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(71) Applicant: **Casolari, Fabio**
42014 Castellarano (Reggio Emilia) (IT)

(72) Inventor: **Casolari, Fabio**
42014 Castellarano (Reggio Emilia) (IT)

(74) Representative: **Gotra, Stefano**
BUGNION S.p.A.
Via Emilia Est 25
41100 Modena (IT)

(54) **A die for forming ceramic tiles**

(57) The die comprises a top half-die (1a) and a bottom half-die (1b) which defined at least two forming cells (30 and 40). At least one of the two half-dies, for example the top half-die (1a), comprises a bearing plate (2) which exhibits at least two seatings (3, 4) at the forming cells (30, 40). Two die-bearing shoes (6, 7) are partially inserted and sealedly coupled internally of the seatings (3, 4), slidably in a parallel direction to a relative direction movement of the two half-dies (1a and 1b). Each of the two die-bearing shoes (6, 7) delimits with a relative seating (3, 4) thereof a closed chamber (10, 11). Each closed chamber (10, 11) is in reciprocal fluid communication with the other closed chamber (10, 11).

Fig. 2

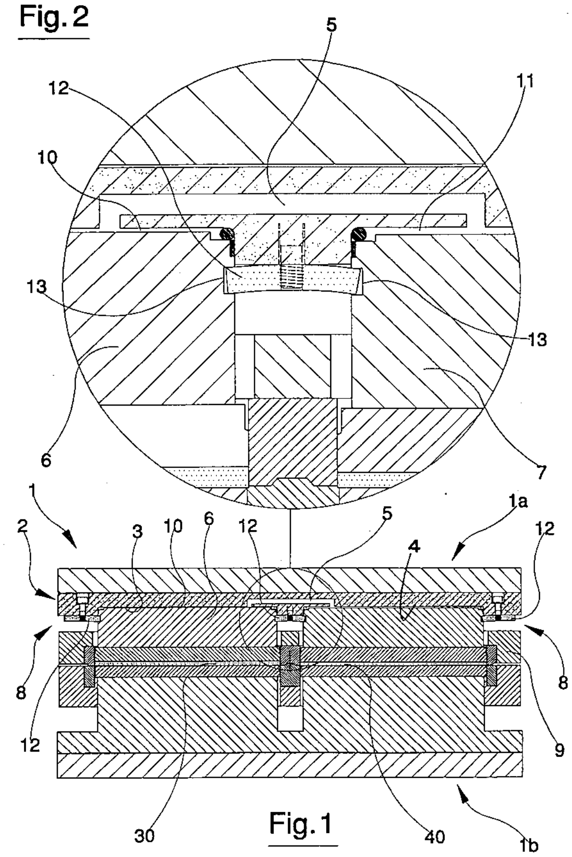

Fig.1

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Description

[0001] The die of the invention exhibits at least two forming cells, which enable at least two tiles to be formed contemporaneously.

[0002] Dies of this type are generally formed by two half-dies which can slide vertically, alternatively nearing and distancing one from the other.

[0003] A typical pressing cycle comprises at least one loading stage of the die with ceramic material, a pressing stage and an unloading stage of the formed tile. The loading stage is performed using a drawer, specially filled with ceramic material, which can slide on the plane comprising the upper face of the bottom half-die. This drawer deposits, by force of gravity, a load of ceramic material internally of the various forming cells of the die. The drawer translates along a predetermined direction, sliding on a loading plane over each of the forming cells of the die, in an alternating cycle.

[0004] As the drawer is provided inferiorly with openings, the ceramic material, in the outgoing journey from the loading plane, falls by gravity internally of the cells. During the return journey the drawer also carries out a levelling action on the material deposited in the cells, flattening and bringing the load to the level of the upper surface of the bottom half-die. Once the die has been loaded, the two half-dies are brought together and the pressing action is performed. The formed tiles are then unloaded from the die and sent on to the kiln for firing.

