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(54) Adaptable punch for pressing ceramic products such as tiles and the like

(57) An adaptable punch for pressing powders during the production of tiles and the like comprises a base (11, 111) which has a surface for pressing the powders which is formed by a flexible layer (13, 113). The flexible layer is supported by a plate (14, 114) which is seated peripherally in a sealed manner inside a seat (15, 115) in the base and which is able to oscillate at least partly on a layer of incompressible fluid. Travel stop devices (26, 126) may be provided between plate and base.

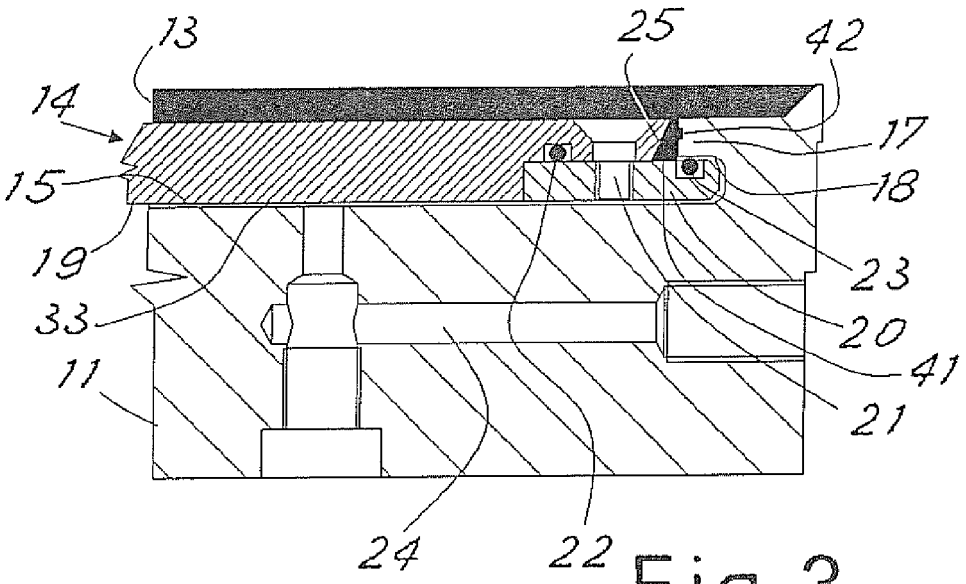

Fig.3

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Description

[0001] The present invention relates to an innovative adaptable punch for pressing ceramic products such as tiles and the like.

[0002] A common problem hitherto unresolved in the production of tiles and the like is that of ensuring uniform pressing of the powders. In fact, varying pressing forces which result in different densities in the pressed powder create defects in the tile. These undesirable effects, including a so-called "trapezium effect", are more or less evident depending, among other things, on the varying moisture conditions, particle size, etc., of the powders, resulting in the need for continuous adjustment of the machines.

[0003] In the tile production sector, therefore, for some time punches referred to as "isostatic punches" have been known. These punches comprise a plate which supports, on its surface, a rubber layer forming the impression on the rear of the tile. Underneath the rubber layer, the plate has a plurality of chambers (each one of which may receive a sliding piston). All the chambers are filled with oil and connected together by means of suitable ducts.

[0004] During pressing, any lack of uniformity in the powders placed inside the mould produces on the pistons different thrusting forces which are distributed by the oil, causing a difference in the height of the overlying rubber layer which thus compensates for the differences in the powder and ensures a uniform density of the powders.

[0005] With this system it is possible to reduce any defects in the tile caused by the density of the powder, but this system also creates further problems. For example, so-called "transparency" problems may arise, where the finished (i.e. fired and optionally enamelled) tile has an impression created by the isostatic circuit, corresponding to more or less compact zones of the tile and consequently a different response of the various surface zones thereof to the treatment performed after pressing.

[0006] In particular, the visible surface of the finished tile (namely the surface opposite to that where the isostatic punch acts) may have discernible defects such as halos, "voids" (i.e. slight depressions) or reliefs which are produced on the finished side of the tile due to the presence of the isostatic circuit (which, in all its known versions, generates, because of its nature, tiles with non-uniform thicknesses) and consequent "settling" of the tile in the kiln.

[0007] These defects may, for example, be highlighted even further by subsequent processing of the noble surface of the tile such as lapping (following too little or excessive lapping of the areas where greater compensation by the isostatic system has occurred), application of particular types of enamels, etc.

