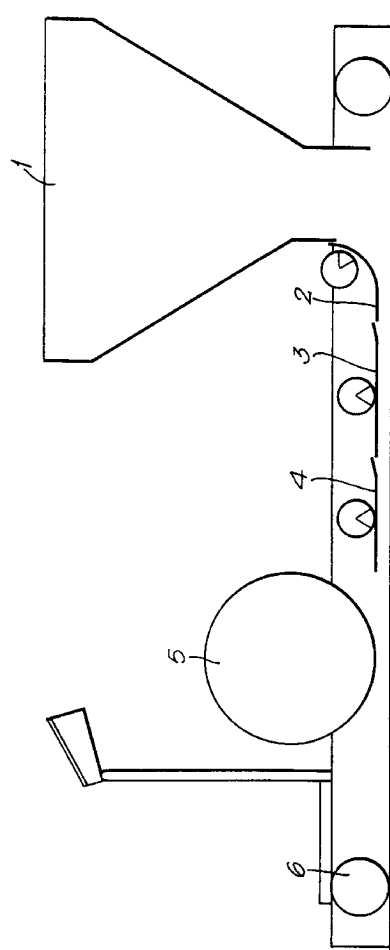
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(54) **A method and an apparatus for casting concrete products.**

(57) Concrete mass is extruded onto a bed into a space between the bed and a mould, and the mass is compacted. After the compaction, the surface layer of the product is again caused to enter into a plastic state by means of vibration and recesses discontinuous in the casting direction are pressed into the surface layer thus plasticized. The apparatus comprises a mould (2, 3) formed of a cover portion and side walls, as well as means (1, 2, 3) for feeding and compacting the concrete mass. At least one mould wall has a pressing means (5) provided with a vibrator. The pressing means (5) provided with a vibrator is placed after the compaction step (3). The pressing means (5) is provided with discontinuous ridges.



The present invention relates to a method for casting concrete products by means of continuous slide casting in such a way that concrete mass is extruded onto a bed into a space between the bed and a mould by means of a slide casting apparatus travelling along the rails of the bed, and the mass is compacted and recesses discontinuous relative to the casting direction are pressed onto the surface of the product. The invention also relates to a slide casting apparatus for casting concrete products provided with recesses discontinuous relative to the casting direction, which apparatus comprises a mould formed by a cover portion and side walls, means for feeding concrete mass into the mould, one or more vibrators for compacting the concrete mass as well as a driving mechanism for driving the feeding and compaction members and for transporting the slide casting apparatus along the rails of the casting bed, whereby at least one mould wall has a pressing means, whose pressing surface is during the casting, when contacting the product, in the casting direction stationary relative to the product and provided with extensions discontinuous relative to the casting direction.

The surface prepared by means of conventional methods by slide casting is relatively smooth. The surface smoothness is in fact generally a desired property, when the product to be cast acts as such as a visible part of the structure. However, in the building industry, structures are often used in which the entire structure is formed of an element prepared at a plant and of a portion to be joined thereto and prepared on site.

The functioning of such concrete structures in the desired manner requires that the bonding of the element to the portion prepared on site is as strong as possible. For ensuring this, it is advantageous that dowel patterns or recesses are made on the surface of the element. The part to be cast on site then fills these recesses and adheres to the element prepared at the plant. For preventing the mutual sliding of the parts of the structure, the patterns have to be both in the casting direction and in the transverse direction discontinuous, e.g. square or rectangular recesses. A suitable dowel depth is e.g. 1-20 mm.

A certain concrete product, in which the dowels are specially important, is a so-called casing slab. The casing slab acts as a mould, on top of which is cast a concrete layer required by the total thickness of the slab. The casing slab remains as part of the structure and the load carrying capacity requires a strong grip between the parts.

The necessary dowel grooves have previously been generally such that the product has not been cast in a slide casting manner but in a mould on site, whose bottom contains bulges. The bulges have formed recesses on the lower surface of the slab. However, a drawback of the method is that one surface of the slab or the upper surface has to be

smoothed separately so that a smooth surface could be made visible on the finished plate. This results in an additional working step in the slab casting.

