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(54) Method and plant for forming ceramic tiles or slabs

(57) A method for forming ceramic tiles or slabs in a press provided with a loading tray, consisting of depositing in a prearranged and/or random manner into a hopper a mixture of powders of different characteristics in such a manner as to create in the hopper a mass of powders presenting veining variously disposed within the mass, said hopper having a discharge mouth of dimensions at least equal to the dimensions of the at least one cavity of the mould of the forming press, both in the carriage translation direction and in the direction perpendicular thereto; from said mass of powders withdrawing successive portions having, in the tray translation direction, a dimension equal to a fraction of the length of said hopper, and in the direction perpendicular thereto a dimension equal to the dimension of the hopper mouth, such as to withdraw an entire layer of said mass; depositing said layer into the interior of said at least one cavity, and pressing the powders.

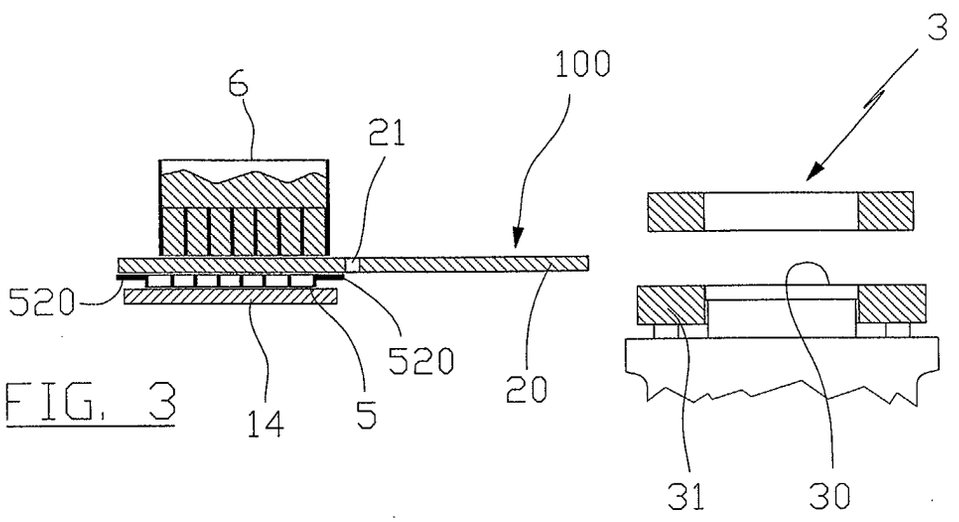

FIG. 3

EP 1 321 260 A2

Description

[0001] This invention relates to a method for depositing powders into the cavities of forming moulds for their pressing by presses, and the plant for implementing the method.

[0002] Research in the ceramic sector is currently aimed at obtaining products imitating natural stone, such as marble and granite. These products are characterised by the presence of continuous veining of random pattern extending through the entire thickness of the slab.

[0003] Such ceramic tiles or slabs are produced by compacting, by hydraulic presses, semi-dry atomized, ground or re-granulated powders variously mixed together in prearranged or random manner. Specifically, the powder mixtures are deposited by suitable means into the forming cavities of rigid steel moulds with which the presses are provided, and are then pressed to obtain the product.

[0004] A widely adopted system for feeding the powders into the mould cavities involves the use of a carriage provided with a bottomless loading tray which moves slidingly along a resting surface aligned with the mould die plate. The carriage moves between a loading position in which the tray lies below a loading hopper, and a discharge position in which the tray lies above the mould forming cavity, which thus receive the powders falling from the tray.

[0005] In practice the loading method using the described equipment comprises the preparation of a powder mixture within the loading hopper, transferring this mixture into the loading tray, and moving said tray from the loading position to the discharge position to deposit the powder mixture contained in the tray into the interior of the cavities in the press moulds.

[0006] A loading system such as the aforedescribed perfectly performs the task of continuously feeding the press without limiting its productivity, but demonstrates certain drawbacks in those cases in which the main objective is to deposit into the mould cavities a mass of mixed-together powders in such a manner as to maintain the same arrangement as they assumed when deposited into the loading hopper.

[0007] In this respect in the described system, during gravity transfer from the feed hopper to the loading tray, undesirable mixing takes place which partly or totally prejudices the powder arrangement achieved within the feed hopper. Further undesirable mixing takes place during the movement of the carriage between the loading position and the discharge position for the powder mass contained in the tray. This is because during the carriage travel the tray slides along the slide surface aligned with the upper surface of the mould die plate. This sliding results in partial remixing of the powders within the tray, generating often undesirable aesthetic effects.

[0008] It has also been found that the use of a system such as that described determines in the final product an appearance presenting numerous inaccuracies in the desired pattern.

[0009] An object of this invention is to overcome the drawbacks of the known art within the framework of a simple and rational solution, which does not prejudice the productivity of the forming lines.

[0010] This and further objects are attained according to the invention by a system for loading the cavities in forming presses which minimizes remixing of mixed powders during their transfer from the loading hopper to the tray and from the tray to the cavity in the forming mould of the press, Specifically, the forming method according to the invention comprises the following operative steps:

- into a hopper having a discharge mouth of dimensions at least equal to the dimensions of the at least one cavity of the mould of a forming press, both in the carriage translation direction and in the direction perpendicular thereto,
- depositing in a prearranged and/or random manner a mixture of powders of different characteristics in such a manner as to create in the hopper a mass of powders presenting veining variously disposed within the mass,
- from said mass of powders, withdrawing portions having, in the tray translation direction, a dimension equal to a fraction of the dimension of the hopper mouth, and in the direction perpendicular thereto a dimension equal to the dimension of the hopper mouth, such as to withdraw an entire layer of powders from said mass,
- depositing said layer in an orderly manner into the interior of said at least one cavity, and pressing the powders.

[0011] According to the method of the invention, said portions of powders are deposited into the interior of a translating tray having plan dimensions at least equal to the dimensions of said at least one cavity of the mould press. Said tray can translate between a loading position in which it lies below said hopper and a discharge position in which it lies above said at least one cavity.

[0012] It should be noted that the hopper according to the invention has a capacity such as to contain a mass of powders sufficient for several loadings. If tiles imitating natural stone are to be provides, a mass of powders is deposited into the hopper presenting veining extending within the mass, in the manner of a block of stone. This offers the advantage of obtaining tiles or slabs presenting veining which varies continuously, as would be obtained by sectioning said block of natural stone into successive layers.

[0013] The invention also comprises the plant for implementing the aforesaid method. Such a plant comprises a hopper for containing a mixture of powders presenting veining within the mass in imitation of a natural

stone, said hopper having plan dimensions at least equal to the at least one cavity of a forming press, with the lower mouth of said hopper there being associated movable powder distribution means able to deposit into said at least one cavity a succession of powder portions withdrawn from said hopper, until said at least one cavity is completely filled.

[0014] According to a preferred embodiment of the invention, said hopper is fixed to said powder distribution means, which are associated with the lower mouth of the hopper, are movable and are arranged to withdraw said powder portions and to deposit them in succession into the interior of the bottomless loading tray of a carriage translating between a loading position, in which the tray lies below the powder loading hopper, and a powder unloading position, in which said at least one tray lies above at least one cavity of the mould of a forming press.