[0008] In some cases, the defects due to the use of the isostatic punch are such that use of the isostatic punch must be completely abandoned.

[0009] Moreover, isostatic punches have a high cost owing to their greater constructional complexity and require more costly maintenance.

[0010] WO 2006/095254 and EP 0,620,089 describe punches in which a plate or a grille which moves inside a cavity full of oil is present underneath a flexible rubber layer. These systems have, however, various defects owing to the substantially uncontrollable movement of the plate or the grille, which gives rise to defects in the pressed product, in particular along the edges.

[0011] The general object of the present invention is to provide a punch which overcomes various problems of isostatic punches, providing characteristics similar to those of a rigid stamp following firing, but which is able to ensure compensation of the pressing defects, advantageously at a cost - in terms of both production and maintenance - less than that of isostatic punches.

[0012] In view of this object the idea which has occurred, according to the present invention, is to provide an adaptable punch for pressing powders during the production of tiles and the like, as claimed in Claim 1.

[0013] In order to illustrate more clearly the innovative principles of the present invention and its advantages compared to the prior art, examples of embodiment applying these principles will be described below, with the aid of the accompanying drawings. In the drawings:

- Figure 1 shows a schematic plan view of a punch provided in accordance with the principles of the present invention;
- Figure 2 shows a partial cross-sectional view along the line II-II of Figure 1;
- Figure 3 shows a partial cross-sectional view, on a larger scale, along the line III-III of Figure 1;
- Figure 4 is a bottom view of part of the plate of the punch according to Figure 1;
- Figure 5 is a view, similar to that of Figure 1, of a variation of embodiment of the punch according to the invention;
- Figure 6 is a partial cross-sectional view along the line VI-VI of Figure 5.

[0014] With reference to the figures, Figure 1 shows a punch according to the invention, denoted generally by 10, for pressing powders during the production of tiles and the like. For greater clarity, Figure 1 does not show the pattern on the pressing surface which imparts the desired impression to the rear of the tile. This pattern is in any case, in its various forms, well-known to the person skilled in the art.

[0015] The punch is intended to be mounted (as can be easily imagined by the person skilled in the art) in a known mould in a known press, in order to perform pressing of the powders using a method which is substantially known per se.

[0016] As can be clearly seen in Figure 2 and, on a larger scale in Figure 3, the punch 10 comprises a base 11 (advantageously made of steel) on which a powder pressing surface 12 which is formed by a flexible layer

13 is provided. Advantageously, the flexible layer is composed of vulcanized rubber. Alternatively, it may also consist of resin or other material which is equivalent from a functional point of view.

[0017] The flexible layer is supported by an underlying plate 14 which is peripherally received in a sealed manner inside a seat 15 formed in the base. The plate, as will become clear below, is able to oscillate at least partly on a layer of incompressible fluid (for example oil). The plate is substantially rigid and is made, for example, of steel of suitable thickness. The seat and the plate have advantageously a rectangular shape and preferably form a punch which overall is as large as the tile to be pressed. The adaptable zone is therefore smaller than the entire tile and excludes a perimetral strip.

[0018] The perimetral edge of the seat 15 has a form and dimensions suitable for withstanding the stresses to which the punch is subject during use thereof and may be optionally provided with one or more grooves of varying shape for increasing cohesion between the steel part of the punch and the layer of flexible material.

[0019] Advantageously, the edge is shaped with a surface 16 which is inclined towards the seat 15 and which forms an element for peripherally containing the flexible layer 13.

[0020] As can be seen more clearly in the enlarged view of Figure 3, the seat 15 has edges 17, close to the edges of the oscillating plate, which project beyond the edges of the plate so as to form an undercut 18 which prevents the plate from coming out of its seat.

[0021] In order to ensure suitable robustness and easy assembly, the edges 17 are formed as one piece with the rest of the base (advantageously formed by means of machining from a single block), while the plate is formed by a sheet-like central body 19 and by edge strips or frame elements 20 which are screwed onto this central body, by means of screws 21, advantageously inside a step-like seat inside which a sealing gasket 22 is also seated.

[0022] The peripheral progression of the edge strips (one on each side of the plate) is clearly visible in Figure 4, where the plate is shown in a view from the bottom side which is inside the seat.

[0023] In this way, all four strips are inserted inside the undercut 18 for assembly so as to form a complete frame and the central body of the sheet is then placed inside the seat. By tightening the screws 21, the plate is mounted in its final configuration.

