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(54) Mold with modular compartments for producing ceramic articles

(57) An improved mold (1) with modular compartments for producing ceramic articles, comprising at least one lower mold part (2) with a single impression (3) and a corresponding upper mold part (4) with multi-

ple punches (5); the multiple punches are each accommodated within a through cell (6), having a closed perimeter, of a grid associated with the upper mold part (4); the multiple punches (5) can be moved with respect to the grid or vice versa.

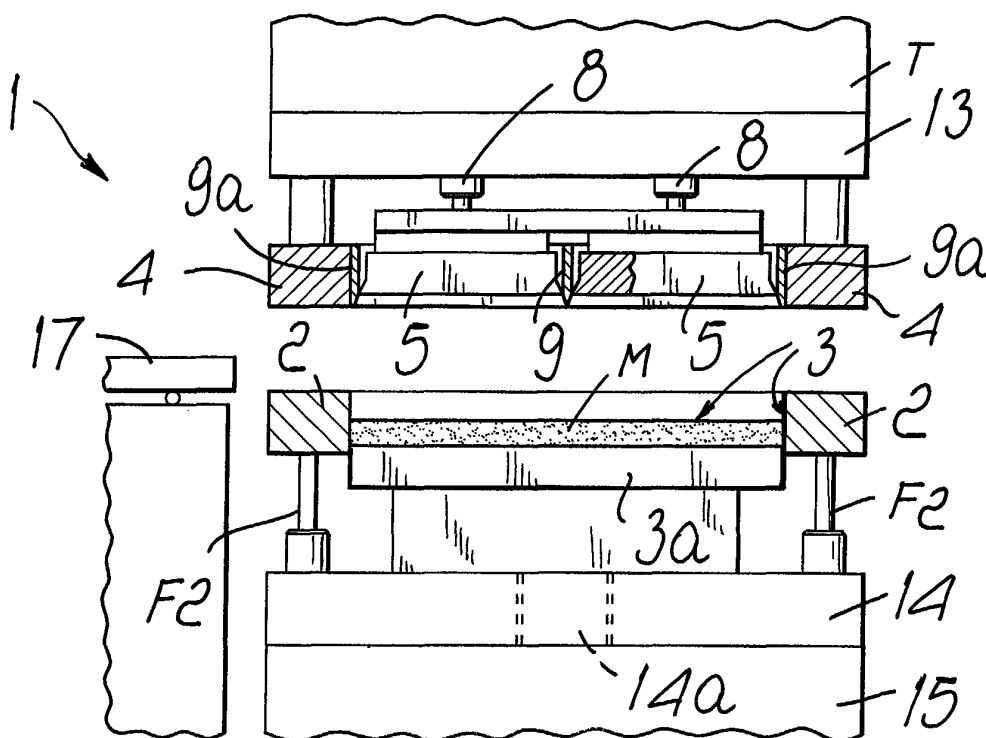


Fig. 1

Description

[0001] The present invention relates to an improved mold with modular compartments for producing ceramic articles.

[0002] In the ceramics industry, articles, i.e. tiles, are mainly produced by pressing.

[0003] In this field there are specific requirements regarding the dimensions of the articles to be produced and accordingly the presses must be equipped with punches and mold parts that correspond to the dimensions required in each instance.

[0004] However, since every mold feeder and the mold proper with its associated punches and mold parts are manufactured to produce a given type of article, when production has to be changed, for example in order to increase or reduce the dimensions of the articles, the entire molding assembly accommodated inside the press and the carriage for feeding it must be replaced or modified.

[0005] This replacement requires stopping the press and an adequate intervention time, which is normally long, in order to complete the replacement or modification operations.

[0006] In order to try to solve the above problem of rapid size changing, monolithic punches have been produced which have impressions divided by sectors formed by ridges that are adapted to cut, during pressing, into the surface of the material to be pressed and thus create the perimeters of the articles to be produced.

[0007] However, these experiments in turn revealed an unsolvable problem, i.e., successful expulsion of the air that is present in the material to be pressed.

[0008] The presence of air in fact causes regions where such air accumulates inside the material to be pressed and therefore causes a non-uniform compaction of the body of the produced unfired article, leading to the partial or total breakage of the unfired product due to violent expulsion of the air when the pressing action ceases.

[0009] The aim of the present invention is to eliminate the above noted drawbacks of the known art, by providing an improved mold with modular compartments for producing ceramic articles that allows to produce articles of different sizes from batch to batch or even simultaneously without necessarily replacing or modifying the feeder carriage and the lower part of the mold, and also allows to expel the air from the pressed clays rapidly and substantially completely, thus avoiding rejects of articles from production.

[0010] This aim and objects that will become better apparent hereinafter are achieved by the present improved mold with modular compartments for producing ceramic articles, comprising at least one lower mold part with a single impression and a corresponding upper mold part with multiple punches, characterized in that said multiple punches are each accommodated within a through cell, having a closed perimeter, of a grid asso-

ciated with the upper mold part, means for the mutual movement of said multiple punches with respect to said grid and vice versa being further provided.

[0011] Further characteristics and advantages of the present invention will become better apparent from the detailed description of a preferred but not exclusive embodiment of an improved mold with modular compartments for producing ceramic articles, illustrated only by way of non-limitative example in the accompanying drawings, wherein:

Figures 1 to 8 are schematic front views of the complete operating sequence of the improved mold with modular compartments according to the invention; Figure 9 is a plan view of a lower mold part with a single impression, which is part of the improved mold according to the invention;

Figure 10 is a bottom view of an upper mold part provided with a grid of rectangular cells according to the invention;

Figure 11 is an enlarged-scale view of the step for expelling the air from the material after a first pressing at medium-low pressure;

Figure 11a illustrates a detail of Figure 11;

Figures 12 to 19 are, like Figures 1 to 8, front views of the complete operating sequence of the improved mold with modular compartments, according to the invention, in a possible second embodiment thereof.

[0012] With reference to the figures, the reference numeral 1 generally designates an improved mold with modular compartments for producing ceramic articles.

[0013] The mold 1 comprises a lower mold part 2 with a single impression 3 and an upper mold part 4 with multiple punches 5, each accommodated within a through cell 6, having a closed perimeter, of a grid 7 that is supported by the upper mold part 4.

[0014] The sum of the surfaces of the impressions of the multiple punches 5 and of the grid 7 substantially corresponds to the overall surface of said single impression 3 of the lower mold part 2.

[0015] The punches 5 can move with respect to the grid 7 or vice versa: in the case of movable punches 5, the movement with respect to the grid 7 occurs synchronously and the multiple punches 5 are actuated by conventional actuators, constituted in practice by hydraulic or pneumatic cylinders 8.

[0016] In a second embodiment of the invention, shown schematically in Figures 12 to 19, the grid 7 is movable with respect to the multiple punches 5, which in this case are rigidly associated with an upper contrast element 13 that supports the corresponding mold part 4.

[0017] The grid 7 is in any case generally constituted by a plurality of laminas 9 arranged edgewise, which intersect one another in directions that are preferably but not exclusively perpendicular, and by strips 9a, which define, together with said laminas 9, the perime-

ters of the articles.

[0018] In each lamina 9, the lower edge that faces the impression 3 of the lower mold part is tapered, with bilateral faces 10 and 11 that converge so as to constitute a sort of cutting edge. Correspondingly, in each punch 5 the lower region 12 has a cross-section that flares outwardly and is preferably shaped like an isosceles trapezoid.

[0019] The upper mold part 4 is supported, as mentioned, by an upper contrast element 13 of the mold 1, which is in turn rigidly coupled to the upper beam T of the press; likewise, the lower mold part 2 is supported by a lower footing 14 with interposed hydraulic or pneumatic actuators F2 for its vertical movement; the bottom of the single impression 3 is in turn constituted by a punch 3a, which is supported so that it can move vertically by the base frame 15 of the press and is actuated by a hydraulic or pneumatic actuator 14a.

