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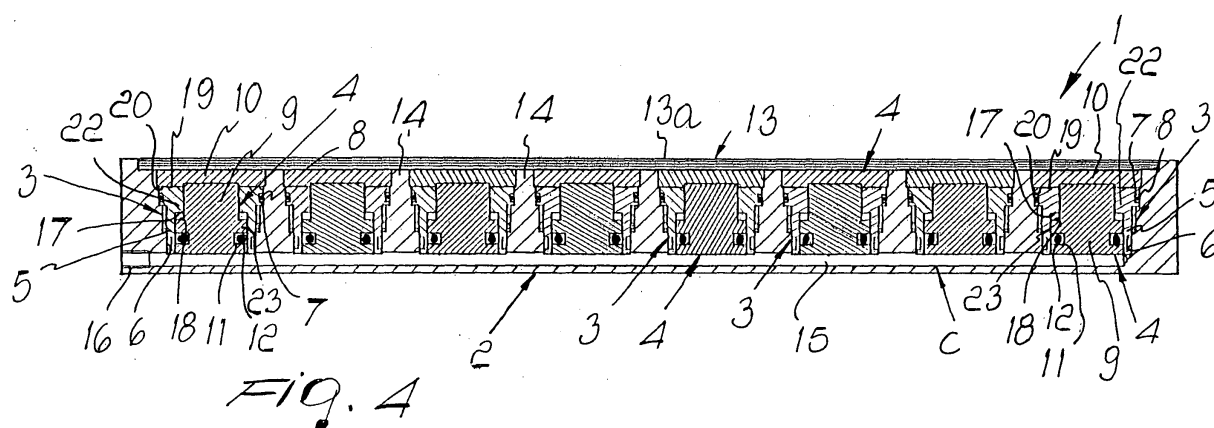
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(54) **Mold part for unidirectional pressing of loose materials, particularly ceramic mixes**

(57) A mold part (1) for unidirectional pressing of loose materials, particularly ceramic mixes, comprising: a substantially plate-like body (2), in which there are a plurality of receptacles (3), each receptacle accommodating a respective piston (4) so that it can slide axially; a wall (13), which is associated with the side of the body at which the crowns of the pistons are exposed and is

adapted to act on the materials to be pressed; and a circuit (C) with a fluid medium, which is associated with the receptacles (3) for the actuation of the respective pistons, the receptacles being provided with at least one surface (19) for stopping the stroke of the pistons, which is adapted to interact with a corresponding abutment surface (20) formed in the pistons.



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Description

[0001] The present invention relates to a mold part for unidirectional pressing of loose materials, particularly ceramic mixes.

[0002] One of the techniques that has long been known in the ceramic sector for forming articles such as tiles is the unidirectional pressing of mixes of loose materials (powders, atomized materials, granulated materials and the like or mixture thereof) between two mold parts, also known as punches or dies, which are intended respectively to form the wear surface and the back, i.e., the exposed surface and the bonding surface, of the tiles.

[0003] The back is constituted by a plurality of areas delimited by raised ribs; the ribs form the grid on which the tiles make contact with the laying surfaces.

[0004] In order to compensate for local variations in the density or thickness of the mixtures loaded between the two mold parts, due for example to defects in filling the mold, to nonuniformities of the mixture or to a heterogeneous composition of the mixture, it is known to use so-called isostatic mold parts, which allow to distribute the pressure uniformly over the entire pressing surface.

[0005] Isostatic mold parts act locally on the back of the tiles at the areas delimited by the ribs, but not at said ribs; it is in fact necessary to avoid deforming the ribs and to keep them substantially mutually co-planar, so that they form a contact surface that is substantially parallel to the wear surface.

[0006] Isostatic mold parts are known which are substantially constituted by a plate-like body, in which there are a plurality of receptacles, each of which accommodates a respective piston so that it can slide axially; by a membrane, which is made of elastically deformable material and is rigidly coupled to the side of the body at which the piston crowns are exposed; and by ducts for the passage of a pressurized fluid adapted to act on the pistons, which are formed in the body of the mold part and mutually interconnect two or more receptacles.

[0007] The membrane is rigidly coupled to the edges that delimit the individual receptacles; accordingly, it is divided into deformable portions, i.e., the portions that close locally the individual receptacles and on which the piston crowns act, enclosed by nondeformable portions, i.e., portions that are rigidly coupled to the body at the edges of the individual receptacles.

[0008] The surface of the membrane intended to act on the mixes bears the contour of the back of the tile; at the nondeformable portions (receptacle edges) there are slots designed to form the ribs of the back, while at the deformable portions (piston crowns) there are raised portions that are designed to form the areas enclosed by the ribs.

[0009] The migration of the fluid from one receptacle to the other allows to balance the molding pressure, compensating local variations in the density or thickness

of the mixes; the fluid migrates from the receptacles where higher pressure are generated toward the receptacles where lower pressures are generated.

[0010] Accordingly, the pistons accommodated in the former receptacles move downward, molding the mixes in areas that protrude from the back, while the pistons accommodated in the latter receptacles rise, molding the mixes in recessed areas in the back of the tiles.

[0011] Mold parts are also known which are constituted by a plate-like body with which a rigid pressing surface is associated so that it can float by means of pistons that are inserted so that they can slide axially in respective receptacles formed in said body and are coupled to the rigid surface for example by means of screws.

[0012] An elastic membrane is interposed between the surface and the body and a chamber for containing an incompressible fluid remains between them.

[0013] These isostatic mold parts are not free from drawbacks, including the fact that they cause structural and aesthetic defects in pressed tiles, caused by the areas that protrude or retract excessively with respect to the back, and do not ensure adequate compensation of molding pressure variations.

[0014] Another disadvantage of known mold parts is constituted by the fact that they are subject to sudden ruptures of the elastic membranes, which due to the thrust applied to them by the pistons, particularly at areas with a low-density or low-thickness mix, are subject to tensions that can weaken and damage them.

[0015] Known mold parts therefore require long and onerous maintenance and/or replacement interventions, which entail disadvantageous downtimes of the presses.

[0016] The aim of the present invention is to eliminate the drawbacks noted above of known mold parts, by providing a mold part for unidirectional pressing of loose materials, particularly ceramic mixes, that allows to press tiles that are uniform and defect-free, to compensate uniformly for molding pressure variations, and to avoid sudden ruptures of the elastic membranes, thus reducing maintenance times and costs.

[0017] Within this aim, an object of the present invention is to provide a mold part that is simple, relatively easy to provide in practice, safe in use, effective in operation, and has a relatively low cost.

[0018] This aim and this and other objects that will become better apparent hereinafter are achieved by the present mold part for unidirectional pressing of loose materials, particularly ceramic mixes, characterized in that it comprises: a substantially plate-like body in which there are a plurality of receptacles, each of which accommodates a respective piston so that it can slide axially; a wall, which is associated with the side of said body at which the crowns of said pistons are exposed and is suitable to act on the materials to be pressed; and a circuit with a fluid medium, which is associated with said receptacles for the actuation of the respective pistons, said receptacles being provided with at least one

surface for stopping the stroke of said pistons, which is suitable to interact with a corresponding abutment surface formed in said pistons.