From FI patent publication 61652 is also known a device, by means of which recesses are formed in the sides of the slab by using two successive wheels, whose claws press the recesses of the side of the slab. Since the concrete mass is compacted between these two wheels, the latter wheel has to be slightly smaller than the wheel operating first, and in addition the speeds of the wheels have to be synchronized by means of a special sliding coupling, which takes into account the changed dimensions of the slab. The device is thus fairly complicated, and it is difficult to make it satisfactorily operative in all conditions.

US patent publication 3 740 176 and FI application 878/71 in turn describe devices, in which the recesses are formed either by means of a flexible belt or one gear wheel. However, problems are caused in both these devices by a deformation caused by the compaction of the slab.

The method of the invention is characterized in that after the compaction, the surface layer of the product is again caused to enter into a plastic state by means of vibration and the recesses are thus pressed into the plasticized surface layer. The apparatus of the invention is characterized in that at least one vibrator is placed, relative to the product, after a wall forming and compacting the product and moving along with a casting machine, which wall is intended to form the product into its final shape, except for the recesses.

In accordance with the invention, the recesses are formed by pressing, i.e. without removing any substance. The slide casting technique requires the use of a fairly dry concrete mass, since the product has to retain its shape after the mould. The pressing of sufficient recesses into such a dry mass compacted once requires the bringing of the surface again into a plastic state, but only to a depth just needed, whereby the cohesion of the entire product after the mould is not in danger.

The method of the invention is preferably applied when forming dowel grooves during the casting of a concrete slab onto an upper surface in a horizontal position. Then, a flat steel plate may be used as a lower surface of the mould and the visible surface of the mould can be made completely smooth.

The invention may also be applied when forming dowels, except for a casing slab, also to other concrete products to be prepared by slide casting, such as to hollow slabs, beams and pillars.

The invention and its details are next described in more detail with reference to the accompanying drawing, which shows one application of the apparatus of the invention, seen from the side.

A slide casting machine comprises a frame and a driving mechanism 6, which may also be replaced by

an external driving device, as well as a funnel and a moulding box 1, via which the concrete mass flows into a slide casting mould.

On the upper surface of the mould is, seen from the funnel 1, first located a moulding beam 2, where to is fixed one or several vibrators. The vibrating moulding beam 2 improves the flowing of the concrete mass into the mould.

Next is located a compacting beam 3, which is provided with more efficient vibrators than the previous ones. The compacting beam 3 compacts the product to be cast into its final form, except for the dowel grooves.

Next is located a pressure balancing/smoothing beam 4, which is further provided with vibrators, but they are less efficient than those of the compacting beam 3. The smoothing beam 4 has two tasks. It smooths the surface of the product to be prepared, and on the other hand it prevents the surface of the concrete mass from rising after the actual compacting beam 3. When the rising is thus prevented, the pressure needed for the compaction remains under the compacting beam 3.

In the application shown in the drawing, the recesses are formed by means of a cylindrical concrete rammer 5, whose surface has bulges. These bulges press the corresponding recesses into the surface of the product. The cylindrical press roll or rammer 5 may also be replaced with an endless belt travelling around rollers, to which belt are fixed bulges for pressing the dowel grooves. The rammer or the belt is rotated at a speed synchronized with the advancement of the machine e.g. by means of a toothed belt or a chain so that the rammer or the belt rolls along the surface of the products to be cast and simultaneously presses a regular dowel pattern onto the concrete surface. In this connection, a belt refers, except for an entirely flexible belt, also to a caterpillar type construction, which is comprised of plates joined to each other.

The rammer or the belt may also be replaced with a stamp-type press, which may operate by means of cranks or levers or also hydraulically. The press performs in the pressing direction a to-and-fro movement towards the product and away therefrom. In addition, the movement track of the device is such that it does not drag along the surface of the product as the machine advances, but it presses a distinct pattern. This means that on one hand, during the pressing step, the press remains stationary relative to the casting direction on the surface of the product, moving relative to the casting machine, and on the other hand, when it comes off the product, it returns back to the same position relative to the casting machine.

Also these dowel making machines have one or more vibrators, whose vibrating effect is by means of the construction directed advantageously from the point of view of the formation of the recesses. The

rammer 5 may be vibrated e.g. by vibrating bearing blocks supporting a rammer drum. Similarly, the vibration of the belt is achieved by vibrating the support rollers of the belt. When using a stamp-type press, the vibrator may be placed inside the press itself.