[0005] A problem of this type of forming is the die loading stage. Since this occurs with the ceramic materials falling by force of gravity, a homogeneous settling of the materials in the various cells is not guaranteed, especially when the cells lie at different distances with respect to the initial position, or rest position, of the loading drawer. Generally the first cell filled by the drawer receives an excess of mateial with respect to the following cell or cells. As the levelling-compacting run is the same for each of the cells, some tiles are more "pressed" than others. This leads to different behaviours during firing of the tiles, in particular determining a non-uniformity in size of the products, i.e. tiles characterised by different densities of material will be subject to different thermal deformation and, consequently, when cold will be of different sizes. In the production of tiles using traditional dies it is therefore necessary to include a "selection" stage of the tiles, following on from the firing stage, to group homogeneously-dimensioned tiles together.

[0006] In dies using isostatic bottom dies, which allow uniformity in density of the pressed material internally of the single forming cells (each of which is singly provided with an isostatic device), attempts have been made to remedy this drawback using connections between the various isostatic bottom dies making up the die.

[0007] This type of solution (connecting up the various isostatic bottom dies) has however revealed itself to be of small advantage in dies where the punch enters the die, difficult in dies with single rows of cells and impracticable in dies where there are double rows of cells, for reasons which will be explained herein below.

[0008] In dies where the punch enters the bottom die, the connection produces a) a reduction in the compensating capacity of the isostatic die, as the quantity of oil therein has to be changed for each pressing cycle; b) frequent losses of oil from connection tubes with possible breakage thereof.

[0009] In single row transfer dies the connection causes a) weakness in the connection tubes which, during work cycles, frequently break due to the effect of the continuous movement of the die in the forming cell; b) impracticable conditions during installation or replacement of the isostatic die; c) reduction in the compensating capacity of the isostatic dies, as they are forced to changed the internal quantity of oil during each pressing cycle.

[0010] In double-row transfer dies the connection, apart from being practically impossible due to lack of space, would also lead to a reduction in the compensating capacity of the isostatic dies, as the dies would be forced to change the quantity of oil inside them during each pressing cycle.

[0011] The main aim of the invention is to obviate the above-described drawbacks by providing a die for forming ceramic tiles which provides homogeneous densities between the forming cells.

[0012] Further characteristics and advantages of the present invention will better emerge from the detailed description that follows, of some preferred but non-limiting examples of the invention, in preferred but non-exclusive embodiments thereof, illustrated by way of example in the accompanying figures of the drawings, in which:

- figure 1 illustrates a first embodiment of the invention, in a pressing position;
- figure 2 shows a detail of figure 1;
- figure 3 shows the die of the invention in an open position, ready for a loading of material to be pressed;
- figure 4 shows the die in an open position after pressing of a tile, ready for unloading the product;
- figure 5 illustrates a second embodiment of the invention, shown in the pressing position.

[0013] With reference to the figures of the drawings, 1 denotes in its entirety a die according to the present invention. It comprises a top half-die 1a and a bottom half-die 1b, which together define at least two forming cells 30 and 40. One of the two half-dies is advantageously provided with an isostatic bottom. The two half-dies are vertically mobile between a loading position, in which they are distanced one from another in order to enable filling of the forming cells with ceramic material, and a pressing position, in which they are pressed together by a press to form the tiles. At least one of the half-dies, for example the top half-die 1a, comprises a bearing plate 2 which exhibits at least two seatings 3 and 4 located at the forming cells 30 and 40. Internally of these seatings 3 and 4 at least two die-bearing shoes 6 and 7 are partially inserted and sealedly coupled, with freedom to slide in a parallel direction to the direction movement of the two half-dies 1a and 1b. Each of the at least two seatings 3 and 4 delimits, together with one of the die-bearing dies 6 and 7 a closed chamber, denoted respectively by 10 and 11, which two closed chambers 10 and 11 are in reciprocal fluid communication.

[0014] The die-bearing shoes 6, 7 are slidable internally of the respective seatings 3 and 4 between a rest position, in which the dies are in contact with the bottom of the respective seatings 3, 4 and an active position in which they are distanced from the bottom of the seatings 3, 4.