[0020] Gaps 16 are formed between the convergent bilateral faces 10 and 11 of the laminas 9 and the lower regions 12 of the punches 5 in the configuration in which the laminas 9 do not intervene; such gaps are designed for the passage of air expelled from the material M contained in the lower mold part 2 with a single impression 3.

[0021] The operation of the improved mold 1 with modular compartments is described hereinafter with reference, by way of example, to the embodiment shown in Figures 1 to 8, and is as follows: a dose of material to be pressed, designated by "M", is deposited in a known manner, by using a feeder 17, inside the single impression 3 of the lower mold part 2; the bottom of the single impression 3, constituted by the upper part of the punch 3a, is lower (Figure 1) than the upper rim of the lower mold part 2, creating the hollow of said impression 3 and its height.

[0022] During the subsequent steps, the upper beam T descends and moves into mutual contact the upper mold part 4 and the lower mold part 2.

[0023] During this descent (Figure 2), the lower edges of the grid 7 are at the same level as the lower face of the upper mold part 4, while the modular punches 5 are kept slightly raised with respect to such level, so that in practice the laminas 9 protrude downwardly with respect thereto.

[0024] In a directly subsequent step (Figure 3), the upper beam T imparts, by descending, a first pressing action to the lower mold part 2 and a consequent first pressing to the material "M" by means of the punches 5, but with a medium-low thrust: accordingly, the material "M" is subjected to a first compaction and to a corresponding incision of its thickness by the laminas 9, which as mentioned protrude downward with respect to the lower faces of the modular punches 5.

[0025] These incisions in practice form the partition between the perimeters of the articles being formed.

[0026] The beam T rises for a short extent (Figure 4), moving upwardly with it the upper mold part 4 with the

grid 7 rigidly coupled thereto, while the punches 5 descend, pushed by the actuators 8, and reach with their respective lower faces substantially the level of the lower face of said mold part 4.

[0027] This relative movement of the punches 5, of the upper mold part 4 and of the grid 7 opens the gaps 16 (Figure 11), through which the air expelled from the material "M" can be evacuated easily and spontaneously, or even aspirated, outward, optionally through the interspace formed between the upper mold part 4 and the lower mold part 2.

[0028] The opening of the gaps 16 is determined by the substantial horizontal alignment between the converging bilateral faces 10 and 11 of the laminas 9 and the lower portions 12, having an outward-flared cross-section, of the modular punches 5; said cross-section, in the preferred embodiment, is shaped like an isosceles trapezoid whose larger parallel side is directed downwardly.

[0029] The pressing step at medium-low pressure can, if required, be repeated even more than once, until air evacuation is substantially complete.

[0030] In the subsequent step (Figure 5), the beam T descends again and the actual pressing of the material "M" at high pressure, i.e., at a pressure suitable for the final compaction thereof, occurs; the laminas 9 reenter the gaps of the previously cut material "M" and divide it so as to form the unfired articles, in the specific case four mutually identical rectangular tiles.

[0031] The upper beam T then rises again (Figure 6), moving the upper part of the mold 1 in the same direction, and is followed by the same extent by the lower mold part 2, moved by the respective conventional cylinders F2, and by the lower punch 3a actuated by the actuator 14a.

[0032] Then (Figure 7) the punches 5 descend by the action of the actuators 8 and disengage the cells 6 of the grid 7 from the formed articles, which thus lie on the lower punch 3a, which is in turn aligned so that the upper face is flush with the lower mold part 2.

[0033] Finally, the upper mold part 4 and the lower mold part 2 are separated one another (Figure 8) to allow free access to extraction of the formed articles after pushing the feeder 17 simultaneously with a new active stroke for loading the material M into the impression 3 of the lower mold part 2.

[0034] If a change in production occurs, it is sufficient to replace only the upper mold section, i.e., the upper mold part 4 and the grid 7 associated therewith and the corresponding multiple punches 5 of the upper mold part 4 with others having new dimensions, without acting on the feeder 17 or on the lower mold part 2 and on the single impression 3 thereof, with a considerable saving both in terms of intervention time as well as of component costs.

[0035] In the further embodiment of the invention shown in Figures 12 to 19, operation remains substantially similar to the one described above, the only varia-

tion being that the vertical movements are performed by the grid 7 together with the upper mold part 4, while the punches 5 rigidly follow the movements of the upper contrast element 13 and therefore of the beam T to which it is rigidly coupled.

[0036] The movement of the grid 7 and of the upper mold part 4 occurs under the action of respective hydraulic or pneumatic cylinders F1 interposed between said grid and said upper contrast element.

[0037] In practice it has been found that the described invention achieves the intended aim and objects.

[0038] The invention thus conceived is susceptible of numerous modifications and variations, all of which are within the scope of the appended claims.

[0039] All the details may further be replaced with other technically equivalent ones.

[0040] 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.

[0041] The disclosures in Italian Patent Application No. M02001A000071 from which this application claims priority are incorporated herein by reference.

[0042] 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. An improved mold with modular compartments for producing ceramic articles, comprising at least one lower mold part with a single impression and a corresponding upper mold part with multiple punches, **characterized in that** said multiple punches are each accommodated within a through cell, having a closed perimeter, of a grid associated with the upper mold part, means for the mutual movement of said multiple punches with respect to said grid and vice versa being further provided.
2. The improved mold according to claim 1, **characterized in that** said multiple punches can move with respect to said grid under the actuation of hydraulic or pneumatic cylinders which are interposed between them and the mutual upper contrast element for supporting the corresponding upper mold part.
3. The improved mold according to claim 2, **characterized in that** said multiple punches can move synchronously with respect to said grid.
4. The improved mold according to claim 1, **characterized in that** said grid is movable with respect to

said multiple punches and is actuated by means of respective hydraulic or pneumatic cylinders which are interposed between said grid and the mutual upper contrast element for supporting the corresponding upper mold part.

5. The improved mold according to the preceding claims, **characterized in that** said grid is constituted by a plurality of laminas, which are arranged edgewise and intersect one another along preset directions, and by perimetric strips, which form, together with said laminas, the perimeters of the articles.
6. The improved mold according to claim 5, **characterized in that** said perimeters compose a pattern of quadrilaterals.
7. The improved mold according to claims 1, 6 and 7, **characterized in that** the sum of the surfaces of the impressions of said multiple punches and of said laminas of the grid corresponds to the total surface of said single impression of the lower mold part.
8. The improved mold according to the preceding claims, **characterized in that** in said laminas the lower edge that is directed toward said impression of the lower mold part tapers, with converging bilateral faces, so as to form a sort of cutting edge.
9. The improved mold according to the preceding claims, **characterized in that** said punches have a lower region whose cross-section is flared and diverges downward.
10. The improved mold according to the preceding claims, **characterized in that** said upper mold part is mounted so as to be rigidly coupled to a corresponding upper contrast element, which is in turn supported by the conventional beam of the press for moving the upper portion of the mold.
11. The improved mold according to the preceding claims, **characterized in that** said upper mold part is supported by a corresponding upper contrast element, which can move vertically with respect to it by means of the actuation of corresponding interposed hydraulic or pneumatic actuators.
12. The improved mold according to claims 5, 6, 8, 9, **characterized in that** gaps for the passage of air expelled from the material contained in said lower mold part with a single impression are formed, in the configuration in which said laminas are not active, between said converging bilateral faces of said laminas and said lower regions of the punches.

13. A method for manufacturing ceramic articles with an improved mold with modular compartments, **characterized in that** it comprises the steps of loading a calibrated volume of material to be pressed inside at least one single-impression lower mold part of a press; pressing said material with a plurality of upper punches, which are sub-modules of said single impression and are supported by a corresponding upper mold part so that each one lies within a cell of a grid of mutually intersecting laminas arranged edgewise, said grid also being supported by said upper mold part; cutting, during said pressing, into the material with said grid of laminas, forming the perimeters of the articles, said punches and said grid with the upper mold part being movable with respect to each other and vice versa.
14. The method according to claim 13, **characterized in that** said pressing occurs in at least two successive steps, a first step for pre-pressing at medium-low pressures, and a second step for pressing at high pressures, air being vented from said material between said steps.

