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(54) **Title:** METHOD FOR MANUFACTURING A PERVIOUS CONCRETE SLAB, A CONCRETE SLAB, AND USE OF THE CONCRETE SLAB

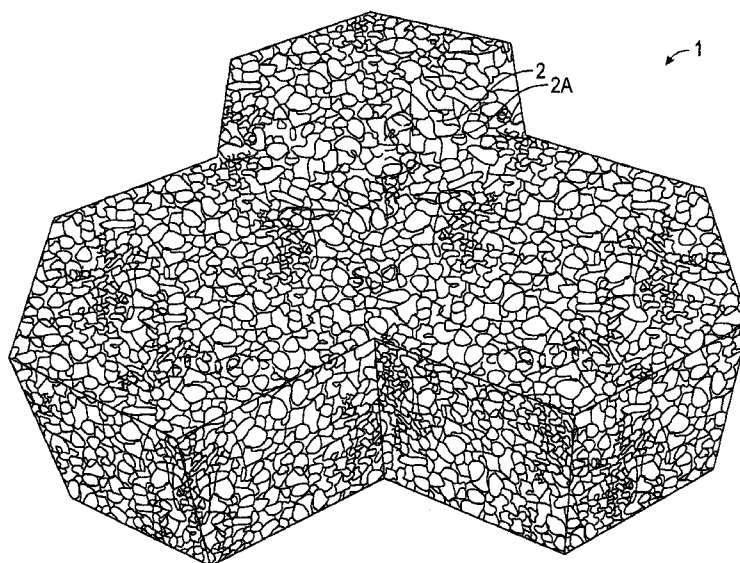


FIG. 1

(57) **Abstract:** Method of manufacturing a pervious concrete slab, where the concrete slab consist of a cement mass containing rounded marine rubbles, wherein the cement mass is compacted using a vertical directed vibration, after which the cement mass is dried.



Method for manufacturing a pervious concrete slab, a concrete slab, and use of the concrete slab.

This invention relates to a method by manufacturing a pervious concrete slab, where a cement mass in a casting machine are provided a number
5 of initial process steps, said initial process steps are terminated by a vibration of the cement mass and successive is finished treated in a number of further processing steps.

10 By building road surfaces, such as traffic lanes, sidewalks and the like it is preferred that the road surfaces beyond having sufficient mechanical strength also is able to remove big amounts of water from the road surface.

By non-pervious sidewalks and road surfaces water is removed by letting
15 water flow between the concrete slabs, said concrete slabs are provided with pit sand, not allowed to be blocked.

The surfaces of these known concrete slabs are non-permeable for water.

It is common knowledge that it is possible to manufacture concrete from
20 cement, sand, stones and water, and remove the main part of the air, that is developed during a hardening of the cement mass by use of vibrations in order to strengthen the finished concretes characteristics. However, it is not described how a permeable concrete slab is achieved.

25 DE 4033100 discloses concrete slab, in which water can penetrate and evaporate.

DE 3630825 discloses another example on a concrete slab that is permeable for water.

30 Nin of the cited documents describes how the known concrete slabs are manufactured.

It is now a purpose with the invention to point out a method by manufacturing a concrete slab of the type defined in the preamble of claim 1, that beyond being permeable for water also provide a sufficient strength for inst. when loadings from trucks shall be absorbed without
5 breaking the concrete slabs.

The purpose of the invention is provided by a method defined in the preamble of claim 1, that is characterized in, that the cement mass used in the casting machine contains rounded marine rubbles and in that, the vibrations are executed in one direction.

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Hereby it is achieved that by the vibration a directional tearing of air inside the concrete slab is obtained, such that permeations channels for water are provided in particular in one direction.

If the vibration were provided in many directions, more air would be
15 pressed out of the concrete slab with the risk that the concrete slab would collapse due to a high content of water.

In other words, a concrete slab is provided that is cost friendly to manufacture, being efficient for lying water permeable, having a big pore space and having sufficient strength.

20

Expedient, as stated in claim 2, that the direction is vertical, is achieved that the cent mass gets a homogeneous structure having the same properties all over the concrete slab.

