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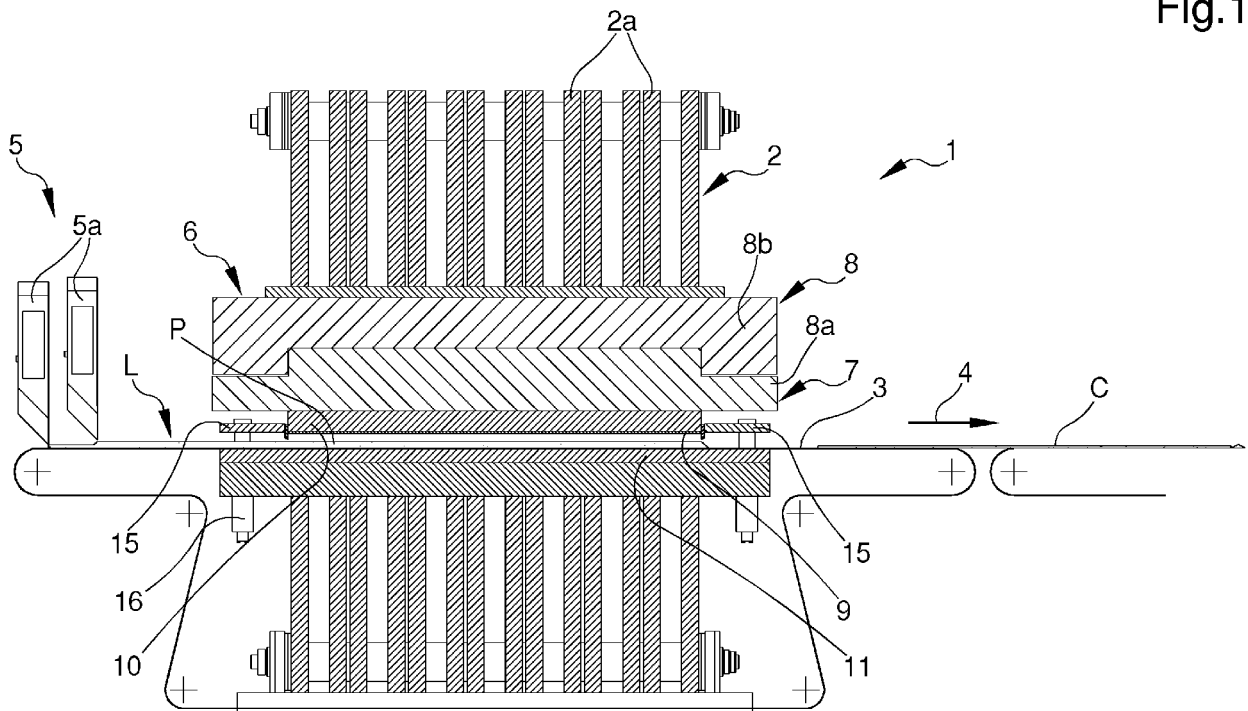
(54) **PROCESS AND EQUIPMENT FOR THE MANUFACTURE OF SLABS OF CERAMIC MATERIAL**

(57) The process for the manufacture of slabs of ceramic material comprises the following phases of:
- feeding ceramic material onto a supporting surface to form a continuous slab (L) to be compacted;
- moving the continuous slab (L) along a forward direction (4);

- pressing a portion (P) of the continuous slab (L) to obtain a compacted slab (C) of predefined dimensions separate from the remaining part of the continuous slab (L).

Equipment (1) for implementing this process is also claimed, said equipment comprising containment means (12) of the portion (P).

Fig.1



Description

Technical Field

[0001] The present invention relates to a process and equipment for the manufacture of slabs of ceramic material.

Background Art

[0002] As is well known, the manufacture of slabs of ceramic material is generally carried out by preparing a predetermined quantity of material to be compacted, placing this predetermined quantity of material on a supporting surface and compacting it using suitable pressing means.

[0003] The traditional method of pressing, relating to the manufacture of small-medium sized products, provides for the ceramic material to be compacted to be placed inside a cavity wherein a relevant pressing pad is inserted. After the pressing action is over, the material thus compacted is extracted from the honeycomb and made to move towards the following drying or firing stations.

[0004] This method of pressing is characterized by low manufacturing outputs due to the high discontinuity of the manufacturing process.

[0005] In the case of large-sized slabs, the supporting surface may be of the type of a belt, on which the ceramic material in powder form to be compacted is therefore deposited. The pressing of the material is achieved by the superimposition of a further belt on the supporting surface carrying the material to be compacted and by the crushing action of such belts on the material positioned between them. The material compacted in this way is then moved forward from the same supporting surface towards the subsequent drying or firing stations.

[0006] Also in this case, however, the production output is limited because of the need to have a close correlation between the forward movement of the supporting surface and the pressing phase. In particular, the supporting surface must be moved forward by the pitch corresponding to the size of the length of the material deposited thereon, so as to bring it exactly at the point where the pressing means are located.

Description of the Invention

[0007] The main aim of the present invention is to devise a process and equipment for the manufacture of slabs of ceramic material which enables the drawbacks of the prior art to be overcome and, in particular, to obtain a higher production output, while maintaining high quality characteristics of the pressed slab.

[0008] Within this aim, one object of the present invention is to minimize the downtime related to the phases of forward movement and pressing of the ceramic material and, at the same time, to obtain high quality standards

in terms of thickness, flatness and minimization of waste on the edges of the slab. Another object of the present invention is to devise a process and equipment for the manufacture of slabs of ceramic material which will enable us to overcome the aforementioned drawbacks of the prior art within the scope of a simple, rational, easy, effective to use and low cost solution.

[0009] The objects set out above are achieved by the present process for the manufacture of slabs of ceramic material according to claim 1.

[0010] The objects set out above are also achieved by the present equipment for the manufacture of slabs of ceramic material according to claim 6.

Brief Description of the Drawings

[0011] Other characteristics and advantages of the present invention will become more apparent from the description of a preferred, but not exclusive, embodiment of a piece of equipment for the manufacture of slabs of ceramic material, illustrated by way of an indicative, yet non-limiting example, in the accompanying tables of drawings wherein:

Figure 1 is a side elevation view of a piece of equipment according to the invention, during the phase of forward movement of the continuous slab;

Figure 2 is a magnifying view of a detail of the piece of equipment in Figure 1;

Figure 3 is a front elevation view of the equipment in Figure 1;

Figure 4 is a magnifying view of a detail of the equipment in Figure 3;

Figure 5 is a side elevation view of the equipment in Figure 1, during the containment phase of a portion of the continuous slab;

Figure 6 is a front view of the equipment in Figure 5;

Figure 7 is a side elevation view of the equipment in Figure 1, during the pressing phase of the portion of the continuous slab;

Figure 8 is a front elevation view of the equipment in Figure 7;

Figure 9 is a side elevation view of the equipment in Figure 1, during the release phase of the compacted portion of the continuous slab;

Figure 10 is a front elevation view of the equipment in Figure 9;

Figure 11 is an axonometric view of the containment means of the equipment in Figure 1.