[0024] Alternatively, as shown in the advantageous variant of Figures 5 and 6, the oscillating plate may be formed as one piece and the edges of the seat may be formed as a frame which is applied to the base after positioning of the plate inside the seat.

[0025] Below, parts which are the same in both embodiments will be indicated by means of the same numbers (increased by 100 for the second embodiment).

[0026] In particular, in the variant shown in Figures 5 and 6, the punch, which is denoted generally by 110, comprises a base 111 (advantageously made of steel), provided with the powder pressing surface 112 which is formed by a flexible layer 113 (as described above for the layer 13) supported by an underlying plate 114 which is peripherally seated in a sealed manner inside the seat 115 present in the base. The plate will in this case also be substantially rigid and will oscillate on a layer of incompressible fluid (for example oil).

[0027] The perimetral edge of the seat 115 is advantageously shaped with an inclined surface 116 for perimetrally containing the flexible layer 113.

[0028] In the variant according to Figures 5 and 6, the seat 115 has side walls which are substantially vertical with respect to the bottom of the seat in order to receive with minimum lateral play the plate 114 via peripheral seals. The side edges of the seat comprise a frame 117 (consisting of one piece or segments) which is fixed to the base by means of screws 121 and which projects above the edges of the plate 114 in order to form the undercut 118 which prevents the plate from coming out of the seat. A seal 121 may be optionally provided in order to ensure tightness between the frame and the base. The height of the undercut groove 18 or 118 formed in the edge of the base is such as to allow suitable play of the sheet which, in the vertical direction, represents the desired travel movement of the oscillating plate. This travel movement may vary from a few tenths of a mm to more than 1 mm, depending on the specific requirements.

[0029] As can be clearly seen in Figure 3, in the case of the first embodiment, and in Figure 6 in the case of the variant, seals (23 or 123, respectively) are provided between facing surfaces of the edges of the plate and the projecting edges of the seat, for sealing the incompressible fluid which is introduced into the cavity 33 or 133 created between plate and seat and on which the plate oscillates.

[0030] In particular, as can be clearly seen in Figure 3, the first embodiment has a seal 23 which is arranged between edges of the plate and facing projecting edges of the seat, so as to be preferably between the top surface of the edges of the plate and the facing bottom surface of the undercut.

[0031] In the variant shown in Figure 6, the seal is instead arranged laterally with respect to the edges of the plate so as to run along the facing side walls of the seat.

[0032] The seal 23 also prevents the entry into the cavity of the resin which is cast on the plate during the rubberizing operation, as will be clarified below. The base comprises advantageously at least one duct 24, 124 which can sealingly closed and which emerges into the seat for introduction of the fluid into the cavity between plate and seat.

[0033] In the embodiment shown in Figure 6 a further seal 140 is also advantageously provided between the facing surfaces of the edge of the plate 114 and the frame 117 in order to prevent entry, underneath the plate, of the resin or rubber during casting (resin-coating/rubber-

izing) of the flexible layer on the punch. This seal will be made of material suitably chosen so that it may be easily compressed in such a way as not to prevent correct movement of the plate during normal operation of the punch.

[0034] As can be clearly seen in the figures, the edges of the plate 14, 114 have advantageously a lateral step 25, 125 situated opposite the undercut 18, 118. In the first embodiment the step is formed by joining together of the frames 20 with the central part of the plate 14, while in the variant according to Figure 6 it is formed in the thickness of the plate. During casting of the flexible layer the material may be advantageously inserted into the cavity which is formed between lateral step 25, 125 and projecting edges 17, 117 of the seat. The flexible layer thus forms gripping projections (41, 141) which are seated inside the cavity. The projecting edge 17, 117 and/or the lateral step 23, 125 may be advantageously provided with grooves 42, 142 for receiving complementary ribs on the gripping projections 41, 141, so as to facilitate firm gripping. Advantageously, travel stop devices 26, 126 are arranged between oscillating plate and base, being distributed over the surface of the plate and fastening the plate to the base with a predetermined play, each so as to limit locally the movement of the plate away from the base. The play of the travel stop devices also corresponds to the desired travel movement of the plate. The travel stop devices may be distributed in a suitable and convenient arrangement so as to obtain a suitable homogeneous distribution of the forces on the plate. For example, they may be distributed as shown in the figures. Other arrangements are obviously possible depending on the specific requirements and dimensions of the punch. Advantageously, each travel stop device is formed by a screw 27, 127 which passes through the bottom of the seat in the base and which is screwed into the plate. The head of the screw is preferably received with play in a seat 28, 128 in the base which is sealingly closed by a closing plug or washer 29, 129 which may be provided with a seal. Alternatively, if the dimensions allow it, the travel stop device could also be designed so as to be screwed in from the top onto the bottom through the plate. In this case the plug 29, 129 would not be required.

