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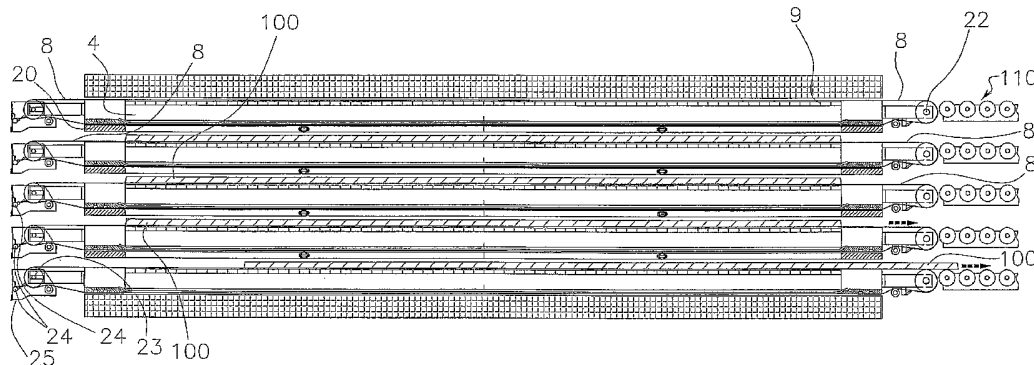
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(54) Title: FILTER PRESS FOR FORMING CERAMIC SLABS, AND ITS FORMING METHOD



(57) Abstract: A filter press comprising at least two horizontal plates movable vertically between a clamped configuration in which they define at least one filtration chamber for receiving material to be filtered, and an open configuration enabling said material to be discharged in the form of a filtered panel, at least one of said two plates being provided with at least one discharge channel for the filtrate, each plate being wrapped by a filter cloth rotatable in order to transfer said panel; and a slab forming method comprising the steps of providing a filtration chamber interposed between two plates, at least the lower plate being wrapped by a rotatable filter cloth; clamping said two plates together; injecting under pressure the material to be filtered into said filtration chamber; drawing said two plates apart and rotating said cloth to remove the filtered material in the form of a slab.



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*For two-letter codes and other abbreviations, refer to the "Guidance Notes on Codes and Abbreviations" appearing at the beginning of each regular issue of the PCT Gazette.*

## DESCRIPTION

### FILTER PRESS FOR FORMING CERAMIC SLABS, AND ITS FORMING METHOD

#### 5 TECHNICAL FIELD

The present invention relates to a filter press for forming ceramic slabs in accordance with the introduction to claim 1, and to a method for forming said slabs therewith.

More particularly, the present invention relates to a filter press of the plate  
10 type for filtering ceramic slip (mixture of water and inert material) for the purpose of providing panels for producing large-dimension slabs of porcelain sandstone.

#### PRIOR ART

15 The use of large-dimension ceramic articles is becoming increasingly more frequent in cladding ventilated walls of large buildings, in kitchen worktops as a replacement for resin-coated compressed chipboard, and in general wherever they can replace natural stone, marble, granite etc.

In manufacturing ceramic slabs, their maximum dimensions are known to  
20 be of the order of 1.2m x 0.8m, these being achieved by the production method known as dry moulding, very similar to that used for producing tiles.

This method implies numerous disadvantages and drawbacks both because of the high investment costs of large-dimension presses, and  
25 because of the high production costs, in particularly energy costs.

Alternatively, in manufacturing sanitary appliances a wet production

process known as the casting process can be applied, using a mould constructed of microporous plaster or resin.

The use of this process for slab production has not yet given notable results.

- 5 There is therefore a strongly felt requirement for a plant enabling large-dimension and large thickness ceramic slabs to be formed which operates continuously and has a production cycle requiring relatively little energy.

#### DISCLOSURE OF THE INVENTION

- 10 The object of the present invention is to provide a slab forming plant having structural and operational characteristics such as to satisfy said requirements while at the same time obviating the stated drawbacks of the known art.

- This object is attained by plant comprising, according to the invention, a  
15 filter press in which at least two plates are horizontal and movable vertically between a first clamped configuration in which they are clamped together to define at least one filtration chamber for receiving material to be filtered, and a second open configuration in which they are spaced apart to enable said material to be discharged in the form of a filtered  
20 panel, at least one of said two plates being provide with at least one discharge channel for the filtrate, each plate being wrapped by a filter cloth rotatable in order to transfer said filtered panel without breakage towards further conveying means.

- The dependent claims define particularly advantageous preferred  
25 embodiments of the ceramic slab filter press of the invention.

Another object is to provide a method for forming said slabs with a plant in

accordance with claim 20.

### BRIEF DESCRIPTION OF THE DRAWINGS

The characteristics and advantages of the invention will be apparent on  
5 reading the ensuing description provided by way of non-limiting example,  
with the aid of the figures shown in the accompanying drawings, in which:  
Figure 1 is a schematic sectional side view of a filter press in a first  
clamped configuration, in accordance with the present invention;  
Figure 2 shows the filter press of Figure 1 in a second open configuration;  
10 Figure 3 is a view of the filter press of Figure 1 from above;  
Figure 4 shows a detail of Figure 1;  
Figure 5 shows a detail of Figure 2;  
Figure 6 is an exploded view of a plate of the filter press of Figure 1;  
Figures 7 and 8 are two alternatives of a detail of the plate of the filter  
15 press of Figure 1;  
Figure 9 is a schematic view of two plates for the filter press of the present  
invention.