Embodiments of the Invention

[0012] With particular reference to such figures, reference numeral 1 globally indicates a piece of equipment for the manufacture of slabs of ceramic material.

[0013] The equipment 1 comprises a load-bearing structure 2, at least one supporting surface 3 associated

with the load-bearing structure 2 and movable along one forward direction 4, feeding means 5 of a powdered ceramic material on the supporting surface 3, and pressing means 6 of the ceramic material.

[0014] More in detail, the load-bearing structure 2 comprises a plurality of sheet metal elements 2a, called ribs, adapted to bear the pressing load, which are bundled together to provide high stiffness of the load-bearing structure itself.

[0015] The pressing means 6 are associated with the load-bearing structure 2.

[0016] More particularly, the pressing means 6 comprise a pressing element 7, intended to contact the ceramic material to be compacted, which is arranged above the supporting surface 3 and movable close to/away from the supporting surface itself. In the embodiment shown in the figures, the pressing means 6 comprise a fluid-operated cylinder 8 provided with a piston 8a, movable with respect to the body 8b of the fluid-operated cylinder itself close to/away from the supporting surface 3, and with which a pressing pad 9 is associated, made e.g. of a resinous material, intended to contact the ceramic material to be compacted. The piston 8a and the pressing pad 9 define the pressing element 7.

[0017] Appropriately, the pad 9 is magnetically associated with the piston 8a, e.g. by means of a magnetic plate 10 positioned between them.

[0018] The pressing means 6 also comprise an abutment element 11, which is arranged below the supporting surface 3 and adapted to act as a stop to the force exerted by the pressing element 7. The abutment element 11 is locked together, e.g. magnetically, with the load-bearing structure 2.

[0019] According to the invention, the feeding means 5 and the pressing means 6 are arranged along the supporting surface 3, wherein the feeding means 5 are adapted to release a continuous slab L to be compacted on the supporting surface 3 and the pressing means 6 are adapted to press a portion P of the continuous slab L placed resting on the supporting surface 3 so as to define a compacted slab C of predefined dimensions which is separate from the continuous slab itself.

[0020] More particularly, the pressing means 6 are arranged downstream of the feeding means 5 with respect to the forward direction 4.

[0021] Preferably, the feeding means 5 comprise one or more hoppers 5a arranged above the supporting surface 3. In the embodiment shown in Figure 1, the feeding means 5 comprise a plurality of hoppers 5a arranged in succession with each other along the forward direction 4.

[0022] Advantageously, the stretch of the supporting surface 3 extending between the feeding means 5 and the pressing means 6 is seamless, meaning that it is without interruption.

[0023] In the embodiment shown in the figures, the supporting surface 3 is of the type of a continuous belt wrapped around a plurality of motor-driven pulleys.

[0024] Advantageously, the supporting surface 3 and

the pressing means 6 are operable intermittently and alternately to each other. In other words, the activation of one of the two corresponds to the interruption of the other, i.e., when the supporting surface 3 is moved along the forward direction 4, the pressing means 6 are stationary and when the pressing means 6 are moving the supporting surface 3 is stationary.

[0025] As a result of the compaction of a portion P of the continuous slab L, the movement of the supporting surface 3 causes the forward movement of the compacted slab C thus obtained, which is then displaced downstream of the pressing means 6, and the simultaneous positioning of a further portion P of the continuous slab L below the pressing means 6.

[0026] Also according to the invention, the equipment 1 comprises containment means 12 of at least one part of the portion P of the continuous slab L.

[0027] The containment means 12 comprise at least one pair of lateral containment elements 13 which extend parallel to the forward direction 4 and which are movable between a home position and an operating position, wherein they are arranged in contact with the supporting surface 3 and at the point where the pressing means 6 are located, so as to contain laterally the portion P of the continuous slab L. The lateral containment elements 13 are arranged facing each other at least in the operating position.

[0028] In the embodiment shown in the figures, the lateral containment elements 13 are mutually movable close to and away. In particular, the lateral containment elements 13 are moved away from each other in the home position and are approached to each other in the operating position. In this embodiment, the lateral containment elements 13 are facing each other both in the home position and in the operating position.

[0029] The containment means 12 comprise lateral movement means 14, e.g. of the type of fluid-operated or electric actuators, adapted to move the lateral containment elements 13 between the home position and the operating position. Alternative embodiments cannot however be ruled out wherein the lateral containment elements 13 are moved in a different way, e.g. vertically or by means of a tilting or retractable mechanism.

[0030] Preferably, the containment means 12 comprise at least one pair of front containment elements 15, which extend transverse to the forward direction 4 and which are movable between a home position, wherein they are moved away from the supporting surface 3 so as to allow the passage of the continuous slab L, and an operating position, wherein they are arranged at the supporting surface 3 so as to intercept the continuous slab L and contain frontally the portion P of the continuous slab itself.

[0031] As can be seen from Figure 11, the front containment elements 15 are vertically movable between the home position and the operating position. More specifically, the front containment elements 15 are raised with respect to the supporting surface 3 in the home position

and are lowered, so as to rest on the supporting surface itself, in the operating position. In this embodiment, the containment means 12 also comprise front movement means 16, e.g. of the type of fluid-operated or electric actuators, adapted to move the front containment elements 15 between the home position and the operating position.

[0032] Alternative embodiments cannot however be ruled out wherein the front containment elements 15 are moved in a different way, e.g. by means of a tilting or retractable mechanism.

[0033] In the embodiment shown in the figures, the containment means 12 comprise both the lateral containment elements 13 and the front containment elements 15. In this embodiment, the lateral containment elements 13 and the front containment elements 15 delimit, when arranged in their respective operating positions, a containment volume 17 of the portion P.

[0034] The containment volume 17 is peripherally closed, is delimited below by the supporting surface 3 and is open above.

[0035] Conveniently, the containment elements 13, 15 are released from the pressing means 6. In particular, the containment elements 13, 15 move independently of the pad 9.

[0036] Preferably, the containment elements 13, 15 move independently of each other between the relevant home and operating positions. The containment elements 13, 15 are mutually released from each other.

[0037] In a particular embodiment, the lateral containment elements 13 move synchronously with respect to each other between the home position and the operating position and independently with respect to the front containment elements 15.

[0038] Conveniently, when the containment elements 13, 15 are in their relevant operating positions, the supporting surface 3 is stationary.

[0039] The containment elements 13, 15 are arranged, at least in their respective operating positions, at the pressing means 6.

[0040] Appropriately, the pressing element 7 is adapted to fit, as a result of its approach to the supporting surface 3, inside the containment volume 17.

[0041] More particularly, the pad 9 is defined so as to fit to size the containment volume 17.

[0042] The operation of the above-described equipment, in carrying out the process according to the invention is as follows.

[0043] The process according to the invention first involves a phase of feeding the ceramic material onto a supporting surface 3 so as to form a continuous slab L to be compacted.