25 An interesting performing of the invention, is as stated in claim 3, that the initial processing steps comprises the following steps:

a) The cement mass is led from a drawer that after a forward going movement of the drawer is poured down in a divided under
30 mould containing the cement mass under which a plate is provided

- b) The drawer is moved back from the under mould
- c) An upper mould is lowered down and placed in the rearmost of the under mould, that the cement mass is encapsulated,

5 and as stated in claim 4, that the further processing steps comprises:

- d) the under mould is lifted whereas the upper mould is secured until a point where the mixture is sufficient rigid in order to being self-supporting
- 10 e) The cement mass is released from the under mould
- f) The plate accommodating the processed concrete slab is provided a drying/hardening process.

15 Finally it is advantageous if as stated in claim 5, that the under mould, the upper mould and the plate is provided in a non-pervious material.

As mentioned, the invention also related to a concrete slab as stated in claim 6.

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This concrete slab is, as stated in claim 7, characterized in that it has pervious channels, mainly vertical direction and is composed of

- a) Marine rubbles
- 25 b) Granite
- c) Quick drying high strength cement (Rapid®)
- d) Fly ash
- e) Pit sand
- f) Water
- 30 g) Eventually silica.

In addition, as, stated in claim 8, a further plasticizing is added, such as Procon®.

A particular expedient composition of the concrete slab according to the invention is, as stated in claim 9, that

- The size of the marine rubbles 8/16 are without limestone are rounded and have no sharpened edges
- 10% chorused granite in the size order 11/16
- 10 - 300 kg Quick hardening high strength cement pr. 100 kg slag
- 9 % fly ash of cement volume
- The pit sand has the graded size 02 eventually 5%.
- Silica 1 %.

The percentage amounts are volume percent unless otherwise stated.

15 The size 8/16 means marine rabbles having a diameter from 6 to 18 mm. Rapid® is RAPID AALBORG CEMENT hat is produced by grinding of Portland's concrete clinker added up to 5 % calcium content.

The grade size 02 means that the pit sand has a diameter up to 2...

20 As mentioned, the invention also relates to a use of the invention
This used is defined in claim 10

The invention will now be more fully explained in connection with the drawing on which

25

Fig. 1 illustrates a concrete slab manufactured according to the invention

Fig. 2 illustrates the elements in a moulding machine to manufacturing concrete slabs according to the invention,

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Fig. 3 illustrated a room divided inner mould, being used in the machine on fig. 2, whereas

Fig. 4 illustrates concrete slabs according to the invention after being prepared in the moulding machine on fig. 2.

In fig. 1, 1 denotes a concrete slab according to the invention.

The outer geometrical form can be different.

The height of the concrete slab can be adapted depending on its use, said use can be a sidewalk or a highway where heavy loads from trucks, semi-trailers etc., are influencing the highway.

As it can be seen on fig. 1, the structure in the concrete slab is formed with small rounded marine rubbles, one of them denoted 2. Between the rounded marine rubbles, permeation channels through the concrete slab are provided. An example denoted 2a, where an input to a permeation channel is shown.

The concrete slab is compounded of a cement mass, in particular containing the following elements:

Marine rubbles, granite, quick drying high strength cement (Rapid®), fly ash, pit sand, plasticizing means, water, and eventually silica in the following relation:

- 10% crushed granite in the size order 11/16
- 300 kg Quick hardening high strength cement pr. 100 kg slag
- 9 % fly ash of cement volume
- The pit sand has the graded size 02 eventually 5%.
- Silica 1 %.

Now coming to the following figured, it will be explained how the basic components of a moulding machine is built for manufacturing concrete slabs according to the invention.

On the figures, 3 and 4 denotes a first vibrations element 3, and another moveable vibration element 4 adapted to provide a vertical motion of a form, consisting of an upper mould 5 and a moveable under mould 6, being divided, cf. also fig. 3.

5 The divided under mould is here shown having cubic space, but other geometric forms are also possible, for inst. as shown on fig. 1

Under the under mould 6 (see also fig. 3) a plate 8 is provided, said plate is formed in a non-absorbent water material.

This plate can be displaced in and out of the moulding machine.

10 Further fig. 2 shows a brush 7, adapted to clean the surface of the concrete slabs produced in the moulding machine, in order to emphasize the colour of the rounded rubbles own colour.

