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Description

[0001] This invention relates to a machine tool and in particular to a grinder for machining operations on sheets of glass and the like.

[0002] In the sector of machining sheets of glass, to which this specification expressly refers for the sake of simplicity also meaning the machining of sheets of similar materials, there are different prior art types of machine tools designed, in particular, for machining edges of the sheets.

[0003] A first type of machine comprises the so-called rectilinear grinders in which the sheet being machined is kept in a substantially vertical position and moved forward, using a suitable transport system, on a train of cup grinding wheels, which vary in number according to the type of machine, having the axes of rotation also substantially vertical.

[0004] The grinding wheels machine one edge of the sheet at a time, for example polishing it, after which the sheet is rotated, usually manually, to progressively position all the edges on the grinding wheels for the respective machining operations.

[0005] Another type of reference machine is the bilateral machine in which the sheet, which is substantially horizontal, is moved forward along a corridor delimited at the sides by two series of cup grinding wheels having axes of rotation also substantially horizontal, which vary in number according to the type of machine, that machine two edges of the sheet at a time.

[0006] In complex systems, there are two bilateral machines positioned in series which machine respectively, in the case of quadrilateral orthogonal sheets, a first pair of parallel edges and a second pair of parallel edges.

[0007] Another type of machine for machining edges of glass sheets is the so-called vertical grinding machine.

[0008] In short, these machines comprise a conveyor of the sheets, kept substantially vertical, and a machining station with a vertical extension comprising at least one head and three axes on which the grinding wheels required by the machining are mounted in succession.

[0009] The sheet is moved forward, in a feed direction, to the machining station where each grinding wheel acts on the front edge of the sheet, considering the feed direction. Successive forward movements of the sheet and/or of the head allow the head to machine the upper edge, the rear edge and the lower edge of the sheet.

[0010] It should be noted that in these machines it is necessary to change the grinding wheels for the machining operations on each side, so, for example, if six grinding wheels for the polishing are needed, between diamond and polishing wheels, six changes of tools are needed for each edge.

[0011] More specifically, once a grinding wheel is installed, all the edges are machined before carrying out each tool change and passing to the next grinding wheel.

[0012] The vertical machines are also, as known, equipped with hole drilling tools which are able to operate on the two opposite faces of the sheet if two opposite heads are provided.

[0013] Another kind of glass plate working apparatus is disclosed in document WO2001/016098, forming the base of the preamble of claim 1.

[0014] Such apparatus is provided for rotating and stropping a glass plate by 90 degrees by a rotary suction cup and for moving the rotary suction cup and the glass pplate linearly in every stop states, so that a straight edge at the lower end of the glass plate rotated and positioned in parallel with the linear movement direction can be ground by passing same through a grinding wheel. Separately of the rotary suction cup, an auxiliary suction cup for sucking and fixing the glass plate and moving linearly together with the glass plate is disposed at a position near the inner side, through which the grinding point of the grinding wheel passes.

[0015] The prior art solutions have some drawbacks.

[0016] The rectilinear grinders allow standard machining operations, for example polishing, on the side which passes above the grinding wheels and require the manual rotation of the sheet to operate on all the sides.

[0017] Also, these grinders are not able to make recesses, holes or slots, which are normally provided in the production of doors and the like for handles and hinges.

[0018] The bilateral machines are very bulky and require tipping of the sheets which are normally stored vertically.

[0019] The vertical grinding machines are, as mentioned, equipped with peripheral grinding wheels. The polishing of the edges obtained with these grinding wheels is not appreciated in the more valuable products in which the better quality polishing obtained with the cup grinding wheels is preferred. Moreover, as mentioned, the productivity is limited due to the need to change the tools during the machining.

[0020] Generally, the rectilinear grinders do not allow the squaring and checking of the nominal dimensions of the sheets being processed.

[0021] In this context, the main technical purpose of this invention is to provide a machine tool designed in particular for the machining of sheets of glass and the like that is free of the above-mentioned drawbacks.

[0022] One aim of this invention is to provide a machine tool which is more versatile than rectilinear grinders and vertical machines.

[0023] Another aim of this invention is to provide a machine tool which is faster and more productive than prior art vertical machines

[0024] The technical purpose indicated and the aims specified are substantially achieved by a machine tool according to claim 1.

[0025] Further features and advantages of this invention are more apparent in the detailed description below, with reference to a preferred, non-limiting embodiment of a machine tool for machining sheets of glass and the like as illustrated in the accompanying drawings, in

which:

- Figure 1 is a schematic perspective view partly in blocks with some parts cut away for greater clarity of the machine tool according to this invention and a sheet being machined in a first position;
- Figure 2 is a schematic perspective view partly in blocks with some parts cut away for greater clarity of the machine tool of Figure 1 and the sheet being machined in a second position;
- Figure 3 is a schematic perspective view partly in blocks with some parts cut away for greater clarity of the machine tool of Figure 1 and the sheet being machined in a third position;
- Figure 4 is a schematic front view partly in blocks with some parts cut away for greater clarity of the machine tool of Figure 1 and the sheet being machined in the third position;
- Figure 5 is a schematic front view partly in blocks with some parts cut away for greater clarity of the machine tool of Figure 1 in a first operating configuration;
- Figure 6 is an enlarged detail of the machine of Figure 5;
- Figure 7 is a schematic perspective view partly in blocks with some parts cut away for greater clarity of the machine tool of Figure 1 in a second operating configuration;
- Figure 8 is a schematic perspective view partly in blocks with some parts cut away for greater clarity of the machine tool of Figure 1 in a second operating configuration;
- Figure 9 is a schematic front view partly in blocks with some parts cut away for greater clarity of the machine tool of Figure 1 in the operating configuration of Figure 8;
- Figure 10 is a schematic perspective view of an enlarged detail of the machine of Figure 8;
- Figure 11 is a schematic perspective view partly in blocks with some parts cut away for greater clarity of the machine tool of Figure 1 and the sheet being machined in a fourth position;

[0026] With reference to the accompanying drawings, the numeral 1 indicates a machine tool according to the present invention.

[0027] The machine tool 1 is preferably designed for machining sheets of glass 2 or the like having at least one edge 3.

[0028] Schematically, the term "sheet" means a solid piece of material characterised by a thickness considerably less than the length or width.

[0029] The machine 1 comprises a frame 4 supporting the sheets 2; the frame 4, of substantially known type, is designed for supporting the sheet 2 in a substantially vertical position.

[0030] As illustrated in the accompanying drawings, the frame 4 has a main direction of extension X which identifies, as explained below, a direction X of movement of the sheet 2.

[0031] The sheet 2 is moved on the frame 4 according to a feed direction V.

[0032] The frame 4 is equipped with a succession of rollers 5, extending in the direction X and positioned beneath the frame 4, on which the sheet 2 to be machined rests.

[0033] As is known, the frame 4 is equipped with wheels, not shown, having substantially vertical axes of rotation, which facilitate the translation of the sheets in the direction X.

[0034] Moreover, the supporting surface of the sheet 2, defined by the above-mentioned frame 4, is, as is customary, inclined by 5° to a vertical lying plane.

[0035] In a preferred embodiment, all or part of the rollers 5 are motor driven for feeding the sheet 2 along the direction of movement X and form means of moving the sheet 2.

[0036] The machine 1 comprises a machining station 6 at which predetermined machining of the sheet 2 is performed.

[0037] The machining station 6 is preferably located in an intermediate portion of the frame 4 in the direction X and the above-mentioned movement means allow the sheet to be taken and moved on the frame 4 along the direction X towards and away from the machining station 6.

[0038] The machine 1 comprises operator means for performing the machining operations at least on the edge 3 of the sheet 2, or substantially at it, in the machining station 6.

[0039] In the example illustrated, the operator means comprise a first train of tools 7, for example cup grinding wheels, and a second train of tools 8, for example peripheral grinding wheels.

[0040] Advantageously, the operator means are positioned beneath the frame 4 and the edge which is machined is the lower edge, observing for example Figure 5, of the sheet 2.

[0041] In alternative embodiments not illustrated, the machine 1 only comprises the train of tools 7 or the train of tools 8.

[0042] For convenience of description reference is made for the first carriage to cup grinding wheels and for the second carriage to peripheral grinding wheels or ball-end milling cutters or the like.

[0043] In other embodiments the train 7 comprises one or more peripheral grinding wheels for example for rounding the corners of the sheet 2.

[0044] In other embodiments the train 8 comprises one or more corner heads equipped with cup grinding wheels of substantially known type or drilling bits, ball-end milling cutters and the like.

[0045] More precisely, the train 8 of peripheral grinding wheels comprises a pair of tool holder heads 9, 10 opposite to each other, that is, positioned, as explained below, on opposite sides of the sheet 2 during their machin-

ing. With particular reference to Figure 6, it should be noted that the train 7 comprises, schematically, one carriage 11 and a plurality of tools 12 on the carriage 11.

[0046] For simplicity, the numeral 12 denotes the pindles for actuating the corresponding tools, of substantially known type and therefore not described further.

[0047] With reference in particular to Figures 4 and 6, the numeral 12a denotes the motors for actuating the spindles 12.

[0048] With particular reference to Figure 10, it should be noted that the train 8 comprises, schematically, one carriage 13 and a plurality of tools 14, preferably actuated by the heads 9, 10, on the carriage 13.

[0049] The carriage 11 is movable between a non-operating position, shown for example in Figure 1, and a working position, shown for example in Figure 5, located in the machining station 6.

[0050] The carriage 13 is movable between a non-operating position, shown for example in Figure 1, and a working position, shown for example in Figure 8, located in the machining station 6.

[0051] With reference to Figure 1, it should be noted that, in the preferred embodiment illustrated, the non-operating position of the first carriage 11 and the non-operating position of the second carriage 13 are located along the direction of movement X from opposite sides relative to the machining station 6.