### BEST MODE FOR CARRYING OUT THE INVENTION

20 With reference to said figures, the reference numeral 1 indicates overall a  
filter press for forming ceramic slabs in accordance with the present  
invention.  
Said filter press is supported by support means which in the example are  
in the form of four support feet 2.  
25 Directly associated with said support feet 2 there is a horizontal fixed head  
on which a plurality of vertically movable plates 4 are stacked, and which

will be described in detail hereinafter.

Said plates 4 are guided by suitable guide means, which in the example are vertically disposed bars 5 surmounted by a crosspiece 5a.

A movable head 6 is positioned above the plates 4.

- 5 Said movable head 6 is driven by suitable drive means, for example a group of four hydraulic cylinder-piston thrust units 7.

Alternatively, the movable head 6 can be positioned below the plates 4 and the fixed head 3 be positioned above, or a pair of heads movable towards and away from each other can be provided.

- 10 In the subsequent description explicit reference will be made to a filter press 1 comprising a plurality of movable horizontal plates 4, however in general terms the filter press comprises at least one pair of plates 4.

Said plates 4 are movable in a vertical direction between a first clamped configuration in which they are clamped together (Figure 1) to define at  
15 least one filtration chamber to receive the material to be filtered, and a second open configuration in which they are spaced apart (Figure 2) to enable said material to be discharged in the form of a filtered panel 100.  
The material to be filtered is a material which must finally be compact and coherent, to be used as a slab, without crumbling.

- 20 Said material is preferably ceramic slip, to which explicit reference will be made in the subsequent description.

The plates 4 of the filter press of the present invention are identical, with dimensions chosen on the basis of the desired panel 100.

In the example, each plate measures about 2.2m x 4m and is constructed  
25 of stainless steel.

According to the present invention, each plate 4 is wrapped with a filter

cloth 8 which it rotatable in order to transfer the filter panel 100 without breakage towards further conveying means, such as roller tables 110.

As can be seen in Figure 6, in the upper face of the plate 4 there is provided a filtration seat 9, of about 20mm - 30mm in depth, bounded by a  
5 perimetral frame 4a, to form a compartment acting as a filtrate chamber of about 1.8m x 3.5m, which houses an electrowelded grid 10 formed from vertical strips of stainless steel.

The grid 10 rests on a continuous surface, corresponding to the base of the seat 9, of solid or alternatively box-like sheet metal.

10 The filtrate collects in the seat 9 and by way of at least one filtrate discharge channel 11, of which in the example four are provided disposed at the vertices of the four corners, is conveyed to the outside, preferably into a sealed tank, not shown, maintained under slight vacuum to facilitate extraction of the filtered liquid.

15 Above said grid there is housed a lattice element 12 of plastic material, preferably polypropylene, with sufficiently dense apertures to support the filter cloth 8 without this deforming excessively under the action of the increasing pressure of the panel 100 being formed.

In the example, said lattice element 12 presents a thickness of about  
20 3mm-5mm and is provided with holes arranged in honeycomb manner. An impermeable membrane 13 is associated with the lower face of the plate 4.

The membrane, with useful dimensions of 1.8m x 3.5m, is maintained in position by a backing frame 14 fixed by screws 15 to the plate 4, to  
25 provide a tight seal towards the outside.

The region between the membrane 13 and the lower face of the plate 4

with which it is associated is reachable by a pressurized fluid via channels 16 communicating with that region.

The pressurized fluid can be air, water or oil.

According to a preferred embodiment of the present invention, the elastic  
5 membrane 13 has that surface in contact with the filter cloth 8 suitably profiled (Figures 7, 8) to form channels.

Essentially, that surface in contact with the filter cloth 8 is covered with a plurality of protuberances 13a, providing a further draining surface.

In a first embodiment shown in Figure 7, a number of connection grooves  
10 are provided in the edge of the membrane 13 to enable the filtrate to leave through holes 16 passing through the membrane, which communicate with corresponding channels 17 in the plate 4 which mate with the filtrate discharge channels 11.

The holes 16 passing through the membrane 13 are provided in its  
15 perimeter and do not communicate with the region into which the pressurized fluid is fed.

In a second preferred embodiment, shown in Figure 8, the backing frame 14 which fixes the membrane 13 to the plate 4 is provided with channels 18 which convey the fluid present on the membrane 13 into a channel 19  
20 provided in the plate 4 and communicating with the filtrate discharge channel 11.

In this second embodiment the seal provided by the membrane 13 is more certain.

According to the present invention, between two consecutive plates 4  
25 there is interposed a frame 20 having the same thickness, for example between 25mm and 50mm, and the same inner empty surface area as

those required for the filtered panel 100.

Essentially, the frame 20 defines a volume corresponding substantially to the filtration chamber within which the panel 100 is formed.

The frame 20 is provided with at least one first entry hole 21, four being  
5 provided in the example disposed in pairs along its long side, through which the slip to be filtered is injected by an external pumping system, not shown.

If veining or variegation effects are to be created in the material being filtered, in order to subsequently obtain a final product of pleasant  
10 appearance imitating natural stone, the frame 20 can be further provided with at least one second entry hole 22, not shown, for injecting a mixture of colorant material.