[0019] Further characteristics and advantages of the present invention will become better apparent from the following detailed description of preferred but not exclusive embodiments of a mold part for unidirectional pressing of loose materials, particularly ceramic mixes, illustrated by way of non-limitative example in the accompanying drawings, wherein:

Figure 1 is a schematic perspective view of a mold part according to the invention;

Figure 2 is a schematic perspective view of a first alternative embodiment of the mold part according to the invention;

Figure 3 is a schematic plan view of a portion of the mold part of Figure 1;

Figure 4 is a schematic enlarged-scale sectional view, taken along the line IV-IV of Figure 3;

Figure 5 is a schematic enlarged-scale sectional view, taken along the line IV-IV of Figure 3, of a second alternative embodiment of the mold part according to the invention;

Figure 6 is a schematic enlarged-scale sectional view, taken along the line IV-IV of Figure 3, of a third alternative embodiment of the mold part according to the invention;

Figure 7 is a schematic enlarged-scale sectional view, taken along the line IV-IV of Figure 3, of a fourth alternative embodiment of the mold part according to the invention;

Figure 8 is a schematic enlarged-scale sectional view of a detail of a fifth alternative embodiment of the mold part according to the invention;

Figure 9 is a schematic enlarged-scale sectional view of a detail of a sixth embodiment of the mold part according to the invention;

Figure 10 is a schematic plan view of a seventh alternative embodiment of the mold part according to the invention;

Figure 11 is a partial schematic sectional view, taken along the plane XI-XI of Figure 10;

Figure 12 is a schematic sectional view of a portion of a further alternative embodiment of the mold part according to the invention.

[0020] With reference to the figures, the reference numeral 1 generally designates a mold part for unidirectional pressing of loose materials, particularly ceramic mixes.

[0021] The mold part 1 is meant to be mounted on a press, of the type conventionally known in the ceramic sector for molding articles such as tiles or other articles such as corner elements, roof tiles, bullnoses or the like, and is meant to interact with a complementary mold part.

[0022] The mold part 1 is of the so-called isostatic type: in particular, it is designed to form the back of tiles

and is usually known as "marking die".

[0023] The mold part 1 comprises a substantially plate-like body 2, in which there are a plurality of receptacles 3; each receptacle accommodates a respective piston 4 so that it can slide axially.

[0024] The receptacles 3 comprise a jacket 5, which is accommodated snugly in a corresponding hole 6 formed in the body 2; between the holes 6 and the jackets 5 there are first seats 7 for containing respective sealing gaskets 8.

[0025] In an alternative embodiment, the receptacles 3 can be constituted solely by holes formed in the body 2 and may not have jackets 5.

[0026] The pistons 4 are constituted by a rod 9, which is inserted so that it can slide axially in the jackets 5 and has an end that protrudes outside them and to which a plate 10 is rigidly coupled, forming their crown.

[0027] Second seats 11 for containing second sealing gaskets 12 are formed between the rod 9 and the jackets 5.

[0028] A wall 13, designed to act on the materials to be pressed, is associated on the side of the body 2 at which the plates 10 are exposed.

[0029] The wall 13 can be constituted for example by a metal plate or can be made of a material of the elastically deformable type, such as rubber; in this case, it is rigidly coupled to the edges 14 that delimit the receptacles 3 peripherally; accordingly, it is divided into a plurality of delimited deformable areas formed at the plates 10 and enclosed by borders that are not deformable since they are rigidly coupled to the edges 14.

[0030] The edges 14 might not be present and might not be in relief with respect to the body 2.

[0031] The face 13a of the wall 13 that is directed toward the outside of the body 2 is designed to act on the materials to be pressed and can be shaped with the impression of the back of the tiles.

[0032] Said impression is constituted by a grid of slots, in order to form the ribs of the back, between which there remain raised portions for forming the quadrangular portions of the back; the slots are formed substantially at the edges 14, while the raised portions are formed substantially at the plates 10.

[0033] Proximate to the side of the body 2 that lies opposite the wall 13 there is a circuit C that uses a fluid medium and is associated with the receptacles 3 for the actuation of the respective pistons 4.

[0034] The circuit C can comprise ducts 15 that mutually connect rows of receptacles 3 and are provided with a respective coupling 16 for connection to means for introducing and discharging a pressurized fluid; the fluid that circulates in the ducts 15 acts directly on the pistons 4, causing their sliding within the receptacles 3.

[0035] Advantageously, the fluid can be constituted by oil or by a gas such as nitrogen.

[0036] The receptacles 3 comprise a rear stop surface 17, which is suitable to interact with a corresponding rear abutment surface 18 that is formed in the pistons 4

in order to stop the sliding stroke of said pistons toward the wall 13.

[0037] The receptacles 3 further comprise a front stop surface 19, which is suitable to interact with a corresponding front abutment surface 20, which is formed in the pistons 4, in order to stop the sliding stroke of said pistons away from the wall 13 toward the inside of the receptacles 3.

[0038] Return means are interposed between the rear stop surface 17 and the rear abutment surfaces 18 and can be for example of the elastic type and constituted for example by a spring 21 of the Belleville type.

[0039] The spring 21 returns its respective piston 4 toward the inside of the receptacle 3 when the thrust applied thereto by the pressurized fluid that circulates in the ducts 15 decreases or ceases.

[0040] The rear stop surface 17 is formed for example by at least one arc of an annular raised portion 22, which protrudes with respect to the internal walls of the holes 6 (Figures 6, 7, 8 and 9) or of the jackets 5 (Figures 4 and 5) or of the receptacles 3 formed directly in the body 2, while the rear abutment surface 18 is formed by at least one arc of an annular collar 23 that protrudes on the outer side wall of the rods 9.

[0041] The front stop surface 19 is constituted by at least one portion of an annular base 24 that is formed at the end of the receptacles 3 (Figure 11) or of the jackets 5 (Figures 4 and 5) or of the holes 6 (Figures 6, 7, 8 and 9) that is directed toward the wall 13; while the front abutment surface 20 is constituted by at least one portion of the face of the plates 10 that lies opposite the wall 13.

[0042] Conveniently, the wall 13 can be coupled to a stiffening lamina 25, which is interposed between said wall and the body 2.

[0043] Figures 4 and 5 illustrate two embodiments of the mold part 1, in which the jackets 5 and the pistons 4 are installed from above, i.e., from the face of the body 2 to which the wall 13 is subsequently coupled; such embodiments differ from each other in the absence or presence of the lamina 25.

[0044] In those embodiments, the pistons 4 are shown in the lowered configuration with respect to the wall 13.

[0045] Figures 6, 7, 8 and 9 illustrate alternative embodiments of the mold part 1, in which the jackets 5 and the rods 9 are installed from below, i.e., from the face of the body 2 that lies opposite the one that is rigidly coupled to the wall 13; in this last case, the body 2 is provided with plugs 26 that close the holes 6 in a lower region.

[0046] Figures 6 and 7 differ from each other in the absence or presence of the lamina 25.

[0047] Advantageously (Figure 8), the rod 9 is constituted by a stem 9a, which ends with a threaded tang 9b, with which a threaded sleeve 27 engages; the annular collar 23 and the second seats 11 of the second sealing gaskets 12 are formed in the sleeve 27.

[0048] The sleeve 27 allows to adjust the rigidity of the spring 21.

[0049] Figure 9 illustrates an alternative embodiment of the mold part 1, in which the means for returning the pistons 4 toward the inside of the receptacles 3 are of the hydraulic type and comprise a variable-volume chamber 28, which is formed between the rear stop surface 17 and the rear abutment surface 18 and is connected to auxiliary ducts 29 for circulating a pressurized fluid; the pistons 4 thus become of the double-acting type.

[0050] The auxiliary ducts 29 are formed partly in the body 2 and partly in the jackets 5 and interconnect the various chambers 28.

[0051] Advantageously, the contour of the plates 10 and therefore of the corresponding containment cavities 30 can be quadrangular or circular, as shown in Figures 1 and 2; the circular contours are used for example if the back of the tiles is constituted by a plurality of hexagonal areas and allow a more uniform distribution of the tensions discharged onto the corresponding areas of the wall 13.