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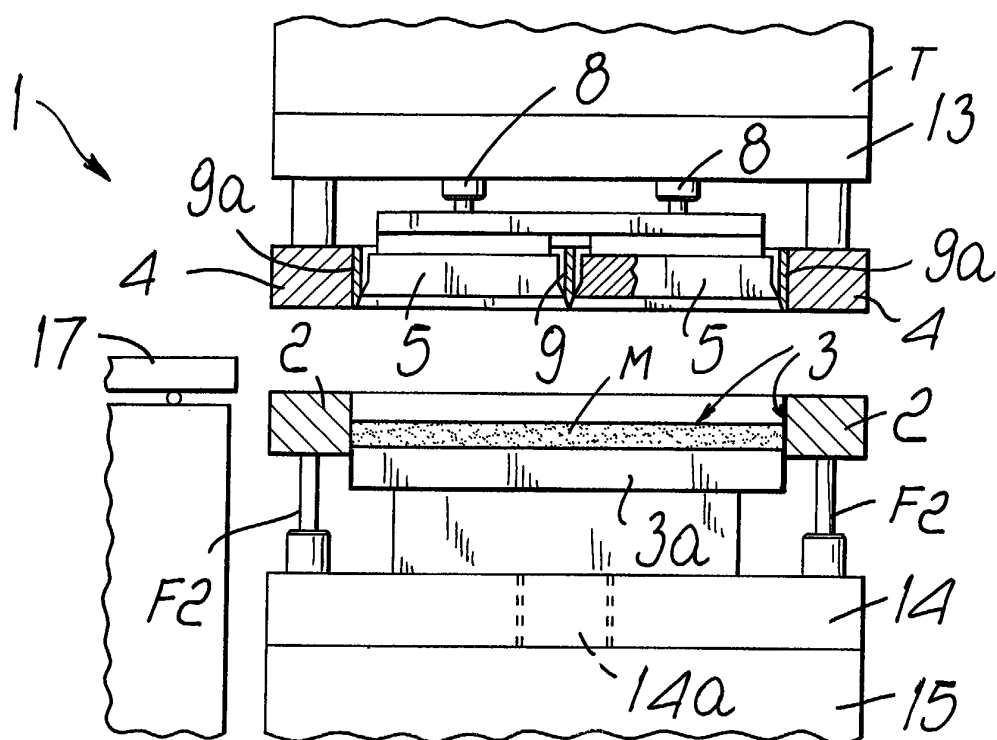