[0044] The ceramic material is of the type of powdered ceramic material.

[0045] The continuous slab L is moved along the forward direction 4.

[0046] As described above, the feeding phase is carried out by means of the feeding means 5, which release

the powdered ceramic material on the supporting surface 3 during the movement of the latter along the forward direction 4.

[0047] Subsequently, a pressing phase is carried out on a portion P of the continuous slab L so as to obtain a compacted slab C of predefined dimensions, which is then separate from the remaining part of the continuous slab L still to be compacted.

[0048] Appropriately, the phases of movement and pressing are carried out intermittently and alternately with each other, so that when the portion P is pressed, the continuous slab L is stationary and when the continuous slab L moves, no pressing of the same is carried out.

[0049] Preferably, a phase of containment of at least one part of the portion P is carried out prior to pressing.

[0050] More particularly, the phase of containment comprises at least one lateral containment sub-phase, parallel to the forward direction 4, of the portion P to be compacted. The phase of lateral containment is carried out by means of the lateral containment elements 13, which are arranged in the home position during the movement of the continuous slab L and are then brought into the operating position after the continuous slab L stops, so as to laterally delimit the portion P to be pressed.

[0051] In the embodiment shown in the figures, the lateral containment elements 13 are therefore pushed away from each other until the continuous slab L moves along the forward direction 4; the instant when the continuous slab L stops and its portion P to be compacted is arranged at the pressing means 6, the lateral containment elements 13 are brought close to each other, thus moving to the operating position.

[0052] Advantageously, the phase of containment also comprises a sub-phase of front containment of the portion P, transversely to the forward direction 4, so as to separate the portion P from the remaining part of the continuous slab L. The phase of front containment is carried out by means of the front containment elements 15, which are arranged in the home position during the movement of the continuous slab L and then move to the operating position after the continuous slab L stops, so as to frontally delimit the portion P to be pressed.

[0053] In the embodiment shown in the figures, the front containment elements 15 are thus raised with respect to the supporting surface 3 until the continuous slab L moves along the forward direction 4; the instant when the continuous slab L stops and its portion P to be compacted is arranged at the pressing means 6, the front containment elements 15 are lowered, so as to contact the supporting surface 3, thereby intercepting the continuous slab L and separating the portion P from the remaining part of the continuous slab itself.

[0054] The implementation of both phases of containment, i.e., lateral and front, results in the perimeter delimitation of the portion P, which is thus arranged inside the containment volume 17.

[0055] The phase of pressing is carried out by means of the pressing means 6 described above.

[0056] In particular, after the portion P has reached the pressing means 6, the pressing element 7 approaches the supporting surface 3 by crushing, using a force of predefined intensity, the portion P to be compacted.

[0057] If the phase of lateral and/or front containment has been previously carried out, the pressing element 7 in its movement towards the supporting surface 3 remains inside the volume delimited by the containment elements 13, 15, remaining substantially flush with them.

[0058] At the end of the phase of pressing, the supporting surface 3 is made to move again in order to simultaneously move forward the compacted slab C and the continuous slab L.

[0059] More in detail, after the phase of pressing is over, i.e. when the pressing element 7 moves away from the supporting surface 3 again, the containment elements 13, 15 are moved from the relevant home positions to the relevant operating positions, so as to "free" the compacted slab C and allow the movement thereof. In particular, the compacted slab C, which is therefore distinct and separate from the remaining part of the continuous slab L, is moved downstream of the pressing means 6, while a new portion P of the continuous slab L is arranged at the pressing means themselves so as to proceed with a further pressing phase.

[0060] It has in practice been ascertained that the described invention achieves the intended objects, and in particular the fact is emphasized that the process and the equipment to which the present invention relates, allow optimizing the phases of feeding and pressing of the ceramic material, thus minimizing the downtime and increasing the output compared to the processes and equipment of known type.

[0061] In particular, the feeding of the material in such a way as to obtain a continuous slab that reaches, without any interruption, the pressing means, allows reducing to a minimum the time required for the preparation of the material to be pressed, the quantity of which is determined by the operating area of the pressing means themselves.

[0062] Moreover, the presence of the containment means makes it possible to simplify the management of the material to be pressed, by carrying out a partial or total compartmentalization of a portion of the continuous slab that is intermittently fed at the point where the pressing means are located.

Claims

1. Process for the manufacture of slabs of ceramic material, **characterized by** the fact that it comprises the following phases of:

- feeding ceramic material onto a supporting surface to form a continuous slab (L) to be compacted;
- moving said continuous slab (L) along a forward

ward direction (4);

- pressing a portion (P) of said continuous slab (L) to obtain a compacted slab (C) of predefined dimensions separate from the remaining part of said continuous slab (L).

2. Process according to claim 1, **characterized by** the fact that said movement and said pressing are carried out intermittently and alternately to each other.

3. Process according to claim 1 or 2, **characterized by** the fact that it comprises, before said pressing, a phase of containment of at least one part of said portion (P) of the continuous slab (L).

4. Process according to claim 3, **characterized by** the fact that said containment comprises at least one phase of lateral containment, parallel to said forward direction (4), of said continuous slab (L).

5. Process according to claim 3 or 4, **characterized by** the fact that said containment comprises at least one phase of frontal containment, transverse to said forward direction (4), of said continuous slab (L), so as to separate said portion (P) from the remaining part of the continuous slab itself.

6. Equipment (1) for the manufacture of slabs of ceramic material, comprising:

- a load-bearing structure (2);
 - at least one supporting surface (3) associated with said load-bearing structure (2) and movable along one forward direction (4);
 - feeding means (5) of a powdered ceramic material on said supporting surface (3);
 - pressing means (6) of the ceramic material;
- characterized by** the fact that said feeding means (5) and said pressing means (6) are arranged in succession along said supporting surface (3), wherein said feeding means (5) are adapted to release a continuous slab (L) to be compacted on said supporting surface (3) and said pressing means (6) are adapted to press a portion (P) of said continuous slab (L) placed resting on said supporting surface (3) so as to define a compacted slab (C) of predefined dimensions which is separate from the continuous slab itself

and by the fact that it comprises containment means (12) of said portion (P).

