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(72) Inventors:  
• **Stefani, Franco**  
**41049 Sassuolo (MO) (IT)**  
• **Gozzi, Franco**  
**41043 Formigine (MO) (IT)**

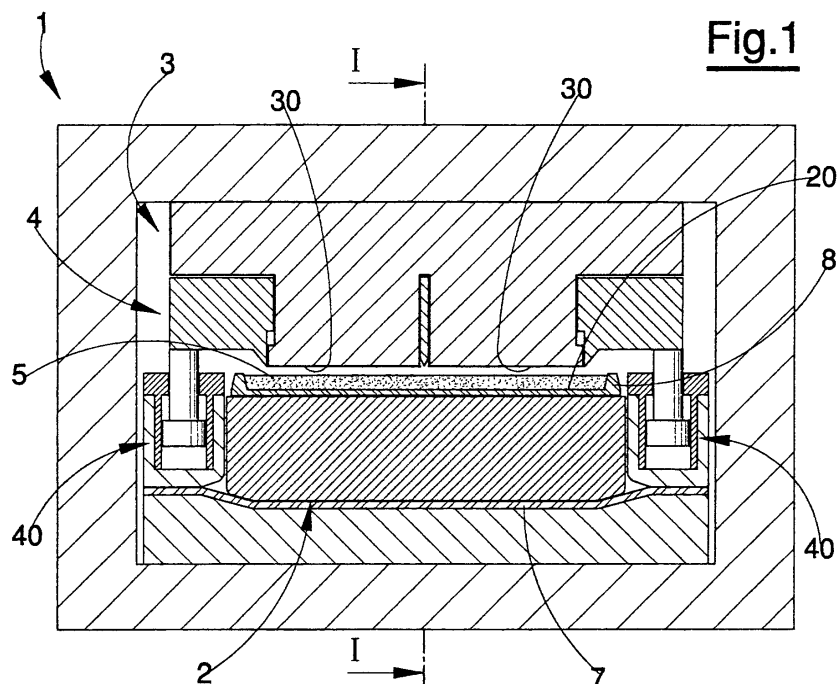
(71) Applicants:  
• **Ronflette S.A.**  
**2233 Luxembourg (LU)**  
• **RONFLETTE S.A. c/o SYSTEM S.p.A.**  
**41042 Fiorano Modenese (MO) (IT)**

(74) Representative: **Gotra, Stefano**  
**BUGNION S.p.A.**  
**No. 25, Via Emilia Est**  
**41100 Modena (IT)**

(54) **A device for forming ceramic products such as tiles and the like, by powder pressing**

(57) The device for forming ceramic products, such as tiles and the like, by pressing of powders or other materials having prevalently plastic characteristics, comprises: a lower body (2) bearing a support surface (20); an upper body (3) provided with at least one active surface (30) arranged facing the support surface (20); at least one shaping frame (4) predisposed in such a way as to perimetally delimit the at least one active surface (30) and to be mobile with respect to the upper body

(3) so as to be able to project inferiorly from the at least one active surface (30); means for depositing a powder layer (5) between the lower body (2) and the upper body (3); the lower body (2) and the upper body (3) being reciprocally mobile in a perpendicular direction to the support surface (20) and the at least one active surface (30) so as to be able to exert on command a pressing force on at least a part of the layer of powders (5) to give the part a permanent shape.



**Fig.1**

## Description

**[0001]** The invention relates particularly to products obtained through pressing ceramic powders or materials having prevalently plastic characteristics.

**[0002]** Specifically, though not exclusively, the invention is usefully applied to the forming of ceramic tiles.

**[0003]** The prior art in the field of forming ceramic tiles is based on the use of dies inserted into presses. The dies are, schematically speaking, constituted by a cavity into which powders are deposited, and by at least one punch having the task of pressing the deposited powders.

**[0004]** The cavity is geometrically designed according to the form and shape of the tile to be produced. It is afforded in the bottom die and at each pressing cycle must be filled with the correct quantity of powder. The batching of the powders is performed by a special device such as a loading hopper, which exists in many forms but always has the characteristic of having to be introduced into the open die, precisely between the bottom die containing the cavity and the top die or punch. To perform its task efficiently the loading hopper has to make an outward and return motion into the open bottom die, which takes a not inconsiderable time within the context of the whole press-forming cycle. This time consumption becomes particularly relevant when, as happens ever more frequently, double-loading hoppers are used to deposit at least two distinct layers of powder separately, one on top of the other, in the cavity. The consequent lengthening of press-forming cycle time has the immediate negative consequence that the whole plant production rate drops.

**[0005]** A further negative aspect of the prior-art realisations is attributable to an inherent and considerable constructional complexity, especially in multiple batching, in the overall functionality of the whole plant.

**[0006]** The structure of the dies in the prior art also contain serious drawbacks, among which one of the most important is certainly the high wear inflicted on the various parts of the die due to the relative motion of the punches and the cavities. The phenomenon is so considerable that in traditional dies the punch is heated by special devices so that it expands to take up the play which over a period of time is created between it and the bottom die.

**[0007]** A functional defect in the prior art, surely due to the structure and the specific functioning modalities of traditional dies, relates to the frequency of defects produced on the workpiece pressed during the extraction phase, that is, the phase in which the pressed piece is extracted from the cavity in which forming has taken place. This tendency to defectiveness is produced around the edges of the piece, where dragging against the cavity walls occurs.

**[0008]** The main aim of the present invention is to overcome the limitations and drawbacks of the prior art as evidenced above, by providing a device for forming

ceramic products by powder pressing, or in any case for forming materials having prevalently plastic characteristics which are functionally and constructionally simple.

**[0009]** More specifically, the present invention provides a device for forming ceramic products by pressing powders, in particular for tile production, for which there is no need for the presence of the loading trucks usually employed in the prior art, which trucks necessarily limit the pressing cycle to the operations for the formation of the layer of powders to be pressed in the cavity.

**[0010]** One advantage of the invention is its economy.

**[0011]** A further advantage consists in its durability over a period of time.

**[0012]** A still further advantage lies in its ability to add considerably to productivity with respect to prior-art applications.