Fig. 1

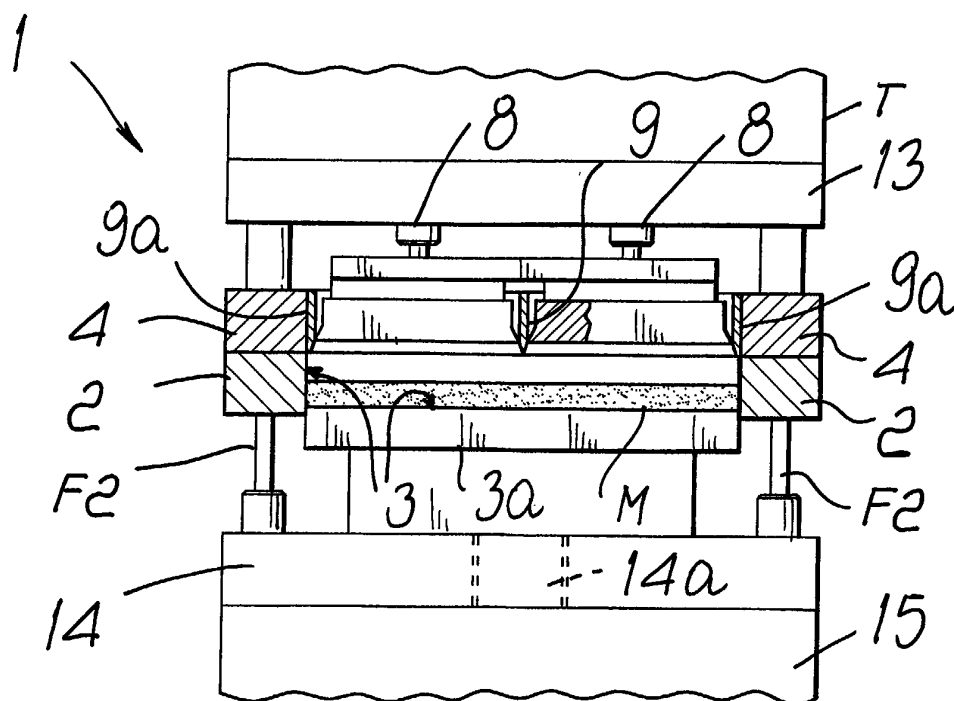
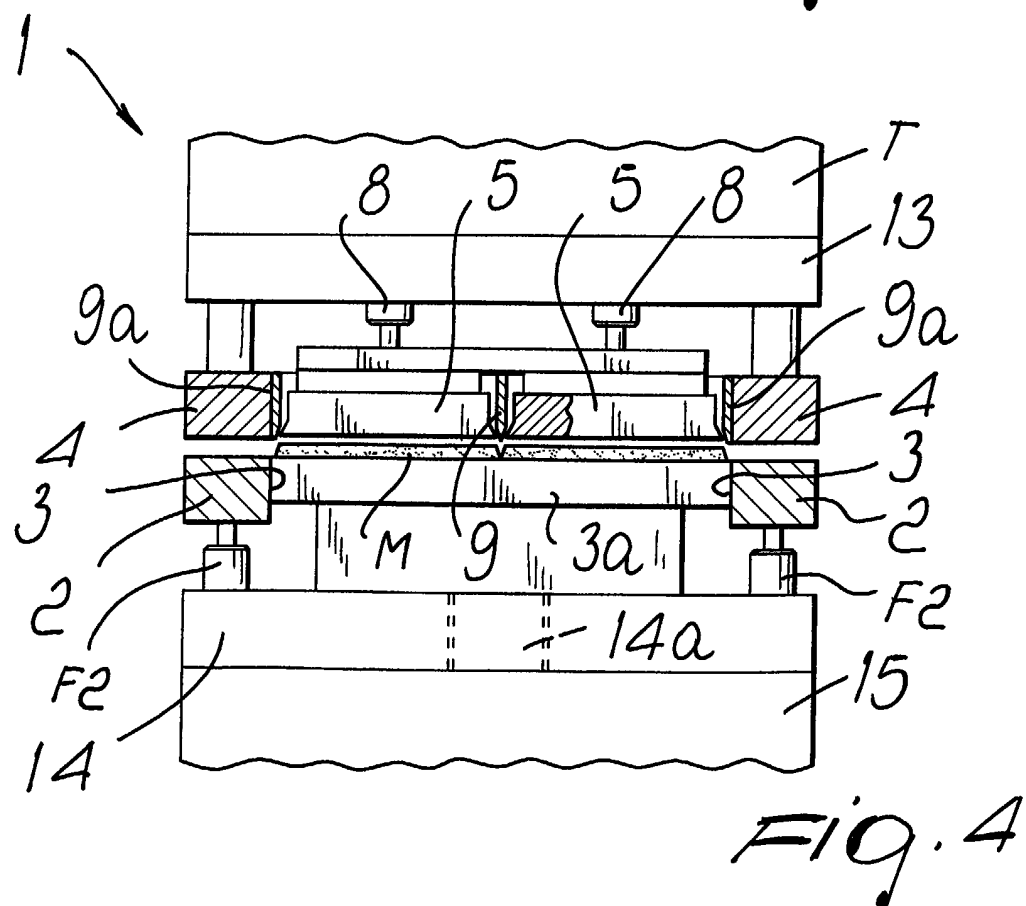
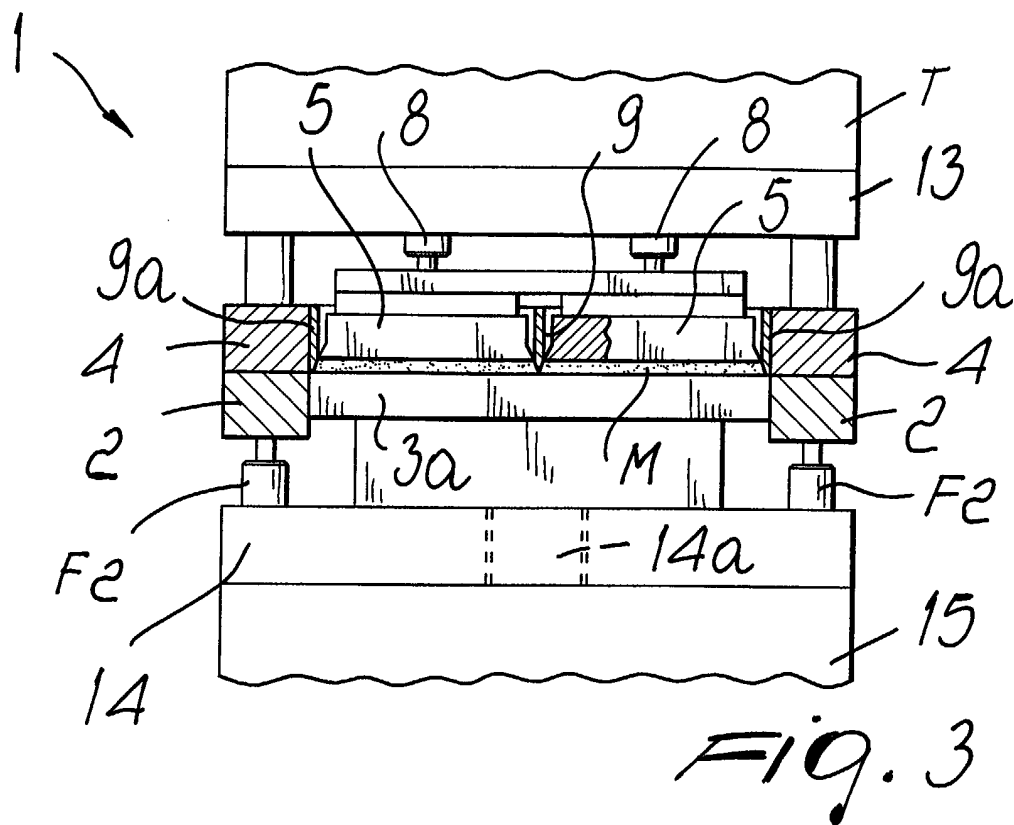
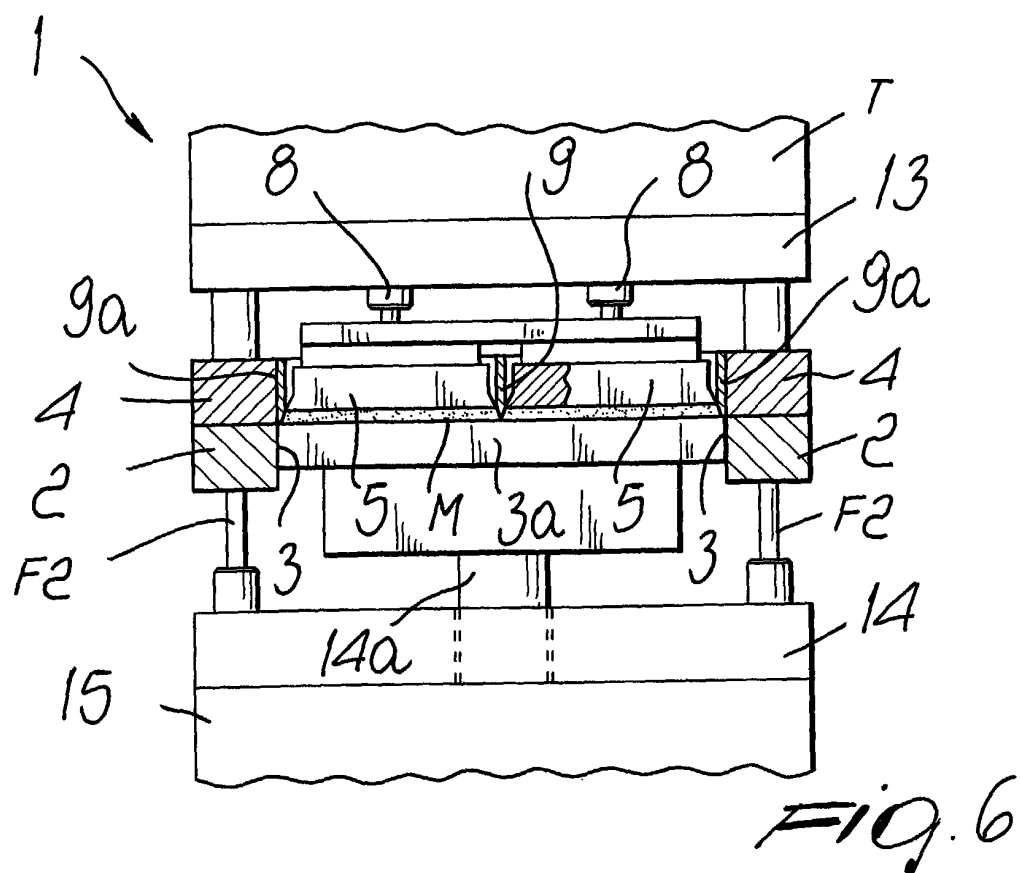
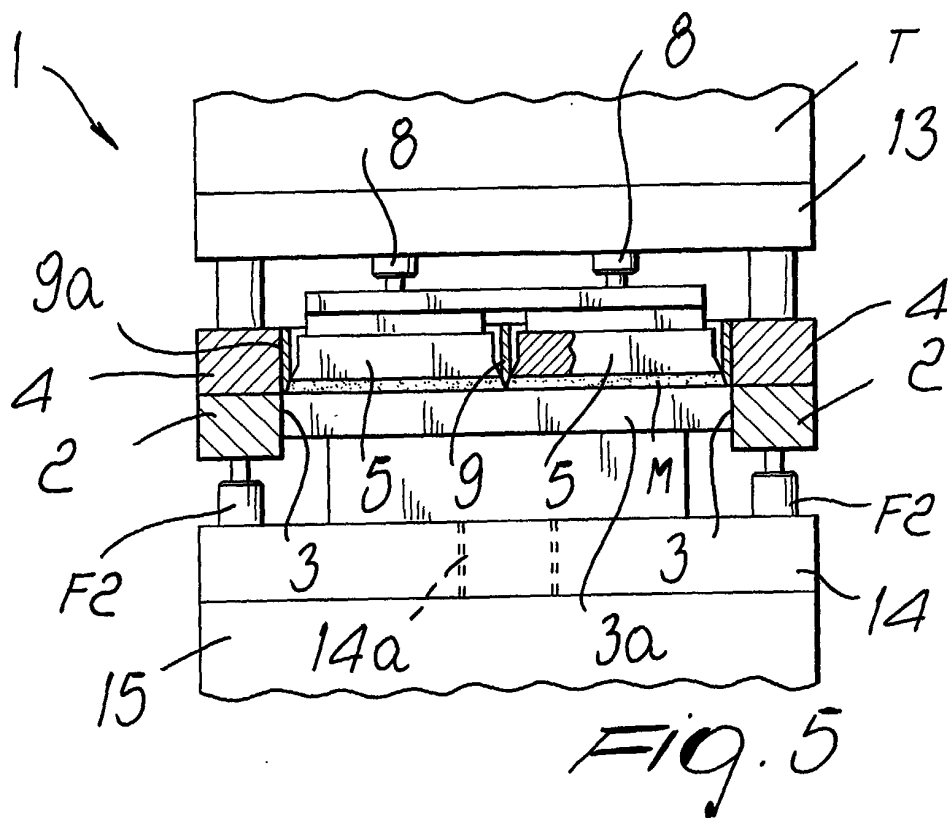


