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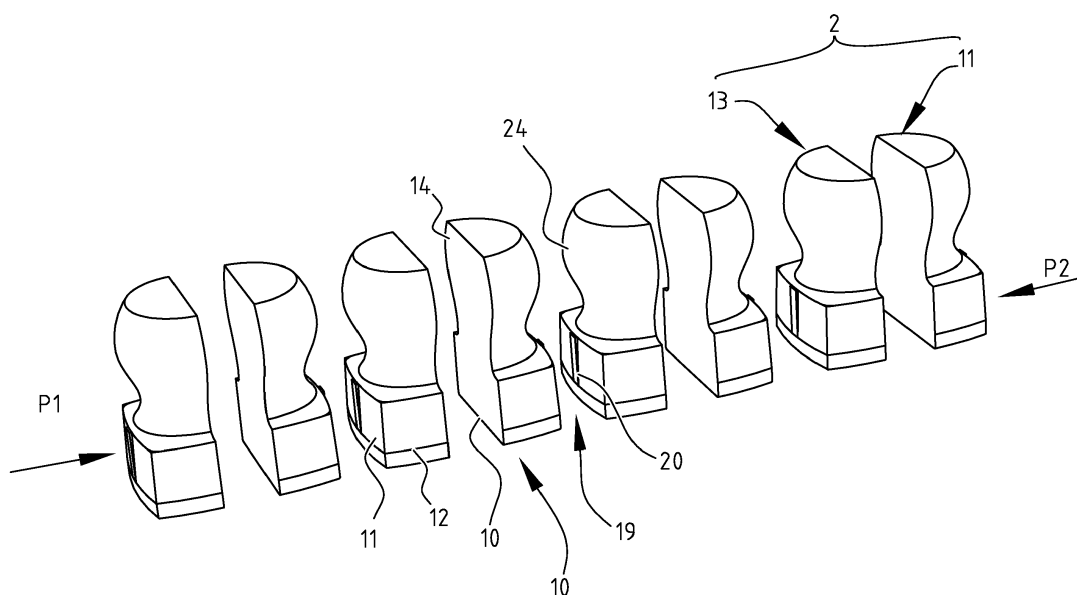
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(54) REVETMENT ELEMENT WITH SPACERS

(57) The invention relates to a revetment element for revetting the sloping side of an elevation or excavation, in particular for an incline or slope, the revetment element comprising a column-like concrete element comprising a base part, a head part and a neck part between the base part and head part, wherein the cross-section at the position of the neck part is smaller than the cross-sections at the position of the base part and the head part and wherein at least one of the base part and the head

part has side surfaces with an at least partially convex and/or tapering form; wherein the revetment element comprises at least one support element formed on a side surface or placeable against a side surface, wherein the support element is formed for the purpose of increasing the contact surface with an adjacent revetment element during use in order to absorb transverse forces exerted or to be exerted on the revetment element.

**FIG. 2****EP 3 078 777 A1**

Description

[0001] The invention relates to a revetment element, in particular a waterside revetment element for revetting a bank/shore, the revetment element comprising a column-like concrete element comprising a base part and a neck part, wherein the cross-section at the position of the neck part is smaller than the cross-section at the position of the base part, wherein at least the base part has side surfaces with an at least partially convex and/or tapering form and wherein the revetment element is formed so as to allow both the base part and the head part of adjacent revetment elements to have a mutual contact surface during use.

[0002] The invention also relates to an assembly of a number of (waterside) revetment elements placed or placeable adjacently of each other in order to form a revetment.

[0003] For the purpose of revetting slopes of elevations such as dikes, sea defences and the like use can be made of concrete set stones, also referred to as concrete waterside revetment elements. These waterside revetment elements are placed in a determined relation on the surface (for instance directly onto the slope or onto a separate substrate) and protect the slopes against external influences, for instance against the action (for instance under the influence of wave action) of water of a water mass (sea, lake, waterway) present adjacently of the elevation or excavation.

[0004] Different types of set stones are applied in practice, such as block-like set stones and column-like joining stones. The different types of set stone are used to realize different types of revetment, more particularly a closed revetment (also referred to as closed slope) and an open revetment (also referred to as an open slope).

[0005] It is known to make use of a large number of concrete set stones, which are placed in a relation of rows such that the sloping side of the elevation or excavation is revetted over at least a part of its surface. The relation in which the set stones are placed in combination with the type of set stone can result in the above stated different types of revetment. The above stated block-like set stones are used for the purpose of realizing a closed slope, i.e. an inclining surface where the water flows substantially only against the upper side (i.e. side directed toward the water). These set stones have a cross-section such that they can be placed against each other substantially without intermediate space. In the case that a water defence is revetted this means that the water tends not to flow along the sides of the block-like set stones, or does so only to a very small extent.

[0006] Examples of waterside revetment elements embodied to protect banks/shores against the influence of water masses by realizing a closed slope are described in documents NL 1019174 C and AU 546 743 B2.

[0007] Use can be made of above stated column-like set stones or column-like revetment elements for the purpose of providing an open slope. These column-like wa-

terside revetment elements are formed such that an intermediate space forms between the revetment elements placed adjacently of each other. Water can flow via this intermediate space, which can result in lower overpressure under the revetment elements as a result of water movements. For the purpose of realizing an open slope use can also be made of a type of waterside revetment element formed with a relatively wide head part, a relatively narrow neck part and then a relatively wide base part. When the waterside revetment elements are placed adjacently of each other, the neck parts form an intermediate space which forms as it were a laterally extending channel along which water can flow. The head parts have a cross-sectional surface area here such that openings are present between the revetment elements. These openings form a connection to the above stated channel so that water can flow from the water mass, via the openings and into the channel (or the channels) and this water can conversely also flow out of the channel again. The sides of the foot parts can further be given a tapering and/or convex form so that intermediate spaces are formed between adjacent foot parts where fixing material, such as split gravel, can accumulate and become wedged. The above stated flows of water subdue the effect of the water on the waterside revetment, this having a positive effect on the defensive capacities of the revetment.

[0008] It is known to transport such revetment elements in one or more rows of revetment elements placed against each other. The revetment elements are for this purpose pressed toward each other at the outer ends of the rows, for instance by having a gripper of a crane or similar device engage on two outer ends of a row and exert transverse forces toward each other on the revetment elements. As a result of the mutual friction force the revetment elements remain in formation and the whole row (or plurality of rows) can be lifted and transported in one operation, for instance to the loading floor of a truck or to the surface for revetting. The revetment elements need not be supported on their underside here.

[0009] It has however been found in practice that the transverse forces necessary to pick up and displace the row of revetment elements can rise so high and/or these transverse forces engage on the revetment elements at positions such that cracks or fractures can occur in the material of the revetment element. Reducing the magnitude of the transverse forces could possibly prevent this, but there is then the risk that the revetment elements can no longer be picked up in stable manner.

[0010] An example of waterside revetment elements for realizing the above mentioned open slope for the purpose of protecting banks/shores against the influence of a water mass is described in the international patent application WO 2011108931 A1. With these known waterside revetment elements the above stated transverse forces can result in the element breaking. Particularly in embodiments wherein the waterside revetment elements are formed such that in use both the head parts and the

base parts of adjacent revetment elements come to lie against each other and thus make contact with each other there is a chance of breakage, particularly at the position of the throat part.

[0011] It is an object of the invention to provide a revetment element and an assembly of a number of revetment elements in which at least one of the above stated drawbacks is obviated.

[0012] It is a further object of the invention to provide revetment elements which, when placed successively in a row, can be picked up and transported quickly, easily and in stable manner wherein there is little risk of damage, for instance as a result of cracking and/or breakage.

