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(54) **Title:** PERMANENT SHELL-CORE FOR PRODUCING INTERNAL CAVITIES OF VIBRO-PRESSED CONCRETE ARTICLES

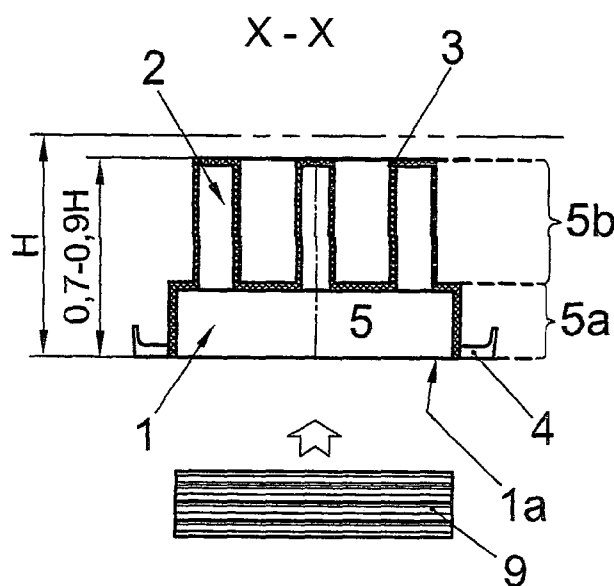


Fig. 2.

(57) **Abstract:** Permanent shell-core for producing internal cavities of vibro-pressed concrete articles, the shell-core defining a three-dimensional spatial region, wherein a first level (5a) of the spatial region is formed by a low-height base space (1) and the second level (5b) thereof is formed by an upright stack (2) disposed on at least one through-cut (1c) formed in a cover plate (1b) of the base space (1a), the cover plate (1b) being parallel with the bottom of the base space (1a) at a height of 70-90% of the total height dimension of the concrete article (10), with the bottom of the base space (1a) having at least one respective positioning projection (4) arranged in the plane thereof in at least two directions.

PERMANENT SHELL-CORE FOR PRODUCING INTERNAL CAVITIES OF
VIBRO-PRESSED CONCRETE ARTICLES

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Technical field

The invention relates to a permanent shell-core for producing internal cavities of vibro-pressed concrete articles, and to a method for forming the internal cavities of the concrete articles.

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Pavers for public spaces, for spaces for private use and for sidewalks, kerbs for roads for pedestrian and vehicle traffic, steps and parking kerbs are nowadays most often made as prefabricated concrete elements.

These elements are marketed with various shapes, colours and surface textures, allowing for great variability, with finishes providing rustic or aged effects.

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Possibilities raised by this diversity of supply have positively affected the quality of the forming of space.

High architecture has the intention that architectural space should give its users extra aesthetic impressions and additional information on top of allowing everyday use.

This is facilitated, by way of example, by

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- selecting the location and type of light sources in a special manner,
 - installing chaser lights for information purposes or for directing attention,
 - applying light strips for separating areas with different functions,
 - climatic intervention by installing spray gates or spray corridors,
 - installing danger indicator light barriers, direction lights indicating escape routes,
- illuminated symbols and advertisements, as well as various other means of forming space.

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To provide these additional functional and aesthetic effects, various extra installation components have to be built in. For a uniform aesthetic impression it is required that the extra components do not appear as out-of-context objects in the architectural space.

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This can only be achieved if the components form organic parts of the concrete articles that provide the basic functionality. These components must also completely match all other components in size, colour, and surface finish.

It follows from this that all of the components should be produced under identical conditions.

Technology based on mass production of concrete articles has not yet had to prepare for such requirements. For demonstration and design modelling purposes
5 completed mass-produced articles were applied, with the cavities required for receiving special components being manually made afterwards.

The quality of such products is haphazard, and the method is not economically competitive.

Such a solution is therefore required which

- 10 - can be integrated in widely applied production systems,
- also allows for producing lower-volume (compared to mass production), custom-designed articles
- does not modify or restrict the main functionality of devices and machinery applied for mass production purposes.

15 In concrete architecture and concrete components manufacturing permanent formworks are applied for providing lightened structures.

Background art

According to the patent description US 7,540,121 dome-like internal cavities are produced by on-site casting in a concrete ceiling structure.

20 In order to lighten the layered structure, open-bottom, dome-shaped shell components are arranged with a regular geometry. In addition to the dome shells, the solution also comprises rod-like components having a snap-in configuration at both ends.

These rods are adapted for connecting two adjacent permanent shells at the plane of the ceiling to be formed in such a way that they are situated at the corners of an equilateral triangle, the longitudinal axes of the rods being coincident with the sides of the triangle. By
25 repeating this arrangement an equilateral triangular grid is formed from the shells and the rods. By interconnecting a sufficient number of components the whole area of the ceiling of the desired size can be filled up. The system of shells and rods is complemented by the rebar steel structure required for bearing loads, and then the ceiling structure is completed
30 by casting concrete in the desired thickness and compacting the concrete by vibration.

In this solution the dome-like shells are applied for producing lightened reinforced concrete slabs.

The patent description US 6,637,464 discloses a protective cap arrangement that is coupled to a pipe fitting installed in the building structure during construction, and is then concreted together with the pipe fitting. The protective cap (closure cap) can also be temporarily coupled to the pipe.

5 The pipe fitting installed between the two bounding planes of a wall panel or on-site cast floor extends through the entire cross section of the wall.

The above described solutions disclose on-site produced cavities and shells that are produced by a casting process. These solutions are not suitable for forming internal cavities in the above described concrete paver components.

10 Therefore a new, complex task to be solved is to produce such cavities in vibro-pressed articles manufactured in closed mould spaces that are capable of receiving components with additional functionality.

 The additional functionalities may require multiple differently shaped internal cavities even in case of a single given product. The core adapted for forming the cavity cannot be a permanent structural component belonging to the mould because that would
15 overly increase the number of different mould variants and thus it is not feasible from an economic point of view. By their nature, permanent shell-cores are only related to the product itself, and can be applied without modifications to the manufacturing machine and the moulds, and therefore they fulfil the above described requirements.

20 Permanent shell-cores have not yet been applied for processes involving a closed mould space and technological steps comprising pressing.

Disclosure of invention

 The object of the present invention is to provide a permanent shell-core that can be applied for producing cavities of pavers or other similar components, creating a new family
25 of products.

 The invention is based on the recognition that by applying an expediently configured, two-level permanent shell-core such a multifunction cavity can be produced inside a concrete article – by way of example, a paver element – that does not have a full through-cut between the two opposite faces of the product.

30 This objective can be fulfilled applying the permanent shell-core designed according to the following description.

 The design is driven by two sets of requirements.

The first set includes the requirements dictating that the shape of the shell-core should be formed such that the internal cavity suited for receiving added functions is produced.

5 The second set of requirements relates to which additional features should the shell-core suited for producing the cavity possess in order that it can be used in a closed mould space, with a technological process that also includes a vibro-pressing step.

The geometrical configuration of the shell-core is prepared as follows:

For installing devices that provide added functionality, an easily accessible “starter space” is needed for each device.

10 Having regard to the subsequent installation position of the concrete article, the base plane of this spatial region coincides with the abutment surface of the concrete article, and is open from this direction to allow for installing the required devices.

This spatial region is called “base space”, which forms the first level of the shell-core shape.

15 It is adapted for receiving the wire connectors and pipe connections related to the components providing added functionality, as well as smaller-sized electronics modules and other similar devices.

The base space expediently has a rectangular block shape, with the height of the block being 1/3-1/4 of the length of one of the sides of its base.

20 A second level of the shell-core body is also required.

This level is made up of a cylindrical or block-shaped spatial region or regions that has/have lower cross sectional area than the bottom of the base space, and is/are directed from the base space through the interior of the concrete article towards the flat face thereof situated opposite the base space. This spatial region is called “stack”.