**[0013]** A further advantage of the invention is considerably to reduce defects in the pressed workpieces.

**[0014]** These aims and advantages and others besides are all achieved by the invention as it is characterised in the appended claims.

**[0015]** Further characteristics and advantages of the present invention will better emerge from the detailed description that follows of a preferred but non-exclusive embodiment of the invention, illustrated purely by way of a nonlimiting example in the accompanying figures of the drawings, in which:

figure 1 is a schematic section made according to a vertical median plane;  
 figures 2, 3, 4, 5 and 6 show the same section as figure 1 in a number of different operative configurations;  
 figure 7 shows a schematic section made along line I-I of figure 1;  
 figure 8 is a schematic section made along line IV-IV of figure 4;  
 figure 9 is the same schematic section as in figure 8 of a further embodiment which provides for various formats;  
 figure 10 is the same section of figures 8 and 9 in a further embodiment.

**[0016]** With reference to the figures, 1 denotes in its entirety a frame on which a lower body 2 is supported, which is superiorly provided with a support surface 20.

**[0017]** In the illustrated embodiment this surface 20, which is flat and lies horizontally, constitutes the rest plane for a support 8 which receives and bears a layer of powders 5 which is destined to be pressed.

**[0018]** A further embodiment, not illustrated in the figures, has the support surface 20 specifically predisposed to receive a layer of powders to be pressed directly on it.

**[0019]** Above the body 2 a punch-bearing upper body 3 is predisposed, which is constrained to the frame 1 and equipped with at least a plurality of contiguous active surfaces 30 facing the support surface 20 of the

body 2.

**[0020]** The active surfaces 30 of the plurality of active surfaces 30 have a punch function and are perimetally delimited by a shaping frame 4 which is grate-structured and is able to move freely with respect to the upper body 3 so that it can project inferiorly from the active surfaces 30, which in the illustrated example are co-planar.

**[0021]** In greater detail, the shaping frame 4 has lower edges which are knife- or blade-shaped. This enables the edges to penetrate very easily into the powders 5 so as to divide them into an internal portion, totally underlying the active surfaces 30, and external portions not underlying said surfaces 30.

**[0022]** The powder layer 5 between the lower body 2 and the upper body 3 is moved into a parallel location to the support surface 20 and the active surfaces 30, essentially by means including the support 8.

**[0023]** The pressing action interests only a part of the powder layer 5 and is effected by relative motion of the lower body 2 and the upper body 3, which bodies move in a perpendicular direction to the support surface 20 and the active surfaces 30. The perpendicular projection of the active surfaces 30, in the direction of the relation motions of the upper body 3 and the lower body 2, interests only a part of the support surface 20.

**[0024]** The shaping frame 4 is also able to move perpendicularly to the support surface 20 and the active surfaces 30 and simply rests on raising devices constituted by extractor cylinders 40 which are constrained to the frame 1 on two opposite sides of the body 2. These extractor cylinders 40 have the task of raising by predetermined amounts and on command the shaping frame 4 and keeping it in the predetermined raised position with respect to the active surfaces 30 and the support surface 20.

**[0025]** In particular, the shaping frame 4 possesses a freedom of movement with respect to the upper body 3 which enables it to project inferiorly from the active surfaces 30 by an amount which is proportional to the thickness of the powder layer 5.

**[0026]** Special organs, not illustrated in the figures, push the shaping frame 4 downwards towards the lower body 2, so that when the antagonist action exerted by the extractor cylinders 40 ceases the lower knife-shaped edges of the shaping frame 4 can easily penetrate into the powder layer 5 up until they contact with the surface of the support 8 on which the powder layer lies.

**[0027]** The upper body 3 is fixed to the frame 1, while the lower body 2 is mobile on command along said perpendicular direction to the active surface 30 and to the support surface 20. The movement of the lower body 2 is made possible by an actuator which comprising a hydraulic actuator constituted by a chamber 6 into which pressurised fluid is forced.

**[0028]** The chamber 6 is superiorly closed by a diaphragm 7 which is designed to support on an external upper face thereof the whole lower body 2 which func-

tions as a sort of piston pushed upwards by the raising of the diaphragm 7, caused by the introduction of a pressurised fluid, namely oil, into the chamber 6.

**[0029]** The greater simplicity of the invention with respect to press-forming devices in the prior art used in the production of tiles means that without the addition of constructionally complex details the whole useful surface of the press can be used, so that pieces of various formats can be produced in a single pressing operation.

**[0030]** It is therefore easy to produce, as shown in figure 9, special formats together with series formats.

**[0031]** It is also possible, through a simple shaping of the lower edges of the blades internal of the shaping frame 4 - which blades separate two contiguous active surfaces 30 - to create connection bridges 10 between two tiles 11.

**[0032]** This possibility could be very useful for small formats which might then form moveable squares which could be treated during laying as rigid bodies.

**[0033]** The functioning of the device can be summed up in an ordered sequence of phases in process comprising:

- laying a powder layer 5 on a support 8 which support can move and is positionable on the support surface 20 of the lower body 2;
- bringing at least one active surface 30 of an upper body 3 into contact with the powder layer 5; the upper body 3 being predisposed facing the support surface 20, on which support surface 20 the support 8 is positioned, and the active surface 30 being perimetally delimited by the shaping frame 4 (which latter can freely move with respect to the upper body 3 so as to be able on command to project inferiorly from the active surfaces 30 by an amount which is in proportion to the thickness of the powder layer 5;
- descent of the shaping frame 4 with respect to the active surface 30 of the upper body 3 to cut the powder layer 5 so as to subdivide it neatly into at least an internal part, entirely underlying the active surfaces 30, and an external part not underlying the active surfaces 30;

pressing the internal part of the powder layer 5 by a relative nearing movement of the lower body 2 and the upper body 3 in a perpendicular direction to the support surface 20 and the active surfaces 30; the pressing being realised in such a way as to give a permanent shape to the pressed material;

removal of the shaped body consisting in raising the shaping frame 4 with respect to the upper body 3 up until a position is reached in which the lower edges of the shaping frame 4 are not positioned below the active surfaces 30 so as not to interfere with the underlying pressed internal part of the powder layer 5;

- distancing of the lower body 2 from the upper body 3 and thus of the support surface 20 and the support

8 located there-on from the active surfaces 30 in a perpendicular direction to the surfaces themselves, which consequently produces the distancing of the active surfaces 30 from the underlying upper surface of the pressed internal portion of the powder layer 5 lying, as is the external portion, on the support 8;

- evacuation of the pressed internal portion and the external portion (not pressed) of the powder layer 5, achieved by moving the support 8 on which the portions are lying.

