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(54) Mould for pressing ceramic tiles, in particular large-dimension slabs

(57) A ceramic tile pressing mould (2) comprising a lower die (3), an upper die (7), and a laterally containing die plate (4) which together with said lower die (3) defines the mould cavity (6) in which the powders to be compacted are deposited, at least one portion of the working surface of one of the dies being provided with a layer of porous material (8) able to receive the air present in said powders.

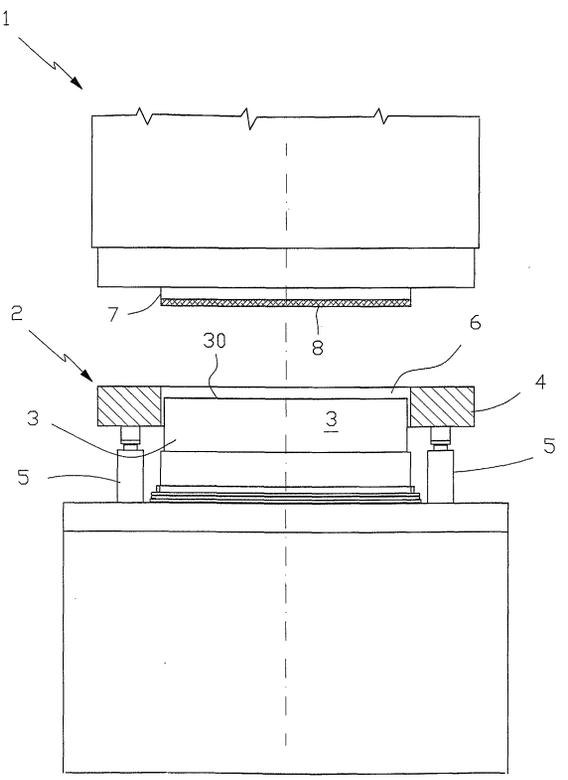

FIG.1

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Description

[0001] This invention relates to a pressing mould of the type used in ceramics in the pressing of ceramic tiles.

[0002] Moulds of known type comprise a lower die, rigid with the movable lower crosspiece of the press and partly inserted into a containing die plate, which can be of fixed or movable type according to the type of mould. The inner lateral walls of said die plate and the surface of the lower die define the forming cavity in which the powders to be pressed are deposited. The powders are pressed by an upper die fixed to the movable upper crosspiece of the press. Once the powders have been loaded into the mould cavity, the pressing cycle consists of pressing the powders with the press upper die until a pressure between 30 and 60 bar has been attained.

[0003] When this pressure is reached, the pressing action has to be interrupted to enable the air to escape from the powder mass. The pressing action is then recontinued until the final compacting pressure of the order of 300-500 bar is attained.

[0004] The interruption in pressing to enable the air contained in the pressed mass to escape from the mould cavity limits the productivity of such forming plants, in particular of plants for producing large-format tiles or slabs, in that the air quantity which has to escape from the mould can be of the order of tens of litres. For example, to form a slab of dimensions 140 x 200 cm and a thickness of 20 mm, about 56 litres of air have to be evacuated from the powder mass; the evacuation of such an air quantity, using moulds of known type, makes the pressing stage very lengthy to the point of rendering the plant productivity inadequate.

[0005] Some mould manufacturers have sought to solve the problem by creating moulds provided on at least one of the active surfaces of the lower die with a plurality of discharge channels which enable the air contained in the powder mass to escape during pressing. Although these moulds partly solve the problem they present the drawback that the deaeration of the powder mass does not take place with uniform distribution over the entire tile surface because of the limited number of channels. This results in a low rate of air evacuation from the powder mass in particular during the final pressing stage.

[0006] An object of the present invention is to overcome the drawbacks of the known art by a simple, rational and low cost solution.

[0007] A second object of the invention is to completely and rapidly deaerate the powder mass within the mould cavities in such a manner as to improve powder compaction, so providing a better quality final product.

[0008] A further object of the invention is to accelerate the powder pressing stage to increase the hourly productivity of plants of known type.

[0009] The invention attains these and other objects by virtue of the characteristics stated in the claims.