Moreover attention is drawn to the fact that the filling of the cement mass in the upper mould take place by use of a non-shown tray, being
15 moveable inside the moulding machine between the under mould 6 and the upper mould 5.

Now it will be explained how the moulding machine function by manufacturing concrete slabs according to the invention.

The plate 8 is led in and under the under mould 6, that successive of the
20 tray is filled with cement mass, such that the tray first is led towards against and over the under mould 6, and afterwards when the under mould is filled is withdrawn, and at the same time the tray scrapes so the under mould is entirely filled.

The upper mould is lowered down over the under mould and in the
25 rearmost of the under moulds such that the cement mass is encapsulated.

Then a vertical vibration is initiated.

When the vibration is finished the under form is lifted, so that the
30 concrete slabs are released from the under mould and left on the plate, after which the plate is led out of the moulding machine for being dried.

It shall be noted that the vertical vibration provides a guarded air in the concrete slab, such that permeation channels for water are provided.

On fig. 4 a number of concrete slabs 9 on the plate 8 us shown, after they
5 have left the moulding machine and transferred to a drying storage.
Those parameters, being used in the vibration process are dependent of
the amount of water contained in the cement mass, and therefore must
be adapted to a given application.

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Claims

1. Method by manufacturing a pervious concrete slab, where a cement mass in a casting machine are provided a number of initial process steps, said initial process steps are terminated by a vibration of the cement mass and successive is finished treated in a number of further processing steps, **characterized in**, that the cement mass used in the casting machine contains rounded marine rubbles and in that the vibrations are executed in one direction.
2. Method according to claim 1, **characterized in**, that the direction is vertical.
3. Method according to claim 1 or 2, **characterized in**, that the initial process steps comprises the following steps:
- g) The cement mass is led from a drawer that after a forward going movement of the drawer is poured down in a divided under mould containing the cement mass under which a plate is provided
 - h) The drawer is moved back from the under mould
 - i) An upper mould is sinked down and placed in the rearmost of the under mould, that the cement mass is encapsulated.
4. Method according to claim 4, , **characterized in**, that the further process steps comprises the following steps:
- j) the under mould is lifted whereas the upper mould is secured until a point where the mixture is sufficient rigid in order to being self-supporting
 - k) The cement mass is released from the under mould

l) The plate accommodating the processed concrete slab is provided a drying/hardening process.

5 5. Method according to claim 3, **characterized in**, that the under mould, the upper mould and the plate is provided in a non-pervious material.

6. Concrete slab obtainable by any of the claims 1 - 5.

10 7. Concrete slab according to claim 6, **characterized in**, that it has pervious channels, mainly vertical direction and is composed of

a) Marine rubbles

b) Granite

15 c) Quick drying high strength cement (Rapid®)

d) Fly ash

e) Pit sand

f) Water

g) Eventually silica.

20 8. Concrete slab according to claim 7, **characterized in**, that a further plasticizing is added, such as Procon®

9. Concrete slab according to claim 7 or 8, **characterized in**, that

25 - The size of the marine rubbles 8/16 are without limestone are rounded and have no sharp edges

- 10% crushed granite in the size order 11/16

- 300 kg Quick hardening high strength cement pr. 100 kg slag

- 9 % fly ash of cement volume

30 - The pit sand has the graded size 02 eventually 5%.

- Silica 1 %.