**[0034]** The moving of the support 8 can easily be realised by causing the support 8 itself to slide on the support surface 20. The support 8 could, for example, be constituted by a sort of tray which before being inserted between the lower body 2 and the upper body 3 in the raised position, be loaded with the powder layer 5. Once shaping has taken place the support 8 - now containing the pressed material (tiles) and the non-pressed external portion of the original layer 5 - can be removed with the same simplicity of movement with which it was previously inserted.

**[0035]** The operative modalities described enable the preparation and laying of the powder layer 5 to be carried out away from the press-forming device, with the obvious advantage that in this way preparation and predisposition of the powder layer 5 to be pressed in the press-forming operation can be done independently one of the other: thus the time needed for the forming cycle is not minimally influenced by the preparation time for the layer of material to be pressed. This means that layers 5 obtained from successive superpositioning of layers, theoretically in indefinite numbers, of various powders can be achieved, in small layers and/or decorations.

**[0036]** Further, the modalities of extracting the tiles from the shaping frames 4, in which the portions of pressed material are loosened from the walls they have been shaped by under pressure, reduce defective production to a minimum.

**[0037]** This is essentially due to the fact that the detachment by dragging with the walls of the shaping frame 4 in contact with the edges of the pressed portion happens with the pressed portion still pressed between the active surfaces 30 and the support surface 20.

**[0038]** A simplified variant of the illustrated process differs there-from only inasmuch as it does not include the use of supports 8 and envisages the laying of a layer of powders 5 directly on the support surface 20 of the lower body 2.

## Claims

1. A device for forming ceramic products, such as tiles and the like, by pressing of powders or other materials having prevalently plastic characteristics, com-

prising:

a lower body (2) bearing a support surface (20); an upper body (3) provided with at least one active surface (30) arranged facing said support surface (20); at least one shaping frame (4) predisposed in such a way as to perimetally delimit said at least one active surface (30) and to be mobile with respect to said upper body (3) so as to be able to project inferiorly from said at least one active surface (30); means for depositing a powder layer (5) between said lower body (2) and said upper body (3); said lower body (2) and said upper body (3) being reciprocally mobile in a perpendicular direction to said support surface (20) and said at least one active surface (30).

2. The device of claim 1, characterised in that said at least one active surface (30), projecting perpendicularly in a direction of motion relative to said upper body (3) and said lower body (2), interests only a portion of said support surface (20).
3. The device of claim 2, characterised in that the shaping frame (4) which perimetally delimits said at least one active surface (30), has lower edges which are blade-shaped.
4. The device of claim 3, characterised in that the means for depositing a layer of powder between said lower body (2) and said upper body (3) comprise a support (8) which is predisposed to be rested on said support surface (20) and to receive said layer of powder.
5. The device of claim 4, characterised in that said support surface (20) and said at least one active surface (30) are flat, parallel and horizontal.
6. The device of claim 5, characterised in that said shaping frame (4) rests on raising devices which on command raise the shaping frame (4) with respect to said lower body (2) and said upper body (3).
7. The device of claim 6, characterised in that said shaping frame (4) is freely movable with respect to said upper body (3) so as to be able to project inferiorly from said at least one active surface (30) by an amount which is proportional to a thickness of said powder layer (5).
8. The device of claim 7, characterised in that said lower body (2) is mobile on command to move along said perpendicular direction of the active surface (30) and the support surface (20); at least one actuator being provided to raise the lower body (2) and push it against the upper body (3) with a predetermined force.

9. The device of claim 8, characterised in that said actuator comprises a hydraulic actuator constituted by a chamber (6) into which pressurised fluid is sent; said chamber (6) being superiorly closed by a diaphragm (7) on an external face of which diaphragm (6) the lower body (2) rests. 5
10. The device of claim 9, characterised in that said shaping frame (4) is grate-structured and perimetrically delimited by a plurality of said active surfaces (30) arranged contiguously. 10
11. A process for forming ceramic products, such as tiles and the like, by pressing of powders or other materials having prevalently plastic characteristics, comprising, in order of process: 15
- laying a powder layer (5) on a support (8) which support can move and is positionable on a support surface (20) of a lower body (2); 20
  - bringing at least one active surface (30) of an upper body (3) into contact with the powder layer (5); the upper body (3) being predisposed facing the support surface (20), on which support surface (20) the support (8) is positioned, the at least one active surface (30) being perimetrically delimited by a shaping frame (4) freely movable with respect to the upper body (3) so as to be able on command to project inferiorly from the at least one active surface (30) by an amount which is in proportion to a thickness of the powder layer (5); 25
  - descent of the shaping frame (4) with respect to the at least one active surface (30) of the upper body (3) to cut and subdivide the powder layer (5) neatly into at least an internal part, entirely underlying the at least one active surface (30), and an external part not underlying the at least one active surface (30); 30
- pressing the internal part of the powder layer (5) by a relative nearing movement of the lower body (2) and the upper body (3) in a perpendicular direction to the support surface (20) and the at least one active surface (30); the pressing being realised in such a way as to give a permanent shape to the internal part; 35
- removal of the internal part after pressing, consisting in a raising of the shaping frame (4) with respect to the upper body (3) up until a position is reached in which lower edges of the shaping frame (4) are not positioned below the at least one active surface (30) so as not to interfere with the underlying pressed internal part of the powder layer (5); 40
- distancing of the lower body (2) from the upper body (3) and thus of the support surface (20) and the support (8) located there-upon from the at least one active surface (30) in a perpendicular direction to the surfaces themselves, consequently producing a distancing of the at least one active surface (30) in a perpendicular direction to the at least one active surface (30), which consequently produces a distancing of the at least one active surface (30) from an underlying upper surface of the pressed internal part of the powder layer (5) lying, as is the external portion, on the support (8); 45
12. A process for forming ceramic products, such as tiles and the like, by pressing of powders or other materials having prevalently plastic characteristics, comprising, in order of process: 50
- laying a powder layer (5) on a support surface (20) of a lower body (2);
  - bringing at least one active surface (30) of an upper body (3) into contact with the powder layer (5); the at least one active surface (30) being predisposed facing the support surface (20), and being perimetrically delimited by a shaping frame (4) which shaping frame (4) can freely move with respect to the upper body (3) so as to be able on command to project inferiorly from the at least one active surface (30) by an amount which is in proportion to a thickness of the powder layer (5);
  - descent of the shaping frame (4) with respect to the active surface (30) of the upper body (3) to cut the powder layer (5) so as to subdivide said powder layer (5) neatly into at least one internal part, entirely underlying the at least one active surface (30), and an external part; 55
- pressing the internal part of the powder layer (5) by a relative nearing movement of the lower body (2) and the upper body (3) in a perpendicular direction to the support surface (20) and the at least one active surface (30); the pressing being realised in such a way as to give, a permanent shape to the internal part of the powder layer (5);
- removal of the internal part by raising the shaping frame (4) with respect to the upper body (3) up until a position is reached in which the lower edges of the shaping frame (4) are not positioned below the at least one active surface (30) so as not to interfere with the pressed internal part of the powder layer (5) underlying said at least one active surface (30);
- distancing of the lower body (2) from the upper body (3) and thus of the support surface (20) and the support (8) located there-upon from the at least one active surface (30) in a perpendicular direction to the surfaces themselves, consequently producing a distancing of the at least