Preferably, the mixture of colorant material presents a density greater than the density of the injected slip in order to prevent complete mixing  
15 between the two and to obtain well defined veining.

In operation, the filter press 1 is positioned in the first tightly clamped position by operating the movable head 6, as shown in Figures 1 and 4. The force exerted by the movable head 6 which vertically compresses the highest plate 4 is equal to that exerted within the compartment between  
20 the membrane 13 and the underlying plate 4, independently of their number.

The substantially liquid slip, of density between 1.2 and 1.6 kg/l in the example, is injected into the interior of the frame 20, and tends to freely release water through the underlying filter cloth 8.  
25 Then when gravity is no longer sufficient to extract water from the slip, the pumping system, not shown, is operated to inject the slip at a pressure of

about 6-10 bar.

When the action of the pumping system becomes insufficient because the space within the frame 20 interposed between two filter cloths 8 is filled with solid substance, the action of the pumping system is halted.

- 5 The panel 100 under formation still contains a certain quantity of water, generally between 25 and 30%.

To complete the formation of the filtered panel 100, compressed air or other fluid at a pressure of about 15-25 bar or more is fed onto the elastic membrane 13.

- 10 The elastic membrane 13 transfers the pressure exerted on it directly onto the panel 100 until it reaches a percentage of dry substance between 80 and 85%.

- On termination of filtration, the residual pressure exerted on the membrane 13 is discharged and the plates 4 are moved into their second open configuration (Figures 2, 5) by a mechanical or hydraulic system, not described as it is of type known to the expert of the art.

- To prevent the membrane 13, because of possible slackening, from sliding against the underlying moving panel 100 to cause possible undesirable deformation, lining or stretching, the pressurized region above the membrane 13 is connected to a suitable tank maintained at less than atmospheric pressure, in order to maintain the membrane 13 adhering to the surface of the upper plate during the subsequent step of removal of the panel 100.

- 20 The frame 20 is also drawn upwards by the respective overlying plate 4, leaving the just formed filtered panel 100 on the underlying movable filter cloth 8.

The panel 100, without the surrounding frame 20 because it has been raised, lies on the cloth 8 by its own weight, to facilitate which the walls of the frame 20 can be given a slight upwardly converging inclination.

The distance travelled by the plate 4 when being lifted must be sufficient  
5 to enable the filtered panel 100 to then be extracted, this in the example being at least 35-40 mm.

A series of motorised roller tables or conveyor belts can be provided to the side of each mould to receive the panels 100 dragged by the respective filter cloths 8.

10 Essentially, when the filter press has been completely opened, the panels 100 are fed to the respective roller tables 110 by an electrical or hydraulic system.

If a single roller table 110 is to be used, the panels 100 must be extracted one at a time, and means be provided to move the roller table vertically.

15 The filter cloths 8 are operated by a traction drive roller 22 positioned at one end of the endless filter cloth 8, said drive roller 22 dragging the filter cloth 8 which passes endlessly about said traction roller 22 and an idle return roller 23 positioned at the other end.

While removing the panel 100 from the plate 4, the filtration power of the  
20 cloth 8 can be regenerated by wash means.

In the example, a bar with nozzles 24 located in the region containing the return roller 23 regenerates the filter cloth 8 by means of jets of pressurized water (at about 20-50 bar).

The wash water can be suitably collected in collection vessels 25 located  
25 below each return roller 23.

This wash operation can be effected on termination of each cycle either

on all the filter cloths 8 or on one or more cloths 8 per cycle, depending on the degree of clogging of the cloths.

When the panels 100 have been extracted, the filter press 1 is ready to commence a new filtration cycle.

- 5 As will be apparent from the foregoing, the filter press for forming ceramic slabs according to the present invention satisfies those requirements and overcomes those drawbacks stated in the introduction to the present description with reference to the known art.

In this respect, the filter press of the present invention enables panels to  
10 be formed which can be used as such, without requiring high electrical power and without excessive wastage of energy.

In addition, said filter press provides large-dimension slabs which, because of the particular arrangement of the filter cloths, can be extracted from the press without suffering any breakage.

- 15 Also important is the facility for obtaining large-dimension slabs similar to natural stone, marble etc. by feeding colorant material into the frame interposed between the cloths.

Numerous modifications and variants can be made to the aforescribed filter press for forming ceramic slabs in order to satisfy contingent specific  
20 requirements, all however contained within the scope of protection of the invention, as defined by the following claims.

## CLAIMS

1. A filter press (1) comprising at least two horizontal plates (4) movable vertically between a first clamped configuration in which they are clamped together to define at least one filtration chamber for receiving material to be filtered, and a second open configuration in which they are spaced apart to enable said material to be discharged in the form of a filtered panel (100), at least one of said two plates (4) being provided with at least one discharge channel for the filtrate, characterised in that each plate (4) is wrapped by a filter cloth (8) rotatable in order to transfer said filtered panel (100) towards further conveying means (110).
2. A filter press (1) as claimed in claim 1, wherein a filtration seat (9) is provided in a face of said plate (4) and is bounded by a perimetral frame (4a) in which a preferably electrowelded grid (10) is housed.
3. A filter press (1) as claimed in claim 2, wherein said at least one discharge channel (11) communicates with said seat (9).
4. A filter press (1) as claimed in claim 2, wherein said at least one discharge channel (11) leads into a sealed tank maintained under vacuum.
5. A filter press (1) as claimed in claim 2, wherein a lattice element (12), preferably of polypropylene, is interposed between said grid (10) and said filter cloth (8), in order to support said cloth (8).
6. A filter press (1) as claimed in claim 1, wherein an impermeable elastic membrane (13) is perimetally associated with a face of said plate (4).
7. A filter press (1) as claimed in claim 6, wherein the region between said membrane (13) and the plate (4) with which it is associated can be

reached by a pressurized fluid.