[0015] The two chambers 10, 11 are connected by means of a channel 5 which develops internally of the bearing plate 2. In a further embodiment, not illustrated, the connnection could be achieved by an external connection conduit. During operation the two chambers 10, 11 are filled with a non-compressible fluid (liquid), for example oil, so that, during the pressing action, the die-bearing shoes 6, 7, through the channel 5, are subject to the same pressure. The presence of the oil internally of the chambers 10 and 11 guarantees a compensating effect for any non-uniformity in the distribution of ceramic material internally of the forming cells. If, for example, there is an excess of material in the cell denoted by 30, thanks to the compensating effect the die-bearing shoe 6 of the forming cell 30 itself will be arranged closer to the plane defined by the bottom of the seatings 3 and 4 than the other die-bearing shoe 7 of the other forming cell 40. Advantageously therefore the pressing run of the die-bearing shoe 6, with respect to the run of the other die-bearing shoe 7, develops by imposing on the ceramic material load in the cell 30 a greater final thickness than the final thickness of the material load in the other forming cell 40. In this way the final pressure internally of the formed tiles is overall homogeneous, so that there is a homogeneous density of material internally of the tiles.

[0016] The die comprises elastic means 8 for maintaining the dies in the rest position.

[0017] The elastic means 8 comprise a plurality of flexion springs 12 connected to the bearing plate 2 and each having an end inserted in a groove 13 afforded in the die-bearing shoes 6, 7. If oil is not sent to the chambers 10 and 11, thanks to the elastic elements 8 the die can function traditionally with the two dies aligned and resting on the bottoms of the seatings 3 and 4.

[0018] In the embodiment of figure 5, the elastic means 8 comprise an elastomer spring 22 which is interpositioned between a mushroom element 23 fixed to the bearing plane 2 and a plate 24, fixed to the die-bearing shoe 6, 7.

[0019] The mushroom element 23 is provided with a stalk which is freely housed with play internally of a through-hole afforded in the plate 24.

[0020] The plate 24 is fixed externally on the upper surface of the single die-bearing shoe 6, 7 and is housed freely internally of a first cavity 25 afforded in the bearing plate 2.

[0021] Each of the die-bearing shoes 6, 7 affords a second cavity 26 in which the set consisting of the elastomer spring 22 mounted on the mushroom element 23 is freely housed.

[0022] The die of the present invention offers considerable advantages, and in particular produces tiles characterised by homogeneous material density. These tiles, thanks to this characteristic, exhibit substantially uniform dimensions following firing, avoiding any need for checking or selection following firing.

Claims

1. A die for forming ceramic tiles, comprising two half-dies, which define at least two forming cells, **characterised in that** at least one of the half-dies comprises:

   a bearing plate (2) having at least two seatings (3, 4) located at the at least two forming cells, internally of which seatings (3, 4) at least two die-bearing shoes (6, 7) are partially and sealedly inserted, slidably in a parallel direction to a relative movement direction of the two half-dies; each of the two die-bearing shoes (6, 7) delimiting with a respective seating (3, 4) a closed chamber (10, 11), each closed chamber (10, 11) being in communication with the other closed chamber (10, 11) and being filled with a non-compressible fluid.

2. The die of claim 1, **characterised in that** the die-bearing shoes (6, 7) are slidable internally of the seatings (3, 4) between a rest position, in which the die-bearing shoes (6, 7) are in contact with a bottom of the seatings (3, 4) and an active position in which the die-bearing shoes (6, 7) are distanced from the bottom of the seatings (3, 4).

3. The die of claim 2, **characterised in that** it comprises elastic means (8) for maintaining the die-bearing shoes (6, 7) in the rest position.

4. The die of claim 3, **characterised in that** the two chambers (10, 11) are placed in reciprocal fluid communication by a channel (5) which develops internally of the bearing plate (2).