[0052] Figures 10 and 11 illustrate another embodiment of the mold part 1, in which the receptacles 3 are formed by holes 31 and in which the fluid-medium circuit C comprises a tubular element 32 for containing said fluid which is accommodated in the receptacles 3 in order to act on the pistons 4; the receptacles 3 are mutually connected by channels for the passage of the tubular element 32, which are not shown.

[0053] In this last case, it is the tubular element 32, which forms a continuous coil accommodated within the body 2, that acts on the pistons 4, mediating the action of the fluid contained therein; this allows to limit the use of sealing gaskets.

[0054] Figure 12 illustrates another alternative embodiment of the mold part 1, in which the body 2 is divided into a first half-body 33, with which the wall 13 is associated, and into a second half-body 34, in which the circuit C that uses a fluid medium is formed; the first half-body 33 and the second half-body 34 are substantially plate-like and can be mutually superimposed and anchored by way of fixing means, for example of the threaded type, shown schematically by the lines 35.

[0055] The first half-body 33 is the one directly involved in the pressing of the mixes and therefore is the one affected by more intense stresses and higher wear: the second half-body 34 is instead the more expensive one to manufacture, since the circuit C is formed therein.

[0056] Dividing the body 2 into the two half-bodies 33 and 34 allows, in case of wear and damage of the first half-body 33, to intervene or replace only said half-body, with consequent cost savings.

[0057] Moreover, without altering the second half-body 34, it is possible to apply thereon different first half-bodies 33, depending on the format or type of tiles to be pressed.

[0058] Finally, it is noted that the pistons 4 can be con-

stituted only by the rod 9, whose end that protrudes outside the receptacles 3 (jackets 5) forms their crown; in this case, the lamina 25 for reinforcing the wall 13 is advantageously thicker.

[0059] The operation of the invention is as follows.

[0060] The pressurized fluid that is present inside the ducts 15 or circulates in the tubular element 32 flows out from the receptacles 3 at which a higher molding pressure is generated, for example due to a higher density or greater thickness of the materials, toward the receptacles 3 at which a lower molding pressure is generated, for example due to a lower density or thickness of the materials, compensating for them.

[0061] Accordingly, the thrust that the fluid applies directly or indirectly to the pistons 4 accommodated in the first receptacles 3 decreases, and the pistons 4, retracted by the thrust of the springs 21 or by the fluid that circulates in the auxiliary ducts 29 and in the chambers 28, slide toward the inside of said receptacles, moving downward with respect to the wall 13; the retraction stroke of the pistons 4 is delimited by the interaction between the front stop surface 19 and the front abutment surface 20.

[0062] The thrust applied by the fluid to the pistons 4 accommodated in the second receptacles 3 increases, and the pistons 4, by contrasting the thrust of the springs 21 or any fluid that is present in the chambers 28, slide toward the wall 13; the stroke of the pistons 4 is delimited by the interaction between the rear stop surface 17 and the rear abutment surface 18.

[0063] The limitations set to the stroke of the pistons 4 in both sliding directions allow to contain the deformation of the areas of the wall 13 that are meant to form the quadrangular portions of the back of the tiles.

[0064] This allows to avoid sudden failures and lesions of the wall 13 and an excessive inward or outward splaying of the quadrangular portions of the back of the pressed tiles.

[0065] It is noted that the circuit C can be divided into a plurality of portions or can be constituted by a plurality of mutually independent partial circuits, each of which is associated with the receptacles 3 of a given area or individually with a respective receptacle 3 of the mold part 1, in order to be able to determine and vary selectively the stroke of the corresponding pistons 4, by adjusting for example the pressure of the fluid that circulates therein; this is particularly useful if, for example, it is necessary to press tiles that have a markedly irregular structure whose mix is loaded and distributed differentially.

[0066] Further, if the mold part 1 is contoured for pressing articles such as for example roof tiles, corner elements and the like, and therefore comprises mutually incident pressing surfaces, each one of said pressing surfaces can have respective receptacles 3 with longitudinal axes that are substantially perpendicular thereto and are associated with a respective circuit C, so as to ensure a local isostatic pressure to each one of said sur-

faces.

[0067] In this last case, the pistons 4 of different surfaces of the mold part 1 act in different directions.

[0068] In practice it has been found that the described invention achieves the proposed aim and object, i.e., it provides a mold part for unidirectional pressing of loose materials that allows to uniform the pressing pressure, to obtain articles, particularly ceramic tiles, that have no structural and aesthetic defects and to avoid risks of sudden failures and ruptures of the wall, reducing interventions and costs for maintenance and replacement thereof.

[0069] The invention thus conceived is susceptible of numerous modifications and variations, all of which are within the scope of the appended claims.

[0070] All the details may further be replaced with other technically equivalent ones.

[0071] In practice, the materials used, as well as the shapes and the dimensions, may be any according to requirements without thereby abandoning the scope of the protection of the appended claims.

[0072] The disclosures in Italian Patent Application No. MO2002A000264 from which this application claims priority are incorporated herein by reference.

[0073] Where technical features mentioned in any claim are followed by reference signs, those reference signs have been included for the sole purpose of increasing the intelligibility of the claims and accordingly, such reference signs do not have any limiting effect on the interpretation of each element identified by way of example by such reference signs.

Claims

1. A mold part for unidirectional pressing of loose materials, particularly ceramic mixes, **characterized in that** it comprises: a substantially plate-like body, in which there are a plurality of receptacles, each of which accommodates a respective piston so that it can slide axially; a wall, which is associated with the side of said body at which the crowns of said pistons are exposed and is adapted to act on the materials to be pressed; and a circuit with a fluid medium, which is associated with said receptacles for the actuation of the respective pistons, said receptacles being provided with at least one surface for stopping the stroke of said pistons, which is adapted to interact with a corresponding abutment surface formed in said pistons.
2. The mold part according to claim 1, **characterized in that** said receptacles comprise a rear stop surface that is adapted to stop the sliding stroke of the pistons toward said wall, said pistons comprising a corresponding rear abutment surface.
3. The mold part according to one or more of the pre-

ceding claims, **characterized in that** said receptacles comprise a front stop surface that is adapted to stop the sliding stroke of the pistons away from said wall, said pistons comprising a corresponding front abutment surface.

4. The mold part according to one or more of the preceding claims, **characterized in that** said circuit with fluid medium comprises ducts for interconnecting two or more of said receptacles formed in said body. 10
5. The mold part according to one or more of the preceding claims, **characterized in that** said interconnection ducts contain a fluid that is adapted to act on said pistons. 15
6. The mold part according to one or more of the preceding claims, **characterized in that** said circuit with fluid medium comprises a tubular element for containing said fluid that is made of elastically deformable material and is accommodated in said receptacles in order to act on said pistons, channels for the passage of said tubular element being formed between said receptacles. 20 25
7. The mold part according to one or more of the preceding claims, **characterized in that** said wall is of the elastically deformable type. 30
8. The mold part according to one or more of the preceding claims, **characterized in that** it comprises means for retracting said pistons toward the inside of said receptacles. 35
9. The mold part according to one or more of the preceding claims, **characterized in that** said retraction means are of the adjustable type. 40
10. The mold part according to one or more of the preceding claims, **characterized in that** said retraction means are interposed between said rear stop surface and said rear abutment surface. 45
11. The mold part according to one or more of the preceding claims, **characterized in that** said retraction means are of the elastic type. 50
12. The mold part according to one or more of the preceding claims, **characterized in that** said retraction means are of the hydraulic type. 55
13. The mold part according to one or more of the preceding claims, **characterized in that** said retraction means of the hydraulic type comprise a variable-volume chamber, which is formed between said rear stop surface and said rear abutment surface and is connected to auxiliary ducts for circulating a pres-

surized fluid.