[0015] Said distribution means comprise a translating plate provided centrally with a slot perpendicular to the direction of translation of said carriage, said plate having a length equal to at least double the length of the lower mouth of said hopper, and a width greater than the width of the lower mouth of the hopper, said slot having a width at least equal to the width of the mould cavity, and a dimension in the carriage translation direction which is a function of the graphic resolution which is to be obtained on the finished tile. In this respect, the greater the dimension of said slot in the carriage translation direction, the lesser will be the graphic resolution of the finished product.

[0016] In addition, with said tray there can be associated a movable shutter panel, which can translate between a withdrawn position in which it lies below the tray during the loading thereof, and an advanced position in which the front edge of the movable panel rests on and is coplanar with the die plate of the press mould.

[0017] The use of the movable panel offers the advantage of reducing powder remixing during the advancement of the carriage between the loading position and the discharge position.

[0018] According to a variant of the invention, said powder distribution means comprise two opposing coplanar belts, each of which has one end wound about an elastically loaded roller, its other end being rigid with a fixed retention element, each of said belts being made to pass about an idle roller, said opposing rollers being spaced apart by a predetermined amount based on the graphic resolution which is to be obtained on the finished tile. The idle rollers are supported by a movable frame caused to translate by a suitable drive unit which provides for making the aperture between said rollers move reciprocatingly at least beyond the front and rear edges of said hopper, such that the powder portions are withdrawn and deposited into the underlying loading tray by way of said aperture.

[0019] In a simplified further embodiment of the invention said hopper and said distribution means are movable between a withdrawn loading position in which they are spaced from said at least one cavity, and an advanced discharge position in which they lie above said at least one cavity. The powders are loaded into said at least one cavity by causing said distribution means to translate relative to the hopper when this is in the material discharge position.

[0020] Further characteristics of the method and plant of the invention are defined in the claims.

[0021] The operation of the method of the invention and the constructional characteristics and merits of the relative means for its implementation will be better understood from the ensuing description given with reference to the figures of the accompanying drawings which illustrate a particular preferred embodiment of said means and of some constructional variants thereof by way of non-limiting example.

[0022] Figure 1 is a schematic side view of the plant according to the invention.

[0023] Figure 2 is an enlarged view of the section II-II shown in Figure 1.

[0024] Figures from 3 to 15 schematically show the steps involved in two loading cycles for the mould cavities according to the invention.

[0025] Figure 16 is a partly sectional view of a variant of the invention.

[0026] Figure 17 is a view from above of a further variant of a detail of the invention.

[0027] Figures 18, 19 and 20 shown the operative steps involved in a further variant of the invention.

[0028] Said figures show the plant 1, which is positioned upstream of a forming press 3.

[0029] The plant 1 comprises a loading carriage 4 provided with a bottomless tray 5 having internal dividing baffles 50, it having preferably the same plan dimensions as the lower die 30 of the forming press 3.

[0030] To the front and rear edges of the tray there are fixed two flat horizontal plates or flanges, their purpose being explained hereinafter.

[0031] The carriage 4 translates reciprocatingly between a position for loading the powders to be pressed, in which the tray 5 lies below an overlying hopper 6, and a powder discharge position in which the tray lies exactly above the lower die 30 of the forming press 3.

[0032] With reference to Figure 2, the carriage 4 is constrained by wheels 7 to translate along two rectilinear parallel guides 8 fixed to a support frame, not shown.

[0033] The carriage 4 is fixed, by two blocks 40, to two parallel belts 9, each of which passes about two pulleys 10 and 11, the pulley 11 being fixed to the exit shaft of a gearmotor 12, the operation of which causes the carriage to translate.

[0034] Below the carriage 4 there is a panel 14 for closing the bottom of the tray 5. The panel 14 translates between a withdrawn position, in which it lies below the tray when this is in the powder loading stage, as shown in Figure 1, and an advanced position in which the front edge of the panel rests on and is coplanar with the die

plate 31 of the mould of the press 3 (Figure 5).

[0035] As shown in Figure 2, the panel 14 is driven by a rack-pinion system operated by a gearmotor 15.

[0036] Specifically, said panel is supported by a frame 16 which can translate along two longitudinal guides 160 via wheels 17. To the lower surface of the frame 16 there is fixed a rack 18 engaging a pinion 19 rotated by said gearmotor 15.

[0037] Between the carriage 4 and the overlying hopper 6 there are positioned distribution means 100 for the powders contained in the hopper. In the illustrated embodiment said means comprise a translating plate 20 provided with a slot 21 for distributing the powders contained in the hopper 6, the slot 21 being perpendicular to the travel direction of the carriage 4. With reference to Figure 2, the plate 20 is supported on two parallel guides 22 along which it can slide via wheels 23. On each of the two guides 22 there is fixed a belt 24 and 25 which engage pulleys 26 and 27 fixed on the shaft of a gearmotor 28, the operation of which causes the plate 20 to translate.

[0038] The gearmotor 28 drives the plate reciprocatingly beyond the front and rear edge of the two flanges 520 of the tray 5.

[0039] The plate 20 has a dimension in the direction perpendicular to the carriage advancement direction which exceeds the dimension of the press mould cavity in the carriage advancement direction, and a dimension in the carriage advancement direction which is at least double the corresponding cavity dimension. The slot 221 has a dimension in the direction perpendicular to the carriage advancement direction which is equal to the corresponding dimension of the tray 5, and a dimension in the carriage advancement direction which depends on the graphic resolution to be obtained on the finished tile. From tests carried out it has been found that to obtain a sufficient graphic resolution quality of the pressed tile, the slot dimension in the carriage advancement direction must not exceed four times the depth of the mould cavity. Preferably this dimension is between one and two times the depth of the mould cavity.

[0040] The hopper 8 has plan dimensions at least equal to the dimensions of the mould cavity, and a height at least three times the height of the loading tray, so that the powders deposited by known means, not shown, into the hopper form overall a mass presenting veining within the mass which reproduces that present in natural stone. In other words it can be said that this mass reproduces a block of natural stone, which is subsequently sectioned into layers which are deposited into the tray through the slot 26. To limit powder slippage during the loading and discharge of the hopper, its internal volume is divided by rigid baffles 60.

[0041] The described plant for implementing the method of the invention is also provided, between its various mutually movable parts, with suitable known sliding seal means, not shown because of known type, to prevent undesirable powder spillage. Specifically, said sliding seal means are positioned between the lower mouth of the tray 5 and the panel 14, below the upper mouth of the tray 5 and the plate 20, and between the lower mouth of the hopper 6 and the plate 20.

[0042] Figure 16 shows a variant of the invention which differs from the described embodiment with respect to said powder distribution means 100, which are positioned between the loading hopper 6 and the tray 56 of the carriage 4.

[0043] In the description of the variant of the invention the elements already described in the illustrated embodiment are indicated by the same reference numerals.

[0044] In this variant of the invention said powder distribution means 100 comprise two opposing coplanar belts or curtains 50, one end of which is fixed to a fixed retention element 52, and the other end is wound about a shaft 53 elastically loaded by a spring, the purpose of which is to maintain the curtain taut. Between said shaft 53 and said fixed element 52, each curtain passes about an idle roller 54 supported by a translating frame 55.

[0045] Said translating frame is operated by a suitable drive unit.

[0046] In the illustrated embodiment said drive unit consists of a rack-pinion system operated by a gearmotor 58.

[0047] As can be seen from Figure 16 the two rollers about which the curtains 50 pass are coplanar and spaced apart by an adjustable amount to provide an aperture through which, during the translation of the frame, powder portions are withdrawn from the overlying hopper 6 and deposited into the underlying loading tray 5.