[0035] In this way, the plate (both in the embodiment according to Figures 1-4 and in the variant according to Figures 5 and 6) can be inclined in a guided manner depending on the thrust acting on it during pressing of the powders in the press.

[0036] Suitable springs for recalling the plate into the rest position could also be envisaged.

[0037] As can be seen in Figures 1-4, advantageously, removable pins 30 for centring the plate in the seat may be present between the bottom of the seat and the facing side of the oscillating plate. These pins are arranged inside suitable seats 31 in the base so as to project into the seat and engage with minimum play in suitable blind holes 32 present in the plate. In this way the plate is perfectly centred during assembly and casting of the flexible layer, as will be clarified below. The pins may then be removed and their seats in the base may be closed with suitable plugs. These pins are advantageously arranged around the periphery of the plate, as can be schematically seen in Figure 1.

[0038] For assembly of the punch according to the first embodiment, it is sufficient to arrange the frame elements 20 in position inside the seat and screw the body of the plate to them, using the seals provided.

[0039] After this, the pins 30, if present, are positioned so as to centre the plate 14 in its seat in the base. The adhesive is then applied and casting of the coating with the flexible layer is performed, filling completely the visible cavity formed by the top surface of the plate and by the lateral frame edges 16 of the base. Vulcanization is then performed.

[0040] Once vulcanization has been completed, the pins are extracted and the corresponding holes are sealingly closed with a plug (if the holes are not required for the following operation of filling with the incompressible fluid, since said holes may replace the ducts 24).

[0041] Finally, the travel stop devices are installed, together with any associated recall springs, and the seats are closed with the plugs 29.

[0042] For assembly of the variant according to Figures 5 and 6, the method is substantially similar, except that the frame elements 117 are inserted and screwed in position.

[0043] In both cases, once assembly has been completed the punch is connected to a suitable hydraulic control unit by means of a suitable connection, for the fluid filling operation. The fluid is introduced until the cavity between seat and plate is filled and the plate is brought back into the correct position. Advantageously it is possible to use a suitable measuring instrument, comparator or the like, so as to be able to adjust with precision the position of the plate.

[0044] Once the fluid filling operation has been completed, the connection (where necessary) is removed and the punch sealed, a single isostatic chamber is thus obtained. The punch thus becomes an adaptable punch, with the flexible surface which is kept substantially entirely coplanar with itself by means of the underlying rigid plate, without the disadvantages of the known isostatic punches with multiple pistons/chambers.

[0045] It should be noted that the structure of the punch and the processing operations performed by it are therefore not dependent on the design on the rear of the tile, the punch consequently being universal and suitable for use with any design.

[0046] At this point it is clear how the predefined objects have been achieved.

[0047] With a punch according to the principles of the invention, the so-called "transparency" effect is practically entirely eliminated owing to the presence of the rigid insert which is more or less undeformable under the thrust of the underlying incompressible fluid. Owing to

the presence of an underlying chamber containing incompressible fluid and the possibility for the insert to move (rigidly oscillate without deformation), moreover with a predetermined travel movement which can be defined during the design stage by means of the central travel stop devices and the perimetral undercut, it is in any case possible to overcome all those defects associated with the use of non-isostatic punches, such as the trapezium effect, misalignments, etc.

[0048] Owing to the possibility of rubber-coating the punch with various designs of back pattern (since machining of the steel part is not dependent on the design of the back pattern), the punch is extremely versatile in terms of use. For example, conventional isostatic punches must have an isostatic circuit which coincides with the depressed zones of the back pattern, the position and form of which is therefore limited by these zones.

[0049] The punch according to the invention is particularly suitable in all those cases where transparency-linked defects do not allow the use of conventional isostatic punches. By way of example, it is possible to mention tiles which must undergo lapping treatment or which must be enamelled using enamels which tend to highlight the superficial imperfections. According to the prior art, in such cases it is required to use rigid stamp punches which however result in trapezium errors of between 2 mm and 6 mm, something which per se constitutes a not insignificant defect since it means that production must be divided up according to different sizes.