one active surface (30) from the underlying upper surface of the pressed internal part of the powder layer (5) lying on the support (8);

- evacuation of the pressed internal part and the unpressed external part.

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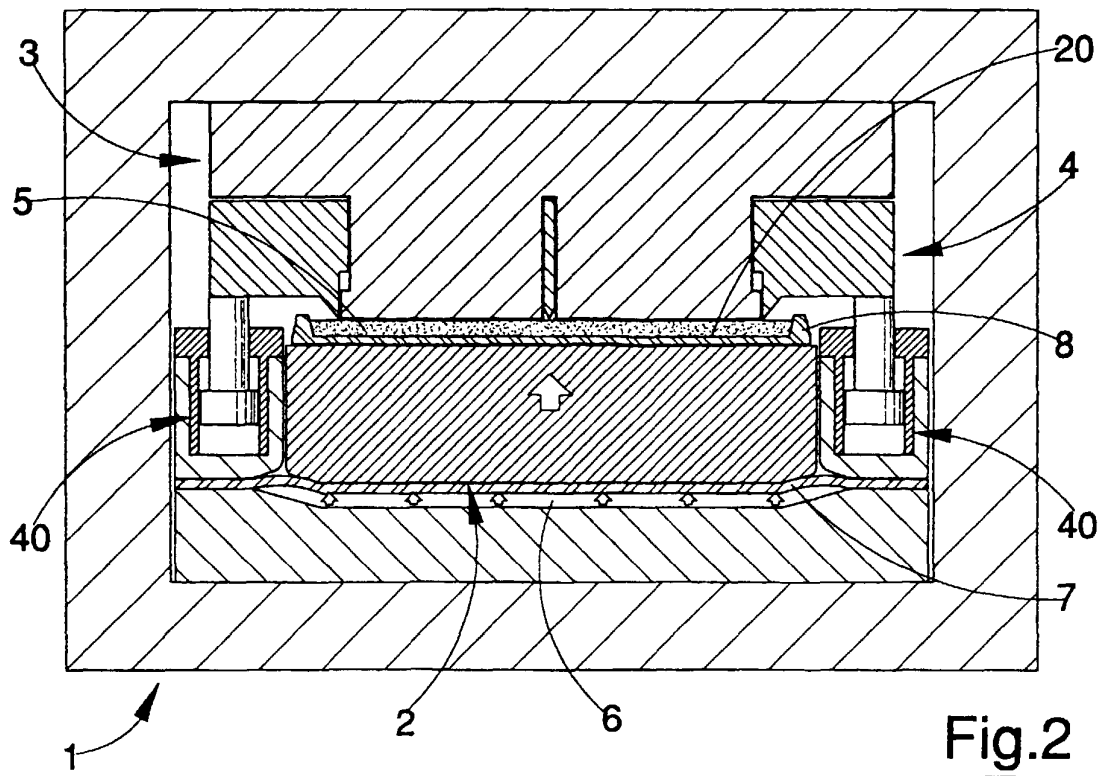