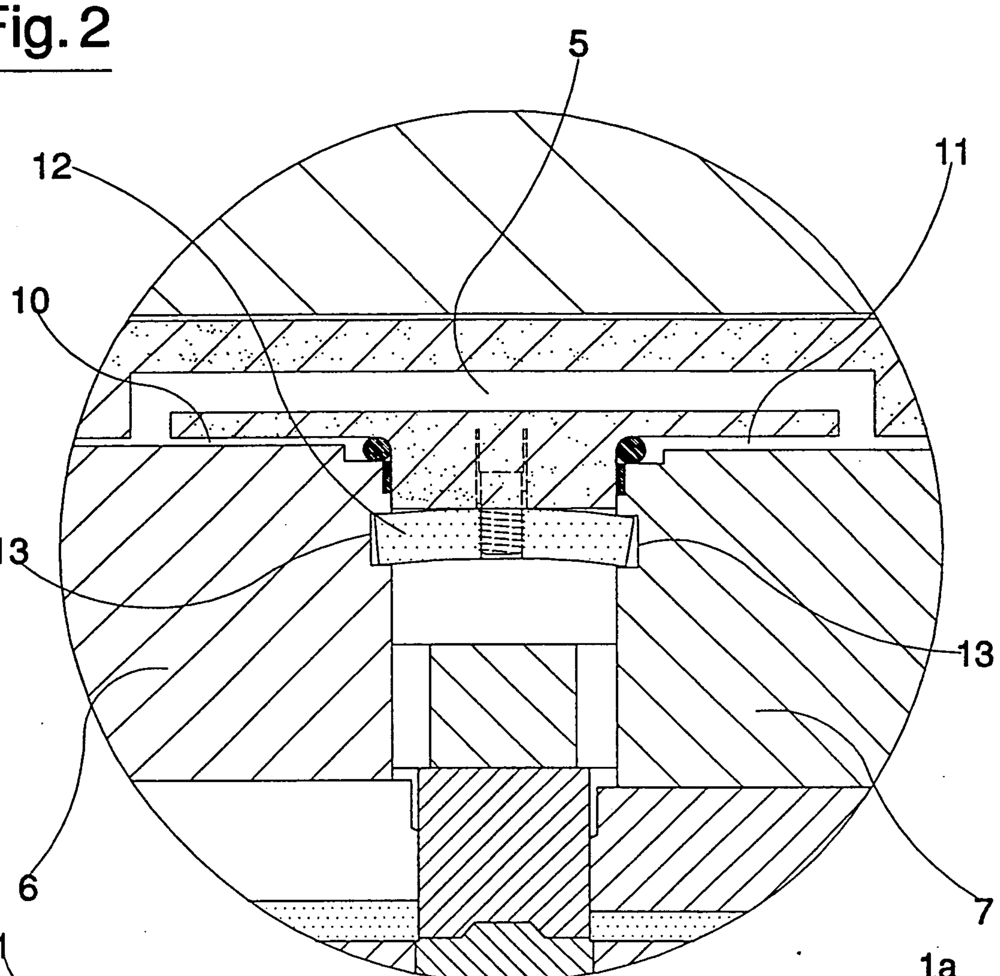
5. The die of claim 3, **characterised in that** the two chambers (10, 11) are in reciprocal fluid communication via an external connection conduit.

6. The die of claim 3, **characterised in that** the elastic means (8) comprise a plurality of flexion springs (12) connected to the bearing plate (2), each having an end inserted in a groove (13) afforded externally on the die-bearing shoes (6, 7).

7. The die of claim 3, **characterised in that** the elastic means (8) comprise an elastomer spring (22) which is interpositioned between a mushroom element (23), fixed to the bearing plate (2), and a plate (24), fixed to the die-bearing shoes (6, 7); the mushroom element (23) being provided with a stalk which is freely housed, with play, internally of a through-hole afforded in the plate (24).

8. The die of claim 7, **characterised in that** the plate (24) is fixed externally on an upper surface of the die-bearing shoe (6, 7) and is housed freely internally of a first cavity (25) afforded in the bearing plate (2); a second cavity (26) being afforded in the die-bearing plate (6, 7), in which a set constitued by the elastomer spring (22) mounted on the mushroom element (23) is freely housed.