[0052] In a preferred embodiment, the carriage 11 and/or the carriage 13 form the above-mentioned means for moving the sheet 2 along the direction X.

[0053] In practice, the carriage 11 and/or the carriage 13 is equipped with a device for picking up the sheet 2, schematically illustrated for example with a block 22 in Figure 1, which is therefore drawn by the carriage 11, 13 along the frame 4.

[0054] In this embodiment, the carriage 11 and/or the carriage 13 move or contribute to the movement of the sheet 2 along the frame 4 using the device 22.

[0055] In the preferred embodiment illustrated as an example, the pickup device 22 allows in particular the positioning of the sheet 2 in the station 6 where the rollers 5 are not present to allow the machining of the tools of the train 7 and/or of the train 8.

[0056] Advantageously, in alternative embodiments not illustrated, the carriage 11 and/or the carriage 13 move the sheet 2 along the frame 4.

[0057] The machine tool 1 comprises means for picking up and moving the sheet 2 located in the station 6.

[0058] In other words, the machining station 6 comprises pickup means which can be activated on the sheet 2 for picking up the sheet 2.

[0059] The pickup means in the machining station 6 are rotatable about an axis of rotation R, or rotary axis R, transversal to the direction of movement X for rotating the sheet 2 about the axis R.

[0060] For simplicity, the pickup means of the station 6 are also indicated as rotary pickup means.

[0061] As described in more detail below, the machine tool 1, thanks to the pickup means in the machining station 6 rotatable about the rotary axis R, is able to rotate the sheet 2 being machined in such a way that the edge 3 to be machined can always be positioned below and can be machined using the tools 12, 14 on the carriages 11, 13.

[0062] In the preferred embodiment illustrated as an example, the pickup means in the machining station 6 comprise at least one suction cup 15.

[0063] The suction cup 15 has the relative main axis, that is, schematically the central axis of symmetry of the suction cup, coinciding with the above-mentioned rotary axis R.

[0064] More specifically, the pickup means comprise a group of suction cups rotatable about the axis R, that is, in a preferred embodiment, the suction cup 15 is of the modular type, that is, formed by a plurality of suction cups. For convenience of description, reference is made below to the single suction cup 15.

[0065] The above-mentioned carriages 11, 13 are movable relative to the suction cup 15 for performing suitable machining operations on the sheet 2 using the cup grinding wheels and/or the peripheral grinding wheels on the edge of the sheet 2 positioned below.

[0066] Preferably, operator means are positioned in the machine 1 below the means for picking up the sheet 2 in the station 6.

[0067] The machine 1 comprises a computerised control unit, schematically illustrated with a block 16, at least in communication with the trains 7, 8, with the means for moving the sheet 2 and with the suction cup 15, or the corresponding group of suction cups.

[0068] The unit 16 is configured for controlling at least the trains 7, 8, the means for moving the sheet 2 and the suction cup 15 for performing the machining operations, for example the polishing, on one of the edges of the sheet.

[0069] So as to render the machine 1 more versatile, the suction cup 15 is movable along a lifting direction Y transversal to the direction of movement X and the axis of rotation R.

[0070] More precisely, the lifting direction Y extends parallel to the above-mentioned supporting surface of the sheet 2 and the axis of rotation R is substantially normal to the supporting surface.

[0071] The sheet 2, supported by the suction cup 15, is therefore movable along the direction Y.

[0072] With reference in particular to Figure 7, it should be noted that the suction cup 15, or the corresponding group of suction cups or, more generally, the means of picking up the sheet in the station 6, are preferably movable along or parallel to the axis of rotation.

[0073] In this way, the sheet 2 can preferably be moved away from the frame 4 and in the case of execution of holes in the sheet the carriage 13 can be used, suitably equipped with a pair of machining heads 9, 10 located opposite each other with respect to the sheet 2.

[0074] The tools of the heads 9 and 10 acting from

opposite sides of the sheet 2, as schematically shown in more detail in particular in Figure 10, act in conjunction to make, for example, a through hole 17 in the sheet 2.

[0075] Advantageously, also for the purposes described in detail below, the train 7 and the train 8, or more specifically the respective tools, are movable along the lifting direction Y between a respective lowered position and a respective raised position.

[0076] This movement allows the setting, for example using the computerised unit 16, of the height or the direction along Y for any machining operations on the sheet 2.

[0077] With particular reference to the heads 9 and 10, it should be noted that they are each movable along the direction Y.

[0078] Moreover, the heads 9 and 10 are movable in a direction Z, preferably parallel to the above-mentioned axis of rotation R.

[0079] In a preferred embodiment, the heads 9 and 10 are rotatable about an axis C, preferably parallel to the axis of rotation R.

[0080] With reference to the accompanying drawings, it should be noted that the machine 1 comprises retaining means which can be activated on the sheet 2 in the machining station 6 to retain the sheet during the machining.

[0081] In the example illustrated, the means for retaining the sheet 2 in the station 6 comprise a plurality of suction cups 18, the retaining means being provided substantially at the tool 12, 14.

[0082] With particular reference to Figures 5 and 9, it should be noted that the suction cups 18 are positioned substantially at a zone of action of the tool 12, 14.

[0083] In the preferred embodiment, the suction cups 18 are aligned in the direction X and are in a portion of the frame 4 observing the accompanying drawings for retaining the sheet 2 close to the edge being machined which, as mentioned, is a lower edge of the sheet.

[0084] It should be noted that, so as to favour the rotation of the sheet 2 in the station 6, the machine 1 comprises an air curtain plane 19 at the suction cup 15.

[0085] The air curtain plane 19, which, in the example illustrated, is formed by two planes positioned on opposite sides of the suction cup 15 in the direction X, is of substantially known type and therefore described only insofar as necessary for understanding this invention.

[0086] The plane 19 is coplanar with the portion of frame substantially vertical on which the sheets 2 being machined rest and it is also substantially vertical. The machine 1 comprises a pneumatic system, schematically illustrated with a block 20, for feeding the operating fluid to the plane 19.

[0087] The pneumatic system 20 is in communication with the computerised unit 16 and controlled by it.

[0088] During rotation of the sheet 2, as for example illustrated in Figure 3, the pneumatic system 20 forms an air curtain between the plane 19 and the sheet 2 so as to facilitate the rotation about the axis R.

[0089] In a preferred embodiment, the pneumatic system 20, suitably controlled, is able to suck air from the plane 19, contributing to retaining the sheet 2, in particular during machining operations on the lower edge of the sheet 2. The machine 1 comprises means for measuring the sheet being machined, schematically illustrated with a block 21, in communication with the computerised control unit 16.

[0090] The measuring means 21 are located upstream, in the feed direction V, of the station 6 and are configured for acquiring at least one dimensional parameter of the sheet 2 being machined.

[0091] In practice, the measuring means 21 are positioned at the inlet of the machining station 6.

[0092] More specifically, in a preferred embodiment, the measuring means 21, which form a system for measuring the sheet at the inlet of the station 6, verify the geometry of the sheet.

[0093] Given the geometry of the sheet, the unit 16 is configured in such a way that the rotary pickup means pick up the sheet centrally, preferably in the barycentre.

[0094] Moreover, given the geometry of the sheet at the inlet, the unit 16 is preferably configured for controlling the operator means, for example the grinding wheels and/or the rotary pickup means for shaping the sheet 2 for example as a function of the expected shape, also correcting any shape errors encountered at the inlet of the machining station.

[0095] Therefore, advantageously, the computerised unit 16 allows the interpolation of the movements of the sheet 2 and of the tools of the trains 7 and 8 both for verifying and recovering the expected shape and dimensions of the sheet and also for compensating the consumption of the tools or the dressing of the tools.

[0096] More specifically, the unit 16 forms an adaptive statistical system for recovering the consumption of the tool and/or dimensional shape of the sheet being machined as a function of the absorption of the motors actuating the tools.

[0097] In the preferred embodiment illustrated in particular in Figure 1, the machining station 6 comprises a device for picking up the sheet 2, for example a suction cup to which express reference will hereinafter be made but without thereby limiting the scope of the invention, schematically illustrated with a block 23, positioned in front of the suction cup 15.

[0098] In practice, the suction cup 23 is positioned on the side opposite the suction cup 15 with respect to the sheet 2 considering the sheet 2 in the machining station 6.

[0099] The suction cup 23 is movable in a direction preferably parallel to the axis R between a position away from the suction cup 15 and a position near the suction cup 15, shown by a dashed line for example in Figure 1.

[0100] The suction cup 23 is advantageously used for the rotation, by the suction cup 15, of a sheet 2a of reduced size, as schematically shown with a dashed line in Figure 3.

[0101] In that case, the suction cup 23 supports the sheet 2a whilst waiting that the suction cup 15 lifts along

Y to pick up again the sheet 2 in a more advantageous position than the lower edge by the very nature of the reduced size of the sheet 2a.

[0102] Advantageously, in a preferred embodiment, the pickup device 23 is installed on the carriage 11 and forms the above-mentioned pickup device 22.

[0103] With reference in particular to Figure 2, it should be noted that the machine 1 also comprises a supporting system, schematically illustrated with a block 24, for sheets 2 with a rectangular shape, that is, not polygonal or with curvilinear edges.

[0104] The system 24 is associated with the frame 4 and is formed for example by a template or by a series of pins which allow the resting of a sheet 2 having any shape.

[0105] The sheet 2 can be moved forward as described above as far as the suction cup 15.

[0106] The suction cup 15 picks up the sheet 2 and thanks to the possibility of rotation about the axis of rotation R and the possibility of translating along the direction Y, suitably interpolated, by the unit 16, allows the machine 1 to perform machining operations also on edges for example curved.

[0107] The invention described brings important advantages.

[0108] With respect to the prior art so-called vertical machines, the proposed solution is faster as tool changes are not necessary for polishing the edge; once the edge to be machined is positioned, if necessary by suitable rotations of the shaft, the train of grinding wheels, which carries all the grinding wheels necessary for the machining operations, performs the machining for each edge after the respective rotations.