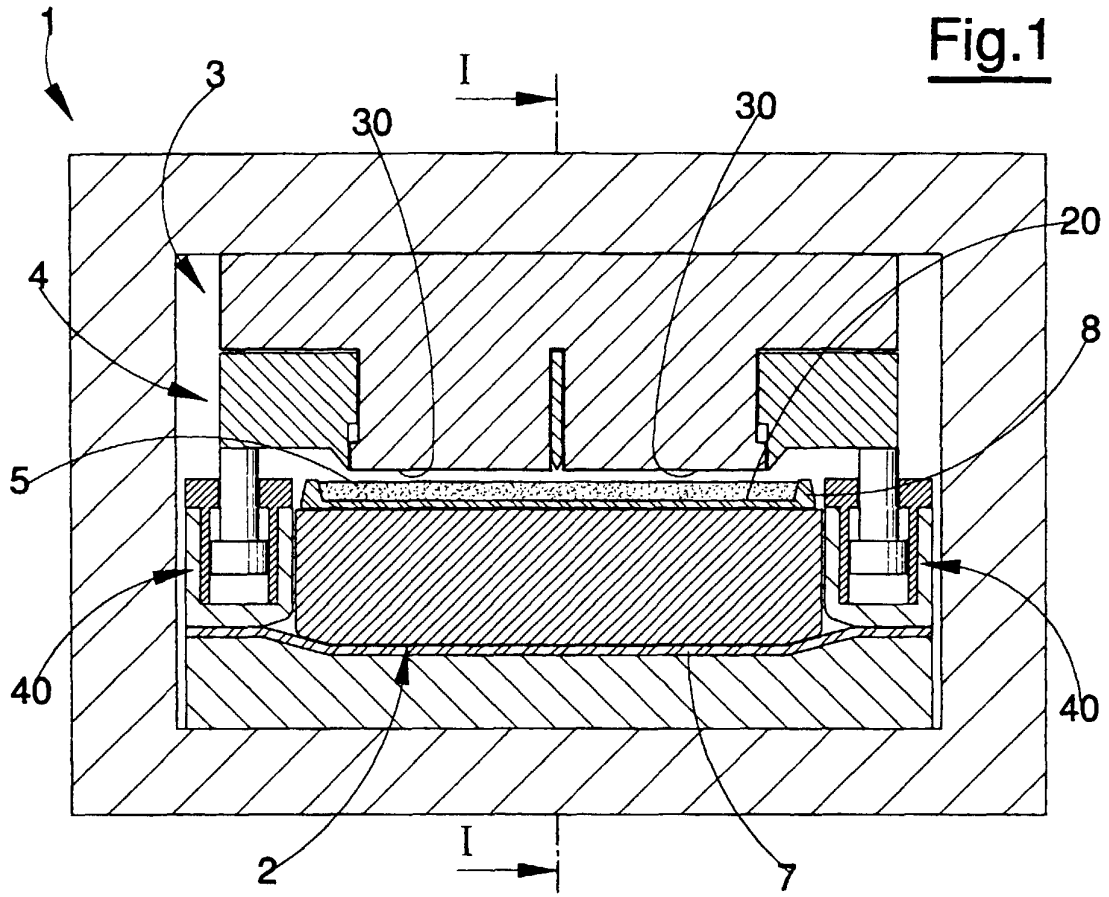
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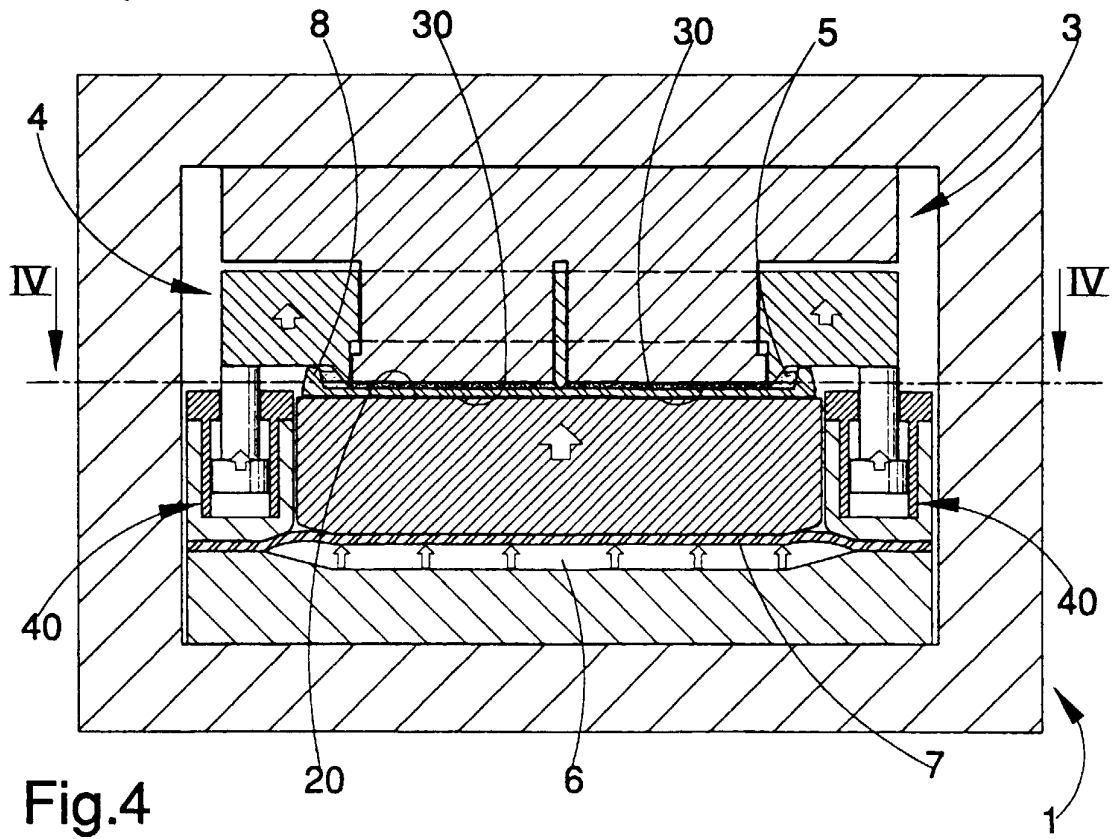
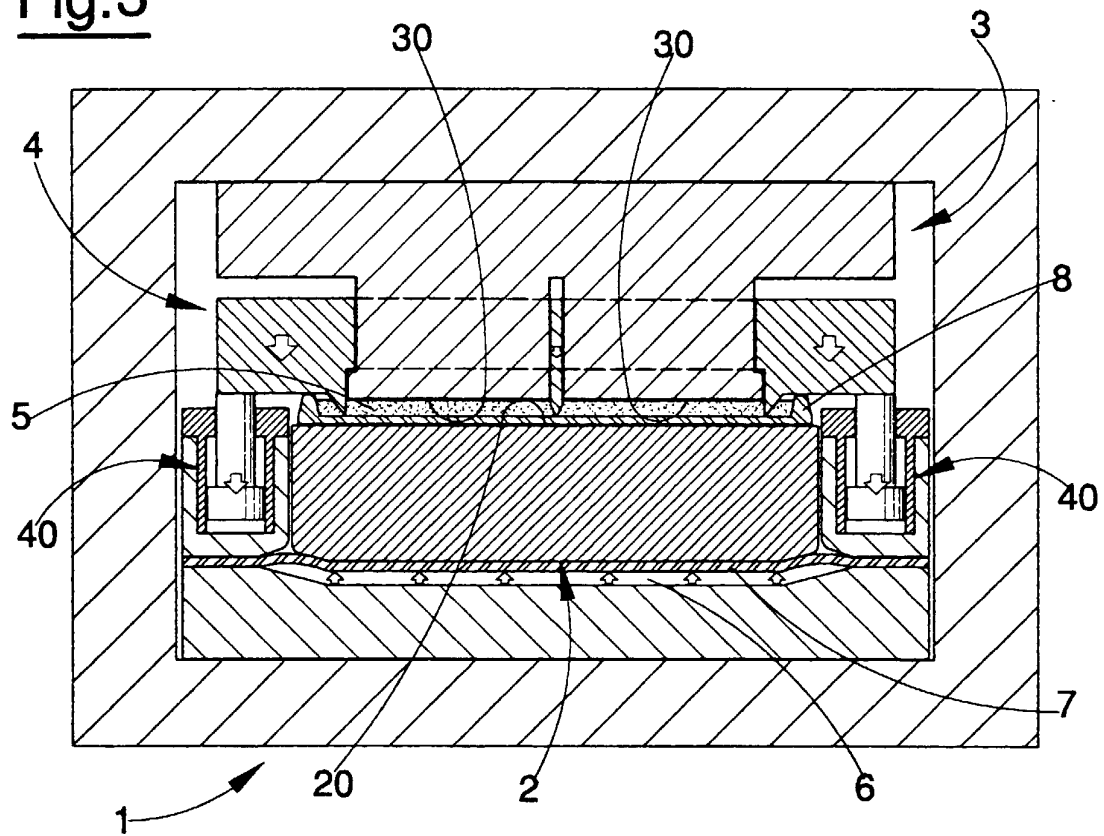
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**Fig.3**