[0048] Figure 17 shows a further variant of the invention regarding the loading tray 5. In this variant the loading tray 5 is provided with two longitudinal parallel baffles or plates 71 in proximity to its lateral edges. The dimensions of the mould cavity will then be equal to that section of the tray bounded by the front and rear edge of said baffles 71.

[0049] The purpose of the baffles 71 is to eliminate any imperfections due to powder slippage against the walls of the hopper 6 during filling of the tray.

[0050] Figures 18, 19 and 20 show a simplified variant of the invention. In this variant of the invention neither the carriage 4 provided with the tray 5 nor the underlying panel 14 is present. The figures show a loading hopper 81 totally similar to the already described hopper 6 but differing only by being associated with a support frame, not shown, to translate between a withdrawn position in which suitable means deposit a powder mass into the hopper 81, and an advanced position (Figure 19) in which the hopper 81 lies exactly above the mould cavity of the press 3.

[0051] The powder distribution means 100 are present below the hopper 81.

[0052] Said means comprise a plate 82 totally similar to the plate 20, except that said plate can translate, as can the hopper, as far as above the mould cavity (Figure 19).

[0053] The plate 82 presents a slot 820 identical to the already described slot 21. Once the hopper 81 and the plate 82 are in position, the plate 82 is made to translate relative to the hopper such that the powders are deposited directly into the mould cavity of the press 3 through the slot 820.

[0054] The operating and control means for the hopper 81 and plate 82 are not shown as these are known to the expert of the art.

[0055] The described plant is controlled by a processor, not shown, which controls the implementation of the method in the following manner.

[0056] With reference to Figures from 3 to 15, at the commencement of the forming cycle the distribution plate 20 is withdrawn so that the tray 5 of the carriage 4 becomes filled with a succession of powder portions which pass from the hopper 6 into the tray through the slot 21.

[0057] As is apparent from Figures 3 and 9, at the commencement of each loading cycle the tray 5 lies below the hopper, but has moved in the carriage advancement direction by an amount at least equal to the dimension of the slot 21 in the same direction, so that a portion of the flanges 520 lies below said hopper 6. This is necessary for transferring the powder portions into the tray without varying their arrangement.

[0058] By filling the tray through said slot, undesirable powder mixing is reduced to a minimum.

[0059] Once the tray has been filled the carriage 4 is advanced, together with the panel 14, until the panel rests on the press die plate with which it is coplanar (Figure 5), so preventing undesirable powder mixing which could occur if the carriage were to slide along a fixed operating table as in the known art. Instead, the carriage continues its travel until it is positioned exactly above the lower die of the press 3 (Figure 6). When in position, the processor causes the lower die of the press to lower, as shown in Figure 7, in order to form the mould cavity to receive the powders contained in the tray. When the mould cavity has been loaded the panel is returned to its withdrawn position, below the mouth of the hopper 6 (Figure 8), after which the tray 5 is made to withdraw to below the mouth of the hopper 6 by withdrawing the carriage 4 (Figure 9). At this point the powders contained in the mould cavity are pressed.

[0060] When the powders have been pressed, the press upper die is raised such that, during the next loading cycle, the carriage advancement causes the tile formed by the press 3 to withdraw by means of the usual pusher, not shown, fixed to the front edge of the carriage 4.

[0061] Figures 10-15 show the next loading cycle of the invention. Said cycle differs from the preceding only in that the powders are loaded into the tray 5 by moving the distribution plate 20 in the opposite direction to its movement during the preceding loading.

[0062] The variant of the invention shown in Figure 16 operates in a totally identical manner to the preceding described embodiment.

[0063] The operation of the variant of the invention shown in Figures 18, 19, 20 is controlled by a processor in the following manner.

[0064] With reference to Figure 18, at the commencement of the loading cycle the hopper 81 and the plate 82 are in their withdrawn position, i.e. distant from the forming press 3. While in this position means, not shown, deposit into the hopper 81 a mixture of powders in a prearranged and/or random manner, to create therein a powder mass presenting veining imitating a natural stone. When the hopper 81 has been loaded the processor causes the hopper and the plate 82 to move to above the mould cavity of the press 3. When the hopper 81 lies exactly above the mould cavity, the processor causes the die 30 to lower and only the plate 82 to translate such as to deposit into the cavity, through the slot 820, a succession of powder portions until it has been completely filled.

[0065] After the cavity has been loaded, the hopper 81 and plate 82 are withdrawn to commence the pressing cycle. At this point the cycle is repeated identically.

[0066] It should be noted that the invention can be subjected to numerous constructional variations, all falling within the aforedescribed inventive concept.

Claims

1. A method for forming ceramic tiles or slabs in a press provided with a loading tray, comprising the following operative steps:

   - into a hopper having a discharge mouth of dimensions at least equal to the dimensions of the at least one cavity of the mould of a forming press, both in the carriage translation direction and in the direction perpendicular thereto,
   - depositing in a prearranged and/or random manner a mixture of powders of different characteristics in such a manner as to create in the hopper a mass of powders presenting veining variously disposed within the mass,
   - from said mass of powders, withdrawing portions having, in the tray translation direction, a dimension equal to a fraction of the length of said hopper, and in the direction perpendicular thereto a dimension equal to the dimension of the hopper mouth, such as to withdraw an entire layer of said mass,
   - depositing said layer into the interior of said at least one cavity, and
   - pressing the powders.

2. A method as claimed in claim 1, **characterised in that** the dimension of said powder portions in the tray translation direction is a function of the graphic resolution to be obtained on the finished tile.

3. A method as claimed in claim 1, **characterised in that** the dimension of said powder portions in the tray translation direction is at most four times the depth of the cavity.

4. A method as claimed in claim 1, **characterised in that** the dimension of said powder portions in the tray translation direction is preferably between one and two times the depth of the cavity.

5. A method as claimed in claim 1, **characterised in that** the ordered deposition of said portions into the cavity takes place by depositing said portions in an orderly manner into the interior of a movable tray having plan dimensions at least equal to the dimensions of said cavity, and causing said tray to translate from a loading position in which it lies below said hopper to a discharge position in which it lies above said at least one cavity.

6. A method as claimed in claim 1, **characterised in that** said cavity is filled by positioning said hopper directly above said at least one mould cavity.

7. A method as claimed in claim 1, **characterised by** comprising powder distribution means associated with the discharge mouth of said hopper.

8. A plant for forming ceramic tiles or slabs by means of a press provided with moulds having at least one cavity, **characterised by** comprising a hopper for containing a mixture of powders, its discharge mouth having plan dimensions equal to the dimensions of at least one cavity, with the lower mouth of said hopper there being associated movable powder distribution means able to deposit into said at least one cavity a succession of powder portions withdrawn from said hopper, until said at least one cavity is completely filled.

9. A plant as claimed in claim 8, **characterised in that** said hopper is fixed and is positioned above a loading carriage provided with at least one bottomless tray arranged to translate between a loading position, in which it lies below said hopper, and a powder discharge position in which said at least one tray lies above at least one cavity of a forming press mould, said powder distribution means being interposed between the hopper and the tray.

10. A plant as claimed in claim 8, **characterised in that** said powder distribution means comprise a translating plate provided centrally with a slot perpendicular to the direction of translation of said carriage, said plate having a dimension in the carriage translation direction which is at least double the dimension of the lower mouth of said hopper in the same direction, and a dimension in the direction perpendicular to the preceding which is at least equal to the dimension of the lower mouth of the hopper in the same direction, said slot having a dimension in the tray translation direction which is at east equal to the dimension of the mould cavity in the same direction, and a dimension in the direction perpendicular thereto which is a function of the thickness of the tile to be formed.