[0109] The presence of a train of peripheral grinding wheels, that is, ball-end milling cutters if necessary with the possibility of tool change, allows the performance of many machining operations on the sheet also due to the movements attributed to the suction cup 15 and to the tool holder carriages 11 and 13.

[0110] The automatic rotation of the sheet not only increases productivity but also makes the machine safer than prior art solutions as the rotation of the sheet is not performed manually by an operator who would be in a danger zone.

[0111] The presence of the supporting system in combination with the rotary axis suitably controlled in combination with the tools allows performance of the machining operations also on sheets having edges which are not rectilinear, for example curved, that is, it renders the machine more versatile and not limited to machining operations on square or rectangular sheets.

Claims

1. A machine tool for machining a sheet of glass (2) or the like having at least one edge (3), the machine comprising
a frame (4) for supporting the sheet (2) in a substantially vertical position;
a station (6) for machining the sheet (2);
operator means (7, 8) for machining at least the edge (3) in the machining station (6),
means (5, 11, 13) for moving the sheet (2) in a direction of movement (X), towards and away from the machining station (6),
the machine tool comprising
a computerised control unit (16) in communication with the operator means (7, 8) and with the movement means (5, 11, 13) and designed for controlling the operator means (7, 8) and the movement means (5, 11, 13), pickup means (15), comprising at least one suction cup (15), which can be activated on the sheet (2) for picking up the sheet (2), the pickup means (15) being rotatable about an axis (R) of rotation transversal to the direction of movement (X) for rotating the sheet (2) about the axis (R) of rotation, the operator means (7, 8) comprising a carriage (11, 13) and at least one tool (12, 14) mounted on the carriage (11, 13), the carriage (11, 13) being movable relative to the pickup means (15) for performing the machining on the sheet (2) using the tool (12, 14), the operator means (7, 8) being preferably positioned below the pickup means (15), the machine being **characterised in that**
the carriage (11, 13) is movable relative to the suction cup (15) between a non-operating position and a working position along the direction of movement (X) for performing suitable machining operations on the sheet (2) using said tool (12, 14), the computerised control unit (16) being designed for controlling the pickup means (15) and the carriage (11, 13) in such a way that they position the edge (3) being machined at the tool (12, 14).

2. The machine tool according to claim 1 **characterised in that** the pickup means (15) are movable in a lifting direction (Y) transversal to the direction of movement (X) and to the axis (R) of rotation.

3. The machine tool according to claim 1 or 2, **characterised in that** the pickup means (15) are movable along the axis (R) of rotation.

4. The machine tool according to any one of claims 1 to 3, **characterised in that** the movement means (5, 11, 13) comprise the carriage (11, 13) and a pickup device (22) which can be activated on the sheet (2) for picking up the sheet (2) and moving it on the frame (4) along the direction of movement (X).

5. The machine tool according to any one of claims 1 to 4, **characterised in that** the tool (12, 14) if formed by a cup grinding wheel.

6. The machine tool according to any one of claims 1

to 5, **characterised in that** the operator means (7, 8) comprise at least one tool holder head (9, 10) and the tool (12, 14) is formed by a peripheral grinding wheel.

7. The machine tool according to any one of claims 1 to 6, **characterised in that** the operator means (7, 8) comprise a first carriage (11) movable between a non-operating position and a working position in the machining station (6), a plurality of cup grinding wheels on the first carriage (11), a second carriage (13) movable between a non-operating position and a work position in the machining station (6), at least one tool holder head (9, 10) actuating a peripheral grinding wheel installed on the second carriage (13), the first and second carriage (11, 13) being movable relative to the pickup means (15) for performing the machining on the sheet (2) using the cup grinding wheels and/or the peripheral grinding wheel in the machining station (6), the non-operating position of the first carriage (11) and the non-operating position of the second carriage (13) being in particular located along the direction of movement (X) from opposite sides relative to the machining station (6).

8. The machine tool according to claim 7, **characterised in that** the movement means (5, 11, 13) comprise the second carriage (13).

9. The machine tool according to any one of claims 1 to 8, **characterised in that** the machining station (6) comprises retaining means (18) which can be activated on the sheet (2) in the machining station (6) for retaining the sheet (2) during the machining, the retaining means (18) being provided substantially at the tool (12, 14).

10. The machine tool according to any one of claims 1 to 9, **characterised in that** it comprises means (21) for measuring the sheet (2) being machined for acquiring at least one parameter of the sheet (2), the measuring means (21) being positioned at an inlet of the machining station (6) and in communication with the computerised control unit (16).

11. The machine tool according to claim 10, **characterised in that** the computerised control unit (16) is designed for controlling at least the pickup means (15) as a function of the parameter and/or for controlling at least the operator means (7, 8) as a function of the parameter.

12. The machine tool according to any one of claims 1 to 11, **characterised in that** the frame (4) comprises at least one air film supporting plane (19) substantially vertical located in the machining station (6), the machine comprising a pneumatic system (20) in communication with the supporting plane (19) for generating the air film and in communication with the computerised control unit (16), the computerised control unit (16) being designed for controlling the pneumatic system (20) so as to generate an air film during a rotation of the sheet (2), the computerised control unit (16) being in particular designed for controlling the pneumatic system (20) so as to suck air from the supporting plane (19) for retaining the sheet (2) at the machining position.

13. The machine tool according to any one of claims 1 to 12, **characterised in that** the tool (12, 14) is movable along a lifting direction (Y) transversal to the direction of movement (X) and the axis (R) of rotation.

14. The machine tool according to any one of claims 1 to 13, **characterised in that** it comprises a second pickup device (23) which can be activated on the sheet (2) for picking up the sheet (2) positioned on the opposite side to the pickup means (15), the second pickup device (23) being movable along a direction parallel to the axis (R) between a position far from the pickup means (15) and a position close to the pickup means (15), the second pickup device (23) being preferably installed on the carriage (11, 13).

15. The machine tool according to any one of claims 1 to 14, **characterised in that** it comprises a system (24) for supporting the sheet (2) associated with the frame (4), the supporting system (24) being designed to support a sheet (2) having at least one curved edge, the supporting system (24) comprising preferably at least one pin.

Patentansprüche

1. Werkzeugmaschine zum Bearbeiten einer Glasplatte (2) oder Ähnlichem, aufweisend mindestens eine Kante (3), wobei die Maschine umfasst
einen Rahmen (4) zum Stützen der Platte (2) in einer im Wesentlichen vertikalen Position;
eine Station (6) zum Bearbeiten der Platte (2); Bearbeitungsmittel (7, 8) zum Bearbeiten von mindestens der Kante (3) in der Bearbeitungsstation (6),
Mittel (5, 11, 13) zum Bewegen der Platte (2) in eine Bewegungsrichtung (X) hinführend zur und wegführend von der Bearbeitungsstation (6),
wobei die Werkzeugmaschine umfasst eine computerisierte Steuereinheit (16) in Kommunikation mit den Bearbeitungsmitteln (7, 8) und mit den Bewegungsmitteln (5, 11, 13) und ausgestaltet zum Steuern der Bearbeitungsmittel (7, 8) und der Bewegungsmittel (5, 11, 13), Aufnahmemittel (15), umfassend mindestens einen Saugnapf (15), die auf der Platte (2) aktiviert werden können, um die Platte (2) aufzunehmen, wobei die Aufnahmemittel (15) um ei-

ne Rotationsachse (R) drehbar sind, die quer zur Bewegungsrichtung (X) verläuft, um die Platte (2) um die Rotationsachse (R) zu drehen, wobei die Bearbeitungsmittel (7, 8) einen Wagen (11, 13) und mindestens ein Werkzeug (12, 14) umfassen, das auf dem Wagen (11, 13) montiert ist, wobei der Wagen (11, 13) relativ zu den Aufnahmemitteln (15) bewegbar ist, um die Bearbeitung auf der Platte (2) mit dem Werkzeug (12, 14) auszuführen, wobei die Bearbeitungsmittel (7, 8) vorzugsweise unter den Aufnahmemitteln (15) positioniert sind und die Maschine **dadurch gekennzeichnet ist, dass** der Wagen (11, 13) relativ zum Saugnapf (15) bewegbar ist zwischen einer Nichtbetriebsposition und einer Arbeitsposition entlang der Bewegungsrichtung (X), um geeignete Bearbeitungsvorgänge auf der Platte (2) unter Nutzung des Werkzeugs (12, 14) durchzuführen, wobei die computerisierte Steuereinheit (16) ausgelegt ist, um die Aufnahmemittel (15) und den Wagen (11, 13) so zu steuern, dass sie die zu bearbeitende Kante (3) am Werkzeug (12, 14) positionieren.

2. Werkzeugmaschine nach Anspruch 1, **dadurch gekennzeichnet, dass** die Aufnahmemittel (15) in eine Heberichtung (Y) bewegbar sind, die quer zur Bewegungsrichtung (X) und zur Rotationsachse (R) verläuft.

3. Werkzeugmaschine nach Anspruch 1 oder 2, **dadurch gekennzeichnet, dass** die Aufnahmemittel (15) entlang der Rotationsachse (R) bewegbar sind.

4. Werkzeugmaschine nach einem der Ansprüche 1 bis 3, **dadurch gekennzeichnet, dass** die Bewegungsmittel (5, 11, 13) den Wagen (11, 13) und eine Aufnahmevorrichtung (22) umfassen, die auf der Platte (2) aktiviert werden kann, um die Platte (2) aufzunehmen und auf dem Rahmen (4) entlang der Bewegungsrichtung (X) zu bewegen.

5. Werkzeugmaschine nach einem der Ansprüche 1 bis 4, **dadurch gekennzeichnet, dass** das Werkzeug (12, 14) durch ein Tassenschleifrad gebildet ist.