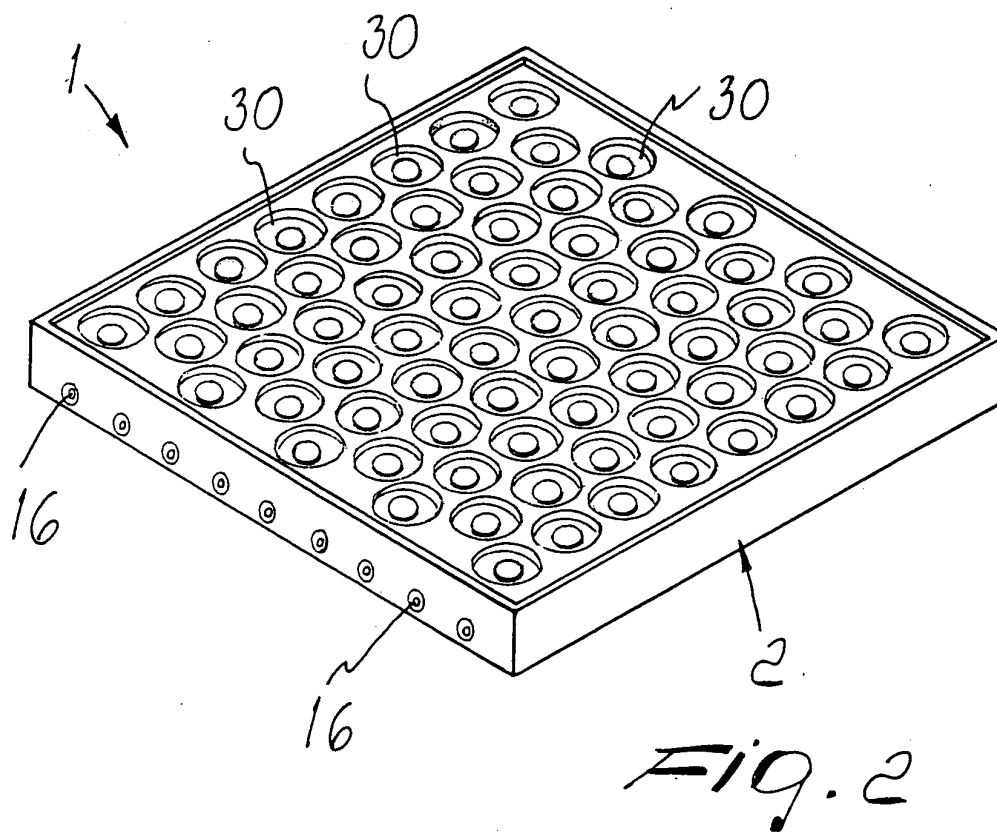
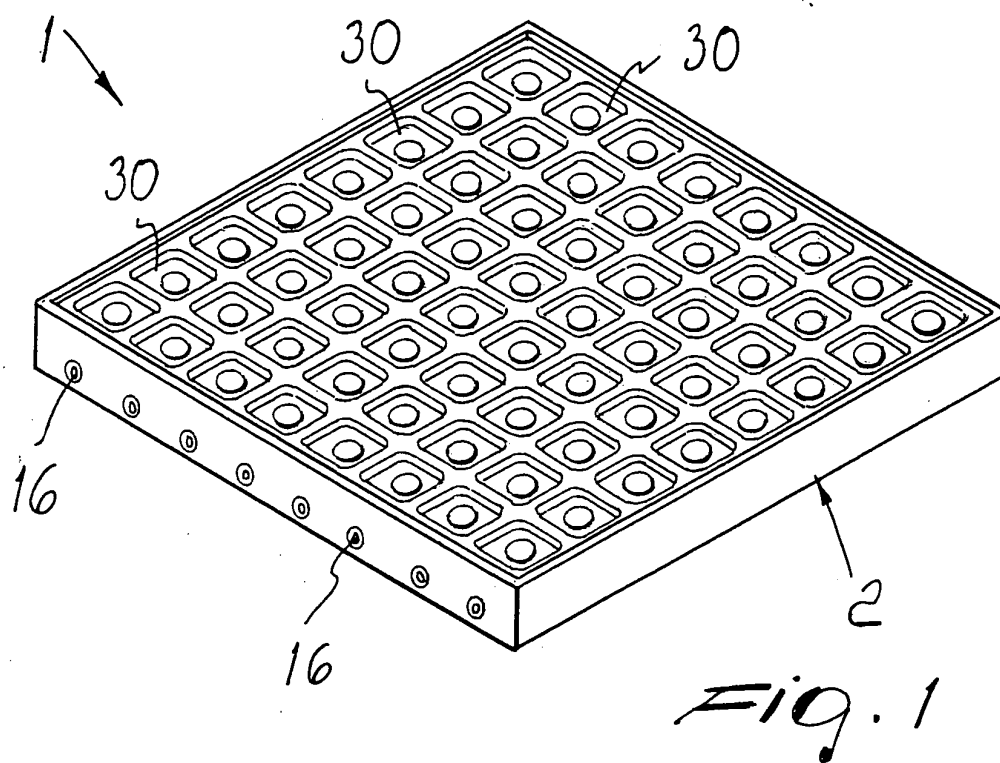
14. The mold part according to one or more of the preceding claims, **characterized in that** said auxiliary ducts are formed at least partially in said body so as to interconnect said chambers.
15. The mold part according to one or more of the preceding claims, **characterized in that** said receptacles comprise jackets that are accommodated in corresponding holes formed in said body.
16. The mold part according to one or more of the preceding claims, **characterized in that** said pistons comprise a rod that is accommodated so that it can slide within said jackets or within said receptacles, with an end that protrudes outside them and forms said respective crowns.
17. The mold part according to one or more of the preceding claims, **characterized in that** said pistons comprise a stem that is accommodated slidingly in said jackets or in said receptacles with an end that protrudes out of them and with which a plate is rigidly coupled, said crowns being formed by said plates.
18. The mold part according to one or more of the preceding claims, **characterized in that** said rear stop surface is formed by at least one arc on an annular raised portion that protrudes with respect to the internal walls of said receptacles or of said jackets or of said holes.
19. The mold part according to one or more of the preceding claims, **characterized in that** said rear abutment surface is formed by at least one arc of an annular collar that protrudes on the outer side wall of said pistons.
20. The mold part according to one or more of the preceding claims, **characterized in that** said front stop surface is constituted by at least one portion of an annular base that is formed at the end of said receptacles or of said jackets or of said holes and is directed toward said wall.
21. The mold part according to one or more of the preceding claims, **characterized in that** said front abutment surface is constituted by at least one portion of the face of said plate that lies opposite said wall.
22. The mold part according to one or more of the preceding claims, **characterized in that** at least one of said receptacles and said pistons comprises seats for respective sealing gaskets.