[0050] If the tile must then be squared, this condition results in the squaring machine having to be continuously adjusted and high costs being incurred during squaring of the tile, since it is required to produce tiles which are substantially bigger than the final finished format in order to be able to form the entire perimeter of the tile during final grinding thereof. Moreover, the greater the amount of material eliminated, the higher the costs which are incurred.

[0051] With a punch according to the present invention it is in any case possible to reduce substantially these dimensional defects. By means of the compensation provided by the punch described herein, it is possible to reduce the trapezium error so as to allow trouble-free machining or ensure uniformity of the grinding operation. With the punch described it is possible to ensure always sufficiently uniform squaring dimensions and perpendicularity of the sides of the tile.

[0052] Obviously, the above description of embodiments which apply the innovative principles of the present invention is provided by way of example of these innovative principles and must therefore not be regarded as limiting the scope of the rights claimed herein. For example, the travel stop devices may be provided with a form and position different from that shown.

Claims

1. Adaptable punch for pressing powders during the production of tiles and the like, comprising a base (11, 111) which has a surface (12, 112) for pressing the powders which is formed by a flexible layer (13, 113), **characterized in that** the flexible layer is supported by a plate (14, 114) which is seated peripherally in a sealed manner inside a seat (15, 115) in the base and which is able to oscillate at least partially on a layer of incompressible fluid and **in that** the seat (15, 115) has edges, close to the edges of the oscillating plate, which project above the edges of the plate so as to form an undercut (18, 118) which prevents the plate from coming out of the seat,

2. Punch according to Claim 1, **characterized in that** seals (23, 123) for sealing the fluid between plate and seat are provided between facing surfaces of the edges of the plate and the edges of the seat.

3. Punch according to Claim 1, **characterized in that** the plate is formed by a central body and by edge strips (20) screwed to the central body.

4. Punch according to Claim 1, **characterized in that** travel stop devices (26) are arranged between plate and base, being distributed on the surface of the plate and fastening the plate to the base, each so as to limit locally the movement of the plate away from the base.

5. Punch according to Claim 4, **characterized in that** each travel stop device (26, 126) is formed by a screw (26, 126) which is connected with play between bottom of the seat and plate.

6. Punch according to Claim 5, **characterized in that** the screw (26, 126) passes through the bottom of the seat in the base and is screwed into the plate (14, 114), the head of the screw being received with play inside a recess in the base which is sealingly closed by a plug (29, 129).

7. Punch according to Claim 1, **characterized in that** the base has at least one duct (24, 124) which emerges inside the said seat, for introducing the incompressible fluid between the oscillating plate and the seat.

8. Punch according to Claim 1, **characterized in that** removable pins (30) for centring the plate in the seat are arranged between bottom of the seat and facing side of the oscillating plate.

9. Punch according to Claim 1, **characterized in that** the flexible layer (26, 126) is a layer of rubber or resin which is vulcanized on the outer side of the oscillating

plate and peripherally on the base around the said seat which receives the oscillating plate.

10. Punch according to Claim 1, **characterized in that** the edges of the seat comprise a frame (117) which is fixed to the base and which projects above the edges of the plate so as to form the said undercut (118).

11. Punch according to Claim 1, **characterized in that** the edges of the plate (14, 114) have a lateral step (25, 125) situated opposite the undercut (18, 118).

12. Punch according to Claim 11, **characterized in that** a cavity which receives gripping projections (41, 141) of the flexible layer is provided between lateral step (25, 125) and projecting edges (17, 1.17) of the seat.

13. Punch according to Claim 12, **characterized in that** grooves (42, 142) for receiving complementary ribs on the gripping projections (41, 141) are provided in the projecting edge (17, 117) and/or in the lateral step (25, 125).