6. Werkzeugmaschine nach einem der Ansprüche 1 bis 5, **dadurch gekennzeichnet, dass** die Bearbeitungsmittel (7, 8) mindestens einen Werkzeughalterkopf (9, 10) umfassen und das Werkzeug (12, 14) durch ein peripherisches Schleifrad gebildet ist.

7. Werkzeugmaschine nach einem der Ansprüche 1 bis 6, **dadurch gekennzeichnet, dass** die Bearbeitungsmittel (7, 8) einen ersten Wagen (11) umfassen, bewegbar zwischen einer Nichtbetriebsposition und einer Arbeitsposition in der Bearbeitungsstation (6), eine Vielzahl an Tassenschleifrädern auf dem ersten Wagen (11), einen zweiten Wagen (13), bewegbar zwischen einer Nichtbetriebsposition und einer Arbeitsposition in der Bearbeitungsstation (6), mindestens einen Werkzeughalterkopf (9, 10) der ein peripherisches Schleifrad betätigt, das auf dem zweiten Wagen (13) montiert ist, wobei der erste und der zweite Wagen (11, 13) relativ zu den Aufnahmemitteln (15) bewegbar sind, um die Bearbeitung auf der Platte (2) unter Nutzung der Tassenschleifräder und/oder des peripherischen Schleifrads in der Bearbeitungsstation (6) auszuführen, wobei die Nichtbetriebsposition des ersten Wagens (11) und die Nichtbetriebsposition des zweiten Wagens (13) insbesondere entlang der Bewegungsrichtung (X) von entgegengesetzten Seiten relativ zur Bearbeitungsstation (6) befindlich sind.

8. Werkzeugmaschine nach Anspruch 7, **dadurch gekennzeichnet, dass** die Bewegungsmittel (5, 11, 13) den zweiten Wagen (13) umfassen.

9. Werkzeugmaschine nach einem der Ansprüche 1 bis 8, **dadurch gekennzeichnet, dass** die Bearbeitungsstation (6) Haltemittel (18) umfasst, die auf der Platte (2) in der Bearbeitungsstation (6) aktiviert werden können, um die Platte (2) während der Bearbeitung zu halten, wobei die Haltemittel (18) im Wesentlichen am Werkzeug (12, 14) bereitgestellt sind.

10. Werkzeugmaschine nach einem der Ansprüche 1 bis 9, **dadurch gekennzeichnet, dass** sie Mittel (21) umfasst, um die zu bearbeitende Platte (2) zu messen, um mindestens einen Parameter der Platte (2) zu erfassen, wobei die Messmittel (21) an einem Einlass der Bearbeitungsstation (6) und in Kommunikation mit der computerisierten Steuereinheit (16) positioniert sind.

11. Werkzeugmaschine nach Anspruch 10, **dadurch gekennzeichnet, dass** die computerisierte Steuereinheit (16) ausgestaltet ist, um mindestens die Aufnahmemittel (15) als eine Funktion des Parameters zu steuern und/oder um mindestens die Bearbeitungsmittel (7, 8) als eine Funktion des Parameters zu steuern.

12. Werkzeugmaschine nach einem der Ansprüche 1 bis 11, **dadurch gekennzeichnet, dass** der Rahmen (4) mindestens eine Luftfolienhalterungsebene (19) umfasst, die im Wesentlichen vertikal in der Bearbeitungsstation (6) untergebracht ist, wobei die Maschine ein Pneumatiksystem (20) in Kommunikation mit der Halterungsebene (19) umfasst, um den Luftfilm zu erzeugen, und in Kommunikation mit der computerisierten Steuereinheit (16), wobei die computerisierte Steuereinheit (16) ausgestaltet ist, um das Pneumatiksystem (20) zu steuern, sodass ein Luftfilm während einer Drehung der Platte (2) erzeugt wird, wobei die computerisierte Steuereinheit (16) insbesondere ausgestaltet ist, um das Pneuma-

tiksystem (20) zu steuern, sodass es Luft von der Halterungsebene (19) absaugt, um die Platte (2) in der Bearbeitungsposition beizubehalten.

13. Werkzeugmaschine nach einem der Ansprüche 1 bis 12, **dadurch gekennzeichnet, dass** das Werkzeug (12, 14) entlang einer Heberichtung (Y) bewegbar ist, die quer zur Bewegungsrichtung (X) und der Rotationsachse (R) verläuft.

14. Werkzeugmaschine nach einem der Ansprüche 1 bis 13, **dadurch gekennzeichnet, dass** sie eine zweite Aufnahmevorrichtung (23) umfasst, die auf der Platte (2) aktiviert werden kann, um die Platte (2) aufzunehmen, positioniert auf der entgegengesetzten Seite der Aufnahmemittel (15), wobei die Aufnahmevorrichtung (23) entlang einer Richtung bewegbar ist, die parallel zur Achse (R) zwischen einer Position entfernt von den Aufnahmemitteln (15) und einer Position nah bei den Aufnahmemitteln (15) bewegbar ist, wobei die zweite Aufnahmevorrichtung (23) vorzugsweise auf dem Wagen (11, 13) montiert ist.

15. Werkzeugmaschine nach einem der Ansprüche 1 bis 14, **dadurch gekennzeichnet, dass** sie ein System (24) umfasst, um die Platte (2) zu stützen, verbunden mit dem Rahmen (4), wobei das Stützsystem (24) ausgestaltet ist, um eine Platte (2) zu stützen, aufweisend mindestens eine gekrümmte Kante, wobei das Stützsystem (24) vorzugsweise mindestens einen Zapfen umfasst.

Revendications

1. Machine-outil destinée à l'usinage d'une plaque de verre (2) ou similaire ayant au moins un bord (3), la machine-outil comprenant
un châssis (4) destiné à supporter la plaque (2) dans une position substantiellement verticale ;
un poste (6) pour usiner la plaque (2) ;
des moyens d'actionnement (7, 8) pour usiner au moins le bord (3) dans le poste d'usinage (6),
des moyens (5, 11, 13) destinés à déplacer la plaque (2), dans une direction de mouvement, qui se rapproche et s'éloigne du poste d'usinage (6),
la machine-outil comprenant une unité de commande informatisée (16) en communication avec les moyens d'actionnement (7, 8) et avec les moyens de déplacement (5, 11, 13) et conçue pour commander les moyens d'actionnement (7, 8) et les moyens de déplacement (5, 11, 13), des moyens de préhension (15), comprenant au moins une ventouse (15), qui peut être activée sur la plaque (2) pour saisir la plaque (2), des moyens de préhension (15) pouvant pivoter autour d'un axe (R) de rotation transversal à la direction de mouvement (X) pour faire tourner la plaque (2) autour de l'axe (R) de rotation, les moyens d'actionnement (7, 8) comprenant un chariot (11, 13) et au moins un outil (12, 14) monté sur le chariot (11, 13), le chariot (11, 13) étant mobile par rapport aux moyens de préhension (15) pour réaliser l'usinage sur la plaque (2) en utilisant l'outil (12, 14), les moyens d'actionnement (7, 8) étant, de préférence, positionnés en dessous des moyens de préhension (15), la machine étant **caractérisée en ce que** le chariot (11, 13) est mobile par rapport à la ventouse (15) entre une position non fonctionnelle et une position de travail le long de la direction de mouvement (X) pour réaliser des opérations d'usinage appropriées sur la plaque (2) en utilisant ledit outil (12, 14), l'unité de commande informatisée (16) étant conçue pour commander les moyens de préhension (15) et le chariot (11, 13) de manière à ce qu'ils positionnent le bord (3) étant usiné à l'outil (12, 14).

2. Machine-outil selon la revendication 1, **caractérisée en ce que** les moyens de préhension (15) sont mobiles dans une direction de levage (Y) transversale à la direction de mouvement (X) et par rapport à l'axe (R) de rotation.

3. Machine-outil selon les revendications 1 ou 2, **caractérisée en ce que** les moyens de préhension (15) sont mobiles le long de l'axe (R) de rotation.

4. Machine-outil selon l'une quelconque des revendications de 1 à 3, **caractérisée en ce que** les moyens de déplacement (5, 11, 13) comprennent le chariot (11, 13) et un dispositif de préhension (22) pouvant être activés sur la plaque (2) pour saisir la plaque (2) et la déplacer sur le châssis (4) le long de la direction de mouvement (X).

5. Machine-outil selon l'une quelconque des revendications de 1 à 4, **caractérisée en ce que** l'outil (12, 14) est formé par une meule boisseau.

6. Machine-outil selon l'une quelconque des revendications de 1 à 5, **caractérisée en ce que** les moyens d'actionnement (7, 8) comprennent au moins une tête porte-outil (9, 10) et l'outil (12, 14) est formé par une meule périphérique.

7. Machine-outil selon l'une quelconque des revendications de 1 à 6, **caractérisée en ce que** les moyens d'actionnement (7, 8) comprennent un premier chariot (11) mobile entre une position non fonctionnelle et une position de travail dans le poste d'usinage (6), une pluralité de meules boisseaux sur le premier chariot (11), un second chariot (13) mobile entre une position non fonctionnelle et une position de travail dans la station d'usinage (6), au moins une tête porte-outil (9, 10) actionnant une meule périphérique installée sur le second chariot (13), le premier et le

second chariot (11, 13) étant mobiles par rapport aux moyens de préhension (15) pour réaliser l'usinage sur la plaque (2) en utilisant les meules boisseaux et/ou la meule périphérique dans le poste d'usinage (6), la position non fonctionnelle du premier chariot (11) et la position non fonctionnelle du second chariot (13) étant, en particulier, situées le long de la direction de mouvement (X) à partir des côtés opposés par rapport au poste d'usinage (6).

8. Machine-outil selon la revendication 7, **caractérisée en ce que** les moyens de déplacement (5, 11, 13) comprennent le second chariot (13).

