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(54) A method and plant for manufacturing ceramic tiles

(57) A method for manufacturing ceramic tiles comprising a stage of horizontally advancing a rest surface (13) in an operational trajectory, resting a grid-shaped body (21) provided with separator walls (23) defining a plurality of cells (24) on the rest surface (13), depositing a powder ceramic material in the cells (24) of the grid-shaped body (21), raising the grid-shaped body (21) from the rest surface (13), such as to leave a layer of the powder ceramic material on the rest surface (13).

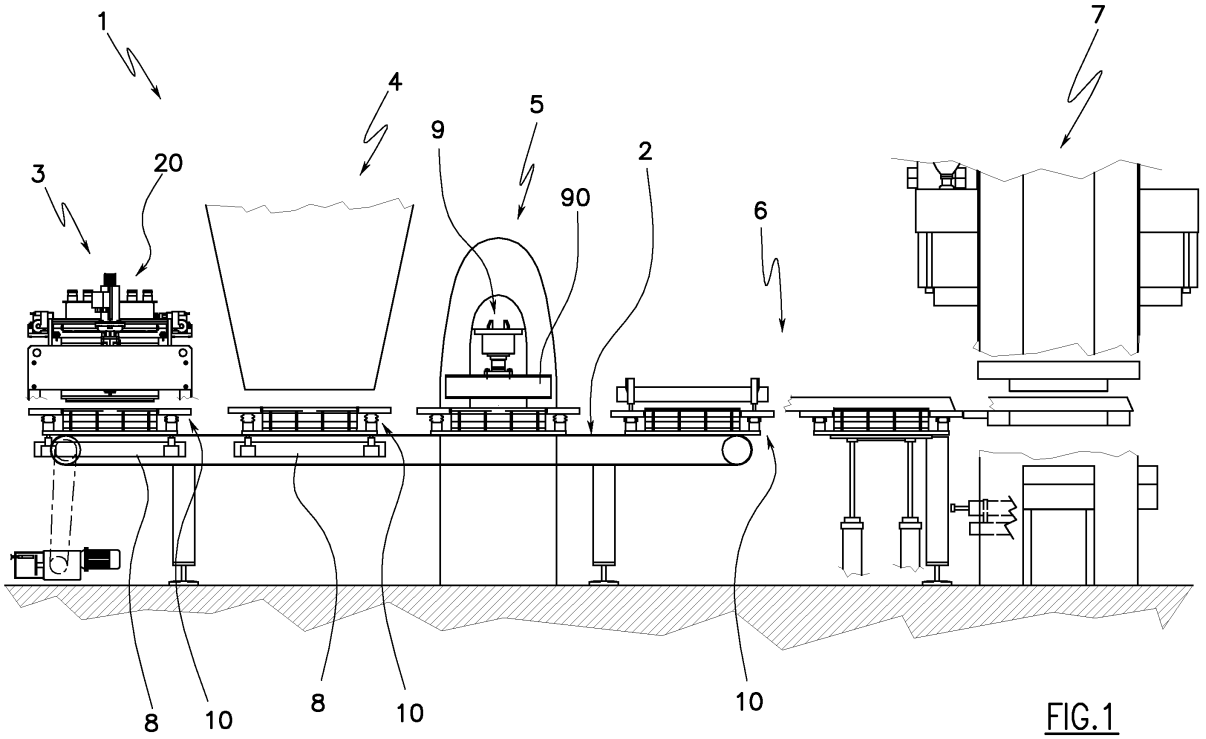

FIG.1

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Description

[0001] The invention relates in general to a method and plant for manufacturing ceramic tiles.

[0002] As is known, ceramic tiles are manufactured starting from an unfired tile made of powdered ceramic material, which is subjected to successive stages of drying and firing up until the final product is obtained.

[0003] The present invention relates in particular to the realisation of the unfired tile.

[0004] Normally the unfired tile is realised by pressing powder ceramic material internally of the forming cavity of a ceramic die.

[0005] Schematically, the ceramic die comprises a bottom die which is slidably inserted internally of a lateral matrix which defines the forming cavity, and an overlying upper die which moves vertically with respect to the bottom die in order to effect the pressing.

[0006] In traditional plants, the powder ceramic material is supplied to the forming cavity by a special filler box, which translates on a sliding plane located close to the die matrix.

[0007] In particular, the translation of the filler box goes from a retracted position, in which it is positioned below a supply hopper of powder material, and an advanced position in which it lies above the bottom die of the ceramic die and releases the powder material into the forming cavity.

[0008] A drawback of this system consists in the fact that the numerous movements of the filler box create long dead times during the ceramic die operation which, inevitably, limit the productivity of the whole system.

[0009] With the aim of overcoming the mentioned drawback, in-line plants have been devised to realise precompacted slabs of powder ceramic material, which are then supplied to the forming cavity of the die.

[0010] These plants generally comprise a horizontal conveyor line which advances a sequence of rest platforms through a series of work stations.

[0011] The work stations comprise one or more supply stations, a compacting station and a transfer station.

[0012] The supply stations release a plurality of overlying layers of powder ceramic material on each platform, forming a soft slab.

[0013] The compacting station compacts the soft slab so as to eliminate the air contained therein and obtain a pre-compacted slab.

[0014] The transfer station then transfers the pre-compacted slab internally of the forming chamber of the ceramic die.

[0015] A requirement of these in-line plants is that in the soft slab decorations are made, in order to improve the appearance of the finished product, as happens in traditional-type plants.

[0016] To realise these decorative motifs, the layer of the soft slab which is destined to remain in sight in the finished tiles is generally obtained using coloured ceramic powders which are distributed according to a predetermined design.

[0017] For this reason, the supply station for realising the above-mentioned layer is often provided with special dispensing heads, which move above the rest element such as to reproduce the desired designs.

[0018] A characteristic of these heads is that they realise designs generally having poorly-defined and hazy edges which are suitable, for example, for reproducing the veins which are typical of natural stone, but are not suitable for obtaining the sharp figures typical of geometrical decorations.

[0019] In particular, the heads do not enable a satisfactory production of the design known as mosaic, i.e. the decorations formed by a group of adjacent zones having different colours and well-delimited edges.

[0020] An aim of the present invention is to obviate the above-described drawback by offering a simple, rational and inexpensive solution.

[0021] The aim is attained by the invention as it is characterised in the independent claims.

[0022] In particular a method for manufacturing ceramic tiles is provided, in which the realisation of the soft slab of powder ceramic material comprises stages of:

horizontally advancing a rest surface in a predetermined operating direction;
resting a shaped body on the rest surface 13 which shaped body is provided with separating elements which define a plurality of cells;
depositing a powder ceramic material internally of each cell of the shaped body;
distancing the shaped body from the rest surface such as to leave a layer of ceramic powder material on the rest surface.

[0023] Thanks to this solution, the above-mentioned layer is formed in plan view by a plurality of adjacent zones of ceramic powders, which reproduce the shape of the cells of the separating grid and are separated by neat and precise edge lines.

[0024] Thus, by specially shaping the cells of the shaped body and distributing ceramic powders in them which ceramic powders have at least one different characteristic, for example a different colour, a variegated layer is left on the rest surface which can realise any geometric decoration, and in particular, but not only, any mosaic decoration.

[0025] In particular, each of the cells of the shaped body can be filled with ceramic material of a different colour to the powder in the adjacent cells, or one or more adjacent cells can be filled with material of the same colour, according to the geometrical design that is to be realised.

[0026] The method of the invention further enables realisation of both ceramic tiles decorated throughout and tiles decorated only on the surface which will be visible when laid.

[0027] In the first case the variegated layer deposited

by means of the shaped body constitutes the entire thickness of the soft slab destined to realise the tiles.

[0028] In the second case, the variegated layer realises only the surface destined to remain in view of the tile, and the thickness of the soft slab is therefore completed with at least a second layer of ceramic material generally having less aesthetically appealing characteristics.

[0029] The second layer can be deposited directly over the variegated layer; or it can be made first, such as to define the rest surface upon which the variegated layer will subsequently be laid.

[0030] According to the invention, the above-described method can be carried out using a plant comprising:

a conveyor for horizontally advancing a rest surface in an operating trajectory;
a shaped body provided with separating elements which define a plurality of cells;
means for moving for resting the shaped body on the rest surface and for raising the body with respect to the surface, and
means for loading for depositing powder ceramic material in the cells of the shaped body, such as to leave a layer of powder ceramic material on the rest surface.

[0031] Finally, the invention makes available a device for depositing powder ceramic material on a horizontally translating rest surface.

[0032] The device comprises a shaped body provided with separating elements which define a plurality of cells, means for moving for moving the shaped body in a vertical direction, and means for loading for releasing a powder ceramic material internally of the cells of the grid-shaped body.

[0033] Further characteristics and advantages of the invention will emerge from a reading of the following description, provided by way of non-limiting example, with the aid of the accompanying figures of the drawings, in which:

- figure 1 is a schematic view of a plant of the invention;
- figure 2 is a perspective view of a platform for receiving a soft slab of ceramic material;
- figure 3 is the view indicated by III in figure 2;
- figure 4 is a perspective view of the decorating station denoted by 3 in figure 1;
- figure 5 is a plan view of the station of figure 4;
- figure 6 is the view indicated by VI in figure 5;
- figure 7 is section VII-VII of figure 6;
- figure 8 is a perspective view showing the lower surface of the shaped body 21 belonging to the depositing device 20 at the station of figure 4;
- figure 9 is section IX-IX of figure 8;
- figure 10 is an exploded perspective view of some parts of the means for loading 27 of the depositing device 20;
- figure 11 is an exploded perspective view of some other components of the means for loading 27 of the depositing device 20;
- figure 12 is a perspective view of the means for moving 26 of the laying device 20;
- figure 13 is a plan view of the means of figure 12;
- figure 14 is the view XIV of figure 13, with some parts removed better to evidence other details of the invention;
- figure 15 is section XV-XV of figure 5;
- figure 16 is an enlarged detail of figure 15;
- figures from 17 to 20 are a detail of figure 7 shown during four stages of functioning of the depositing device 20;
- figure 21 is a section made along a vertical plane of a platform for receiving the soft slab, in a preferred embodiment of the invention;
- figure 22 is the platform of figure 21 during the laying stage of the powder ceramic material in the decoration station 3 of the plant of figure 1;
- figure 23 is the same section as in figure 7, but relating to a decorating station 3 of a further embodiment;
- figure 24 is an exploded view in perspective elevation of the means for loading 27 of the decorating station illustrated in figure 23;
- figure 25 is an exploded view in perspective elevation of a means for dispensing 65 belonging to the means for loading illustrated in figure 24.

[0034] The plant 1 for manufacturing ceramic tiles illustrated in the figures comprises a conveyor 2 which horizontally advances a sequence of platforms 10 through a series of work stations, stopping it at each of them.

[0035] In the illustrated example, the conveyor 2 is constituted by a conveyor belt, although it might be substituted by any other suitable conveying system having the same functional characteristics.

[0036] The work stations comprise two supply stations, respectively a decorating station 3 and a finishing station 4, which are overall aimed at realising a soft slab of ceramic powder on each platform 10.

[0037] In particular, the decorating station 3 deposits the layer of powder material on the station which powder material is destined to remain in sight in the finished tile.

[0038] The second station, the finishing station 4, deposits a second layer of powder ceramic material above the one deposited by the decoration station 3, such as to complete the width of the soft slab.

[0039] Downstream of the finishing station 4 is a compacting station 5, which is provided with a press 9 for compacting the soft slab in order to remove the air contained therein and to obtain a transportable compacted slab.

[0040] Finally, downstream of the compacting station 5 there is a transfer station 6 in which means of known type are installed for transferring each compacted slab

towards the cavity of a ceramic die 7, where it is subjected to the real pressing operation before being sent on to the drying and final firing stages.

[0041] As shown in figures 2 and 3, each platform 10 comprises a broadened base 11 at the centre of which a punch 12 is fixed, an upper face of which defines a horizontal rest surface 13 for the powder ceramic material.

[0042] In the illustrated example, the punch 12 has a rectangular plan, but it could also be square or any other shape.

[0043] The punch 12 is snugly inserted in a relative containing matrix 14, which is vertically mobile with respect to the underlying broadened base 11.

[0044] In particular, the containing matrix 14 is provided with a series of vertical stems 15 projecting from the lower surface thereof, each of which stems 15 is contained in a respective hollow cylinder 16 fixed to the broadened base 11.

[0045] The vertical stems 15 project below the broadened base 11 without interfering with the conveyor belt 2.

[0046] Commanded means for retaining (not illustrated) are interposed between each vertical stem 15 and the relative cylinder 16, which generate sufficient friction to prevent any undesired vertical movement of the containing matrix with respect to the punch 11.

[0047] The vertical motions of the containing matrix 14 are caused by special raising devices 8, comprising for example a series of jacks, which are positioned below the conveyor belt 2 and act on projecting tracts of the vertical stems 15 (see figure 1).

[0048] In particular the raising devices 8 are located at both supply stations 3, 4 of the powder ceramic material.

[0049] As shown in figure 4, the decorating station 3 is provided with a special device for depositing the powder ceramic material, denoted in its entirety by 20.

[0050] The depositing device 20 comprises a grid-shaped body 21 which is positioned horizontally and located higher than the underlying rest surface 13 of the platform 10.

[0051] The grid-shaped body 21 (see figure 8) comprises a grid of vertically-developing separating walls 23, which define a substantially rectangular perimeter frame 22 an internal space of which is sub-divided into a plurality of separate cells 24.

[0052] The frame 22 exhibits, in plan view, a lateral perimeter having a same shape and substantially same dimensions as the plan-view perimeter of the punch 12 of the platform 10, such as to be snugly insertable inside the matrices 14.

[0053] The lower edges of the separator walls 23 are all positioned at a same height, such as to contemporaneously rest on the rest surface 13.

[0054] Further, the transversal section of the separating walls 23 exhibits a tapered lower end, such that the thickness at the lower edge is minimal, preferably around a few tenths of millimetres (see figure 9).

[0055] The grid-shaped body 21 is fixed to a support frame 21' by which it is connected to a rigid support frame 25.

[0056] The rigid support frame 25 is associated to means 26 for moving the shaped body 21 in a vertical direction with respect to the underlying rest surface 13.

[0057] Means for loading, denoted in their entirety by 27, are located on the support frame 25, which means for loading release a powder ceramic material into each cell 24 of the grid-shaped body 21.

[0058] In particular, the means for loading 27 can release a different-coloured ceramic material into each cell 24, or can release ceramic material of the same colour into one or more adjacent cells 24, according to the decoration that is to be realised.