25 The stacks receive the components of the arrangement which are adapted for transferring/conveying the physical entities and/or agents related to the added functionalities.

30 These may be light sources or glass or plastic bodies adapted for light transfer, as well as water spray or jet nozzles, output openings of coloured smoke/fog generators or other components.

Due to the vibro-pressing technology the stack(s) cannot be open at the top because otherwise concrete may enter the base space when the mould space is filled up. In addition

to that it has to be ensured that the main face of the concrete article has a uniform surface (i.e. pressed, coloured, roughened).

This can be achieved by providing that the components of the second level, i.e. the stack(s) of the permanent shell-core do not extend as far upwards as the top face of the concrete article, but are terminated by a respective end plate at 70%-90% of the combined height of the product.

During manufacturing the concrete bridging above the end plate is subjected to compaction as with the other parts of the product, and thus the outward appearance of the surface remains uniform.

Due to the characteristics of the product only small-series production is foreseen.

The concrete bridging situated above the end plate can be removed together with the end plate at little cost applying known methods such as rigid diamond-grain tools, diamond-coated cutting wires, or water jet cutting.

By removing the concrete bridging and the end plate a free connection is created between the bottom and upper faces of the concrete article for installing additional components.

During the manufacturing process the two-level shell-core is placed into a closed mould space.

The simplest and most generic shape of the mould space is a box shape with a rectangular base.

The mould space is bounded first by the manufacturing plate, with multiple manufacturing plates being continuously circulated among the stations of the manufacturing system.

A given manufacturing plate only stays in the working space of the manufacturing machine for the duration while the shape of the product is formed. Then the shaped "wet" product is carried on by the flat manufacturing plate.

The base of the mould space is defined by the plane of the manufacturing plate. This plane is coincident with the abutment surface of the product, and also with the bottom of the base space.

The lateral faces of the box shape are constituted by the mould itself. In this simple case the mould is constituted by four plates of an expediently selected thickness that are set perpendicular to the plane of the manufacturing plate and are firmly joined along their adjacent edges.

Thereby five of the bounding faces of the mould space are formed, the space still being open at the top and ready for receiving the concrete material forming the concrete article.

5 The closed mould space is formed by moving the pressing die that forms the sixth face of the box shape from a direction perpendicular to the plane of the manufacturing plate into the space bounded by the mould faces.

The permanent shell-core has to be introduced into the mould space in the stage wherein the space is still open at the top and the casting of the concrete has not yet begun.

The shell-core cannot have an arbitrary position in the mould space.

10 The bottom of the base space has to be laid on the plane of the manufacturing plate, and also has to be set in a particular position with respect to the side walls.

According to the invention this is brought about by providing the shell core with positioning members during manufacturing. The geometrical position of the positioning members is at the base plane of base space, directed from the edges thereof towards the sides of the mould space. These components – which, due to their shape, will hereinafter be termed “positioning projections” – are made to have the appropriate length and are arranged on the circumference of the shell core in a number and the directions required.

Thereby it is ensured that the shell-core has the desired position inside the mould space and, consequently, inside the concrete article.

20 For reasons of easy shaping and low cost, shell-cores are usually made of plastic, with low wall thickness. This can be regarded expedient also because thereby the ratio of useful internal volume is high relative to the contour of the shell-core.

25 However, lightweight plastic shells can withstand only limited external loads. The cover plate of the shell (parallel with the base plane of the base space) is prone to oscillate under the effect of vibrating and may get deformed by the pressing force (transferred damped by the concrete particles), springing back after the pressing force has disappeared.

The recognition that lead to the solution according to the invention was that it is sufficient to increase the load-bearing capacity of the shell-core only for the period during which the additional loads (i.e. the effects of vibro-pressing) are present.

30 This can be achieved by placing such a load bearing insert into the base space of the shell-core that completely fills up the base space and has a thickness corresponding to the distance between the bottom of the base space and the cover plate thereof.

The insert is placed into the base space of the shell-core, followed by inserting the two items together into the mould space. The mould space is then filled up with concrete, and the concrete body is produced in a generally known manner, applying vibro-pressing.

5 During vibro-pressing the insert – abutting against the manufacturing plate – provides secure support for the cover plate of the base space and the concrete article can receive the required amount of compaction.

10 At the end of the operation the completed concrete article – encompassing the shell-core and the insert – leaves the manufacturing machine and proceeds through the remaining steps of the technological process. As soon as the concrete article is rigid enough to be handled it is removed from the manufacturing plate and the temporary load bearing insert is removed. The load bearing insert can be reused for another shell-core.

From the aspect of practical application, therefore, a kit is applied that consists of a two-level shell-core and a geometrically corresponding load bearing insert.

15 The object of the invention is accomplished by providing a permanent shell-core for producing the internal cavities of vibro-pressed concrete articles that defines a three-dimensional spatial region, where the base plane of the spatial region coincides with a bounding plane of the concrete article, is open from this direction, and is characterised in that the three-dimensional spatial region of the shell-core has two connected levels built upon one another, where the first level of the spatial region is formed by a low-height base space and the second level thereof is formed by an upright stack disposed on at least one through-cut formed in the cover plate of the base space, the cover plate being parallel with the bottom of the base space, where the stack is terminated by an end plate disposed parallel with the bottom of the base space at a height of 70-90% of the total height dimension of the concrete article, with the bottom of the base space having at least one
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25 respective positioning projection arranged in the plane thereof in at least two directions, and with an optional load bearing insert being also receivable in the base space.

30 In a preferred embodiment of the permanent shell-core according to the invention the vertical projection of the base space is a regular plane figure (square, rectangle, polygon, circle, ellipse), and the through-cut formed in the cover plate of the base space is a regular plane figure (square, rectangle, polygon, circle, ellipse) or a graphic pattern that can be drawn as a continuous closed curve.

In another preferred embodiment of the permanent shell-core according to the invention the interior surfaces of the stacks are constituted by walls perpendicular to the cover plate of the base space.

5 In a further preferred embodiment of the permanent shell-core according to the invention more than one through-cuts of identical or different geometrical shape are disposed in the cover plate of the base space.

10 In an expedient embodiment of the permanent shell-core according to the invention the stacks are arranged inside the concrete article along a grid having perpendicular grid lines, the walls of the stacks situated on the cover plate of the base space having an oblong perpendicular trapezoidal cross-sectional shape, or a shape consisting of rectangles with gradually decreasing width.

15 In an expedient embodiment of the permanent shell-core according to the invention the positioning spacer has a rod-like interconnecting section and an insertion tongue disposed at the end of the interconnecting section, the insertion tongue lying at an angle of 70-85° relative to the bottom of the base space, with the interconnecting section having different length at different sides of the base space, and being made of thermoplastic plastic.

The permanent shell-core according to the invention also comprises a load bearing insert that can be temporarily placed in the base space.