9. Machine-outil selon l'une quelconque des revendications de 1 à 8, **caractérisée en ce que** le poste d'usinage (6) comprend des moyens de retenue (18) qui peuvent être actionnés sur la plaque (2) dans le poste d'usinage (6) pour retenir la plaque (2) lors de l'usinage, les moyens de retenue (18) étant prévus substantiellement au niveau de l'outil (12, 14).

10. Machine-outil selon l'une quelconque des revendications de 1 à 9, **caractérisée en ce qu'**elle comprend des moyens (21) servant à mesurer la plaque (2) étant usinée pour obtenir au moins un paramètre de la plaque (2), les moyens de mesure (21) étant positionnés au niveau d'une entrée du poste d'usinage (6) et en communication avec l'unité de commande informatisée (16).

11. Machine-outil selon la revendication 10, **caractérisée en ce que** l'unité de commande informatisée (16) est conçue pour commander au moins les moyens de préhension (15) en fonction du paramètre et/ou pour commander au moins les moyens d'actionnement (7, 8) en fonction du paramètre.

12. Machine-outil selon l'une quelconque des revendications de 1 à 11, **caractérisée en ce que** le châssis (4) comprend au moins un plan de support à film d'air (19) substantiellement vertical situé dans le poste d'usinage (6), la machine comprenant un système pneumatique (20) en communication avec le plan de support (19) pour générer le film d'air et en communication avec l'unité de commande informatisée (16), l'unité de commande informatisée (16) étant conçue pour commander le système pneumatique (20) de manière à générer un film d'air lors d'une rotation de la plaque (2), l'unité de commande informatisée (16) étant, en particulier, conçue pour commander le système pneumatique (20) de manière à aspirer l'air à partir du plan de support (19) afin de retenir la plaque (2) lorsqu'elle se trouve en position d'usinage.

13. Machine-outil selon l'une quelconque des revendications de 1 à 12, **caractérisée en ce que** l'outil (12, 14) est mobile le long d'une direction de levage (Y) transversale à la direction de mouvement (X) et à l'axe (R) de rotation.

14. Machine-outil selon l'une quelconque des revendications de 1 à 13, **caractérisée en ce qu'**elle comprend un second dispositif de préhension (23) qui peut être actionné sur la plaque (2) pour saisir la plaque (2) positionnée du côté opposé aux moyens de préhension (15), le second dispositif de préhension (23) étant mobile le long d'une direction parallèle par rapport à l'axe (R) entre une position éloignée des moyens de préhension (15) et une position rapprochée des moyens de préhension (15), le second dispositif de préhension (23) étant, de préférence, installé sur le chariot (11, 13).

15. Machine-outil selon l'une quelconque des revendications de 1 à 14, **caractérisée en ce qu'**elle comprend un système (24) destiné à supporter la plaque (2) associé au châssis (4), le système de support (24) étant conçu pour supporter une plaque (2) ayant au moins un bord incurvé, le système de support (24) comprenant, de préférence, au moins un goujon.