Fig. 2





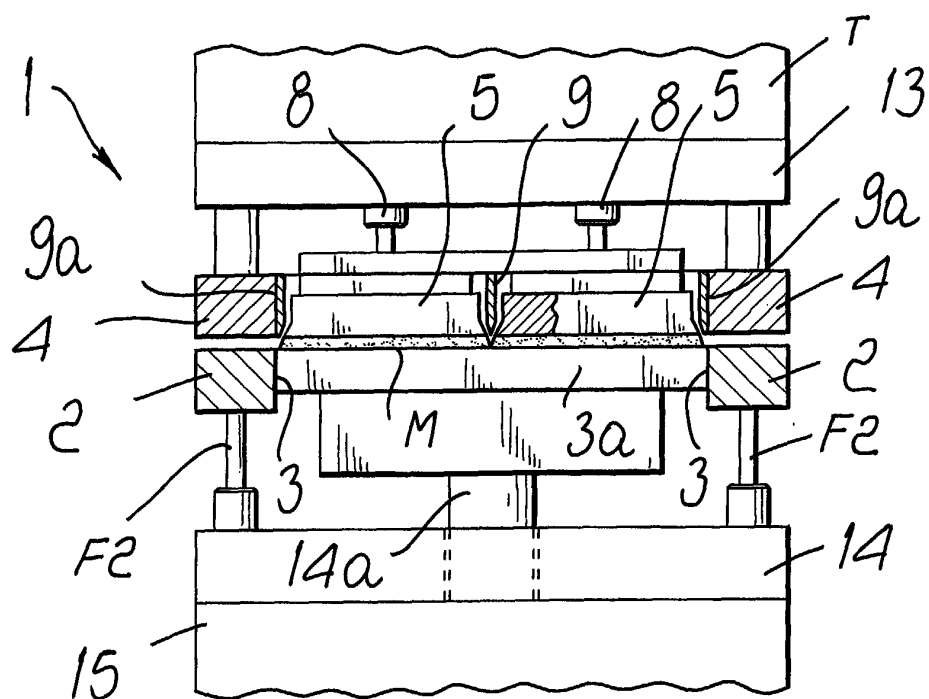


Fig. 7

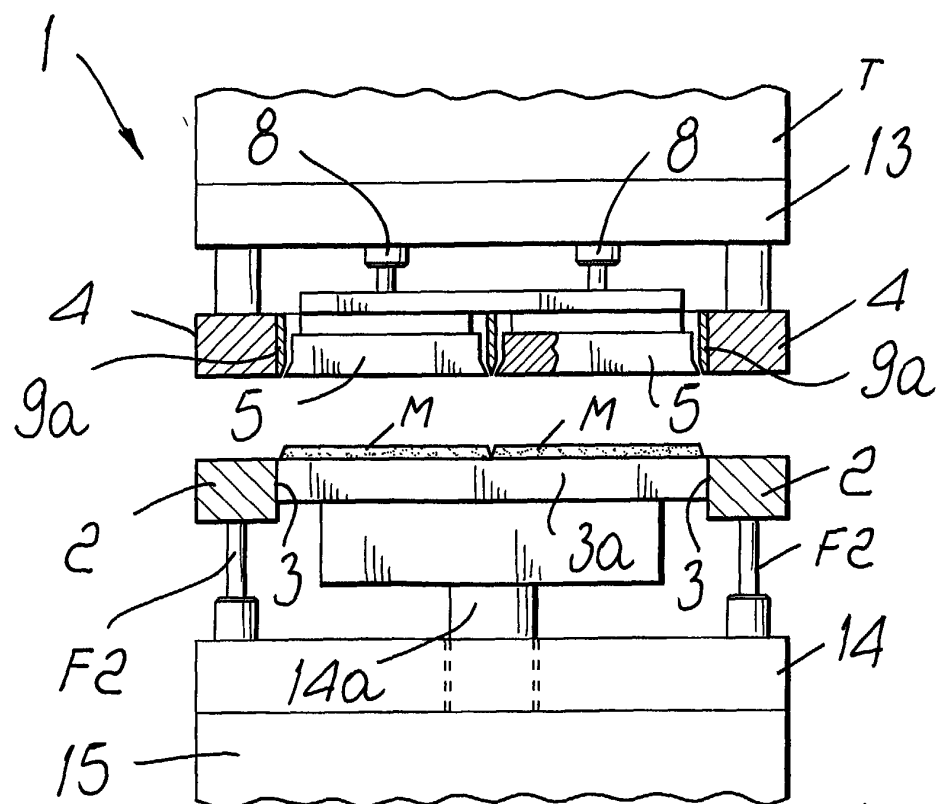


Fig. 8