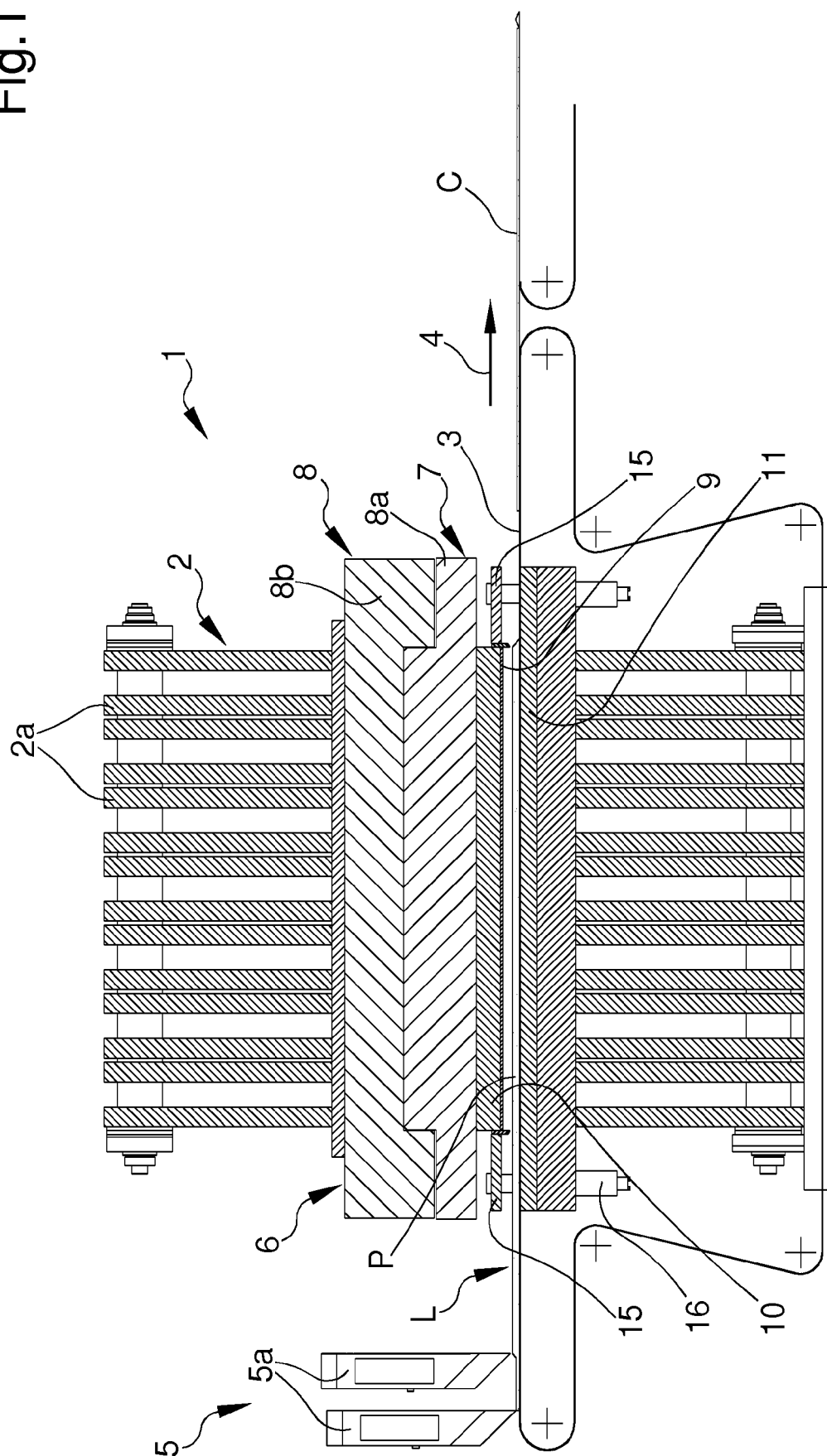
7. Equipment (1) according to claim 6, **characterized by** the fact that said supporting surface (3) and said pressing means (6) are operable intermittently and alternately to each other, so that said supporting surface (3) is stationary during the operation of said

pressing means (6) and that said pressing means (6) are stationary during the movement of said supporting surface (3).

8. Equipment (1) according to claim 7, **characterized by** the fact that said containment means (12) comprise at least one pair of lateral containment elements (13) which extend parallel to said forward direction (4) and which are movable between a home position, wherein they are moved away from each other, and an operating position, wherein they are moved close to each other with respect to the home position so as to contain laterally said portion (P) of the continuous slab (L). 5 10 15
9. Equipment (1) according to claim 8, **characterized by** the fact that said lateral containment elements (13) are arranged facing each other at least in said operating position. 20
10. Equipment (1) according to one or more of claims 6 to 9, **characterized by** the fact that said containment means (12) comprises at least one pair of front containment elements (15), which extend transverse to said forward direction (4) and which are movable between a home position, wherein they are moved away from said supporting surface (3) so as to allow the passage of said continuous slab (L), and an operating position, wherein they are arranged at said supporting surface (3) so as to intercept said continuous slab (L) and contain frontally said portion (P) of the continuous slab itself. 25 30
11. Equipment (1) according to claim 8 or 9 and claim 10, **characterized by** the fact that said lateral containment elements (13) and said front containment elements (15) delimit, in their respective operating positions, a containment volume (17) of said portion (P) of the continuous slab (L). 35 40
12. Equipment (1) according to one or more of claims 8 to 11, **characterized by** the fact that said containment elements (13, 15) move independently of each other between the relevant home position and operating position. 45
13. Equipment (1) according to one or more of claims 8 to 11, **characterized by** the fact that said lateral containment elements (13) move synchronously with each other between the home position and the operating position and independently of the front containment elements (15). 50
14. Equipment (1) according to one or more of claims 8 to 13, **characterized by** the fact that when said containment elements (13, 15) are in their respective operating positions, said supporting surface (3) is stationary. 55

15. Equipment (1) according to one or more of claims 8 to 14, **characterized by** the fact that said containment elements (13, 15) are released from said pressing means (6) and are arranged, at least in their respective operating positions, at said pressing means (6).

