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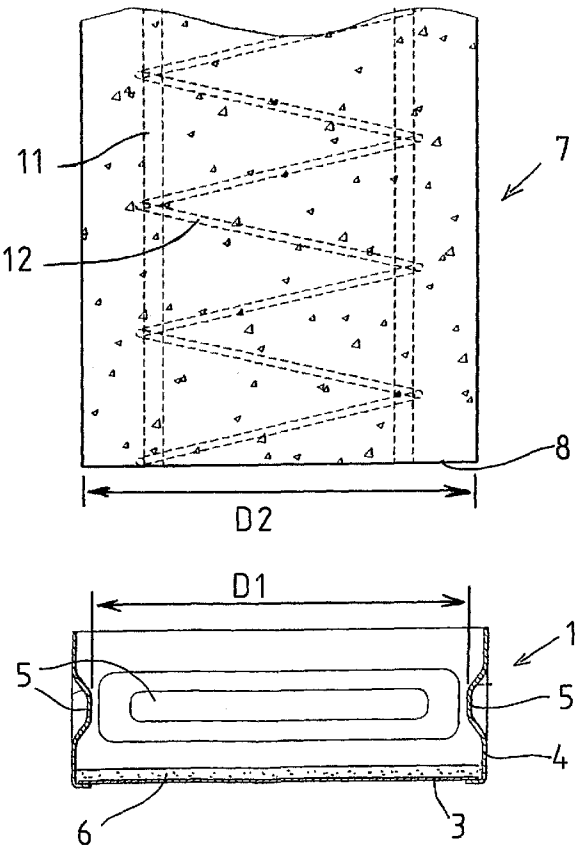
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[Continued on next page]

(54) Title: POINT STRUCTURE OF A PILE OF REINFORCED CONCRETE



(57) Abstract: The present invention relates to a point structure of a pile of reinforced concrete which is provided with a domed point of the pile (1, 2) at the end of the pile, made of steel and having a bottom (3) and an edge (4) circulating it, installed afterwards outside of the point of the pile. According to the present invention, between the bottom (3) of the point of the pile (1, 2) and the pile there is provided an equalizer (6), which has been organized to divide evenly to the entire area of the end of the pile the effect of the impact force between the end of the pile and the bottom of the point of the pile.

WO 2007/080216 A1

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POINT STRUCTURE OF A PILE OF REINFORCED CONCRETE

FIELD OF THE INVENTION

The present invention relates to the point structure of a pile of reinforced concrete defined in the preamble of claim 1.

BACKGROUND OF THE INVENTION

The problem with piling the ground with reinforced concrete piles is that the length of the pile penetrating the ground can not be defined precisely in advance although careful soil quality studies are made before piling in the area to be piled. Thus, in piling, the piles that remain too long need to be cut with the result that pile bits of various lengths are left over.

However, methods have been developed with which the cut pile bits can be utilized so that the piling of the subsequent pile into the ground is begun by using the cut bit of the reinforced concrete pile to the end of which the new pile is attached.

The problem with these has been that the end of the cut pile has not in all conditions endured the penetration into the ground and the hitting caused by it without splitting. The reason for this is that, in order to make penetration into the ground possible, the reinforced concrete piles usually have sufficient reinforcement at the end of the pile, to which end the pile point has been firmly attached during manufacturing i.e. moulding.

When a new pile point is attached to the cut end of the reinforced concrete pile afterwards, this spot does not have sufficient reinforcement so that the end of the pile penetrating the ground often splits inside or near the added pile point.

Structures slightly resembling the present invention are presented in patent publication

US4537534, which presents a steel splice with which two reinforced concrete piles can be attached together end to end. In this, the splice has only been made to be sufficiently tight so that it appropriately extends and stays in place at the end of the pile. The said extension structure is not, however, applicable to the end of the pile and it does not contribute to controlling the forces which tend to break the end of the pile when it is being driven into the ground.

THE OBJECT OF THE INVENTION

The object of the invention is to remove the above-mentioned disadvantages. Especially, the purpose of the present invention is to present a new kind of point structure of a pile of reinforced concrete, with which the stresses directed towards the point of the pile can be controlled and guided so that the breaking of the point of the pile when being hit can be avoided.