11. A plant as claimed in claim 8, **characterised in that** the dimension of said slot in the tray translation direction is at most four times the depth of the cavity.

12. A plant as claimed in claim 11, **characterised in that** the dimension of said slot in the tray translation direction is preferably between one and two times the depth of the press cavity.

13. A plant as claimed in claim 10, **characterised in that** said plate below said hopper is operated by a gearmotor which causes the plate to translate such as to reciprocatingly bring said slot at least beyond the front and rear edges of the mouth of said hopper.

14. A plant as claimed in claim 8, **characterised in that** a movable shutter panel is associated with said at least one tray.

15. A plant as claimed in claim 14, **characterised in that** said panel can translate together with the tray between a withdrawn position in which it lies below the tray during the loading thereof, and an advanced position in which it lies below the tray when the front edge reaches the edge of the mould die plate.

16. A plant as claimed in claim 14, **characterised in that** said panel is made to translate by a suitable drive unit.

17. A plant as claimed in claim 8, **characterised in that** said powder distribution means comprise two opposing coplanar belts, each of which has one end wound about an elastically loaded roller, its other end being rigid with a fixed retention element, each of said belts being made to pass about an idle roller spaced from the corresponding roller about which the other belt passes, by a predetermined amount based on the thickness of the tile to be formed.

18. A plant as claimed in claim 16, **characterised in that** said rollers are supported by a movable frame caused to translate by a suitable drive unit which causes the aperture between said rollers to translate reciprocatingly at least beyond the front and rear edges of said hopper.

19. A plant as claimed in claim 17, **characterised in**

that said distance between the rollers varies preferably from one to three times the thickness of said at least one press cavity.

20. A plant as claimed in claim 8, **characterised in that** said hopper is movable between a withdrawn loading position in which it is distant from said at least one cavity, and an advanced discharge position in which it lies above said at least one cavity.

21. A plant as claimed in claim 20, **characterised in that** below the hopper there are provided powder distribution means which translate, together with said hopper, between a withdrawn position during hopper loading, and an advanced position in which the hopper lies above said at least one cavity.

22. A plant as claimed in claim 21, **characterised in that** when in said advanced position, said powder distribution means translate below said hopper.

23. A plant as claimed in claim 8, **characterised in that** said tray presents two parallel baffles positioned in proximity to its longitudinal edges, the area between said baffles and the front and rear edges of the tray being at least equal to the dimensions of said at least one mould cavity.