Fig. 1



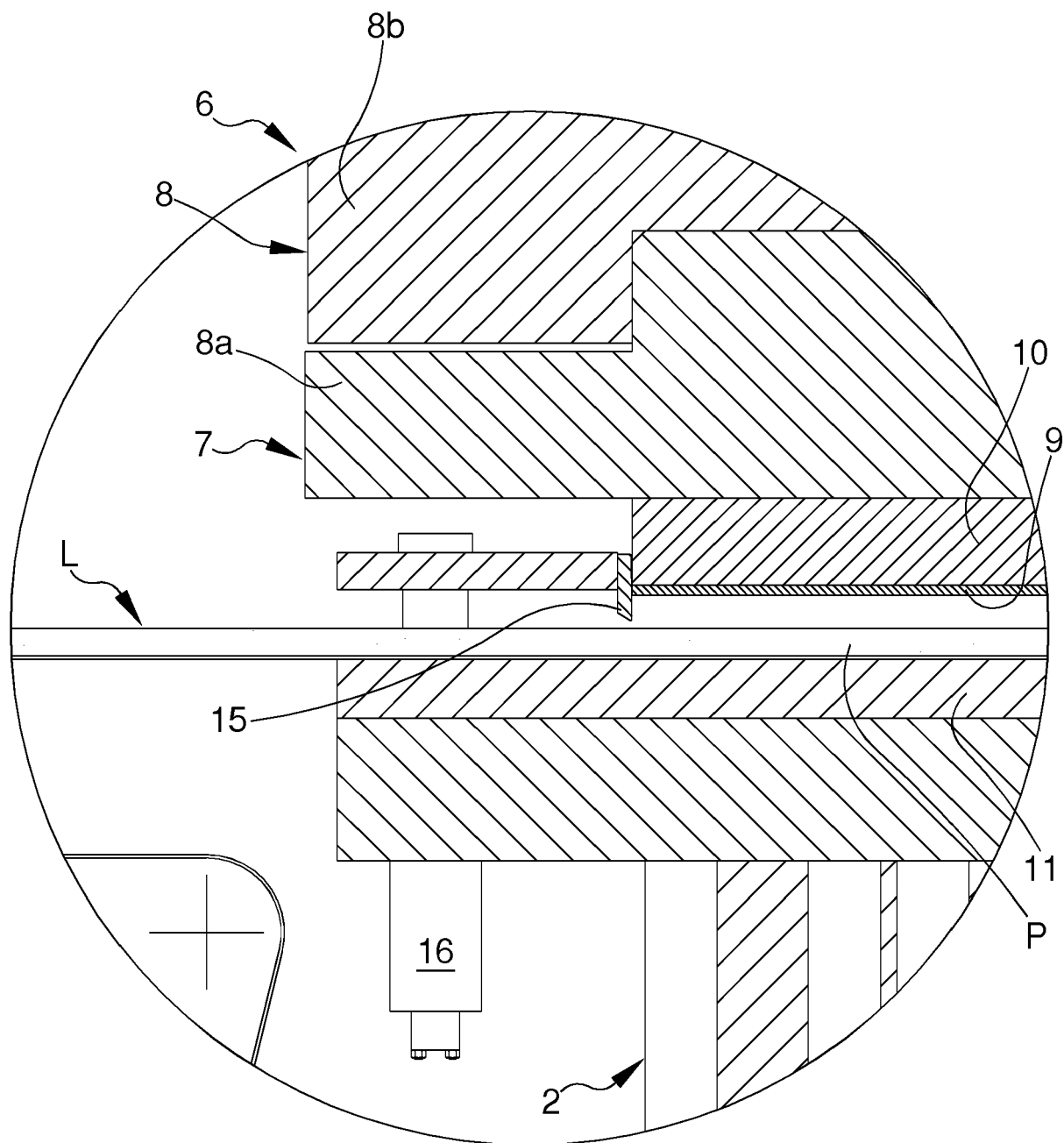


Fig.2

Fig.3

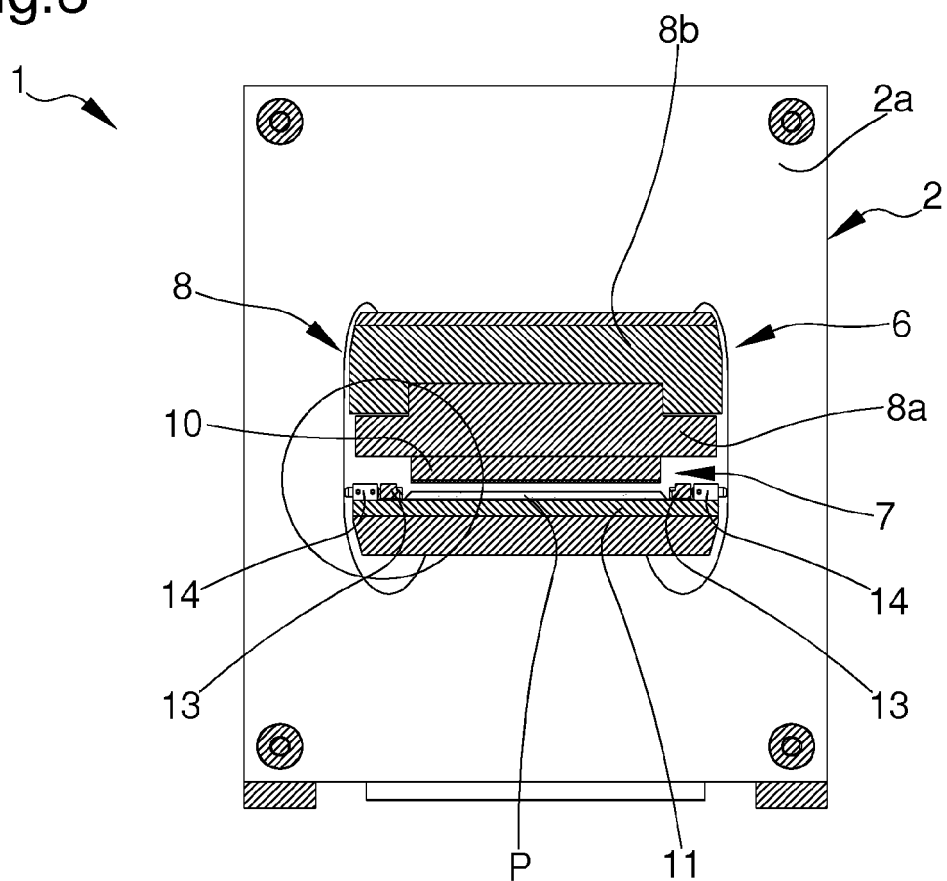


Fig.4

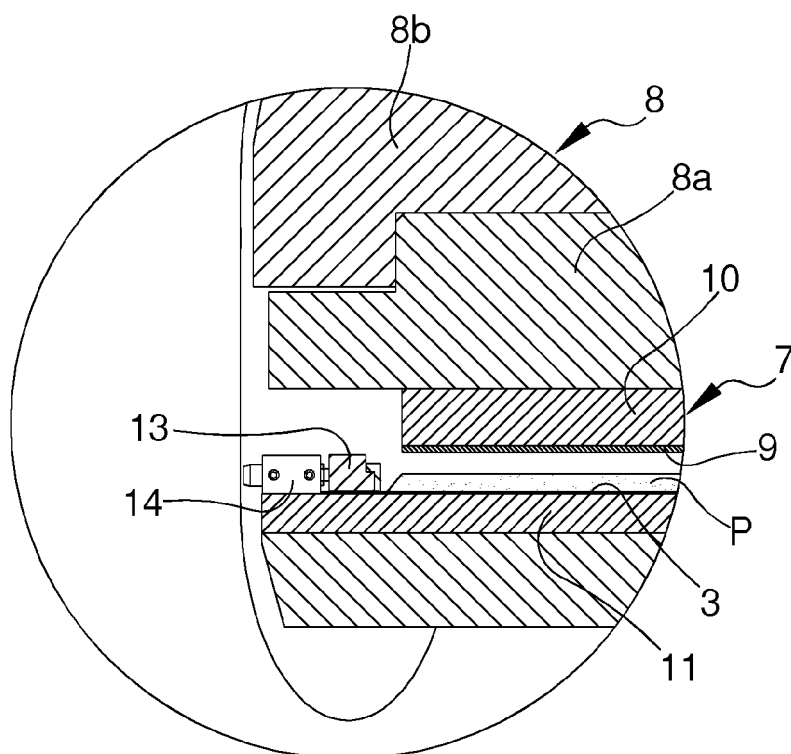