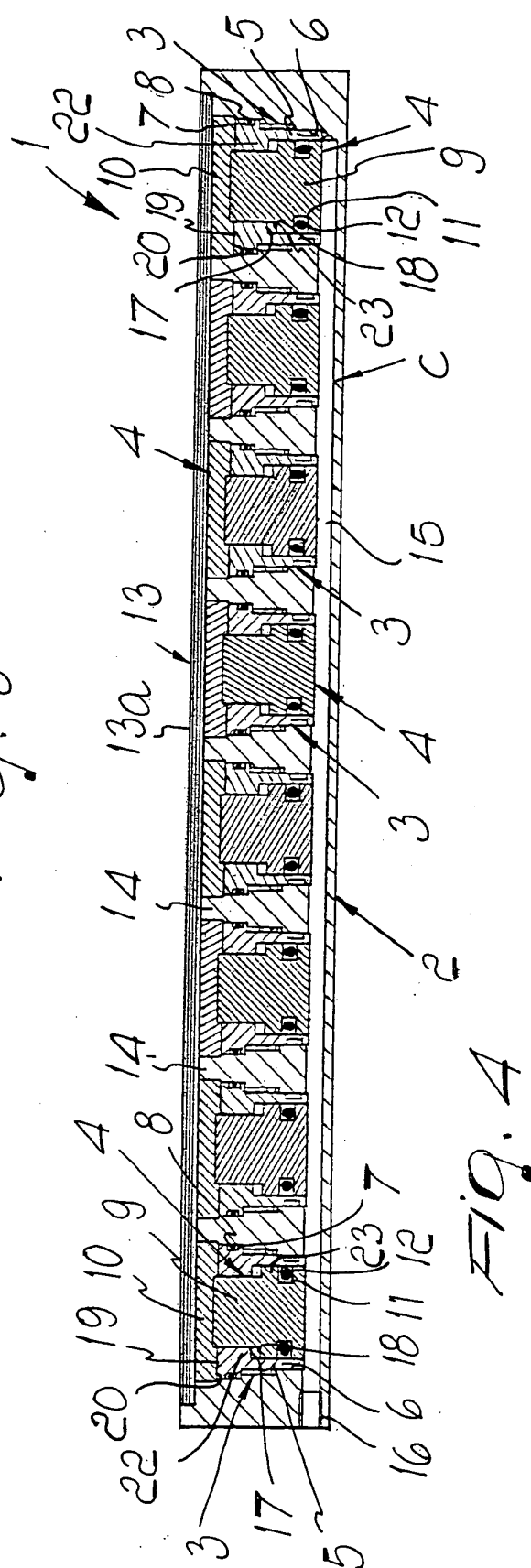
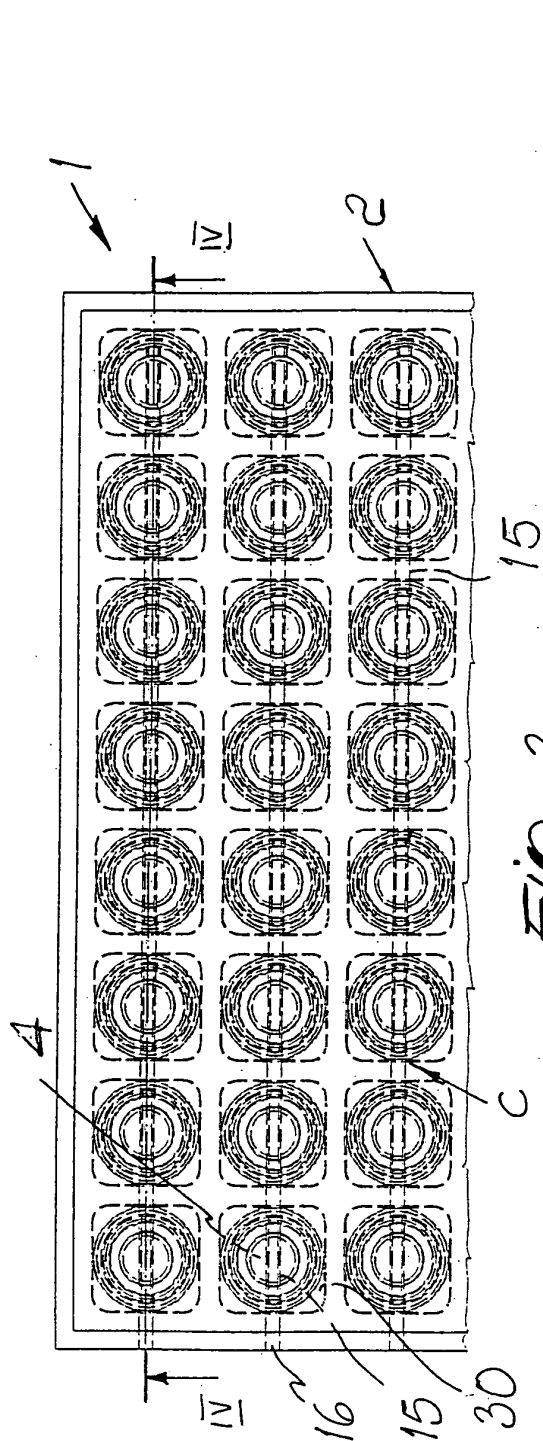
23. The mold part according to one or more of the preceding claims, **characterized in that** it comprises a stiffening lamina that is associated with said wall.
24. The mold part according to one or more of the preceding claims, **characterized in that** said body is divided into a first half-body, with which said wall is associated, and into a second half-body, in which said circuit that uses a fluid medium is formed, said half-bodies being substantially plate-like and adapted to be mutually superimposed and anchored by fixing means. 5 10
25. The mold part according to one or more of the preceding claims, **characterized in that** said fixing means are of the threaded type. 15
26. The mold part according to one or more of the preceding claims, **characterized in that** said connection ducts are formed proximate to the face of said body that lies opposite said wall. 20
27. The mold part according to one or more of the preceding claims, **characterized in that** said circuit is divided into independent portions, each of which is associated with at least one of said receptacles and is adapted to determine selectively the stroke of the respective piston. 25
28. The mold part according to one or more of the preceding claims, **characterized in that** said mold part is of the contoured type, adapted to mold articles such as roof tiles, comer elements and the like, and comprises at least two pressing surfaces that are substantially mutually incident and for each of which there is at least one of said receptacles with a longitudinal axis that is substantially perpendicular thereto and accommodates a respective said piston and is associated with a respective said circuit. 30 35 40

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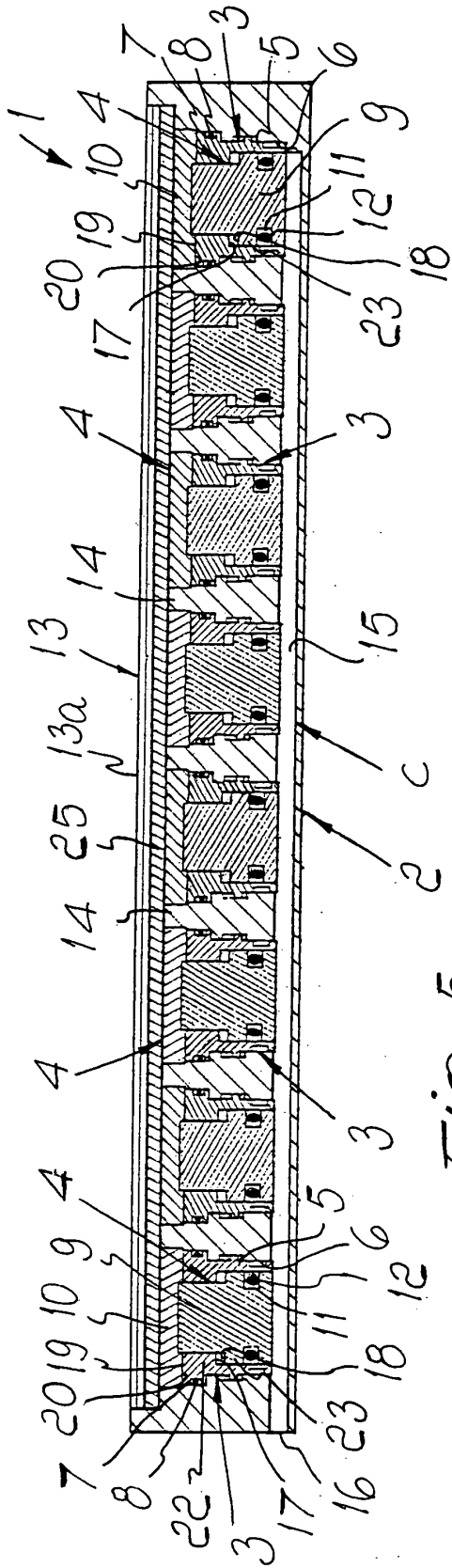