SUMMARY OF THE INVENTION

A point structure of a pile of reinforced concrete according to the present invention is characterized in Claim 1.

A point structure of a pile of reinforced concrete according to the present invention is provided with a domed point of a pile at the end of the pile, made of steel and having a bottom and a circulating edge, installed afterwards outside of the point of the pile. According to the present invention, between the bottom of the point of the pile and the pile an equalizer of forces is provided that is organized to distribute evenly the effect of the impact force between the end of the pile and the bottom of the point of the pile in the area of the end of the pile. Roughness of various kinds may be found in the cut end

of the pile. When the cut has been made on site, the cut surface is seldom perfectly smooth. Also, a part of the reinforcement may be left protruding somewhat from the cut surface. Thus, the pile impacts the bottom of the point of the pile unevenly which easily breaks either the concrete head of the pile or the point of the pile or even both. In this case, the equalizer between the bottom and the pile prevents the breakage and equalizes and guides the occurring impact forces as a homogenous impact on the entire surface area of the point of the pile.

A preferable and easy as well as simple solution for the equalizer is sand or clay or a layer of mass of equivalent substance, which forms itself between the point of the pile and the end of the pile. If this layer is sufficiently thick it will eliminate the roughness at the end of the pile. The thickness of the layer of mass can be for example around 2 - 5 cm.

In a second embodiment, the equalizer can be a board made of a substance that is softer than concrete and steel, such as rubber, plastic or a firm board made of a wood-based substance. Although such a board would have even thickness in free form, it will adjust itself under pressure between the pile and the point of the pile, functioning essentially in the same way as the layer of mass described above.

In an embodiment of the present invention, in the inner surface of the edge are provided compression organs, which have been organized to form a powerful transverse compression in the area of the point of the pile inside the domed point of pile when pushing the pile into the point of the pile.

Preferably, the compression organs according to the present invention are located symmetrically in relation to the centre axle of the pile, for example on opposite sides or most preferably evenly on each

side of the pile when the piles to be used have a rectangular quadrangle cross section, such as a square.

In an embodiment of the present invention, the compression surface of the compression organ is transverse in relation to the lengthwise direction, and oblong, essentially a surface circulating the pile, i.e. a flexible ridge with appropriate rigidity, which is pressed tightly into the casing of the pile.

The compression and control of forces has been noted to be more efficient when the compression does not happen as an even surface in the entire area of the edge of the domed point of the pile, but rather only in a part of it, for example in oblong and essentially stripe-like compression loads appropriately surrounding or circulating the pile. Thus, preferably the compression surface is under 50 %, for example 10 - 20 % of the inner surface of the edge of the point of the pile.

Although the compression according to the present invention can be realized with separate compression organs installed inside the point of the pile, it has been found that a preferable and functioning solution is one in which the compression organ is formed by a form, bevel-walled protrusion, ridge or the like of the edge of the point of the pile, extending inwards, that partly gives way and presses outwards from its free form when the pile is being pushed inside the point of the pile.

The point structure of a pile of reinforced concrete according to the invention has considerable advantages compared with prior art. The structure according to the present invention allows to efficiently control and guide the forces which impact the lower end of a reinforced concrete pile when it is being driven into the ground either mechanically or hydraulically. Efficient guiding and control of forces prevent the ends of piles from getting damaged even

though they are only lightly reinforced. Thus, the present invention allows the use of left over cut bits of concrete piles to be used in piling, which has a great economic significance in piling operations.

LIST OF FIGURES

In the following the present invention is explained in detail through examples of embodiments and referring to the attached drawings in which

Fig. 1 shows a side projection of a reinforced concrete pile according to prior art, having a ground point,

Fig. 2 shows a side projection of a reinforced concrete pile according to prior art, having a rock point,

Fig. 3 shows a side projection of a cut reinforced concrete pile and of a point of the pile to be attached to it, according to the present invention,

Fig. 4 shows a side projection of the parts of Fig. 3 when they are placed touching each other.

Fig. 5 shows a side projection of a cut reinforced concrete pile and of a second point of the pile to be attached to it, according to the present invention, and

Fig. 6 shows a side projection of the parts of Fig. 5 when they are placed touching each other.