8. A filter press (1) as claimed in claim 6, wherein that surface of said elastic membrane (13) opposite that of the plate (4) with which it is associated is profiled to form channels.

5 9. A filter press (1) as claimed in claim 6, wherein said membrane (13) is interposed between said filter cloth (8) and said plate (4).

10. A filter press (1) as claimed in claim 6, wherein said membrane (13) is maintained in position by a backing frame (14) fixed perimetally to the plate (4).

10 11. A filter press (1) as claimed in claim 10, wherein said backing frame (14) is provided with channels (18) communicating with said at least one discharge channel (11).

12. A filter press (1) as claimed in claim 1, wherein a frame (20) having the same thickness and the same inner empty surface area as those  
15 required for the filtered panel (100) is interposed between said at least two plates (4).

13. A filter press (1) as claimed in claim 12, wherein said frame (20) is provided with at least one first entry hole (21) for injecting said material to be filtered in the form of slip.

20 14. A filter press (1) as claimed in claim 12, wherein said frame (20) is provided with at least one second entry hole for injecting colorant material.

15. A filter press (1) as claimed in claim 1, comprising at least one movable head (6) to vertically compress said plates (4).

16. A filter press (1) as claimed in claim 1, comprising wash means (24)  
25 for restoring the permeability characteristics of the filter cloth (8) on termination of each slab forming cycle.

17. A filter press (1) as claimed in claim 1, wherein said filter cloths (8) are operated by a drive roller (22) positioned at one end of each plate (4) and an idle roller (23) positioned at the opposite end.
18. A filter press (1) as claimed in claim 1, comprising a plurality of said  
5 plates (4).
19. A filter press (1) as claimed in claim 1, wherein said material to be filtered is ceramic slip.
20. A slab forming method comprising the following steps:
- a) providing a filtration chamber interposed between two horizontally  
10 disposed plates (4), namely an upper and a lower plate, a filtration seat (9) being provided in the upper face of the lower plate, at least said lower plate being wrapped by a rotatable filter cloth (8);
- b) clamping said two plates (4) together;
- c) injecting under pressure the material to be filtered into said filtration  
15 chamber via at least one first entry hole (21);
- d) drawing said two plates (4) apart and rotating said cloth (8) to remove the filtered material in the form of a slab.
21. A method as claimed in claim 20, wherein said step c) is conducted at a pressure of 25 bar.
- 20 22. A method as claimed in claim 20, wherein with the lower face of said upper plate there is associated an elastic membrane (13) onto which a pressurized fluid is fed in order to exert a pressure against said material to be filtered.
23. A method as claimed in claim 22, wherein said step c) is conducted  
25 at a pressure between 6 and 10 bar.
24. A method as claimed in claim 22, wherein said pressurized fluid is

fed in at a pressure between 15 and 25 bar.

25. A method as claimed in claim 20, wherein said material to be filtered is a suspension of ceramic slip and its derivatives.