[0010] Specifically, the invention attains said objects by virtue of a mould in which at least one of the two dies is provided, at least on its working surface, with a layer of porous material able to absorb, during pressing, practically all the air contained within the powders to be pressed. This air is then released on termination of pressing during die withdrawal.

[0011] Said layer of porous material can be formed from porous resins, sintered metals or sintered plastic, or from any other material presenting mechanical characteristics suitable for the purpose. According to the invention said layer is preferably formed from microporous resins and presents a plurality of mutually communicating pores having a mean diameter variable between 1 and 40 μm, and an open total porosity (in volume) of the order of 10-50%. The thickness of the layer is a function of the dimensions of the mould cavity, i.e. of the quantity of air present in the powders to be pressed.

[0012] In a first variant of the invention, said layer is connected to the external environment by suitable air discharge channels.

[0013] In a further variant of the invention, said layer is connected to air suction means to facilitate air evacuation from the mould cavity.

[0014] Said layer can also be connected to pressurized fluid feed means which on termination of each pressing cycle, or after a predetermined number of cycles, feed a pressurized fluid, for example compressed air, through the pores of said layer to remove any powder particles clogging the pores.

[0015] It should be noted that because of the microporosity of the invention, powder deaeration takes place with uniform distribution over the entire die surface, resulting in rapid deaeration of the powder mass.

[0016] Advantageously, the invention enables the powders to be pressed by a single pressing action without the need to interrupt pressing to enable air to escape from the mould cavity.

[0017] The use of the invention also enables the construction costs of the pressing plant to be reduced as it is no longer necessary to use devices for cleaning the die surface on termination of each pressing cycle, die cleaning being achieved by the actual air appropriated by the porous layer during powder deaeration.

[0018] All this has as a direct advantage an increase in plant productivity in that the powder pressing time is drastically reduced.

[0019] The use of the invention also results in a reduction, if not elimination, of the air stream which during pressing passes through the interstices between the dies and die plate, with the advantage of increasing the average die life. In this respect, it has been noted that the air which passes through said interstices during pressing entrains powders containing abrasive ceramic particles which lead to premature die wear.

[0020] The constructional and functional characteristics of the invention will be more apparent from the en-

suing description of a preferred embodiment thereof given by way of non-limiting example and illustrated in the accompanying drawings.

[0021] Figure 1 is as partly sectional view of the mould of the invention associated with a press.

[0022] Figure 2 is an enlarged view of a part of Figure 1.

[0023] Figure 3 is a partly sectional view of a variant of the mould of the invention associated with a press.

[0024] Figure 1 shows a press 1, on which a mould 2 of the movable die plate type is installed. The mould 2 comprises a movable lower die 3 rigid with the lower crosspiece of the press 1 and partly inserted into a laterally containing die plate 4. Said die plate 4 rests on the bed of the press 1 via elastic elements 5.

[0025] The upper surface 30 of the die 3 and the inner walls 40 of the die plate define the mould forming cavity 6 in which the powders to be compacted are deposited by known means, not shown.

[0026] In a position overlying the lower die 3, the press 1 supports the upper die 7, which is fixed to the movable upper crosspiece of the press 1. The outer dimensions of the upper die 7 are virtually identical to those of the lower die and such as to enable it to be inserted into the die plate 4 to enable the material contained in the forming cavity 6 to be pressed.

[0027] With particular reference to Figure 2, it can be seen that the upper surface 30 of the die 3 is provided with a layer 8 of air-permeable porous material.

[0028] According to the invention, the layer 8 can be formed from sintered metals, sintered plastic or porous resins.

[0029] In the specific illustrated embodiment the layer 8 consists of rigid porous resins having 10-50% of open total porosity (by volume) and a thickness of 5-30 mm. The mean pore diameter of the porous resin varies between 1 and 50 μm on the basis of the material with which the layer is constructed and the size of the atomized powder particles used in the forming process.

[0030] The composition of a porous resin suitable for the purpose is fully described in patent applications EP 165952 and EP 516224 of the same applicant and comprises the following components:

- acrylic monomers
- styrene monomers
- unsaturated polyester resins
- acrylic resins

[0031] The thickness of said layer 8 varies as a function of the open total porosity, and of the dimensions of the slab to be formed.

