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(54) **Machine for grinding the edges of plates of glass, marble, and stone materials in general, with integrated drilling/milling unit**

Vorrichtung zum Schleifen der Ränder von Glasplatten, Marmor und Gesteinsmaterialien im Allgemeinen, mit integrierter Bohr-/Fräseinheit

Machine à meuler les bords de plaques de verre, de marbre, et de matériaux en pierre en général, avec unité de fraisage/forage intégrée

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(73) Proprietor: **Biesse S.p.A.**
61122 Chiusa di Ginestreto (Pesaro Urbino) (IT)

(72) Inventors:
• **Belli, Marco**
I-61122 Chiusa di Ginestreto (Pesaro Urbino) (IT)
• **Gervasoni, Massimiliano**
I-61122 Chiusa di Ginestreto (Pesaro Urbino) (IT)

(74) Representative: **Notaro, Giancarlo**
Buzzi, Notaro & Antonielli d'Oulx
Via Maria Vittoria 18
10123 Torino (IT)

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EP 2 687 327 B1

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Description

[0001] The present invention relates to a machine for grinding the edges of plates of glass, marble, and stone materials in general, of the type comprising:

- a first machine unit for advancing a plate to be machined arranged horizontally in a first direction substantially parallel to two first opposite edges of the plate, said first machine unit comprising two arrays of grinding tools for simultaneously grinding said first edges of the plate while this advances in said first direction;
- a second machine unit set downstream of the first unit, for advancing the machined plate from said first unit in a second direction orthogonal to said first direction, said second machine unit comprising two arrays of grinding tools for simultaneously grinding the two opposite edges of the plate orthogonal to the first edges already machined, whilst the plate advances in said second direction;
- a transfer unit of the plates.

[0002] Grinding machines of the type specified above have been produced and used for some time and are referred to as "bilateral" (cf. for instance EP 1 063 053).

[0003] In the production of plane plates of glass, it is moreover necessary, after precise squaring of the plate, to obtain by drilling and/or milling openings or shapings that are necessary for the specific application of the finished product (for example, circular holes for mounting handles on glass doors, or recesses for mounting hinges, etc.).

[0004] The current state of the art envisages the use of dedicated machines for carrying out the aforesaid drilling and/or milling operations on the plates. These machines are arranged downstream of the grinding machines in the production lines.

[0005] Currently, then, the entire process of machining of the plates takes place in two distinct steps. A first grinding step is carried out, for example, with the aforesaid bilateral machines, or with unilateral machines in which the plate is made to pass twice by orienting it first in one direction E and then in the other. Next, after transfer of the plate downstream of the grinding machine, there is the second step, which is a step of drilling and/or milling using appropriate dedicated machines, referred to as "mill/drill machines".

[0006] Both of the aforesaid machining steps are performed by setting the plate in a horizontal plane.

[0007] It should be noted that today there already exist stand-alone unilateral machines, which are able to grind, drill, and mill the aforesaid plates of glass, marble, and stone materials, but the quality of the result and the level of productivity are both very low.

[0008] The ratio between the quality of grinding of the edges of a plate and the machining time, in the case of so-called "bilateral" machines, is to be considered cur-

rently as hard to improve upon. Instead, the additional step of drilling and milling gives rise to an excessive lengthening of the production times and consequently penalizes the productivity of the line, in addition to entailing also problems in relation to the space occupied in the workplace.

[0009] The object of the present invention is to overcome the above drawbacks.

[0010] With a view to achieving the above purpose, the subject of the invention is a machine for grinding the edges of plates of glass, marble, and stone materials in general, of the type indicated at the start of the present description and moreover characterized in that:

- the grinding machine is provided with at least one drilling/milling unit for carrying out drilling and/or milling operations on the plates;
- said at least one drilling/milling unit is associated to the transfer unit of the plates interposed between the first machine unit and the second machine unit, or set immediately downstream of the second machine unit;
- the transfer unit being designed to receive plates at a first higher level and to supply plates at a second lower level; and
- said at least one drilling/milling unit being pre-arranged for carrying out drilling and/or milling operations on a plate when this is in said transfer unit at said first higher level.

[0011] In the preferred embodiment, the transfer unit comprises a supporting structure, lateral means for supporting and guiding the plate, carried by said supporting structure, for supporting and guiding said first opposite edges of a plate that is received within the transfer unit at the first higher level, the lateral supporting means being mobile between an operative position, where they are set close to one another, and an inoperative position, where they are spaced apart, and bottom means for supporting the plate, which are vertically mobile within said transfer unit between an operative raised position, in which said bottom supporting means are designed to take up a plate that is located at said first, higher, level when said lateral supporting means are brought into their inoperative position, and an inoperative lowered position, in which said bottom supporting means are designed to deposit the plate on said second level, where conveying means are provided for supply of the plate in said second direction out of the transfer unit.

[0012] In particular, associated to the supporting structure is the aforesaid drilling/milling unit, which is pre-arranged in such a way as to be designed for carrying out drilling and/or milling operations on the plate when this is supported at the first higher level by the bottom supporting means, and the lateral supporting means are in their inoperative position.

[0013] The drilling/milling unit comprises a suction-operated withholding member designed to be brought into

contact with a face of the plate for withholding it in position during execution of drilling/milling operations.

[0014] Once again in the case of the preferred embodiment, the drilling/milling unit comprises a top drilling head and a bottom drilling head, which are designed to co-operate for making circular holes in the plates; the top and bottom heads are each supported in a displaceable way along three orthogonal axes by the supporting structure of the transfer unit.

[0015] The top drilling head comprises a spindle pre-arranged for carrying in an interchangeable way a top drilling tool or a milling tool.

[0016] Once again in the preferred embodiment the lateral means for supporting and guiding the plate comprise two opposite and facing arrays of motor-driven vertical rollers, and at least one of the arrays of rollers is horizontally displaceable for being moved away from and/or up to the other array so as to be able to receive plates of different sizes.

[0017] Further characteristics and advantages of the invention will emerge from the ensuing description with reference to the annexed drawings, which are provided purely by way of non-limiting example and in which:

- Figure 1, corresponding to the known art, is a schematic plan view of a U-shaped machining line comprising a bilateral machine and downstream thereof a mill/drill machine;
- Figure 2 shows an example of application of the plates machined according to the present invention;
- Figures 3 and 4 show at a larger scale the machining tools of a mill/drill machine;
- Figure 5 shows a first embodiment of the machine according to the present invention, in which the drilling/milling unit is associated to the transfer unit interposed between the first machine unit and the second machine unit;
- Figure 6 is a top plan view of the transfer unit provided with four drilling/milling units;
- Figure 7 is a perspective and schematic view of the transfer unit, visible in which is the first higher level on which the plates to be machined are received and the second lower level from which the machined plates are supplied;
- Figure 7A is a schematic side view of the lateral means for supporting and guiding the plate and of the bottom supporting means;
- Figure 8 is a side view of the transfer unit, visible in which are the lateral means for supporting and guiding the plate;
- Figure 9 is a side view of the transfer unit provided with two drilling and/or milling units arranged on opposite sides;
- Figure 10 shows a drilling unit in a resting position;
- Figures 11 and 12 show successive steps of an operation of drilling of a plate;
- Figure 13 shows a step of an operation of milling of a plate;

- Figure 14 shows a detail of the suction-operated withholding member present in the drilling/milling unit; and

- Figure 15 shows a second embodiment of the machine according to the present invention, in which the drilling/milling unit is associated to the transfer unit set immediately downstream of the second machine unit.

[0018] With reference to Figure 1, corresponding to the known art, a machining line for plates of glass, marble, and stone materials in general is designated as a whole by the reference 1. The machining line comprises a station for loading 2 the plates, which supplies a first machine unit 3 for grinding the edges of the plates.

[0019] In particular, the first machine unit 3 has the purpose of advancing a plate to be machined set horizontally in a first direction A substantially parallel to two first opposite edges of the plate. During this advance of the plate, two opposite arrays of grinding tools carried by two cross members 3a and 3b simultaneously grind the first edges of the plate whilst this advances in the first direction A.

[0020] As it proceeds always in the first direction A, the plate is received in a transfer station 4, which is designed to receive the plates at a first higher level and to supply the plates at a second lower level. The transfer station 4 receives the plates from the first machine unit 3, which is located upstream, at the higher level, and supplies it to a second machine unit 5, set downstream of the transfer station 4, at the second lower level.

[0021] The second machine unit 5 has the purpose of causing the machined plate to advance from the first unit 3 in a second direction B orthogonal to the first direction A. The second machine unit 5 also comprises two arrays of grinding tools carried by two cross members 5a and 5b for simultaneously grinding the two opposite edges of the plate orthogonal to the first edges already machined, whilst the plate advances in the second direction B.

[0022] The first machine unit 3 and the second machine unit 5 constitute (together with the transfer station 4) a so-called "bilateral line" for grinding the four edges of the plates.

[0023] Once again with reference to Figure 1, the machining line 1 further comprises a second transfer station 6 in which the plates are received in the second direction B and are supplied in a third direction C, parallel and opposite to the first direction A. The plates at output from the second transfer station 6 are supplied to a mill/drill machine 7.

[0024] Finally, in the example illustrated in Figure 1, the machined plates can be forwarded to a washing and drying station 8, and then end up in a station 9 for unloading of the plates.

[0025] The line illustrated in Figure 1 has a considerable length, even though by providing a U-shaped path an attempt has been made to limit the overall dimensions thereof.

[0026] Figure 2 shows an example of application of the plates machined with the machining line illustrated in Figure 1. In particular, the plate L can be used as a door for a shower box. Alternatively, the machined plates can, for example, be used as structural glasses for external façades of buildings, or as partition walls for internal environments or as doors in general.

[0027] With reference to Figure 2, for insertion of the handle 10 a circular hole is previously provided located at a pre-set distance from a first edge L1 of the plate L at a height that is approximately half the height of the plate L. In order to make this hole, cup-wheel tools 12 and 13 are used of the type illustrated in Figure 3. The tools 12 and 13 are coaxial and rotate around one and the same axis A1. In particular, in order to obtain the hole, the plate L is machined in two distinct steps. In a first step the bottom tool 12 is operative and makes a circular incision for approximately half the thickness S of the plate L. At the end of the first step, the tool 12 is moved away from the plate L, and the second step can start in which the top tool 13 is brought into action and completes the incision so as to make the through hole. The machining tools have a cup-wheel portion 12a and 13a and a stem portion 13b for coupling with a spindle actuated by an electric motor (not illustrated in the figures) carried by a machining head of the machine.