DESCRIPTION OF THE INVENTION

Fig. 1 shows a reinforced concrete pile according to prior art, in which inside the concrete 10 there are vertical 11 and essentially horizontal 12 reinforcement steel bars. The steel bars are placed with varying density into the pile in zones a, b and c. Most of the steel 12 is in the lower end of the pile, i.e. zone a, which first penetrates the ground when the pile is being hit. At this end, already dur-

ing the manufacturing or moulding of the pile, a domed point of the pile made of steel has been attached, which in Fig. 1 is a ground point 13. The quantity of steel used decreases in the pile closer to the top so that in zone b there is less of steel 12 than in zone a and further, the density of the steel 12 decreases when advancing to zone c. Thus, the quantity of steel varies in lengthwise direction according to the required strength of the pile.

Fig. 2 shows a second reinforced concrete pile according to prior art. Its structure corresponds to the reinforced concrete pile in Fig. 1 with the distinction, however, that the ground point 13 has been replaced with a rock point 14, which apart from the domed structure has a downwards pointed steel cone 15 and at its point a steel pin 16.The rock point has also been attached to the end of the pile with extra vertical steel bars.

Fig. 3 shows a cut reinforced concrete pile 7 in which the reinforcements 11 and 12 are evenly paced upwards from its cut end 8 in the entire length of the pile.

It is further to be noted that the cut end 8 which is done in site conditions is not necessarily perfectly perpendicular in relation to the lengthwise direction of the pile and additionally it may have minor roughness. Because at the end of the cut pile, the quantity of steel bars 12 has not been increased as in the ends of uncut piles, it is clear that the cut end is more likely to split when it is being driven into the ground.

To solve this problem, a domed point of pile made of steel, shown in the lower part of Fig. 3, has been developed, which in the present embodiment is a flat head ground point. The point of the pile is provided with a straight and level bottom 3 and edges 4 that rise up from it and which circulate around the

entire bottom. Thus is formed a domed structure, with closed sides and bottom, and open at the top. Flexible, spring-like functioning compression organs 5 have been formed on the edges 4, i.e. a part of the surface area of the edge boards has been bent to form inwards extending bulges or indents. These compression organs 5 are in each edge 4 of the quadrangle-shaped point of the pile 1. The inwards extensions of the compression organs 5 have been so dimensioned that the distance DI of the opposite compression organs from each other is smaller than the equivalent thickness D2 of the reinforced concrete pile. Furthermore, on top of the domed bottom 3 of the point of the pile 1 a sand layer 6 has been placed to function as an equalizer.

When the reinforced concrete pile is pushed inside the domed point of pile 1 according to Fig. 4, the spring-like compression organs 5 partly give way and push outwards so that the pile, whose thickness D2 is bigger than the inner measurement of the dome DI, can push itself all the way to the bottom 3, i.e. all the way to the sand layer 6. As a result of the pushing described above, a continuously pressing essentially circular force is focused on all the edges of the lower end of the reinforced concrete pile, that significantly decreases the sensitivity to beak of the end of the pile when driving the pile into the ground. Furthermore, the sand layer 6 between the maybe slightly uneven end of the pile and the bottom 3 of the point of the pile 1 evens out those impact forces which influence between the end of the pile, the bottom 3 and the ground. Thus, regardless of the roughness of the cut surface of the pile, the effective powerful forces influence evenly the entire area of the concrete.

Fig. 5 and 6 show a second embodiment of the present invention equivalent to Fig. 3 and 4, in which a steel cone 15 and a steel pin 16 required by the

rock point have also been attached to the domed point of the pile. Because the rock point has an acute point and thus is easily guided and bent in hard ground, the structure of the domed point of the pile has been deepened in this embodiment. Thus, the edge 4 of the point of the pile 2 is provided with three compression organs 5, placed sequentially in lengthwise direction, that are formed out of forms, such as folds or wave-like structures made in the edge of the steel plate 4. Thus, on the edge 4, there are three essentially stripe-like, toroidal and circular compression organs which are placed sequentially in lengthwise direction of the pile and in the middle of which the pile is pushed all the way to the bottom 3.The measurements of the compression organs 5 are equivalent to those of the embodiment in Fig. 3 and 4, i.e. DI is clearly smaller than D2.