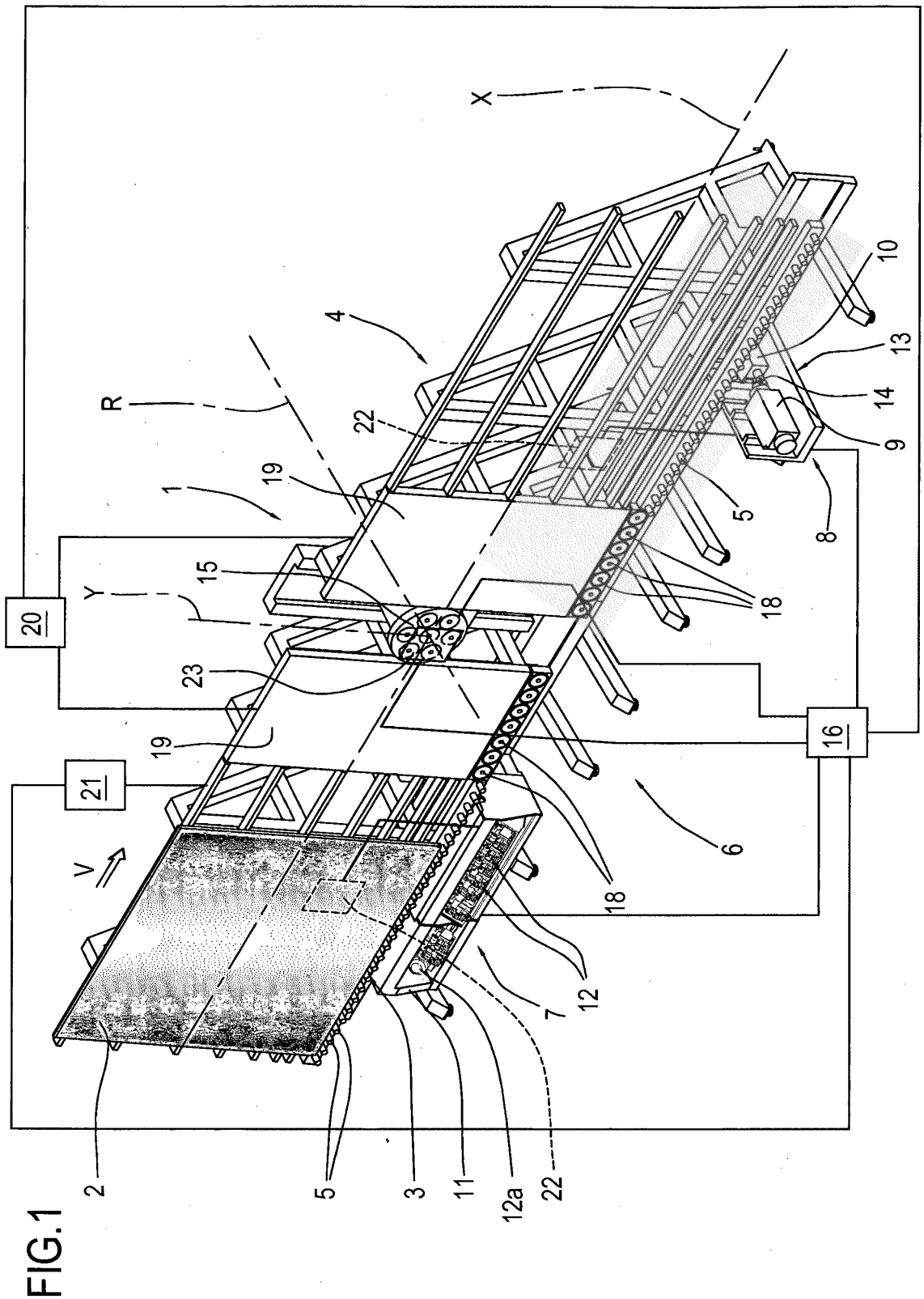


FIG.1

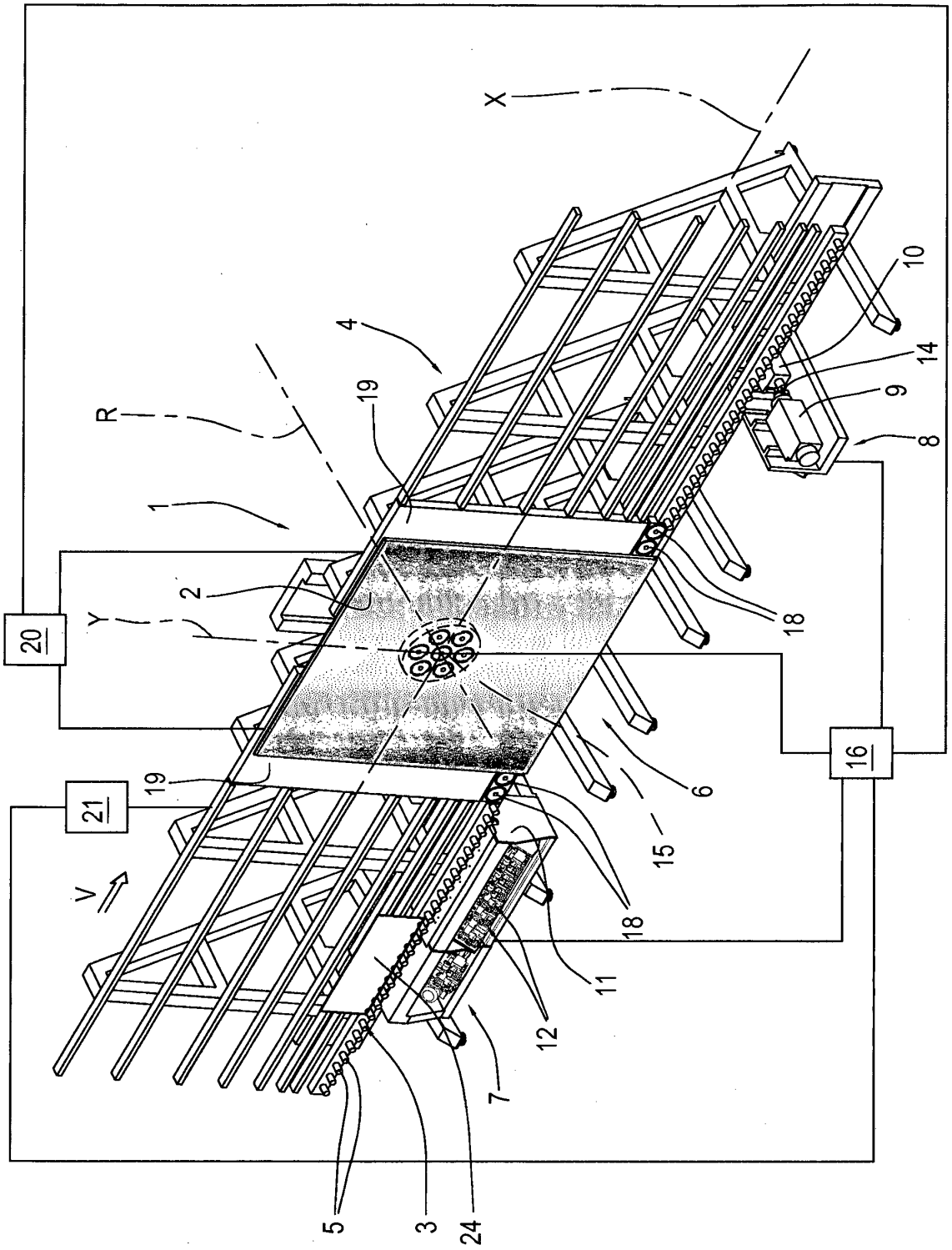


FIG.2

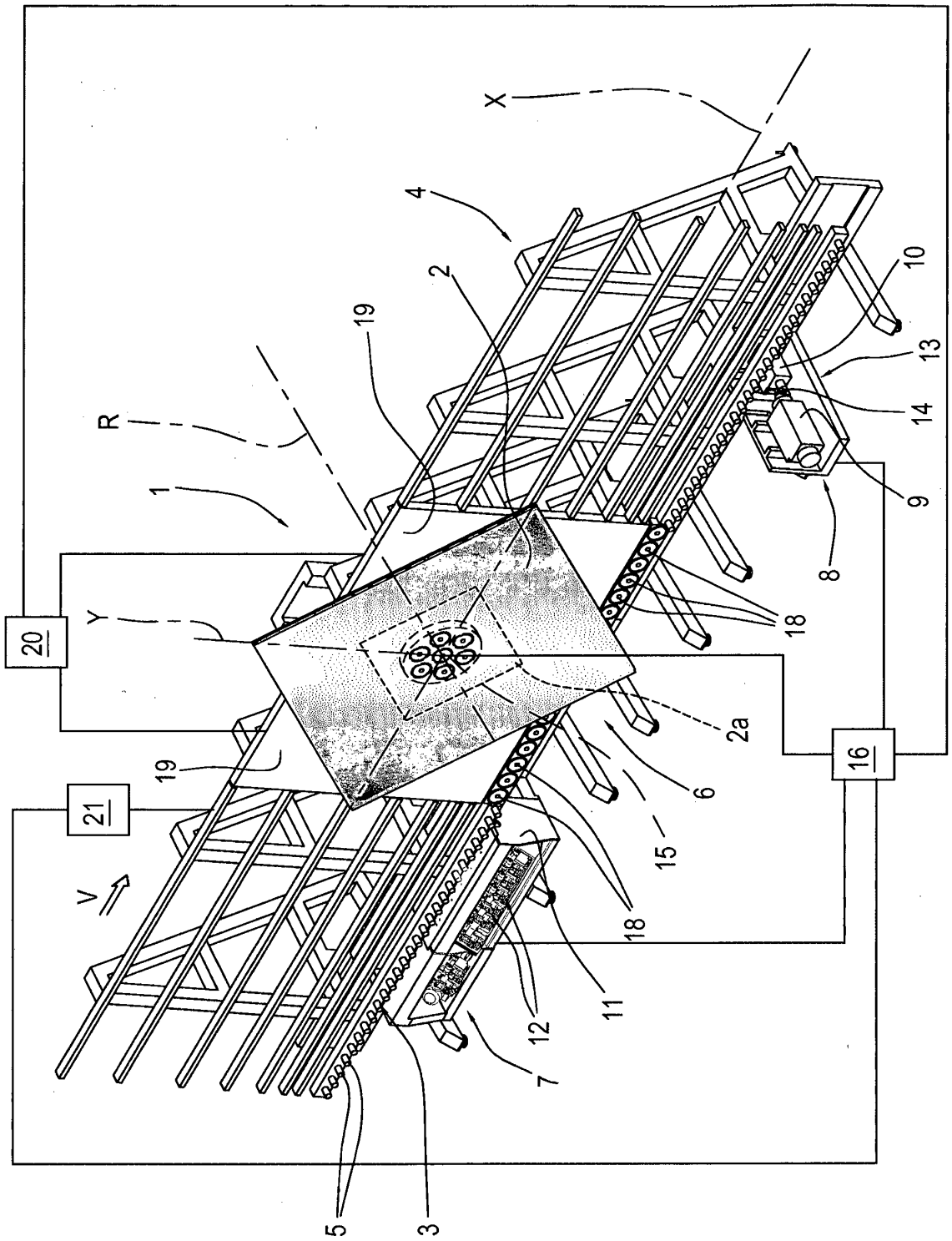