[0032] The mean pore diameter influences the tile surface quality, i.e. its roughness, in that a decrease in mean pore diameter of the layer 8 results in lesser tile surface roughness.

[0033] The purpose of the layer 8 is to absorb all or a large part of the air contained in the powders during slab pressing. The air is then expelled on termination of pressing as soon as the upper die no longer exerts pressure on the powders. It should be noted that advantageously the expulsion of air on termination of pressing contributes to maintaining the pores of the layer 8 free and clean. To prevent the air escaping from the interior of the layer 8 during deaeration, the perimetral edge of the layer can be provided with a perimetral frame not shown, of non-porous material. For example said perimetral frame can be made from a suitable impermeable varnish, or by metal edging applied to the perimetral edge of the layer 8. In this latter case said metal edging can be rigid with the die to which the layer 8 is fixed.

[0034] In certain embodiments of the invention, said layer 8 is connected to suitable means for feeding a pressurized fluid, for example compressed air, these means feeding air through the pores of said layer on termination of the pressing cycle, to expel any powder particles which may be trapped within the pores.

[0035] Figure 3 shows a variant of the invention. The description of this variant uses the same reference numerals to indicate components identical to those previously described.

[0036] Said figure shows the press 1 on which a mould 20 of movable die plate type is installed. The mould 20 comprises a lower die 21 partly inserted into a movable die plate 4. The inner lateral walls of the die plate 4 and the surface of the lower die 21 define the mould cavity 6, in which the powder mass to be pressed is deposited. The upper crosspiece of the press 1 supports the upper die 7 above the lower die 21.

[0037] As can be seen from Figure 3, both press dies are faced with a layer 8 of porous material, in particular resin, the purpose of which as previously described is to absorb, during the pressing action, the mass of air contained within the powders to be pressed.

[0038] The air-permeable layer 8 is connected to a plurality of air discharge channels 23 which are provided within the two dies 3 and 7 and have one end opening into the die surfaces, their other end being connected to a suitable air feed device 24' and a suitable air suction device 24", valve elements 240 being interposed between said devices and said layers.

[0039] During the pressing action said device 24" creates a vacuum within the layers 8 in order to accelerate air evacuation from the powder mass to be pressed. In contrast, on termination of the pressing cycle the device 24' feeds compressed air through the layers 8 to eliminate any powder particles which have remained trapped within the layer pores.

[0040] It should be noted that according to the embodiments of the invention said air-permeable porous material layer 8 can constitute a facing of the entire die surface or of only a portion thereof.

[0041] Finally, although the invention has been described in combination with a mould of movable die plate type, it can be applied to at least one of the dies of any type of mould provided that it is suitable for the purpose.

Claims

1. A ceramic tile pressing mould comprising a lower die, an upper die, and a laterally containing die plate which together with said lower die defines the mould cavity in which the powders to be compacted are deposited, **characterised in that** at least one portion of the working surface of one of the dies comprises a layer of porous material able to receive the air present in said powders.

2. A mould as claimed in claim 1, **characterised in that** said porous material layer is rigid.

3. A mould as claimed in claim 1, **characterised in that** said porous layer is connected to atmosphere via at least one discharge channel.

4. A mould as claimed in claim 1, **characterised in that** said surface layer is connected to suction means.

5. A mould as claimed in claim 1, **characterised in that** said surface layer is connected to air feed means.

6. A mould as claimed in claim 5, **characterised in that** said means comprise at least one compressed air feed device, at least one suction device and suitable valve elements.

7. A mould as claimed in claim 5, **characterised in that** said means comprise at least one air suction device and suitable valve elements.

8. A mould as claimed in claim 1, **characterised in that** said porous material layer is a microporous resin.

9. A mould as claimed in claim 1, **characterised in that** said microporous resin layer preferably comprises at least the following components: acrylic monomers, acrylic resins.

10. A mould as claimed in claim 1, **characterised in that** the open total porosity of said resin is between 10% and 50% by volume.

11. A mould as claimed in claim 1, **characterised in that** the mean pore diameter of said resin layer varies between 1 and 50 μm.