[0013] According to a first aspect of the invention, at least one of the objects is at least partially achieved in a (waterside) revetment element of the type stated in the preamble wherein the revetment element comprises at least one support element formed on a side surface or placeable against a side surface, wherein the support element has a substantially flat side surface in order to provide a substantially flat contact surface with a support element of the adjacent revetment element for the purpose of increasing the contact surface with the adjacent revetment element during use in order to absorb transverse force exerted or to be exerted on the revetment element.

[0014] In use, i.e. when at least two revetment elements are pressed against each other, the optionally flat sides of the support elements of adjacent revetment elements are placed against each other. The pressing force, brought about for instance by a gripper with which an assembly of revetment elements can be fixedly clamped, can in this way be distributed over a greater contact surface at the position of the base part and/or head part (at the position where the support elements are situated). This decreases the chance of damage to the revetment elements resulting from the tensile forces occurring because of the pressing.

[0015] According to an embodiment the side surface of the base part and/or head part is shaped so as to provide a contact surface extending over at least half, preferably more than 70% or 90%, of the height of the base part and/or head part. Distributing the transverse force over such a great part of the height of for instance the base part reduces the chance of "buckling" of the revetment element, and thereby the occurrence of undesirable tensile forces in the concrete.

[0016] In determined embodiments the revetment element has no head part or it has a head part of a smaller cross-section than the base part. In these embodiments only the base parts of adjacent revetment elements would be in contact with each other in use. Provided in other embodiments are both a base part and a head part which have shape and dimensions such that the head parts and base parts contact each other (and so have respective contact surfaces) when the revetment elements are disposed adjacently of each other. The support elements can be provided on the base part and/or on the

head part (if present). It is preferably the case that the support elements are provided on that part of the revetment element on which the greatest transverse forces are exerted. In practice this will therefore usually (though not always) be the base part, since the gripper of the crane usually engages on the lower part of the base part.

[0017] According to an embodiment the support element has a substantially flat side surface for the purpose of providing a substantially flat contact surface with a support element of an adjacent revetment element. The side surface can be given a flat (straight) form, although in other embodiments the side surface of a first support element defines a determined shape (for instance a curved shape and/or a shape with protrusions) while a second support element defines a counter-shape.

[0018] According to an embodiment the revetment element comprises a first and a second support element, wherein the first support element is provided on a first side surface of a base and/or head part and the second support element is provided on a second side surface opposite the first side surface. The revetment element can be manufactured integrally here or from two or more revetment element parts to be placed against each other. When there are for instance two half-revetment element parts which together form a revetment element, each of the revetment element parts is provided with a single support element of its own.

[0019] In determined embodiments the support elements are provided only on the said side surfaces. The support elements hereby ensure absorption of transverse forces in a single direction. In other embodiments support elements are provided on more sides (for instance on four sides) of the head part and/or the base part so that the support elements are suitable for absorbing transverse forces in two (orthogonal) directions.

[0020] According to an embodiment the support element forms an elongate contact surface, preferably with a width of at least 1 cm and a maximum of 10 cm.

[0021] According to an embodiment the base part is formed for the purpose of providing a first contact surface at the position of the lower edge of the base part and a second contact surface between the lower edge and the upper edge of the base part. The second contact surface can be formed here on the support element. The contact surface is in this way enlarged toward the top, this reducing the chance of damage when transverse forces occur.

[0022] According to an embodiment the cross-sectional dimensions of the neck part are at least 20% smaller than those of the head part in order to form a throughflow space between adjacent neck parts and/or the cross-sectional dimensions of the head part are at least 10% smaller than those of the base part. Once the revetment elements have been placed on the surface for revetting, intermediate spaces must be left between the base parts of adjacent revetment elements so that sand and similar material is given the opportunity to accumulate in the intermediate spaces and anchor the revetment elements to each other.

[0023] Provided according to an embodiment is an assembly of revetment elements of the type described herein placed or placeable against each other. The revetment elements are preferably waterside revetment elements for protecting a bank/shore against the influence of an adjacent water mass. The waterside revetment elements are preferably embodied here such that the neck parts thereof are suitable for forming an intermediate space along which water can flow away in lateral direction. The intermediate space can for instance take the form of a system of laterally extending channels (i.e. channels extending perpendicularly of the height direction of the waterside revetment element) along which water can flow. An open slope can be realized with the thus embodied waterside revetment elements.

[0024] Further advantages, features and details of the present invention will be elucidated on the basis of the following description thereof. Reference is made in the description to the accompanying figures, in which:

Figure 1 shows a cross-section through a dike provided with an assembly of revetment elements according to an embodiment of the invention;

Figure 2 shows a perspective view of a row of revetment elements comprising eight part-elements in the situation before they are pressed toward each other on the end surfaces of the row;

Figure 3 shows the revetment elements of figure 2 in the situation in which the part-elements have been pressed against each other;

Figure 4 shows a detail view of the base part of a revetment element provided with a support element according to an embodiment of the invention;

Figure 5 shows a detail view of the foot parts of two revetment elements positioned adjacently of each other, wherein the support elements are placed directly against each other;

Figure 6 shows a perspective view of a number of revetment elements placed against each other, wherein head parts make direct contact with each other and the foot parts make contact only via support elements;

Figure 7 shows a top view of a row of revetment elements placed against each other; and

Figures 8-10 show respective side views of revetment elements according to further embodiments of the invention.

[0025] Shown in figure 1 is a situation in which an assembly of revetment elements according to the invention is applied. In the shown situation the revetment elements are intended for the purpose of revetting the oblique side of a slope of a dike or similar water defence for retaining a water mass. The revetment must on the one hand be able to withstand long-term influences of the water but must on the other hand have an appearance which is as natural as possible.

[0026] Shown in figure 1 is an example in which the

revetment is arranged on a slope (H) of a dike (D). The dike is arranged on a substrate (B) and has the function of retaining the water (W) of an adjacent waterway or the like. The revetment comprises an assembly 1 of separate revetment elements 2. The revetment elements are placed in a number of rows and columns adjacently of each other on the slope.

[0027] Referring to figure 3, a concrete revetment element 3 is shown. This revetment element is essentially column-like. The lower outer end of the revetment element, also referred to herein as base part 6, has a substantially polygonal cross-section while the upper outer end of the revetment element, also referred to herein as head part 4, has a round, for instance substantially circular or oval cross-section. Other shapes of the revetment element are of course also possible. In the shown embodiment a neck part 5 is provided between head part 4 and base part 6. Just as the head part, this neck part has a substantially round cross-section. The cross-section at the position of the neck part is however smaller than that of the base part and of the head part.

[0028] Provided as a result of the shape and dimensions of neck parts 5 relative to the head parts are throughflow passages or throughflow spaces 7 along which water can flow. The width (b_1) of head part 4 is preferably roughly as great as the width (b_3) of base part 6, while the smallest width (b_2) of neck part 5 is much smaller than the width of head part 4. When the revetment elements are placed against each other there will be contact surfaces at the position of the head part and the base part where the revetment elements make contact with each other. Via openings 20 (figure 7) between the adjacent head parts 4 water (W) from the water mass can enter the continuous throughflow space 7 formed between neck parts 5.

[0029] Referring to figure 2, each revetment element 2 can be constructed in a determined embodiment from two (or more) revetment element parts 13, 13'. In the shown embodiment a revetment element further consists of two identical halves, wherein each half (revetment element part) has a flat side 14. In the situation of use revetment element parts 13 are placed with their flat sides 14 against each other in order to together form a single (assembled/combined) revetment element 2. In other embodiments however, the revetment elements have a monolithic structure and are formed as one part.

[0030] The combined revetment element 2 further has a flat underside 10 with which it can rest in stable manner on a flat surface, for instance the above stated substrate (B) or the loading floor of a truck. Base part 6 of revetment element 2 further has a wide upright side 11 and two narrow upright sides 12. Each of the sides 11, 12 takes a slightly convex form, wherein the convex side is oriented outward.