FIG.3

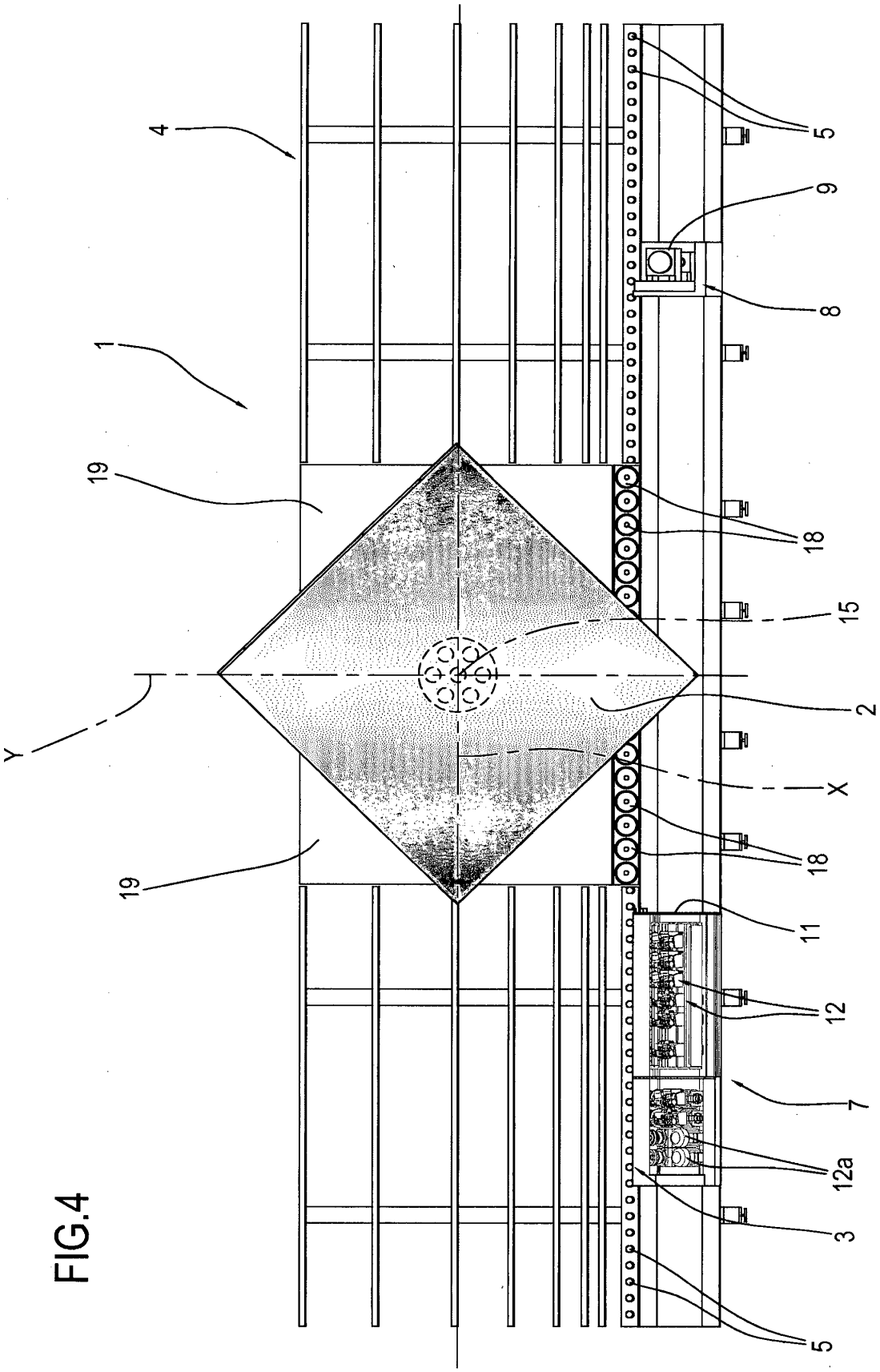


FIG.4

FIG.5

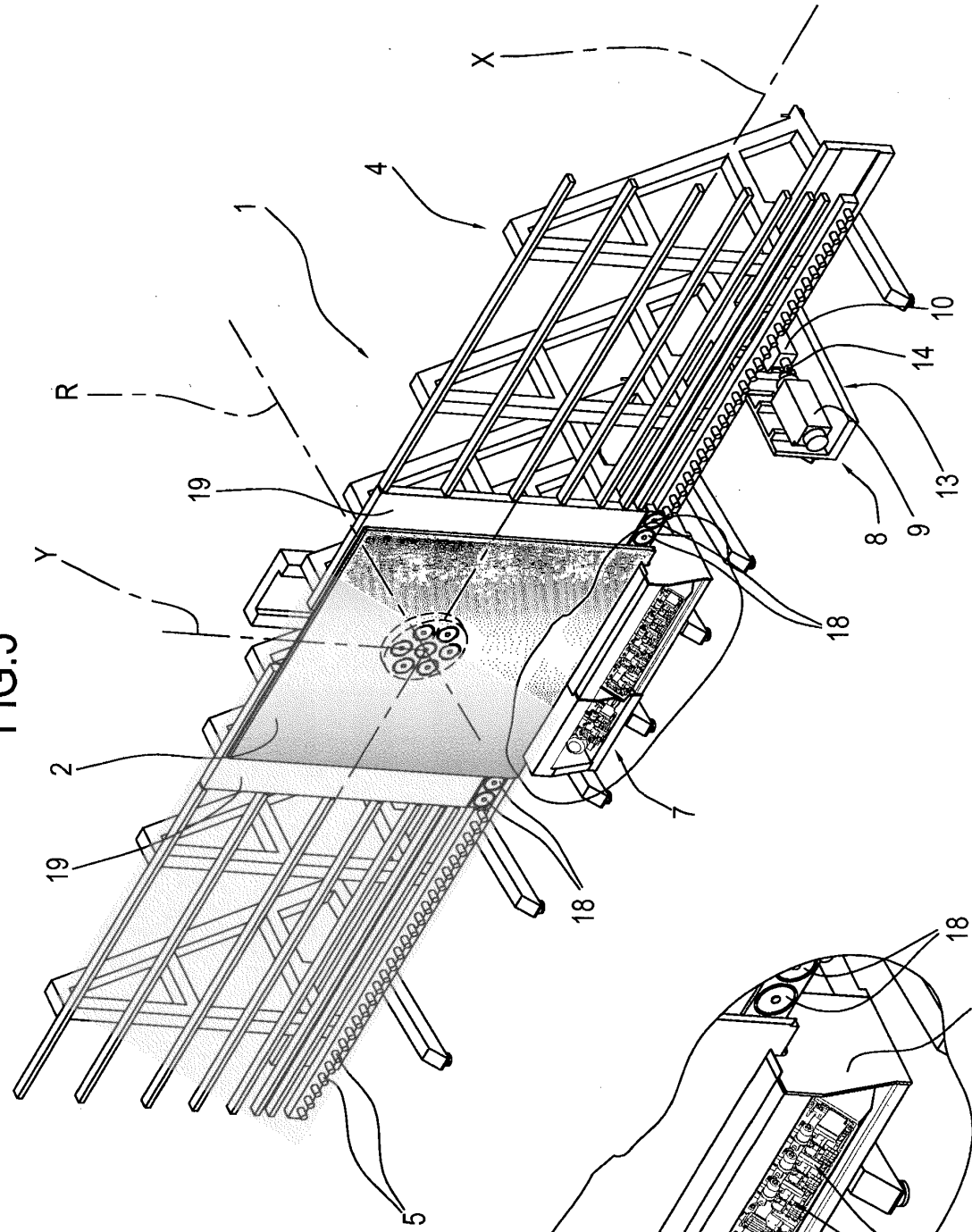
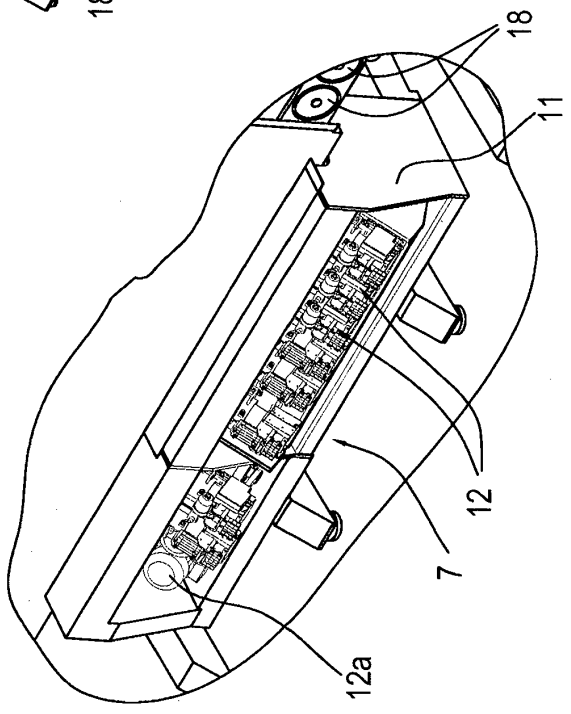