12. A mould as claimed in claim 1, **characterised in that** said porous material layer consists of sintered metals.

13. A mould as claimed in claim 1, **characterised in that** said porous material layer consists of sintered synthetic resin.

14. A mould as claimed in claim 1, **characterised in that** said layer is provided with a perimetral frame of non-porous material.

15. A mould as claimed in claim 14, **characterised in that** said perimetral frame is formed from impermeabilizing varnish.

16. A mould as claimed in claim 14, **characterised in that** said frame is of steel.

17. A mould as claimed in claim 14, **characterised in that** said perimetral frame is rigid with the edge of the die with which said layer is associated.

18. A die for a ceramic powder pressing mould, **characterised by** presenting at least one of the characteristics stated in claims from 1 to 17.

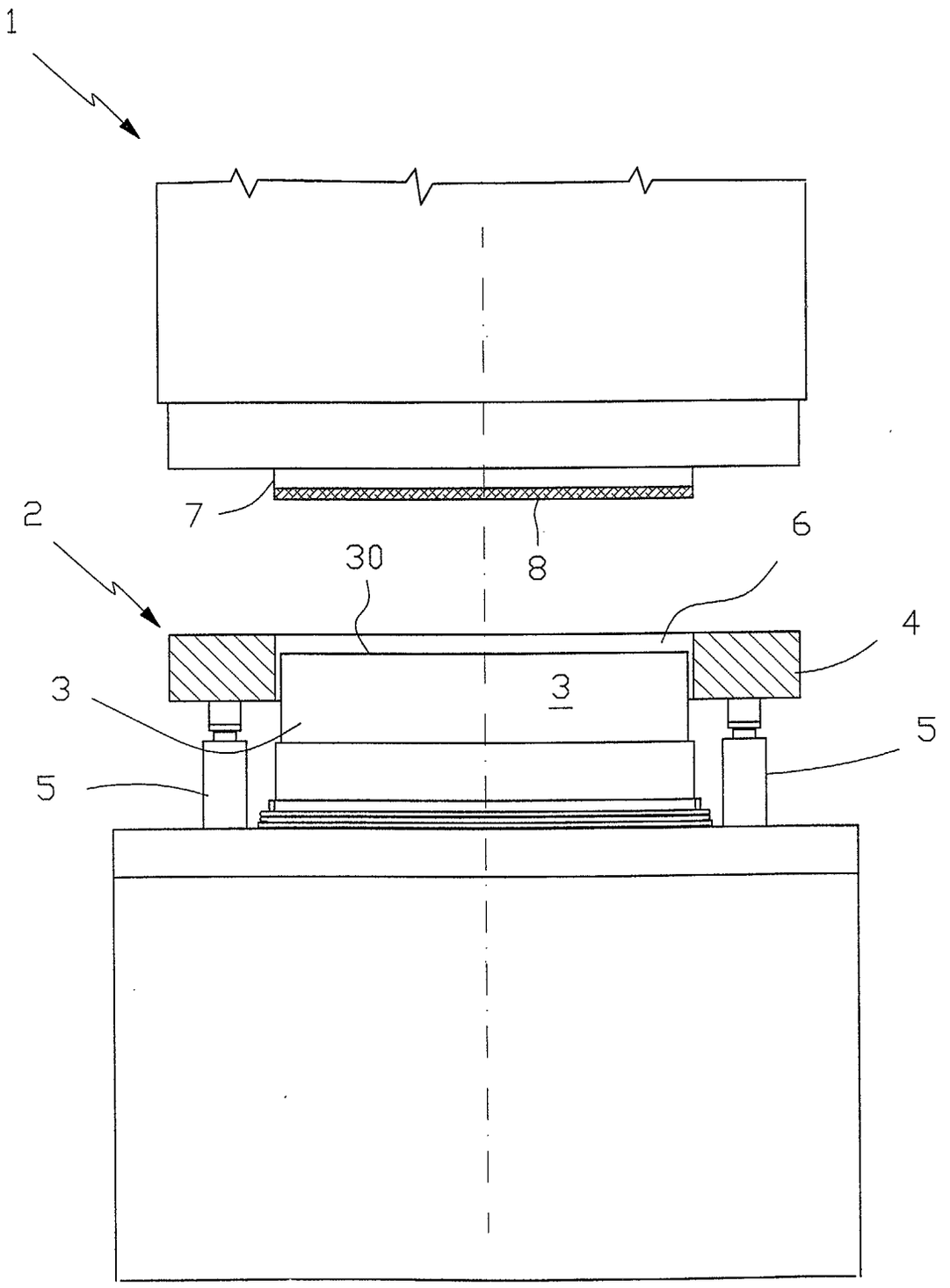

FIG.1

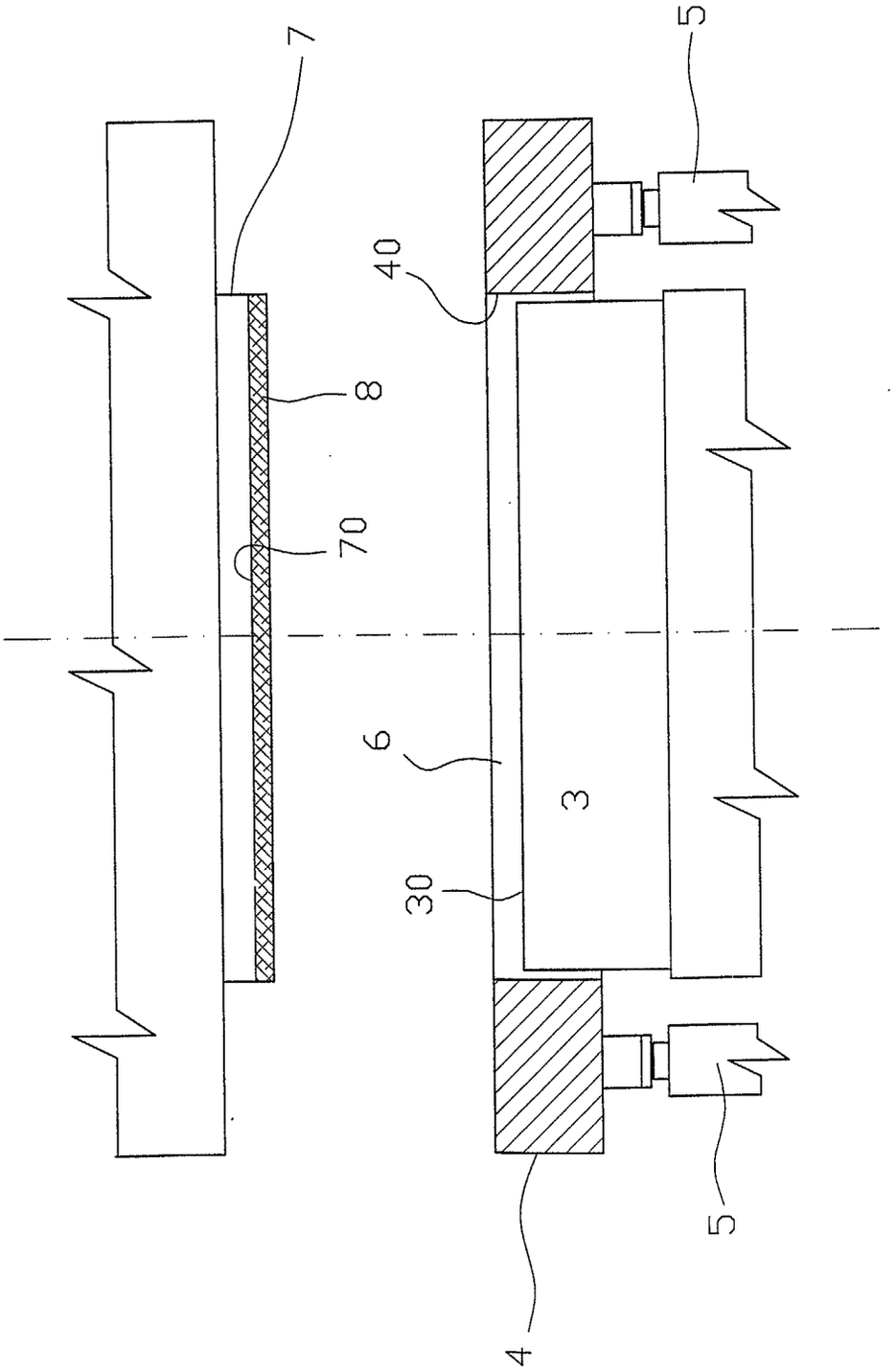

FIG.2

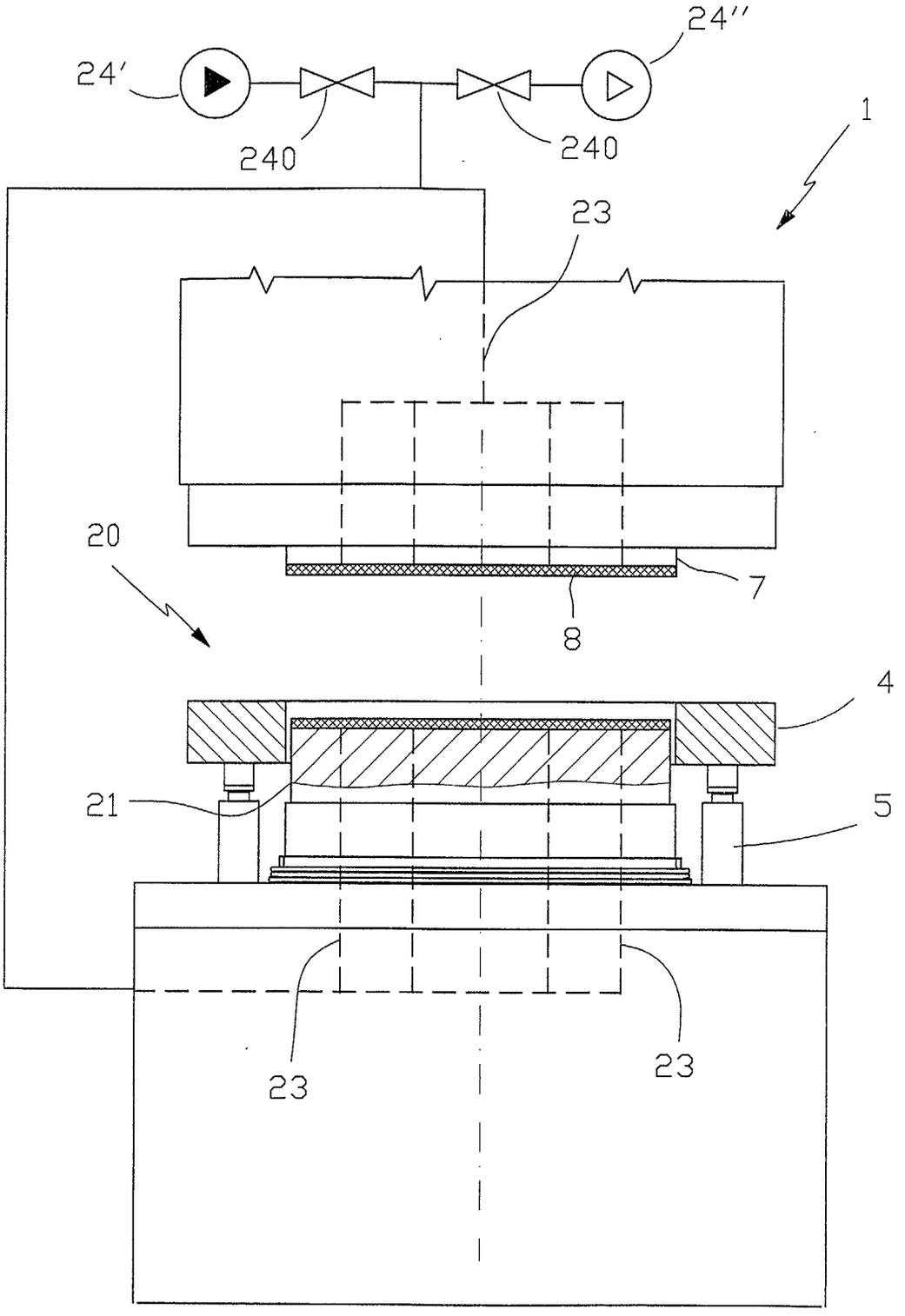

FIG.3