[0031] When both revetment elements 2 are now placed against each other, for instance when the revetment elements have to be transported or when they are placed on the surface, because of the convex sides 11

of the base part of the revetment element a partial intermediate space 8 (figure 3) will be created between the sides 11 of adjacent revetment elements. The convex form of side surfaces 11 of the revetment elements ensures that, at least at the position of the foot parts or base parts, the revetment elements placed against each other have only a small contact surface. If the whole of the side surfaces were to have a convex form, this contact surface would form a point contact or line contact.

[0032] Figure 2 shows a row of four revetment elements 2, each constructed from two part-elements 13, 13'. When the revetment elements have to be transported, for instance with a truck, from the concrete manufacturer to the destination or from the loading floor of the truck to the surface of the slope, they are pressed against each other by exerting opposing transverse forces (in directions P_1 and P_2) on the end surfaces of the row of revetment elements. This can be realized for instance with a metal gripper (not shown) with clamping jaw which can engage on the end surfaces of the row of revetment elements and press these toward each other until the revetment elements are placed tightly against each other (figure 3). This gripper can for instance be arranged on a crane mounted on the truck or can form part of a machine with which the revetment elements are placed on the slope or the dike. By making the pressing force sufficiently great the revetment elements can be pressed so firmly against each other that the whole row of revetment elements can be lifted in a single operation by the gripper (without further support) and set down at the correct location. Although only a single row of revetment elements is gripped in the figures, two or more adjacent rows of revetment elements can in practice be fixedly clamped and picked up in a single operation.

[0033] Because of the shape of side surfaces 11 of the base parts of the revetment elements the contact surfaces between the revetment elements would form a point contact or line contact. The contact surfaces would hereby be relatively small. In the shown embodiment the foot parts are formed (i.e. with the largest width on the lower edge of the base part and with a width decreasing from the lower edge to the upper edge, for instance by having the base part narrow (in linear manner or in a curve, wherein the curved has for instance a radius of 600 mm)) such that the contact surface defines a point contact. The size of the contact surface is thus extremely small (substantially zero) in this embodiment. In figure 4 the contact surface 19 is shown as being relatively large for the sake of clarity in the drawing. In the shown embodiment the contact surface will in fact be smaller. In other embodiments, for instance in embodiments in which the lower edge of the foot has a less convex side, the contact surface is larger.

[0034] Because of the shown shape of the side surfaces the contact surfaces (which are designated schematically in figures 2 and 4 with reference numeral 19) would further be located at the lower outer end of the revetment element, i.e. close to surface 10. If the above stated

pressing forces now become too great, tensile forces can occur in the revetment elements as a result of the relatively small contact surfaces 19 and/or because of the position of contact surfaces 19 in relation to the further form of the revetment elements. These tensile forces can cause damage to the revetment elements, certainly in the case the revetment elements are manufactured from (non-reinforced) concrete.

[0035] In order to avoid said damage or reduce the risk thereof the surfaces 11 are provided with support elements 20. Support elements 20 are formed in the embodiment of figure 4 by an elongate protruding part which is shaped such that locally the curvature of the side surface is wholly or partially accommodated. A support element 20 more particularly comprises a substantially wedge-shaped strip of concrete material which has on the underside (close to the existing contact surface 19) a relatively small thickness (d) and on the upper side a relatively great thickness (d) (figure 6). The strip of concrete material further forms a flat side 21. When revetment elements 2 are now pressed against each other and adjacent support elements 20, 20' (figure 5) are pressed against each other, an additional contact surface 23 will be realized adjacently of contact surface 19. This further contact surface provides for a more uniform distribution of the forces over the revetment element (in other words, the overall contact surface is increased, is typically five times larger, ten times larger or even larger still). In determined embodiments the contact surface provided by a support element has a width of at least 5%, preferably at least 10% of the overall width of a base part (for instance a width of at least 1 cm, such as 2 cm, at a width of the base part of 25 cm) and/or a height of at least 50% or at least 70% of the height of the base part (for instance 14 cm at a height of the base part of 17 cm).

[0036] The specific position of the additional contact surface 23, i.e. above the original contact surface 19, ensures together with contact surface 24 between adjacent head parts 3 that lesser internal tensile forces occur in the concrete revetment element. These measures greatly reduce the risk of breakage of the revetment elements, for instance during transport in the factory, transport with a truck from factory to the vicinity where the revetment elements have to be placed and transport from the truck to the surface to be revetted.

[0037] In the shown embodiments support elements 20 are formed on both relatively large side surfaces 11 of a revetment element and the other relatively small side surfaces 12 are not provided with such support elements. This means that for transport purposes the revetment elements with their large side surfaces 11 facing toward each other are pressed against each other with sufficient force so as to be able to pick up the whole without support on the underside. When two or more rows of revetment elements are transported simultaneously, the small side surfaces 12 of adjacent rows of revetment elements can optionally make contact with each other. However, since these are not pressed against each other with great force,

the above stated support elements 20 can be dispensed with. In other embodiments support elements are however provided on both the large side surfaces 11 and small side surfaces 12.

[0038] In the shown embodiment support elements 20 are formed such that the flat side 21 extends substantially vertically (when the revetment element is disposed with underside 10 on a horizontal surface). In other embodiments the flat side 21 can also extend obliquely relative to the underside. In these embodiments the support elements are no longer all the same. In a determined embodiment a first side surface 11 has a support element with a flat side which extends obliquely inward while on the opposite second side surface the flat side extends obliquely outward. When the revetment elements are placed against each other in correct manner, a complete contact surface can thus still be realized between adjacent revetment elements. Other variants are also possible, but in many cases are less practical. The side surfaces of the support elements need not for instance be flat. They can have a determined specific shape. As long as this shape can be accommodated by a counter-shape of an opposite support element, a relatively large contact surface can still be realized. With a correct choice of the shape and counter-shape, for instance when side 21 describes an S-shape in cross-section, shifting of the revetment elements relative to each other in up or downward direction can be prevented.

[0039] The support elements can be formed during the production process of the revetment element, for instance by providing a corresponding recess in the mould cavity of the mould and casting concrete into this mould cavity with recess. In other embodiments the support elements are manufactured in a separate production process and, following manufacture, fixed to the revetment elements, for instance by being adhered fixedly thereto. In these embodiments the support element can also be manufactured from a base material other than concrete, for instance plastic. In other embodiments the separately manufactured support elements are not fixed to the revetment element but are placed loosely between the adjacent revetment elements. In these latter embodiments the support elements can be given a substantially dual form relative to the support elements shown in figures: each support element comprises two mutually opposite curved side surfaces shaped to accommodate the curvatures of two adjacent revetment elements.

[0040] Figure 8 shows a row 40 of revetment elements 41 of differing form. In these embodiments a revetment element comprises only a base part 42 and a throat or neck part 43. In the shown embodiments throat or neck part 43 has the form of a truncated sphere. Further embodiments are also shown in figures 9 and 10. In each of these embodiments base part 42 is the same as that of revetment elements 41 of figure 8, although in figure 9 the throat part takes a concave form (with a cavity 45 on the upper side of the revetment element) and in figure 10 the throat part is embodied as a somewhat elongated

sphere (with a spherical shape 46 on the upper side of the throat part). In embodiments without head part or with a head part smaller than the base part there will be no contact surface on the upper side of the revetment element when the revetment elements are placed against each other. This means there is a chance that the revetment elements, when being clamped with a gripper or clamp, can fall out of the gripper/clamp because they incline toward each other and cannot support against the adjacent head parts. Inclining of the revetment elements toward each other can be prevented or reduced by placing one or more of the above stated support elements between the revetment elements.