**Fig.4**



Fig.5

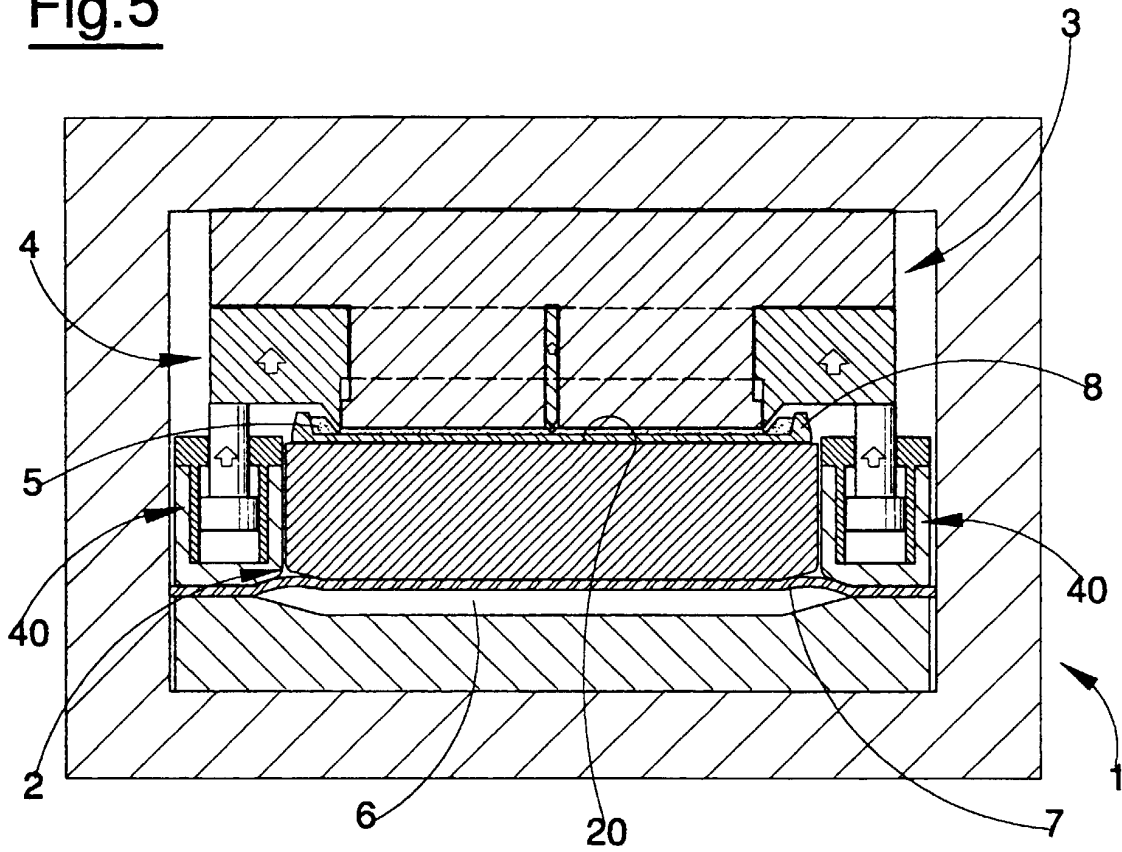