Fig. 2



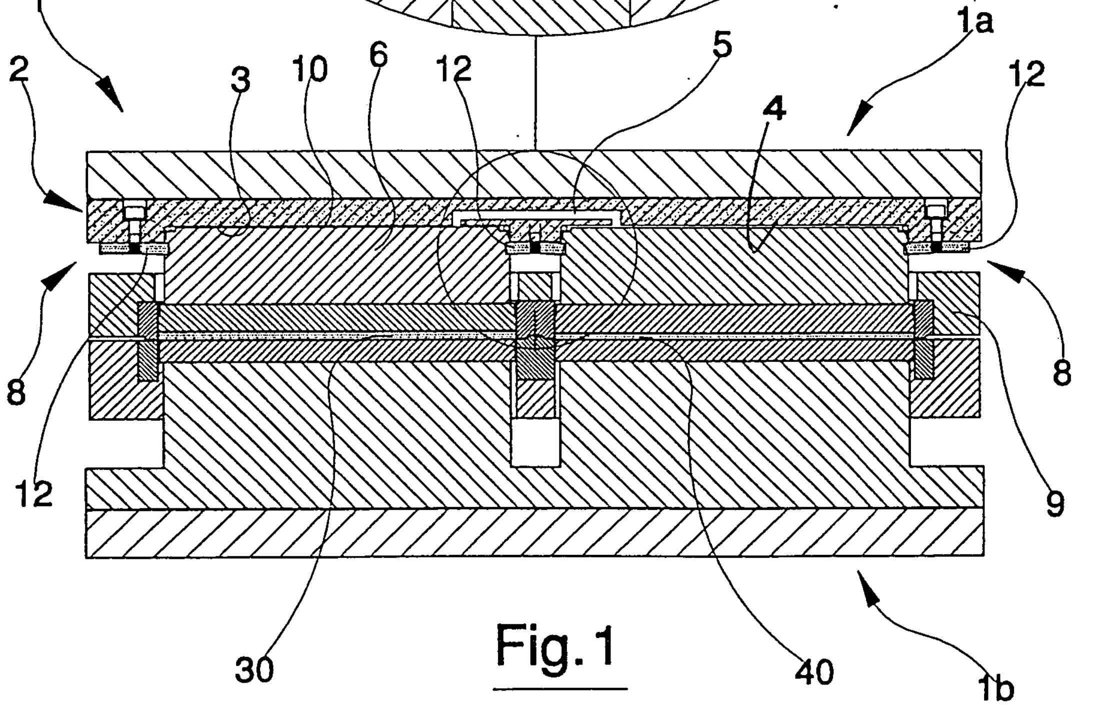


Fig. 1

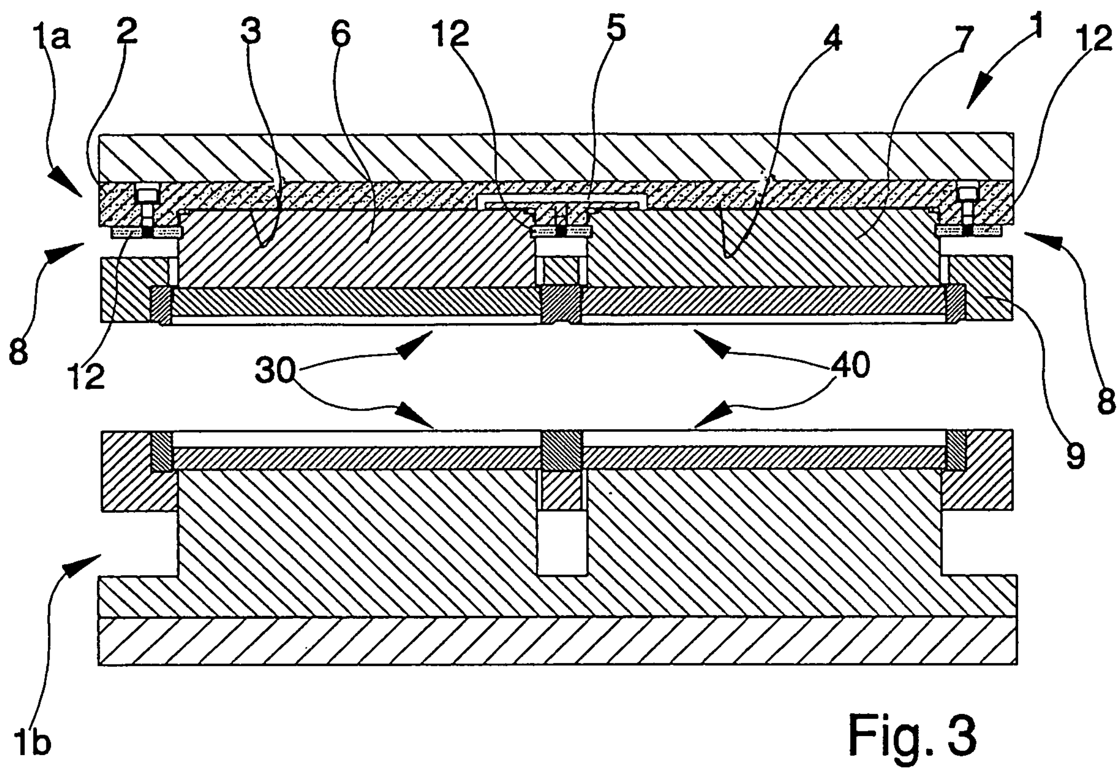