[0041] The present invention is not limited to the embodiments thereof described herein. The rights sought are defined by the following claims, within the scope of which numerous modifications can be envisaged.

Claims

1. Revetment element, in particular a waterside revetment element for revetting a bank/shore, the revetment element comprising a column-like concrete element comprising a base part and a neck part, wherein the cross-section at the position of the neck part is smaller than the cross-section at the position of the base part, and wherein at least the base part has side surfaces with an at least partially convex and/or tapering form; wherein the revetment element is formed so as to allow both the base part and the head part of adjacent revetment elements to have a mutual contact surface during use and wherein the contact surface is formed at the position of the base part by at least one support element formed on a side surface or placeable against a side surface, wherein the support element has a substantially flat side surface in order to provide a substantially flat contact surface with a support element of the adjacent revetment element for the purpose of increasing the contact surface with the adjacent revetment element during use in order to absorb transverse force exerted or to be exerted on the revetment element.
2. Revetment element as claimed in claim 1, wherein the support element forms an elongate contact surface, preferably with a width of at least 5% or at least 10% of the overall width of a base part and/or with a width of at least 1 cm and a maximum of 10 cm.
3. Revetment element as claimed in claim 1 or 2, wherein the support element is embodied to increase more than 5 or 10 times the overall contact surface between base parts of adjacent revetment elements.
4. Revetment element as claimed in claim 1, 2 or 3, wherein the column-like concrete element compris-

es a base part, a head part and a neck part between the base part and head part, wherein

- the cross-section at the position of the neck part is smaller than the cross-section at the position of the base part and the head part, 5
 - at least one of the base part and the head part has side surfaces with an at least partially convex and/or tapering form,
 - the revetment element comprises at least one support element formed on a side surface or placeable against a side surface, and 10
 - wherein the support element is formed for the purpose of increasing the contact surface with an adjacent revetment element during use in order to absorb transverse forces exerted or to be exerted on the revetment element. 15
5. Revetment element as claimed in any of the foregoing claims, wherein the side surface of the base part and/or head part is shaped so as to provide a contact surface extending over at least half, preferably more than 70% or 90%, of the height of the base part and/or head part. 20
 6. Revetment element as claimed in any of the foregoing claims, wherein the support element is configured to at least partially accommodate the convex and/or tapering form of the side surface of the base and/or head part. 25 30
 7. Revetment element as claimed in any of the foregoing claims, wherein the side surface is substantially straight and/or wherein the side surface is embodied to extend in vertical direction when the revetment element is placed on a horizontal surface. 35
 8. Revetment element as claimed in any of the foregoing claims, comprising a first and a second support element, wherein the first support element is provided on a first side surface of a base and/or head part and the second support element is provided on a second side surface opposite the first side surface. 40
 9. Revetment element as claimed in any of the foregoing claims, wherein the base part is formed for the purpose of providing a first contact surface at the position of the lower edge of the base part and a second contact surface between the lower edge and the upper edge of the base part. 45 50
 10. Revetment element as claimed in any of the foregoing claims, wherein the support element has substantially a wedge shape and/or wherein the base part has a polygonal cross-section and/or wherein the sides take a convex form. 55
 11. Revetment element as claimed in any of the forego-

ing claims, wherein the revetment element takes a monolithic form.

12. Revetment element as claimed in any of the foregoing claims, wherein the concrete of the whole revetment element is substantially homogeneous.
13. Revetment element as claimed in any of the foregoing claims, wherein the cross-sectional dimensions of the neck part are at least 20% smaller than those of the head part in order to form a throughflow space between adjacent neck parts and/or wherein the cross-sectional dimensions of the head part are at least 10% smaller than those of the base part.
14. Revetment element as claimed in any of the foregoing claims, wherein the base part has a polygonal cross-section and wherein the sides take a convex form.
15. Assembly of revetment elements as claimed in any of the foregoing claims placed or placeable adjacently of each other, wherein the revetment elements are in contact with each other at least via the support elements, wherein the revetment elements are preferably waterside revetment elements, the neck parts of which are embodied so as to form an intermediate space along which water can flow away in lateral direction.