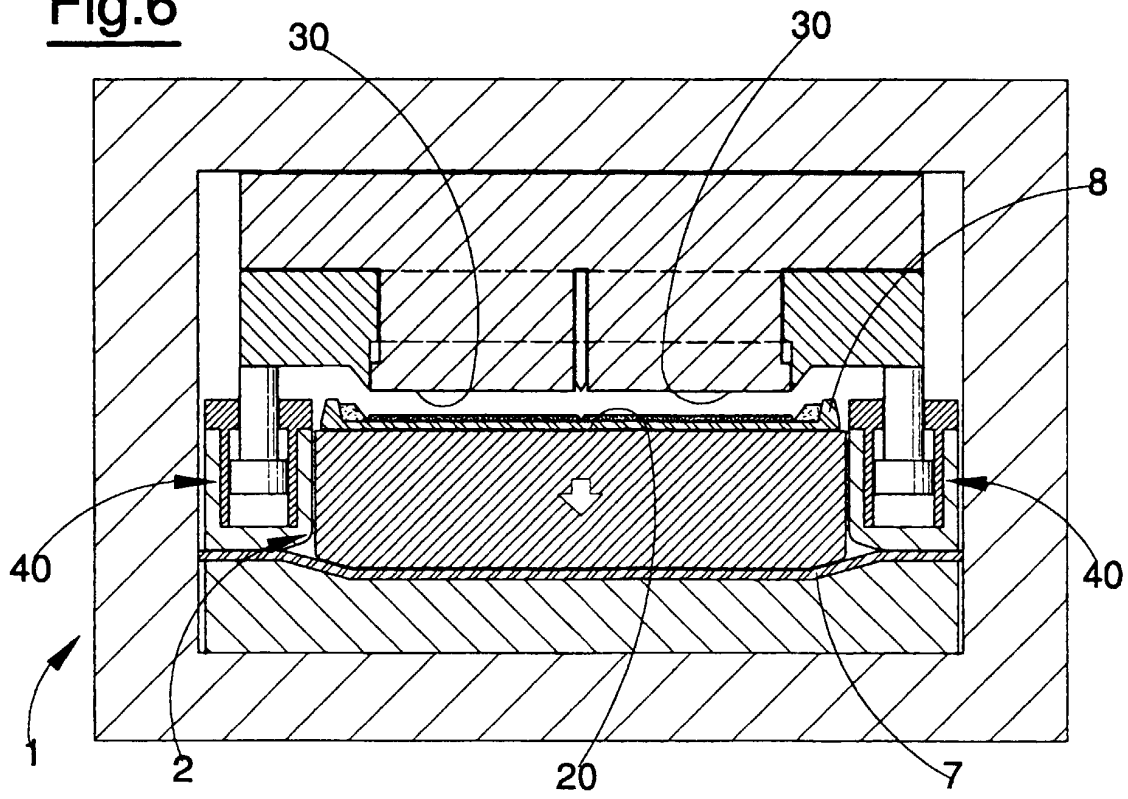
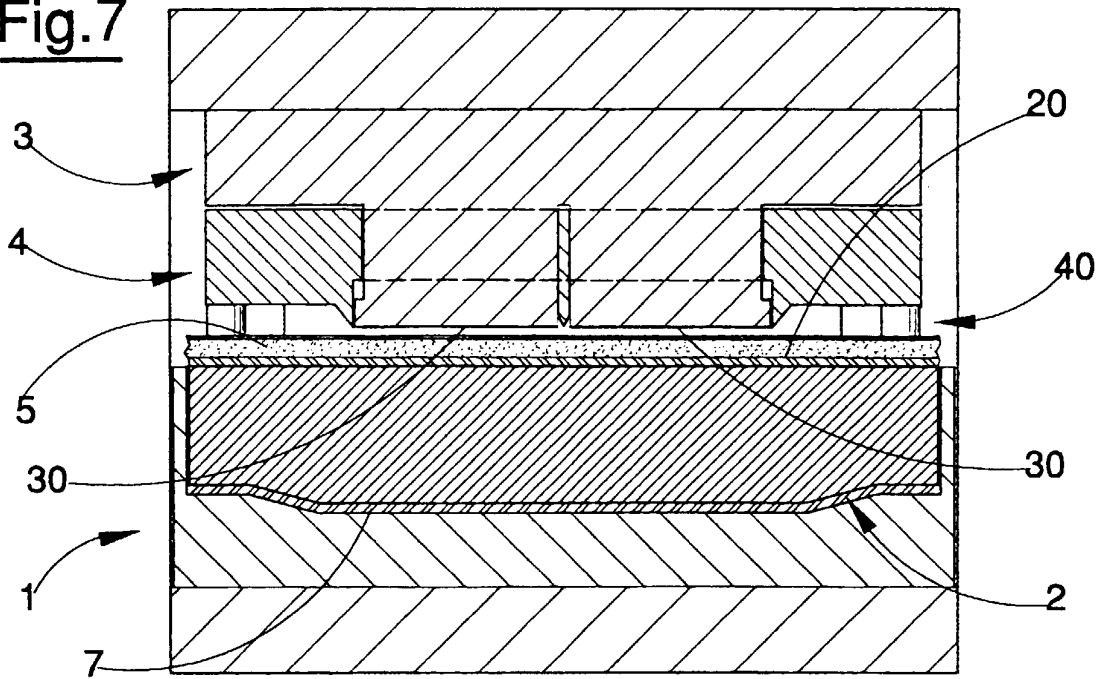