10. Use of the concrete slab according to claim 5 – 9 in making sidewalks, highways, streets and the like.

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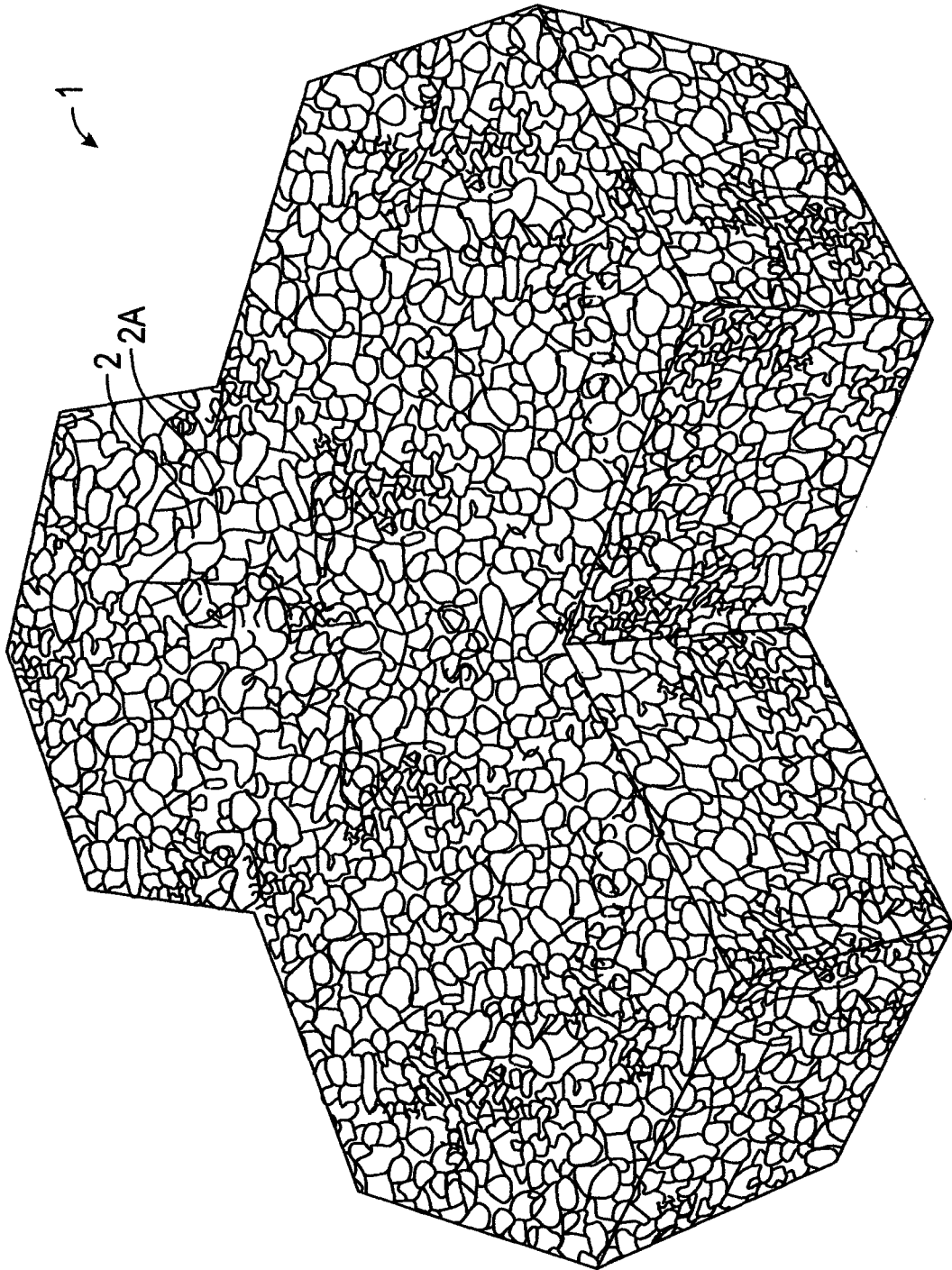