[0059] As illustrated in figure 10, the means for loading 27 comprise a hopper 28 for the powder ceramic material, which exhibits a profile in plan view that coincides with the plan-view profile of the perimeter frame 22 of the grid-shaped body 21 and which is located vertically above the grid-shaped body 21 itself.

[0060] The internal volume of the hopper 28 is subdivided by a grid of separating walls 29 of a same height which define a plurality of distinct vertically-developing container cells 30, each of which contains a powder ceramic material.

[0061] In particular, the separating walls 29 of the hopper 28 are arranged, in plan view, to form a grid having a same shape and dimensions as the grid of separating walls 23 of the grid-shaped body 21.

[0062] The hopper 28 is superiorly closed by a cover 31 exhibiting a series of inlet holes 32, each of which opens internally of a respective container cell 30.

[0063] Sleeves 33 are associated to the inlet holes 32, which sleeves 33, via a series of flexible spiral tubes (not illustrated), are connected to a central supply system of the powder ceramic material.

[0064] The bottom of each container cell 30 is superposed on a respective cell 24 of the grid-shaped body 21, and is open to enable outlet and direct transfer of the ceramic material internally of the cell 24.

[0065] The hopper 28 is associated to means for selectively opening and closing the bottom of the container cells 30 of the powder ceramic material.

[0066] The means comprise a first perforated slab 35 which closes the bottom of the hopper 28 such as to intercept all of the container cells 30, and an underlying second perforated slab 36 facing and in contact with the first perforated slab 35.

[0067] The first and second perforated slabs 35, 36 are reciprocally slidable between an open configuration, in which they make available a plurality of passages for the powder ceramic material, and a closed position, in which they completely close the passages.

[0068] In particular, the second perforated slab 36 is solidly fixed to the support frame 25, while the first perforated slab 35 is fixed to the hopper 28 which is mounted on the support frame 25 by means of two sliding guides

37 which enable it to move in horizontal directions.

[0069] The movements are commanded by special actuator means 38 which move the hopper 28 alternatingly in a short run between the open and closed positions.

[0070] In the illustrated example, the actuator means 38 comprise a pneumatic jack installed on the support frame 25, such as to act on a lateral flank of the hopper 28.

[0071] As illustrated in figure 11, the means for loading 27 further comprise a vibrating frame 39, located below the perforated slabs 35, 36, which vibrating frame 39 is connected to the support frame 25 by means of elastic suspension means, for example strips of soft and amorphous rubber.

[0072] The vibrating frame 39 is substantially frame-shaped, and exhibits a shape in plan view that coincides with the plan-view shape of the frame 22 of the grid-shaped body 21, and is vertically superposed thereon.

[0073] The vibrating frame 39 frames a sieve 40 which is therefore interposed between the outlet bottom of the container cells 30 of the powder ceramic material and the cells 24 of the grid-shaped body 21.

[0074] In more detail, the internal space of the vibrating frame 39 is subdivided by a grid of separating walls 41 into a plurality of separate areas 42, each of which communicates with a respective cell 24 of the grid-shaped body 21 and is closed by the sieve 40.

[0075] The separating walls 41 are arranged in plan view to form a grid having the same shape and dimensions as the grid of separating walls 23 of the grid-shaped body 21, and have a vertical development which is greater than the thickness of the sieve 40, which is in an intermediate position with respect to the height thereof.

[0076] The vibrating frame 39 is vibrated by a usual pair of vibrators 43 which generate a vertical oscillation of the frame 39 on the support frame 25.

[0077] In the illustrated example, the vibrators 43 are electromechanical with counter-rotating cams, with a vertical and/or horizontal resultant of the centrifugal force.

[0078] The vibration induced by the vibrators can be adjusted by acting on the angular position of the eccentric masses with respect to the rotating shaft, or by varying the rotation velocity of the motor.

[0079] Alternatively, the vibrators 43 can be of the electromagnetic type with the casing fixed to the support frame 25 and the vibrating part fixed to the vibrating frame 39.

[0080] The vibration induced by the electromagnetic vibrators can be adjusted by varying the distance between the casing and the vibrating part, or by varying the current intensity of the coil using appropriate potentiometer systems.

[0081] As illustrated in figure 11, the means for loading 27 comprise a vertically-developing distancing tunnel 44, having an upper end which is fixed to the support frame 25 and a lower end which is fixed to the support frame 21' of the grid-shaped body 21.

[0082] The distancing tunnel 44 comprises an external casing 45 which exhibits a profile in plan view which coincides with the plan-view profile of the frame 21' to which it is fixed.

[0083] The internal volume of the casing 45 is subdivided by a grid of vertical partition walls 46 of a same height which define a plurality of distinct vertically-developing drop chutes 47, each of which sets the outlet of a respective container cell 30 in communication with a respect cell 24 of the grid-shaped body 21 such as to guide the relative powder ceramic material in descent.

[0084] In particular, the partition walls 46 of the external casing 45 are arranged in plan view to form a grid having the same shape and dimensions as the grid of separating walls 23 of the grid-shaped body 21.

[0085] The distancing tunnel 44 is transversally subdivided into a plurality of identical superposed modular segments 48, which can be mounted and dismounted to vary the overall height of the distancing tunnel 44.

[0086] As illustrated in figure 12, the means 26 for moving the depositing device 20 comprise a translating group 49 on which the support frame 25 of the grid-shaped body 21 is mounted, and means for activating 50 for vertically moving the translating group 49.

[0087] The translating group 49 comprises a flat rectangular frame 51, internally of which a support scaffold 52 is fixed, for the support frame 25 of the grid-shaped body 21.

[0088] The support scaffold 52 comprises four vertical columns 53 arranged substantially at the corners of the rectangle, which four columns 53 are inferiorly fixed to the flat frame 51 and are reciprocally joined at the top thereof by four horizontal beams 54.

[0089] The support frame 25 rests on two opposite horizontal beams 54, each of which is provided with two upwardly-projecting vertical pins 55 which slidably insert in a respective through-hole 56 in the support frame 25 (see also figure 11).

[0090] The vertical pins 55 project above the support frame 25, where they exhibit a broadened head 57 which compresses a respective elastic suspension, in the present embodiment a spring, against the upper surface of the support frame 25 (see figures 15 and 16).

[0091] In this way, the slidable connection between the pins 55 and the holes 56 enables the support frame 25 to perform small movements in a vertical direction with respect to the support scaffold 52.

[0092] These movements are limited as far as rising is concerned by the elastic suspensions 58, while as far as lowering is concerned they are limited by the resting contact between the support frame 25 and the horizontal beams 54 of the support scaffold 52.

[0093] As illustrated in figures 13 and 14, the means for activating 50 which vertically move the translating group 49 comprise a first and a second rotating shaft, respectively 59 and 60, which are arranged parallel along two opposite sides of the flat rectangular frame 51.

[0094] Two identical pairs of cams 61 are keyed on the rotating shafts 59, 60, each of which cams 61 acts against a relative cam follower 62 which projects from the side

of the flat frame 51 adjacent thereto.

[0095] The cams 61 keyed on a same rotating shaft 59 are perfectly in phase with one another and are specularly arranged with respect to the cams 61 keyed on the opposite shaft 60.

[0096] The first and the second rotating shafts 59, 60 are mechanically connected by two identical articulated systems 63.

[0097] The articulated systems 63 are configured such as to engage the rotating shafts 59, 60 to rotate in opposite directions at equal angles.

[0098] Both the rotating shafts 59, 60 are activated by a same motor 64, which is keyed at an intermediate point of the first rotating shaft 59.

[0099] When the rotating shafts 59, 60 are activated, the respective cams 61 rotate in opposite directions, raising or lowering the flat frame 51, keeping it constantly parallel to itself.

[0100] There follows an illustration of the operation of the depositing device 20, with reference to figures from 17 to 20.

[0101] The platform 10 reaches the decorating station 3 with the container matrix 14 located proximal to the rest surface 13 of the punch 12, and stops exactly below the grid-shaped body 21.

[0102] The means for moving 26 the depositing device 20 lower the grid-shaped body 21 onto the rest surface 13, locating it internally of the container matrix 14.

[0103] Thanks to the soft connection between the support scaffold 52 and the support frame 25, which enables the support frame 25 to make small movements in a vertical direction, the grid-shaped body 21 is lowered up until it completely rests on the rest surface 13, compensating for any small planarity irregularities thereof and enabling the device 20 to adapt to any height of the punch 11.

[0104] The grid-shaped body 21 sub-divides the rest surface 13 into a plurality of distinct and separate zones, which are delimited by the vertically-developing separating walls 23 and by the perimeter frame 22.

[0105] Each container cell 30 of the hopper 28 is filled with a powder ceramic material having a different colour to the colour in the adjacent container cells 30.

[0106] At this point, the hopper 28 is shifted into the open position, so that the perforated slabs 35, 36 which intercept the outlets of the container cells 38 define a series of passages from which the powder ceramic material falls by force of gravity in a downwards direction.

[0107] The ceramic material exiting from each container cell 30 passes onto the sieve 40, remaining separate from the other materials thanks to the separating walls 41 of the vibrating frame 39.

[0108] During this stage the vibrating frame 39 is vibrated by the vibrators 43 so that the sieve 40 uniformly distributes the material over the whole of the relative area 22 and generates a plurality of substantially vertical lines of material which fall down onto the underlying rest surface 13 through the distancing tunnel 44.

[0109] In the distancing tunnel 44 too, the ceramic materials coming from each container cell 33 remain completely isolated from one another, being guided by the relative drop chute 47 and separated by the partition walls 46.

[0110] The function of the distancing tunnel 44 is to impart on the powder ceramic material a kinetic energy which is sufficient so that following the impact on the rest surface 13 it spreads over the whole area defined by the relative cell 24 of the grid-shaped body 21.

[0111] The height of the distancing tunnel 44 therefore depends substantially on the type of powder material used and can be varied by selecting the number of modular segments 48 it is made up of.

[0112] When the powder ceramic material reaches the rest surface 13, it creates thereon a variegate layer formed by a plurality of distinct zones located side-by-side and having different colours.

[0113] During this stage, as the material gradually deposits on the rest surface 13, the raising devices 8 located below the conveyor belt 2 progressively raise the container matrix 14 with respect to the punch 12 so that a lateral border is delimited for the material (see figure 19).

[0114] After the depositing operation has concluded, the means for moving 36 raise the grid-shaped body 21 and distance it from the rest surface 13, such as to leave the variegated layer of ceramic material thereon.

[0115] Following this raising movement, a certain mixing of the powder ceramic material of each zone occurs, with the material of the adjacent zones.

[0116] However, thanks to the very thin lower edge of the separating walls 23, this mixing phenomenon is so tiny as to be practically imperceptible, the result being that the zones appearing on the rest surface are distinct and very well delimited.

[0117] Alternatively during the powder ceramic material depositing stage on the rest surface 13, the container matrix 14 can be made to remain stationary at the level of the rest surface 13 itself.

[0118] After the depositing operation has been completed, the means for activating (not illustrated as of usual type) could lower the punch 12 with respect to the grid-shaped body 21 which stays still, such as to distance the grid-shaped body 21 from the rest surface 13, leaving thereon the variegated layer of ceramic material.

[0119] After the variegated layer has been realised on the rest surface 13, the conveyor belt 2 advances the platform 10 and stops it at the finishing station 4, where at least a further layer of powder ceramic material is deposited onto the variegated layer in order to complete the soft slab.

[0120] Usual means for loading powder ceramic material can be located in the finishing station 4, for example a simple hopper provided with a closing hatch.

[0121] The finishing layer is obtained using ceramic material having generally inferior qualities with respect to the material used to make the variegated layer, as it is destined to remain in the hidden part of the finished tile.

[0122] During this stage, the raising device 8 further

raises the container matrix 14 with respect to the punch 12, in order to restrain the new powder material laterally too.

[0123] Then the platform 10 with the soft slab passes on to the compacting station 5, and stops below the press which performs the compacting.

[0124] In particular, the crossbar of the press 9 supports a press plate 90 which is larger than the container matrix 14 which, during the compression, is pushed downwards, overcoming the friction which normally keeps it in position.

[0125] Finally, the platform 10 passes on to the transfer station 6, where the compacted slab is removed and transferred to the ceramic die 7 in order to be subjected to the true pressing process.

[0126] Figure 23 illustrates a further embodiment of the decorating station 3, in which the depositing device 20 of the powder ceramic material is constructionally simpler and more economical and further renders the depositing stage of the ceramic material on the rest surface 13 of the platform 10 more reliable

[0127] The depositing device 20 of this embodiment differs from the previously-described device only regarding the means for loading 27 which release the powder ceramic material internally of each cell 24 of the grid-shaped body 21.

[0128] In particular, the means for loading 27 still comprise the vertically-developing distancing tunnel 44, which exhibits a top end which is fixed to the support frame 25 and a bottom end which is fixed to the support frame 21' of the grid-shaped body 21.

[0129] As illustrated in figure 24, the distancing tunnel 44 comprises an external casing 45 which exhibits a plan-view profile which coincides with the plan-view profile of the frame 21', and a volume of which is sub-divided by a net of vertical partition walls 46 of a same height in a plurality of distinct vertically-developing drop chutes 47, each of which surmounts and is set in communication with a respective cell 24 of the grid-shaped body 21.

[0130] The distancing tunnel 44 is directly associated to a plurality of distinct devices 65 for dispensing the powder ceramic material, which devices 65 each open internally of a respective drop chute 47, where they can release a powder ceramic material having a different colour with respect to the colour released into the adjacent drop chutes 47.

[0131] Each dispensing device 65 is associated to a respective flexible tube 66, by means of which it is connected to a centralised system (not illustrated) for supplying the powder material.

[0132] As illustrated in figure 25, each dispensing device 65 comprises a rigid tube 67 having a top end thereof coupled with the flexible tube 66, and a bottom end 68 thereof inserted internally of a funnel-shaped body 69, which in turn is partially inserted from above into the respective drop chute 47 of the distancing tunnel 44.

[0133] Each dispensing device 65 further comprises a mobile obturator, in the example a tilting shutter 70, which is hinged to the body of the rigid tube 67, and is connected to a relative actuating jack 71, such as to be able to oscillate selectively between an open position and a closed position at the bottom end 68.

[0134] In particular, the tilting shutter 70 is partially contained internally of the upper mouth of the funnel body 69, which is directly fixed to the body of the relative rigid tube 67 (see figure 24).

[0135] As illustrated in figure 23, all the dispensing devices 65 are mounted on a single support structure 72, which is fixed to the support frame 25 in such a way that the dispensing devices 65 move solidly together with the distancing tunnel 44, during the raising and the lowering of the depositing device 20.