Fig. 5

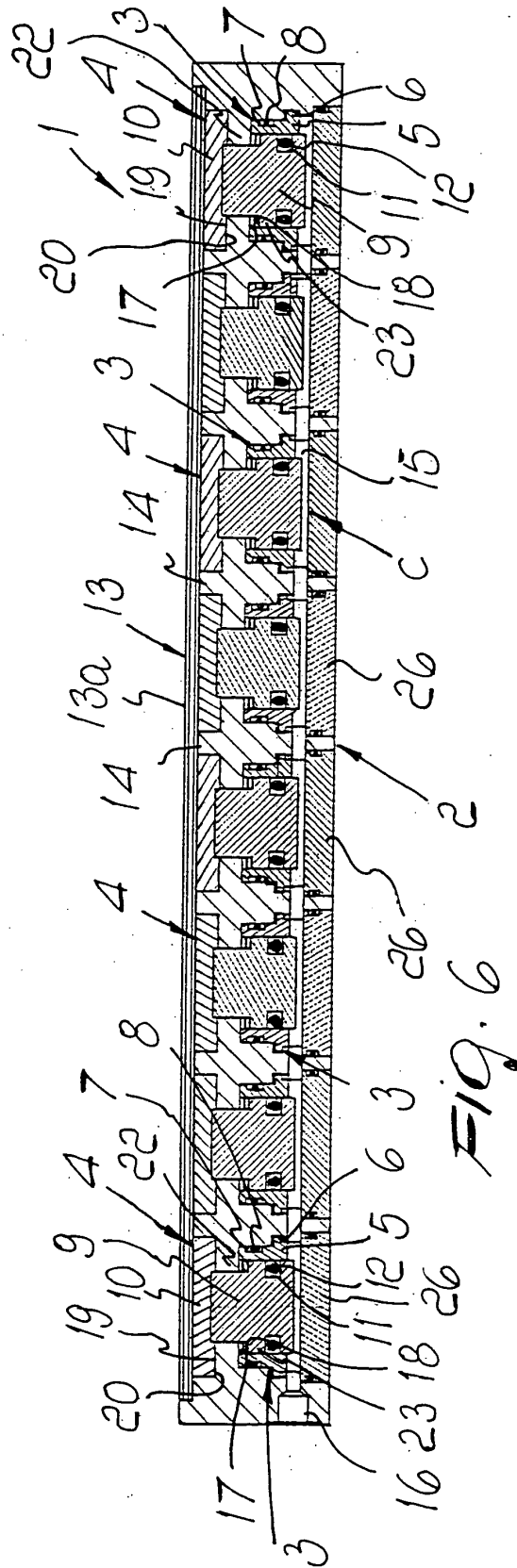
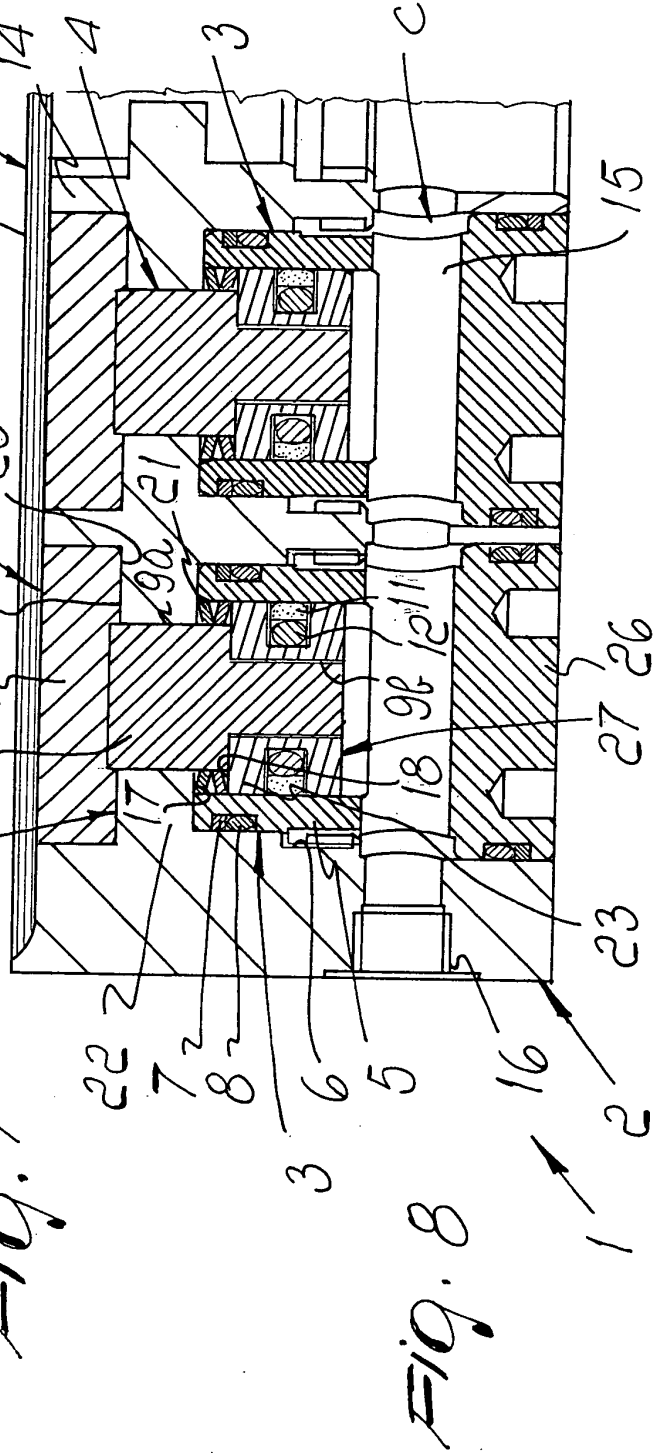
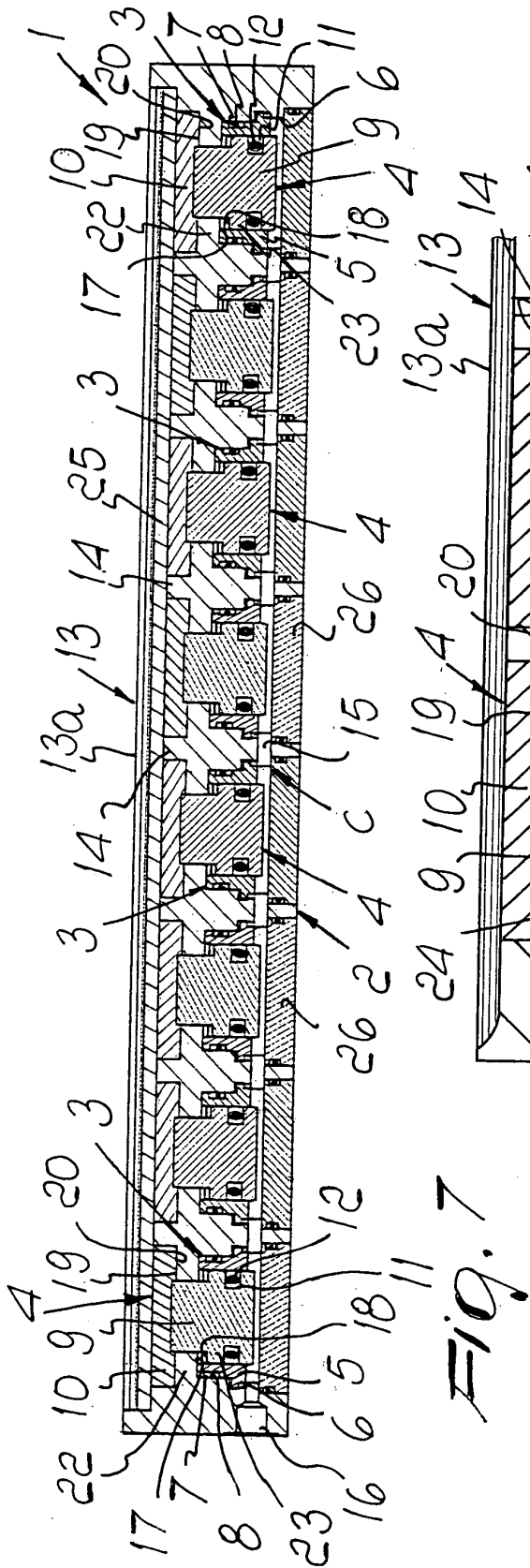