Fig.6



**Fig.7**



**Fig.8**

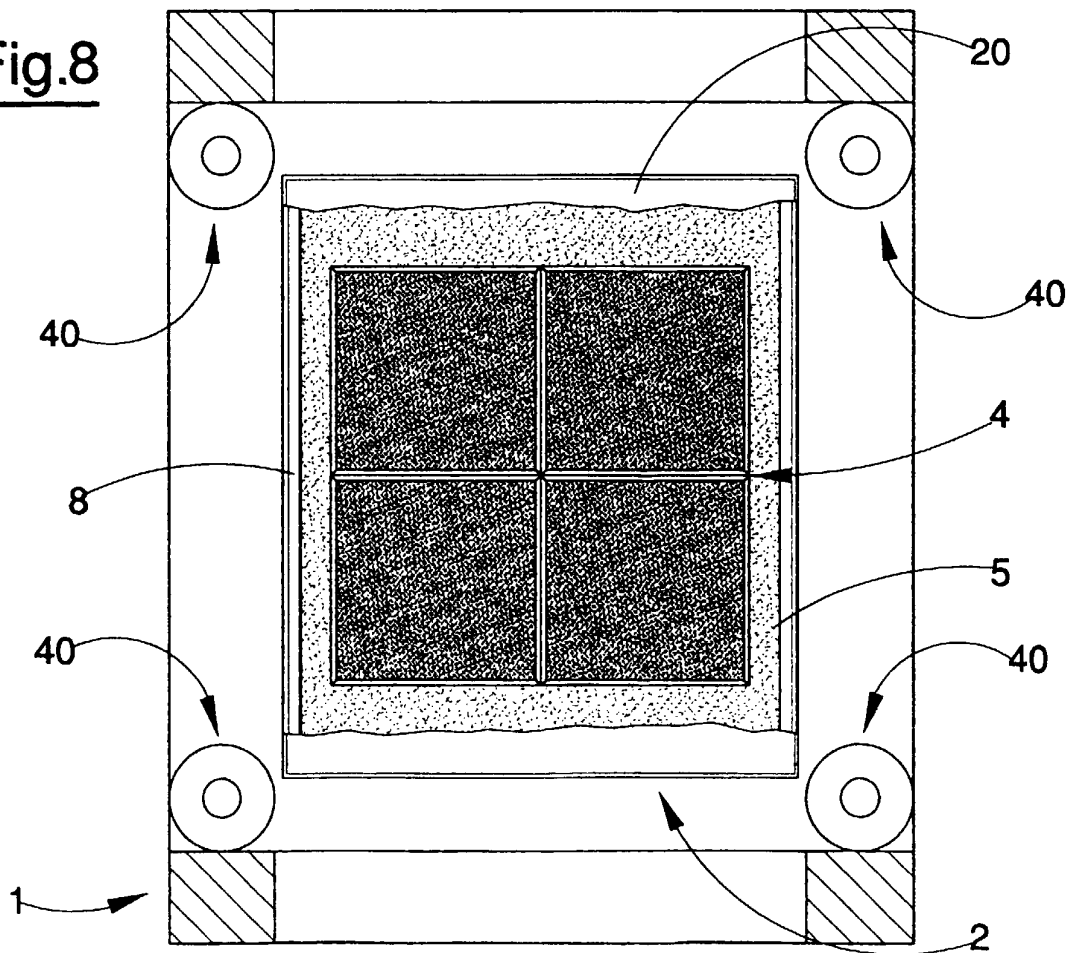


Fig.10

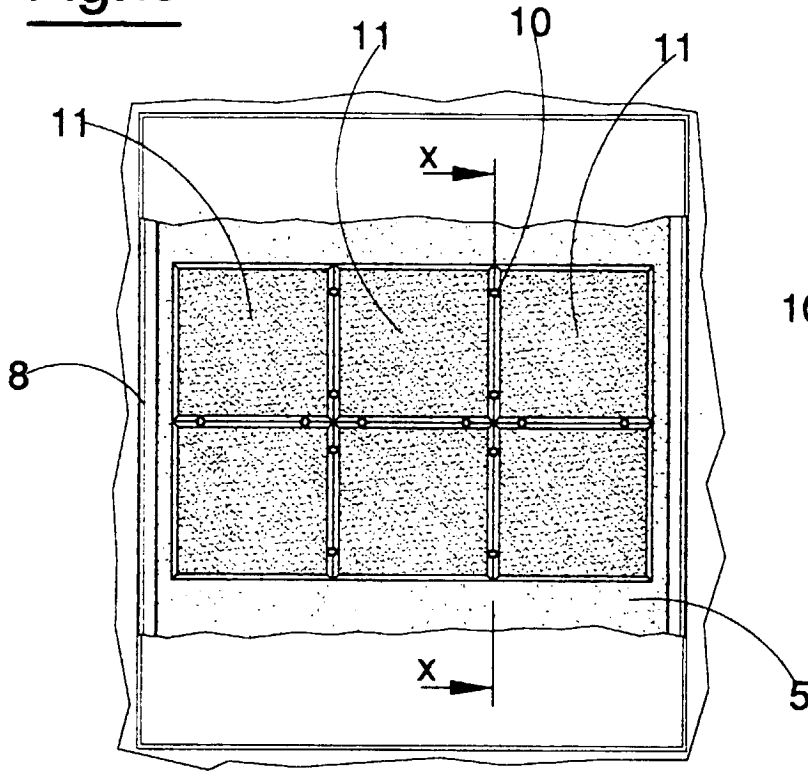


Fig.11

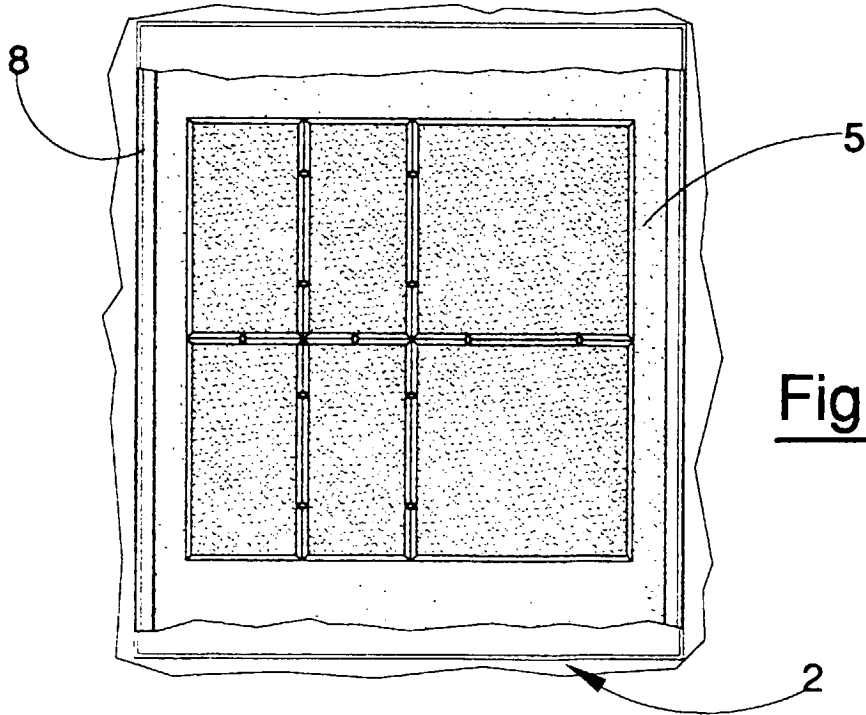
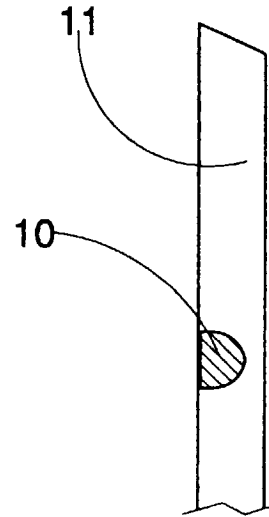


Fig. 9



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ANNEX TO THE EUROPEAN SEARCH REPORT  
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