20 Brief description of drawings

The permanent shell-core according to the invention is described in detail with reference to the accompanying drawings, where

Fig. 1 shows the top plan view of the permanent shell-core according to the invention,

25 Fig. 2 is a section of the permanent shell-core of Fig. 1 taken along plane X-X,

Fig. 3 shows a rotated view of a section of the permanent shell-core of Fig. 1 taken along plane Y-Y,

Fig. 4 shows the through-cut situated on the cover plate of the base space of the permanent shell-core according to the invention,

30 Fig. 5 is a section of the permanent shell-core of Fig. 1 taken along plane Z-Z,

Fig. 6 shows a magnified view of detail P of Fig. 3,

Fig. 7 illustrates an alternative implementation of the detail shown in Fig. 6,

Fig. 8 shows the top plan view of a permanent shell-core according to the invention inserted into a mould space,

Fig. 9 shows a sectional view of Fig. 8 taken along plane Q-Q,

Fig. 10 shows the top plan view of a hollow concrete article,

5 Fig. 11 is a sectional view of Fig. 10 taken along plane R-R,

Fig. 12 shows the top plan view of the permanent shell-core according to the invention, including a stack with a “H” symbol,

Fig. 13 shows the top plan view of the permanent shell-core according to the invention, with a stack configured for a solar cell,

10 Fig. 14 shows a top plan view of the permanent shell-core according to the invention, with stack having cross sectional shapes suggesting a digital display,

Fig. 15 shows the top plan view of the permanent shell-core according to the invention, including a stack with a “+” symbol,

15 Fig. 16 shows the top plan view of the permanent shell-core according to the invention, having a “C” symbol,

Fig. 17 shows the top plan view of the permanent shell-cores according to the invention included in a mould set with a mould space having base module dimensions $L \times B$,

20 Fig. 18 shows the top plan view of the permanent shell-cores according to the invention included in a mould set with double base module dimensions $L \times 2B$, with a central arrangement in the base module,

Fig. 19 shows the top plan view of the permanent shell-cores according to the invention included in a mould set with double base module dimensions $L \times 2B$, with a side-aligned arrangement in the base module,

25 Fig. 20 shows the top plan view of the permanent shell-cores according to the invention included in a mould set with quadruple base module dimensions $2L \times 2B$, with a central arrangement in the base module,

Fig. 21 shows the through-cut contour with a “leaf” symbol situated on the cover plate of the base space of the permanent shell-core according to the invention, and

30 Fig. 22 shows the top plan view of the permanent shell-cores according to the invention included in a mould set with quadruple base module dimensions $2L \times 2B$, with a side-aligned arrangement in the base module, showing a composite symbol when seen from above.

Best mode of carrying out the invention

Fig. 1 shows the top plan view of a permanent shell-core. Further detail views of the permanent shell-core are shown in Figs. 2, 3, and 5.

In Figs. 1, 2, and 3 a conceivable configuration of the two-level permanent shell-core 5 is depicted. At the first level 5a the shell-core comprises a rectangular block-shaped base space 1 that is open from the direction of its bottom 1a, and is bounded by a cover plate 1b situated opposite the base space bottom 1a. The cover plate 1b has a through-cut 1c with a contour of an expediently chosen geometry.

At the second level 5b, a spatial region (a stack 2) having lower area but proportionately greater height compared to the base space 1 is connected to the through-cut 1c (see Fig. 2). The interior surface 2a of the stack 2 is constituted by straight lines set on the contour line of the through-cut 2c situated on the cover plate 1b of the base space perpendicular to the bottom 1a thereof. The stack 2 is terminated by an end plate 3. The end plate 3 is parallel with the bottom 1a of the base space.

In Fig. 2 there can also be seen the load bearing insert 9 which has solid structure and is dimensioned to fit into the base space 1, where it can be inserted in the direction indicated by the arrow.

In Fig. 4 there can be seen a possible configuration of the through-cut 1c of the cover plate 1b, which in this case is an “arrow” symbol that can be drawn as a continuous, closed curve. It can also be seen in Figs. 1, 2 how the shell-core according to the invention is situated inside a vibro-pressed concrete article specified by the generic parameters $L \times B \times H$ (length x width x height).

In the same drawings a mould space 6 and mould 7 defined by the base module dimensions $L \times B$ characteristic of a concrete article are also shown schematically. The position of the permanent shell-core in the mould space 6 is determined by providing positioning projections 4.

As can be seen in Fig. 2, the end plate 3 of the permanent shell-core adapted for closing the stack 2 is disposed at a height range $0.7-0.9H$ from the bottom 1a of the base space (H is the height of the concrete article). The configuration of the positioning projections 4 is shown in Fig. 5 which is a sectional view of Fig. 1 taken along plane Z-Z, according to which the positioning projections 4 have a respective interconnecting section 4a extending along the bottom 1a and terminating in a tongue 4b that expediently lies at an angle α of $70-85^\circ$ with respect to the plane 1a. As it is described below, setting the tongue

4b at such an angle facilitates the insertion of the permanent shell-core into the mould space 6.

In Figs. 6 and 7 detail P of Fig. 3 is depicted, illustrating the section of the stack wall 2b of the stack 2, with the thickness of the stack wall increasing – corresponding to the load borne – either in steps or continuously from the end plate 3 towards the cover plate 1b of the base space.

Fig. 8 shows the permanent shell-core 15 described above, placed centrally into the mould space 6 of a mould 7 having base module dimensions $L \times B$. The illustrated permanent shell-core 15 has multiple (by way of example, nine) stacks 2 having cylindrical cross section. These stacks 2 are situated at the nodes of an orthogonal grid with a grid distance t .

Fig. 9 is a sectional view of Fig. 8 taken along plane Q-Q, illustrating the permanent shell-core 15 placed in the mould space 6 of the mould 7 situated on the manufacturing plate 8. In this arrangement it can also be seen that the base space 1 of the permanent shell-core 15 is completely filled up by the load bearing insert 9 inserted therein.

The mould space 6 is filled with concrete up to the fill level F, followed by vibro-pressing the concrete in the direction of pressing 11 until the end level 6b of the mould space is reached (which corresponds to the height H of the finished product). The end plate 3 of the previously described stacks 2 prevents the vibro-pressed concrete from entering the internal space of the permanent shell-core 15. During the pressing operation one or multiple concrete bridgings 12 are formed between the end plate 3 and the end level 6b. The concrete bridging 12 and the end plate 3 can subsequently be removed at little additional cost, thereby creating a free connection between the bottom and upper faces of the concrete article for installing additional components.

In Fig. 10 a top plan view of a hollow concrete article 10 is shown, wherein the cavity along section plane R-R is formed applying the permanent shell-core 15.

Fig. 11 shows the entire cross section (along the plane R-R) of the hollow concrete article 10 in a state in which the concrete bridgings 13 and the end plates 3 of the stacks have already been removed. The load bearing insert 9, placed temporarily into the base space 1, is then removed in the direction of the arrow shown in the drawing. The insert can be used again.

The hollow concrete article 10 shown in Figs. 10-11 has a base module size of $L \times B$ and a height H , determined by the base level of mould space 6a and the end level of the finished product.

As it can also be observed in Fig. 10, only the concrete bridgings 13 lying in the plane Z-Z are removed from above the nine stacks of the permanent shell-core, the other concrete bridgings 14 are permanent.

The permanent shell-core is expediently configured in a manner that such a number of stacks 2 are connected to the base space 1 which allow for recognizing various graphical symbols (letters, numbers, etc.). By varying the number and placement of the removable and the permanent concrete bridgings 13, 14, concrete articles displaying multiple different symbols can be produced utilizing the same permanent shell-core. This solution can be applied for producing hollow concrete articles adapted to perform similar functions in higher volumes.

Depending on the number and the arrangement of the stack(s) 2 and on the geometry of the through-cut 1c that constitutes the base of the stack(s) 2, hollow concrete articles adapted for displaying a diverse range of symbols and for performing various functions can be produced.

Some of these are illustrated in Figs. 12-16, showing
a permanent shell-core 16 with a "H" symbol,
a permanent shell-core 17 adapted to be applied with a solar cell,
a permanent shell-core 18 with stacks having a base shaped as digital display segments,
a permanent shell-core 19 with a "+" symbol (i.e. red cross, first aid location),
a permanent shell-core 20 with a C° symbol.

In Fig. 1 and Figs. 8-9 the permanent shell-cores are placed into the mould space 6 (with base module dimensions $L \times B$) of a mould 7 shown schematically.