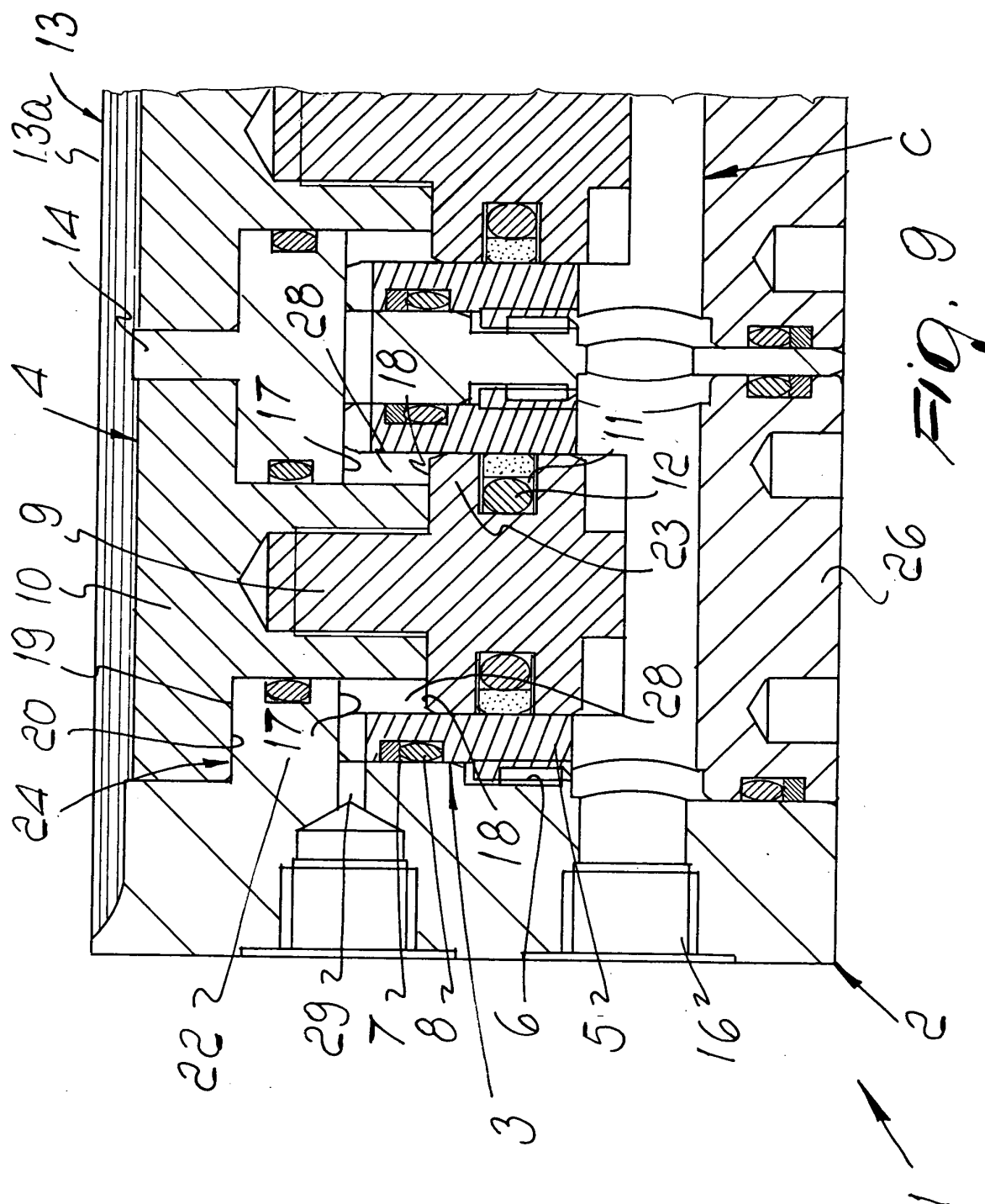
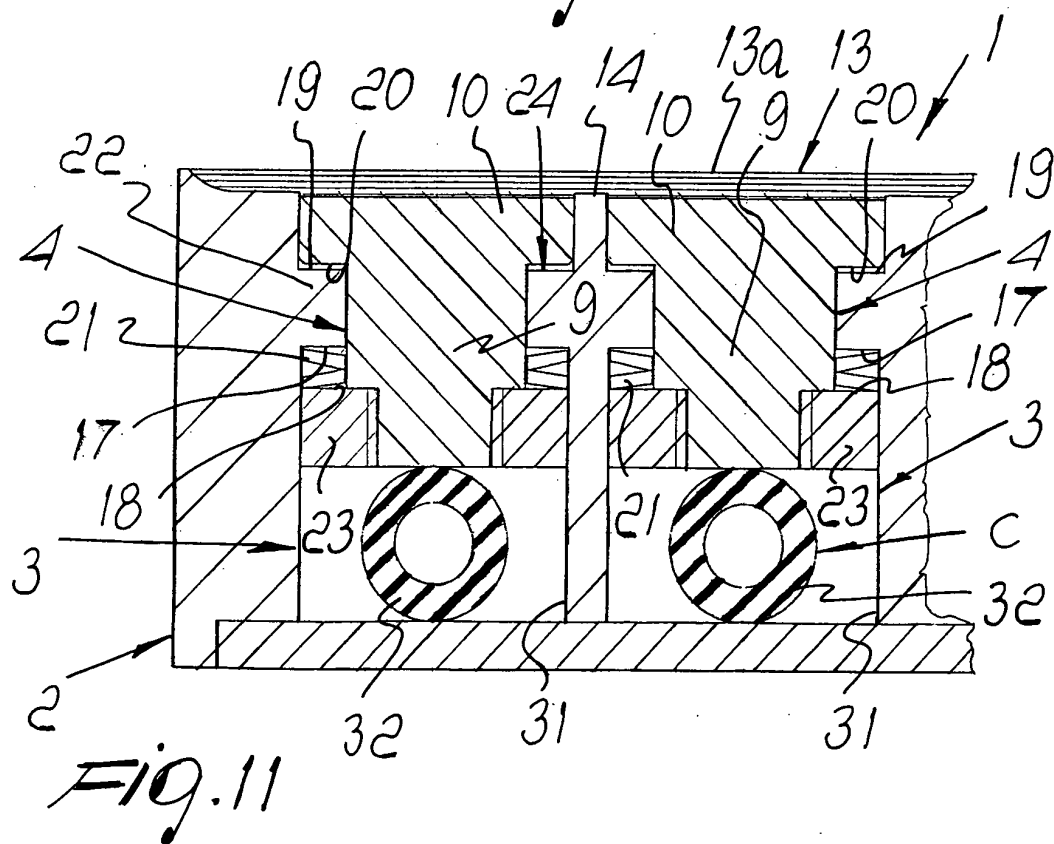
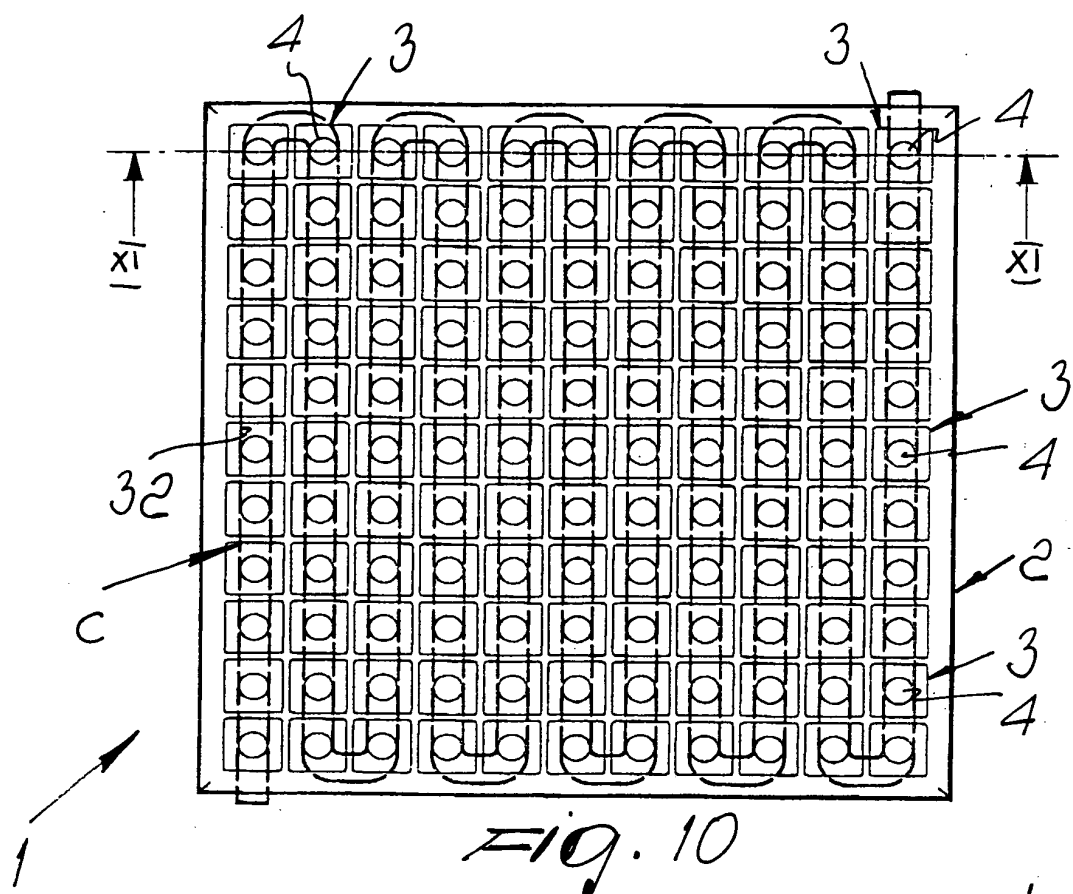