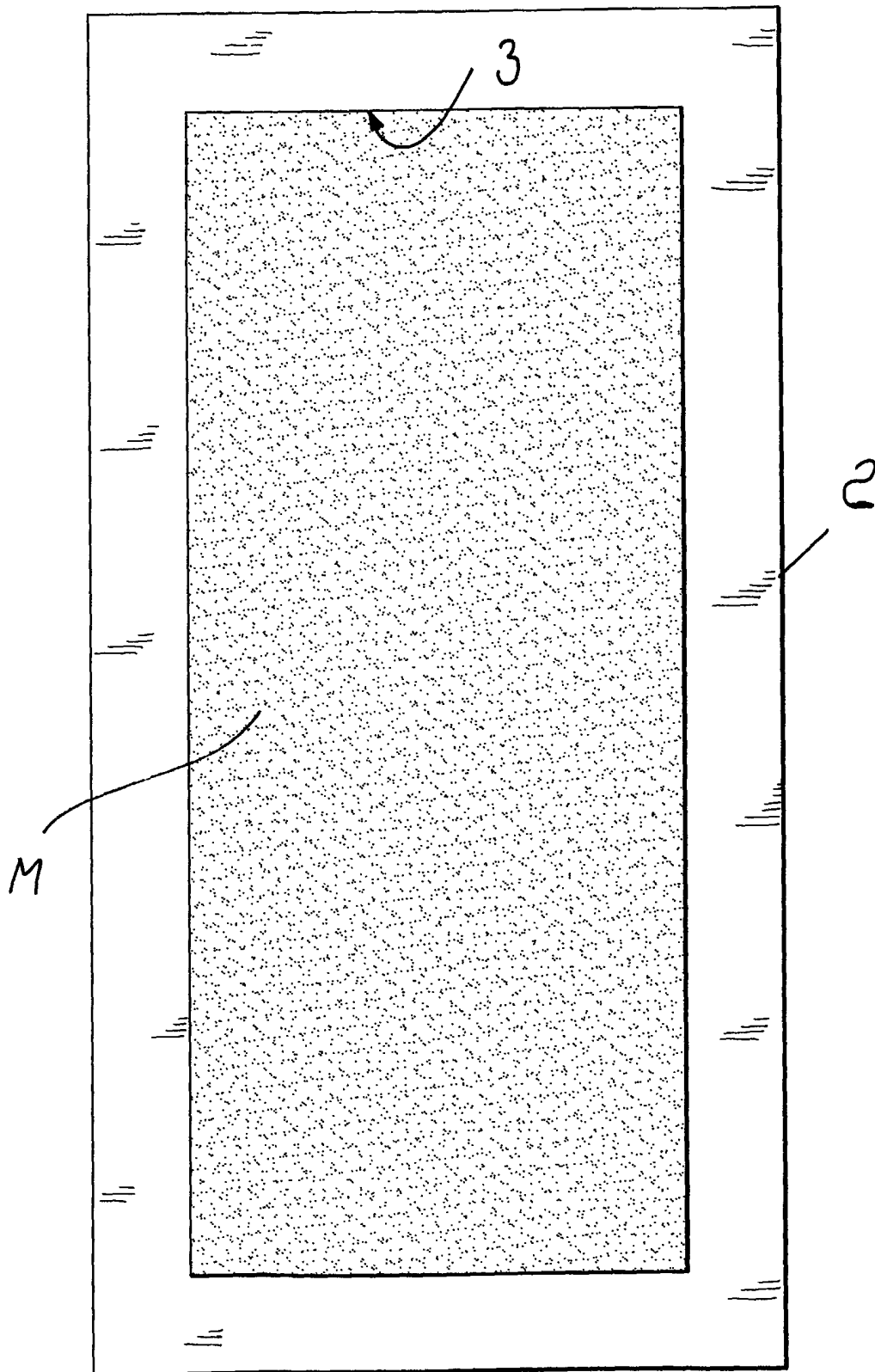


Fig. 9

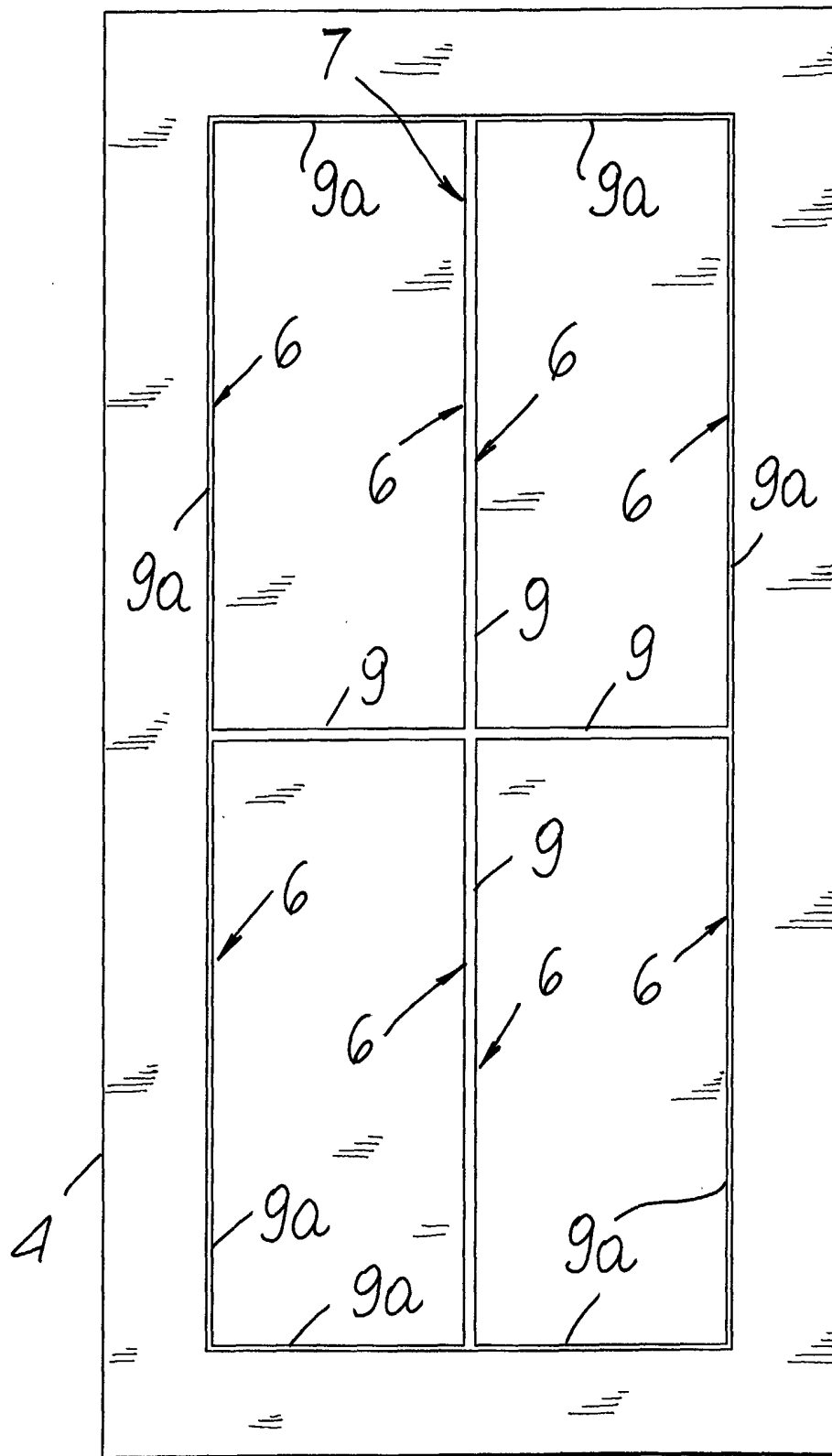
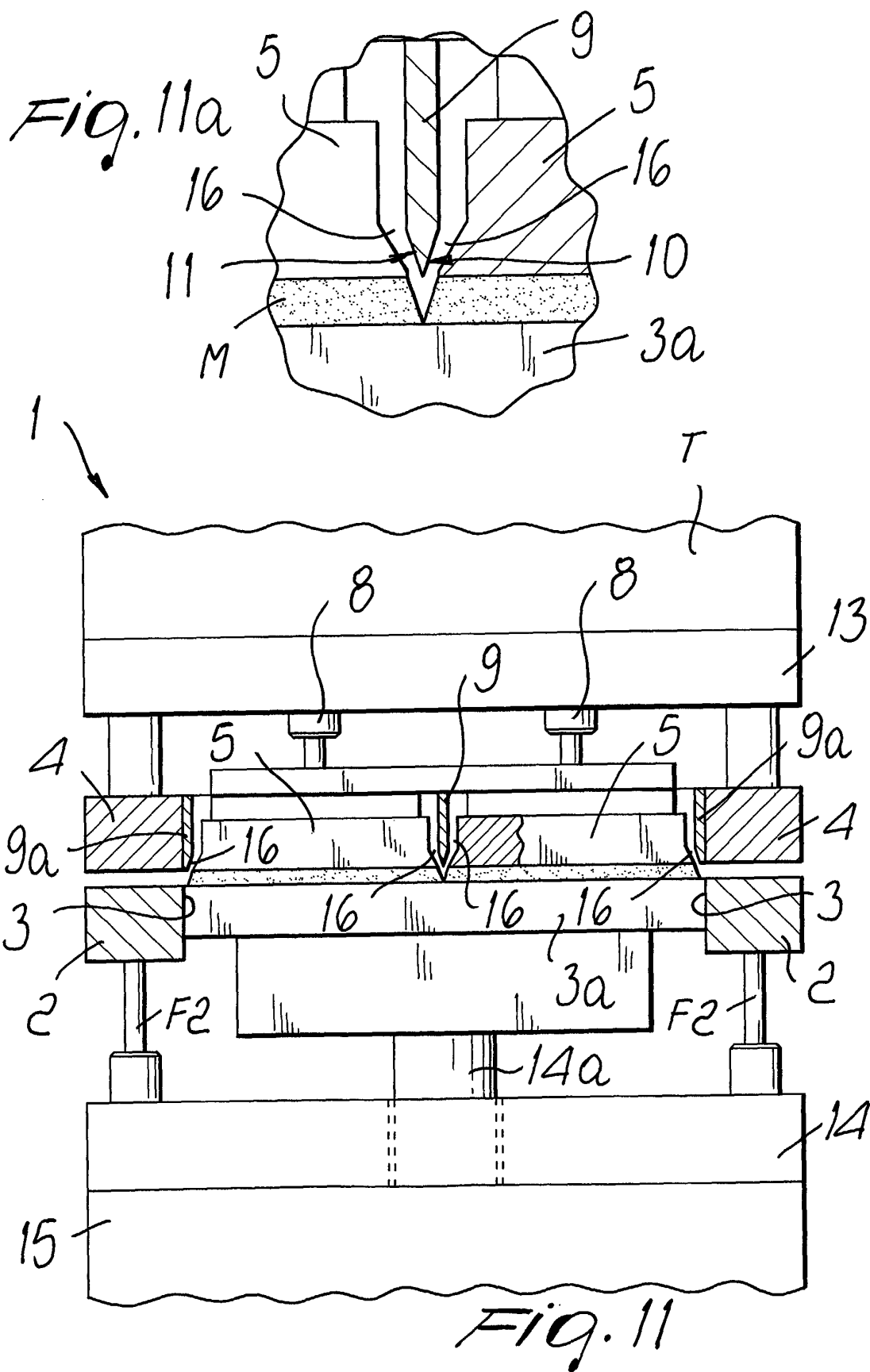