For productivity reasons, mould sets are applied in actual practice for making multiple products in a single run.

A detail of a mould with such a configuration can be seen in Fig. 17 in top plan view. The mould set 21 is produced by multiplying the mould space 6 having base module dimensions $L \times B$.

In addition to the obviously higher productivity provided by mould sets, Fig. 17 also illustrates the flexibility of application of the permanent shell-cores. Applying mould spaces 6 with identical base module dimensions with the shell-cores 15, 16, 17, three different products can be manufactured simultaneously.

Concrete articles produced applying mould sets are often made according to a dimension series.

The base of the series is a base module with dimensions $L \times B$ (length $\times$ width), with the elements having double or quadruple dimensions ($L \times 2B$ or $2L \times 2B$) allowing for various possible applications.

As illustrated in Figs. 18, 19, 20, 22, by inserting the permanent shell-cores into mould spaces produced by doubling or quadrupling the base modules with dimensions $L \times B$ further product variants can be provided.

In Fig. 18 a detail of a mould set 23 with mould spaces 22 having double base module dimensions $L \times 2B$ can be seen in top plan view. Permanent shell-cores designated with the reference numerals 5 and 17 were placed in these mould spaces 22 such that the centre points of the cores coincide with the $L \times B$ base module centre points.

By modifying the length of the interconnecting sections 4a of the spacers (positioning projections) 4 of the permanent shell-cores 5, 15, 16-20 on one side, and/or removing the spacers 4 on some of the sides, the position of the permanent shell-cores inside a given mould space can be easily modified.

Fig. 19 also shows a mould set 23 comprising mould spaces 22 with double base module dimensions. The spacers (positioning projections) 4 were removed at one side of each permanent shell-core 17, 18 placed into the mould space 22, with the interconnections sections 4a being lengthened at the respective opposite sides. This configuration allows that the two permanent shell-cores having base module dimensions are in direct contact at one side, and can therefore display a composite symbol, for example a number and a measurement unit (C°) in the same concrete article.

In Fig. 20 a detail of a mould set 25 with mould spaces 24 having quadruple base module dimensions $2L \times 2B$ can be seen in top plan view. The permanent shell-cores 15, 16, and 19 having base module dimensions were placed into the mould spaces 24 without any modification. Applying this configuration shell-cores having base module dimensions $L \times B$ that can be produced with lower cost at higher volume were included in a larger-size concrete product.

Fig. 21 shows a permanent shell-core 26 with (single) base module dimensions with the positioning projections 4 being removed from two adjacent sides, and with the interconnecting sections 4a being lengthened at the respective opposite sides.

In Fig. 22 there can be seen how the permanent shell-core 26 can be applied for forming a composite symbol with larger surface area in a mould set 25 having mould spaces 24 with quadruple base module dimensions ($2L \times 2B$). In that case, two sides of each permanent shell-core 26 are aligned against the adjacent shell-cores. The possibility for placing differently configured shell-cores (such as the ones designated with the reference numerals 26 and 15) in adjacent mould spaces 24 also exists here.

Applying the permanent shell-cores described in relation to Figs. 17., 18., 19., 20., and 22, the widely known vibro-pressing technology can be applied (in addition to producing solid concrete articles) for producing hollow concrete articles adapted to perform special additional functions, without any modifications to the mould sets 21-23-25 adapted for mass production, or to the manufacturing machines utilizing the moulds.

LIST OF REFERENCE NUMERALS

- 1 base space
- 1a bottom of base space
- 1b base space cover plate
- 1c through-cut
- 2 stack
- 2a interior stack surface
- 2b stack wall
- 3 end plate
- 4 positioning projection
- 4a interconnecting section
- 4b tongue
- 5 permanent shell-core
- 5a first level of permanent shell-core
- 5b second level of permanent shell-core
- 6 mould space with module size $L \times B$
- 6a base level of mould space

- 6b end level of mould space
- 7 mould
- 8 manufacturing plate
- 9 load bearing insert
- 5 10 hollow concrete body
- 11 direction of pressing
- 12 concrete bridging
- 13 removed concrete bridging
- 14 permanent concrete bridging
- 10 15 permanent shell-core with cylindrical stacks
- 16 permanent shell-core
- 17 permanent shell-core
- 18 permanent shell-core
- 19 permanent shell-core
- 15 20 permanent shell-core
- 21 mould set
- 22 mould space $L \times 2B$
- 23 mould set
- 24 mould space $2L \times 2B$
- 20 25 mould set
- 26 permanent shell-core with bilateral positioning projections

CLAIMS

1. Permanent shell-core for producing internal cavities of vibro-pressed concrete articles, the shell-core defining a three-dimensional spatial region, where the base plane of the spatial region coincides with a bounding plane of the concrete article (10) and is open from this direction characterised in that the three-dimensional spatial region of the shell-core has two connected levels built upon one another, where the first level (5a) of the spatial region is formed by a low-height base space (1) and the second level (5b) thereof is formed by an upright stack (2) disposed on at least one through-cut (1c) formed in the cover plate (1b) of the base space, the cover plate (1b) being parallel with the bottom of the base space (1a), where the stack (2) ends at an end plate (3) disposed parallel with the bottom of the base space (1a) at a height of 70-90% of the total height dimension of the concrete article (10), with the bottom of the base space (1a) having at least one respective positioning projection (4) arranged in the plane thereof in at least two directions, and with an optional load bearing insert (9) being also receivable in the base space (1).

2. The permanent shell-core according to Claim 1, characterised in that the vertical projection of the base space (1) is a regular plane figure (square, rectangle, polygon, circle, ellipse).

3. The permanent shell-core according to Claim 1 or 2, characterised in that the through-cut (1c) formed in the cover plate (1b) of the base space (1) is a regular plane figure (square, rectangle, polygon, circle, ellipse) or a graphic pattern that can be drawn as a continuous closed curve.

4. The permanent shell-core according to any one of Claims 1-3, characterised in that the interior surface (2a) of the stacks (2) is constituted by walls perpendicular to the cover plate (1b) of the base space.

5. The permanent shell-core according to Claim 1, characterised in that more than one through-cuts (1c) of identical or different geometrical shape are disposed in the cover plate (1b) of the base space (1).

6. The permanent shell-core according to Claim 1, characterised in that the stacks (2) are arranged inside the concrete article (10) along an equidistant grid having perpendicular grid lines.

7. The permanent shell-core according to any one of Claims 1-6, characterised in that the walls (2b) of the stacks (2) situated on the cover plate (1b) of the base space (1) have an oblong perpendicular trapezoidal cross-sectional shape.