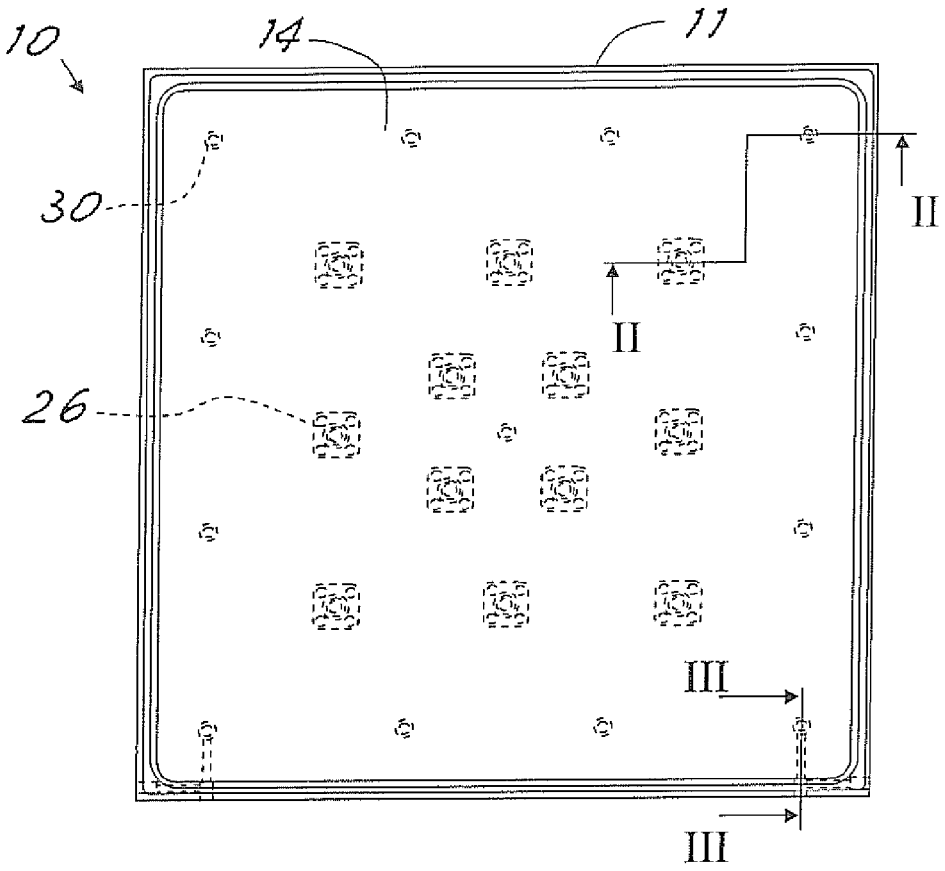
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Fig. 1

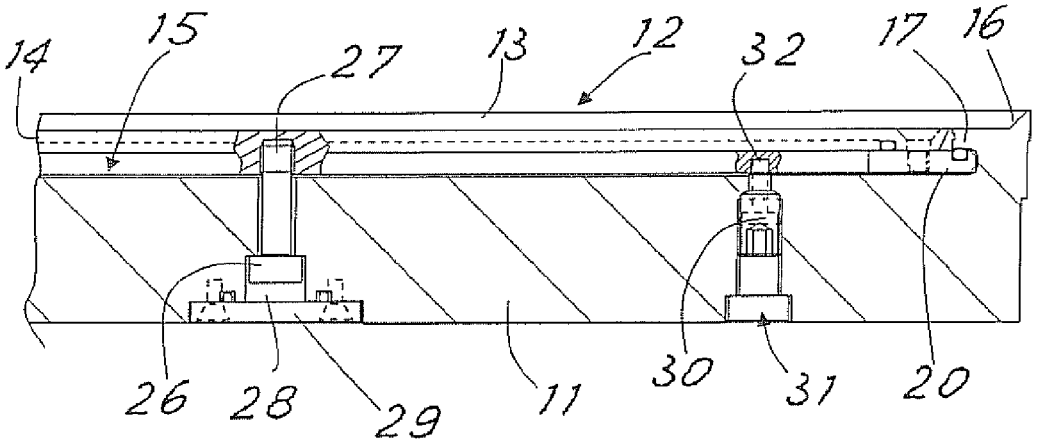
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Fig. 2