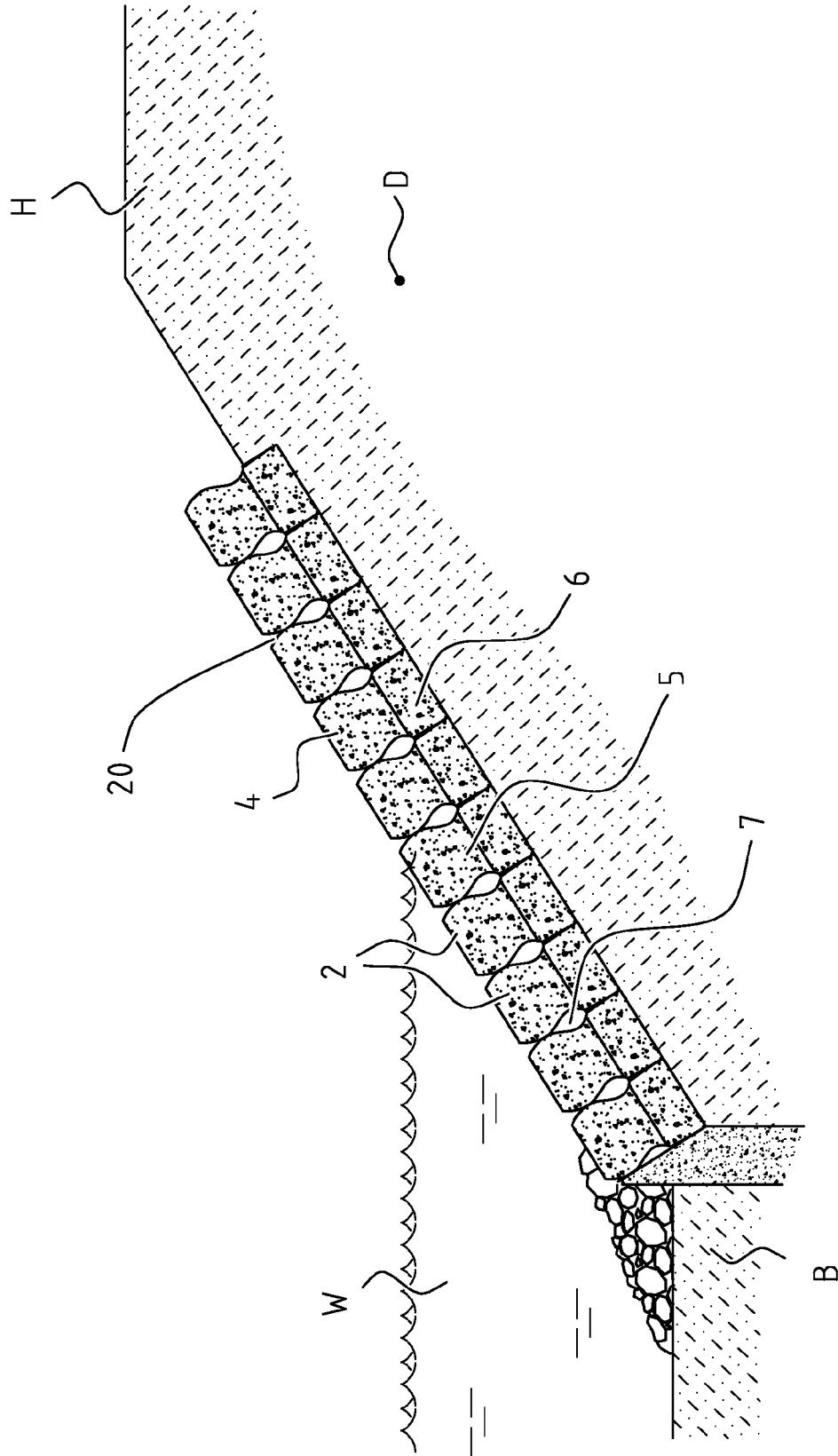


FIG. 1

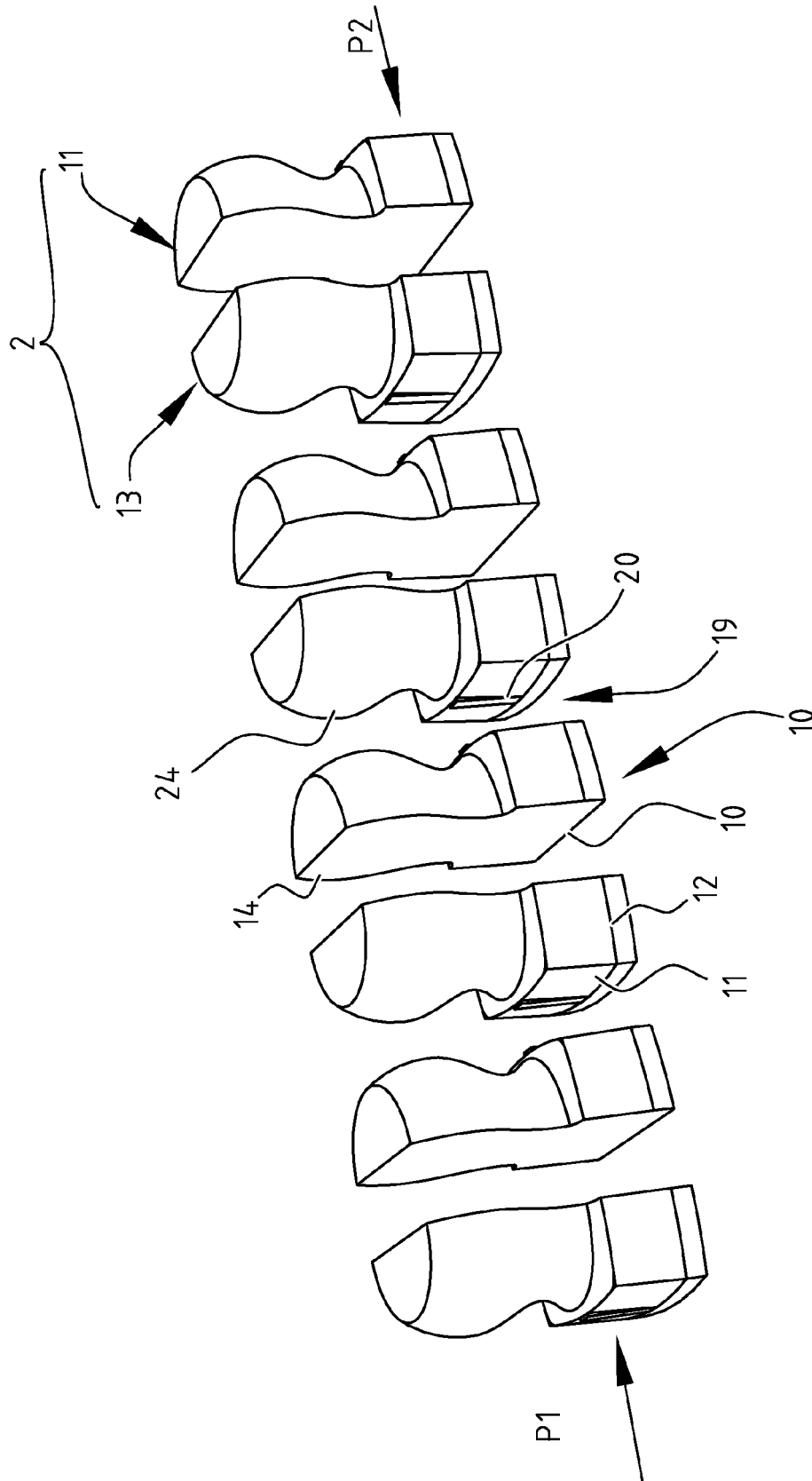


FIG. 2

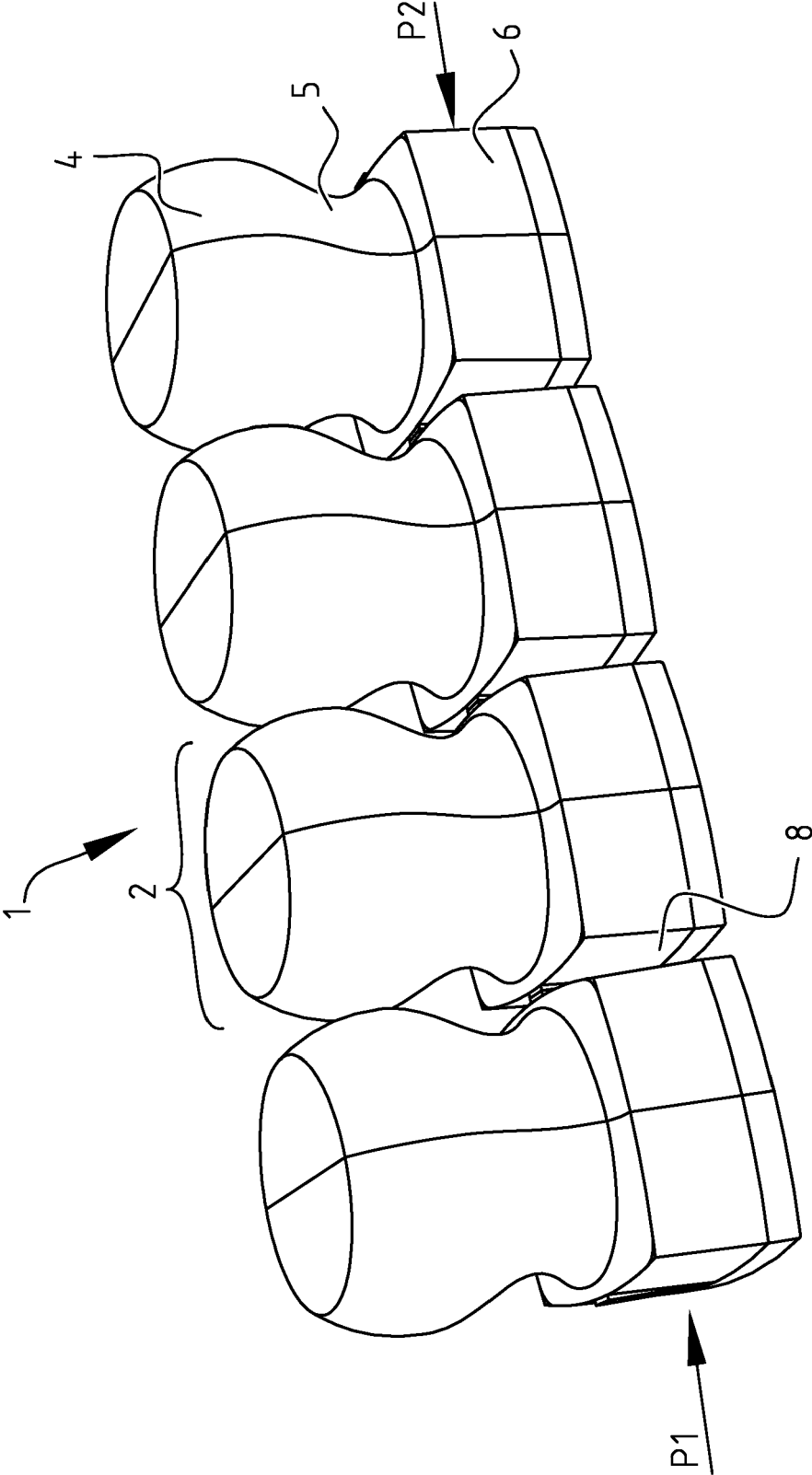


FIG. 3

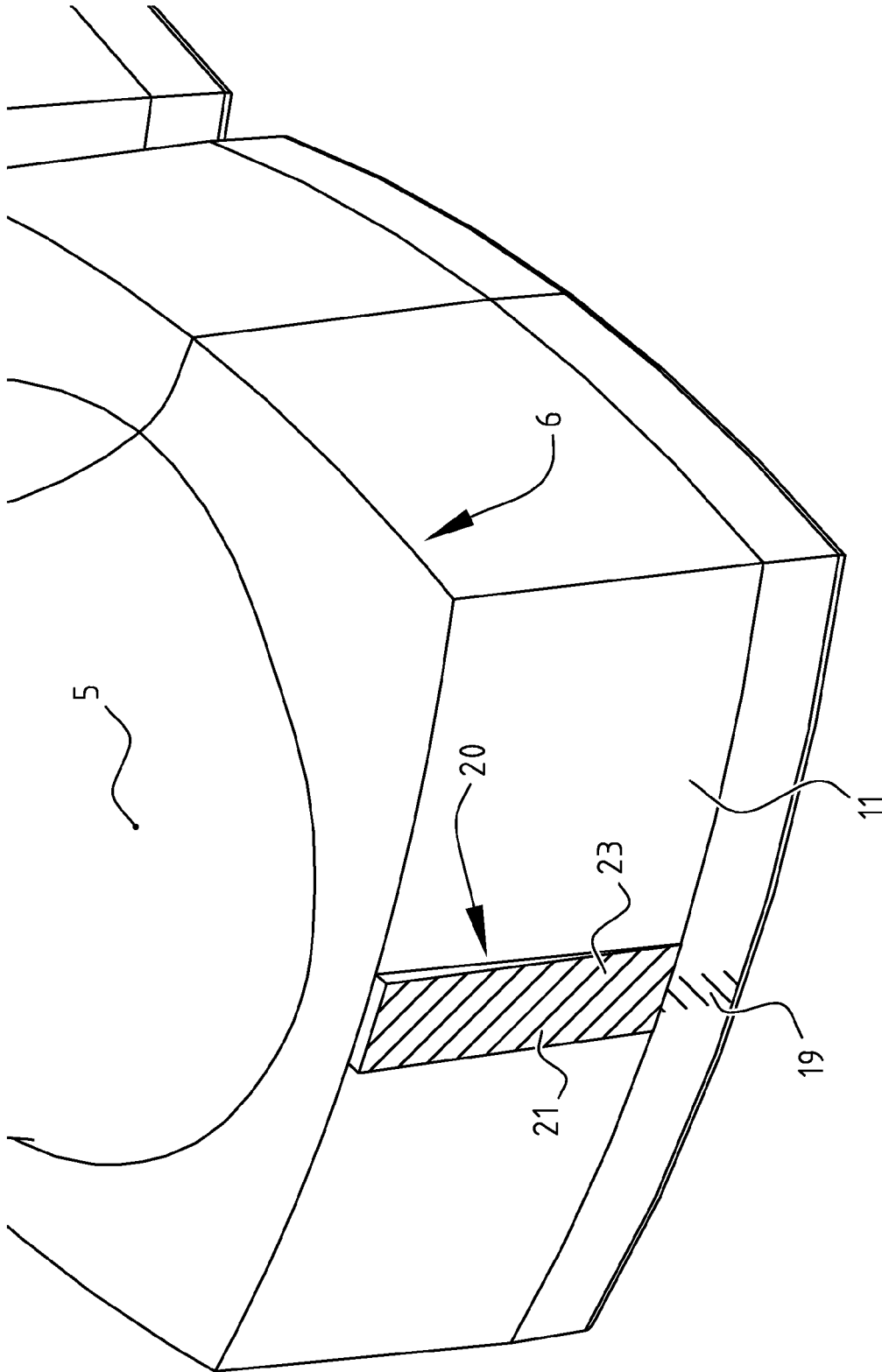


FIG. 4

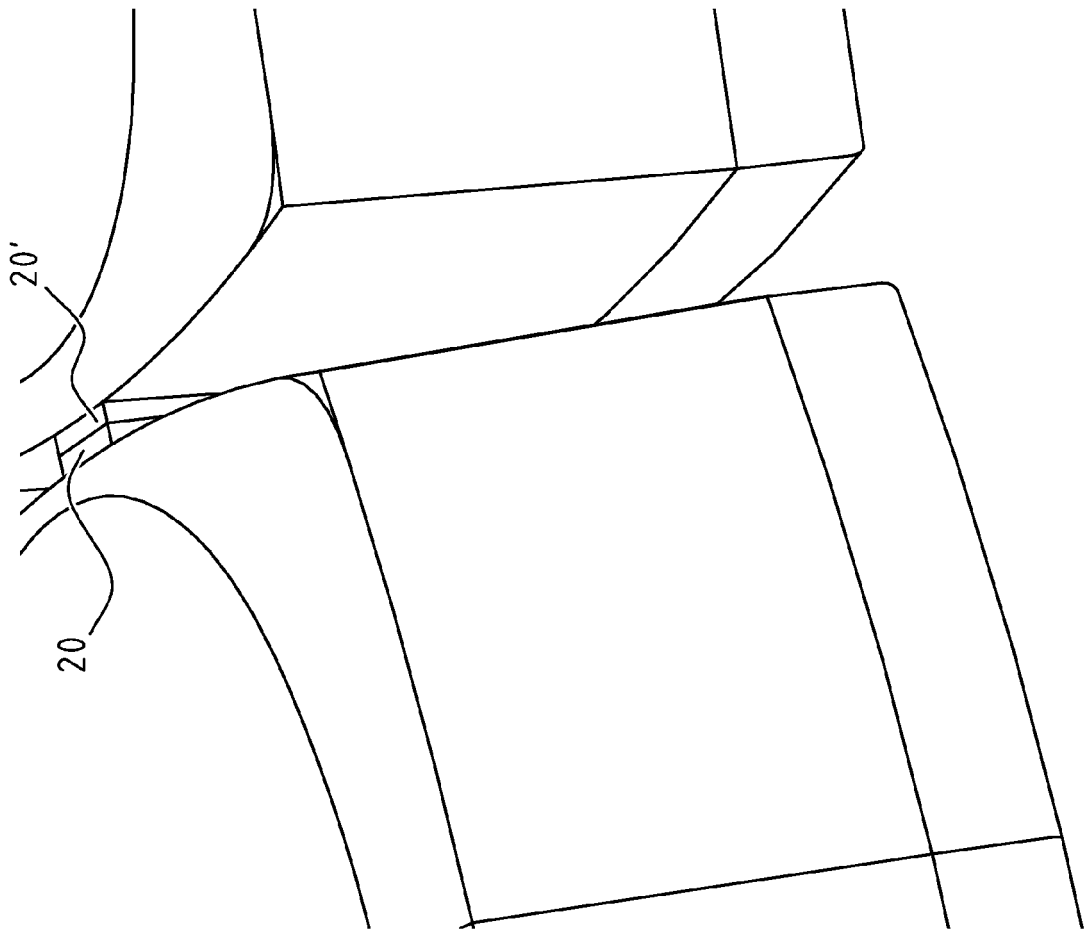


FIG. 5

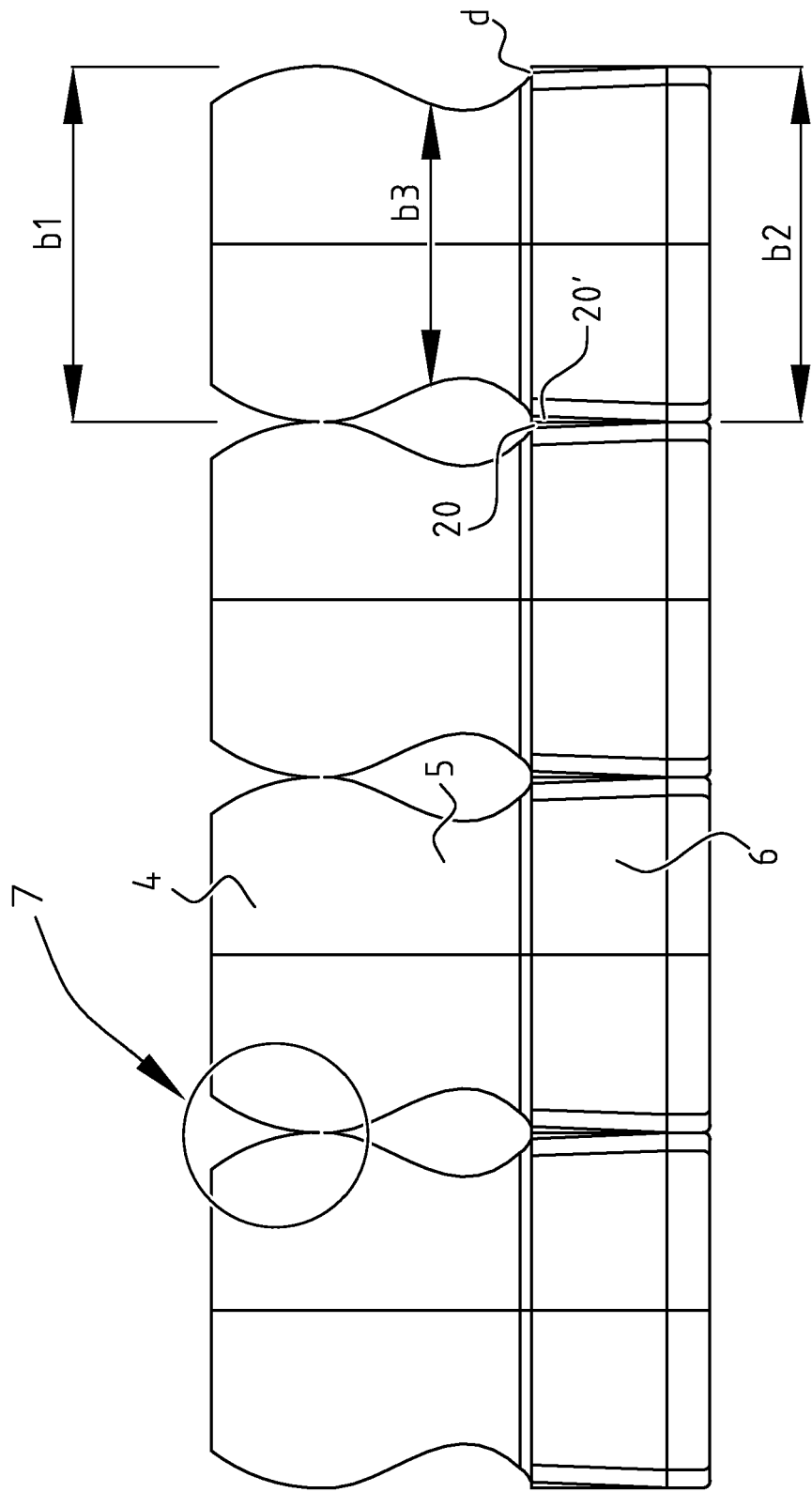


FIG. 6

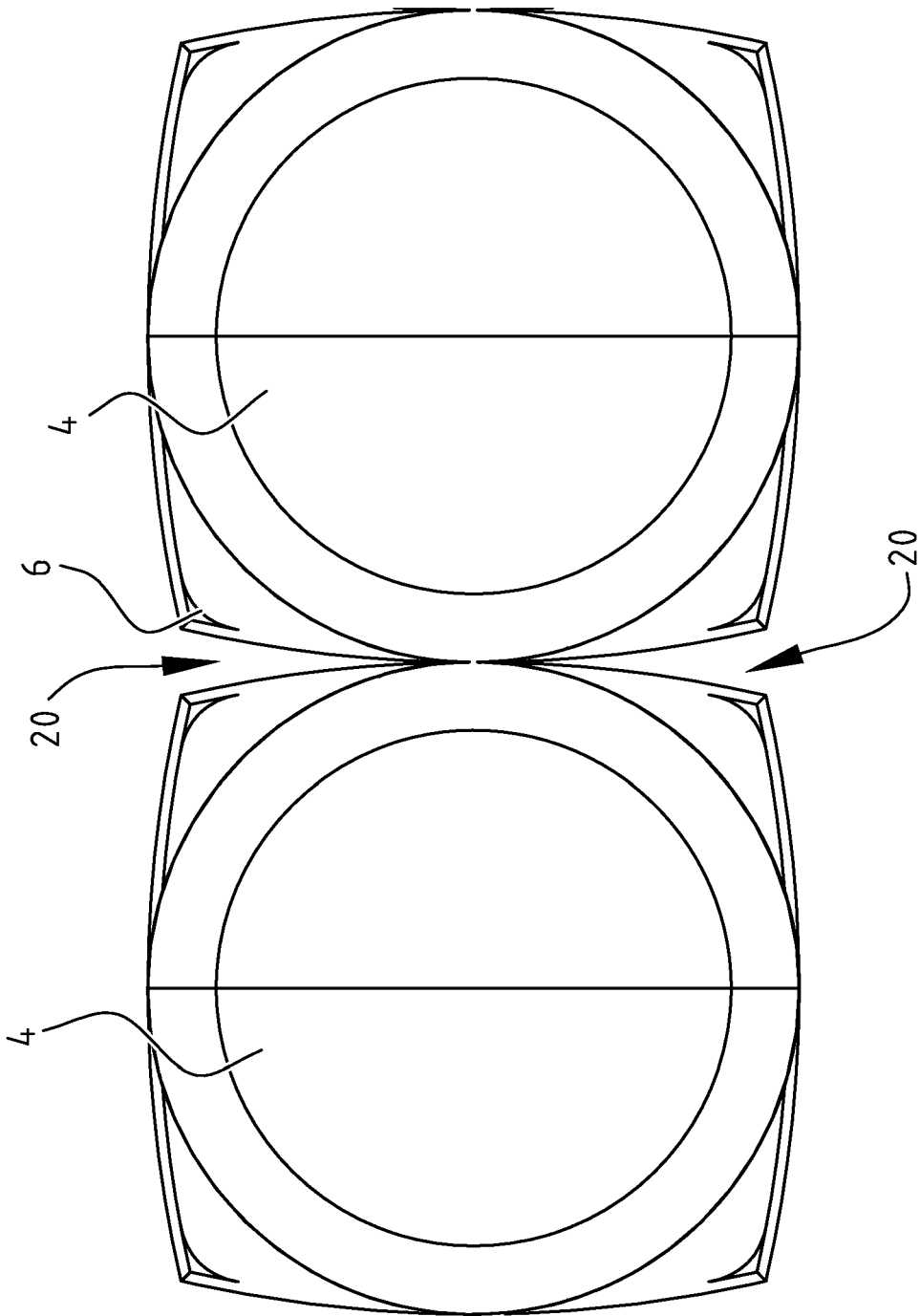


FIG. 7

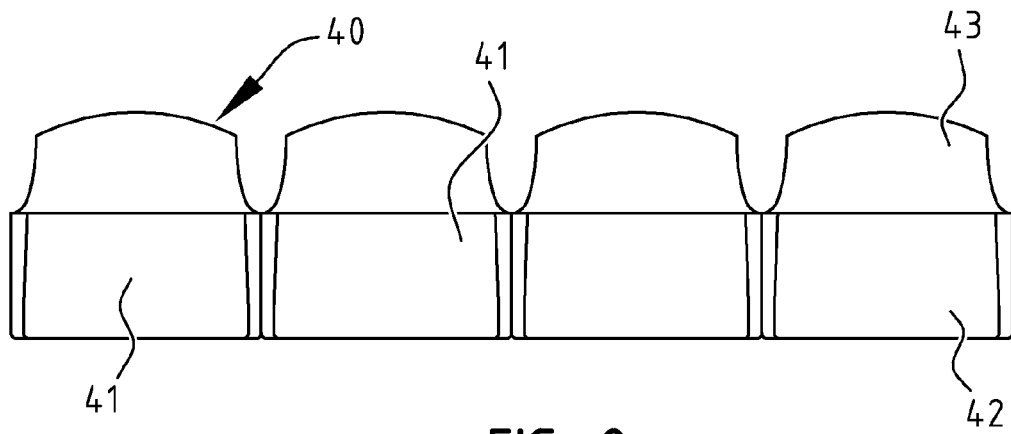


FIG. 8

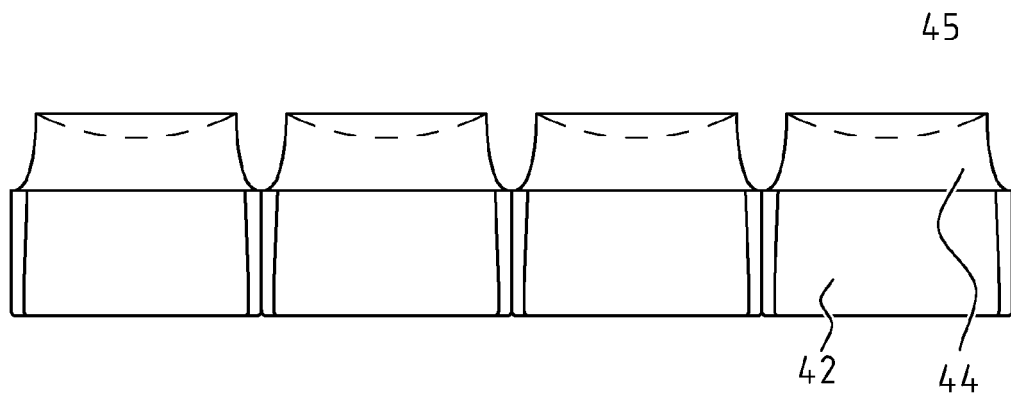


FIG. 9

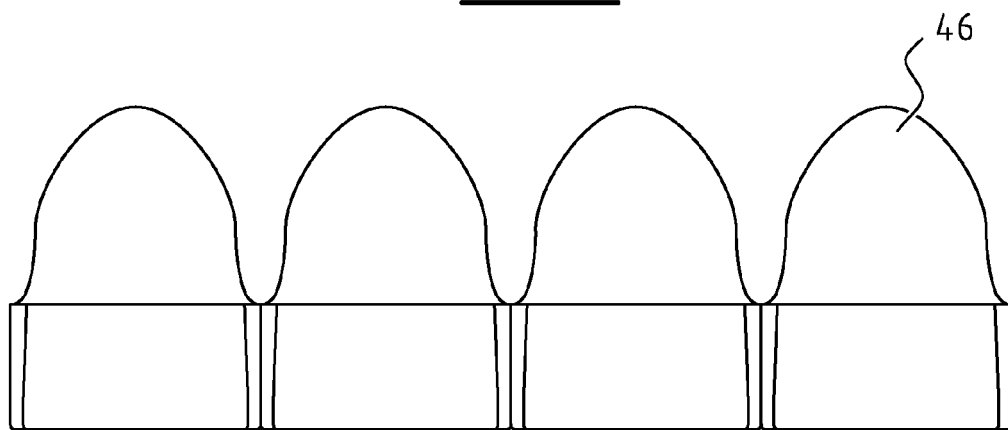


FIG. 10



EUROPEAN SEARCH REPORT

Application Number
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DOCUMENTS CONSIDERED TO BE RELEVANT			
Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
X	US 1 422 193 A (SULLIVAN CHARLES L ET AL) 11 July 1922 (1922-07-11) * page 1, column 1, line 1 - page 1, column 2, line 103; figures *	1-15	INV. E02B3/14 E02B3/12 E02D17/20 E02D29/02 E01C5/00