[0028] Moreover, once again with reference to Figure 2, for application of hinges 11, two milling operations have been performed on the peripheral edge L2 opposite to the edge L1. In order to carry out the above milling operations, instead, a milling tool 14 like the one illustrated in Figure 4 is used. The tool 14 has a bit 14a and a stem portion 14b for coupling with the spindle. The bit 14a has cutting ribbings 14a1 on its lateral portion. The tool 14 turns around the axis A2.

[0029] The milling tools 14 are designed for machining laterally instead of frontally like the drilling tools 13, coming into contact with the edge of the plate throughout its thickness instead of the face of the plate as in the case of the drilling tools 13. The tool 14 is displaced in the direction D (see Figure 4), and the bit 14a removes the material throughout the thickness S of the plate L. In Figure 4, to the right of the milling tool 14, there is the portion of plate already machined.

[0030] Figure 5 illustrates a first embodiment of the machine according to the present invention. In particular, the machine comprises a bilateral machine formed by the first machine unit 3 and the second machine unit 5, interposed between which is a transfer station 4. Moreover present in the embodiment illustrated is a station 9 for unloading the plates.

[0031] In the embodiment illustrated in Figure 5, the machine is provided with four drilling/milling units 20 associated to the transfer station 4.

[0032] The plates are loaded on the first machine unit 3 and are made to advance in the direction A. The first machine unit 3 envisages a structure with a fixed cross member 3a that supports the first array of grinding tools,

and a cross member 3b mobile in the direction E, orthogonal to the direction A, which supports the second array of grinding tools. By displacing the cross member 3b that supports the second array of grinding tools in the direction E, it is possible to receive and machine plates having different transverse sizes.

[0033] The second machine unit 5, which is similar to the first machine unit 3, also comprises a structure with a fixed cross member 5a that supports the first array of grinding tools, and a cross member 5b mobile in the direction F, orthogonal to the direction B, which supports the second array of grinding tools.

[0034] At the end of the operation of grinding of the first two edges, the plate is received by the transfer station 4 at a first higher level. Exploiting the fact that the plate is raised, the drilling/milling unit 20 can intervene on the plate to make through holes and/or carry out milling operations. The drilling and milling operations will be described in greater detail in the sequel of the present description.

[0035] At the end of the drilling and/or milling operations, the transfer station 4 supplies the plate to the second machine unit 5 at a second lower level.

[0036] In the transfer station 4 the plates arrive in the direction A at a higher level, and are forwarded in a direction B, orthogonal to the direction A, at a lower level. The structure of the transfer station 4 is shown in greater detail in Figures 6, 7, 7A, and 8.

[0037] In particular, the transfer station 4 comprises a supporting structure that envisages a fixed cross member 4a and a cross member 4b mobile in the direction G orthogonal to the direction A. The two cross members 4a and 4b are provided with lateral means 4c for supporting and guiding the plate.

[0038] In the embodiment illustrated, the lateral supporting and guiding means are provided via two opposite and facing arrays of motor-driven vertical rollers 4c (see Figure 7), which are able to receive, support, and advance the plate in the direction A. In particular, the rollers 4c comprise a main body 4c1 and a peripheral edge 4c2 projecting radially outwards, resting on which are the first opposite edges of the plate L (see Figure 7A).

[0039] The rollers 4c support and guide the first opposite edges of the plate L, which is received within the transfer unit 4 at the first higher level (see plate L' in Figure 7). Each array of rollers 4c is controlled by a single motor 4cm (see Figure 8) carried by the beams 4a and 4b of the supporting structure.

[0040] With reference to Figure 7A, the rollers 4c are mobile between an operative position where they are set close to one another (represented with a solid line), in which they support the plate L, and an inoperative position where they are set apart from one another (represented with a dashed line), in which the rollers free the edges of the plate L.

[0041] When the plate L is in the position L' illustrated in Figure 7, the motor is turned off and the rollers are blocked, keeping the plate stationary and raised. Next,

bottom means 4e for supporting the plate go into action. The bottom supporting means 4e are mobile in a vertical direction, i.e., along the axis Z, within the transfer unit 4 between an operative raised position (see Figure 7A), in which the bottom supporting means 4e are designed to take up the plate L that is located at the first higher level L' when the lateral supporting means 4c are brought into their inoperative position where they are spaced apart, and an inoperative lowered position, in which the bottom supporting means 4e are designed to deposit the plate L' at the second level L".

[0042] The bottom supporting means 4e comprise rods 4e1 that carry at their free end a roller 4e2, which comes into contact with the bottom surface of the plate L. At the other end the rods 4e1 are carried by a structure 4e3 (see Figure 8) mobile underneath the transfer station 4. Ascent and descent of the rods 4e1 is controlled, for example, by hydraulic actuators of a known type (not illustrated).

[0043] On the second level L" conveying means 4d are provided for conveying the plate L" in the second direction B outside the transfer unit 4. In particular, the conveying means 4d comprise belts 4d1, which receive the plate L on the second level L" and carry it outside the transfer station in the direction B. The belts 4d1 are actuated by motor-driven wheels or rollers 4d2m connected to a single motor. Moreover present are idle return wheels or rollers 4d2.

[0044] To return to Figure 6, the transfer station 4 receives the plate L from the first machine unit 3 that is located upstream. The motor-driven rollers 4c will have a speed synchronous with the speed of advance of the first machine unit 3.

[0045] The plate L will be stopped in a reference point coinciding with the point of deposit on the bottom level (see Figure 7). Next, the bottom means 4e enter into action for supporting the plate, and are set in contact with the bottom surface of the plate L, which is set horizontally. At this point, in the transfer station 4 the operations of drilling or milling are carried out, with the plate stationary and kept raised at the first level thanks to the bottom means 4e.

[0046] At the end of the machining operations the plate must be brought to the second lower level L".

[0047] This is obtained by envisaging release of the supporting and guide mechanism constituted by the rollers 4c (see Figure 7A). In particular, the arrays of rollers 4c pass from their operative position (with their axis vertical) to their inoperative position, moving away from one another and releasing the edges of the plate L. The arrays of rollers 4c are made to oscillate outwards around a fixed point P passing through the axis of rotation A3, and the axis of rotation is inclined until the position designated by the references A3' or A3" is reached.

[0048] With reference to Figure 6, the plate L is located at the first higher level supported by the bottom supporting means 4e (Figure 7A), and with activation of purposefully provided lateral thrust elements 4g and the aid of front

referencing elements 4f the plate is centred with respect to the transfer station 4.

[0049] There now follows a detailed description of a drilling operation.

[0050] In the same period of time (masked time) or in a shorter period of time, the drilling units 20, 21 (which work both from the bottom and from the top of the plate) will be positioned on the respective drilling co-ordinates (see Figures 9, 11).

[0051] The drilling units 20 comprise a supporting structure 20a mobile in two mutually orthogonal directions (X, Y) for positioning the machining head 20b on the plate to be machined. The machining head 20b will be able to displace vertically along the axis Z in order to carry out the required machining operations. The machining head carries the drilling tools 13 (or alternatively the milling tools 14).

[0052] The bottom drilling units 21 will be provided with a suction-pad body 21a, set adjacent to the drilling tool 12 (see Figures 10 and 14) having a top mouth provided with a peripheral sealing gasket 210 designed to come into contact with the bottom face of the plate and to render hermetic the chamber that is to be defined between the bottom face of the plate and a bottom wall 211 adjacent to the mouth of the body 21a. Giving out in 212 on the wall 211 is a duct that can be connected to a source of negative pressure. The suction-pad body 21a has the purpose of blocking and supporting the plate in the area around the point where the hole is to be made (see Figure 11). As has been illustrated, the body 21a has its top part with a C-shaped configuration, for preventing interference with the tool 12 and blocking the plate in an area adjacent to the tool 12, on three different sides.

[0053] Hence, the drilling units 20 and 21 are mobile along three orthogonal axes thanks to the supporting structure of the transfer unit 4.

[0054] In Figure 10, the plate L is illustrated at the first, higher, level L', still supported by the rollers 4c. The bottom supporting means 4e enter into action, whilst the rollers 4c are brought into their inoperative condition, i.e., no longer in contact with the edge of the plate (see Figure 11). With the plate blocked in position and supported by the bottom supporting means 4e, the bottom drilling unit 21 makes the partial hole, making an incision in the plate for approximately one half of its thickness (see Figure 11), and once this operation is completed, the bottom drilling unit 21 displaces from the drilling axis AF positioning itself in an area outside the drilling region (see Figure 12).

[0055] The bottom drilling unit 21 comprises a slide 21b that is horizontally mobile so as to position itself underneath the bottom surface of the plate L. The slide 21b carries the bottom drilling tool 12, i.e., a cup grinding wheel.

[0056] The following step, illustrated in Figure 12, envisages descent of the top drilling head 20, which will make the complete hole thanks to the top cup-wheel tool 13, thus making a through hole in the plate L.

[0057] As already indicated, the top drilling head comprises a spindle pre-arranged for carrying in an interchangeable way a top drilling tool or a milling tool.

[0058] At the end of this step, the top drilling head 20 is brought back into a resting position like the one illustrated in Figure 10, away from the machining area.

[0059] In the case where there is envisaged drilling of other holes, the bottom machining head 21 and top machining head 20, will be positioned on the next drilling co-ordinates for carrying out a new machining operation.

[0060] Once all the drilling operations have been completed, the lateral thrust elements 4g and the suction-pad body 21a will be placed in the parking position, outside the overall dimensions of the area where the plate is laid (see Figure 10).

[0061] Next, the bottom supporting means 4e will be brought into their lowered inoperative position, i.e., lower than the second lower level L". The bottom supporting means 4e are hence brought below the second level, i.e., below the plane constituted by the conveyor belts 4d1 (see Figure 7).

[0062] In particular, the bottom supporting means 4e disappear between one belt 4d1 and the next, positioning themselves in the lowered inoperative condition. The plate is rested on the belts, and the belt conveyor is activated for transferring the plate towards the second machine unit 5 downstream of the transfer station. Simultaneously, the next plate, coming from the first machine unit 3 set upstream, will be housed on the top level for repeating the sequence described above.

[0063] For the steps of transfer, arrest, centring, and blocking of the plate that precede the operation of milling, reference may be made to what has been described as regards the drilling operations.