[0136] The support structure 72 preferably comprises a sheet steel casing which closes and therefore protects the dispensing devices 65.

[0137] The functioning of the loading device 20 in this embodiment is almost entirely similar to the one described herein above, with the sole difference being that the depositing of the powder ceramic material on the rest surface 13 of the platform 10 is controlled by the selective opening and closing of the tilting shutters 70 of the dispensing devices 65.

[0138] In particular, this embodiment does not include a stage of sieving the powder ceramic material as the kinetic energy acquired by the material during the fall thereof in the drop chutes 47 is sufficient to guarantee that it will be distributed on the rest surface 13 over the whole area defined by the relative cell 24 of the grid-shaped body 21.

[0139] Thus a considerable constructional simplification of the depositing device 20 is obtained, which being free of vibrators further enables a more effective and reliable distribution of the ceramic material on the platforms 10.

[0140] There now follows a description of an improvement of the invention which enables the powder ceramic material to be more uniformly distributed on the rest surface 13, effectively preventing the formation of accumulations and thus enabling a layer of a substantially uniform thickness to be created, including at the edges thereof.

[0141] As illustrated in figure 21, in this improvement the upper surface of the punch 12 of the platform 10 exhibits a recess in which a rigid plate 17 made of porous material snugly fits, which rigid plate 17 defines the whole horizontal rest surface 13 for the powder ceramic material.

[0142] The porous plate 17 is made of an undeformable material having a mean pore diameter of generally less than the granulometry of the powder ceramic material, such as to restrain the ceramic powder on the rest surface 13, while at the same time preventing the powder from clogging the pores.

[0143] The porous plate 17 can, for example, be made of sintered steel.

[0144] A plurality of reciprocally-communicating channels is afforded on the bottom of the punch 12 recess,

which develop uniformly over the whole extension of the lower surface of the porous plate 17.

[0145] The grid of channels defines a closed hollow space 18 between the porous plate 17 and the punch 12.

[0146] The hollow space 18 is set in communication with the outside through a passing conduit 19, which is afforded in the punch 12 and opens to the outside at the connection joint to which means for sourcing (not illustrated) are associated, which supply a gas to the hollow space 18.

[0147] The means for sourcing are located at the decorating station 3 and preferably supply air.

[0148] As illustrated in figure 22, during the stage of depositing the powder ceramic material on the part of the device 20 in the decorating station 3, the means for sourcing supply air internally of the hollow space 18.

[0149] The grid conformation of the hollow space 18 enables the air to flow and be distributed below the whole porous plate 17, then to exit freely through the pores thereof.

[0150] In this way, an air current is obtained which diffuses more or less uniformly from the rest surface 13 upwards.

[0151] The air current therefore strikes the ceramic material deposited in each cell 24 of the shaped body 21, causing a remixing of the material which distributes it homogeneously, including at the separating walls 23.

[0152] In conclusion, note that the finishing station 4 could also be located upstream of the decorating station 3.

[0153] In this case, the finishing layer of "poor" material would be deposited first and, thereafter, the variegated layer of coloured material would be laid above the said layer, in the ways described herein above, which layer of coloured material would however be destined to be the in-view part of the finished tile.

[0154] A further point of importance is that the grid-shaped body 21 is dismountable and can therefore be easily substituted by a further similar body having a different shape, in order to obtain a different distribution and/or shape of the zones which are made up of the coloured ceramic material in the variegated layer.

[0155] Finally, in a further embodiment of the plant 1, the compacting station 5 could be absent, and the transfer station 6 could be provided with means of known type for transferring the soft slab of powder ceramic material directly internally of the ceramic die 7, without the soft slab being preliminarily subjected to any compacting stage.

Claims

1. A method for manufacturing ceramic tiles comprising a stage of horizontally advancing a rest surface (13) in an operational trajectory, **characterised in that** it comprises stages of:
   a) resting a grid-shaped body (21) on the rest surface (13), the grid-shaped body (21) being provided with separating walls (23) which define a plurality of cells (24),
   b) depositing a powder ceramic material in the cells (24) of the grid-shaped body (21),
   c) reciprocally distancing the grid-shaped body (21) from the rest surface (13), such as to leave a layer of the powder ceramic material on the rest surface (13).

2. The method of claim 1, **characterised in that** the stage of reciprocally distancing the grid-shaped body (21) from the rest surface (13) comprises a stage of raising the grid-shaped body (21) with respect to the rest surface (13).

3. The method of claim 1, **characterised in that** it laterally contains the layer of powder ceramic material by means of a container frame (14) which advances together with the rest surface (13).

4. The method of claim 2, **characterised in that** it includes locating the grid-shaped body (21) internally of the container frame (14).

5. The method of claim 1, **characterised in that** it includes performing stages a), b) and c) while keeping the rest surface (13) stationary in a same position along the operational trajectory.

6. The method of claim 1, **characterised in that** it comprises a stage of transferring the layer of ceramic material left by the grid-shaped body (21) internally of a cavity of a ceramic die (7).

7. The method of claim 6, **characterised in that** it comprises a stage of compacting the layer of ceramic material left by the grid-shaped body (21), before the stage of transfer thereof internally of the cavity of a ceramic die (7).

8. The method of claim 1, **characterised in that** it comprises a stage of realising at least a further layer of powder ceramic material above the layer of powder ceramic material left by the grid-shaped body (21), such as to form a single slab of powder ceramic material.

9. The method of claim 8, **characterised in that** it comprises a stage of transferring the single slab of powder ceramic material internally of a cavity of a ceramic die (7).

10. The method of claim 9, **characterised in that** it comprise a stage of compacting the single slab of powder ceramic material before the stage of transferring the slab into the cavity of a ceramic die (7).

11. The method of claim 1, **characterised in that** the rest surface is defined by at least a layer of previously-deposited powder ceramic material, the layer of powder ceramic material left by the grid-shaped body forming a single slab of powder ceramic material together with the previously-deposited layer.

12. The method of claim 11, **characterised in that** it comprises a stage of transferring the single slab of powder ceramic material internally of a cavity of a ceramic die (7).

13. The method of claim 12, **characterised in that** it comprises a stage of compacting the single slab of powder ceramic material before the stage of transfer thereof into the cavity of a ceramic die (7).

14. The method of claim 1, **characterised in that** it includes depositing, internally of each cell (24) of the grid-shaped body (21), a powder ceramic material having at least a different characteristic to the material deposited in the adjacent cells (24).

15. The method of claim 14, **characterised in that** the at least a different characteristic of the powder ceramic material is a colour thereof.

16. The method of claim 1, **characterised in that** it comprises a stage of generating a gaseous current which diffuses from the rest surface (13), striking the ceramic material deposited internally of the cells (24) of the grid-shaped body (21).

17. The method of claim 16, **characterised in that** the gaseous current is an air current.

18. A plant for manufacturing ceramic tiles, comprising means for realising a layer of powder ceramic material, the means comprising a conveyor (2) for horizontally advancing a rest surface (13) in an operational trajectory, **characterised in that** the means for realising a slab of ceramic material in powder comprises:

a grid-shaped body (21) provided with separating walls (23) which define a plurality of cells (24),
means for moving (26) for resting the grid-shaped body (21) on the rest surface (13) and for raising it with respect thereto, and
means for loading (27) for depositing a powder ceramic material internally of the cells (24) of the grid-shaped body (21), such as to leave a layer of powder ceramic material on the rest surface (24).

19. The plant of claim 18, **characterised in that** the means for loading (27) are mounted on a support frame (25) which is rigidly fixed to the grid-shaped body (21).

20. The plant of claim 18, **characterised in that** the means for loading (27) comprise a plurality of distinct vertically-developing drop chutes (47), each of which is located above and in communication with a respective cell (24) of the grid-shaped body (21).

21. The plant of claim 20, **characterised in that** the drop chutes (47) are defined by a vertically-developing tubular casing (45) which is provided with partition walls (46) which define the drop chutes (47) internally thereof.

22. The plant of claim 21, **characterised in that** the plan-view arrangement of the partition walls (46) coincides with the plan-view arrangement of the separating walls (23) of the shaped body (21)

23. The plant of claim 20, **characterised in that** the tubular casing (45) is a modular body comprising a plurality of superposed elements, which are dismountable and mountable such as to be able to vary a height of the tubular casing (45).

24. The plant of claim 20, **characterised in that** the means for loading (27) comprise a plurality of distinct container cells (30) of the powder ceramic material, which are located above the drop chutes 47 and which are singly provided with an outlet for the powder ceramic material which outlet is in communication with a respective drop chute (47).

25. The plant of claim 24, **characterised in that** the container cells (30) are defined by a hopper (28), which hopper (28) is provided with separating walls (29) defining the container cells (30) internally of the hopper.

26. The plant of claim 25, **characterised in that** the plan-view arrangement of the separating walls (29) coincides with the plan-view arrangement of the separating walls (23) of the grid-shaped body (21).

27. The plant of claim 25, **characterised in that** the hopper (28) is superiorly closed by a cover (31) which exhibits a series of holes (32), each of which opens internally of a respective container cell (30) for inlet of the powder ceramic material.

28. The plant of claim 25, **characterised in that** means for selectively opening and closing (36, 37) the outlets of the container cells (30) of the powder ceramic material are associated to the hopper (28).

29. The plant of claim 28, **characterised in that** the means comprise a first perforated slab (36) fixed to

the hopper (28) such as to intercept the outlet of all the container cells (30), a second perforated slab (37) facing the first perforated slab (36), and actuator means (38) for sliding the first and second perforated slabs (36, 37) reciprocally between an open configuration, in which they provide a plurality of passages for the powder ceramic material, and a closed position, in which they close the passages.

30. The plant of claim 29, **characterised in that** the second perforated slab (37) is fixed to the support frame (25) of the grid-shaped body (21), and **in that** the actuator means (38) move the hopper (28) with respect to the support frame (25).

31. The plant of claim 24, **characterised in that** the means for loading (27) comprise a vibrating frame (39) for supporting a sieve (40) which sieve (40) is interposed between the outlets of the container cells (30) and the grid-shaped body (21).

32. The plant of claim 31, **characterised in that** the vibrating frame (39) is frame-shaped and is provided with separator walls (41) which define a plurality of separate areas (41) internally of the frame, each of the areas being intercepted by the sieve (40) and being in communication with a respective cell (24) of the grid-shaped body (21).

33. The plant of claim 28, **characterised in that** the plan-view arrangement of the separator walls (41) coincides with the plan-view arrangement of the separating walls (23) of the grid-shaped body (21).

34. The plant of claim 20, **characterised in that** the means for loading (27) comprise a plurality of distinct devices (65) for dispensing powder material, each of which dispenses powder material internally of a respective drop chute (47) and is provided with mobile obturator means (70) for selectively enabling or preventing passage of the powder material.

35. The plant of claim 18, **characterised in that** the means for moving (26) comprise a translating group (49) on which a support frame (25) is mounted, which support frame (25) is fixed to the grid-shaped body (21), and means for activating (50) which move the translating group (49) in a vertical direction.

36. The plant of claim 35, **characterised in that** the support frame (25) of the grid-shaped body (21) is mounted on the translating group (49) by means for connecting (55-58) which enable the support frame (25) to perform movements in a vertical direction with respect to the translating group (49).

37. The plant of claim 36, **characterised in that** the means for connecting comprise a plurality of elastic suspensions (58).

38. The plant of claim 35, **characterised in that** the means for activating (50) comprise two cam systems (59, 60, 61) which translate a rotary motion of a respective rotating shaft (59, 60) into a vertical translation of the translating group (49), the rotating shafts (59, 60) being activated by a same motor (64) and being mechanically connected to one another by at least an articulated system (63) which causes them to rotate identically in opposite directions.

39. The plant of claim 18, **characterised in that** the means for realising a slab of powder ceramic material comprise means for depositing at least a layer of powder ceramic material above the layer of powder ceramic material left by the grid-shaped body (21).

40. The plant of claim 18, **characterised in that** the means for realising a slab of powder ceramic material comprise means for depositing at least a layer of powder ceramic material on the conveyor (2), which layer of powder ceramic material defines the rest surface (13).

41. The plant of claim 18, **characterised in that** it comprises a press (9) for compacting the slab of powder ceramic material on the conveyor (2).

42. The plant of claim 18, **characterised in that** it comprises means for transferring the slab of powder ceramic material internally of a cavity of a ceramic die (7).

43. The plant of claim 18, **characterised in that** the rest surface (13) is inserted in a container frame (14) which laterally retains the powder ceramic material.

44. The plant of claim 43, **characterised in that** the container frame (14) is mobile in a vertical direction with respect to the rest surface (13).

45. The plant of claim 43, **characterised in that** the grid-shaped body (21) inserts snugly internally of the container frame (14).

46. The plant of claim 18, **characterised in that** the rest surface (13) is defined by a porous body (17) which retains the powder ceramic material and is crossed by a flow of gas.

47. The plant of claim 46, **characterised in that** the porous body (17) is associated to a support element (12) with which it defines a hollow space (18) which is placed in communication with an outside environment by means of at least a conduit (19) associated to means for sourcing the gas.

48. The plant of claim 47, **characterised in that** the means for sourcing supply air.

49. A device for depositing powder ceramic material on a horizontally-translating surface (13), **characterised in that** it comprises a grid-shaped body (21) provided with separating walls (23) which define a plurality of cells (24), means (26) for moving the grid-shaped body (21) in a vertical direction, and means for loading (27) for releasing a powder ceramic material internally of the cells (24) of the grid-shaped body (21).

50. The device of claim 49, **characterised in that** the means for loading (27) are mounted on a support frame (25) which is rigidly fixed to the grid-shaped body (21).

51. The device of claim 49, **characterised in that** the means for loading (27) comprise a plurality of distinct vertically-developing drop chutes (47), each of which is located above and in communication with a respective cell (24) of the grid-shaped body (21).

52. The device of claim 51, **characterised in that** the drop chutes (47) are defined by a vertically-developing tubular casing (45) which is provided with partition walls (46) defining the drop chutes (47) internally of the casing (45).

53. The device of claim 52, **characterised in that** the plan-view arrangement of the partition walls (46) coincides with the plan-view arrangement of the grid-shaped body (21).

54. The device of claim 52, **characterised in that** the tubular casing (45) is a modular body comprising a plurality of superposed elements, which are dismountable and mountable such as to vary a height of the tubular casing (45).