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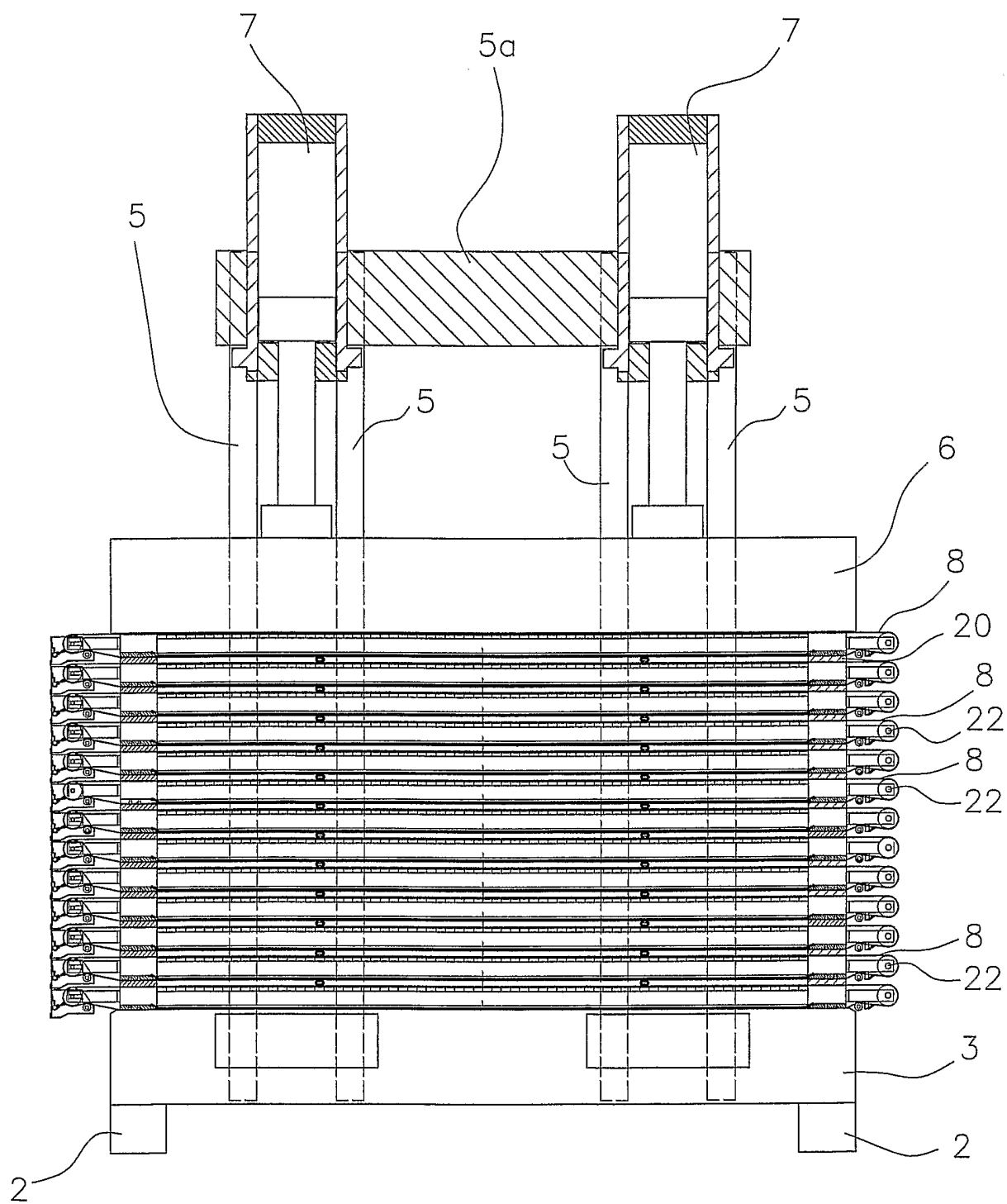
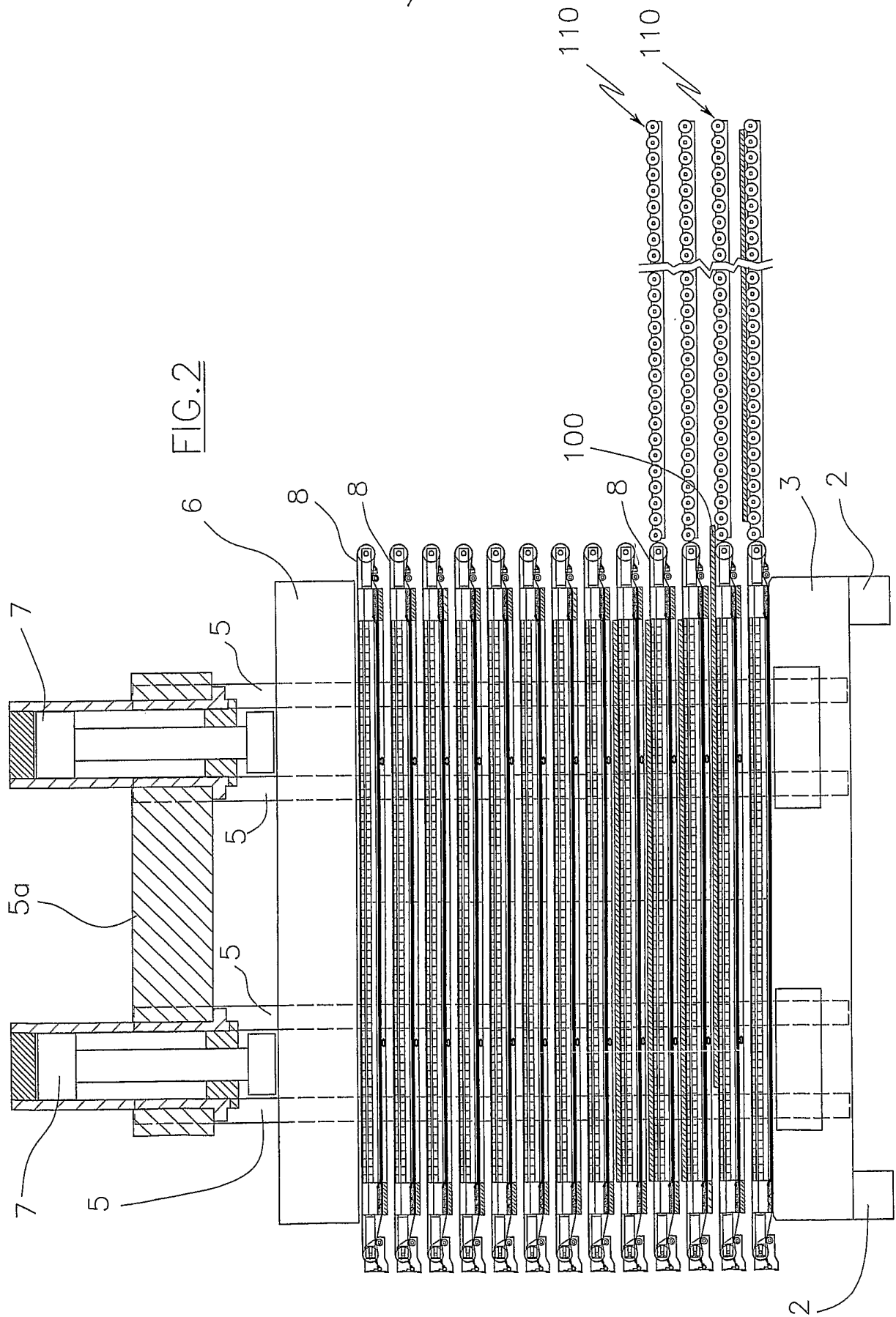