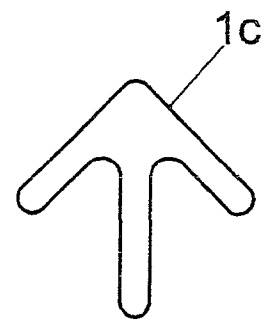
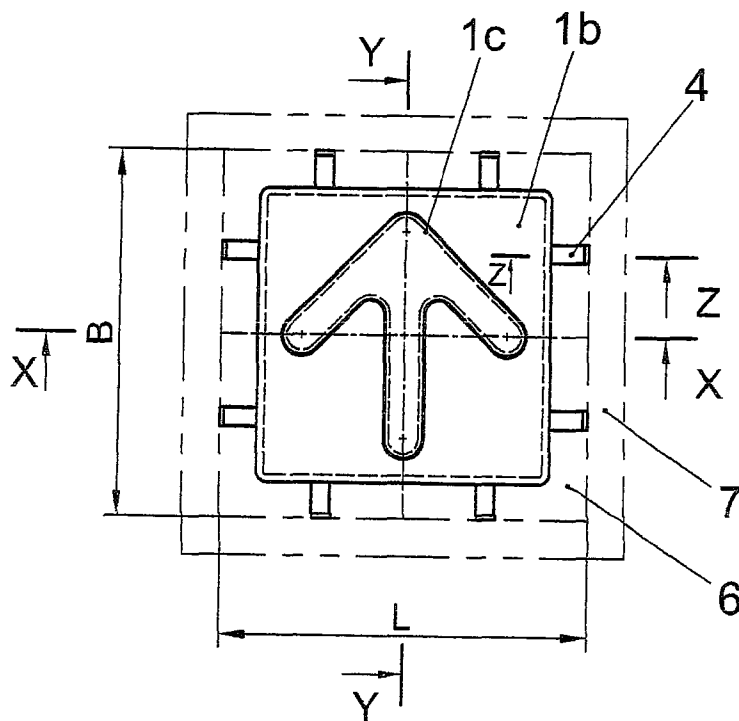
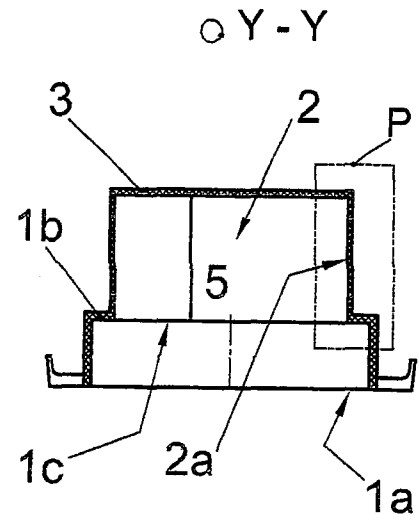
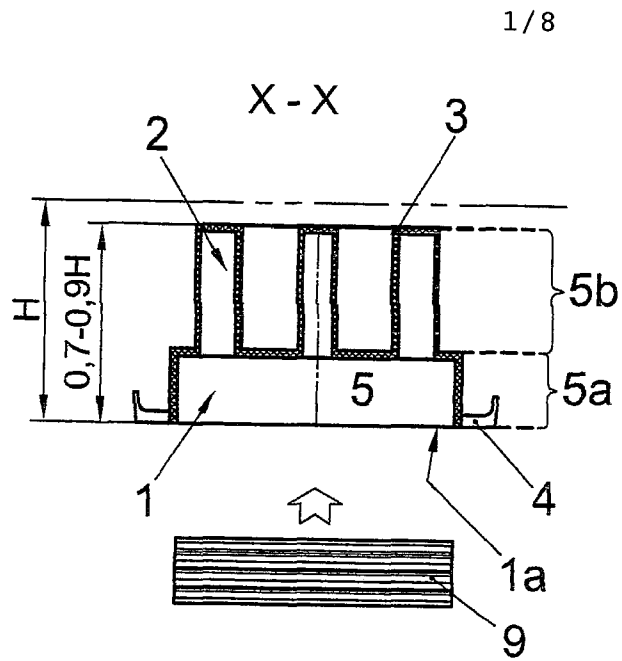
5 8. The permanent shell-core according to any one of Claims 1-6, characterised in that the walls (2b) of the stacks (2) situated on the cover plate (1b) of the base space (1) have a cross-sectional shape consisting of rectangles having gradually decreasing width.

9. The permanent shell-core according to any one of Claims 1-8, characterised in that the positioning projection (4) has a rod-like interconnecting section (4a) and an insertion tongue (4b) disposed at the end of the interconnecting section (4a).

10 10. The permanent shell-core according to Claim 9, characterised in that the insertion tongue (4b) of the positioning projection (4) lies at an angle of 70-85° with respect to the bottom (1a) of the base space.

11. The permanent shell-core according to Claim 9, characterised in that the interconnecting section (4) of the positioning projection (4a) has different length at
15 different sides of the base space (1).

12. The permanent shell-core according to any one of Claims 1-11, characterised in that it is made of thermoplastic plastic material.