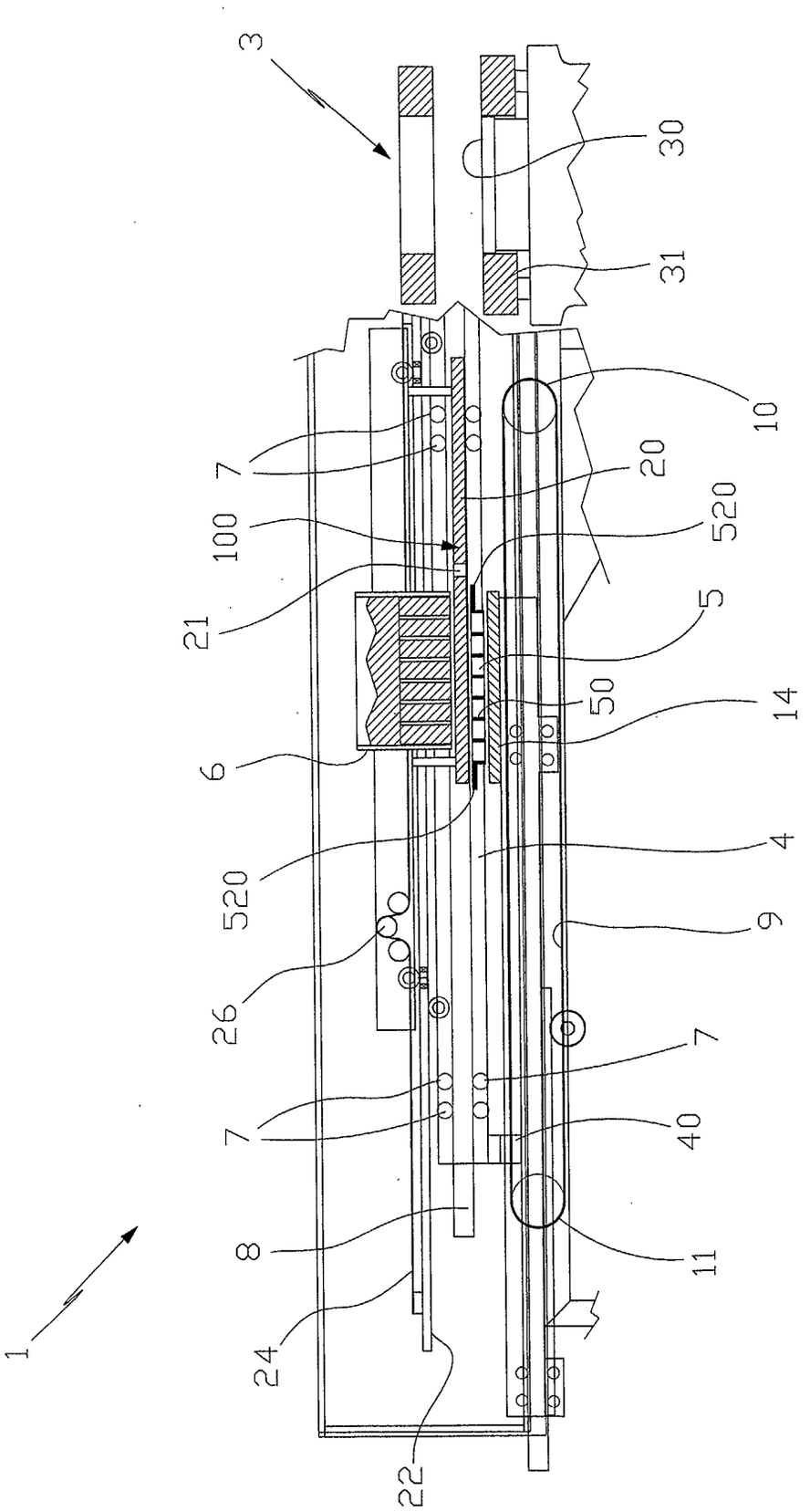

FIG. 1

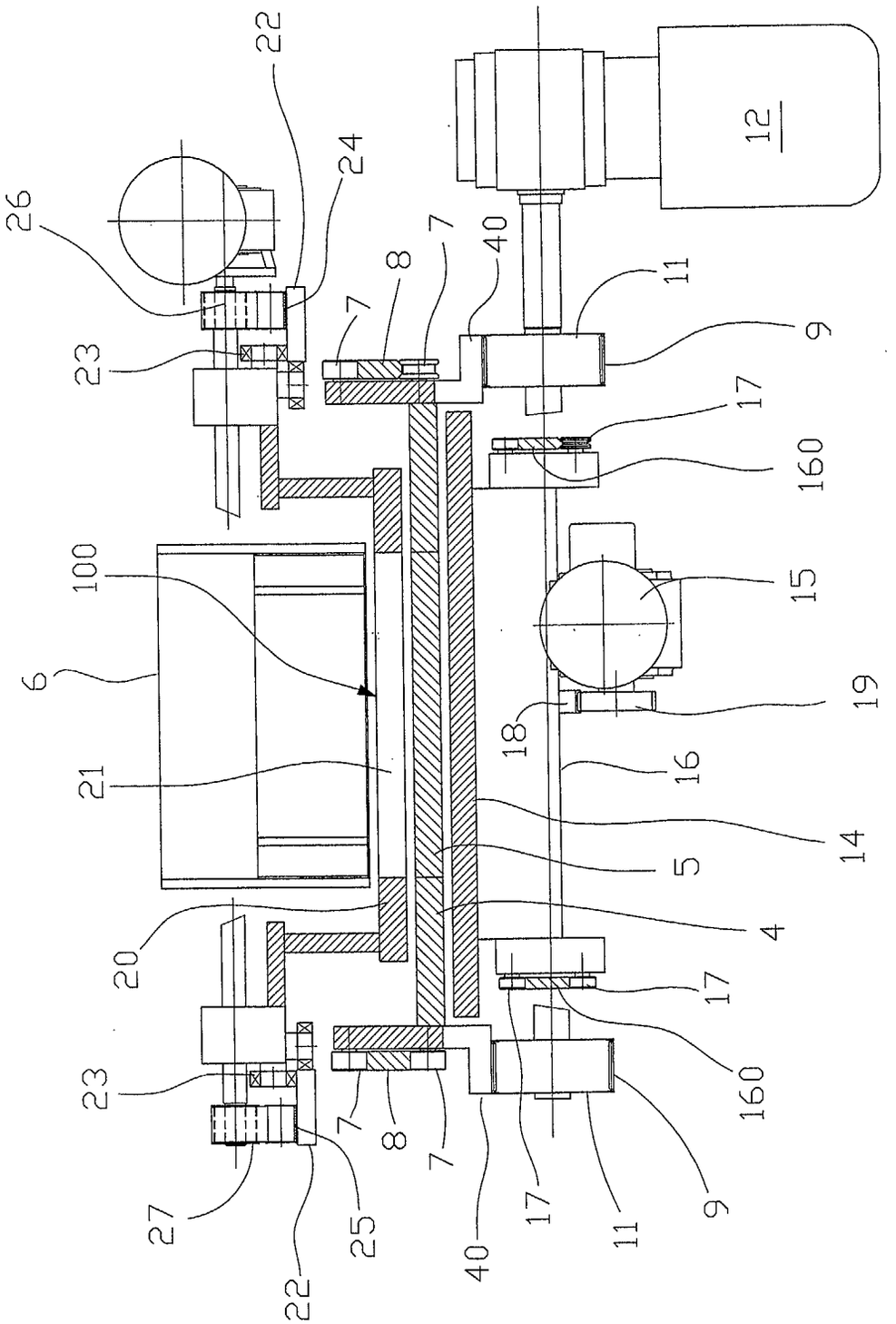
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FIG. 2