On top of the bottom 3 of the point of the pile there is an equalizer 6, i.e. an equalizing layer of the effective forces, made of sand or other appropriate mass, which in its part dampens the impacts focusing on the end of the pile when piling. Furthermore, its purpose is also to even out the forces focusing on the end 8 of the reinforced concrete pile so that no point of the end 8 is impacted by a great point load that is clearly deviating from the rest of the surface area of the end, thus perhaps causing the splitting of the end of the pile.

Fig. 3 - 6 show the best embodiments of the present invention but naturally the points of the piles according to the present invention are functioning also provided only with a dampening layer of mass without the spring-structured strong side compression.

The invention is not limited to the embodiment examples presented above, but many variations are possible while remaining in the framework of the idea of the invention defined in the claims.

CLAIMS

1. A point structure of a pile of reinforced concrete provided with a domed steel point of the pile (1, 2), organized to be installed afterwards in the end of the pile and outside of it, which has a bottom (3) and an edge (4) circulating it, characterized in that between the bottom (3) of the point of the pile (1, 2) and the pile there is provided an equalizer (6), which has been organized to divide evenly to the entire area of the end of the pile the effect of the impact force between the end of the pile and the bottom of the point of the pile.

2. A point structure according to claim 1, characterized in that the equalizer (6) is a layer of sand, clay or other such mass.

3. A point structure according to claim 1, characterized in that the equalizer (6) is a board made of a substance that is softer than concrete and steel, such as rubber, plastic or wood.

4. A point structure according to anyone of claims 1 - 3, characterized in that the inner surface of the edge (4) is provided with compression organs (5) which are organized to focus the powerful transverse compression on the area of the point of the pile when the pile is being pushed into the point of the pile.

5. A point structure according to claim 4, characterized in that the compression organs (5) are located uniformly on each side of the pile.

6. A point structure according to claims 4 or 5, characterized in that the compression surface of the compression organ (5) is transverse in relation to the lengthwise direction of the pile, and an oblong surface, essentially circulating the pile.

7. A point structure according to claim 6, characterized in that the compression surface

is less than 50%, preferably 10 - 20% of the inner surface area of the edge of the point of the pile.

8. A point structure according to anyone of claims 4 - 7, characterized in that the compression organ (5) is formed by an inwards extending shape of the edge of the point of the pile.