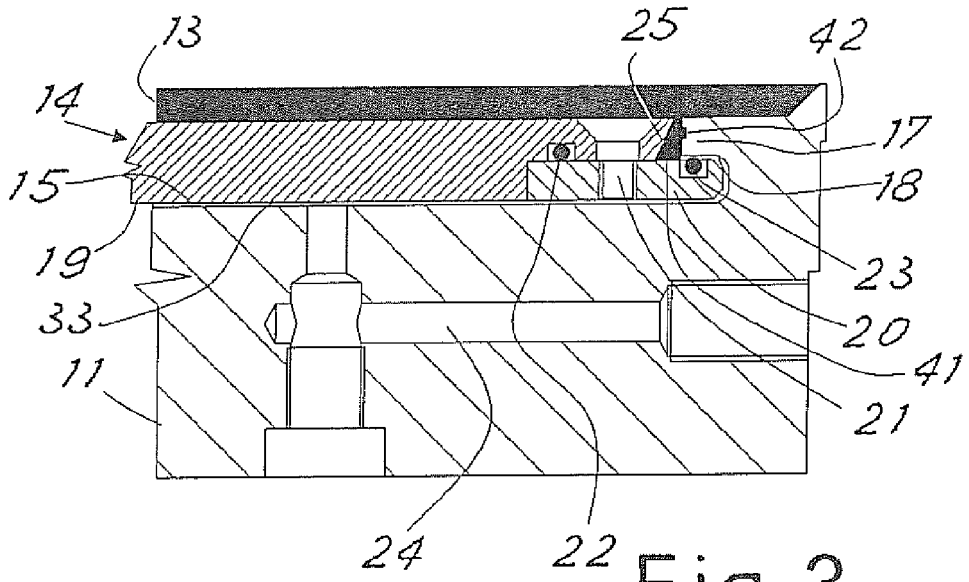
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Fig.3

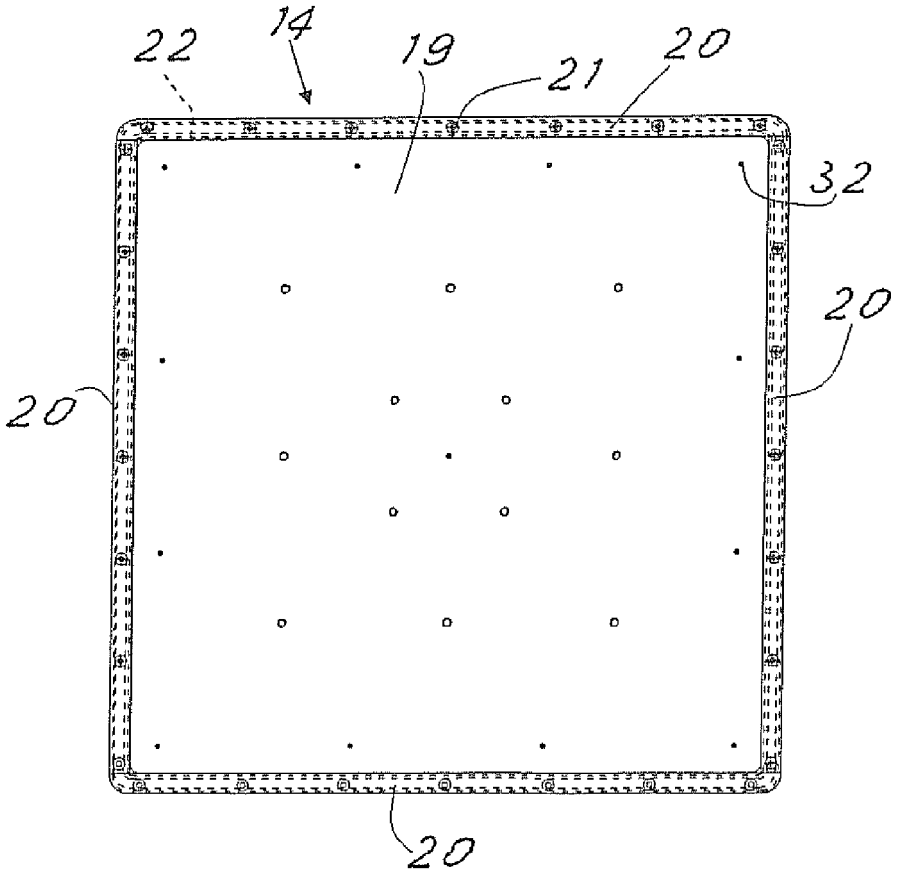
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Fig.4