[0064] In this case, the bottom drilling unit 21 does not carry out any machining operation while the supporting and guiding means 4c are brought into a parking position so as to allow space for the top machining head 20b, which carries in this case a milling tool (see Figure 13). The machining head 20b will be moved so as to enable execution of the desired shape.

[0065] Also in this case, at the end of the milling operation, the plate will be brought to the second, lower, level L" and is then supplied to the second machine unit 5, for machining the second edges of the plate.

[0066] The drilling or milling operations can be carried out on one and the same plate making an automatic tool change.

[0067] The drilling and milling operations described above envisage that the plate during these steps is stationary. However, in an alternative mode, these machining operations could be implemented also with the plate moving. In this case, while the plate advances in the transfer station 4, the machining units 20, 21 are made to advance at the same speed at which the plate advances, in the same direction of advance and carry out the drilling or milling operations.

[0068] With reference to Figure 15, the drilling/milling

units are associated to a transfer unit 6 of the plates, which is set immediately downstream of the second machine unit 5.

[0069] The operation is exactly the same, but in this case the plate reaches the transfer station 6, where it undergoes the drilling and/or milling operations, after all four sides thereof have been ground.

[0070] The machine described herein can use abrasive tools, or else techniques for removal of stock using a jet of water at extremely high pressure, possibly with the addition of an abrasive, or with techniques that exploit sources of heat, such as for example laser.

[0071] With the invention there is an increase in productivity, with elimination of all the times for loading and unloading of the plates on the mill/drill machines, which in the known art are provided downstream of the grinding line.

[0072] In particular, the drilling and milling operations are integrated and carried out in the station for transfer of the plates. Combination of these two operations entails a lower production cost in so far as a large part of the technology of conveyance is exploited for the drilling and milling operations, thus enabling a considerably more competitive price on the market as compared to the current state of the art.

[0073] Of course, without prejudice to the principle of the invention, the details of construction and the embodiments may vary widely with respect to what has been described and illustrated herein purely by way of example, without thereby departing from the scope of the present invention which is defined by the appended claims.

Claims

1. A machine for grinding the edges of plates of glass, marble, and stone materials in general, comprising:

- a first machine unit (3) for advancing a plate (L) to be machined set horizontally in a first direction (A) substantially parallel to two first opposite edges of the plate, said first machine unit (3) comprising two arrays of grinding tools (3a, 3b) for simultaneously grinding said first edges of the plate whilst this advances in said first direction (A);
- a second machine unit (5) set downstream of the first unit (3), for advancing the plate (L) machined from said first unit (3) in a second direction (B) orthogonal to said first direction (A), said second machine unit (5) comprising two arrays of grinding tools (5a, 5b) for simultaneously grinding the two opposite edges of the plate orthogonal to the first edges already machined, whilst the plate (L) advances in said second direction (B);
- a transfer unit (4, 6) of the plates (L),

characterized in that:

- said machine (1) is provided with at least one drilling/milling unit (20) for carrying out drilling and/or milling operations on the plates;
- said at least one drilling/milling unit (20) is associated to the transfer unit (4, 6) of the plates (L) interposed (4) between said first machine unit (3) and said second machine unit (5), or set immediately downstream (6) of said second machine unit (5);
- said transfer unit (4, 6) being designed to receive plates at a first higher level (L') and to supply plates at a second lower level (L"); and
- said at least one drilling/milling unit (20) being pre-arranged for carrying out drilling and/or milling operations on a plate (L) when the latter is in said transfer unit (4, 6) at said first higher level (L').

2. The machine according to Claim 1, wherein said transfer unit comprises:

- a supporting structure (4a, 4b);
- lateral means (4c) for supporting and guiding the plate, carried by said supporting structure, for supporting and guiding said first opposite edges of a plate (L) that is received within the transfer unit (4, 6) at said first higher level (L'), said lateral supporting means (4c) being mobile between an operative position (A3) where they are set close to one another and an inoperative position (A3', A3") where they are spaced apart;
- bottom supporting means (4e) for supporting the plate (L), vertically mobile within said transfer unit (4, 6) between an operative raised position, wherein said bottom supporting means are designed to take up a plate that is located at said first higher level (L') when said lateral supporting means are brought into their inoperative position, and an inoperative lowered position, wherein said bottom supporting means are designed to deposit the plate on said second level (L"), where conveying means (4d) are provided for feeding the plate (L) in said second direction (B) out of said transfer unit (4, 6),

said machine being **characterized in that** associated to said supporting structure (4a, 4b) is said at least one drilling/milling unit (20), which is pre-arranged in such a way as to be designed to carry out drilling and/or milling operations on the plate (L) when the latter is supported at said first higher level (L') by said bottom supporting means (4e) and said lateral supporting means (4c) are in their inoperative position (A3', A3").

3. The machine according to Claim 2, **characterized**

in that said at least one drilling/milling unit (20) comprises at least one suction-operated withholding member (21a) designed to be brought into contact with a face of the plate (L) for withholding it in position during execution of drilling/milling operations.

4. The machine according to Claim 3, **characterized in that** said at least one drilling/milling unit (20) comprises a top drilling head (20b) and a bottom drilling head (21), which are designed to co-operate with one another for making circular holes in the plates, said top head (20b) and bottom head (21) being each supported in a displaceable way along three orthogonal axes by said supporting structure of said transfer unit (4, 6).

5. The machine according to Claim 4, **characterized in that** said top drilling head (20b) comprises a spindle pre-arranged for carrying a top drilling tool (13) or a milling tool (14).

6. The machine according to Claim 4, **characterized in that** said top drilling head (20b) is provided with high-pressure water-jet removal means, which use a jet of water at extremely high pressure possibly with the addition of an abrasive.

7. The machine according to Claim 4, **characterized in that** said top drilling head (20b) is provided with means for removal operating using heat, which exploit sources that produce heat, for example a laser.

8. The machine according to any one of Claims 2 to 7, **characterized in that** said lateral means (4c) for supporting and guiding the plate (L) comprise two opposite and facing arrays of motor-driven vertical rollers (4c).

9. The machine according to Claim 8, **characterized in that** at least one of said arrays of rollers (4c) is horizontally displaceable for being moved away from and/or up to the other array so as to be able to receive plates of different sizes.

Patentansprüche

1. Maschine zum Fräsen der Kanten von Platten, im Allgemeinen aus Glas-, Marmor- und Stein-Materialien, wobei die Maschine umfasst:

- eine erste Maschinen-Einheit (3), um eine Platte (L), die bearbeitet werden soll und horizontal angeordnet ist, in eine erste Richtung (A) vorzuschieben, die im Wesentlichen parallel zu zwei ersten einander gegenüberliegenden Kanten der Platte verläuft, wobei die erste Maschinen-Einheit (3) zwei Sätze von Fräswerkzeugen

- (3a, 3b) umfasst, um die ersten Kanten der Platte gleichzeitig zu fräsen, während diese in der ersten Richtung (A) vorgeschoben wird;
- eine zweite Maschinen-Einheit (5), die stromabwärts der ersten Einheit (3) angeordnet ist, um die Platte (L), die von der ersten Einheit (3) bearbeitet wurde, in einer zweiten Richtung (B) vorzuschieben, die senkrecht zur ersten Richtung (A) verläuft, wobei die zweite Maschinen-Einheit (5) zwei Sätze von Fräswerkzeugen (5a, 5b) umfasst, um gleichzeitig jene beiden einander gegenüberliegenden Kanten der Platte, die senkrecht zu den ersten Kanten liegen, die bereits bearbeitet wurden, zu fräsen, während die Platte (L) in der zweiten Richtung (B) vorgeschoben wird;
 - eine Transfer-Einheit (4, 6) für die Platten (L), **dadurch gekennzeichnet, dass:**
 - die Maschine (1) mit zumindest einer Bohr/Fräs-Einheit (20) ausgestattet ist, um auf den Platten Bohr- und/oder Fräs-Vorgänge auszuführen;
 - die zumindest eine Bohr/Fräs-Einheit (20) der Transfer-Einheit (4, 6) für die Platten (L) zugeordnet ist, wobei die Transfer-Einheit (4) zwischen der ersten Maschinen-Einheit (3) und der zweiten Maschinen-Einheit (5) liegt oder die Transfer-Einheit (6) unmittelbar stromabwärts der zweiten Maschinen-Einheit (5) liegt;
 - die Transfer-Einheit (4, 6) so ausgelegt ist, dass sie die Platten auf einem ersten höheren Niveau (L') empfängt und die Platten auf einem zweiten niedrigeren Niveau (L'') bereitstellt; und
 - die zumindest eine Bohr/Fräs-Einheit (20) so ausgelegt ist, dass sie auf einer Platte (L) dann Bohr- und/oder Fräs-Vorgänge ausführt, wenn sich die Platte in der Transfer-Einheit (4, 6) auf dem ersten höheren Niveau (L') befindet.
2. Maschine gemäß Anspruch 1, wobei die Transfer-Einheit umfasst:
- eine Tragstruktur (4a, 4b);
 - seitliche Einrichtungen (4c), um die Platte, die von der Tragstruktur getragen wird, zu tragen und zu führen, um die ersten einander gegenüberliegenden Kanten einer Platte (L), die in der Transfer-Einheit (4, 6) auf dem ersten höheren Niveau (L') aufgenommen wurde, zu tragen und zu führen, wobei die seitlichen Trag-Einrichtungen (4c) zwischen einer Betriebsstellung (A3), in der sie nahe beieinander liegen, zu einer Ruhestellung (A3', A3'') bewegt werden können, in der sie voneinander beabstandet sind;
 - untere Trageinrichtungen (4e) zum Tragen der Platte (L), wobei die unteren Trageinrichtungen innerhalb der Transfer-Einheit (4, 6) zwischen einer angehobenen Betriebsstellung, in der die

unteren Trageinrichtungen so ausgelegt sind, dass sie eine Platte aufnehmen, die auf dem ersten höheren Niveau (L') angeordnet ist, wenn die seitlichen Trageinrichtungen in ihre Ruhestellung gebracht wurden, und einer abgesenkten Ruhestellung bewegt werden können, in der die unteren Trageinrichtungen so ausgelegt sind, dass sie die Platte auf dem zweiten Niveau (L'') ablegen, wobei Transport-Einrichtungen (4d) vorgesehen sind, um die Platte (L) in der zweiten Richtung (B) aus der Transfer-Einheit (4, 6) zu transportieren,

wobei die Maschine **dadurch gekennzeichnet ist, dass** der Tragstruktur (4a, 4b) zumindest eine Bohr/Fräs-Einheit (20) zugeordnet ist, die so vorangeordnet wird, dass sie dazu ausgelegt ist, dass sie die Bohr- und/oder Fräs-Vorgänge auf der Platte (L) dann ausführt, wenn diese von den unteren Trageinrichtungen (4e) auf ihrem ersten höheren Niveau (L') gehalten wird und sich die seitlichen Trageinrichtungen in ihrer Ruhestellung (A3', A3'') befinden.