Fig. 3

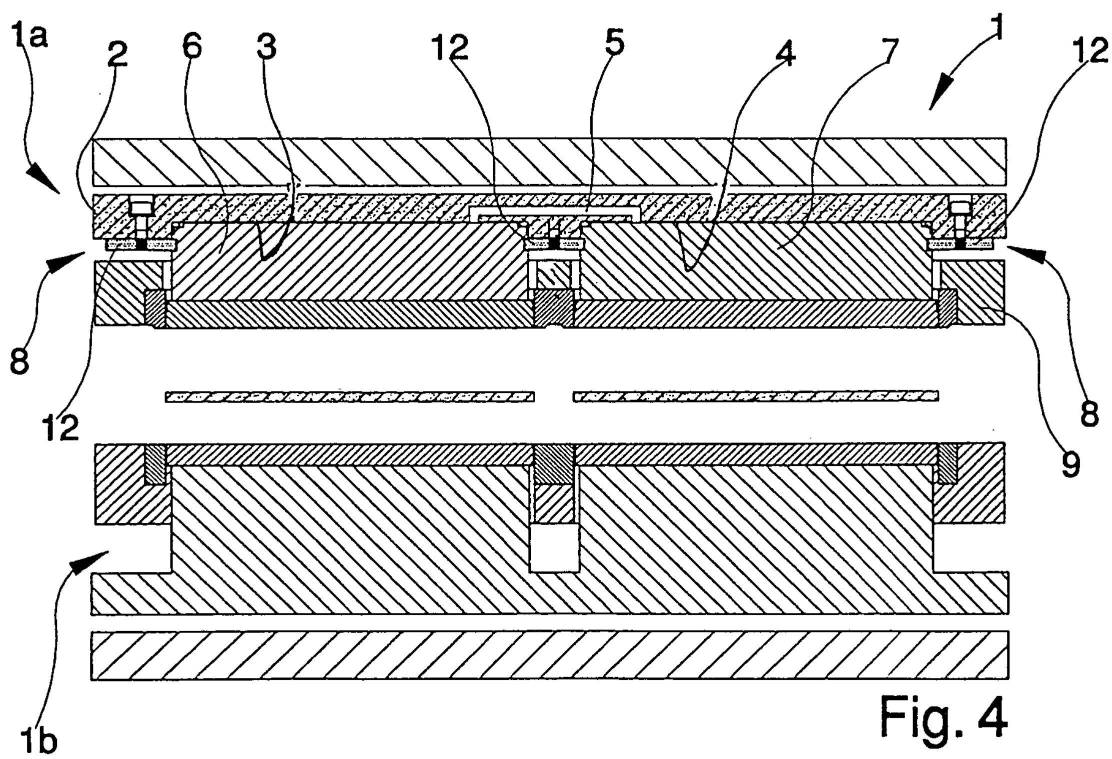


Fig. 4

Fig. 5