X	DE 94 02 682 U1 (LOESCH GMBH BETONWERKE [DE]) 14 June 1995 (1995-06-14) * page 1 - page 3; figures *	1-3, 5-12,14, 15	
X,D	NL 1 019 174 C2 (PANNEKOEK JAKOB GERRIT HENDRIK [NL]) 9 January 2003 (2003-01-09) * page 5, line 18 - page 8, line 6; figures *	1-3, 6-12,14, 15	
X,D	AU 546 743 B2 (NICOLON NV) 19 September 1985 (1985-09-19) * page 7, line 13 - page 19, line 38; figures *	1-3, 5-12,14, 15	
A	US 929 366 A (ALCOTT EDWARD [US]) 27 July 1909 (1909-07-27) * page 1, line 58 - page 2, line 17; figures *	1-15	TECHNICAL FIELDS SEARCHED (IPC) E02B E02D E01C
A	DE 199 18 143 A1 (SF KOOP GMBH BETON KONZEPTE [DE]) 26 October 2000 (2000-10-26) * column 3, line 7 - column 6, line 46; figures *	1-15	
A,D	WO 2011/108931 A1 (HILL HANS [NL]) 9 September 2011 (2011-09-09) * page 8, line 2 - page 11, line 17; figures *	1-15	
The present search report has been drawn up for all claims			
Place of search The Hague		Date of completion of the search 26 July 2016	Examiner Van Bost, Sonia