The vibrating effects of both the dowel making device itself and of the balancing beam 4 have been selected such that they are sufficient for plasticizing again the surface of the slab, but only to such a depth that the dowel patterns may be pressed without yet endangering the remaining of the entire slab in its correct shape.

When the method is applied to making dowel grooves in a hollow slab, the upper surface of the slide mould of the hollow-slab machine is replaced with an apparatus described above. In the hollow-slab extruder, the mass flow into the slide mould is arranged by screws as well as the compaction of the mass by compacting mandrels located after the screws.

Such a machine is described e.g. in Finnish patent publication 70821.

In addition to the upper surface of the concrete product to be slide cast, the method and apparatus of the invention may produce dowel patterns also onto the side surfaces of a concrete element by installing corresponding devices on the side walls of a slide cast mould.

Claims

1. A method for casting concrete products by means of continuous slide casting in such a way that concrete mass is extruded onto a bed into a space between the bed and a mould, by means of a slide casting apparatus travelling along the rails of the bed, and the mass is compacted and recesses discontinuous relative to the casting direction are pressed onto the surface of the product so that after the compaction, the surface layer of the product is again caused to enter into a plastic state by means of vibration and recesses are pressed onto the surface layer thus plasticized, **characterized** in that the effect of vibration occurring after the compaction is so low and directed in such a way that the surface of the product is plasticized again only to a depth necessary from the point of view of the pressing of the recesses, but the main portion of the product still remains compact.
2. A slide casting apparatus for casting concrete products provided with discontinuous recesses relative to the casting direction, which apparatus comprises a mould (2, 3) formed of a cover portion and side walls, means (1) for feeding concrete mass into the mould, one or more vibrators

for compacting the concrete mass as well as a driving mechanism (6) for driving the feeding and compaction members and for transporting the slide casting apparatus along the rails of the casting bed, whereby at least one mould wall has a pressing means (5), whose pressing surface is during the casting, when contacting the product, in the casting direction stationary relative to the product and provided with extensions discontinuous relative to the casting direction, and whereby at least one vibrator is placed, relative to the product, after a wall (3) forming and compacting the product and moving along with a casting machine, which wall is intended to form the product into its final shape, except for the recesses, **characterized** in that the vibrating effect of the vibrators located after the compacting wall (3) is so low and directed in such a way that it is sufficient to plasticize again the surface of the product only to a depth necessary from the point of view of the pressing of the recesses, as the main portion of the product remains compact.

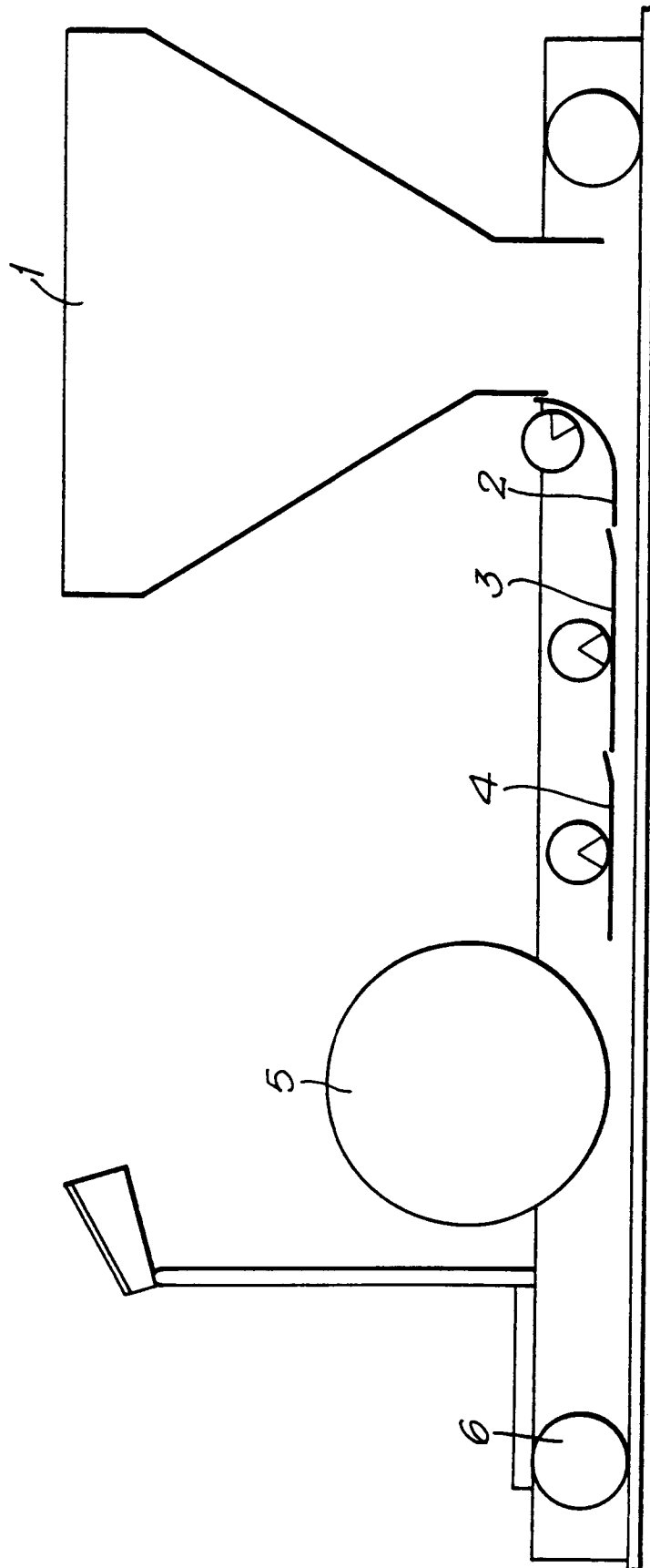
3. An apparatus according to claim 2, characterized in that after the compacting wall (3) is fitted a wall (4) provided with a vibrator, the vibrator of which wall (4) together with a vibrator of the pressing means (5) plasticizes the surface of the product again after the compaction.