FIG. 1



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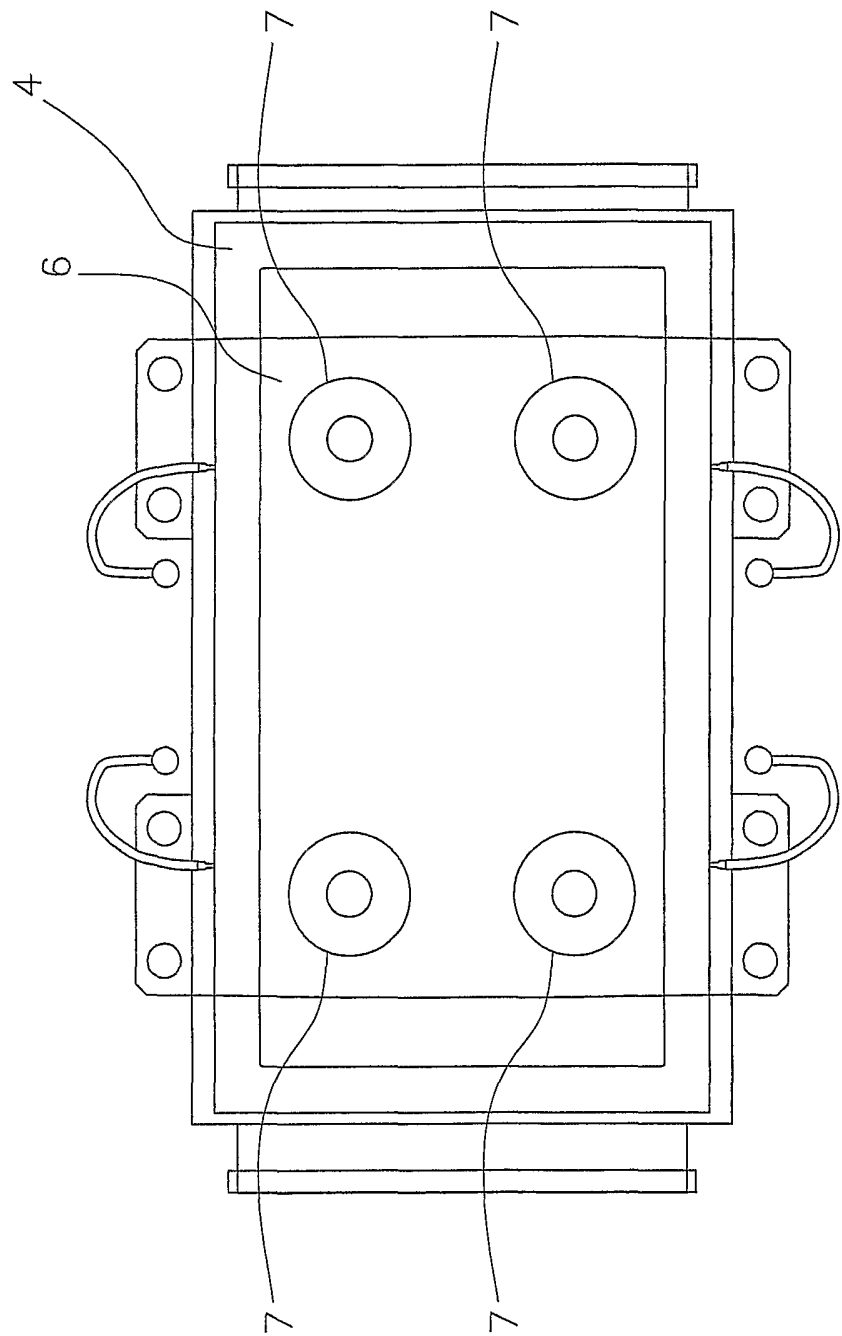