PRIOR ART

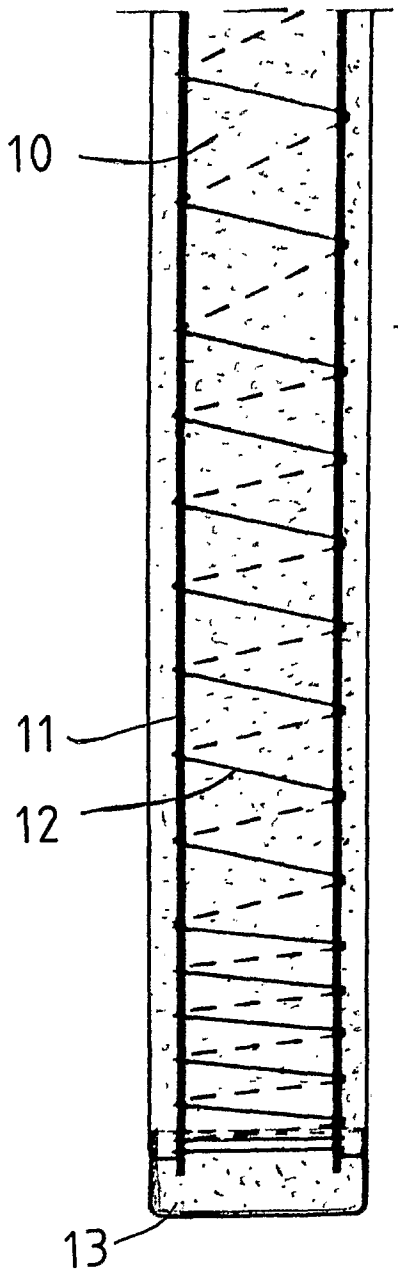


Fig 1

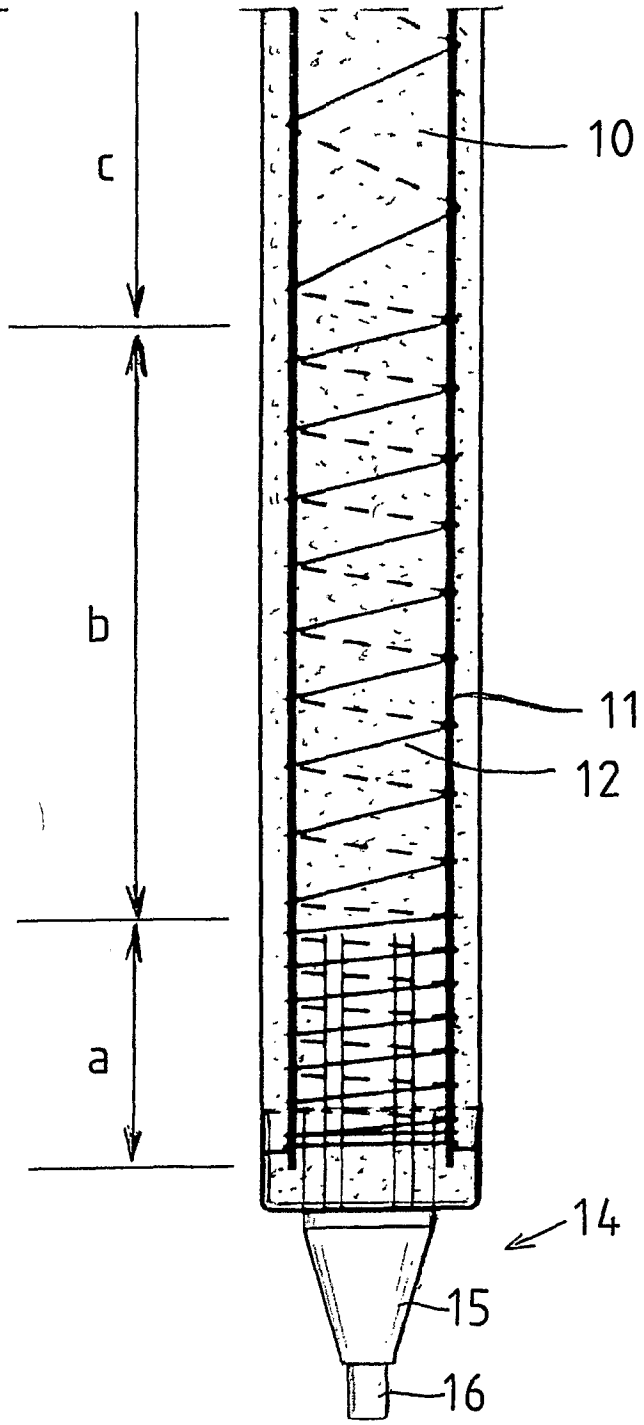


Fig 2

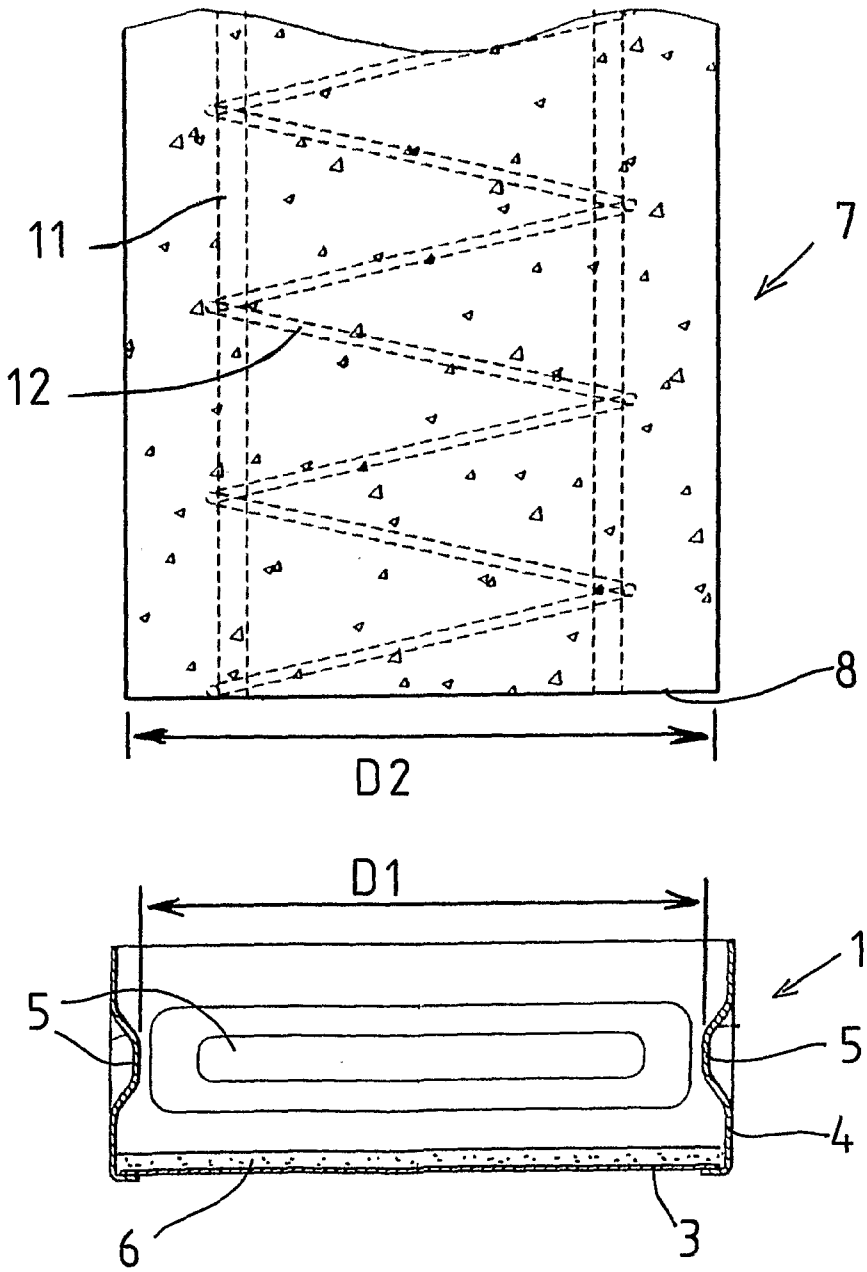


Fig 3

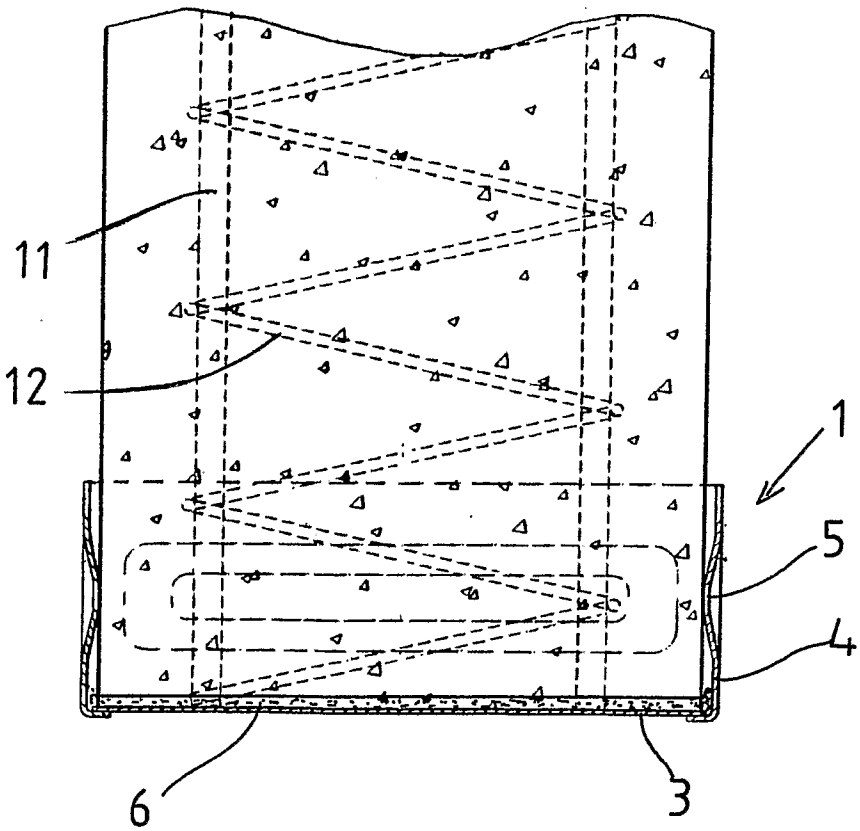


Fig 4

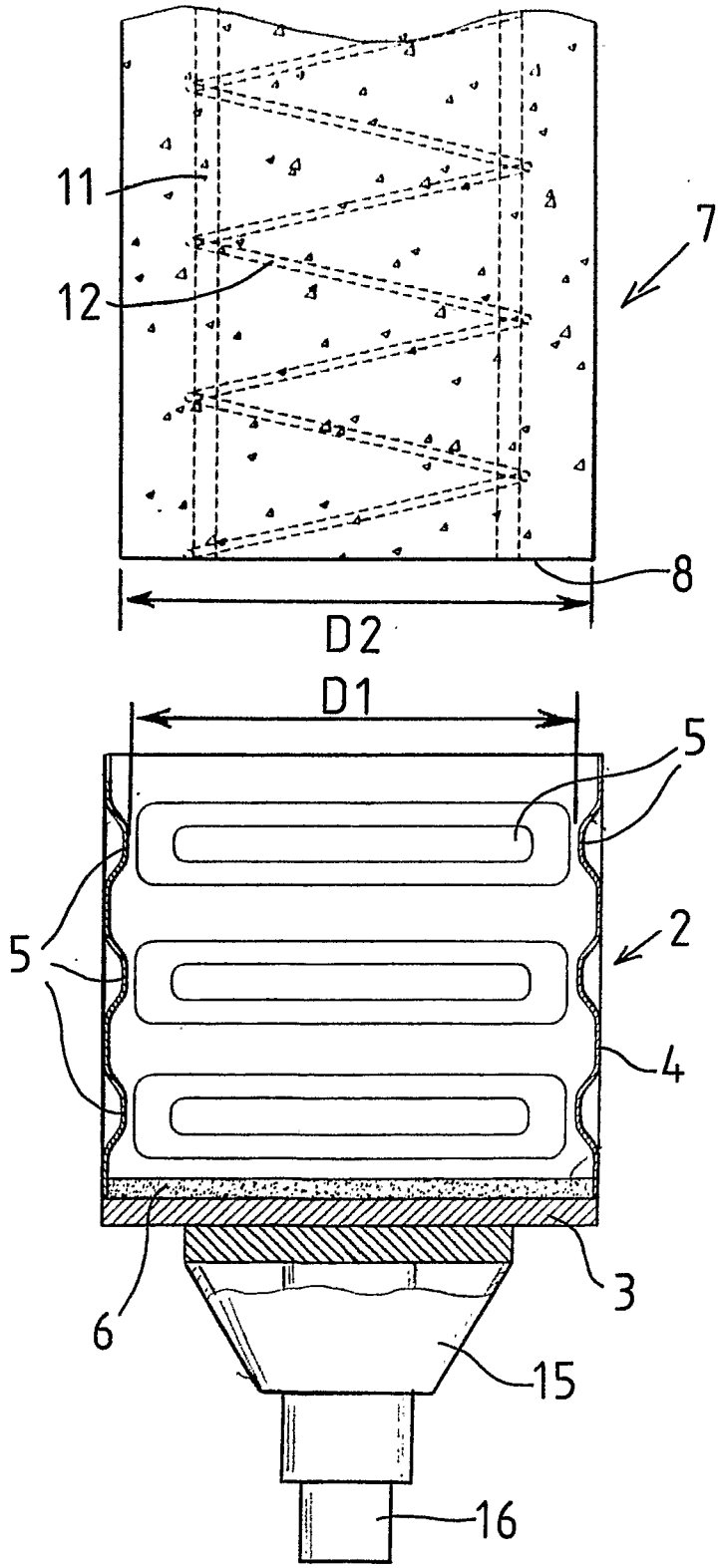


Fig 5

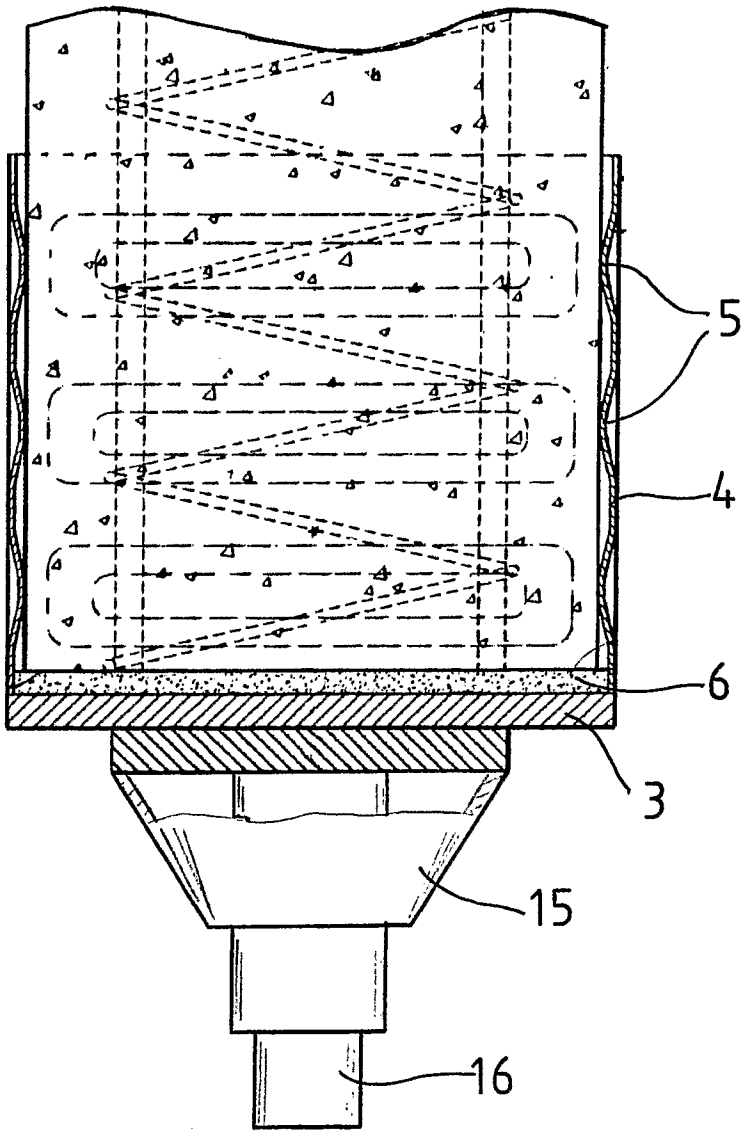


Fig 6

INTERNATIONAL SEARCH REPORT

International application No.
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A. CLASSIFICATION OF SUBJECT MATTER

See extra sheet

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)

IPC 8: E02D

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

FI, SE, DK, NO

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

EPO-Internal, WPI

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	GB 2261456 A (CHOY BING WING) 19 May 1993 (19.05.1993), whole document	1-8
A	US 3924413 A (MARSH JR RICHARD O) 09 December 1975 (09.12.1975), column 2, line 62- column 3, line 42; figures 1-3	1-8
A	FI 85901 B (LEIMET OY) 28 February 1992 (28.02.1992), whole document	1-8
A	US 4537534 A (MARSH JR RICHARD O) 27 August 1985 (27.08.1985), column 2, lines 3-10; column 2, line 49- column 3, line 62; figures 1-4	1-8

☐ 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
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"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
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Date of the actual completion of the international search	Date of mailing of the international search report
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INTERNATIONAL SEARCH REPORT
Information on patent family members

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Patent document cited in search report	Publication date	Patent family members(s)	Publication date
GB 2261456 A	19/05/1993	HK 1006981 A1 CN 1072231 A	26/03/1999 19/05/1993
US 3924413 A	09/12/1975	None	
FI 85901 B	28/02/1992	None	
US 4537534 A	27/08/1985	None	

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CLASSIFICATION OF SUBJECT MATTER

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