55. The device of claim 51, **characterised in that** the means for loading (27) comprise a plurality of distinct container cells (30) for the powder ceramic material, which are located above the drop chutes (47) and which are singly provided with an outlet for the powder ceramic material which is in communication with a respective drop chute (47).

56. The device of claim 55, **characterised in that** the container cells (30) are defined by a hopper (28), which is provided with separating walls (29) which internally define the container cells (30).

57. The device of claim 56, **characterised in that** the plan-view arrangement of the separating walls (29) coincides with the plan-view arrangement of the separating walls (23) of the grid-shaped body (21).

58. The device of claim 56, **characterised in that** the hopper (28) is superiorly closed by a cover (31) exhibiting a series of holes (32), each of which opens internally of a respective container cell (30) for inlet of the powder ceramic material.

59. The device of claim 56, **characterised in that** means (36, 37) for selectively opening and closing the outlets of the container cells (30) of the powder ceramic material are associated to the hopper (28).

60. The device of claim 59, **characterised in that** the means comprise a first perforated slab (36) fixed to the hopper (28) such as to intercept the outlet of all the container cells (30), a second perforated slab (37) facing the first perforated slab (36), and actuator means (38) for reciprocally sliding the first and second perforated slabs (36, 37) between an open configuration, in which a plurality of passages are provided for the powder ceramic material, and a closed position, in which the passages are closed.

61. The device of claim 60, **characterised in that** the second perforated slab (37) is fixed to the support frame (25) of the grid-shaped body (21) and **in that** the actuator means (38) move the hopper (28) with respect to the support frame (25).

62. The device of claim 55, **characterised in that** the means for loading (27) comprise a vibrating frame (39) which supports a sieve (40) interposed between the outlets of the container cells (30) and the drop chutes (47).

63. The device of claim 62, **characterised in that** the vibrating frame (39) is frame-shaped and is provided with separating walls (41) which define a plurality of separated areas internally of the frame, each of the areas being intercepted by the sieve (40) and being in communication with a respective cell (24) of the grid-shaped body (21).

64. The device of claim 63, **characterised in that** the plan-view arrangement of the separator walls (41) coincides with the plan-view arrangement of the separating walls (23) of the grid-shaped body (21).

65. The device of claim 51, **characterised in that** the means for loading (27) comprise a plurality of distinct devices (65) for dispensing the powder material, each of which dispenses powder material internally of a respective drop chute (47), and is provided with mobile obturator means (70) which selectively enable or prevent passage of the powder material.

66. The device of claim 49, **characterised in that** the means for moving (26) comprise a translating group (49) on which a support frame (25) is mounted, which

support frame (25) is fixed to the grid-shaped body (21), and means for activating (50) for moving the translating group (49) in a vertical direction.

67. The device of claim 66, **characterised in that** the support frame (25) of the grid-shaped body (21) is mounted on the translating group (49) by means for connecting (55-58) which enable the support frame (25) to perform movements in a vertical direction with respect to the translating group (49).

68. The device of claim 67, **characterised in that** the means for connecting comprise a plurality of elastic suspensions (58).

69. The device of claim 64, **characterised in that** the means for activating (50) comprise two cam systems (59, 60, 61) which translate the rotating motion of a respective rotating shaft (59, 60) into the vertical translation of the translating group (49), the rotating shafts (59, 60) being activated by a same motor (64) and being mechanically connected to one another by at least an articulated system (63) which causes them to rotate identically in opposite directions.