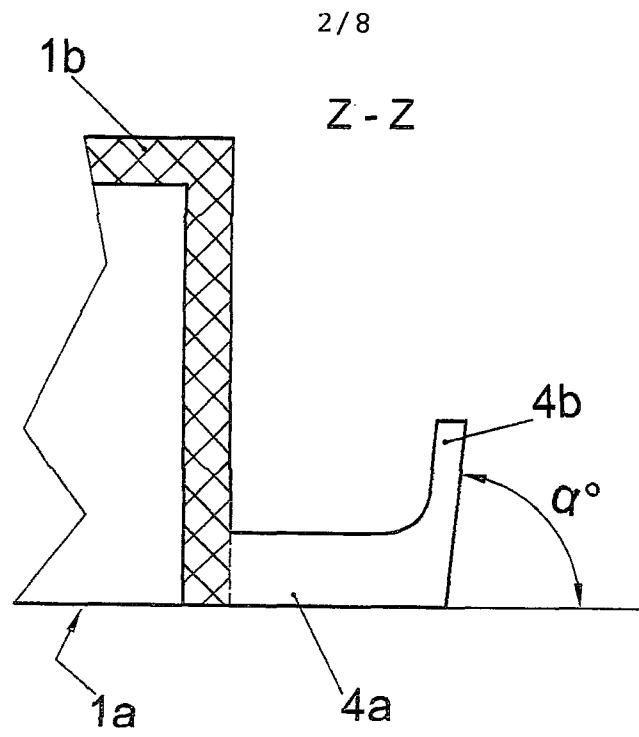


Fig. 5

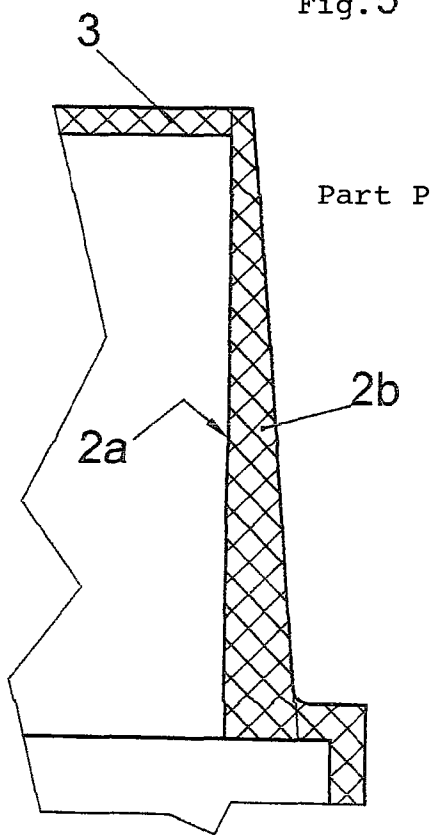


Fig. 6

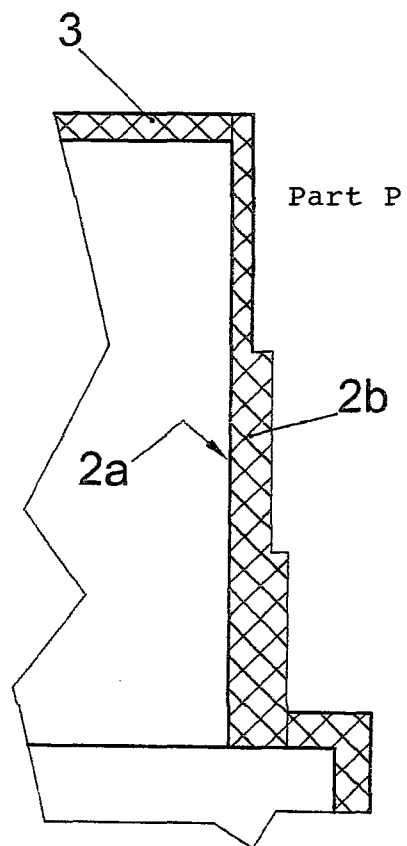
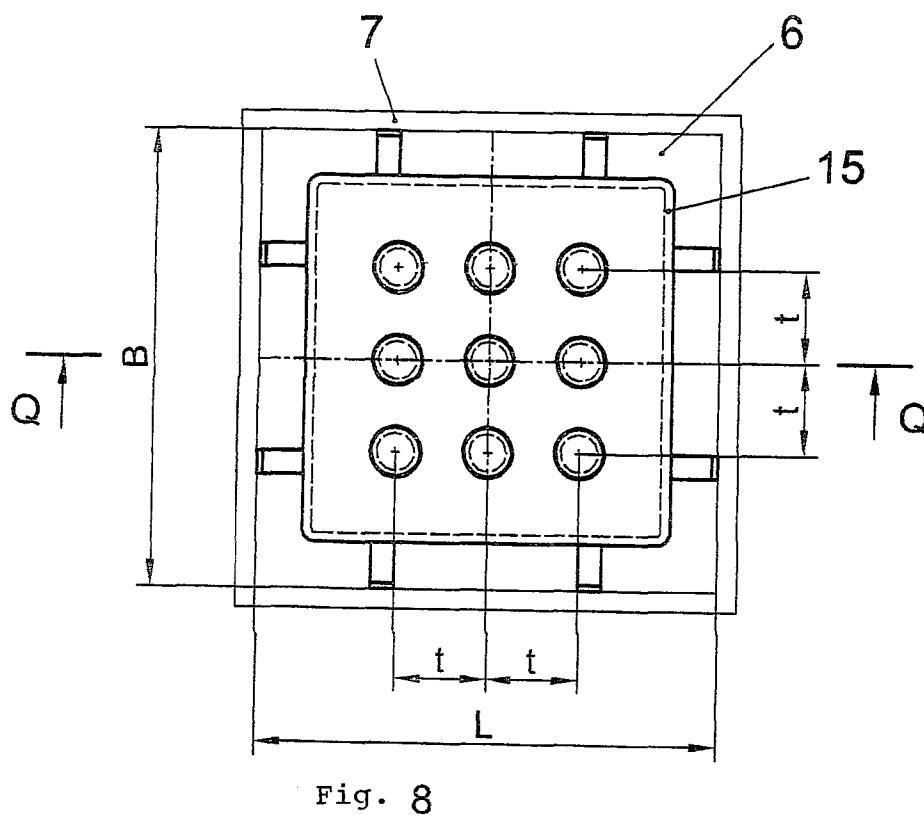
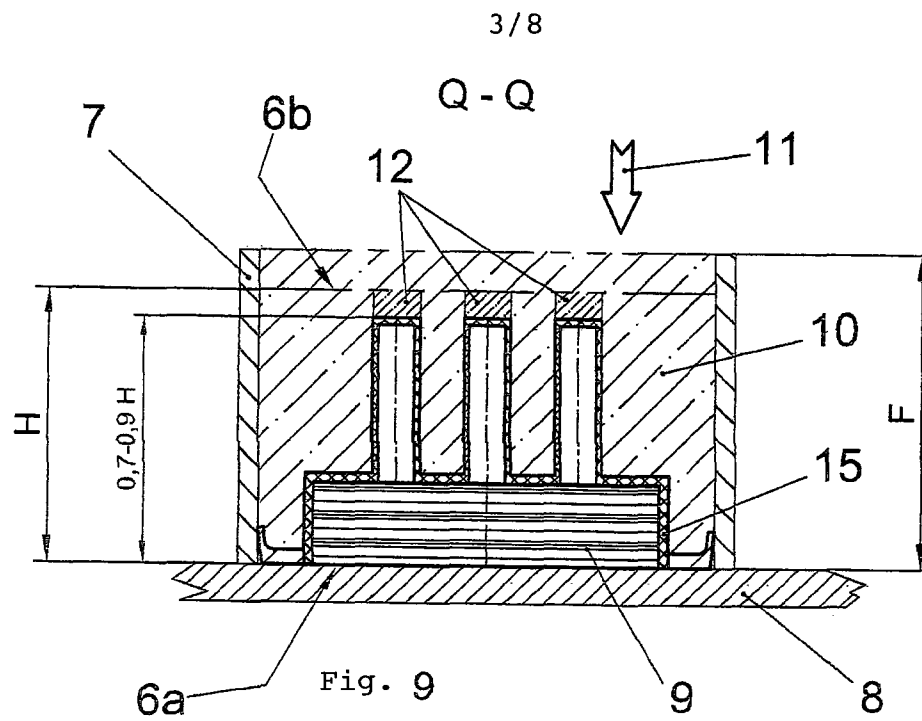


Fig. 7



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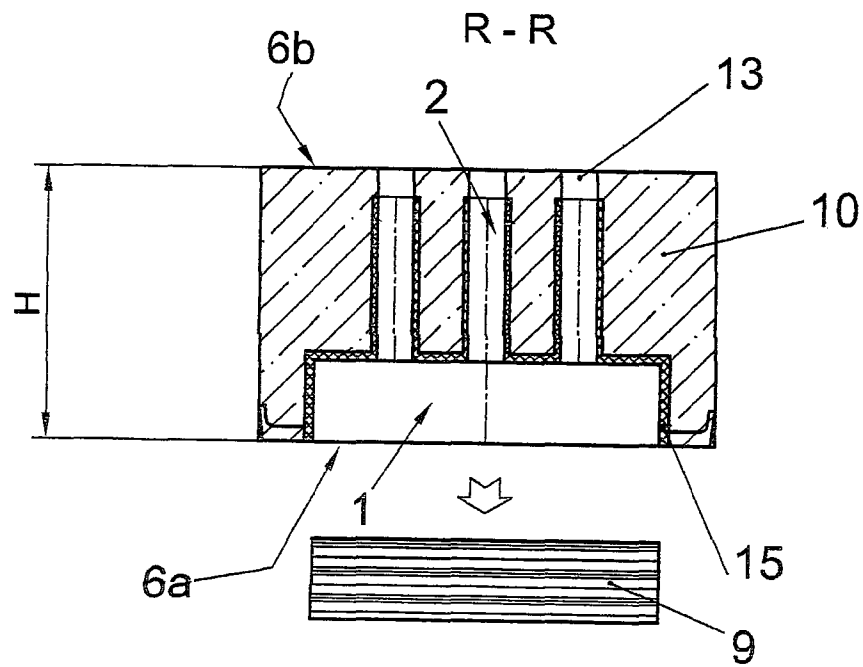