FIG. 1

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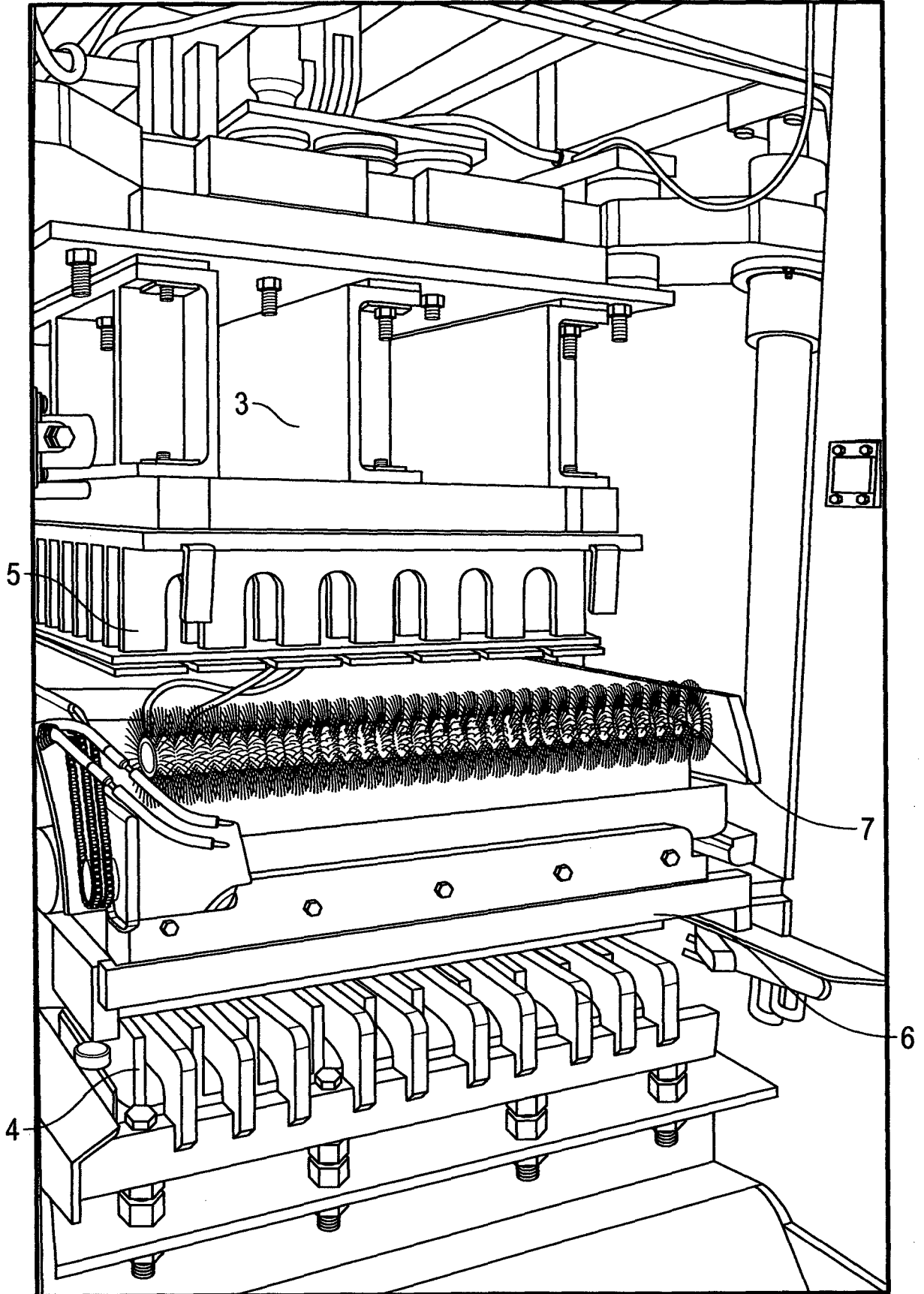