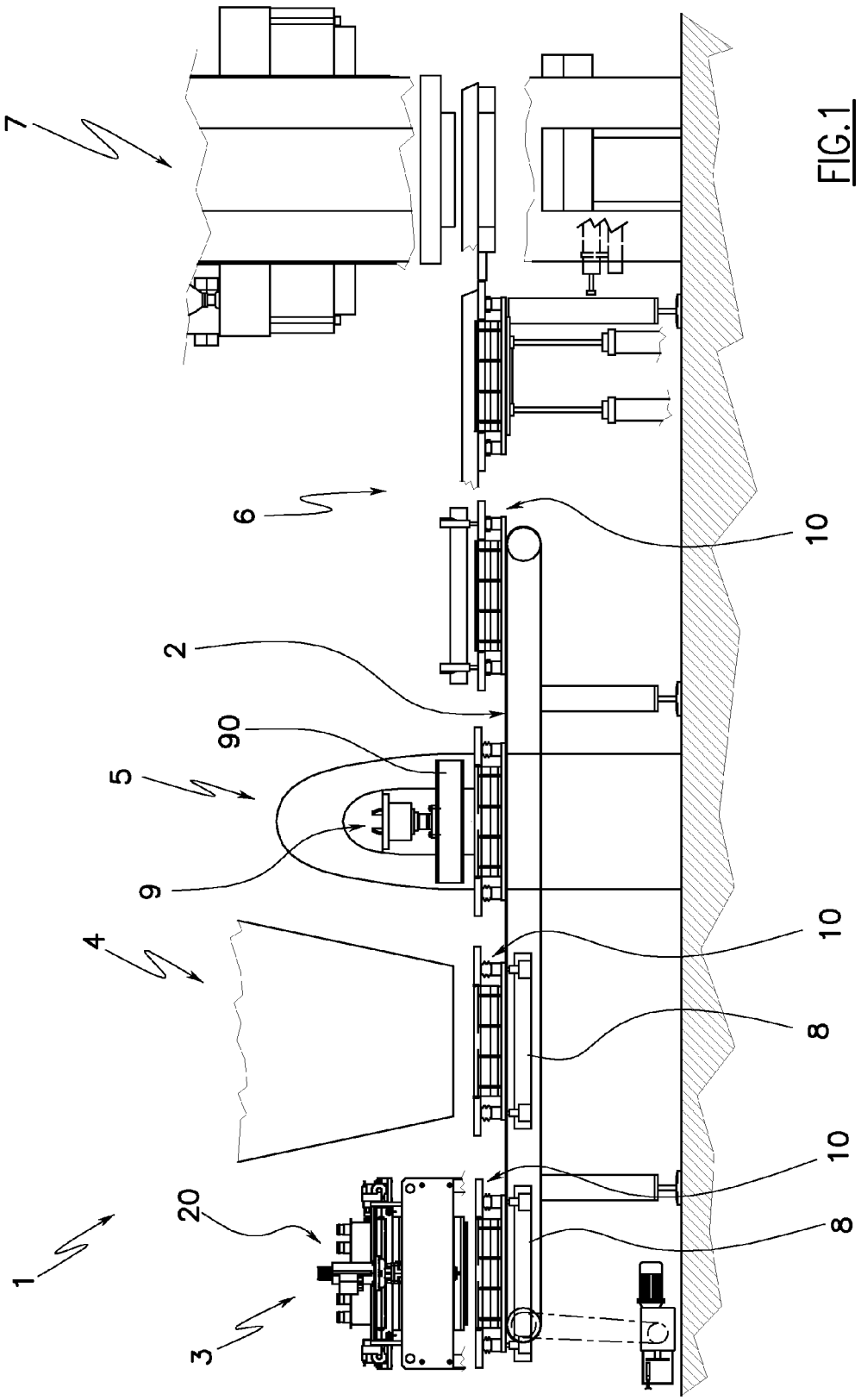

FIG.1

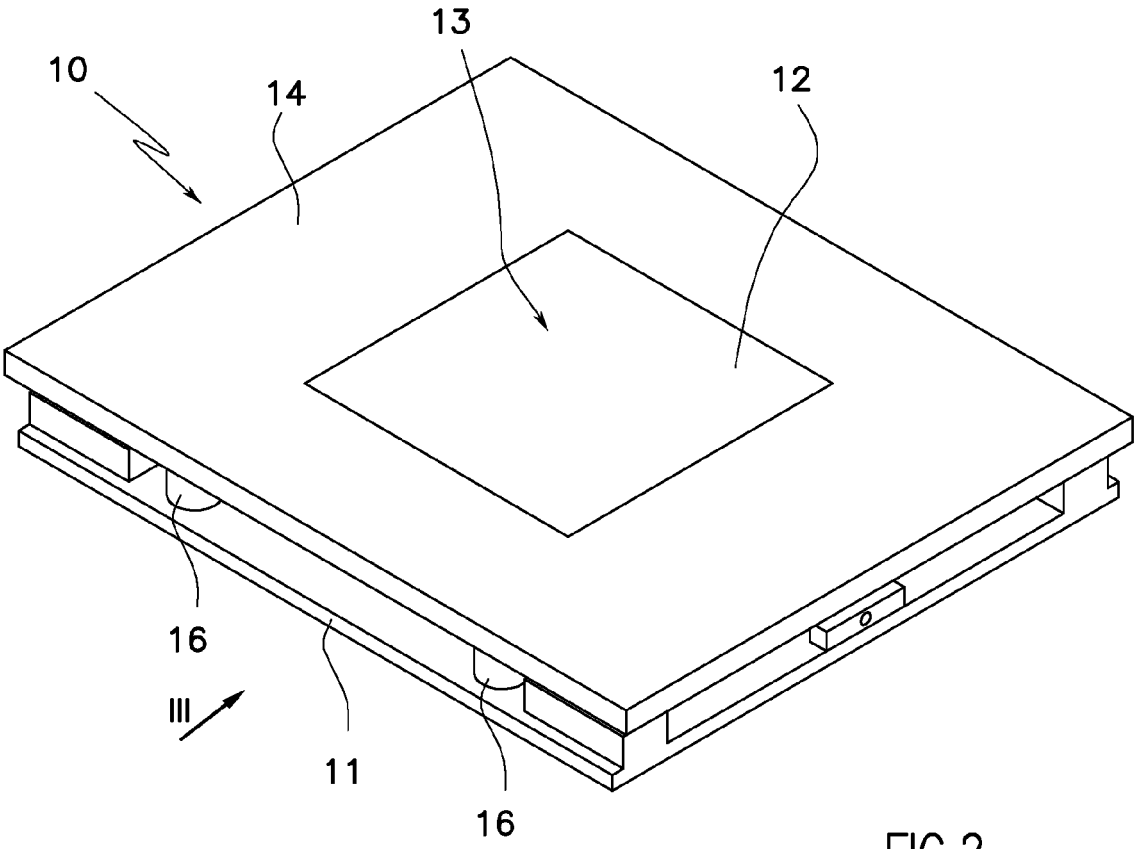

FIG.2

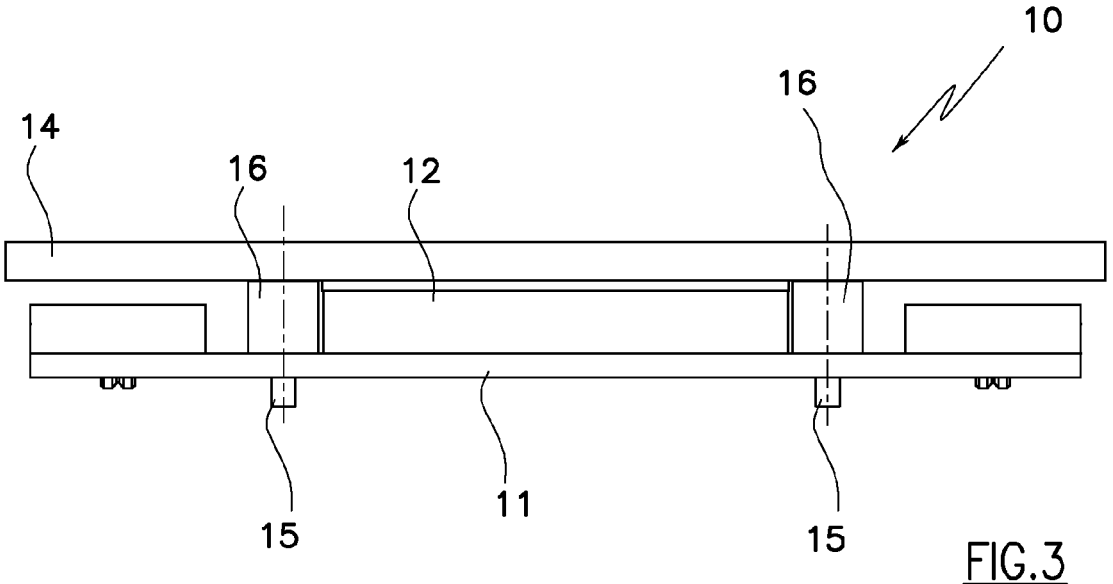

FIG.3

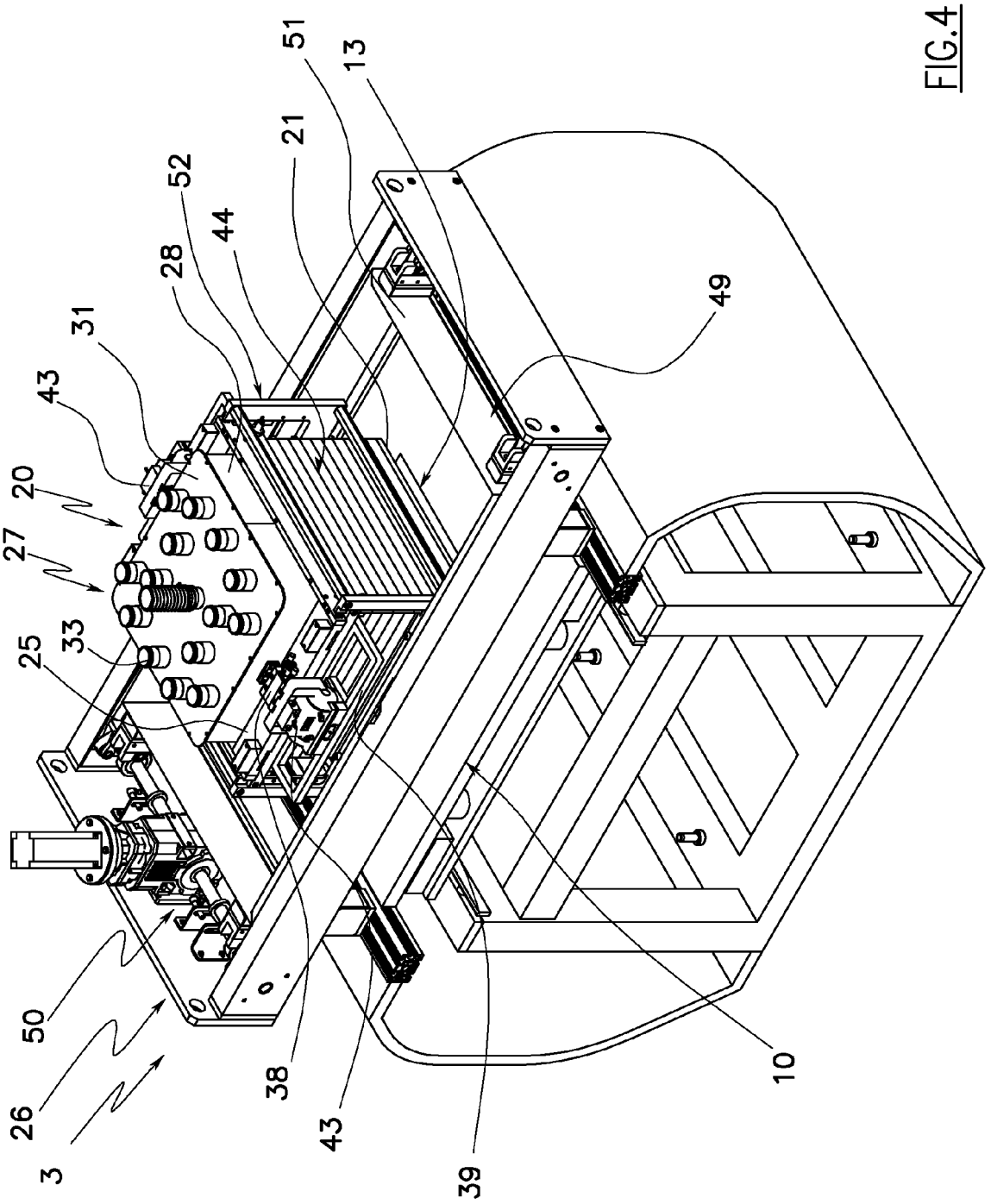

FIG.4

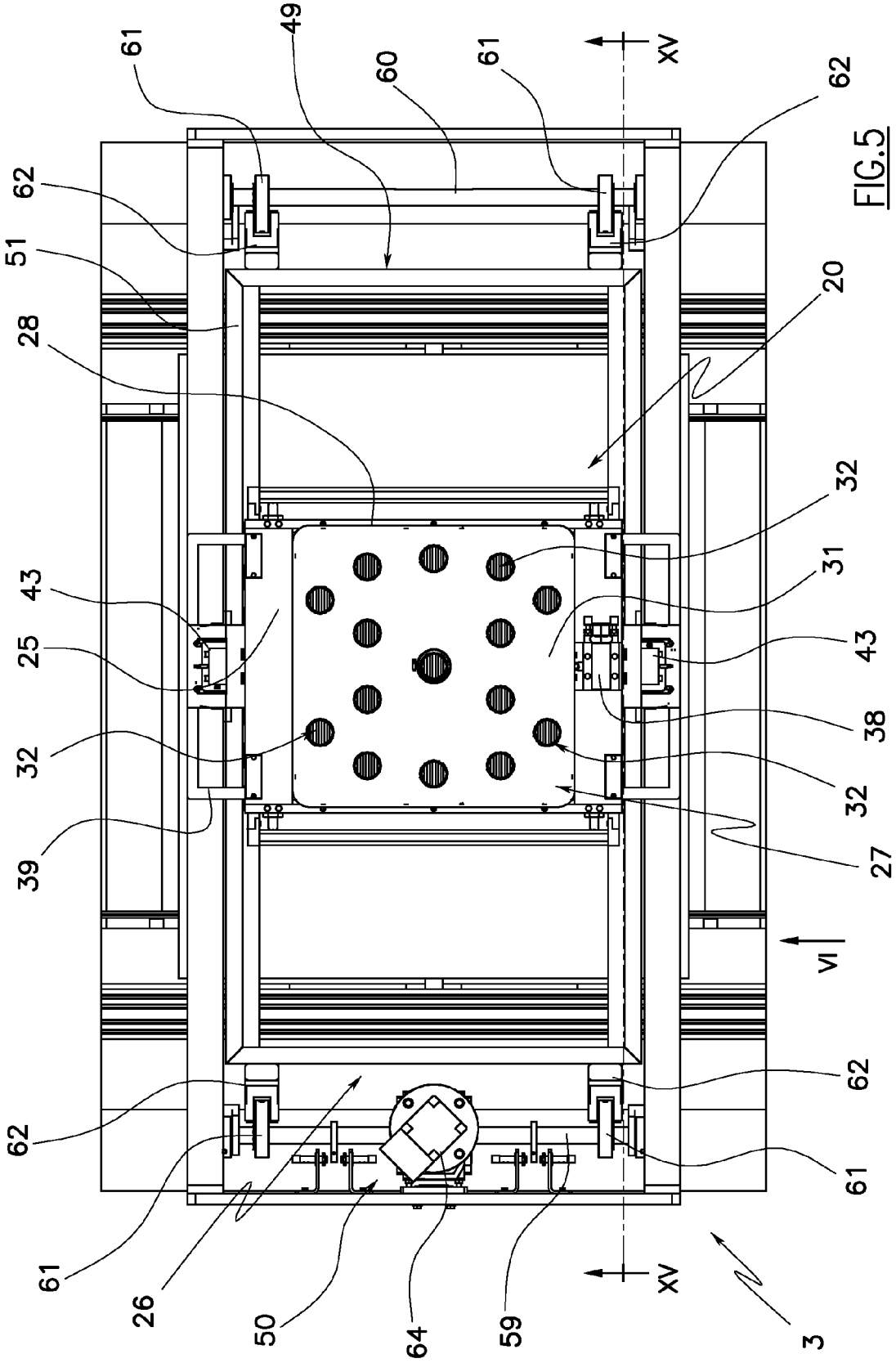
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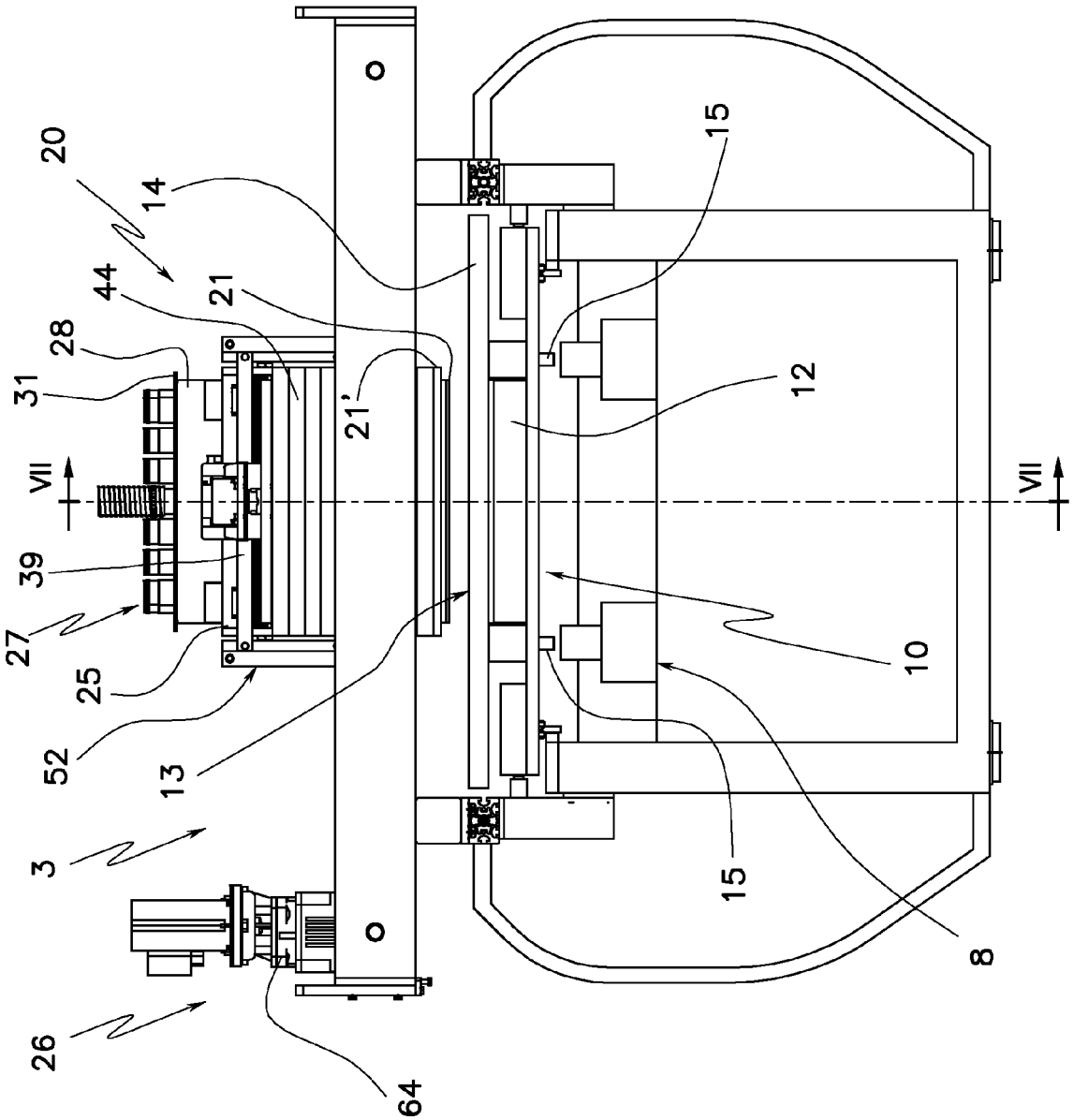
FIG.5