3. Maschine gemäß Anspruch 2, **dadurch gekennzeichnet, dass** die zumindest eine Bohr/Fräs-Einheit (20) zumindest ein mit einer Saugwirkung arbeitendes Arretier-Element (21a) umfasst, das so ausgelegt ist, dass es mit einer Fläche der Platte (L) in Berührung gebracht werden kann, um die Platte in ihrer Stellung zu arretieren, während die Bohr/Fräs-Vorgänge ausgeführt werden.
4. Maschine gemäß Anspruch 3, **dadurch gekennzeichnet, dass** die zumindest eine Bohr/Fräs-Einheit (20) einen oberen Bohrkopf (20b) sowie einen unteren Bohrkopf (21) umfasst, die so ausgebildet sind, dass sie miteinander zusammenwirken, um in den Platten kreisförmige Öffnungen auszubilden, wobei sowohl der obere Kopf (20b) als auch der untere Kopf (21) von der Tragstruktur der Transfer-Einheit (4, 6) so getragen werden, dass sie entlang von drei aufeinander senkrecht stehenden Achsen ausgelenkt werden können.
5. Maschine gemäß Anspruch 4, **dadurch gekennzeichnet, dass** der obere Bohrkopf (20b) eine Welle umfasst, die so ausgelegt ist, dass sie ein oberes Bohrwerkzeug (13) oder ein Fräswerkzeug (14) trägt.
6. Maschine gemäß Anspruch 4, **dadurch gekennzeichnet, dass** das obere Bohrwerkzeug (20b) mit Mittel zum Abgeben eines abtragenden Hochdruck-Wasserstrahls versehen ist, die einen unter einem extrem hohen Druck stehenden Wasserstrahl verwenden, dem wahlweise ein Schleifmittel beigegeben ist.

7. Machine gemäß Anspruch 4, **dadurch gekennzeichnet, dass** der obere Bohrkopf (20b) mit abtragenden Mitteln versehen ist, die mithilfe von Wärme arbeiten und wärmeerzeugende Quellen verwenden, wie etwa einen Laser. 5
8. Machine gemäß irgendeinem der Ansprüche 2 bis 7, **dadurch gekennzeichnet, dass** die seitlichen Einrichtungen (4c) zum Tragen und Führen der Platte (L) zwei einander gegenüberliegende und zueinander gerichtete Sätze von motorgetriebenen vertikalen Rollen (4c) umfassen. 10
9. Machine gemäß Anspruch 8, **dadurch gekennzeichnet, dass** zumindest einer der Sätze von Rollen (4c) horizontal so ausgelenkt werden kann, dass er vom anderen Satz weg und/oder auf den anderen Satz zu bewegt werden kann, sodass Platten aufgenommen werden können, die verschieden groß sind. 15

Revendications

1. Machine pour meuler les bords de plaques de verre, de marbre et de matériaux en pierre en général, comprenant : 25
- une première unité de machine (3) pour faire avancer une plaque (L) à usiner disposée horizontalement dans une première direction (A) sensiblement parallèle à deux premiers bords opposés de la plaque, ladite première unité de machine (3) comprenant deux réseaux d'outils de meulage (3a, 3b) pour meuler simultanément lesdits premiers bords de la plaque pendant que celle-ci avance dans ladite première direction (A) ; 30
 - une deuxième unité de machine (5) disposée en aval de la première unité (3), pour faire avancer la plaque (L) usinée de ladite première unité (3) dans une deuxième direction (B) orthogonale à ladite première direction (A), ladite deuxième unité de machine (5) comprenant deux réseaux d'outils de meulage (5a, 5b) pour meuler simultanément les deux bords opposés de la plaque orthogonaux aux premiers bords déjà usinés, pendant que la plaque (L) avance dans ladite deuxième direction (B) ; 35
 - une unité de transfert (4, 6) des plaques (L), 40

caractérisée en ce que :

- ladite machine (1) est munie d'au moins une unité de perçage/fraisage (20) pour effectuer des opérations de perçage et/ou de fraisage sur les plaques ; 45
- ladite au moins une unité de perçage/fraisage (20) est associée à l'unité de transfert (4, 6) des 50

plaques (L) interposée entre ladite première unité de machine (3) et ladite deuxième unité de machine (5), ou disposée immédiatement en aval (6) de ladite deuxième unité de machine (5) ;

- ladite unité de transfert (4, 6) étant conçue pour recevoir des plaques à un premier niveau supérieur (L') et pour fournir des plaques à un deuxième niveau inférieur (L") ; et

- ladite au moins une unité de perçage/fraisage (20) étant pré-agencée pour effectuer des opérations de perçage et/ou de fraisage sur une plaque (L) lorsque cette dernière se trouve dans ladite unité de transfert (4, 6) audit premier niveau supérieur (L') 5

2. Machine selon la revendication 1, dans laquelle ladite unité de transfert comprend : 20

- une structure de support (4a, 4b) ;

- des moyens latéraux (4c) pour supporter et guider la plaque, portée par ladite structure de support, pour supporter et guider lesdits premiers bords opposés d'une plaque (L) qui est reçue à l'intérieur de l'unité de transfert (4, 6) audit premier niveau supérieur (L'), lesdits moyens de support latéraux (4c) étant mobiles entre une position de fonctionnement (A3) où ils sont disposés les uns à côté des autres et une position de repos (A3', A3'') où ils sont espacés ;

- des moyens de support de fond (4e) pour supporter la plaque (L), mobile verticalement à l'intérieur de ladite unité de transfert (4, 6) entre une position de fonctionnement élevée, dans laquelle lesdits moyens de support de fond sont conçus pour prendre une plaque qui est située audit premier niveau supérieur (L') lorsque lesdits moyens de support latéraux sont ramenés dans leur position de repos et une position de repos abaissée, dans laquelle lesdits moyens de support de fond sont conçus pour déposer la plaque sur ledit deuxième niveau (L''), où des moyens de transport (4d) sont prévus pour acheminer la plaque (L) dans ladite deuxième direction (B) hors de ladite unité de transfert (4, 6), 60

ladite machine étant **caractérisée en ce que** ladite au moins une unité de perçage/fraisage (20) est associée à ladite structure de support (4a, 4b), laquelle unité est pré-agencée de manière à être conçue pour effectuer des opérations de perçage et/ou de fraisage sur la plaque (L) lorsque cette dernière est supportée audit premier niveau supérieur (L') par lesdits moyens de support de fond (4e) et lesdits moyens de support latéraux (4c) se trouvent dans leur position de repos (A3', A3''). 65

3. Machine selon la revendication 2, **caractérisée en ce que** ladite au moins une unité de perçage/fraisage (20) comprend au moins un élément de retenue actionné par aspiration (21 a) conçu pour être amené en contact avec une face de la plaque (L) pour la retenir en position lors de l'exécution des opérations de perçage/fraisage. 5

4. Machine selon la revendication 3, **caractérisée en ce que** ladite au moins une unité de perçage/fraisage (20) comprend une tête de perçage supérieure (20b) et une tête de perçage inférieure (21), qui sont conçues pour coopérer l'une avec l'autre pour faire des trous circulaires dans les plaques, ladite tête supérieure (20b) et ladite tête inférieure (21) étant supportées chacune de manière amovible le long de trois axes orthogonaux par ladite structure de support de ladite unité de transfert (4, 6). 10
15

5. Machine selon la revendication 4, **caractérisée en ce que** ladite tête de perçage supérieure (20b) comprend une broche pré-agencée pour porter un outil de perçage supérieur (13) ou un outil de fraisage (14). 20
25

6. Machine selon la revendication 4, **caractérisée en ce que** ladite tête de perçage supérieure (20b) est munie de moyens de retrait par jet d'eau à haute pression, qui utilisent un jet d'eau à une pression extrêmement élevée avec éventuellement l'ajout d'un abrasif. 30

7. Machine selon la revendication 4, **caractérisée en ce que** ladite tête de perçage supérieure (20b) est munie de moyens de retrait fonctionnant à la chaleur, qui exploitent des sources qui produisent de chaleur, par exemple un laser. 35

8. Machine selon l'une quelconque des revendications 2 à 7, **caractérisée en ce que** lesdits moyens latéraux (4c) de support et de guidage de la plaque (L) comprennent deux réseaux de rouleaux verticaux (4c) opposés et en vis-à-vis entraînés par moteur. 40

9. Machine selon la revendication 8, **caractérisée en ce qu'**au moins l'un desdits réseaux de rouleaux (4c) est amovible horizontalement pour être déplacé loin de et/ou jusqu'à l'autre réseau de manière à pouvoir recevoir des plaques de tailles différentes. 45
50