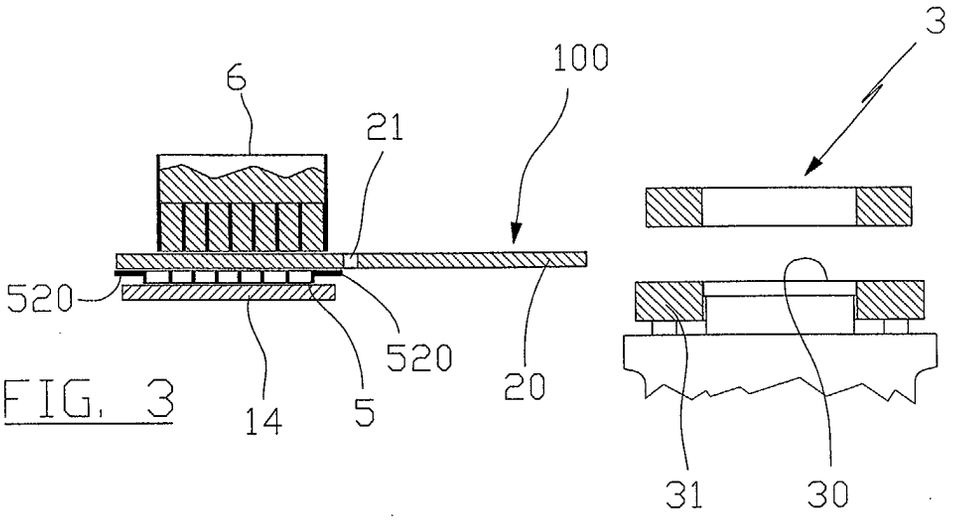


FIG. 3

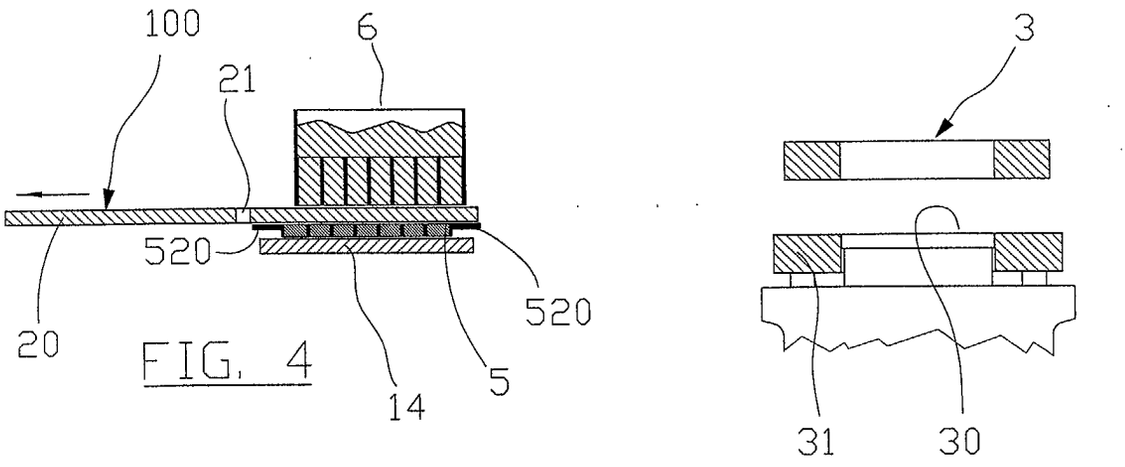


FIG. 4

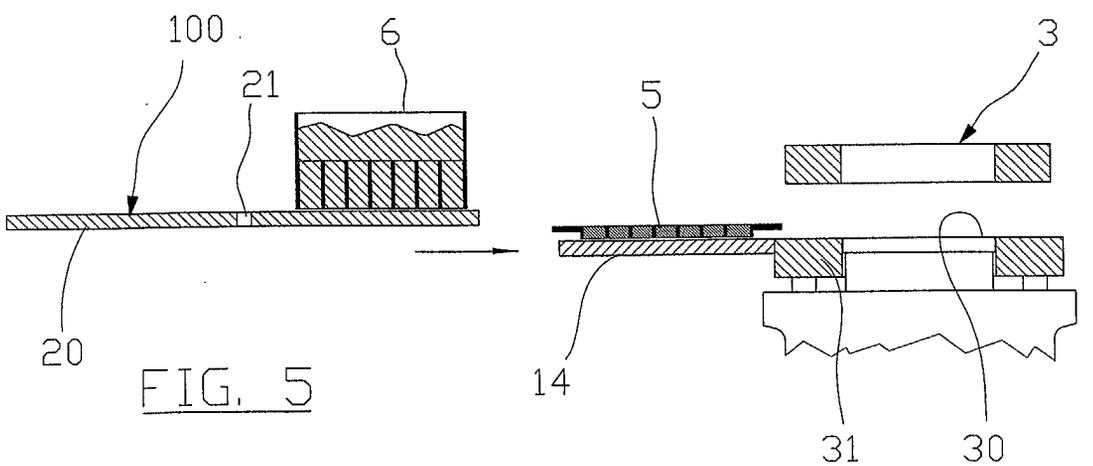


FIG. 5

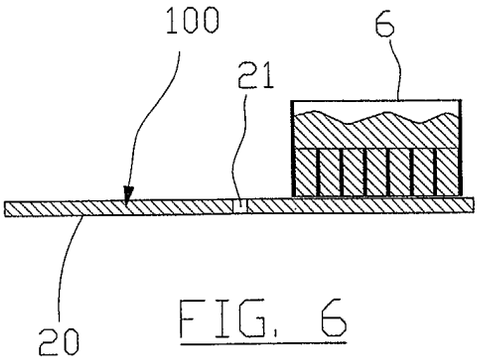
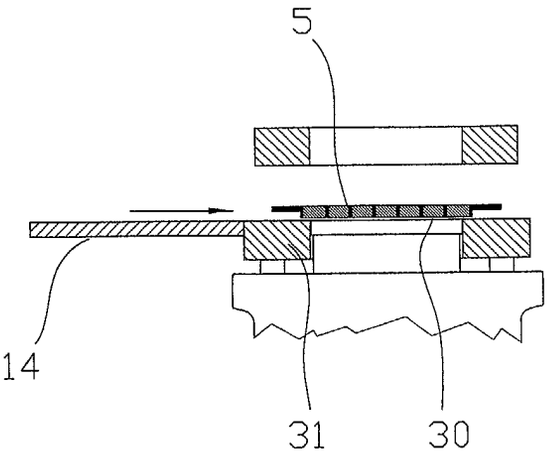


FIG. 6



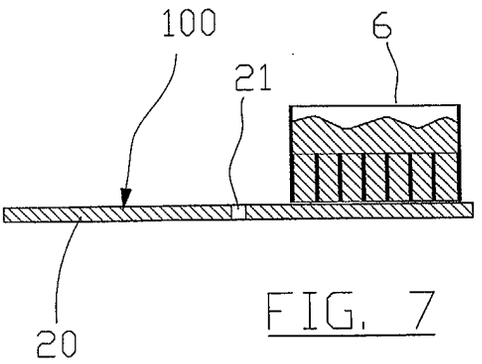
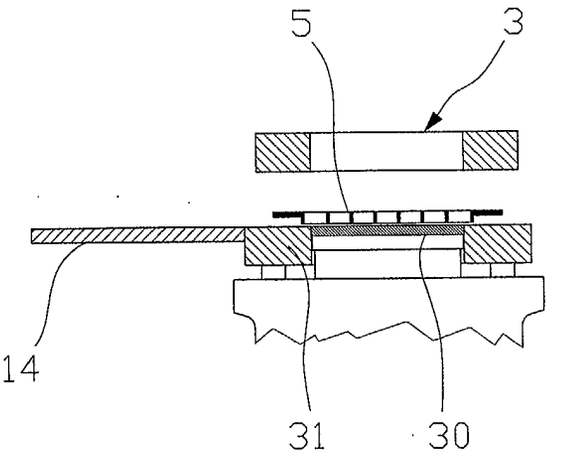


FIG. 7



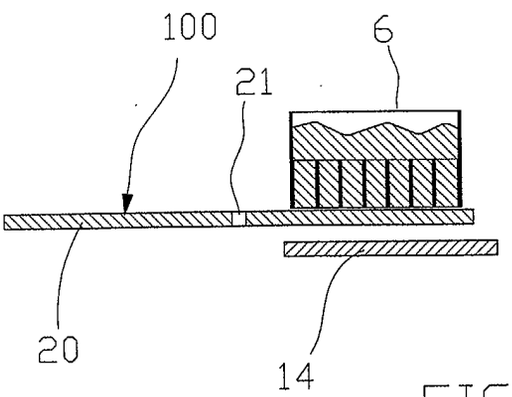
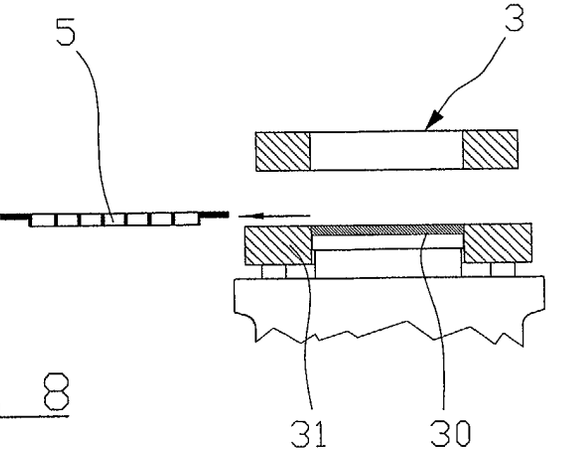