FIG.6



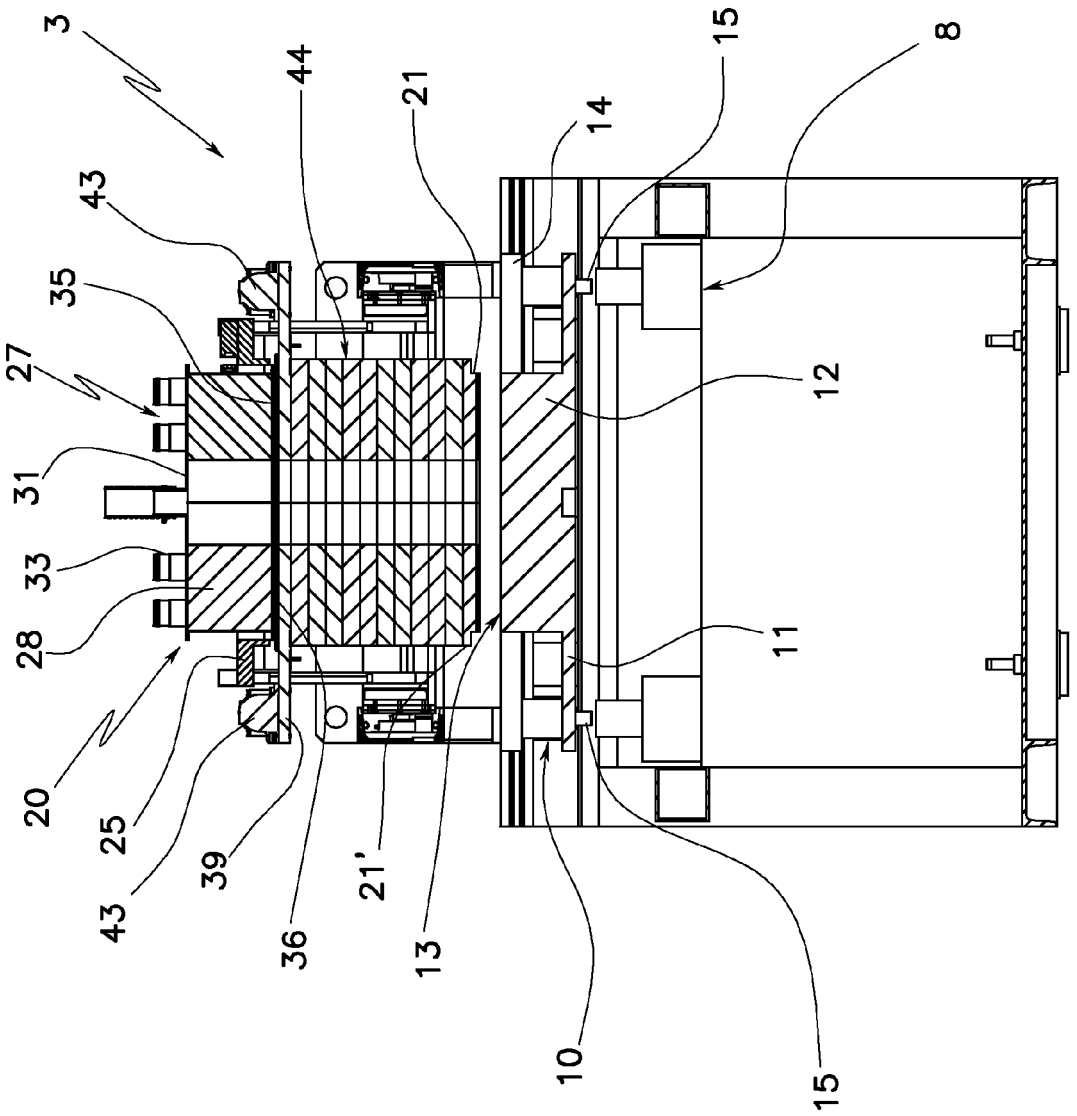


FIG.7

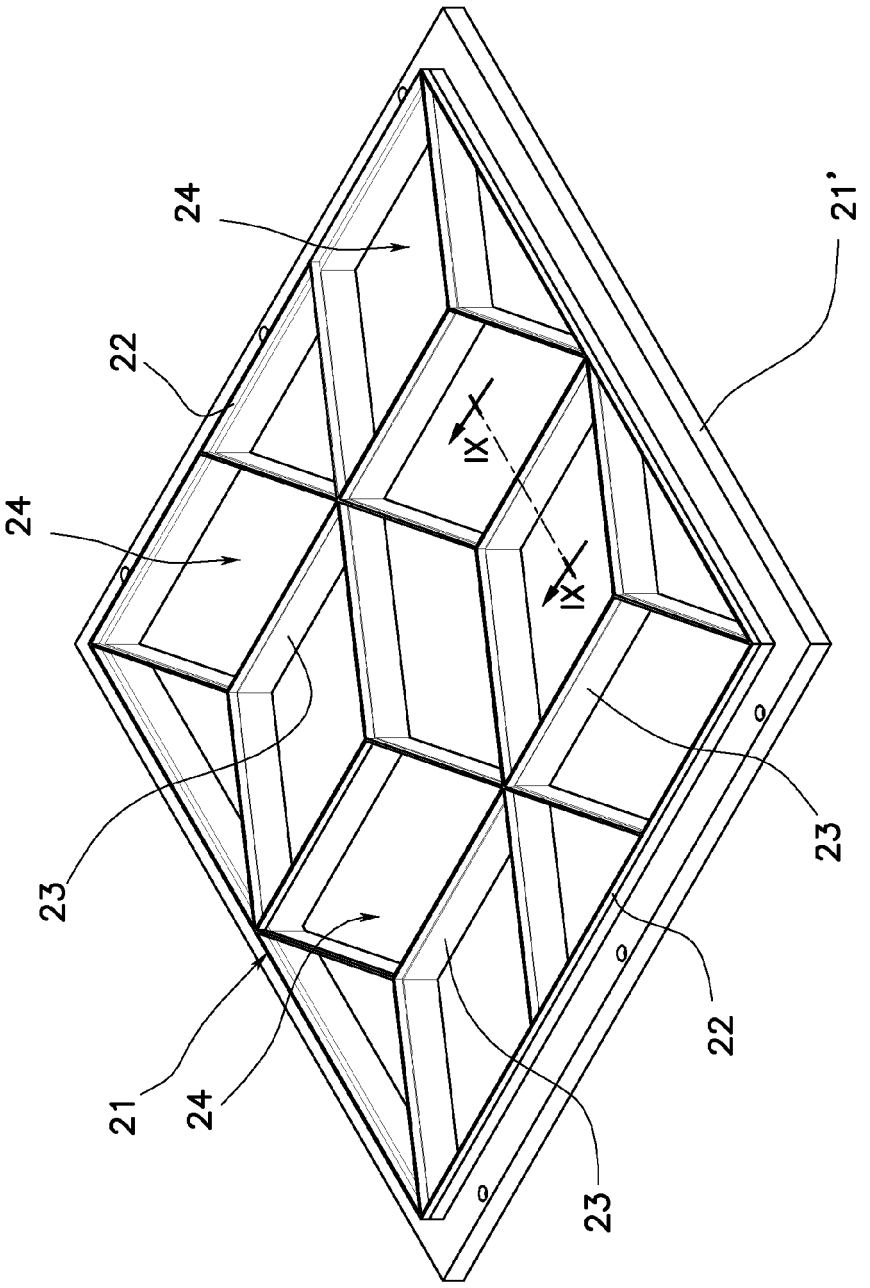


FIG.8

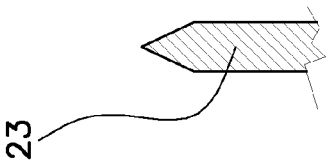


FIG.9

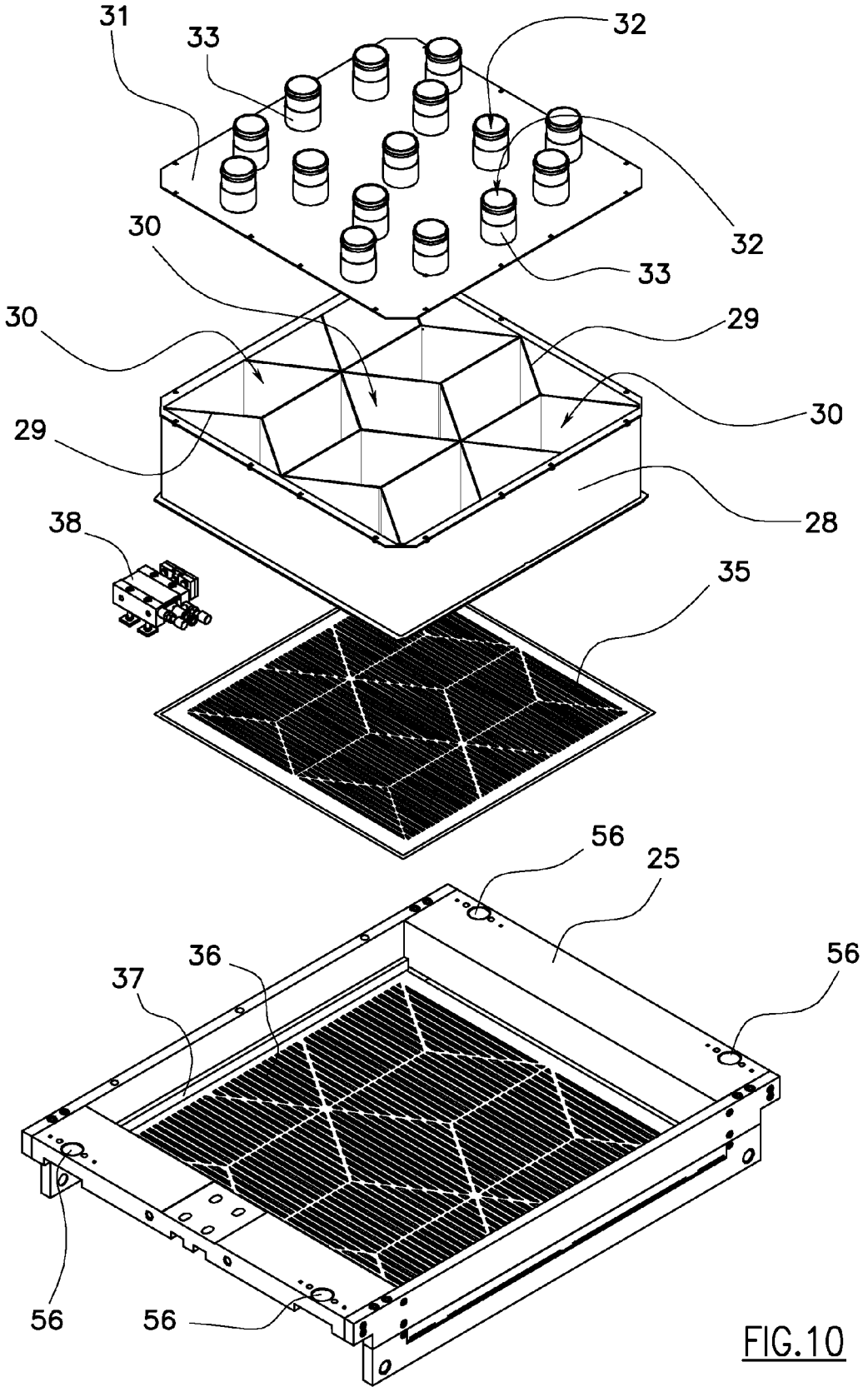


FIG.10

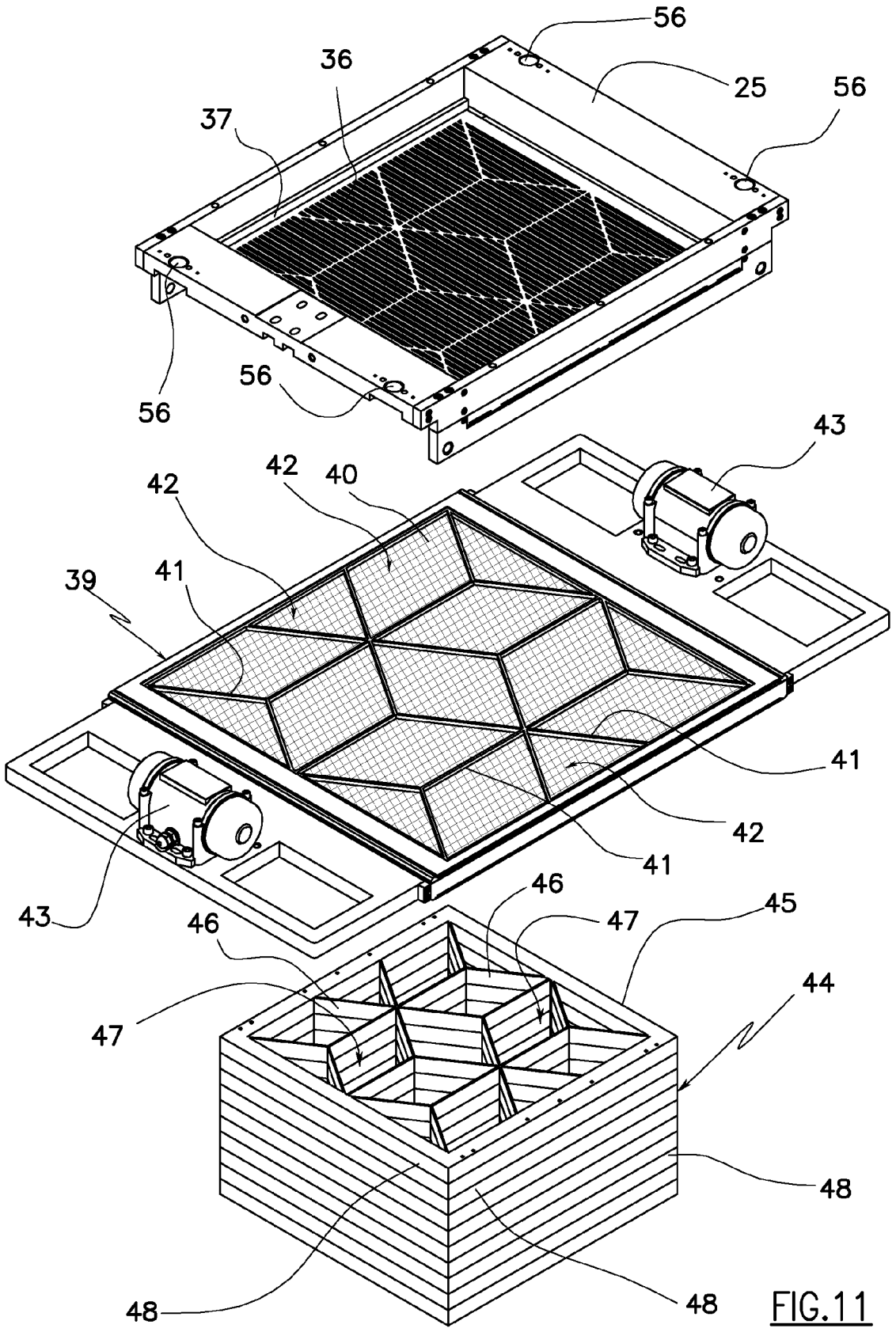