Fig. 11

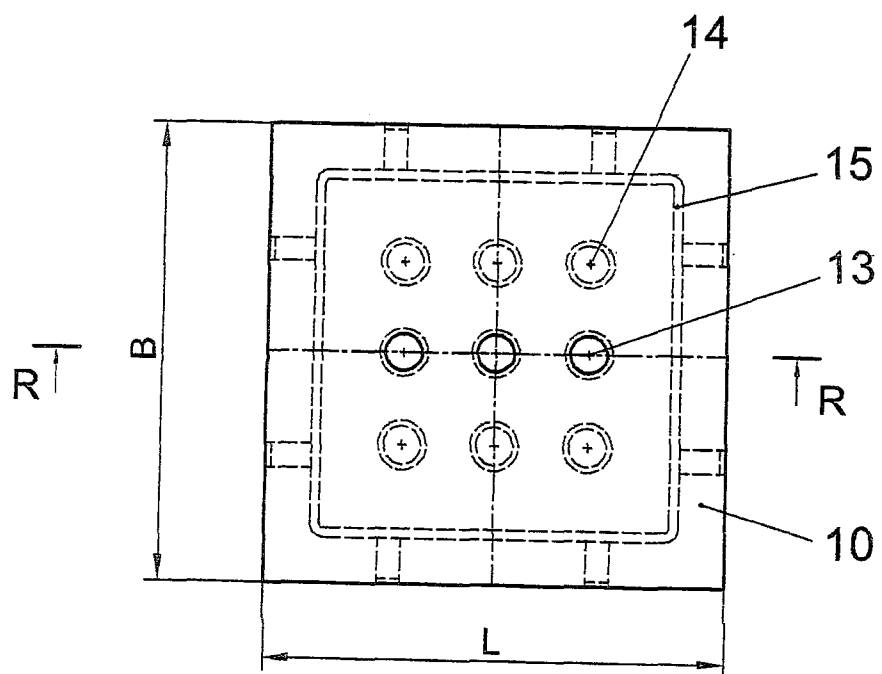


Fig. 10

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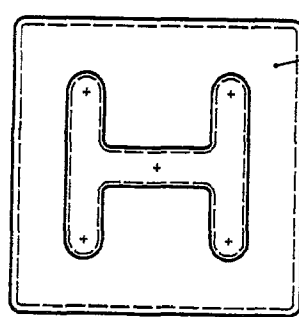


Fig. 12.

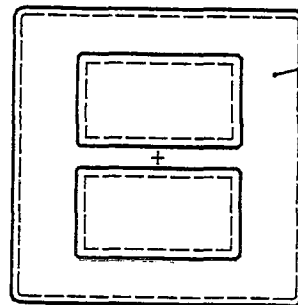


Fig. 13

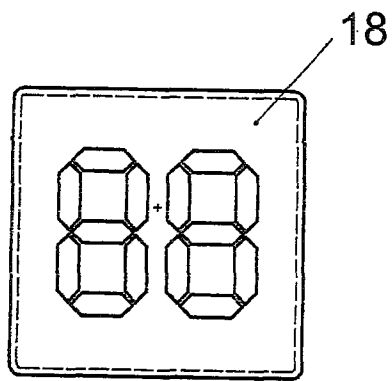


Fig. 14

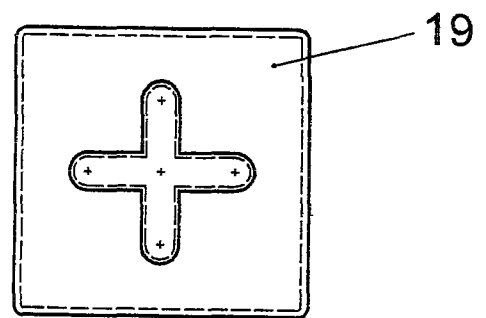


Fig. 15

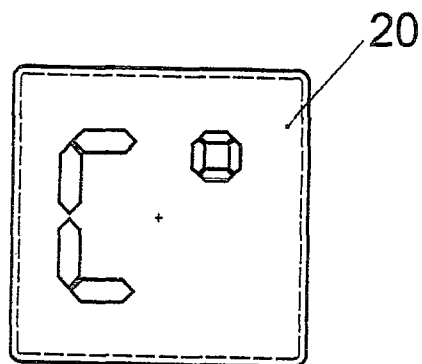


Fig. 16.

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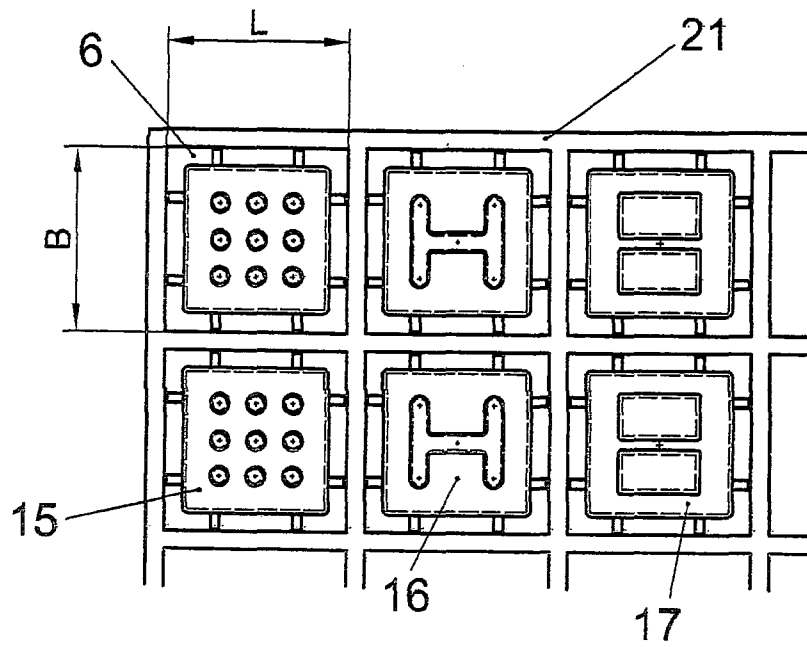