Fig. 6







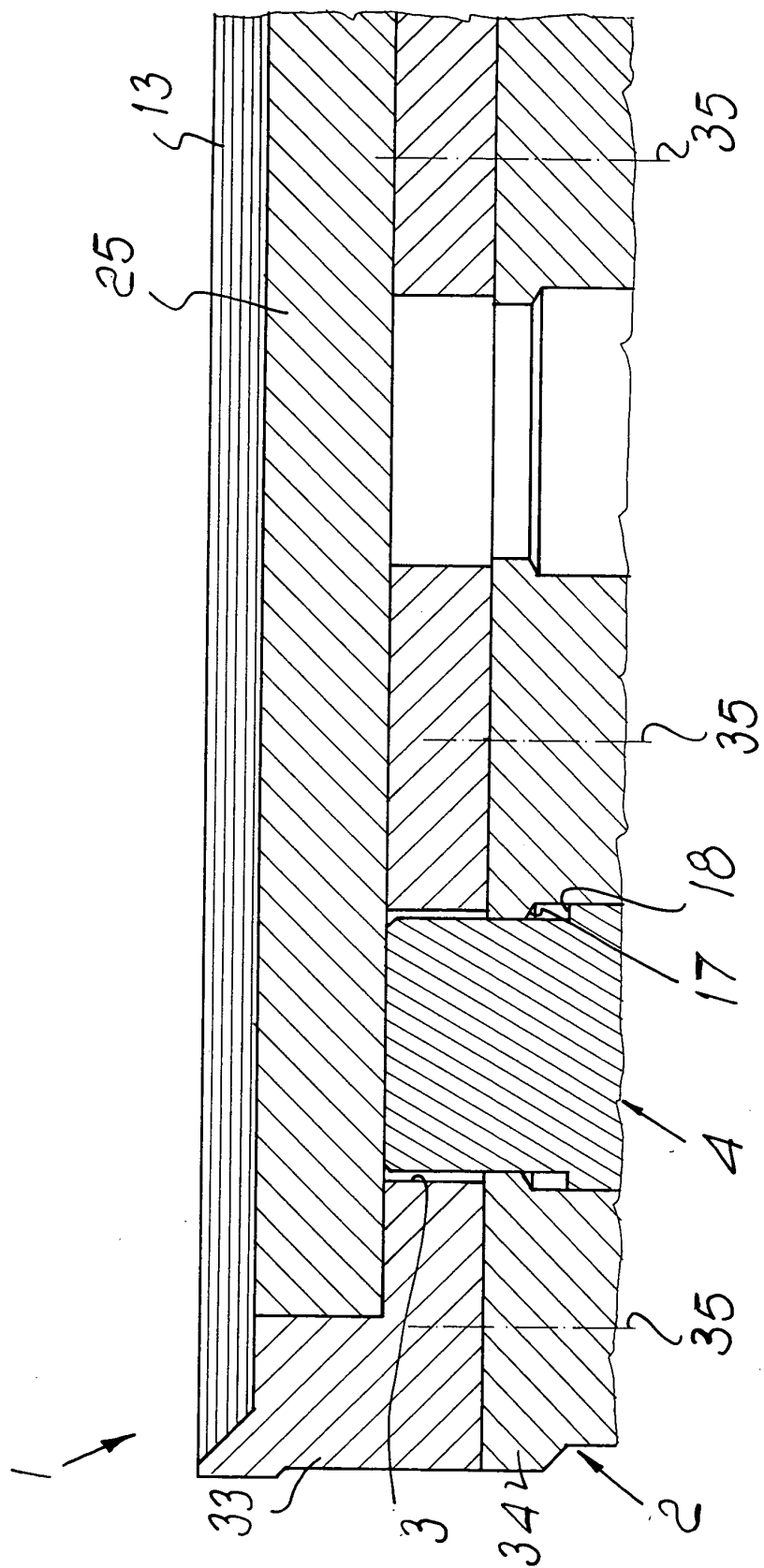


Fig. 12