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FIG.11

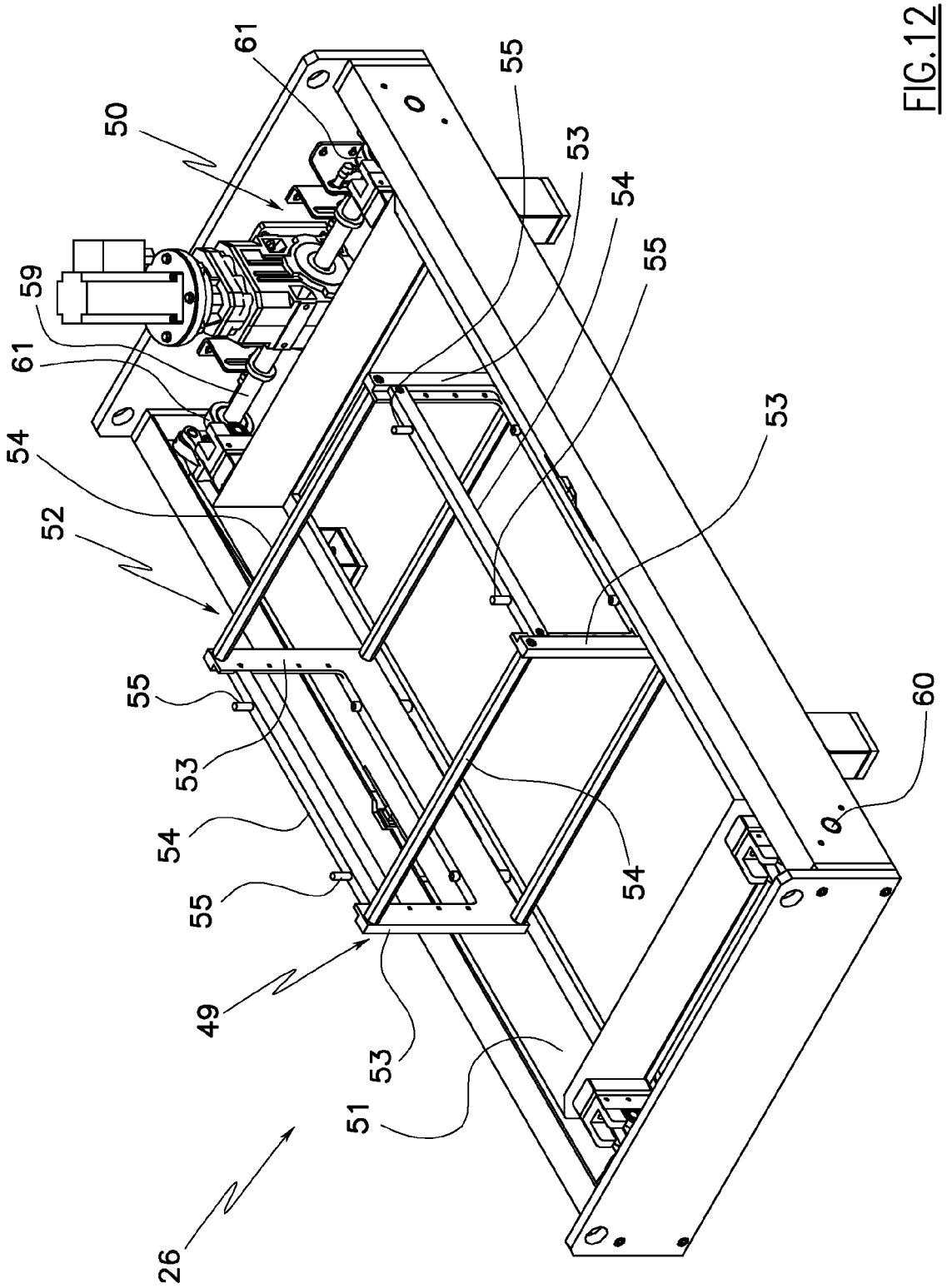

FIG.12

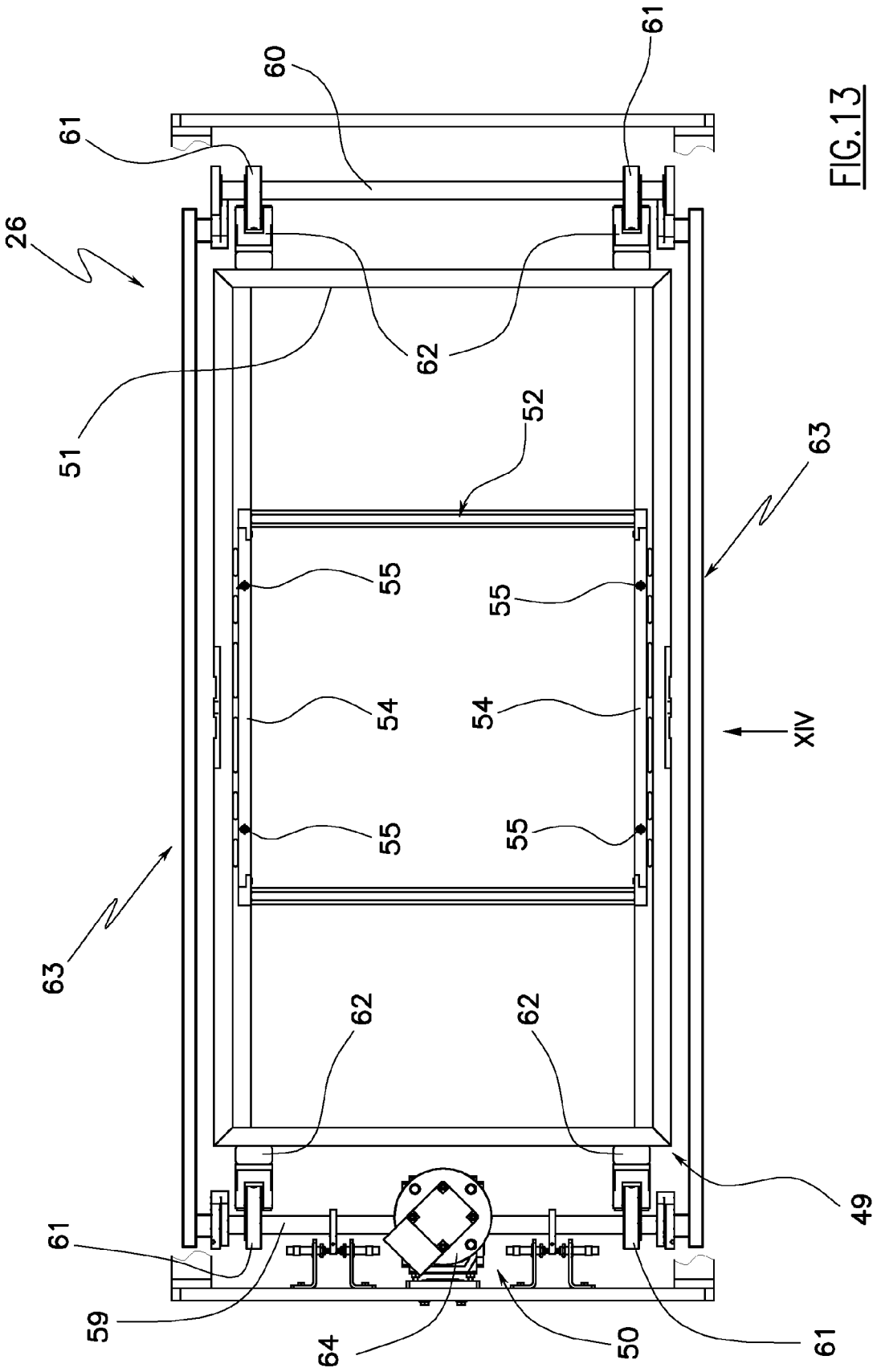

FIG.13

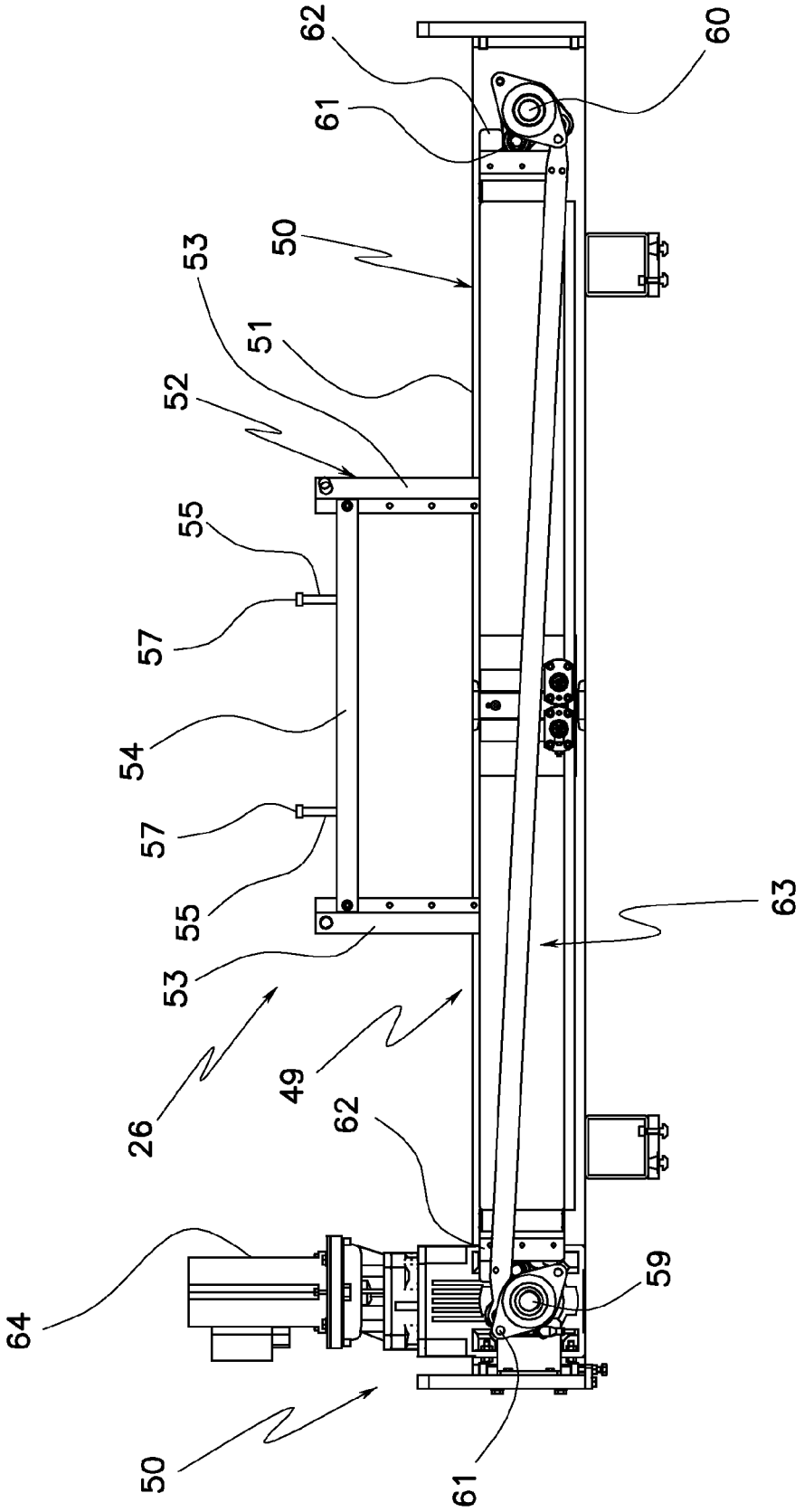

FIG.14

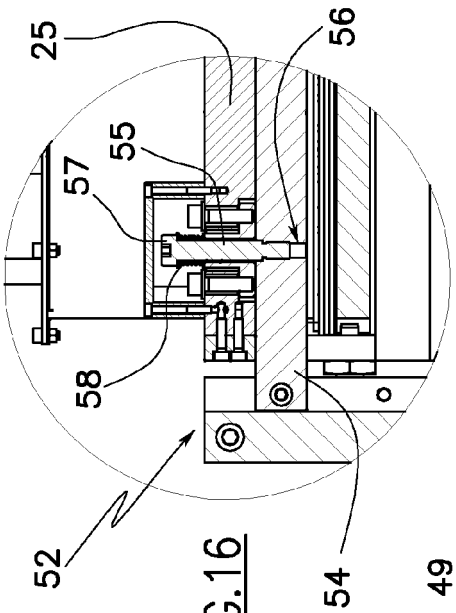
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FIG.16