55

FIG. 1

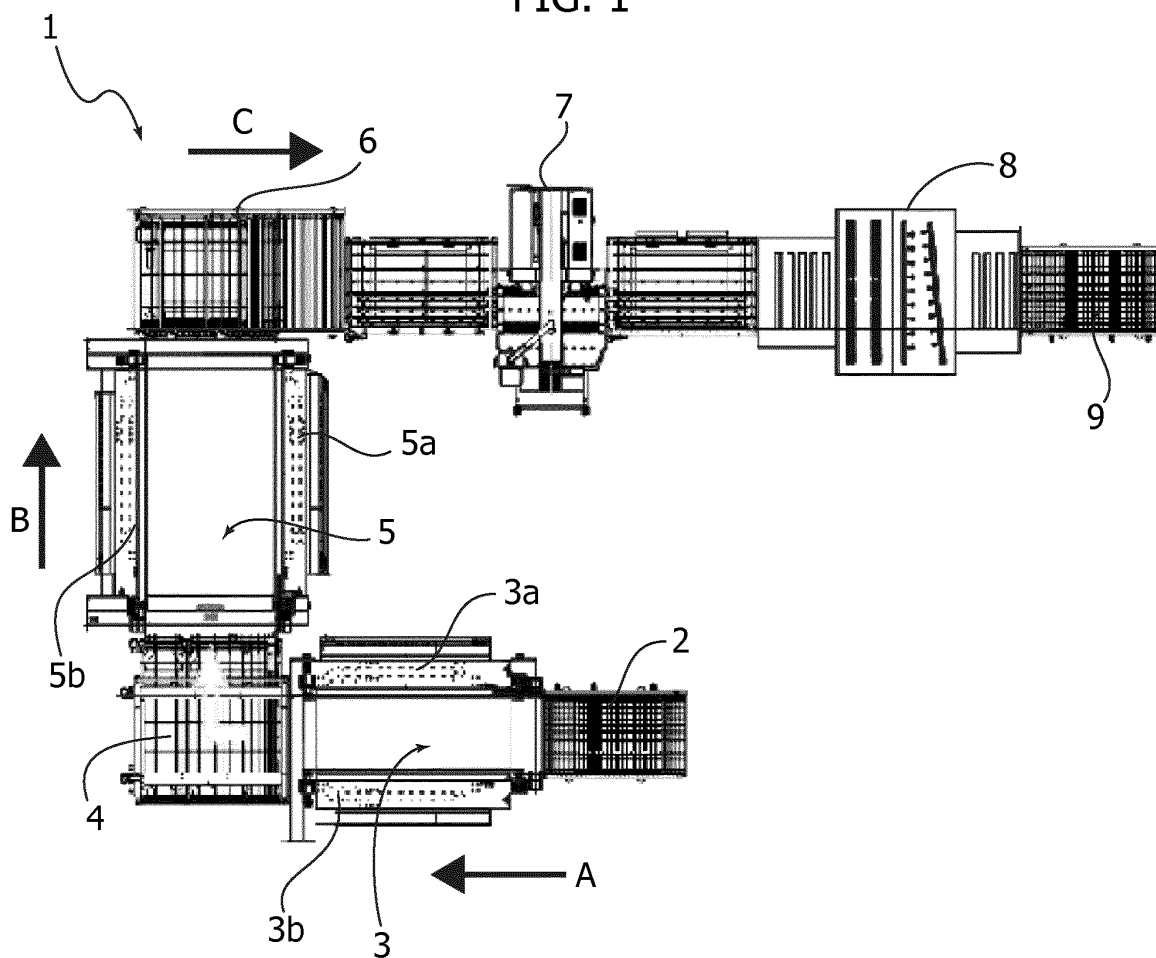


FIG. 2

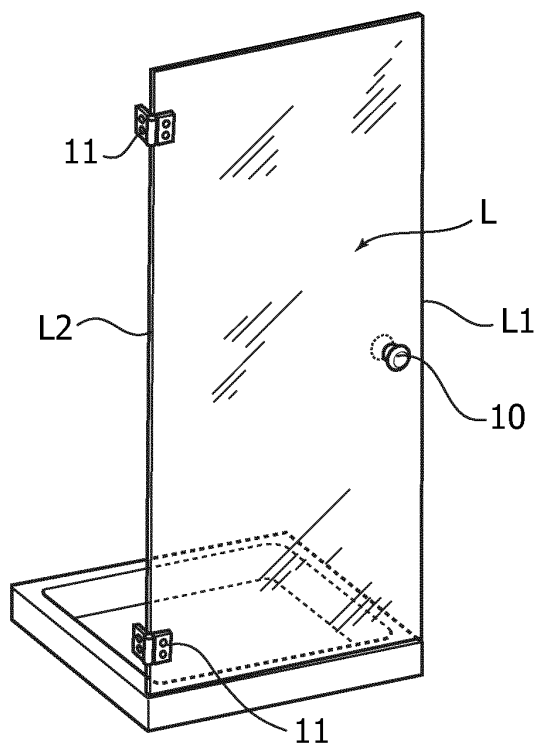


FIG. 3

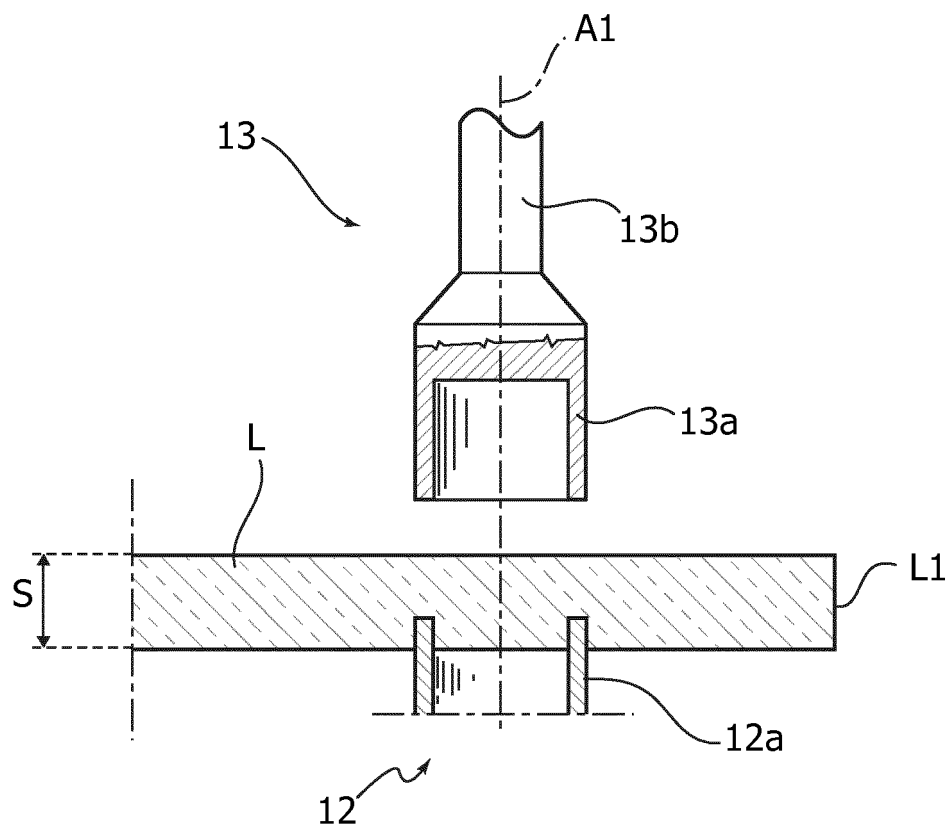


FIG. 4

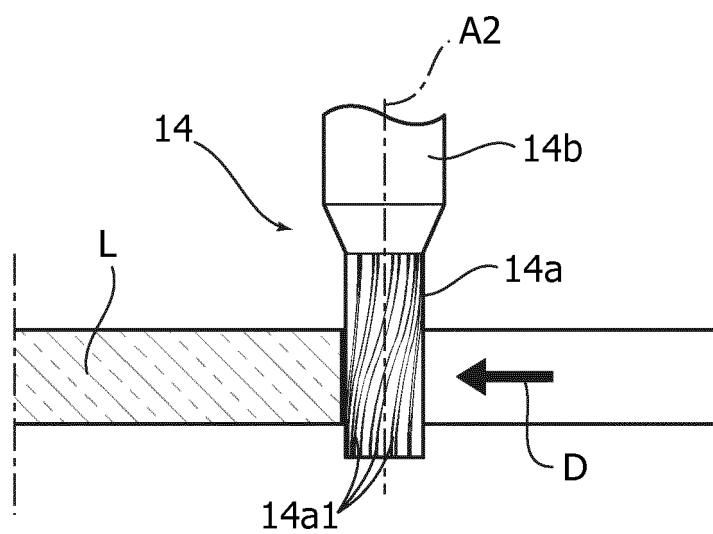


FIG. 5