Fig. 10



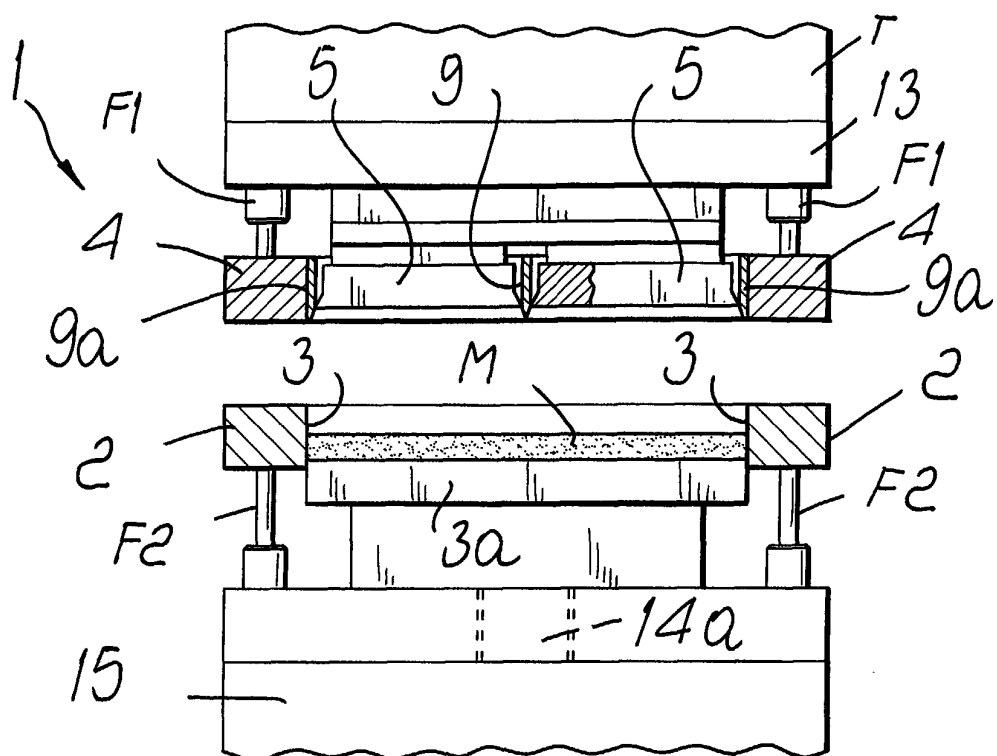


Fig. 12

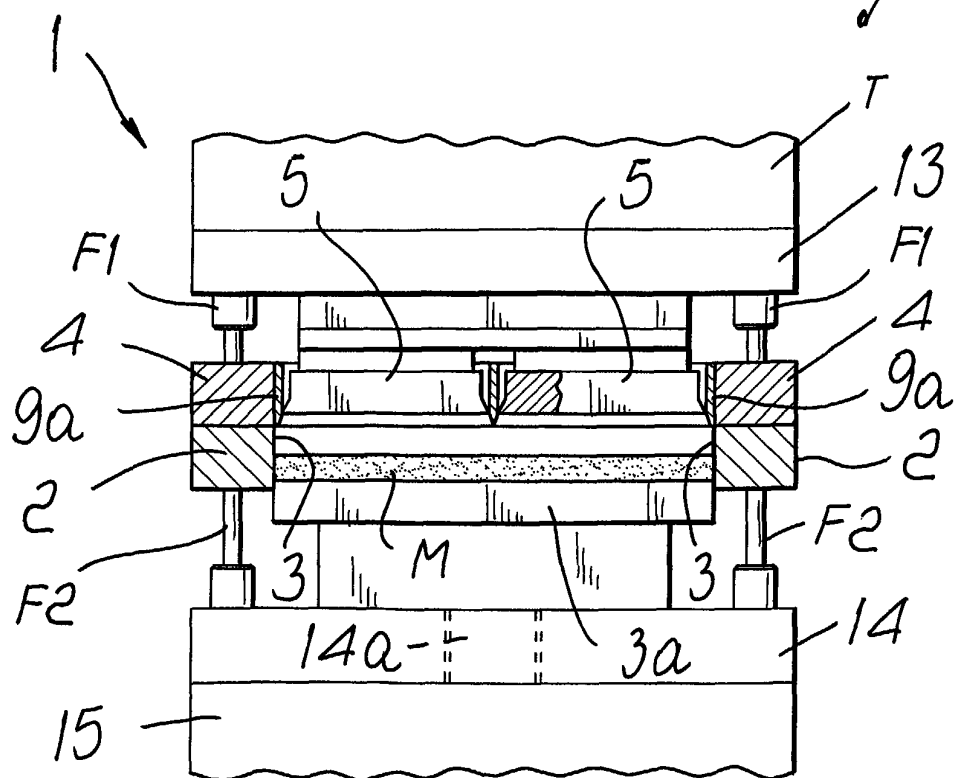
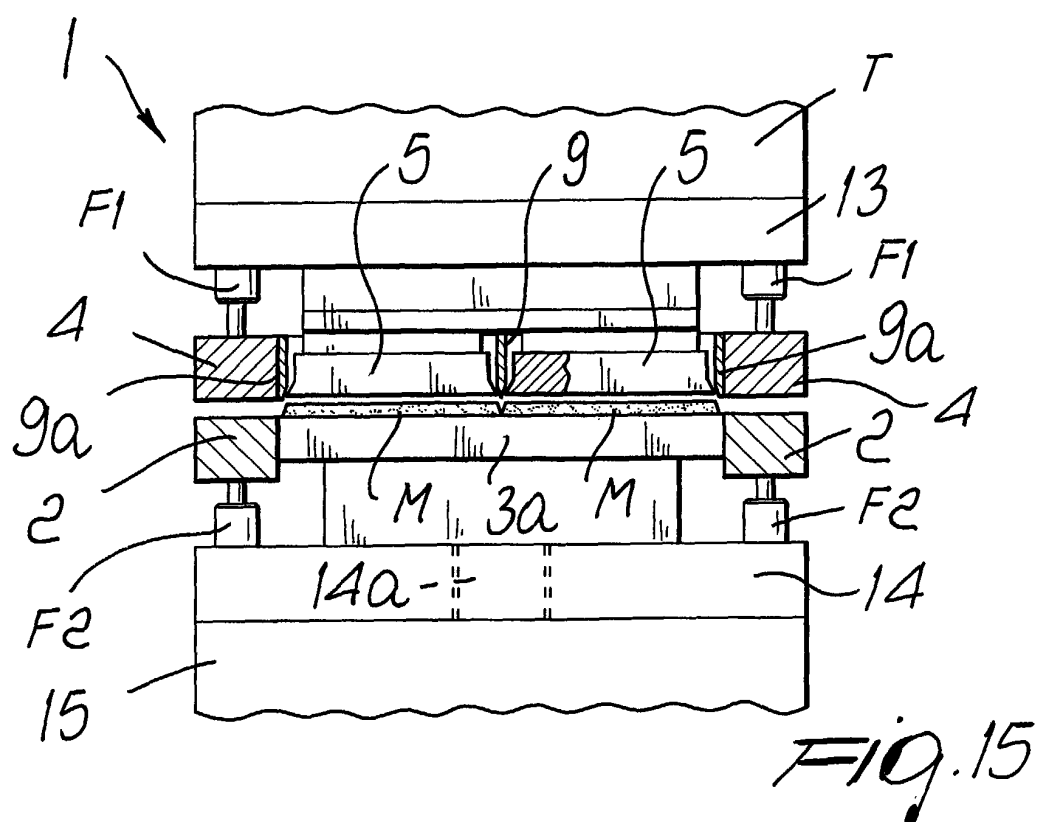
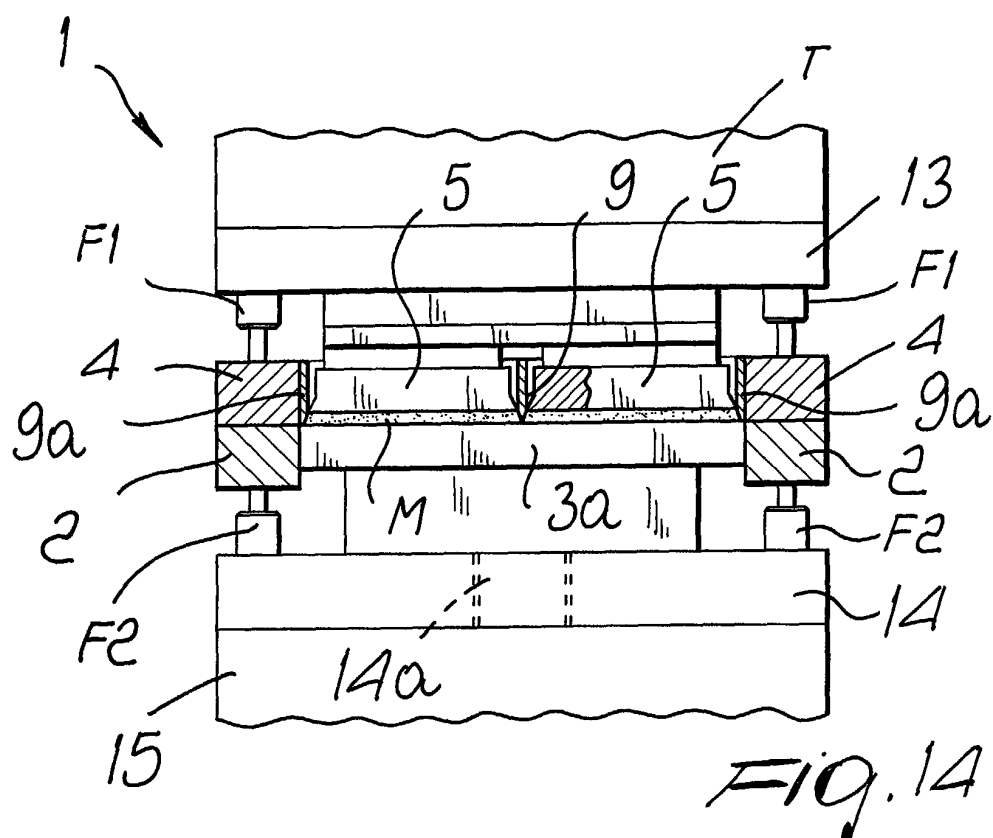