FIG. 8



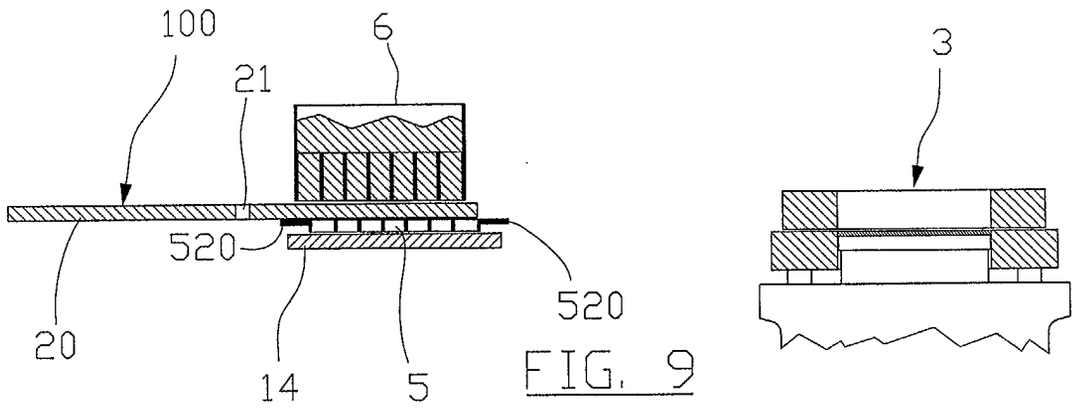


FIG. 9

FIG. 10

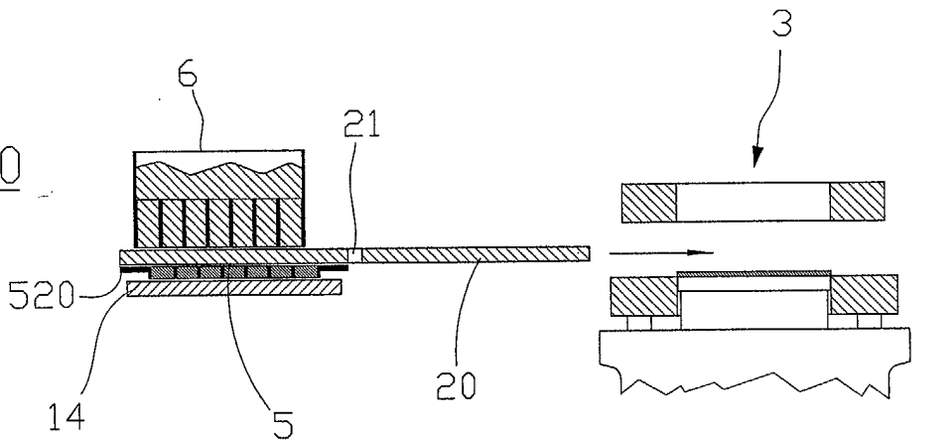
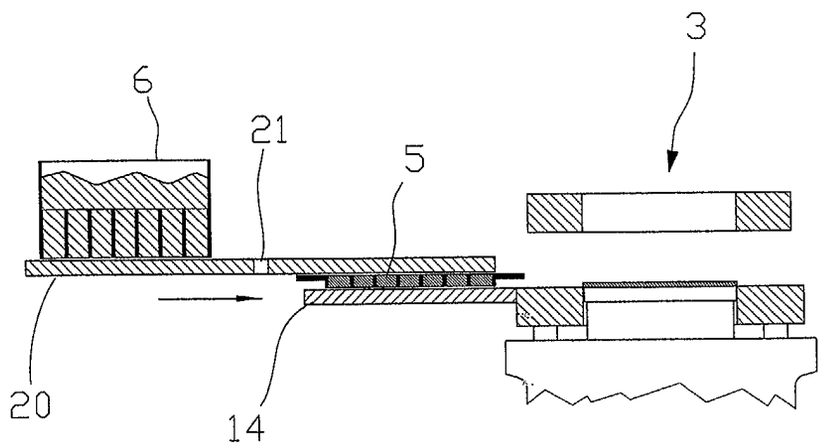


FIG. 11



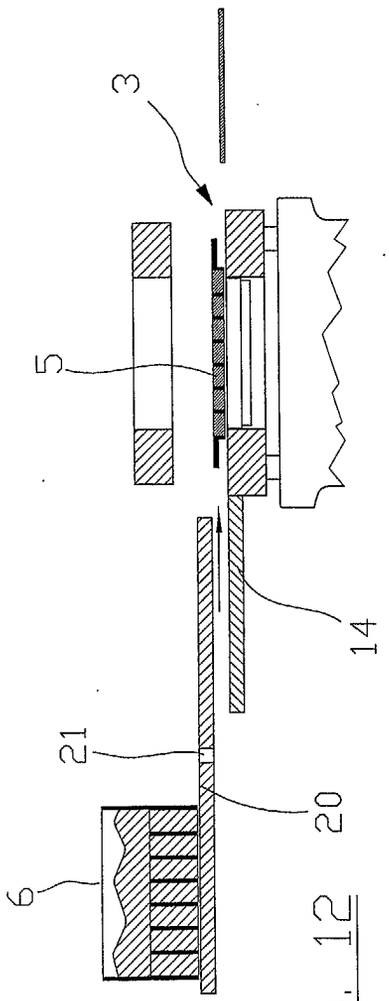


FIG. 12

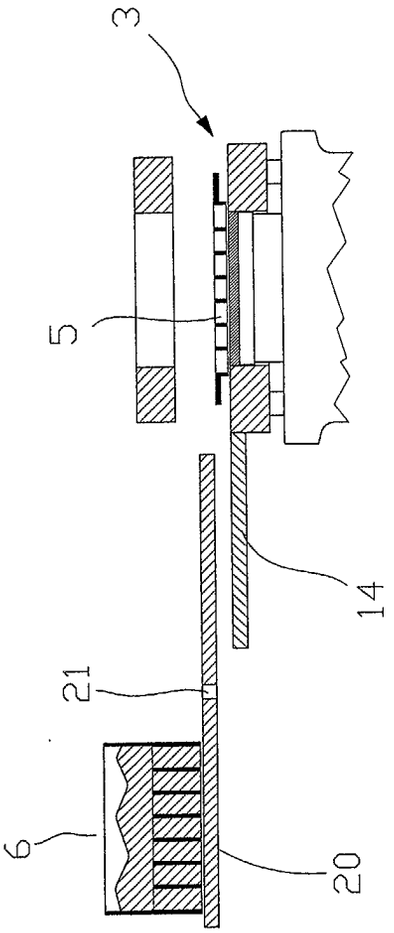


FIG. 13

FIG. 14

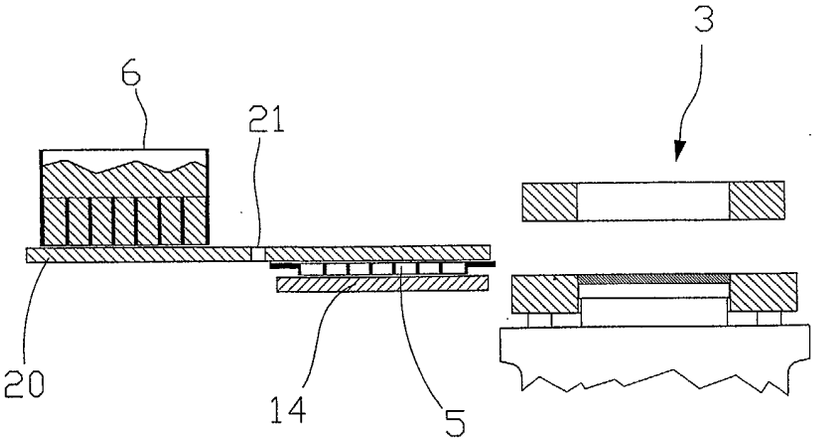
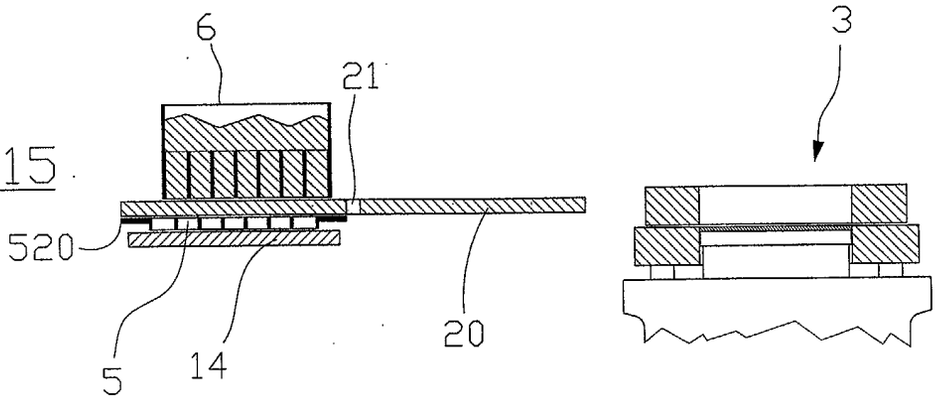