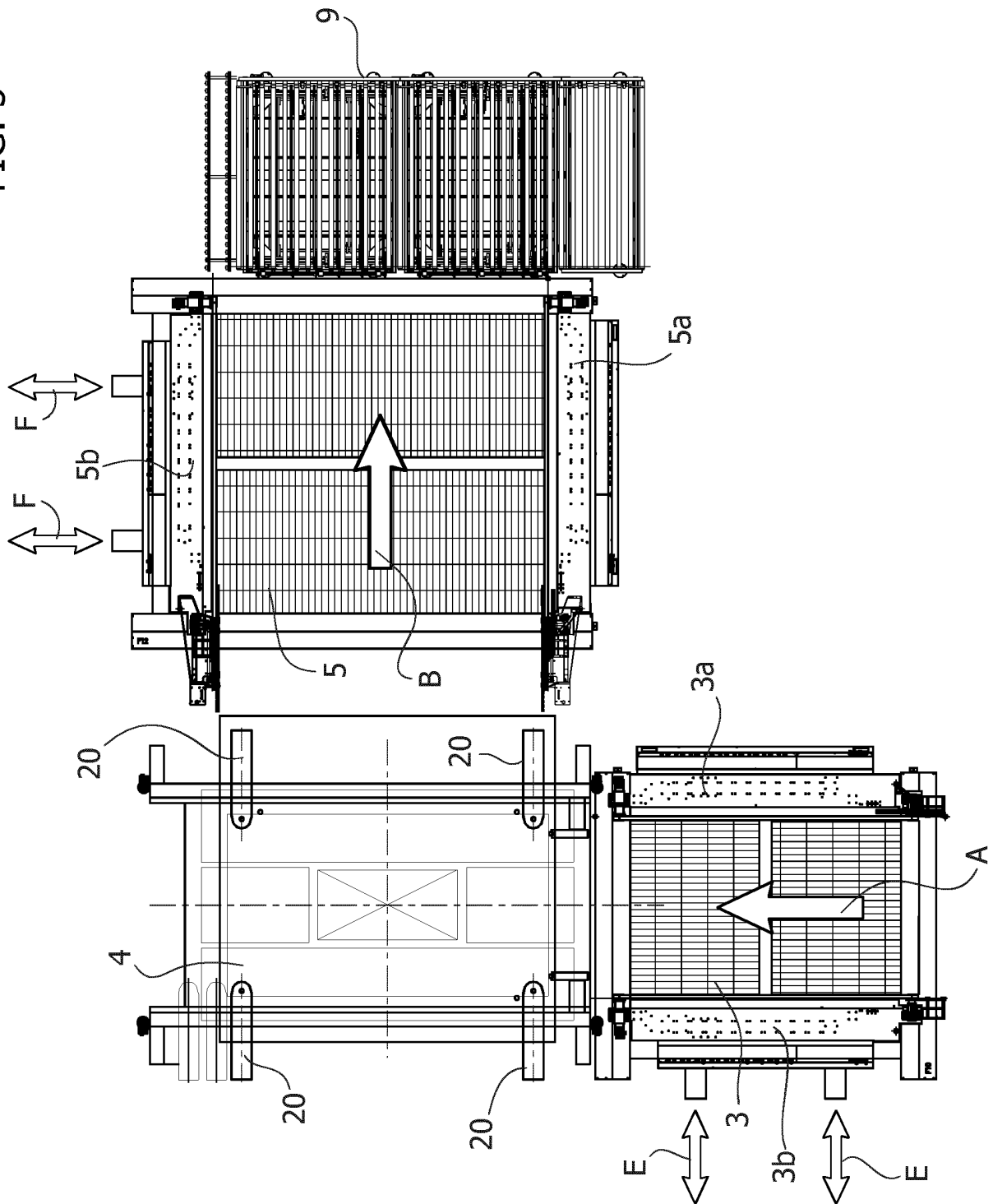


FIG. 6

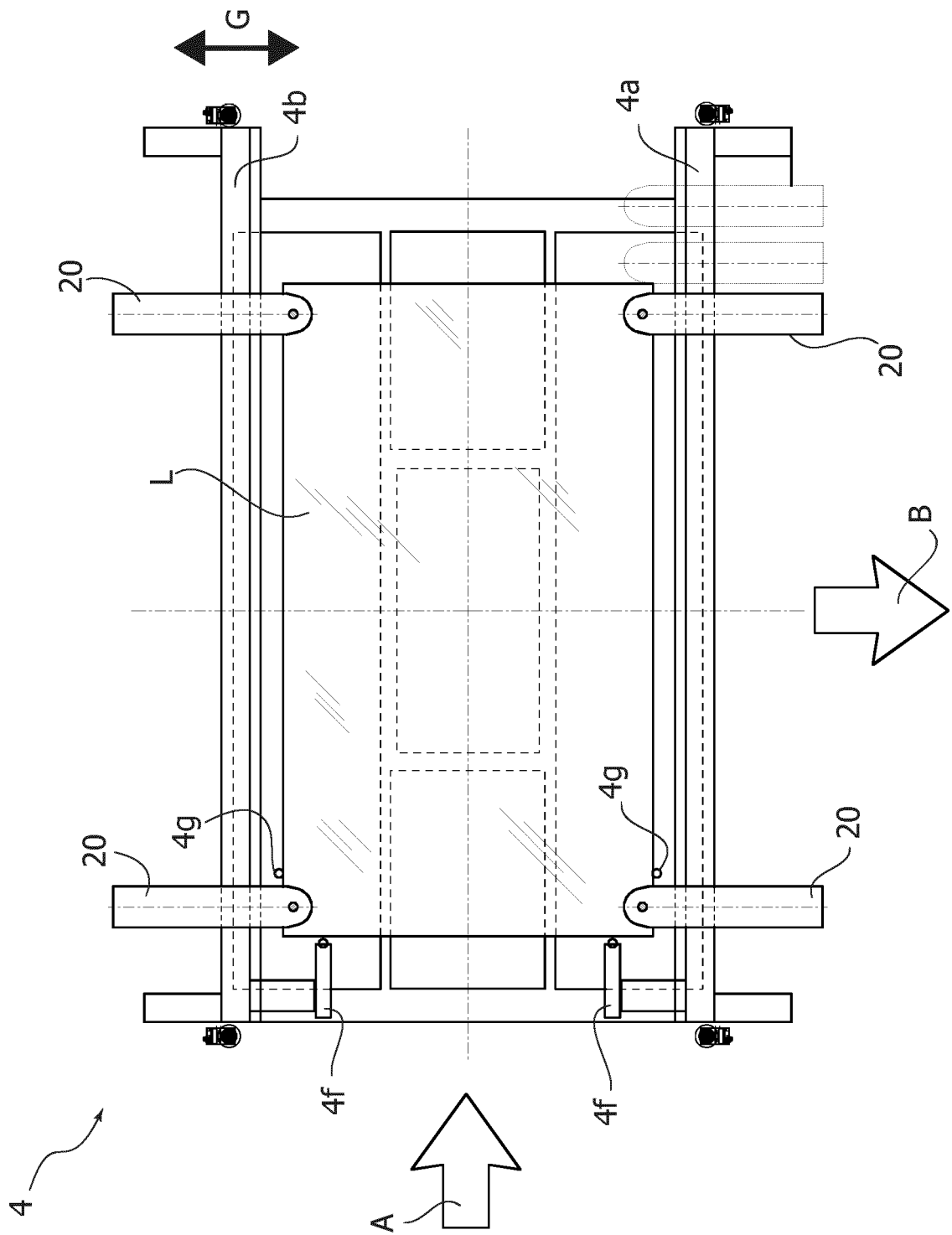


FIG. 7

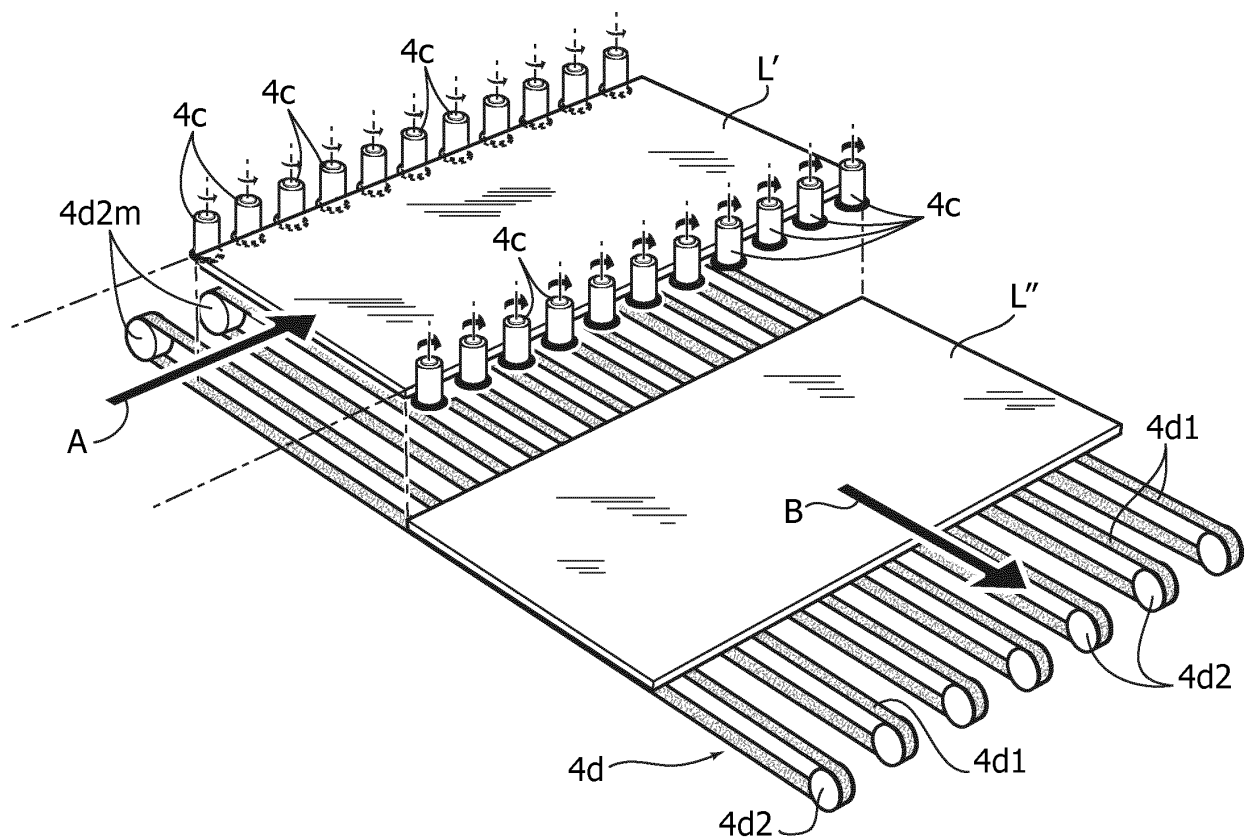


FIG. 7A

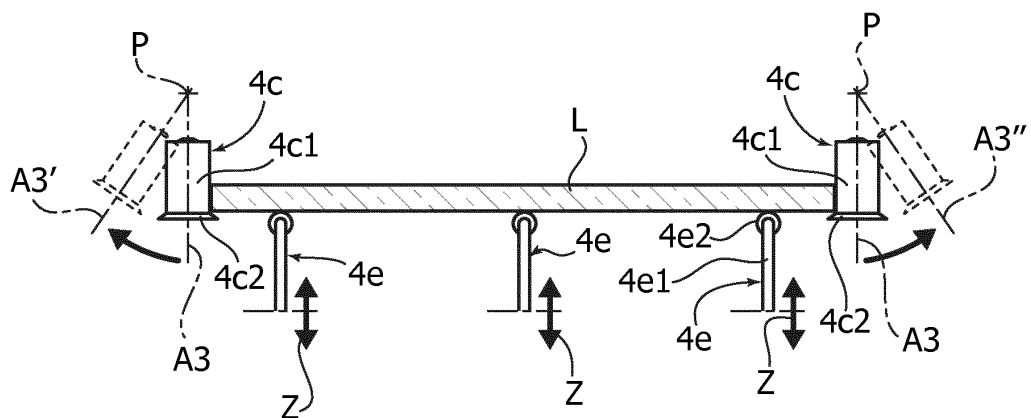


FIG. 8

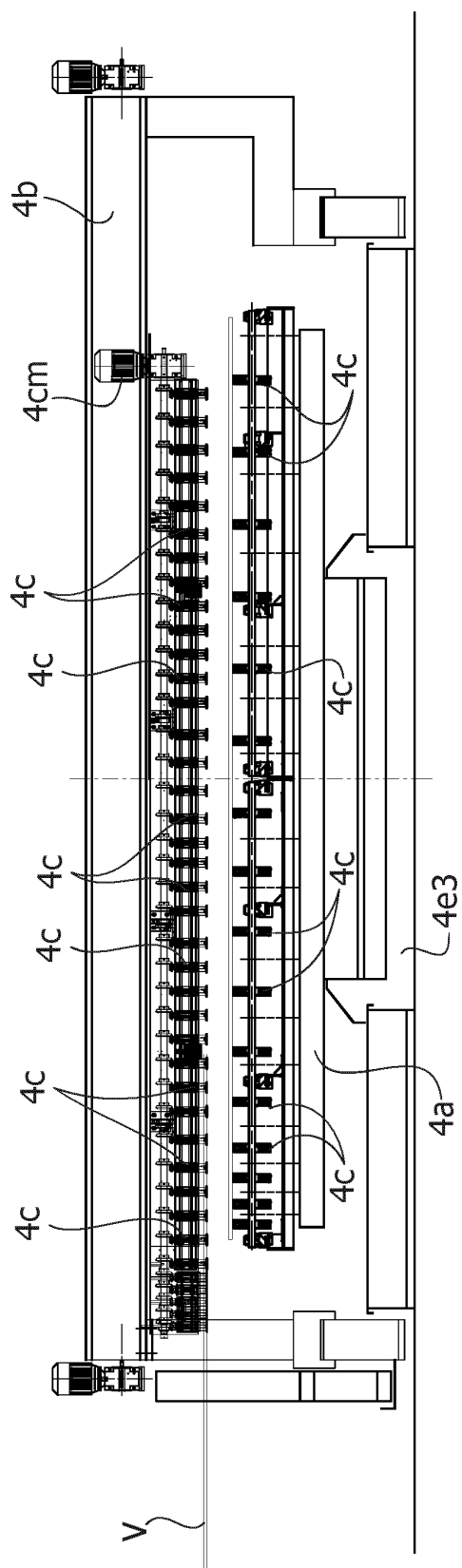


FIG. 9