Fig.5

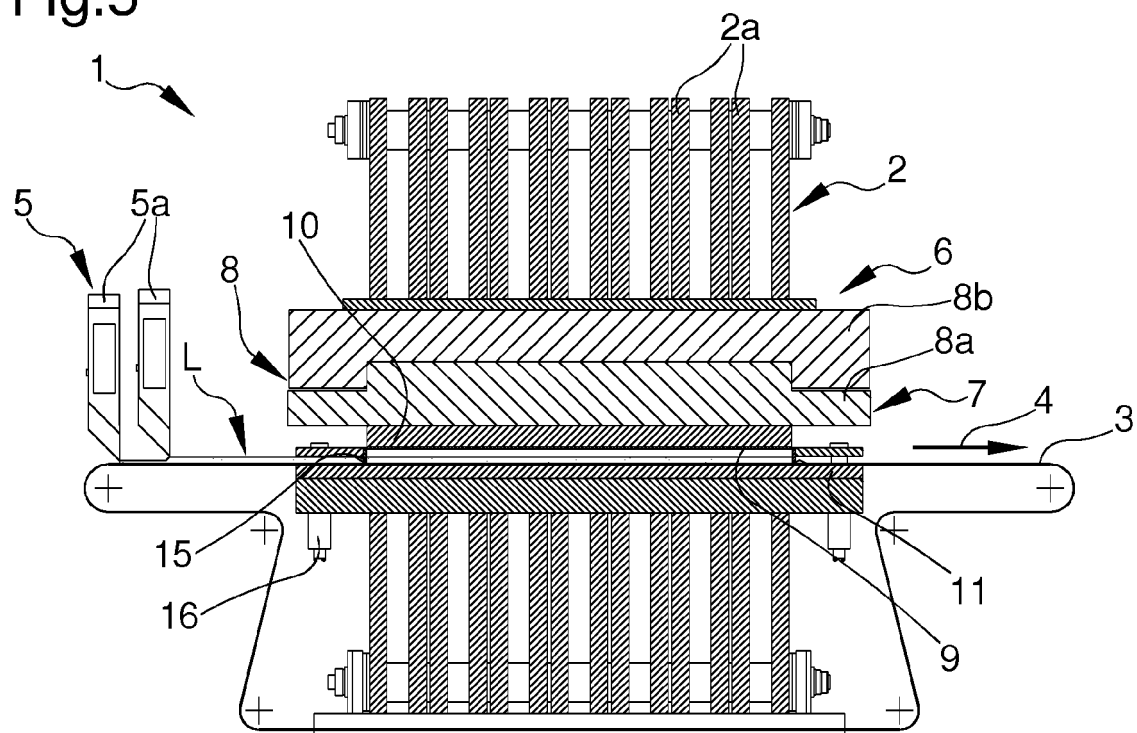


Fig.6

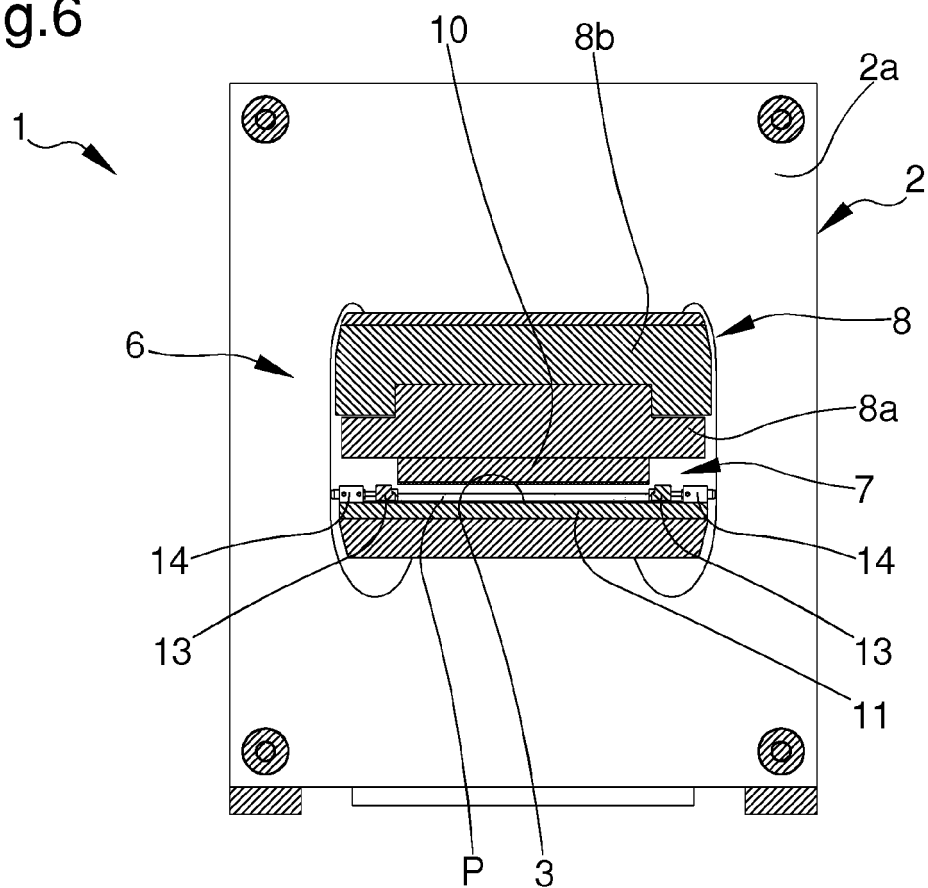


Fig.7

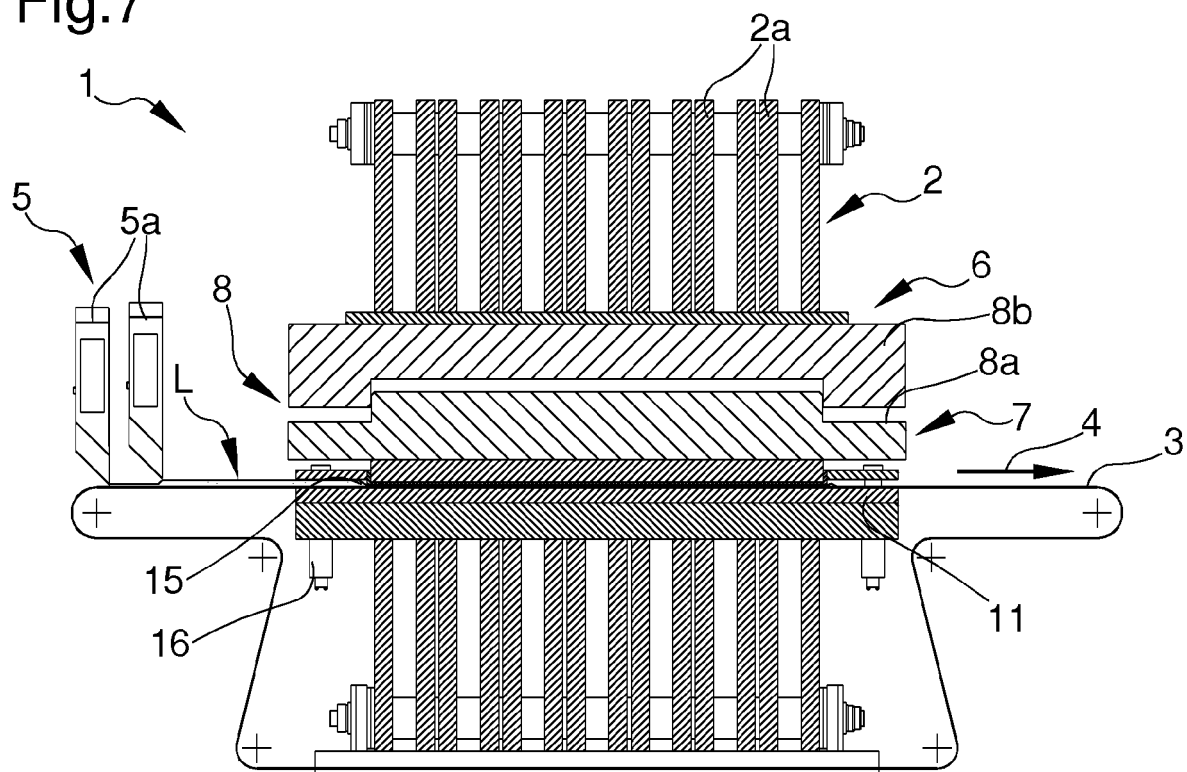