FIG. 3

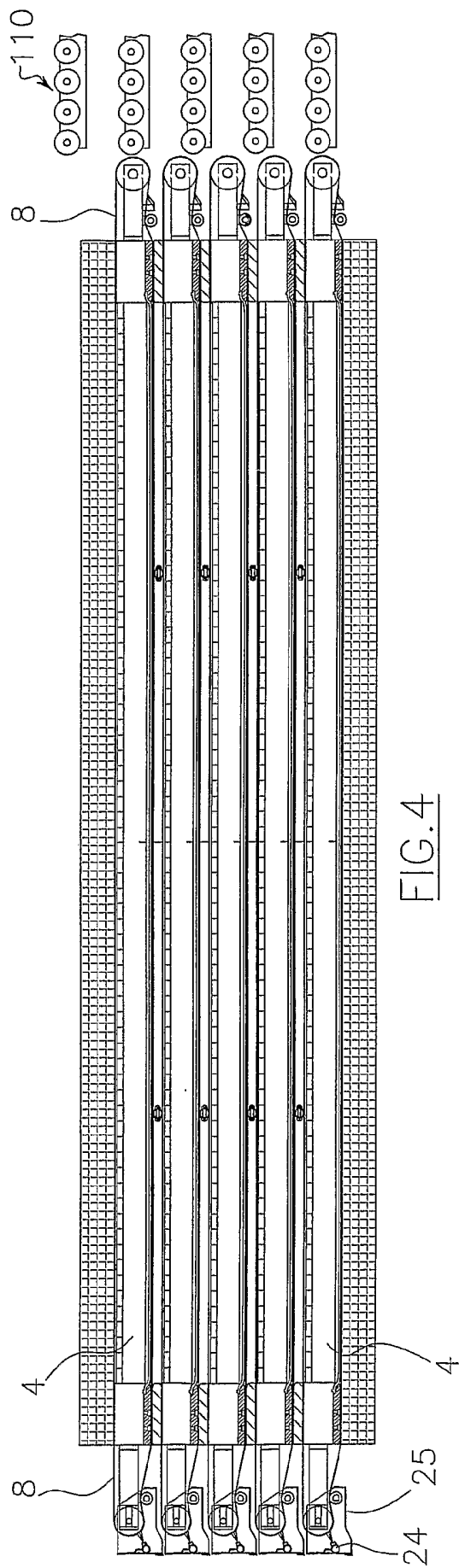


FIG. 4

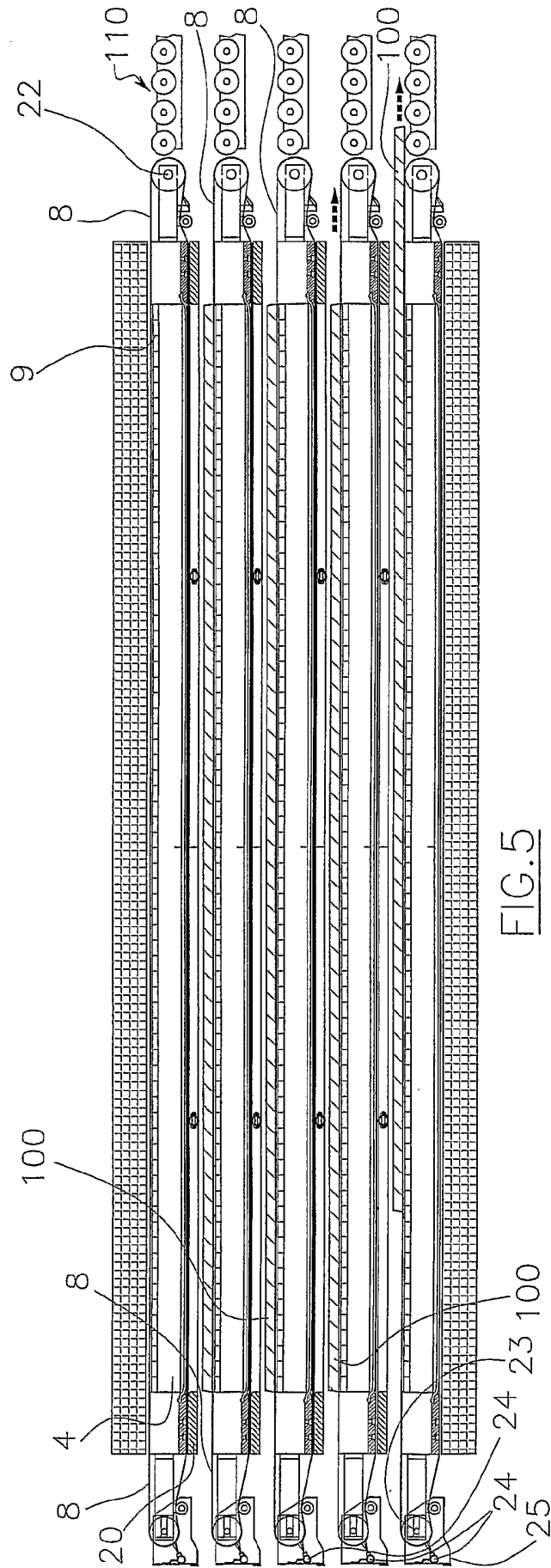
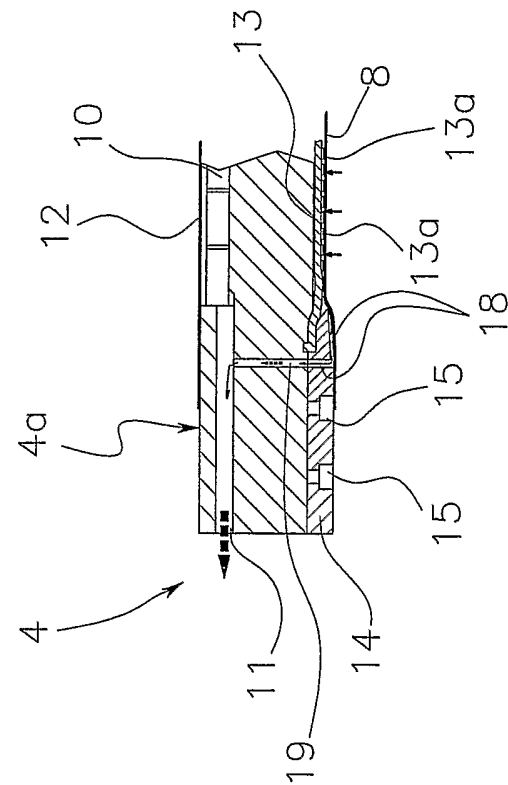
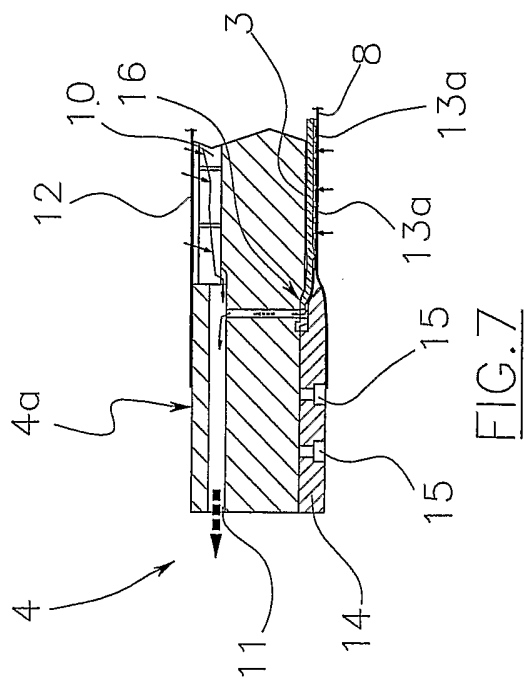
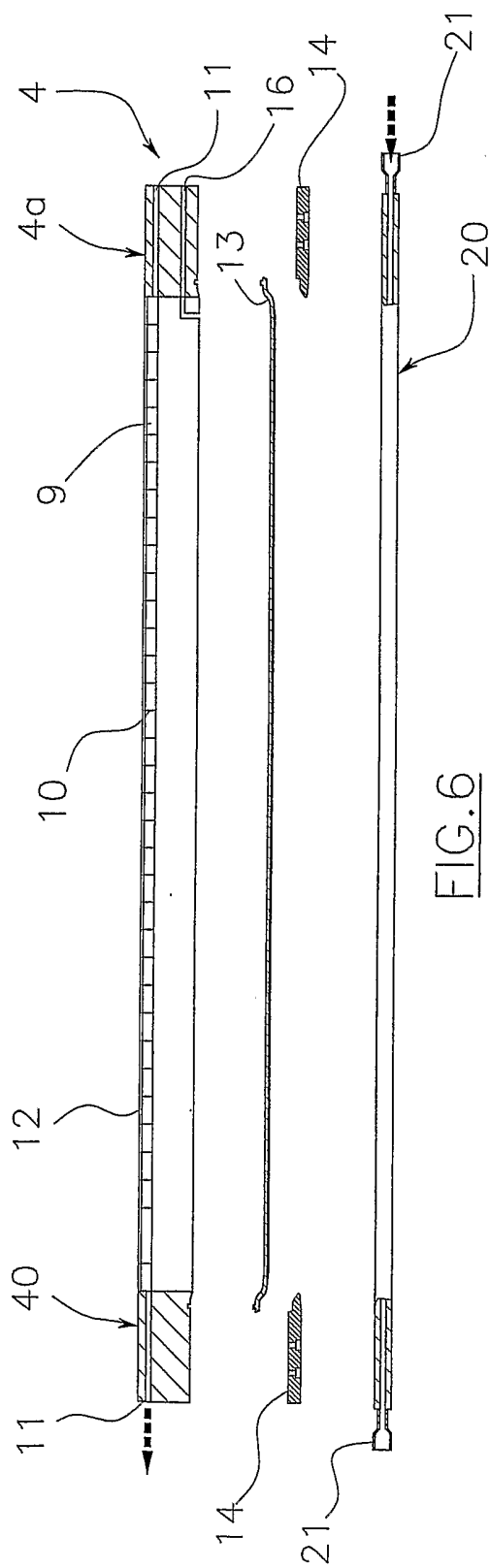