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FIG.15

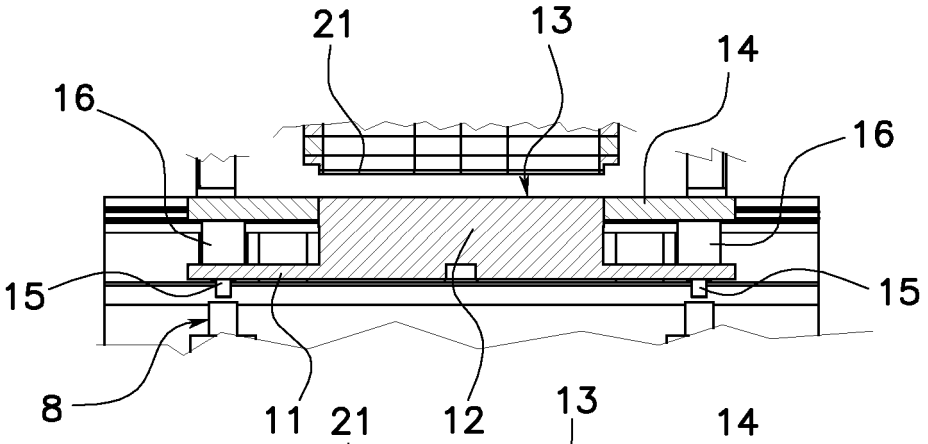

FIG.17

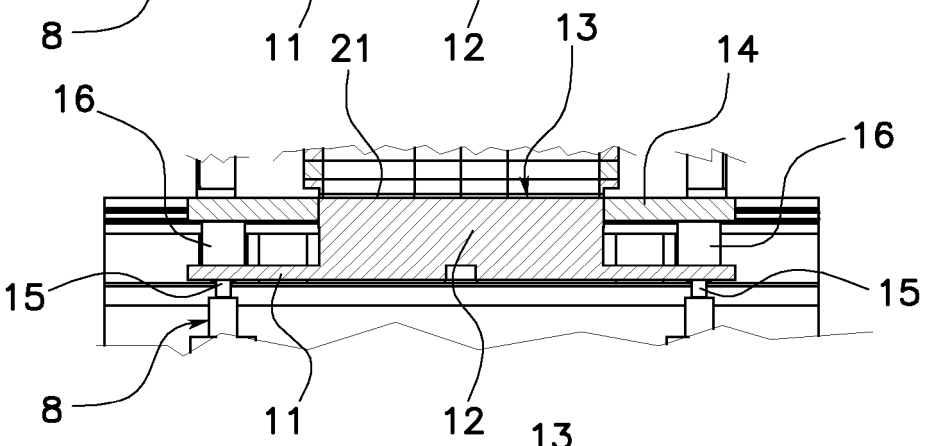

FIG.18

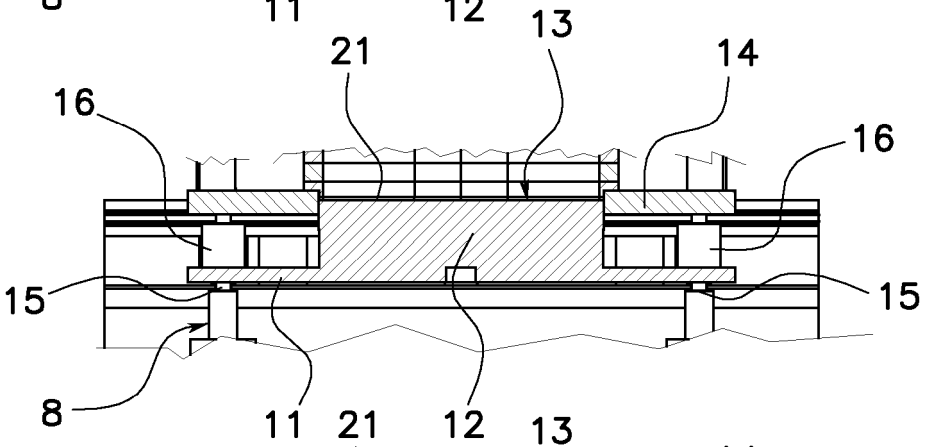

FIG.19

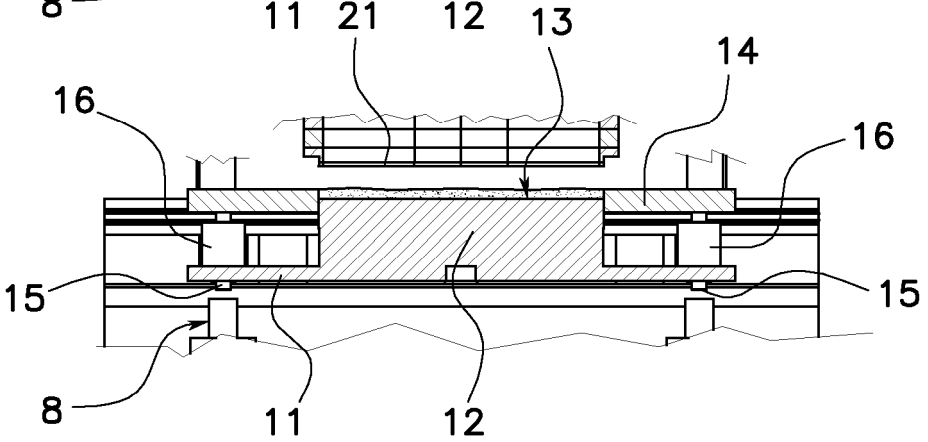

FIG.20

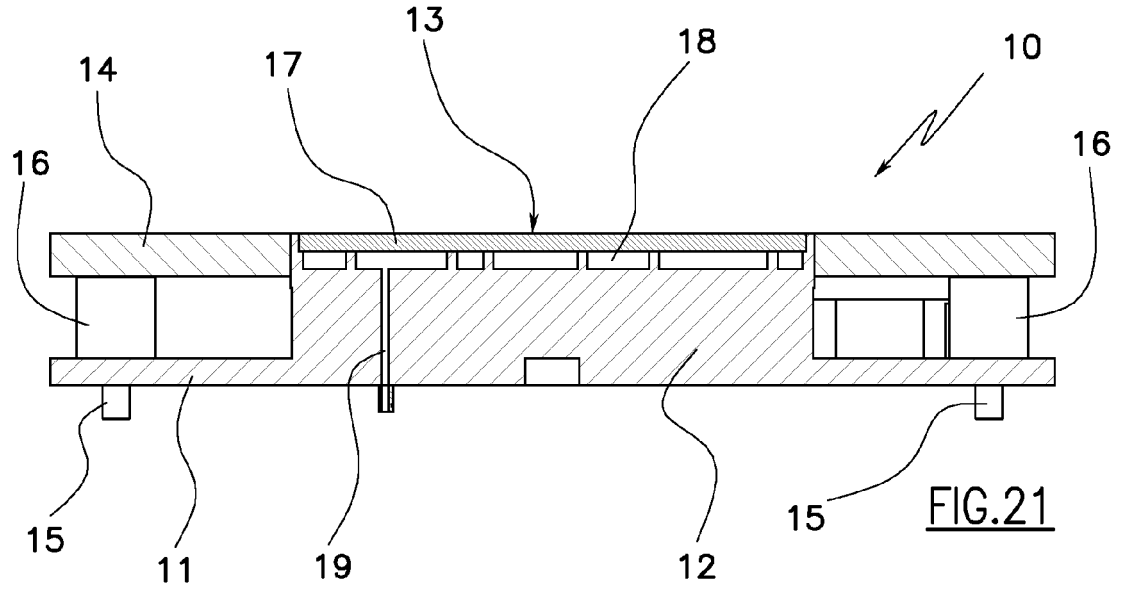

FIG.21

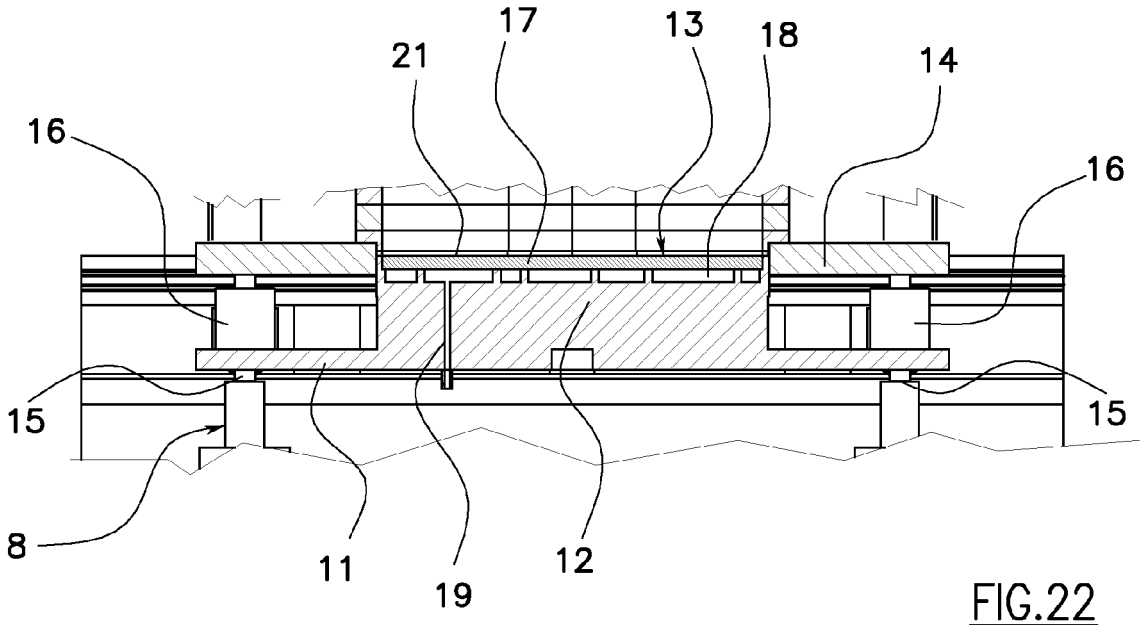

FIG.22

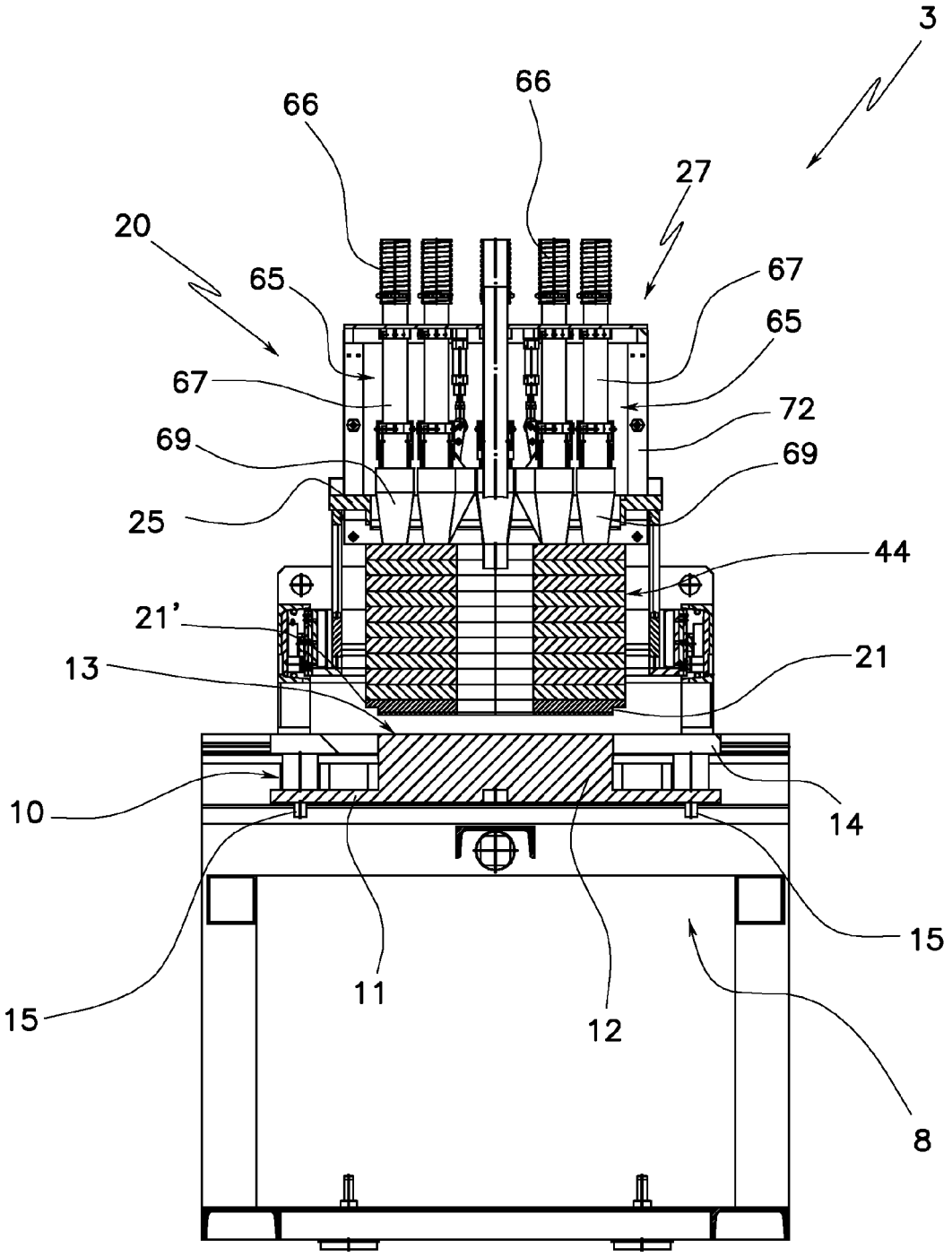

FIG.23

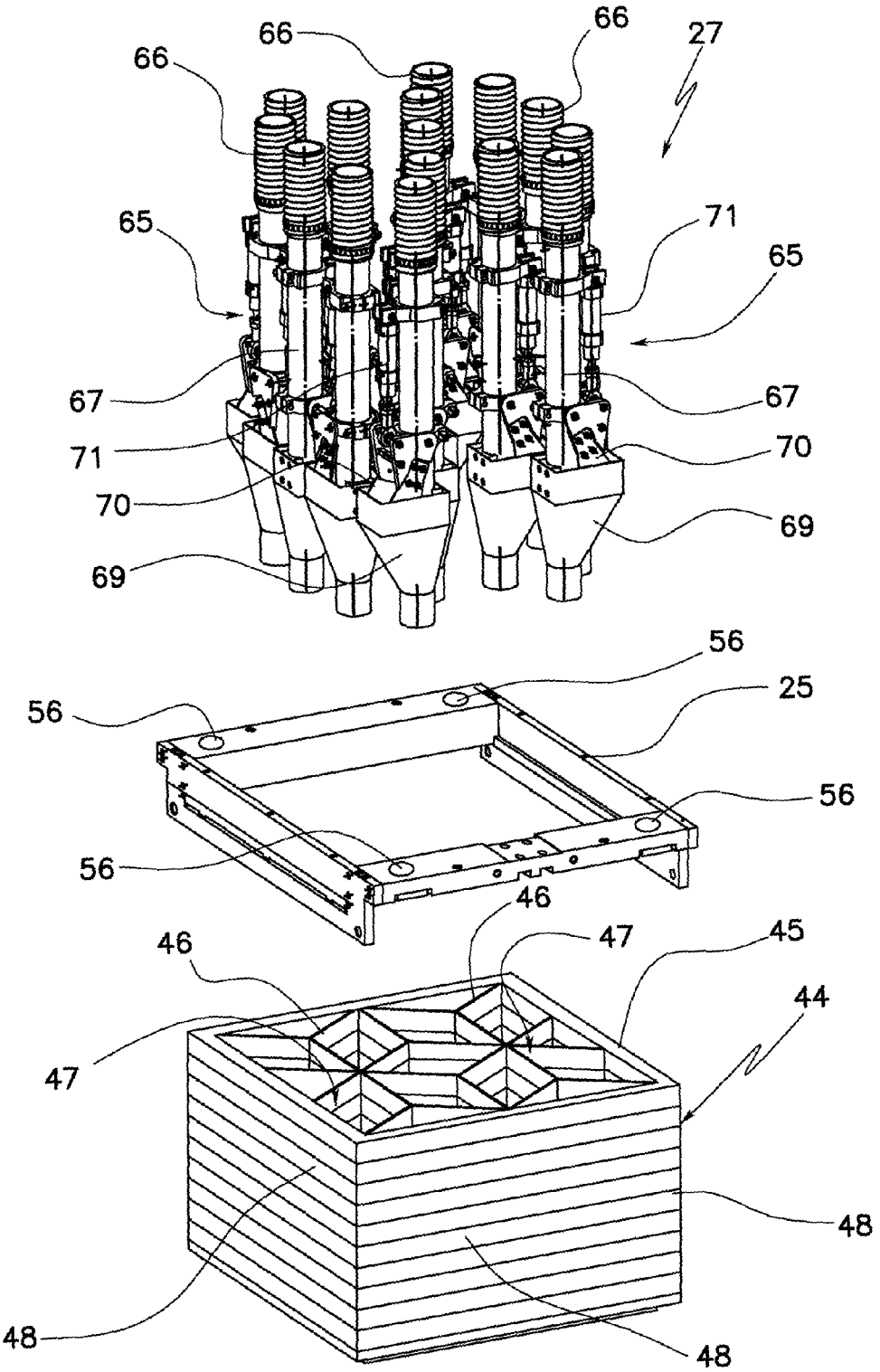
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FIG.24

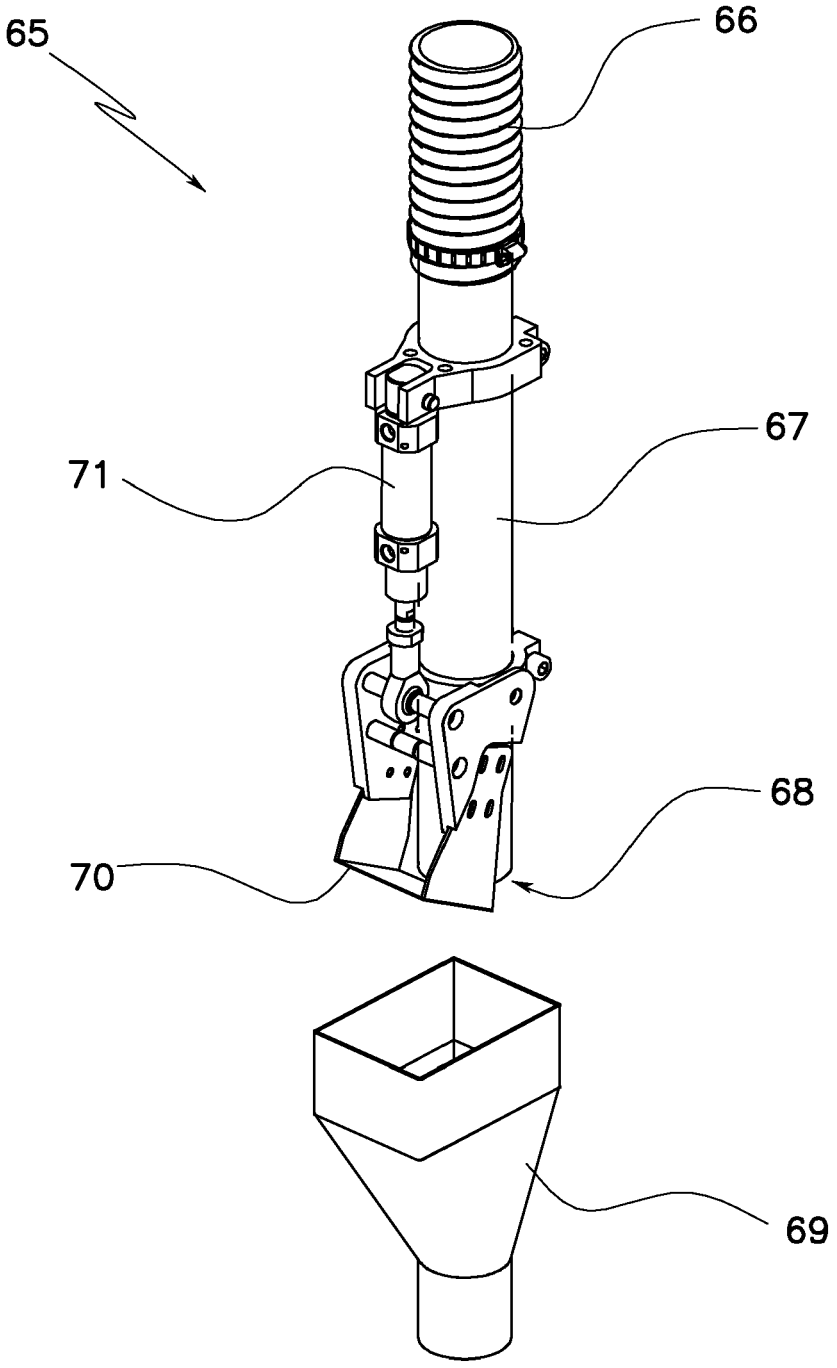

FIG.25