Fig.8

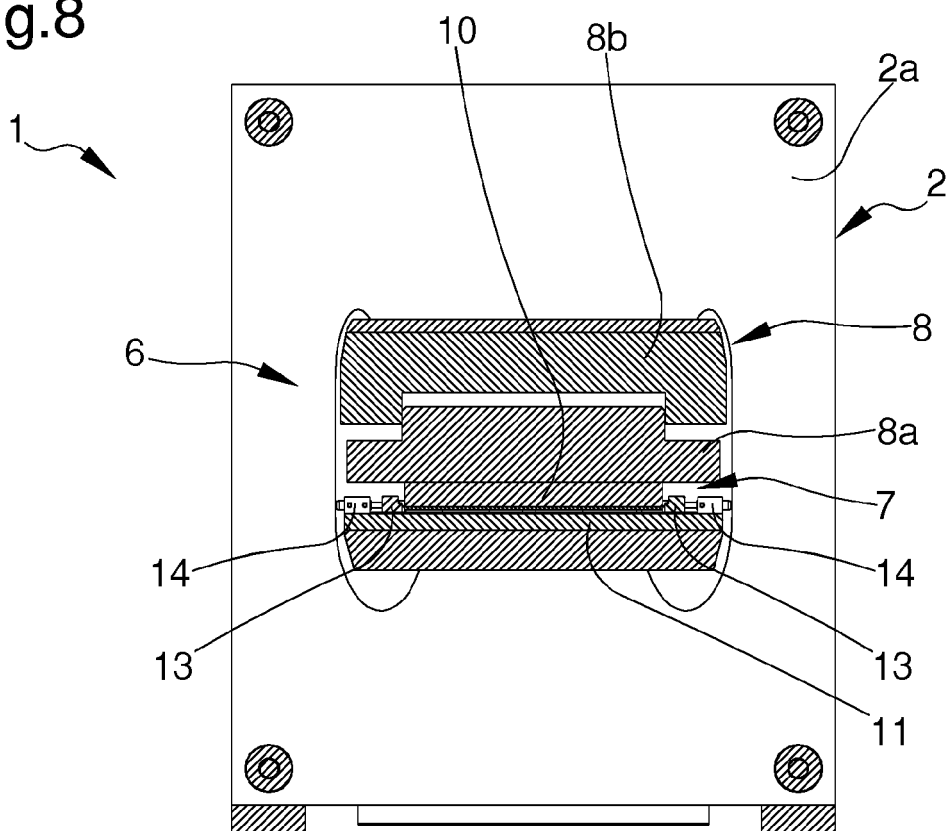


Fig.9

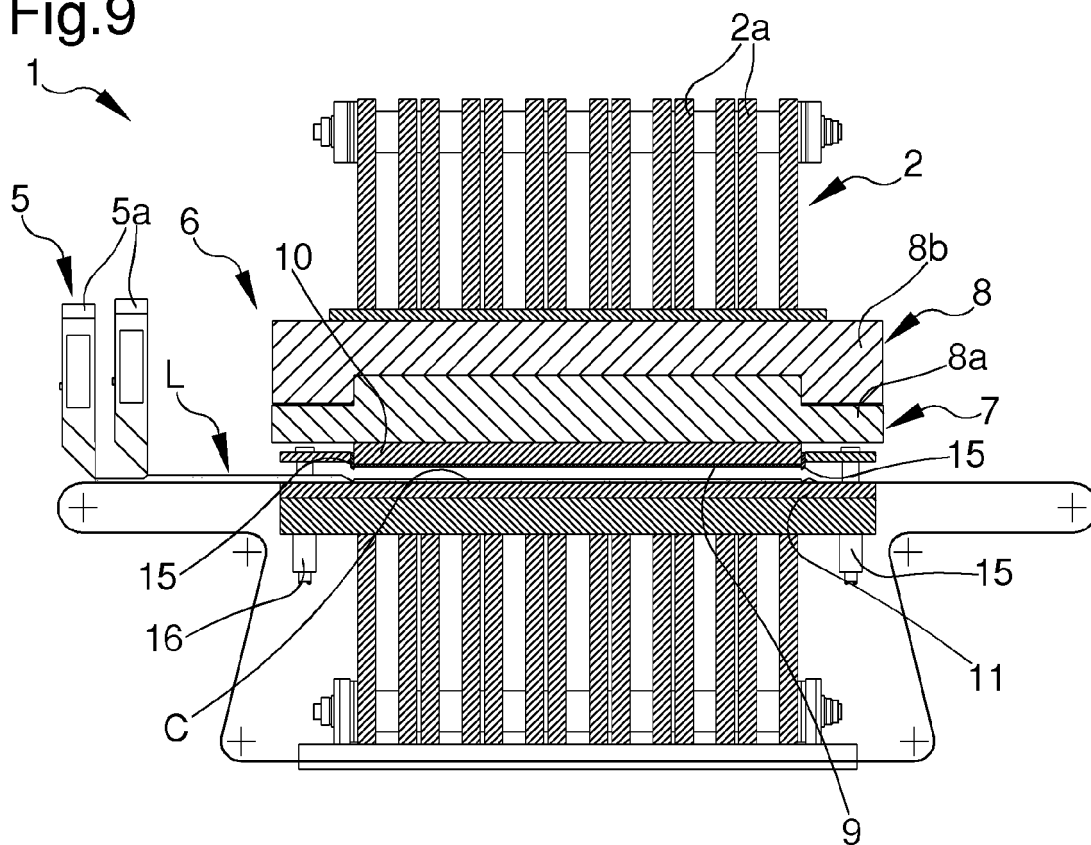
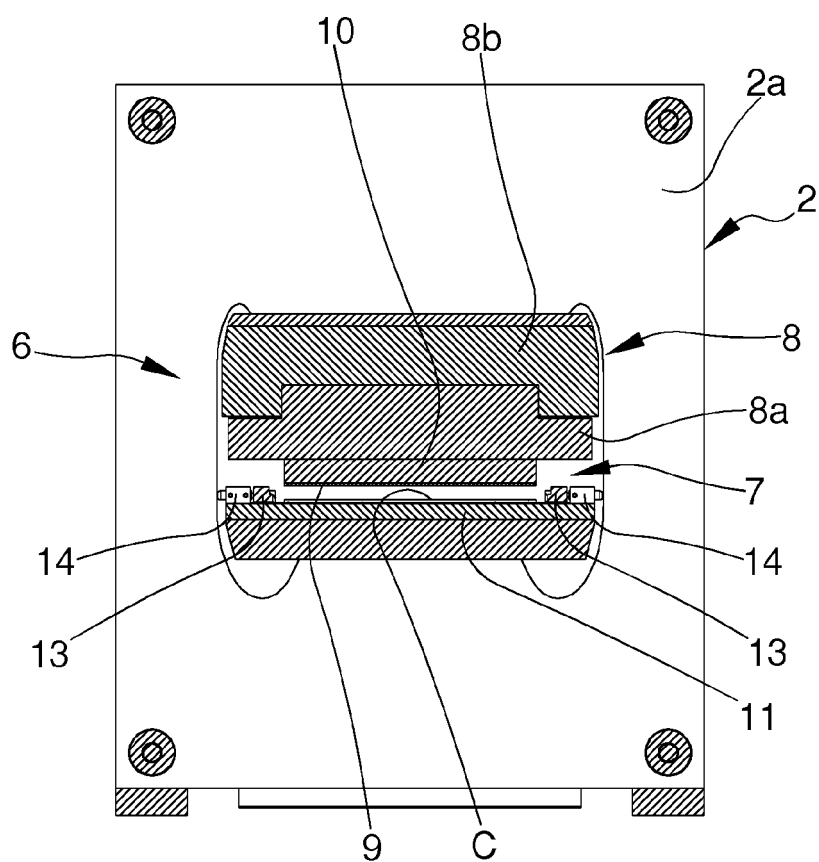