Fig. 17

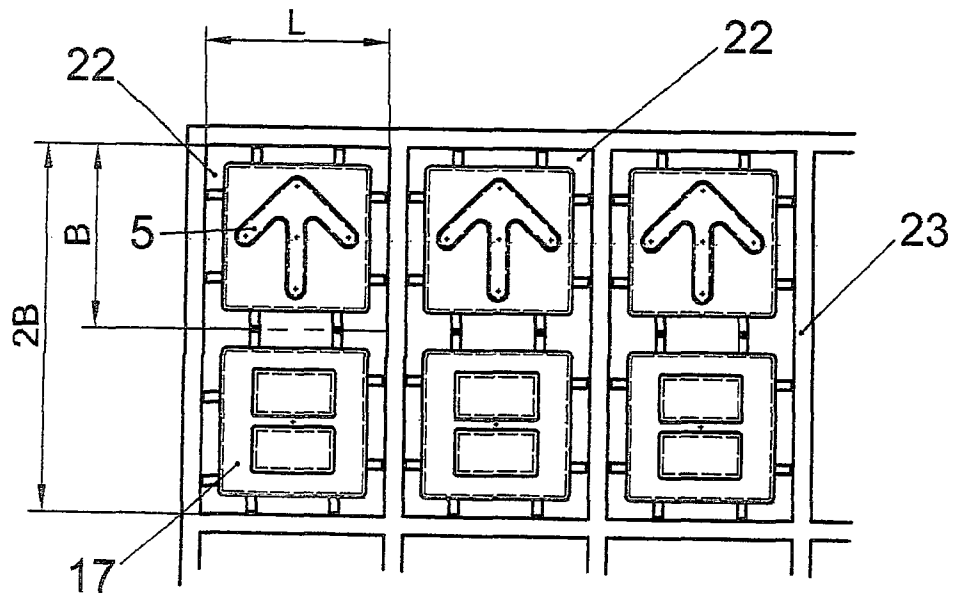
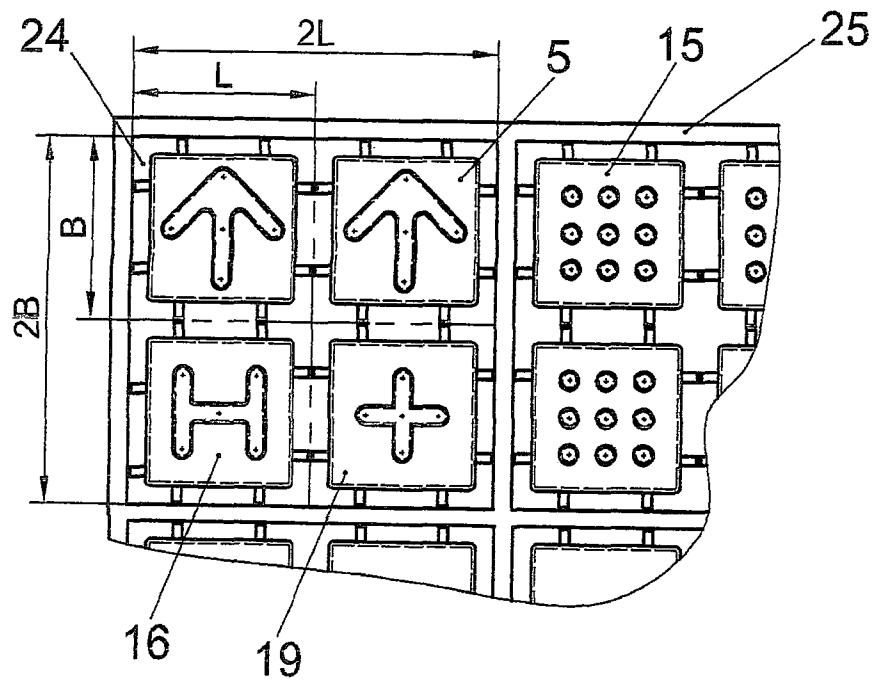
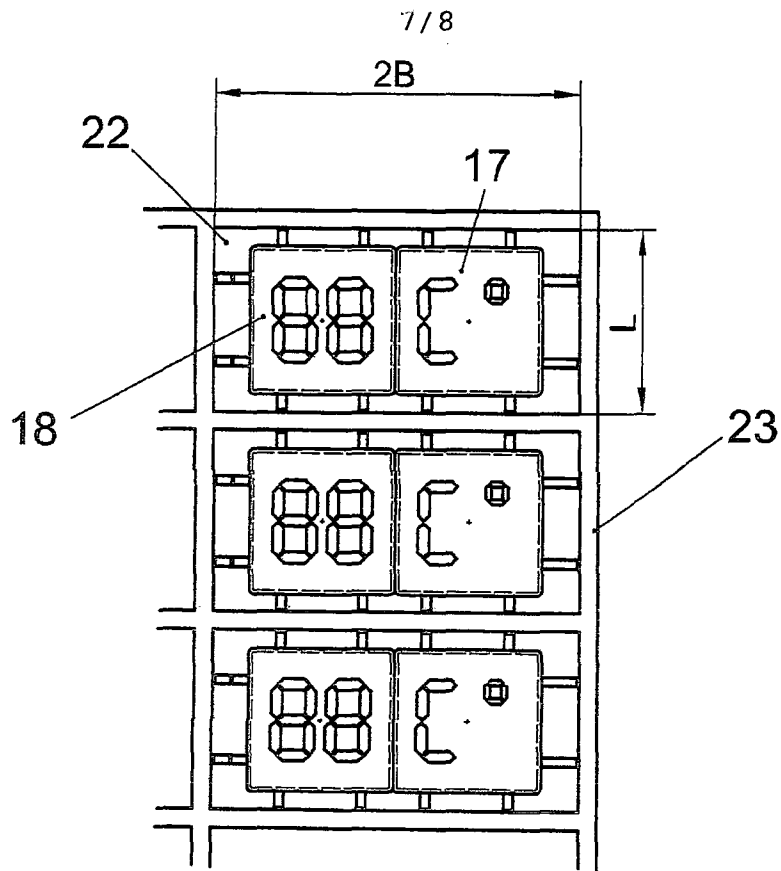


Fig. 18



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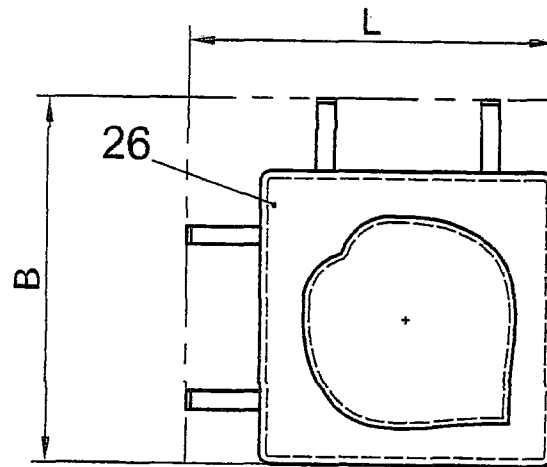


Fig. 21

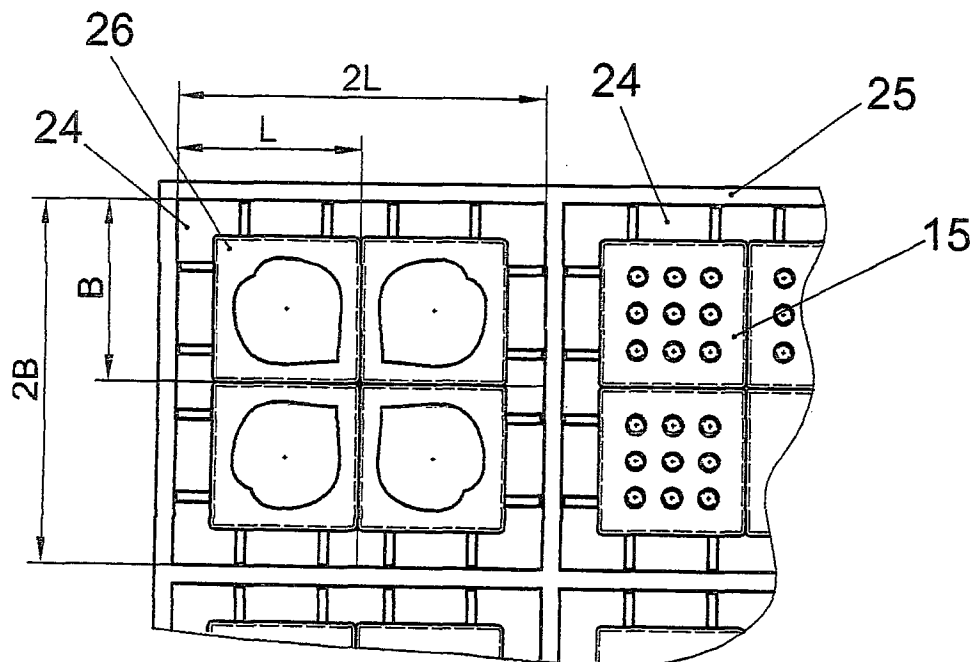


Fig. 22

INTERNATIONAL SEARCH REPORT

International application No

PCT/HU2016/000048

A. CLASSIFICATION OF SUBJECT MATTER

INV. B28B7/34 B28B23/00 E04C2/54
ADD.

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

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

B28B E04C

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

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

EPO-Internal, WPI Data

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	DE 10 2007 031935 A1 (FRANZKE JÖRG ET AL) 2 January 2009 (2009-01-02) abstract paragraph [0007] - paragraph [0017] paragraph [0034] - paragraph [0046] paragraph [0050] - paragraph [0055] claims figures	1-12
X	US 2004/211138 A1 (SAKNO) 28 October 2004 (2004-10-28) abstract paragraph [0018] paragraph [0050] - paragraph [0051] claims figures	1-6,12



Further documents are listed in the continuation of Box C.



See patent family annex.

* Special categories of cited documents :

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

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

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

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

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

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

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

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

"&" document member of the same patent family

Date of the actual completion of the international search

18 November 2016

Date of mailing of the international search report

30/11/2016

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Authorized officer

van der Zee, Willem

INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No

PCT/HU2016/000048

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
DE 102007031935 A1	02-01-2009	DE 102007031935 A1	02-01-2009
		WO 2009003941 A1	08-01-2009

US 2004211138 A1	28-10-2004	AU 2002227821 A1	30-07-2002
		US 2004211138 A1	28-10-2004