Fig. 13



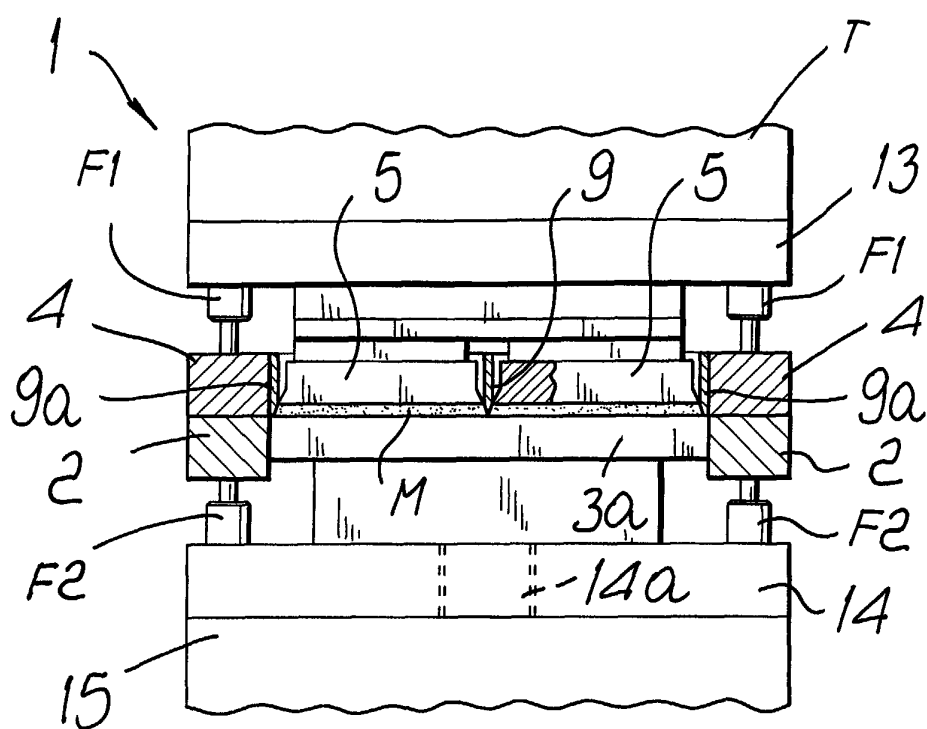


Fig. 16

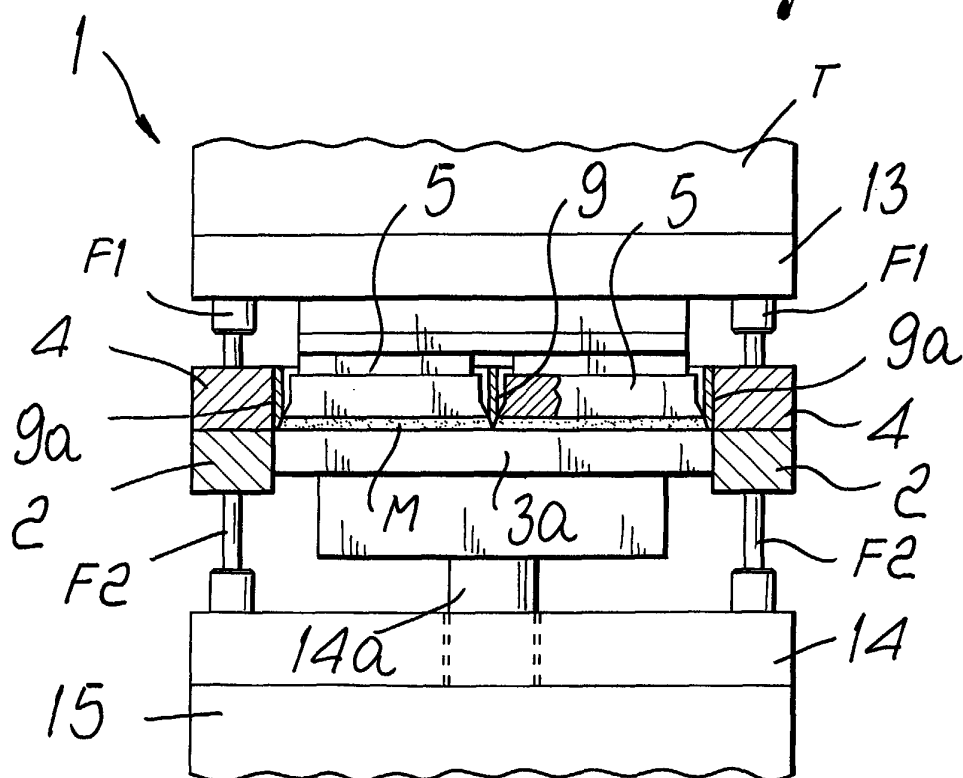


Fig. 17