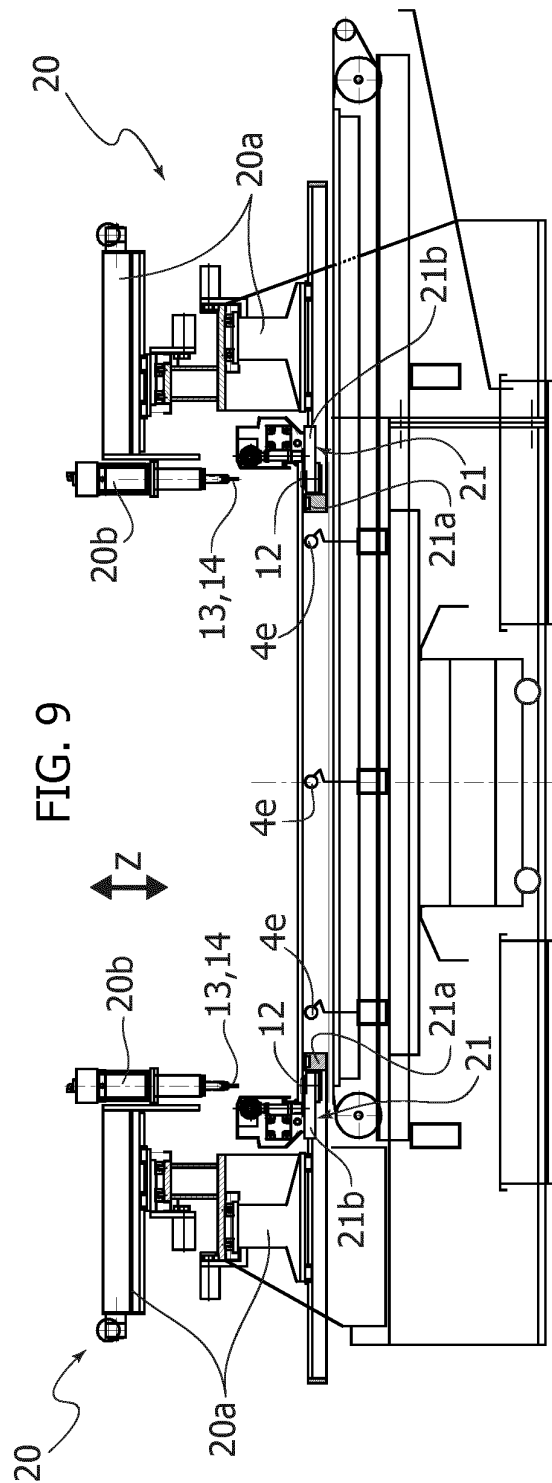


FIG. 10

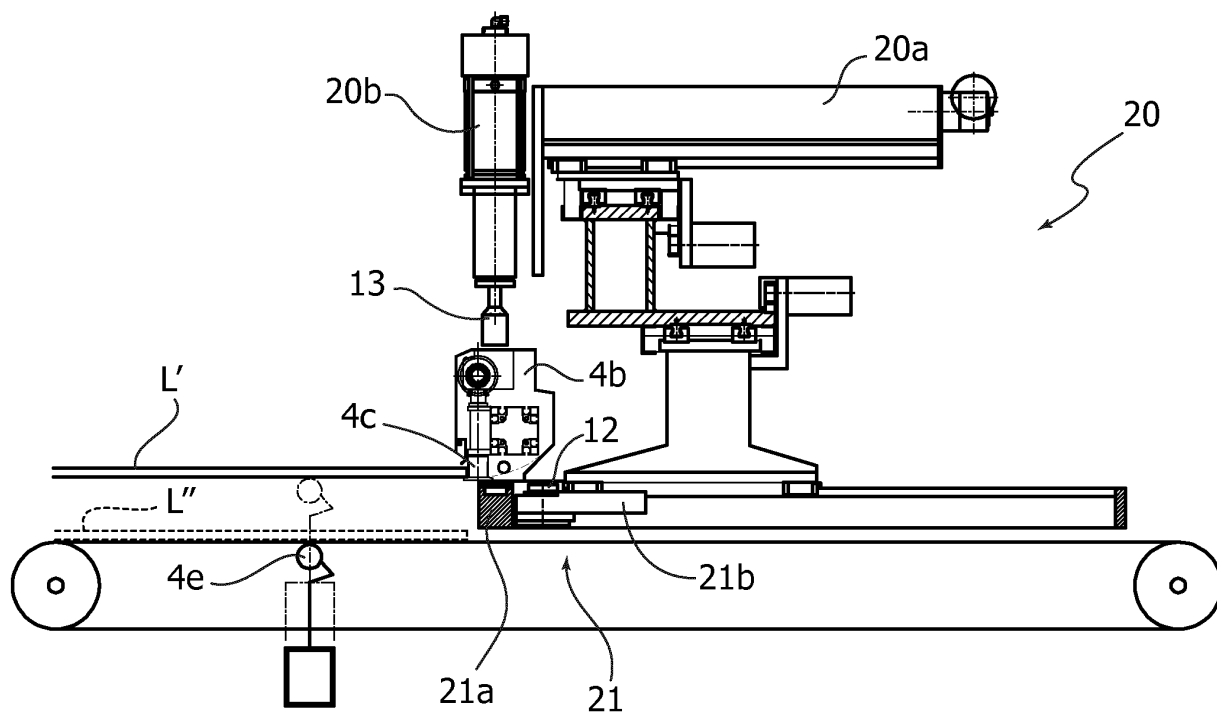


FIG. 11

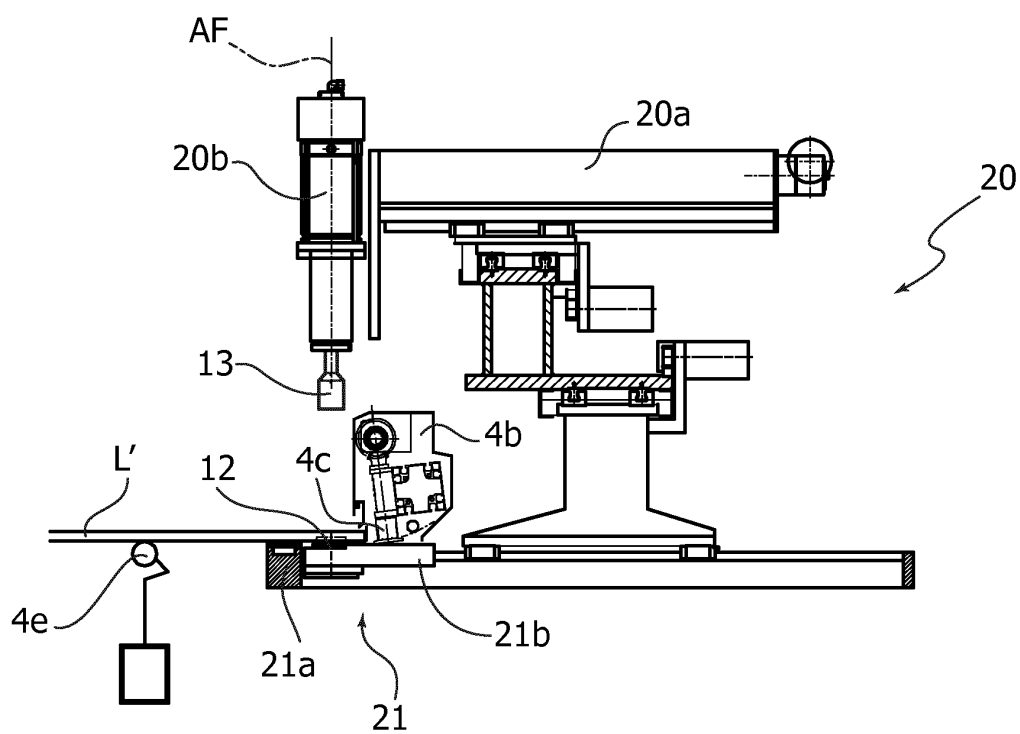


FIG. 12

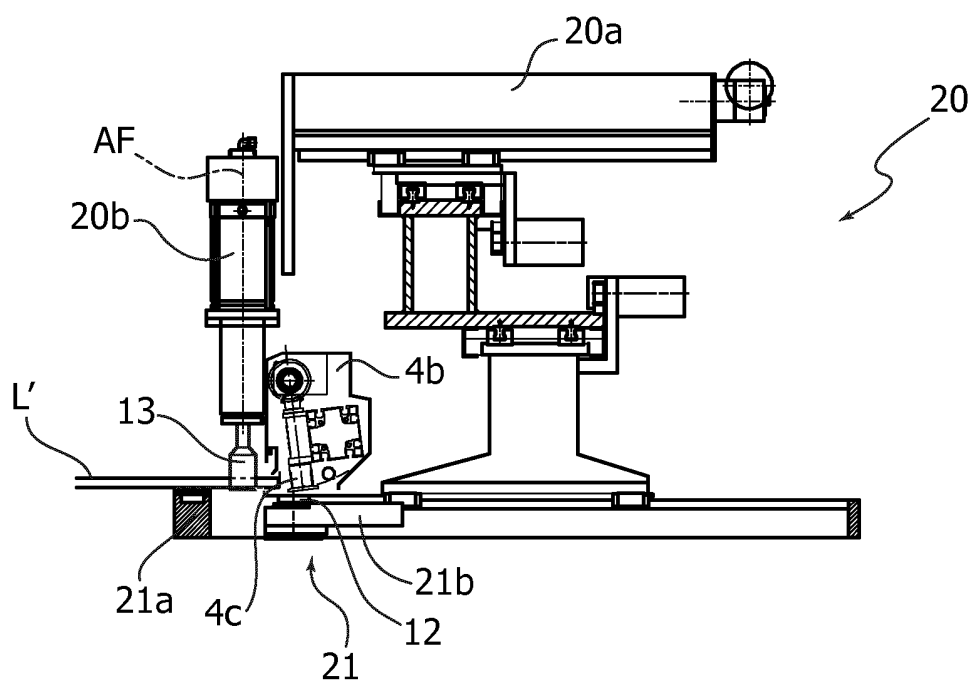


FIG. 13

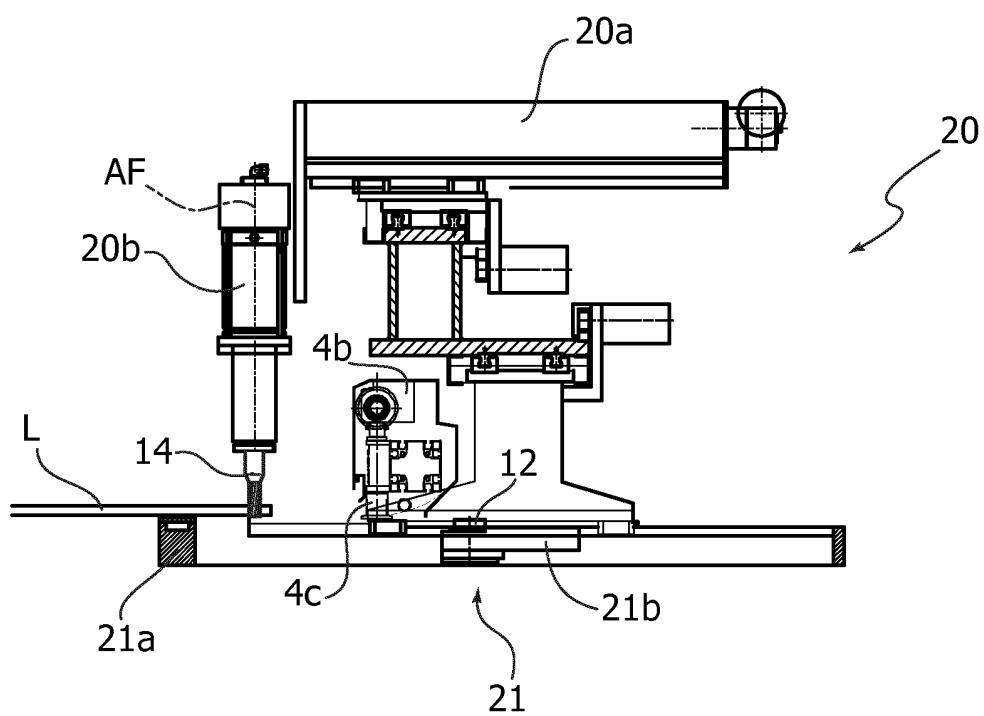