FIG. 15



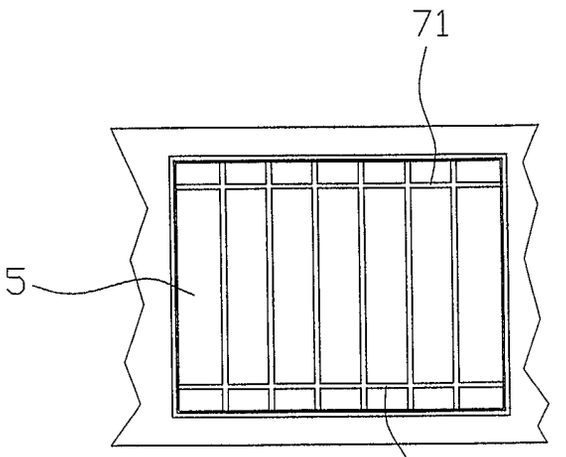


FIG. 17

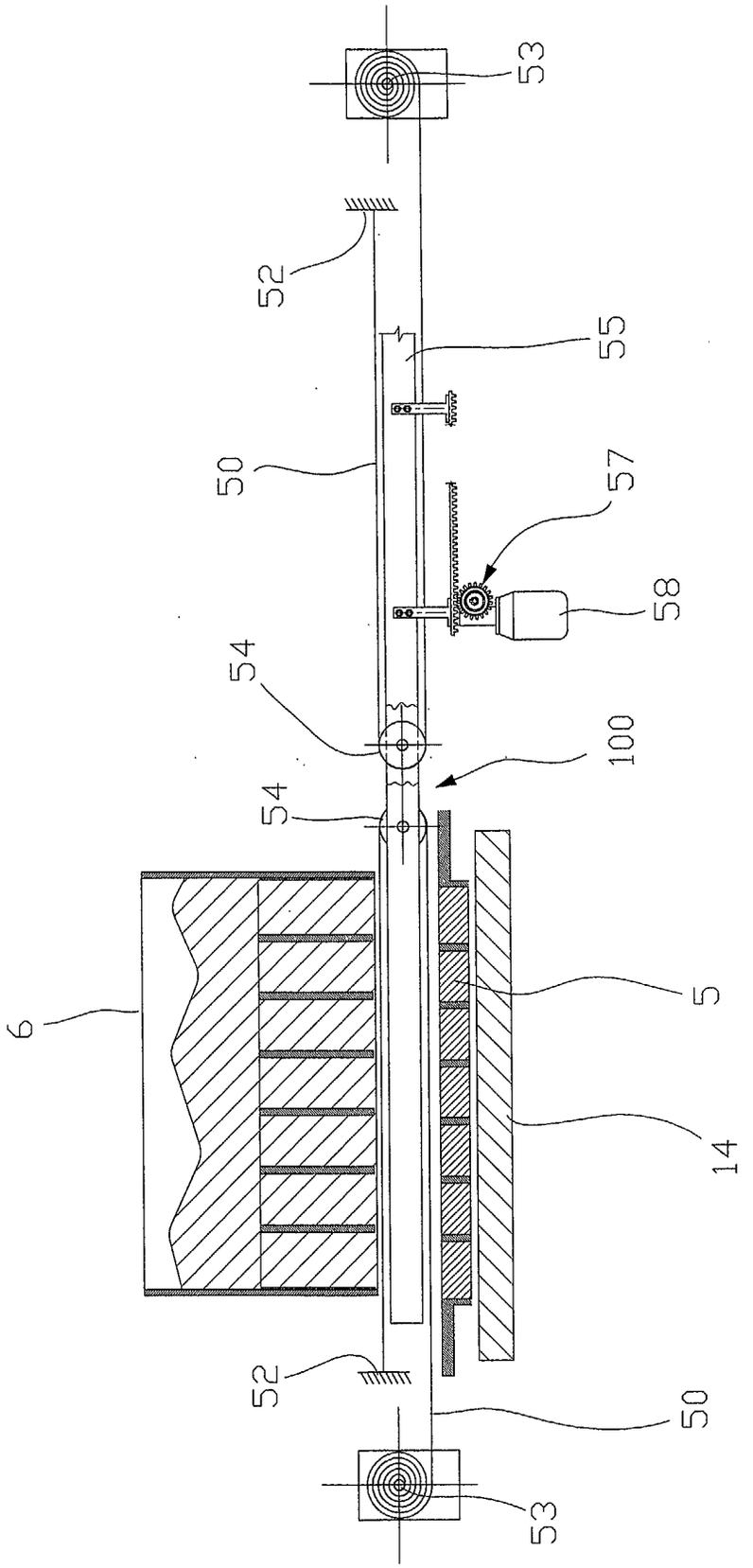


FIG. 16

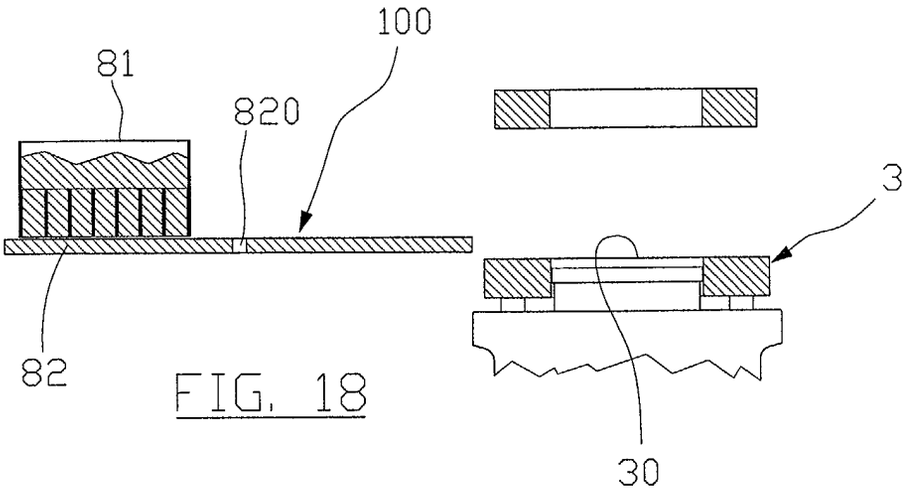


FIG. 18

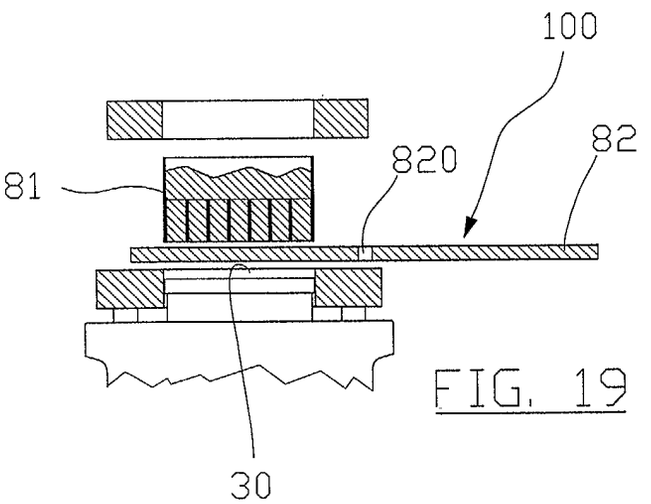


FIG. 19

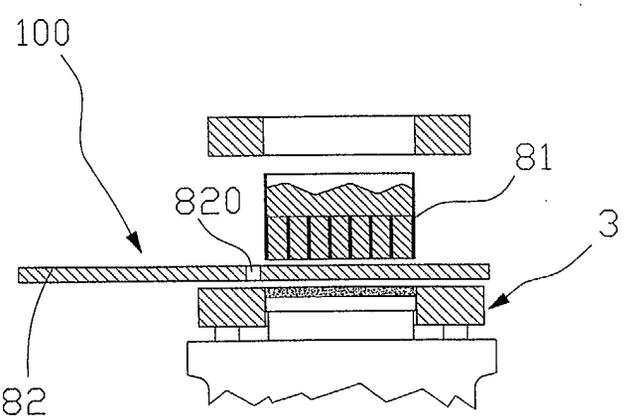


FIG. 20