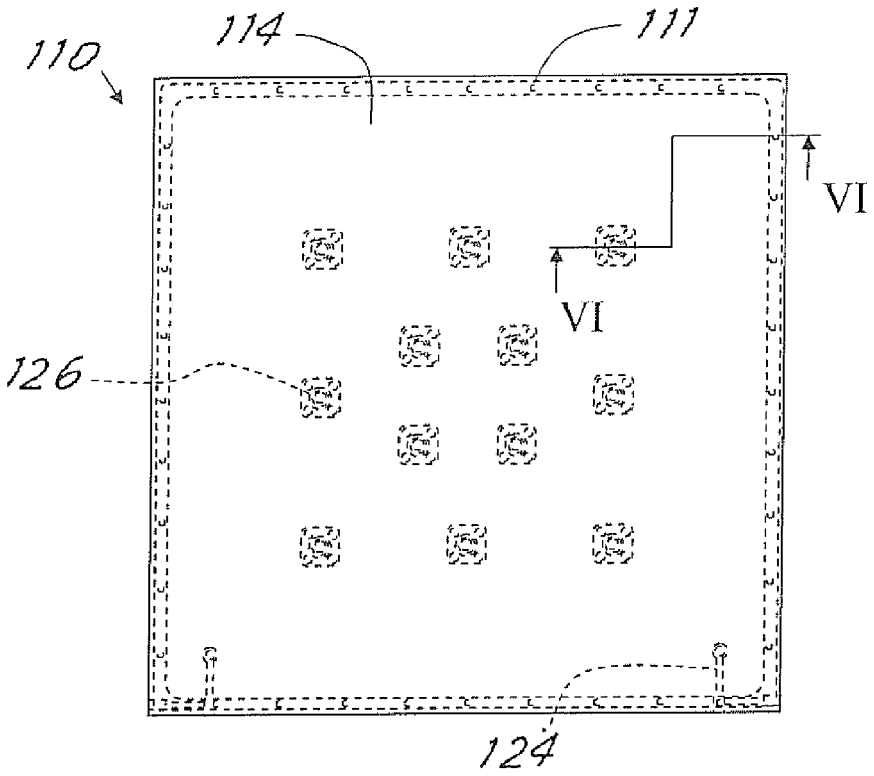
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Fig.5

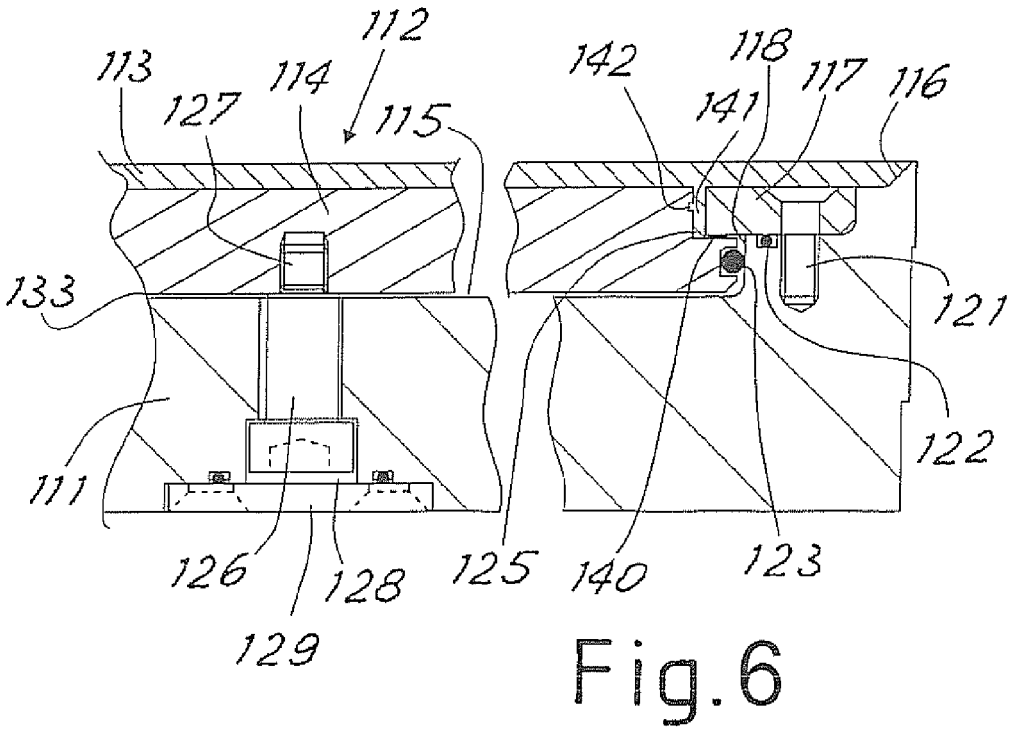
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Fig.6

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EUROPEAN SEARCH REPORT

Application Number
EP 12 18 9410

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The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
The Hague	7 January 2013	Voltz, Eric

CATEGORY OF CITED DOCUMENTS

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1

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ANNEX TO THE EUROPEAN SEARCH REPORT ON EUROPEAN PATENT APPLICATION NO. EP 12 18 9410

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