FIG. 2

3/4

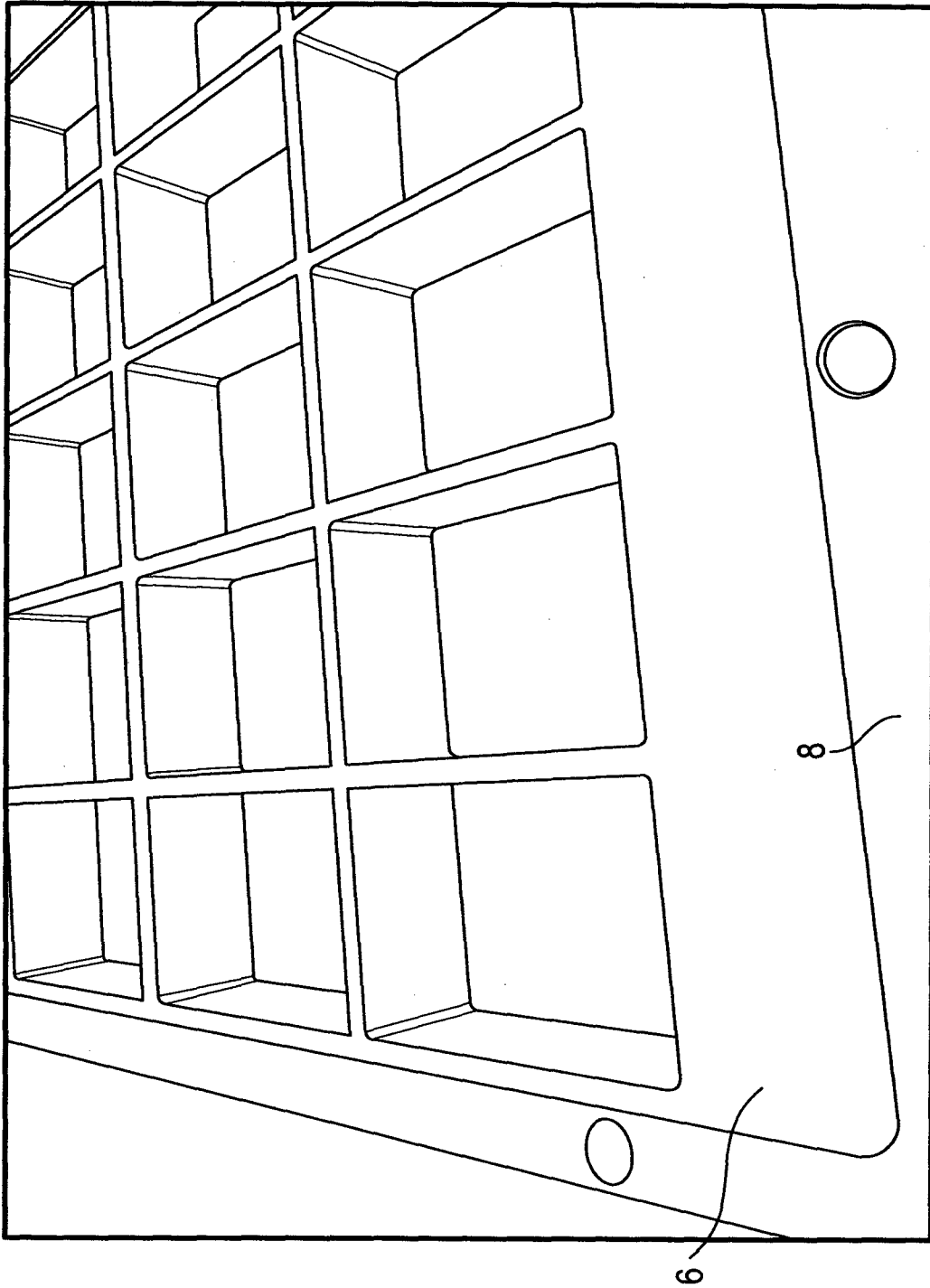


FIG. 3

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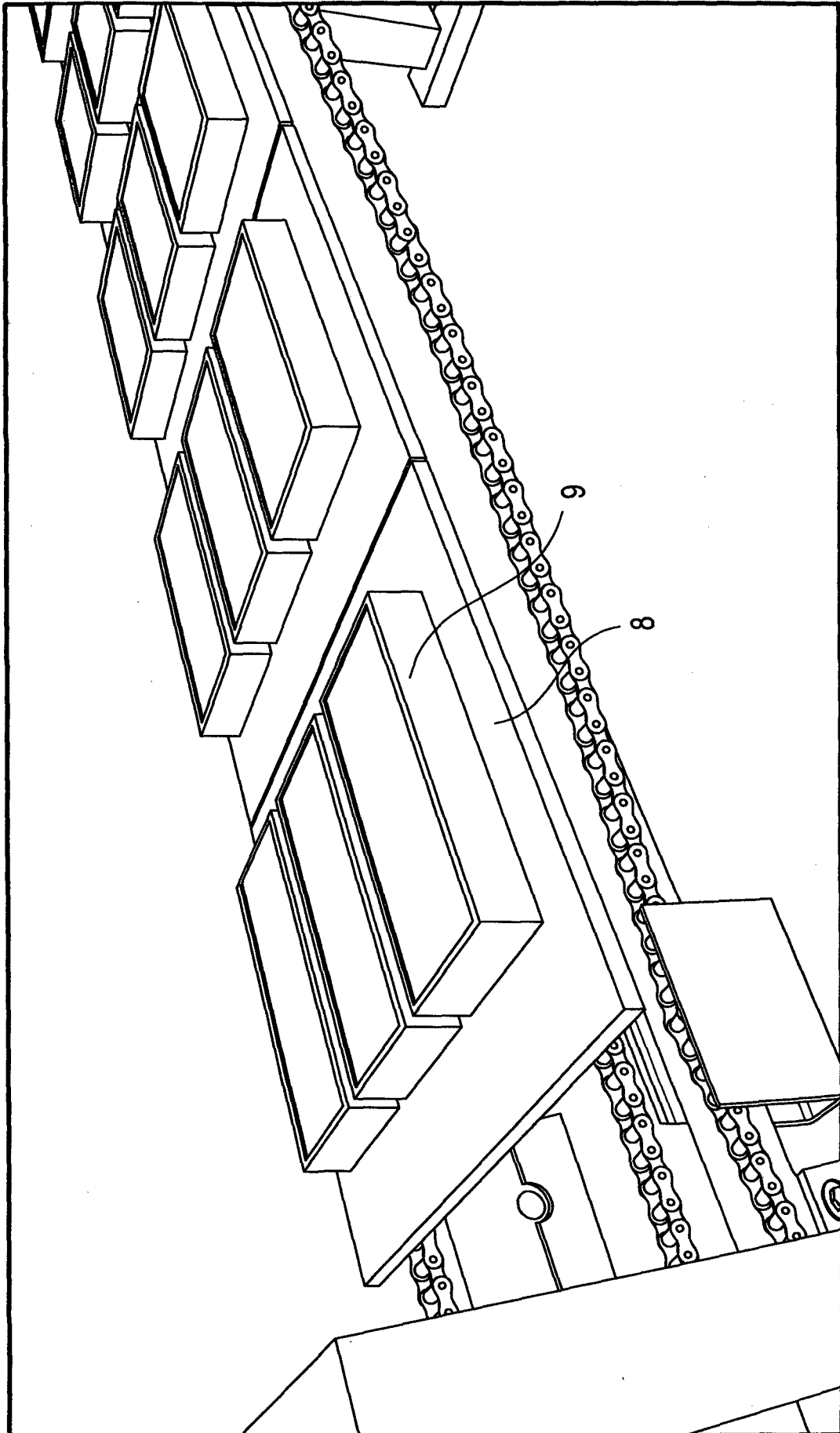


FIG. 4

INTERNATIONAL SEARCH REPORT

International application No
PCT/DK2013/000076

A. CLASSIFICATION OF SUBJECT MATTER INV. E01C5/06 E01C11/22 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) E01C		
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.
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Y	column 1, line 31 - column 4, line 42; figures 1-12	2
Y	----- US 4 332 540 A (VAN DE CAVEYE YVES H) 1 June 1982 (1982-06-01) column 1, line 39 - line 40	2
Y	----- WO 2006/081480 A2 (COLUMBIA MACHINE [US]; HIGH DOUGLAS VERMON [US]; GILDERSLEEVE STACY L) 3 August 2006 (2006-08-03) page 11, line 3 - line 8	2
X	----- DE 40 33 100 A1 (IDEALBETON GMBH & CO KG [DE]) 23 April 1992 (1992-04-23) cited in the application the whole document -----	6,10
-/--		
<input checked="" type="checkbox"/> Further documents are listed in the continuation of Box C. <input checked="" type="checkbox"/> 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 <p align="center">18 March 2014</p>	Date of mailing of the international search report <p align="center">27/03/2014</p>	
Name and mailing address of the ISA/ European Patent Office, P.B. 5818 Patentlaan 2 NL - 2280 HV Rijswijk Tel. (+31-70) 340-2040, Fax: (+31-70) 340-3016	Authorized officer <p align="center">Beucher, Stefan</p>	

INTERNATIONAL SEARCH REPORT

International application No PCT/DK2013/000076

C(Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

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