4. A method of casting a concrete product by using continuous slide casting, wherein concrete mass is extruded onto a bed and into a space between the bed and a mould, by means of slide casting apparatus travelling along the bed, and the mass is compacted and, after the compaction, recesses discontinuous in the casting direction are formed in a surface layer of the product by using vibration to cause the surface layer to enter a plastic state and by pressing the recesses into the surface layer thus plasticized, characterized in that the effect of the vibration occurring after the compaction is sufficiently low and directed in such a way that the surface layer is plasticized only to a depth necessary to permit the pressing of the recesses, whilst the main portion of the product remains in its compacted state.

5. Slide casting apparatus for casting a concrete product provided with recesses discontinuous in the casting direction, which apparatus comprises a mould (2, 3), means (1) for feeding concrete mass into the mould, one or more compacting vibrators for compacting the concrete mass, at least one plasticizing vibrator (4) for plasticizing a surface layer of the compacted concrete mass, pressing means (5) having a pressing surface arranged to be stationary, in the casting direction,

whilst forming the recesses in the plasticized surface layer, and a driving mechanism (6) for driving the feeding means and vibrators and for transporting the mould along a casting bed, characterized in that the plasticizing vibrator(s) are arranged so that the effect of the vibration occurring after the compaction is sufficiently low and directed in such a way that the surface layer is plasticized only to a depth necessary to permit the pressing of the recesses, whilst the main portion of the product remains compacted.

6. Apparatus according to claim 5, wherein the plasticizing vibrators comprise (i) a vibrating wall (4) downstream of the compacting vibrator(s) (33) and (ii) the pressing means (5), which is downstream of the vibrating wall (4) and is arranged to vibrate.





European Patent
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EUROPEAN SEARCH REPORT

Application Number
EP 93 30 7890

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.5)
A	DE-A-24 26 205 (STETTER GMBH) * the whole document * ---	1-6	B28B1/08 B28B1/29 B28B3/12
A	BE-A-676 705 (M. BARRANGAN SEBASTIAN) * the whole document * ---	1-6	
A	US-A-4 067 676 (F. M. HEWITT) * column 4, line 42 - column 5, line 62; figures 4,5 * ---	1-6	
A	FR-A-2 448 422 (SOCIETE D'ETUDES ET APPLICATIONS CERAMIQUES) * the whole document * ---	1-6	
A	FR-A-2 145 206 (SPIROLL CORPORATION LTD) * the whole document * -----	1-6	
			TECHNICAL FIELDS SEARCHED (Int.Cl.5)
			B28B E01C
The present search report has been drawn up for all claims			
Place of search THE HAGUE		Date of completion of the search 10 December 1993	Examiner Gourier, P
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