Fig.10



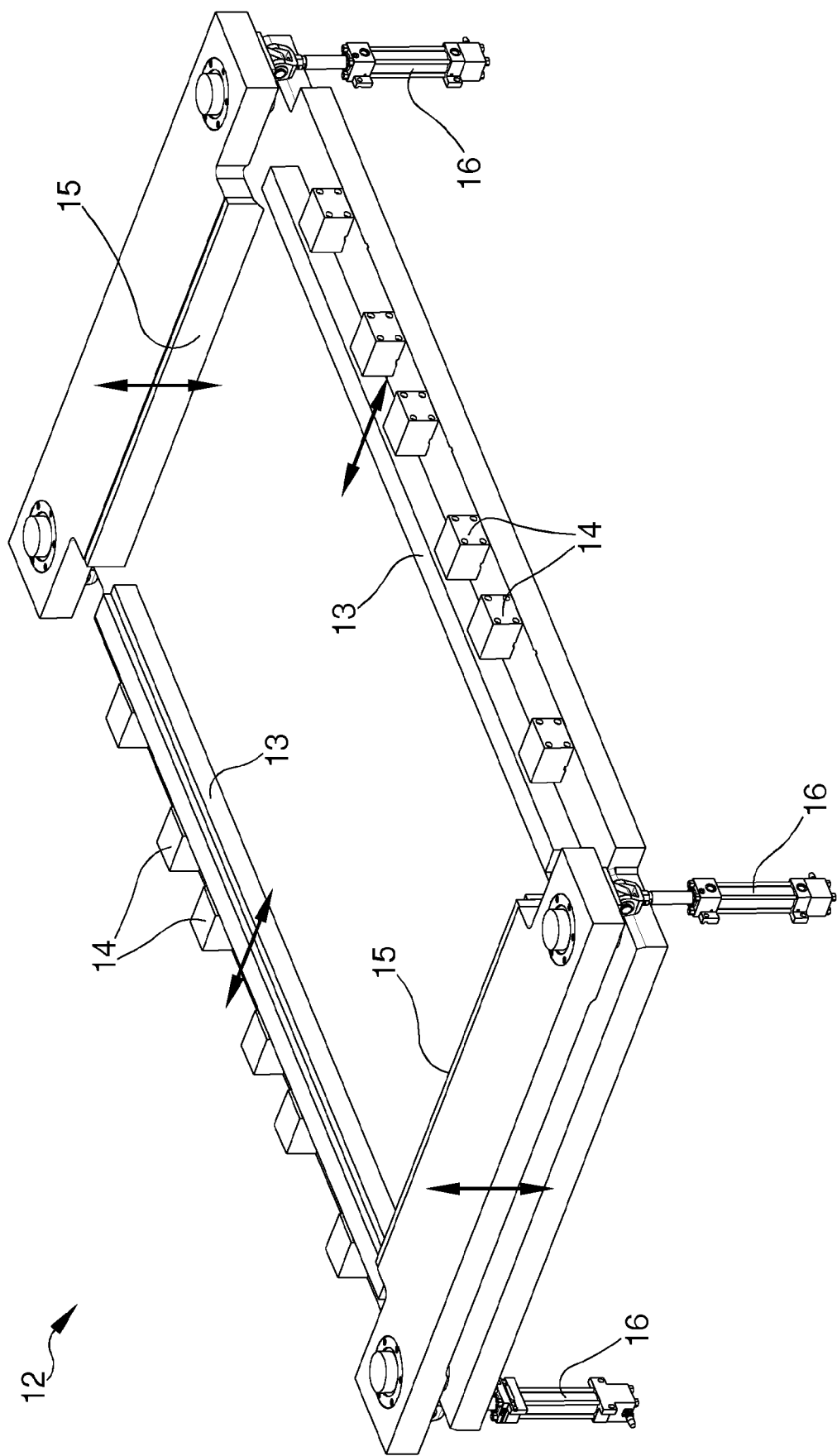


Fig.11



EUROPEAN SEARCH REPORT

 Application Number
 EP 21 17 3381

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The present search report has been drawn up for all claims			
Place of search The Hague		Date of completion of the search 23 September 2021	Examiner Papakostas, Ioannis
CATEGORY OF CITED DOCUMENTS X : particularly relevant if taken alone Y : particularly relevant if combined with another document of the same category A : technological background O : non-written disclosure P : intermediate document		T : theory or principle underlying the invention E : earlier patent document, but published on, or after the filing date D : document cited in the application L : document cited for other reasons ----- & : member of the same patent family, corresponding document	

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Place of search The Hague		Date of completion of the search 23 September 2021	Examiner Papakostas, Ioannis
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