FIG. 14

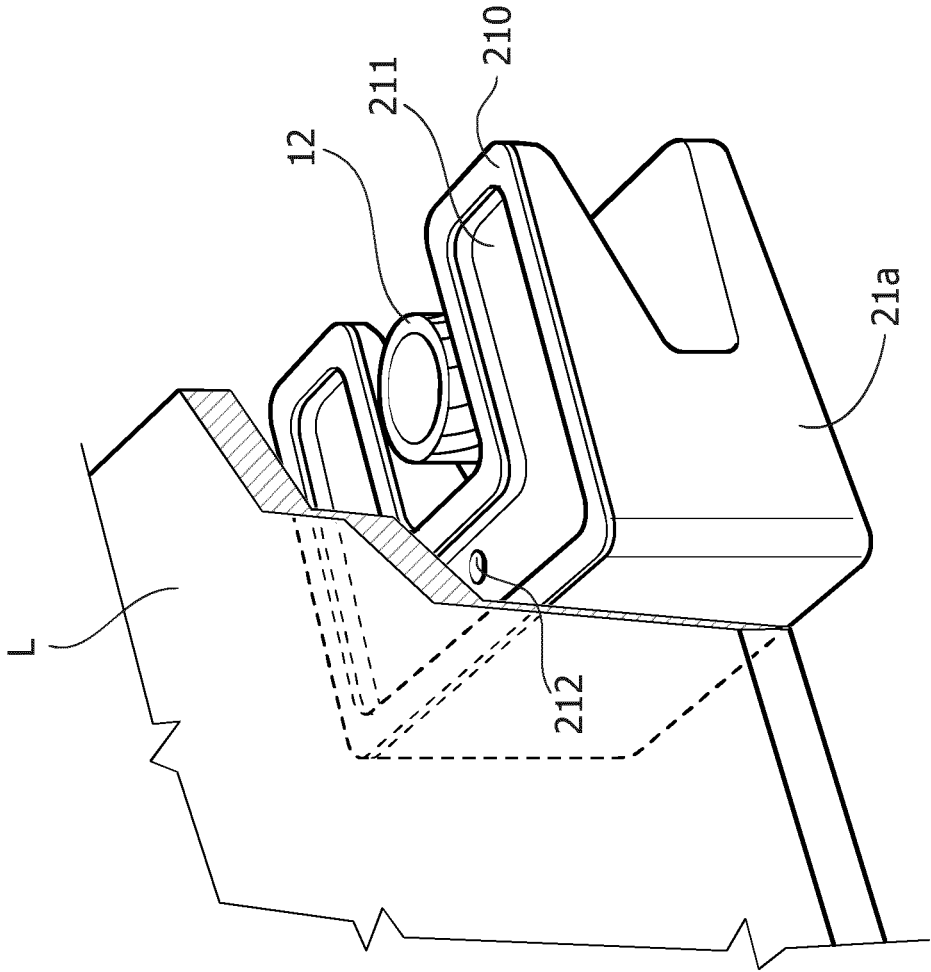
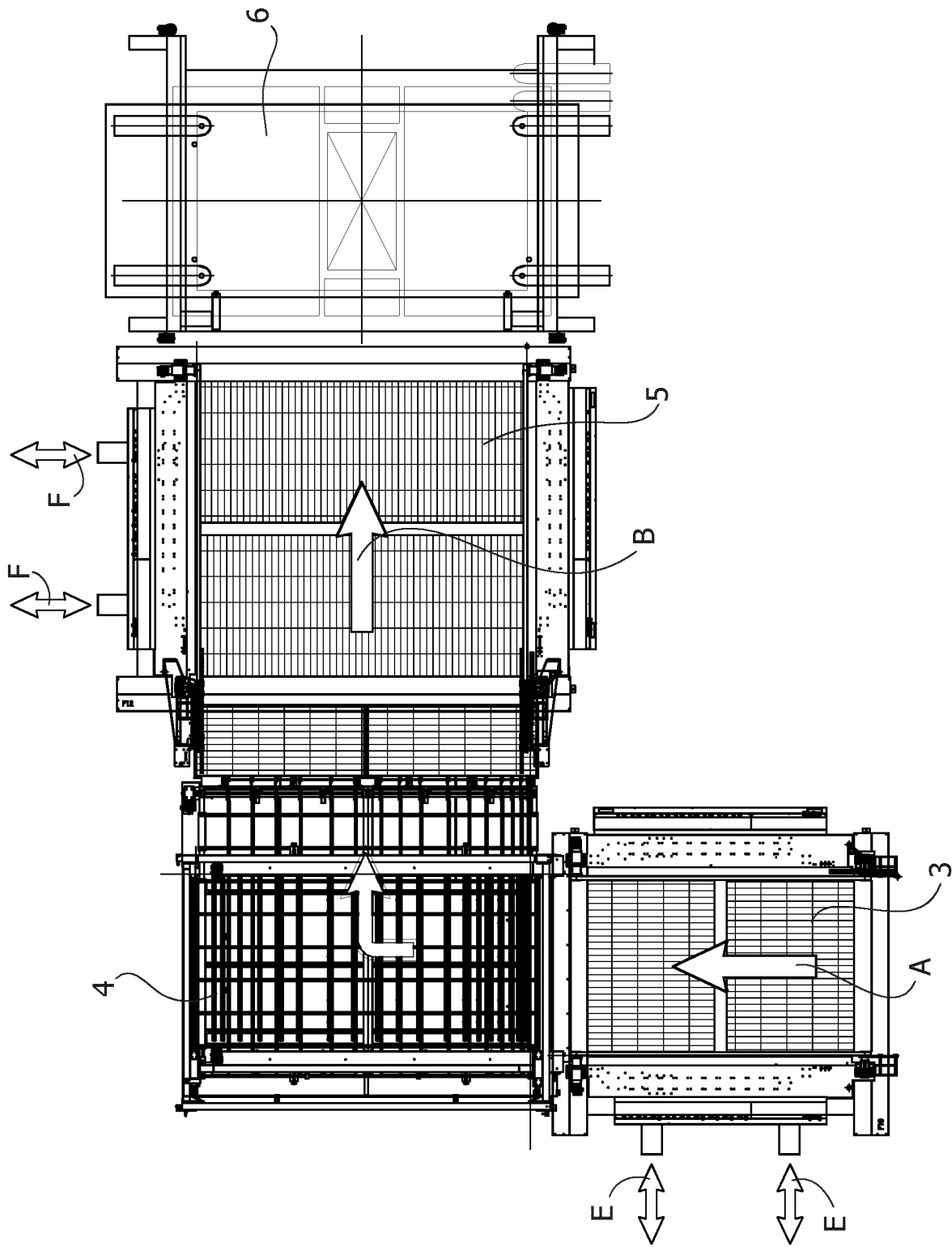


FIG. 15



REFERENCES CITED IN THE DESCRIPTION

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- EP 1063053 A [0002]