FIG. 5





# INTERNATIONAL SEARCH REPORT

International Application No  
PCT/EP2005/005650

## A. CLASSIFICATION OF SUBJECT MATTER

IPC 7 B30B9/22

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 7 B01D B30B

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 practical, search terms used)

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## C. DOCUMENTS CONSIDERED TO BE RELEVANT

| Category * | Citation of document, with indication, where appropriate, of the relevant passages                                        | Relevant to claim No. |
|------------|---------------------------------------------------------------------------------------------------------------------------|-----------------------|
| X          | WO 98/33573 A (BENESI, STEVE, C)<br>6 August 1998 (1998-08-06)<br>the whole document                                      | 1-25                  |
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| A          | US 3 698 557 A (EIICHI ISHIGAKI)<br>17 October 1972 (1972-10-17)<br>abstract; figures                                     | 1, 20                 |
| A          | EP 0 830 936 A (MEINAN MACHINERY WORKS,<br>INC) 25 March 1998 (1998-03-25)<br>abstract; figures                           | 1, 20                 |
|            | -/--                                                                                                                      |                       |

☒ Further documents are listed in the continuation of box C.

☒ Patent family members are listed in annex.

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Date of the actual completion of the international search

2 August 2005

Date of mailing of the international search report

10/08/2005

Name and mailing address of the ISA

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## C.(Continuation) 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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Information on patent family members

International Application No

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| Patent document<br>cited in search report |    | Publication<br>date | Patent family<br>member(s)                                                                                                                                                                                                                                  | Publication<br>date                                                                                                                                                                                            |
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