CATEGORY OF CITED DOCUMENTS X : particularly relevant if taken alone Y : particularly relevant if combined with another document of the same category A : technological background O : non-written disclosure P : intermediate document T : theory or principle underlying the invention E : earlier patent document, but published on, or after the filing date D : document cited in the application L : document cited for other reasons & : member of the same patent family, corresponding document			

EPO FORM 1503 03.82 (P04C01)

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ON EUROPEAN PATENT APPLICATION NO.**

EP 16 16 4416

5

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The members are as contained in the European Patent Office EDP file on
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26-07-2016

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45

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Patent document cited in search report	Publication date	Patent family member(s)	Publication date
US 1422193 A	11-07-1922	NONE	
DE 9402682 U1	14-06-1995	NONE	
NL 1019174 C2	09-01-2003	NONE	
AU 546743 B2	19-09-1985	AU 546743 B2	19-09-1985
		AU 7738081 A	19-05-1983
US 929366 A	27-07-1909	NONE	
DE 19918143 A1	26-10-2000	NONE	
WO 2011108931 A1	09-09-2011	AU 2011221640 A1	27-09-2012
		CA 2792239 A1	09-09-2011
		CN 102859072 A	02-01-2013
		EP 2542720 A1	09-01-2013
		JP 5679593 B2	04-03-2015
		JP 2013521424 A	10-06-2013
		KR 20130004495 A	10-01-2013
		NL 2004345 C	09-09-2011
		RU 2012142323 A	10-04-2014
		US 2013031852 A1	07-02-2013
		US 2014314487 A1	23-10-2014
		WO 2011108931 A1	09-09-2011

REFERENCES CITED IN THE DESCRIPTION

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Patent documents cited in the description

- NL 1019174 C [0006]
- AU 546743 B2 [0006]
- WO 2011108931 A1 [0010]