FIG.6



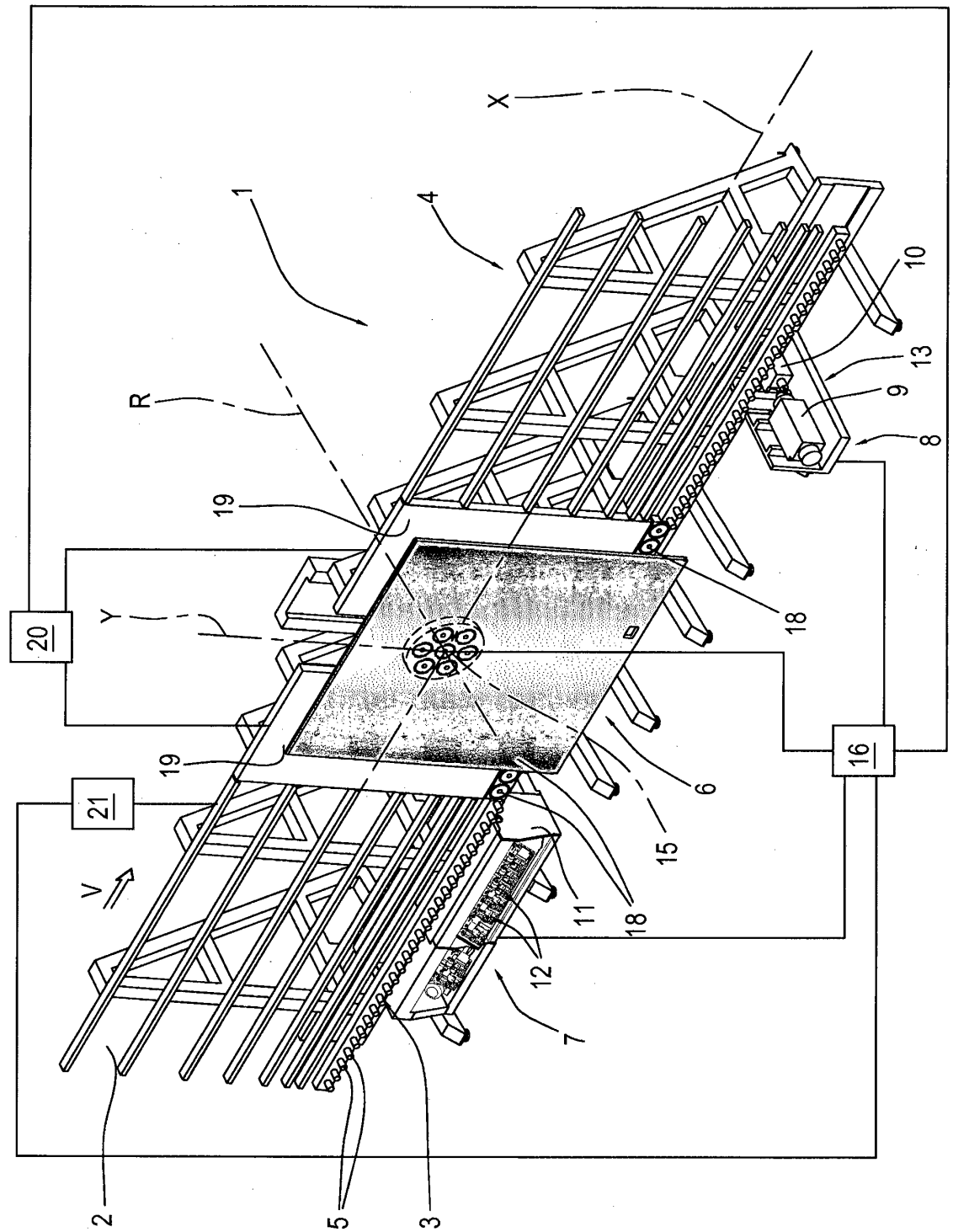


FIG.7

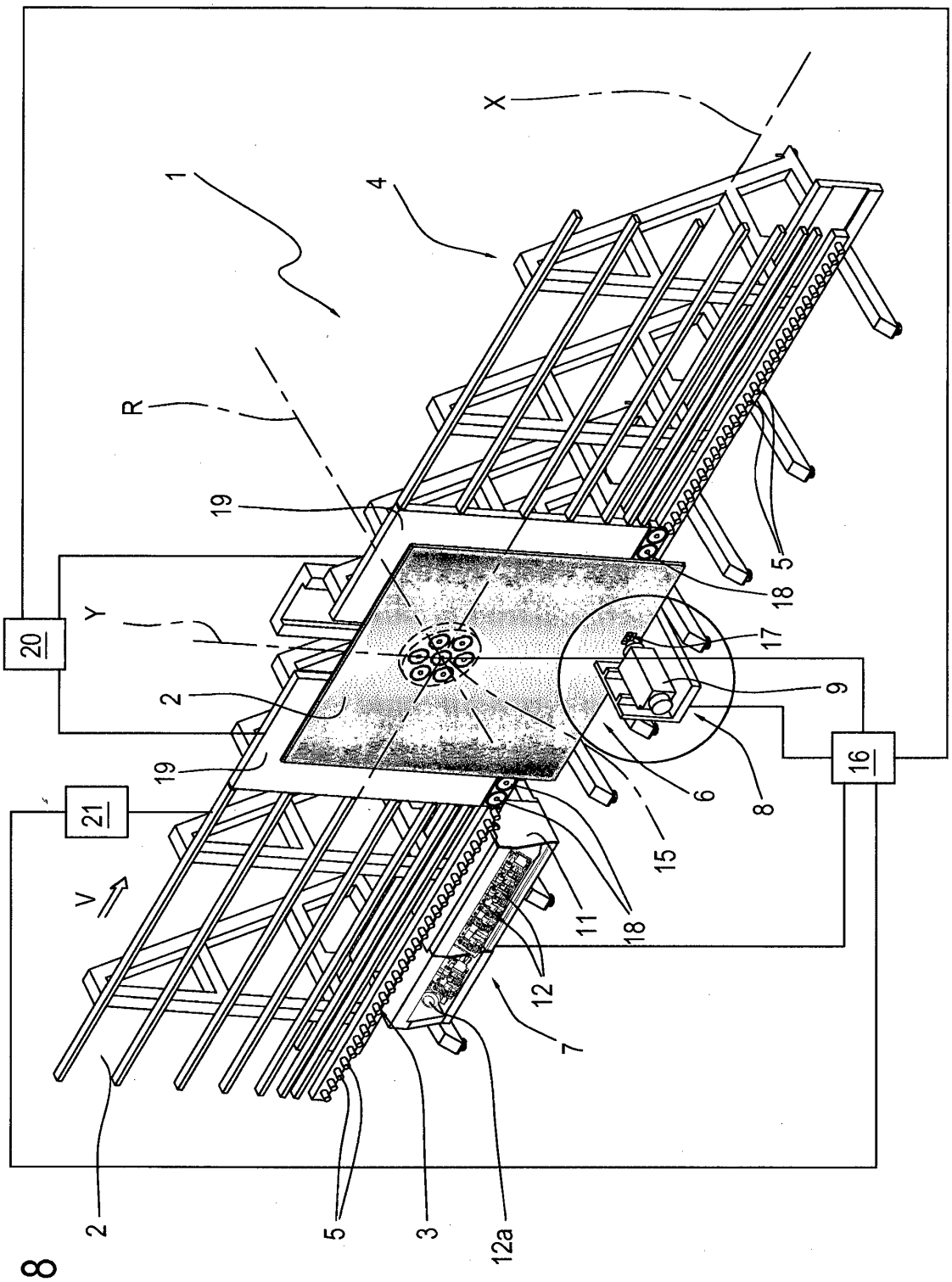


FIG.8

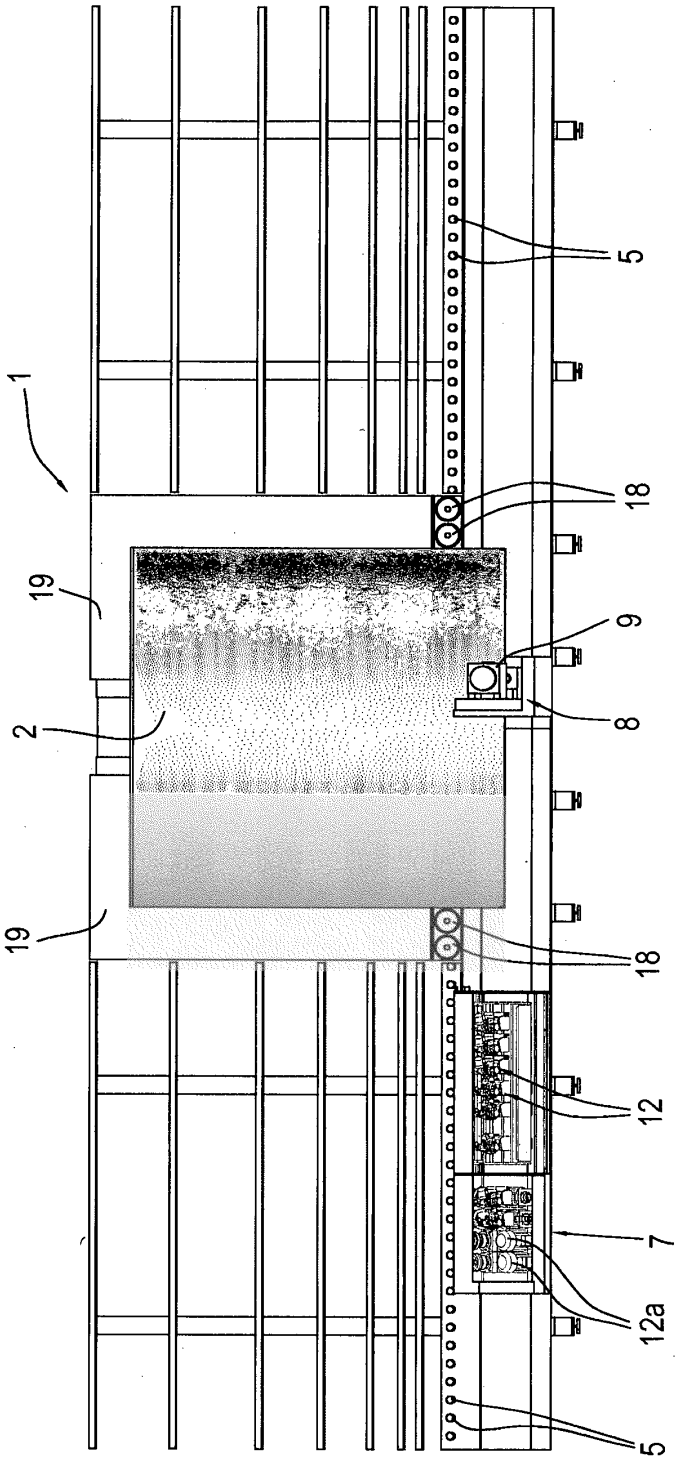


FIG.9

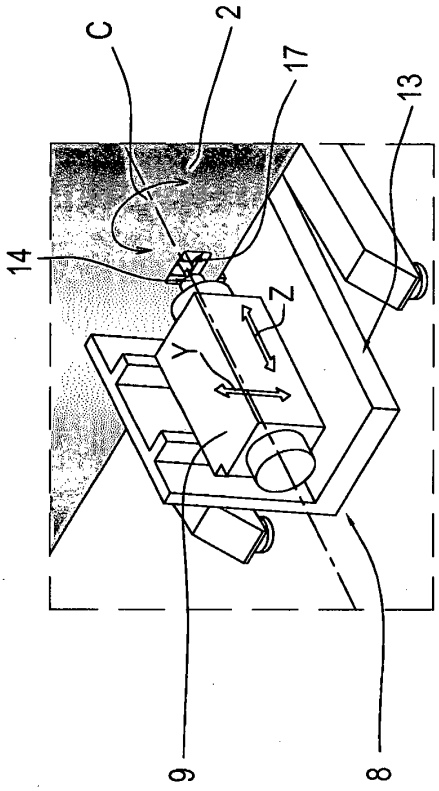


FIG.10

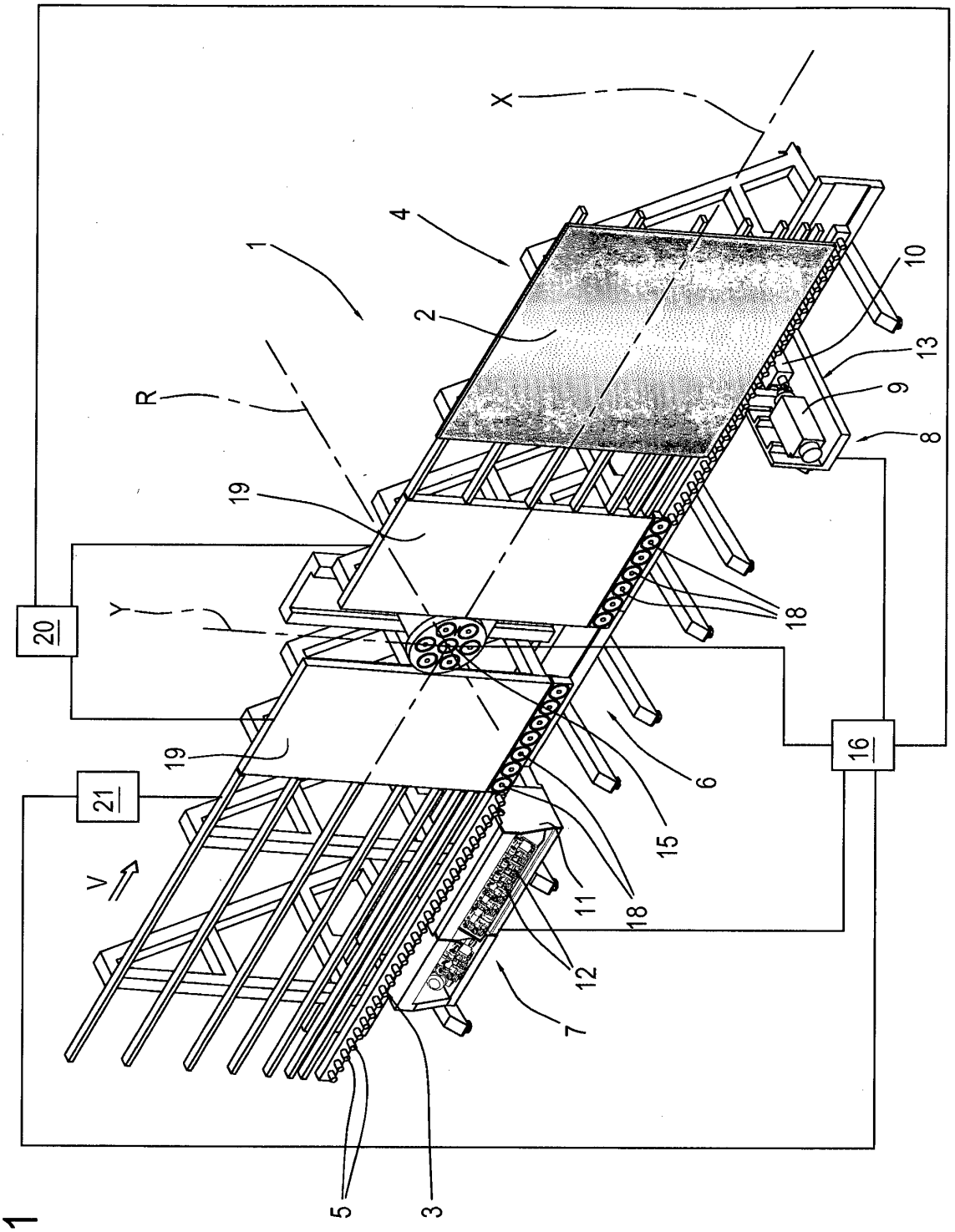


FIG.11

REFERENCES CITED IN THE DESCRIPTION

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